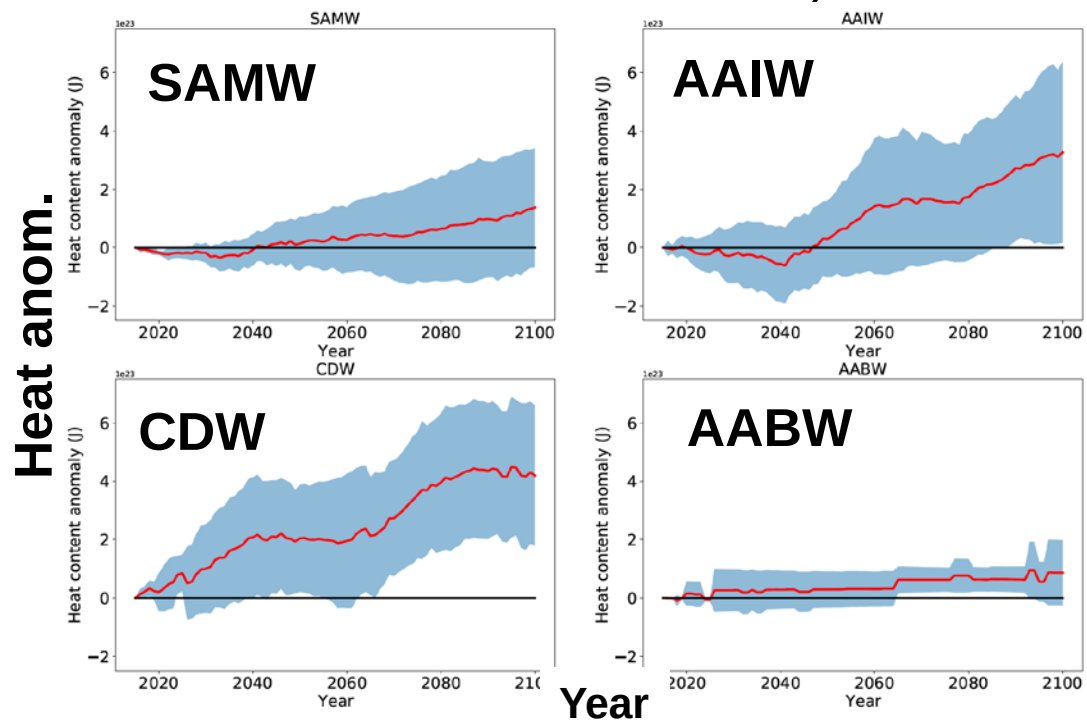


Southern Ocean water mass properties and circulation in CMIP6

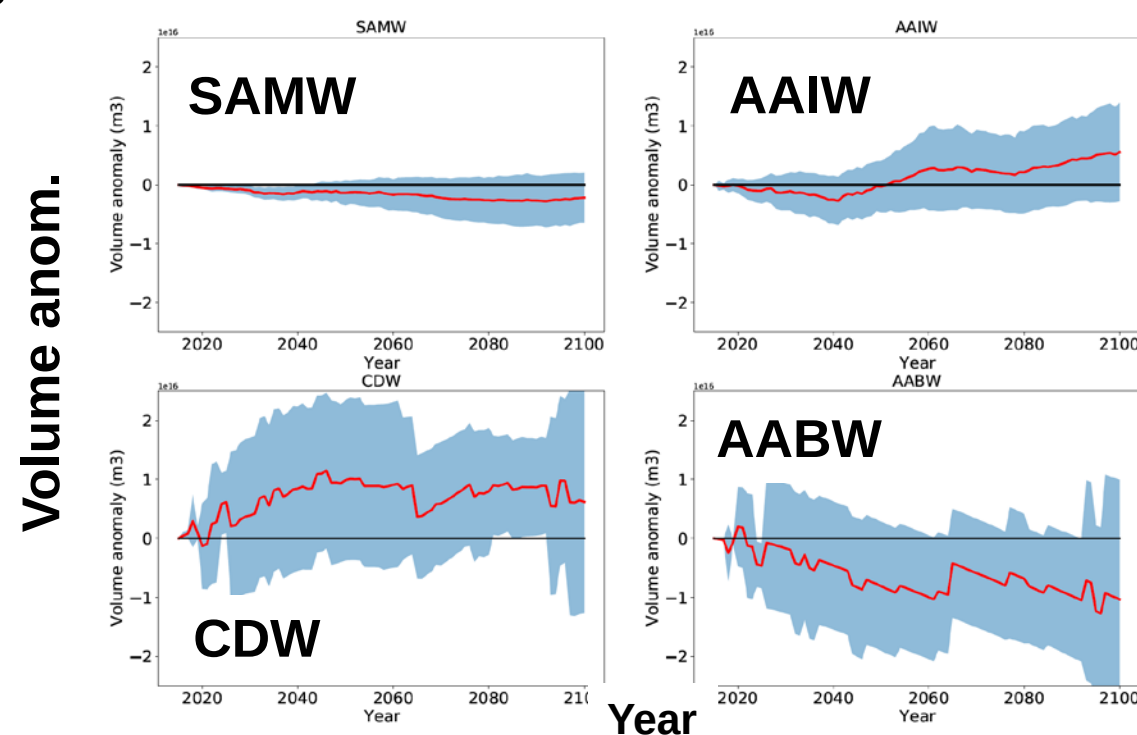
Andrew Meijers, David Munday, Tilla Roy and Jean Baptiste Sallée



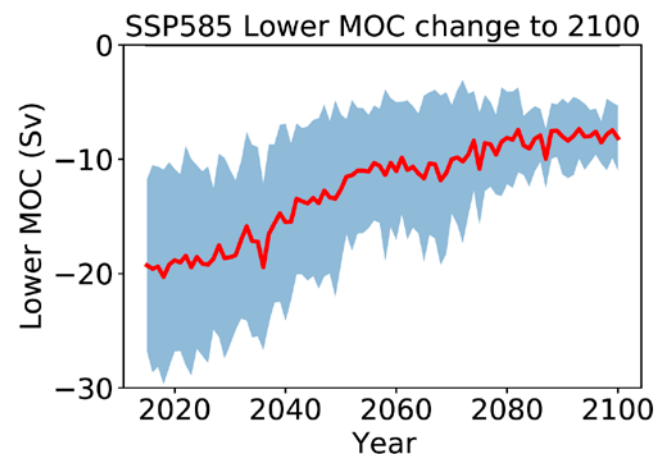
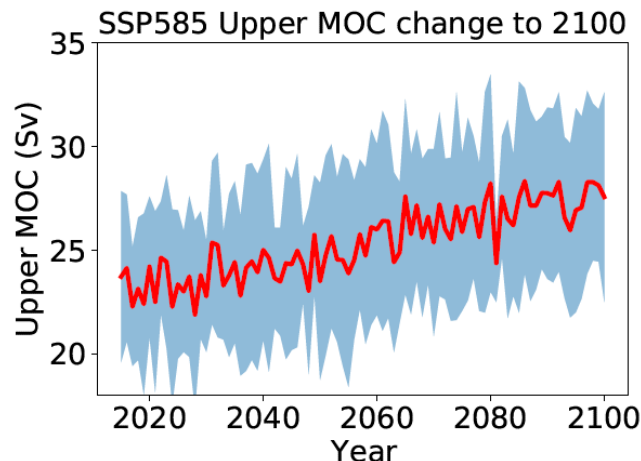
1. Heat content anom. to 2100, dominated by...



