GPM in the Alps: a Swiss perspective

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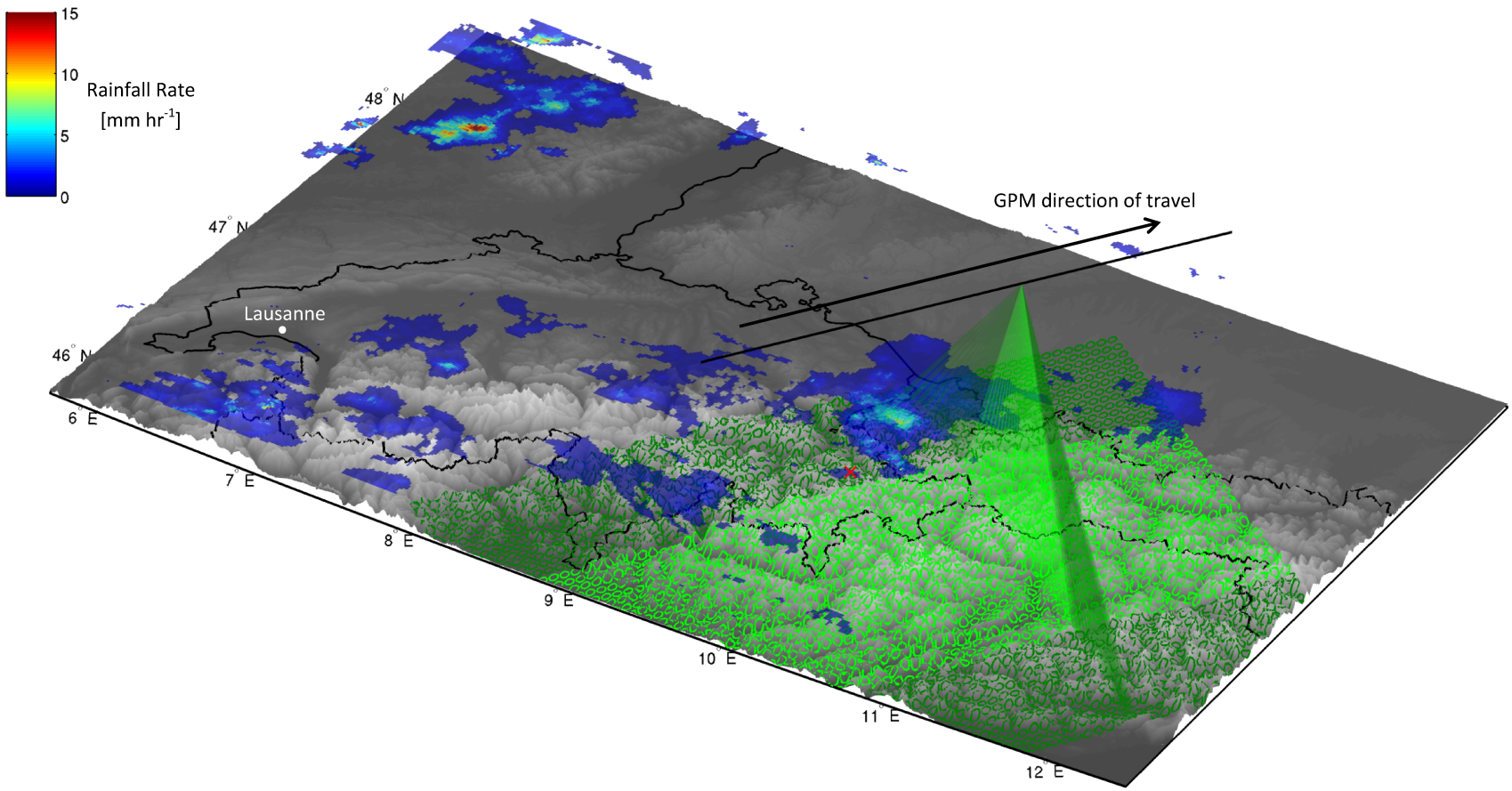
Motivation

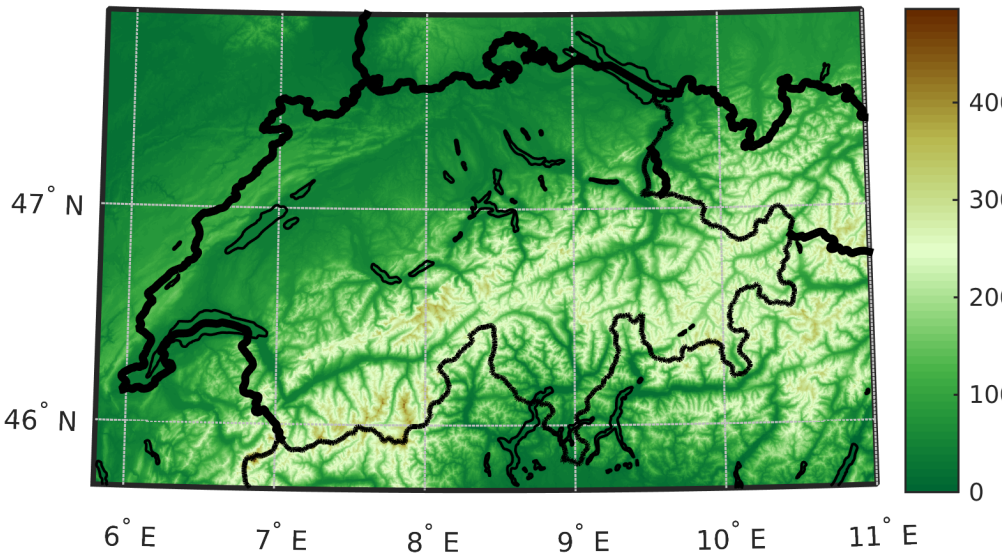
How does the GPM DPR perform in complex terrain?

