

Non-linear time series analysis of precipitation events using regional climate networks for the region of Germany

Aljoscha Rheinwalt, Norbert Marwan,
Jürgen Kurths, Friedrich-Wilhelm Gerstengarbe and Peter Werner;
Niklas Boers and Bedartha Goswami

EGU 2013



POTS DAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

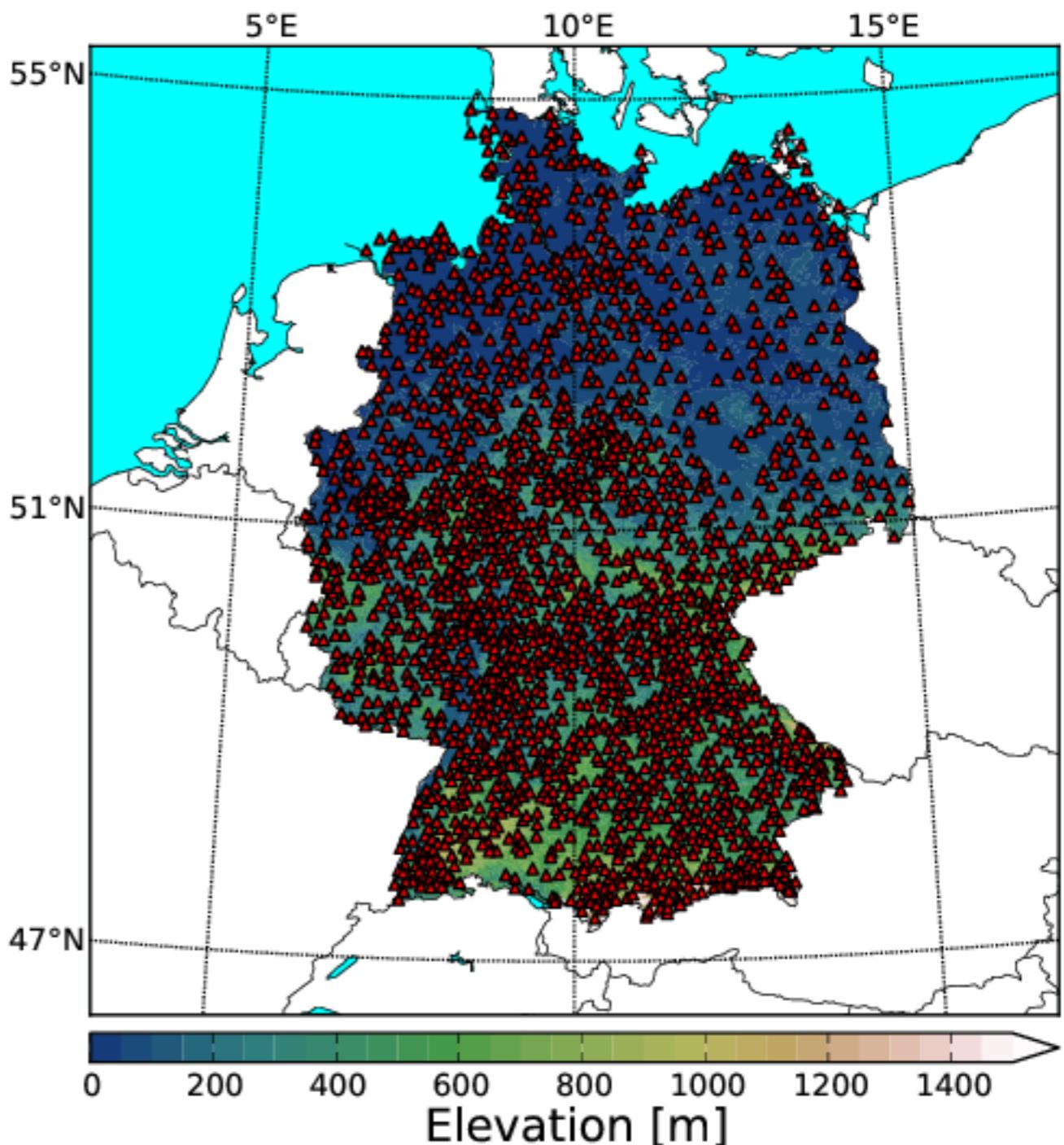
Data

Precipitation

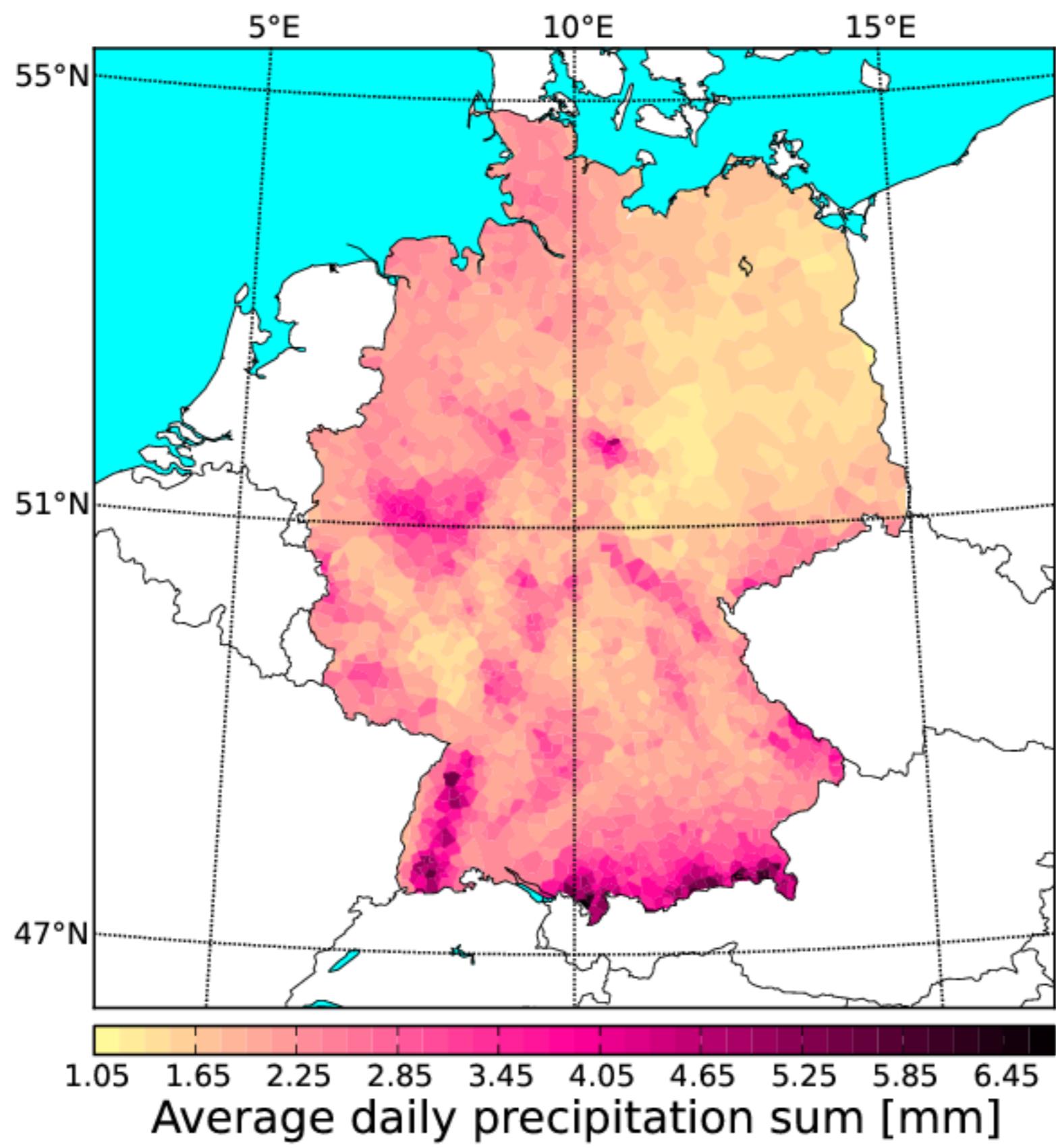
- More than 2300 weather stations.
- 56 years daily precipitation sums.
- Irregular sampled time series in space.
- No missing values and no interpolations.
- Provided by the German Weather Service (DWD) and the Potsdam Institute for Climate Impact Research (PIK).

