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# **A Network Analysis approach of the Venetian Incanto System.**

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# Research context

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- Project from the EPFL's DHLAB, in collaboration with Ca' Foscari University (Venice).
  - The objective of the project is to model 1000 years of the city (800-1800).
  - One of the research topics is the modelling of the Venetian maritime network.
  - We focused on one navigation's type: the navigation based on auctionning called *Incanto*.
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# Preliminary work

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The secondary sources' research linked directly or not to the Venetian Sea Power allowed us to go back to the primary sources.

Navigation and colonies.

For this particular analysis we focused on previous works, especially on Dr. Stöckly researches on the *Incanto* (1283 - 1453).

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# The *Incanto* system

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The *Incanto* was a regular maritime exchange system localized in the Mediterranean Sea, the Black Sea and until England and Flanders.

The main objective was to use the *galee* during peace time through a process of pre-conditions established by the Venetian Senate.

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# The *Incanto* system

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Started in 1283 by the Venetian Senate

State navigation, attempts for different liaisons with big trade and exchange places as Constantinople and their own colonies.

Gallees during peace time for the transport and exchange of high value cargoes.

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# To think and build a H-GIS on the Venetian maritime history.

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The *Incanto* system has been the subject of two large studies (Tenenti & Vivanti, 1961; Stöckly, 1992 et 1995).

In the 1961 study the focus is made on the reconstruction of the phenomenon as a film sequence.

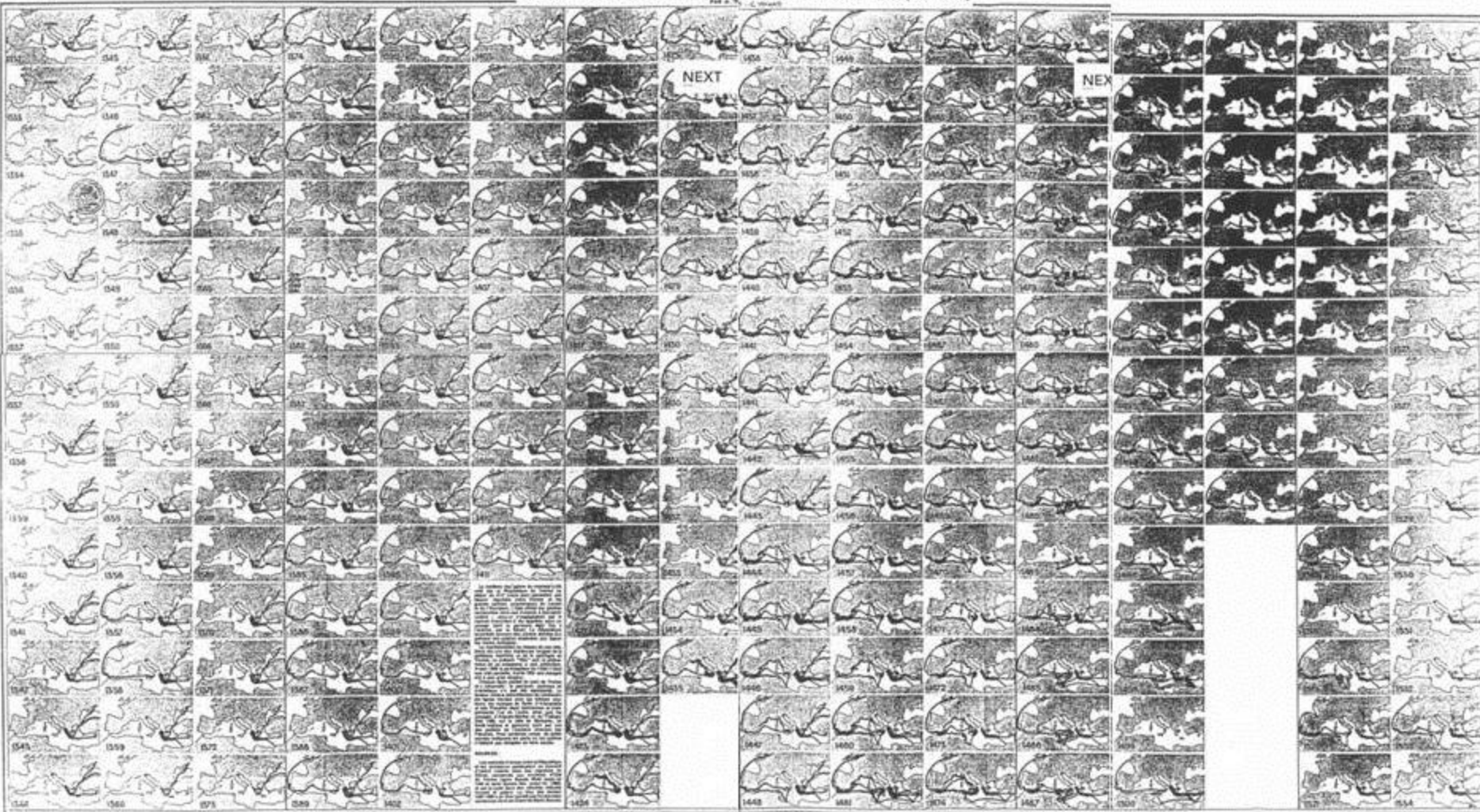
The 1992 research is an exhaustive analysis of sources on the journeys of Venetian galee but without any modeling.

