

Spatial dependence of floods and droughts: learning from differences in regional and seasonal patterns

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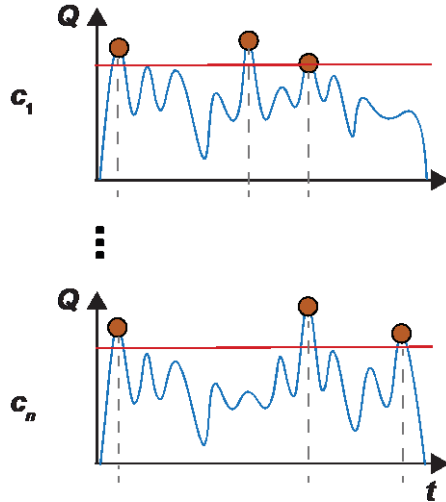
Motivation

- The spatial dimension of droughts and floods is often neglected when deriving hazard estimates.
- We know little about the processes governing the spatial dependencies of floods and droughts.

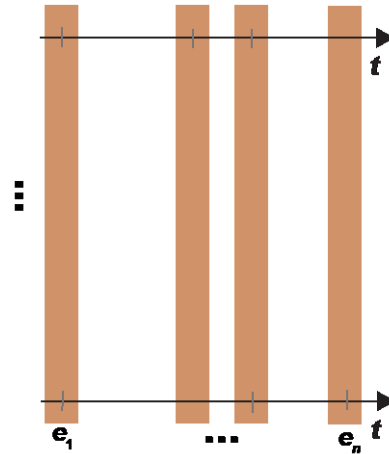
We investigate how spatial dependencies in floods and droughts vary seasonally and regionally over the United States.

Event identification

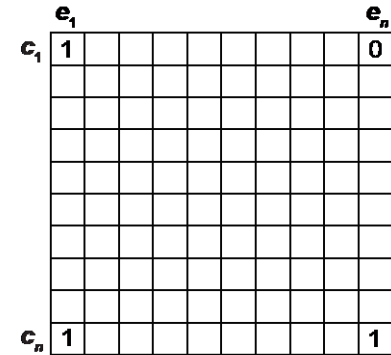
(1) Events at individual catchments: Peak-over-threshold (floods)/threshold level (droughts)



