ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

INTERDISCIPLINARY - INTERDEPARTMENTAL PROGRAMME OF POSTGRADUATE STUDIES "ENVIRONMENT AND DEVELOPMENT"

THE CONTRIBUTION OF REMOTE SENSING DATA FOR THE DETECTION OF NATURAL SELECTION SIGNATURES IN NORTH AMERICAN GREY WOLVES

Master Thesis

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Environment and Development

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Lausanne, January 2010

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CONTENTS

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ABSTRACT

The current thesis constitutes an interdisciplinary approach of detecting a selection pressure driven by the environment examining the contribution of Remote Sensing and Spatial Analysis in the field of Landscape Genetics. Even though several studies have been attempting to link genetic and environmental information so as to discover the genes that are being shaped by natural selection because of various interacted environmental factors, aspiring remote sensing derived parameters may have not been extensively exploited. This project aims to fill a part of this gap by analysing whether Remote Sensing data would provoke the emergence of significant gene-environment associations. A heterogeneous set of quantitative and qualitative data from a wide variety of sources with different data structures was collected and tested for potential associations between allelic frequencies at marker loci and environmental parameters in order to identify signatures of natural selection within genomes of North American grey wolves (*Canis lupus*). Emphasis was set to the inquiry of Normalized Difference Vegetation Index (NDVI) as novel candidate predictor in the evolutionary divergence of the sampled populations.

The dataset that has been eventually analysed, consisted of genetic samples by microsatellites, and of two types environmental data, climatic and remote sensed (NDVI, altitude) that have been collected as monthly variables – when available – in order to scan for possible effect of seasonality on genetic data. The procession has been elaborated by Spatial Analysis Method (SAM) on 22 environmental and 523 genetic parameters. SAM requires georeferenced genetic data of the study population so as to retrieve information to characterize the sampling location and to correlate genetic parameters to one or more environmental parameters. The research is summarized in three phases. The first phase requires the desired information to be derived by the corresponding data using a Geographic Information System, so as to proceed to the second stage, which is the encoding of the acquired data and the compilation of a combination matrix with the values of the environmental parameters and the binomial information of the genetic ones. The third, and final, part included the implementation of multiple univariate logistic regressions and the computation of the association degrees between the parameters, in order to establish hypotheses about the possible force that each parameter in question could form.

Comparing the two groups of environmental parameters, derived from remote sensing data and climatic data, it is concluded that climatic variables are exerting a selection pressure that could lead to genetic diversity, in contrast to vegetation index and altitude that ceased to be involved in significant associations from the first two lowest confidence levels. Vegetation index tends to shape a reduced selective power for the study area and population in question, although this is not an overall conclusion and the results denote that future researchers could arrive to an outcome that would potentially be more unambiguous by using a dataset of higher resolution and varied content. An explanation that this index is restrained from consisting a powerful candidate for natural selection lies within the computation of the NDVI values proved to be sensitive to a number of perturbing factors including clouds and cloud shadows that due to the prevailing climatic conditions of the study area are not scarce. Furthermore, the missing values of initial genetic dataset prevented the effectuation of G test, so potentially with a complete dataset and additional alleles, a greater amount and range of environmental parameters, NDVI included, would have been unveiled to be under natural selection. From the aspect of genetic data, spatial distribution of alleles should be further analysed for the acquisition of information concerning their local effects and potential emergence of spatial patterns that could unveil an environmental oriented link.

Concluding, this thesis has been elaborated under a geographical information point of view, although a biologically-oriented interpretation-analysis will be realised in the context of a future publication together with specialized molecular biologist.

KEYWORDS

Natural selection, signature detection, Spatial Analysis Method (SAM), microsatellites, landscape genetics, remote sensing, NDVI, logistic regression, association models, significant alleles, spatial analysis, GIS, environmental pressure, genetic diversity.

1. INTRODUCTION

In a multidisciplinary approach, this thesis aims to present the research of the possibility of the general contribution of Remote Sensing and Geographic Information Systems (GIS) in the field of Landscape Genetics, with a view of detecting natural selection signatures in a representative sample of North American grey wolves' population. Namely, in the context of the study of local adaptation in wolf populations, the problematics stands on whether remote sensing data could be relevant to stimulate the emergence of gene by environment associations.

Attempting to integrate the concepts and the methods of the mentioned sciences, relevant literature has been studied, in order to explore the potential guidelines that would lead in the right direction of addressing the issue, avoiding methods and technical details that could be proved unsuccessful (§2. Relevant Literature). The imagery that was used in this project (§3. Data), was selected and collected on the basis of the nature and the extent of the study area that the under examination population is located – Yukon Territory and Northwest territories of northern Canada and northern States of USA (Minnesota, Wisconsin, Michigan) – in addition to the prospect of having complimentary access to the dataset. In the same context information about the specifications of the corresponding data can be found, as well as their acquisition techniques. In the following chapters are presented the method that was used to process and analyse the datasets and the final results and conclusions.

The subject of the project consists on the observation that even though Landscape Genetics attempts to link genetic and environmental information so as to discover potential pressure of natural selection driven by environment, remote sensing data may have not been extensively used. Since Manel et al. in 2003 coined for the first time the term landscape genetics (Storfer et al. 2007), this field composes an aspiring research area that integrates population genetics, landscape ecology and spatial statistics (Storfer et al., 2007), and that "promises to facilitate our understanding of how geographical and environmental features structure genetic variation at both the population and individual levels", as "the two key steps of landscape genetics are the detection of genetic discontinuities and the correlation of these discontinuities with landscape and environmental features, such as barriers (e.g. mountains, gradient of humidity)" (Manel et al., 2003). To be said in more explicit way, it examines the influence of the environment on the genome and attempts to understand how geographical and environmental features structure genetic information (Joost, 2006).

1.1. General Thesis Goal and Objectives

The data and methods that Remote Sensing provides, consist an aspiring field from which may be derived utilizable environmental datasets, in order to be used for computing association models, or plausibly for other purposes also, and presumably to analyse their contribution in landscape genetics. In particular, one of the objectives is to examine the possibility of identifying pertinent Remote Sensing indices, such as vegetation index (NDVI) so as to be used in the context of association models, namely to attempt the unveiling of a specific remote sensed-oriented factor behind the aetiology of interactions between environment and phenotypes. Moreover the relevance of the use of NDVI should be assessed in gene - environment (GxE) association studies, in order to evaluate its impact degree to genetic diversity.

2. RELEVANT LITERATURE

This scientific field of landscape genetics has been emerged as an amalgamation of population genetics and landscape ecology (Manel et al., 2003). This discipline aims to provide information on how landscape and environmental features influence gene flow, population structure and local adaptation, but also aids in identifying cryptic genetic discontinuities, that is breaks in gene flow without any obvious cause, or secondary contact among previously isolated populations.

Landscape genetics studies require data from two distinct sources: a) landscape data (e.g. remotely sensed data, digital elevation models, field collections) and b) multilocus genetic data. Landscape data are gathered in a number of ways, including: field surveys, aerial remote sensing and/or satellite remote sensing (Storfer et al., 2007). "In general, landscape genetics seeks to understand the influence of ecological processes (Turner et al., 2001) on genetic variation by quantifying the relationship between landscape variables, population genetic structure and genetic variation...". Recent advances in fine scale data resolution (<4m) and analysis methods have greatly improved the spatial accuracy and precision of detecting, classifying and delineating landscape habitat characteristics in both two (Wulder et al., 2004; Greenberg et al., 2005) and three dimensions. Such fine scale data can help create detailed digital elevation models and spatially explicit vegetation canopy structure products. At coarser spatial scales (resolution 250 m–1.1 km), image data are acquired for the entire globe twice per day, enabling analyses at unprecedented temporal resolution (Rahman et al., 2004; Running et al., 2004) to compare vegetation phenology with genetic variation in plants and animals. However, it is important to note that the scale at which data are collected should match the scale of the study questions and hypotheses" (Storfer et al., 2007).

The two key steps of landscape genetics are the detection and location of genetic discontinuities and the correlation of these discontinuities with landscape and environmental features (Manel et al., 2003). The putative causal, which possibly lead to genetic differentiations and contribute to population divergence, is composed by multiple factors that are due to the combined influences of biogeography, geographical distance and habitat discontinuities (Riginos & Nachman, 2001), such as temperature, gradient of humidity, drainage pattern, salinity of water, geographical distance, altitude, topographical slope, human-induced factors, land cover and putative movement barriers (e.g. mountains, rivers, roads, deforested areas). Identifying the abiotic and biotic factors involved in evolutionary processes is essential for modelling and predicting the evolution of genetic diversity under different scenarios, especially those related to environmental changes due to human activity, so as to monitor the threatened species.

The synergy of Geographical Information Systems to Landscape Genetics has been lately utilized through "a new method to detect signatures of natural selection based on the application of spatial analysis", by Joost et al. (2007). With this Spatial Analysis Method (SAM), it has been tested the association between the allelic frequencies at molecular markers and data from various environmental variables, with the contribution of geographical information systems (GIS), environmental data, molecular data and multiple univariate logistic regressions (Joost et al., 2007).

In order to find the process in which an imagery-derived environmental parameter or a signature of natural selection within genome, detected by a remote sensed technique, influences the genome and possibly to conclude that the specific genome is being subjected to the rules of natural selection, it is mandatory to unveil those operational factors that are hidden behind the observable ones at a digital dataset, but also to encode the phenological ones. Influences of topoclimate, synergistic effects of minerals, soil fertility and soil humidity on plant growth, and mutual biotic influences belong to the indirectly observable operational factors, which may be correlated with the variation of biophysical parameters that lead to differentiation, at least among fish population (Zonneveld, 1989). As far as the phenological factors are concerned, Griffith had referred to some studies, which used the imagery-derived normalized difference vegetation index (NDVI) and vegetation phenological metrics derived from time-series NDVI data to explain some of the variation in water quality, indicating in this way an early-warning signal of stress to aquatic systems (Griffith, 2002).

As previously pointed out, two of the aims of landscape genetics are to detect the location of genetic discontinuities and to correlate them with landscape and environmental features, such as mountains, rivers, roads, gradient of humidity and deforested areas (Manel et al., 2003; Guillot et al., 2007). Nevertheless, none of the above mentioned studies neither present any efficient remote sensed process or data to identify and locate genetic discontinuities nor reveals any evident connection between the last and environmental or landscape indices derived from them.

Furthermore, several published methods (Pritchard et al., 2000; Dawson and Belkhir, 2001; Falush et al., 2003; Kerr and Ostrovsky, 2003) recognizing the importance of georeferencing genetic data, led up to an error implying through the algorithms implemented spatial homogeneity in the distribution of the causal phenomena. This criterion is only an assumption made in an endeavour to quantify and correlate genetic data to environmental indices. Normally, uniform distribution is not encountered by organisms, as it tends for individuals to rarely be located in this way in space. Besides, based on this assumption individuals are forced to be assigned in regions that are enclosed by unsuitable habitats, where the species cannot be present (Guillot et al., 2007; Kidd & Ritchie, 2006). In recognition of this, some researchers have recently begun to adopt "landscape genetic" approaches, where individuals are sampled across broad landscapes, genetic relatedness between individuals assessed, and these relationships correlated with landscape features (Vitalis and Couvet, 2001; Manel et al., 2003; Coulon et al., 2004, 2006; Scribner et al., 2005).

Addressing the quantifying problem, several researches tend to apply only simple null-hypothesis testing for landscape genetics, such as testing for the presence of a barrier, rather than comparing the evidence for competing hypotheses involving more complex landscape effects. This may lead to important misinterpretations, as illustrated by Cushman et al. (2006) who found that although simple models of isolation-by-distance or a single barrier to gene flow were statistically significant, models involving land cover and elevation were much better at explaining the observed genetic structure in black bears (Balkenhol et al., 2009).

Based on that 2006 reference, it was ascertained that patterns of genetic structure are primarily related to landscape gradients of land cover and elevation (Cushman et al., 2006). By the term landscape gradients the authors imply that landscape is not a binary mosaic of suitable and unsuitable habitat, but that it is more likely that organisms experience landscapes as gradients of varying quality and resistance to movement rather than as mosaics of uniformly good habitat in a uniformly inhospitable matrix (McIntyre and Barrett, 1992; Manning et al., 2004; McGarigal and Cushman, 2005).

Patterns of genetic relatedness among individuals can be correlated with landscape features by building resistance surfaces that assign different resistance-to-movement values to different landscape features. A matrix of movement costs can then be computed, based on the least-cost paths between all pairs of individuals, and partial Mantel tests to hypotheses describing alternative relationships between landscape factors and gene flow. By comparing genetic differentiation among individuals with cost distances between them, researchers can test specific hypotheses about the influences of landscape features and environmental conditions on gene flow (Cushman et al., 2006; Vos et al., 2001; Coulon et al., 2004, 2006; Spear et al. 2005). So apart from supporting the aforementioned theory of not uniform distribution, it is moreover indicated a correlation between observed genetic patterns and interpopulation distance or putative movement barriers. Of this taking as starting, it has to be pointed out that the putative causal, which possibly lead to genetic differentiations and contribute to population divergence, is composed by multiple factors that are due to the combined influences of biogeography, geographical distance and habitat discontinuities (Riginos & Nachman, 2001), such as temperature, humidity, drainage pattern, salinity of water, altitude, topographical slope, human-induced factors, land cover and putative movement barriers (e.g. mountains, rivers, roads, deforested areas).

Another study to be mentioned because of the attempt to answer to the key questions raised by landscape genetics and of the fact that approached most of the issues addressed by this thesis, is that of Guillot et al. (2007). A new statistical model is being introduced, which aims at inferring and locating genetic discontinuities between populations in space from individual georeferenced multi-locus genetic data, without any a priori knowledge in the populational units and limits, accepting the challenge of lifting the barriers and expanding current analytical limitations (Balkenhol et al., 2009). The study area was at the northwestern United States and the analysis set was wolverine individuals. Genetic discontinuities were identified and spatially located, using observed genetic data. Furthermore, accurate landscape descriptors were implemented, which can be used in a geographic information system (GIS) to associate the inferred genetic discontinuities with landscape features, and hence generated hypotheses about the cause of genetic boundaries. An attempt in this direction had been as well made by Piertney et al. (1998), but the spatial method of Guillot appears to have better results in revealing cryptic genetic structure and in detecting migrants, such as individuals poorly genetically related to their spatial neighbors and their assignment to their population of origin, even for highly mobile species. Emphasis has to be given in the fact that the method has been designed for genetic codominant markers, as allozymes, micro-satellites, and single nucleotide polymorphisms. Regarding individual sampling strategy, efficient conclusion in landscape genetics implies random sampling across the entire studied area and not just sampling some individuals in each of several a priori defined populations (Manel et al., 2003).

One of the advantages of the research in question is that accuracy increases with the sampling effort, something that implies also the increasing of the strength of genetic discontinuity between populations. Two more significant advantages are that by the developed statistical method it had been made possible to infer that several spatial domains, which may be apparently unconnected within the sampling window, can belong to the same population unit, and that henceforth the number of population units can be an unknown parameter.

The only aim that was initially raised by the study and has not been clarified, is the one about the correlation between environmental and landscape parameters and genetic discontinuities. The single environmental parameter that it is reported affecting the population examined, is that of human impact at habitat of even highly mobile species. Nevertheless, it has been derived that a method similar to those used at remote sensed imagery for removing image noise by applying suitable filters, has been used in order to denoise blurred coordinates of sampled individuals.

Drawing an overall conclusion from the relevant literature, it is being presumed that the contribution of remote sensing may be greater than the literature suggests because its use it is not reported in the majority of studies, mostly due to the irrelevance of the researchers with that field.

3. DATA

3.1. Study Area

The populations of grey wolves that is under examination in the current study, is located in the central sub-Arctic and high latitude forest regions of Canada (Yukon Territory and Northwest territories) and in northern states of USA (Minnesota, Wisconsin, Michigan) (Figure 3.1.). Due to the fact that is sited next to North Pole, particular characteristics are added.

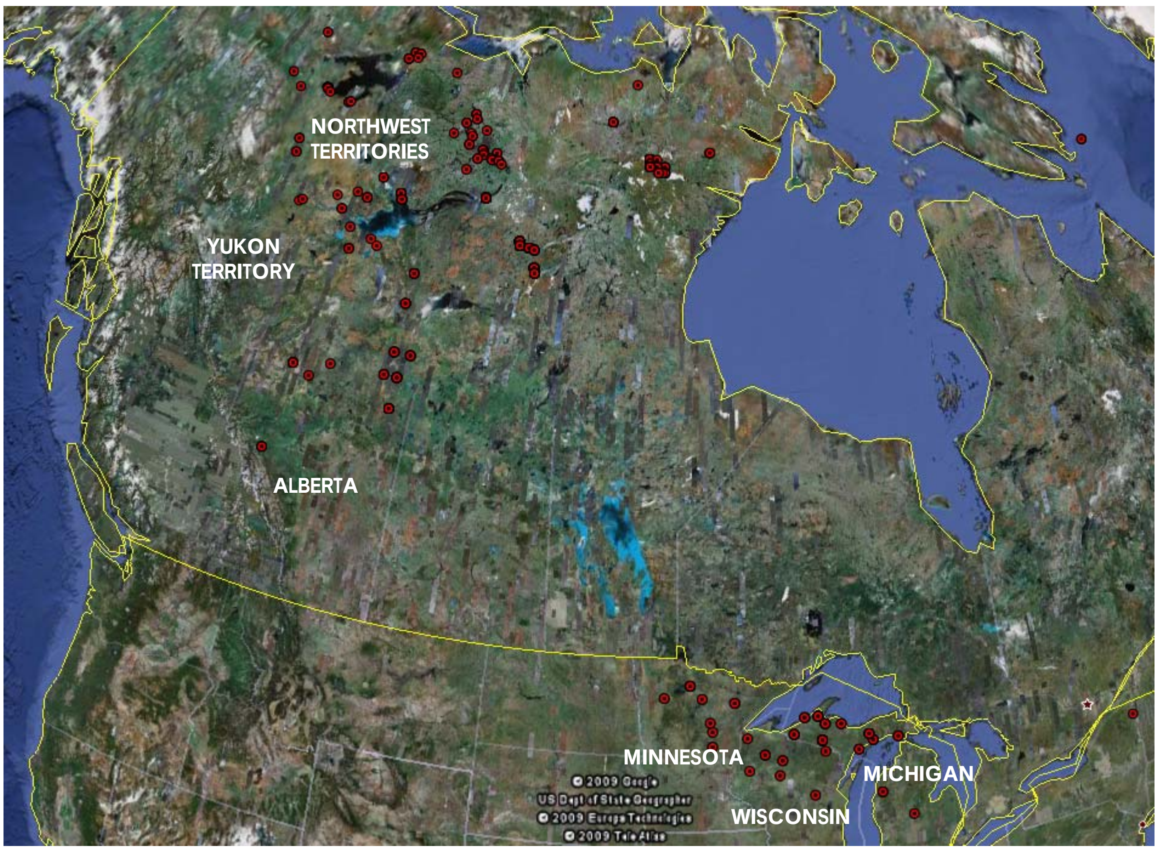


Figure 3.1. Sampling locations (depicted in red points) and the 523 samples of wolf individuals used in current analysis. (Source: Google Earth)

The climate of the northeastern part of the study area consists of semi-arid low-Arctic tundra (Bliss, 1988) and is characterised by only two seasons, that is winter and summer. The southwestern parts of the study area encompasses the Northern Canadian Shield Taiga, that is characterised by short cool summers and long winters, and the boreal coniferous forest that is portrayed by high rainfalls (Figure 3.2.). The landscape features that are encountered in these regions are lakes, frozen over half of the year, high density forests and gently rolling topography (Musiani et al, 2007).

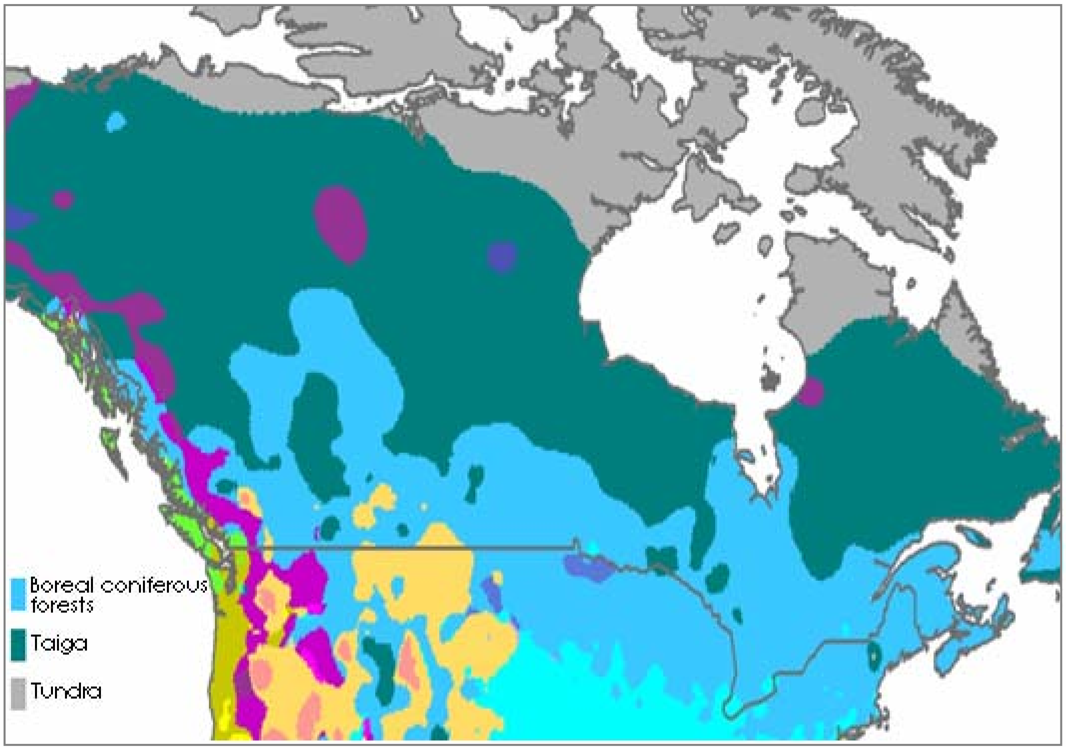


Figure 3.2. Climatic map of the study area in N. Canada and N. U.S.A. The climatic conditions at the sampling locations of wolf population are displayed in cyan for the boreal coniferous forests, in sea green for taiga and in grey for tundra.

3.2. Description of Collected Environmental Data

In order to study the possibility that an environmental parameter forms a significant force to shape a proportion of the genome, climatic and environmental datasets were collected that are presented in the following subchapters.

The collected data have different projections. *Lambert Azimuthal Equal Area* Projection covers 48 conterminous U.S. states and Canada and is usually used for DEM and landcover data. Within the *World Geodetic System* (WGS), there are several different datums that have been in use throughout the years. The WGS 84 is currently the one in use for this system and is valid until 2010. The North American Datum of 1983 is based on the *Geodetic Reference System 1980* (GRS80) spheroid; it is an Earth-centered datum having no initial point or initial direction. This is the horizontal datum used for National

Atlas map layers. In addition, it is one of the most widely used datums around the world. In order to manage, process and analyze the relevant information, it is demanded to be all reprojected in one projection system. The approach and the adequacy of the image process that is being followed by GIS software packages, so as to correct the differences when converting between spheroids, it is not clear and many problems are to be aroused. The visualisation of the data that have been eventually taken into consideration are presented at appendix [1] (Figure A1).

3.2.1. Climatic data

Climatic data have been collected from the environmental database of the ECONOGENE project where there have been assembled from the Climatic Research Unit (CRU) for a 40-year period (Table 3.1.). All environmental data (climatic and NDVI) have been collected as monthly variables in order to inquire the effect of seasonality on genetic data. Further details on their construction of the data set can be found at the article of New et al. (2002).

Table 3.1. Specifications of collected climatic data.

Data	Satellite/ Sensor	Resolution	Projection/ Ellipsoid-Datum	Area	Source	Original Collection Date
Precipitation, coefficient of variation of monthly precipitation, relative humidity, mean & diurnal temperature, ground frost & sunshine duration, no. of wet days	885 stations	spatial resolution 10' lat/lon, ~ 12000 m	GCS North American 1983/ Geodetic Reference System 1980 (GRS80)	Northern America	Climate Research Unit http://www.cru.uea.ac.uk (in courtesy of Laboratory of Geographic Information Systems (LaSIG), EPFL)	1961–2001

3.2.2. Remote Sensing data

3.2.2.1. Acquisition techniques of collected data

Remote Sensing is the science and technique that examines the principles, the methods, the instruments and systems with which is achieved the remote collection, processing, analysis and interpretation of information that are relevant to specific features of objects or phenomena. Remote Sensing is applicable to agriculture, forestry, geology, geomorphology, oceanography, climatology, geography and regional development and also to recording and monitoring of natural and human-induced resources (Argialas, 1977; Badekas, 1984; Rokos, 1988).

In the current thesis those applications are attempted to be broadened by the research of the potential contribution of Remote Sensing in Landscape Genetics. The aspects that Remote Sensing provides, consist an aspiring starting point for the use of its derived data methods. The environmental datasets that could be collected by passive or active sensors, would provide features and thus factors in order to be used for computing association models, and presumably to analyse their contribution in landscape genetics, aiming to ascertain the possibility of detecting signatures of natural selection within genomes of organisms (grey wolves) with the synergy of Remote Sensing.

The derived remote sensing features that would be examined if they can serve as environmental predictors in the evolutionary divergence of the grey wolf population, are mainly the Normalized Difference Vegetation Index (NDVI) but also the altitude from Digital Elevation Models.

NDVI is a numerical indicator that assesses the content in chlorophyll and moisture of the object in question and it is calculated by the following equation (1):

$$NDVI = \frac{NIR - R}{NIR + R} \tag{1}$$

where R and NIR stands for the spectral reflectance measurements acquired in red and near-infrared spectral region. This ratio is based on the fact that live green plants that contain high proportion of chlorophyll absorb solar radiation, as it is used during the process of photosynthesis, and leaf cells reflect solar radiation in the near-infrared region of the spectrum as in case this amount of energy would be absorbed by the plant it would provoke overheat and possibly damage. As a result of the observation and since NOAA's AVHRR acquired data in those spectral regions, the above equation was emerged. The NDVI varies between -1.0 and +1.0. In a satellite image (Figure 3.3.) the regions that are depicted in bright tones of grey, in comparison to their neighbouring, form vegetation regions and as they are characterized by high reflectance tend to have values greater than 1, whilst the rest of the region, such as water and impervious surfaces that absorb the radiation, tend to be dark areas with negative values. Consequently the identification of vegetation is imminent.

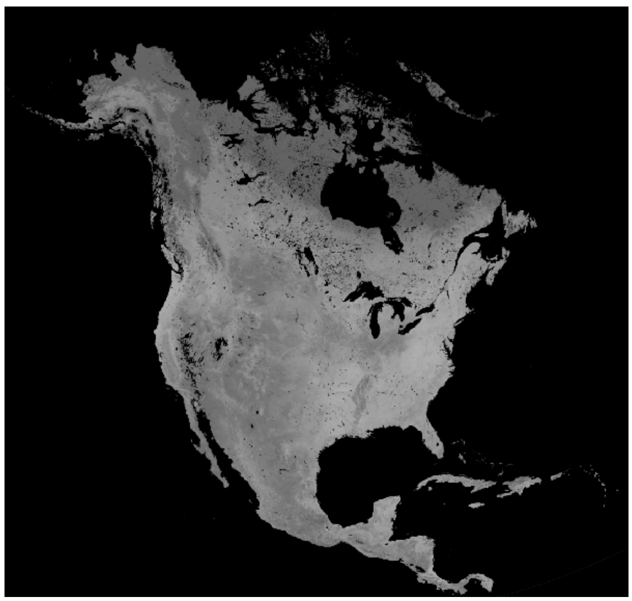


Figure 3.3. NDVI composite of Northern America from NOAA satellite in May 1992. Original projection in Lambert Azimuthal Equal Area, here reprojected in WGS84. Source: http://edc2.usgs.gov/glcc/glcc_version1.php#NorthAmerica

Nevertheless, the limited range of [-1.0, +1.0] of the index is inadequate to be represented in a 8-bit image, in addition to the fact that the scaling process of the image for classification reasons is rendered rather complicated. To resolve the issue, the Scaled Normalized Difference Vegetation Index was established:

$$ScaledNDVI = 100 \cdot \left(\frac{NIR - R}{NIR + R} + 1 \right)$$

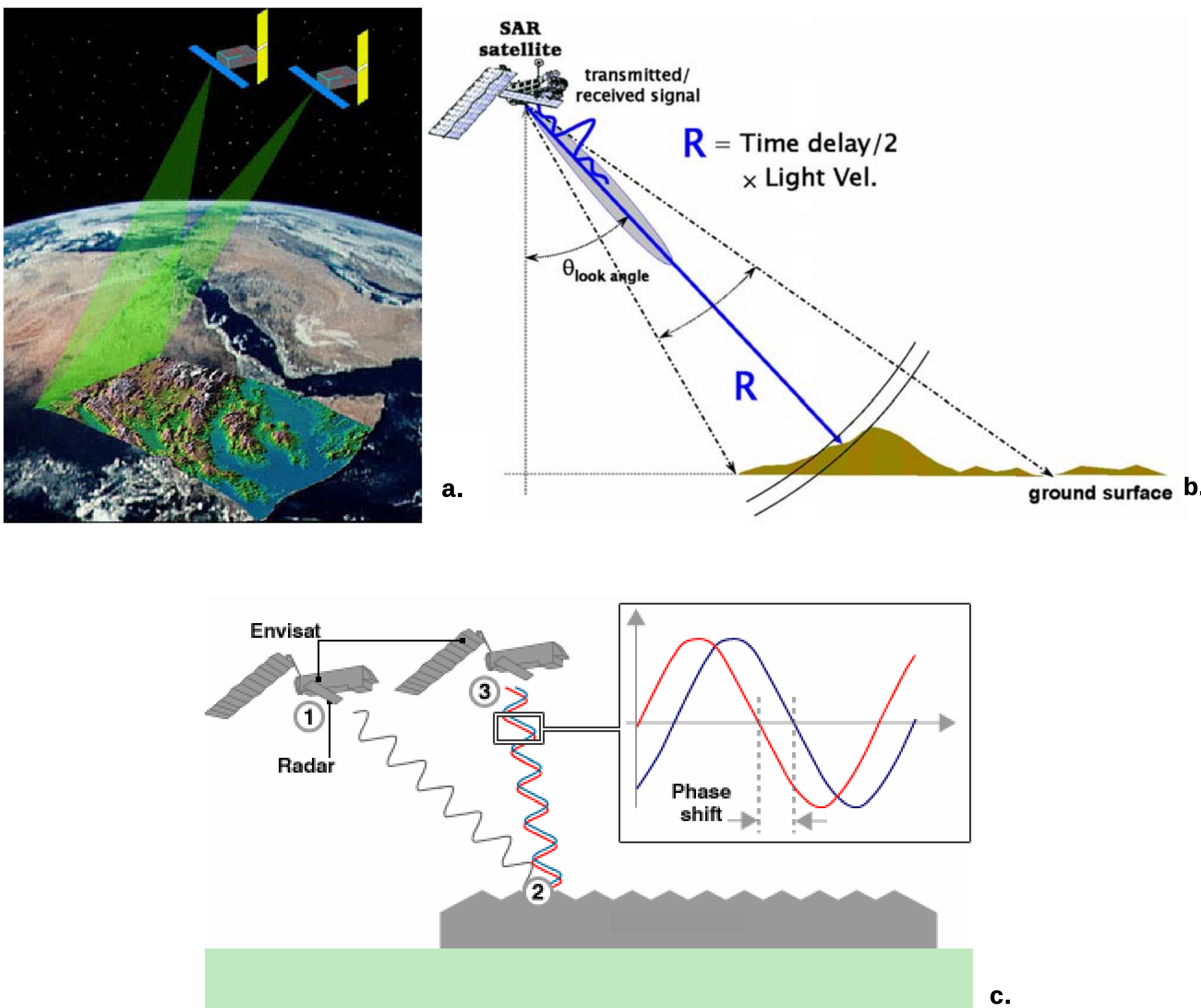
whose extended range of [0, 200] consents to a more precise classification. The value -1.0 of the range of NDVI corresponds to the value 0 of the range of Scaled NDVI, the value 0 of NDVI to 100 of Scaled NDVI and the value +1.0 to the value 200. So a pixel or an object of NDVI value 0.43 corresponds to 143. In a Scaled NDVI composite the areas with values lower than 100 are classified as clouds, water surfaces or other non-vegetation surfaces, whereas areas with values greater than 100 are classified as vegetation. The index is calculated for every object of a satellite image by the mean values of reflectance measurements of the pixels that consist it for the band R of NIR respectively (Argialas, 1998).

