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Flood forecast sensitivity to temperature using ECMWF ensembles for 145 catchments in Norway

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The Norwegian flood forecasting service is based on a flood-forecasting model run on 145 basins. The basins are located all across Norway and differ in both size and hydrological regime. Current flood forecasting system is based on deterministic meteorological forecasts, and uses an auto-regressive procedure to achieve probabilistic forecasts. An alternative approach is to use meteorological and hydrological ensemble forecasts to quantify the uncertainty in forecasted streamflow. The aim of our study is to establish and assess the performance of both meteorological and hydrological ensembles for 145 catchments in Norway, which differ in size, elevation and hydrological regime. We identify regional differences and improvements in performance for preprocessed meteorological forecasts. A separate study further investigates the sensitivity to forecasted temperature for specific snowmelt induced floods. In Norway, snowmelt and combined rain and snowmelt floods are frequent. Hence, temperature is important for correct calculations of snowmelt. Temperature and precipitation ensembles are derived from ECMWF covering a period of nearly three years (01.03.2013 to 31.12.2015). To improve the spread and reduce bias we used standard methods provided by the Norwegian Meteorological Institute. Precipitation is corrected applying a zero-adjusted gamma distribution method (correcting the spread), and temperature is bias corrected using a quantile-quantile mapping (using Hirlam (RCM) 5 km temperature grid as a reference). Observed temperature and precipitation data are station data for all of Norway, interpolated to a 1×1 km2 grid (SeNorge.no). Streamflow observations are available from the NVE database. The hydrological model is the flood-forecasting operational HBV model, run with daily catchment average values. The results show that the methods applied to meteorological ensemble data reduce the cold bias present in the ECMWF temperature ensembles. Catchments on the western coast, having a lower initial performance, show the highest improvement by the temperature corrections, whereas some inland catchments in southeastern Norway show reduced performance. Ensemble spread for precipitation improves, but is not recognized in the discharge performance measures. Both precipitation and temperature show an east-west divide in performance. Corrected temperature ensemble lead to improved performance in discharge for some western catchments. Overall, the regional analyzes including all data, show that catchments have different sensitivity to temperature correction and will benefit from regional or catchment specific bias correction. Spring flood events, in catchments located west and southeast, showed different discharge response to temperature correction (more than 2°C). For the western catchment the increased temperature, led to higher discharge, whereas there were minor change for the southeastern catchment.