(2) Event occurrences across all catchments



(3) Binary occurrence matrix

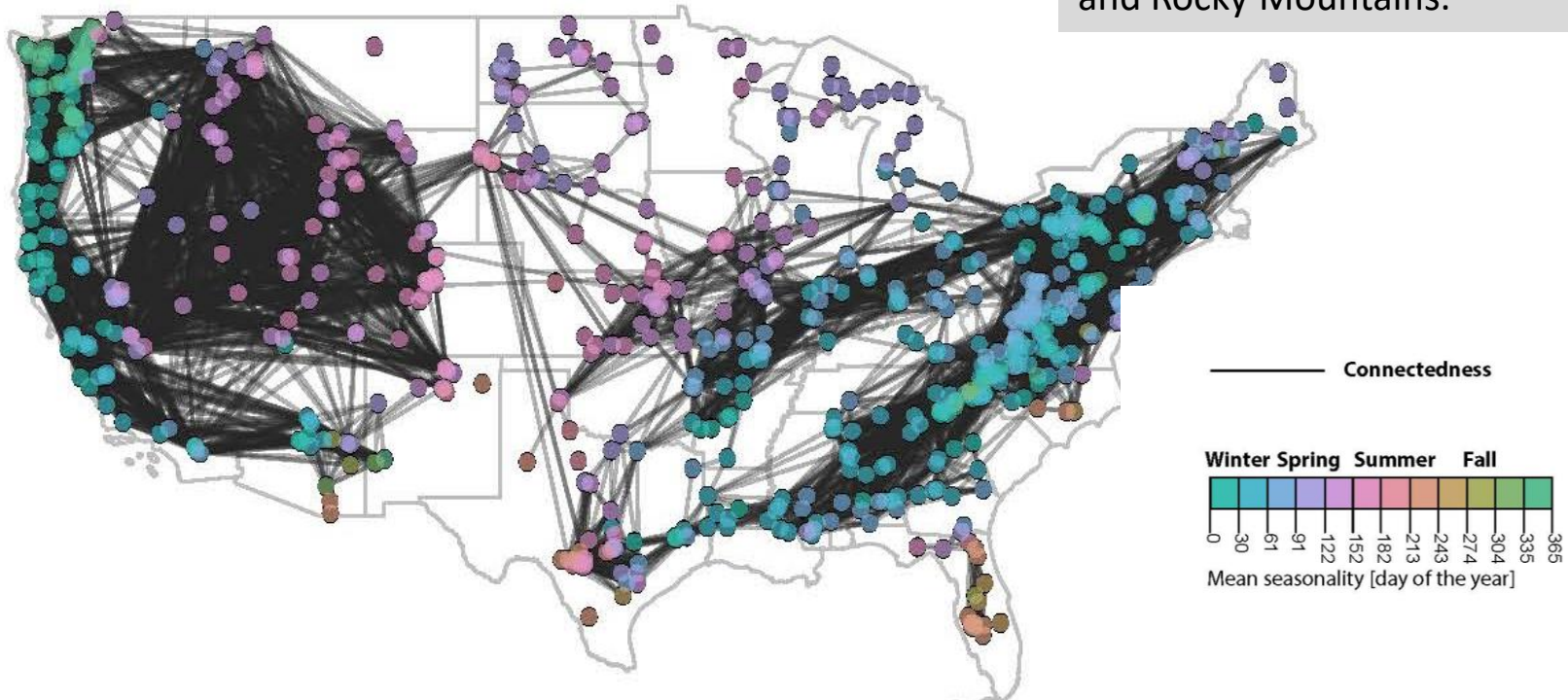


(4) Determination of flood/drought connectedness: number of catchments with which a specific catchment co-experiences flood/drought events

Spatial flood dependencies

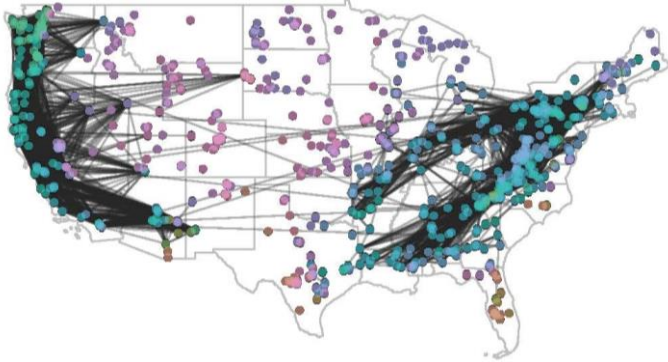
Spatial flood dependencies vary regionally and are strongest in the Pacific Northwest, the Appalachian and Rocky Mountains.

All seasons

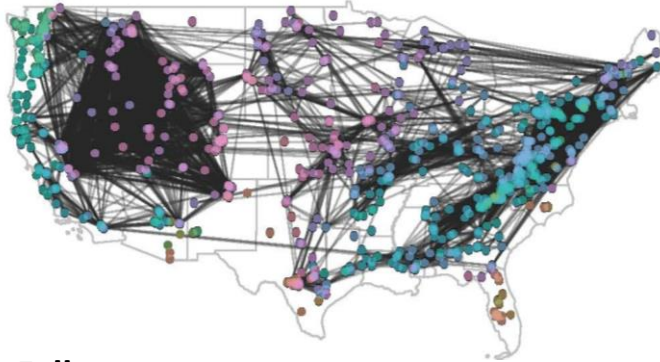


Seasonal variations in flood connectedness

Winter

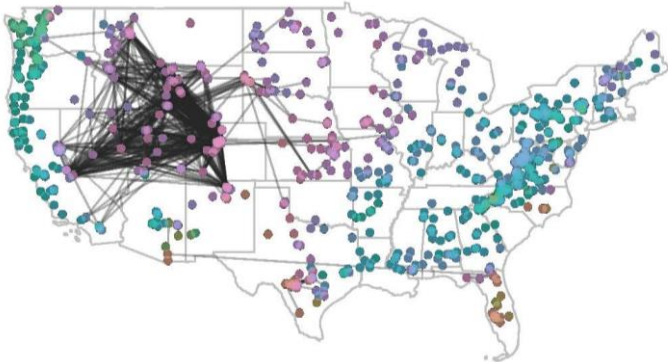


Spring

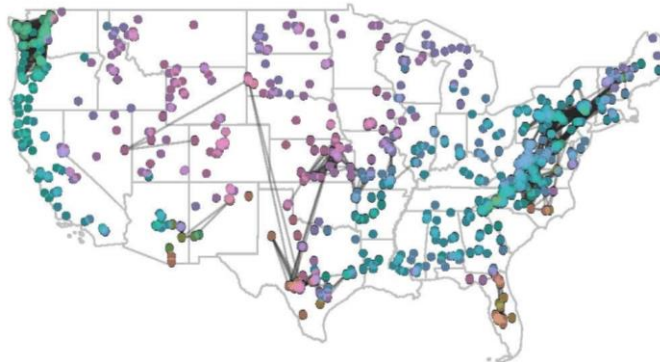


Spatial flood dependencies vary seasonally and are overall strongest in winter and spring.