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NEXT

NEX



An	dest	nav	no	c/p	prénom	patron	capitaine	ordo	incanto	prix	départ	route	source
1437	fl/lo	gal			Je q Ma	Dandolo	Mocenigo Ma	fev26	fev26	10.1s	avr20/jun	habituelle,Londres2g nov8	Mi59f193v,Mi60f13v16,ACR8f171
1437	fl/lo	gal			D q Jo	Pasqualigo NAUF?	Mocenigo Ma	fev26	fev26	5.	avr20/jun	habituelle,Bruges2g/Londres2g	Mi59f193v,Mi60f13v16,P79f117
1437	fl/lo	gal			Bt f Ut	Canal da NAUF?	Mocenigo Ma	fev26	fev26	12.1s	avr20/jun	habituelle,Bruges2g/Londres2g	Mi59f193v,Mi60f13v16,P79f171
1437	am/p	gal	1		Jo « Or	Molin da «Giusti		dec10	dec10	131.10	mr15/ml19	Messine,Palermo,Pise,Bucari,Aigues-M.(Catal,Valence)	Mi59f186v60f10v,P79f144s,NC6
1437	ba/oc	gal	1		La q At	Moro PAS PARTIE		dec10	dec10	351.	fev25	Syracuse,Tunis,côte,Cadix,Séville,Cadix/Catal,Barbarie	Mi59f187r
1437	ba/oc	gal	1		Je qSy-P	Morosini-Contari		mai18		183.3s	jun15	IgCrCu,Syrac,Tunis,côte,Cadix,Séville,Cadix/Catal,Barbarie	Mi60f12v27j24,GQ9vs
1438	ba/oc	gal	1		Carolus	Querini Dandula		jun6	jun6	100.2s	ju15/a17	Syracuse,Tripoli,Tunis,Cadix,Séville/Catal/Barbarie	Mi60f89v101v,GQ13v
1438	fl/lo	gal	4		Pd q Ab	Contarini	Diedo At maior	fev26	fev26	20.18	jun29d?	Bruges2g/Anvers/Londres2g	Mi6060v-387r94
1438	fl/lo	gal			Bapt q J	Contarini	Diedo At maior	fev26	fev26	22.3?	avr15/j28	Bruges2g/Anvers/Londres2g	Mi6060v-387r94
1438	fl/lo	gal			V q G	Capello	Diedo At maior	fev26	fev26	15.1s	avr15/j28	Bruges2g/Anvers/Londres2g	Mi6060v-387r94
1438	fl/lo	gal			J q A	Barbarigo	Diedo At =VCLo	fev26	fev26	25.10	avr15/j28	Londres avec autres galés	Mi6060v-387r94
1438	ro/tt	gal	4		A q \	Teupulo	Minio La -Ta	jun16	jun16	92.11	ju20/ag5	Corf1,Cor1,Modon1,Négr2,CP2,(Caffa2)Tana/Sinope1-2,Simis1-2,Tréb14/Mavrocasi1g 15,CP	Mi60f87-90rSV4,Badoer282,ACR8f238
1438	ro/tt	gal			TdquJu-Ma	Giustinian-Priolis	Minio La -Ta	jun16	jun16	101.	ju20/ag5	Corf1,Cor1,Modon1,Négr2,CP2,(Caffa2)Tana/Sinope1-2,Simis1-2,Tréb14/Mavrocasi1g 15,CP	Mi60f87r-90r,Badoer282,P19
1438	ro/tt	gal			Le -Zili	Duodo - MorosiPlq	Minio La -Ta	jun16	jun16	100.3s	ju20/ag5	Corf1,Cor1,Modon1,Négr2,CP2,(Caffa2)Tana/Sinope1-2,Simis1-2,Tréb14/Mavrocasi1g 15,CP	Mi60f87-90rSV4,Badoer282,ACR8f238
1438	ro/tt	gal			Paulusq\	Zorzi	Minio La -Ta	jun16	jun16	101.3s	ju20/ag5	Corf1,Cor1,Modon1,Négr2,CP2,(Caffa2)Tana/Sinope1-2,Simis1-2,Tréb14/Mavrocasi1g 15,CP	Mi60f87-90rSV4,Badoer282,P19
1438	cr/ra	gal	1		Je q Bc	Bembo «ContaMiqBe		jan23	jan27	140.4s	fev4	Candie6	Mi60f51r57vie14
1438	mo/ra	gal	1		Francisc	Loredan -L. Pl fr		jan23	jan23	131.1s	fev4	Modon6	Mi60f51r57vie14
1438	cl/ra	gal	1		P q Th	Zeno		jan23	jan23	281.10	fev4	Corfou	Mi60f51r57vie14
