Impact of the Atlantic Multidecadal Oscillation on Baltic Sea variability

Florian Börgel[1] , Claudia Frauen[1] , Thomas Neumann[1] , S. Schimanke[2], H. E. Markus Meier[1,2]

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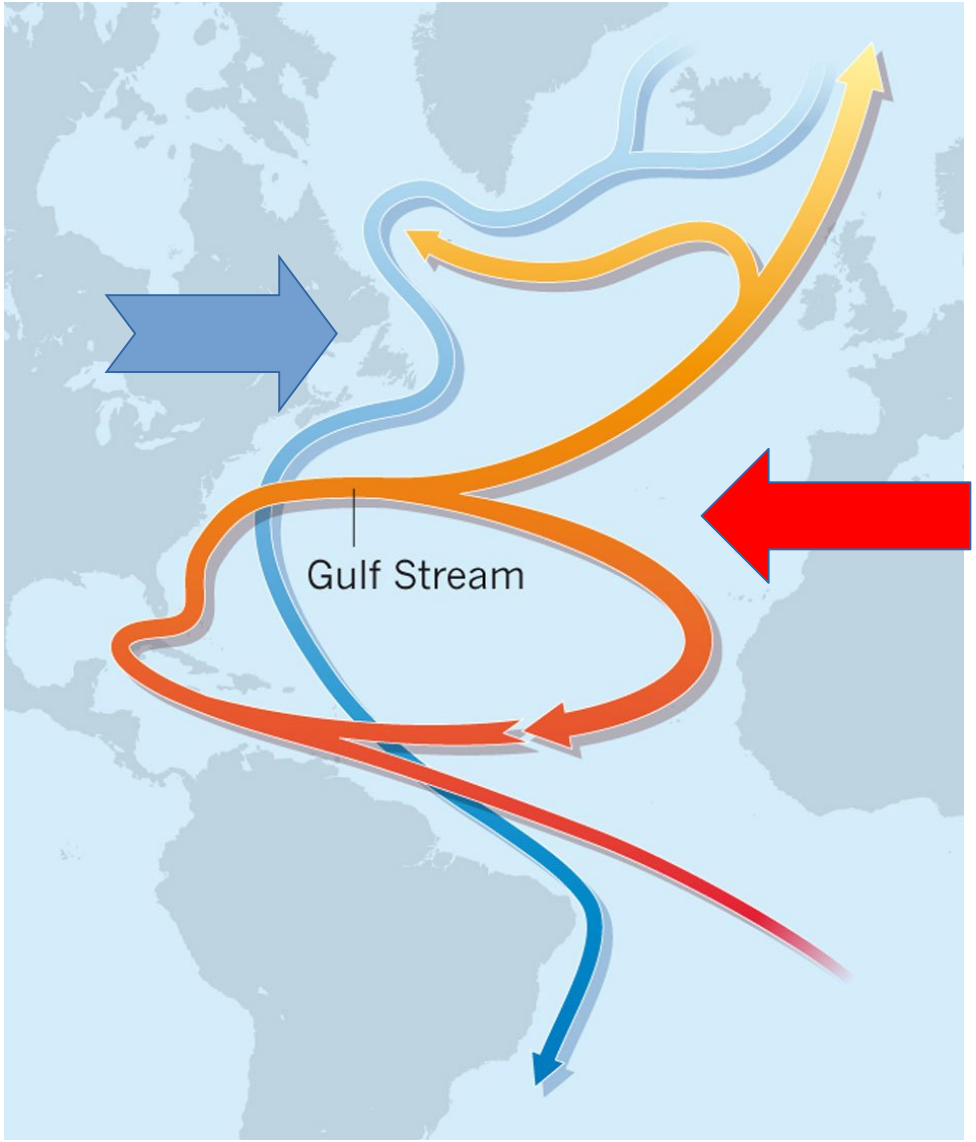
[1] Leibniz Institute for Baltic Sea Research, Warnemünde, Germany