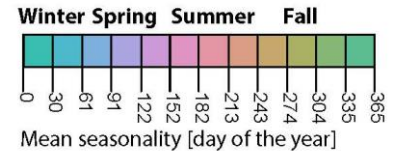
Summer



Fall



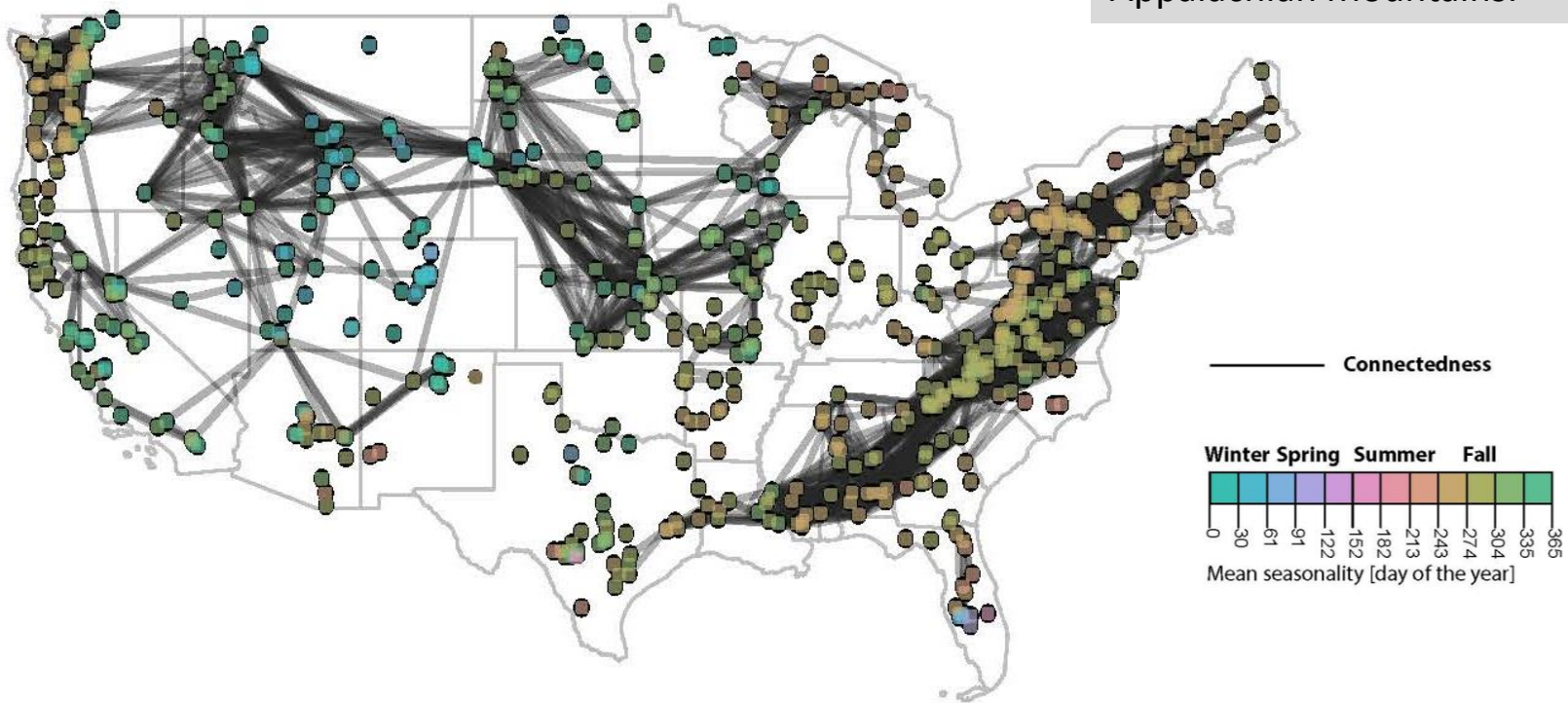
Connectedness



Spatial drought dependencies

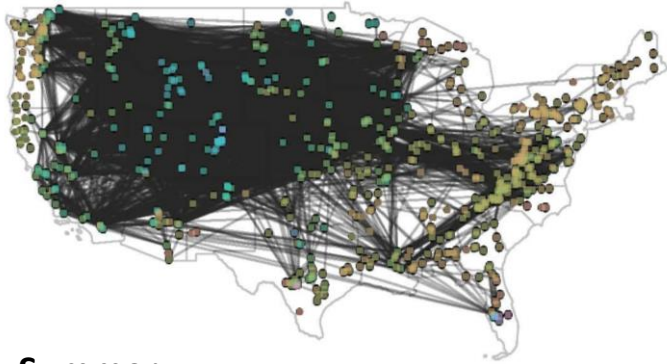
All seasons: fixed drought threshold (i.e. low flows)

Spatial drought dependencies also vary regionally and are strongest in the Pacific Northwest and the Appalachian Mountains.