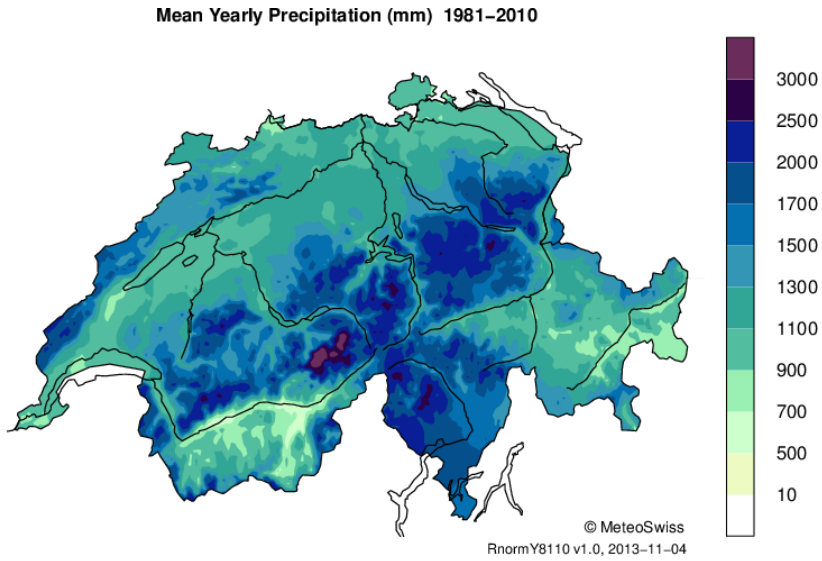


Objective

Evaluation of GPM measurements and products in the Swiss Alps

- Comparison of rain rate products from GPM and MeteoSwiss.
- Comparison of reflectivity measured by GPM and by an X-band radar.

