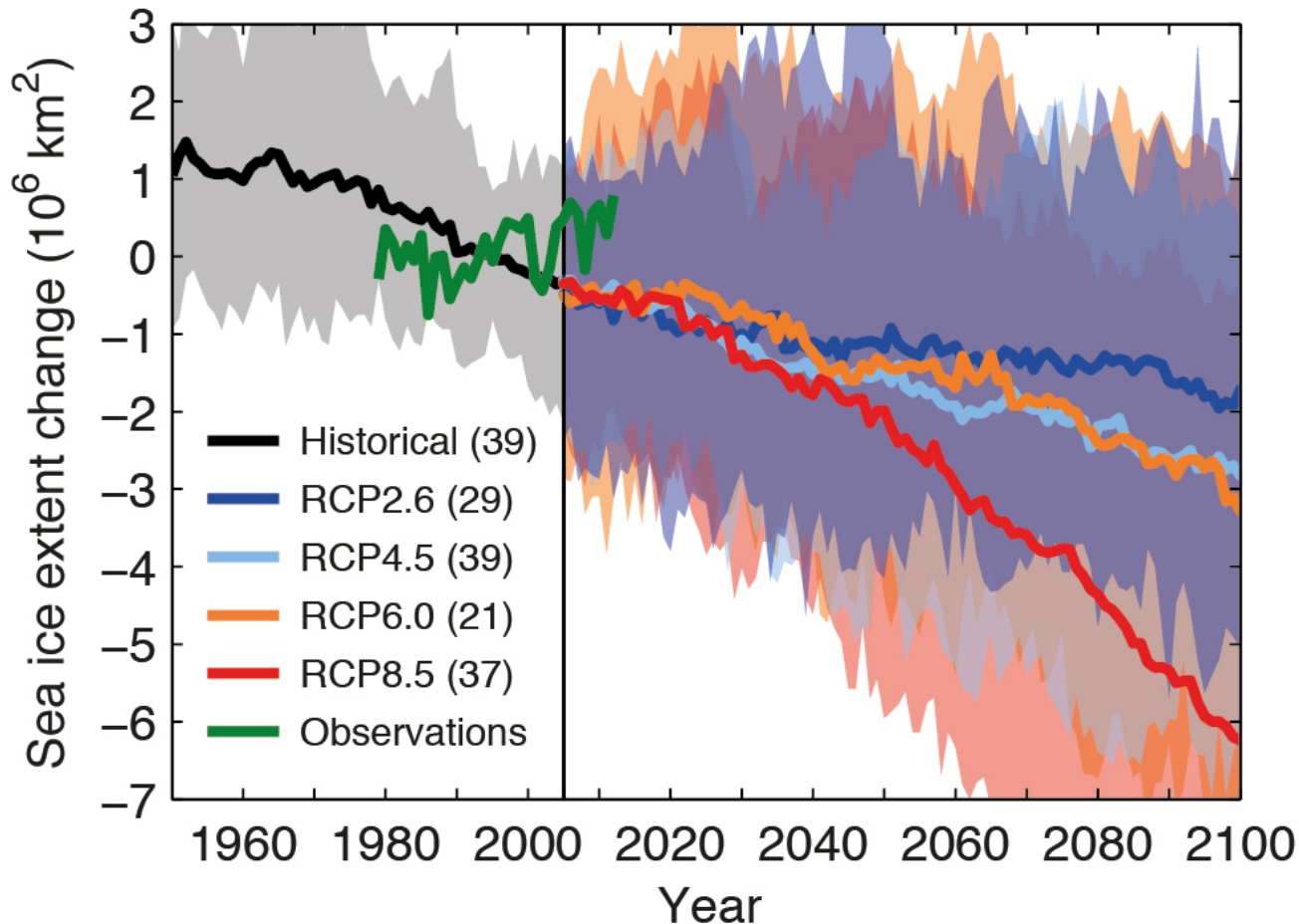


Variability & Trends of Antarctic Sea-ice in HighResMIP Simulations with AWI-CM

Thomas Rackow, Alfred Wegener Institute,
Helmholtz Centre for Polar and Marine Research

1. Motivation

- **CMIP5 models struggle to reproduce the overall increase of Antarctic sea ice extent (September)**



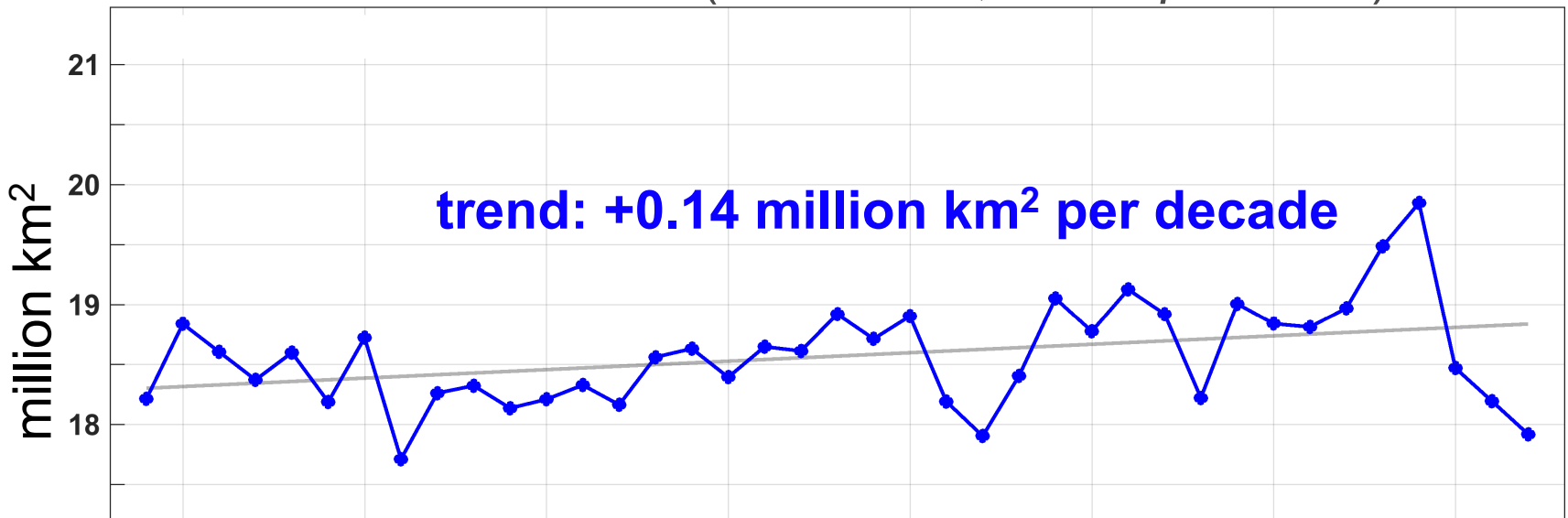
*IPCC AR5,
Chap.12:*

*„...low
confidence
in these
Antarctic
sea ice
projections“*

1. Motivation

- **CMIP5 models struggle to reproduce the overall increase of Antarctic sea ice extent (September)**