[2] Swedish Meteorological and Hydrological Institute, Norrköpping, Sweden

florian.boergel@io-warnemuende.de

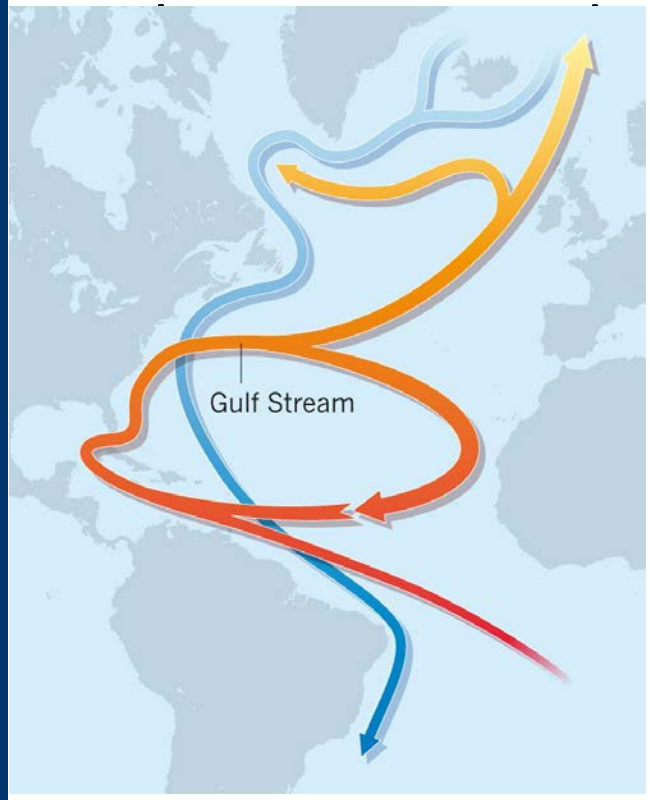
Atlantic Meridional Overturning Circulation

- Northward flow of warm, salty water in the upper layers of the Atlantic
- Southward flow of colder, deep waters



Schematic Representation of the Atlantic Meridional Overturning Circulation (Nature, 2012)

What is the AMO?



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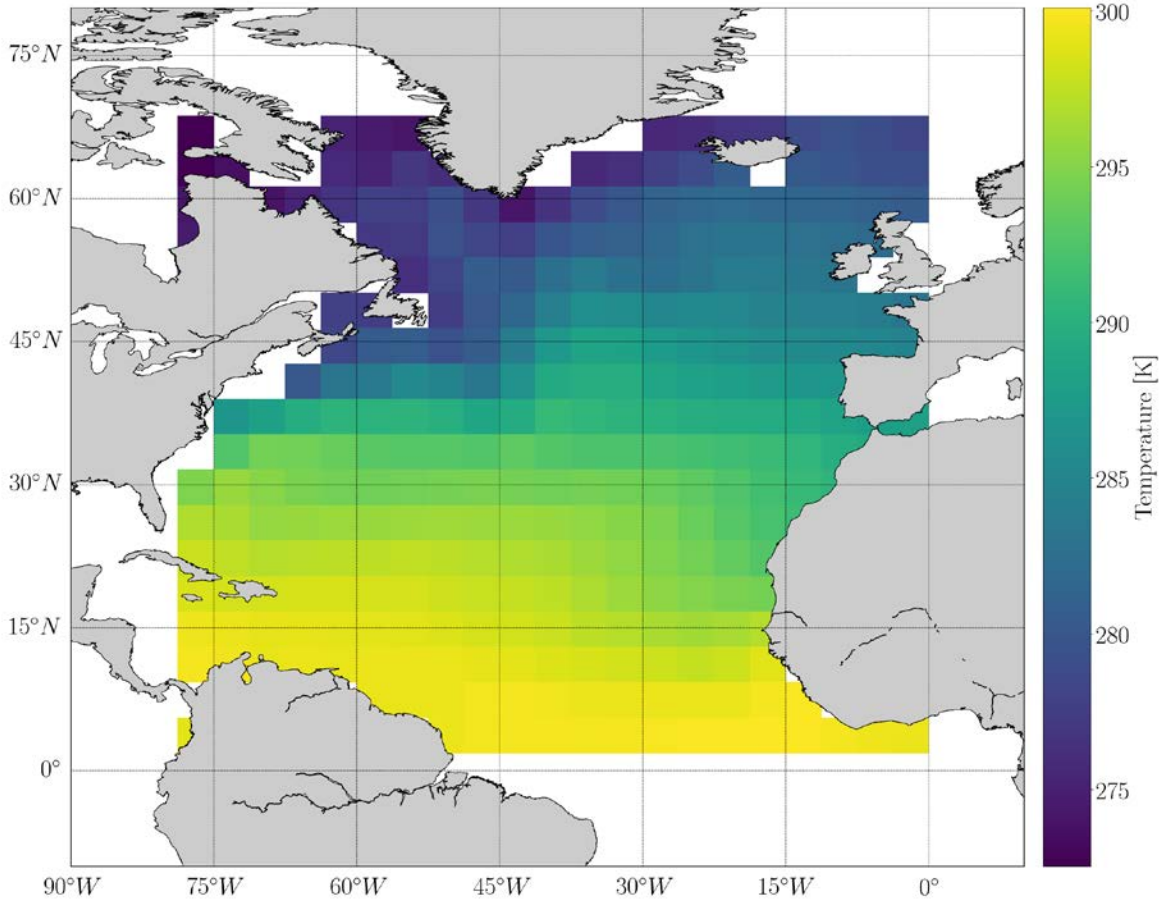

