A 2000 year drought data set for present-day and 2K warming

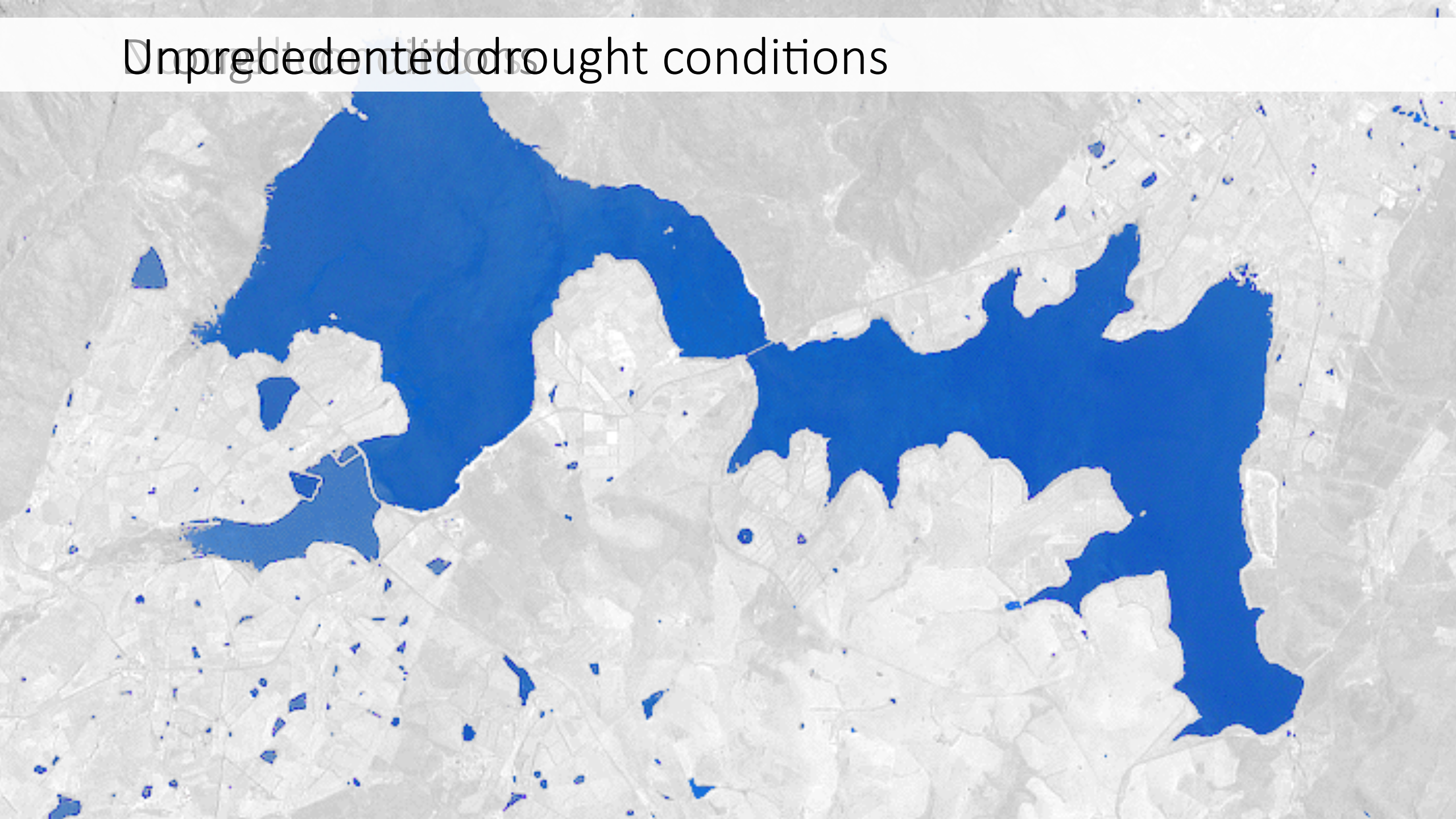
Niko Wanders, Karin van der Wiel, Frank Selten, Marc Bierkens

Utrecht University

Royal Netherlands Meteorological Institute

HIWAVES3

Unprecedented drought conditions



Research objective

Wat is the effect of 2K global warming on hydrological droughts

- Focus on extreme drought events
- Make use of large-ensemble meteorological forcing
- Coupling with state-of-the-art global hydrological model

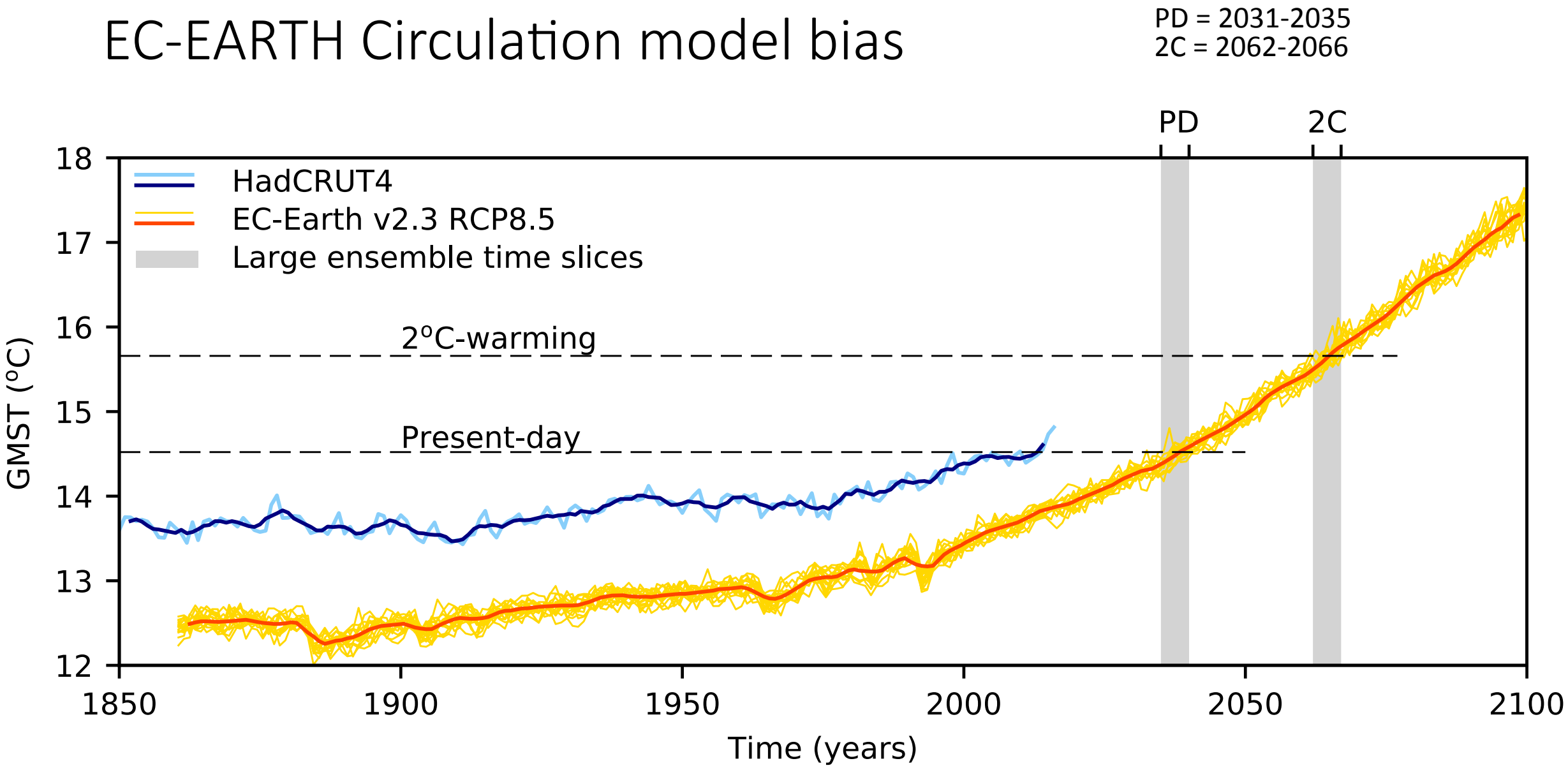
EC-EARTH Circulation model setup

- Model resolution:
  - T-159 (0.75°)
  - Sub-daily time step
  - Bias corrected to ERA-Interim