Elevation

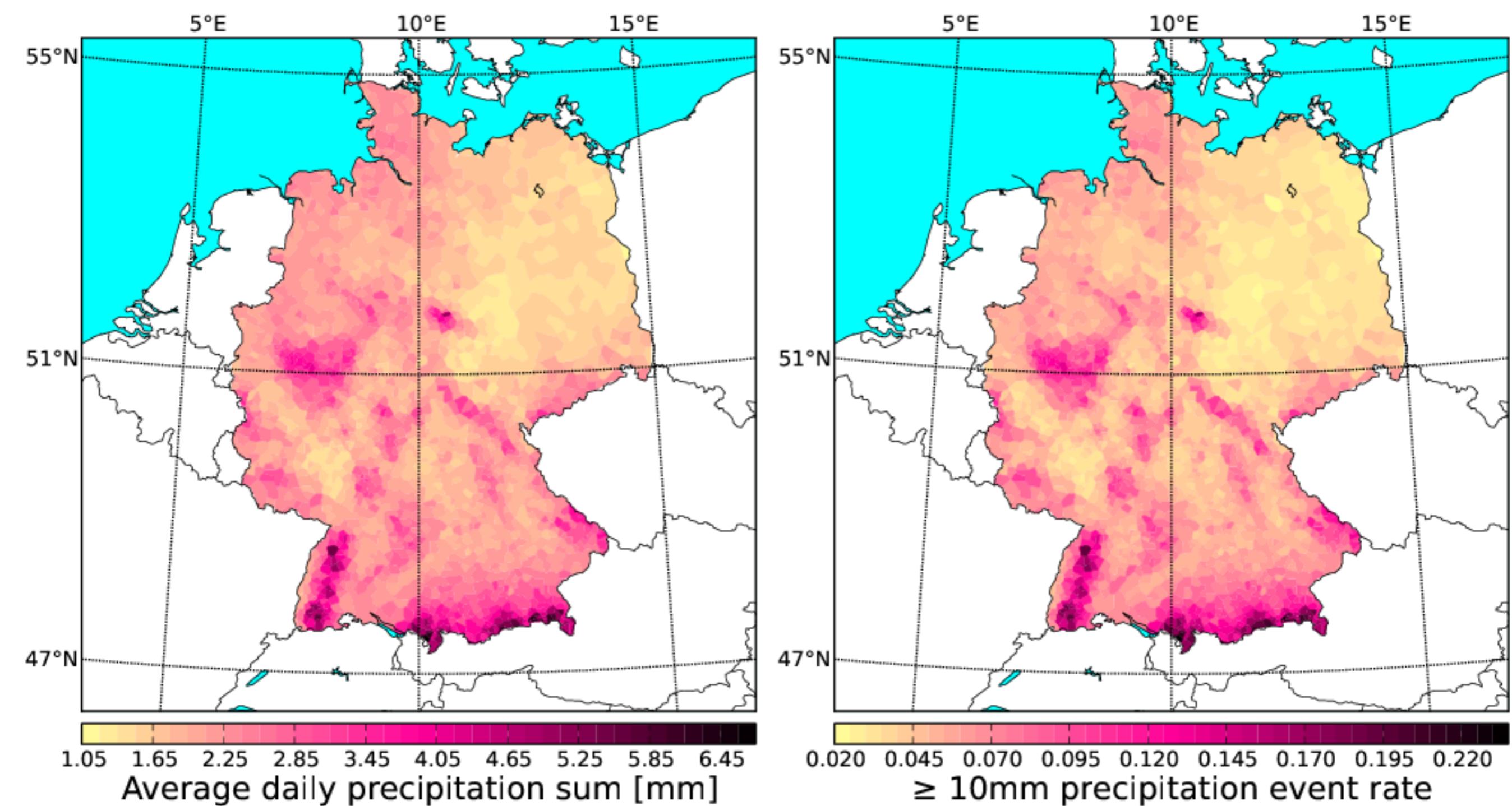
- 90m SRTM data set provided by CGIAR-CSI.



