Dynamical downscaling of precipitation – Comparison with rain gauge data

Ólafur Rögnvaldsson[1],Teitur Arason[2,3] and Haraldur Ólafsson[2,3]
[1]Institute for Meteorological Research
[2]University of Iceland and [3]Icelandic Meteorological Office

or@belgingur.is

Overview of this Talk

- ***Numerical and observational data***
- ***Observed and simulated precipitation quantity***
- ***Observed and simulated occurrence and non-occurrence of precipitation***
- ***Classifying errors according to wind direction and other meteorological factors***

Numerical Simulations

- ***PSU/NCAR MM5 model***

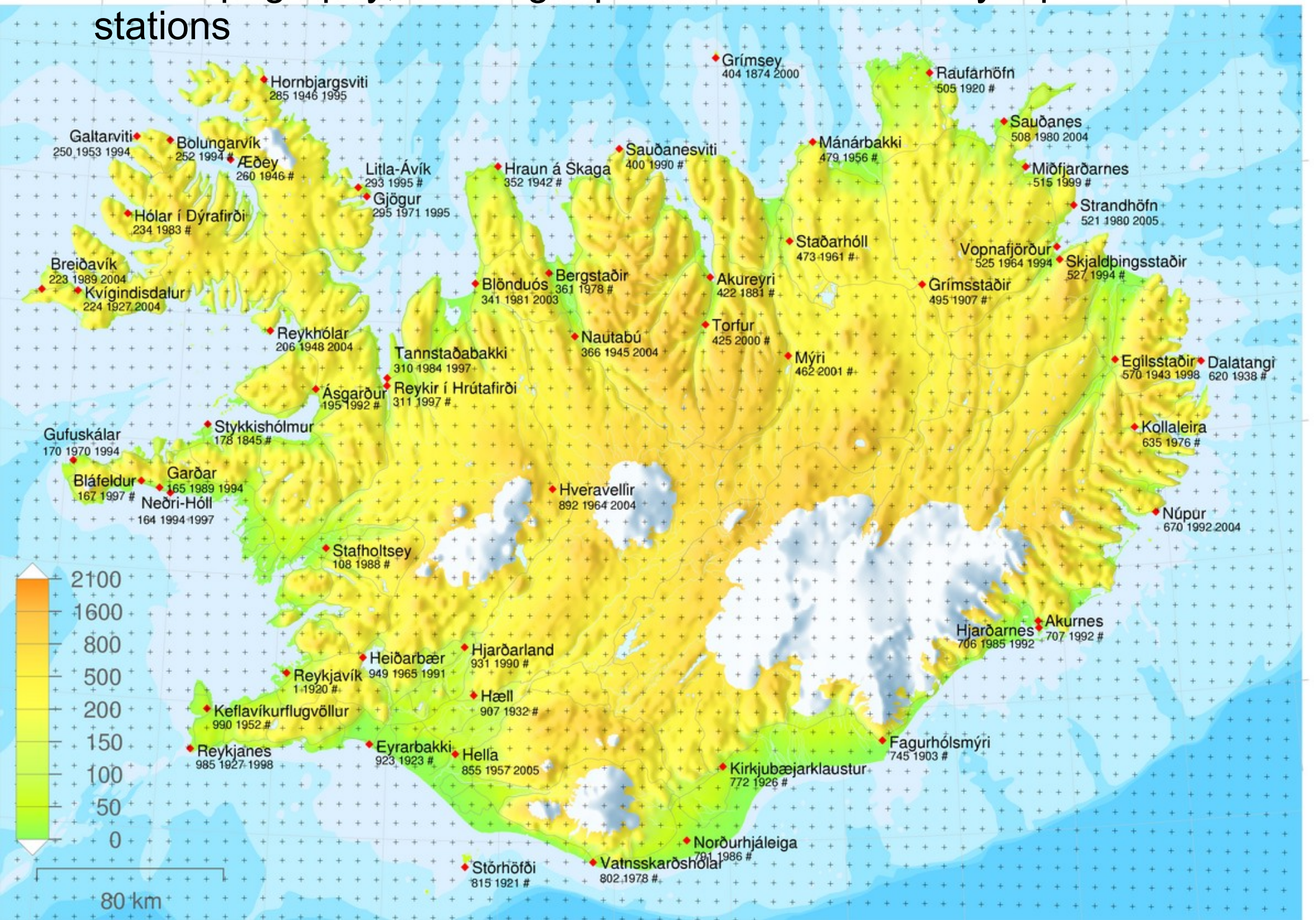
  Microphysics: Reisner 2

- ***Horizontal gridpoint spacing: 8km***
- ***23 vertical levels***
- ***Boundary conditions: ERA40***
- ***Period: 1987-2003***

Motivations for Research

- The MM5 limited area model is in operational use in Iceland for procuction of short to medium range weather forecasts. Need to assess strong and weak points of simulations to aid forecasters and understand which aspects need improving.
- The outcome will hopefully yield better understanding of climatological precipitation simulations using MM5 which are already heavily used in the hydrological industry.

True topography, model gridpoints and available synoptic stations

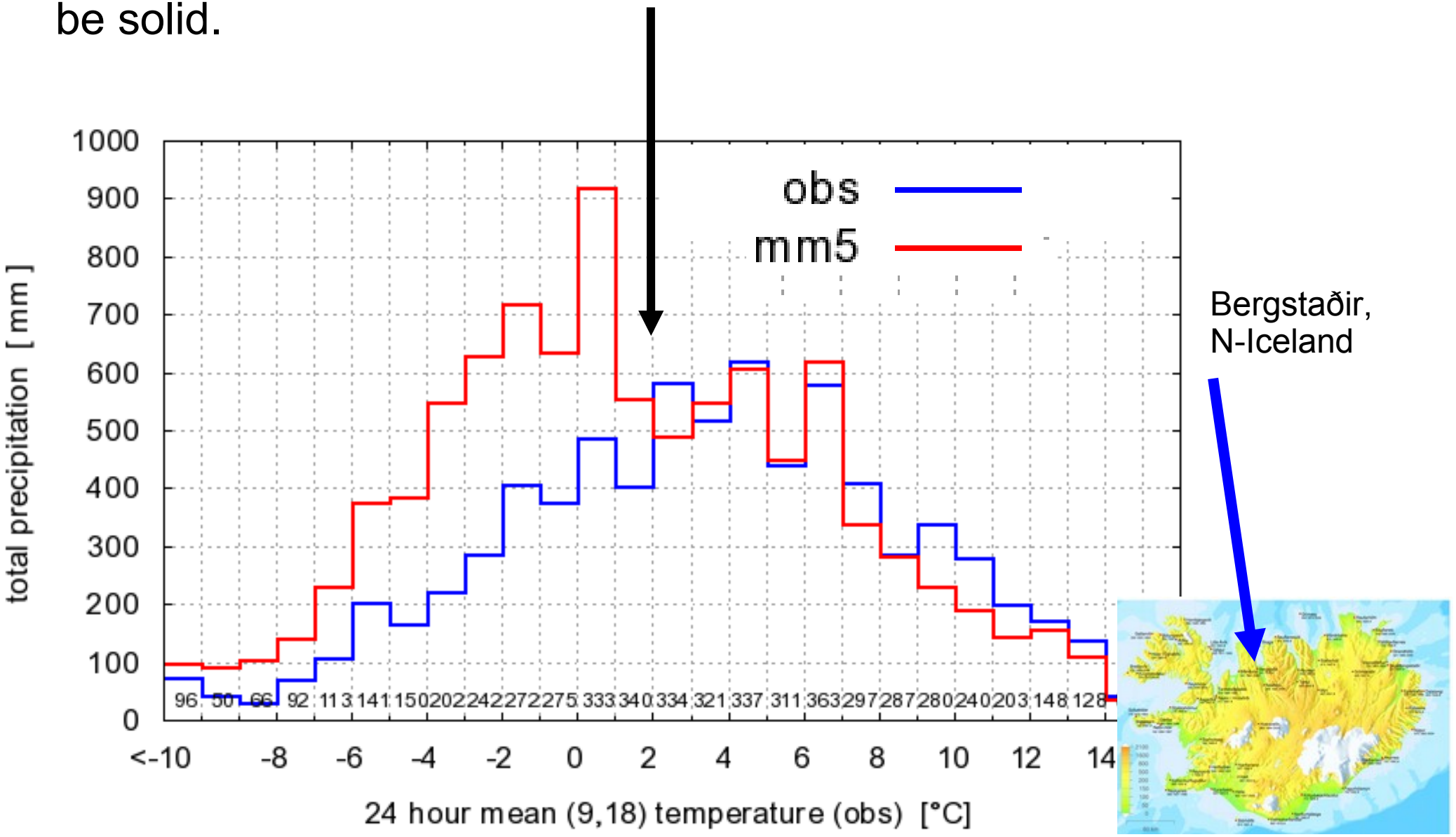


The big problem in precipitation observations in cold and windy climate:

Large undercatchment of solid precipitation

Classifying errors by temperature:

- for this station we see a sharp increase in the error below the temperature which we expect precipitation to be solid.