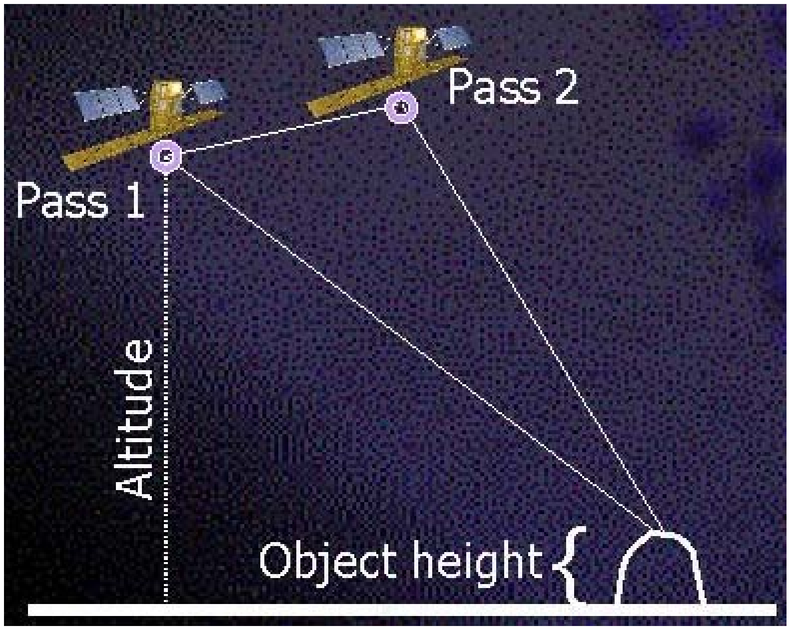
It is important to note that due the sensitivity of NDVI certain disambiguities may occur. Given that NDVI assesses the water content by its low reflectance and in its composites is presented with dark tones, wet soils tend to give different values of NDVI according to its moisture and not because of vegetation changes. Moreover thin or small clouds and cloud shadows with dimensions smaller than the resolution of the image, may lead to erroneous NDVI measurements and thus to misinterpretations. These considerations are minimized by forming composite images from daily or near-daily images. Since this index constitutes the originality of the thesis, emphasis was placed on the collection and the interpretation of the imagery to avoid the misleading.

The second feature that was derived from remote sensing data was the altitude. For this reason Digital Elevation Models (DEM) were invoked. DEM is a digital continuous representation of the topography of the Earth's surface or its subset (Figure 3.4.).

Figure 3.4. Digital Elevation Model (DEM) of Northern America from NOAA satellite. Original projection in Lambert Azimuthal Equal Area, here reprojected in WGS84. Source: http://edc2.usgs.gov/glcc/glcc_version1.php#NorthAmerica

It is also called Digital Terrain Model (DTM) and it contains only the terrain, excluding the human induced features as buildings, vegetation etc. A DEM can be represented as a raster or as a triangular irregular network (TIN) and are obtained with remote sensing techniques, with the synergy of LiDAR data, stero-photogrammetry, radars, and rarely nowadays with direct land surveying and by instruments such as theodolite or total station. A remote sensing technique that is used for the preparation of a DEM is *Interferometric Synthetic Aperture Radar* (InSAR). Two passes of a radar satellite (eg. RADARSAT-1) or a single pass of a two antenna equipped satellite (eg SRTM) cover an area sufficient for the composition of tens of kilometers elevation map.





d.

Figure 3.5. Schematic representation of Interferometric Synthetic Aperture Radar (InSAR). **a.**Single-pass interferometry from two separate antennas simultanesously, **b.** and **c.** ①, ②, ③. Principles and technique of InSAR, **d.** Repeat-pass interferometry with single-antenna SAR system.
(Source : a., b. http://www.geodesy.miami.edu/sar.html,
c. http://news.bbc.co.uk/2/hi/science/nature/6231334.stm
d. http://envisat.esa.int/handbooks/asar/CNTR1-1-5.htm)

Figure 3.5.a. shows two satellites illuminating the same region of the Earth. In the case of simultaneous imaging from two separate antennas, one antenna both transmits and receives the radar signal. This antenna is known as the master. The second antenna, know as the slave, only receives. This method is sometimes referred to as single-pass interferometry (Figure 3.5.a.). In the case where a single-antenna SAR system revisits the same position and images the same area on the ground after several days or weeks, the repeat-pass interferometry method is used. With this method, each antenna acts as both transmitter and receiver, as depicted in Figure 2.3.d. In practice, a single satellite beams radar signal to the area (Figure 3.5.c. ① and ②), followed several weeks to years later with a second image from the same satellite in the same nominal orbit. Displacement of the Earth's surface between the two successive satellite passes is estimated, following principles illustrated in Figure 3.5.b. The two basic requirements are that the orbits of both satellite passes are known precisely, and that the phase information inherent in the SAR signal, that is the use of both amplitude and phase is exploited. Then phase information from the two satellite passes (each of which in effect is a type of distance measurement)

is used to estimate the change in distance (range change) between the two passes (Figure 3.5.c ③), in the direction of the satellite line of site ("look angle"). This means that the measurement is inherently scalar. The use of both ascending and descending passes can be used to determine a two dimensional vector measurement.

Another technique is the *digital image correlation* that derives a stero-pair with different angles taken from the same pass of an Earth Observation Satellite (ASTER, SPOT5) or of an airborne sensor (Figure 3.6.). For the rare cases that interferometry does not render adequate results, mainly in mountainous areas, direct survey of the land surface is involved producing *interpolating digital contour maps*. The precision of a DEM is depended on the accuracy of data collection (absolute accuracy) and on the accuracy of presenting the morphology (relative accuracy).

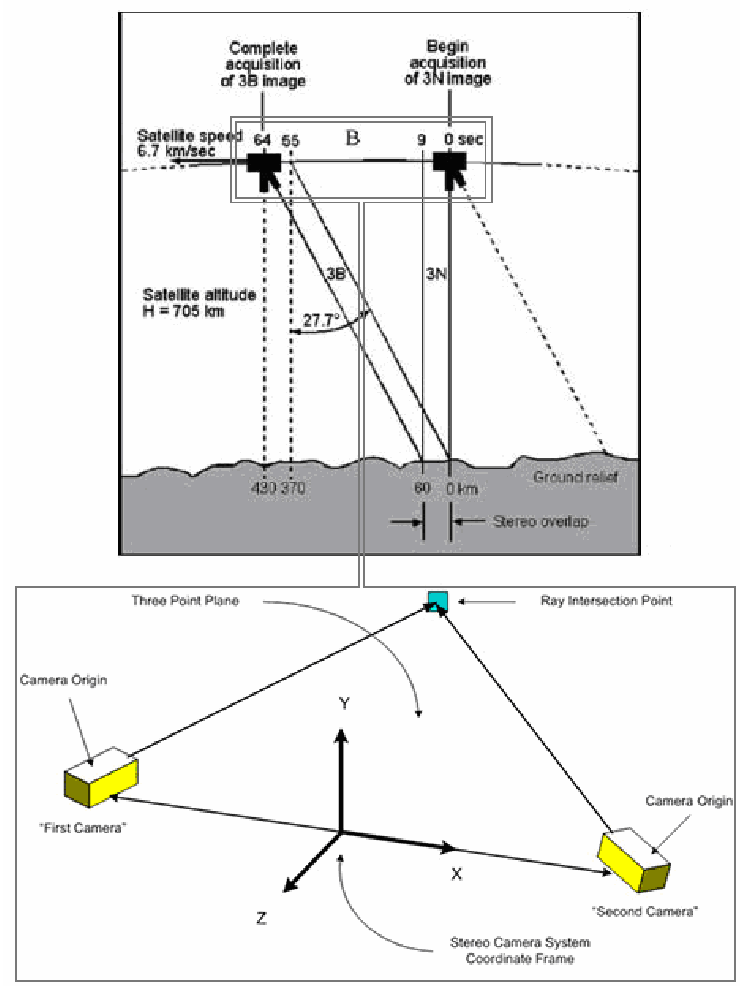


Figure 3.6. Schematic representation of stereo configuration. (Source : De Oliveira and Paradella, 2009 ; Toutin, 2002)

The remote sensing data that have been collected are accordingly to the aims of this thesis and the nature and extent of the study area. Specifications about the imagery and the satellites that have been selected to serve this cause are explicitly given in following section.

3.2.2.2. Collected Remote Sensing data

The available complimentary data that had been collected from different sources and their corresponding specifications, which will be used to explore the application of Remote Sensing to landscape genetics, are being presented at the following table (Table 3.2.).

Table 3.2. Specifications of collected remote sensing data.

Data	Satellite/ Sensor	Resolution	Projection/ Ellipsoid-Datum	Area	Source	Original Collection Date
Digital Terrain Elevation Data (DTED)	Shuttle Radar Topography Mission (SRTM)	30m and 90 m (1 arc second and 3 arc second, Level 2 and 1 respectively)	EPSG/ WGS 84	Wisconsin, Michigan, Minnesota (USA)	eros.usgs.gov/products/elevation	02/2002
Multispectral, bi-directional reflectance properties	Moderate Resolution Imaging Spectroradiometer (MODIS)	1000 m	Lambert Conformal Conic (LCC) / Geodetic Reference System 1980 (GRS80)	Land surface over Canada	http://geogratis.gc.ca/geogratis/en/option/select.do?id=25509	2000, day 49
AVHRR Land cover digital data	NOAA	1000 m (need to be defined)	Lambert Conformal Conic (LCC) 49/77/ Geodetic Reference System 1980 (GRS80)	Land cover over Canada	http://geogratis.cgdi.gc.ca/download/landcover/scale/	01/01/1992 – 31/12/1993

Digitized hypsographic and hydrographic data of the National Topographic Data Base from scale 1:250000	-	~90 m	GCS North American 1983/ Geodetic Reference System 1980 (GRS80)	Canada	ftp://ftp2.cits.rncan.gc.ca/pub/geobase/official/cded/250k_dem/001/	01/01/1973
Canada and USA mosaic of Fine Quad-Polarization beam	RADARSAT -2	12 m	need to be defined	Canada and USA	ftp://ftp.mda.ca	
Orthorectified tri-decadal, pan-sharpened Landsat digital images draped with National Elevation Dataset (NED)	Landsat ETM+	15 m (panchromatic band), 60 m (thermal infrared band)	GCS North American 1983/ Geodetic Reference System 1980 (GRS80)	Wisconsin, Michigan, Minnesota (USA)	http://eros.usgs.gov/imagegallery/index.php	07/1999 – 09/2002
AVHRR Land cover regions image, Monthly NDVI composite images, Digital Elevation Model (DEM) image	NOAA	1000 m	Lambert Azimuthal Equal Area/ Sphere of radius 6,370,997 meters	Northern America	http://edc2.usgs.gov/glcc/glcc_version1.php#NorthAmerica	04/1992 – 03/1993

National Oceanic and Atmospheric Administration (NOAA) has been recording weekly snow cover extent (SCE) since 1966, over the Northern Hemisphere, but during the spring melt period it has been mentioned an overestimation of the SCE (Wang et al., 2005). The latest dataset that can be derived from NOAA (NOAA-15) since 1998, is being characterized by 6 channels, that record data to an AVHRR/3 instrument mainly for daytime and night cloud and surface mapping, but also for snow and ice detection (Noaasis.noaa.gov).

RADARSAT is a satellite that monitors environmental changes, operating two times per day in all weather conditions, providing coverage of vast areas. Both RADARSAT-1 and 2 are in a polar sun-synchronous orbit. Particularly RADARSAT-2 can be used for forestry and agriculture applications, due to its dual-polarization and quadrature polarization modes. Polarization refers to the orientation of the radar beam relative to the Earth's surface. RADARSAT-2 can send and receive radar waves in both Horizontal (H) and Vertical (V) polarizations. This produces co-polarized signals (HH and VV) and cross-polarized signals (HV and VH) (MDA, 2008).

The dataset that has been collected and processed in this project is of Fine Quadrature-polarization beam mode (Fine Quad-Pol), which means that four images are acquired simultaneously, producing fully polarimetric datasets of two co-polarized images (HH and VV) and two cross-polarized images (HV and VH). In other words, four (4) different polarization channels are acquired per image. Quad-pol data retain both the amplitude and phase information of the radar waves, and the relative phase between the channels is also measured (Figure 3.7.). The reason for the selections of this beam mode is that information provided in a quad-pol dataset improves both the ability to characterize physical properties of objects and the retrieval of bio- or geophysical properties of the Earth's surface.

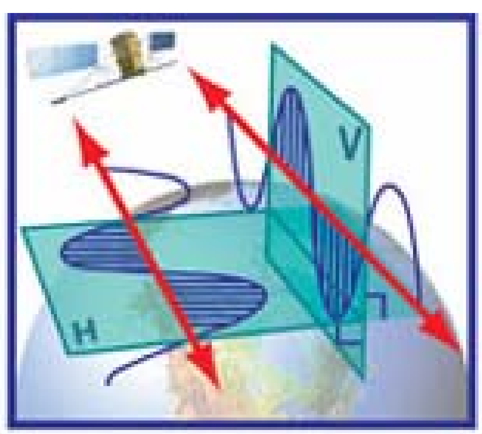


Figure 3.7. RadarSat-2 acquiring Quadrature Polatization data

Table 3.3. Specifications of satellite RADARSAT-2. (Source: MDA, 2008)

Spatial Resolution	3 to 100 meters	Suite of spatial resolution options accommodates a wide range of applications. Ultra-Fine beam improves object detection and classification
Polarization	Fine Quad-Pol (HH, HV, VV and VH), nominal Swath Width 25m, approximate range resolution 12m, approximate azimuth resolution 8m, approximate incident angle 20°-41°	Better discrimination of various surface types and improved object detection and recognition
Look Direction	Left- and right-looking imaging	Decreases revisit time for greater monitoring efficiencies
Onboard Recording Device	Solid-state recorders	Guarantees image acquisition anywhere in the world for subsequent downlinking High capacity (300 Gb) random access storage Simultaneous reading and writing
Onboard Location Accuracy Device	GPS receivers onboard	± 60-meter real-time position information GPS-derived geometric accuracy, provides greater positional control for fast delivery products (no ground control)
Attitude Control	Yaw steering	Control of yaw steering for zero Doppler shift at beam centre facilitates accurate image processing

The frequency used by RADARSAT-1 (5.3 GHz) falls within those used by wireless LANs (5.250 to 5.350 GHz), so the frequency used by RADARSAT-2 has been shifted to 5.405 GHz to avoid possible interference with wireless LANs. This eliminates the possibility of image quality being affected as wireless LAN use in this band increases. (MDA, 2008)

Landsat Thematic Mapper has seven (7) spectral bands, of which six (6) records Earth reflectance data in visible and reflective infrared regions of electromagnetic spectrum, and one (1) acquires Earth temperature data. The spatial resolution of the above mentioned six bands is 30 meters.

3.2.3. Remote Sensing and climatic data integration, georeference and visualisation

The data that have been eventually used, are consisted of geographic oriented, remote sensed, climatic (Tables 3.1., 3.2.) and genetic data (will be presented at Table 3.6) and are presented in the following table (Table 3.4.).

Table 3.4. Specifications of used data.

Data Type	Data	Satellite/ Sensor	Resolution	Projection/ Ellipsoid-Datum	Area	Source	Original Collection Date
Remote Sensing	Digital Terrain Elevation Data (DTED)	Shuttle Radar Topo-graphy Mission (SRTM)	90m (3 arc second, Level 1)	EPSG/ WGS 84	Wisconsin, Michigan, Minnesota (USA)	eros.usgs.gov/products/elevation	02/2002
	Digitized hypsographic and hydrographic data of the National Topographic Data Base from scale 1:250000	-	~90 m	GCS North American 1983/ Geodetic Reference System 1980 (GRS80)	Canada	ftp://ftp2.cits.rncan.gc.ca/pub/geobase/official/cded/250k_dem/001/	01/01/1973
	Monthly NDVI composite images (April 1992, March 1993), Digital Elevation Model (DEM) image	NOAA	1000 m	Lambert Azimuthal Equal Area/ Sphere of radius 6,370,997 meters	Northern America	http://edc2.usgs.gov/glcc/glcc_version1.php#NorthAmerica	04/1992–03/1993

Climatic	Precipitation, coefficient of variation of monthly precipitation, relative humidity, mean and diurnal temperature, ground frost & sunshine duration, no. of wet days	885 stations	spatial resolution 10' lat/lon, ~ 12000 m	GCS North American 1983/ Geodetic Reference System 1980 (GRS80)	Northern America	Climate Research Unit http://www.cru.uea.ac.uk (in courtesy of Laboratory of Geographic Information Systems (LaSIG), École Polytechnique Fédérale de Lausanne, Switzerland)	1961–2001
Genetic	Molecular markers derived by DNA samples (blood, tissue from pelts) of captures and legally hunted grey wolves (location included)	Micro-satellite telemetry, VHF radiocollars		WGS 84	Wisconsin, Michigan, Minnesota (USA), Yukon, Northwest Territories (Northern Canada)	In courtesy of Dpt. of Evolutionary Biology of University of Uppsala (Sweden) and of Laboratory of Geographic Information Systems (LaSIG) of École Polytechnique Fédérale de Lausanne (Switzerland)	1997-2000

The visualization of the used data is shown in the appendix [1] (Figure A1). The remote sensing data have been collected so as to cover the study area in a resolution that would be consistent to the spatial distribution of the climatic data set. The types of satellites and their products should also be selected on the basis of the immensity of the study area and the climatic conditions (covered most of the year by snow or clouds due to tundra and taiga, See §3.1. Study Area). Therefore very high spatial resolution imagery have not been used, as this would signify the requisition of processing an extremely large dataset and hence the failure of the system to perform a task.

The remote sensing data that have been used were Digital Elevation Models (DEM) and Normalized Difference Vegetation Index (NDVI) composites, aiming to ascertain whether the derived features, that are respectively the altitude and the content of vegetation, consist imposing factors in the evolutionary divergence of the grey wolf population. Climatic data have been processed for the same application. The reason for the selection of two DEM datasets with different resolution lies in the fact that the results after the statistical analysis were not expected and it should be considered whether the coarse resolution of 1000m was involved. This will be analyzed further in the following chapter §4.3.3. Data Preparation.

The management and analysis of geographic information was rendered possible with the use of spatial-oriented software suite, *ArcGIS*. Importing and georeferencing information from the collected SRTM products and the digitized hypsographic data along with the coordinates of genetic markers to the same coordinate system (WGS '84), resulted to the their combined visualization in the figure hereunder (Figure 3.8.).

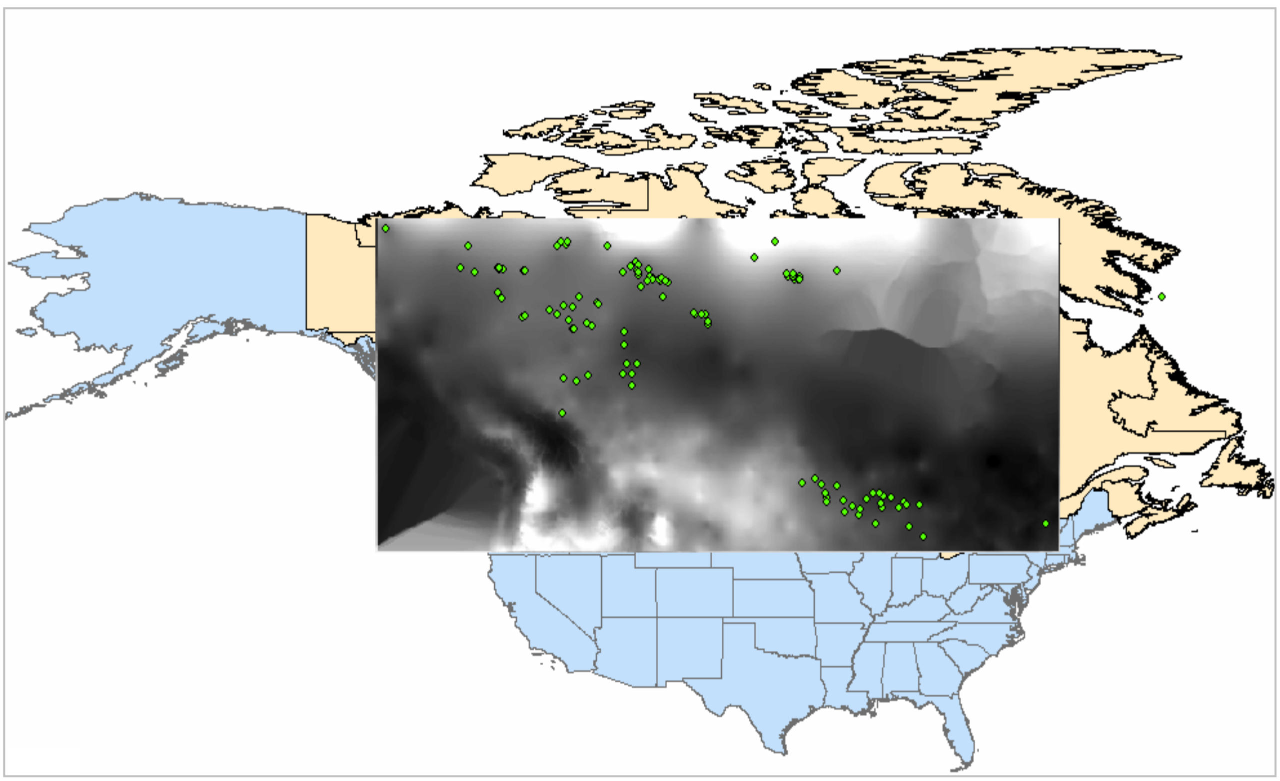


Figure 3.8. Map of Digital Elevation Model (DEM) in Northern USA from SRTM sensor, digitized hypsographic data in Canada, climatic data and locations of genetic markers of the population under examination (*Canis lupus*) in Northern Canada and U.S.A, here indicated by green points. Reprojection of map in WGS 84. For the sources of the collected data see Table 4.

The above figure was managed to be presented after the reprojection of all the components of the map to the projection of the genetic data (WGS84). The reprojection of digitized hypsographic and hydrographic data (DEM) of Canada has been effectuated at ArcToolbox with the tool Project Raster (Data Management Tools → Projections and Transformations → Raster).

Since the projection of the Canadian DEM is GCS North American 1983, the output raster should be converted to WGS84 and moreover encompasses the Northern American Continent, the geographic transformation that could be applied is NAD_1983_To_WGS_1984_1[2], which led to the selection indicated at Figure 4. The accuracy of the transformation varies, with greater accuracy at southern latitudes, and less accuracy at more northern latitudes, but overall with maximum offset of 2 meters.

Regarding to the climatic data, their file format had to be changed in order to be processed by the software. They have been opted to be changed to a more stable format, therefore the extension *.grd was renamed *.asc. Their projection was also initially GCS North American 1983, so as to be reprojected according to the genetic data, it has been completed as described above for the DEM.

However, the correlation between all the available information, and specifically the NOAA products (DEM and NDVI composites) was impossible as the process has been interrupted by the incapability of ArcGIS to support the Lambert Azimuthal Equal Area Projection. As the projection is not included in the database of ArcGIS software package, an attempt of creating it has been made. Based on the documentation of the NOAA products (central meridian/longtitude: -100, latitude of origin: 50), a modification at North Pole Lambert Azimuthal Equal Area was made, selecting an Authalic sphere for the reprojection.

The modification of the existed projection for the georeference of the required data was followed by a reprojection from Lambert to WGS84 via ArcCatalog and ArcToolbox, similar to the above procedure from GCS North American 1983 to WGS84 (Figure 4). Nevertheless, due to the unknown method that is applied by ArcGIS for conversions between spheroids and the restrained capabilities in the creation of a projection, the georeference of the data was unfeasible.

The solution was given by another software for viewing, converting and editing map data that is called *Manifold*. The composition of a map that contains the data of interest, is effectuated in a simpler manner as far as the georeference is concerned. A raster dataset can be added by File → Import → Surface and its projection is defined by the dialogue Edit → Assign Projection. Since Lambert Azimuthal Equal Projection is fully supported by Manifold the corresponding datasets were added without other complicated operations.

In order to process the NOAA derivatives, DEM and NDVI composites, the format of the files has been converted from the general type of image (*.img) to *.bil (Band Interleaved by Line) format that is a binary file containing the actual pixels of a grayscale or multispectral image. There are four image description files (ASCII text file format) that can accompany the bil data: a header file, a statistics file, a resolution file, and a color file. Since the original datasets had been collected in img format, in order to be rendered readable after their conversion to bil, at least the creation of equal in number header files (*.hdr) is deemed necessary. The header files are text files that accompany the raster data and provide information for their georeference[3] and nature. The content of the 9 line header for a Lambert Azimuthal Equal Area Projection is as follows:

byteorder M	
nbits 8	→ to declare the file depth
xdim 1000.000000 ydim 1000.000000	→ to declare the pixel size and so the scale of the image
ncols 9223	→ to declare the number of the columns of the raster file
nrows 8996	→ to declare the number of the rows of the raster file
nbands 1	→ to declare the number of bands that the file contains
ulxmap -4487000.00000 ulymap 4480000.00000	→ to define the position that the image has to be located based on upper left grid cell

The import of the data of Table 3.4., in Lambert Azimuthal Equal Projection and the combination of different opacity levels for each layer resulted to the map hereunder (Figure 3.9.).

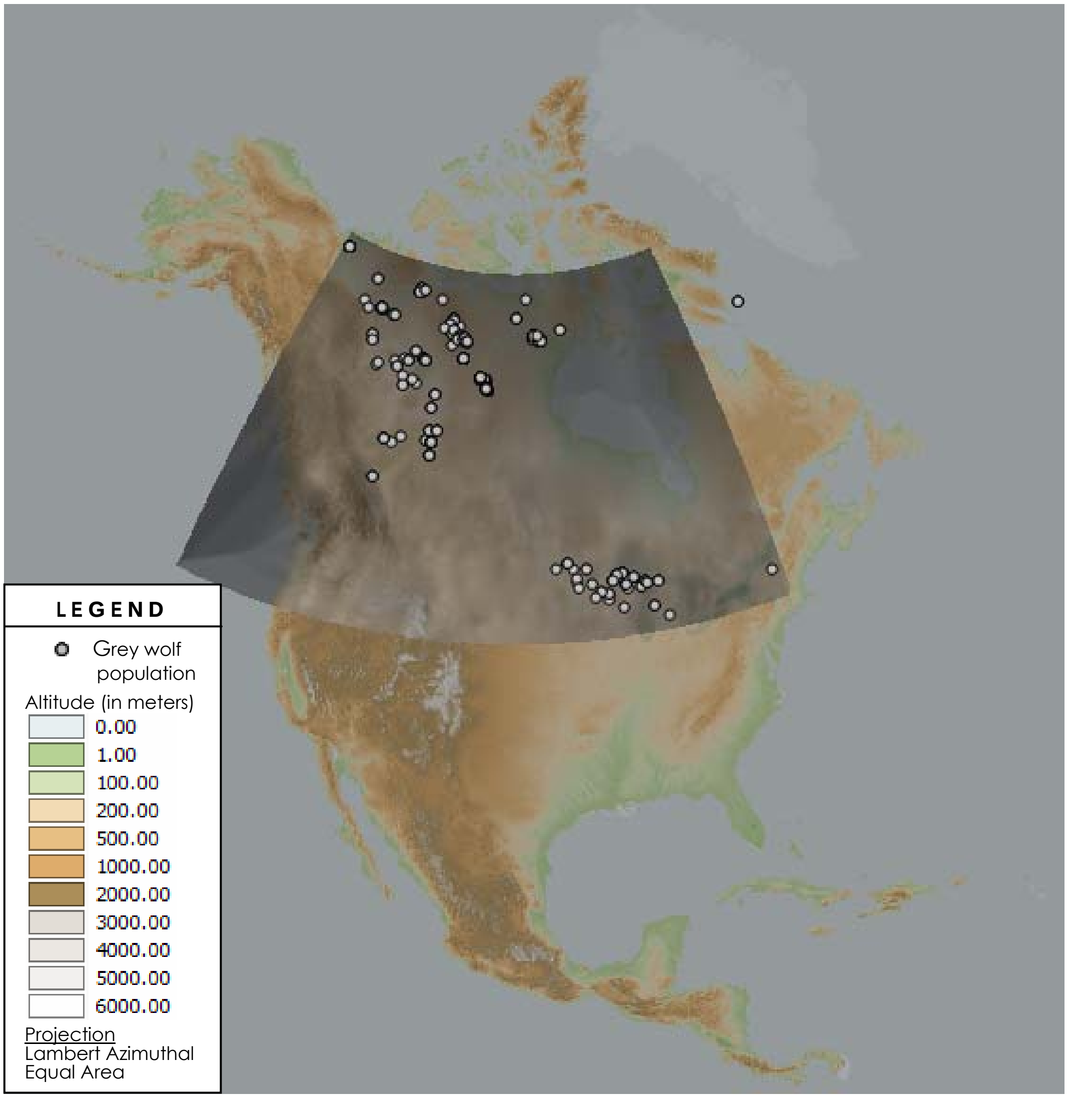


Figure 3.9. Map of remote sensing, climatic data and locations of genetic data, described at Table 3.4., in Lambert Azimuthal Equal Area Projection.