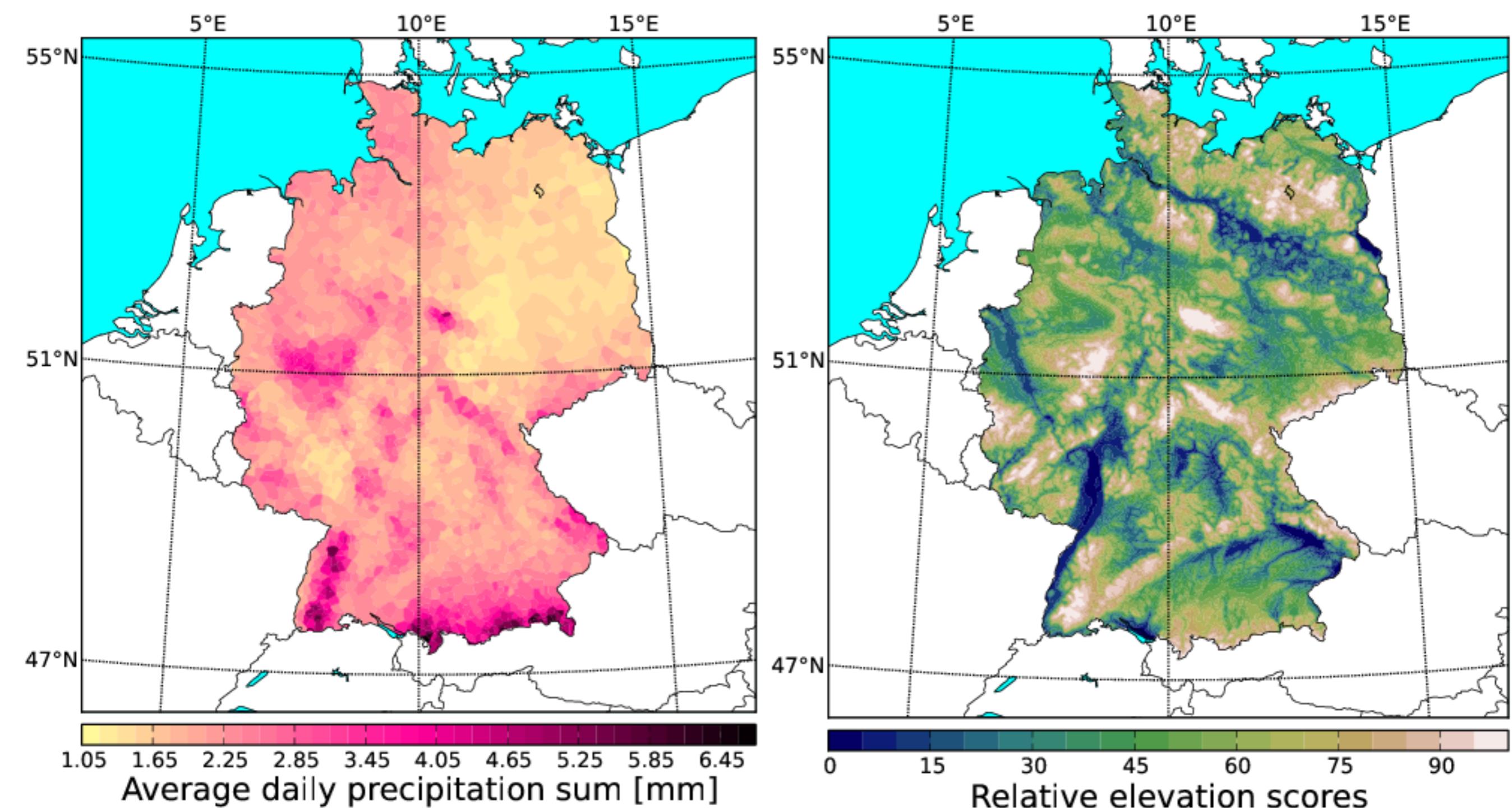
Motivation



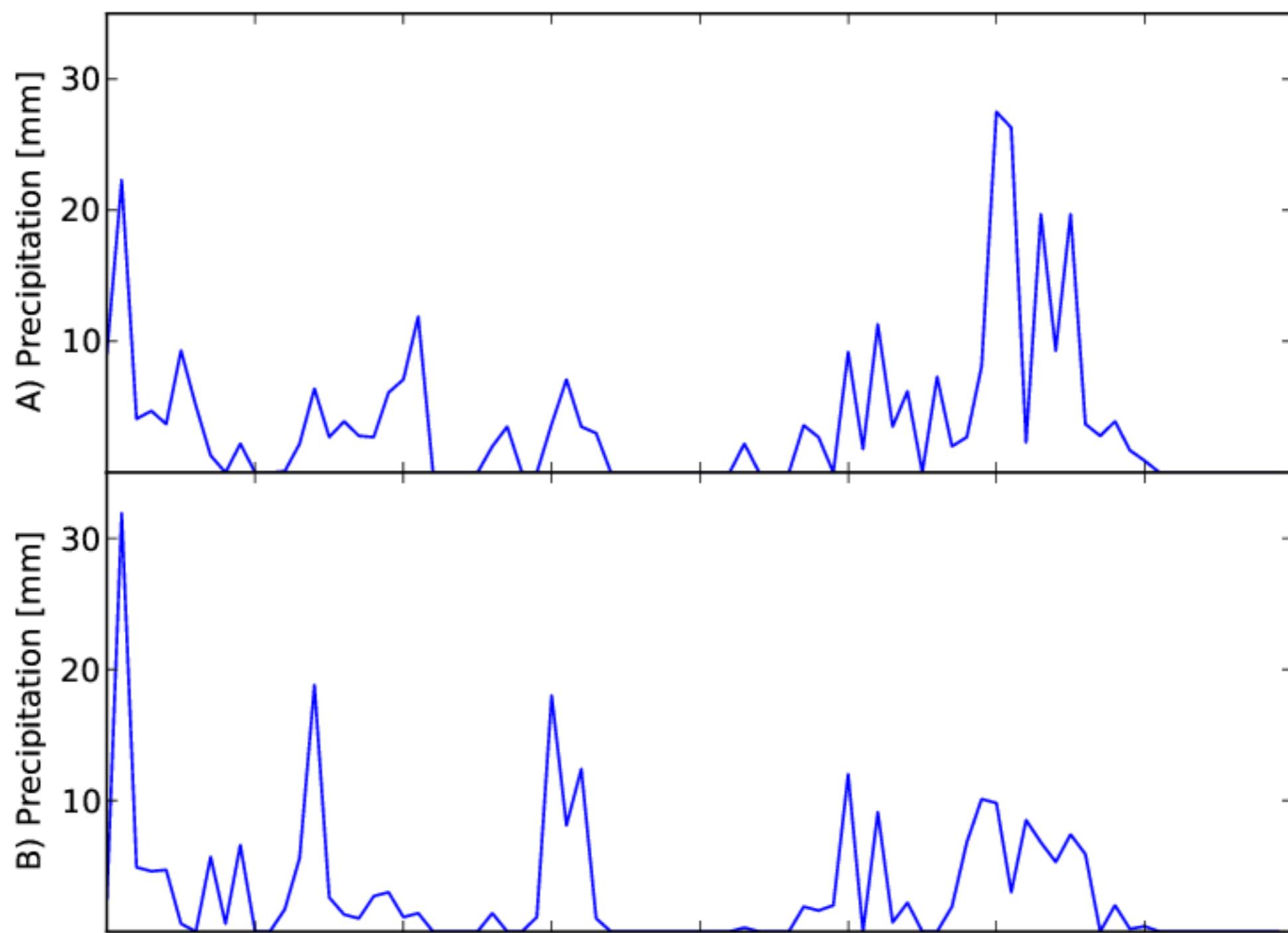
10mm threshold precipitation events



Precipitation and relative elevation

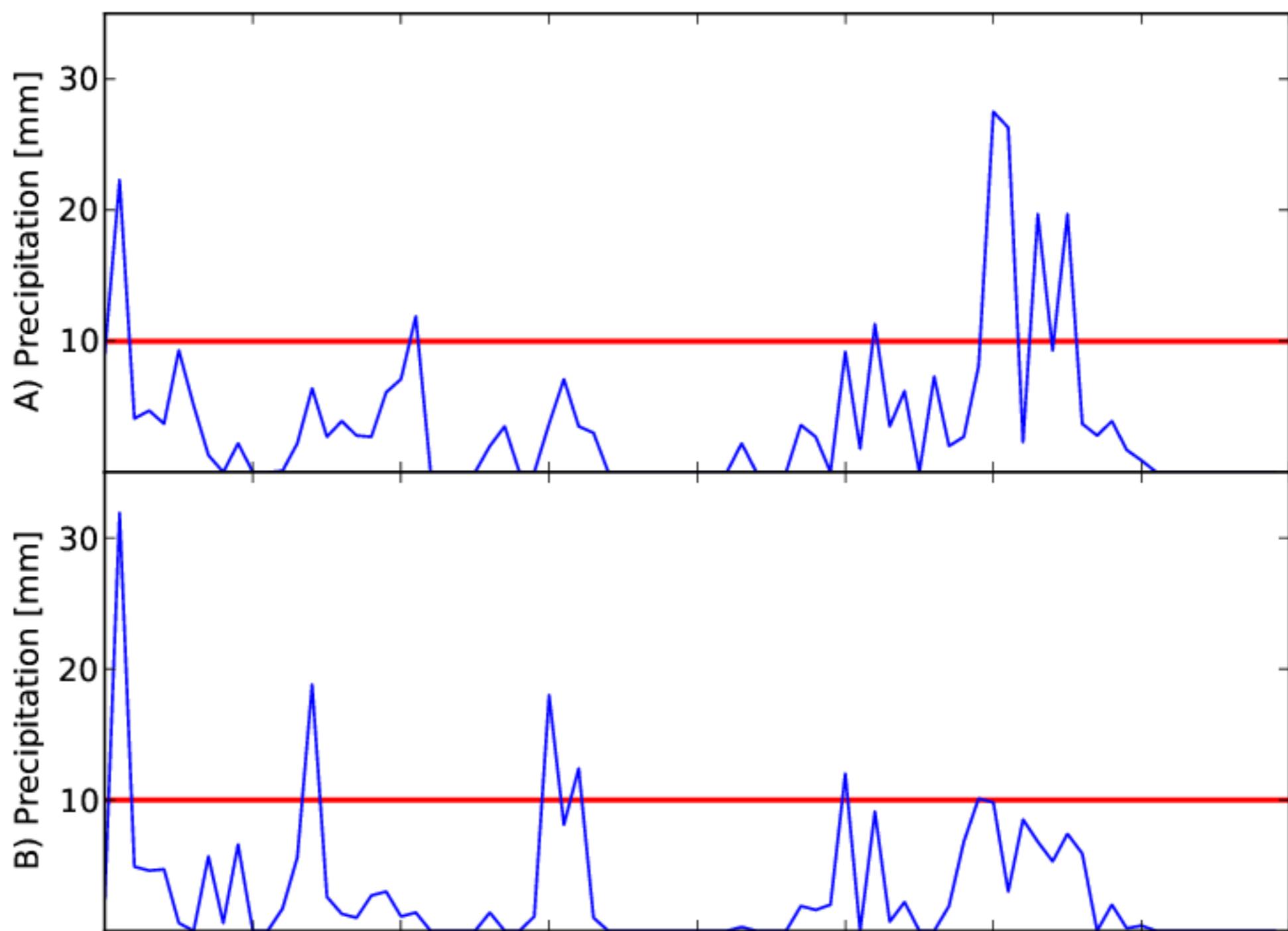


Event synchronization



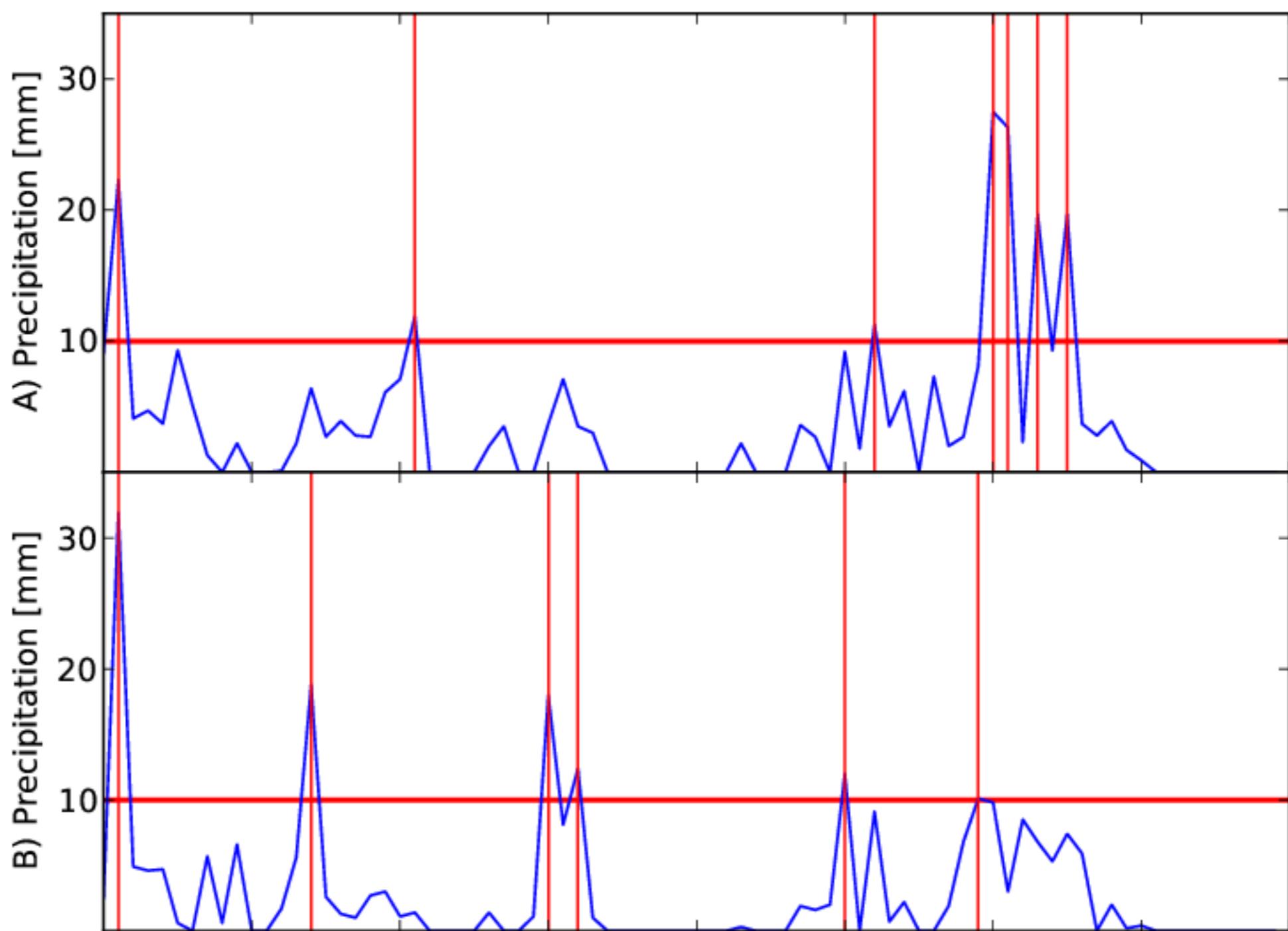
QUIROGA et al. *Phys. Rev. E* (2002), MALIK et al. *Clim. Dyn.* (2011).