1438	am	gal	1		Jo	SC Molin -ContaNt		fev7	fev7	334.4s	mar31/mit	Messine,Palermo,Pise,Bucari,Am>1,Catag,Valence1	Mi60f58s75r
1438	am	gal	2	c	J q V	Morosini	Contarini Mt	mai31	mai31	185.2s	jun30/j21	<i>solita</i> ,Collioure=maximum,(Bucari,Marseille av.aug25) R:Gênes/Gaète/Naples	Mi60f85v-87r97
1438	am	gal		c	Mi qBe-V	Contarini -Capello	Contarini Mt	mai31	mai31	186.3s	jun30/j21	<i>solita</i> ,Collioure=maximum,(Bucari,Marseille av.aug25) R:Gênes/Gaète/Naples	Mi60f85v-87r97
1438	cy/cr	gal	1		La q Bt	Loredan						Crète,Chypre	Mi60f108r oct30
1438	ja/pe	gal	1			Grii VA PAS							Mi60f66v mar11
1439	fl/lo	gal	4		Ludovicu	Diedo VCLo	Loredan JqP	mar23	mar3	20.1s	mai15 sic	Messine,Palermo, <i>solita</i> ,Majorq,Cadix,Malaga1,Londres2g90,Southampton	Mi60f128-30v143
												/Bruges2gSluis,Anvers,R:habituel,Malaga1	
1439	fl	gal			Ab qG-Be	Capello -Superant	Loredan JqP	mar2	mar3	15.2s	mai15 sic	Messine,Palermo, <i>solita</i> ,Majorq,Cadix,Malaga1,Londres2g90,Southampton	Mi60f128-30v143
												/Bruges2gSluis,Anvers,R:habituel,Malaga1	
1439	fl	gal			Ld q Bc	Bembo - ContarMi	Loredan JqP	mar2	mar3	25.2s	mai15 sic	Messine,Palermo, <i>solita</i> ,Majorq,Cadix,Malaga1,Londres2g90,Southampton	Mi60f128-30v143
												/Bruges2gSluis,Anvers,R:habituel,Malaga1	
1439	fl	gal			F q Be	Dandolo	Loredan JqP	mar2	mar3	30.2s	mai15 sic	Messine,Palermo, <i>solita</i> ,Majorq,Cadix,Malaga1,Londres2g90,Southampton	Mi60f128-30v143
												/Bruges2gSluis,Anvers,R:habituel,Malaga1	
1439	am	gal	1		Jo -Atiq?	Molin da -Contar		1438		330.4s	dec15/fev	Messine,Palermo,Pise,Bucari1,Aigues-M/Agde,Catal,Valence R:idem	Mi60f108v108r
1439	ba/oc	gal	1		Az q At	Priolis de		mar11	mar11	102.2s	mai31/a18	Syracuse(Tripoli)Tunis,libreCadix/Barbarie/Catagone	Mi60f132 151/3r
1439	ro/tt	gal	3		Tadeo	Giustinian	Zeno Marco	mai30	mai30	135.18	ju125	Corfou1,Modon1,Coron,Négr2,CP2(Caffa2)Tana2,Caf1/(Sinope,Simisso2)Trébizonde14,CP6	Mi60f147-8r155
1439	ro/tt	gal			F q M	Manolesso	Zeno Marco	mai30	mai30	128.17	ju125?	Corfou1,Modon1,Coron,Négr2,CP2(Caffa2)Tana2,Caf1/(Sinope,Simisso2)Trébizonde14,CP6	Mi60f147-8r155
1439	ro/tt	gal			A q Do	Contarini	Zeno Marco	mai30	mai30	150.10	ju125?	Corfou,Modon1,Coron,Négr2,CP2(Caffa2)Tana2,Caf1/(Sinope,Simisso2)Trébizonde14,CP6	Mi60f147-8r155,153
1439	al	gal	3	p	F q P pr	Loredan	Foscarini Da	ju11	ju11	130.1s	aug31?	<i>solita</i> ,Alexandrie20	Mi60f157/8r176
1439	al	gal		p	J qF=VqN	Loredan «Dolfin	Foscarini Da	ju11	ju11	132.7s	aug31?	<i>solita</i> ,Alexandrie20	Mi60f157/8r176
1439	al	gal		p	Pl q Ppr	Loredan	Foscarini Da	ju11	ju11	122.19	aug31?	<i>solita</i> ,Alexandrie20	Mi60f157/8r176

