Geophysical Research Abstracts
Vol. 17, EGU2015-10661, 2015
EGU General Assembly 2015

Precipitation interpolation in mountainous areas

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Different precipitation interpolation techniques as well as external drift covariates are tested and compared in a 26000 km2 mountainous area in Norway, using daily data from 60 stations. The main method of assessment is cross-validation. Annual precipitation in the area varies from below 500 mm to more than 2000 mm. The data were corrected for wind-driven undercatch according to operational standards.

While temporal evaluation produce seemingly acceptable at-station correlation values (on average around 0.6), the average daily spatial correlation is less than 0.1. Penalising also bias, Nash-Sutcliffe R2 values are negative for spatial correspondence, and around 0.15 for temporal. Despite largely violated assumptions, plain Kriging produces better results than simple inverse distance weighting. More surprisingly, the presumably 'worst-case' benchmark of no interpolation at all, simply averaging all 60 stations for each day, actually outperformed the standard interpolation techniques.

For logistic reasons, high altitudes are under-represented in the gauge network. The possible effect of this was investigated by a) fitting a precipitation lapse rate as an external drift, and b) applying a linear model of orographic enhancement (Smith and Barstad, 2004). These techniques improved the results only marginally.

The gauge density in the region is one for each 433 km2; higher than the overall density of the Norwegian national network. Admittedly the cross-validation technique reduces the gauge density, still the results suggest that we are far from able to provide hydrological models with adequate data for the main driving force.