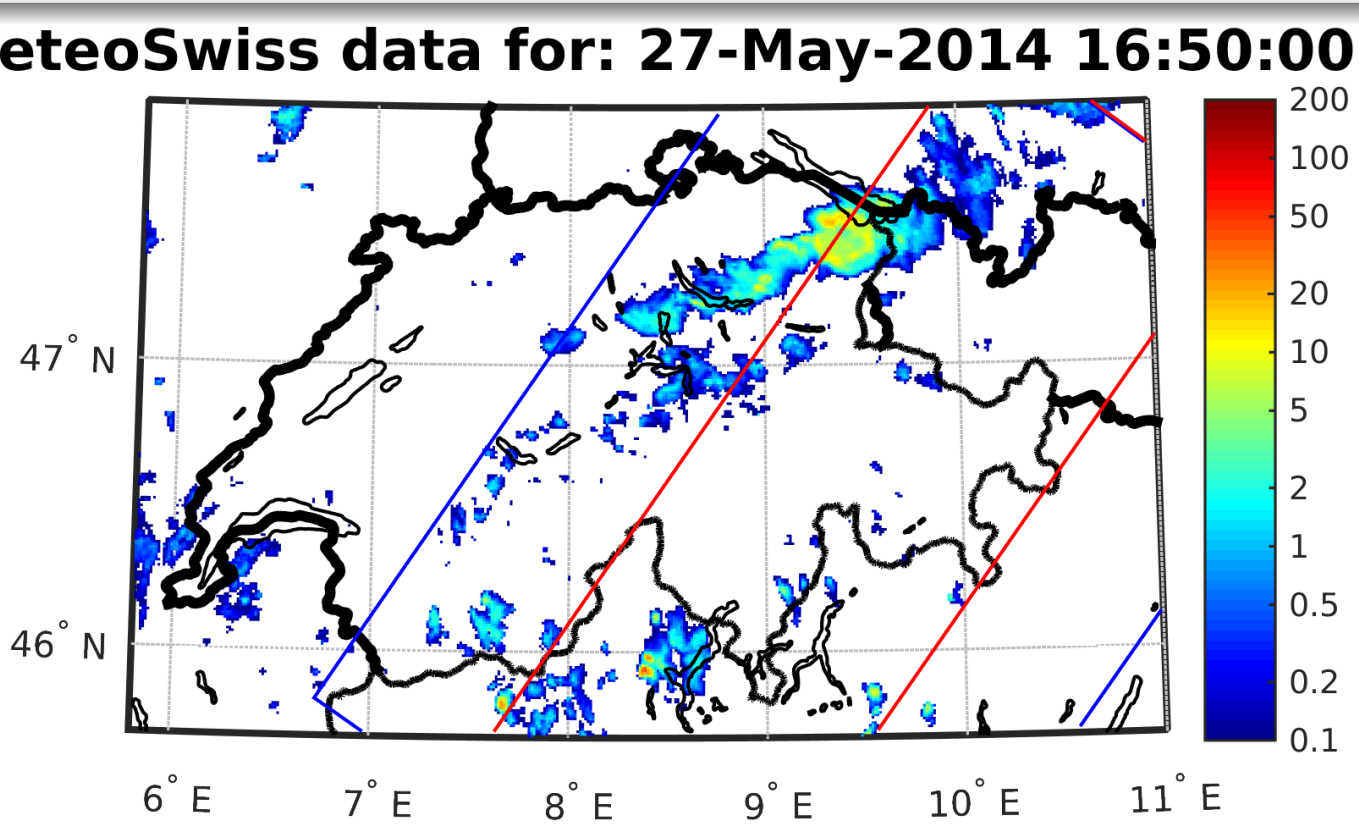




Outline

Comparison at the regional scale

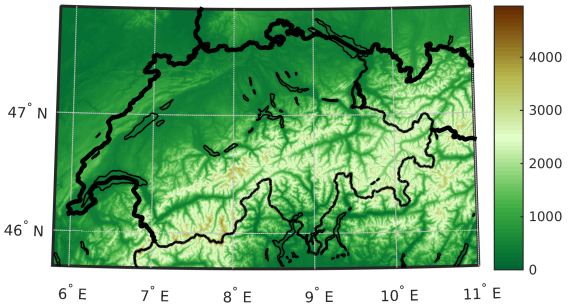
- Rain rate from 4 operational C-band radars at 1×1 km^2 - 5 min.
- Correction of clutter and vertical structure but no gauge adjustment.
- 03/2014 - 06/2015: $\sim$ 250 (rainy) overpasses over CH
  $\sim$ 300'000 pixels in NS (about half in MS and HS) of which $\sim$ 5% rainy.



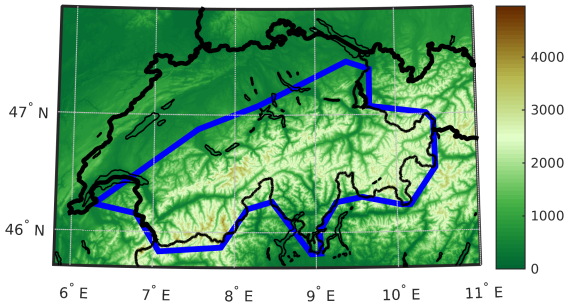
Pixel-to-pixel comparison for MS data (1)