OCR



Noise  
Rotation  
Grid

Data extraction



Cleaning data

One line = one ship  
Type  
Convoy  
Patron  
Captain  
Stopovers  
Numbers of days  
Departure  
Arrival

Geolocalisation  
Name disambiguation



Visualization



R  
GIS

1262		gal							av mai11?		PSM268
1283	ro/cp	gal	1	c					Raguse:31oct ,CP +amb		DivCanc1f68v
1294		gal			Tommaso	Michiel			av dec8?		CSMltra196
1294	ar	gal							nov		MC Thiri
1297	ar	gal									PSM278 TronTh
1300	cr	gal	2	o		Baroci Angelo				Crète,Venise2g	Piz77fév20cop80
1301	ro	gal	4			Morosini G				Ro R:Crète	Mi Cessi
1301	cy/ar	gal	3			Michiel Marco			fév28marf	Modon,CrèteIChypre5,ArménieCilic.8,Modon,Raguse	MCIéV2Mi1f113Lj
1301	cy/ar	gal	10			Morosini Fiof	mar 3			BucaCulfiPatras,Modon,Crète,Chypre Arménie,Raguse	Mi1Ce21Brix131
1301	ar	gal	5-6 p			jul11				Crète,Arménie,3 & 6 galées	Mi1Cep.35,40 Brix131sma24
1301	ro/ra	gal						fév 5	marfin	BucaCulfi,Patras R:Raguse	Mi1 Cep.35
1301	al	gal				Opiciono Pucio			ap aug21	Candie,Alexandrie	Brix 131s
1301	al	gal			Amigeto	Tartaro					Brix 131s
1301		gal	1		Mariono	Morosini					Mi1 Ce n°128
1302	ar/cr	gal	12	o			Foscarini Ro	av5j6	jun6/MapP	Patras,Coron,Modon,Candie,Chypre,Arménie	Mi1 Ce n°71,248
1302	ro/cp	gal								CP	Mi1p.177Ce p76
1302		gal						jul26	15-30aug/23sep		Mi1 Ce 219
1303		gal						jul26	févmi/fin		Mi1 Ce p.60
1303	cy/sy	gal						avril			Mi2 Ce n°18
1303	ar	gal						avril			Mi2 Ce
1303	ro/p	gal						jan 5	fé15,mr15	Durazzo,Corfou1,Claence1,CPICrète/Négrepont,Venise	Mi1 304
1303	ro/h	gal						jan 5	au15,sep9	Durazzo,Corfou,Claence,CPICrète/Négrepont,Venise	Mi1184-6Cep.85
1303	ro/cp	gal						avril			Mi2 Ce n°18
1303	al/cr	gal	2					jan			Mi2 Ce n°12
1304	ro/cp	gal	2								Mi2 Ce n°70
1304	al/ca	gal				Veneria				Candie,jul21	Piz804jul21,832
1305	ro/cp	gal								Négrepont,CPI R: Istrie	Mi2Ce
1305	al	gal						fév			Mi2 Ce n°163
1305	sy/h	gal							libre,aug	Alexandrie 1gal? R: CP,Romanie	Mi2 Ce n°163
1306	ro/cp	gal		o						CP,MNI Alexandrie?,Chypre\Arménie	Mi2 Ce n°180,183s
1306	cy/ar	gal		c				jan06			Mi2 Ce n°177,180
1306	al/sy	gal		c				jan		Alexandrie20	Mi2 Ce n°177,196,210
1306		gal	1	c	Bertucio	Gradenigo		jun12			Mi2 Ce n°211
1307	cy	gal	1	p	Federico	Cornaro		déc06		Chypre	Mi2 Ce n°212
1307	cy/sy	gal	4					mars		ChypreI,Syrie libre \Arménie	Mi2 Ce n°223
1307	al	gal								Alexandrie20	Mi3 Ce n°472
1308	al	gal									Mi2 Ce n°32
1308	cy/sy	gal	2					jun		Chypre\erra Soldani	Mi3 Ce n°39,41
1309	al	gal	2					jun			Mi3 Ce n°69
1311	cy/ar	gal	2	p/c		Loredana ou Commune	fév			Mi3 Ce n°96,97	

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R  
GIS



1384	be	gal		Jo	Canal da	Zeno N +C	jun2	jun2	40.6s	aug15/se7	+gCu,Beyrouth28,Damas(aug30)	Mi38f133s, 144,157rt 61
1384	be	gal		Michael	Malipiero	Zeno Nico	jun2	jun2	43.78	aug15/se7	+gCu,Beyrouth28	Mi38f133s,144,157r
1384	be	gal		Fc	Canal da	Zeno Nico	jun2	jun2	40.1S	aug15/se7	+gCu,Beyrouth28	Mi38f133s,144,157r
1384	al	eo	2	Francisc	Mocenigo		mai.25	mai.25		lui15ia18	Candie,Modon,Coron,Alexandrie8j	Mi38f128/9v146v
1384	al	eo		Nicola us	Paulo		mai.25	mai.25		augi 5/20	Modon2,Alexandrie16,attendre N.Mocenigo	Mi38f128/9v
1384	sy/po	gal		Bf Jo	Nadal						Jaffa.Babylone (\\terre Soldani)	Mi38f103rmar7
1384	sy/pe	gal		DafA	Morosinl						SaintSépulcre	Mi38f121vavr4
1384	sy/pe	gal		Francisc	Michiel						SaintSépulcre	Mi38f121rmai12
1384	sy/pe	gad		Raphalet	Stella de						SaintSépulcre	Mi38f137rjun20
1385	be	gal	4 P	Pf He	Venier	Querigu/\	mai.27	mai.29	136.5S	augi 5/23	Beyrouth26,Tripoli1g	Mi39f88v-90r,SV2
1385	be	gal	P	Stephanu	Pisani	Querigu/\	mai.27	mai.29	143.5S	augi 5/23	Beyrouth28,Tripoli1g	Mi39f88v-90r,SV2
1385	be	gal	P	Francisc	Canal da	Querigu/\	mai.27	mai.29	151	augi 5/23	Beyrouth28,Damas	Mi39f88v-90r,134r,SV2
1385	be	gal	P	MqP«Or	Giustiniar	Querigu/\	mai.27	mai.29	150.5	augi 5/23	Beyrouth28,Damas	Mi39f88v-90r,134r,SV2
1385	fi	gal	4 P	Paulus	Querini	Zeno Nico	janv.10	janv.11	47.1 s	man8/a27	Flandre4f+10®ruges,MiddlebourglAntona1Malaga	Mi39f36rv62r68r
1385	fi	gal	P	Jo	Capello	Zeno Nico	janv.10	janv.11	10.2S	man8/a27	Flandre40+1 OtBruges.Middlebourg.Antona.Mataga	Mi39f36rv62r68r
1385	fi	gal	P	Pietro	Arimondo	Zeno Nico	janv.10	janv.11	12.3S	mar18/a27	Flandro40+1 OlBruges.Middlebourg, Antona.Malaga	Mi39f36rv62r68r