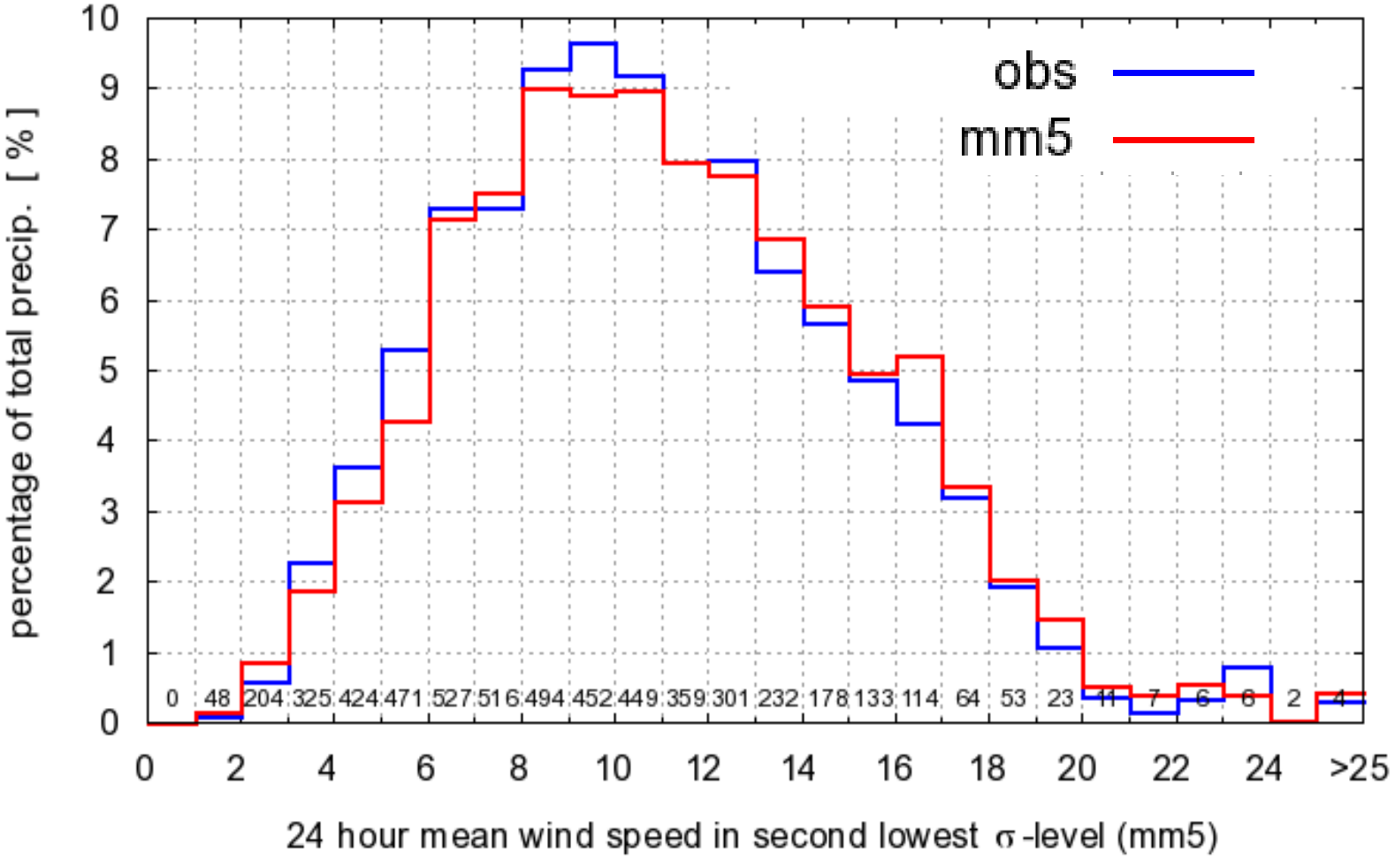


How to deal with the undercatchment problem?

- Look only at liquid precipitation (summer or temperature criteria)
- Compare occurrence of precipitation

Classifying errors by wind speed:

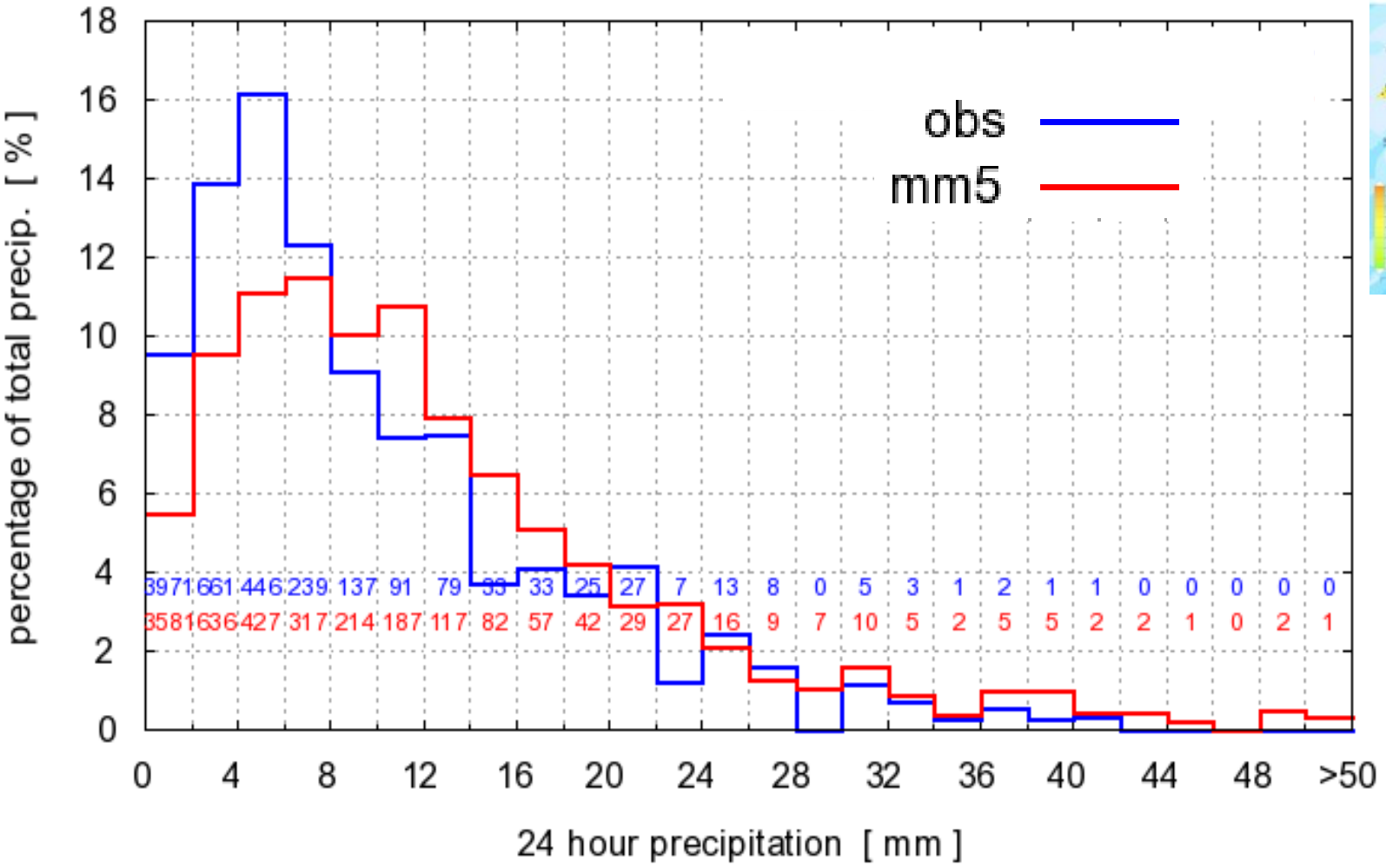
- The model reproduces accumulated precipitation equally well for all wind speeds.
This is true for most of the stations.