Sea surface temperature for the calculation of the AMO index

The impact of AMO states

- Atlantic hurricanes (Goldenberg et al., 2001; Knight et al., 2006)
- India/Sahel rainfall (Knight et al., 2006)
- North American climate (Enfield et al., 2001)
- Arctic temperature (Chylek et al., 2009)
- Weather regimes over Europe (Zampieri et al., 2017)

Motivation

- Impact of the AMO on the Baltic Sea ecosystem
- Limited observations of about 150 years
- Tracking records of marine species are even shorter (Alheit, 2014)

=> numerical model approach

Ocean model and forcing

- Regional Rossby Centre Ocean model (RCO) to simulate the Baltic Sea from 950 – 1800 (Schimanke and Meier, 2016)
- horizontal resolution of 3.7 km and 83 vertical layers with a maximum depth of 250 m
- Forcing data: Rossby Centre Atmosphere model (RCA3) with a resolution of 0.44° covering nearly the whole area of Europe (Schimanke, 2012)
- RCA3 is driven by the global paleoclimate model ECHO-G at the lateral boundaries (Legutke and Voss, 1999)

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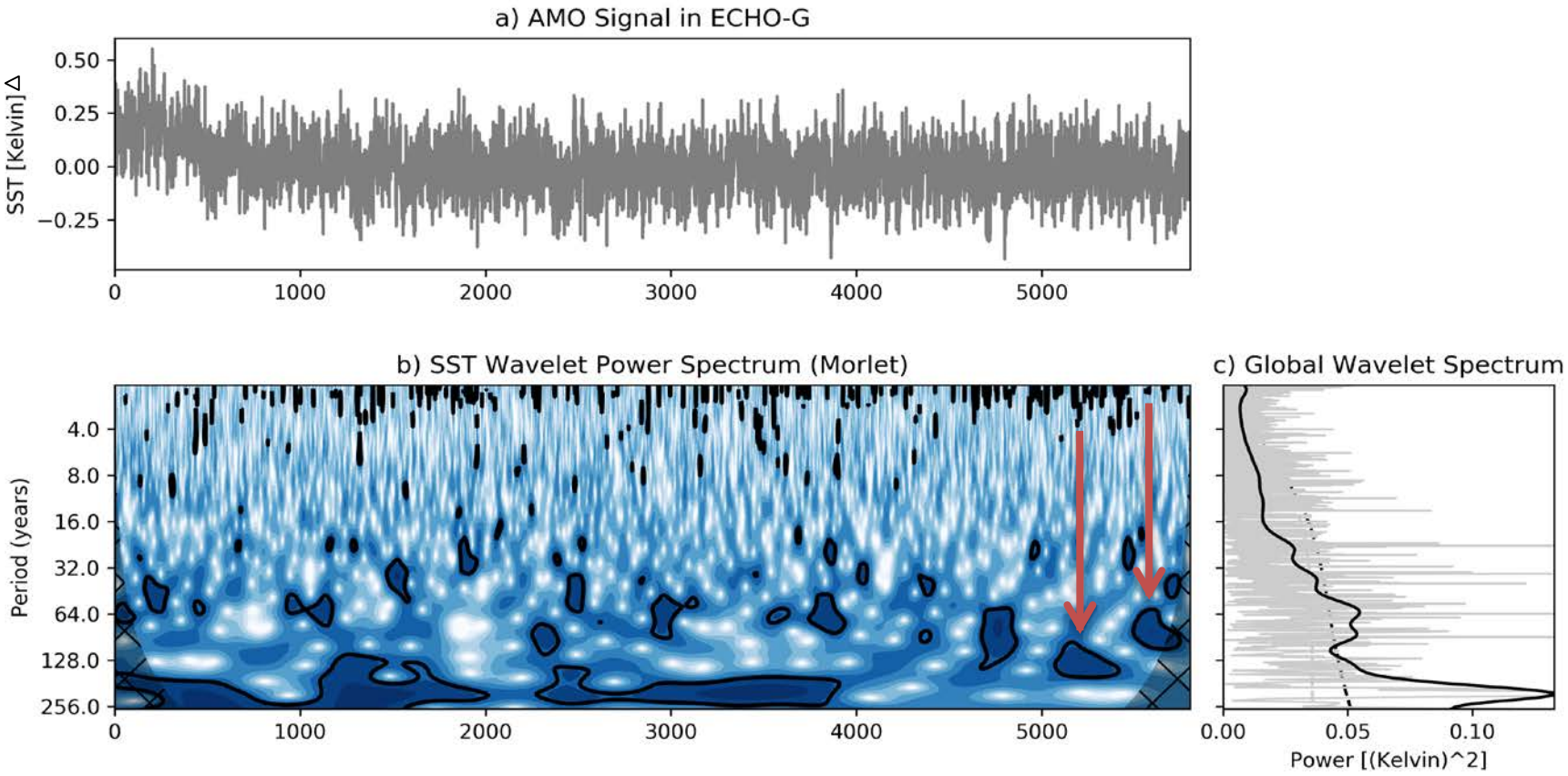