Year	Dest	Nav_Type	NBR	?	First Name	Patron	Capitaine	Ordo	Incanto	Price	Departure	Stop1	Stop2	Stop3	Stop4
1262		gal									Before May11?	Stop1	Stop2	Stop3	Stop4
1283	Romanie/Constantinople	gal	1	c								Ragusa 31oct	Constantinople (with the Ambassador)		
1294		gal			Tommaso	Michiel					Before Dec8 ?				
1294	Armenia	gal									Nov				
1297	Armenia	gal													
1300	Crete	gal	2	o			Baroci Angelo					Crete 2g			
1301	Romania	gal	4				Morosini G					Romania	Crete		
1301	Cyprus/Armenia	gal	3				Michiel Marco				Feb 28 – End of Mar	Modon	Crete	Cyprus5	Armenia Cilic8
1301	Cyprus/Armenia	gal	10				Morosini Fiof	03/03/1301				BucaCuffil	Patras	Modon	Crete
1301	Armenia	gal	5-6	p				11/07/1301				Crete	Armenia 3-6g		
1301	Romanie/Ragusa	gal									End of March	BucaCuffil	Patras	Ragusa	
1301	Alexandria	gal			Amigeto	Tartaro			05/02/01		After Aug 21	Candia	Alexandria		
1301	Alexandria	gal	1		Mariono	Morosini									
1302	Armenia/Crete	gal	12	o			Foscarini Ro	Before Jun5			06/06/02	Patras	Coron	Modon	Candia
1302	Romanie/Constantinople	gal										Constantinople			
1302		gal						26/07/1302			15-30aug/23sep				
1303		gal						26/07/1303			Between mid-Feb to end-Feb				
1303	Cyprus/Syria	gal						Apr							
1303	Armenia	gal						Apr							
1303	Romanie/p	gal						05/01/1303			Between 15/02/1303 – 15/03/1303	Durazzo	Corfu	Glarentza1	Constantinople
1303	Romanie/h	gal						05/01/1303			Between 15/08/1303 – 09/09/1303	Durazzo	Corfu	Glarentza	Constantinople
1303	Romanie/Constantinople	gal						Apr							
1303	Alexandria/Crete	gal	2					Jan							
1304	Romanie/Constantinople	gal	2												
1304	Alexandria/Candia	gal				Veneria						Candia			
1305	Romanie/Constantinople	gal										Negrepoint	Constantinople	Istria	
1305	Alexandria	gal						Feb							
1305	Syria/h	gal									Free Aug	Alexandria 1gal?	Constantinople	Romanie	
1306	Romanie/Constantinople	gal	o									Constantinopl	Black Sea	Alexandria?	Cyprus
1306	Cyprus/Armenia	gal	c					06/01/1306							
1306	Alexandria/Syria	gal	c					Jan				Alexandria20			
1306		gal	1	c	Bertucio	Gradenigo		12/06/1306							
1307	Cyprus	gal	1	p	Federico	Cornaro		06/12/1307				Cyprus			
1307	Cyprus/Syria	gal	4					Mar				Cyprus	Syria free	Armenia	
1307	Alexandria	gal										Alexandria20			
1308	Alexandria	gal													
1308	Cyprus/Syria	gal	2					Jun				Cyprus	Terra Soldani		
1309	Alexandria	gal	2					Jun							
1311	Cyprus/Armenia	gal	2	p/c		Loredana or Commune		Feb							
1311	ultima	gal		P				Jan							
1311	Alexandria/Syria	gal		c	Nicoletto	Calegarius		Feb							
1312	Alexandria/Syria	gal		c				Nov							
1312	Alexandria/Candia	gal	5									Alexandria	Candia		
1312	Romanie/Constantinople	gal	2	c				Mar/Jun				Negrepoint	Constantinople	Black Sea	Ragusa:expected 27 oct
1312	Cyprus/Alexandria	gal	2	p				Mar				Cyprus	Armenia	Ragusa:expected 27 oct.	
1313	Cyprus/Alexandria	gal	2	c				Nov				Cyprus	Armenia		
1313	Alexandria	gal		c								Alexandria			
1314	Romanie/Black Sea	gal	2					22/01/14							

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One line = one ship  
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Visualization



