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A method for spatial calibration of precipitation forecasts

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The aim of this work is to calibrate precipitation forecasts for Southern Norway and to quantify their uncertainties for any location, i.e. also for locations without measurements. The main focus of this presentation is the spatial calibration method developed, though some validation and quantification of uncertainty of precipitation forecasts (before and after calibration) is presented.

Precipitation forecasts in Southern Norway (even 1 day ahead) have systematic errors/ bias compared to gauge measurements, and the bias changes with different weather system (typically eastern or western). It is also known that precipitation has large seasonal variations in Norway.

Our analyses are based on data from September 2001 to August 2005 for 473 precipitation measurement series in Southern Norway (from involved hydro-power companies and Norwegian Meteorological Institute) and two deterministic 24 hour ahead precipitation forecast series (ECMWFs' deterministic operative forecast and Norwegian Meteorological Institutes Hirlam 10 forecast).

Based on the analysis/ validation of the forecasts we choose to find different calibrations for the eight season / wind direction classes (autumn, winter, spring, summer for eastly or westly wind). Further, we only calibrate forecasts when any precipitation is forecasted, and we choose to minimize the root mean square error. The spatial calibration method consists of three steps (preformed for each season-wind class independently):

1. For each measurement series site (i = 1. . . 473): A linear transform that minimize rmse is found, truncated to avoid negative calibrated forecasts. Hence, we find two calibration parameters, *ai* and *bi*, at each measurement series site.

2. We assume that the 473 calibration parameters *ai* found in 1) are noisy realizations from a spatially smooth surface of the calibration parameter a. An ordinary kriging model with exponential variogram is assumed for the a-field. The kriging parameters (range, sill and nugget) are estimated from the calibration parameters found in 1). The same assumptions and procedure are done for the b-field.

3. The kriging models with parameters found in 2) conditioned on the calibration parameters found in 1) are used to find calibration parameters for ungauged locations of interest.

Cross-validation is used to evaluate our spatial calibration method. The results show that this simple spatial calibration method gives improved rmse also for locations without precipitation measurement series (5-15% reduction for most locations, up to 50% for some). Even though the ECMWF forecast is the coarsest, it has the smallest rmse both before and after calibration. Even so, calibration improves the Hirlam 10 forecast the most.