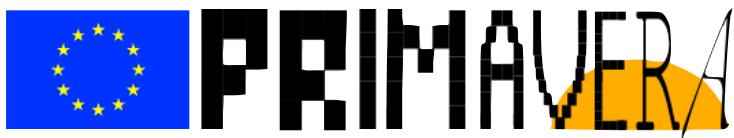


# Causes of AMOC slowdown in high- resolution MPI-ESM

Dian Putrasahan; Jin-Song von Storch; Johann Jungclaus; Katja Lohmann; Helmuth Haak; Daniela Matei; Oliver Gutjahr

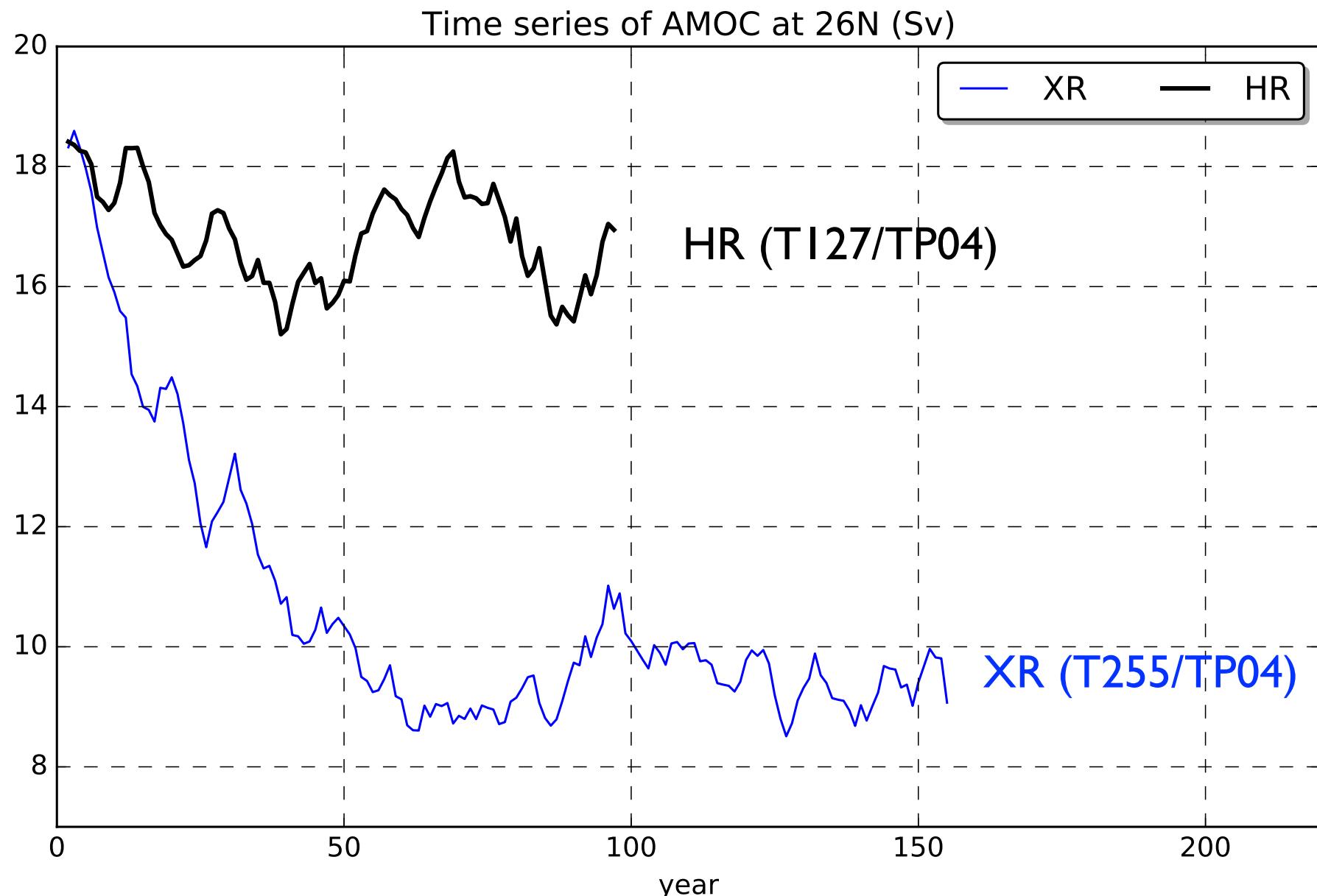
PRIMAVERA 2<sup>nd</sup> GA Meeting  
Nov. 29<sup>th</sup>, 2016