To create a matrix that correlates the environmental parameters, consisted by the information derived from the imported remote sensing and climatic data, with the locations of the genetic data and later on with the genetic parameters, the dialogue Surface → Transfer Heights was used. The output table was the required input for the passage to the statistical analysis part. A sample table with the first 10 out of 519 individuals/genetic markers follows (Table 3.5). The entire table can be found at the appendix **[4]** (Table A1).

Table 3.5. Part of the initial table with environmental parameters correlated to locations of population of grey wolves (Manifold exported).

CODE	Longitude	Latitude	Altitude (1000m)	NDVI April	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY
JAL2346	-117.56	53.41	1036	122	-120	-92	-90	-91	-109	-123	116	99	104	119	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2347	-117.56	53.41	1036	120	-117	-94	-91	-90	-109	-121	116	99	104	120	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2349	-117.56	53.41	1036	121	-118	-95	-93	-97	126	126	116	99	101	107	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82

As it was observed in Table A1. the values of the environmental parameter Normalized Difference Vegetation Index (NDVI) formed a range of [-127, 127]. Since the NDVI composites had values in this range it was assumed that it concerns the Scaled NDVI so the expected range should be [0,200]. The error lies in the fact that due to the format conversion of the files from *.img to *.bil format in order to be processed by Manifold, the NDVI values could not have been calculated correctly. For this reason the binary files converted to grid format via ArcCatalog and the dialogue Export → Raster to different format.

Selecting not to add a file extension to the Output Raster dialogue indicates the conversion and storing of data in grid. Grids are implemented using a tiled raster data structure in which the basic unit of data storage is a rectangular block of cells. The name of a grid cannot be stored using spaces or any special characters except underscores, it must not start with a number, and it cannot be longer than 13 characters. The grid, like a coverage, is stored as a separate directory with associated tables and files that contain specific information about the grid [5]. Since each block is stored as one variable-length record Manifold would calculate and transfer to table the correct NDVI values, as described above. A part of the final table that was used for the statistical analysis and that contained no errors is presented hereunder (Table 3.6.). The entire table can be found at the appendix [6] (Table A2.).

Table 3.6. Part of the final table with 21 environmental parameters correlated to locations of population of grey wolves, used for statistical analysis (Manifold exported).

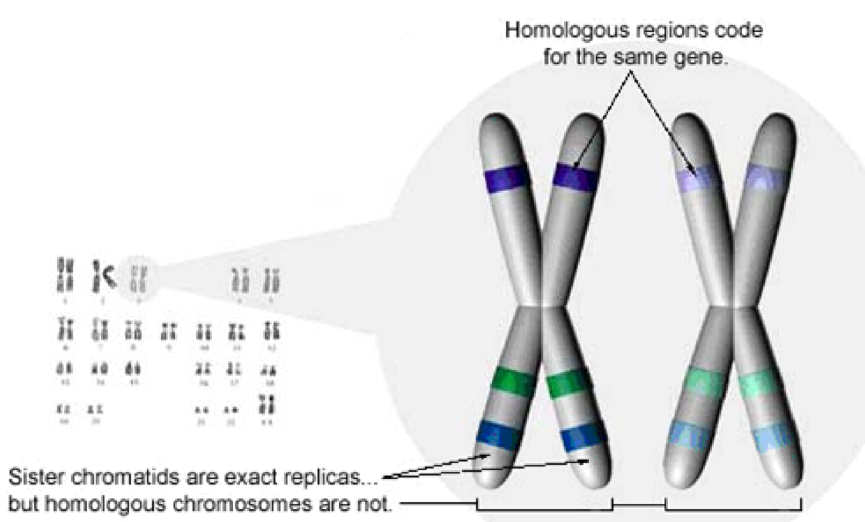
CODE	Longitude	Latitude	Altitude 1000m	NDVI April	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY
JAL2346	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2347	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2349	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82

3.3. Genetic Data

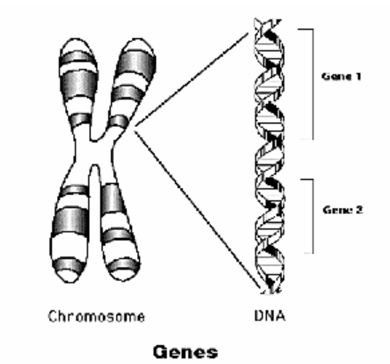
3.3.1. Microsatellite markers

The molecular data that have been used are specific fragments of DNA, of known nucleotide sequence or not, that are called **genetic markers**. These markers were used as benchmarks for the study of the genome and they are not essentially considered as genes, even though they can be statistically associated to the under examination genes. At each marker, every examined individual possess a genetic profile that is called genotype and that is composed by a pair of alleles. The analysis of a fragment of DNA at an a given locus - a site in the genome – and at a given population, may reveal several variations. These different variables in a locus are called **alleles**. A genotype that would contain the same allele is called ***homozygote***, whereas a genotype with two different alleles is called ***heterozygote***. In case that the determination of the genotype of an individual is not accessible, as certain alleles tend to hide the presence of other alleles, it is can be accessed via the phenotype. The phenotype is the translation of the genotype when in observable character. The alleles that have the power of masking other alleles are known as ***dominant*** and those that are masked are known as *recessive*. Within a population, the distribution of the genotypes evolves under the effect of great evolutionary forces like the **natural selection**. Several manners of detecting molecular markers within the genome have been developed (AFLP, microsatellite markers etc). In this study, genome was scanned with microsatellite markers. Generally **microsatellite markers** have several alleles without relation of dominance or recessiveness. Thus the exact genotype can be identified based on the phenotype, which renders microsatellites more informative than other detection methods, in addition to the fact that are less expensive and available in great amounts (Joost et al., 2008). An example with the information collected for this thesis, follows.

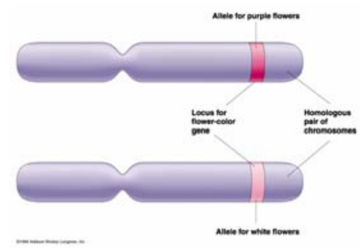
Each individual (wolf) has two (2) homologues chromosomes (eg. C2088-1 and C2088-2) one for each of the two (2) helices of DNA, and is located at a precise place (locus) on the DNA strain. Homologues chromosomes contain similar genetic information but they are not identical copies of each other. They have the same genes at the same loci but with different versions that are called alleles (Figure 3.10.). Each one is responsible for the expression of a unique feature, as i.e. the colour of the pelt. Alleles have various lengths, which means that the nucleotides at each chromosome are diverse variations of the four bases: Adenine (A), Thymine (T), Cytosine (C) and Guanine (G), which creates the genetic diversity. For example allele C2088-1-115 has 115 lines of bases A,T,C,G and forms pairs with allele C2088-2 at his homologous chromosome that happens to have the same length (115) but with different variation of bases. This case, where the values for both chromosomes are the same, is called homozygosity.



a.



b.



c.

Figure 3.10. a. Pair of homologues chromosomes. Alleles (here depicted as blue and green stripes) are located at the same loci without being identical as are consisted of various lengths of the four bases. Each allele is uncoiled as shown at figure **b** and is responsible for the expression of a specific feature (**c.**).

The molecular data sets used are presented in matrices. A part of the initial genetic dataset in question is presented in Table 3.7. Each row of the table corresponds to a sampled individual, here of a grey wolf. The first column contains an identification code (genetic marker) for each sample, the two following columns contain geographical coordinates, in WGS84 coordinate system, and in the column entitled "Location" is described the explicit location where the DNA sample was derived. The next columns contain the length of a specific DNA sequence, i.e. the number 107 corresponds to 107 bases. Wherever among these columns, the cells are blank or filled with 0 are missing information. In order to derive the contained information, the matrix would be processed by logistic regression after a encoding phase so as to be converted to binomial information with number 1 or 0 that sign in correspondence the presence of absence of an allele (see chapter §4. Method).

Table 3.7. Part of the initial table with georeferenced genetic markers from the corresponding molecular dataset of the population of grey wolf. Each of the numbers appeared in the last columns correspond to the length of a specific DNA sequence.

CODE	Latitude	Longitude	Location	C2088	C2088	C2017	C2017	C2001	C2001	N2096	N2096	VWF	VWF
MARCO008	56.23	-117.43	Peace River	0	0	266	266	149	153	99	99	163	181
MARCO007	56.23	-117.43	Peace River	107	115	262	266	129	153	103	103	157	175
MARCO001	56.00	-116.28	Peavine Metis Settlement, AB	115	115	266	266	145	145	95	99	157	157
JAL5170	46.21	-88.51	GreatLakes			266	270					141	159

3.3.2. Description of sampled genetic data

The genetic data that were used for the achievement of this thesis' aims are derived of sampled blood from satellite-collared wolves live-captured in the Northwest Territories and tissue from pelts of legally hunted wolves. Hide samples were from wolves killed by hunters from 1999 to 2000 in the Northwest Territories, Nunavut and Alberta. Pelt colour and sex was recorded for each hide sample and each captured wolf. The descriptions of colour morphs were standardized using the fur grading and pelt guide from Obbard (1987). However, since pelt colour varies over the body surface of a wolf and the position of hide samples was unknown, pelt colour was classified into two general categories, "dark" (grey through black) and "light" (white to near white) (Musiani et al., 2007).

3.3.3. Data preparation for analysis

Having already acquired the essential information from remote sensing and climatic data and correlated them with the georeferenced under examination population, that is the genetic markers of grey wolves, the environmental parameters have been formed and became part of the matrix that will be served as input in the statistical analysis stage. The only further procedure which has to be integrated before this phase, is that due to the use of version 1 of SAM software – that will be described in §5.3. Implementation of SAM – their precision is required to be limited to two (2) decimals.

The genetic data that are used in the current thesis are microsatellite markers, thus their preparation in the form of an encoding phase, in order to provide binomial information for the multiple univariate logistic regressions, deems essential. The outline of the encode phase to the sampled individuals is briefly presented schematically below in Figure 3.11. A part of the initial genetic dataset in question is presented in Table 3.8.

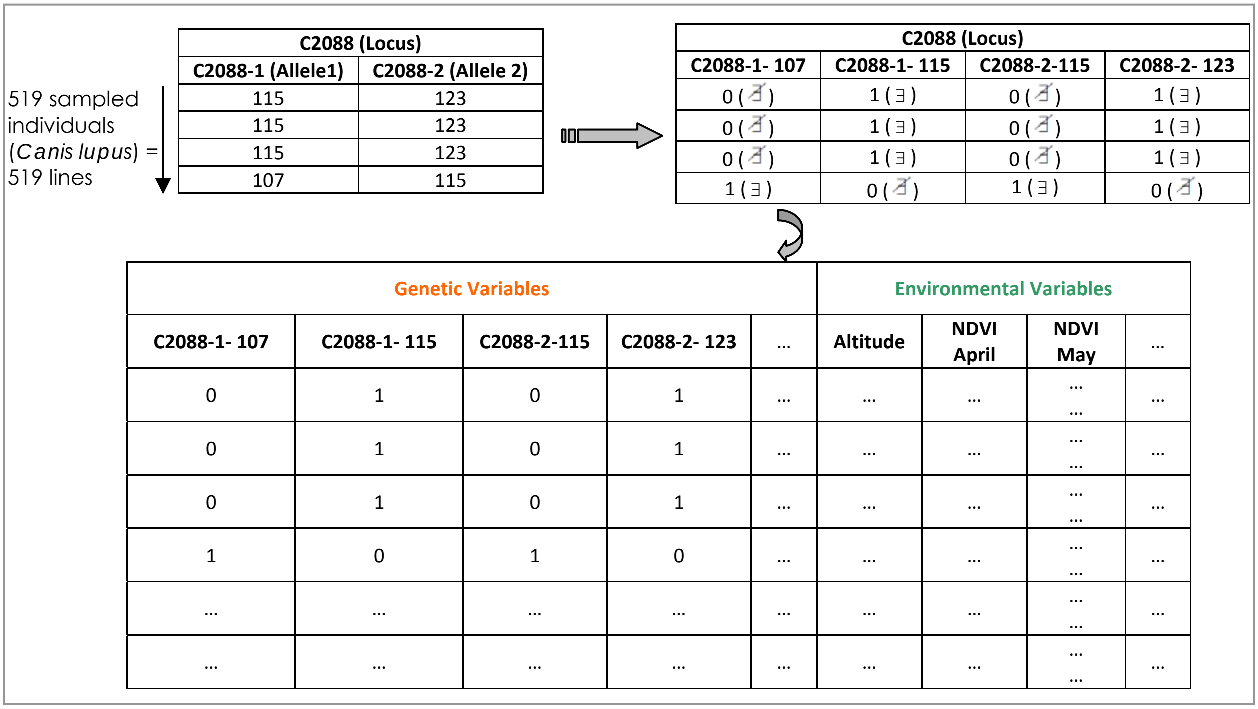


Figure 3.11. Schematic presentation of the encoding phase of microsatellite markers of sampled individuals.

Table 3.8. Sample table with georeferenced genetic markers before encoding.

CODE	Latitude	Longitude	Location	C2088	C2088	C2017	C2017	C2001	C2001	N2096	N2096	VWF	VWF
MARCO008	56.23	-117.43	Peace River	0	0	266	266	149	153	99	99	163	181
MARCO007	56.23	-117.43	Peace River	107	115	262	266	129	153	103	103	157	175
MARCO001	56.00	-116.28	Peavine Metis Settlement, AB	115	115	266	266	145	145	95	99	157	157
JAL5170	46.21	-88.51	GreatLakes			266	270					141	159

The fact that each individual, and so each sample, is georeferenced permits the collection of environmental information and its correlation to the sampling location. In order to form the input matrix of Spatial Analysis Method – described in the following chapter – that contains the environmental variables and the presence or absence of a given marker, the missing values (empty cells) and 0 values will be replaced by the "NaN" command (N=upper case a= lower-case N=upper case), which is a loan from Matlab syntax and means Not a Number. Each allele will be transposed to a column and if the allele in question is present is placed 1, otherwise is placed 0. If an allele of a chromosome has a length that the allele of its homologue chromosome does not have, a column is created only for the fist one, as there is no meaning in creating a column which contains only 0 values. An example of encoding follows (Table 3.9.).

Table 3.9. Part of Table 3.8. with the same georeferenced genetic markers after encoding.

CODE	C2088-1	C2088-1-107	C2088-1-115	C2088-2	C2088-2-115
MARCO008	0	NaN	NaN	0	NaN
MARCO007	107	1	0	115	1
MARCO001	115	0	1	115	1
JAL5170		NaN	NaN		NaN

After the completion of the encoding of genetic markers the red columns are deleted, the environmental parameters of Table A2. are added and the descriptive elements (title row and title column) are removed. The genetic parameters were sorted out, as mentioned before (§2.5.1. Introduction to Spatial Analysis Method), according to their frequency, that is computed by the sum of the binomial information of each marker. The final matrix that is ready to be processed by matSAM contains 21 environmental and 523 genetic parameters. A part of it is the following table 3.11.

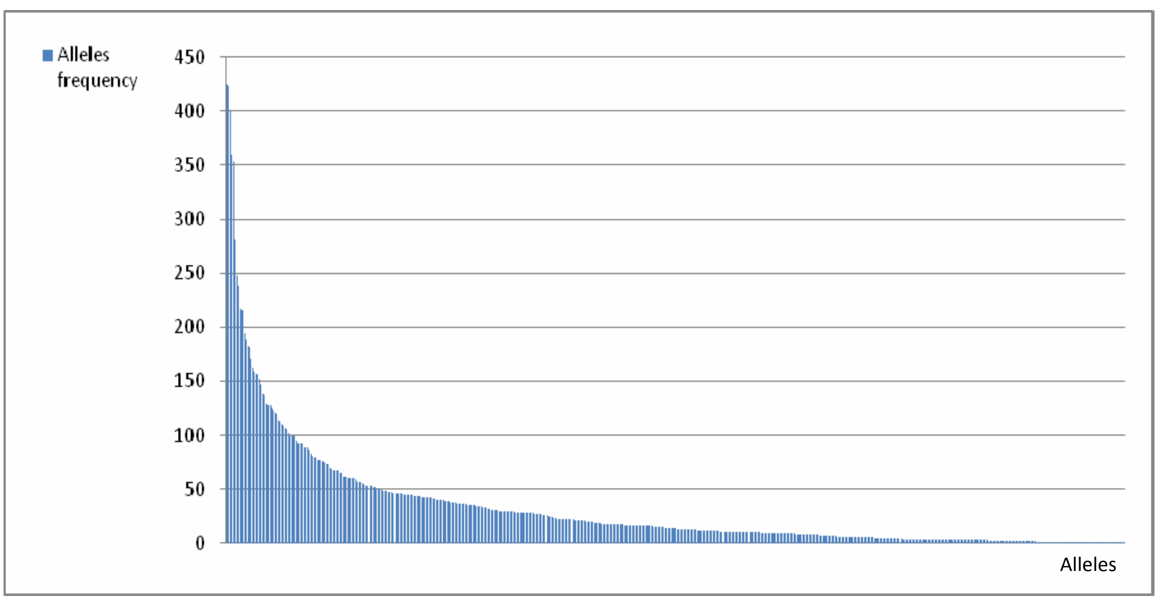


Figure 3.13. Frequency of occurrence of the alleles of the population under examination (*Canis lupus*) in Northern Canada and U.S.A.

Table 3.10. Part of final matrix with the georeferenced environmental and genetic variables after encoding and the title row and column with the variable names. The orange box, on the right side of the matrix contains the genetic variables with the presence or absence of an allele, the green box on the left the environmental variables. (21 of 21 environmental and 5 of 523 genetic variables are displayed)

CODE	Altitude 1000m	NDVI April	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY	C2017-2-266	C2017-1-266	PEZ_05-1-100	N253-2-108	N253-1-108
MARCO008	597.00	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86	1	0	1	0	1
MARCO007	597.00	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86	1	0	1	NaN	NaN
MARCO001	437.00	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13	0	1	1	1	1
JAL5170	518.00	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33	0	1	1	0	0

Table 3.11. Part of final matrix with the georeferenced environmental and genetic variables after encoding ready to be processed by matSAM, without containing the title row and column with the variable names. On the right side of the matrix the genetic variables, on the left the environmental variables. (21 of 21 environmental and 5 of 523 genetic variables are displayed)

597.00	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86	1	0	1	0	1
597.00	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86	1	0	1	NaN	NaN
437.00	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13	0	1	1	1	1
518.00	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33	0	1	1	0	0

4. METHOD

In the current thesis a heterogeneous set of quantitative and qualitative data was obtained from a wide variety of sources with different data structures. The first phase requires the desired information to be derived by the corresponding data using a Geographic Information System, so as to proceed to the second stage which is the encoding of the acquired data. The third, and final, part will include the implementation of multiple univariate logistic regressions, in order to accomplish the goal of the thesis that is to conclude whether exists a force for each parameter under examination by testing for association between allelic frequencies at marker loci and environmental parameters.

4.1. Spatial Analysis Approach Based on Association Models

Apart from the usual applications of Spatial Analysis, lately a new one was developed. The utility of GIS has been broadened, as mentioned above, with a method introduced by Joost et al. (2007), under the name Spatial Analysis Method and hereinafter referred to as SAM. Based on GIS, multiple univariate logistic regressions, environmental and molecular data, SAM detects signatures of natural selection by calculating the association degrees between the allelic frequencies at molecular markers and data from various environmental variables, in order to establish hypotheses about the possible factors that are correlated to selection pressure.

SAM requires georeferenced genetic data of the study population so as to retrieve information to characterize the sampling location and to correlate genetic parameters to one or more environmental parameters. The molecular datasets used for this spatial analysis are in the form of matrices. Each row of the matrix corresponds to a sampled individual of the under examination population, while the columns are organised according to the sampled individual's geographic coordinates and contain binary information (1 or 0), relating to the status of the genetic marker (presence or absence respectively). For AFLP markers, the numbers 1 or 0 indicate the phenotypes "presence of band" and "absence of band". For microsatellite markers, the numbers 1 and 0 indicate the presence or absence of a given allele at the locus in question (for genetic terms see §3.3.1. Microsatellite markers). The method was also recently successfully applied to SNPs

(Pariset, Joost, Ajmone and Valentini, 2009). For microsatellites and SNPs, an encoding phase is necessary, while AFLP data are ideal for logistic regression because they provide binomial information.

The input matrix that is to be processed by "matSAM.exe" program is a combination matrix with the values of the environmental parameters and the binomial information of the genetic ones (Table 4.2). It has to be a text file (*.txt) delimited with spaces and the descriptive lines and columns with the titles of both parameters have to be removed. During the preparation of the matrix is preferred to sort out the parameters, number them and keep the same order for all files to avoid the disambiguation. The genetic markers can be sort out according to their frequency among sampled animal or plant organisms.

Table 4.1. Part of input matrix with the georeferenced environmental (altitude of 90m resolution included) and genetic variables after encoding and the title row and column with the variable names. The orange box, on the right side of the matrix contains the genetic variables with the presence or absence of an allele, the green box on the left the environmental variables. (22 of 22 environmental and 5 of 523 genetic variables are displayed)

CODE	Altitude 1000m	Altitude 90m	NDVI April92	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY	C2017-2-266	C2017-1-266	PEZ_05-1-100	N253-2-108	N253-1-108
MARCO011	476.00	470.00	135	142	154	159	160	149	136	106	99	109	130	133	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67	1	0	1	1	1
MARCO012	351.00	372.00	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25	1	1	1	NaN	NaN
MARCO013	351.00	372.00	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25	1	1	1	1	1

Table 4.2. Part of final input matrix with the georeferenced environmental (altitude of 90m resolution included) and genetic variables after encoding ready to be processed by matSAM, without containing the title row and column with the variable names. On the right side of the matrix the genetic variables, on the left the environmental variables. (22 of 22 environmental and only 5 of 523 genetic variables are displayed)

476.00	470.00	135	142	154	159	160	149	136	106	99	109	130	133	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67	1	0	1	1	1
351.00	372.00	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25	1	1	1	NaN	NaN
351.00	372.00	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25	1	1	1	1	1

It must be noted that the sample analysed by SAM is subjected to different rules than standard analyses in population genetics. The aim is to obtain a statistically representative number of individuals per type of landscape and not per population. The sampling has to be planned with intention of using the specific method, as it is rather difficult to re-assign locations to previous datasets collected in the field without having recorded geographical coordinates, but it must be representative of the study area where a studied species occurs as accurately as possible and with environmental data, in order that the best possible models of association to be produced. Among the constraints of the method is that the scale of the study area will determine the available data which should be as accurate as possible and that GIS skills are indispensable for the production of the input matrices to SAM (Joost et al., 2007).

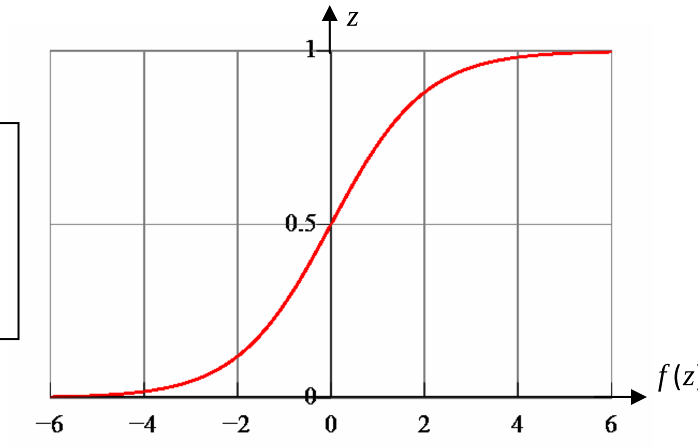
4.2. Logistic Regression

The logistic regression theory that is used by SAM is one of the methods of statistical analysis. It is a generalized linear model used for binomial regression that uses a set of independent variables to predict the absence or the presence of a feature on a set of categorical dependent variables. For this method the environmental parameters serve as independent variables and the molecular data as dependent variables, so the logistic model is used to predict the probability of occurrence of an event (presence or absence) of an allele according to a an environmental parameter by fitting data to a logistic curve formed by the function of logistic regression that is presented in Figure 4.1.

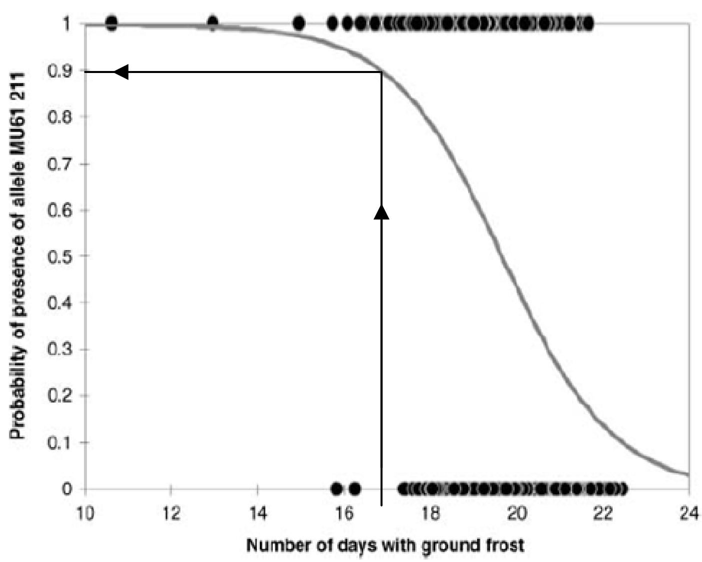
The prediction is based on the construction of a linear model and specifically on the assessment of the values of the factors of a set of independent variables that are being used as predictor variables.

$$z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \quad (1)$$

$$f(z) = \frac{e^z}{e^z + 1} = \frac{1}{1 + e^{-z}} \quad (2)$$



a.



b.

Figure 4.1.a. The function and a graph of logistic regression, **b.** example of logistic regression. (Source: Pariset L., Joost S., Ajmone-Marsan P., Valentini A., 2009; Econogene project http://www.econogene.eu/software/sam/default.asp#data)

The first part of the function of logistic regression (1) contains the values of the dependant variable in the form of logarithm of the possibility p (Fokianos and Charalambous):

$$z = \log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \quad (3)$$

The regression coefficients β_i are assessed by the method of maximum likelihood on the basis that the dependent variable follows the binomial distribution, fact that explains the sigmoid curve of logistic regression. From equation (3) the probability p can be computed by the equation (4):

$$p = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k)}{1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k)} \tag{4}$$

The second part of the function is a result of the linear combination of the independent variables that participate at the model of regression. At Figure 4.1.b., the graph of logistic regression for independent variable the environmental variable "Number of days with ground frost" and dependant the genetic variable the "Allele MU61 211", indicates that if for example the number of days with ground frost are 17, then the probability of allele MU61 211 to be presented (depicted by a black dot and value 1) is 0.9 (90%). However, besides the prediction, a model of logistic regression provides a measure of the association between the frequency of a georeferenced genetic and an environmental parameter for each location and in contrary to the multiple regression, in dependent variables can be used other than a ratio scale also a nominal scale. Subsequently, the association is tested between each allele and each environmental parameter. Logistic regression is used to assess the significance of the models constituted by all possible pairs between the two kinds of parameters and to accentuate the genetic markers implicated in the most significant models as potential candidates for linkage to genomic regions involved in adaptation. This aim is achieved by the evaluation of significance of coefficients calculated by the function of logistic regression by statistical tests addressing the question of whether a model including an environmental variable is more informative about the response variable than a model with a constant only. As mentioned above, in logistic regression, the comparison of observed with predicted values is based on the log-likelihood function. The significance of the models was determined by likelihood ratio (G) and Wald tests (Hosmer and Lemeshow, 2000; Joost et al., 2007). The *likelihood ratio* or *G statistic* is:

$$G = -2 \ln \frac{L}{L'}$$

where L : likelihood of the initial model (with a constant only)

L': likelihood of the new model including the examined variable

If added parameters are equal to zero, this statistic follows a chi-squared distribution, where the degrees of freedom equal the number of added parameters (Hosmer & Lemeshow 2000).

The *Wald statistic* is:

$$W = \frac{\hat{\beta}_i}{\sigma\left(\hat{\beta}_i\right)}$$

where β : maximum likelihood of parameter i

$\hat{\beta}_i$: maximum likelihood estimate of parameter β_i

$\sigma\left(\hat{\beta}_i\right)$: estimate of the standard error of maximum likelihood estimate of parameter β_i

For null hypothesis – which means that the model with the examined variable does not explain the observed distribution better that a model with a constant only – the resulting ratio follows a normal distribution, but the variance is assessed on the basis of the theory of maximum likelihood.

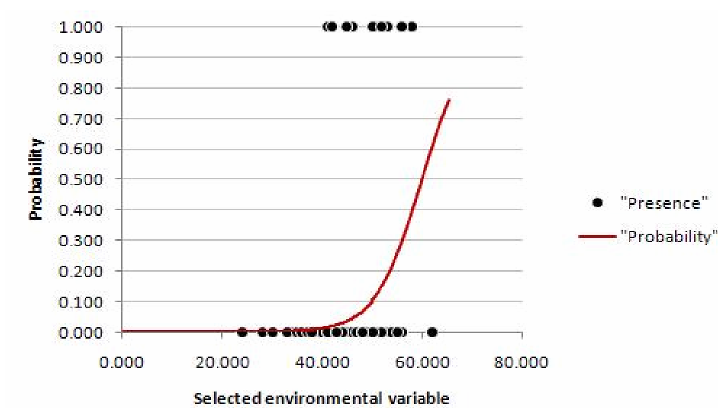
Only if both likelihood ratio test and Wald test reject the corresponding null hypothesis the model is considered significant. This double safety requirement is certifying the validity of the results since the reliability of each test separately has been repeatedly called into question from relevant literature. According to Hauck and Donner (1977) (Joost et al., 2007) the Wald test behaves in an aberrant manner and frequently fails to reject the null hypothesis, while an other research concluded that the likelihood ratio test outperforms the Wald test, which has satisfactory precision only with large samples (Agresti,1990; Tu and Zhou, 1999). Nevertheless a 2003 study of Conte and de Maio maintains that Wald test outperforms the others but that in case of large logit coefficients the standard error is inflated, which lowers the Wald statistic and leads to Type II (or β), errors that fail to reject the null hypothesis when it is false.