Raufarhöfn,
NE-Iceland

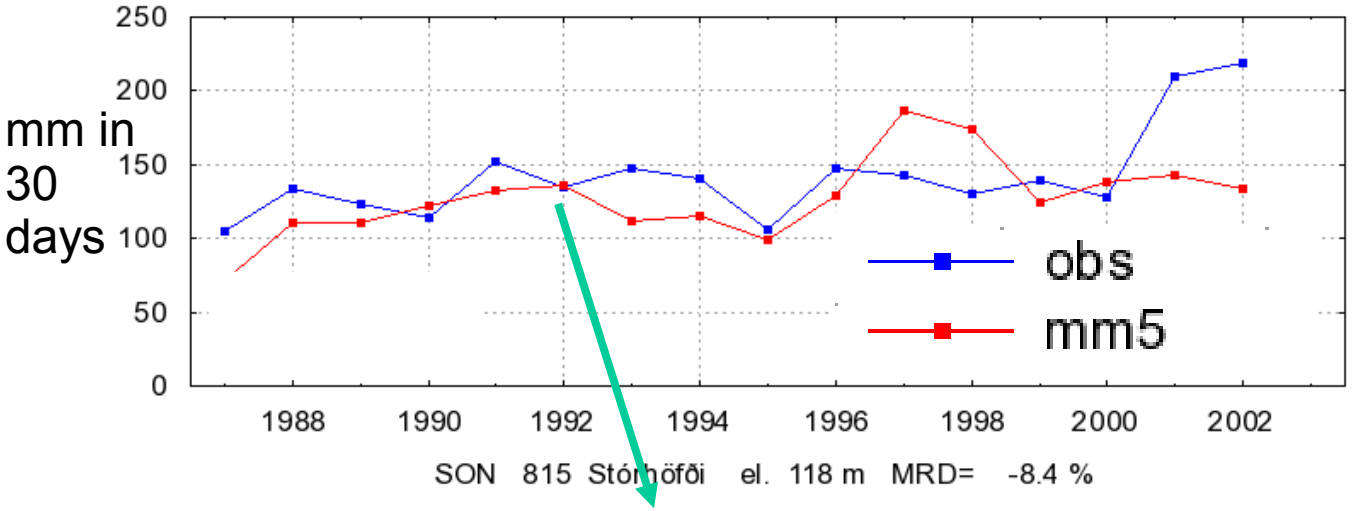
Classifying errors by precipitation quantity:

- The number of small events is underestimated in many places.

