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Global flood risk response to large-scale land-ocean-atmospheric interactions

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Introduction

The social and economic impacts of flooding are huge, as exemplified by recent floods in Thailand, Pakistan, and the Mississippi. Much research assesses how this may be related to socioeconomic development or climate change, but the role of **interannual climate variability** is poorly understood. We provide the first global assessment of the effects of El Niño Southern Oscillation (ENSO) on flood impacts, e.g. economic damage or affected population.

Research approach

We carried out the research through the following steps (Figure 1):

1. Used gridded daily temperature & precipitation from the EU-WATCH project (0.5º x 0.5º)
2. Simulated daily flood volumes for the period 1958-2000 using PCRGLOB-WB (0.5º x 0.5º)
3. Estimated flood volumes per grid-cell for flood return periods (RP) from 1 to 100 years, using extreme value statistics (Gumbel distribution) (0.5º x 0.5º)
4. Simulated inundation extent and depth for different RPs using dynRout (1km x 1km)
5. Combined inundation maps with socioeconomic data (e.g. population, asset values) to calculate flood risk.

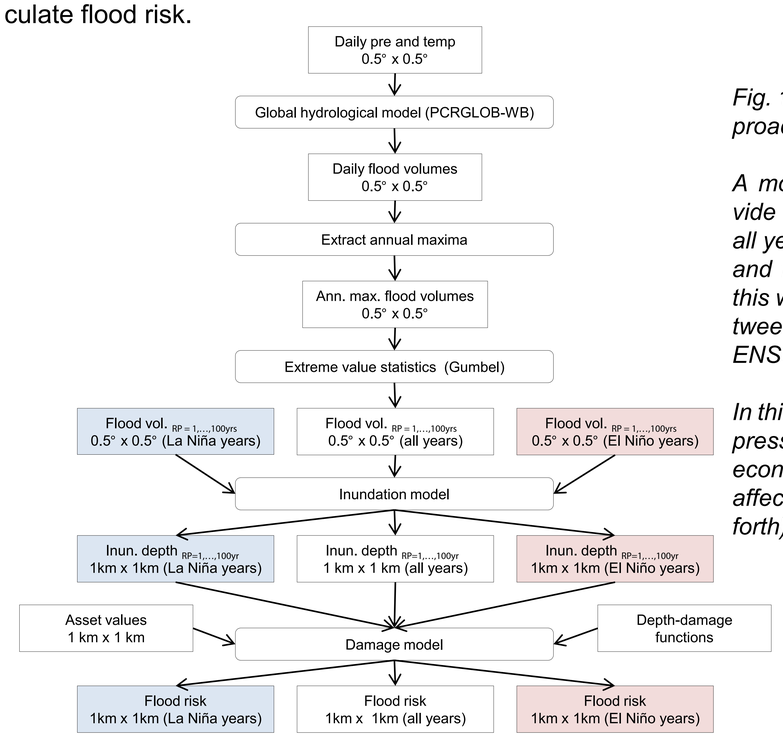

Fig. 1: Overview of research approach.

A model chain is used to provide estimates of flood risk for all years, for El Niño years only, and for La Niña years only. In this way, the anomaly in risk between the different phases of ENSO can be assessed.

In this approach, flood risk is expressed as indicators such as economic damage, loss of life, affected population, and so forth)

Flood risk anomalies between ENSO and neutral years

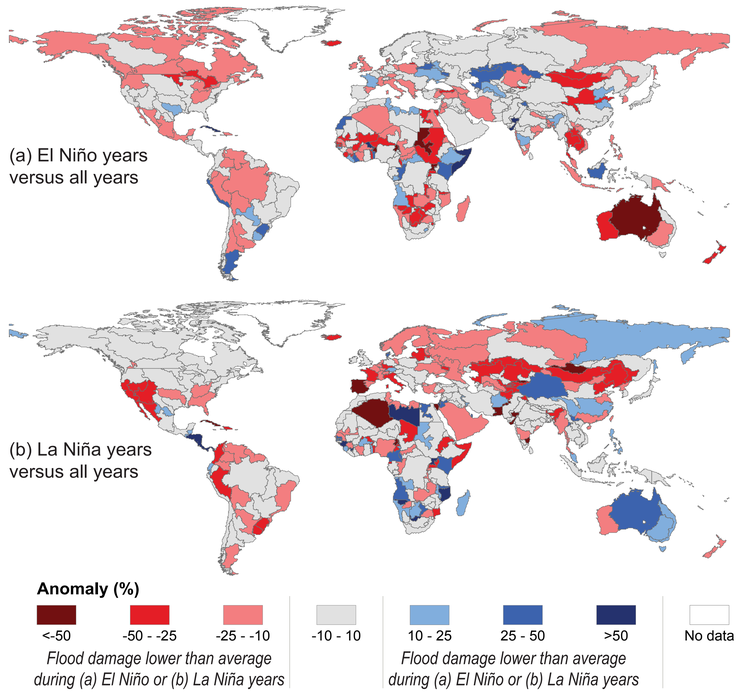

Fig. 2: Percentage anomalies in flood damage between (a) El Niño years and non-El Niño years, and (b) La Niña years and non-La Niña years

In Figure 2, clear relationships can be seen between economic flood damage and the different phases of ENSO (El Niño and/or La Niña.

The results shown here are for one indicator of flood risk (direct economic damage in urban regions), but the tool also allows for the simulation of ENSO impacts for a wide range of flood impact indicators, such as mortality, affected population, and affected (critical) infrastructure.

Conclusions and outlook

This study shows results of a spatially distributed global-scale assessment of the effects of ENSO on flood risk. The methods are being extended to assess the impacts of a wide range of land-ocean-atmospheric interaction, such as PDO, NAO, and so forth.

The implications for flood management and adaptation are large. For example, by linking the results to the predictability of ENSO, probabilistic flood risk forecasts could be developed, enabling humanitarian and development agencies to prioritise short-term risk reduction efforts and contingency planning in the most at risk regions.

Further reading

Ward, P.J. et al., 2011. Sensitivity of river discharge to ENSO. Geophysical Research Letters, 37, L12402, doi:10.1029/2010GL043215.

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