Assessment of temperature fingerprints in the North Atlantic for the reconstruction of deep water formation

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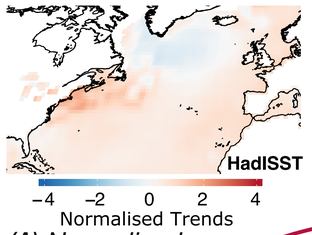
1 Motivation

Direct observations of the Atlantic Meridional Overturning Circulation (AMOC) are only available from 2004 onwards[1,2]. Because of the importance of the AMOC for the thermohaline circulation and the global climate system, indirect reconstructions are necessary to study long-term variability[3,4]. Suggested indirect reconstruction methods often use a temperature dipole in sea surface or subsurface temperatures of the North Atlanic[5,6,7] which are however subject to a multitude of forcings[e.g.8,9]. We test whether these dipole methods are reliable for reconstructions on all time scales.

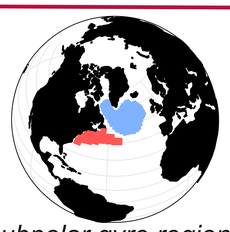
Please let me know if you have questions or ideas on the project!



***(A)** Normalised SST trends 1870 -2005*

2 Methods and Data

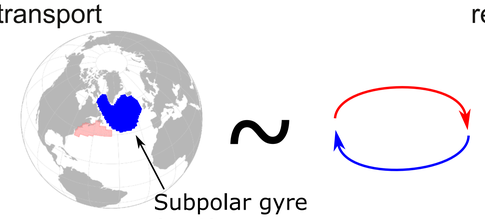
For two palaeoclimate model simulations of the past millennium (**HadCM3**[10]) and the past two millennia (**CESM1**[11]) AMOC strength and ocean temperatures are compared in terms of their distribution of variance and correlation. This allows to compare AMOC and temperatures for a period longer than the short observational record of AMOC.



***(B)** blue: subpolar gyre region as used in this project red: Gulf stream path. Redrawn after[6].*

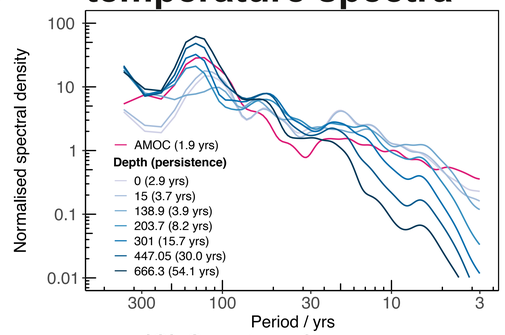
AMOC strength: Maximum volume transport in depth and across latitudes in the yearly averaged volume transport

sea surface temperatures (SST) and subsurface temperatures: yearly average across subpolar gyre (SPG) region in North Atlantic



AMOC indices from temperatures assume a correlation between SST or subsurface temperatures in the North Atlantic and the AMOC strength. Often a linear regression between the two is performed[4-9].

Surface to subsurface temperature spectra

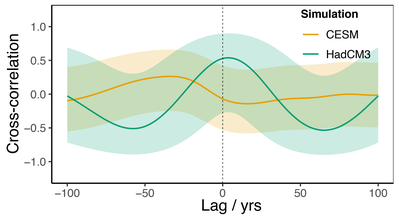


(C) Spectra of ocean temperatures in HadCM3 reveal that distribution of variance changes with depth and relation to AMOC spectrum

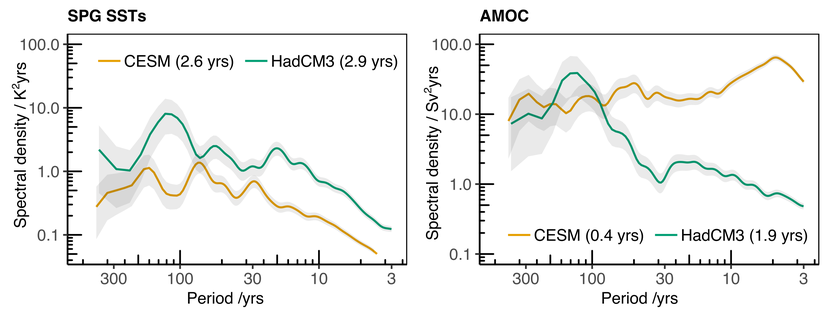
3 Results

We find discrepancies in the cross-correlations and the spectral densities between AMOC and SSTs in the two models. This decreases the skill of regresion indices for the AMOC especially in CESM. The differences between the models might be attributable to the spatial representation of the overturning.

***(D)** Cross-correlation between AMOC strength and SST in SPG region*



***(E)** Spectra of SST in subpolar gyre region and AMOC strength in the two models simulations of CESM and HadCM3. Numbers in brackets denote to persistence times of the time series*



4 Conclusions and Outlook

- Index reconstructions of AMOC not robust in all models
- Uniform index definition difficult due to discrepancies in cross-correlations
- Considering additional models
- Analyse spatial correlation between SST and AMOC
- Check spectrum of different AMOC strength definitions

References

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