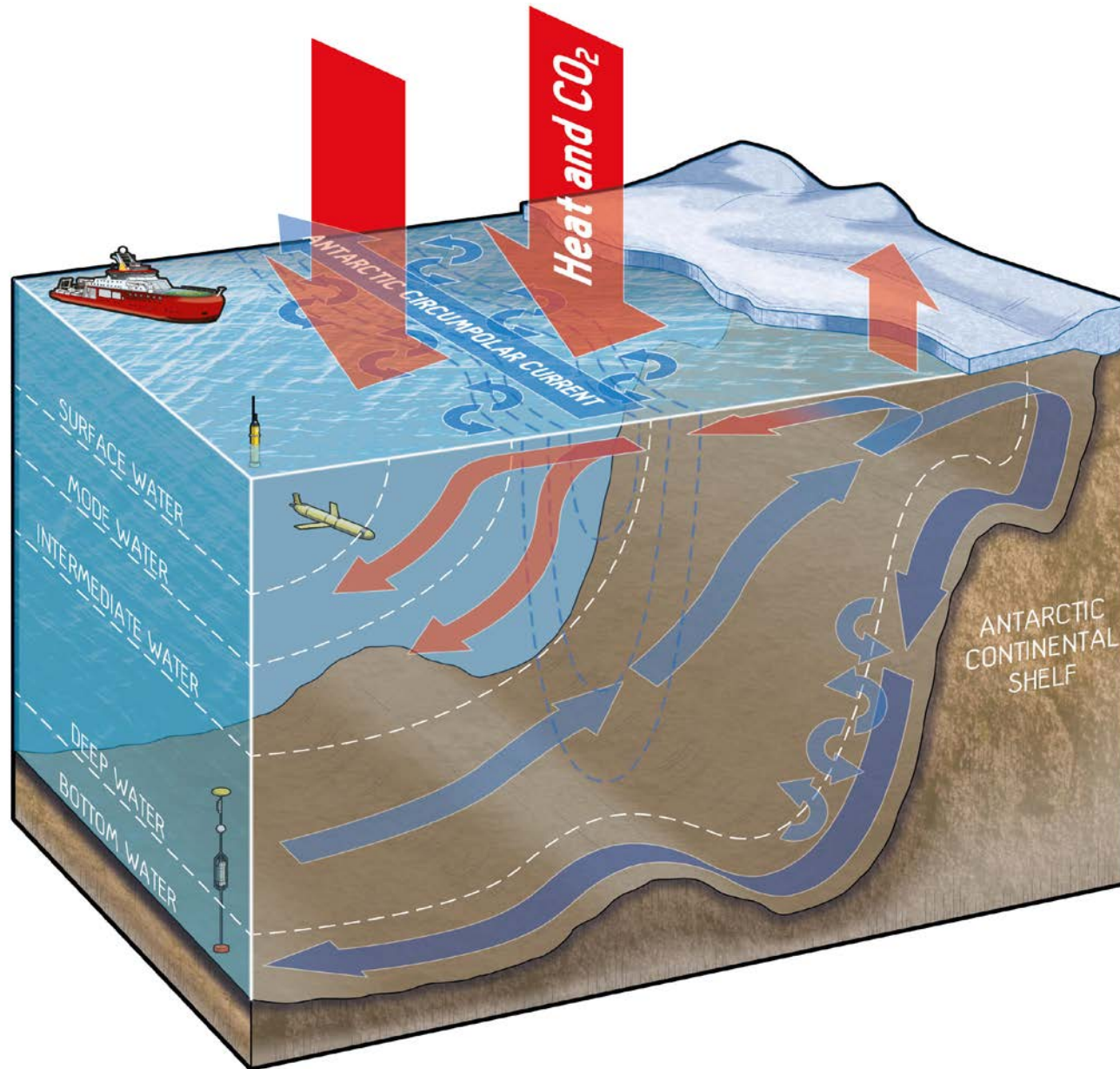
2. Water mass volume anom. to 2100



3. Upper MOC cell accelerates, lower cell crashes

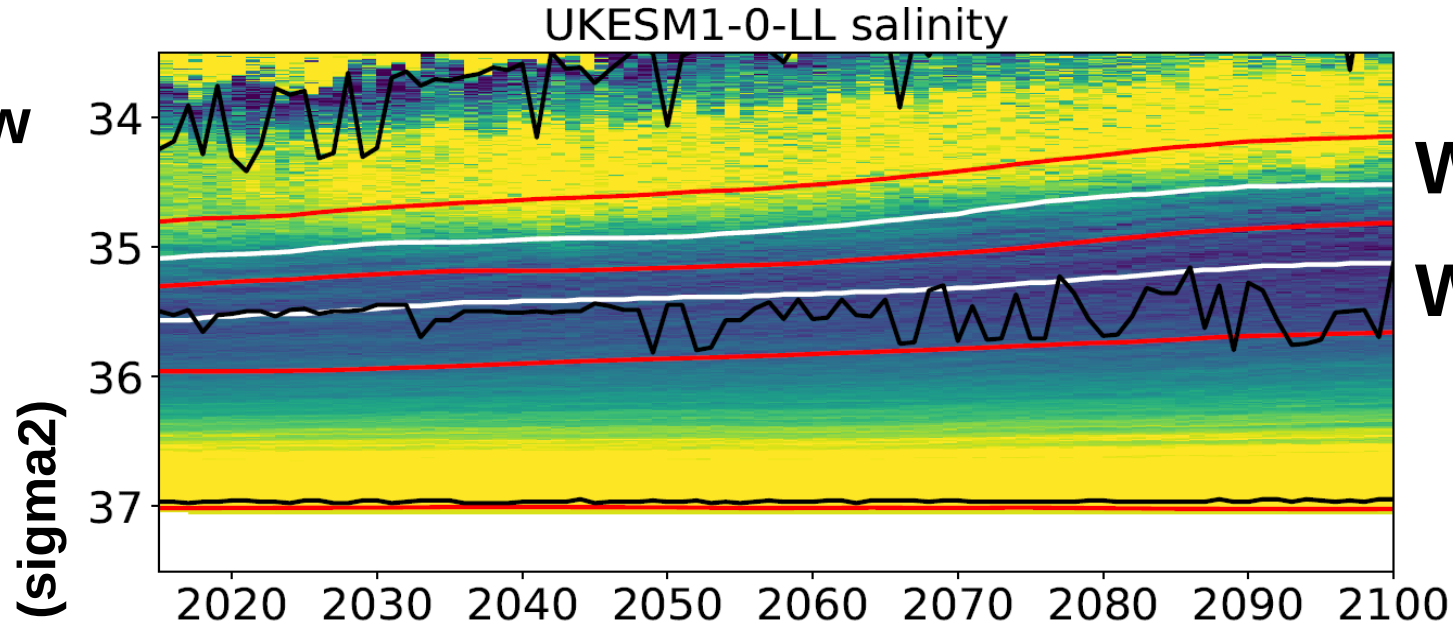


4. Lower cell loss dominated by surface freshening



Dynamic water mass definitions (zonal means at 40°S)