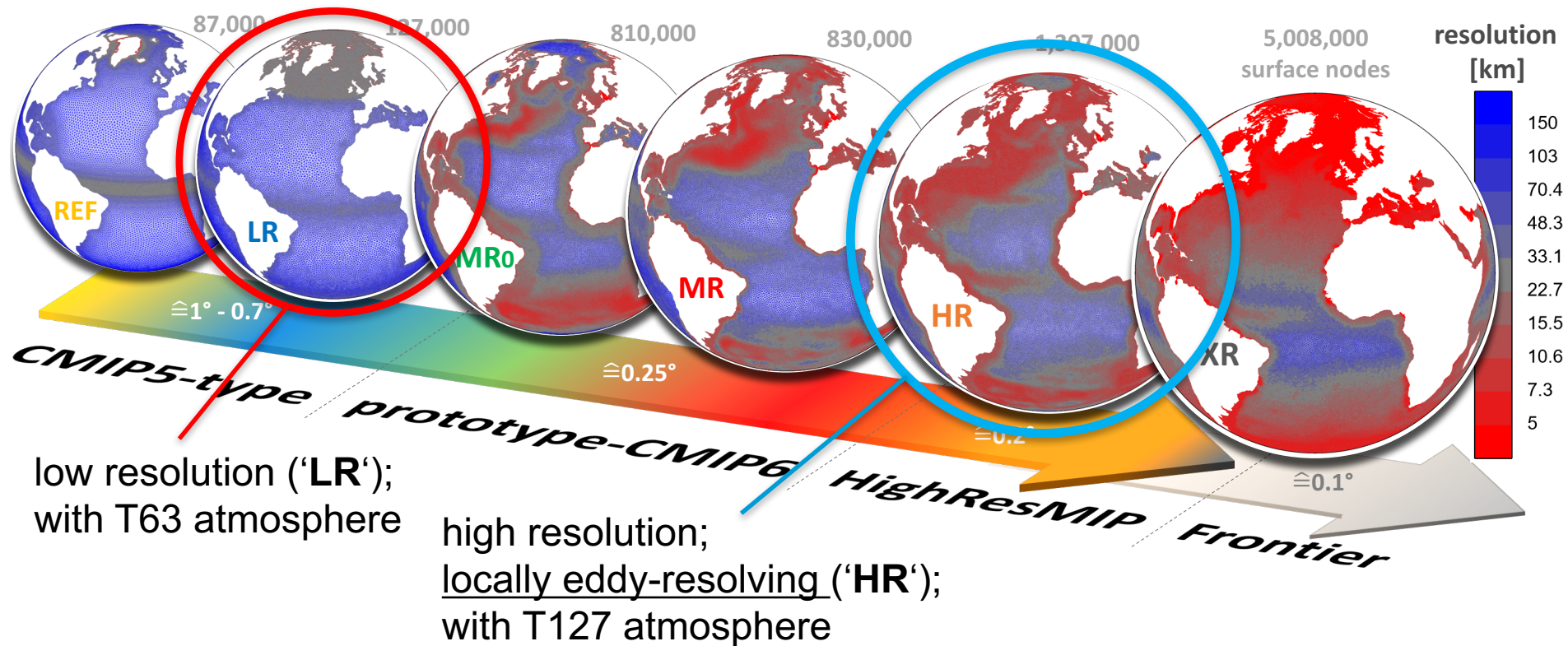
observed **AWI** data (1979-2017; *seaiceportal.de*)



Q: Could this shortcoming be related to the coarse climate (ocean) model resolution (~1°)?

2. The AWI Climate Model (AWI-CM)

- Coupled configuration of FESOM and ECHAM6
(*Sidorenko et al. 2015; Rackow et al. 2016; Clim. Dyn.*)
- Hierarchy of different FESOM meshes (increasing resolution):



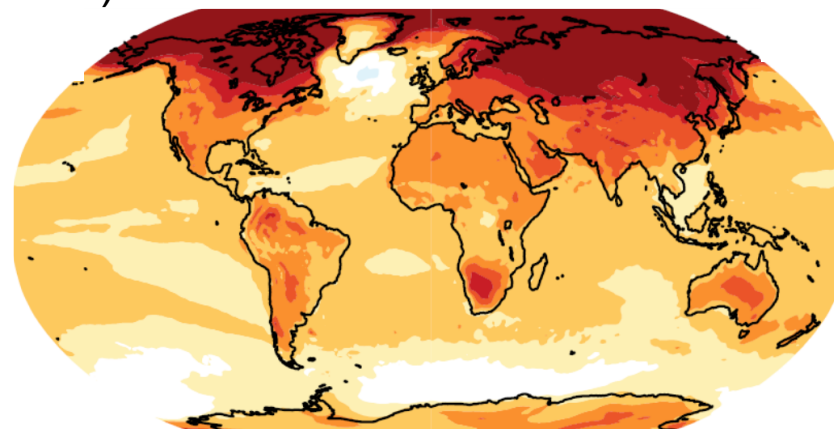
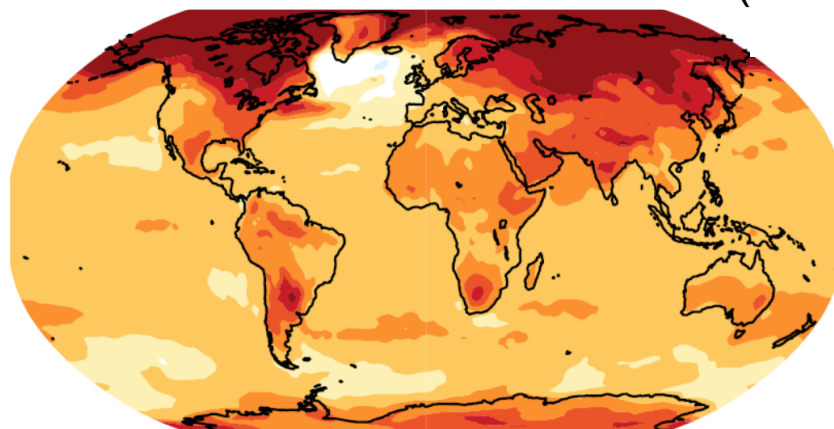
3. Results: RCP8.5 climate change pattern

(2070-2099) –
(1976-2005)

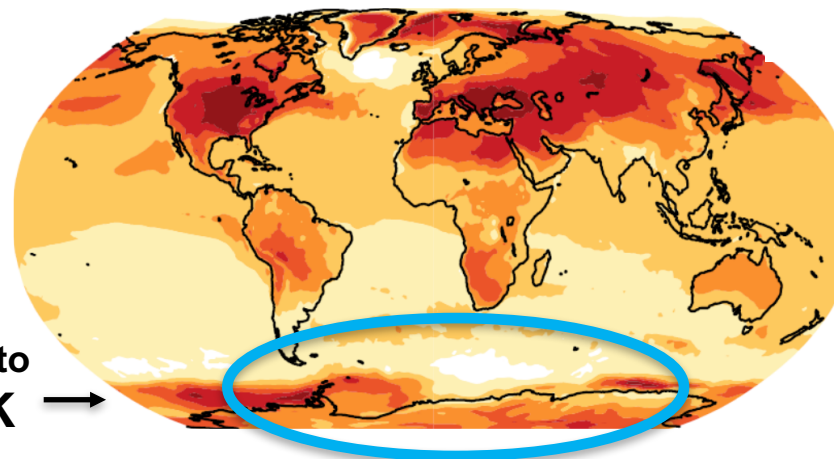
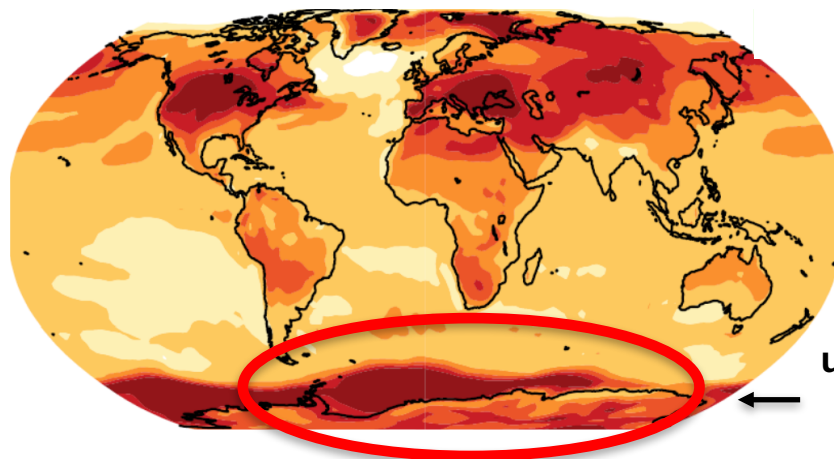
LR (low-res)