Since Spatial Analysis Method is able to run simultaneously many univariate models for many genetic and environmental parameters in order to detect the markers that it is more possible to be influenced by natural selection, a correction has to be selected that would maintain the FamilyWise Error Rate (FWER) to low levels. FWER is the probability of marking one or more Type I(a) errors – rejection of null hypothesis when it is true – when performing multiple pairwise tests. If the significance level for testing several hypothesis simultaneously has to be a (at most), then the Type I error probability is typically much higher than a, but with the implementation of *Bonferroni correction* the tests are being effectuated at a significance level of $\frac{a}{n}$, where a is the desired significance threshold and n the number of comparisons, or in this case the number of models simultaneously processed. The correction that was selected is very conservative so as to conclude to robust candidate associations. However, the SAM application allows the adaptation of confidence threshold and thus more models can be taken into consideration according to user's aims (Joost et al., 2007).

The processing of the numerous resulting models has been automated within the SAM program developed in Matlab, subsuming and adapting the GLMfit function, a generalized linear model fitting introduced by MacCullagh and Nelder (1989). For the preparation of the structure of a rejection table – an analysis table that assists to the identification of most important models by rejecting the ones with less significance according to the significance level decided – the number of markers and the number of environmental parameters that would be processed, are defined in order to assess the models. The procedure is then solving the likelihood equations allowing the maximum likelihood of the parameters to be determined and calculating for each model the P-values that are associated with both G and Wald statistical tests. The derived export tables and graphs, with response curves for each model, are text files (*.txt) that could be imported to a statistical software or a spreadsheet application (Figure 4.2.). Through an Excel macro that was developed in Visual Basic, the provided results, regardless their amount, can be processed and eventually adapted conforming to the selected confidence level by dynamic tables of analysis. More explicitly, by setting an initial confidence level that is adapted progressively the most significant models are emerged. The pairs of genetic markers and environmental parameters involved in significant models are ascertained by both or even by one test, in case that the maximum number of iteration is reached before the maximum likelihood equation is solved for one of the tests. The method permits the inclusion of the model that appointed as significant by only one test if for example the marker was detected by a population genetics approach (Joost et al., 2007).

	A	B	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1		Frequency	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2		Marker	AGA142-3	AGA142-4	AGA144	AGA144-1	AGA144-2	AGA144-3	AGA144-4	AGA146	AGA146-1	AGA146-2	AGA146-3	AGA148	AGA148-1	AGA148-2	AGA148-3	AGA150	AGA150-1
111	Dynamic null hypothesis analysis for G and Wald Beta 1																		
112	Null hypothesis for G	ddeg300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113		etptcompc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
114		hillshade	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
115		mnt25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116		precpcompc2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117		sfroyy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118		slope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119		sradpcompcc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
120		swb2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	Null hypothesis for Wald Beta 1	ddeg300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122		etptcompc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
123		hillshade	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124		mnt25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125		precpcompc2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126		sfroyy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127		slope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128		sradpcompcc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
129		swb2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	Cumulated test	ddeg300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131		etptcompc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
132		hillshade	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133		mnt25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134		precpcompc2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135		sfroyy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136		slope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137		sradpcompcc1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
138		swb2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
139	Confidence threshold with Bonferroni correction																		
140	8.55E-05																		
141																			
142																			
143	Probability	1.00E-02																	
144	Number of environmental variables	9																	
145	Number of molecular markers	84																	
146	Total number of models	117																	

a.



b.

Figure 4.2. Table **a** and graph **b** are examples of SAM derivatives imported to spreadsheet application.
a. Highlighted are the significant models for G, Wald and both tests, and the level of confidence that can be modified for the identification of the most significant models.
b. Graph of sigmoid form, depicting the probability that the genetic marker is present for the corresponding environmental parameter in question, with X axis: environmental parameter (scale given by the statistic distribution of the parameter), Y axis: genetic parameter. (Source: Pariset L., Joost S., Ajmone-Marsan P., Valentini A., 2009; Econogene project, www.econogene.eu/software/sam/default.asp#data)

4.3. Implementation of Spatial Analysis Method (SAM)

One of the methods of statistical analysis is logistic regression that uses a set of independent variables to predict the absence or the presence of a feature on set of categorical dependent variables. With the synergy of multiple univariate logistic regressions, GIS, environmental and molecular data, a new method to detect signatures of natural selection based on the application of spatial analysis was introduced by Joost et al. (2007), under the name Spatial Analysis Method (see §2.5 GIS and Landscape Genetics) and hereinafter referred to as SAM. SAM is the method that was applied on the under examination population of 519 grey wolves of the current thesis. The tests that have been carried out have been mainly used in order to detect the adaptive – because of various factors – loci and thus to locate the proportion of the genome, or which genes, are being shaped by natural selection, but also to calculate the association degrees between environmental and genetic parameters and so to establish hypotheses about the possible factors that are correlated to selection pressure.

The process that is required by SAM in order to obtain and analyse the desirable results on the significant models and thus the environmental parameters and their potential linkage to genomic regions involved in adaptation, is presented schematically in Figure 4.3. It is effectuated by matSAM, a Windows executable file, tested for the fist time on Windows Vista, that can process many simultaneous logistic regression models based on the GLMfit function (see §4.2.Logistic Regression).

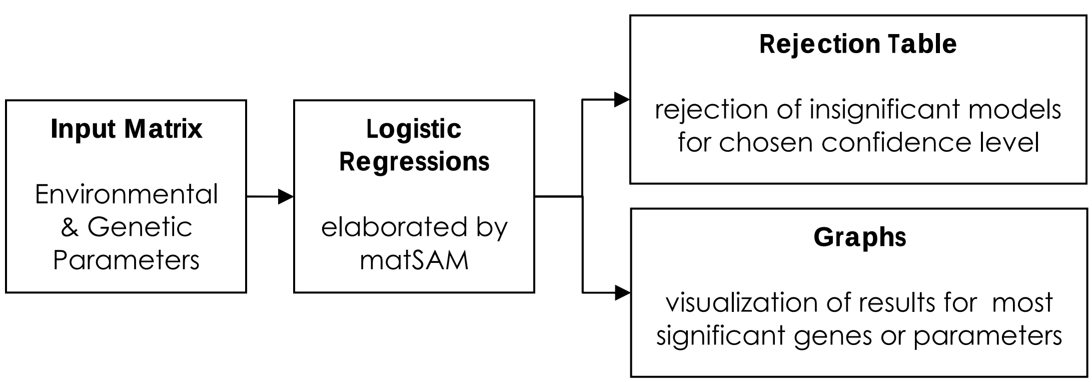


Figure 4.3. Flowchart of the process required in matSAM.

Having already contrived the table described as Input Matrix in Figure 4.3., part of which is Table 3.11., in order to proceed to the statistical analysis, the subsequent and most substantial phase of the method, the matSAM program has to be run. For this reason the MS DOS console is used and the following commands have to be written:

```
C:
cd␣C:\[path]\SAM
matSAM.exe␣ [NameFile.txt] ␣ [nb env. variables] ␣ [nb gen. variables] ␣1
```

where:

- C: the volume where the program is stored
- cd: **c**hange **d**irectory from C: to the folder that SAM program is stored
- ␣: space
- [path]: the path where SAM program is stored
- [NameFile.txt]: the name of the input matrix
- [nb env. variables]: the number of environmental variables that input matrix contains
- [nb gen. variables]: the number of genetic variables that input matrix contains
- 1: the type of the preferred function of the graph that would be exported by matSAM. Since the sigmoid function is the one that is implemented in the current version of matSAM, the only possible form is 1.

For the current input matrix of 21 environmental parameters and 523 genetic markers (part of if in Table 3.12.), after its conversion and storage from spreadsheet file to text file, the actual commands is:

```
C:
cd C:\samprogram\SAM
matSAM.exe env21gen523.txt 21 523 1
```

Due to the large dimensional input matrix, large amount of pairs between the two kinds of parameters have to be computed, the model processing delays several minutes. The process will be finished when the prompt with the path is displayed again and two files with the output table and the graph appear in the current folder.

The message - errors that could be arisen concern either the system local settings or the number of variables that were declared. The first error should be ignored, since it is displayed if the system settings are set in a different language than English, but the results are not affected. The second error (Figure 4.4.) is resulted by the user and the wrong declaration of the number that input matrix contains. The inconsistency is mentioned by matSAM and should be corrected by the user.

Figure 4.4. Example of potential error displayed by matSAM.

The output files are text files delimited with spaces. The graph output is structured in four lines for every model. The first line of each model contains the values of the environmental variable of the model in question, line 2 contains binomial information which depicts the presence or absence of the genetic marker (0 or 1), in line 3 the subdivision of the X axis can be found, in a scale formed by the statistic distribution of the environmental variable, and the last line contains the probability that the genetic marker investigated is present for the corresponding environmental variable.

Both output files were edited in an editing application in order to replace the spaces by commas that are better recognizable during their import in a spreadsheet application. Nevertheless after the import, an empty column was placed when the first column of the file contained NaN. For eliminating the unwanted addition, in an editing application via a Unix expression loan, the \n NaN (end of line ␣ NaN) was replaced by \nNaN (end of line no space NaN). After the completion of the operation the files were re-imported in a spreadsheet application and the large amount of results were processed by an Excel macro that was developed in Visual Basic to set up dynamic tables, in the sense that the confidence level that was initially set, can be adapted in order to identify the most significant models (Joost et al., 2007). The initial table that resulted contains 15 different groups of statistical data:

1. Log Likelyhood2
2. Log Likelyhood1
3. Degrees of freedom
4. G value
5. P value for G
6. Null hypothesis rejected for G (default confidence level = 99%)
7. Wald for Beta 0
8. Wald for Beta 1
9. P value for Wald Beta 0
10. P value for Wald Beta 1
11. Null hypothesis rejected for Wald Beta 0 (default confidence level = 99%)
12. Null hypothesis rejected for Wald Beta 1 (default confidence level = 99%)
13. Dynamic null hypothesis analysis for G and Wald Beta 1: Null hypothesis for G
14. Dynamic null hypothesis analysis for G and Wald Beta 1: Null hypothesis for Wald Beta 1
15. Dynamic null hypothesis analysis for G and Wald Beta 1: Cumulated test

} Dynamic Part of rejection table (items 12–15)

In the following chapter the resulted rejection table will be presented, on the basis of which the emerged associations will be analysed, so as to be unveiled whether the objectives of the thesis were reached.

5. RESULTS

Each of the above mentioned group (subchapter §4.3. Implementation of Spatial Analysis Method (SAM)) is consisted of 21 rows, corresponding to the number of environmental parameters, and 523 columns corresponding to the number of genetic markers. The dynamic part of table is adapted according to the confidence level that is set to unveil the most significant models. Due to certain missing values in the input matrix, likelihood ratio (G statistic) could not be computed, thus the "Cumulated test" was rendered also unusable (Joost et al., 2007). After the statistical analysis run by matSAM for 21 environmental parameters and 523 genetic markers, it was observed that none allele was associated to the environmental parameter "Altitude". None interaction on univariate models resulted also for every confidence level tested. Since this parameter is reasonably expected to affect natural selection and genetic diversity, it was decided to examine the possibility that was an effect of the coarse analysis (1000 m) of the remote sensing dataset by which it was derived (NOAA) and so to use the SRTM dataset of 3arc resolution (30 m). All the phases described above, in subchapters §3.3.3. and §4.3., were repeated for 22 environmental and 523 genetic parameters. In Tables 4.1. and 4.2. had been presented the preparation of the input table to SAM.

The process described in previous chapters resulted to the final rejection table (Table 5.1.), where only the Wald test rendered results, as certain missing values from the initial genetic dataset prevented the computation of G test and thus of cumulated test.

Table 5.1. Part of rejection table exported by matSAM with 22 environmental and 523 genetic variables (displayed are 19 of 523 most significant association models), for confidence level 99% (0.01) (ST=8.69E-07 Bonferroni correction included).

	Frequency	65	52	32	57	28	102	113	21	25	33	18	26	61	30	120	152	121	89	37
	Marker	**109-1-142**	**FH2914-2-211**	**VWF-2-177**	**VWF-1-159**	**VWF-2-171**	**N250-2-132**	**PEZ_05-2-108**	**VWF-2-159**	**Ren274F18-1-198**	**N253-2-116**	**VWF-1-171**	**FH2785-2-337**	**Ren239K24-1-298**	**C02#894-2-155**	**N250-2-136**	**C2010-2-233**	**VWF-2-175**	**VWF-2-181**	**C02#894-2-161**
Null hypothesis for Wald Beta 1	Altitude 1000m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Altitude 90m	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	NDVI April	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI May	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Jun	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Jul	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Aug	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Sept	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	NDVI Oct	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Nov	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Dec	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Jan	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI Feb	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NDVI March	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mean Temperature Yearly TMPY	1	0	0	1	0	1	1	1	1	1	1	1	0	0	1	0	0	1	0
	Temperature Diurnal Yearly DTRY	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0
	Max% possible Sunshine Yearly SUNY	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	Days Ground Frost Yearly FRSY	1	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0
	Coefficient Precipitation Yearly PRCV	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	Precipitation Yearly PRY	1	1	0	1	1	1	1	1	0	1	1	0	1	1	0	0	1	0	0
	Wet Days Yearly RDOY	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0
	Relative Humidity Yearly% REHY	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0
	SUM	**18**	**14**	**7**	**6**	**6**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**4**	**2**	**1**	**1**	**1**	**1**	**1**
Confidence threshold with Bonferroni correction (ST)	**8.69E-07**																			
Probability	**1.00E-02**																			
Number of environmental variables	22																			
Number of molecular markers	523																			
Total number of models	11506																			

This rejection table (Table 5.1.) contains the results derived from the Spatial Analysis Method on 22 environmental and 523 genetic variables by parallel processing of many univariate logistic regressions. The first line refers to the frequency of appearance of alleles and it is not a SAM export, but information added afterwards in order to allow the visual emphasis on significant models. The second line is a descriptive row that contains the titles of the alleles. Each cell represents an association model, that is a pair of both kinds of parameters, for which is examined whether the null hypothesis is rejected by the Wald test, since it is the only that renders results as clarified above and hereinafter when test is mentioned the reference corresponds to the Wald test. If the null hypothesis is rejected for the chosen confidence level, the variable in question significantly contributes in explaining the genetic diversity, and this is indicated by 1. The last lines of the tables contain information about the number of produced models (11506), the parameters used (22 environmental and 523 genetic) and the significance level, including Bonferroni correction so as to limit the errors of rejecting the null hypothesis when it is true and hence result in eliminating significant variables.

Based on the rejection table can be concluded that 19 alleles at 11 loci were identified as significant, as they were involved in 94 significant models, 0.82% of a total of 11506 models whose significance was assessed, where null hypothesis has been rejected by Wald test for a confidence level of 99.0% (significance threshold ST set to 8.69E-07, Bonferroni correction included) and also 21 of the 22 environmental parameters were significantly associated to alleles. Especially locus VWF could constitute a candidate for selection, involving in 30 significant models (0.26% out of total). For significance threshold (ST) 8.69E-08 (Bonferroni correction included) corresponding to a 99.9% (1.00E-03) confidence level, the alleles that are significantly associated to certain environmental parameters are lessened to 13 involving in 62 significant models (0.45% of total, Table 5.2). Nevertheless, for ST=8.69E-09 (Bonferroni correction included) only 7 environmental parameters were still significant and contributing to explain that certain region of the genome (loci) were involved in adaptation processes and were correlated to 26 significant models (0.22% of total models), whereas the alleles involved in significant association models were halved to 8. Four alleles from 3 loci were highly significant and still associated with up to six environmental variables at the confidence level of 99.99999% (ST=8.69E-12) and these are from locus VMF (two alleles: VMF-1-159, VMF-2-171, from locus PEZ_05 (one allele: PEZ_05-2-108) and from N250 (one allele: N250-2-132).

These four alleles are involved in 22 (ST=8.69E-07) up to 12 (ST=8.69E-12) significant models according to the Wald test, that is correspondingly 0.19% up to 0.10% of the total 11506 number of models processed. After the increase of the confidence level to 99.99999999% (1.00E-10) these four alleles were still standing, but associated with 4 environmental parameters the yearly mean temperature (TMPY) in C°, the yearly mean percent of maximum possible sunshine (SUNY), the yearly mean precipitation (PRY) in mm/month and the yearly mean wet days (RDOY) which is the number of days with more than 0.1mm rain per month. These four dominant alleles, amongst which lay the best candidates for selection, as they tend to be associated with environmental parameters even with ST=8.69E-12, and the significant alleles for each confidence level from 99% (ST=8.69E-07) to 99.999999999% (ST=8.69E-16), are depicted in plots visualising the significance in percentage (Figure 5.1.). Alleles VMF-1-159 and N250-2-132 were remained involved in 5 models (0.04% of total models processed) and associated to the four above referenced environmental parameters for ST=8.69E-15. Allele VMF-1-159 was eventually the last that continued to preserve an association with four environmental parameters in spite the increase of ST to over 8.69E-16 (99.999999999%). From level of significance set to over than 99.99999% (ST=8.69E-12) is involved in up to six significant models (0.05% of the total number of models processed). Although allele 109-1-142 gave the most significant associations (involved in 18 models, 0.16% out of total) for ST=8.69E-07, however for ST greater than 8.69E-16, only VMF-1-159 was associated with the 4 abovementioned environmental variables and was involved in 4 significant models. So the best candidate for selection is allele VMF-1-159 and among the best the above mentioned four alleles that are significantly associated with up to six environmental variables at the confidence level of 99.99999% (ST=8.69E-12) and are involved in 23 (ST=8.69E-07) up to 12 (ST=8.69E-12) significant models, that is correspondingly 0.21% up to 0.11% of the total 10983 number of models processed. In Figure 5.2., are demonstrated the environmental parameters that rendered the most significant associations and whose presence is significantly in the population in question.

Table 5.2. Number of significant association models between alleles and environmental parameters (displayed are 19 of most significant association models in a total of 523 genetic variables and 22 environmental), for confidence level from 99% (ST=8.69E-07) to 99.999999999% (ST=8.69E-16).

Alleles \ Confidence level	1.00E-02	1.00E-03	1.00E-04	1.00E-05	1.00E-06	1.00E-07	1.00E-08	1.00E-09	1.00E-10	1.00E-11
109-1-142	18	13	1	0	0	0	0	0	0	0
FH2914-2-211	14	2	0	0	0	0	0	0	0	0
VWF-2-177	7	0	0	0	0	0	0	0	0	0
VWF-1-159	6	6	6	6	6	6	5	4	4	4
VWF-2-171	6	6	5	3	2	2	2	1	0	0
PEZ_05-2-108	5	3	3	3	2	1	0	0	0	0
N250-2-132	5	4	3	3	3	3	1	1	1	0
Ren274F18-1-198	5	3	0	0	0	0	0	0	0	0
VWF-2-159	5	4	3	2	0	0	0	0	0	0
Ren239K24-1-298	4	1	0	0	0	0	0	0	0	0
N253-2-116	4	4	3	2	1	0	0	0	0	0
FH2785-2-337	4	2	0	0	0	0	0	0	0	0
VWF-1-171	4	3	2	0	0	0	0	0	0	0
C02#894-2-155	2	0	0	0	0	0	0	0	0	0
C2010-2-233	1	0	0	0	0	0	0	0	0	0
VWF-2-175	1	0	0	0	0	0	0	0	0	0
N250-2-136	1	1	0	0	0	0	0	0	0	0
VWF-2-181	1	0	0	0	0	0	0	0	0	0
C02#894-2-161	1	0	0	0	0	0	0	0	0	0
Number of models (sum) whose variable significantly contributes in explaining diversity for each confidence level out of total 11506 models	94	52	26	19	14	12	8	6	5	4
% of models whose variable significantly contributes in explaining diversity for each confidence level	0.8169651	0.4519381	0.2259691	0.1651312	0.1216756	0.1042934	0.0695289	0.0521467	0.0434556	0.0347645
Number of models (sum) in association with four most significant alleles (VWF-1-159, VWF-2-171, PEZ_05-2-108, N250-2-132) for each confidence level	22	19	17	15	13	12	8	6	5	4
% of models in association with four most significant alleles (VWF-1-159, VWF-2-171, PEZ_05-2-108, N250-2-132 out of total 11506 models	0.1912046	0.1651312	0.147749	0.1303668	0.1129845	0.1042934	0.0695289	0.0521467	0.0434556	0.0347645

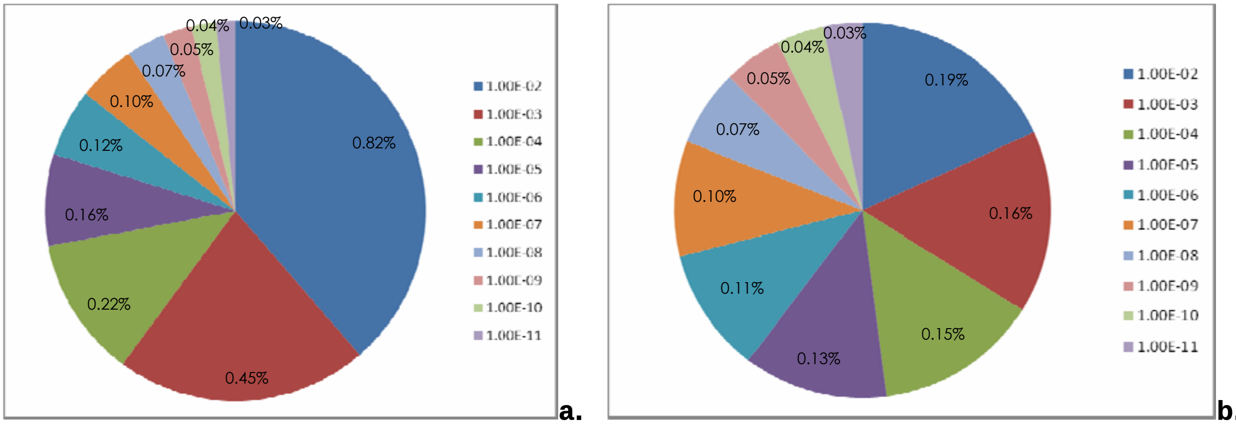


Figure 5.1. Plot of percentage of significant models out of 11506 models in total, according to confidence level (dataset of 22 environmental&523 genetic parameters) for **a.** sum of alleles, **b.** most significant alleles (VMF-1-159,VMF-2-171,PEZ_05-2-108,N250-2-132).

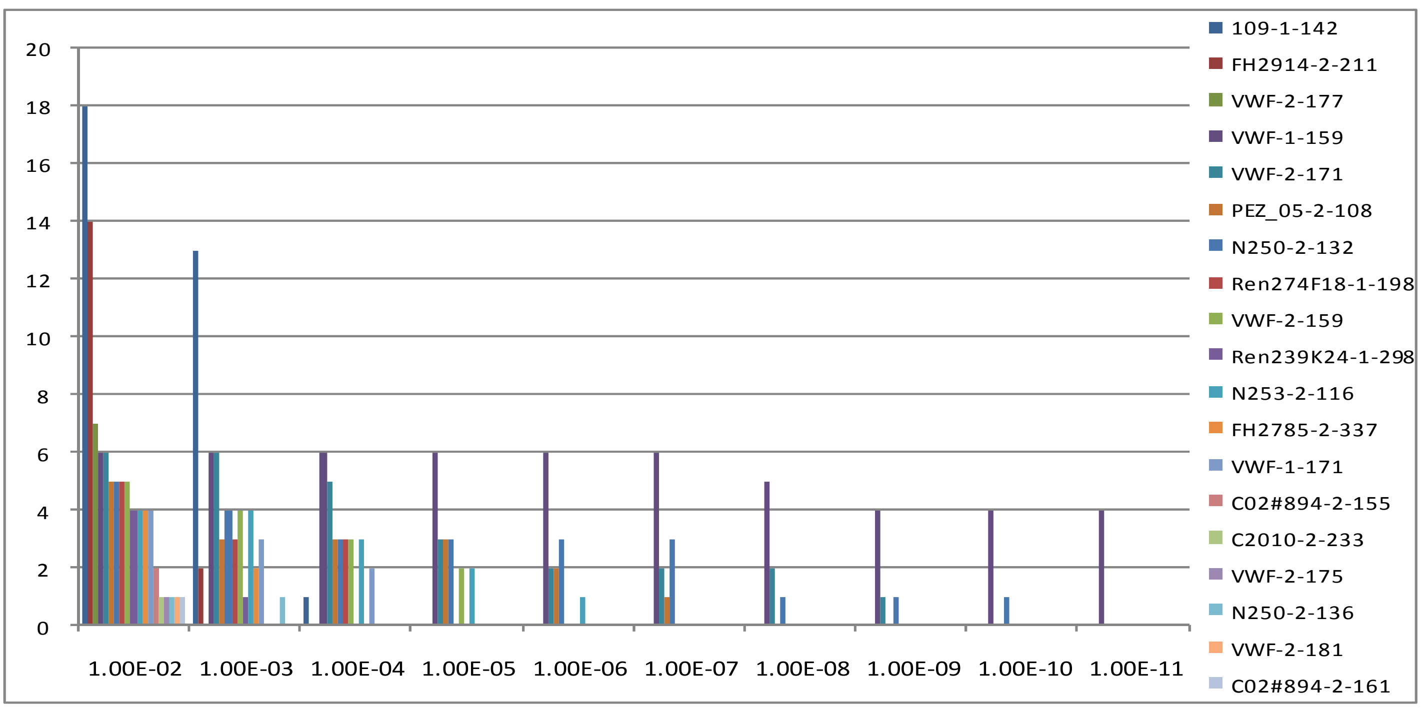


Figure 5.2. Plot of significant association models between alleles and environmental parameters according to confidence level. From confidence level 99.99999% (ST=8.69E -12) at a dataset of 22 environmental and 523 genetic parameters only VMF-1-159, VMF-2-171, PEZ_05-2-108 and N250-2-132 are significantly present.

The columns of Table 5.2. were formed by the later-constructed rows in rejection tables of each confidence level, containing the sum of significant models of each rejection table (eg. Table 5.1., three-toned greyscale highlighted row). The three-tone scale of the table was used to emphasize the number of significant models for each confidence level, so

as to arrive promptly in conclusions on the number of alleles and environmental parameters associated in significant models. As the number of models increases, and thus the significant alleles and environmental parameters, the cells are highlighted with darker tones of grey and as the number decreases are highlighted with lighter grey tones. The two last rows contain the sum and the percentage of alleles involved in significant models of the total number of models processed for each confidence level. In the lowest confidence level in the current analysis (99%, ST=-8.69E-07) 19 alleles are involved in 94 significant models (0.82%) and in the highest (99.999999999%, ST=-8.69E-16) one allele (VMF-1-159) is involved in 4 significant models. Allele VMF-1-159 is involved in four significant models (0.03% of the total number of models processed) even for significance threshold greater than ST=8.69E-16. From level of significance set to over than 99.99999% (ST=8.69E-12) is involved in up to six significant models (0.05% of the total number of models processed) and associated to at least four environmental parameters, as it is displayed in Figure 5.2., the yearly mean temperature (TMPY) in C°, the yearly mean percent of maximum possible sunshine (SUNY), the yearly mean precipitation (PRY) in mm/month and the yearly mean wet days (RDOY) that is the number of days with more than 0.1mm rain per month.
For the same confidence level 21 of 22 environmental parameters were significantly associated to alleles.

Comparing both rejection tables resulted from 523 genetic parameters and 21 or 22 environmental parameters correspondingly, is concluded that with SAM slight differences in the values of environmental variables may trigger associations to exist. In the case in question, the results were slightly modified with the addition of altitude with the finer resolution of 90 meters to the 21 environmental parameters listed in the input matrix (Table 5.1.), as the altitude of 1000 meters resolution, regardless the processing of input matrices in various confidence levels, had not been associated with none alleles, whereas the altitude of 90 meters was associated to one (Ren274F18-1-198) for ST=8.69E-07 (99%). Albeit this addition generated the reformation of pairs between environmental and genetic variables the number of significant parameters was not altered.
Consequently the final dataset consisted of 523 alleles located at 39 loci and were analysed in relation to 22 remote sensing and climatic environmental variables. A total of 19 alleles, representing 3.63% of the total number of investigated alleles, identified by SAM as significantly associated to at least one environmental parameter, for a

confidence level of 99% corresponding to significance threshold of 8.69E-07. Six alleles (VWF-1-159, VWF-2-159, VWF-2-171, N250-2-132, PEZ_05-2-1089, N253-2-116) at 3 loci were detected as significantly associated with at least 2 climatic variables. As it is depicted in Figure 5.3., the number of significant alleles and of environmental parameters associated with these is decreased with the increase of confidence level. At ST=8.69E-16 and above, only one allele (VWF-1-159) remained significant and associated to 4 climatic parameters. Locus VWF was associated mainly with climatic parameters except for confidence level 99% that was associated with the content of plants in chlorophyll (NDVI July, August, November, December, January, February, March), and only allele VWF-2-177. Whereas, for the same confidence level (99%, ST=8.69E-07) alleles 109-1-142 and FH2914-2-211 associated with almost all NDVI in addition to certain climatic (see Table 5.1.)

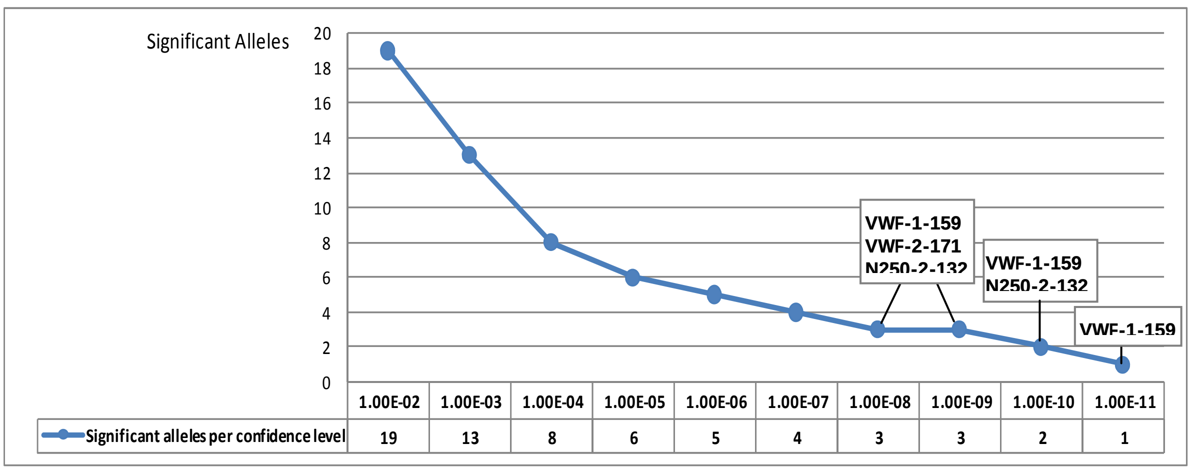


Figure 5.3. Continuous representation of a discrete number of significant models per confidence level (1.00E-02 to 1.00E-011) derived from the analysis of 22 environmental and 523 genetic parameters.