- Model includes:
  - ECMWF's atmospheric circulation model IFS, cycle 31r3, including H-Tessel
  - Ocean model NEMO2, including the Louvain-la-Neuve Sea Ice Model
  - PISCES v2 ocean bio-geo-chemistry component
  - Dynamical vegetation model LPJ-GUESS v4
  - Atmosphere composition and aerosol model TM5
  - PISM 0.7 ice sheet model

Hazeleger et al, 2012, Climate Dynamics

EC-EARTH Circulation model bias



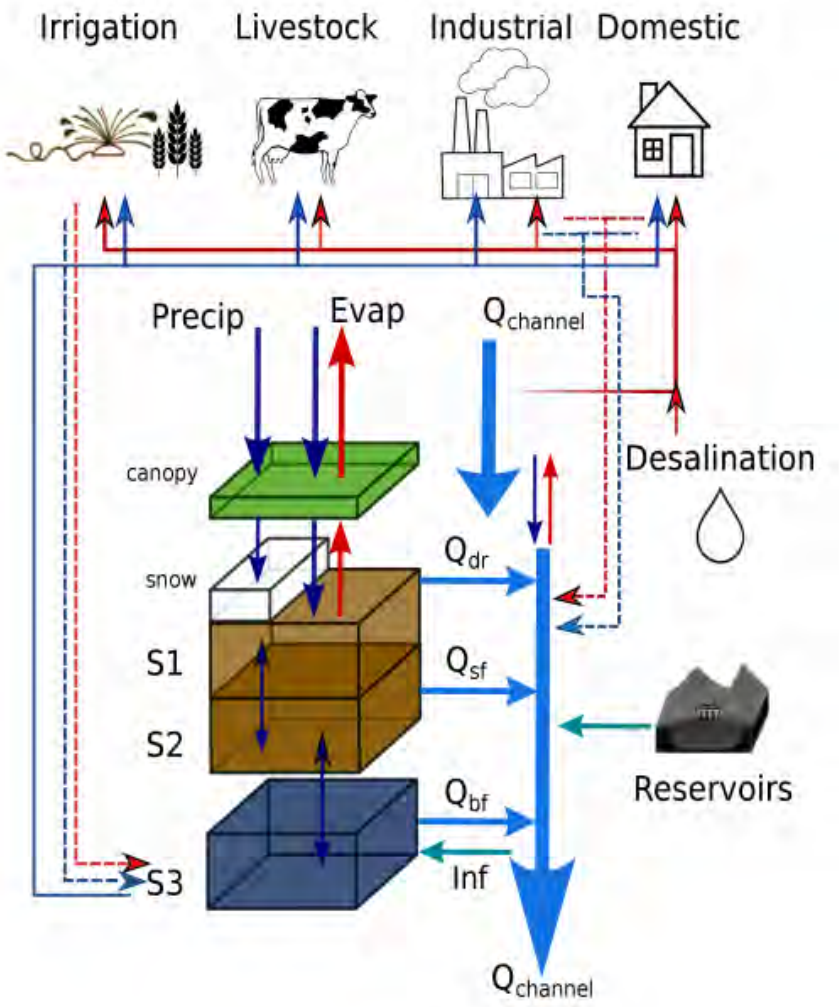
PCR-GLOBWB 2 hydrological model structure

Model resolution:

- Regular grid of 0.5° (50 km) and 0.1° (10 km)
- Daily time step

Model includes:

- Human water interactions
  - Groundwater pumping
  - Irrigation
  - Surface water abstraction
  - Lakes and reservoirs
- Flood plains
- 2D groundwater flow
- Coupling with hydrodynamic models
- Water temperature



Sutanudjaja et al, 2017, GMDD

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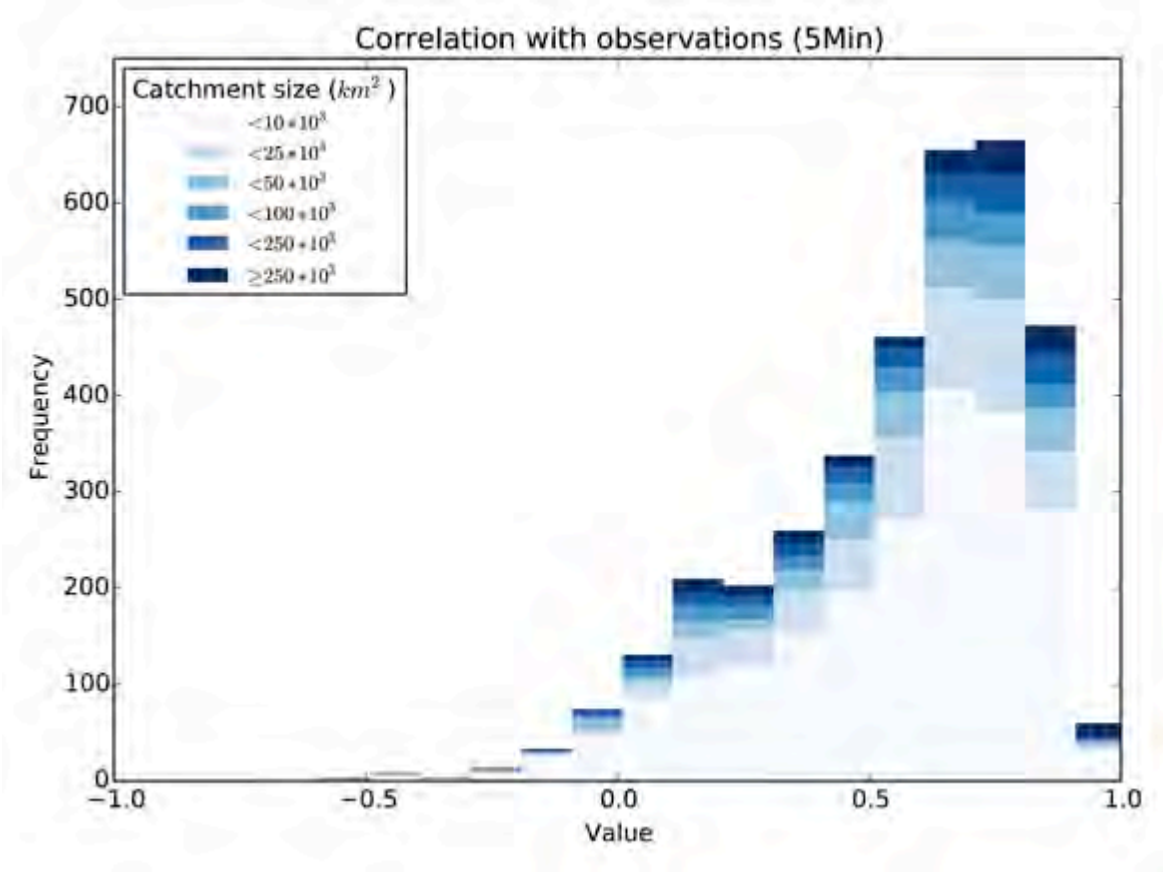
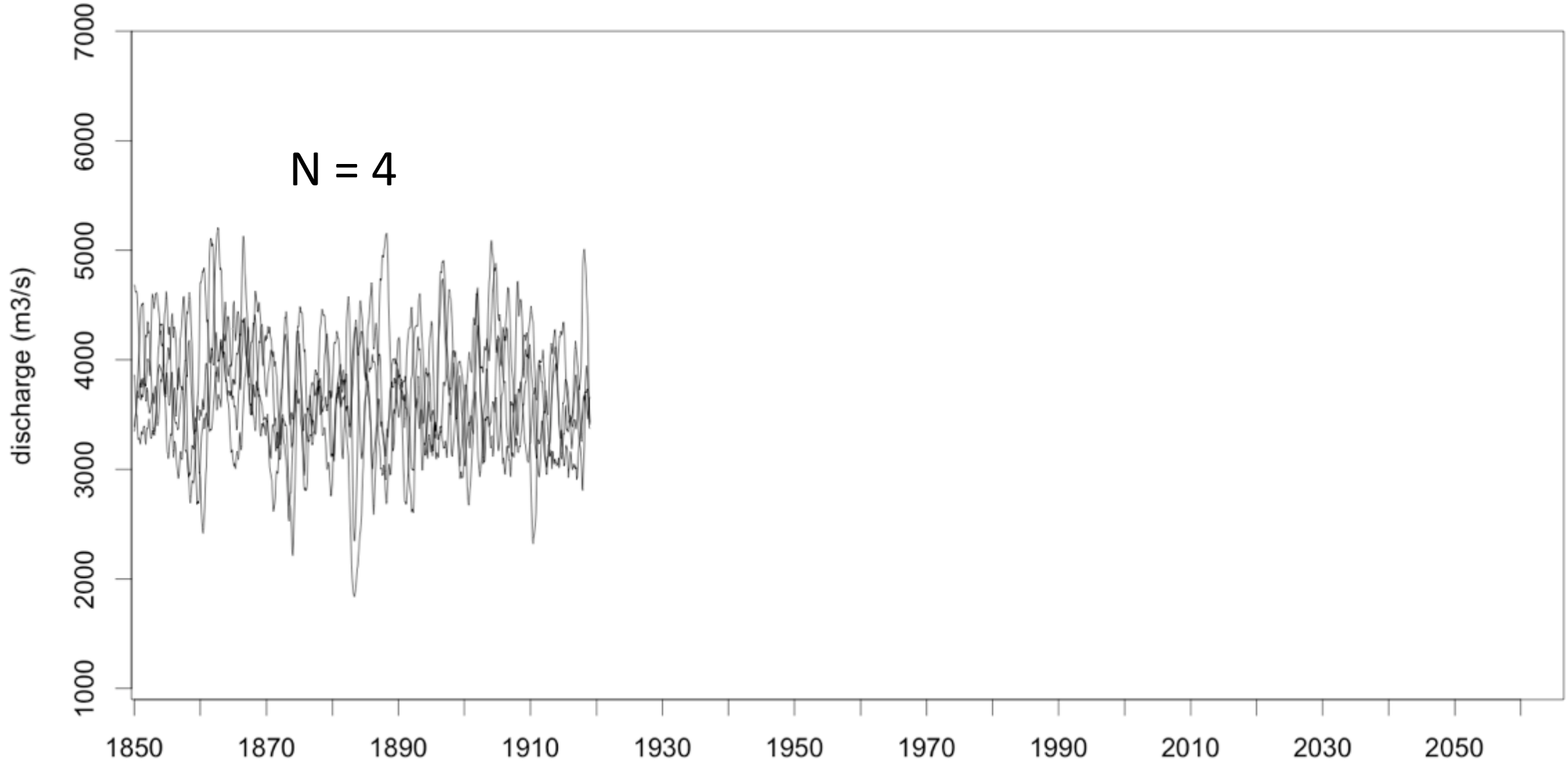