R  
GIS

	A	B	C	D	E
1	LAT	LONG	NAME		
2	39.718361	19.771744	Corcyra, Korkyra, Corypho, Corfo, Goreiro, Skheria, isle of the Pheacians	Isle of Corfu, Kerkira	
3	35.019082	33.239826	Cyprus	Isle of Cyprus	
4	38.572494	23.769356	Euboea	Negrepont	
5	40.190912	26.405553	Abydos		
6	32.918629	35.072046	Acre, Akko		
7	43.314327	3.468434	Agde		
8	43.5675	4.193333	Aigues-Mortes		
9	31.205574	29.894432	Alexandrie		
10	36.787242	3.068616	Alger		
11	41.301751	36.360351	Amisos, Amisus, Peiraieus	Simisso	
12	51.21667	4.4	Anvers	Antwerpen	
13	36.76735	35.79105	Armenia	Lajazzo port	
14	32.542	44.42	Babylone		
15	33.899231	35.505065	Berytos, Beryte, Beyrouth, Laodikeia in Phoenicia	Beyrouth, Beirut	
16	43	34	Black Sea		
17	51.2	3.216667	Brugge		
18	40.988729	28.958939	Byzantium, Byzance, Bosphore	Constantinople	
19	36.53333	-6.283333	Cadix		
20	41.220392	13.575845	Caiète, Caieta, Caeatas	Gaeta	
21	38.99357	16.45752	Calabre		
22	41.8167	1.46667	Catalugna		
23	42.092341	11.787671	Centumcellae, Palace of the Hundred Chambres. It is the translator of Pliny the Younger who calls it like this, but the « hundred chambres » could also mean the numerous caves in this area, rather than a palace	Civitavecchia, and its Torre del Lazzaretto and its Torre del Bicchiere	
24	38.429380	26.041350	Chios	Isle of Chios	
25	42.52667	3.081389	Collioure		
26	39.585390	2.998611	Columba, Balearis Maior	Mallorca	
27	36.964036	21.940778	Corone, Korone, ex Epeia	Petalidi, inside the Messenia gulf	
28	35.2	25	Crete	Candia	
29	39.083333,	17.11667	Crotone		
30	37.934105	21.160558	Cyllène, Kytlene (port of the Eleans)	Glarentza	Clarence/Glarentza
31	33.5122	36.29838	Damas		
32	40.814375	0.521016	Dertosa	Tortosa, on R Ebre	
33	33.8	10.85	Djerba		
34	51.03833	2.3775	Dune		
35	41.303976	19.469128	Dyrrachio, Dyrrachium, ex Epidamnos, with possible ancient lighthouse	Durrës, Durres	Durazzo
36	51.5	-0.116667	England		
37	42.934297	10.559041	Falesia, Porto Falese	Piombino	
38	35.11667	33.95	Famagouste		
39	35.2	24.13333	Fraschia/Sfacchia		
40	44.41111	8.932778	Genoa		
41	37.17806	-3.600833	Granada		
42	35.177762	-1.661114	Gypsaria, Artisiga, port of the Ifrénids	Honaïne	Honein
	36.881760	7.747497	Hippone, Hippo Regius	Annaba, on the left bank of R Wadi Seybouse, nearly 1	

OCR



Noise  
Rotation  
Grid

Data extraction



Cleaning data

One line = one ship  
Type  
Convoy  
Patron  
Captain  
Stopovers  
Numbers of days  
Departure  
Arrival

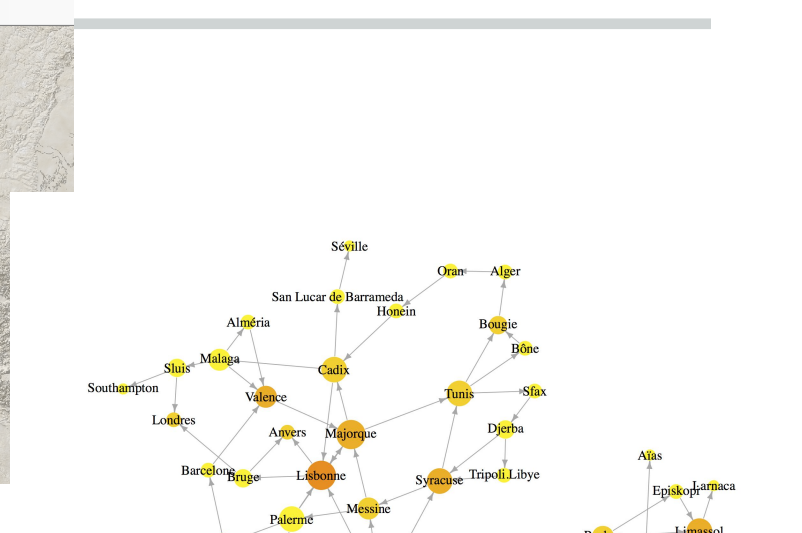
Geolocalisation  
Name disambiguation



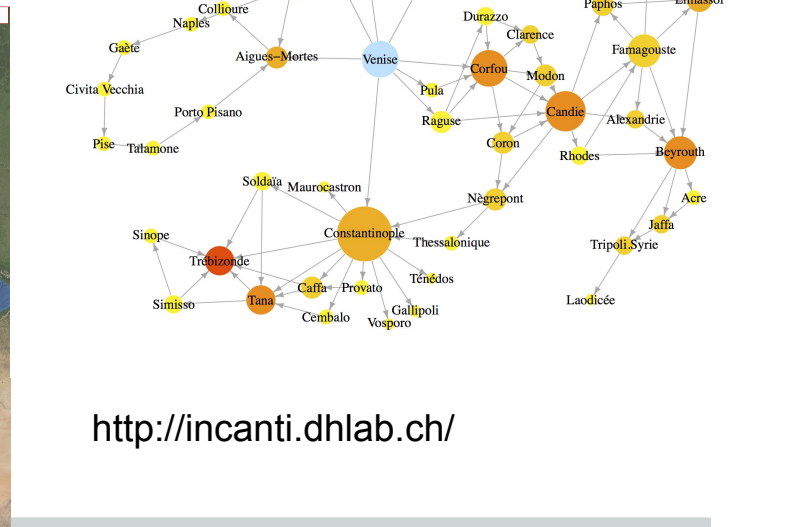
Visualization



R  
GIS



- Nombre de galées identifiées entre 1301 - 1453: **1924**



# From OCR'd to edge list

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- Segmentation (starting & ending points)
  - Attributes (year, days, ships)
-

```
> head(all.edges[,-6], 25)
```