Max-Planck-Institut  
für Meteorologie

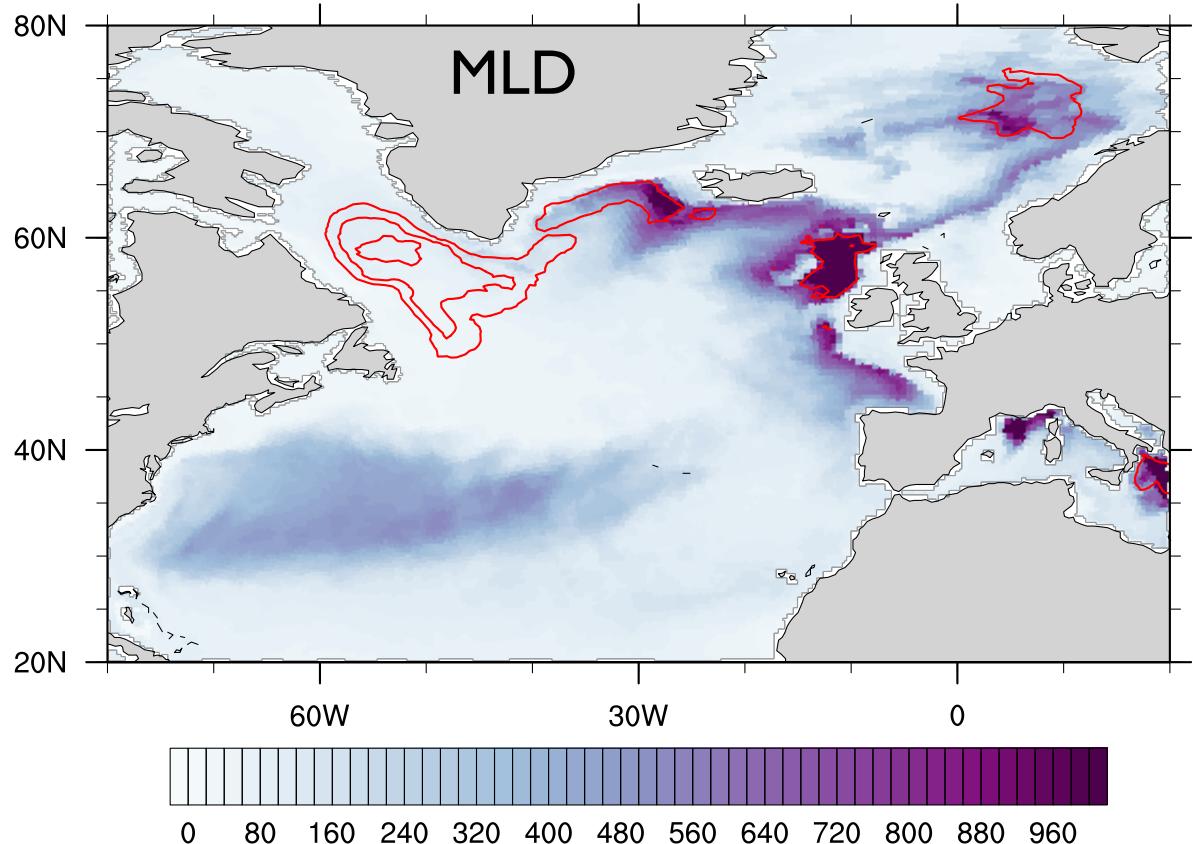
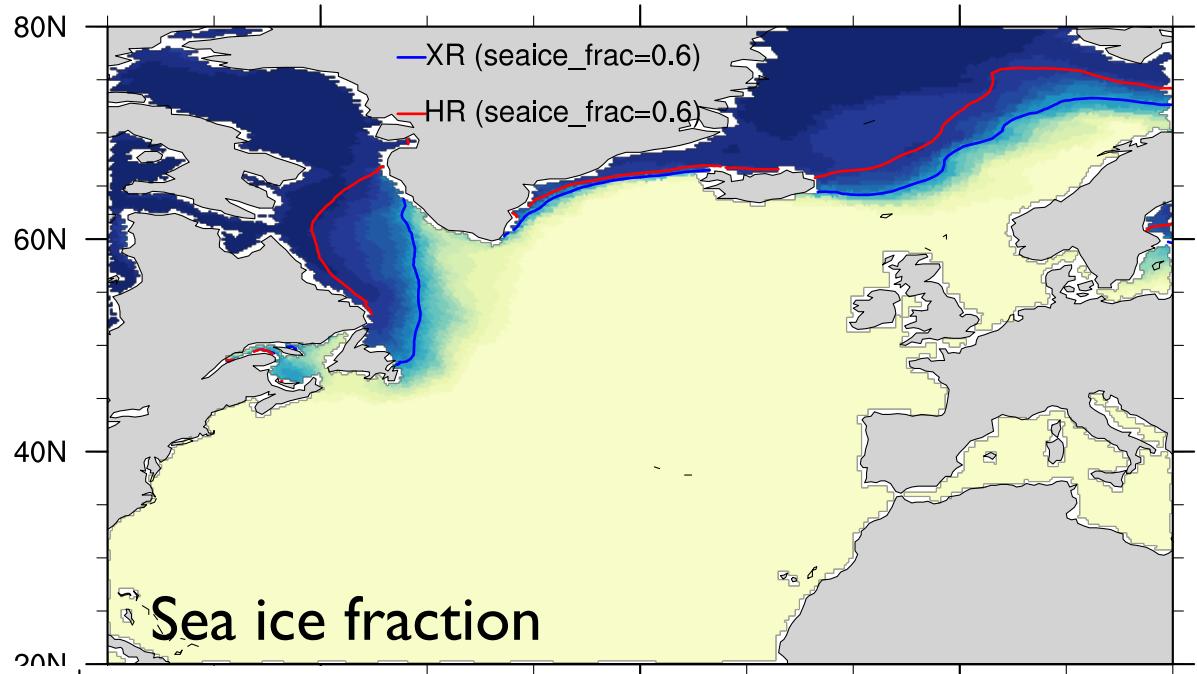
# Challenge:

## Unstable / low AMOC in high resolution MPI-ESM



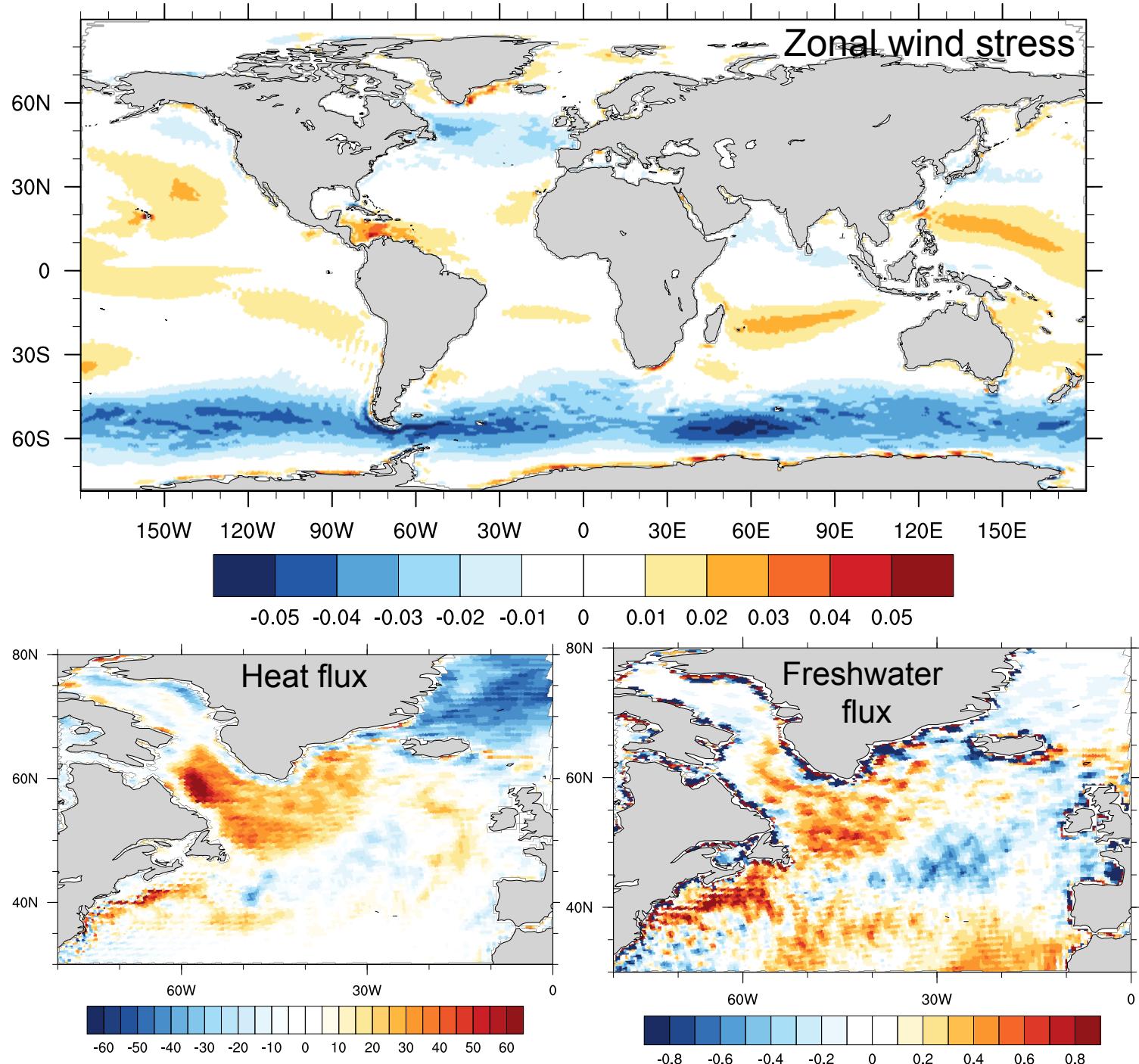
# Challenge:

- Sea ice formation over Labrador Seas
- Shutdown of deep convection



# Possible reasons for AMOC slowdown:

- Dynamical effect from weakening of surface winds
- Increased freshwater flux (less evaporation)
- Increased heat flux (less latent heat loss from presence of sea ice)



**Challenge:** High computational cost for running eddy-permitting/resolving GCMs

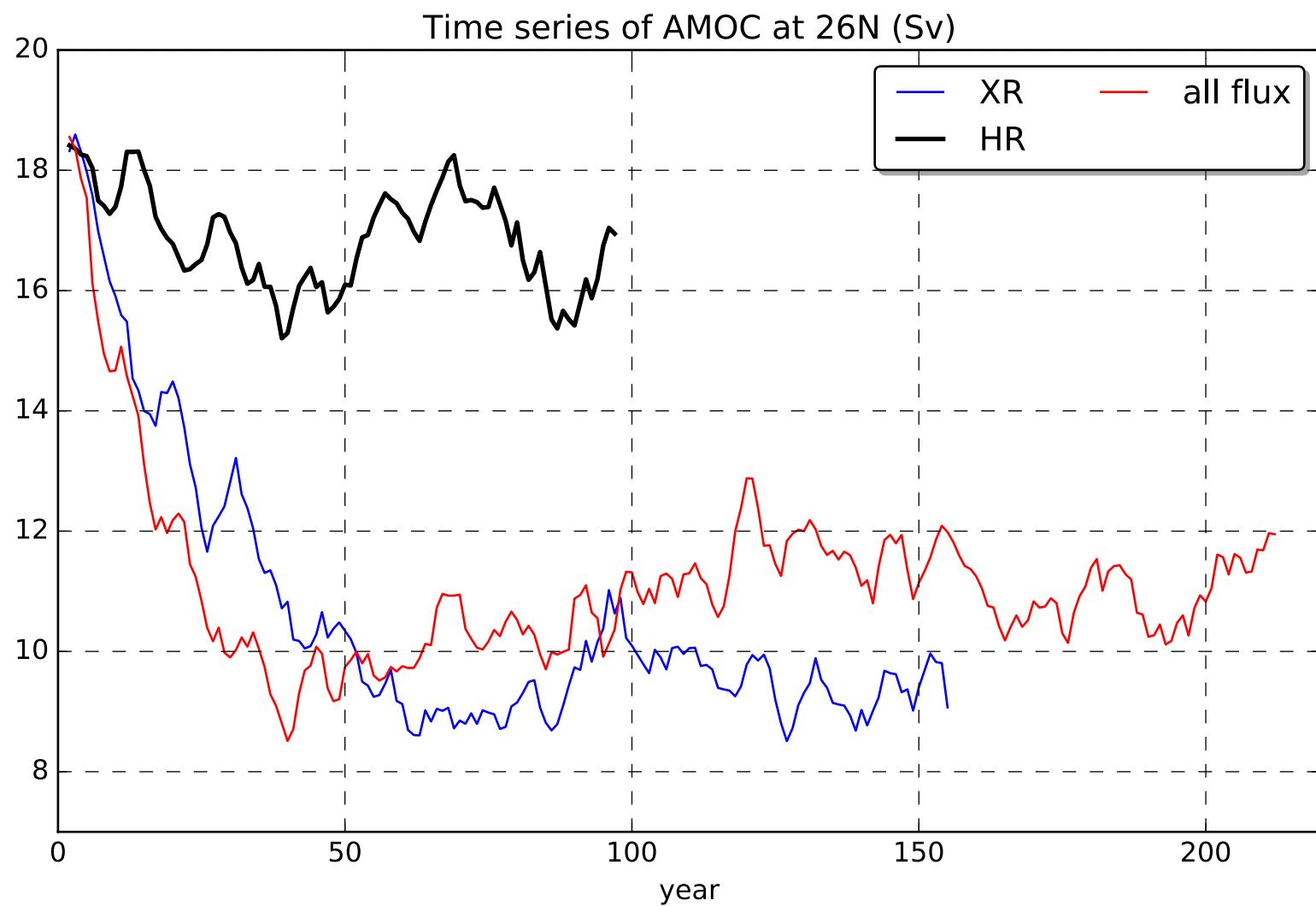
**Strategy:** Use flux-adjusted HR (T127/TP04) runs to mimic XR (T255/TP04) runs