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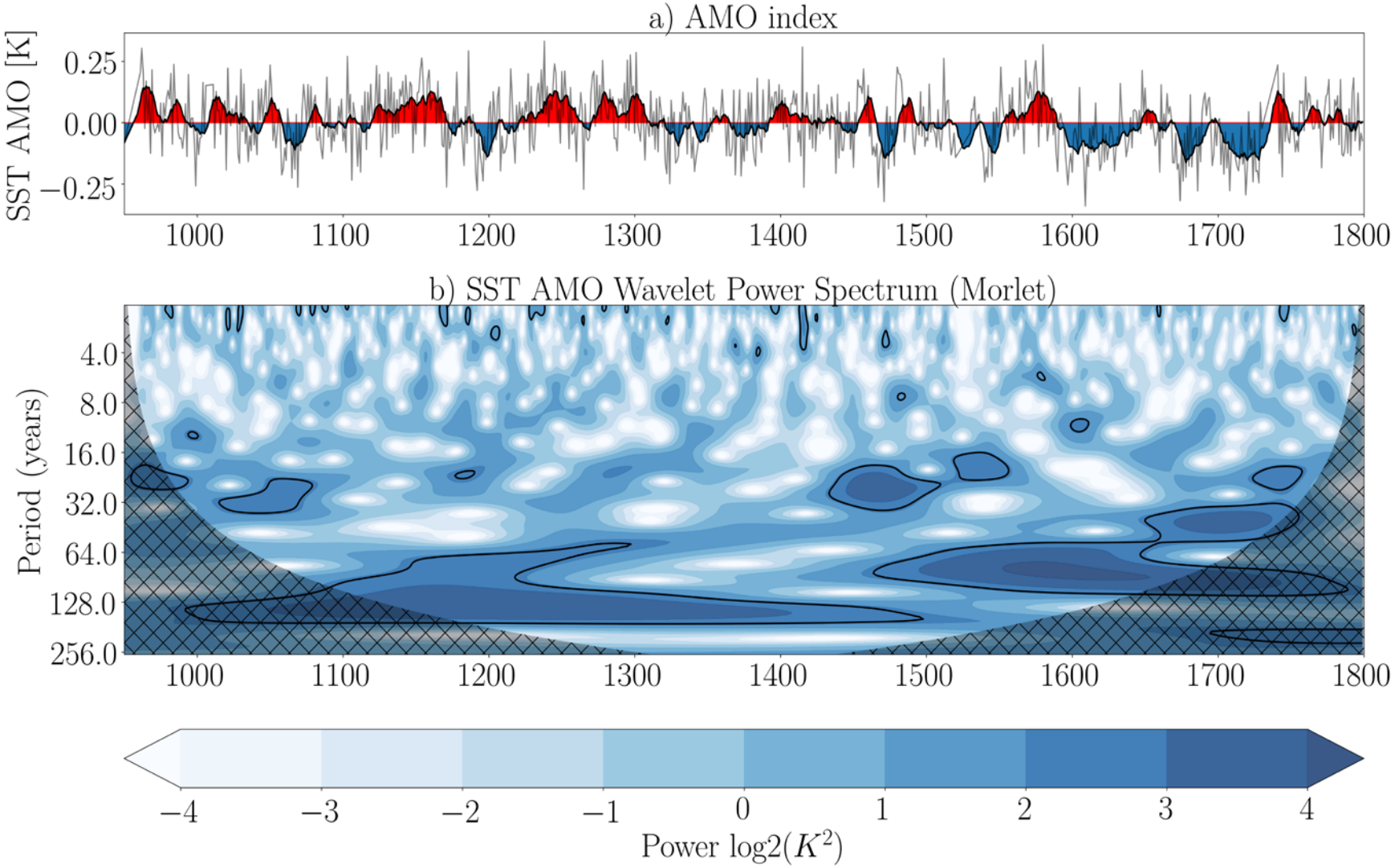
Baltic Earth
Earth System Science for the Baltic Sea Region