HR (high-res)

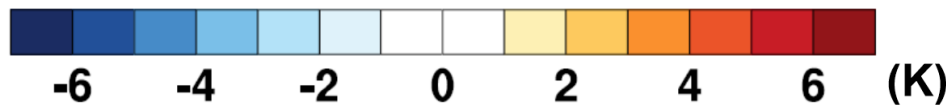
DJF



JJA



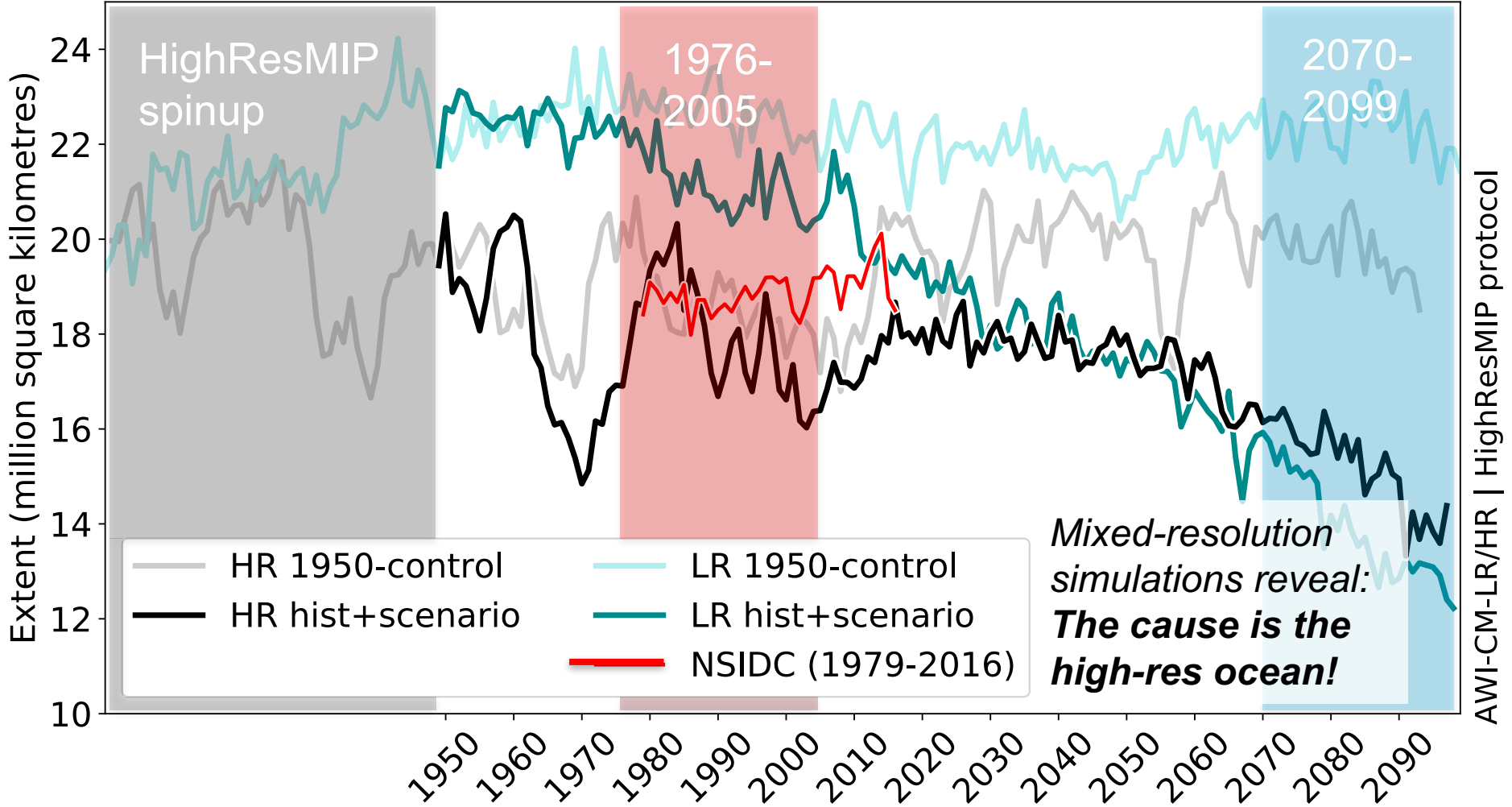
← up to 6K →



3. Projections for Antarctic sea ice

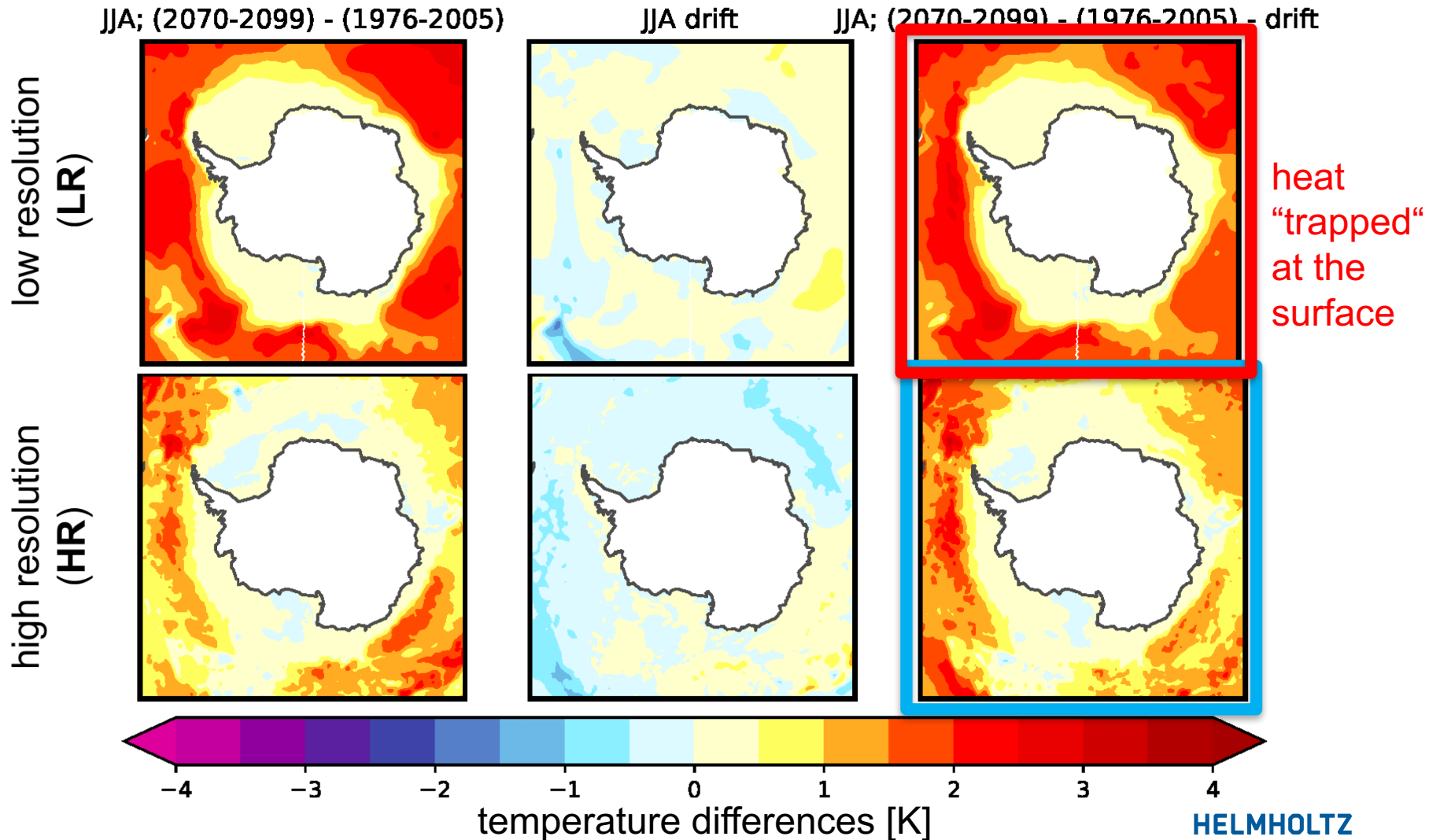


Antarctic Sea Ice Extent (September 1950-2099)



4. What is causing the stable sea ice?

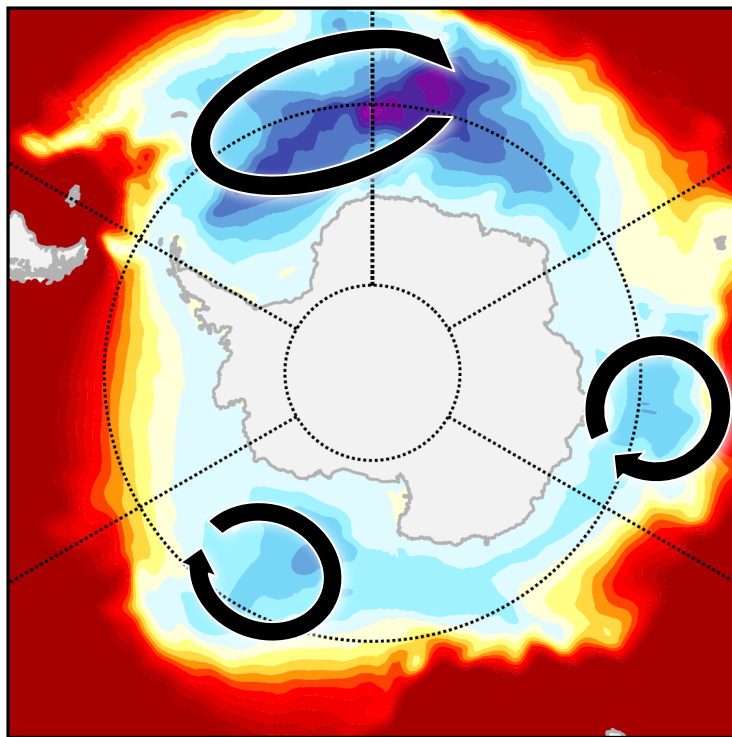
- Change of **sea surface temperature (JJA)**



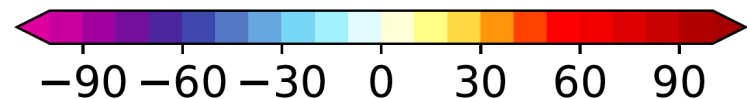
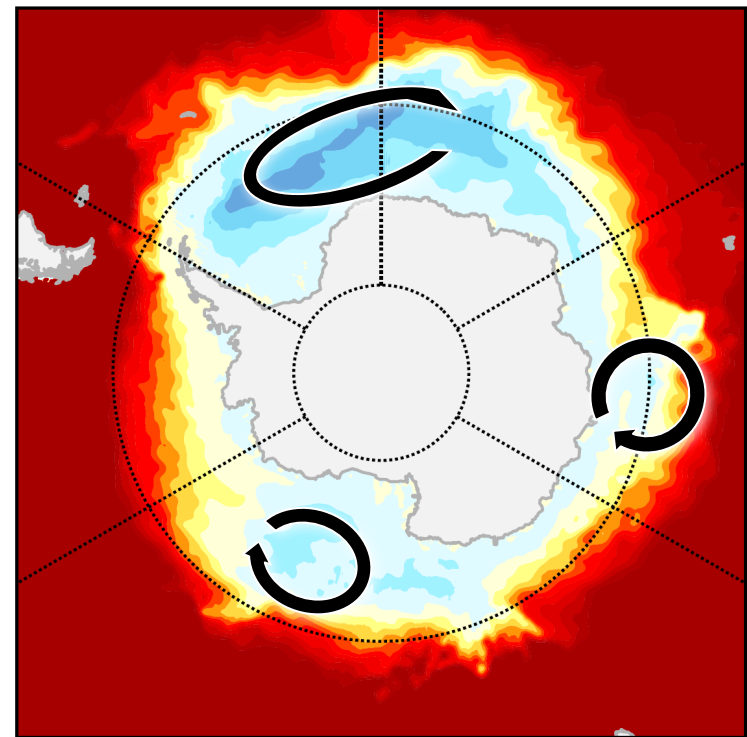
4. What is causing the stable sea ice?

- Barotropic streamfunction [Sv] in the control runs

low resolution (LR)

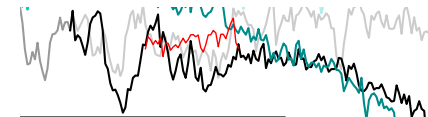