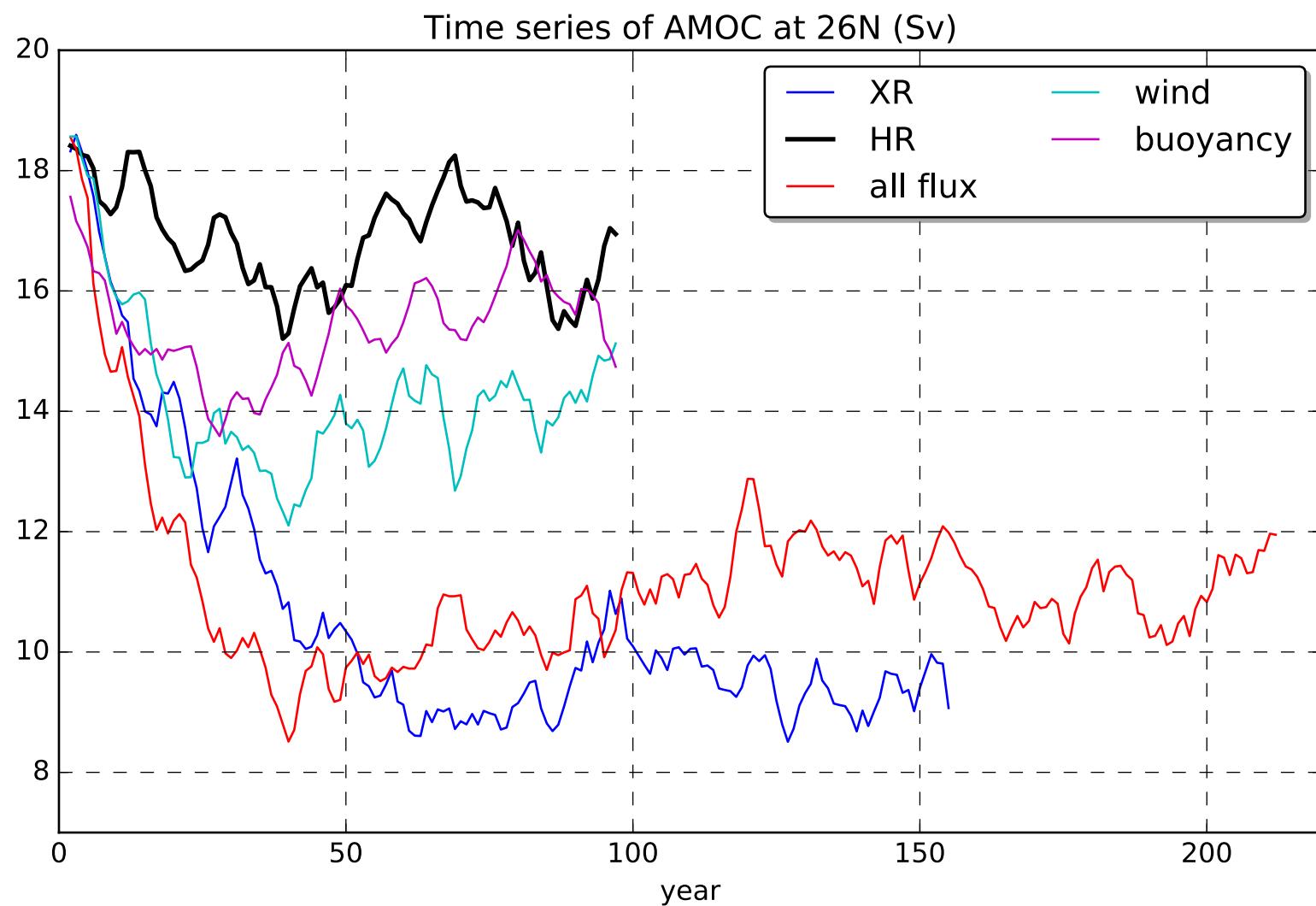
$$\text{HR\_orig} = \text{meanHR} + \text{variabilityHR}$$