Sutanudjaja et al, 2017, GMDD

Setup of large-ensemble



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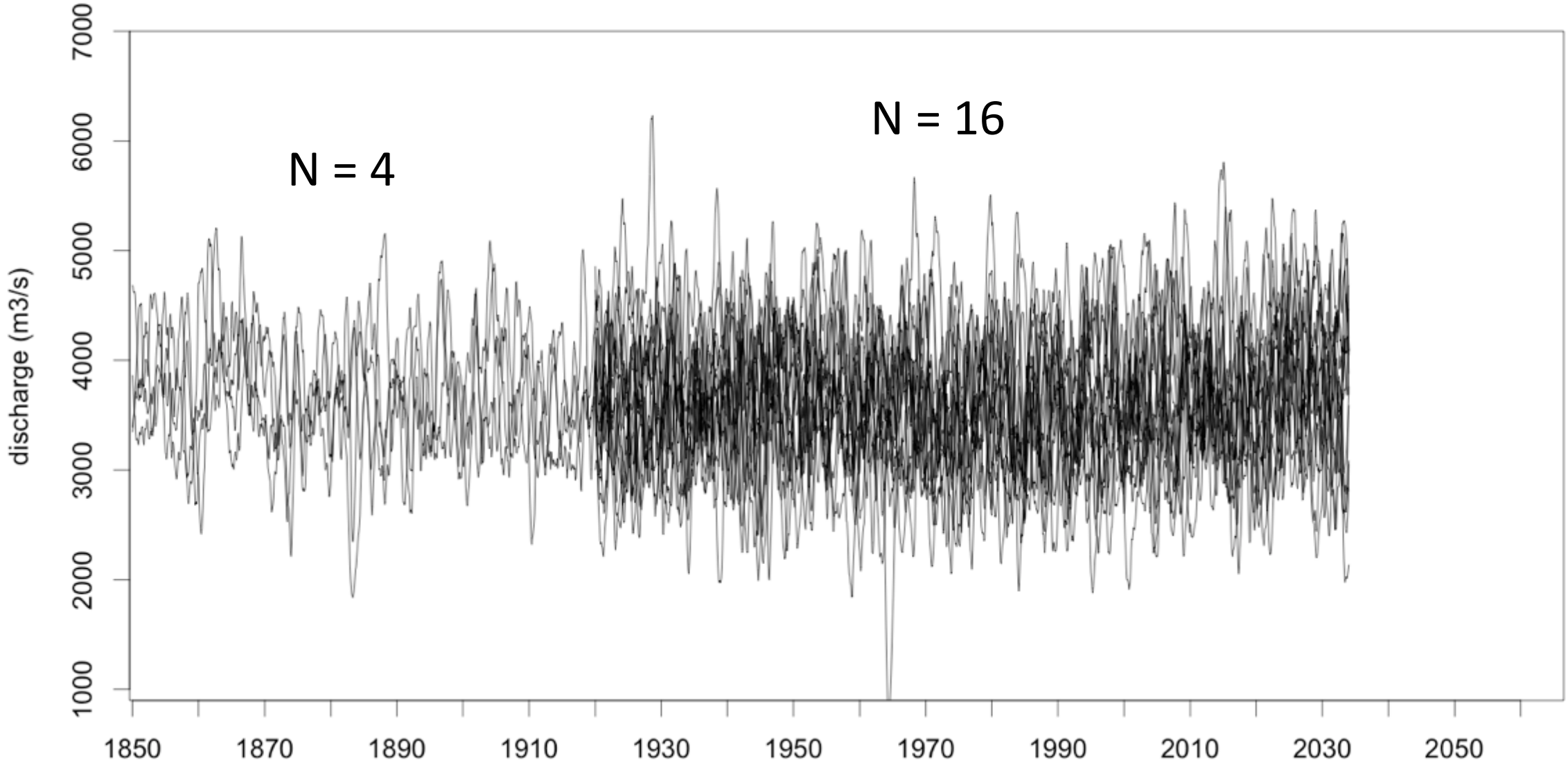