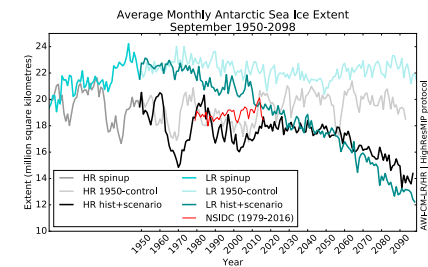
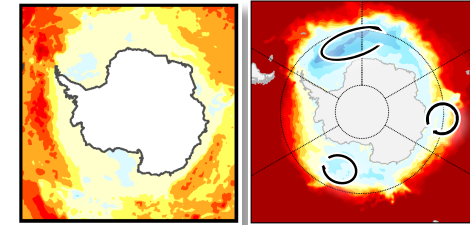


high resolution (HR)



5. Conclusions

- Reduced sea surface temperature warming and lower heat transport into the Antarctic in HR compared to LR (CMIP5-type res.)
- **Accordingly, the polarity of September sea ice trends is tied to ocean resolution**
 - low-resolution simulation shows strong decrease
 - high-resolution simulation with stable sea ice extent is more in line with satellite observations over the historical period
- **HighResMIP protocol could benefit from longer spinups**; strong ice extent variability in HR that dies down over time



Thank you!