Event synchronization



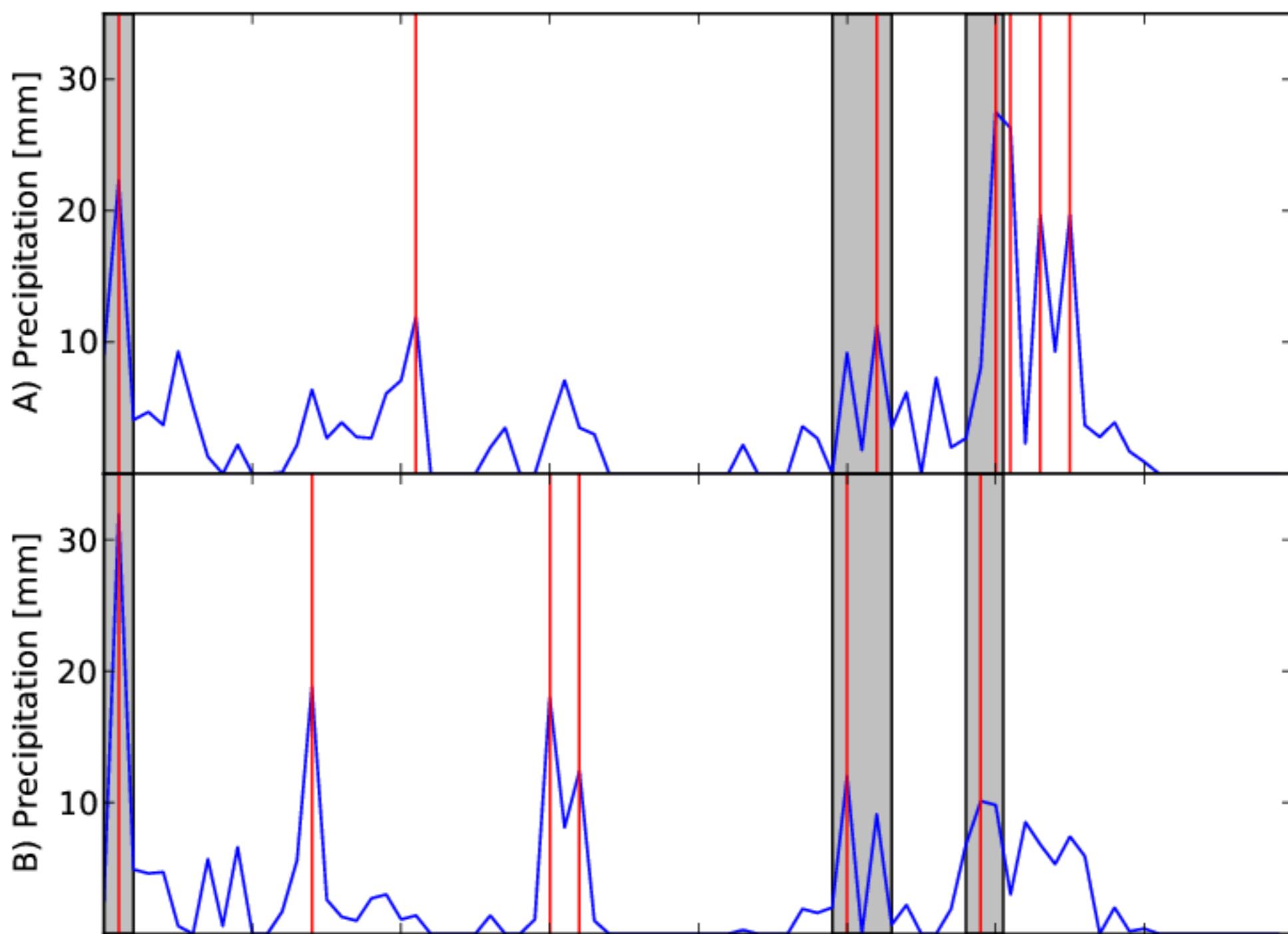
QUIROGA et al. *Phys. Rev. E* (2002), MALIK et al. *Clim. Dyn.* (2011).

Event synchronization



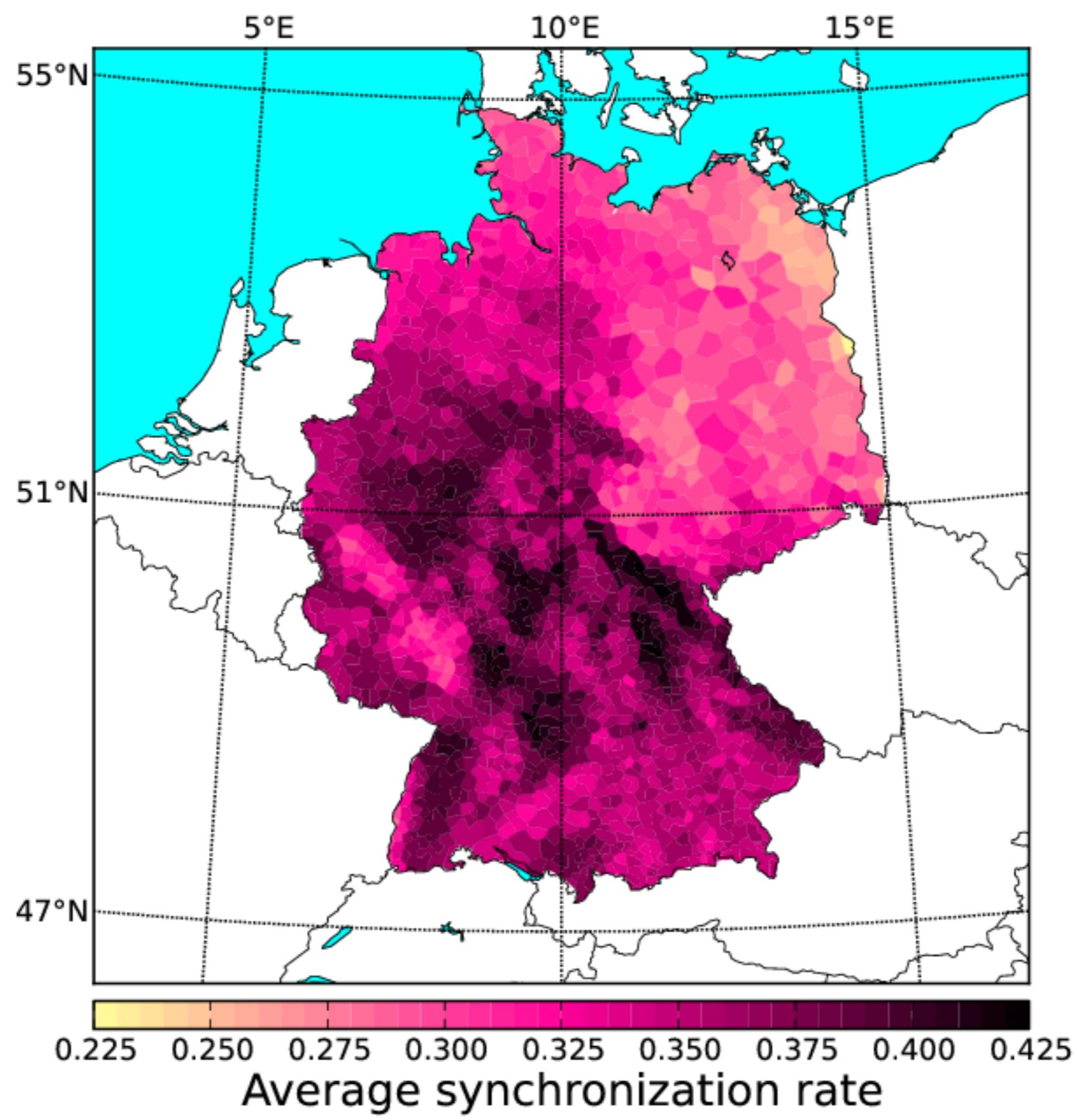
QUIROGA et al. *Phys. Rev. E* (2002), MALIK et al. *Clim. Dyn.* (2011).

