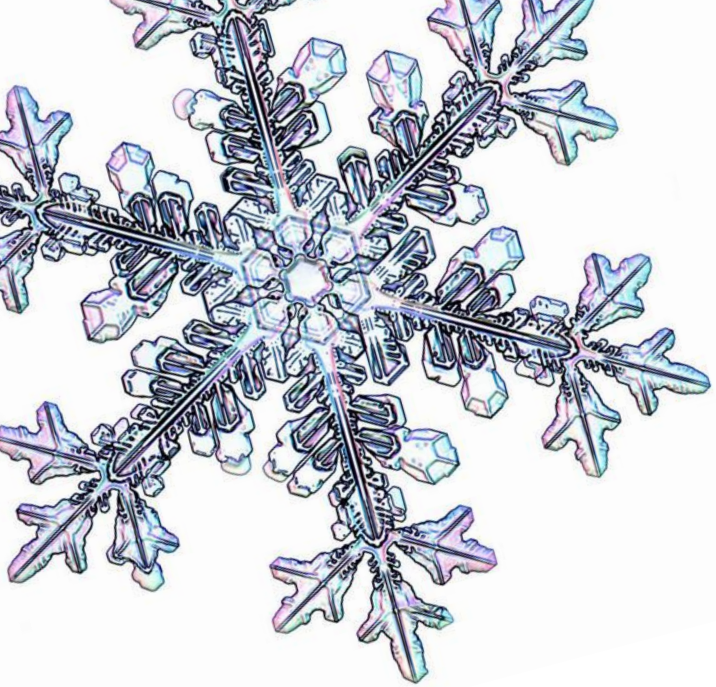
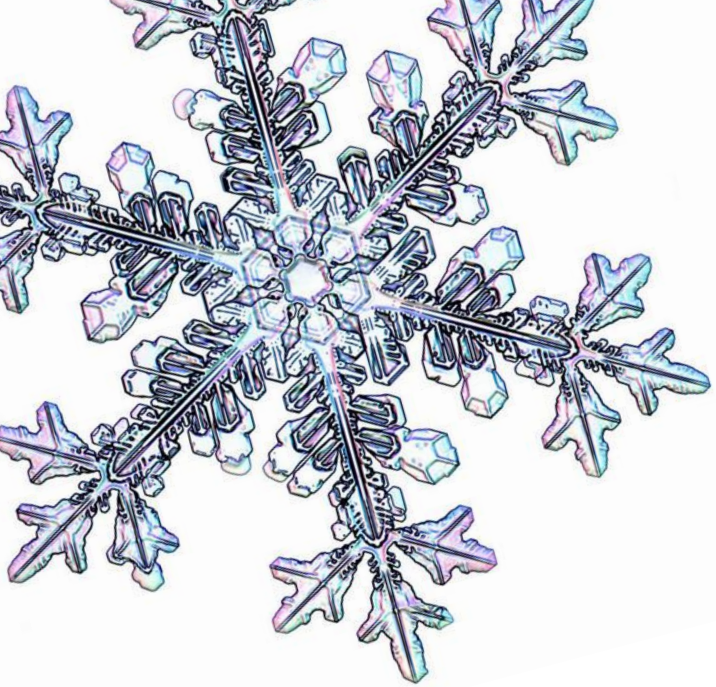


The **influence** of mountain-ridge scale snow precipitation processes on the local snow distribution

Franziska Gerber (gerberf@slf.ch), Rebecca Mott, Michael Lehning

IUGG, July 12, 2019



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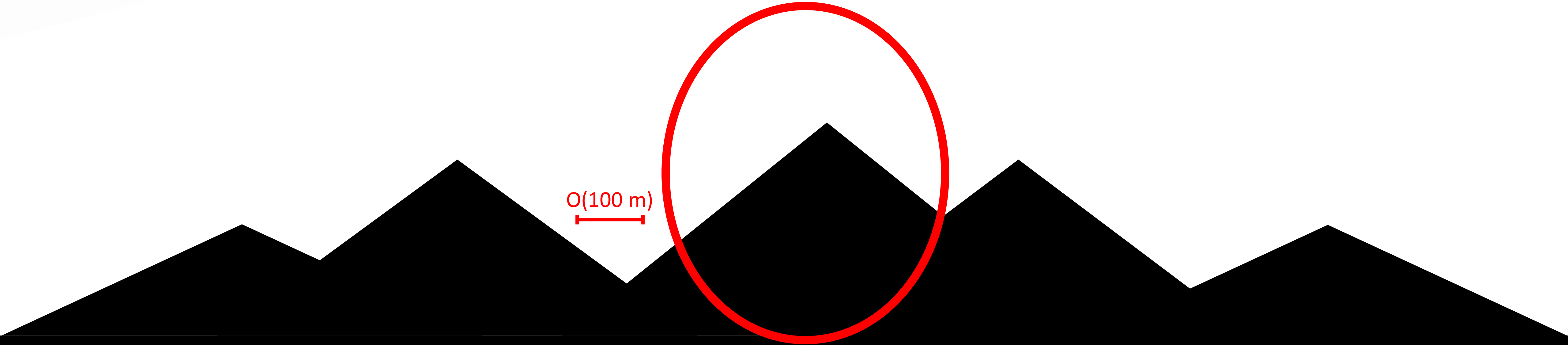

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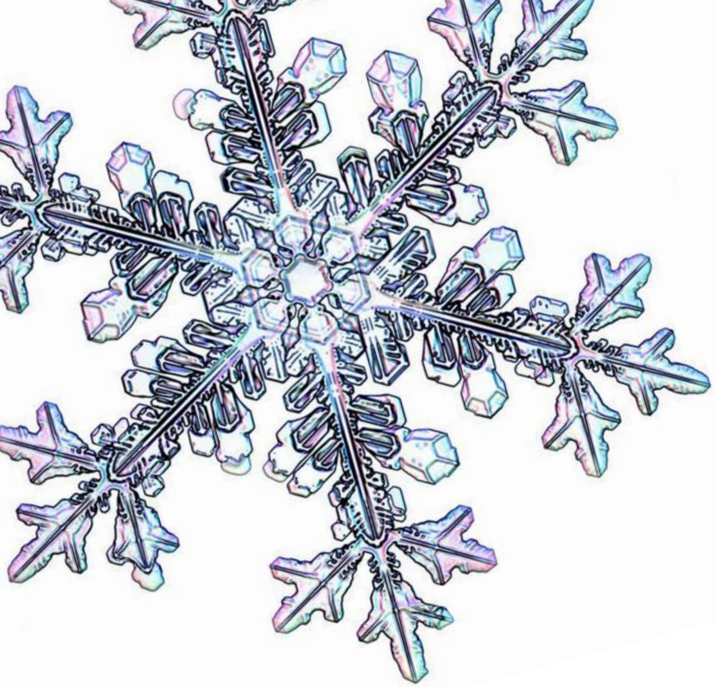

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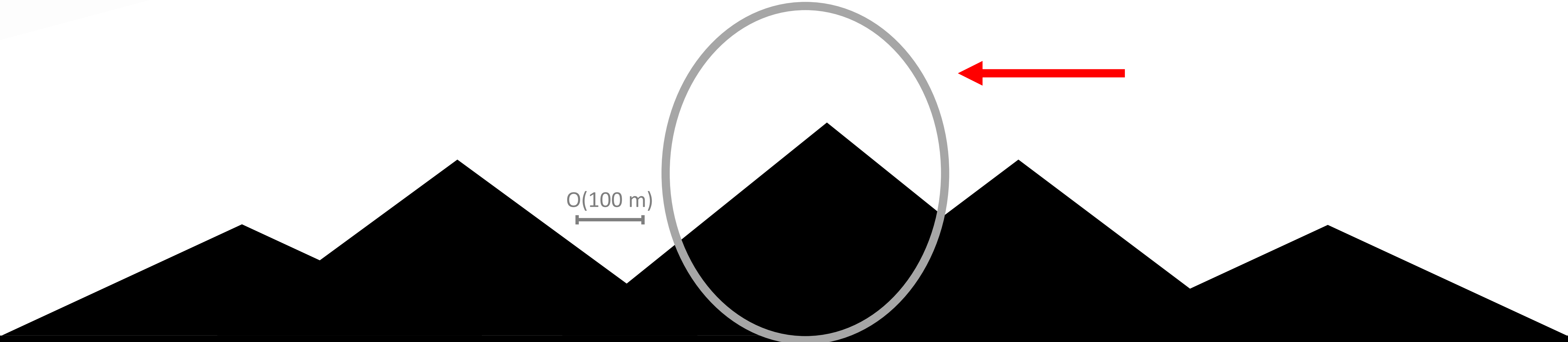

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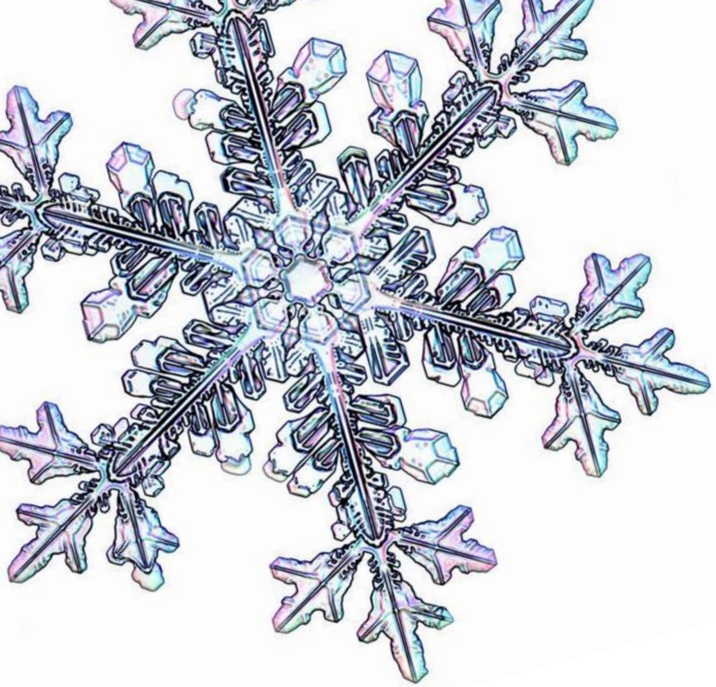