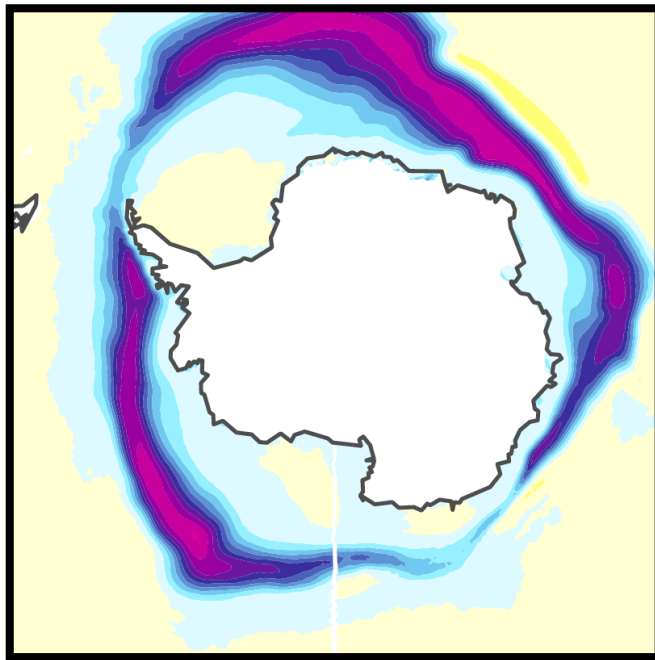
Appendix



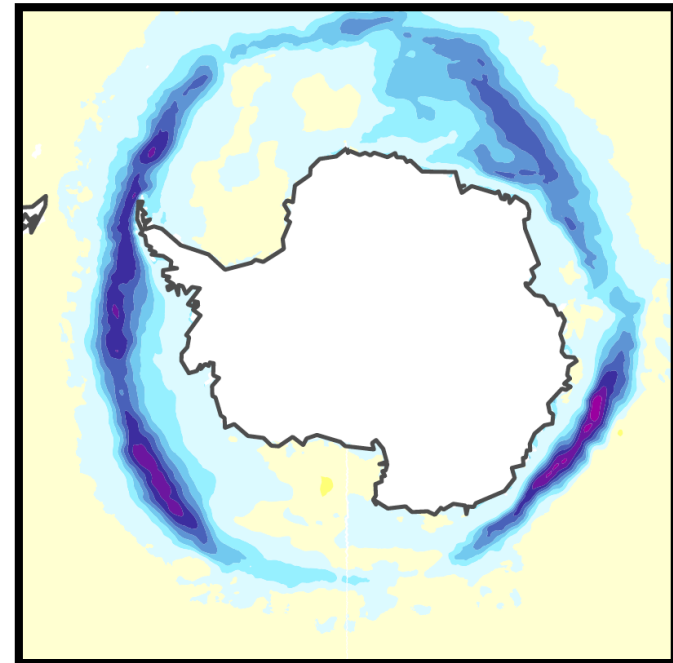
3. Results

- Change of **sea ice concentration** in September at the end of the century (2070-2099), relative to 1976-2005

low resolution (LR)



high resolution (HR)