Event synchronization

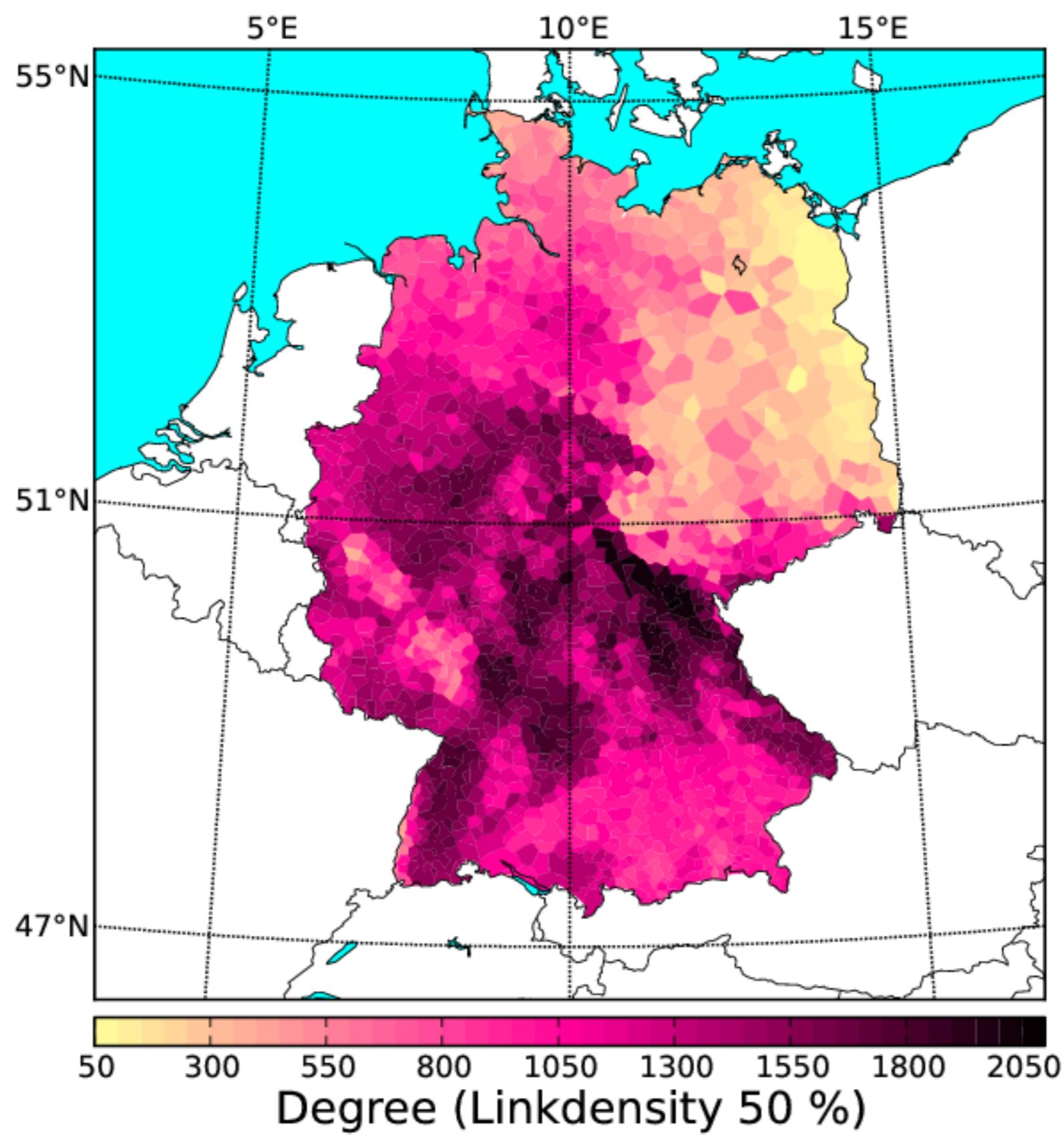


QUIROGA et al. *Phys. Rev. E* (2002), MALIK et al. *Clim. Dyn.* (2011).