Comparison over 3 domains

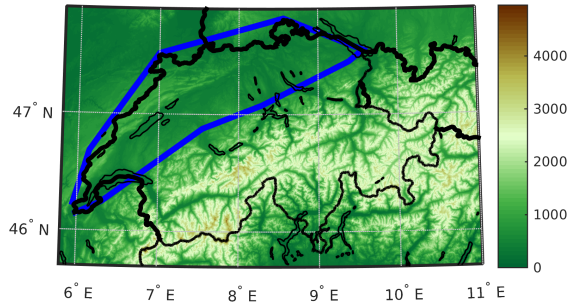
All CH



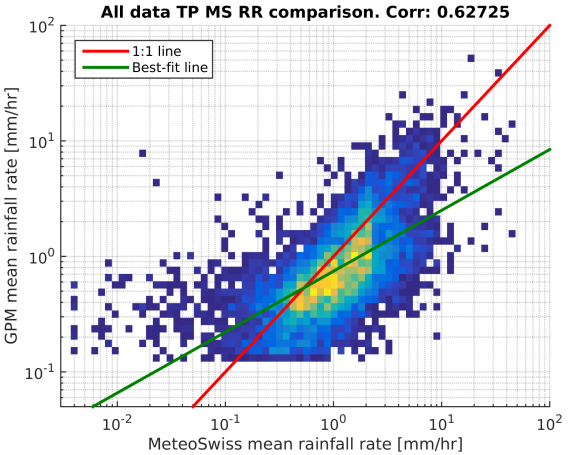
Alps

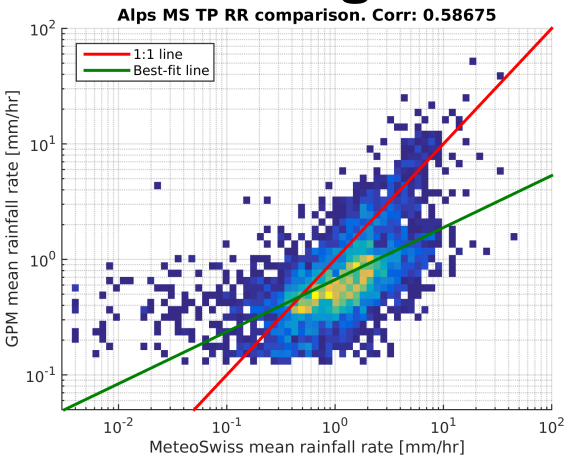


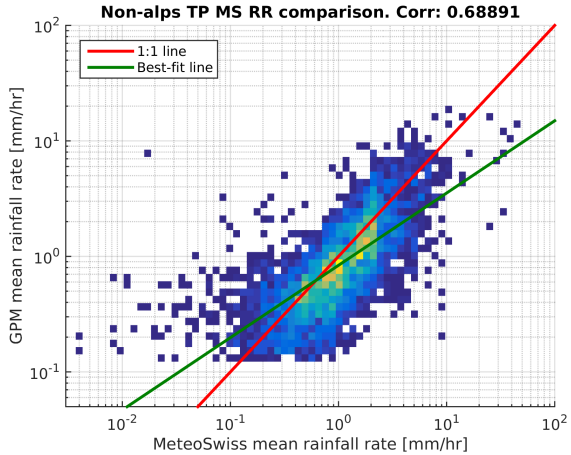
Non-Alps



All data together





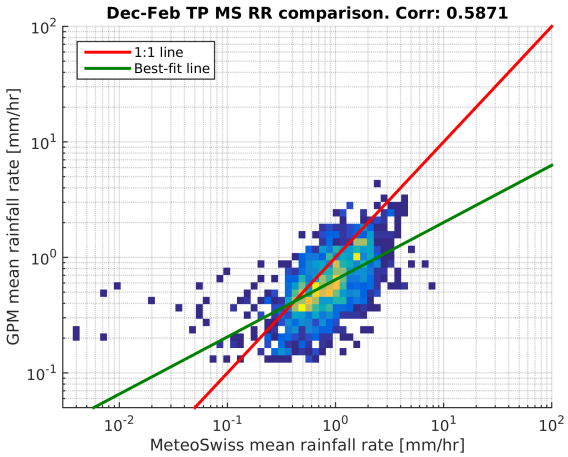


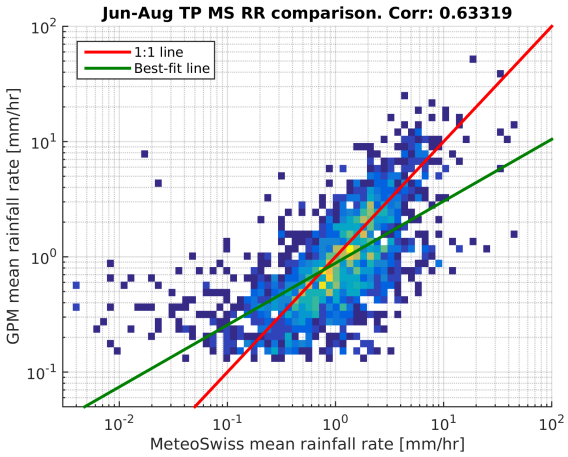
- Overall bias due to low rain rates and complex topography.
- Similar results for other scans (HS and NS).

Pixel-to-pixel comparison for MS data (2)

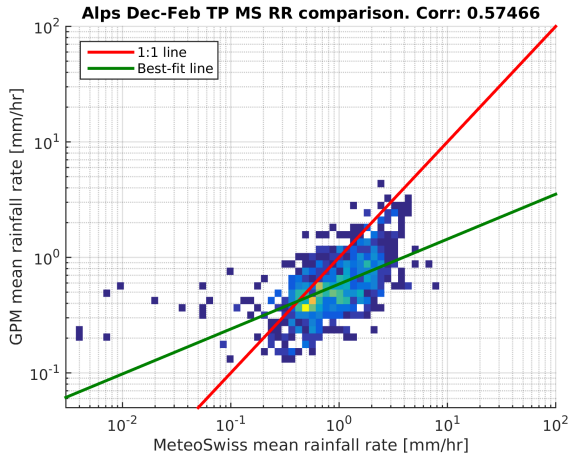
Comparison over 2 seasons: winter (DJF) and summer (JJA)