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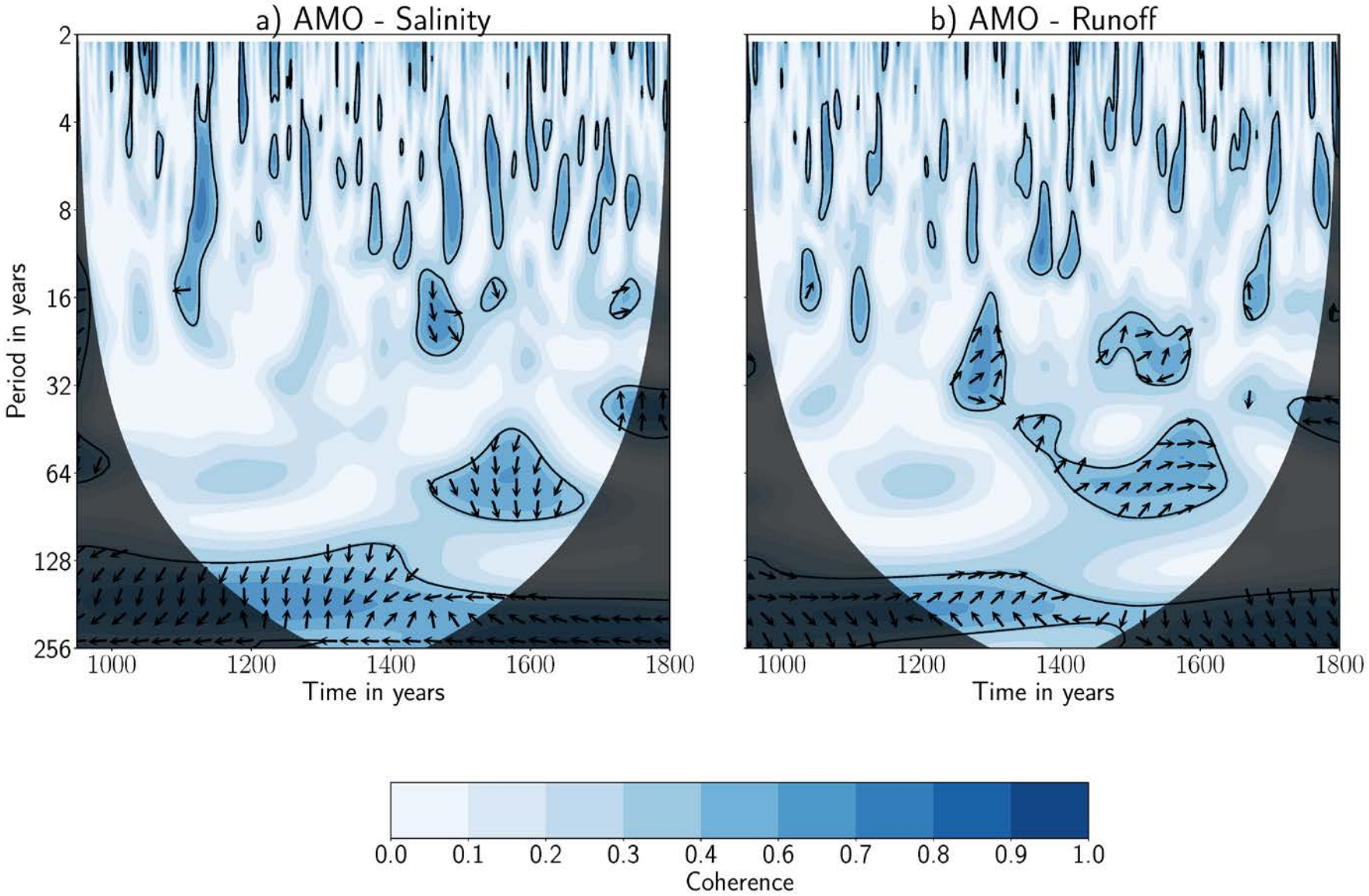
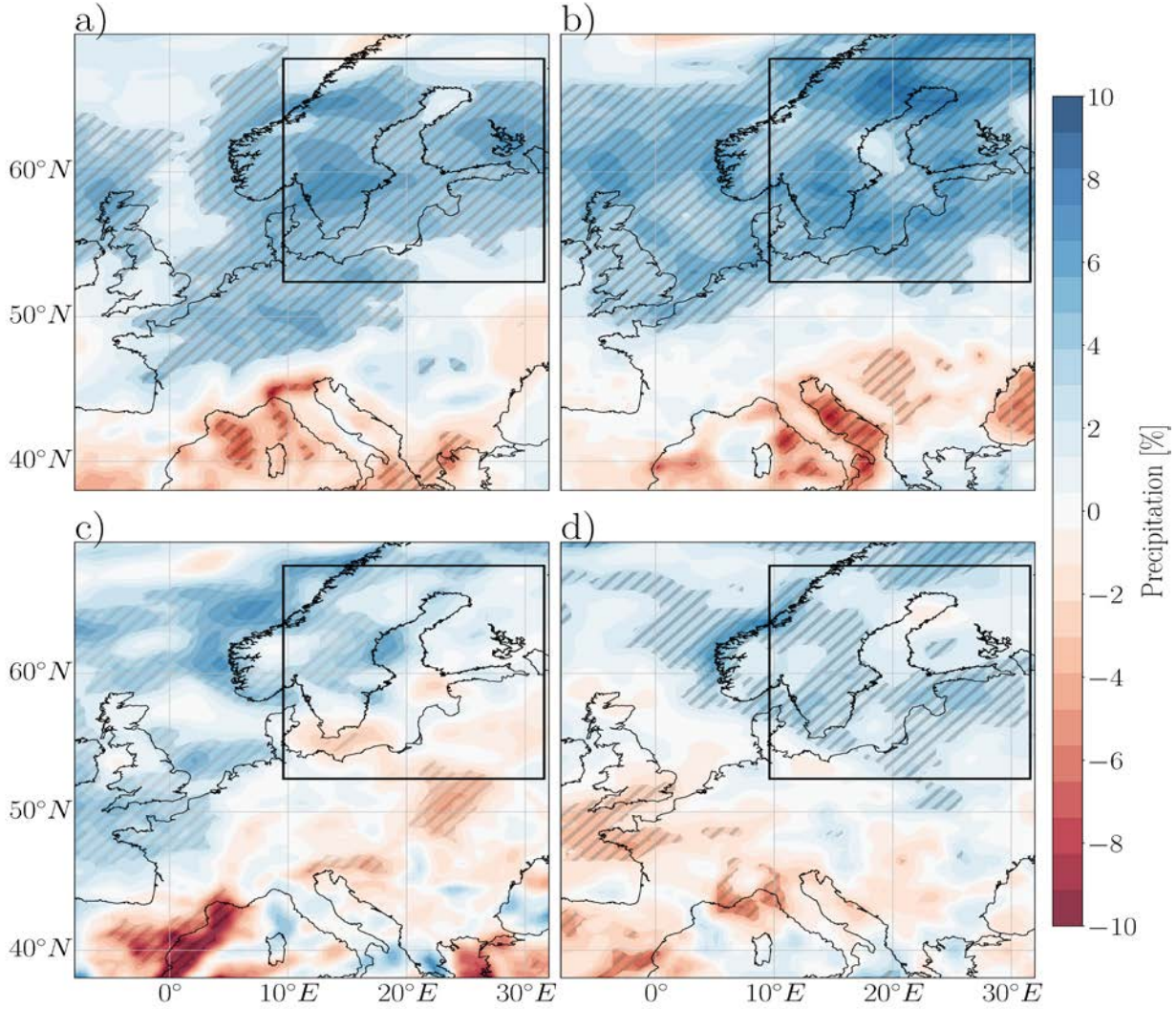