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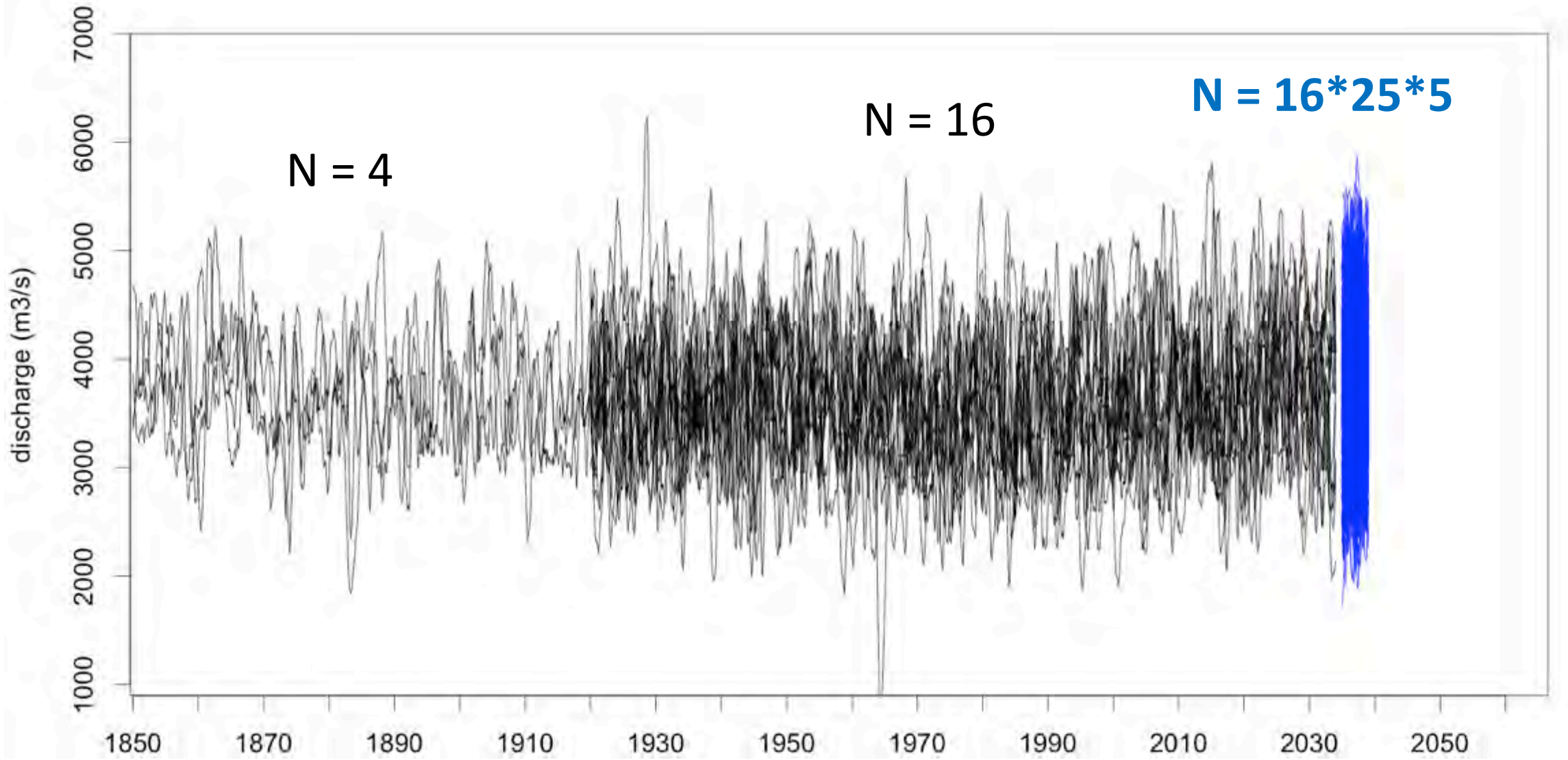

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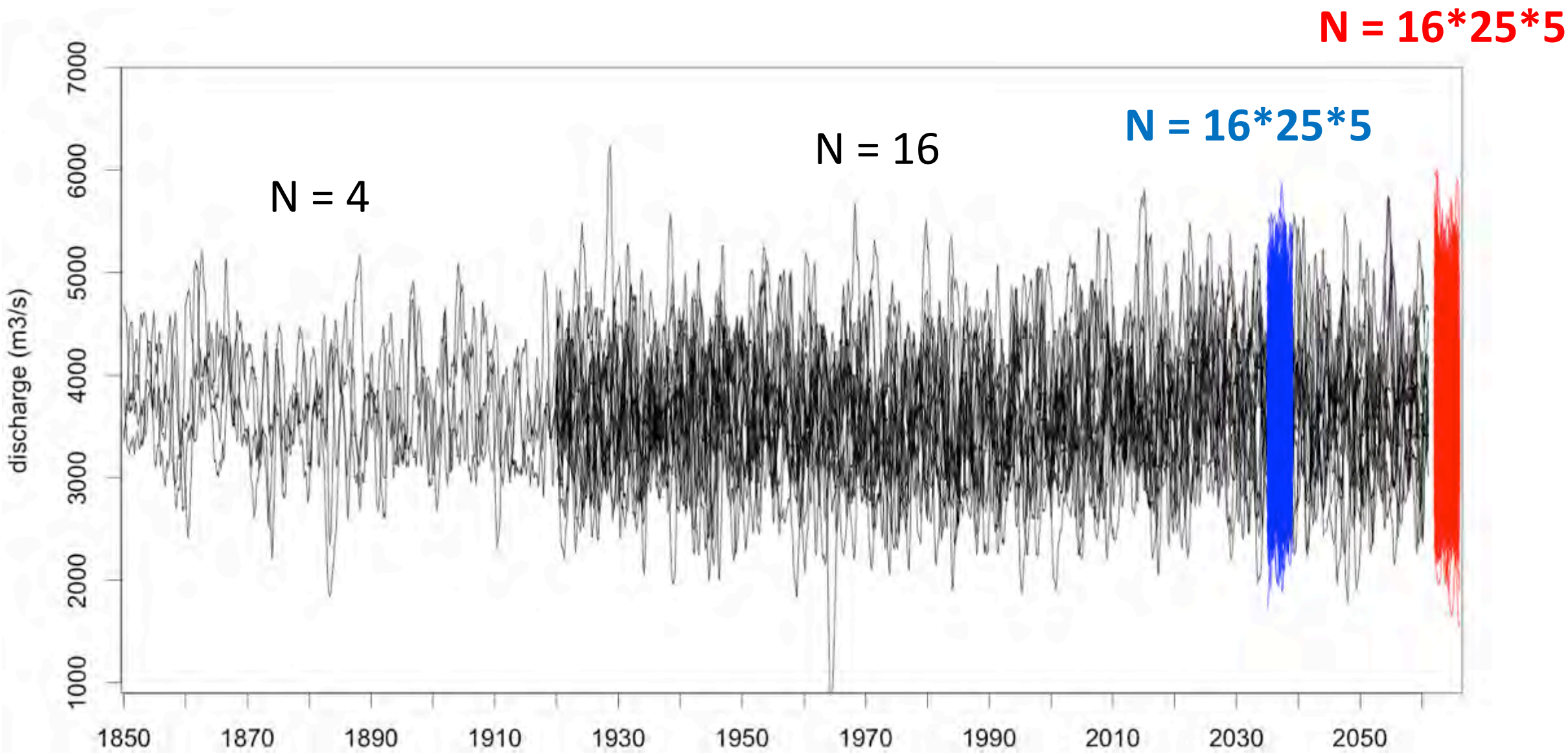
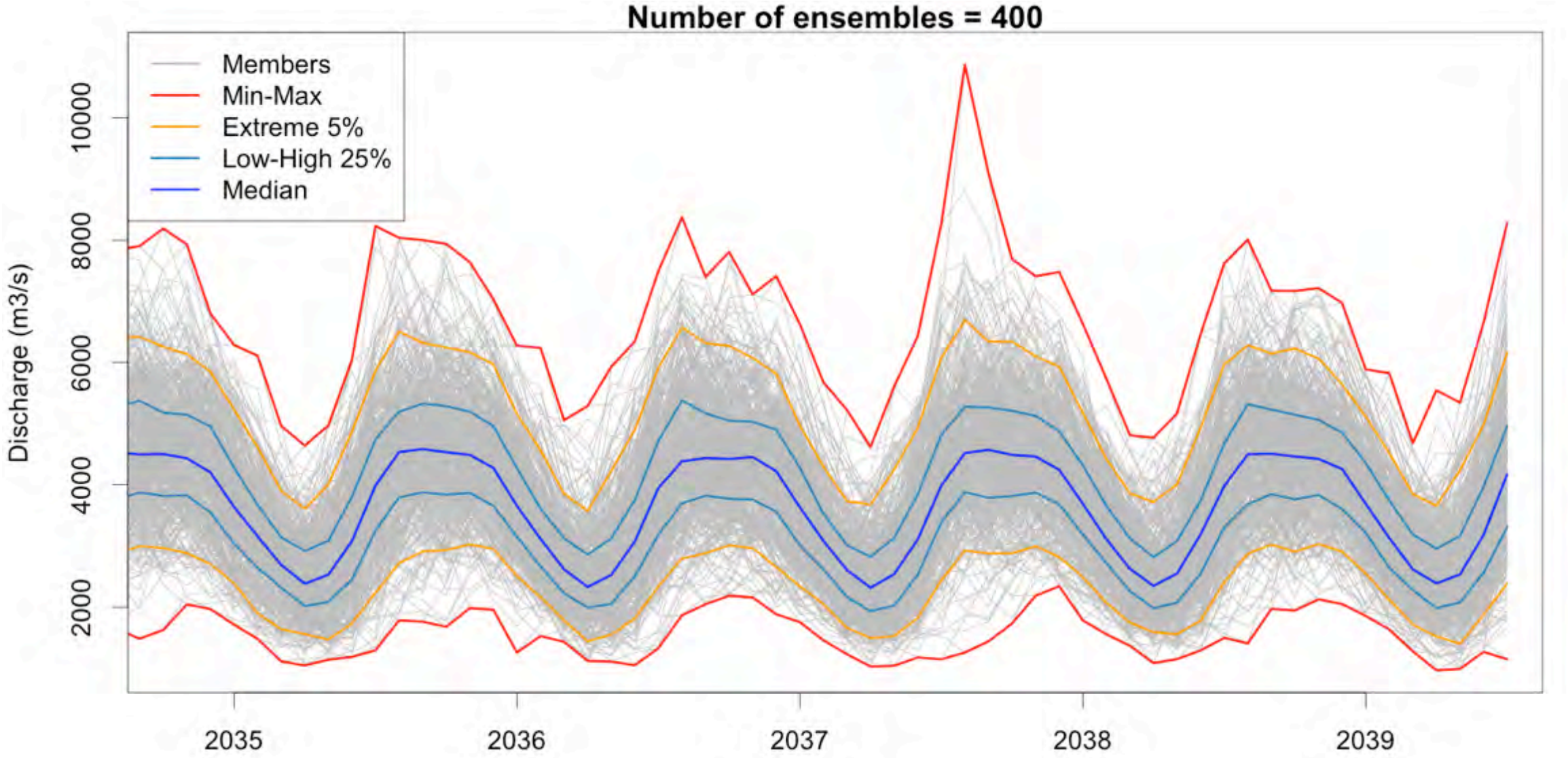


