Geophysical Research Abstracts
Vol. 21, EGU2019-14755, 2019
EGU General Assembly 2019

Range-dependent threshold uncertainty in global flood early warning

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Early warning systems (EWS) for river flooding have gradually become strategic tools for effective disaster risk management over many regions of the world in recent years. When driven by ensemble Numerical Weather Prediction (NWP) forecasts, flood EWS can nowadays provide skilful streamflow forecasts even beyond the monthly time scale in large river basins. For effective flood detection, accurate estimation of warning thresholds is essential, to represent the hazard levels reliably along the entire river network and forecast horizon.
This research introduces a novel approach to estimate warning thresholds which retain statistical consistency with the operational hydrological forecasts at all lead times. The procedure is developed in the context of the Global Flood Awareness System (GloFAS) of the Copernicus Emergency Management Service (CEMS). A 21-year, forecast-consistent ensemble hindcast dataset with 11 members is used to derive different flood thresholds with global coverage and forecast range up to several weeks ahead. Reference thresholds, computed from the baseline ERA5 global reanalysis simulation over 1986-2017, are compared with thresholds derived using different sampling configurations of the 21-year ensemble dataset.
Findings show that in the current 30-day GloFAS forecasts, constant thresholds based on ERA5 can be consistently used throughout the entire forecast range in only a relatively short part of the river network, depending on the flood return period. In addition, it is shown that the sample configuration chosen to compute the thresholds, i.e using only the control forecast member or a randomly chosen ensemble member of the 21-year hindcast dataset, has a very significant impact on the thresholds and subsequently on the related skill of the GloFAS forecasts.
It is argued that range-dependent thresholds, that provide the best similarity to the ensemble forecast characteristics, should replace time-constant thresholds to improve model consistency as well as the skills in flood monitoring and early warning.