AMO influences the precipitation over the Baltic Sea



Difference in precipitation between AMO+ and AMO-. a) winter (DJF), b) spring (MAM), c) summer (JJA), d) autumn (SON). The scale shows the relative difference to the local seasonal mean. Statistical significant regions are hatched.

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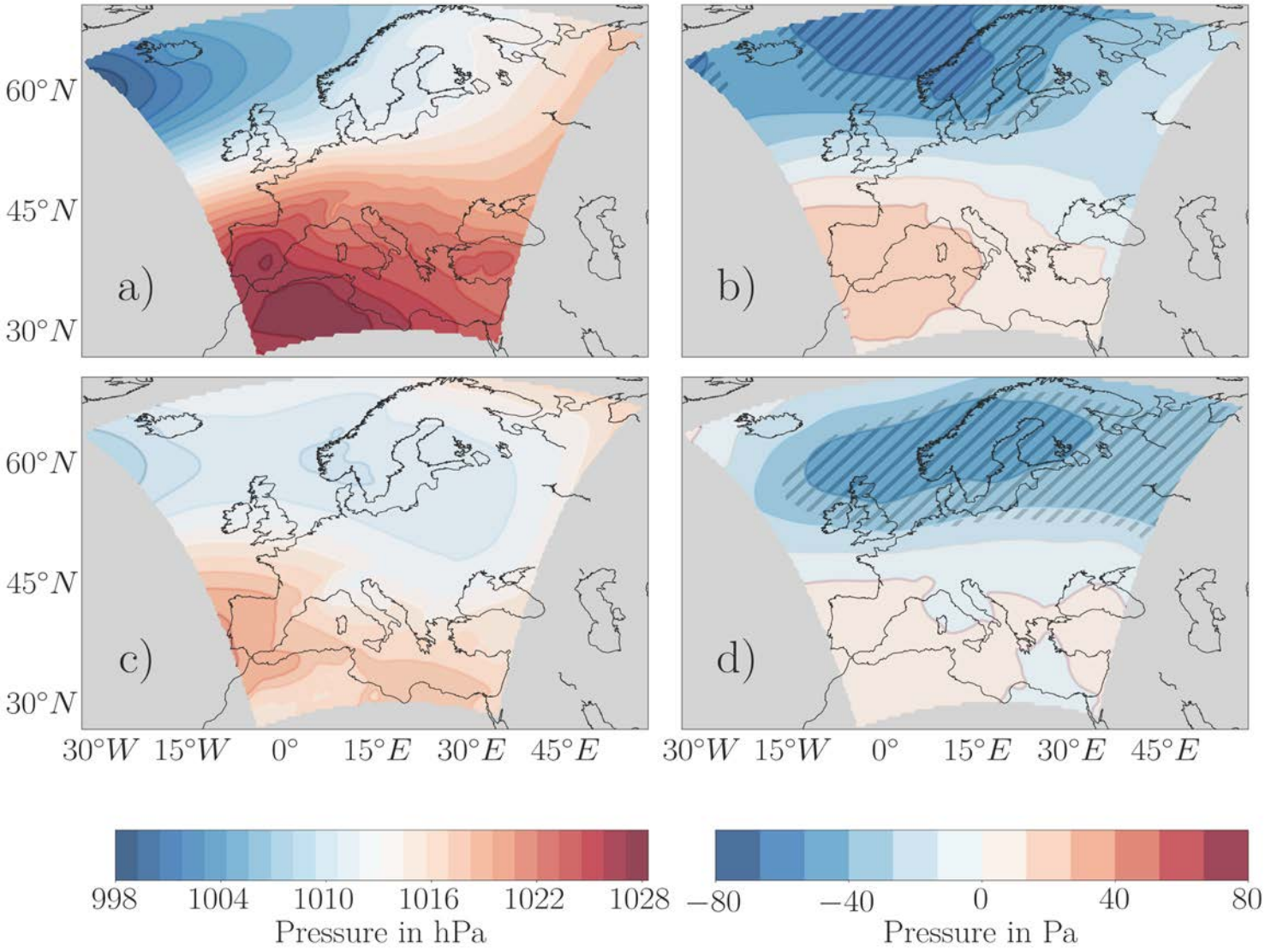