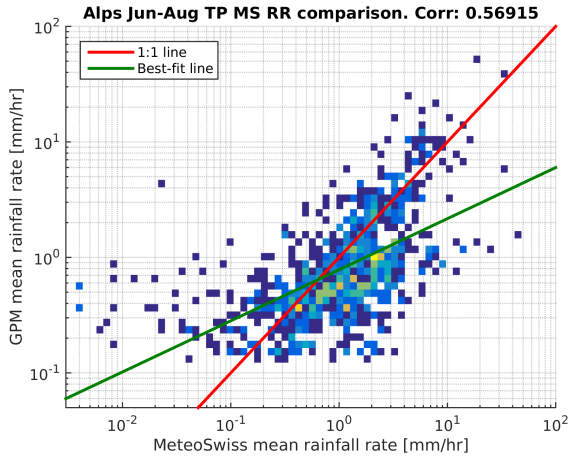
All CH



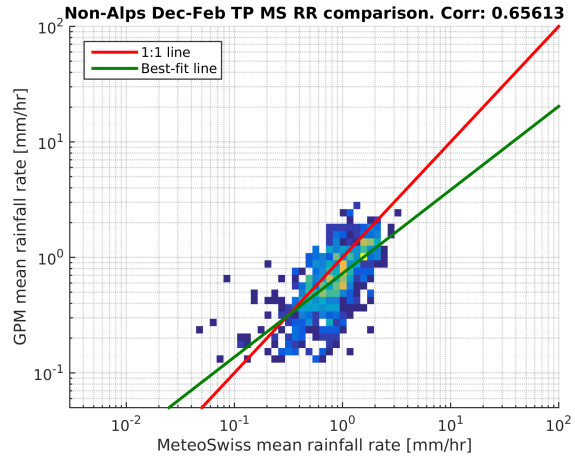


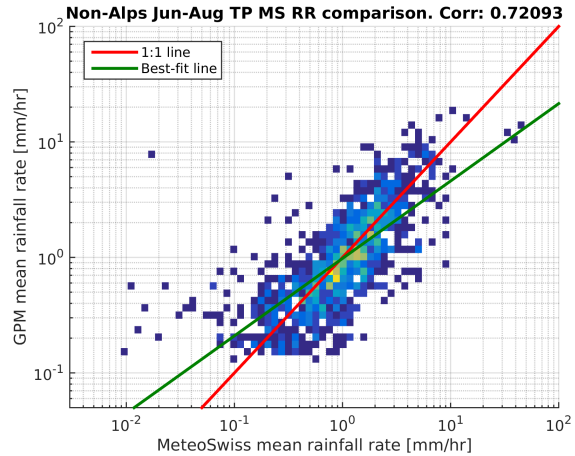
Alps





Non-Alps



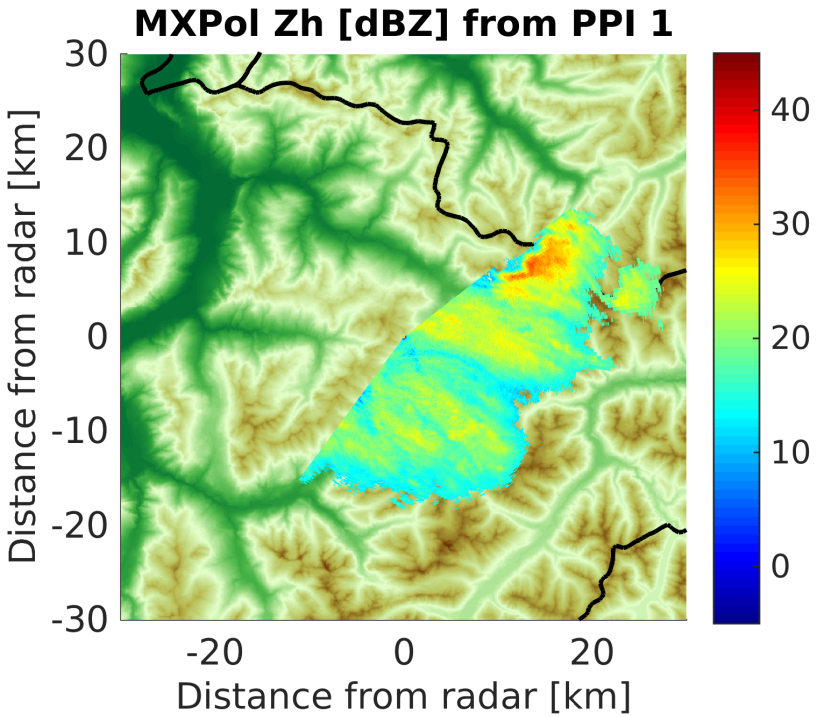


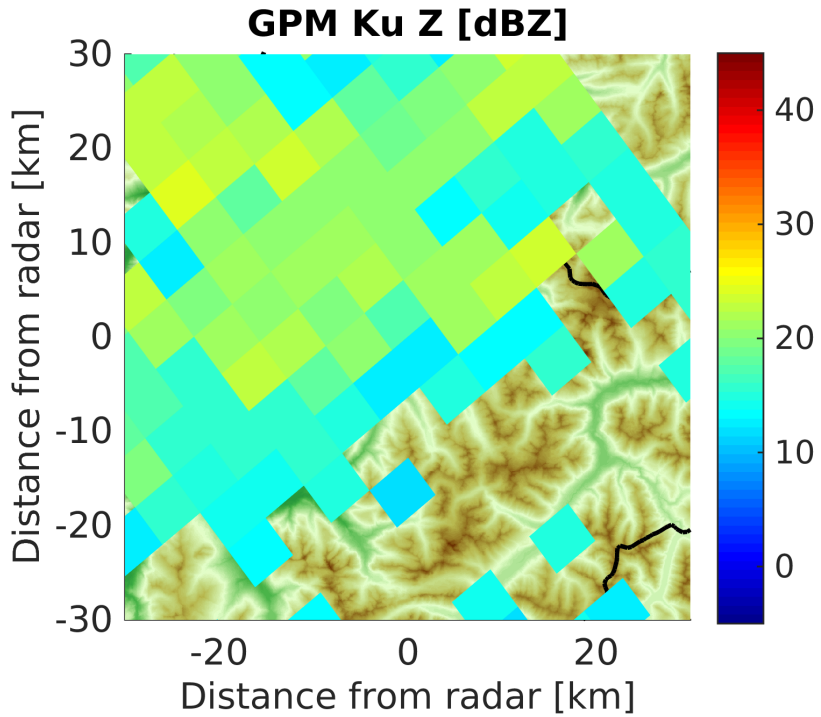
Much better agreement in summer and over less complex topography.

Comparison at the local scale (1)

X-band polarimetric radar (MXPol) deployed in the Swiss Alps.
Dedicated scan: 2 PPIs, 3 RHI (22 precip overpasses).