River Rhine example (present day)



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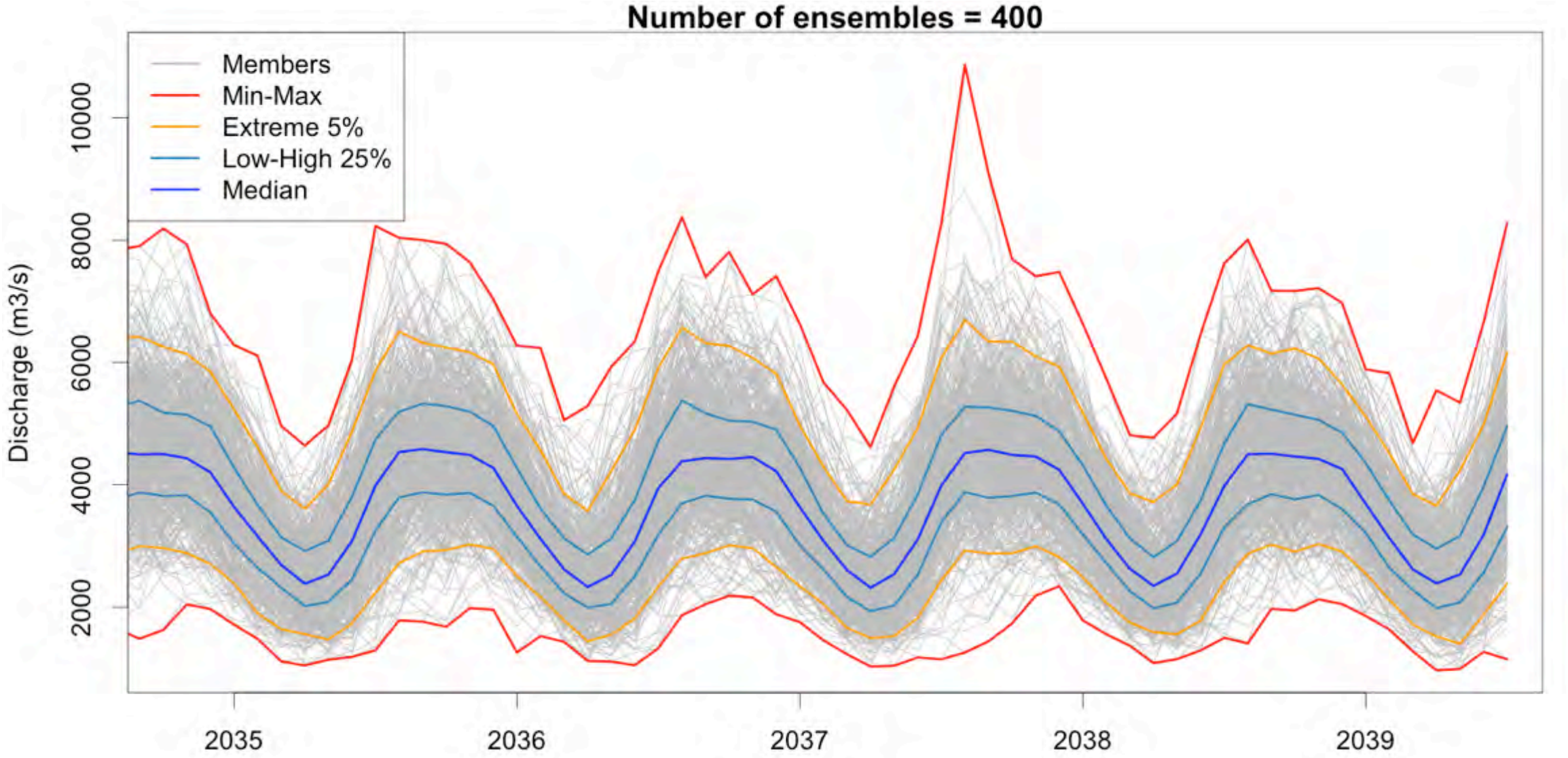