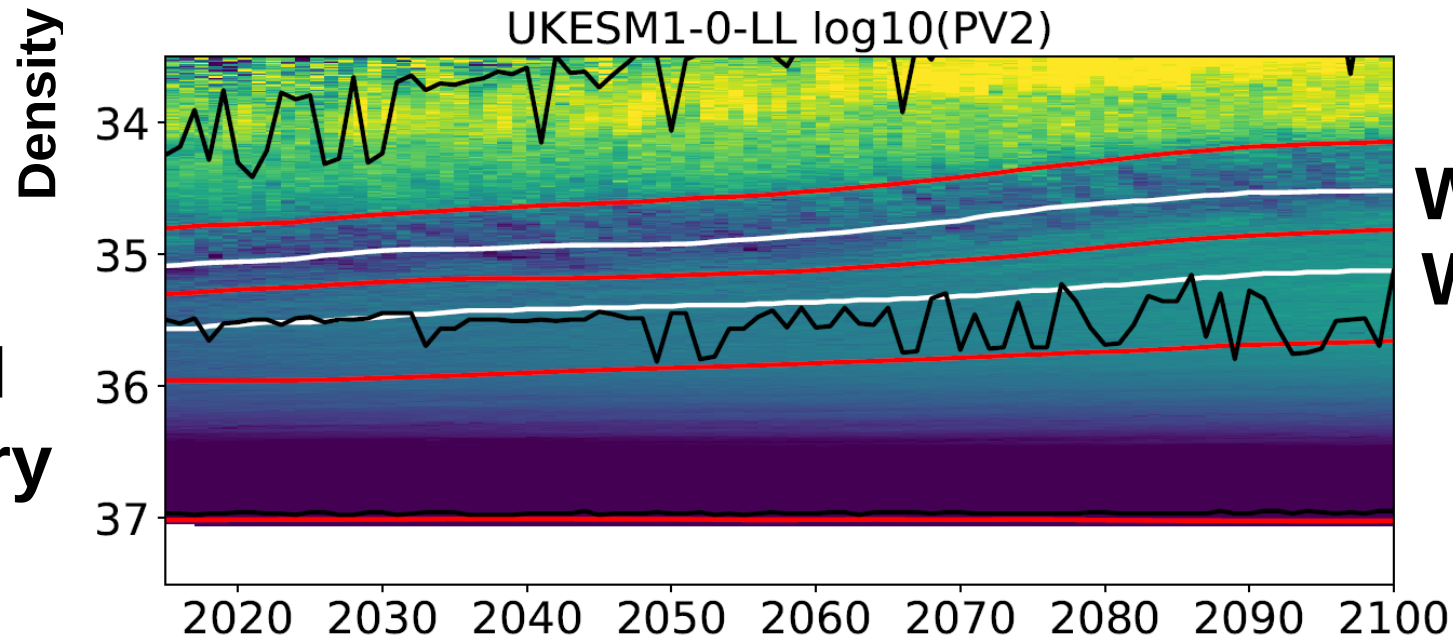
**Black=Flow
boundary**



White PV_min

White S_min

**Red WM
boundary**

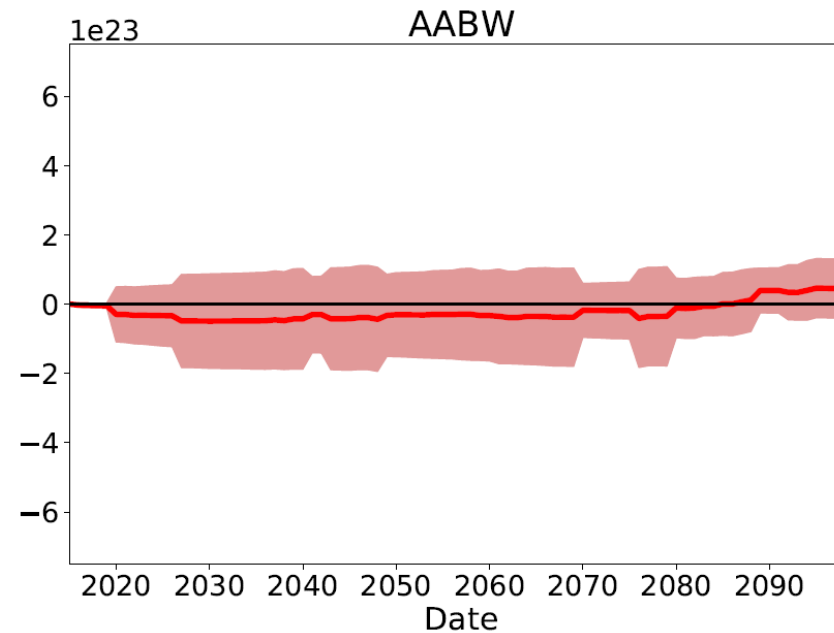
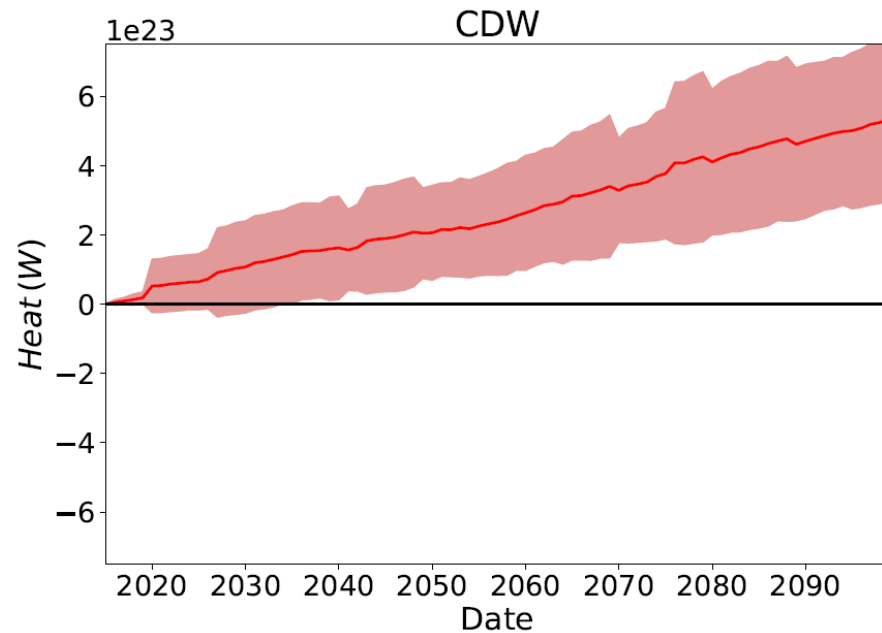
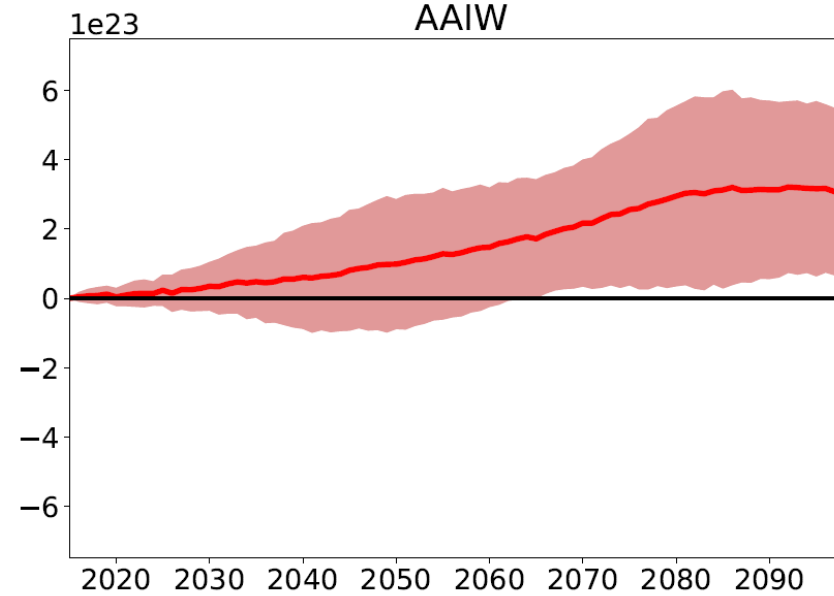
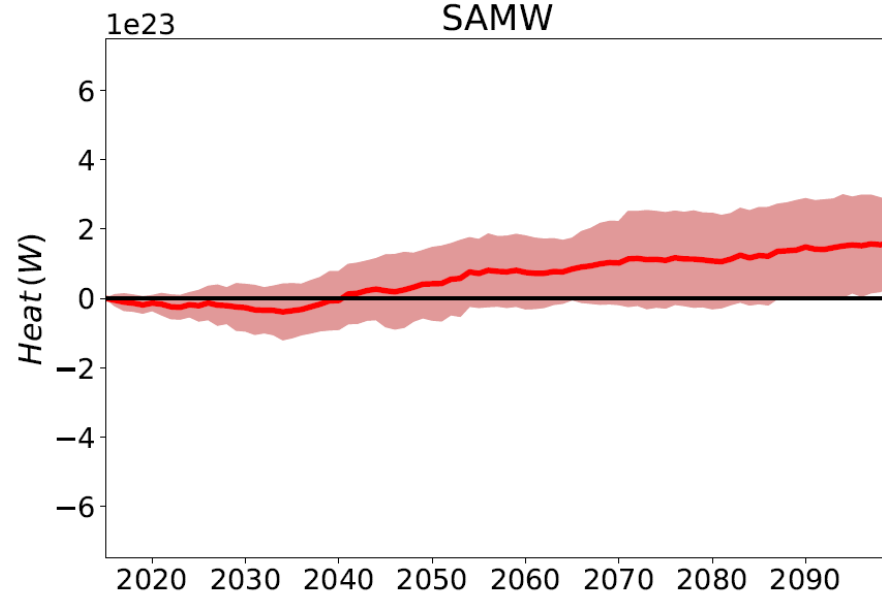


White PV_min

White S_min

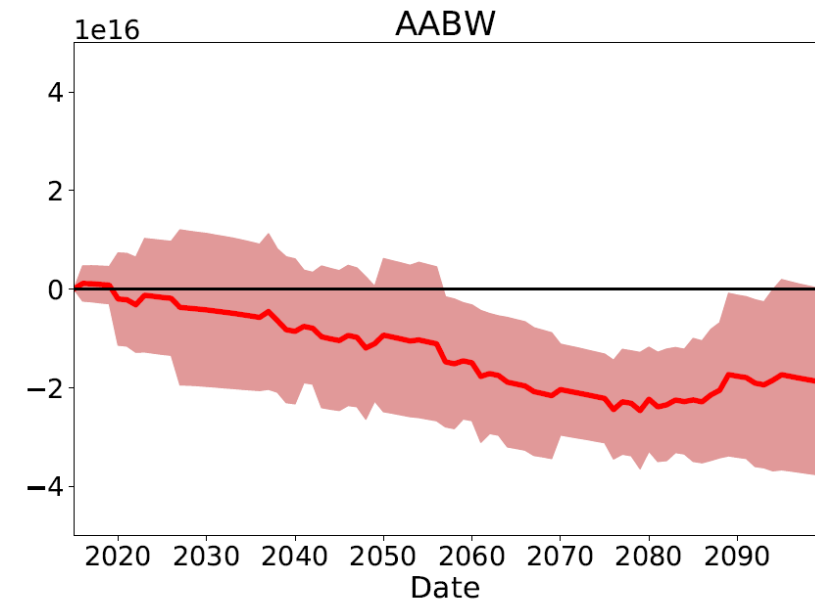
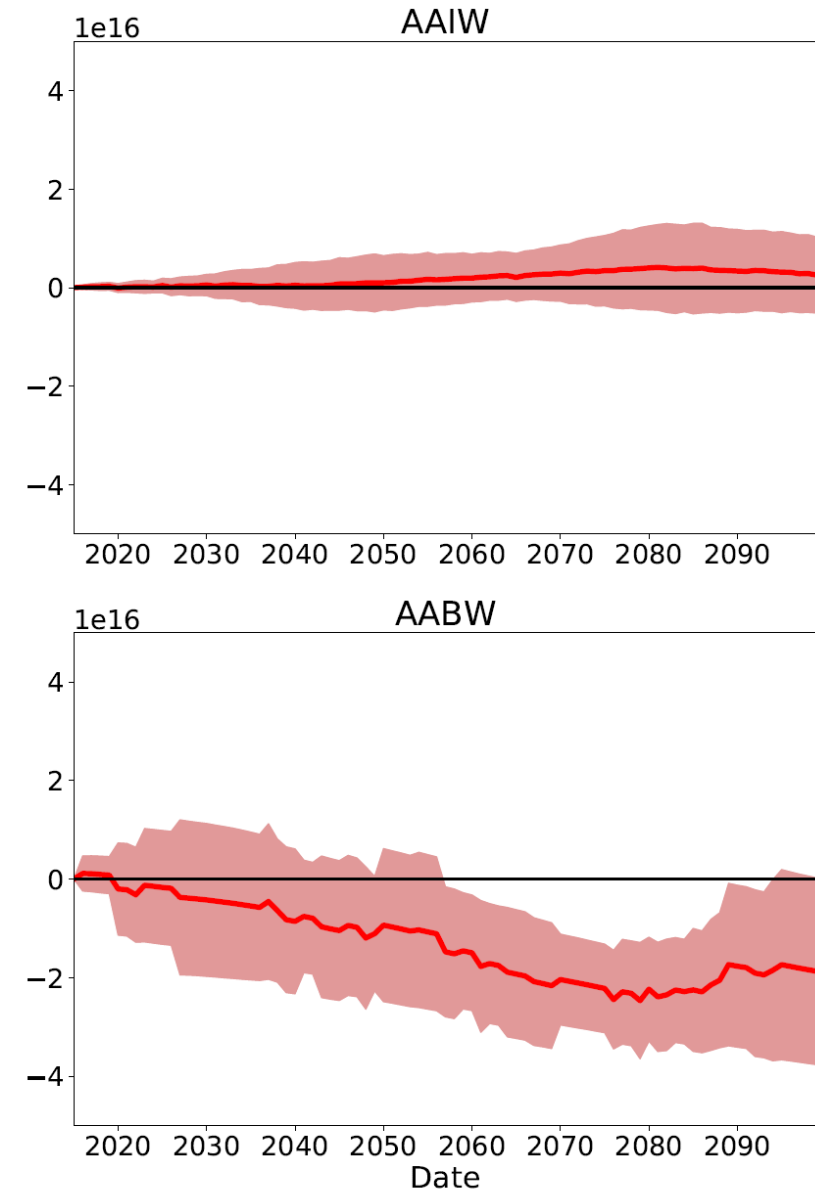
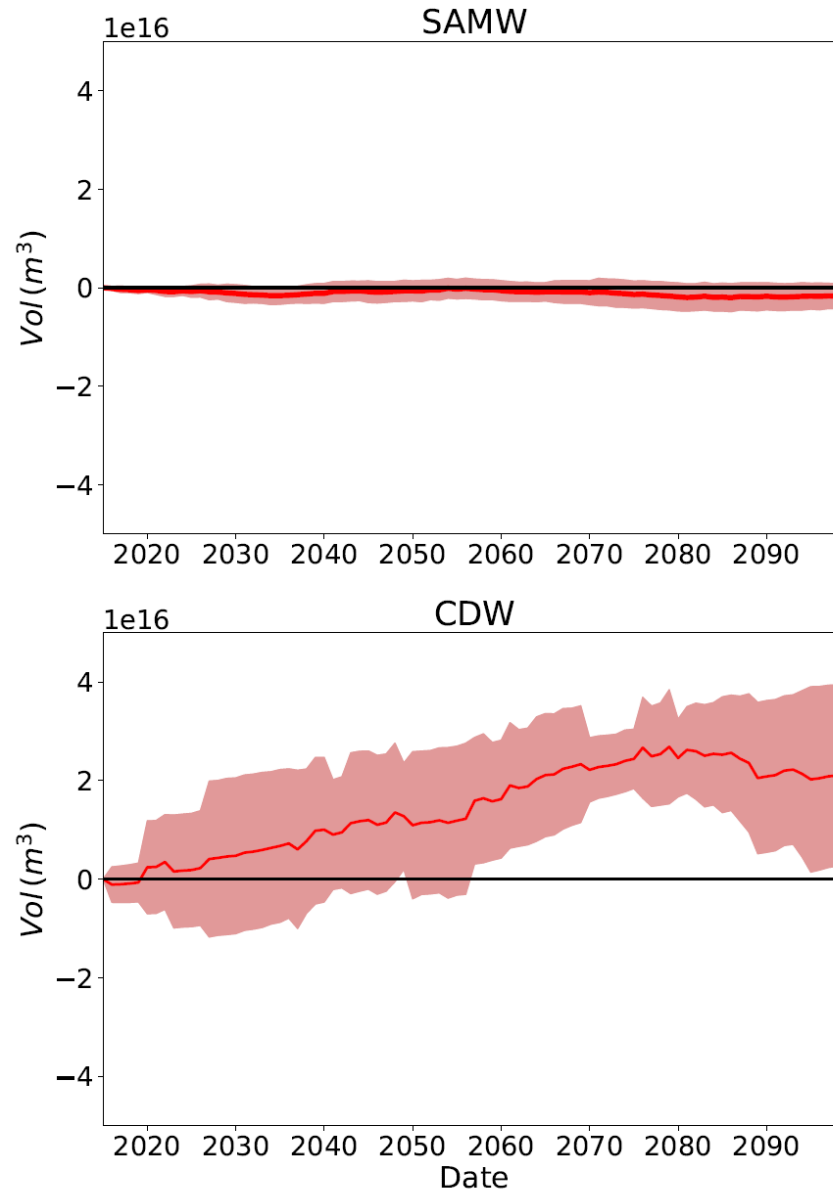