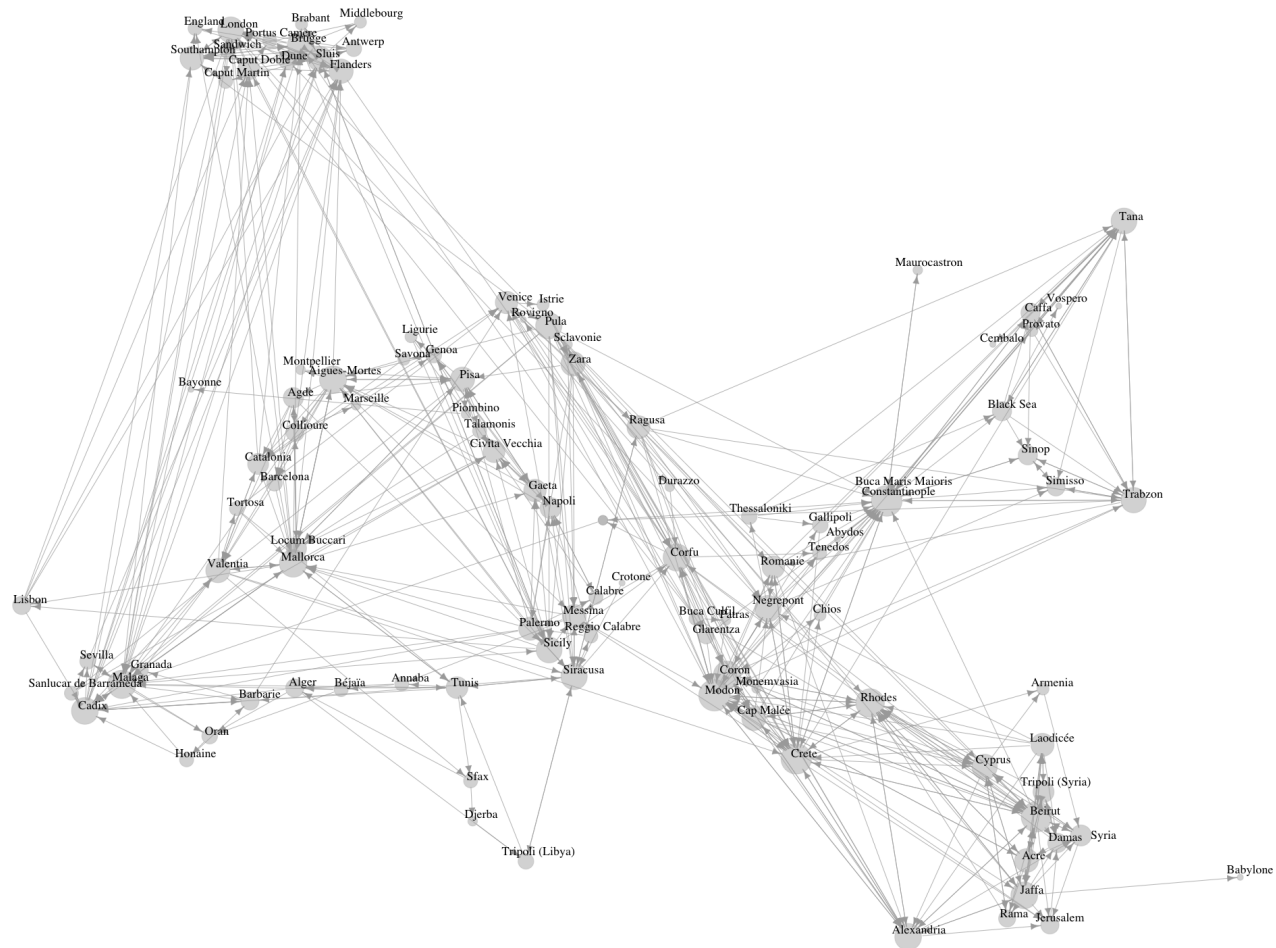
	start	end	year	ships	days
1	Venice	Ragusa	1283	1	1
2	Ragusa	Constantinople	1283	1	1
3	Venice	Crete	1300	2	1
4	Venice	Romanie	1301	4	1
5	Venice	Modon	1301	3	1
6	Modon	Crete	1301	3	1
7	Crete	Cyprus	1301	3	5
8	Cyprus	Armenia	1301	3	8
9	Venice	Buca.Culfil	1301	10	1
10	Buca.Culfil	Patras	1301	10	1
11	Patras	Modon	1301	10	1
12	Modon	Crete	1301	10	1
13	Crete	Cyprus	1301	10	1
14	Cyprus	Armenia	1301	10	1
15	Venice	Crete	1301	5	1
16	Crete	Armenia	1301	5	1
17	Venice	Buca.Culfil	1301	1	1
18	Buca.Culfil	Patras	1301	1	1
19	Venice	Crete	1301	1	1
20	Crete	Alexandrie	1301	1	1