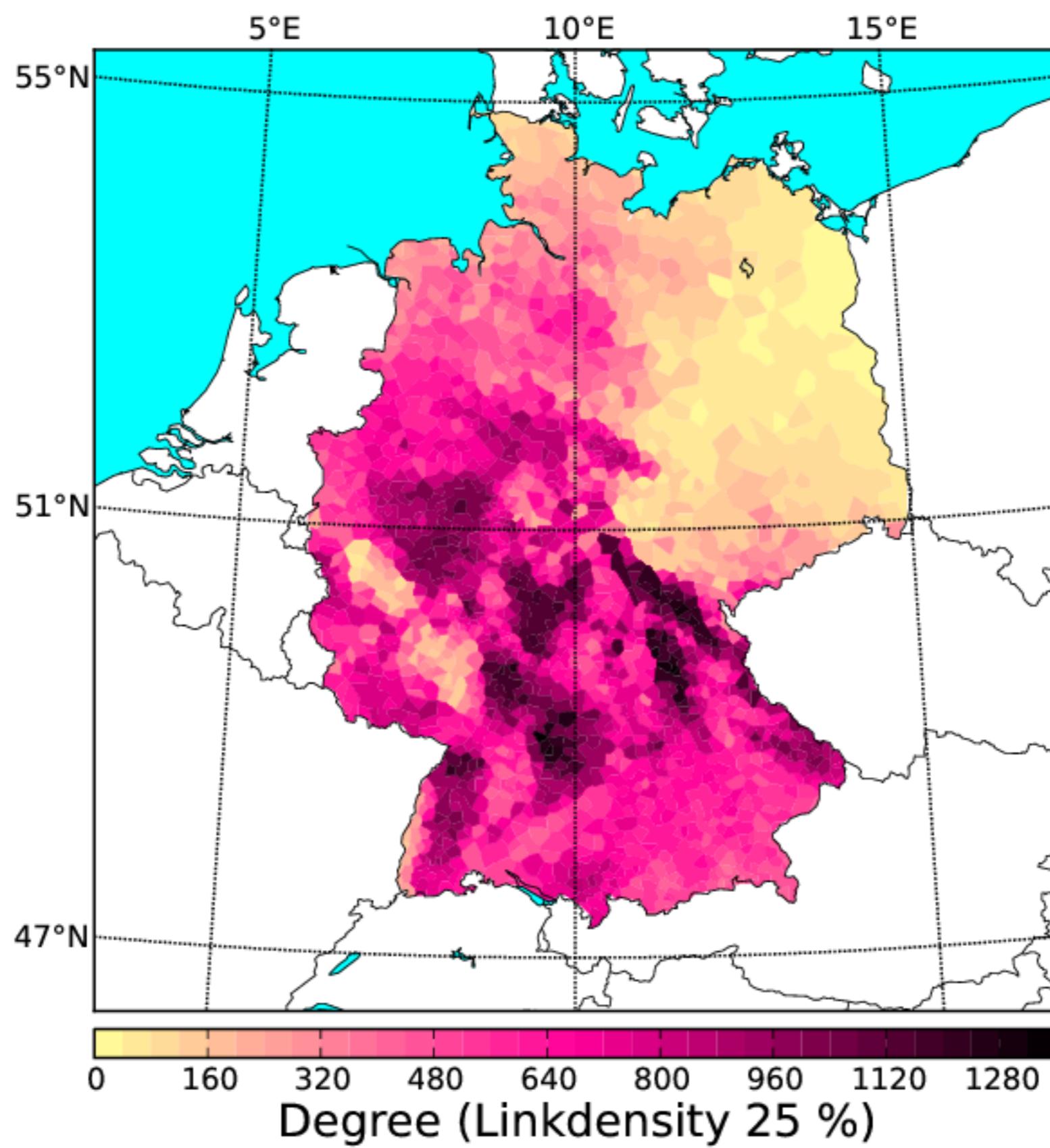
Synchronization strength



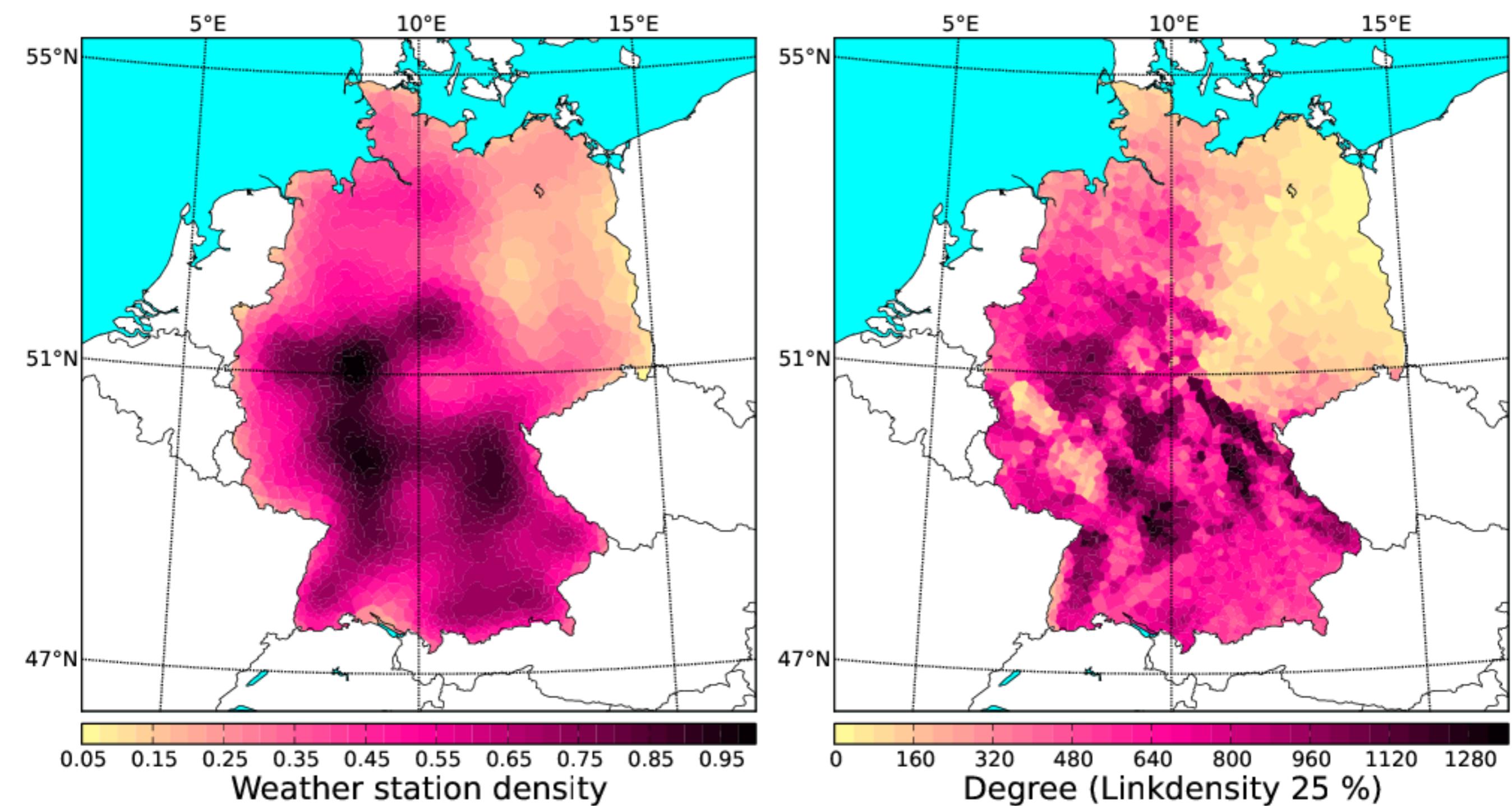
Undirected, unweighted networks



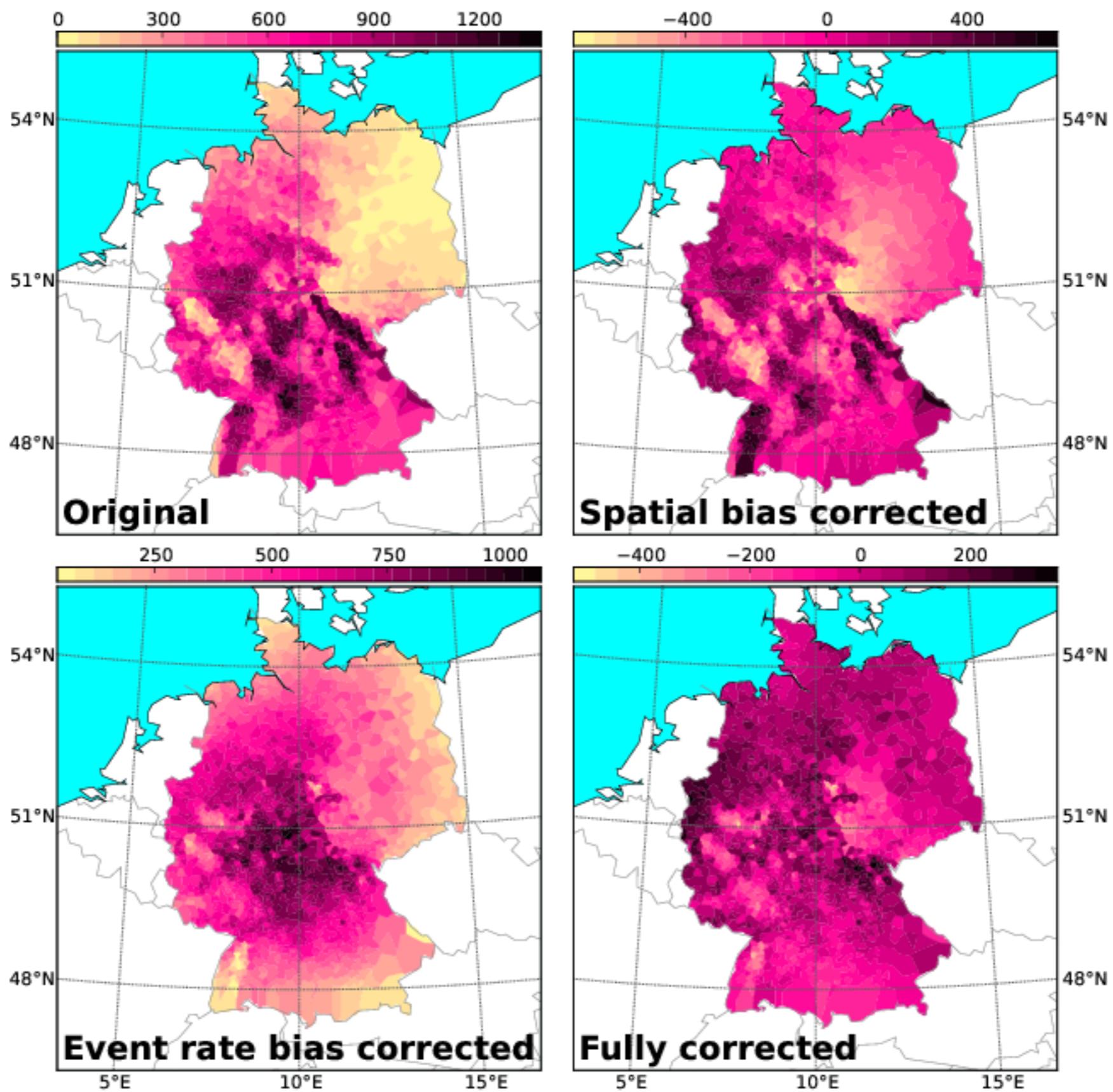
Undirected, unweighted networks



Spatial embedding effects