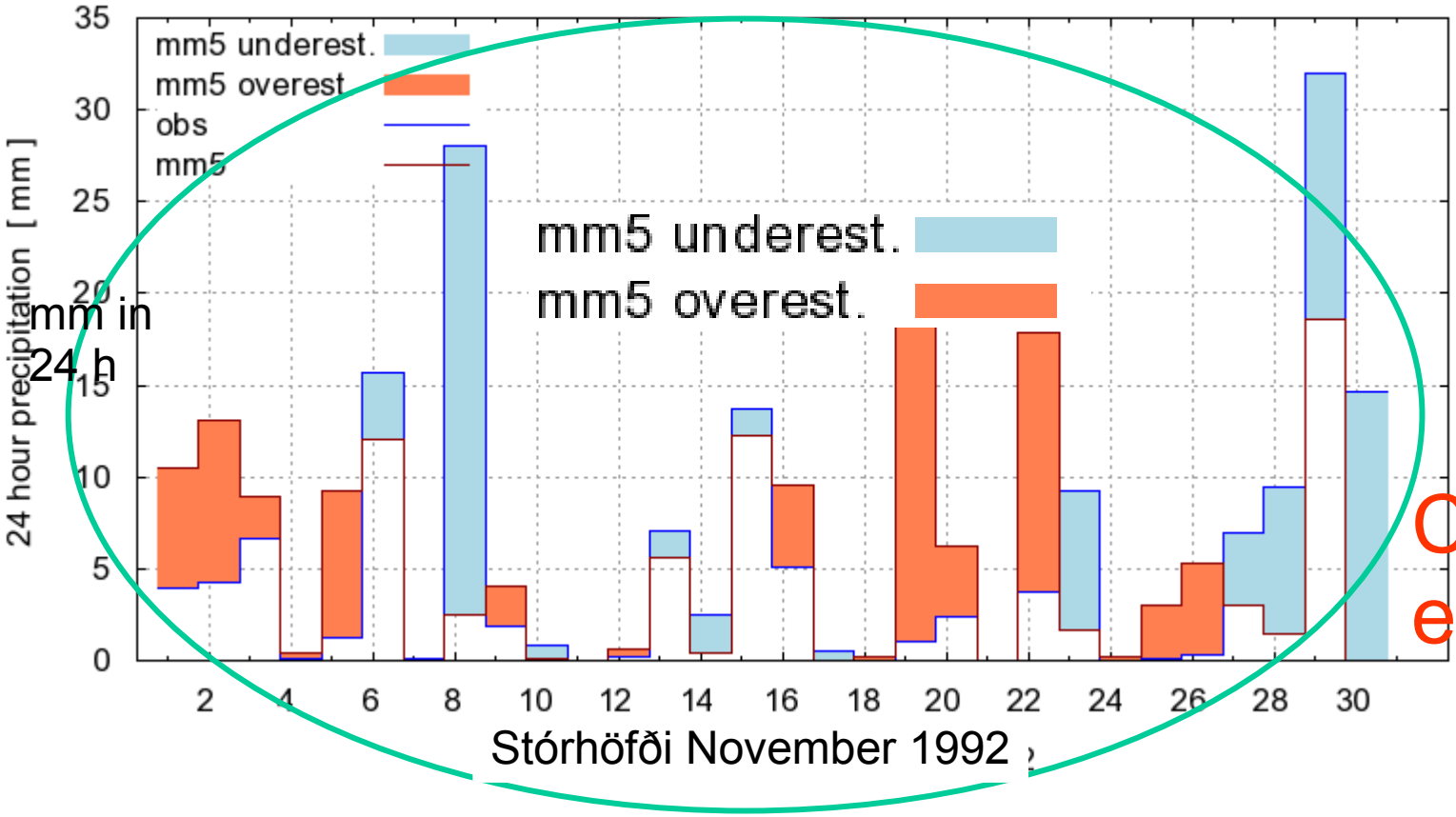


Reykjavík,
SW-Iceland

Point comparison of simulated and measured precip

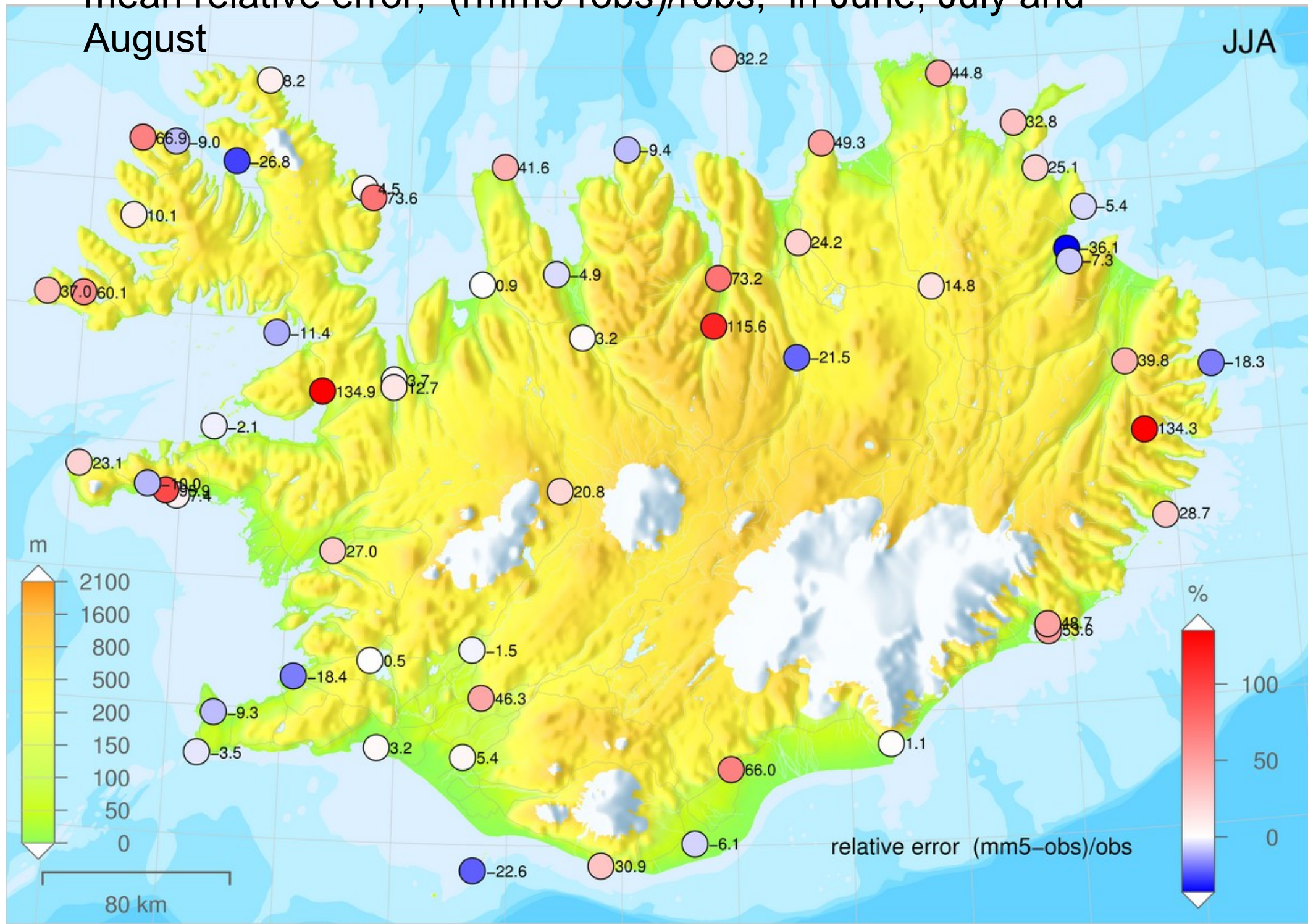


Stórhöfði in Vestmann Islands South of Iceland

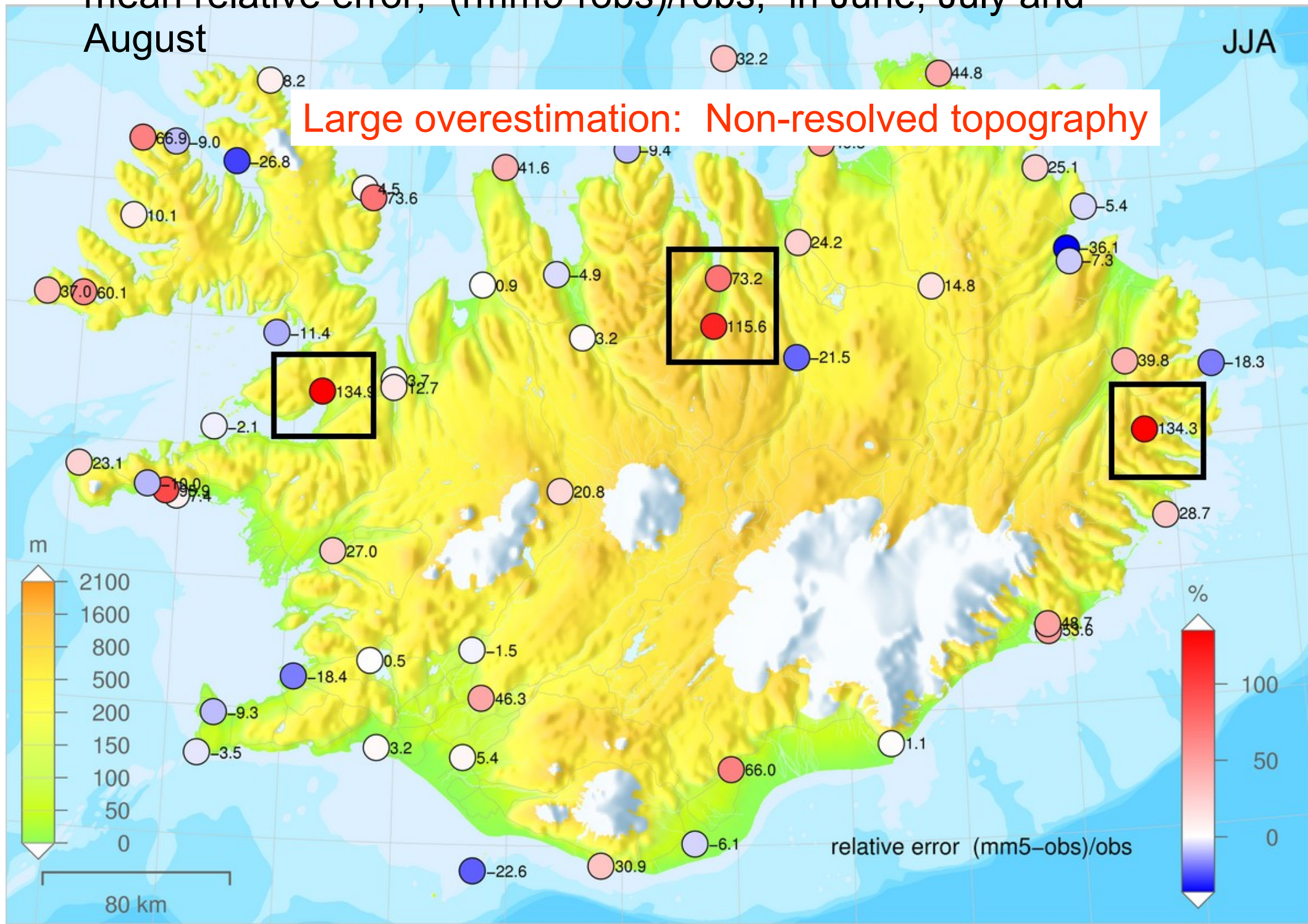


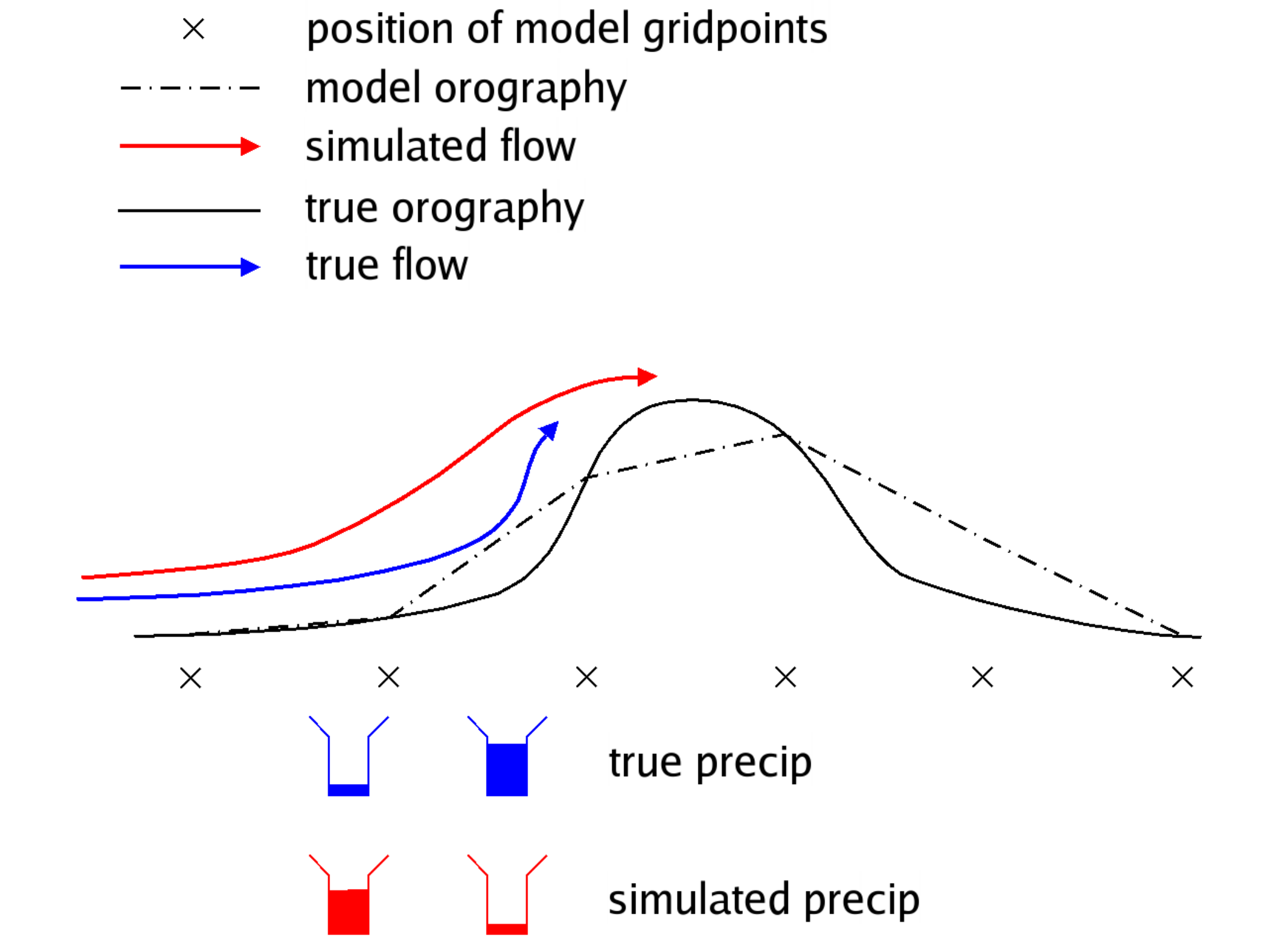