-0.8

-0.6

-0.4

-0.2

0.0

0.2

0.4

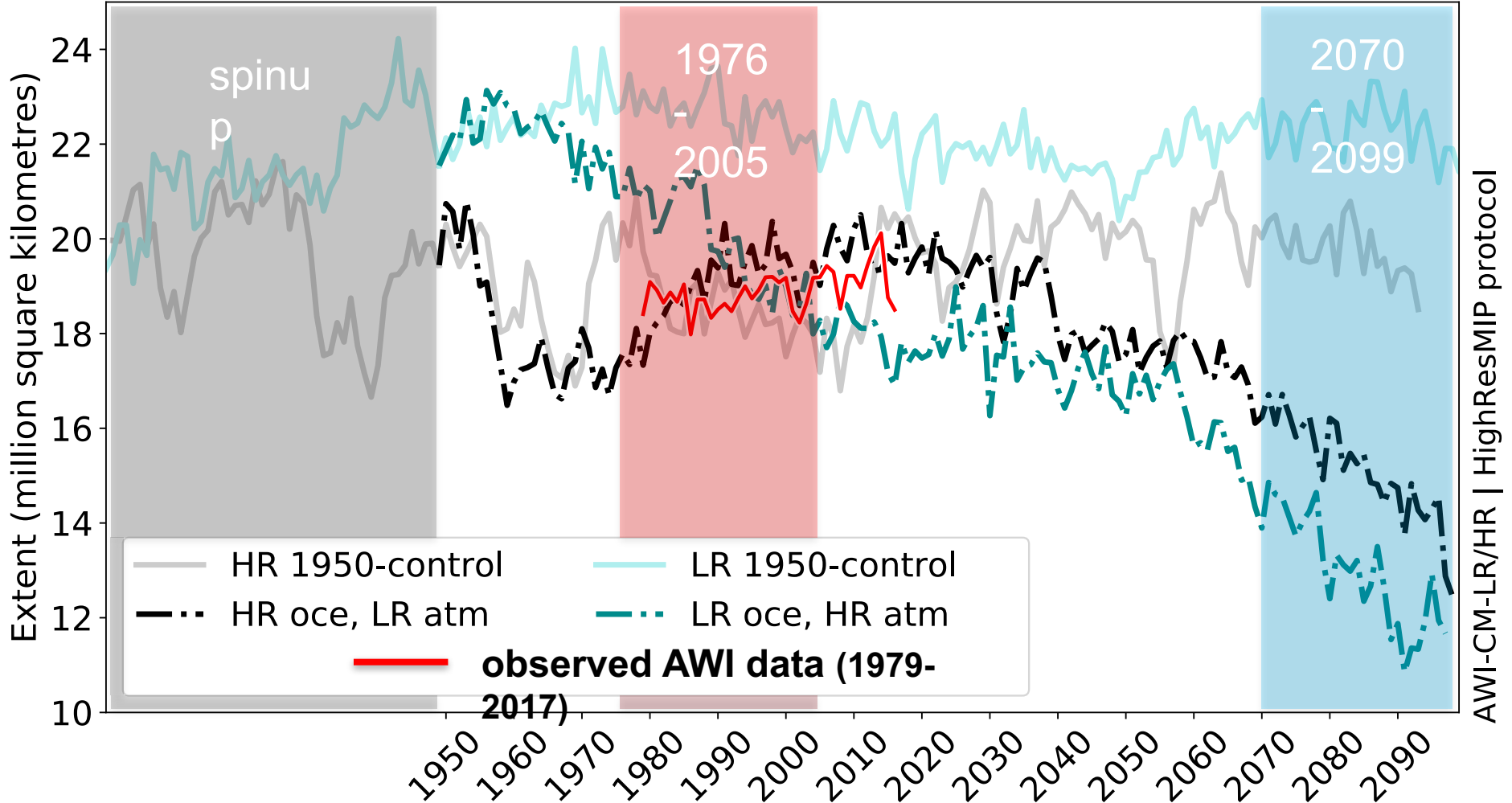
0.6

0.8

3. Mixed-resolution runs



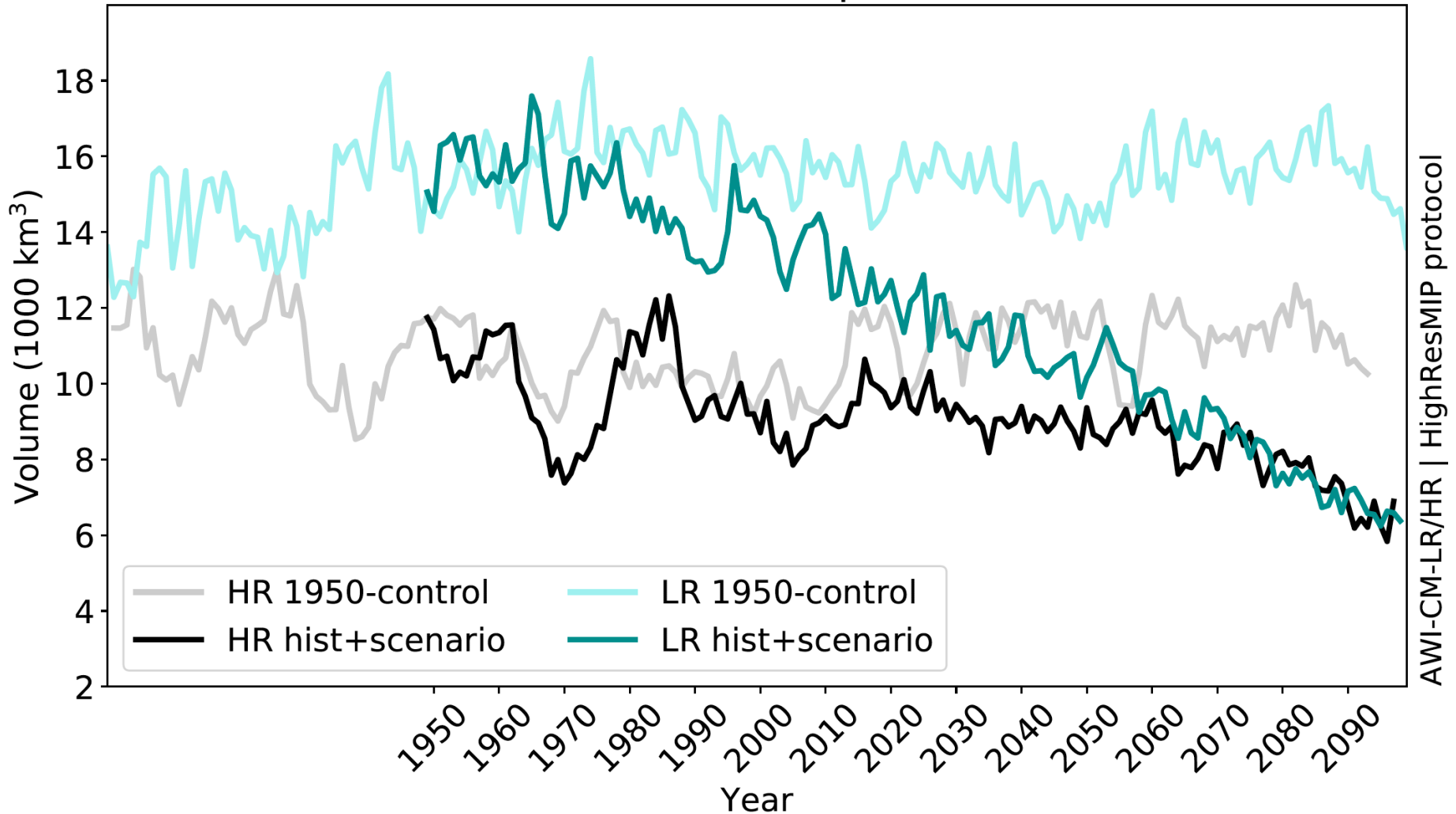
Antarctic Sea Ice Extent (September 1950-2099)



Appendix: sea ice volume

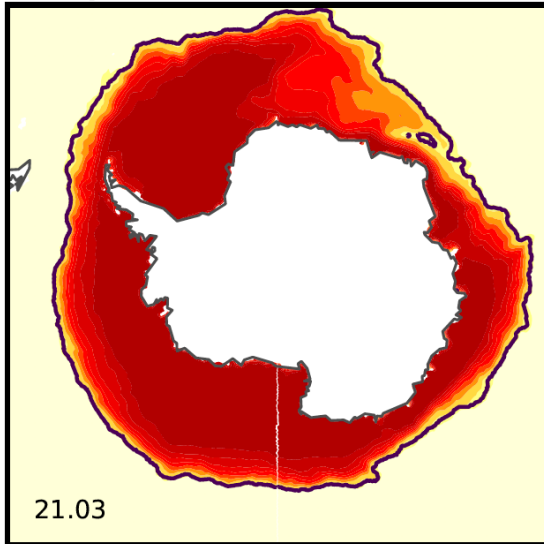


Antarctic Sea Ice Volume (September 1950-2099)

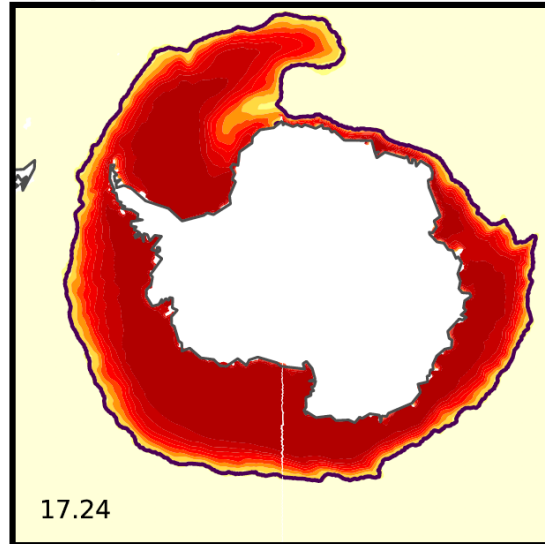


Appendix: initial variability

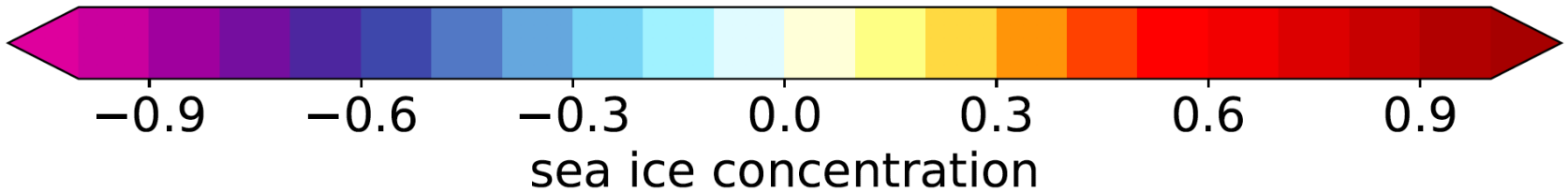
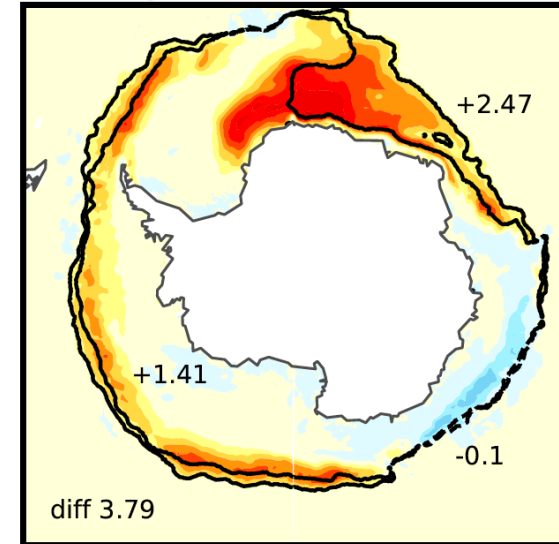
Sep. Hi (1955-1965)



Sep. Lo (1965-1975)