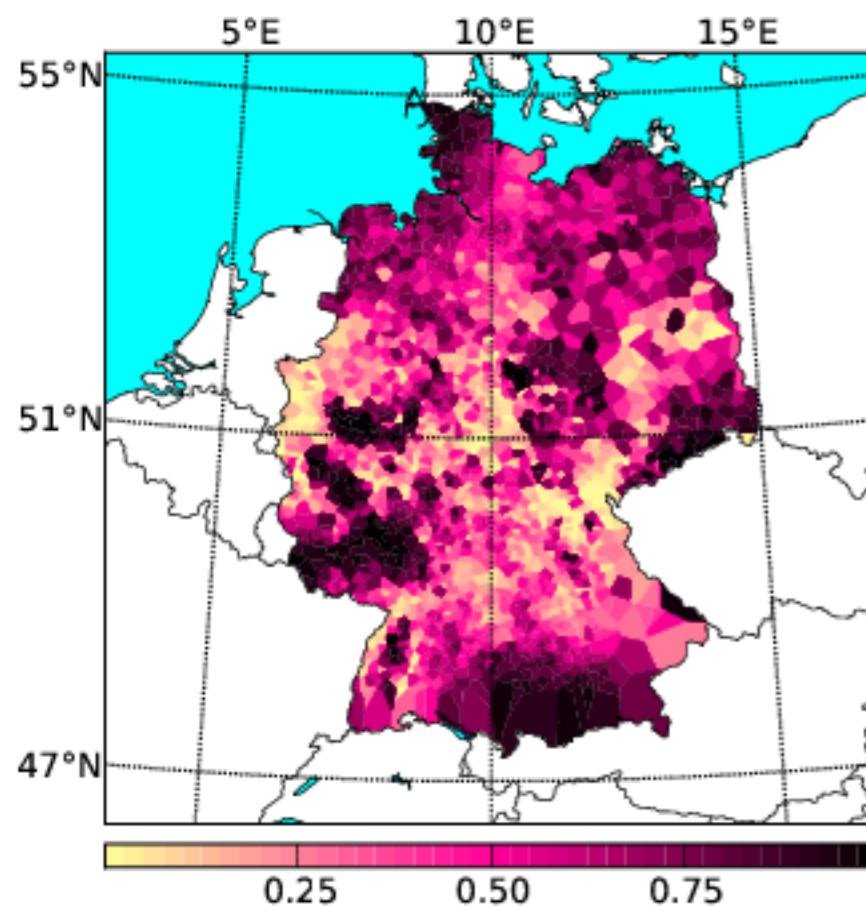


Spatial bias and event rate bias in Degree

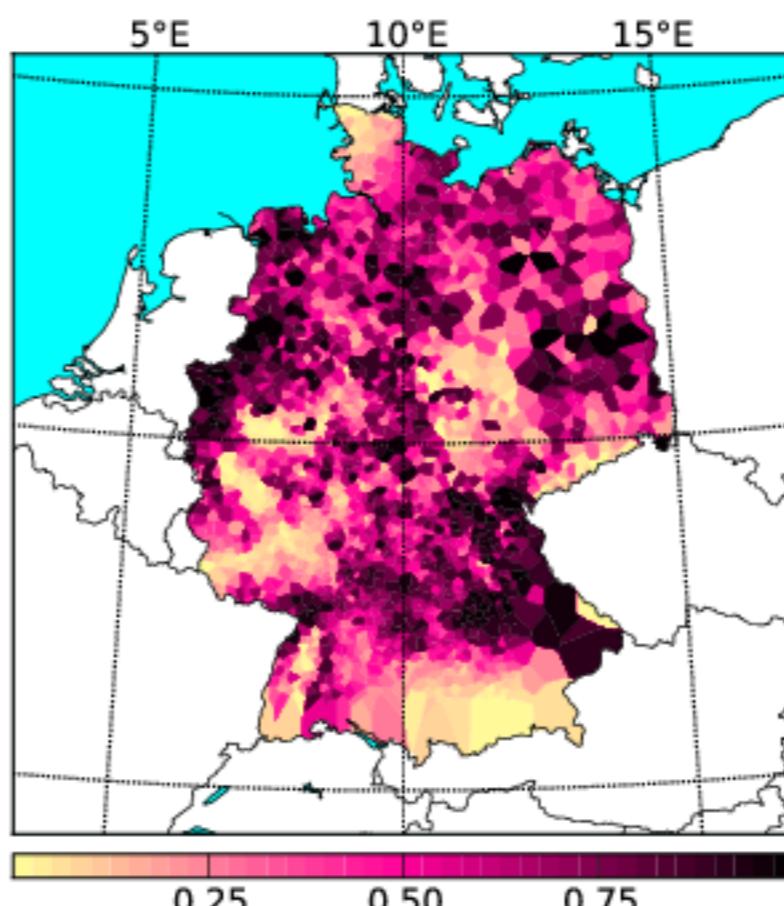


Case study for the region of Germany

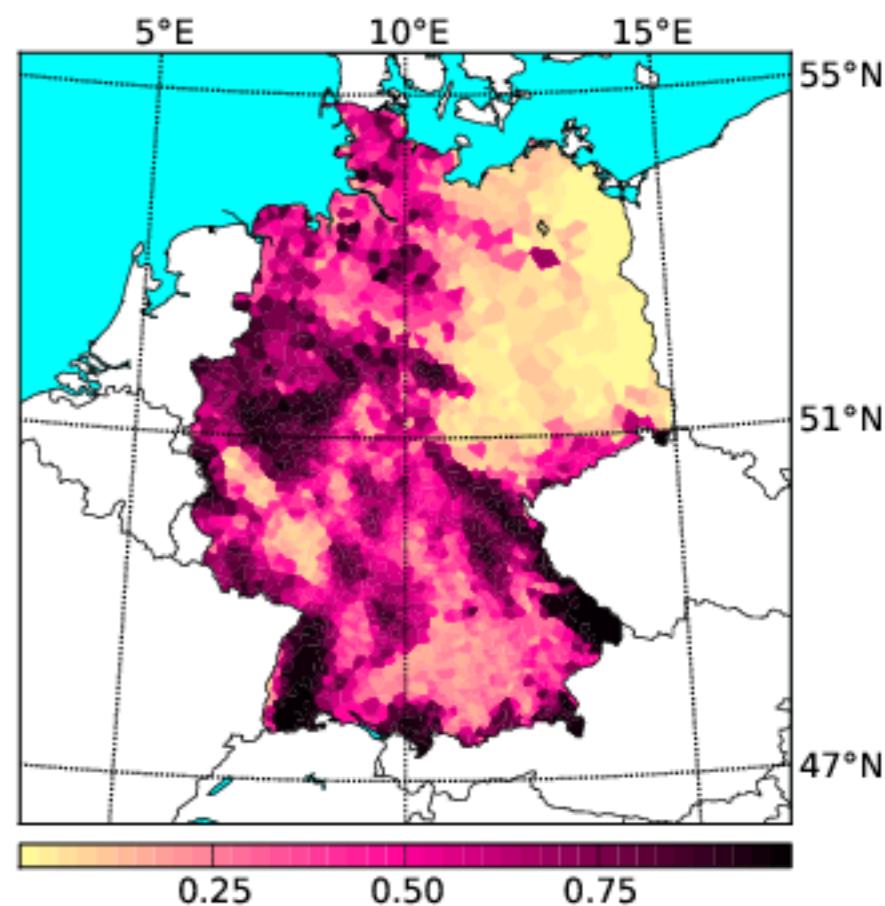
Network measure ranks divided by the number of nodes