Heat change in CMIP6 SSP585 (10 mdls, dynamic WM definition)



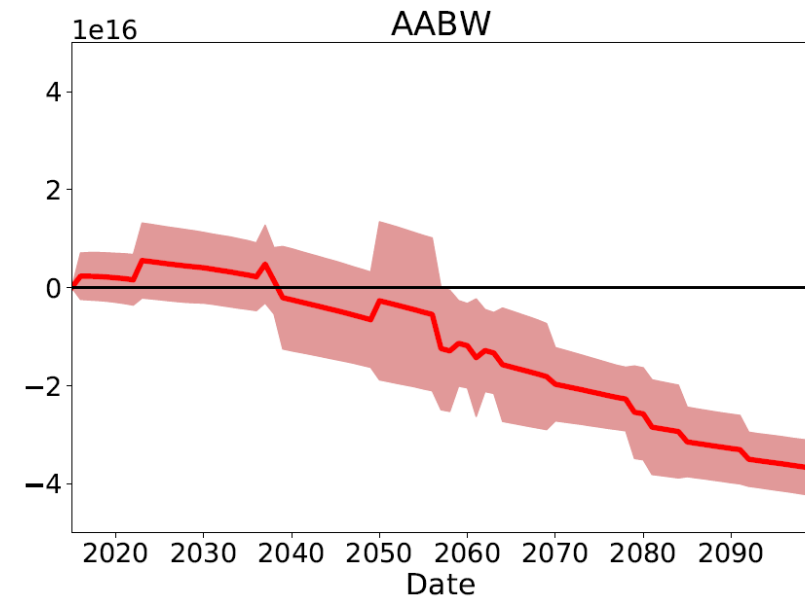
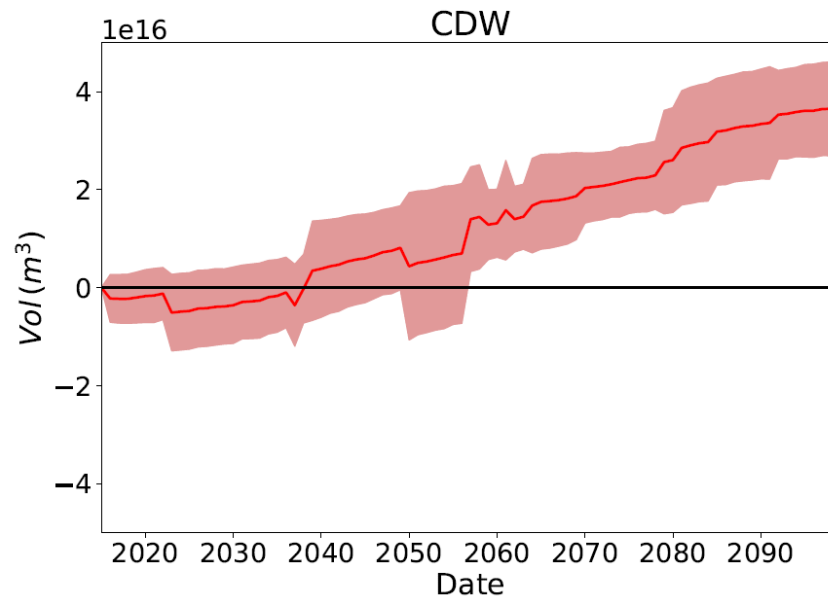
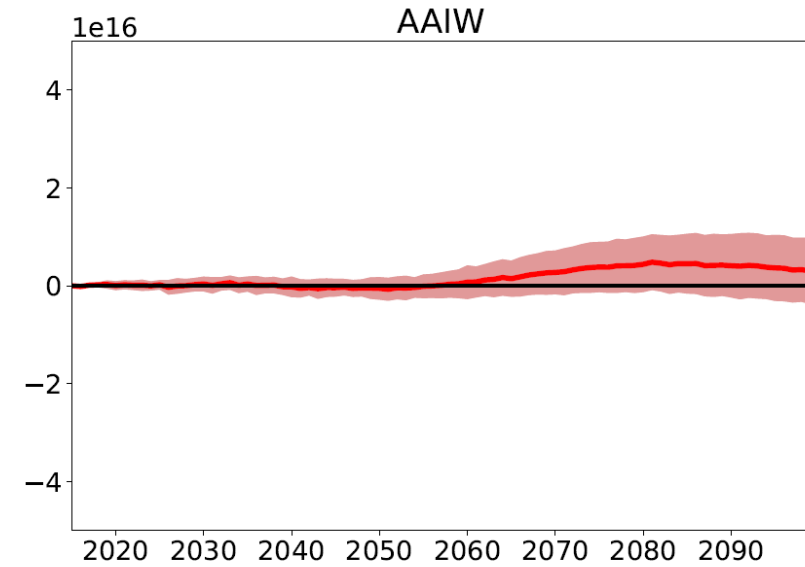
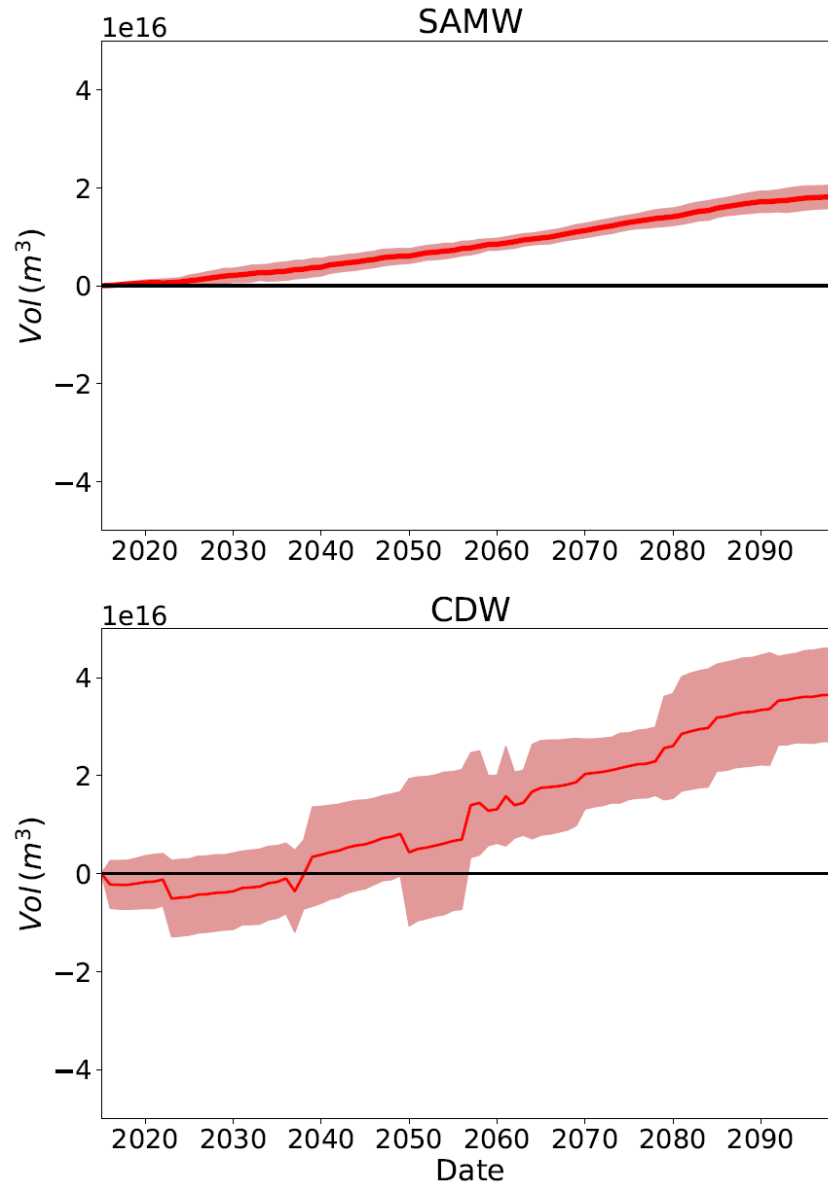
Role of volume change in setting uptake

