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On the influence of orography on the predictability of winter weather

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For short term (0 - 2 hours) weather forecast - nowcasting - of precipitation in most situations extrapolation techniques based on radar observations are used. Numerical weather prediction models (NWP) are limited for this time span since data analysis takes time and the spin-up of the model hinders forecasts within the first hours.
When airflow comes over open sea or approaches mountains, snowfall is more difficult to forecast by extrapolation than in other situations. In order to study the effect of sea the nowcast of the DIW (de-icing weather index) for Helsinki (Finland) and Stockholm (Sweden) airport were evaluated. The same methodology was applied to study the effect of mountains for the airports of Oslo (Norway) and Rovaniemi (Finland). It was observed that forecast quality was worse compared to all flow directions in situation when the flow was coming from sea or directed towards mountains.
A similar methodology was developed for Munich (Germany) and Salzburg (Austria) airport using probabilistic extrapolation of radar images. Cold frontal systems were observed to be retarded when approaching the Alps leading to long-lasting precipitation events. Other systems did cross the area and the Alps without any sustainable modification. Here the situation is much more complex compared to the smaller Scandinavian mountains since during winter when the tropopause is low the Alps act as a major obstacle and cause a considerable distortion of the atmospheric flow. Especially during those conditions which were classified as up-slope or delay often low pressure systems develop in the Alpine region causing long-lasting precipitation and no more distinctive motion characteristics. It was found that the flow properties expressed by the wind profile and the Froude number were different for the two regimes.
Extrapolation based nowcasting methods are limited in those situation. With the continuous improvement of numerical weather prediction models, higher spatial resolution, more frequent initiation, and assimilation of radar observations (reflectivity, Doppler velocity, hydrometeor class) the quality of NWP will improve and the gap between nowcasting by extrapolation and NWP forecasts will get smaller. Higher resolution NWP is also able to describe and thus consider more aspects of precipitation microphysics and their reaction on underlying topographic features.