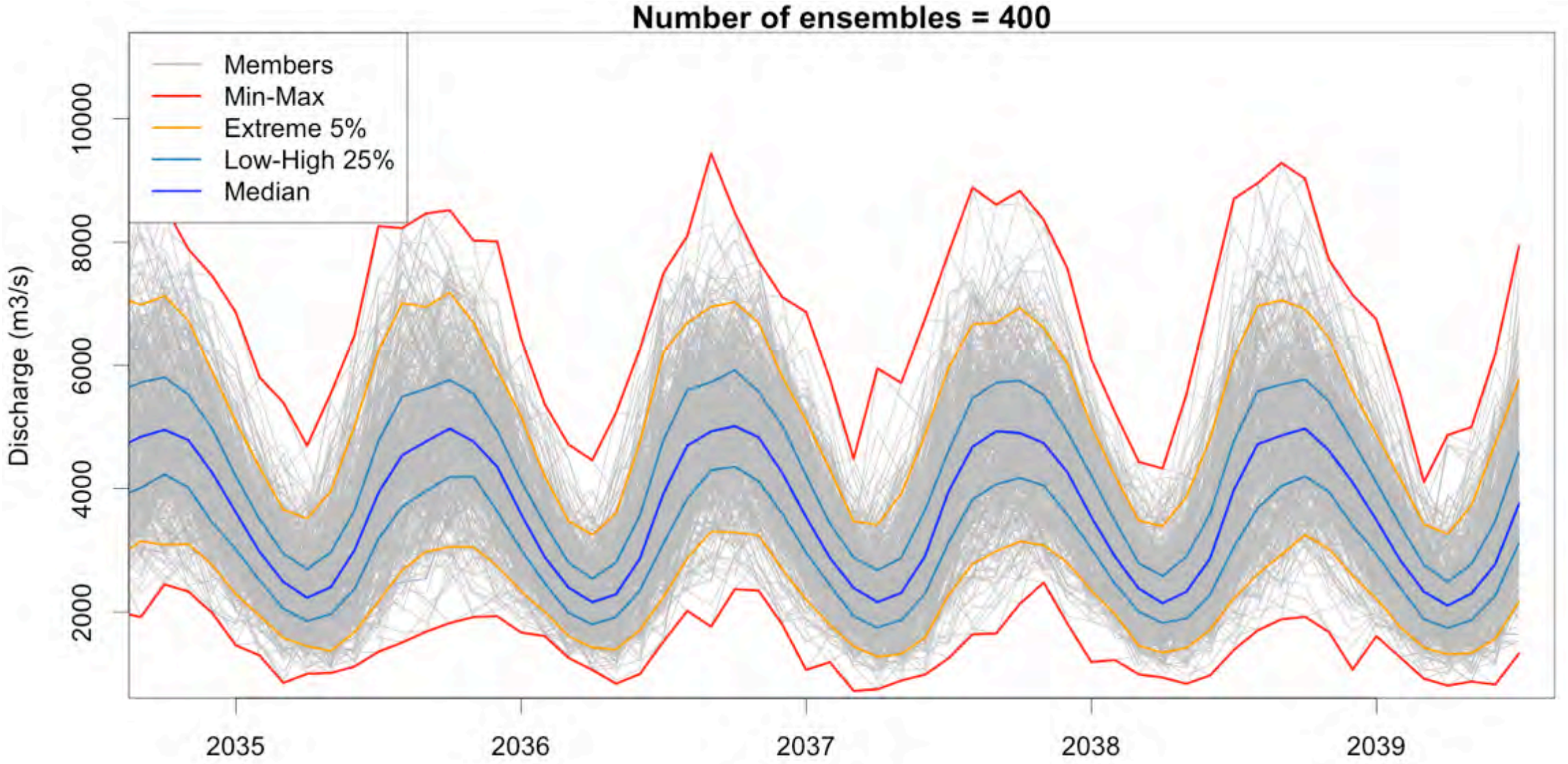
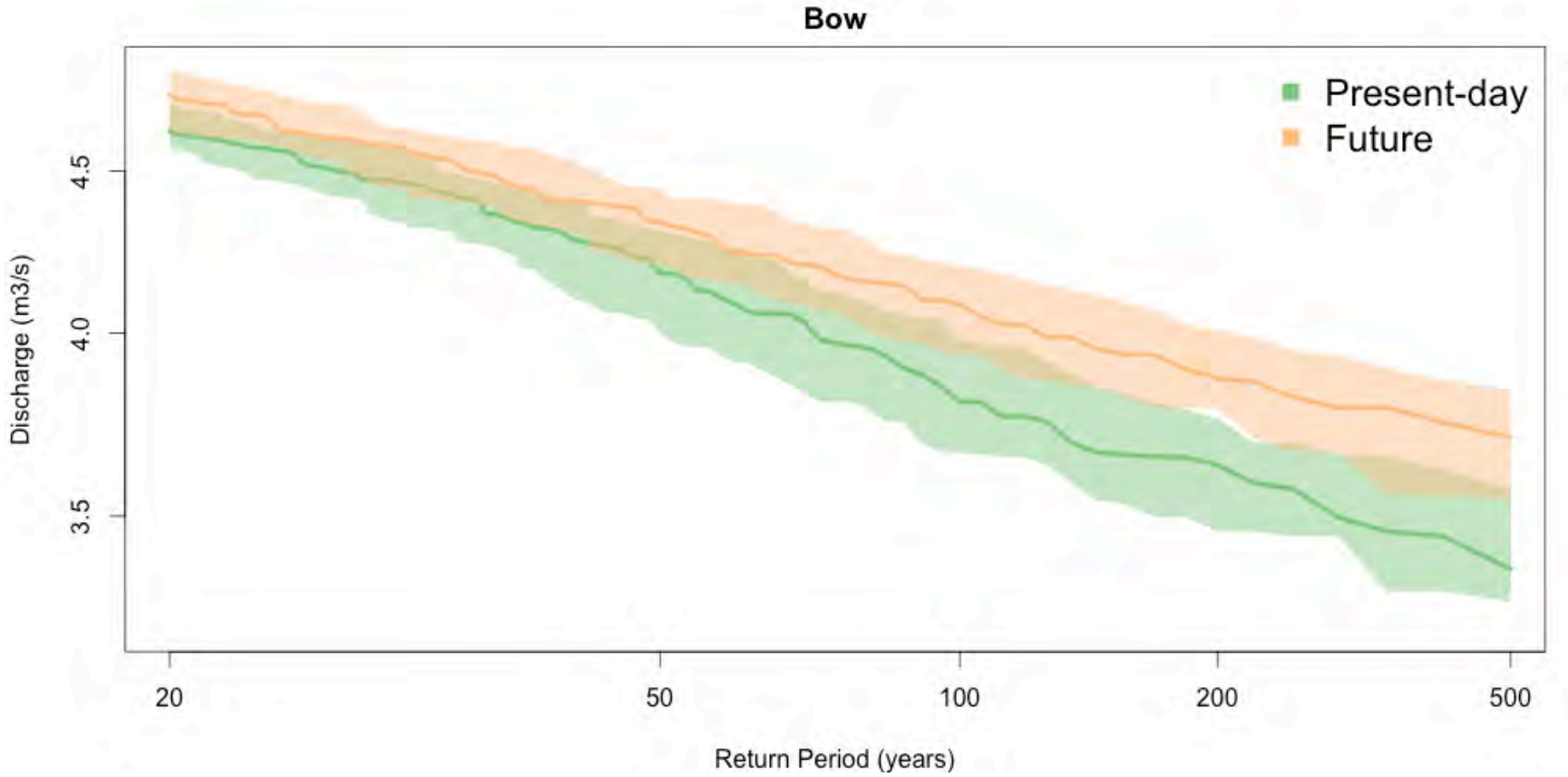
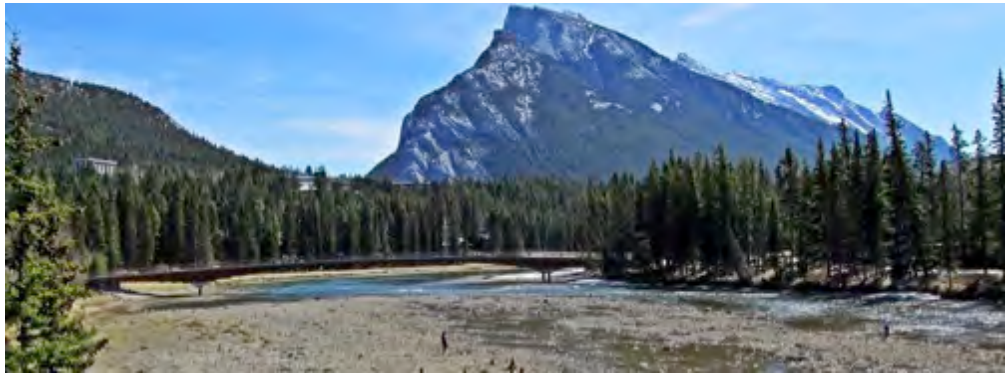