Flux adjustment =  $\text{meanXR} - \text{meanHR}$  @ every coupling time step

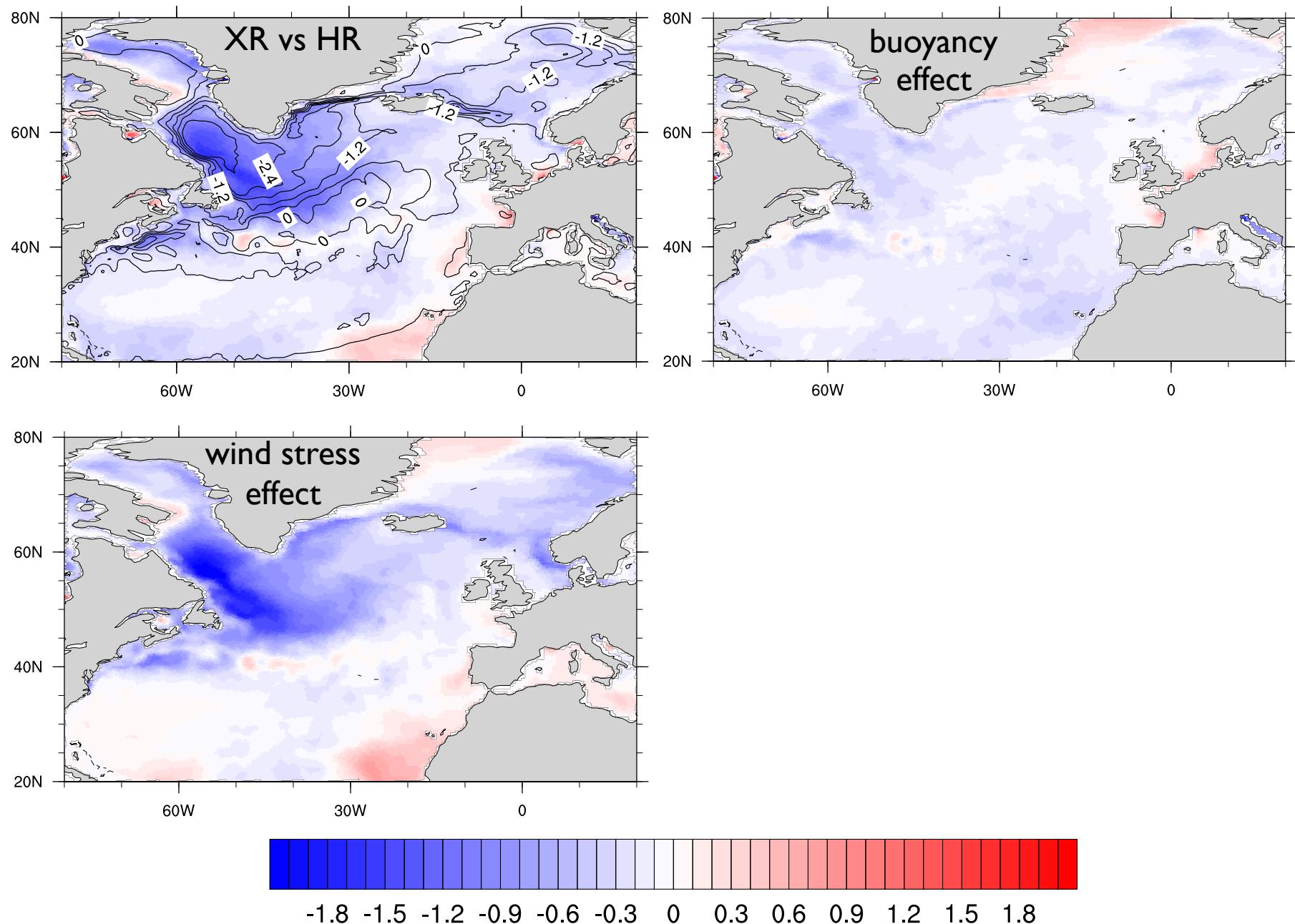
$$\text{HR\_XRadjust} = \text{HR\_orig} + \text{flux adjustment} = \text{meanXR} + \text{variabilityHR}$$

Expt. name	Flux adjusted to XR
XR_orig (T255/TP04)	Control run at high resolution (pre-industrial)
HR_orig (T127/TP04)	Control run at low resolution (pre-industrial)
HR_XRalladjust	momentum, freshwater and heat fluxes
HR_XRbuoyancy	only freshwater and heat fluxes
HR_XRwinds	only wind stress over water
XR_1.5winds	High resolution with 1.5*(wind stress over water)