- In common with CMIP5 SAMW and AAIW volumes change little, or shrink.
- Unlike CMIP5 the volume of AABW decreases significantly, largely being replaced by CDW



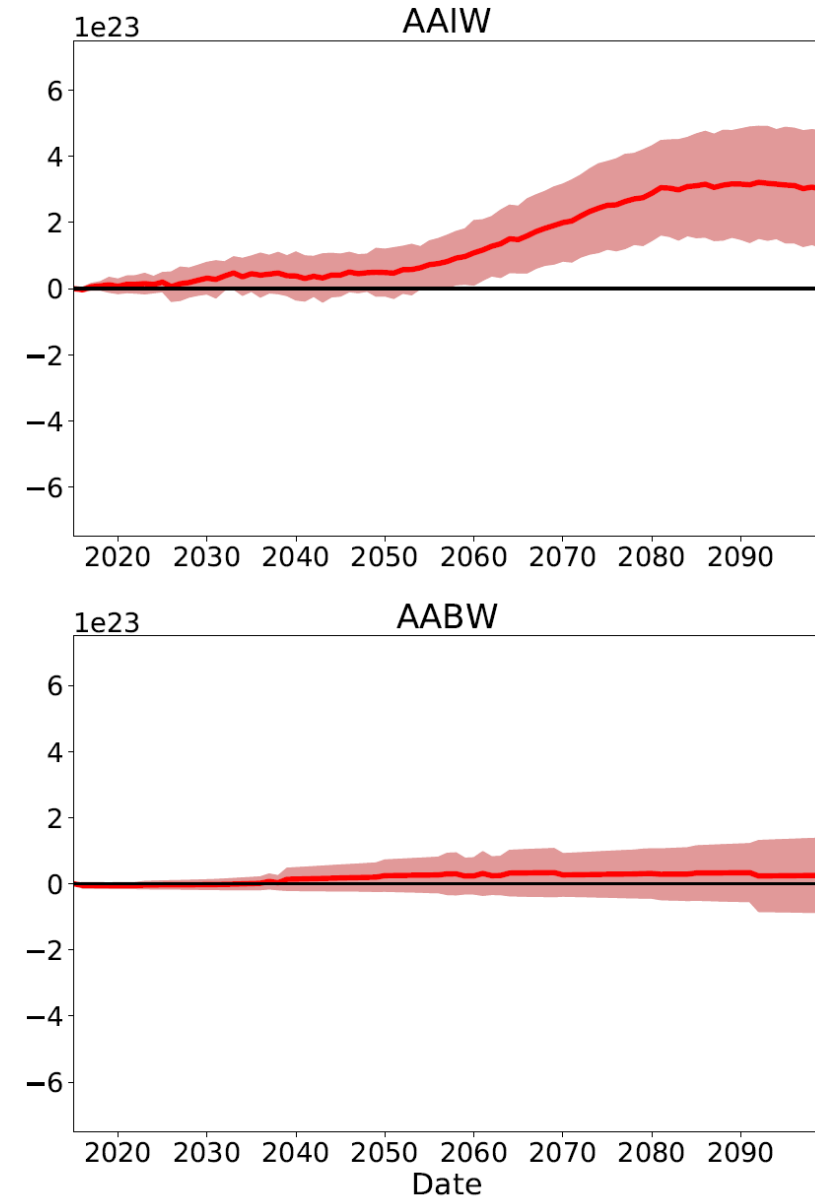
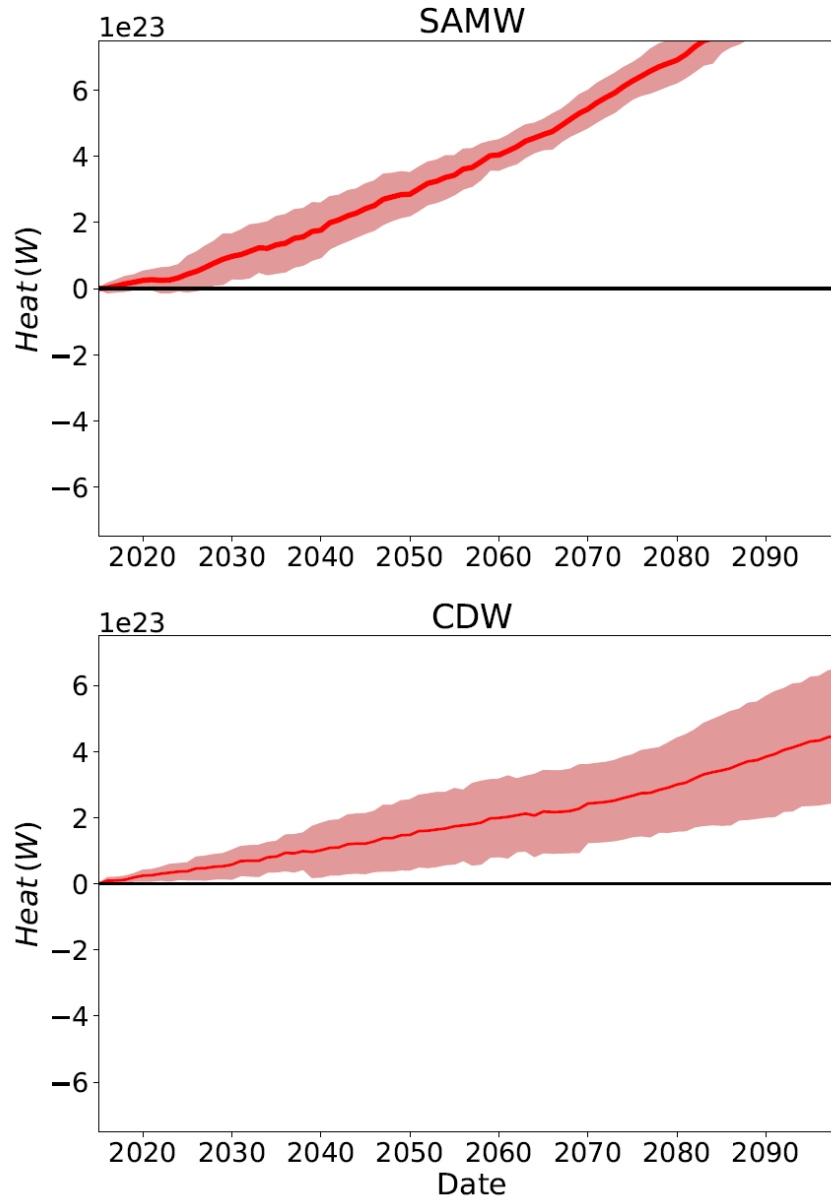
Setting WM definitions as fixed dramatically changes SAMW volume

- Does not capture shoaling and thinning of SAMW/AAIW
- Or change in AABW volume post 2070