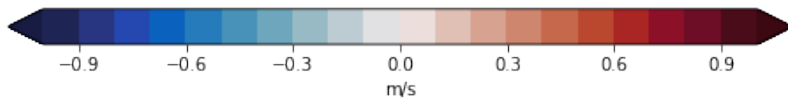
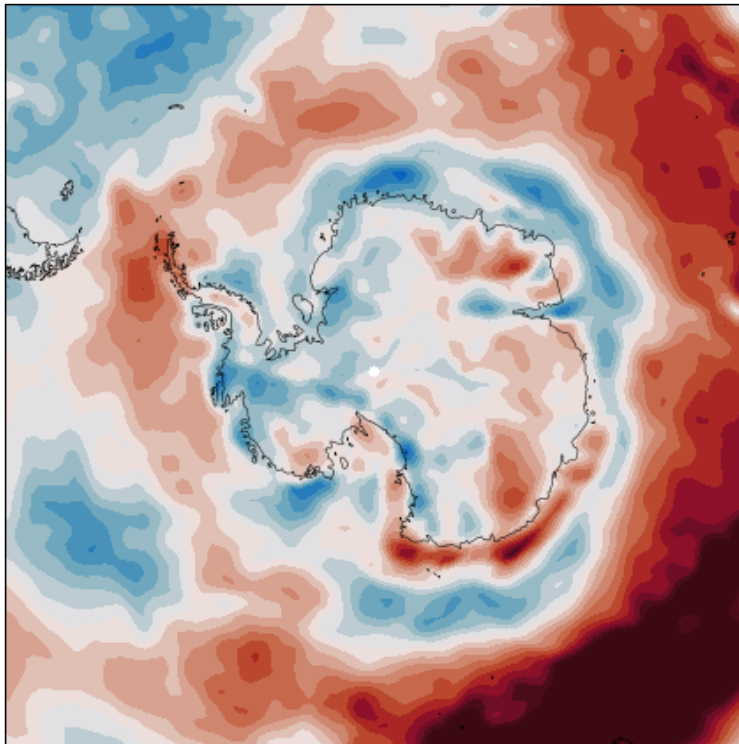


September Hi-Lo

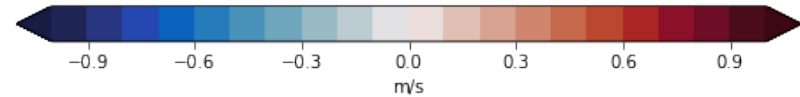
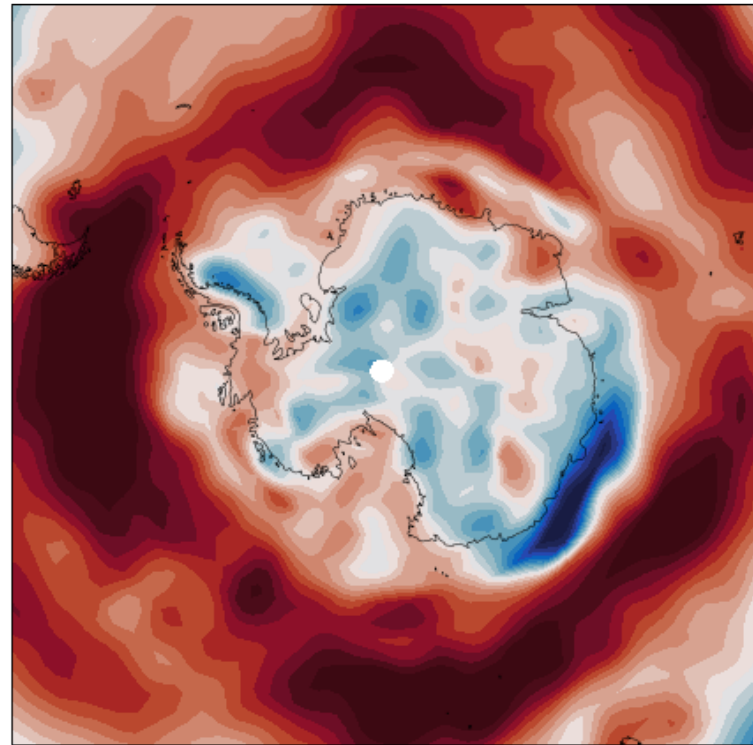