# Global network

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- Overview encoding 170 years of navigation



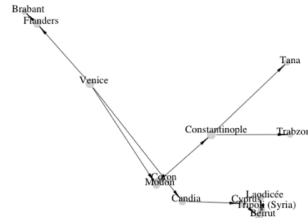
# Temporal networks

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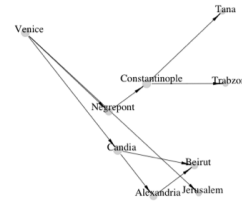
- Year-by-year, dynamic view
  - Sparse but can be stacked
  - Meaning of measures
-

# Temporal networks (Chioggia war)

1375



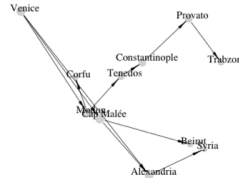
1376



1377



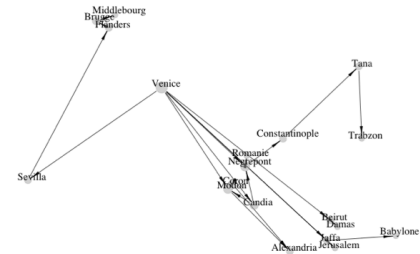
1382



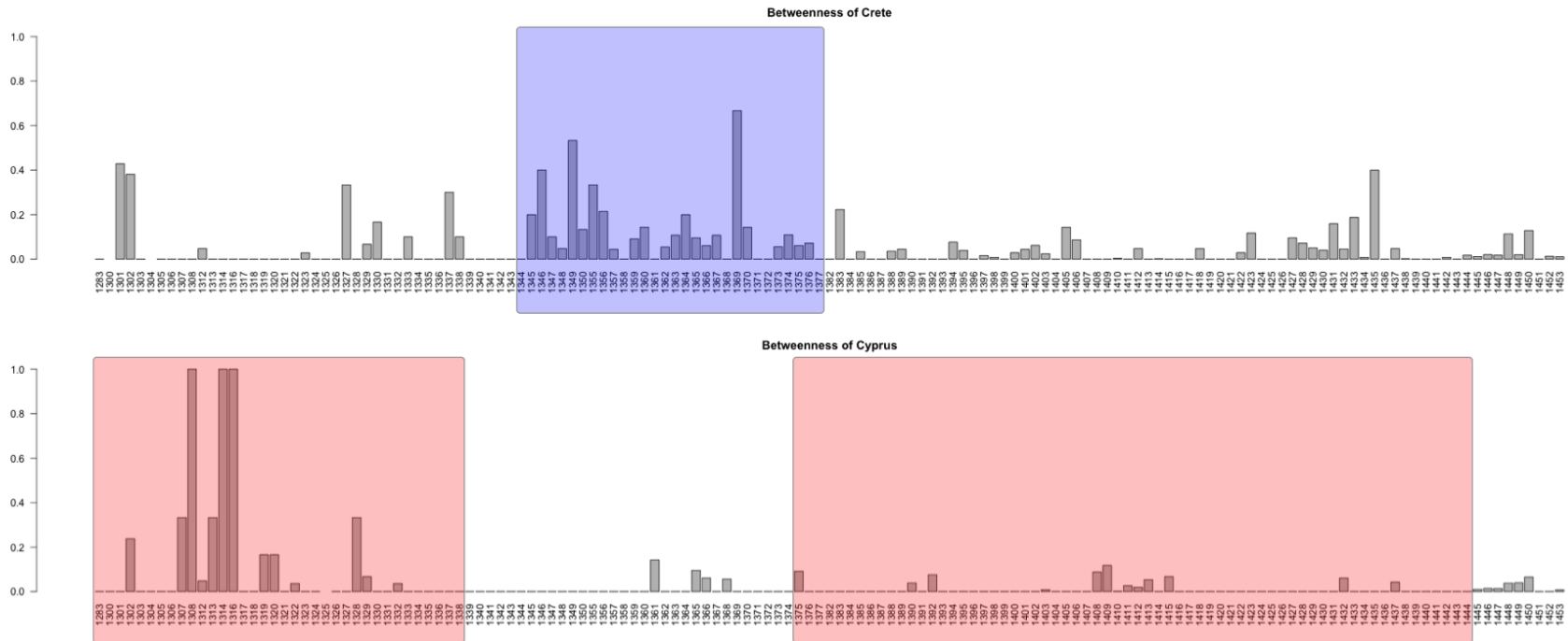
1383



1384



# e.g. Analysis of centrality



# Conclusion

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These visualisations are only the different possibilities known and reported for one specific navigation type.

There is a phenomenal quantity of geographical information which is not or little taken into account.

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# Conclusion

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The digital format allows us to go beyond the narration.

The historical cartography and mathematical modelling push towards the explanation of the historical processes.

It leads to standardize and translate these processes under an algorithmic format.

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