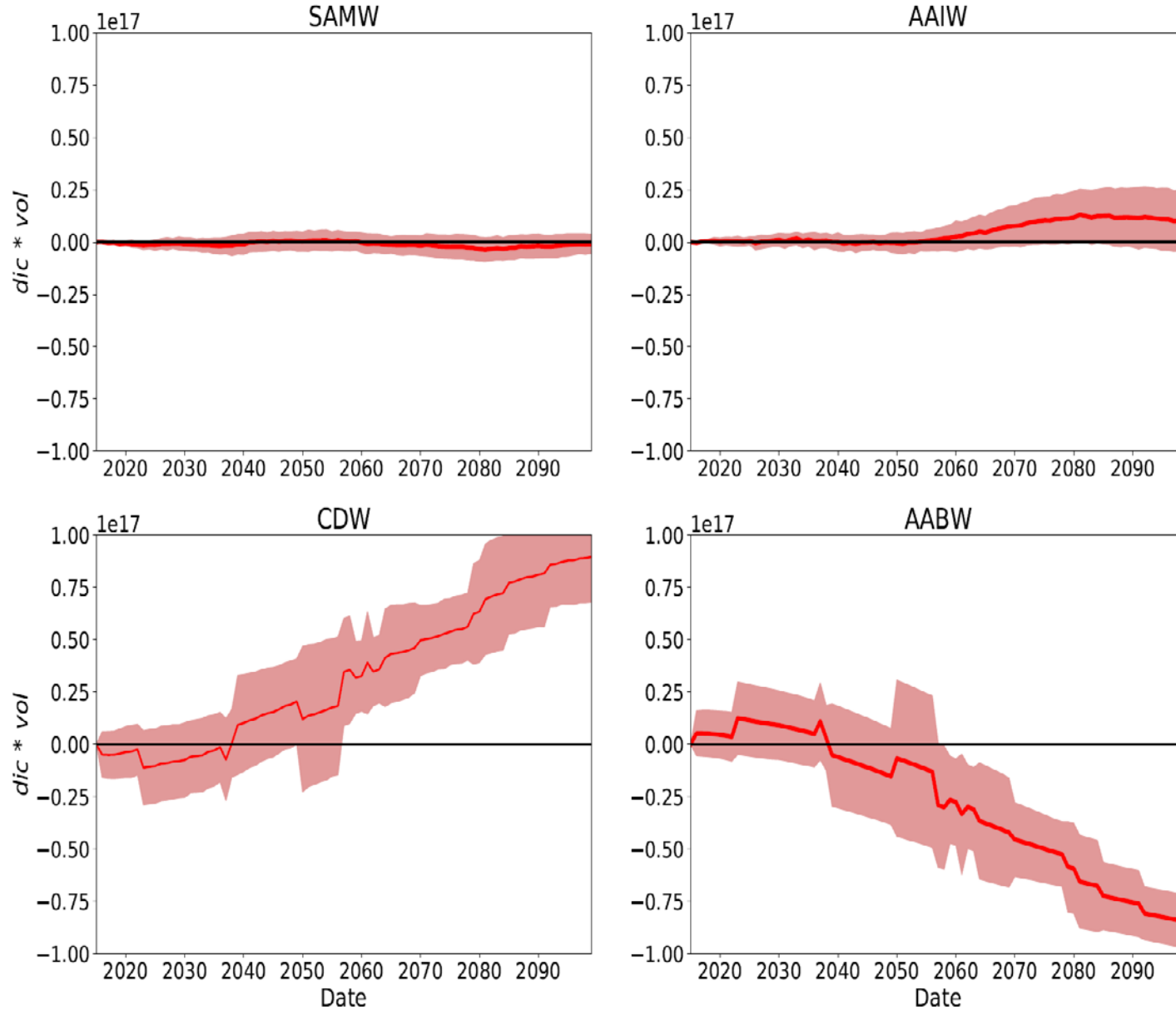


Role of volume change in setting heat uptake

- Considerable temperature increase of SAMW combines with increased volume for much larger heat content increase.



