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This week's paper

Exploring the ENSO Impact on Basin-Scale Floods Using Hydrological Simulations and TRMM Precipitation

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Motivation

- ENSO impacts global floods
 - \circ precipitation
 - weather
 - atmospheric circulations
- Limitation of previous studies by scattered streamflow data
- Higher impact on annual high-flow events than on mean annual discharge
- Improve flood (impact) forecasts
- "Collective " measure of ENSO impact on river basins
 - Comparison of ENSOs impact on floods and ENSOs impact on precipitation

Data

- TRMM period (1998 2013)
- Dominant river Routing Integrated with VIC Environment model (DRIVE)
 - \circ spatial resolution: (0.125° x 0.125°)
- Global and more detailed analysis of ENSOs impact on river basins
- Niño 3.4 Index

Definition of a flood event

- Flooding event when the routed runoff is greater than the predefined flood threshold
 - R: routed runoff, δ : standard deviation, 0

P95: 95th percentile, Q: discharge in m³/s

min. of 4 time steps with: 0

 $R > P95 + 0.5 \cdot \delta$ and Q > 10

Flood indices

Flood Frequency (FF)	Flood Duration (FD)	Flood Intensity (FI)	Total Flood Intensity (FTI)
<u>Total Number of flood events</u> Total days in month	Total Number of flood duration total flood events per month	Total flood intensity Total number of flood events in calendar month	Total flood intensity in a calendar month
in [^{numbers} / day]	in [^{hours} /event]	in [^{mm} / event]	in [^{mm} / month]

Peak flood months



Peak months for precipitation



- consistent with peak months for FF and FD
- 1 month time lag
 - might reflect routing time



Precipitation indices

Pr	Monthly mean precipitation rate		
Pr xx	Total R \ge xx mm day ⁻¹ precipitation/total days in a month		
F xx	Total rainy days (R \ge xx mm day ⁻¹)/total days in a month		
R xx	Total R \ge xx mm day ⁻¹ precipitation/ total days with R ³ mm day ⁻¹ in a month		
with R as daily rain rates			

Key points

- peak months for FF and FD seem consistent
- peak months for FI and FTI seem consistent
- peak months for FF/FD and peak precipitation months seem consistent
- spatially neighboring basins often show similar peak months

Correlation of Flood Indices and Niño 3.4



Figure 2. Simultaneous correlations between flood indices and Niño 3.4 in the respective peak months of four individual flood indices, i.e., (a) FF, (b) FD, (c) FI and (d) FTI. Striped lines denote those above the 90% confidence level.

Correlation of precipitation indices and Niño 3.4



Key points

- FF and FD show in general similar correlation with ENSO (sign)
- FI and FTI show in general similar correlation with ENSO (sign)
- FF/FD correlations with ENSO show similarities with correlations between precipitation indices and ENSO
 - \circ ~ ENSO effect on floods might go through related variations in precipitation
 - Higher correlations between ENSO and FF/FD than for the precipitation indices can be seen for many basins.
- No significant correlation for FI and FTI between 20°S and 20°N
 - \circ indication of possible other driving factors
- Flood Intensity FI/FTI might be more affected by other mechanisms than ENSO (less and smaller correlation)

Lagged correlation of floods with ENSO



Figure 3. The Niño 3.4 leading months (including zero-lag month) with the highest correlations between Niño 3.4 and flood indices, i.e., (a) FF, (b) FD, (c) FI and (d) FTI, corresponding to their respective peak months. Striped lines denote those above the 90% confidence level.

Lagged correlation of floods with maximums ENSO- leading months



Figure 4. The maximum Niño3.4 leading months with the correlations between Niño 3.4 and flood indices (i.e., (a) FF, (b) FD, (c) FI and (d) FTI) which can reach the 90% confidence level corresponding to their respective peak flood months.

Lagged correlation of precipitation with ENSO according to FD peak months



Key points

- General similarities between lags of max. correlations in FF and FD with ENSO
- General similarities between lags of max. correlation between FI and FTI with ENSO
- Significant correlations even with ENSO leading for several months in some basins
- Similar features for FF and FD lags and lags for precipitation indices in those regions.
 - Role of precipitation in modulating floods in those regions.
 - Other regions might be more complex and include other driving factors

Take home message

- Flood-prone river basins in the tropics and mid-latitudes show correlation with ENSO
- Significant ENSO correlations on river-floods even with high lags
- ENSO signals might be more noticeable in basin-scale streamflow than in precipitation.
 - might be a better indicator for water-cycle variations