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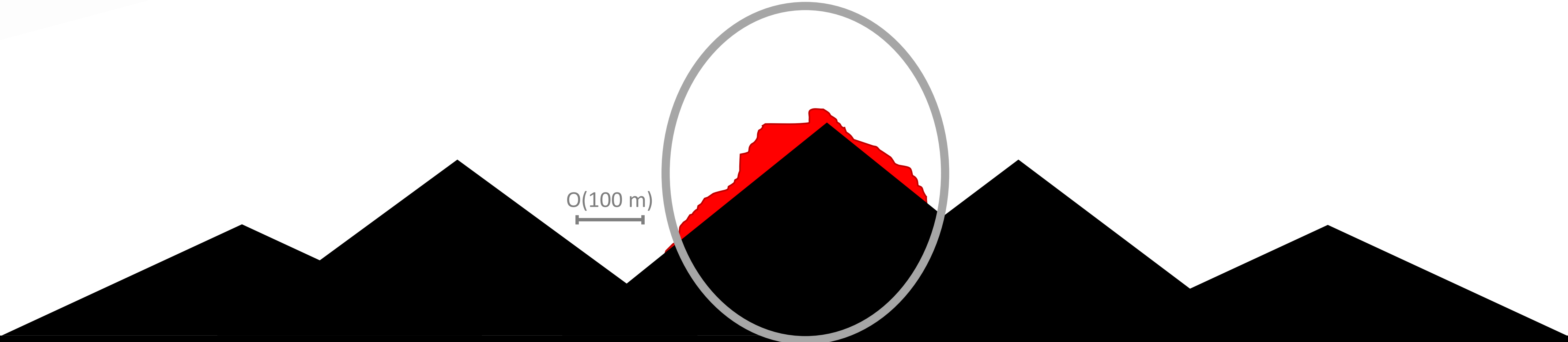

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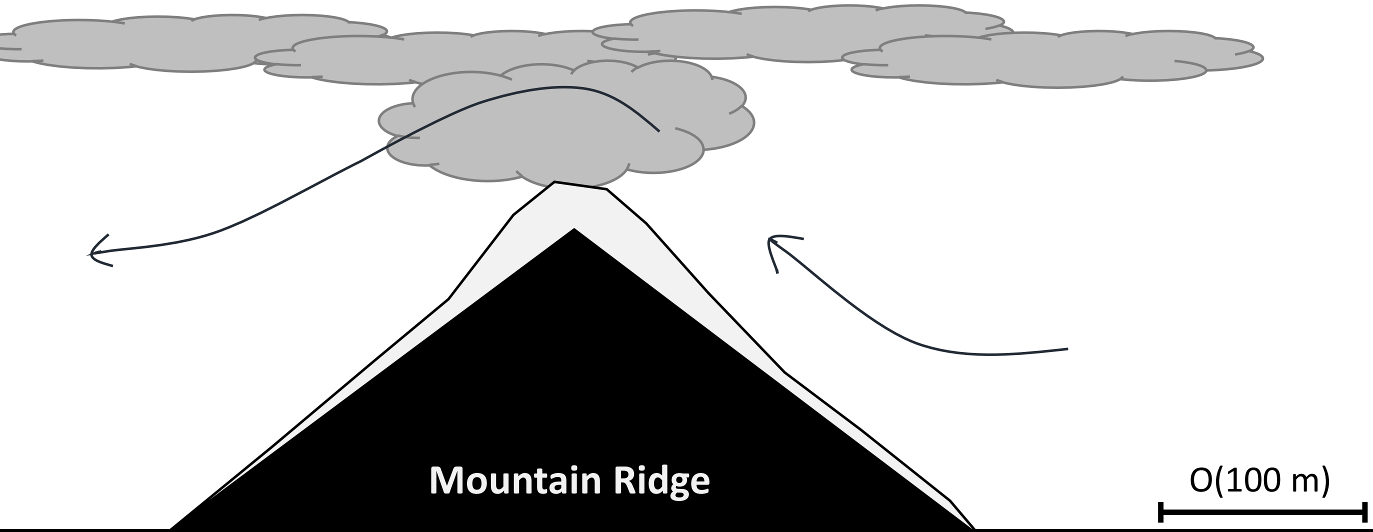
Mountain ridge-scale snow precipitation processes

- Small-scale/Local orographic enhancement

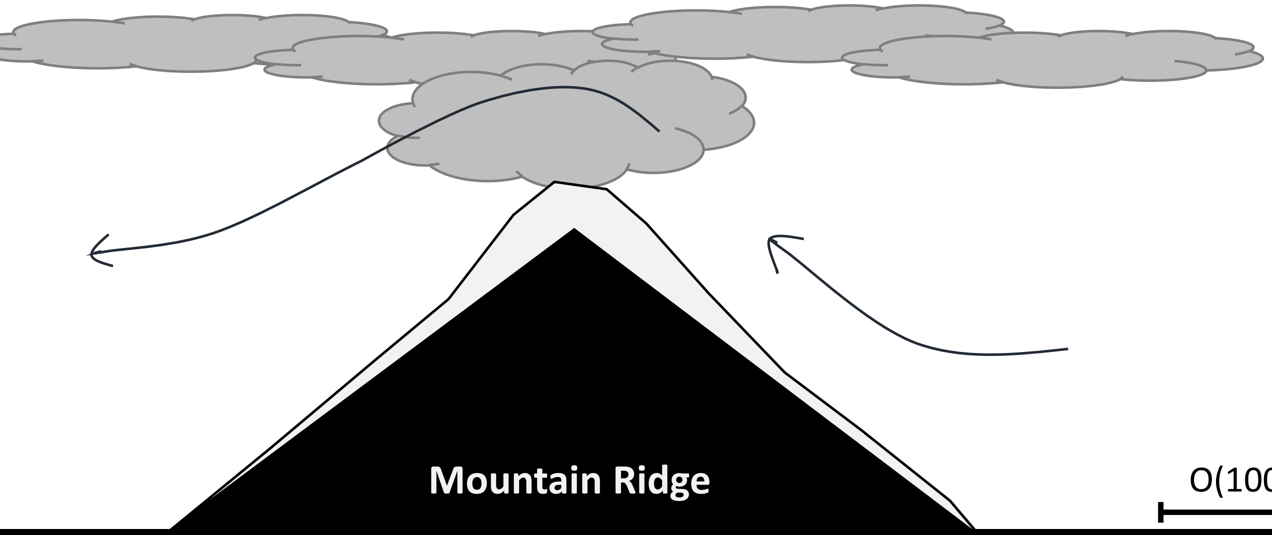
e.g. Seeder-Feeder mechanism



Mountain ridge-scale snow precipitation processes

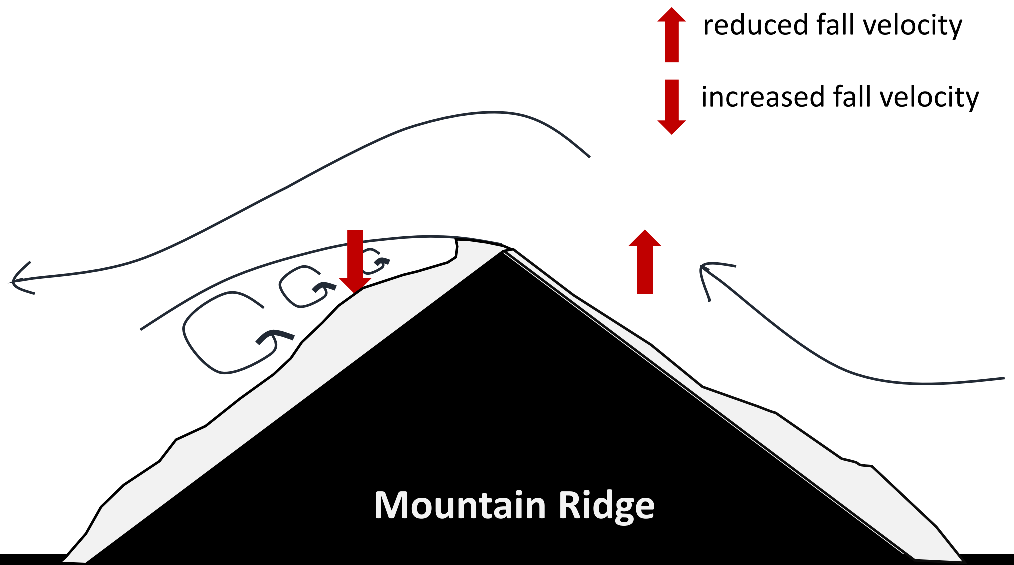
- Small-scale/Local orographic enhancement
- Preferential deposition

e.g. Seeder-Feeder mechanism



O(100 m)