Horizontal structure

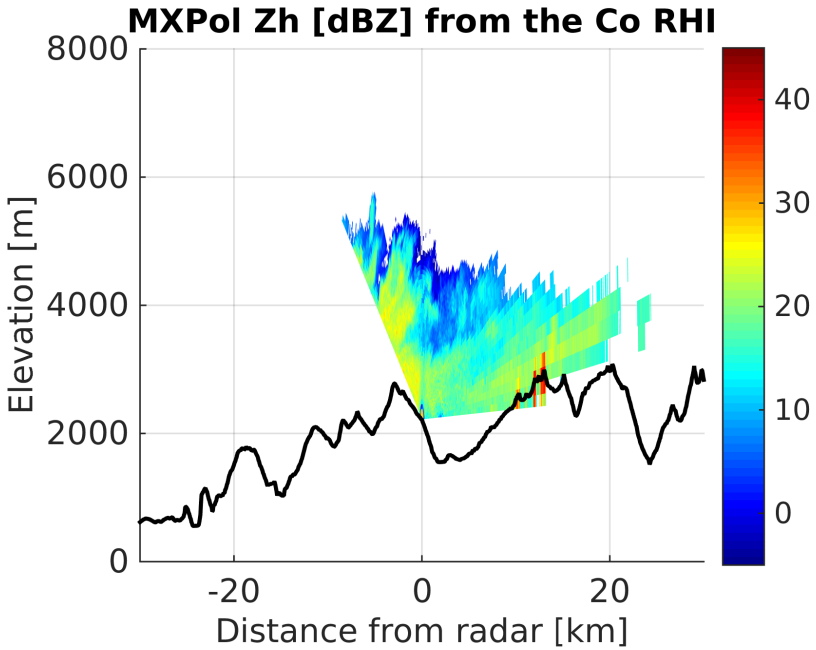


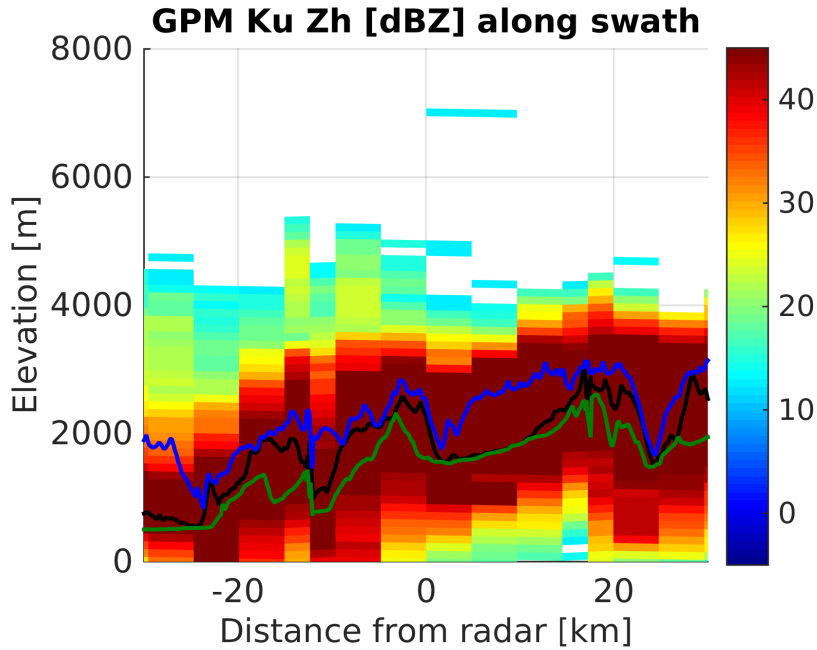


Sensitivity is not the main problem → vertical structure?

Comparison at the local scale (2)

Vertical structure



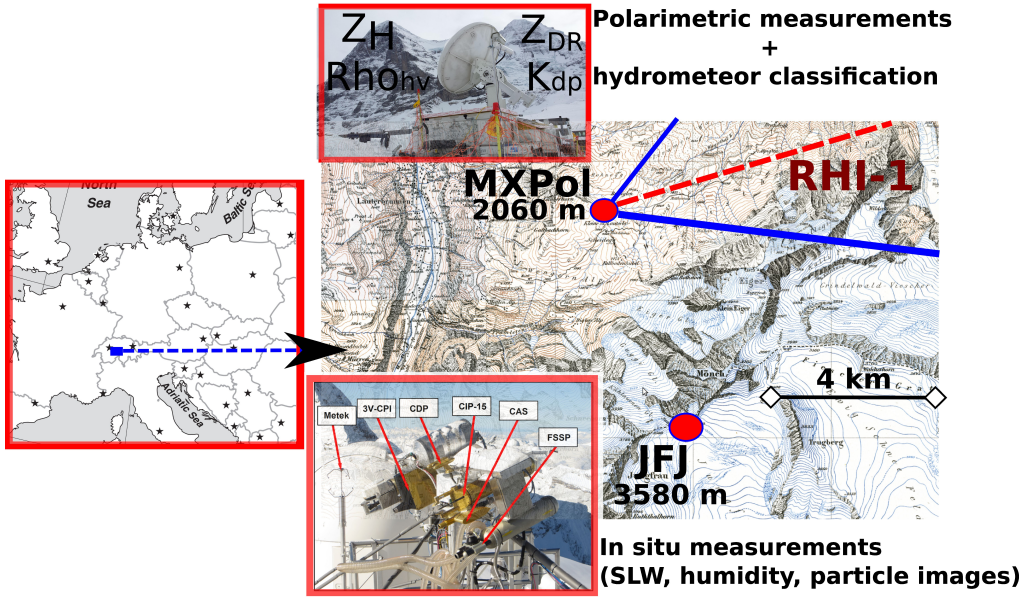


Strong clutter contamination in the 1st km above ground
$\rightarrow$ potential issue for the detection of winter low level precipitation.