Equivalent to Table 5.2. and Figure 5.2. are represented the environmental parameters that are considered significant for each confidence level, and that were computed by adding their presence, when such, in models (Table 5.3., Figure 5.4.). Twenty-one of 22 environmental variables were involved in significant models (95.45% of the total environmental parameters). The only environmental parameter that was not involved in a significant model was the altitude of 1000 meters resolution, which was the reason for the addition of altitude of 90 meters resolution, as mentioned above.

Table 5.3. Number of associations of environmental parameters with alleles for 22 environmental parameters and 523 genetic parameters of confidence level from 99% (ST=8.69E-07) to 99.99999% (ST=8.69E-16).

Environmental parameters \ Confidence level	1.00E-02	1.00E-03	1.00E-04	1.00E-05	1.00E-06	1.00E-07	1.00E-08	1.00E-09	1.00E-10	1.00E-11
Mean Temperature Yearly TMPY	11	7	4	3	3	3	1	1	1	1
Max% possible Sunshine Yearly SUNY	12	9	6	5	3	3	2	1	1	1
Precipitation Yearly PRY	12	10	8	5	4	2	2	2	2	1
Wet Days Yearly RDOY	7	5	3	3	2	2	2	2	1	1
Days Ground Frost Yearly FRSY	7	5	1	1	1	1	1	0	0	0
Temperature Diurnal Yearly DTRY	6	4	3	2	1	1	0	0	0	0
Altitude 90m	1	0	0	0	0	0	0	0	0	0
Altitude 1000m	0	0	0	0	0	0	0	0	0	0
NDVI April92	2	1	0	0	0	0	0	0	0	0
NDVI May	2	1	0	0	0	0	0	0	0	0
NDVI Jun	2	1	0	0	0	0	0	0	0	0
NDVI Jul	3	1	0	0	0	0	0	0	0	0
NDVI Aug	3	1	0	0	0	0	0	0	0	0
NDVI Sept	3	1	0	0	0	0	0	0	0	0
NDVI Oct	2	1	0	0	0	0	0	0	0	0
NDVI Nov	3	0	0	0	0	0	0	0	0	0
NDVI Dec	3	1	0	0	0	0	0	0	0	0
NDVI Jan	3	0	0	0	0	0	0	0	0	0
NDVI Feb	2	0	0	0	0	0	0	0	0	0
NDVI March	2	0	0	0	0	0	0	0	0	0
Coefficient Precipitation Yearly PRCV	4	2	0	0	0	0	0	0	0	0
Relative Humidity Yearly% REHY	4	2	1	0	0	0	0	0	0	0
Sum of association to significant models	94	**52**	**25**	**19**	**14**	**12**	**8**	**6**	**5**	**4**
Number of significant environmental parameters	**21**	**16**	**7**	**6**	**6**	**6**	**5**	**4**	**4**	**4**

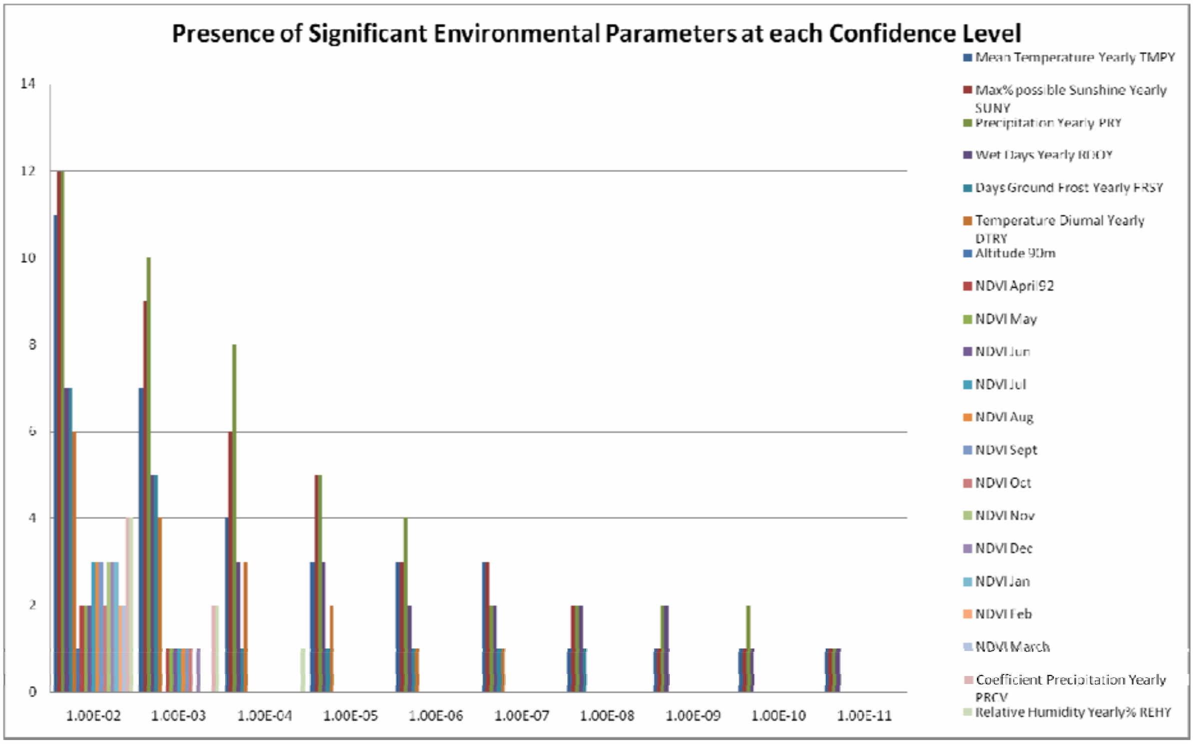


Figure 5.4. Histogram with the presence of environmental parameters for each confidence level that was emerged as being associated with genetic markers and involved in 11506 significant models.

6. DISCUSSION – CONCLUSIONS – PROSPECTIVE

This research constitutes an interdisciplinary work as information from the fields of Remote Sensing, Geographical Information Systems (GIS) and Molecular Ecology were gathered, in the merge of which lies its interest, usefulness and originality. The current thesis was an attempt of detecting a selection pressure driven by the environment. The Normalized Difference Vegetation Index (NDVI) was examined as a possible candidate, affecting indirectly the population under examination of grey wolf (*Canis lupus*). The main concept was based on the fact that since the dietary of their prey is consisted of plants, which can be identified by NDVI, a seasonally alteration of flora from autumn/winter to spring/summer, and hence of the food shortage or not, would have drawn its effect on a locus of the DNA sequence. Given that the decoding of genome of the species has been completed, the correlation of an environmental parameter with an allele, by Spatial Analysis Method (SAM), would have led to its link to an exact feature. Through SAM, the scientific community has in its disposal a tool that is able to provide tracking points for gene location and that contributes in the comprehension of their function (Joost et al., 2008). This discussion was held under a geographical information point of view, although a biologically-oriented interpretation-analysis would be elaborated in the context of a future publication together with specialized Molecular Biologist Professor Jennifer Leonard (Dpt. of Evolutionary Biology, University of Uppsala).

The dataset that has been eventually analysed, consisted of genetic samples by microsatellites, and of environmental data (climatic and NDVI) that have been collected as monthly variables in order to inquire the effect of seasonality on genetic data. The procession that has been elaborated by SAM included 523 genetic parameters and 22 environmental, after the addition of altitude with higher resolution (90 meters) because of the observation that when analyses were effectuated for both data sets (of 21 and of 22 environmental parameters and 523 genetic variables) the altitude of low resolution (1000m) did not interacted with none univariate models.

The environmental parameters stand as the independent variables of the analysis. Emphasis was laid on NDVI and whether consists a significant force of natural selection, as this index has not yet been included in a relevant research. Based on the results that were exposed in chapter 5, the hypothesis has not been confirmed due to reasons that will be attempted to be presented as follows. Nevertheless, the reduced selective power that NDVI tends to have in this case, does not consist an overall conclusion, as further study has to be effectuated with data of various resolution and content.

The health and availability of flora, especially during late March to August that the study area is not covered by snow and the higher temperatures values favour the development of plants, was expected to have affected indirectly the population in question via their dietary habits. Nevertheless, the extensive period of snow cover (mid-September to March), the small vegetation regions due to low temperatures, in addition to the low resolution of data (1000m)fact and to that the majority of examined population is located in North could partly explain the reason of involvement of NDVI parameters in significant models only for the two lowest significance thresholds. Indeed, for confidence levels of 99.0% (ST=8.69E-07 Bonferroni correction included) and 99.9% (ST=8.69E-08 Bonferroni correction included) NDVI is associated with 4 of the 523 alleles (0.76%) processed by SAM. For confidence level 99.9%, NDVI is associated only with allele

109-1-142. For the 99% confidence level, these alleles are from 4 loci, 109 (allele 109-1-142), FH2914 (allele FH2914-2-211), VWF (allele VWF-2-177) and Ren239K24 (allele Ren239K24-1-298). Amongst them the first three gave the highest number of associations in the current level (109-1-142 FH2914-2-211 VWF-2-177). In addition, from locus VWF was derived allele VWF-1-159 involved in the 4 most significant models even for significance levels set to over 99.999999999% (ST=8.69E-16) (see Table 5.2). As such, VWF could be considered as probable locus from which could be derived alleles that are under natural selection and consequently the environmental variables involved in the corresponding significant models could be regarded as an environmental-oriented selection pressure.

However, the association of NDVI to the above mentioned as significant alleles is effectuated in low confidence levels (99.0%, 99.9%) where generalist behaviour is observed (Table 5.1.). More explicitly, even though it seems that for the levels in question certain environmental parameters appear to be significant and consist candidate signatures of natural selection, simultaneously the majority of alleles are associated to all categories of environmental variables, thus are associated to a generalized involvement in environmental parameters. Because of this reason there are certain discrepancies in verifying the seasonality of the index by monthly environmental variables.

Another explanation that this index is restrained from consisting a powerful candidate for natural selection lies within the computation of the NDVI values proved to be sensitive to a number of perturbing factors including clouds and cloud shadows that due to the prevailing climatic conditions of the study area are not scarce. Deep, optically thick, clouds may be quite noticeable in high resolution satellite imagery and yield characteristic NDVI values that ease their screening, but thin or small clouds with typical linear dimensions smaller than the diameter of the area that is actually scanned by the sensors, can significantly contaminate the measurements. Similarly, cloud shadows can affect NDVI values and lead to misinterpretations. Even though these considerations are minimized by forming composite images from daily or near-daily images, as the ones collected, the effects are not annihilated due to the resolution of the current dataset. In addition to that at SAM slight differences in the values of environmental variables may trigger associations to exist or not (Joost et al., 2007), the evidence suggest that the results may have been distorted in great extend and thus to vindicate the non-formation of a significant force of natural selection.

Furthermore, the missing values of initial genetic dataset prevented the effectuation of G test. As a result the models that were considered as significant could differ from the actual ones, because ideally the rejection of the corresponding null hypothesis is carried out by both Wald and G tests. So potentially in that case, additional alleles and thus greater amount and range of environmental parameters, NDVI included, would have been unveiled to be under natural selection.

On the topic of the remaining environmental parameters, the variables yearly mean temperature (TMPY), yearly mean percent of maximum possible sunshine (SUNY), yearly mean precipitation (PRY) and yearly mean wet days (RDOY) (number of days with more than 0.1mm rain per month) are the climatic parameters that are associated with a genetic parameter (VWF-1-159) regardless the increase of confidence level (over 1.00E-11, ST=8.69E-16) and that are involved in the greatest number of significant models. This allele and the four climatic environmental variables which gave the most significant associations are presented in the following table (Table 6.1.). Besides its link to climatic variables, locus VWF seems to be also associated to vegetation index, but only due the generalist behaviour and in a low confidence level (99.0%).

Table 6.1. The environmental variables involved in the most significant models of the highest confidence level and the allele that is most likely to be under natural selection.

Environmental Variables	Allele
Yearly mean temperature (TMPY) Yearly mean % of maximum possible sunshine (SUNY) Yearly mean precipitation (PRY) Yearly mean wet days (RDOY)	VWF-1-159

Probably this also denotes that this significant location (VWF) could be involved in adaptation processes in addition to different factors. Even though, the low frequency of allele VWF-1-159 decreases the probability of forming indeed a candidate for further research, its spatial distribution indicates that it is more frequently encountered in northern states of U.S.A., except for three cases in Canada (Figure 6.1.). Thus VWF-1-159 forms spatial patterns that via Functional Genomics could be unveiled in order to be emerged results about the manner that environmental parameters, associated to it, have influenced the response to novel selective pressures. Even with four significant associations, as is the case in question, the area that the four climatic georeferenced parameters that VWF-1-159 is associated to, can be defined. A more precise explanation of what should be the expression of the feature because of these four parameters, would be elucidated only with the synergy of a biologist expert, who would attempt to discover the effect of environmental parameters to the gene. In fact, given that the confidence level is high and the allele only one, invigorates the possibility that VWF is a candidate loci for selection.

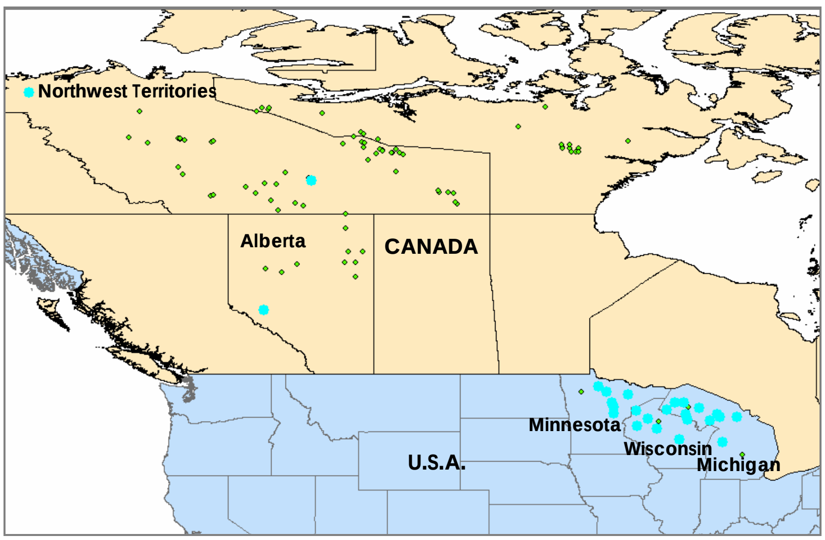


Figure 6.1. Spatial distribution of most significant allele VWF-1-159. In green points are displayed the locations of the population in examination and in cyan points the location that allele VWF-1-159 is encountered.

Comparing the two groups of environmental parameters, derived from remote sensing data and climatic data, it is concluded that climatic variables are exerting a selection pressure that could lead to genetic diversity, in contrast to vegetation index and altitude that ceased to be involved in significant associations from the first two lowest confidence levels. The extenuation that potentially excuses their efficiency and should be studied further, stands on the resolution of the collected data. Climatic data were collected by ground measuring stations and even though the resolution is low, the mean squared errors of the ground measurements are low, because of their co-computation via statistical prediction models. As a result the true values of climatic phenomena were better quantified, in contrast to the remote sensed data whose quality of acquired information of the corresponding features (vegetation content, altitude) is depended on spatial, spectral, radiometric and temporal resolutions, each of which is probably implicated to errors. The abovementioned observation should be interpreted in conjunction to that the study was effectuated with a method (SAM) in which slight differences in the values of environmental variables may trigger associations to exist. This did not extensively happen neither with NDVI nor with the addition of altitude derived by a finer resolution remote sensing dataset (90m). Altitude was significantly associated only with one allele for a low confidence level (99% or ST=8.69E-07) and NDVI with alleles that did not proved to be significant, also in low confidence levels (99% and 99.9%). Given that the alterations were slight and occurred in low ST could be presumed that for the genetic dataset derived by the population of *canis lupus* in the current study area, none of the remote sensing variables form a parameter that could justify a selection pressure driven by environment. Another important aspect that should be mentioned is that a comparison between the low confidence levels for which NDVI is emerged (99.0% and 99.9%) and the ones that climatic parameters are (99.0% to 99.999999999%), confirms that the selective power of NDVI is not so forceful.

Consequently, finding accurate environmental datasets constitutes the main constraint on SAM (Joost et al., 2007). Since the dimensions of the current study area are classified as large geographical scale, the options for the remote sensing data were amongst a DEM derived by SRTM with a resolution of about 90 meters (3arc second), a digitized hypsographic dataset with a resolution about 90 meters –many errors are expected to be included due to deprivation of specific spatial prediction as it has been digitized by analog type mean (map) – and a DEM and NDVI composites derived by NOAA with a 1000 meters resolution. For the management and correlation of these environmental datasets, so as the input matrix to SAM to be formed, the synergy of GIS was indispensable. Amongst the advantages of SAM is included the emergence of the above referred significant alleles, as their connection to specific regions of the genome and to environmental variables, unveils the nature of a potential environmental selection pressure. Therefore, even though the interpretation of the results requires further research by a biologist expert, the current thesis lays the foundation for an oriented study of specific genes that emerged as significant and that are involved in specific functional processes, With the reserve that the distance from the location that is proved linked to a gene, to the actual gene is differentiated according to the recombination rate and time since selection (Wiehe, 1998; Joost et al., 2007).

Despite the probable less selective power of vegetation index in the current study, due to the sensibility of the method used, the results denote that potentially with finer resolution dataset the outcome would be more unambiguous. Alternatively in future researches, several remote sensing indices for the assessment of vegetation water content, and by that of the soil water condition, could be examined as candidates for selection pressure, certain of which, in contrast to NDVI, are not neglecting some environmental factors (eg. temperature and precipitation) that in the current thesis proved to be significant. Water Deficit Index (WDI) and Temperature Condition Index (TCI) are not proposed, because these indices are suitable to a smaller scale study area, unlike areas usually covered by a free-living population, as they utilize the statistic value of remote sensing data for years and they are on the basis of pixel scale, therefore the precision of quantitatively assessing surface water is limited to some extent. In view of these problems and of the above justified pursuit of greater information content or higher spatial resolution data, hyperspectral data derived by AVIRIS or Hyperion (hundreds to thousands bands, up to 1 degree spatial resolution) or MODIS data (36 bands, 250 meters spatial resolution) could be selected as data source, for the exploitation of the extended variation of reflective spectrum of vegetation that is affected by soil. Thus soil water content could be assessed indirectly with the potential favourable use of Vegetation Condition Index (VCI), Anomaly Vegetation Index, Normalized Difference Water index (NDWI), Leaf Area Index (LAI), Modified Soil-Adjusted Vegetation Index (MSAVI) or the coupling character of three indices with Vegetation Water Synthesis Index – the most reasonable method as indicated by Song et al. (2007) – according to the emissivity distribution of vegetation. Concluding, from the aspect of genetic data, spatial distribution of alleles should be further analysed for the acquisition of information concerning their local effects and potential emergence of spatial patterns that could unveil an environmental oriented link.

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LIST OF TABLES

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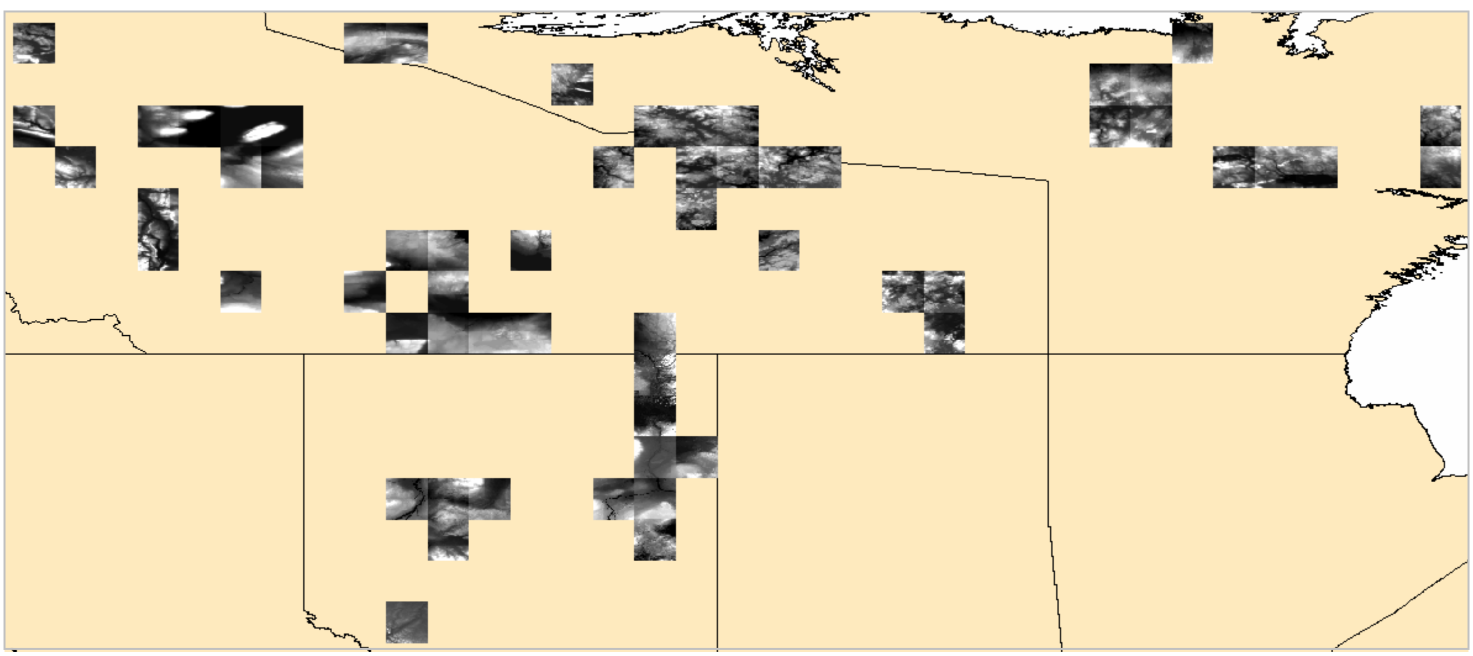
APPENDIX

[1]

Figure A1.a. Digitized hypsographic and hydrographic data in Canada, **b.**Digital Elevation Model (DEM) in Northern USA from SRTM sensor, **c.**Digital Elevation Model (DEM) image in Northern America from NOAA satellite,
d.Monthly NDVI composite images in Northern America: **d.1.** April 1992, **d.2.** May 1992, **d.3.** June 1992, **d.4.** July 1992, **d.5.** August 1992, **d.6.** September 1992, **d.7.** October 1992, **d.8.** November 1992, **d.9.** December 1992, **d.10.** January 1993, **d.11.** February 1993, **d.12.**March1993,
e.Climatic data:
e.1 Monthly temperature (C°), **e.2.**Diurnal Tmeperature range (C°), **e.3.**Ground frost duration (days), **e.4.**Max possible sunshine duration (%), **e.5.**Precipitation (mm/month), **e.6.**Coefficient of variation of monthly precipitation,
e.7. Relative humidity(%), **e.8.**Number of wet days
f. Spatial distribution of genetic markers of the population of (*Canis lupus*) at study area of Northern Canada and U.S.A. Administrative boundaries collected from http://www.gadm.org/country for display purposes only, no information derived. Projection of **a, f**: WGS 84, of **b**: initially GCS North American 1983 but here reprojected in WGS 84, of **c, d**: Lambert Azimuthal Equal Area, **e**: initially GCS North American 1983 but here reprojected in Lambert Azimuthal Equal Area. For the sources of the collected data see Table 3.4.



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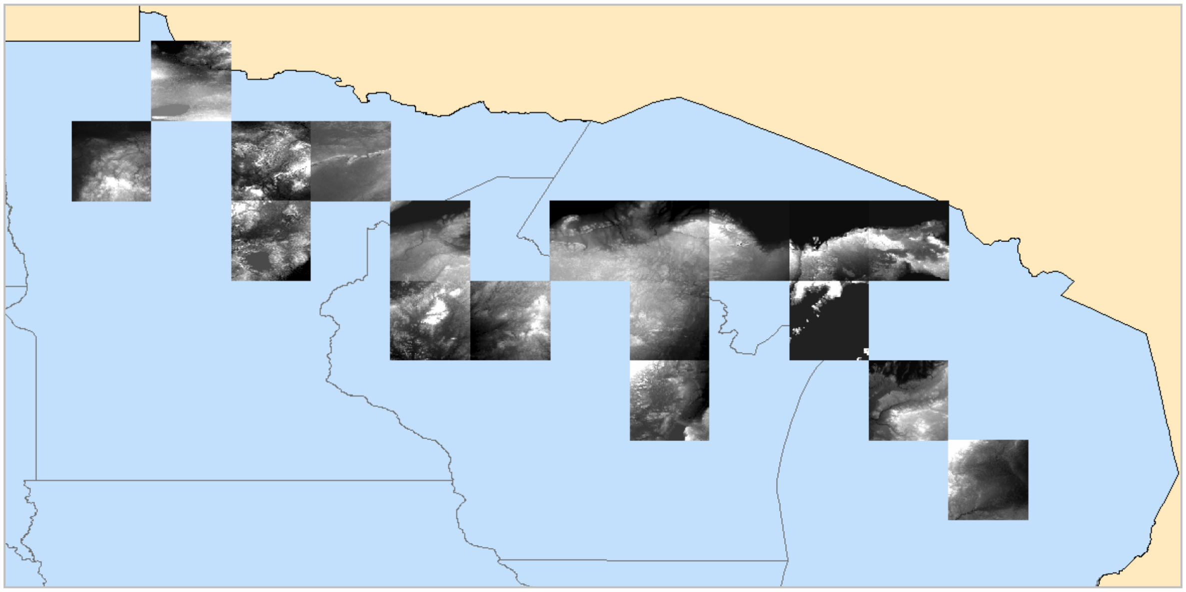

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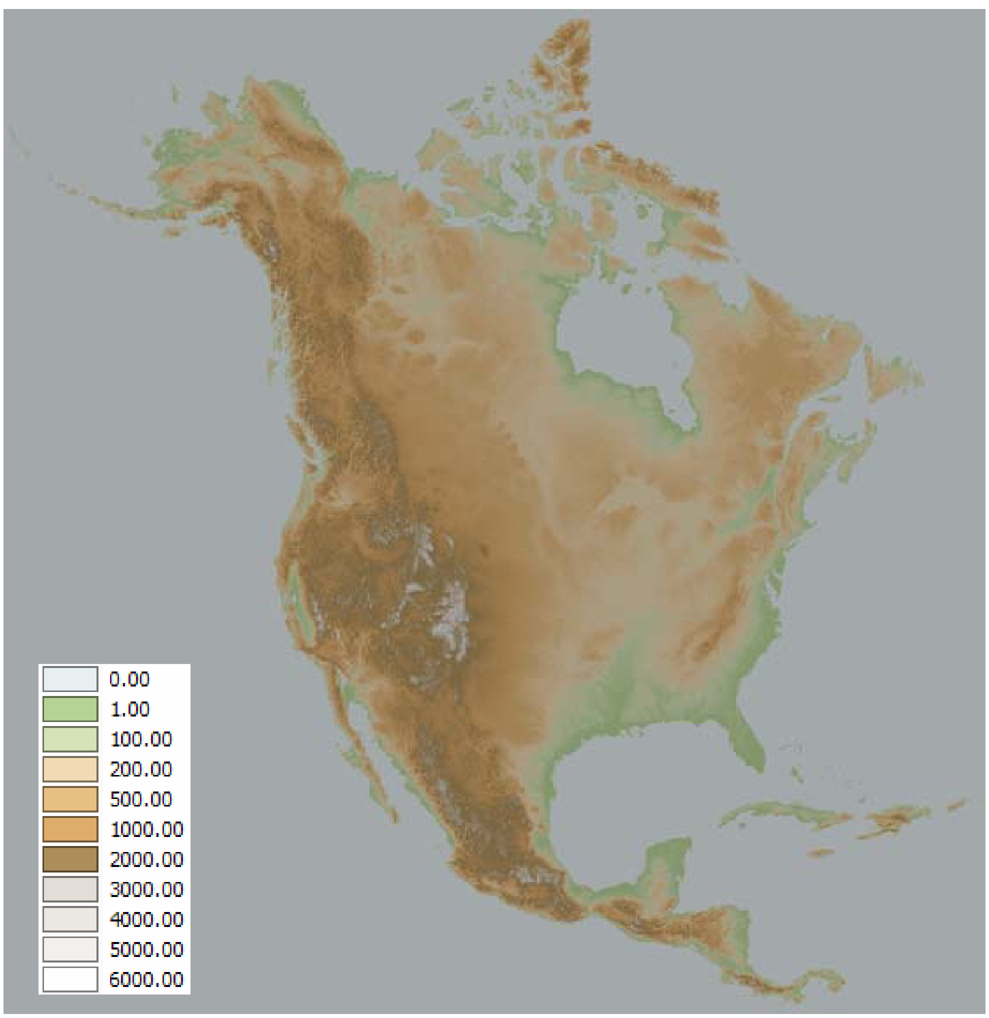
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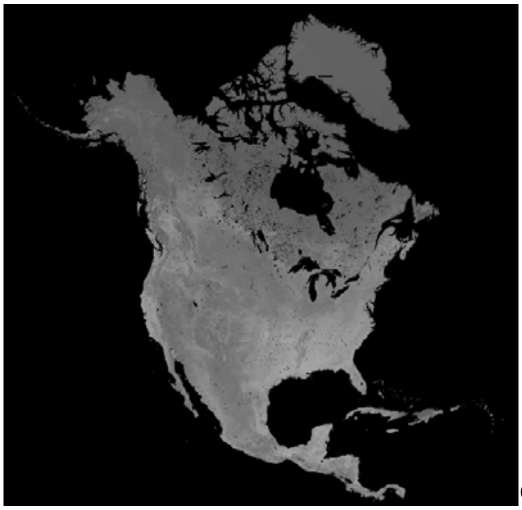
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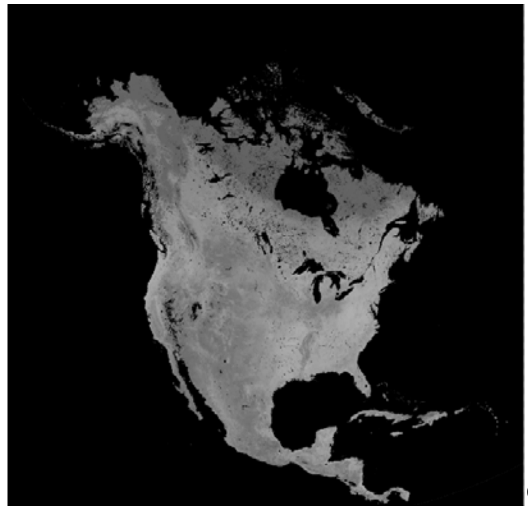
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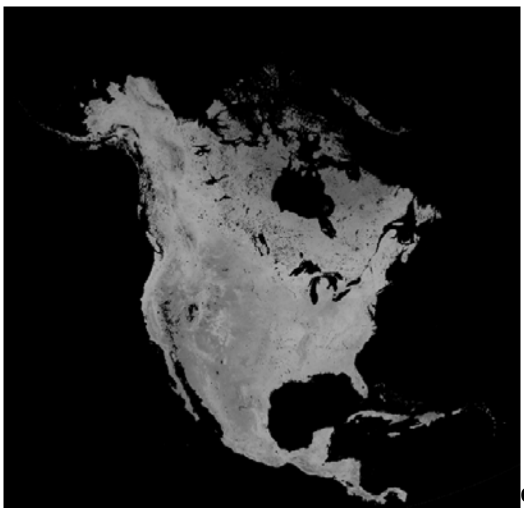
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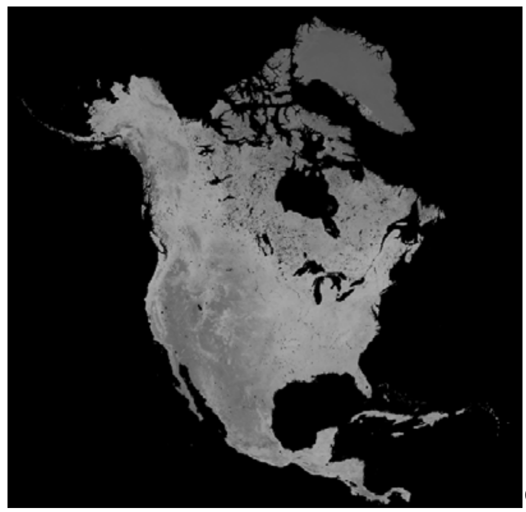
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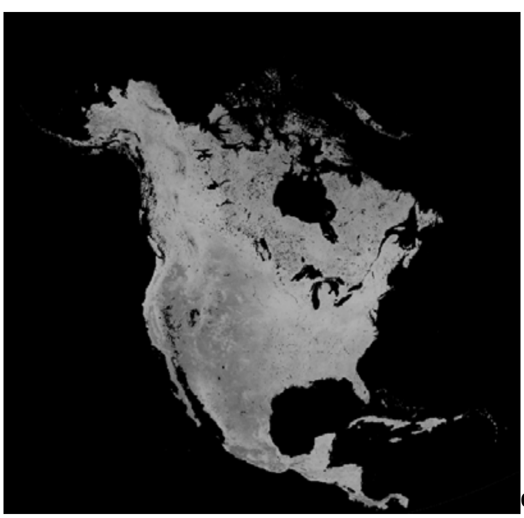
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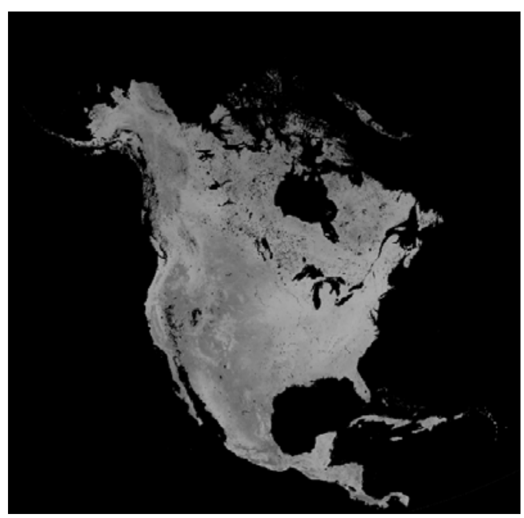
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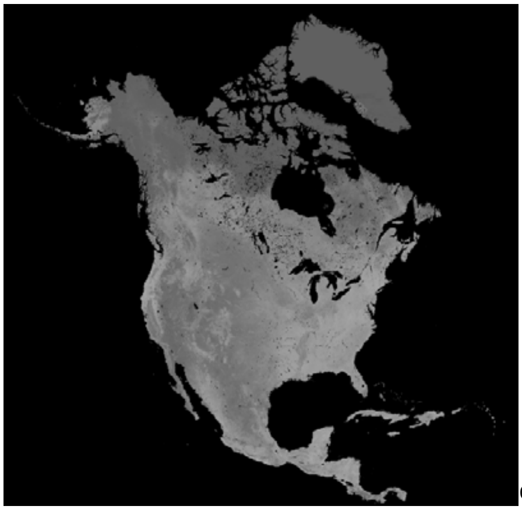