e.g. Preferential deposition

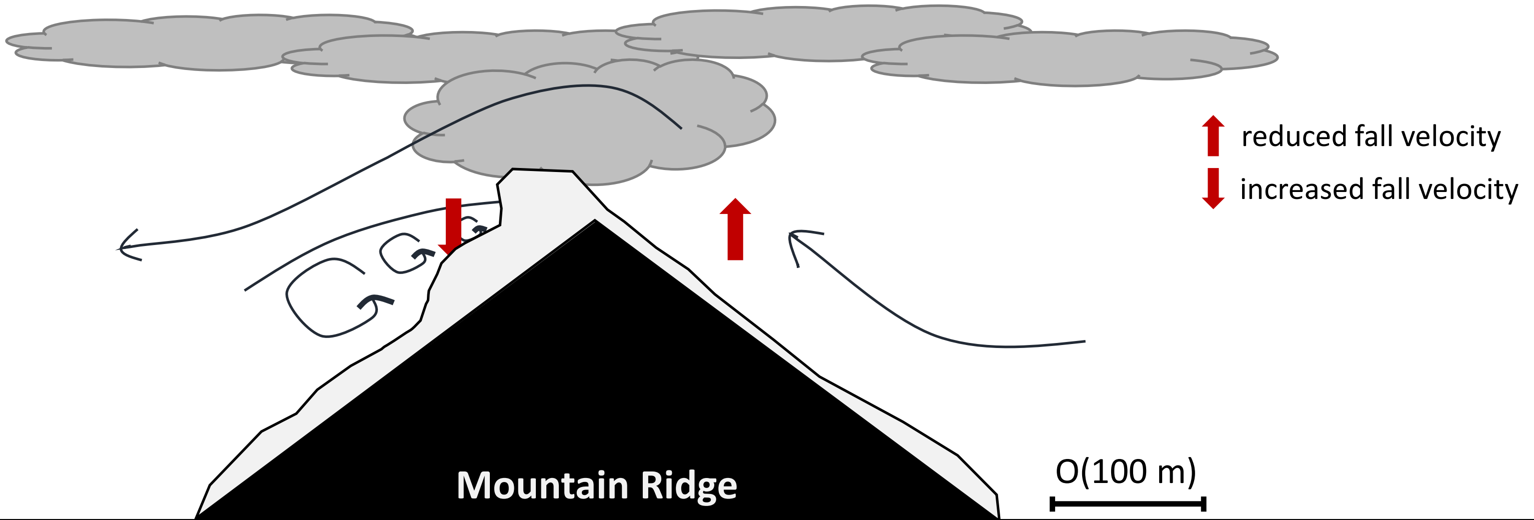


Franziska Gerber (gerberf@slf.ch)

Mountain ridge-scale snow precipitation processes

- Small-scale/Local orographic enhancement
- Preferential deposition

Combined effect – Asymmetric snow distribution across mountain ridge



Motivation

Tourism | Avalanches | Ecology | Hydropower | Drinking water

Motivation

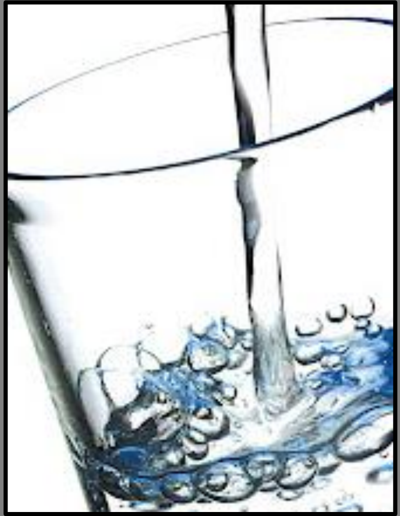
Tourism

Avalanches

Ecology

Hydropower

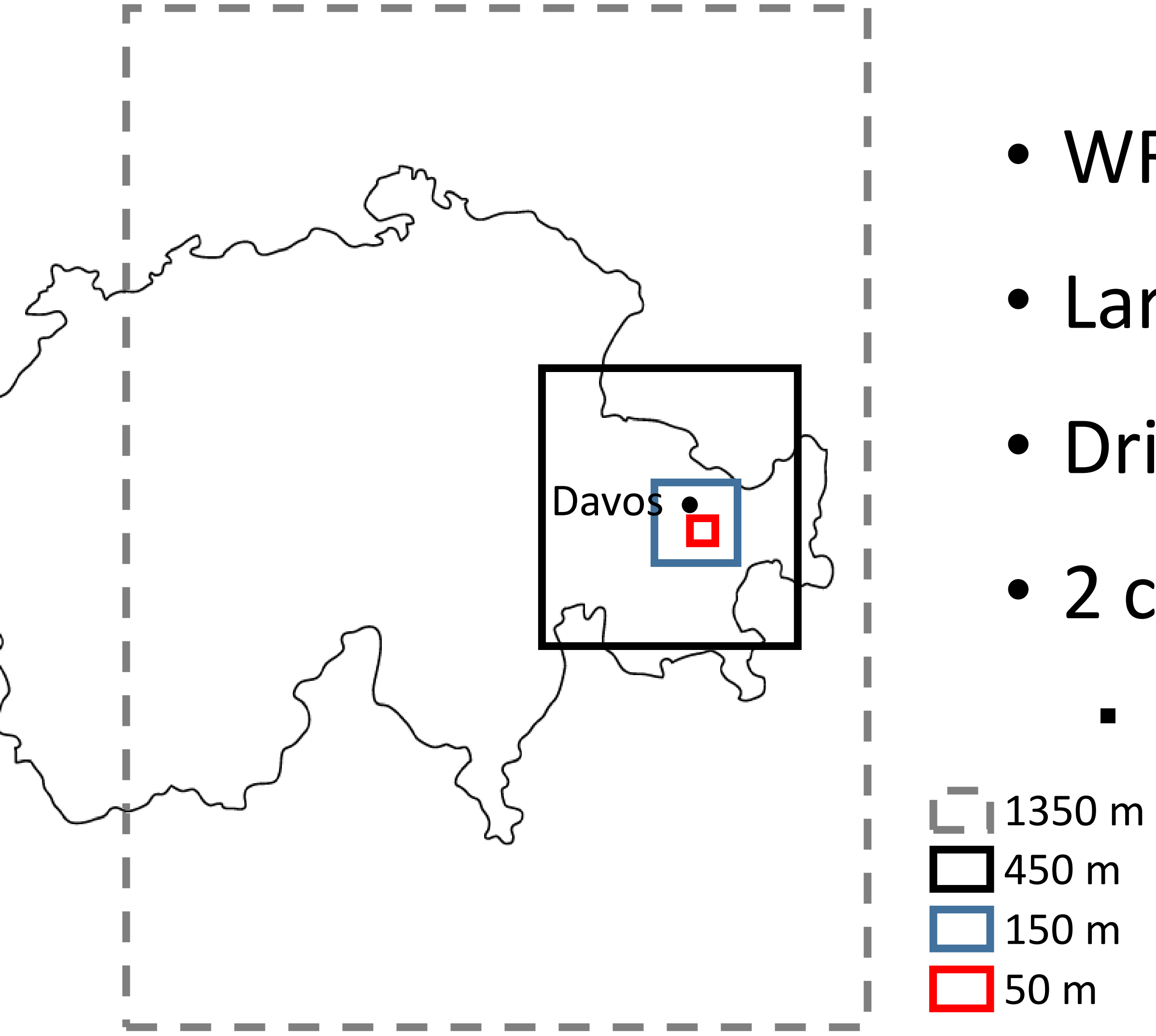
Drinking water



Model validation

Climate Change → Modified atmospheric circulation? → Modified snow accumulation?