Compensating errors!

mean relative error, (rmm5-robs)/robs, in June, July and August

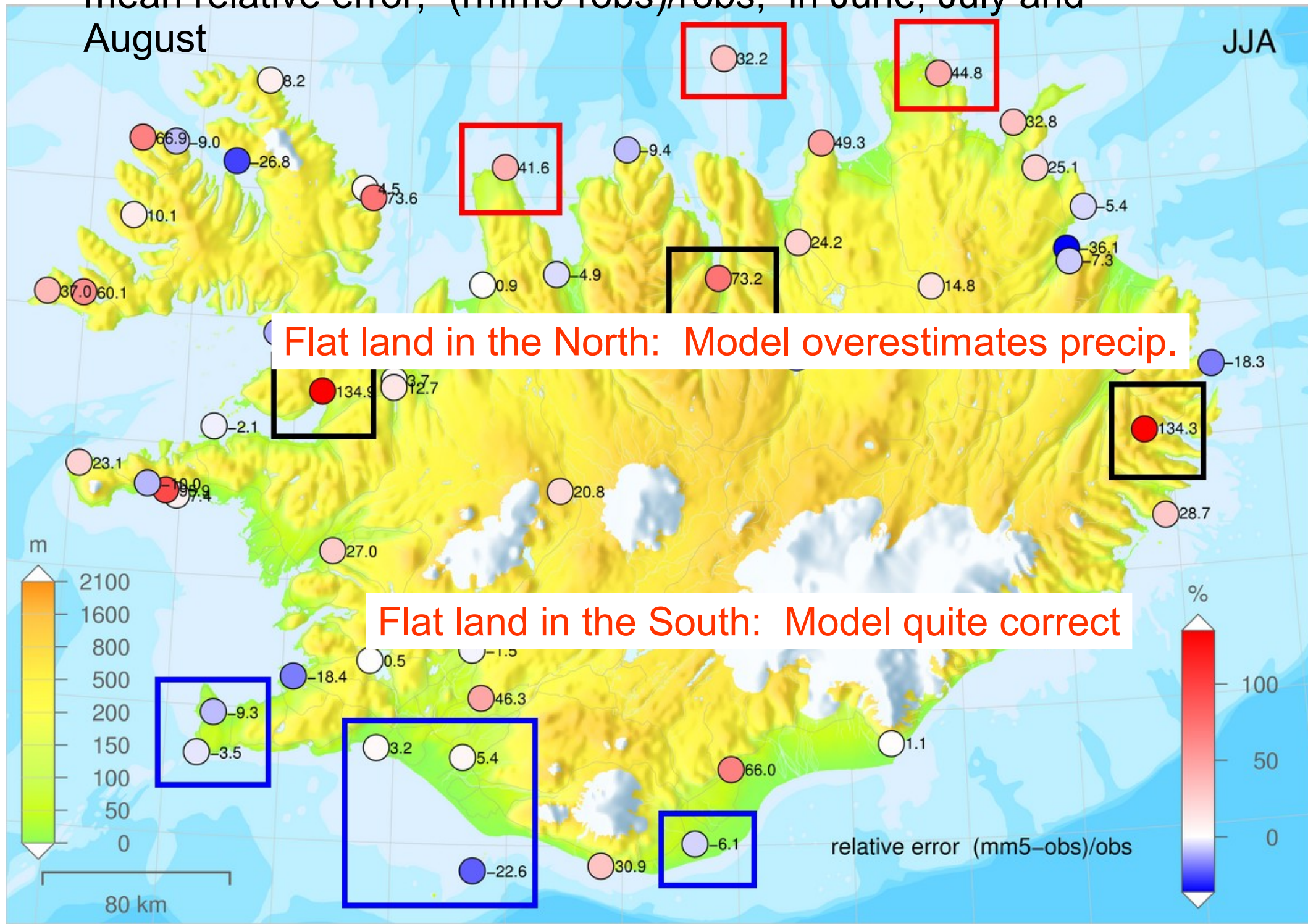


mean relative error, (rmm5-robs)/robs, in June, July and August




position of model gridpoints
model orography
simulated flow
true orography
true flow
true precip
simulated precip