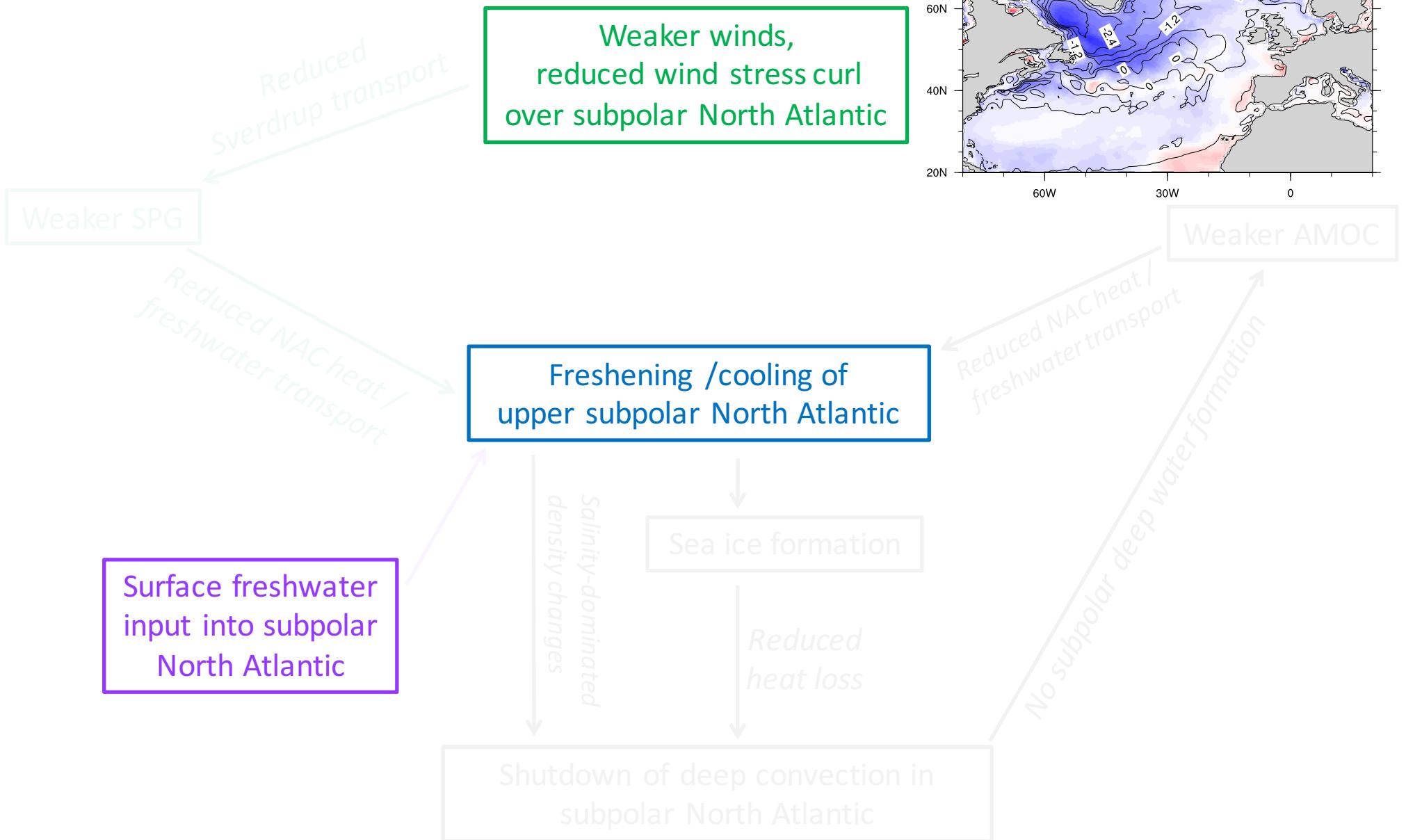




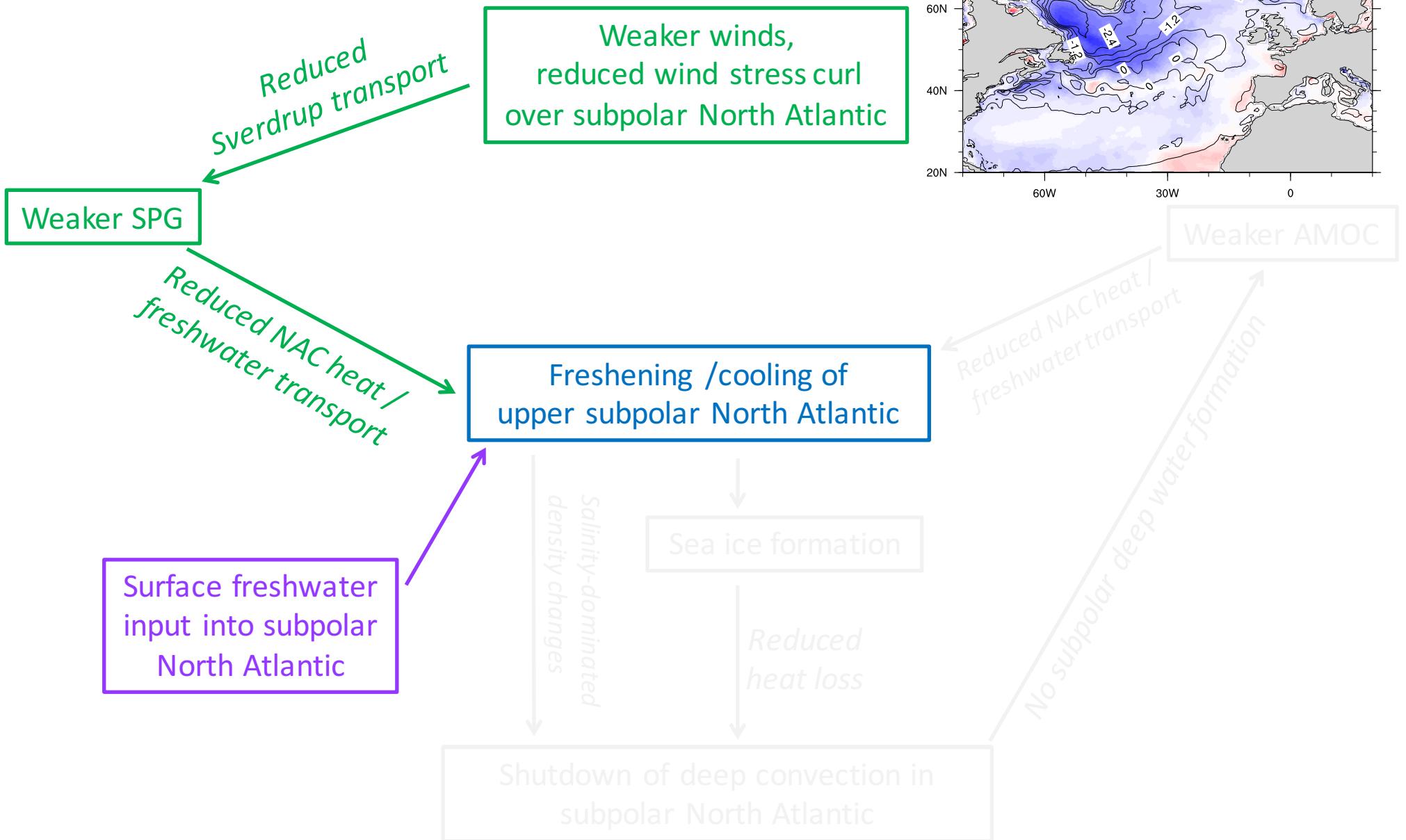
# Effect on surface salinity