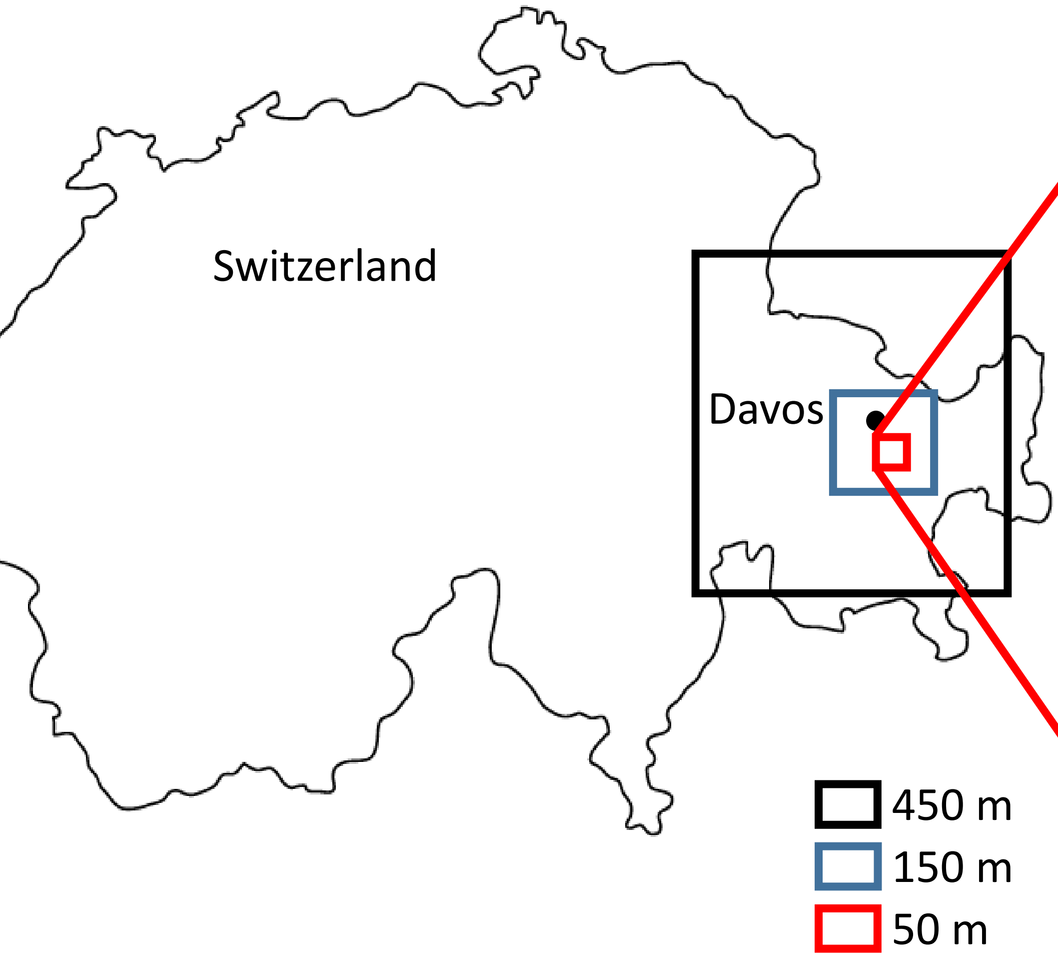
Simulation setup



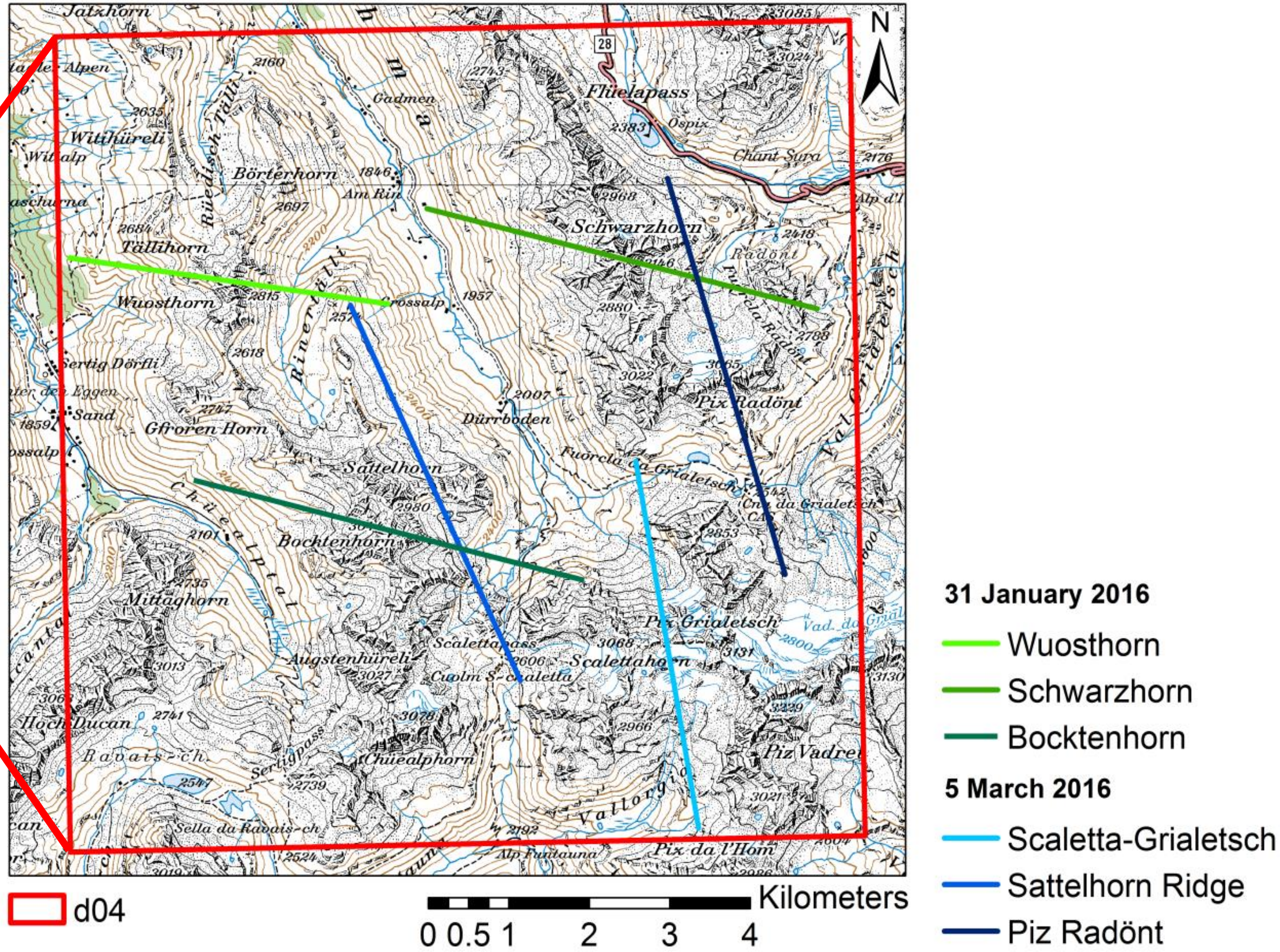
- WRF at very high resolution
- Large eddy simulation (LES) mode
- Driven by COSMO-2 (2 km resolution)
- 2 case studies
  - January 31/March 5, 2016

WRF: Weather Research and Forecasting model
COSMO: Consortium for Small-Scale Modeling

Study area



Switzerland
Davos
450 m
150 m
50 m



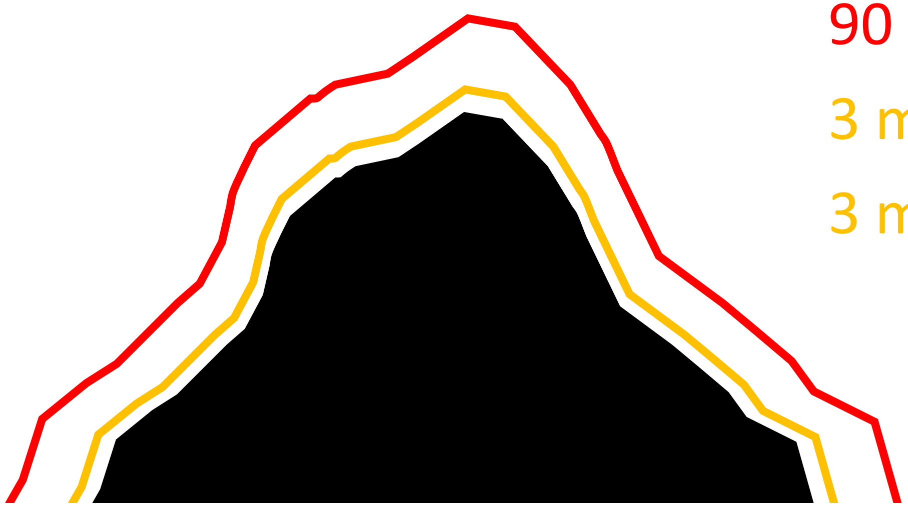
N
d04
Kilometers
0 0.5 1 2 3 4
31 January 2016
Wuosthorn
Schwarzhorn
Bocktenhorn
5 March 2016
Scaletta-Grialetsch
Sattelhorn Ridge
Piz Radönt

Process distinction

Assumption:

- Cloud dynamics → negligible in the lowest 90 m ag
- Preferential deposition → dominant in lowest 90 m ag

Process distinction

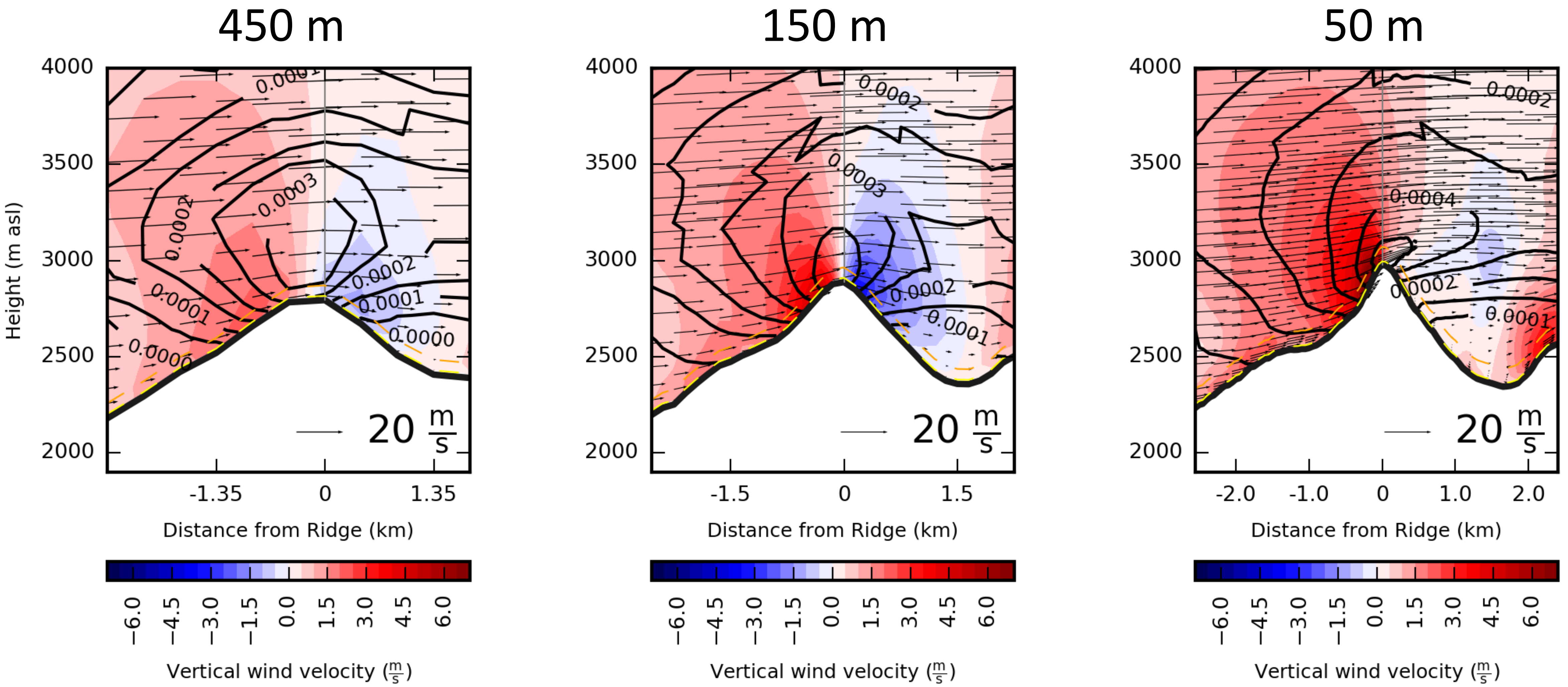


90 m ag:	Cloud dynamics + mean advection
3 m ag:	All effects
3 m ag – 90 m ag:	Near-surface preferential deposition

m ag: meter above ground

Assumption:
- Cloud dynamics → negligible in the lowest 90 m ag
- Preferential deposition → dominant in lowest 90 m ag