Local clustering ranks



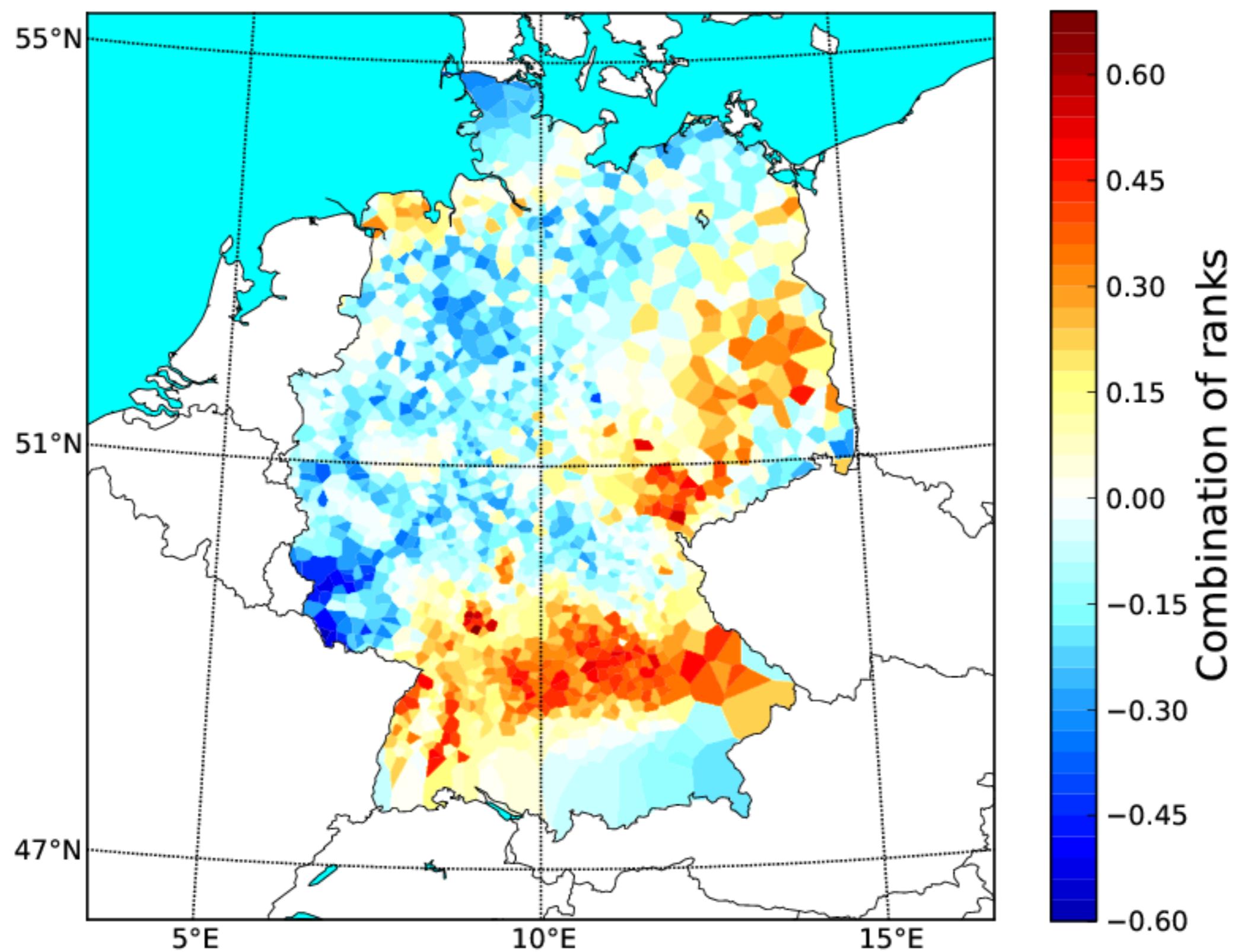
Betweenness ranks



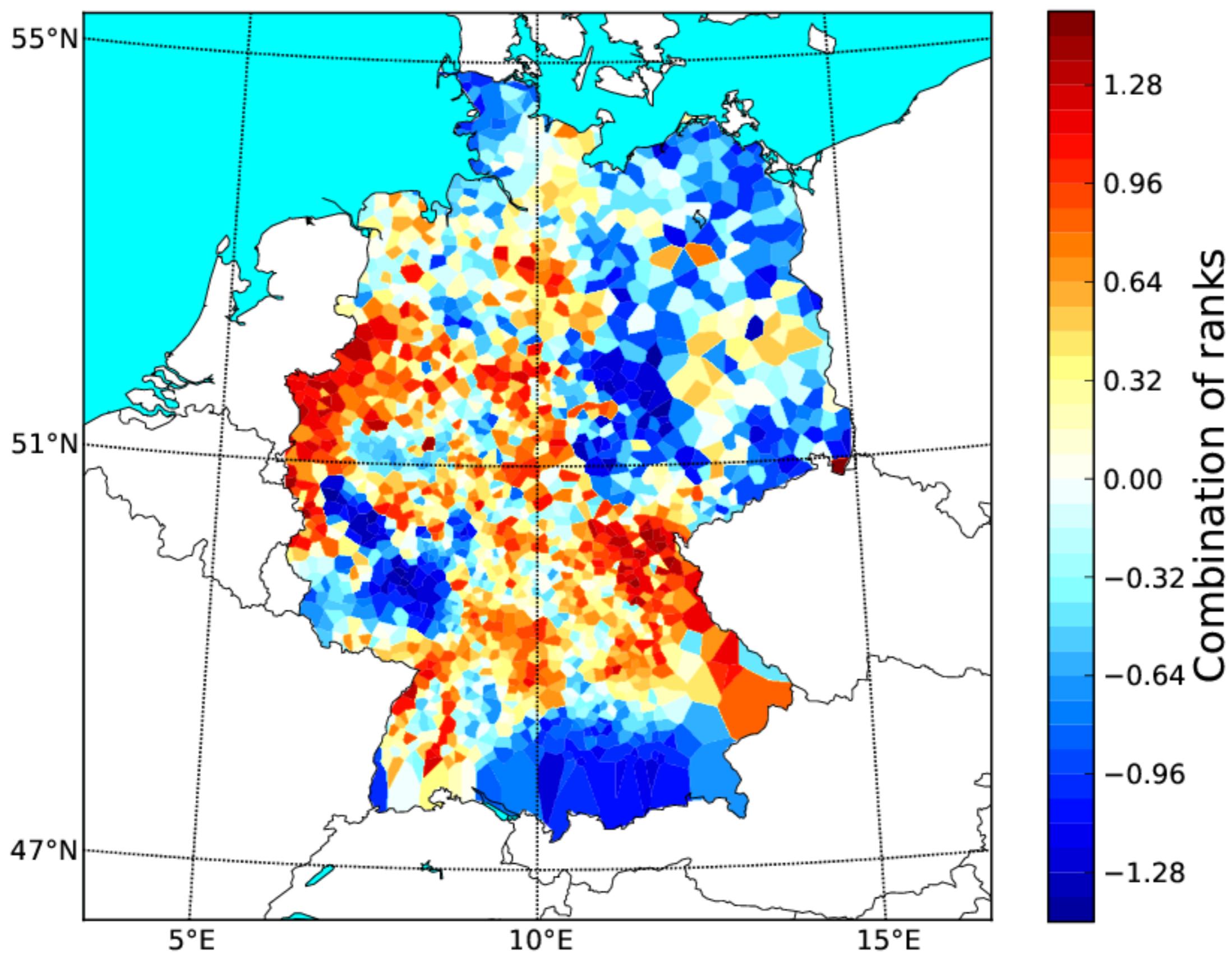
Spatial distance ranks

Bottlenecks

Shortest-path betweenness - degree



S.-path betweenness - local clustering + (link length - 0.5)



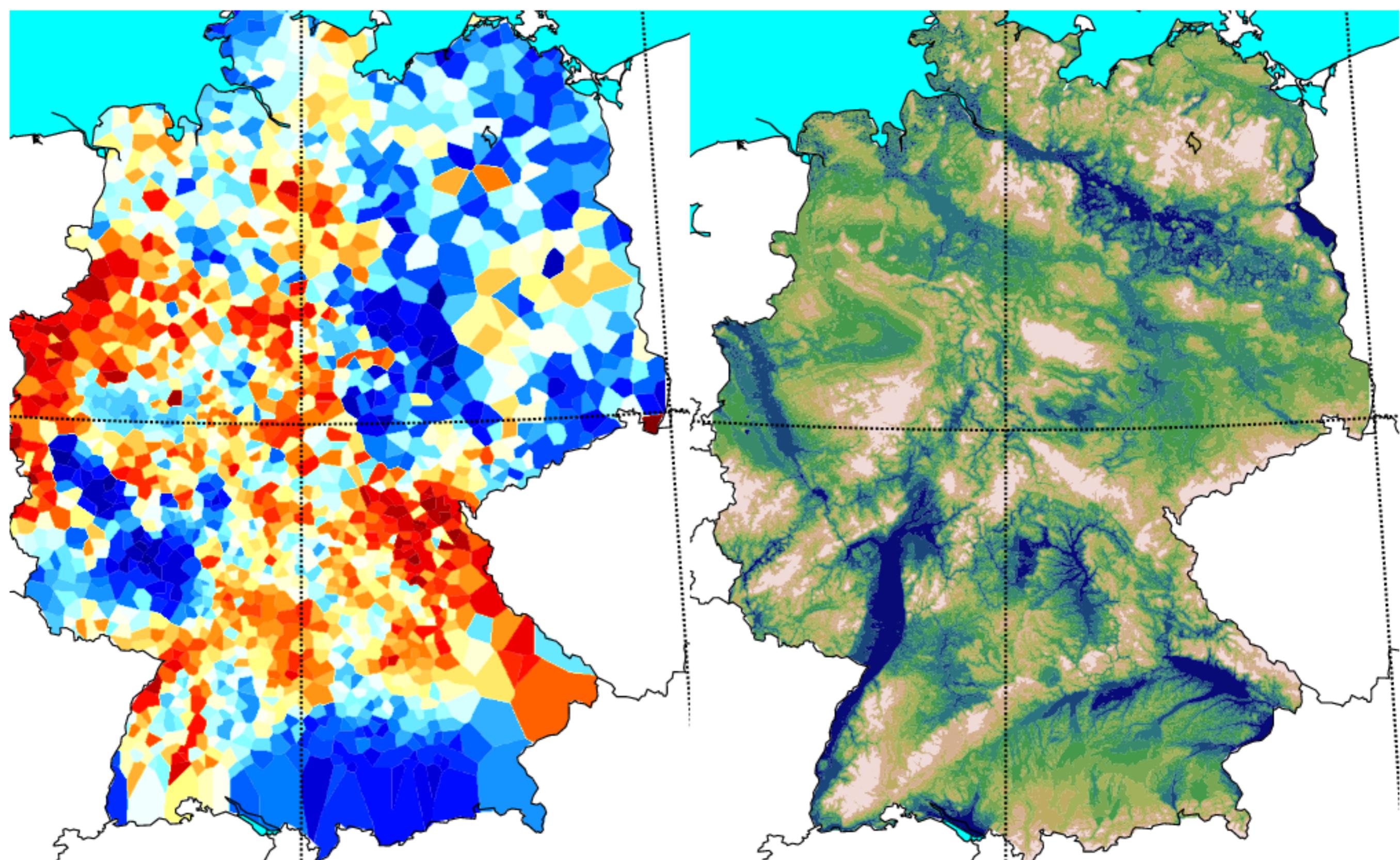
Motivation

- Methods

- Challenges

Application

- Summary



Summary

Synchronizations between precipitation events are measured as **synchronization rates**.

These rates are improved by **subtracting white noise synchronizations**.

Highly **synchronized weather stations** refer to **connected nodes** in a regional climate network.

Such a network is affected by its spatial embedding and **we correct** for these **spatial effects in network measures**.

Especially combinations of these **corrected network measures** unravel interesting **synchronization patterns in space**.

Paper: RHEINWALT et al. *Europhys. Lett.* (2012).

Contact: aljoscha@pik-potsdam.de