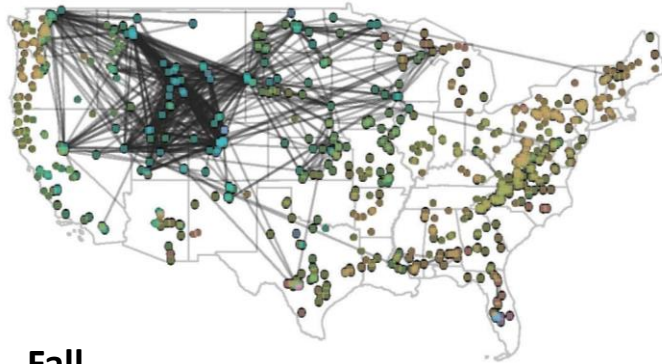


Seasonal variations in drought connectedness

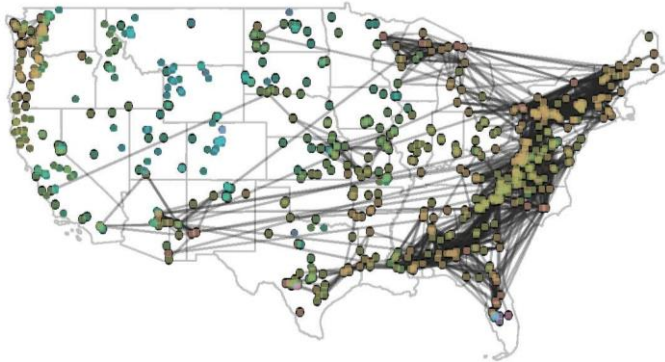
Winter



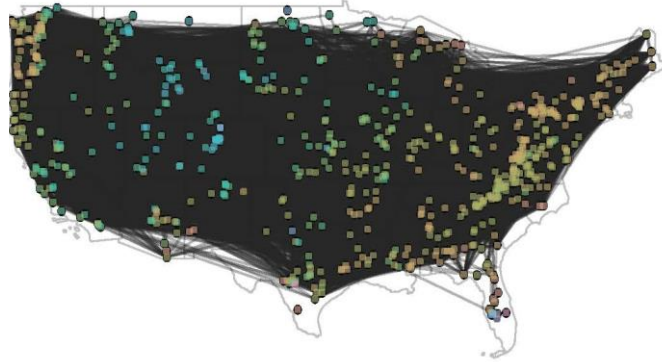
Spring



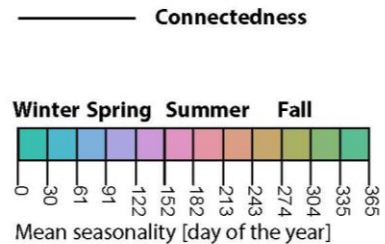
Summer



Fall

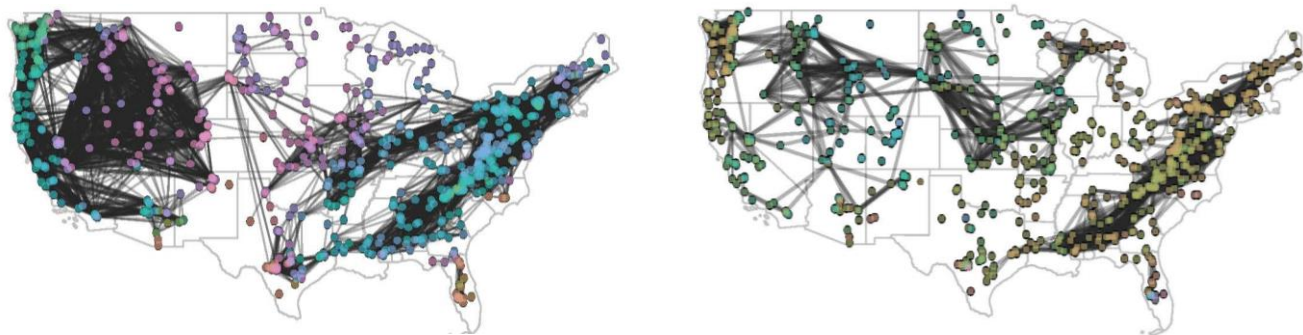


Spatial drought dependencies vary seasonally and are strongest in winter in the Rocky Mountains and strongest in fall elsewhere.



Conclusions

- (1) Meteorological and land surface processes shape the spatial dependence patterns of droughts and floods.
- (2) Seasonal and regional variations in flood and drought connectedness should be taken into account in regional hazard analyses.



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