Resolution dependency



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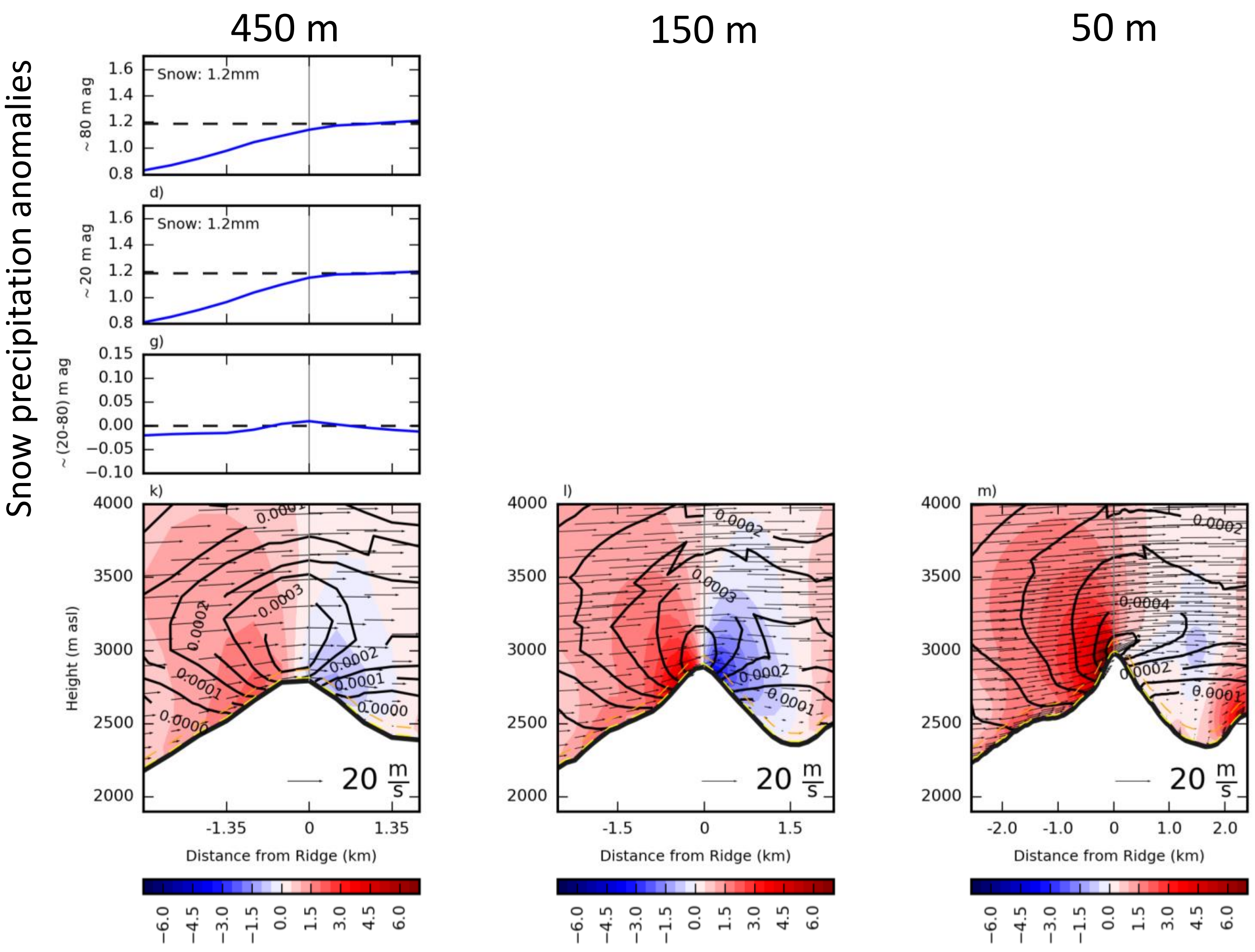


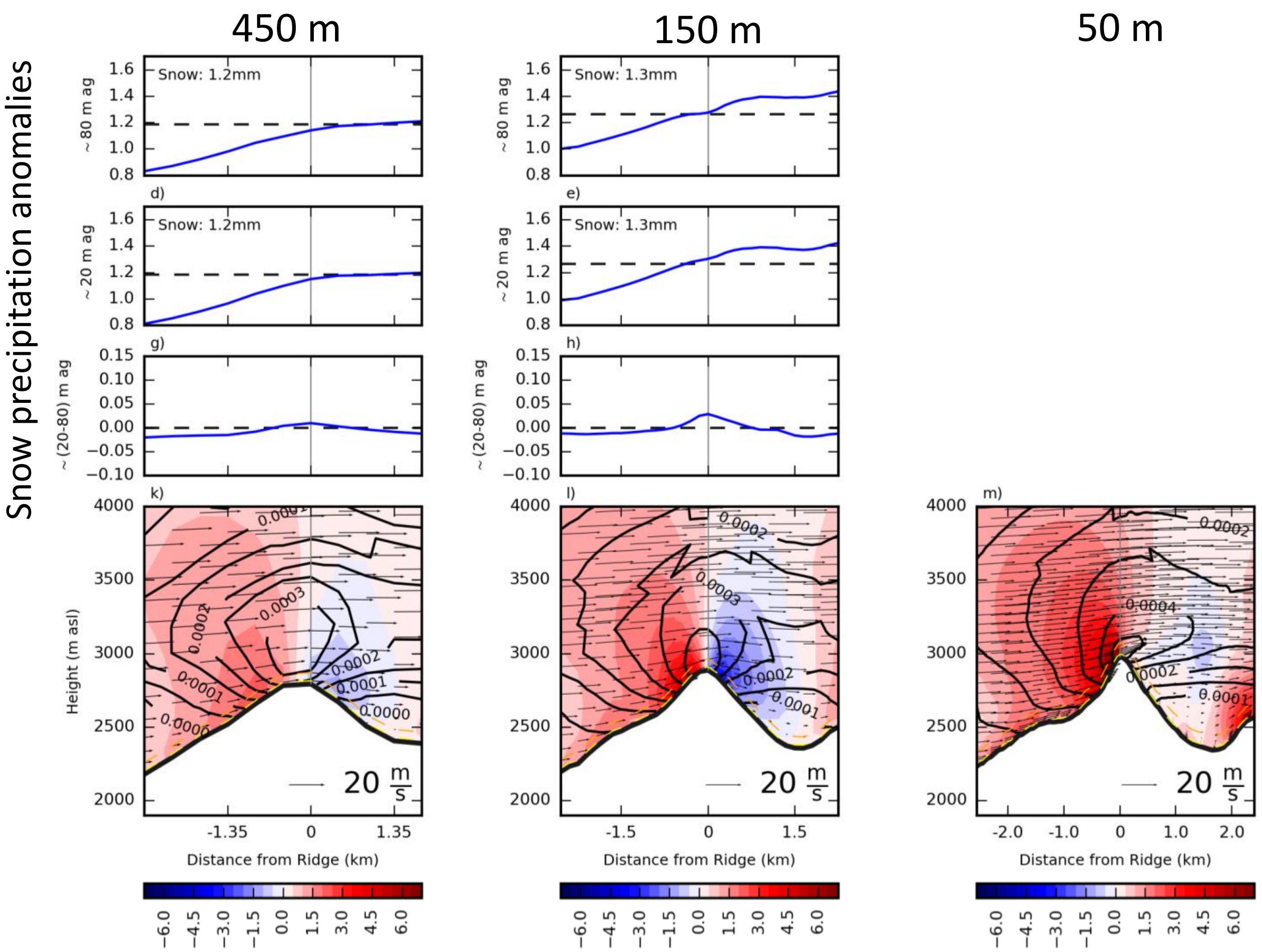
"Cloud dynamics
+ mean advection"

"All effects"

"Near-surface
Preferential deposition"

Vertical velocity (m/s)