Riming in alpine snowfall

CLACE 2014

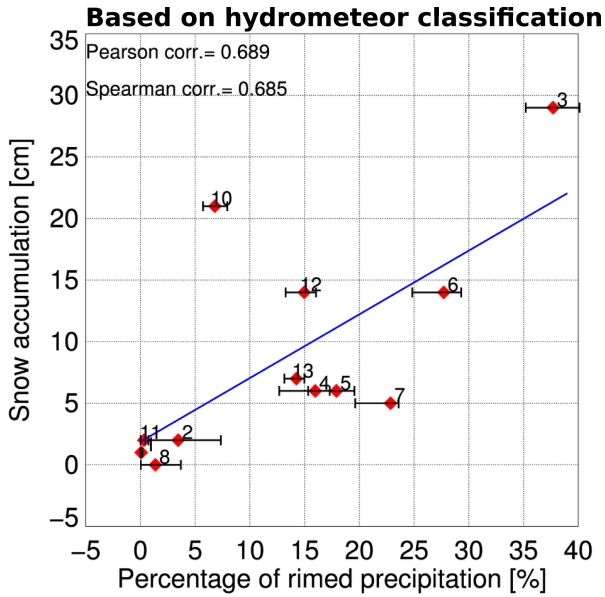
- Jan-Feb 2014 in Swiss Alps.
- MXPol + in-situ cloud probes (LWC, IWC, 2D particle im.).



Riming

- Freezing of SLW droplets upon impact.
- Co-fluctuate with snowfall intensity.

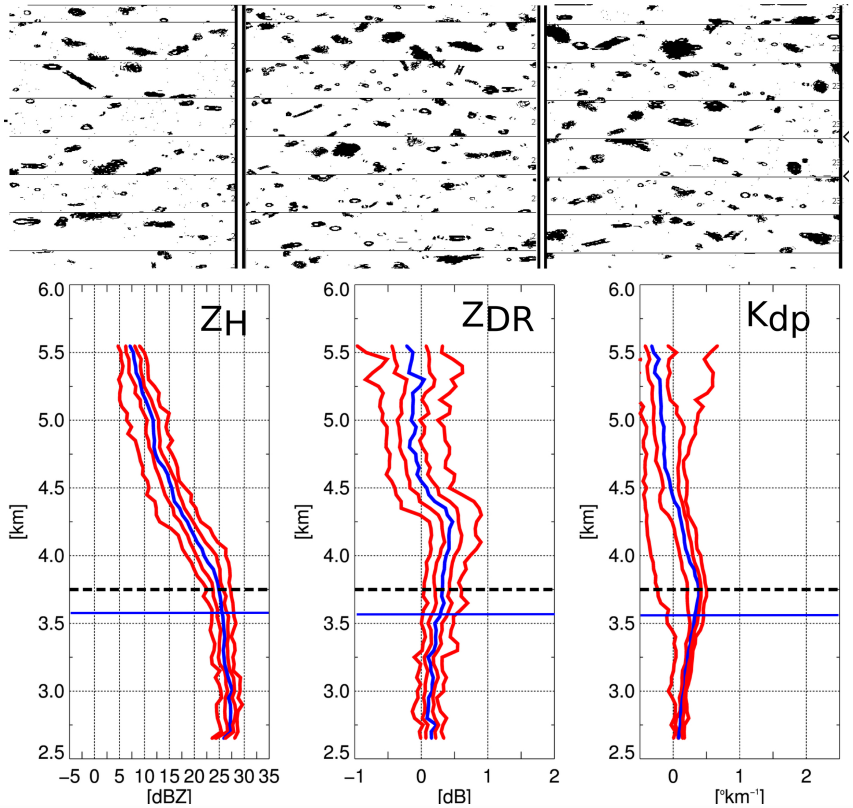
→ How/when does riming occur?



Vertical structure in rimed precip

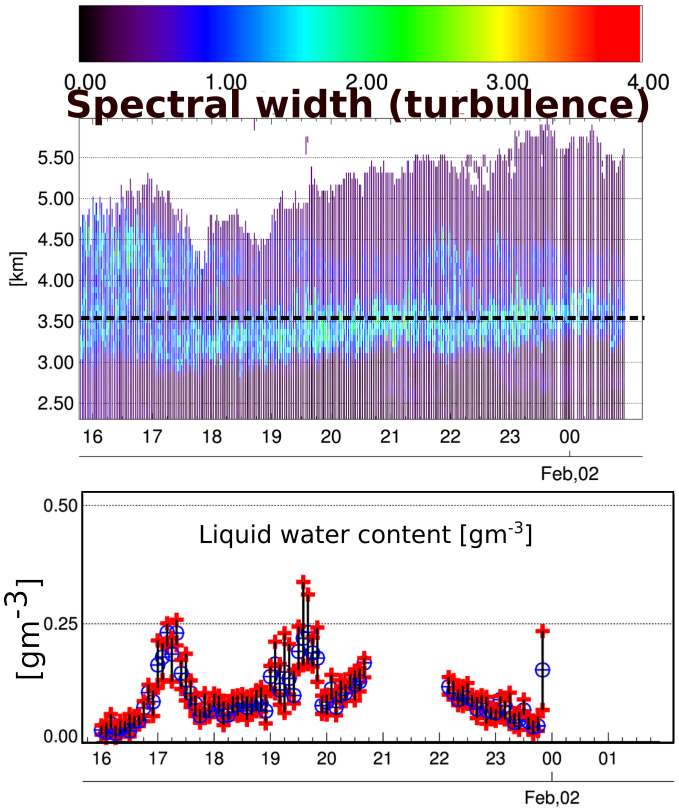
Single time step

- MXPol → profiles of polar var.
- Peak Z_{DR} then K_{dp} then Z_H.
- Riming + secondary ice gen.

