Can we really use El Niño to predict flood hazard?


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Why El Niño?

• Most dominant pattern of climate variability - ENSO
• Pacific Ocean temperatures fluctuate:
  • La Niña = abnormally cool Pacific
  • El Niño = abnormally warm Pacific
• Results in changes in atmospheric circulation
El Niño & La Niña affect river flow & flooding around the globe!
Can we use El Niño to predict floods and provide earlier warnings?
Why?

- Earlier awareness of floods and droughts could benefit many water-related sectors
- If we can estimate the likelihood of flooding, we can help to prepare for it
- Global overviews are key for organisations working at the global scale
Why?

So how do we estimate the likely impacts of El Niño / La Niña?

And how good are these estimations?
Historical Probabilities

- Likelihood (%) based on what has happened during past El Niños / La Niñas
- Provide useful information based on historical evidence
Historical Probabilities

- Typically, historical probabilities of extreme rainfall are used as a proxy for flooding
  - Due to a lack of hydrological analyses

- However...
  - The nonlinearity between precipitation and floodiness highlights the need to estimate these probabilities using hydrological data

Stephens et al., 2015: Precipitation and Floodiness, GRL, 42
Historical Probabilities

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The motivation behind our work was to provide similar information, but taking into account the hydrology as well as the meteorology, aiming to answer the question: “what is the probability of flooding during El Niño / La Niña?”
Hydrological Data: ERA-20CM-R

20th Century (1901-2010) reconstruction of daily river flow for the global river network

- Produced by forcing the CaMaFlood routing model with ERA-20CM
  - 125km horizontal resolution meteorological reconstruction downscaled to 0.5° (~50km)
  - 10 ensemble members representing uncertainty in the data
- Obtained a dataset with consistent global coverage for an extended time period
  - Containing 30 El Niños, 33 La Niñas
Can we use El Niño to predict flood hazard?

How likely is it that flood hazard will be *increased* (or *decreased*) during El Niño?

- Probability (%) of low river flow
- Probability (%) of high river flow

June
What about the Uncertainty?

- Uncertainty in the response, vs. uncertainty in the data

- How might this impact decision-making?
Importance of the Hydrology
Maximum Probabilities

- Quick, global overviews
- Where is likely to see an influence on river flow during El Niño / La Niña?
“We conclude that while it may seem possible to use historical probabilities to evaluate regions across the globe that are more likely to be at risk of flooding during an El Niño/La Niña… the reality is much more complex.”

Emerton et al., 2017: Complex Picture for Likelihood of ENSO-Driven Flood Hazard, Nature Communications, 8:14796
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