mean relative error, (rmm5-robs)/robs, in June, July and August

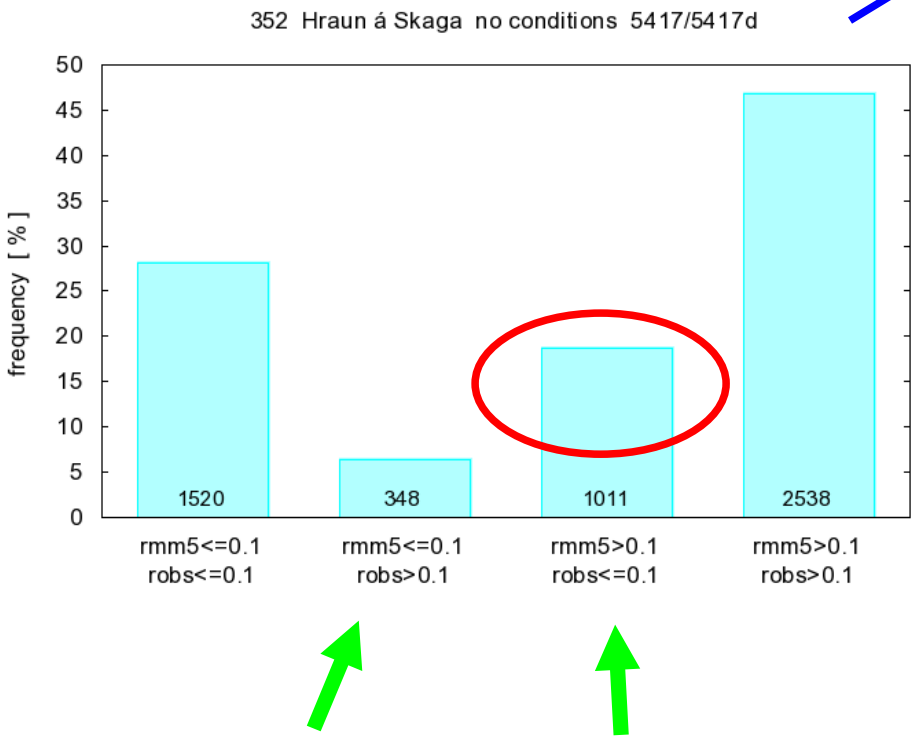


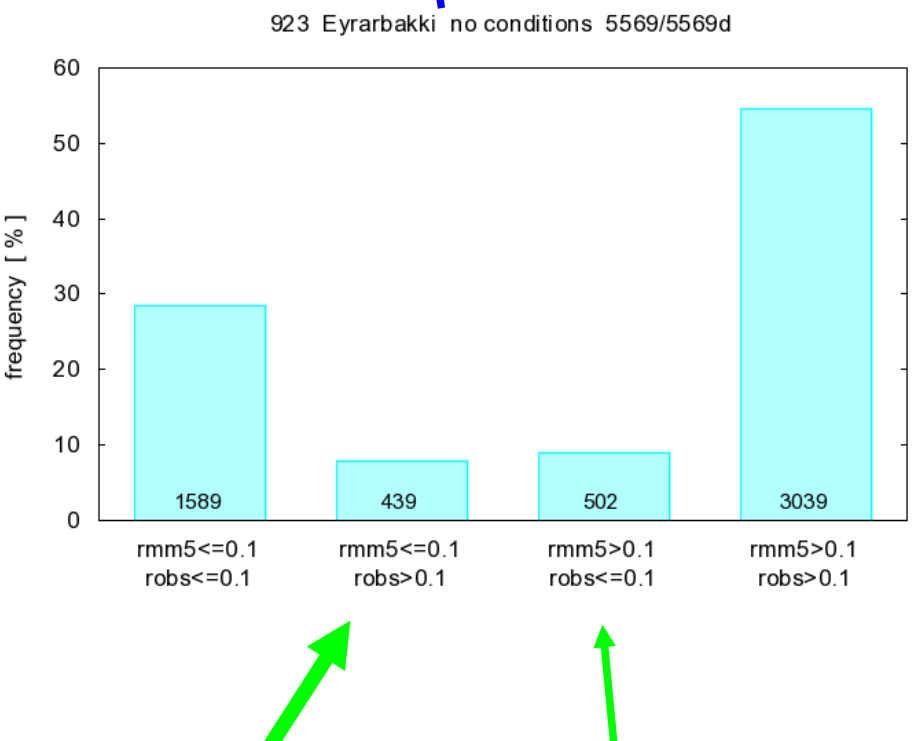
What about the occurrence and non-occurrence of precipitation?

This is of primary importance in everyday weather forecasting!

Occurrence and non-occurrence of precipitation:

24h observed and simulated precipitation divide days into 4 groups:





missing events (mm5 dry, obs wet)

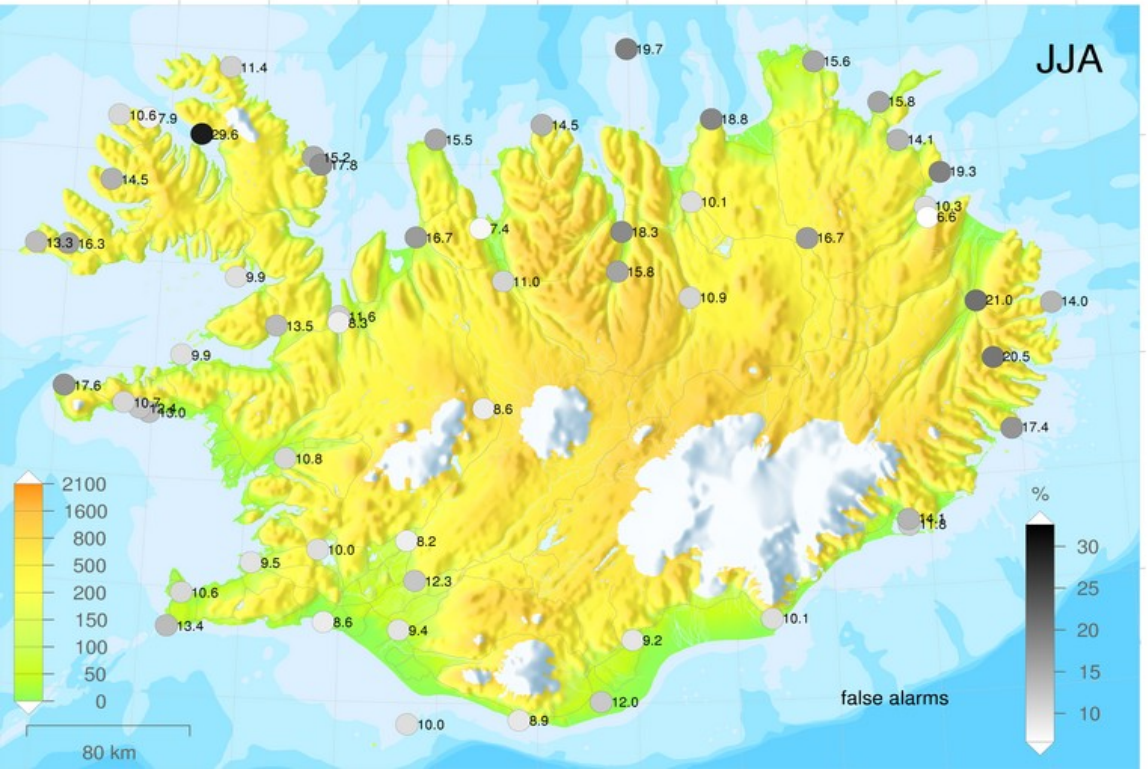
false alarms (mm5 wet, obs wet)

error: ~25% of days

missing events (mm5 dry, obs wet)

false alarms (mm5 wet, obs wet)