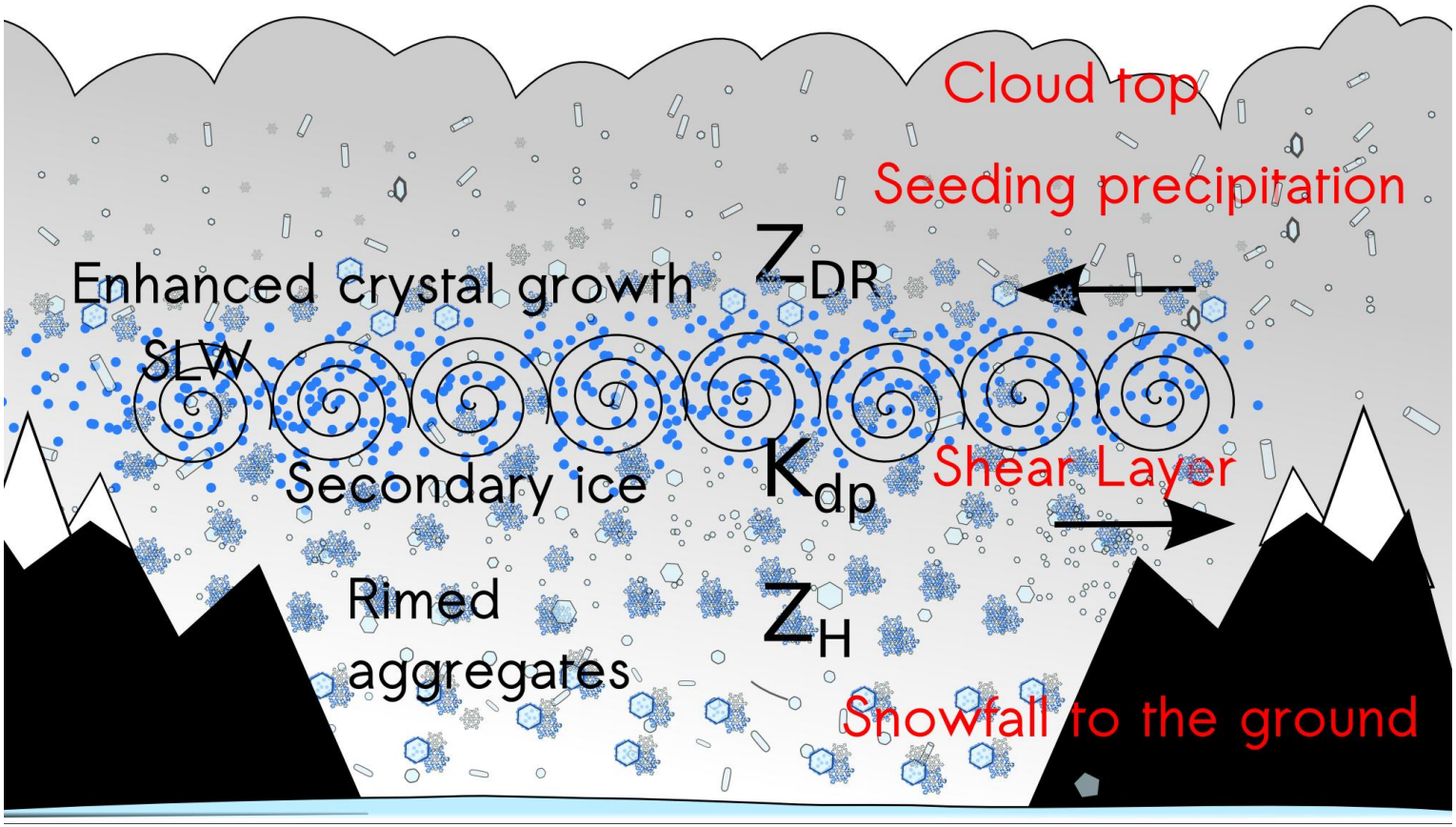


Entire event

- Spectral width → turbulent layer.
- In-situ probes → SLW.



Conceptual model



Situation associated with the passage of a cold front.

(Grazioli et al, submitted to ACP)

Summary and perspectives

Summary

- GPM rain product is underestimated in the Alps (for $R > 0.5$ mmh^{-1}).
- GPM reflectivity measurements are strongly contaminated by clutter in the 1st km above ground.
- Riming seems to be an important process in alpine snowfall.

Future work

- Further statistical analyses at the regional and local scales.
- Investigation of the NUBF / sub-grid variability.
- Influence of dominant microphysical processes on uncertainties.

Thank you for your attention!