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Impacts of ENSO on global hydrology

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The economic consequences of flooding are huge, as exemplified by recent major floods in Thailand, Pakistan, and Australia. Moreover, research shows that economic losses due to flooding have increased dramatically in recent decades. Whilst much research is being carried out to assess how this may be related to socioeconomic development (increased exposure to floods) or climate change (increased hazard), the role of interannual climate variability is poorly understood at the global scale. We provide the first global assessment of the sensitivity of extreme global river discharge to the El Niño Southern Oscillation (ENSO). Past studies have either: (a) assessed this at the local scale; or (b) assessed only global correlations between ENSO and mean river discharge. Firstly, we used a daily observed discharge dataset for 622 gauging stations (from the GRDC database), and assessed and mapped correlations and sensitivities between these time-series and several indices of ENSO. We found that, on average, for the stations studied ENSO has a greater impact on annual high-flow events than on mean annual discharge, especially in the extra-tropics. However, the geographical coverage of the dataset is poor in some regions, and is highly skewed towards certain areas (e.g. North America, Europe, and eastern Australia). This renders a truly global assessment of ENSO impacts impossible based on these observed time-series. Hence, we are also using a modelling approach to estimate correlations and sensitivities in all basins, gauged and ungauged. For this, we are using a gridded time-series of modelled daily discharge from the EU-WATCH project, and analysing relationships between these time-series (per grid-cell) and indices of ENSO. This allows for the first truly global assessment of the impact of ENSO variability on river discharge; these analyses are ongoing. Of course, this approach entails its own problems; the use of global hydrological models to derive daily discharge time-series introduces its own uncertainties. Hence, the results derived from the modelling exercise will be validated against the results derived from the observed data. The quantification of ENSO impacts provides relevant information for water management, allowing the identification of problem areas and providing a basis for risk assessments.