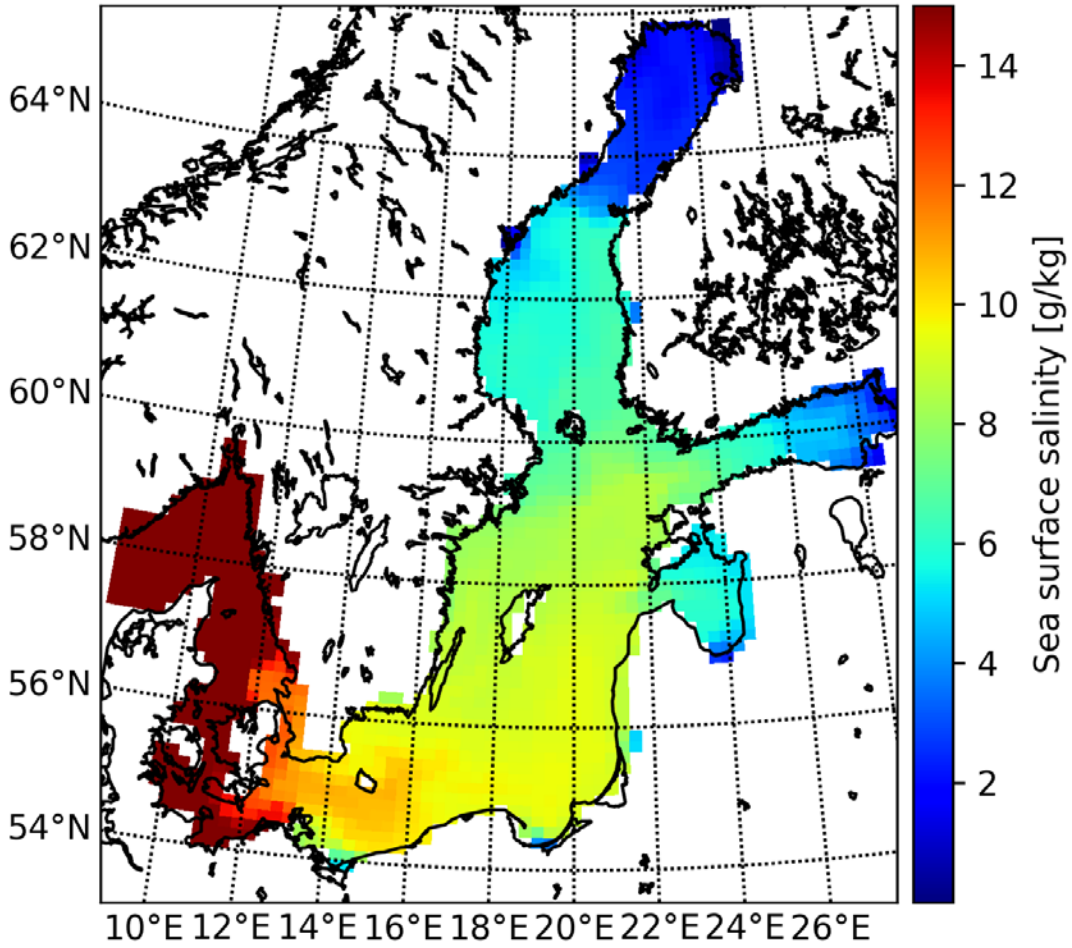
Mean SLP in winter a), SLP difference between AMO+ and AMO- winter b), mean SLP spring c), difference spring d)

Conclusions

- Dynamical downscaling of global paleoclimate simulation ECHO-G shows the impact of AMO on the Baltic Sea
- AMO-induced changes in the atmospheric circulation impact the precipitation over the Baltic Sea catchment area

Conclusions

- Precipitation affects river runoff which in turn affects the mean salinity causing multi-decadal salinity changes of 0.8 g/kg
- Horizontal salinity gradient affects the species distribution



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Questions?