Resolution dependency



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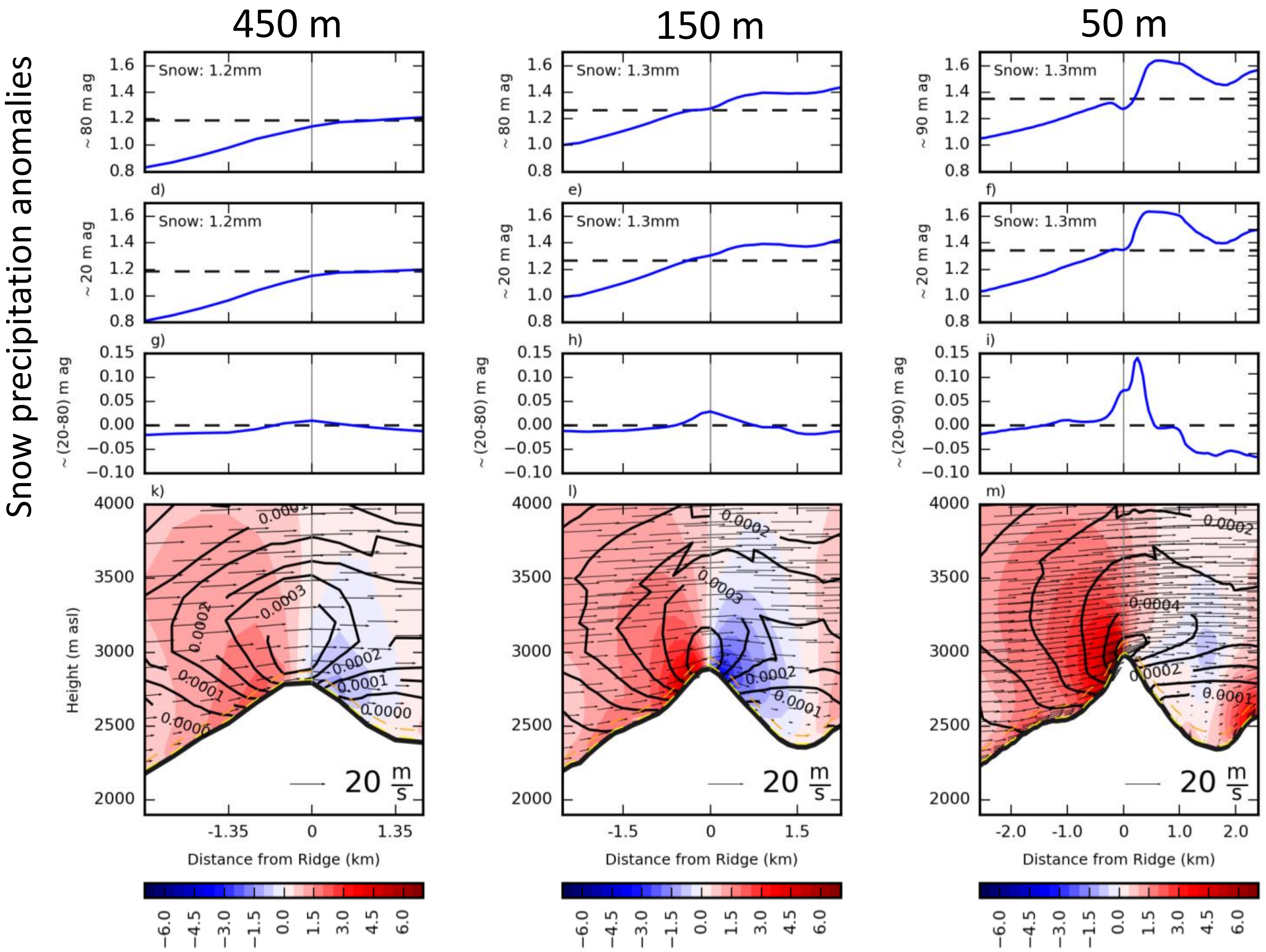
Vertical velocity (m/s)

Resolution dependency



"Cloud dynamics + mean advection"

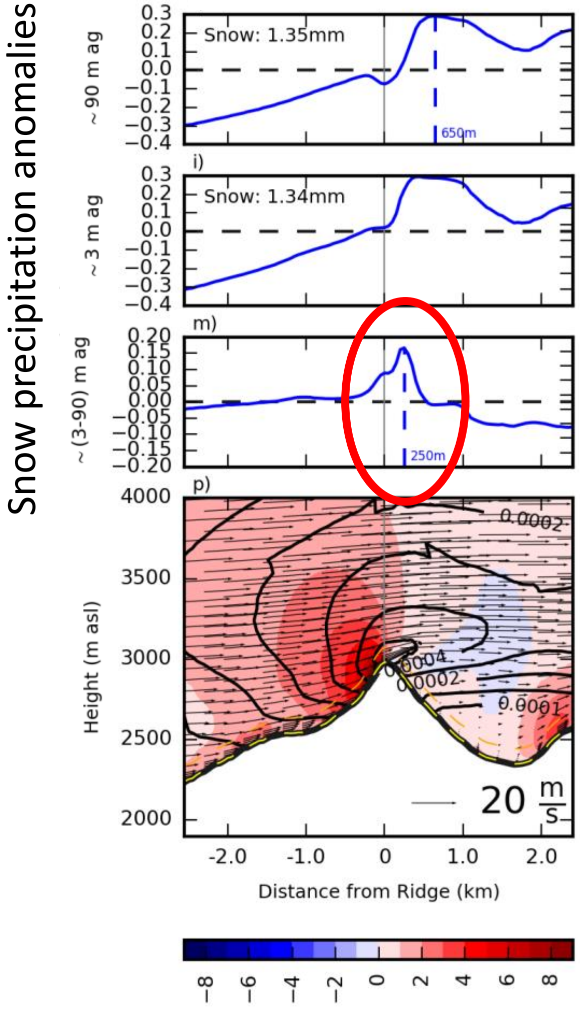
"All effects"

"Near-surface Preferential deposition"

Vertical velocity (m/s)

Processes

31 January 2016

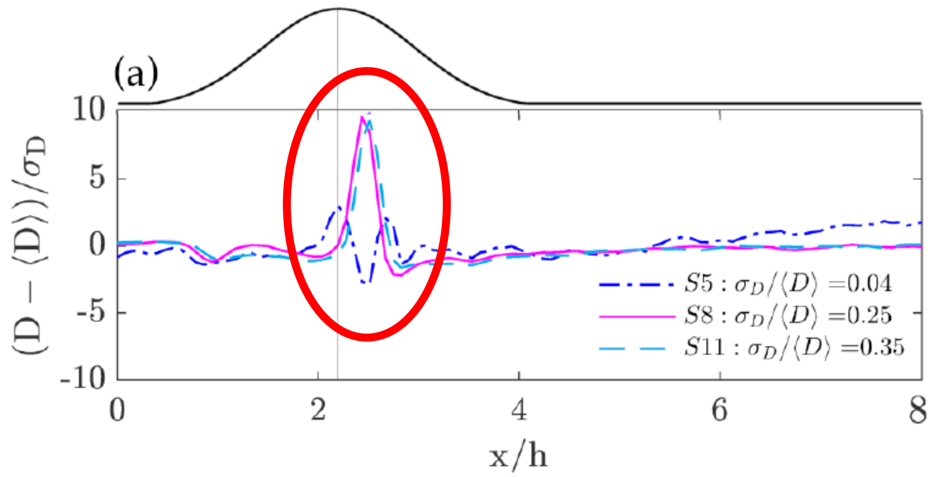


"Cloud dynamics
+ mean advection"

"All effects"

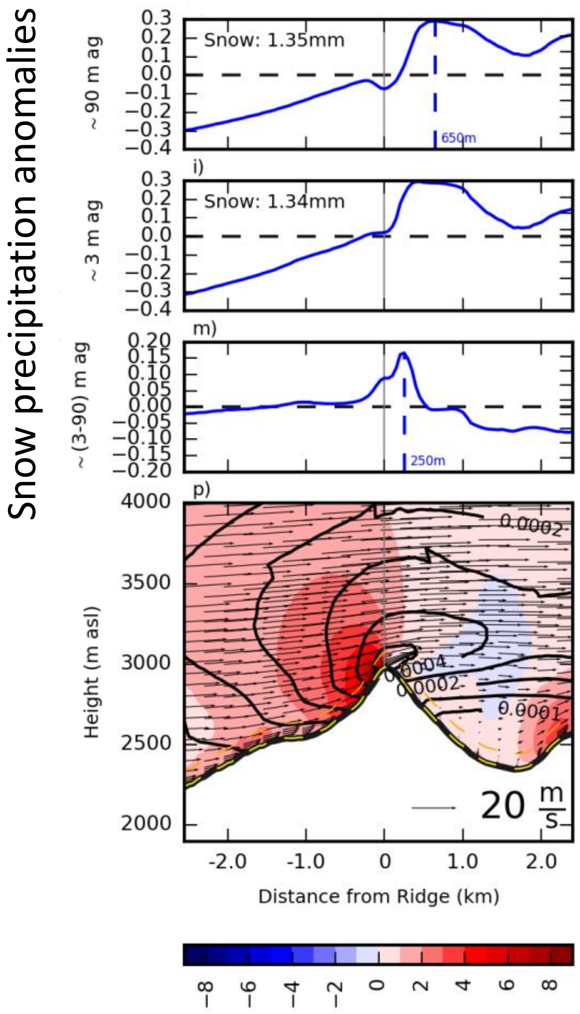
"Near-surface
Preferential deposition"

Round with inertia
Dendritic with inertia
Inertialess



Comola et al., 2019: Preferential deposition of snow and dust over hills: governing processes and relevant scales, JGR Atmospheres, accepted.