River Rhine example (2K warming)

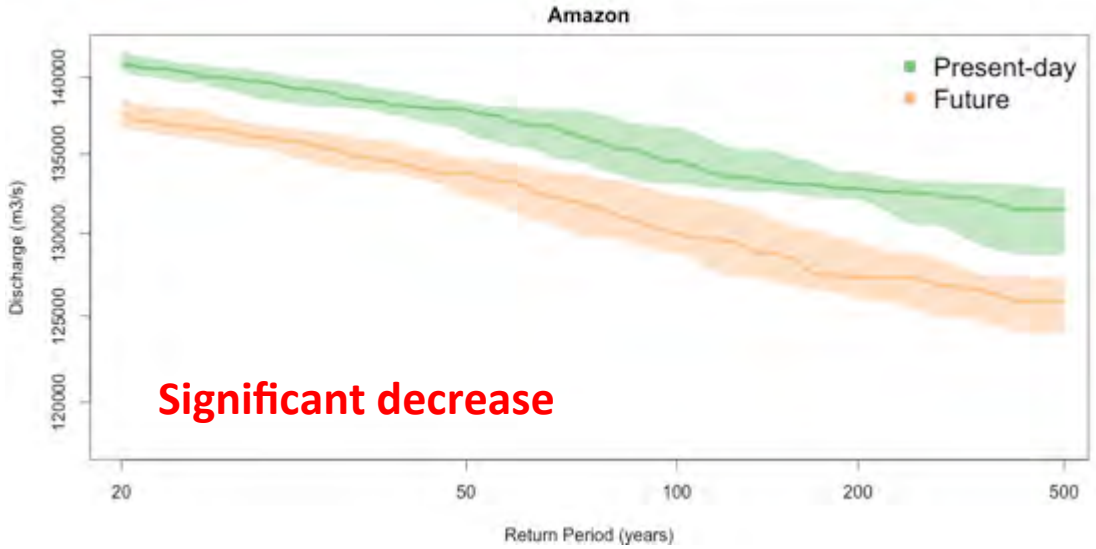


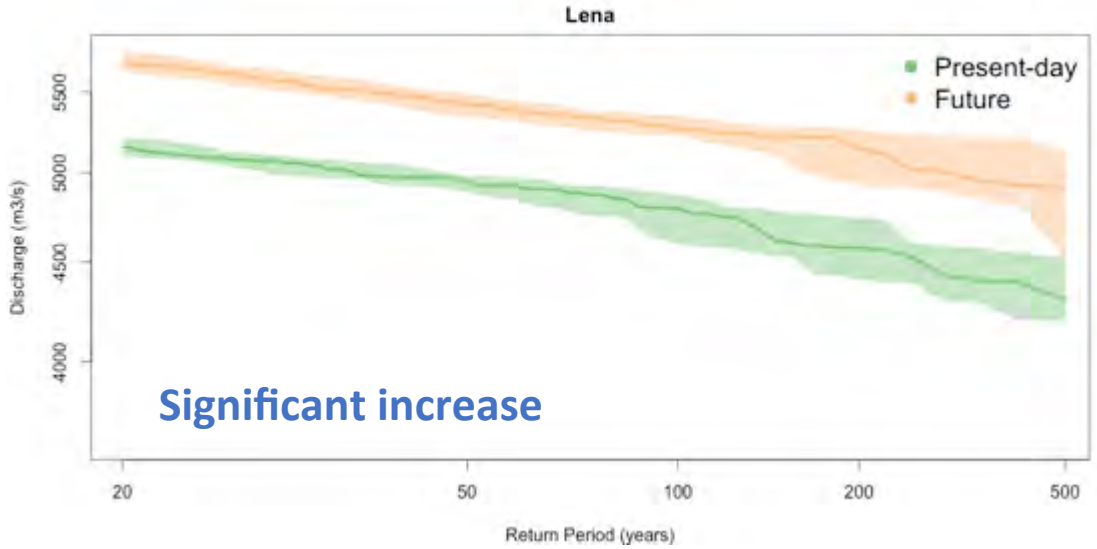
Bow River changes extreme events

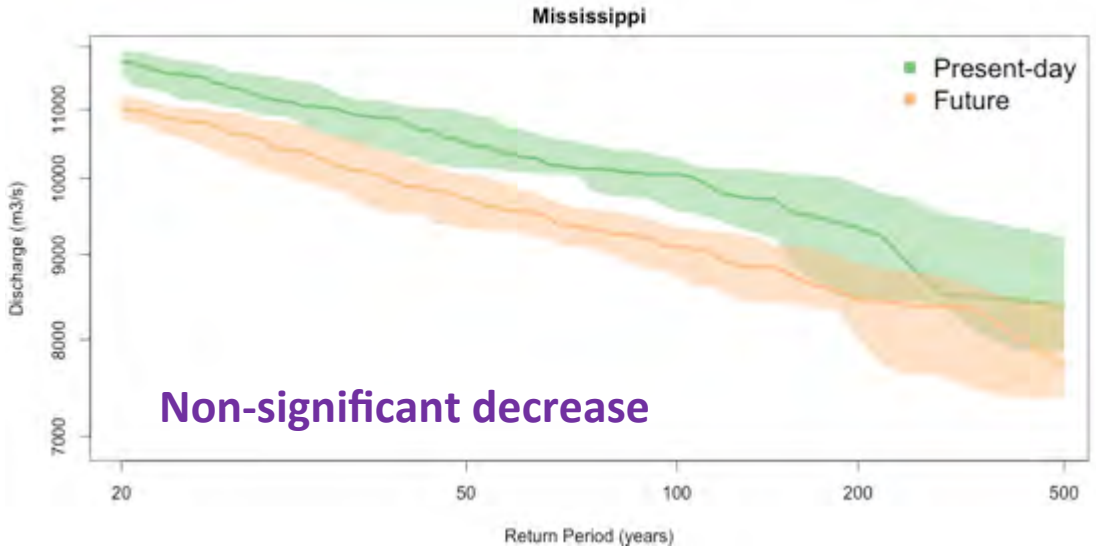


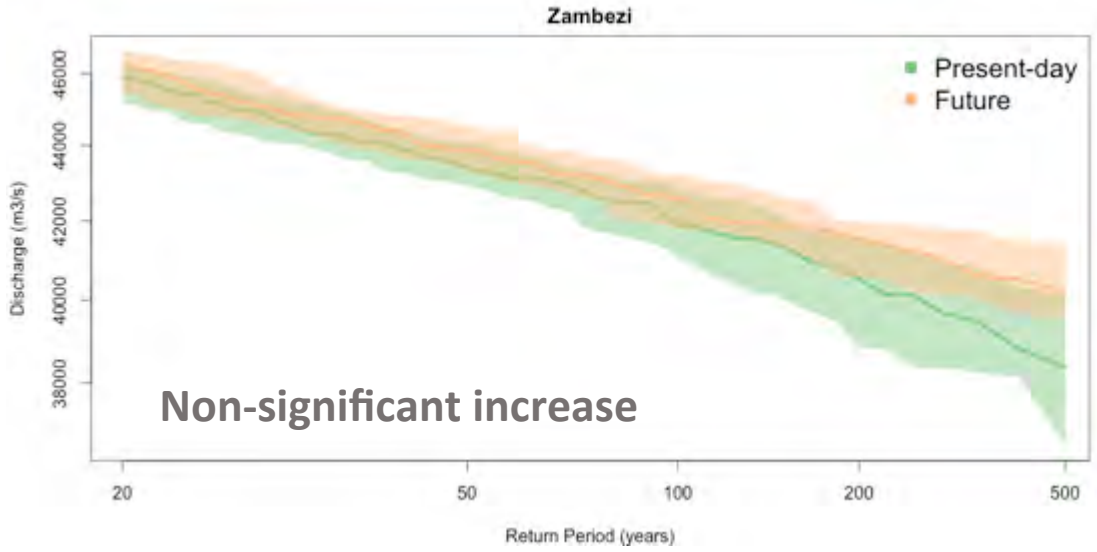


Major river examples

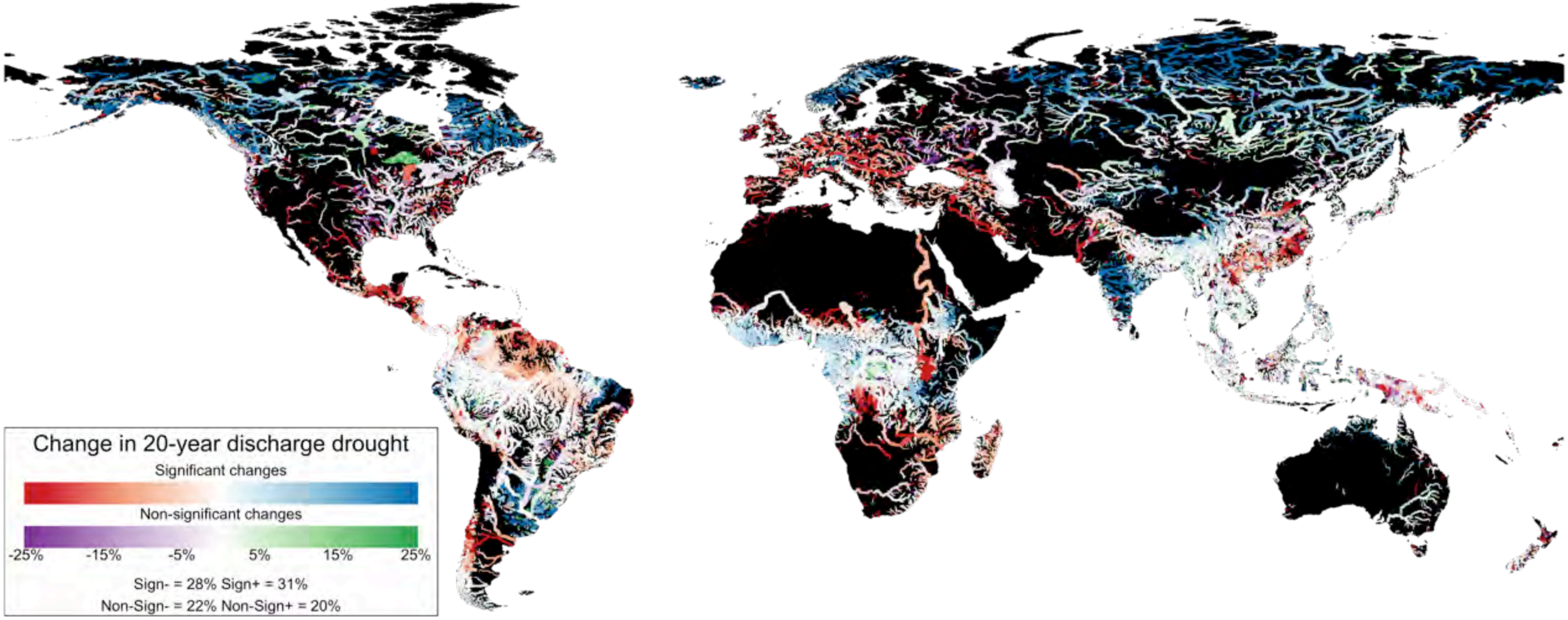








Global outlook



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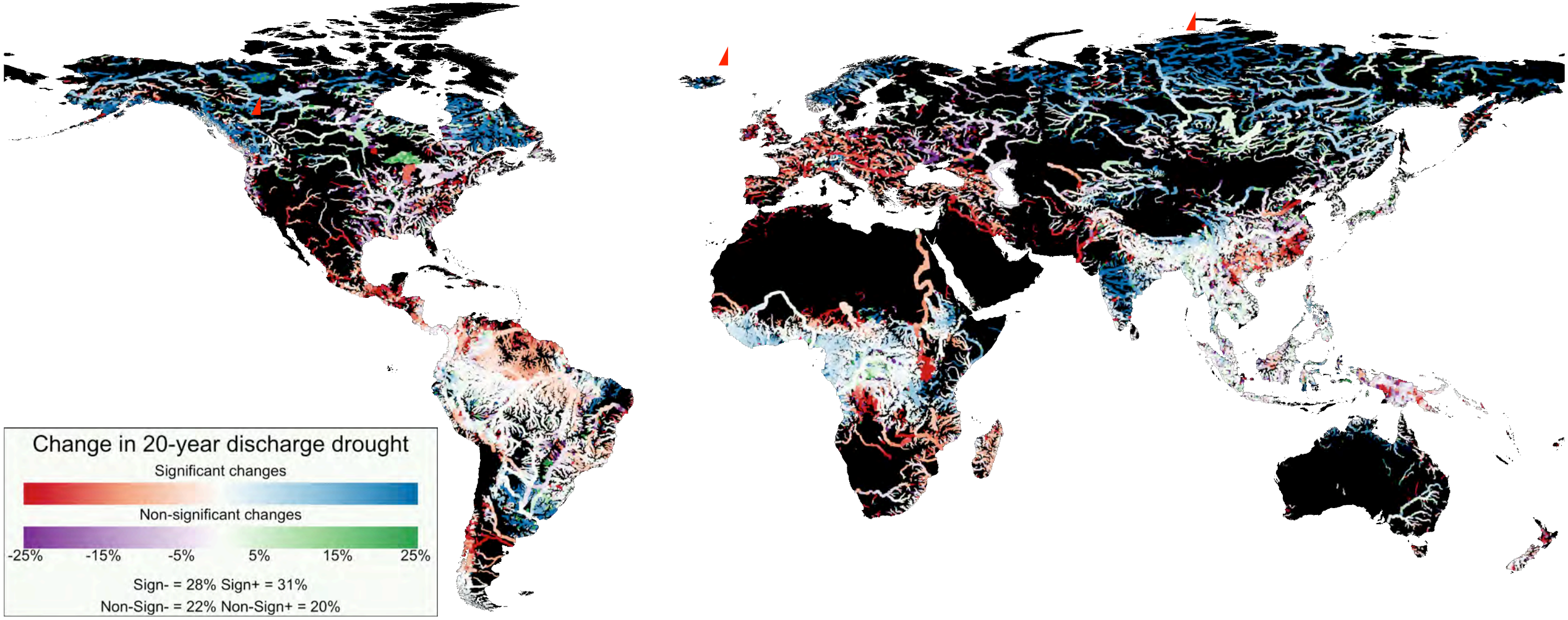

In conclusion

- Extreme drought event show similar trends as “normal” droughts

- Large ensembles allow us to better estimate changes in drought:
  - Estimate uncertainty
  - Stationary conditions
  - No assumptions on extreme value distribution needed
  - We can start looking into the tails of the distribution

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Teleconnections of extremes, historic period