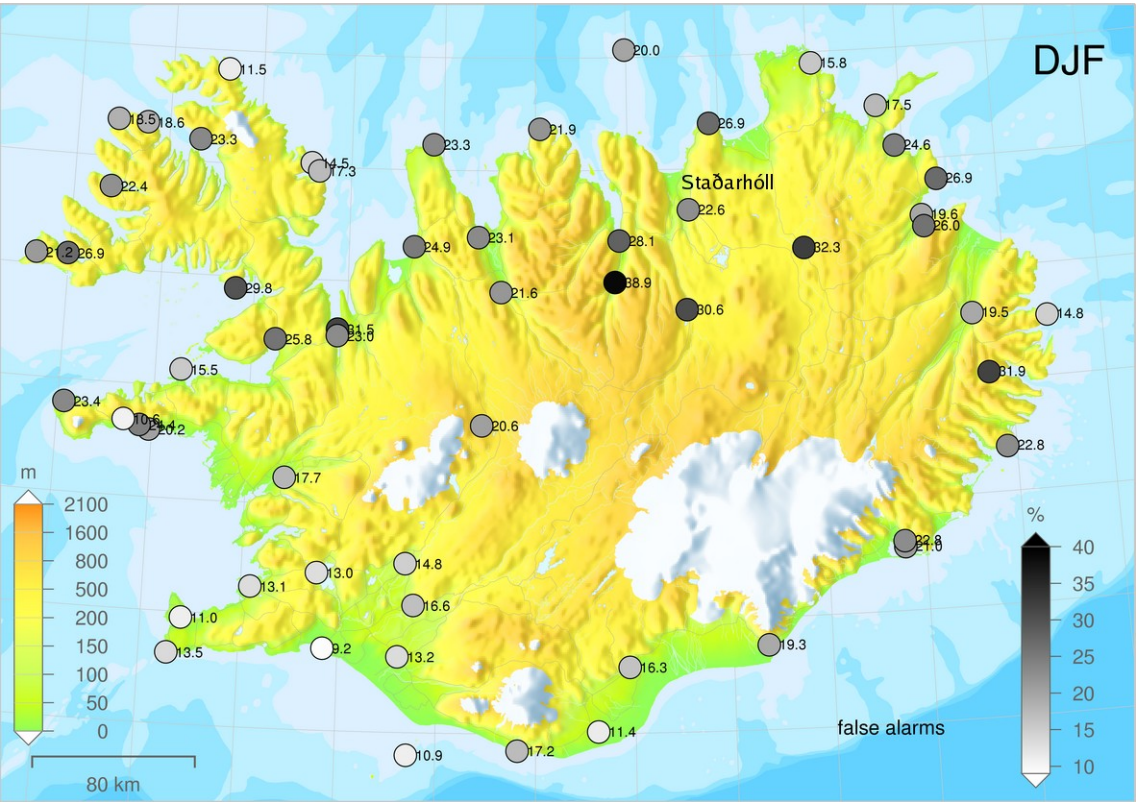
error: ~17% of days



Summer

Seasonality of false alarms:

- Increased probability of false alarms in winter, most notably for inland areas in N-Iceland

