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Estimation of extreme precipitation; Return period values and PMP for Norway

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Estimates of extreme values of precipitation represented as return period values and Probable Maximum Precipitation (PMP) are frequently used in flood evaluation as well as dimensioning of hydro power dams. The estimates are also of interest for infrastructure constructions (e.g. urban runoff). The estimates establish a reference to how rare a heavy rainfall event at a location is. This study presents present-day and future return period values and PMP estimates for several catchments in Norway.

Daily precipitation values are extracted from grids covering the Norwegian mainland, spatial resolution 1 x 1 km2, for the time period 1957 – 2009. The grids are interpolated from observations at all available rain gage stations operated by the Norwegian Meteorolgoical Institute in Norway. The maps can be seen at http://senorge.no (Mohr, 2009; Jansson et al., 2007). The rain gauge network in the high mountain region is sparse, leading to reduced quality in these regions. A rough correction of daily gauge precipitation for undercatch because of wind exposure is performed before interpolation.

Six climate projections downscaled with different Regional Climate Models (RCMs) are adjusted to be representative locally for the Norwegian mainland (Engen-Skaugen, 2007). Daily precipitation projections are established for the same grid extent as for observations. Time series of daily precipitation are then extracted from these grids representing the same catchments as the historic data.

The estimates of extreme precipitation are based on daily precipitation values (Førland, 1992; Alfnes, 2007). Instead of producing area estimates based on site values adjusted by an Area Reduction Factor (ARF), area estimates in the present study is based on time series of daily precipitation representing the actual catchments extracted from the high resolution grids. Alfnes (2007) found that the five-year return value estimates (M5) for these two methods were similar, with exceptions for catchments located in south-western Norway. In these regions the M5 estimates based on daily grids lead to larger estimates. A reason for this may be that the wind correction factor is too large. However, there is also a possibility that the traditional method under-estimates the return period values and PMP estimates.

To study future changes in extreme design values, estimates are obtained for four time periods: 1961 – 1990, 1981 – 2010, 2021 – 2050 and 2071 - 2100 (6, 1, 4 and 6 model runs respectively). The estimates for the historic periods are compared to estimates for the same periods based on observations giving an idea of how representative the estimates based on the control runs in the RCMs are. The percentage change from the historic to the future periods 2021 – 2050 and 2071 – 2100 are then calculated.

The results are to be used in the CES project (Nordic Project on Climate and Energy Systems, www.os.is/ces) to study the effects of changing extreme precipitation for future flooding conditions, and particularly for the dimensioning of hydro power dams.

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