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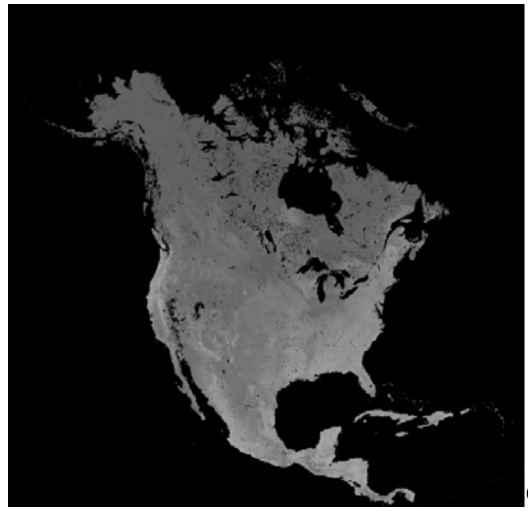

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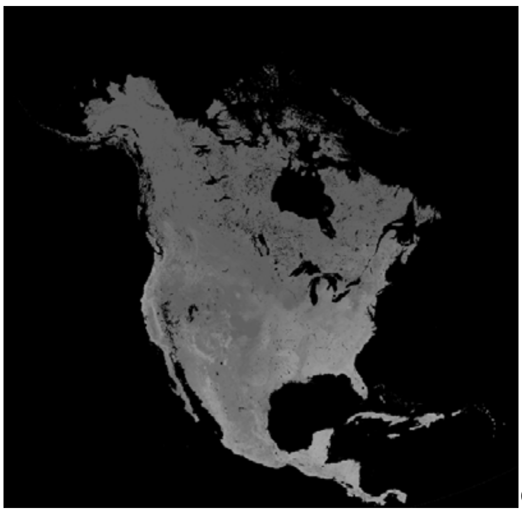

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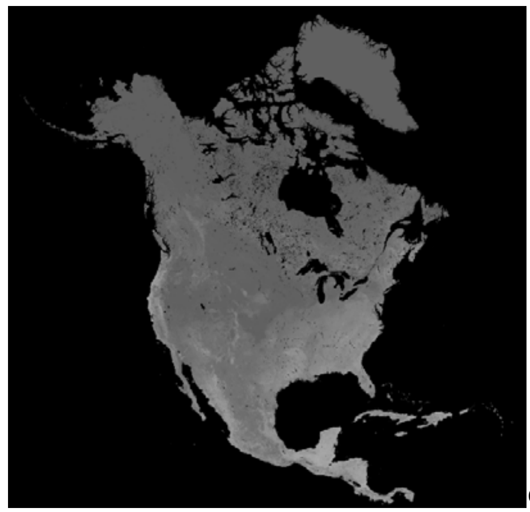

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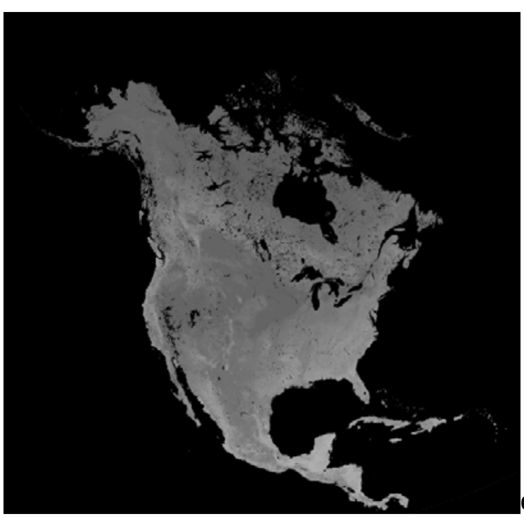

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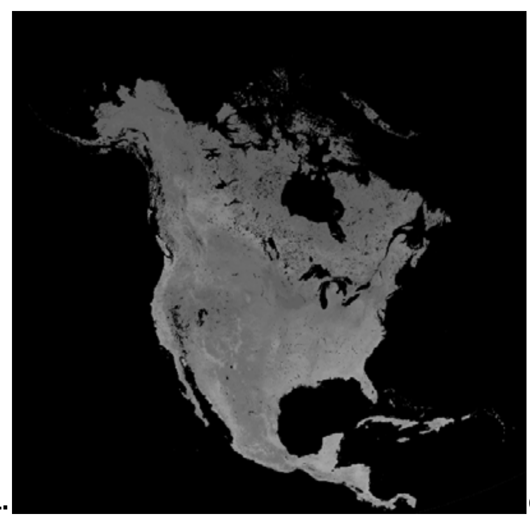

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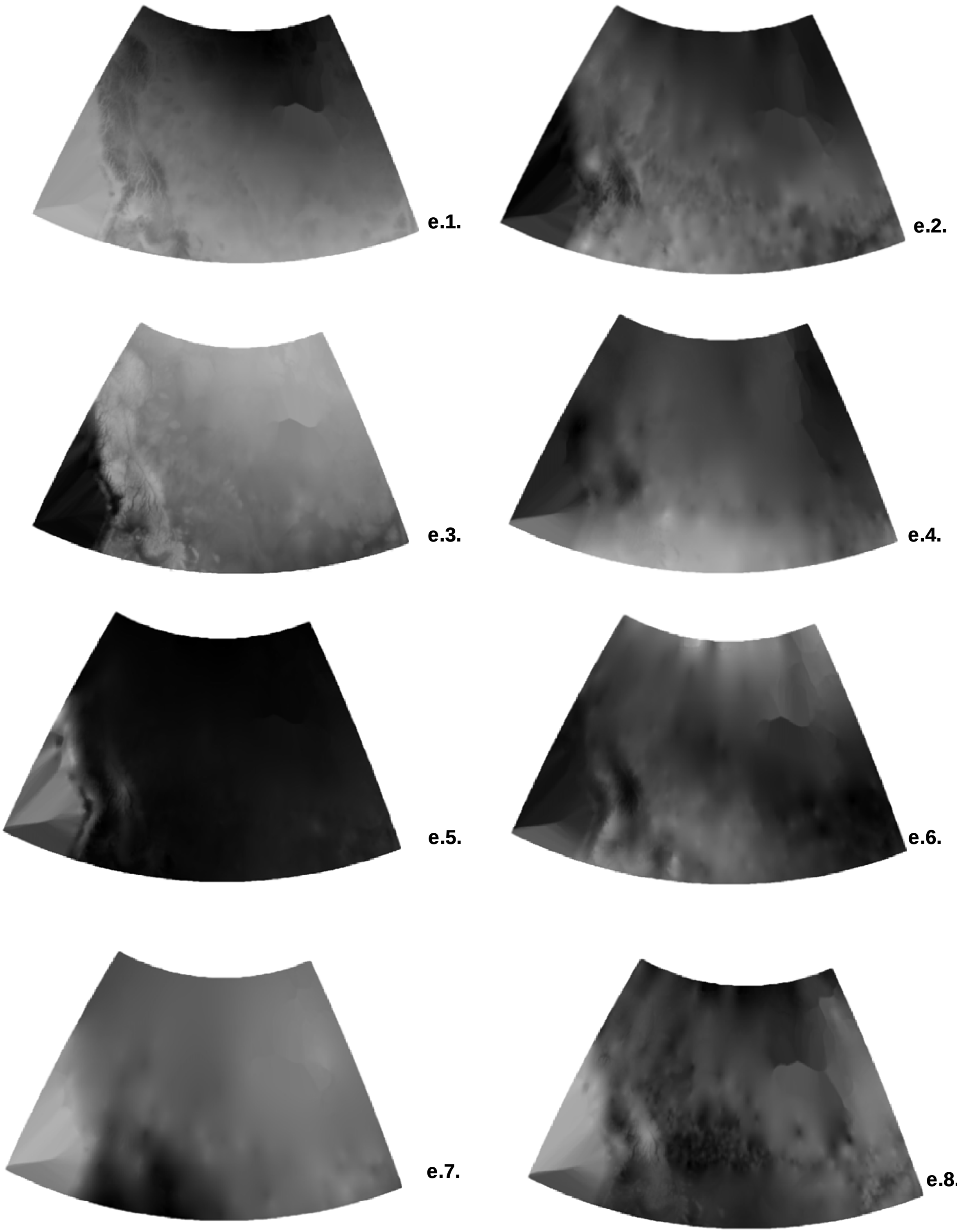

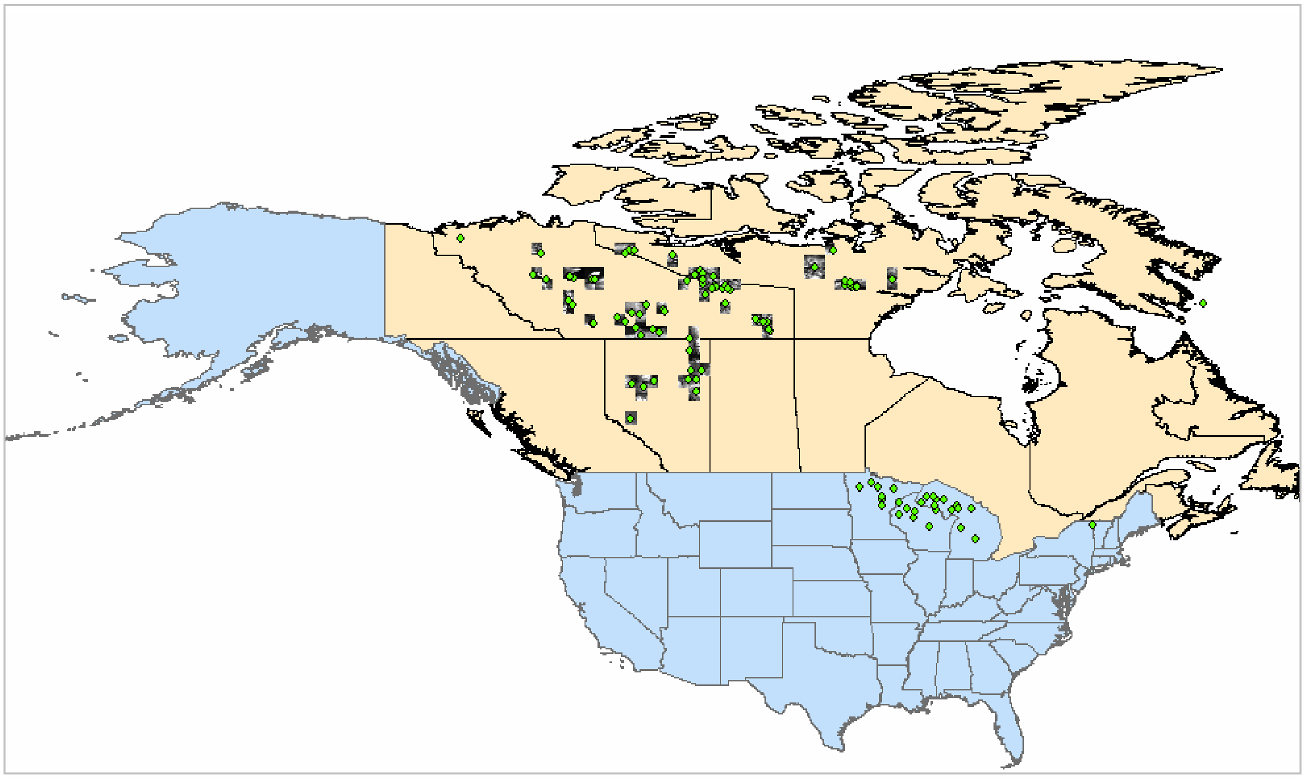

f.

[2] *HowTo: Determine which NAD_1983_To_WGS_1984 transformation to use*
support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=24159
(information acquired at 29/09/09)

NAD_1983_To_WGS_1984_1
Published accuracy from EPSG is 2 meters. This transformation applies to the entire North American continent. Accuracy of the transformation varies, with greater accuracy at southern latitudes, and less accuracy at more northern latitudes with maximum offset of 2 meters.

This transformation uses the Geocentric Translation method, with the transformation's parameters (dx, dy, and dz) all equal to zeroes. This transformation treats the NAD 1983 and WGS 1984 datums as though they are equivalent.

NAD_1983_To_WGS_1984_2
Calculated by the U. S. Defence Mapping Agency (DMA), now known as the National Geospatial Intelligence Agency (NGA) for the Aleutian islands. Accuracy is listed by EPSG at +/-8 m.

NAD_1983_To_WGS_1984_3
Calculated by the NGA for Hawai'i. Accuracy is listed by EPSG at +/-4 m.

NAD_1983_To_WGS_1984_4

Formerly applied within the 48 contiguous states, but is superseded by _5. This transformation method should no longer be used.

NAD_1983_To_WGS_1984_5
Transformation parameters calculated by the U. S. National Geodetic Survey (NGS) using CORS stations, and ties WGS 1984 to ITRF96. Accuracy according to EPSG is +/- 1 meter.

NAD_1983_To_WGS_1984_6, _7, and _8
Canadian NTv2 transformations, for the Quebec, Saskatchewan and Alberta provinces, respectively.
Each of these datum transformations can be used for the specified area, and arguments can be made for the application of each transformation. One of the most important considerations is consistency, using the same transformation each time, to transform between these two Geographic Coordinate Systems (datums). When using the Project Tool, the transformation method is recorded in the metadata.
The European Petroleum Survey Group (EPSG) database can be downloaded at the similarly titled link in Related Information. This database is a free download, and is updated frequently. This database includes information on the source of datum transformation parameters, and in many cases includes the accuracy of the transformation from the transformation source.
ArcGIS Desktop version 9.2 uses information from version 6.10.2 of the database. Version 9.3 uses information from version 6.13.

The difference between the GRS 1980 spheroid, the basis for the NAD 1983 datum, and the WGS 1984 spheroid is 0.0001 meters in the length of the semi-minor axis - the distance between the geodetic center of the earth and the North Pole. The semi-minor axis for GRS 1980 is 6356752.3141 meters. This axis for WGS 1984 is 6356752.3142 meters, while the semi-major axis both spheroids measures 6378137 meters "

[3] *Documentation on North America Land Cover Characteristics*, Data Base Version 1.2, Geometric Characteristics, Lambert Azimuthal Equal Area http://edc2.usgs.gov/glcc/nadoc1_2.php
(information acquired at 29/09/09)

2.2 Lambert Azimuthal Equal Area Projection Parameters

The data dimensions of the Lambert Azimuthal Equal Area projection for the North America land cover characteristics data set are 8,996 lines (rows) and 9,223 samples (columns) resulting in a data set size of approximately 83 megabytes for 8-bit (byte) images. The following is a summary of the map projection parameters used for this projection:

Projection Type: Lambert Azimuthal Equal Area
Units of Measure: meters
Pixel Size: 1000 meters
Radius of sphere: 6370997 m
Longitude of origin: 100 00 00 W
Latitude of origin: 50 00 00 N
False easting: 0.0
False northing: 0.0
XY corner coordinates (center of pixel) in projection units (meters):
Lower left: (-4487000, -4515000)
Upper left: (-4487000, 4480000)
Upper right: (4735000, 4480000)
Lower right: (4735000, -4515000)

[4]

Table A1. Initial table with environmental parameters correlated to locations of population of grey wolves. The NDVI parameters contain errors regarding to the range, which have been corrected and presented at Table A2.

CODE	Longitude	Latitude	Altitude	NDVI April	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY
JAL2346	-117.56	53.41	1036	122	-120	-92	-90	-91	-109	-123	116	99	104	119	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2347	-117.56	53.41	1036	120	-117	-94	-91	-90	-109	-121	116	99	104	120	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2349	-117.56	53.41	1036	121	-118	-95	-93	-97	126	126	116	99	101	107	-124	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL3328	-90.50	45.21	455	121	-118	-95	-93	-97	126	126	126	99	101	107	109	4.71	12.04	54.15	15.69	56.08	67.80	10.70	72.06
JAL3329	-88.40	45.85	426	121	-118	-95	-93	-97	126	126	105	99	101	107	123	4.05	12.99	51.24	16.80	51.56	64.43	12.01	73.15

JAL3331	-91.14	45.90	428	121	-118	-95	-93	-97	126	126	105	99	101	107	107	4.86	12.36	53.15	15.95	57.86	65.63	10.98	71.53
JAL3333	-84.61	43.41	222	121	-118	-95	-93	-97	126	126	103	99	101	107	107	7.83	11.15	49.38	13.28	51.86	64.83	11.57	73.80
JAL3334	-88.51	46.21	437	121	-118	-95	-93	-97	126	126	107	99	101	107	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL3335	-90.36	45.68	457	-121	-114	-102	-97	-96	-107	-120	-128	99	109	-126	112	4.39	12.21	53.01	16.35	54.73	68.37	11.11	72.06
JAL3339	-90.36	45.68	457	-121	-114	-102	-97	-96	-107	-120	-128	99	109	-126	112	4.39	12.21	53.01	16.35	54.73	68.37	11.11	72.06
JAL3340	-91.91	46.45	366	127	-103	-96	-87	-86	-116	-116	120	99	105	123	111	4.68	11.60	52.49	15.53	59.13	63.08	10.91	70.93
JAL3341	-88.97	44.48	271	127	-103	-96	-87	-86	-116	-116	-121	99	105	123	114	6.12	12.27	54.13	14.87	57.29	65.33	10.26	72.65
JAL3342	-91.14	45.90	428	-118	-108	-102	-93	-94	-100	-116	105	99	112	-123	107	4.86	12.36	53.15	15.95	57.86	65.63	10.98	71.53
JAL3611	-93.48	46.70	379	-118	-108	-102	-93	-94	-100	-116	116	99	112	-123	106	4.98	13.34	52.86	15.61	59.80	59.31	10.26	69.73
JAL3612	-95.68	47.77	396	-118	-108	-102	-93	-94	-100	-116	107	99	112	-123	115	3.48	12.95	52.07	16.39	65.14	49.12	8.88	70.18

JAL3613	-93.58	46.98	411	-118	-108	-102	-93	-94	-100	-116	106	99	112	-123	114	4.92	13.21	51.91	15.77	59.43	58.62	10.35	69.85
JAL3614	-93.48	46.23	409	107	-116	-106	-100	-97	-114	-128	115	99	99	109	103	4.78	13.56	54.50	15.49	60.74	60.77	10.03	69.39
JAL3616	-92.46	47.58	461	105	-126	-111	-99	-103	-111	-127	108	99	99	106	111	3.18	11.60	48.31	16.69	55.87	60.83	11.46	70.99
JAL3617	-92.46	47.58	461	108	127	-112	-103	-106	-128	-115	108	99	99	106	111	3.18	11.60	48.31	16.69	55.87	60.83	11.46	70.99
JAL3618	-93.95	47.73	411	100	126	-108	-102	-95	-105	-126	115	99	99	104	120	3.87	12.43	49.39	16.21	58.78	56.45	10.52	70.09
JAL3619	-94.50	48.15	360	107	-118	-105	-97	-99	-106	-122	113	99	99	111	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3620	-94.50	48.15	360	108	-124	-109	-95	-101	-119	113	113	99	99	103	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3621	-94.50	48.15	360	105	-121	-115	-106	-118	-128	-125	113	99	99	105	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3622	-94.50	48.15	360	106	-124	-104	-100	-103	127	-111	113	99	99	106	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3759	-73.43	44.58	29	105	-121	-115	-106	-118	-128	-125	0	99	99	105	0	6.73	10.68	47.13	13.90	46.53	62.28	12.71	71.10

JAL4890	-89.79	46.48	518	108	-124	-109	-95	-101	-119	113	100	99	99	103	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL4891	-86.87	45.78	184	114	-124	-104	-103	-102	-124	-110	110	99	99	112	-128	5.54	9.83	48.93	15.09	53.39	61.26	12.65	74.12
JAL4909	-85.95	44.30	302	100	123	-104	-98	-101	-122	-119	102	99	99	100	113	6.78	10.72	48.58	13.96	51.28	67.51	12.30	73.98
JAL4910	-88.65	46.98	290	105	127	-117	-104	-106	-121	-124	106	99	99	102	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4911	-88.65	46.98	290	114	-114	-96	-90	-91	-97	-111	106	99	111	126	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4912	-86.35	46.23	224	114	-121	-103	-98	-101	-105	-104	100	99	100	-128	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75
JAL4913	-88.65	46.98	290	114	-121	-103	-98	-101	-105	-104	106	99	100	-128	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4914	-86.35	46.23	224	114	-121	-103	-98	-101	-105	-104	100	99	100	-128	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75
JAL4915	-91.85	45.42	336	114	-114	-96	-90	-91	-97	-111	-121	99	111	126	105	5.81	12.26	55.13	14.98	60.47	63.34	10.39	70.94
JAL4916	-88.65	46.98	290	114	-114	-96	-90	-91	-97	-111	106	99	111	126	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92

JAL4917	-88.51	46.21	437	0	0	0	0	0	0	0	107	0	0	0	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL4918	-86.19	46.02	215	0	0	0	0	0	0	0	103	0	0	0	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL4919	-85.01	46.01	198	127	-103	-96	-87	-86	-116	-116	126	99	105	123	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87
JAL4920	-89.27	46.98	183	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL4921	-89.79	46.48	518	127	-103	-96	-87	-86	-116	-116	100	99	105	123	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL4922	-86.19	46.02	215	127	-103	-96	-87	-86	-116	-116	103	99	105	123	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL4923	-87.60	46.66	250	127	-103	-96	-87	-86	-116	-116	105	99	105	123	116	4.30	11.26	48.70	16.80	48.64	70.96	12.73	73.77
JAL5050	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5051	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5052	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5053	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5054	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5055	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5056	-133.73	68.36	15	127	-103	-96	-87	-86	-116	-116	0	99	105	123	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5057	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5058	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5059	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5060	-133.73	68.36	15	-114	-101	-100	-91	-94	-103	-108	0	99	120	-114	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5061	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5062	-133.73	68.36	15	-114	-101	-100	-91	-94	-103	-108	0	99	120	-114	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5063	-133.73	68.36	15	-114	-101	-100	-91	-94	-103	-108	0	99	120	-114	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5064	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5065	-133.73	68.36	15	-121	-107	-93	-98	-88	-109	-105	0	99	115	-126	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5066	-133.73	68.36	15	-114	-101	-100	-91	-94	-103	-108	0	99	120	-114	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5067	-133.73	68.36	15	114	-121	-103	-98	-101	-105	-104	0	99	100	-128	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5068	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5069	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5070	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5071	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5072	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5073	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5074	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5075	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5077	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5078	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5079	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5080	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5081	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5083	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5084	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40

JAL5085	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5086	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5087	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5088	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5089	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5090	-133.73	68.36	15	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5091	-114.24	62.27	156	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5094	-89.27	46.98	183	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL5095	-86.87	45.78	184	100	100	-121	-111	-110	-119	-118	110	99	99	103	-128	5.54	9.83	48.93	15.09	53.39	61.26	12.65	74.12
JAL5096	-86.35	46.23	224	100	100	-121	-111	-110	-119	-118	100	99	99	103	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75

JAL5097	-88.34	46.72	417	100	100	-121	-111	-110	-119	-118	101	99	99	103	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5098	-88.65	46.98	290	100	100	-121	-111	-110	-119	-118	106	99	99	103	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5099	-88.51	46.21	437	100	100	-121	-111	-110	-119	-118	107	99	99	103	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5100	-86.19	46.02	215	100	100	-121	-111	-110	-119	-118	103	99	99	103	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL5101	-89.27	46.98	183	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL5102	-88.34	46.72	417	100	100	-121	-111	-110	-119	-118	101	99	99	103	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5103	-89.79	46.48	518	100	100	-121	-111	-110	-119	-118	100	99	99	103	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5147	-85.95	44.30	302	100	100	-121	-111	-110	-119	-118	102	99	99	103	113	6.78	10.72	48.58	13.96	51.28	67.51	12.30	73.98
JAL5148	-89.79	46.48	518	100	100	-121	-111	-110	-119	-118	100	99	99	103	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5149	-89.27	46.98	183	100	100	-121	-111	-110	-119	-118	0	99	99	103	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45

JAL5150	-85.01	46.01	198	100	100	-121	-111	-110	-119	-118	126	99	99	103	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87
JAL5152	-88.51	46.21	437	100	100	-121	-111	-110	-119	-118	107	99	99	103	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5153	-86.19	46.02	215	100	100	-121	-111	-110	-119	-118	103	99	99	103	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL5154	-88.51	46.21	437	100	100	-121	-111	-110	-119	-118	107	99	99	103	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5155	-88.51	46.21	437	100	100	-121	-111	-110	-119	-118	107	99	99	103	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5156	-89.79	46.48	518	100	100	-121	-111	-110	-119	-118	100	99	99	103	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5157	-86.19	46.02	215	100	100	-121	-111	-110	-119	-118	103	99	99	103	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL5158	-87.60	46.66	250	100	100	-121	-111	-110	-119	-118	105	99	99	103	116	4.30	11.26	48.70	16.80	48.64	70.96	12.73	73.77
JAL5159	-88.51	46.21	437	0	0	0	0	0	0	0	107	0	0	0	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5161	-88.34	46.72	417	103	119	-120	-114	-117	-121	-121	101	99	99	104	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20

JAL5162	-88.65	46.98	290	103	119	-120	-114	-117	-121	-121	106	99	99	104	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5163	-85.01	46.01	198	103	119	-120	-114	-117	-121	-121	126	99	99	104	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87
JAL5164	-88.51	46.21	437	103	119	-120	-114	-117	-121	-121	107	99	99	104	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5165	-88.65	46.98	290	103	119	-120	-114	-117	-121	-121	106	99	99	104	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5166	-88.34	46.72	417	103	119	-120	-114	-117	-121	-121	101	99	99	104	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5167	-88.51	46.21	437	103	119	-120	-114	-117	-121	-121	107	99	99	104	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5168	-88.51	46.21	437	111	125	-118	-107	-107	-112	-113	107	99	99	107	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5169	-89.79	46.48	518	0	0	0	0	0	0	0	100	0	0	0	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5170	-88.51	46.21	437	0	0	0	0	0	0	0	107	0	0	0	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
MARCO001	-116.28	56.00	685	111	125	-118	-107	-107	-112	-113	105	99	99	107	123	0.34	12.03	42.43	19.10	59.20	39.08	9.47	71.65

MARCO002	-115.25	56.55	533	111	125	-118	-107	-107	-112	-113	100	99	99	107	125	0.86	12.14	43.38	18.68	59.04	35.83	9.33	71.72
MARCO003	-117.43	56.23	597	98	101	-121	-112	-114	-120	101	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO004	-117.43	56.23	597	98	101	-121	-112	-114	-120	101	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO005	-117.43	56.23	597	98	101	-121	-112	-114	-120	101	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO006	-117.43	56.23	597	99	100	-125	-117	-120	-125	100	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO007	-117.43	56.23	597	98	101	-121	-112	-114	-120	101	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO008	-117.43	56.23	597	98	101	-121	-112	-114	-120	101	106	99	99	100	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO010	-112.00	56.65	476	98	101	-121	-112	-114	-120	101	106	99	99	100	-123	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67
MARCO011	-112.00	56.65	476	0	0	0	0	0	0	0	106	0	0	0	-123	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67
MARCO012	-111.22	56.65	351	97	100	100	123	126	115	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25

