MODULATION OF FLOOD ECONOMIC LOSSES BY THE NORTH ATLANTIC OSCILLATION

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RMS



OUTLINE

NAO and Precipitation

Does the North Atlantic Oscillation impact flood economic losses in Europe?

Data

NAO and losses – Model



NAO and river flows

NAO and losses –

"The North Atlantic Oscillation describes the changes in sea level pressure between the Azores high and the Icelandic low"



"The North Atlantic Oscillation describes the changes in sea level pressure between the Azores high and the Icelandic low"



- The NAO correlates highly with European precipitation patterns
- During **positive NAO** phases, stronger and more frequent storms travel Northern Europe, causing wetter than usual conditions, while Southern Europe is drier than usual
- During **negative NAO** phases, storms tend to travel across Southern Europe, causing drier than usual conditions in Northern Europe while Southern Europe is wetter

NAO EFFECT ON WINTER PRECIPITATION

- Correlation between NAO and E-OBS data at monthly level
- Winter precipitation only 1960 to 2010
- North-South seesaw pattern









The NAO displays long periods of positive or negative phase





The NAO displays long periods of positive or negative phase



Indirect effect through long-term wet/dry conditions

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What is the NAO when rivers peak across Europe?

- NAO is on average positive when rivers peak in Northern Europe
- NAO is on average negative when rivers peak in Southern Europe



[Bloschl et al. 2017, Science; Zanardo et al., 2019, GRL]



Do catastrophic flood events follow the same pattern?



- Distributions of NAO observed during historical flood events
- Winter flood events in Northern Europe occurred mostly during a **positive NAO** phase
- Winter flood events in Southern Europe do not show any particular trend

Hanze event dataset: 1950-2017 – data by country

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[Paproptny et al. 2018, ESSD; Zanardo et al., 2019, GRL]



Do catastrophic flood events follow the same pattern?



- Winter flood events in **UK** occurred mostly during a positive NAO phase
- Winter flood events in **Spain** occurred mostly during a **negative NAO** phase
- Clear pattern of occurrence can also be seen at monthly level

Hanze event dataset: 1950-2017

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[Paproptny et al. 2018, ESSD; Zanardo et al., 2019, GRL]



NEED FOR A FLOOD LOSS MODEL

Stochastic precipitation

 50,000 years of continuous precipitation across Europe with correlation with NAO based on historical data

RRM and river routing model

 Stochastic rainfall is fed to a rainfall-runoff model and a river routing model

SWE inundation

 Rainfall and river inundation is calculated using shallow water equation

Vulnerability and exposure

 50,000 years of flood events are used to compute damage from a vulnerability and exposure database



Losses

 Loss statistics for the whole European domain are derived

Impact of NAO on flood losses across Europe

- 4 large clusters of positive/negative effect of NAO on losses
- NAO variability is a strong source for loss correlation across countries
- Loss difference between opposite phases can reach 50%





CONCLUSIONS

- We examined whether the NAO has a significant impact on flood losses across Europe.
- Data show that the NAO has an impact on precipitation and flows.
- Catastrophic flood data show an NAO "signature" on the event occurrence, however loss data are scarce.
- The application of a probabilistic flood catastrophe model shows that the impact of NAO on losses is significant and it has specific spatial patterns.



THANK YOU

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