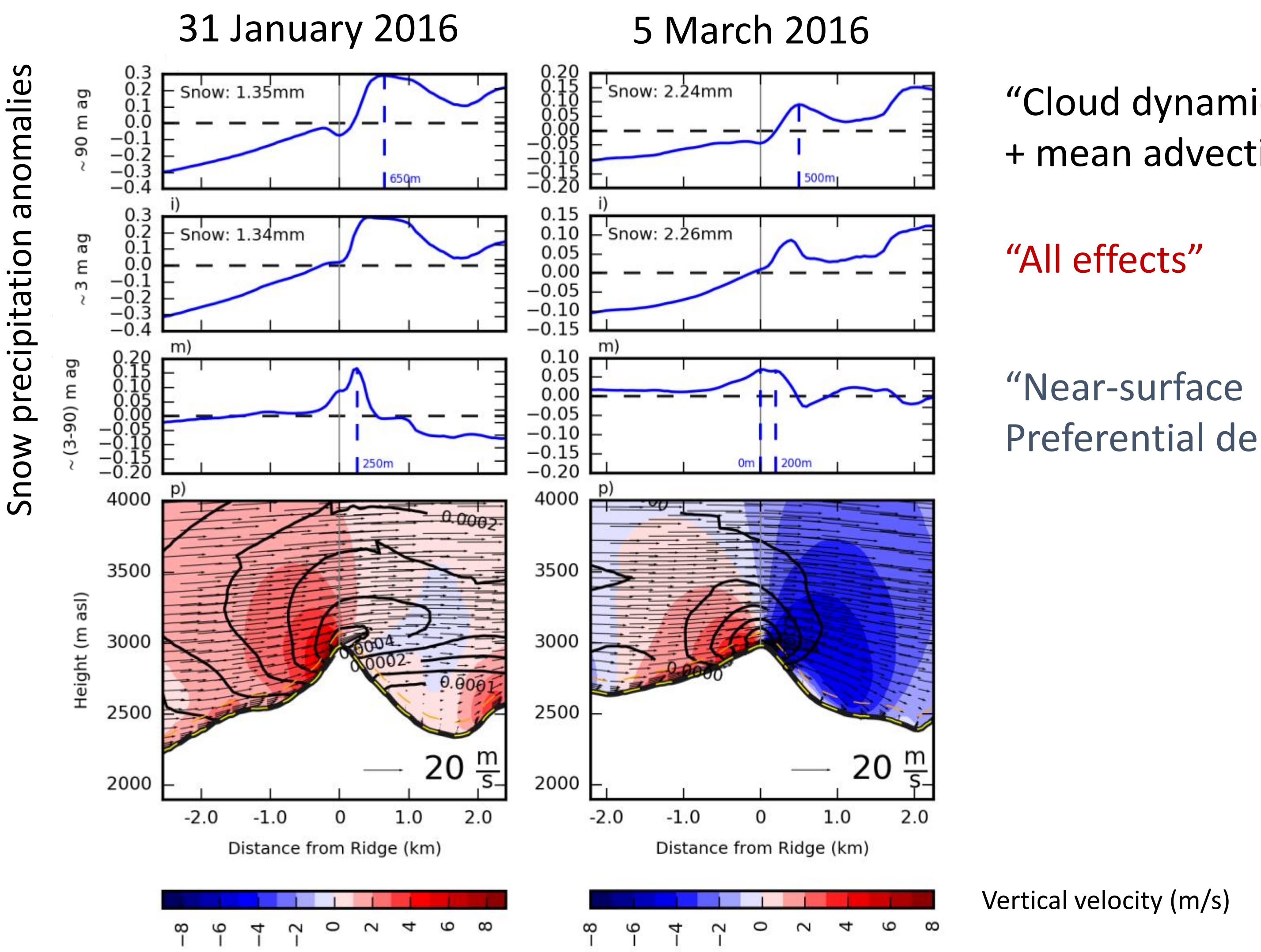
31 January 2016



31 January 2016

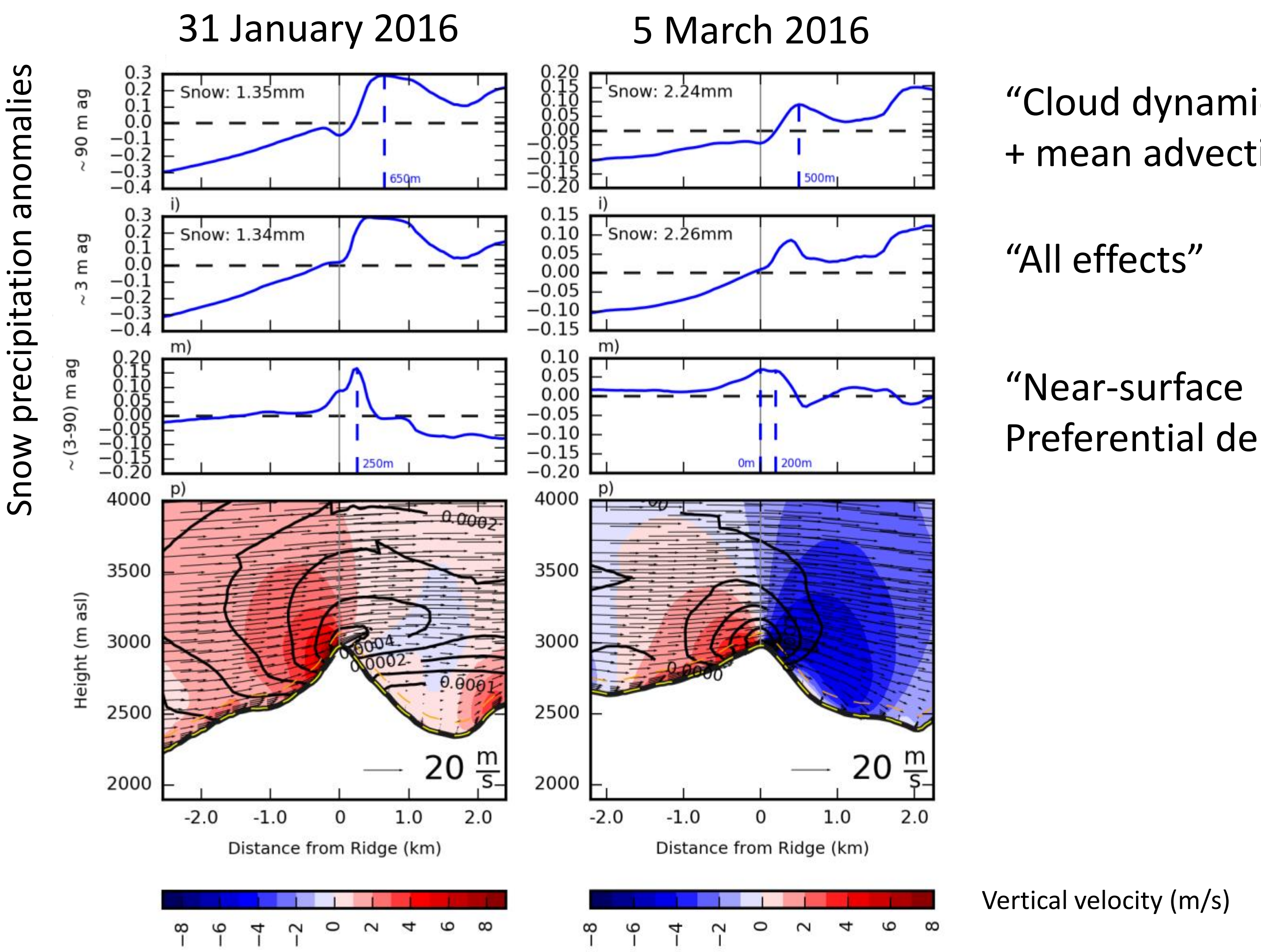
"Cloud dynamics + mean advection"	**14-21 %**
"All effects"	**26-28 %**
"Near-surface Preferential deposition"	**8-12 %**

Processes



	31 January 2016	5 March 2016
"Cloud dynamics + mean advection"	**14-21 %**	**0.5-7 %**
"All effects"	**26-28 %**	**-2.2-6 %**
"Near-surface Preferential deposition"	**8-12 %**	**3%**

Processes



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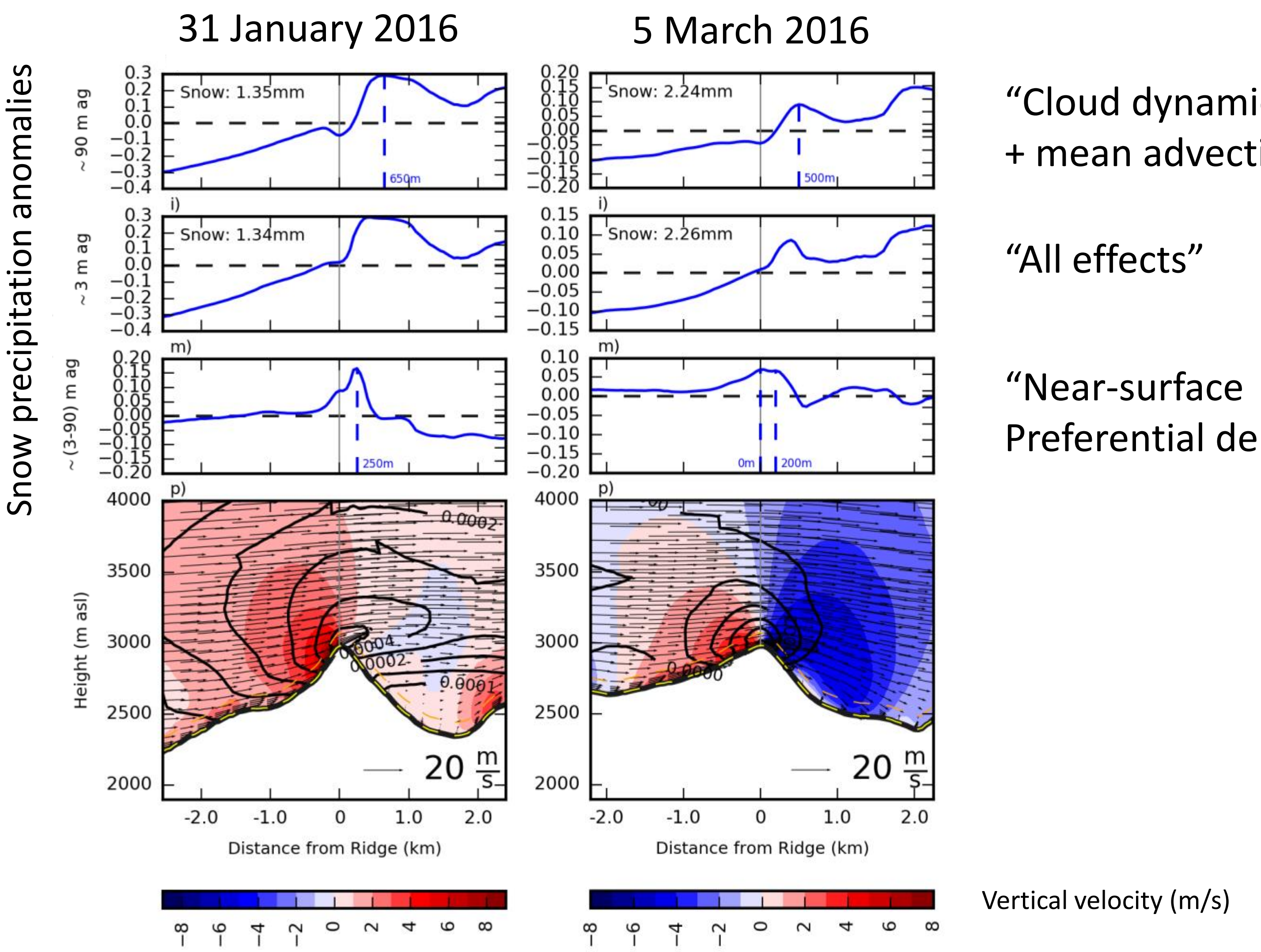
This case study