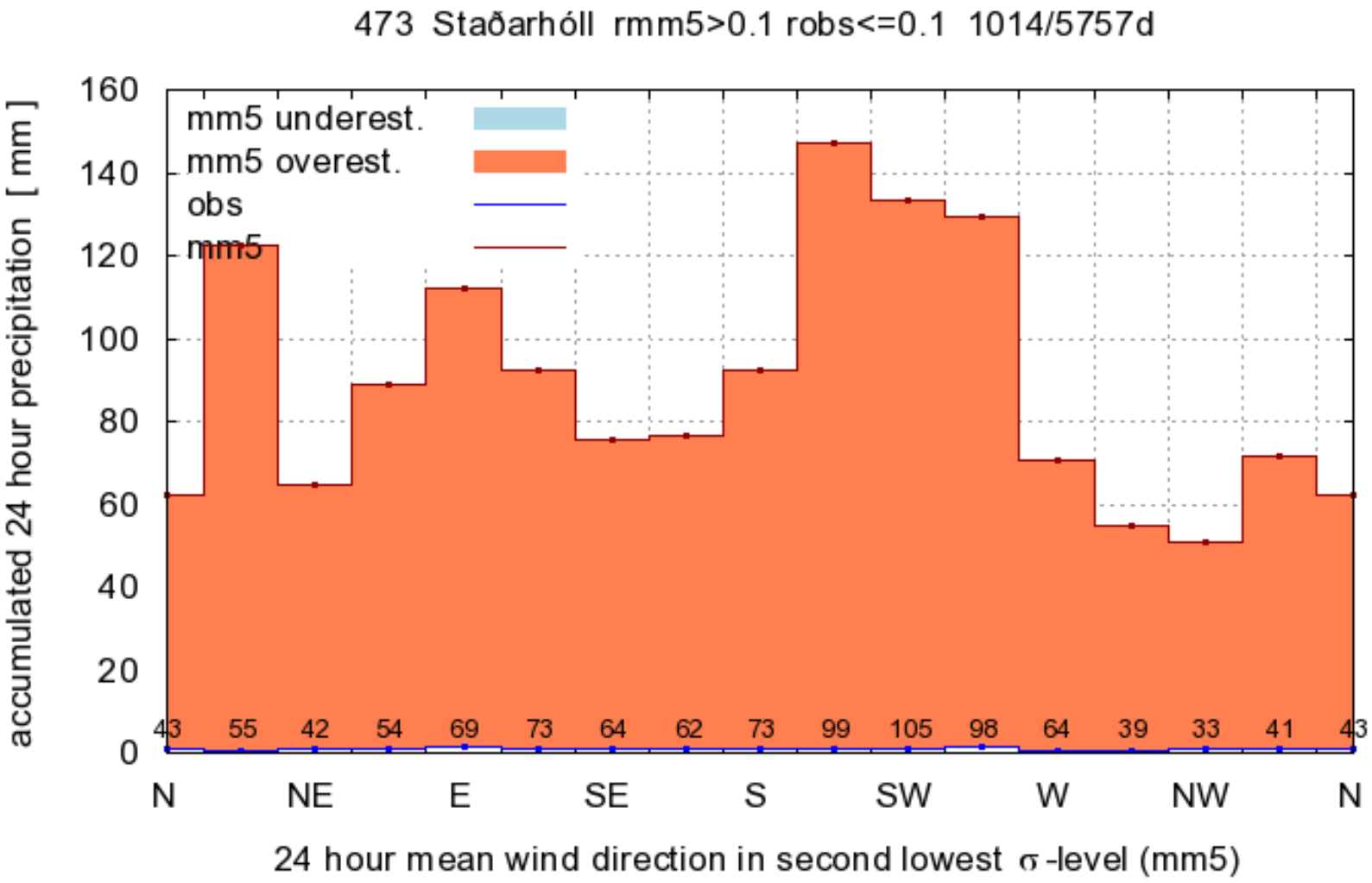


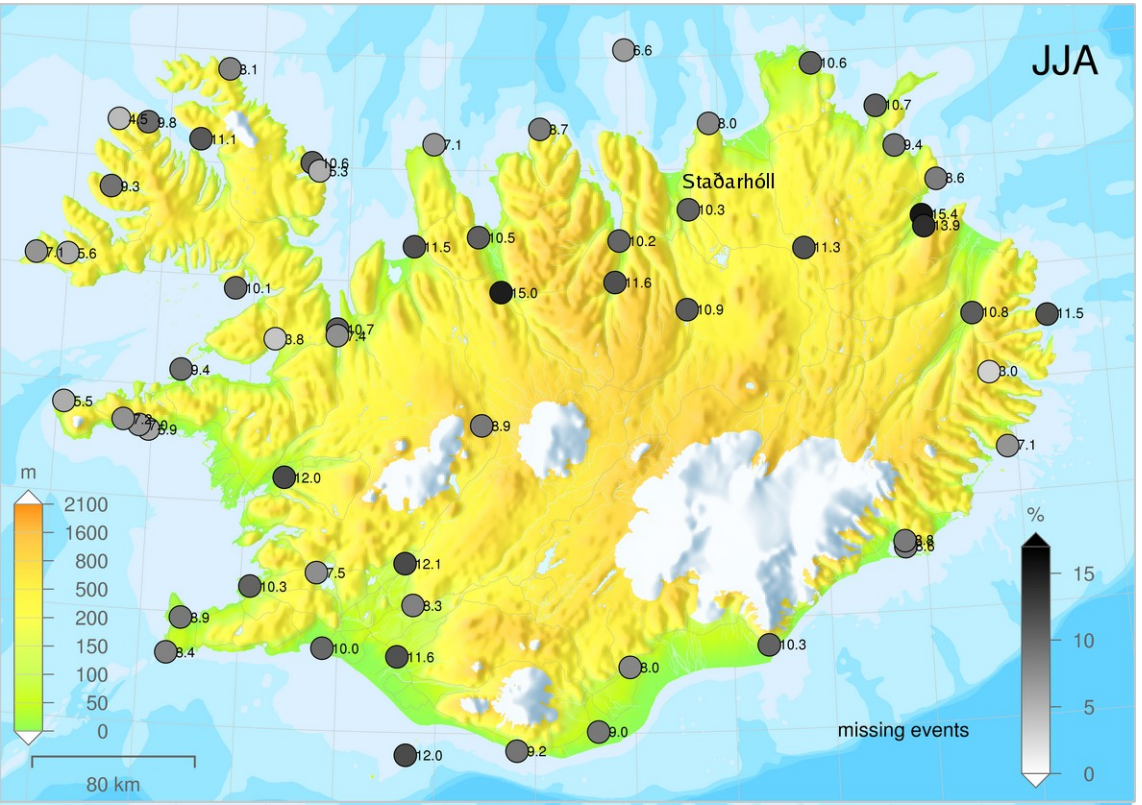
Winter

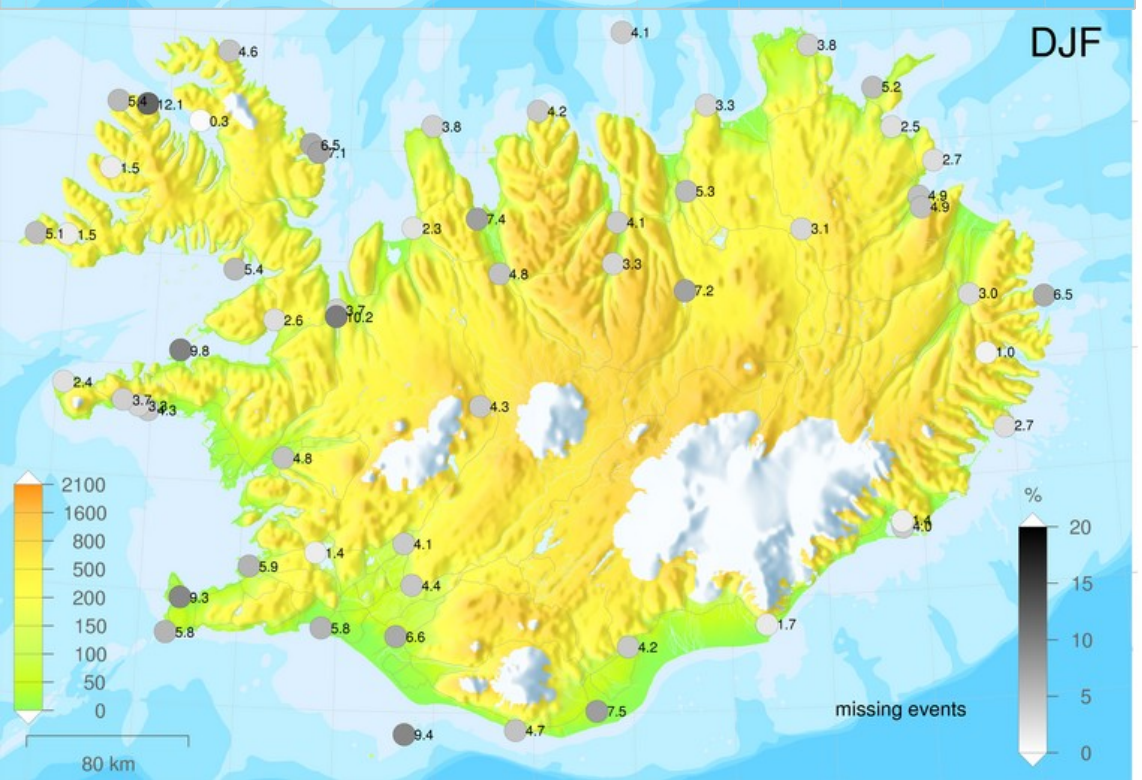
Classifying false alarms by wind direction

At this station in NE-Iceland, the greatest error occurs during southerly winds (lee side).

Staðarhóll, NE-Iceland







Summer

Seasonality of missing events:

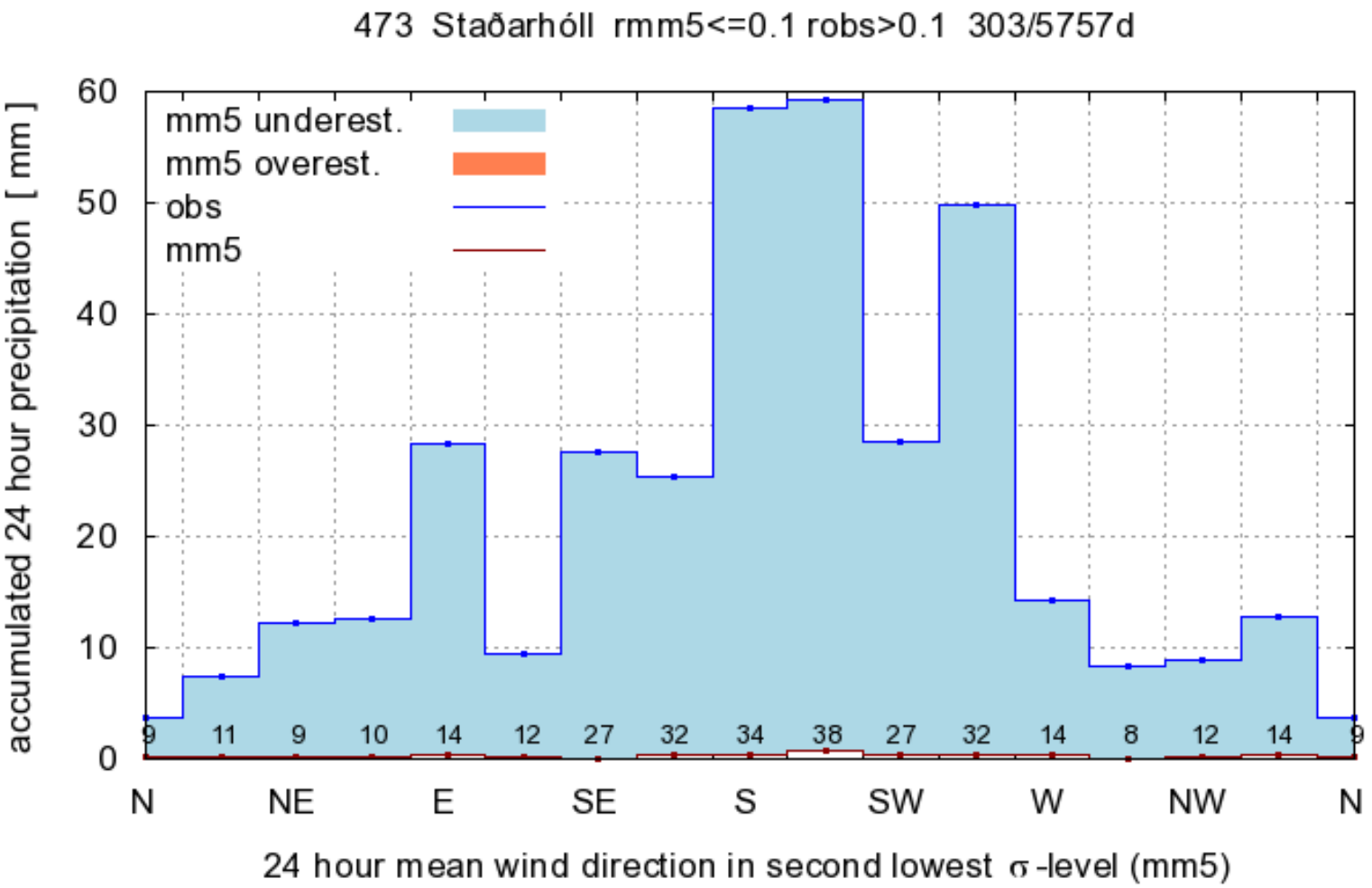
- Increased probability of missing events in summer, especially inland

Winter

Classifying missing events by wind direction

Again, southerly winds (lee side) are primarily responsible for the error!

Staðarhóll, NE-Iceland



Summary

- Simulated precipitation is usually greater than observed for T < 2°C, where precipitation is normally solid. No clear connection between temperature and model error for T > 2°C
- The model reproduces accumulated precipitation equally well for all wind speeds.
- The number of small events is underestimated in many places.
- Away from non-resolved orography, long term (months, years) sums of simulated precipitation are quite correct in the south but too high in the north. This is partly due to compensating errors on a smaller time scale (days).

Summary (cont.)

- Probability of false alarms is highest in N-Iceland, particularly during winter.
- Probability of missing events is highest in the summer inland and on the lee side of Iceland in southerly flows.
- During southerly flows, the simulated precipitation on the lee side of Iceland is prone to errors, both in quantity and occurrence.

Thank you !