MARCO013	-111.22	56.65	351	0	0	0	0	0	0	0	103	0	0	0	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO014	-111.75	57.42	316	99	100	-125	-117	-120	-125	100	100	99	99	100	-120	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO015	-111.75	57.42	316	0	0	0	0	0	0	0	100	0	0	0	-120	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO016	-111.75	57.42	316	99	100	-125	-117	-120	-125	100	100	99	99	100	-120	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO017	-111.75	57.42	316	98	100	-128	-114	-111	-118	100	100	99	99	100	-120	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO018	-116.58	60.25	214	98	101	-121	-112	-114	-120	101	99	99	99	100	110	-3.26	12.47	42.61	20.02	60.70	29.93	8.44	70.30
MARCO019	-114.83	60.58	169	98	101	-121	-112	-114	-120	101	99	99	99	100	105	-3.36	10.33	43.48	19.44	61.44	28.26	9.44	71.42
MARCO020	-117.03	60.95	196	0	0	0	0	0	0	0	99	0	0	0	108	-3.71	12.14	42.27	20.23	61.32	27.04	7.80	70.47
MARCO021	-115.37	60.75	165	98	100	-121	-109	-112	-121	100	99	99	99	100	109	-3.38	10.35	43.51	19.29	61.23	28.32	9.75	71.55
MARCO022	-116.57	60.27	211	98	100	-121	-109	-112	-121	100	99	99	99	100	108	-3.26	12.46	42.63	20.01	60.71	29.91	8.43	70.33

MARCO023	-123.12	62.75	55	98	100	123	-120	-122	125	100	99	99	99	100	112	-4.89	11.38	37.83	20.95	59.60	29.73	9.69	70.13
MARCO024	-123.42	63.22	52	98	100	-128	-114	-111	-118	100	99	99	99	100	107	-5.54	10.77	37.36	21.15	58.71	29.21	9.77	69.99
MARCO025	-121.22	61.25	257	97	99	103	-124	-120	-126	100	99	99	99	100	113	-3.57	11.47	39.65	20.20	61.92	31.10	10.04	70.23
MARCO026	-123.42	63.22	52	97	99	103	-120	-116	-123	100	99	99	99	100	107	-5.54	10.77	37.36	21.15	58.71	29.21	9.77	69.99
MARCO027	-123.12	62.75	55	98	99	101	-120	-116	-121	100	99	99	99	100	112	-4.89	11.38	37.83	20.95	59.60	29.73	9.69	70.13
MARCO028	-121.03	61.33	225	97	99	103	-120	-116	-123	100	99	99	99	100	122	-3.55	11.47	39.73	20.05	61.99	30.34	9.94	70.19
MARCO029	-118.77	61.83	243	98	99	101	-120	-116	-121	100	99	99	99	100	100	-4.47	11.55	40.73	20.58	61.67	25.71	7.98	70.14
MARCO030	-117.47	62.13	193	98	99	101	-120	-116	-121	100	99	99	99	100	102	-4.66	11.32	41.74	20.37	61.85	23.83	7.38	70.64
MARCO031	-111.88	59.00	208	98	100	100	121	122	119	100	99	99	99	100	-126	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82
MARCO032	-111.88	60.00	204	98	99	101	-120	-116	-121	100	99	99	99	100	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94

MARCO033	-111.88	60.00	204	98	99	101	-119	-118	-122	100	99	99	99	100	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO034	-111.88	60.00	204	98	99	101	-120	-116	-121	100	99	99	99	100	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO035	-111.88	59.00	208	97	99	107	-120	-117	-122	100	99	99	99	100	-126	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82
MARCO036	-111.88	59.00	208	98	100	100	121	122	119	100	99	99	99	100	-126	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82
MARCO037	-118.08	61.45	143	98	99	101	-120	-116	-121	100	0	99	99	100	0	-3.73	11.98	41.46	20.18	61.89	24.55	7.19	70.19
MARCO038	-118.08	61.45	143	97	99	103	-120	-116	-123	100	0	99	99	100	0	-3.73	11.98	41.46	20.18	61.89	24.55	7.19	70.19
MARCO039	-111.22	56.65	351	98	99	101	-120	-116	-121	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO040	-111.22	56.65	351	97	99	103	-124	-120	-126	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO041	-111.22	56.65	351	97	99	103	-120	-116	-123	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO042	-111.22	56.65	351	98	99	101	-120	-116	-121	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25

MARCO043	-111.22	56.65	351	97	99	103	-120	-116	-123	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO044	-111.22	56.65	351	98	99	102	-122	-120	-123	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO045	-111.22	56.65	351	97	99	102	-119	-115	-122	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO046	-111.22	56.65	351	98	99	101	-120	-116	-121	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO047	-111.22	56.65	351	98	99	102	-122	-120	-123	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO048	-111.22	56.65	351	97	99	103	-124	-120	-126	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO049	-111.22	55.65	602	98	99	101	-120	-116	-121	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO050	-111.22	56.65	351	97	99	103	-120	-116	-123	100	103	99	99	100	-128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO051	-111.22	55.65	602	98	99	102	-122	-120	-123	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO052	-111.22	55.65	602	98	100	100	121	122	119	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50

MARCO053	-111.22	55.65	602	98	99	101	-120	-116	-121	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO054	-110.75	57.42	356	97	99	103	-124	-120	-126	100	100	99	99	100	-112	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO055	-111.22	55.65	602	97	99	103	-120	-116	-123	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO056	-110.75	57.42	356	97	99	102	-119	-115	-122	100	100	99	99	100	-112	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO057	-110.75	57.42	356	98	99	102	-122	-120	-123	100	100	99	99	100	-112	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO058	-111.22	55.65	602	98	99	101	-119	-118	-122	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO059	-111.22	55.65	602	99	99	100	118	125	120	100	113	99	99	100	-118	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO060	-110.75	57.42	356	99	99	100	118	125	120	100	100	99	99	100	-112	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO061	-111.88	60.00	204	98	99	101	-119	-118	-122	100	99	99	99	100	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO062	-108.46	62.89	315	97	99	103	-120	-116	-123	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO063	-108.46	62.89	315	97	99	110	-120	-119	124	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO064	-108.46	62.89	315	97	99	103	-120	-116	-123	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO065	-108.46	62.89	315	98	99	101	-120	-116	-121	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO066	-108.46	62.89	315	97	99	103	-124	-120	-126	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO067	-108.46	62.89	315	97	99	103	-124	-120	-126	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO068	-108.46	62.89	315	98	99	101	-120	-116	-121	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO069	-108.46	62.89	315	98	99	101	-120	-116	-121	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO070	-108.46	62.89	315	98	100	100	121	122	119	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO071	-108.46	62.89	315	97	99	102	-119	-115	-122	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO072	-108.46	62.89	315	97	99	100	-118	-114	-120	100	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO073	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO074	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO075	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO076	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO077	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO078	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO079	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO080	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO081	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO082	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO083	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO084	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO085	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO086	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO087	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO088	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO089	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO090	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO091	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO092	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO093	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO094	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO095	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO096	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO097	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO098	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO099	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO100	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO101	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO102	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO103	-108.46	62.89	315	0	0	0	0	0	0	0	99	0	0	0	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO104	-108.46	62.89	315	99	100	113	-120	-118	125	103	99	99	99	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO105	-109.67	65.17	435	99	100	113	-120	-118	125	103	0	99	99	100	0	-11.38	8.10	39.63	23.49	63.27	20.40	9.92	70.97
MARCO106	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO107	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO108	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO109	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO110	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO111	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO112	-114.44	62.46	256	99	100	113	-120	-118	125	103	99	99	99	100	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39

MARCO113	-116.65	62.03	194	99	100	113	-120	-118	125	103	99	99	99	100	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO114	-116.07	62.83	156	99	100	113	-120	-118	125	103	0	99	99	100	0	-5.46	10.26	42.43	20.17	62.09	22.65	7.84	71.15
MARCO115	-116.07	62.83	156	99	100	113	-120	-118	125	103	0	99	99	100	0	-5.46	10.26	42.43	20.17	62.09	22.65	7.84	71.15
MARCO116	-116.65	62.03	194	99	106	-120	-114	-115	123	103	99	99	99	100	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO117	-116.65	62.03	194	99	106	-120	-114	-115	123	103	99	99	99	100	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO118	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO119	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO120	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO121	-117.67	67.33	290	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO122	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25

MARCO123	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO124	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO125	-110.83	65.67	446	99	106	-120	-114	-115	123	103	0	99	99	100	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97
MARCO127	-98.18	67.38	57	99	106	-120	-114	-115	123	103	99	99	99	100	100	-14.64	7.50	35.33	25.13	86.34	12.37	5.99	72.73
MARCO128	-110.83	65.67	446	99	106	-120	-114	-115	123	103	0	99	99	100	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97
MARCO129	-117.67	67.33	290	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO130	-117.25	67.17	304	99	106	-120	-114	-115	123	103	0	99	99	100	0	-11.47	8.24	39.10	23.52	67.56	19.81	8.55	70.36
MARCO131	-117.67	67.33	290	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO132	-110.67	65.50	500	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.70	7.91	39.71	23.81	63.54	20.29	9.85	70.97
MARCO133	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25

MARCO134	-118.02	67.05	279	99	106	-120	-114	-115	123	103	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO136	-110.83	65.67	446	99	106	-120	-114	-115	123	103	0	99	99	100	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97
MARCO137	-117.17	67.33	352	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.48	8.19	39.14	23.57	68.63	19.26	8.38	70.35
MARCO138	-117.17	67.33	352	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.48	8.19	39.14	23.57	68.63	19.26	8.38	70.35
MARCO139	-113.50	66.97	451	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.25	7.60	39.47	24.23	74.84	17.50	7.93	70.81
MARCO140	-110.67	65.50	500	99	106	-120	-114	-115	123	103	99	99	99	100	100	-11.70	7.91	39.71	23.81	63.54	20.29	9.85	70.97
MARCO141	-96.50	64.50	143	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO142	-97.00	64.50	152	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO143	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO144	-97.00	64.50	152	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48

MARCO145	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO146	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO147	-100.00	66.00	153	99	106	-120	-114	-115	123	103	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO148	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO149	-97.00	64.60	80	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47
MARCO150	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO151	-96.37	64.30	11	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.29	7.81	34.94	23.75	67.41	20.13	8.95	73.74
MARCO152	-100.00	66.00	153	99	106	-120	-114	-115	123	103	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO153	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO154	-97.00	64.50	152	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48

MARCO155	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO156	-96.50	64.50	143	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO157	-97.00	64.50	152	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO158	-97.05	64.77	65	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO159	-97.00	64.50	152	99	106	-120	-114	-115	123	103	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO160	-95.90	64.50	83	0	0	0	0	0	0	0	99	0	0	0	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO161	-95.90	64.30	22	0	0	0	0	0	0	0	99	0	0	0	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94
MARCO162	-97.05	64.77	65	0	0	0	0	0	0	0	99	0	0	0	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO163	-95.90	64.50	83	0	0	0	0	0	0	0	99	0	0	0	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO164	-96.50	64.50	143	0	0	0	0	0	0	0	99	0	0	0	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68

MARCO165	-97.05	64.77	65	0	0	0	0	0	0	0	99	0	0	0	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO166	-97.00	64.50	152	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO167	-95.90	64.50	83	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO168	-100.00	66.00	153	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO169	-97.05	64.77	65	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO170	-96.50	64.50	143	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO171	-97.00	64.50	152	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO172	-95.90	64.30	22	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94
MARCO173	-95.90	64.50	83	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO174	-97.00	64.60	80	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47

MARCO175	-92.50	65.00	173	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-13.60	7.47	37.33	24.53	74.26	21.00	7.71	74.97
MARCO176	-92.50	65.00	173	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-13.60	7.47	37.33	24.53	74.26	21.00	7.71	74.97
MARCO177	-97.00	64.60	80	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47
MARCO178	-97.00	64.50	152	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO179	-96.08	64.30	15	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.28	7.80	34.81	23.74	66.59	20.34	9.03	73.87
MARCO180	-97.00	64.50	152	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO181	-97.05	64.77	65	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO182	-96.50	64.50	143	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO183	-96.50	64.50	143	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO184	-97.05	64.77	65	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42

MARCO185	-97.05	64.77	65	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO186	-100.00	66.00	153	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO187	-95.90	64.30	22	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94
MARCO188	-96.50	64.75	149	100	114	-118	-115	-112	-119	108	99	99	99	101	100	-12.85	7.77	34.79	24.15	69.69	19.79	8.72	73.65
MARCO189	-104.25	60.67	364	100	114	-118	-115	-112	-119	108	0	99	99	101	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO190	-105.50	61.50	386	100	114	-118	-115	-112	-119	108	0	99	99	101	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO191	-105.50	61.50	386	100	114	-118	-115	-112	-119	108	0	99	99	101	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO192	-105.50	61.50	386	100	114	-118	-115	-112	-119	108	0	99	99	101	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO193	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO194	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52

MARCO195	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO196	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO197	-104.25	60.67	364	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO198	-104.25	60.67	364	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO199	-104.25	60.67	364	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO200	-104.25	60.67	364	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO201	-104.25	60.67	364	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO202	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO203	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO204	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52

MARCO205	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO206	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO207	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO208	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO209	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO210	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO211	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO212	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO213	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO214	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52

MARCO215	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO216	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO217	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO218	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO219	-105.50	61.50	386	99	101	-121	-116	-118	-127	103	0	99	99	100	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO220	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO221	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO222	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO223	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO224	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58

MARCO225	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO226	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO227	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO228	-104.50	61.42	362	99	101	-121	-116	-118	-127	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO229	-104.50	61.42	362	98	100	-126	-108	-103	124	100	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO230	-104.50	61.42	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO231	-104.50	61.42	362	0	0	0	0	0	0	0	100	0	0	0	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO232	-104.87	61.47	362	104	121	-115	-113	-113	-127	108	100	99	99	104	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO233	-104.87	61.47	362	102	115	-120	-111	-113	-119	104	100	99	99	101	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO234	-104.87	61.47	362	102	124	-116	-108	-113	-118	104	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO235	-104.87	61.47	362	101	100	-122	-116	-118	-126	100	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO236	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO237	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO238	-104.87	61.47	362	102	124	-116	-108	-113	-118	104	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO239	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO240	-104.87	61.47	362	101	100	-122	-116	-118	-126	100	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO241	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO242	-104.87	61.47	362	102	124	-116	-108	-113	-118	104	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO243	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO244	-104.87	61.47	362	102	124	-116	-108	-113	-118	104	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO245	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO246	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO247	-104.87	61.47	362	109	113	-125	-111	-111	-124	107	100	99	99	104	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO248	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO249	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO250	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO251	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO252	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO253	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO254	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO255	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO256	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO257	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO258	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO259	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO260	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO261	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO262	-104.87	61.47	362	102	115	-120	-111	-113	-119	104	100	99	99	101	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO263	-104.87	61.47	362	100	100	-121	-111	-110	-119	-118	100	99	99	103	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO264	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO265	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO266	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO267	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO268	-104.87	61.47	362	101	119	-116	-109	-111	-117	105	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO269	-104.87	61.47	362	103	100	-126	-109	-108	-126	112	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO270	-104.87	61.47	362	0	0	0	0	0	0	0	100	0	0	0	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO271	-104.87	61.47	362	98	99	-125	-111	-110	-116	100	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO272	-104.87	61.47	362	98	100	-128	-113	-119	-120	104	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO273	-104.87	61.47	362	99	100	121	-117	-117	-123	100	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO274	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41

MARCO275	-104.25	60.67	364	98	100	-121	-108	-107	-113	101	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO276	-104.25	60.67	364	98	100	-121	-108	-107	-113	101	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO277	-104.25	60.67	364	98	99	-125	-111	-110	-116	100	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO278	-104.25	60.67	364	100	100	-124	-113	-114	-127	100	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO279	-104.25	60.67	364	98	100	-121	-108	-107	-113	101	0	99	99	100	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO280	-104.33	60.83	364	99	100	121	-117	-117	-123	100	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO281	-104.33	60.83	364	99	100	121	-117	-117	-123	100	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO282	-104.33	60.83	364	97	100	-128	-118	-116	127	-121	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO283	-104.33	60.83	364	98	100	-126	-108	-103	124	100	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO284	-104.33	60.83	364	98	100	-126	-108	-103	124	100	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45

MARCO285	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO286	-104.33	60.83	364	98	100	-124	-113	-112	120	109	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO287	-104.33	60.83	364	98	100	-124	-113	-112	120	109	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO288	-104.33	60.83	364	98	100	-125	-114	-111	-119	102	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO289	-104.33	60.83	364	98	100	-125	-114	-111	-119	102	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO290	-104.33	60.83	364	98	100	-123	-109	-108	-120	105	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO291	-104.33	60.83	364	98	100	-123	-109	-108	-120	105	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO292	-104.33	60.83	364	98	100	126	-112	-111	-122	107	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO293	-104.33	60.83	364	98	100	126	-112	-111	-122	107	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO294	-104.33	60.83	364	98	100	126	-112	-111	-122	107	99	99	99	100	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45

MARCO295	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO296	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO297	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO298	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO299	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO300	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO301	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO302	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO303	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO304	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45

MARCO305	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO306	-104.33	60.83	364	0	0	0	0	0	0	0	99	0	0	0	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO307	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO308	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO309	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO310	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO311	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO312	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO313	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO314	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO315	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO316	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO317	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO318	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO319	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO320	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO321	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO322	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO323	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO324	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO325	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO326	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO327	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO328	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO329	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO330	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO331	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO332	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO333	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO334	-105.56	61.63	387	0	0	0	0	0	0	0	100	0	0	0	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO335	-105.56	61.63	387	-125	-115	-106	-99	-99	-110	-107	100	111	119	-109	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO336	-105.56	61.63	387	-125	-115	-106	-99	-99	-110	-107	100	111	119	-109	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO337	-105.56	61.63	387	-125	-115	-106	-99	-99	-110	-107	100	111	119	-109	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO338	-105.56	61.63	387	120	-110	-89	-98	-101	-98	-110	100	102	101	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO339	-105.56	61.63	387	119	-111	-92	-99	-102	-109	-114	100	102	101	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO340	-105.56	61.63	387	127	-103	-82	-93	-95	-105	-112	100	110	115	113	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO341	-105.56	61.63	387	124	-96	-87	-98	-89	-100	-115	100	105	108	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO342	-105.56	61.63	387	124	-111	-90	-105	-103	-102	-116	100	105	108	109	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO356	-109.55	64.48	454	124	-111	-90	-105	-103	-102	-116	99	105	108	109	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96
MARCO357	-108.46	62.89	315	126	-105	-88	-92	-92	-106	-113	99	109	115	118	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO358	-123.00	65.08	156	-124	-111	-92	-92	-96	-116	-109	0	103	110	106	0	-7.02	9.44	37.47	21.44	63.26	23.99	9.42	69.75
MARCO359	-126.83	65.28	20	-124	-111	-92	-92	-96	-116	-109	99	103	110	106	103	-6.27	9.76	34.39	20.70	60.63	27.06	10.77	69.19
MARCO360	-121.00	65.00	163	-124	-111	-92	-92	-96	-116	-109	99	103	110	106	100	-7.29	9.47	38.63	21.32	63.85	22.64	8.92	70.00
MARCO361	-123.42	65.20	187	-124	-111	-92	-92	-96	-116	-109	99	103	110	106	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO362	-126.12	67.03	247	126	-90	-90	-92	-90	-88	-103	99	105	107	115	100	-9.04	8.51	35.55	22.58	67.65	20.85	9.49	68.94
MARCO363	-121.13	64.95	156	126	-88	-79	-86	-87	-81	-117	0	105	106	118	0	-7.21	9.51	38.56	21.31	63.77	22.83	8.97	69.98
MARCO364	-123.33	65.17	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68
MARCO365	-123.42	65.20	187	-121	-108	-94	-91	-91	-100	-118	99	115	117	120	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO366	-123.33	65.20	199	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO367	-126.12	67.03	247	-125	-110	-92	-84	-91	-98	-104	99	110	107	109	100	-9.04	8.51	35.55	22.58	67.65	20.85	9.49	68.94

MARCO368	-121.13	64.95	156	-125	-102	-84	-90	-88	-86	-107	0	107	109	116	0	-7.21	9.51	38.56	21.31	63.77	22.83	8.97	69.98
MARCO369	-123.42	65.20	187	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO370	-123.33	65.17	156	126	-88	-79	-86	-87	-81	-117	0	105	106	118	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68
MARCO371	-123.42	65.20	187	-125	-110	-92	-84	-91	-98	-104	99	110	107	109	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO372	-108.46	62.89	315	-127	-95	-85	-84	-85	-84	-115	99	107	116	108	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO373	-123.33	65.17	156	-125	-102	-84	-90	-88	-86	-107	0	107	109	116	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68
MARCO374	-125.55	64.90	17	127	-95	-81	-79	-85	-86	-116	99	107	115	118	104	-6.02	9.81	35.64	20.70	61.04	27.40	10.37	69.44
MARCO375	-108.46	62.89	315	127	-95	-81	-85	-83	-83	-117	99	105	104	110	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO376	-108.46	62.89	315	-121	-108	-94	-91	-91	-100	-118	99	115	117	120	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO377	-108.46	62.89	315	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO378	-108.46	62.89	315	127	-95	-81	-85	-83	-83	-117	99	105	104	110	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO379	-108.46	62.89	315	127	-95	-81	-79	-85	-86	-116	99	107	115	118	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO380	-108.46	62.89	315	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO381	-108.46	62.89	315	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO382	-108.46	62.89	315	126	-88	-79	-86	-87	-81	-117	99	105	106	118	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO383	-108.46	62.89	315	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO384	-62.89	62.89	0	-125	-98	-88	-90	-96	-85	-106	0	105	109	109	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO385	-62.89	62.89	0	-127	-98	-80	-88	-83	-82	-111	0	115	116	122	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO386	-62.89	62.89	0	123	-114	-95	-90	-93	-82	-120	0	105	102	105	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO387	-108.46	62.89	315	115	122	-127	-103	-88	-97	-111	99	120	103	100	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO388	-108.46	62.89	315	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO389	-121.00	65.00	163	-127	-97	-86	-92	-98	-96	-106	99	106	102	103	100	-7.29	9.47	38.63	21.32	63.85	22.64	8.92	70.00
MARCO390	-108.46	62.89	315	-127	-97	-86	-92	-98	-96	-106	99	106	102	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO392	-123.33	65.20	199	-126	-98	-83	-88	-97	-86	-107	99	112	114	115	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO393	-123.33	65.20	199	125	-123	-106	-90	-88	-89	-101	99	100	101	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO394	-123.33	65.20	199	123	-114	-95	-90	-93	-82	-120	99	105	102	105	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO395	-123.33	65.20	199	0	0	0	0	0	0	0	99	0	0	0	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO396	-123.33	65.20	199	-120	-105	-86	-84	-86	-90	-106	99	108	121	123	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO399	-108.70	64.19	369	-127	-115	-92	-89	-90	-101	-108	99	108	113	112	100	-9.87	8.50	39.98	22.43	62.04	21.18	9.94	70.91
MARCO400	-109.39	64.37	385	127	-95	-81	-79	-85	-86	-116	0	107	115	118	0	-10.09	8.45	40.05	22.65	61.58	21.16	10.09	70.95

MARCO401	-111.38	65.30	485	127	-95	-81	-85	-83	-83	-117	99	105	104	110	100	-11.20	8.02	39.99	23.69	64.90	20.52	9.61	71.00
MARCO403	-107.94	64.10	385	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	100	-9.96	8.53	39.72	22.52	62.55	21.41	9.78	70.88
MARCO404	-110.63	64.88	493	-125	-110	-92	-84	-91	-98	-104	99	110	107	109	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99
MARCO406	-110.80	64.98	489	0	0	0	0	0	0	0	0	0	0	0	0	-10.98	8.18	39.98	23.46	61.96	21.27	10.11	71.00
MARCO407	-110.68	64.59	466	127	-95	-81	-79	-85	-86	-116	99	107	115	118	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO408	-110.68	64.59	466	126	-88	-79	-86	-87	-81	-117	99	105	106	118	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO409	-111.38	65.30	485	126	-88	-79	-86	-87	-81	-117	99	105	106	118	100	-11.20	8.02	39.99	23.69	64.90	20.52	9.61	71.00
MARCO410	-112.10	64.86	427	-120	-105	-86	-84	-86	-90	-106	99	108	121	123	100	-10.24	8.48	40.49	23.21	64.56	21.13	9.51	71.04
MARCO411	-110.68	64.59	466	126	-90	-90	-92	-90	-88	-103	99	105	107	115	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO412	-110.63	64.88	493	127	-95	-81	-85	-83	-83	-117	99	105	104	110	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99

MARCO413	-110.63	64.88	493	127	-95	-81	-85	-83	-83	-117	99	105	104	110	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99
MARCO414	-110.37	63.72	457	-127	-115	-92	-89	-90	-101	-108	99	108	113	112	100	-9.10	8.80	40.49	22.33	59.92	22.71	10.46	70.98
MARCO415	-109.55	64.48	454	127	-95	-81	-85	-83	-83	-117	99	105	104	110	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96
MARCO416	-109.55	64.48	454	-127	-115	-92	-89	-90	-101	-108	99	108	113	112	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96
MARCO417	-109.40	64.31	376	126	-121	-103	-98	-92	-95	-107	0	106	100	100	0	-9.98	8.47	40.09	22.58	61.41	21.25	10.11	70.95
MARCO418	-109.78	64.15	383	127	-95	-81	-85	-83	-83	-117	99	105	104	110	100	-9.71	8.57	40.24	22.50	60.68	21.68	10.27	70.95
MARCO419	-109.78	64.15	383	-125	-102	-84	-90	-88	-86	-107	99	107	109	116	100	-9.71	8.57	40.24	22.50	60.68	21.68	10.27	70.95
MARCO420	-108.78	64.24	374	-125	-110	-92	-84	-91	-98	-104	99	110	107	109	100	-9.92	8.48	39.98	22.46	62.06	21.13	9.95	70.90
MARCO421	-108.78	64.24	374	-121	-108	-94	-91	-91	-100	-118	99	115	117	120	100	-9.92	8.48	39.98	22.46	62.06	21.13	9.95	70.90
MARCO422	-108.46	64.45	356	0	0	0	0	0	0	0	99	0	0	0	100	-10.27	8.40	39.77	22.66	63.05	20.73	9.77	70.93

MARCO423	-108.46	64.45	356	126	-88	-79	-86	-87	-81	-117	99	105	106	118	100	-10.27	8.40	39.77	22.66	63.05	20.73	9.77	70.93
MARCO424	-108.19	64.20	366	-125	-110	-92	-84	-91	-98	-104	99	110	107	109	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90
MARCO425	-108.19	64.20	366	-127	-95	-85	-84	-85	-84	-115	99	107	116	108	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90
MARCO426	-108.19	64.20	366	0	0	0	0	0	0	0	99	0	0	0	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90

[5] *About the ESRI Grid format*
http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=About_the_ESRI_grid_format
(information acquired at 25/12/09)

Grid data structure

Grids are implemented using a tiled raster data structure in which the basic unit of data storage is a rectangular block of cells. Blocks are stored on disk in compressed form in a variable-length file structure referred to as a tile. Each block is stored as one variable-length record.

The size of the tile for a grid is based on the number of rows and columns in the grid at the time of creation. The upper limit on the size of a tile is set by the application and is very large (currently set at 4,000,000 x 4,000,000 cells). As a result, most grids used for GIS applications are automatically stored in a single tile. The spatial data for a grid is automatically split across multiple tiles if the size of the grid at the time of creation is larger than the upper limit for the size of a tile.

The blocked storage organization for grids supports both sequential and random spatial access to large raster datasets. The blocking structure imposes no restrictions on the joint analysis of grids. Tiles and blocks from different grids also need not coincide in map space for joint analysis. The tile and block structure of a grid is completely hidden from the user, who always creates and *manipulates a grid as though it were a seamless raster of uniformly square cells.*

Grids use a run-length raster compression scheme that is adaptive at the block level. Each block is tested to determine the depth (bits per cell) to be used for the block and to determine which storage technique (cell-by-cell or run-length-coded) is more efficient. The block is stored in the format that requires less disk space. The adaptive compression scheme is the optimal choice because of its ability to efficiently represent both homogenous categorical data and heterogenous continuous data while supporting joint analysis using both types of data. Single layer per-cell operations, such as data reclassification, operate directly on runs of data without decompression. Multilayer per-cell operations on compressed input layers intersect runs of data from the different layers and operate on the intersected runs. Single layer per-neighborhood operations and multilayer per-cell operations that mix compressed and uncompressed data expand runs into cells and perform traditional cell-by-cell processing transparently.

Grid data storage

A grid is stored in an ArcInfo workspace. The name of a grid cannot be stored using spaces, it cannot start with a number, and it cannot be longer than 13 characters (a multiband grid is allowed up to 9 characters). The grid, like a coverage, is stored as a separate directory with associated tables and files that contain specific information about the grid. In an integer grid directory (originally created by ArcInfo Workstation), the following tables and files are found: the BND table, which stores the boundary of the grid; the HDR file, which stores specific information describing the grid, for example, cell resolution and blocking factor; the STA table, which contains statistics for the grid; the VAT table, which stores the attribute data associated with the zones of the grid; the LOG, which monitors the activity that has occurred on the grid; and the tile file w001001.adf (q0x1y1), which stores the cell data and the accompanying index file w001001x.adf (q0x1y1x) that indexes the blocks in the tile and the LOG. (Some of these may not exist if created using ArcGIS operators, such as the LOG file.)

[6]

Table A2. Final table with environmental parameters correlated to locations of population of grey wolves. The NDVI parameters have been corrected.