Drier atmosphere = weaker effect

Processes



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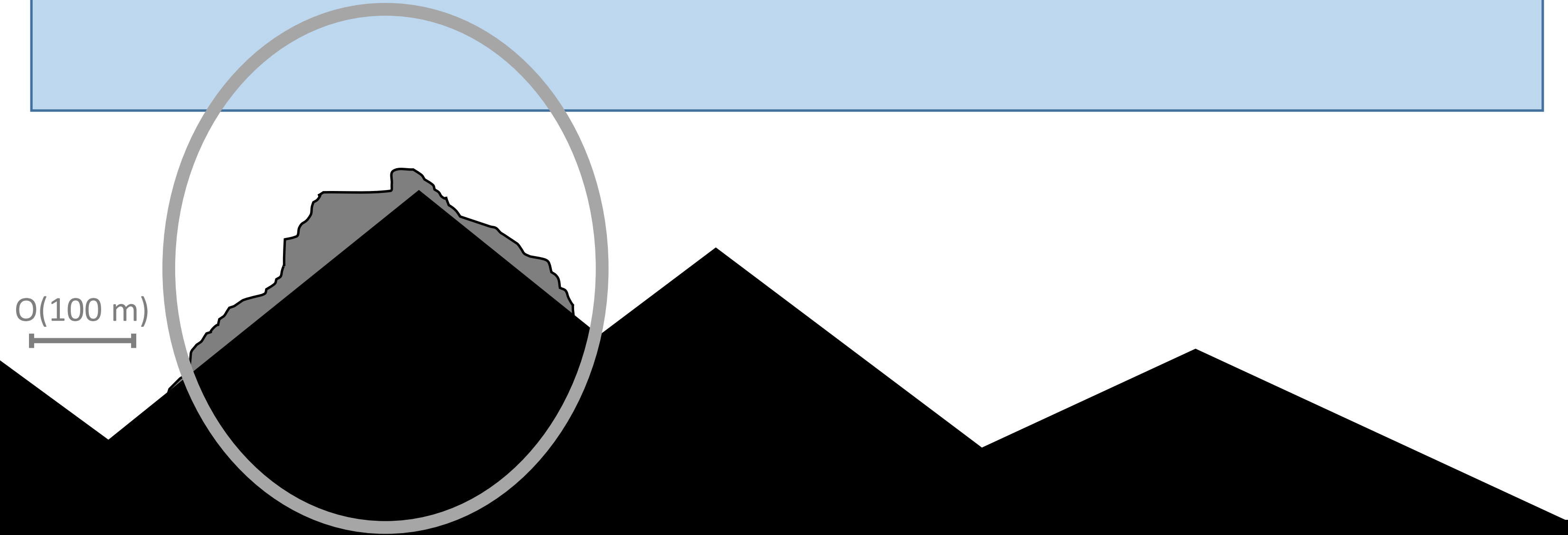
This case study
Drier atmosphere = weaker effect

- Model validation with measurements
- Passive tracer experiment

Conclusion

Image snowflake: https://www.srf.ch/sendungen/einstein/einstein/schneeflocken-die-welt-der-himmlischen-kristalle, Kenneth Libbrecht

- **Mountain-ridge scale precipitation: ≤ 50 m res.**



Gerber, F., R. Mott, M. Lehning (2019): The Importance of Near-Surface Winter Precipitation Processes in Complex Alpine Terrain, Journal of Hydrometeorology, 30, 177–196, doi:10.1175/JHM-D-18-0055.1.

Conclusion

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- **Mountain-ridge scale precipitation: ≤ 50 m res.**
- Cloud dynamics and mean advection: O(20 %)
- Near-surface preferential deposition: O(5-10 %)

26-28 % enhanced precipitation on leeward side

(depending on the event)

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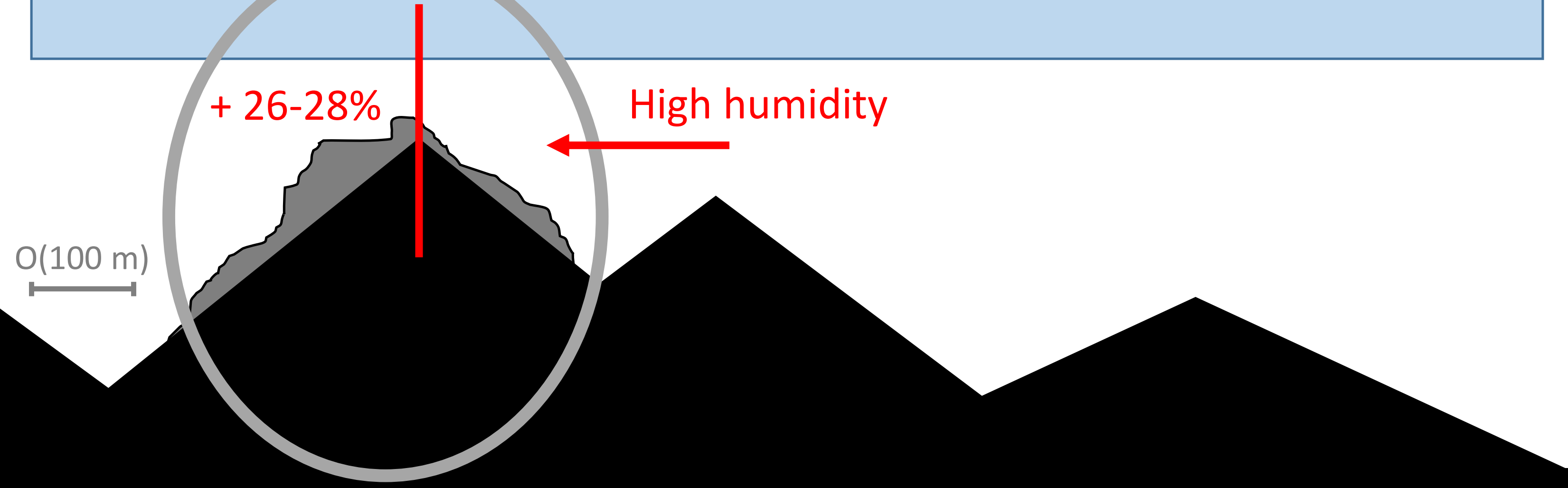

Questions?

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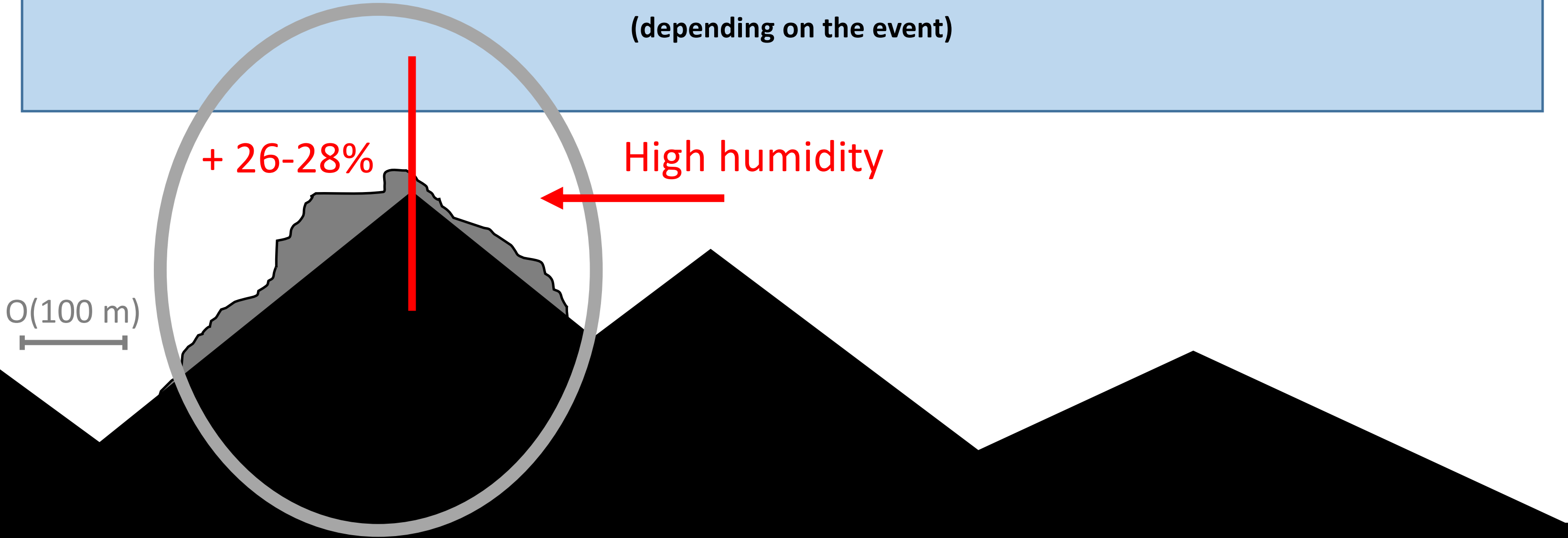

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