Appendix: 10m wind speed changes

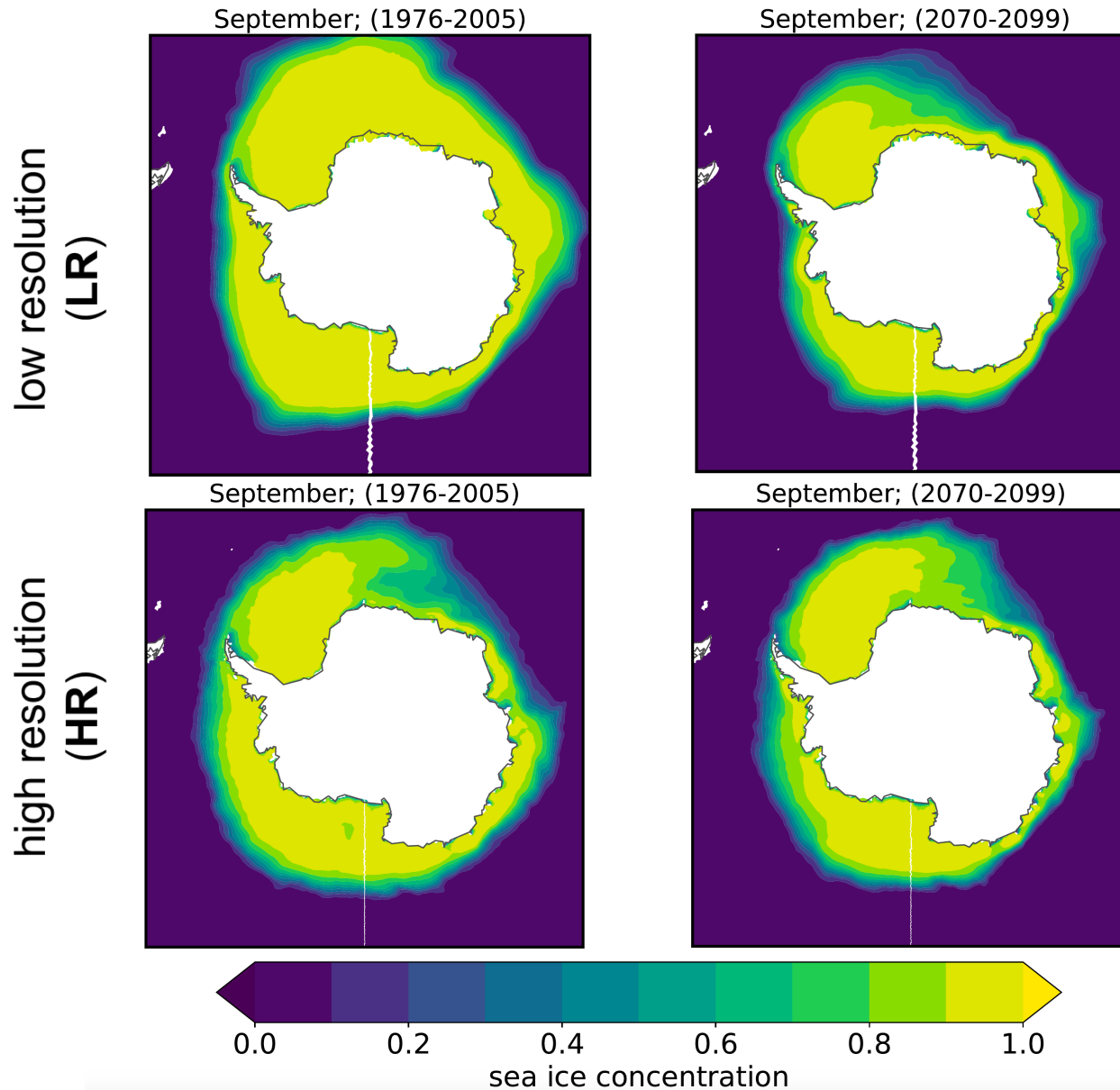
HR/T127



LR/T63

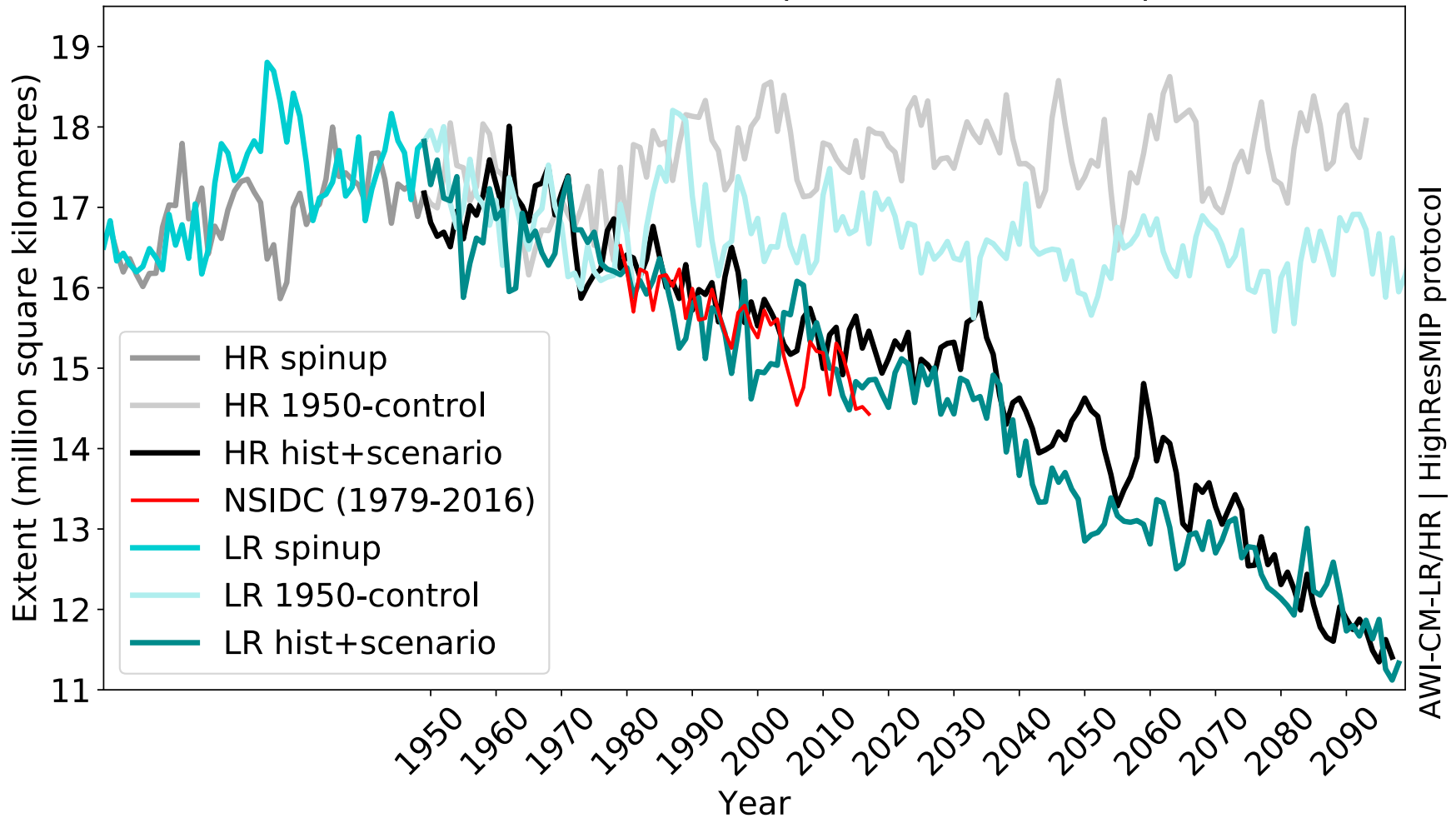


Appendix: concentration patterns



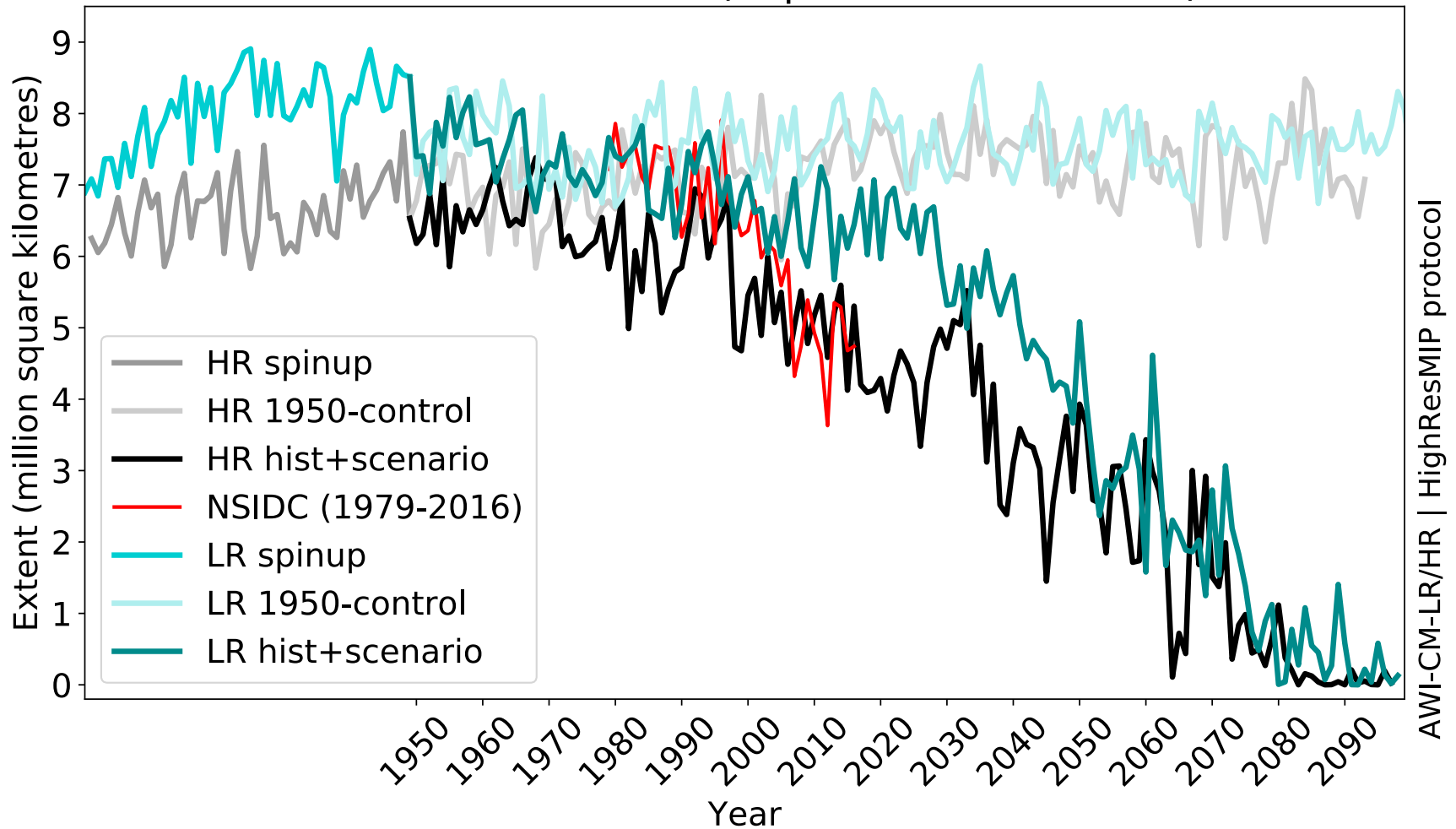
Appendix: Arctic sea ice extent

Arctic Sea Ice Extent (March 1950-2099)



Appendix: Arctic sea ice extent

Arctic Sea Ice Extent (September 1950-2099)



Appendix

increased decadal (20-yr) SST variability in the Southern Ocean

HadISST (1870-2016): standard deviation of 20yr-running mean SST, detrend