CODE	Longitude	Latitude	Altitude	NDVI April	NDVI May	NDVI Jun	NDVI Jul	NDVI Aug	NDVI Sept	NDVI Oct	NDVI Nov	NDVI Dec	NDVI Jan	NDVI Feb	NDVI March	Mean Temperature Yearly TMPY	Temperature Diurnal Yearly DTRY	Max% possible Sunshine Yearly SUNY	Days Ground Frost Yearly FRSY	Coefficient Precipitation Yearly PRCV	Precipitation Yearly PRY	Wet Days Yearly RDOY	Relative Humidity Yearly% REHY
JAL2346	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2347	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL2349	-117.56	53.41	1036	131	141	150	157	157	146	149	116	111	119	147	132	1.85	13.24	40.95	20.76	64.25	47.22	8.38	69.82
JAL3328	-90.50	45.21	455	131	158	168	166	160	171	150	126	105	109	109	109	4.71	12.04	54.15	15.69	56.08	67.80	10.70	72.06
JAL3329	-88.40	45.85	426	129	158	176	168	173	174	145	105	115	116	122	123	4.05	12.99	51.24	16.80	51.56	64.43	12.01	73.15
JAL3331	-91.14	45.90	428	123	142	161	166	163	174	136	105	105	102	105	107	4.86	12.36	53.15	15.95	57.86	65.63	10.98	71.53
JAL3333	-84.61	43.41	222	115	122	129	153	168	159	145	103	120	103	100	107	7.83	11.15	49.38	13.28	51.86	64.83	11.57	73.80
JAL3334	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13

JAL3335	-90.36	45.68	457	129	159	170	164	158	160	150	128	106	102	103	112	4.39	12.21	53.01	16.35	54.73	68.37	11.11	72.06
JAL3339	-90.36	45.68	457	129	159	170	164	158	160	150	128	106	102	103	112	4.39	12.21	53.01	16.35	54.73	68.37	11.11	72.06
JAL3340	-91.91	46.45	366	130	158	173	168	159	170	149	120	112	114	115	111	4.68	11.60	52.49	15.53	59.13	63.08	10.91	70.93
JAL3341	-88.97	44.48	271	125	133	150	166	168	167	155	135	100	101	100	114	6.12	12.27	54.13	14.87	57.29	65.33	10.26	72.65
JAL3342	-91.14	45.90	428	123	142	161	166	163	174	136	105	105	102	105	107	4.86	12.36	53.15	15.95	57.86	65.63	10.98	71.53
JAL3611	-93.48	46.70	379	120	146	167	158	155	158	146	116	102	101	100	106	4.98	13.34	52.86	15.61	59.80	59.31	10.26	69.73
JAL3612	-95.68	47.77	396	119	145	164	157	154	147	142	107	102	101	100	115	3.48	12.95	52.07	16.39	65.14	49.12	8.88	70.18
JAL3613	-93.58	46.98	411	127	153	174	163	161	151	144	106	110	115	113	114	4.92	13.21	51.91	15.77	59.43	58.62	10.35	69.85
JAL3614	-93.48	46.23	409	124	160	169	158	167	156	141	115	105	108	100	103	4.78	13.56	54.50	15.49	60.74	60.77	10.03	69.39
JAL3616	-92.46	47.58	461	124	145	166	151	153	154	140	108	105	108	109	111	3.18	11.60	48.31	16.69	55.87	60.83	11.46	70.99

JAL3617	-92.46	47.58	461	124	145	166	151	153	154	140	108	105	108	109	111	3.18	11.60	48.31	16.69	55.87	60.83	11.46	70.99
JAL3618	-93.95	47.73	411	126	151	168	164	164	150	143	115	109	115	118	120	3.87	12.43	49.39	16.21	58.78	56.45	10.52	70.09
JAL3619	-94.50	48.15	360	132	145	164	164	160	140	147	113	103	110	106	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3620	-94.50	48.15	360	132	145	164	164	160	140	147	113	103	110	106	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3621	-94.50	48.15	360	132	145	164	164	160	140	147	113	103	110	106	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3622	-94.50	48.15	360	132	145	164	164	160	140	147	113	103	110	106	117	3.22	12.40	48.87	16.49	60.51	53.58	10.28	70.11
JAL3759	-73.43	44.58	29	0	0	0	0	0	0	0	0	0	0	0	0	6.73	10.68	47.13	13.90	46.53	62.28	12.71	71.10
JAL4890	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL4891	-86.87	45.78	184	136	151	170	172	170	166	150	110	108	121	123	128	5.54	9.83	48.93	15.09	53.39	61.26	12.65	74.12
JAL4909	-85.95	44.30	302	126	166	166	164	166	168	153	102	105	107	115	113	6.78	10.72	48.58	13.96	51.28	67.51	12.30	73.98

JAL4910	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4911	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4912	-86.35	46.23	224	129	141	164	167	166	155	148	100	108	113	112	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75
JAL4913	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4914	-86.35	46.23	224	129	141	164	167	166	155	148	100	108	113	112	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75
JAL4915	-91.85	45.42	336	126	135	153	158	164	161	149	135	106	100	100	105	5.81	12.26	55.13	14.98	60.47	63.34	10.39	70.94
JAL4916	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL4917	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL4918	-86.19	46.02	215	131	146	164	172	165	158	152	103	110	107	109	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL4919	-85.01	46.01	198	135	148	162	165	165	156	138	126	115	117	120	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87

JAL4920	-89.27	46.98	183	0	0	0	0	0	0	0	0	0	0	0	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL4921	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL4922	-86.19	46.02	215	131	146	164	172	165	158	152	103	110	107	109	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL4923	-87.60	46.66	250	129	161	171	172	171	172	141	105	107	116	108	116	4.30	11.26	48.70	16.80	48.64	70.96	12.73	73.77
JAL5050	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5051	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5052	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5053	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5054	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5055	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5056	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5057	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5058	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5059	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5060	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5061	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5062	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5063	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5064	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5065	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5066	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5067	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5068	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5069	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5070	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5071	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5072	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5073	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5074	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5075	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46

JAL5077	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5078	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5079	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5080	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5081	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5083	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5084	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5085	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5086	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5087	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40

JAL5088	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5089	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5090	-133.73	68.36	15	0	0	0	0	0	0	0	0	0	0	0	0	-9.64	9.72	34.98	22.88	64.35	20.58	9.97	67.46
JAL5091	-114.24	62.27	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.11	9.53	43.32	19.88	62.21	23.53	9.50	71.40
JAL5094	-89.27	46.98	183	0	0	0	0	0	0	0	0	0	0	0	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL5095	-86.87	45.78	184	136	151	170	172	170	166	150	110	108	121	123	128	5.54	9.83	48.93	15.09	53.39	61.26	12.65	74.12
JAL5096	-86.35	46.23	224	129	141	164	167	166	155	148	100	108	113	112	111	5.02	10.16	46.53	15.52	49.51	65.27	13.16	74.75
JAL5097	-88.34	46.72	417	127	161	175	177	171	170	140	101	107	115	118	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5098	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5099	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13

JAL5100	-86.19	46.02	215	131	146	164	172	165	158	152	103	110	107	109	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL5101	-89.27	46.98	183	0	0	0	0	0	0	0	0	0	0	0	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL5102	-88.34	46.72	417	127	161	175	177	171	170	140	101	107	115	118	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5103	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5147	-85.95	44.30	302	126	166	166	164	166	168	153	102	105	107	115	113	6.78	10.72	48.58	13.96	51.28	67.51	12.30	73.98
JAL5148	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5149	-89.27	46.98	183	0	0	0	0	0	0	0	0	0	0	0	0	4.46	11.28	49.96	17.09	50.70	67.43	11.25	72.45
JAL5150	-85.01	46.01	198	135	148	162	165	165	156	138	126	115	117	120	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87
JAL5152	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5153	-86.19	46.02	215	131	146	164	172	165	158	152	103	110	107	109	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81

JAL5154	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5155	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5156	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5157	-86.19	46.02	215	131	146	164	172	165	158	152	103	110	107	109	116	5.32	9.97	46.65	15.15	50.46	64.20	13.13	74.81
JAL5158	-87.60	46.66	250	129	161	171	172	171	172	141	105	107	116	108	116	4.30	11.26	48.70	16.80	48.64	70.96	12.73	73.77
JAL5159	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5161	-88.34	46.72	417	127	161	175	177	171	170	140	101	107	115	118	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5162	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5163	-85.01	46.01	198	135	148	162	165	165	156	138	126	115	117	120	110	5.00	10.69	44.31	15.31	48.09	68.84	13.88	75.87
JAL5164	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13

JAL5165	-88.65	46.98	290	127	161	175	171	173	173	139	106	105	104	110	108	4.61	10.09	49.30	17.33	49.17	69.49	11.60	72.92
JAL5166	-88.34	46.72	417	127	161	175	177	171	170	140	101	107	115	118	115	4.20	11.47	49.40	17.46	48.92	68.56	12.11	73.20
JAL5167	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5168	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
JAL5169	-89.79	46.48	518	126	168	177	170	169	175	139	100	105	106	118	110	3.70	12.33	50.86	17.45	50.73	71.30	11.57	72.33
JAL5170	-88.51	46.21	437	131	154	172	166	168	170	149	107	107	109	116	116	3.58	12.96	50.52	17.50	50.19	65.98	12.21	73.13
MARCO001	-116.28	56.00	685	122	136	164	166	165	147	133	105	99	104	119	123	0.34	12.03	42.43	19.10	59.20	39.08	9.47	71.65
MARCO002	-115.25	56.55	533	120	139	162	165	166	147	135	100	99	104	120	125	0.86	12.14	43.38	18.68	59.04	35.83	9.33	71.72
MARCO003	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO004	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86

MARCO005	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO006	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO007	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO008	-117.43	56.23	597	121	138	161	163	159	126	126	106	99	101	107	119	0.87	12.00	41.54	18.44	63.87	32.54	9.24	70.86
MARCO010	-112.00	56.65	476	135	142	154	159	160	149	136	106	99	109	130	133	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67
MARCO011	-112.00	56.65	476	135	142	154	159	160	149	136	106	99	109	130	133	-0.14	12.37	44.69	18.65	55.65	38.63	9.65	70.67
MARCO012	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO013	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO014	-111.75	57.42	316	138	148	154	163	162	156	140	100	99	112	133	136	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO015	-111.75	57.42	316	138	148	154	163	162	156	140	100	99	112	133	136	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59

MARCO016	-111.75	57.42	316	138	148	154	163	162	156	140	100	99	112	133	136	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO017	-111.75	57.42	316	138	148	154	163	162	156	140	100	99	112	133	136	-0.66	12.72	44.30	18.45	54.06	36.08	9.03	70.59
MARCO018	-116.58	60.25	214	107	140	150	156	159	142	128	99	99	99	109	110	-3.26	12.47	42.61	20.02	60.70	29.93	8.44	70.30
MARCO019	-114.83	60.58	169	105	130	145	157	153	145	129	99	99	99	106	105	-3.36	10.33	43.48	19.44	61.44	28.26	9.44	71.42
MARCO020	-117.03	60.95	196	108	127	144	153	150	128	141	99	99	99	106	108	-3.71	12.14	42.27	20.23	61.32	27.04	7.80	70.47
MARCO021	-115.37	60.75	165	100	126	148	154	161	151	130	99	99	99	104	109	-3.38	10.35	43.51	19.29	61.23	28.32	9.75	71.55
MARCO022	-116.57	60.27	211	107	138	151	159	157	150	134	99	99	99	111	108	-3.26	12.46	42.63	20.01	60.71	29.91	8.43	70.33
MARCO023	-123.12	62.75	55	108	132	147	161	155	137	113	99	99	99	103	112	-4.89	11.38	37.83	20.95	59.60	29.73	9.69	70.13
MARCO024	-123.42	63.22	52	105	135	141	150	138	128	131	99	99	99	105	107	-5.54	10.77	37.36	21.15	58.71	29.21	9.77	69.99
MARCO025	-121.22	61.25	257	106	132	152	156	153	127	145	99	99	99	106	113	-3.57	11.47	39.65	20.20	61.92	31.10	10.04	70.23

MARCO026	-123.42	63.22	52	105	135	141	150	138	128	131	99	99	99	105	107	-5.54	10.77	37.36	21.15	58.71	29.21	9.77	69.99
MARCO027	-123.12	62.75	55	108	132	147	161	155	137	113	99	99	99	103	112	-4.89	11.38	37.83	20.95	59.60	29.73	9.69	70.13
MARCO028	-121.03	61.33	225	114	132	152	153	154	132	146	99	99	99	112	122	-3.55	11.47	39.73	20.05	61.99	30.34	9.94	70.19
MARCO029	-118.77	61.83	243	100	123	152	158	155	134	137	99	99	99	100	100	-4.47	11.55	40.73	20.58	61.67	25.71	7.98	70.14
MARCO030	-117.47	62.13	193	105	127	139	152	150	135	132	99	99	99	102	102	-4.66	11.32	41.74	20.37	61.85	23.83	7.38	70.64
MARCO031	-111.88	59.00	208	114	142	160	166	165	159	145	99	99	111	126	130	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82
MARCO032	-111.88	60.00	204	114	135	153	158	155	151	152	99	99	100	128	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO033	-111.88	60.00	204	114	135	153	158	155	151	152	99	99	100	128	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO034	-111.88	60.00	204	114	135	153	158	155	151	152	99	99	100	128	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO035	-111.88	59.00	208	114	142	160	166	165	159	145	99	99	111	126	130	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82

MARCO036	-111.88	59.00	208	114	142	160	166	165	159	145	99	99	111	126	130	-2.09	11.63	42.72	19.20	52.92	31.38	8.27	70.82
MARCO037	-118.08	61.45	143	0	0	0	0	0	0	0	0	0	0	0	0	-3.73	11.98	41.46	20.18	61.89	24.55	7.19	70.19
MARCO038	-118.08	61.45	143	0	0	0	0	0	0	0	0	0	0	0	0	-3.73	11.98	41.46	20.18	61.89	24.55	7.19	70.19
MARCO039	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO040	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO041	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO042	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO043	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO044	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO045	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25

MARCO046	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO047	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO048	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO049	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO050	-111.22	56.65	351	127	153	160	169	170	140	140	103	99	105	123	128	0.09	12.06	44.69	18.49	55.08	38.69	11.20	70.25
MARCO051	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO052	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO053	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO054	-110.75	57.42	356	142	155	156	165	162	153	148	100	99	120	142	144	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO055	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50

MARCO056	-110.75	57.42	356	142	155	156	165	162	153	148	100	99	120	142	144	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO057	-110.75	57.42	356	142	155	156	165	162	153	148	100	99	120	142	144	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO058	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO059	-111.22	55.65	602	135	149	163	158	168	147	151	113	99	115	130	138	0.03	11.91	45.07	18.96	57.24	40.12	10.41	70.50
MARCO060	-110.75	57.42	356	142	155	156	165	162	153	148	100	99	120	142	144	-0.74	11.65	44.01	18.63	52.81	36.61	10.64	70.27
MARCO061	-111.88	60.00	204	114	135	153	158	155	151	152	99	99	100	128	116	-3.10	11.44	40.83	19.80	54.28	29.42	9.04	70.94
MARCO062	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO063	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO064	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO065	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO066	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO067	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO068	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO069	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO070	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO071	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO072	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO073	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO074	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO075	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO076	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO077	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO078	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO079	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO080	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO081	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO082	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO083	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO084	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO085	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO086	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO087	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO088	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO089	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO090	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO091	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO092	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO093	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO094	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO095	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO096	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO097	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO098	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO099	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO100	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO101	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO102	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO103	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO104	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO105	-109.67	65.17	435	0	0	0	0	0	0	0	0	0	0	0	0	-11.38	8.10	39.63	23.49	63.27	20.40	9.92	70.97

MARCO106	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO107	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO108	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO109	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO110	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO111	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO112	-114.44	62.46	256	103	119	136	142	139	135	135	99	99	99	104	106	-5.36	9.25	43.21	19.88	62.09	23.03	9.59	71.39
MARCO113	-116.65	62.03	194	111	125	138	149	149	144	143	99	99	99	107	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO114	-116.07	62.83	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.46	10.26	42.43	20.17	62.09	22.65	7.84	71.15
MARCO115	-116.07	62.83	156	0	0	0	0	0	0	0	0	0	0	0	0	-5.46	10.26	42.43	20.17	62.09	22.65	7.84	71.15

MARCO116	-116.65	62.03	194	111	125	138	149	149	144	143	99	99	99	107	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO117	-116.65	62.03	194	111	125	138	149	149	144	143	99	99	99	107	110	-4.66	10.91	42.37	20.17	61.76	24.41	7.93	71.00
MARCO118	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO119	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO120	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO121	-117.67	67.33	290	99	100	131	139	136	131	100	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO122	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO123	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO124	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO125	-110.83	65.67	446	0	0	0	0	0	0	0	0	0	0	0	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97

MARCO127	-98.18	67.38	57	97	100	100	123	126	115	100	99	99	99	100	100	-14.64	7.50	35.33	25.13	86.34	12.37	5.99	72.73
MARCO128	-110.83	65.67	446	0	0	0	0	0	0	0	0	0	0	0	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97
MARCO129	-117.67	67.33	290	99	100	131	139	136	131	100	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO130	-117.25	67.17	304	0	0	0	0	0	0	0	0	0	0	0	0	-11.47	8.24	39.10	23.52	67.56	19.81	8.55	70.36
MARCO131	-117.67	67.33	290	99	100	131	139	136	131	100	99	99	99	100	100	-11.22	8.19	39.07	23.32	68.77	19.05	8.23	70.28
MARCO132	-110.67	65.50	500	98	100	128	142	145	138	100	99	99	99	100	100	-11.70	7.91	39.71	23.81	63.54	20.29	9.85	70.97
MARCO133	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO134	-118.02	67.05	279	98	101	135	144	142	136	101	99	99	99	100	100	-10.63	8.33	39.16	22.75	67.28	19.26	8.31	70.25
MARCO136	-110.83	65.67	446	0	0	0	0	0	0	0	0	0	0	0	0	-11.81	7.81	39.68	23.90	65.54	19.75	9.53	70.97
MARCO137	-117.17	67.33	352	98	100	135	147	144	135	100	99	99	99	100	100	-11.48	8.19	39.14	23.57	68.63	19.26	8.38	70.35

MARCO138	-117.17	67.33	352	98	100	135	147	144	135	100	99	99	99	100	100	-11.48	8.19	39.14	23.57	68.63	19.26	8.38	70.35
MARCO139	-113.50	66.97	451	98	100	123	136	134	125	100	99	99	99	100	100	-12.25	7.60	39.47	24.23	74.84	17.50	7.93	70.81
MARCO140	-110.67	65.50	500	98	100	128	142	145	138	100	99	99	99	100	100	-11.70	7.91	39.71	23.81	63.54	20.29	9.85	70.97
MARCO141	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO142	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO143	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO144	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO145	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO146	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO147	-100.00	66.00	153	98	100	100	121	122	119	100	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30

MARCO148	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO149	-97.00	64.60	80	98	99	101	137	138	134	100	99	99	99	100	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47
MARCO150	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO151	-96.37	64.30	11	97	99	107	136	139	134	100	99	99	99	100	100	-12.29	7.81	34.94	23.75	67.41	20.13	8.95	73.74
MARCO152	-100.00	66.00	153	98	100	100	121	122	119	100	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO153	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO154	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO155	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO156	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO157	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48

MARCO158	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO159	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO160	-95.90	64.50	83	98	99	102	134	136	133	100	99	99	99	100	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO161	-95.90	64.30	22	97	99	102	137	141	134	100	99	99	99	100	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94
MARCO162	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO163	-95.90	64.50	83	98	99	102	134	136	133	100	99	99	99	100	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO164	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO165	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO166	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO167	-95.90	64.50	83	98	99	102	134	136	133	100	99	99	99	100	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92

MARCO168	-100.00	66.00	153	98	100	100	121	122	119	100	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO169	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO170	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO171	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO172	-95.90	64.30	22	97	99	102	137	141	134	100	99	99	99	100	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94
MARCO173	-95.90	64.50	83	98	99	102	134	136	133	100	99	99	99	100	100	-12.64	7.76	34.81	24.00	67.49	20.53	8.90	73.92
MARCO174	-97.00	64.60	80	98	99	101	137	138	134	100	99	99	99	100	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47
MARCO175	-92.50	65.00	173	99	99	100	118	125	120	100	99	99	99	100	100	-13.60	7.47	37.33	24.53	74.26	21.00	7.71	74.97
MARCO176	-92.50	65.00	173	99	99	100	118	125	120	100	99	99	99	100	100	-13.60	7.47	37.33	24.53	74.26	21.00	7.71	74.97
MARCO177	-97.00	64.60	80	98	99	101	137	138	134	100	99	99	99	100	100	-12.71	7.81	35.05	24.10	70.04	19.85	8.68	73.47

MARCO178	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO179	-96.08	64.30	15	97	99	110	136	137	124	100	99	99	99	100	100	-12.28	7.80	34.81	23.74	66.59	20.34	9.03	73.87
MARCO180	-97.00	64.50	152	97	99	103	136	140	133	100	99	99	99	100	100	-12.59	7.82	35.10	24.04	69.54	20.07	8.75	73.48
MARCO181	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO182	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO183	-96.50	64.50	143	97	99	103	132	136	130	100	99	99	99	100	100	-12.52	7.79	34.88	23.94	68.36	20.01	8.87	73.68
MARCO184	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO185	-97.05	64.77	65	98	99	101	136	140	135	100	99	99	99	100	100	-12.78	7.80	35.09	24.12	70.99	19.25	8.53	73.42
MARCO186	-100.00	66.00	153	98	100	100	121	122	119	100	99	99	99	100	100	-13.63	7.62	36.12	24.70	80.65	15.95	7.01	72.30
MARCO187	-95.90	64.30	22	97	99	102	137	141	134	100	99	99	99	100	100	-12.33	7.78	34.92	23.77	66.60	20.48	8.95	73.94

MARCO188	-96.50	64.75	149	97	99	100	138	142	136	100	99	99	99	100	100	-12.85	7.77	34.79	24.15	69.69	19.79	8.72	73.65
MARCO189	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO190	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO191	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO192	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO193	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO194	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO195	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO196	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO197	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41

MARCO198	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO199	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO200	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO201	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO202	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO203	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO204	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO205	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO206	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO207	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52

MARCO208	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO209	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO210	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO211	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO212	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO213	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO214	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO215	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO216	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO217	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52

MARCO218	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO219	-105.50	61.50	386	0	0	0	0	0	0	0	0	0	0	0	0	-7.63	9.58	39.96	21.83	57.59	28.27	9.64	70.52
MARCO220	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO221	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO222	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO223	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO224	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO225	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO226	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO227	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58

MARCO228	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO229	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO230	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO231	-104.50	61.42	362	99	100	113	136	138	125	103	100	99	99	100	101	-7.97	9.43	39.77	22.00	58.15	29.04	9.83	70.58
MARCO232	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO233	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO234	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO235	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO236	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO237	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO238	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO239	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO240	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO241	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO242	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO243	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO244	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO245	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO246	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO247	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO248	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO249	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO250	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO251	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO252	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO253	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO254	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO255	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO256	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO257	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO258	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO259	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO260	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO261	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO262	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO263	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO264	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO265	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO266	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO267	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55

MARCO268	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO269	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO270	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO271	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO272	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO273	-104.87	61.47	362	99	106	136	142	141	123	103	100	99	99	100	103	-7.82	9.51	39.85	21.93	57.88	28.76	9.71	70.55
MARCO274	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO275	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO276	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO277	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41

MARCO278	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO279	-104.25	60.67	364	0	0	0	0	0	0	0	0	0	0	0	0	-7.12	9.62	40.05	21.65	56.09	31.72	10.12	70.41
MARCO280	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO281	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO282	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO283	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO284	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO285	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO286	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO287	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45

MARCO288	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO289	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO290	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO291	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO292	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO293	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO294	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO295	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO296	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO297	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45

MARCO298	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO299	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO300	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO301	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO302	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO303	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO304	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO305	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO306	-104.33	60.83	364	100	114	138	141	144	137	108	99	99	99	101	104	-7.28	9.60	40.01	21.73	56.53	31.03	10.01	70.45
MARCO307	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO308	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO309	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO310	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO311	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO312	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO313	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO314	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO315	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO316	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO317	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO318	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO319	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO320	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO321	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO322	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO323	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO324	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO325	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO326	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO327	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO328	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO329	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO330	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO331	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO332	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO333	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO334	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO335	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO336	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO337	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55

MARCO338	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO339	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO340	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO341	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO342	-105.56	61.63	387	99	101	135	140	138	129	103	100	99	99	100	100	-7.80	9.54	39.92	21.89	57.94	27.84	9.66	70.55
MARCO356	-109.55	64.48	454	98	100	130	148	153	124	100	99	99	99	100	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96
MARCO357	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO358	-123.00	65.08	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.02	9.44	37.47	21.44	63.26	23.99	9.42	69.75
MARCO359	-126.83	65.28	20	104	121	141	143	143	129	108	99	99	99	104	103	-6.27	9.76	34.39	20.70	60.63	27.06	10.77	69.19
MARCO360	-121.00	65.00	163	102	115	136	145	143	137	104	99	99	99	101	100	-7.29	9.47	38.63	21.32	63.85	22.64	8.92	70.00

MARCO361	-123.42	65.20	187	102	124	140	148	143	138	104	99	99	99	100	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO362	-126.12	67.03	247	101	100	134	140	138	130	100	99	99	99	100	100	-9.04	8.51	35.55	22.58	67.65	20.85	9.49	68.94
MARCO363	-121.13	64.95	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.51	38.56	21.31	63.77	22.83	8.97	69.98
MARCO364	-123.33	65.17	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68
MARCO365	-123.42	65.20	187	102	124	140	148	143	138	104	99	99	99	100	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO366	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO367	-126.12	67.03	247	101	100	134	140	138	130	100	99	99	99	100	100	-9.04	8.51	35.55	22.58	67.65	20.85	9.49	68.94
MARCO368	-121.13	64.95	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.51	38.56	21.31	63.77	22.83	8.97	69.98
MARCO369	-123.42	65.20	187	102	124	140	148	143	138	104	99	99	99	100	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO370	-123.33	65.17	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68

MARCO371	-123.42	65.20	187	102	124	140	148	143	138	104	99	99	99	100	100	-7.29	9.34	37.08	21.68	63.19	24.41	9.62	69.66
MARCO372	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO373	-123.33	65.17	156	0	0	0	0	0	0	0	0	0	0	0	0	-7.21	9.38	37.15	21.61	63.16	24.36	9.59	69.68
MARCO374	-125.55	64.90	17	109	113	131	145	145	132	107	99	99	99	104	104	-6.02	9.81	35.64	20.70	61.04	27.40	10.37	69.44
MARCO375	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO376	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO377	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO378	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO379	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO380	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO381	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO382	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO383	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO384	-62.89	62.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO385	-62.89	62.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO386	-62.89	62.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MARCO387	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO388	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79
MARCO389	-121.00	65.00	163	102	115	136	145	143	137	104	99	99	99	101	100	-7.29	9.47	38.63	21.32	63.85	22.64	8.92	70.00
MARCO390	-108.46	62.89	315	100	100	135	145	146	137	138	99	99	99	103	103	-8.00	9.00	40.53	21.37	59.49	23.24	10.21	70.79

MARCO392	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO393	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO394	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO395	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO396	-123.33	65.20	199	101	119	140	147	145	139	105	99	99	99	100	103	-7.29	9.34	37.14	21.67	63.24	24.32	9.59	69.67
MARCO399	-108.70	64.19	369	103	100	130	147	148	130	112	99	99	99	100	100	-9.87	8.50	39.98	22.43	62.04	21.18	9.94	70.91
MARCO400	-109.39	64.37	385	0	0	0	0	0	0	0	0	0	0	0	0	-10.09	8.45	40.05	22.65	61.58	21.16	10.09	70.95
MARCO401	-111.38	65.30	485	98	99	131	145	146	140	100	99	99	99	100	100	-11.20	8.02	39.99	23.69	64.90	20.52	9.61	71.00
MARCO403	-107.94	64.10	385	98	100	128	143	137	136	104	99	99	99	100	100	-9.96	8.53	39.72	22.52	62.55	21.41	9.78	70.88
MARCO404	-110.63	64.88	493	99	100	121	139	139	133	100	99	99	99	100	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99

MARCO406	-110.80	64.98	489	0	0	0	0	0	0	0	0	0	0	0	0	-10.98	8.18	39.98	23.46	61.96	21.27	10.11	71.00
MARCO407	-110.68	64.59	466	98	100	135	148	149	143	101	99	99	99	100	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO408	-110.68	64.59	466	98	100	135	148	149	143	101	99	99	99	100	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO409	-111.38	65.30	485	98	99	131	145	146	140	100	99	99	99	100	100	-11.20	8.02	39.99	23.69	64.90	20.52	9.61	71.00
MARCO410	-112.10	64.86	427	100	100	132	143	142	129	100	99	99	99	100	100	-10.24	8.48	40.49	23.21	64.56	21.13	9.51	71.04
MARCO411	-110.68	64.59	466	98	100	135	148	149	143	101	99	99	99	100	100	-10.39	8.41	40.19	23.08	61.16	21.63	10.22	71.00
MARCO412	-110.63	64.88	493	99	100	121	139	139	133	100	99	99	99	100	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99
MARCO413	-110.63	64.88	493	99	100	121	139	139	133	100	99	99	99	100	100	-10.96	8.23	39.97	23.42	61.54	21.37	10.19	70.99
MARCO414	-110.37	63.72	457	97	100	128	138	140	127	135	99	99	99	100	100	-9.10	8.80	40.49	22.33	59.92	22.71	10.46	70.98
MARCO415	-109.55	64.48	454	98	100	130	148	153	124	100	99	99	99	100	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96

MARCO416	-109.55	64.48	454	98	100	130	148	153	124	100	99	99	99	100	100	-10.29	8.38	40.00	22.82	61.43	21.34	10.17	70.96
MARCO417	-109.40	64.31	376	0	0	0	0	0	0	0	0	0	0	0	0	-9.98	8.47	40.09	22.58	61.41	21.25	10.11	70.95
MARCO418	-109.78	64.15	383	98	100	132	143	144	120	109	99	99	99	100	100	-9.71	8.57	40.24	22.50	60.68	21.68	10.27	70.95
MARCO419	-109.78	64.15	383	98	100	132	143	144	120	109	99	99	99	100	100	-9.71	8.57	40.24	22.50	60.68	21.68	10.27	70.95
MARCO420	-108.78	64.24	374	98	100	131	142	145	137	102	99	99	99	100	100	-9.92	8.48	39.98	22.46	62.06	21.13	9.95	70.90
MARCO421	-108.78	64.24	374	98	100	131	142	145	137	102	99	99	99	100	100	-9.92	8.48	39.98	22.46	62.06	21.13	9.95	70.90
MARCO422	-108.46	64.45	356	98	100	133	147	148	136	105	99	99	99	100	100	-10.27	8.40	39.77	22.66	63.05	20.73	9.77	70.93
MARCO423	-108.46	64.45	356	98	100	133	147	148	136	105	99	99	99	100	100	-10.27	8.40	39.77	22.66	63.05	20.73	9.77	70.93
MARCO424	-108.19	64.20	366	98	100	126	144	145	134	107	99	99	99	100	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90
MARCO425	-108.19	64.20	366	98	100	126	144	145	134	107	99	99	99	100	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90

MARCO426	-108.19	64.20	366	98	100	126	144	145	134	107	99	99	99	100	100	-10.03	8.50	39.78	22.53	62.60	21.19	9.80	70.90

[7] The results of my investigations and also the data, images, PDF of the current thesis and the referenced articles have been included in attached CD-rom.