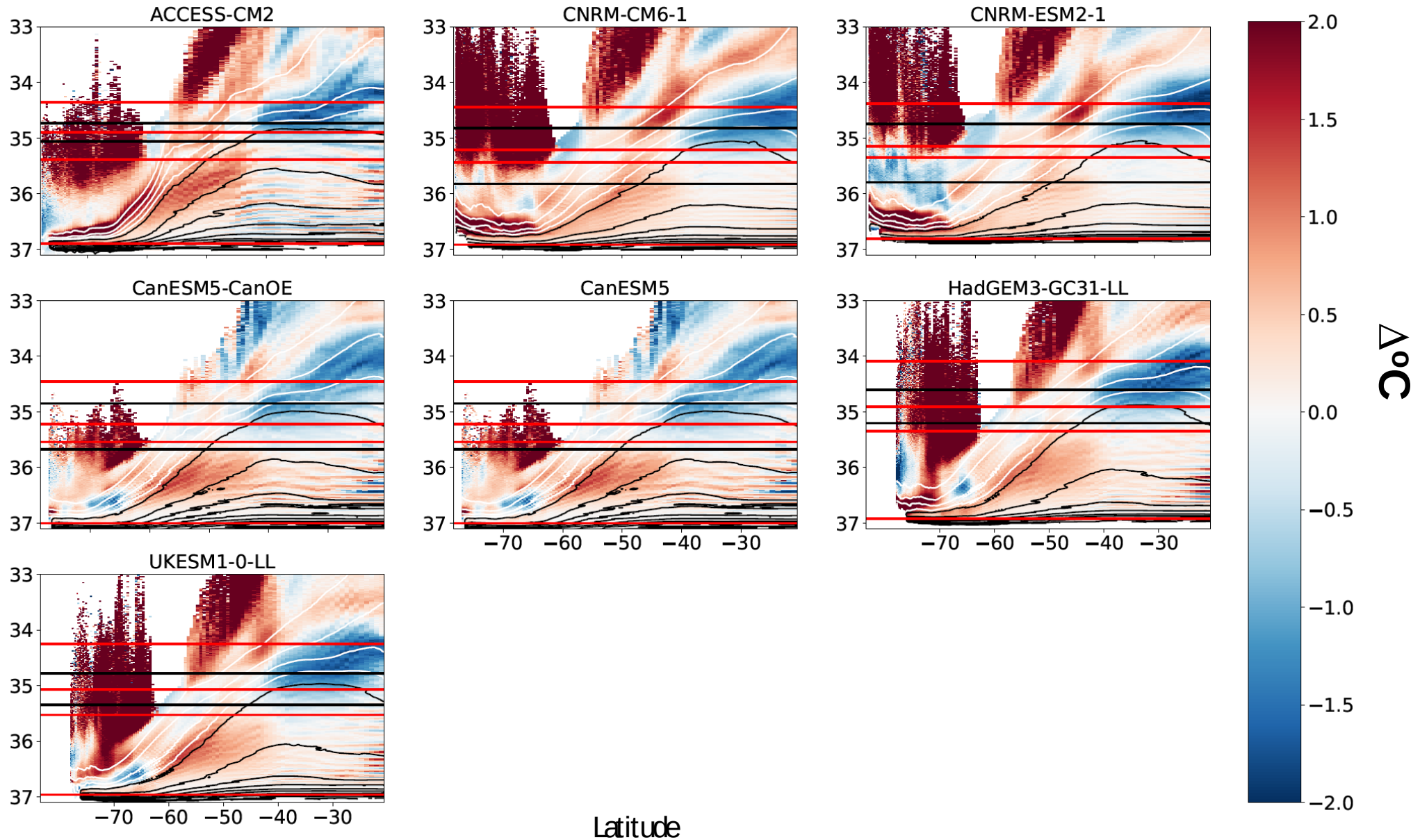
ssp585 DIC uptake



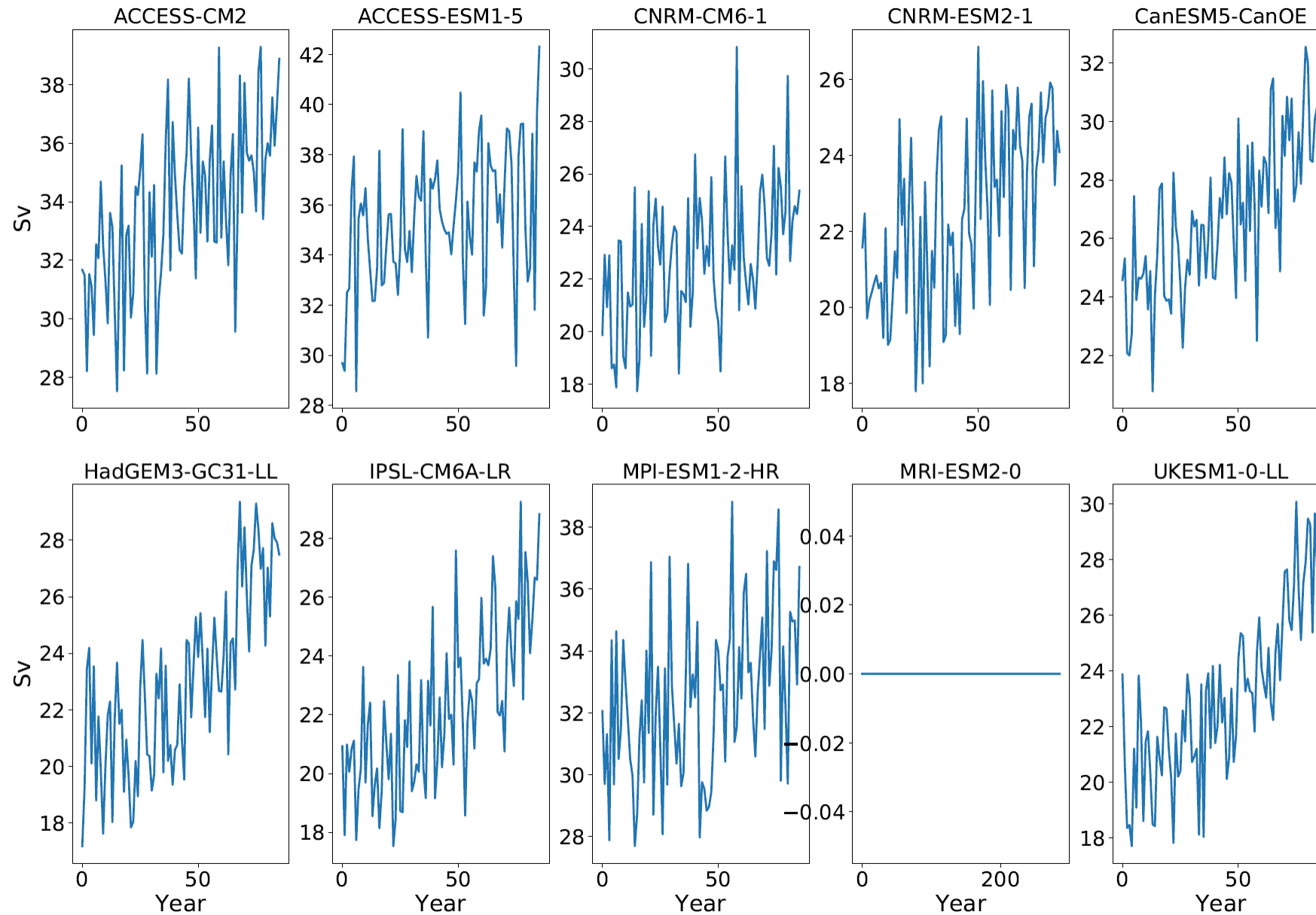
With time varying WM definition



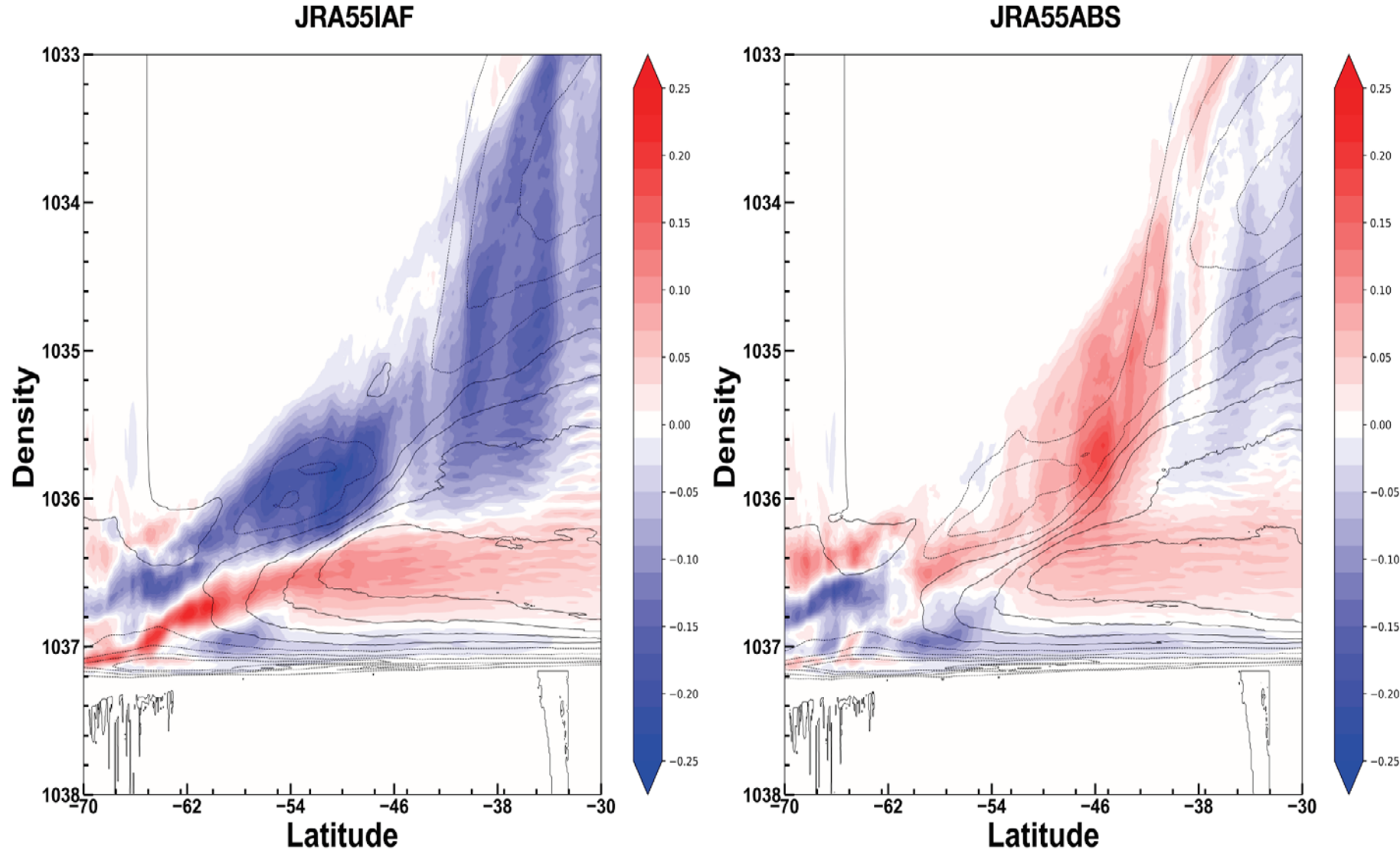
Temperature change 2100-2016 CMIP6 SSP585



Significant upper cell transport increase 2016-2100, CMIP6 SSP585



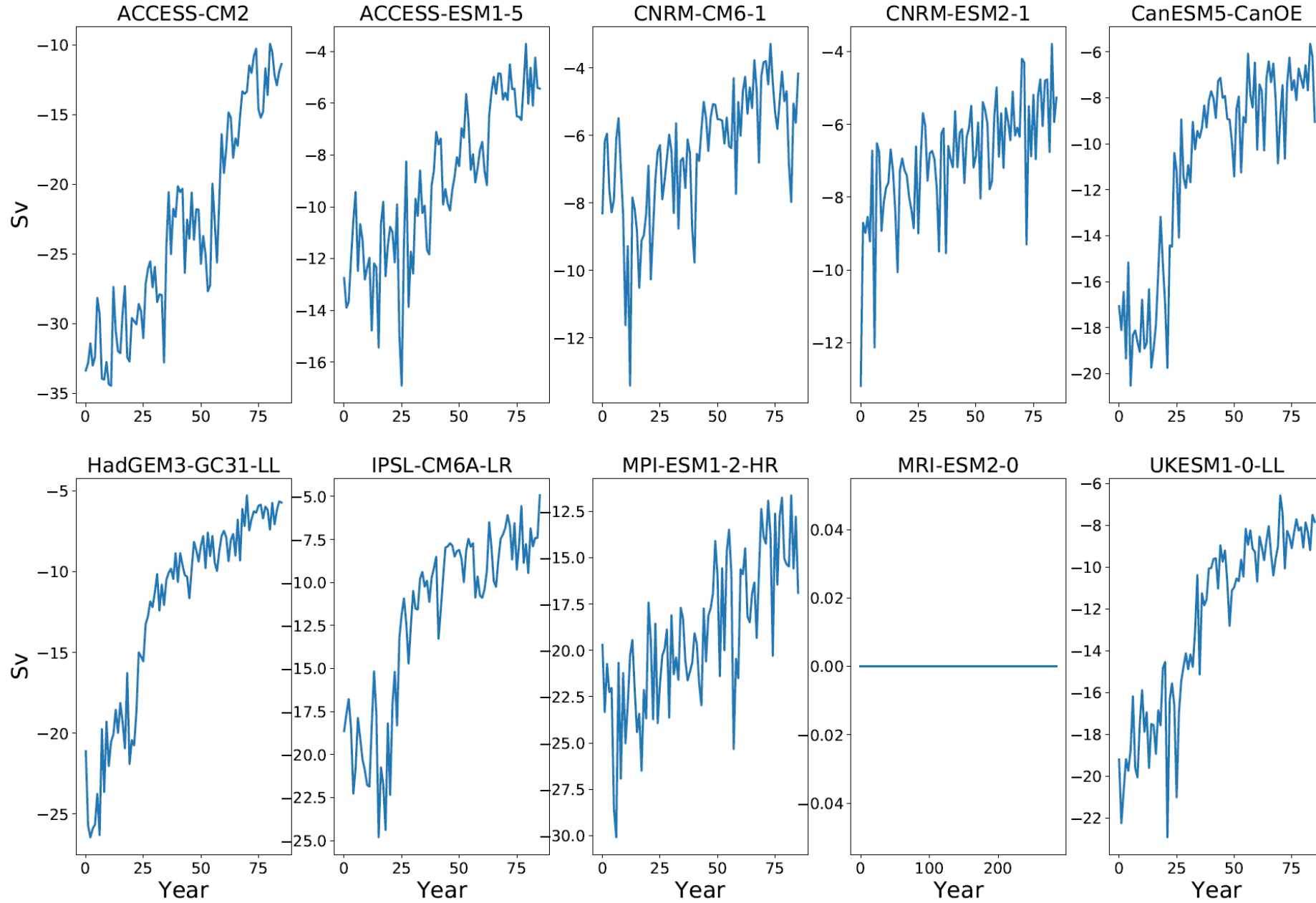
Strong surface warming due to increased CDW eddy upwelling?



