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EDgE multi-model hydro-meteorological seasonal hindcast experiments over Europe

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Extreme hydrometeorological events (e.g., floods, droughts and heat waves) caused serious damage to society and infrastructures over Europe during the past decades. Developing a seamless and skillful operational seasonal forecasting system of these extreme events is therefore a key tool for short-term decision making at local and regional scales.

The EDgE project funded by the Copernicus programme (C3S) provides an unique opportunity to investigate the skill of a newly created large multi-model hydro-meteorological ensemble for predicting extreme events over the Pan-EU domain at a higher resolution 5×5 km^2.

Two state-of-the-art seasonal prediction systems were chosen for this project. Two models from the North American MultiModel ensemble (NMME) with 22 realizations, and two models provided by the ECMWF with 30 realizations. All models provide daily forcings (P, Ta, Tmin, Tmax) of the the Pan-EU at 1°. Downscaling has been carried out with the MTCLIM algorithm (Bohn et al. 2013) and external drift Kriging using elevation as drift to induce orographic effects. In this project, four high-resolution seamless hydrologic simulations with the mHM (www.ufz.de/mhm), Noah-MP, VIC and PCR-GLOBWB have been completed for the common hindcast period of 1993-2012 resulting in an ensemble size of 208 realizations.

Key indicators are focussing on six terrestrial Essential Climate Variables (tECVs): river runoff, soil moisture, groundwater recharge, precipitation, potential evapotranspiration, and snow water equivalent. Impact Indicators have been co-designed with stakeholders in Norway (hydro-power), UK (water supply), and Spain (river basin authority) to provide an improved information for decision making. The Indicators encompass diverse information such as the occurrence of high and low streamflow percentiles (floods, and hydrological drought) and lower percentiles of top soil moisture (agricultural drought) among others.

Preliminary results evaluated at study sites in Norway, Spain, and UK indicate that extreme events such as the 2003 European drought can be forecasted consistently by all models at short lead times of one to two months. At six month lead time, the 208 model realizations show little skill to forecast extreme events. The predictability of extreme events is not uniformly distributed across Europe. For example, Northern Europe exhibits higher predictability due to the persistence induced by cold processes (e.g., snow). In general, the major source of poor forecasting skill is the little skill in precipitation forecast.

References

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