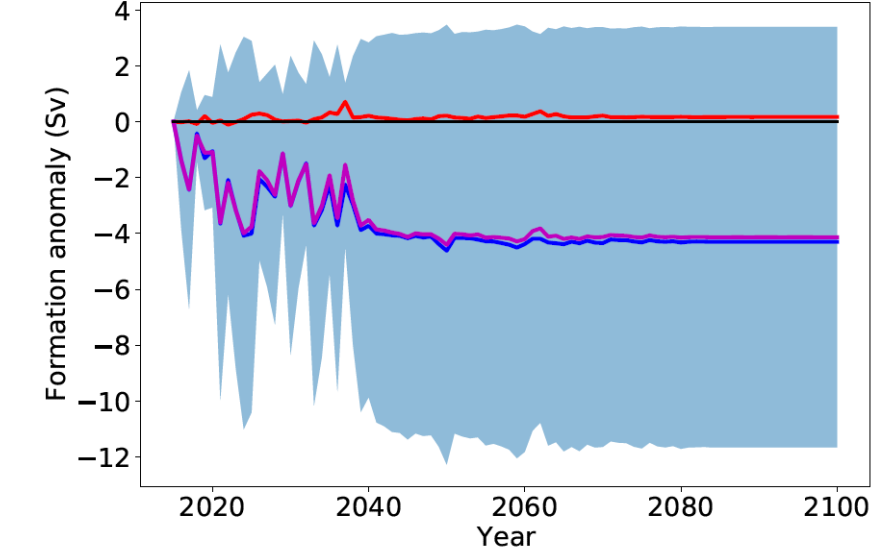
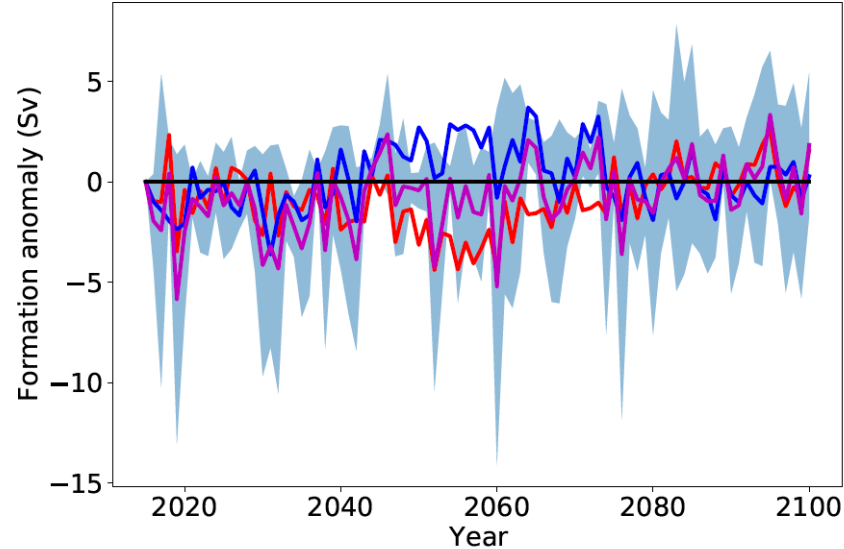
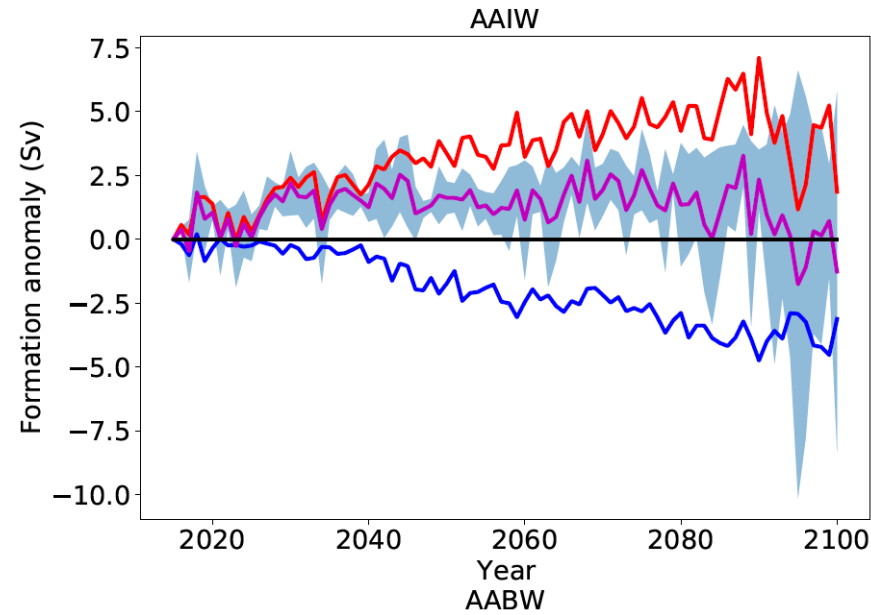
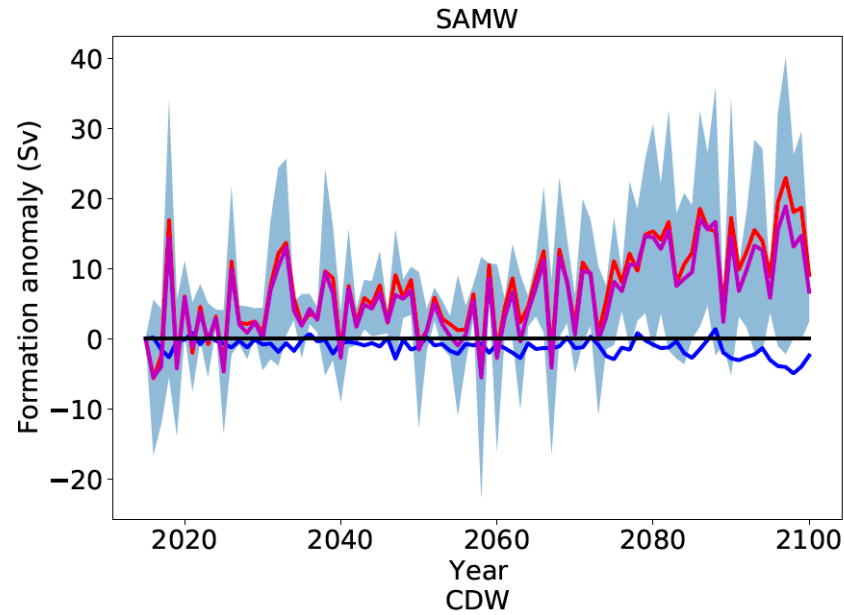
Temperature change over 20 years with (left) historic forcing and (right) 50% more eddy activity and 2% more wind. (Meijers and Munday, in prep.)



Collapse of lower cell transport 2016-2100, CMIP6 SSP585

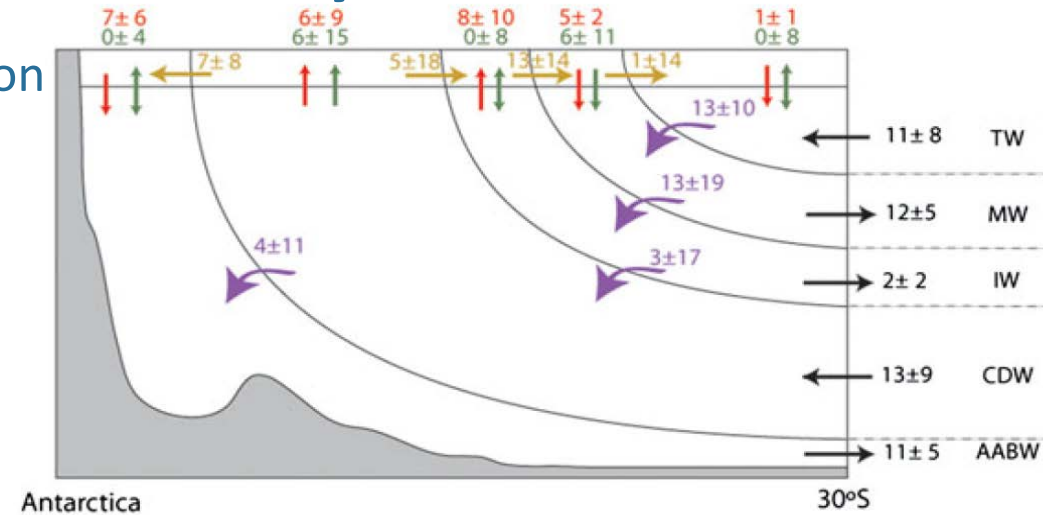


First analysis of surface forcing suggests freshwater fluxes destroys deep cell

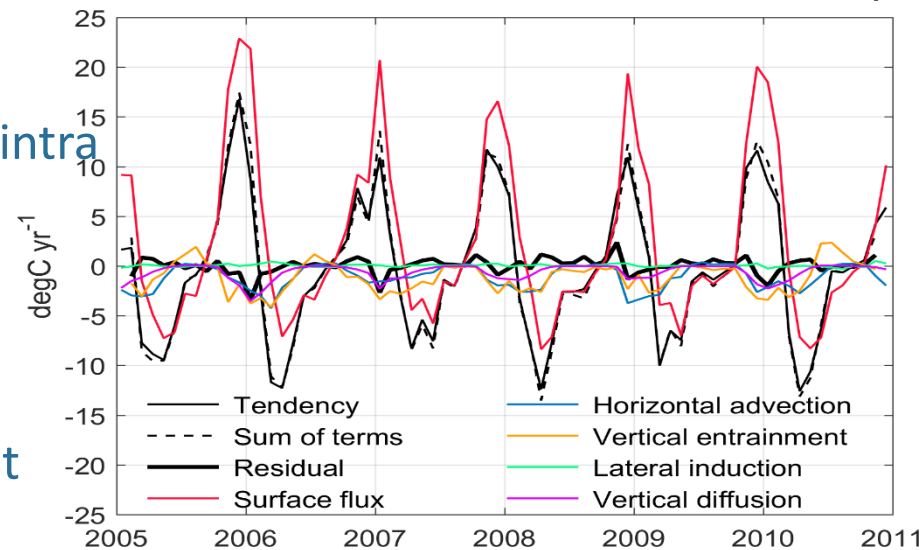


Future plans – CMIP6/UKESM1 assessment of SO heat uptake and variability

- **Water mass Walin budgets:** Formation/transformation and export of key watermasses
- **Mixed layer budgets**
 - **Impact of climate modes:** SAM/ENSO role in subduction.
- **Interior change:** Water mass evolution, heat, freshwater and CO₂ trends. (RoSES SARDINE)
 - **MOC analysis:** Impact of resolution, role of resolved/parameterised eddy transport, inter/intra model variability.
 - **Wind vs buoyancy:** Forcing analysis
- **Synthesis SO heat uptake:** Comparison with observations (S. Atl. Box and SO-CHIC work), adjoint modelling and regional model perturbation tests.



Sallee et al., 2013



Sanders et al., in prep



PANGEO ARCHITECTURE