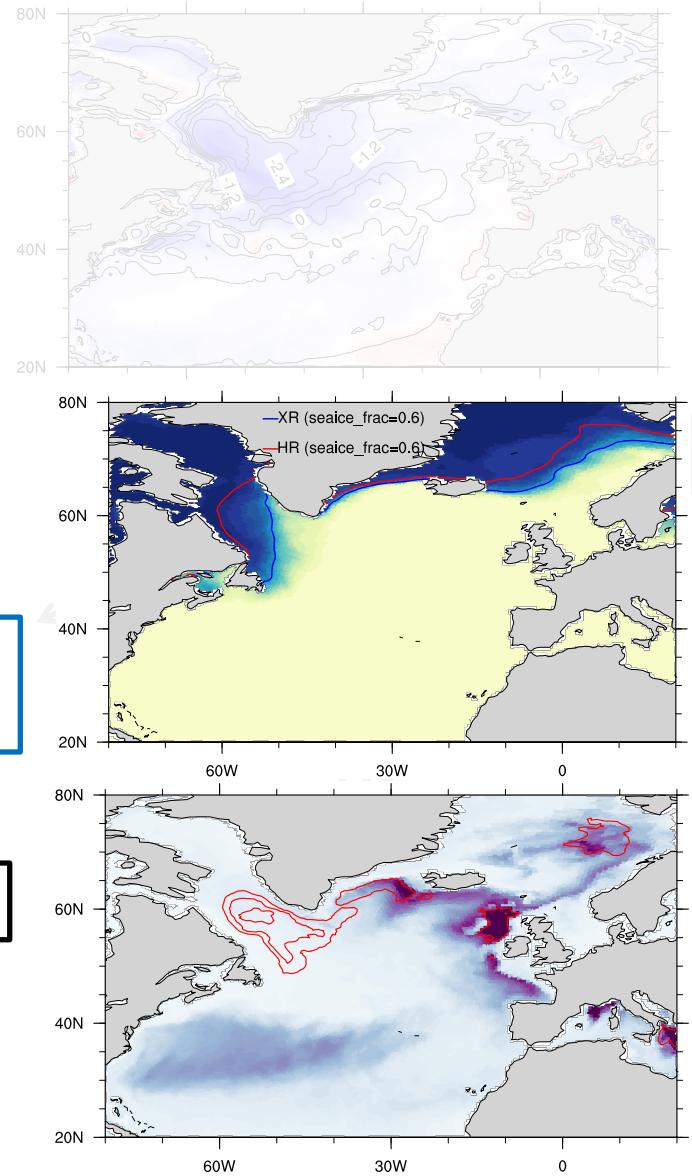
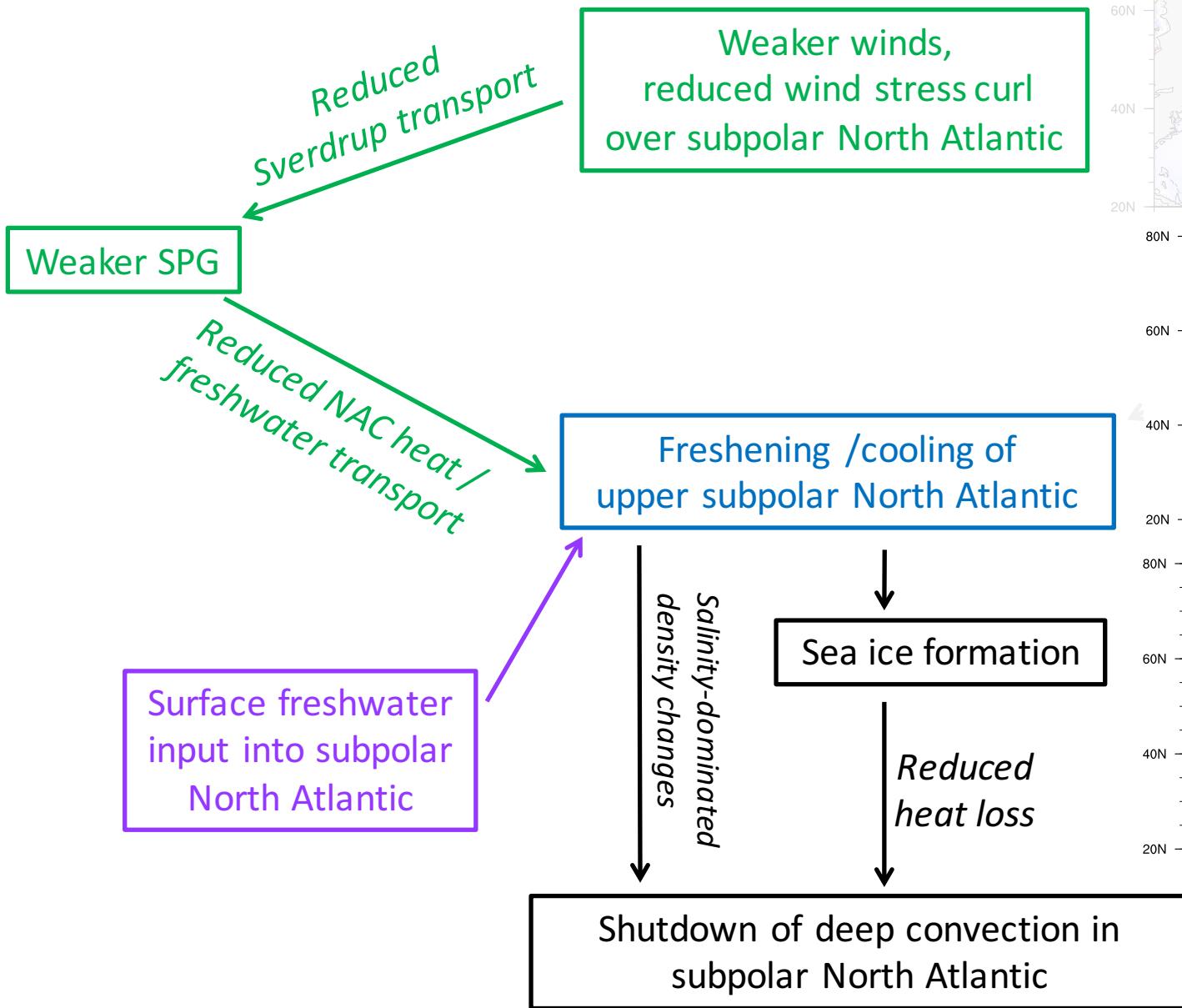
# Proposed AMOC weakening mechanism:



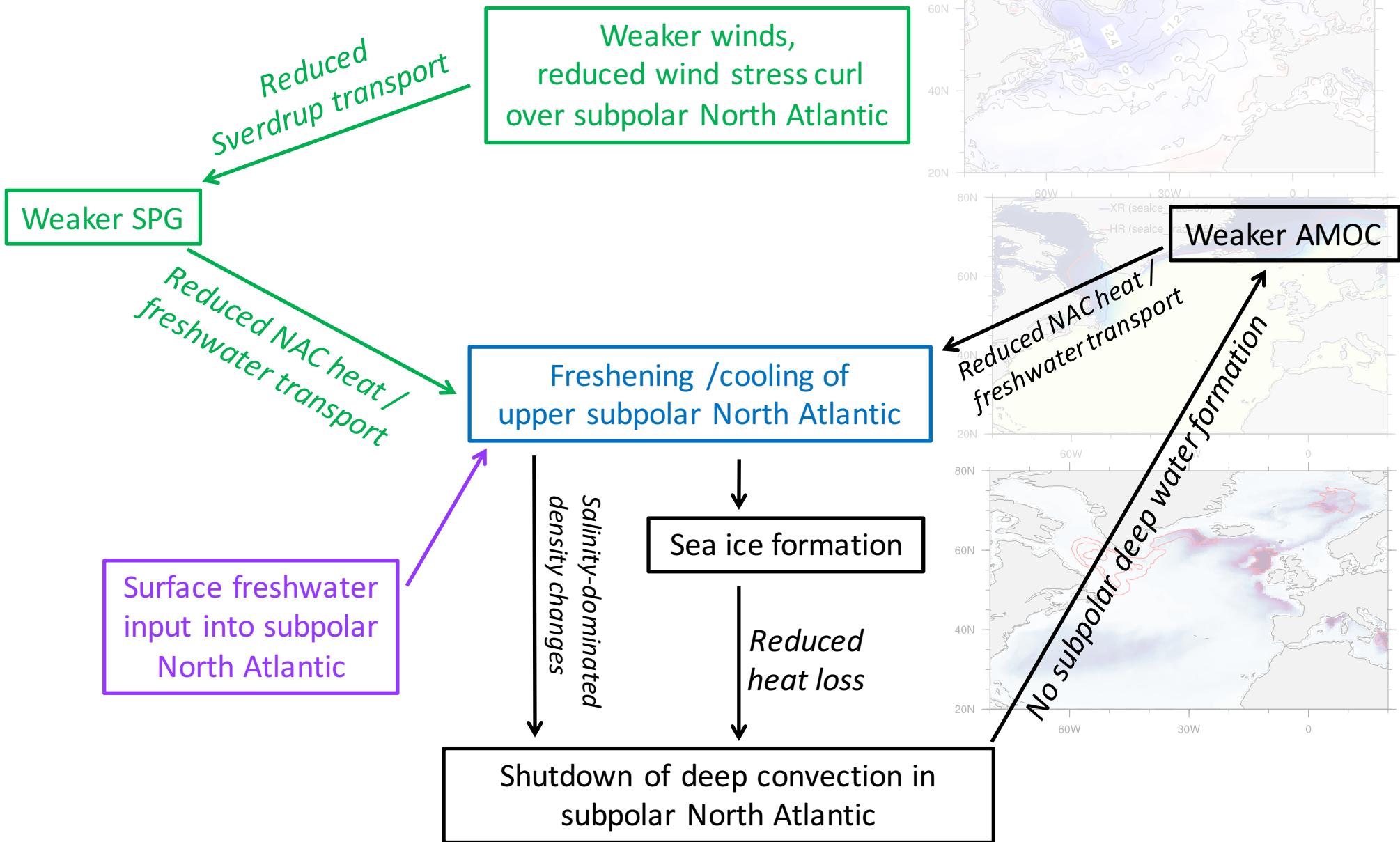
# Proposed AMOC weakening mechanism:



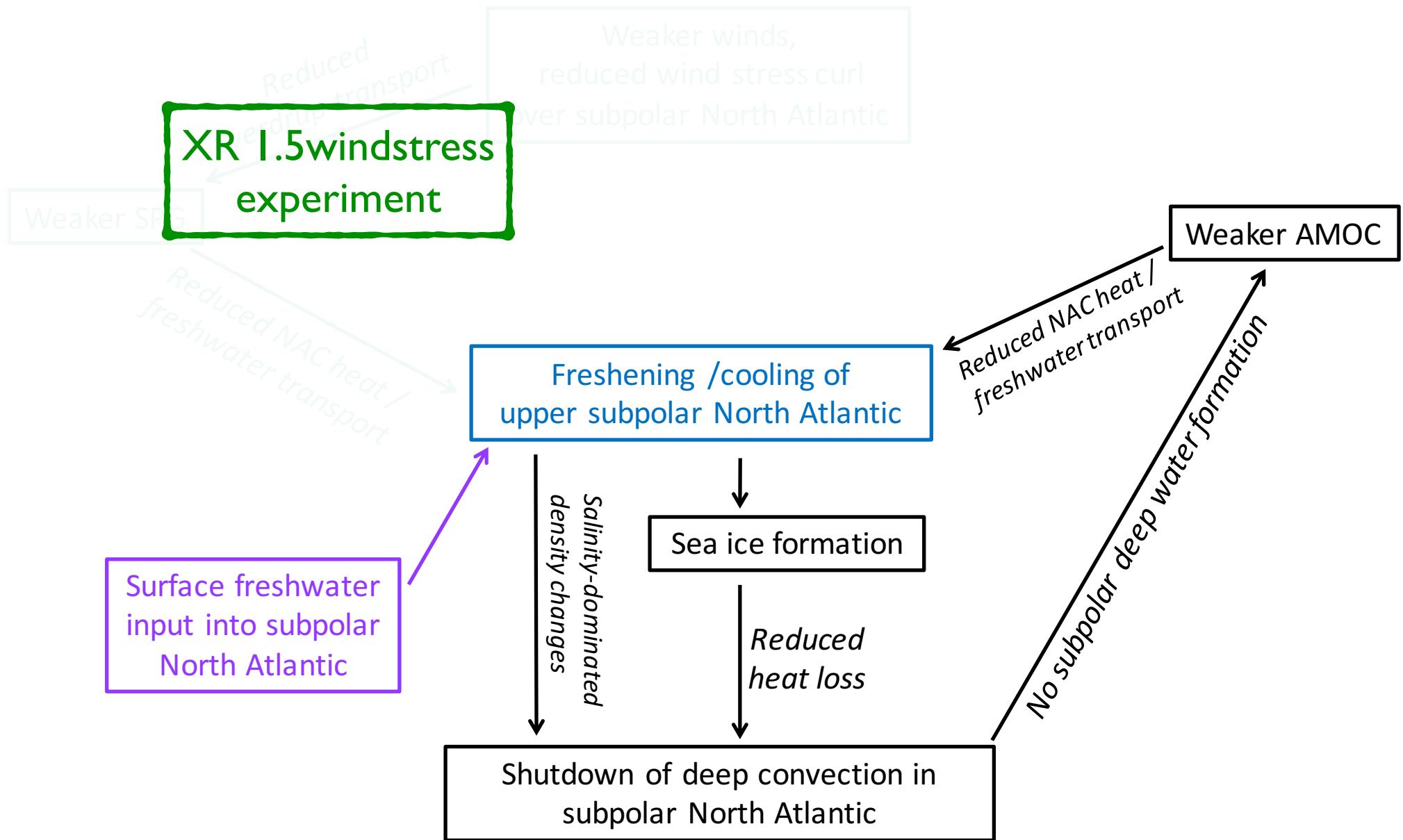
# Proposed AMOC weakening mechanism:



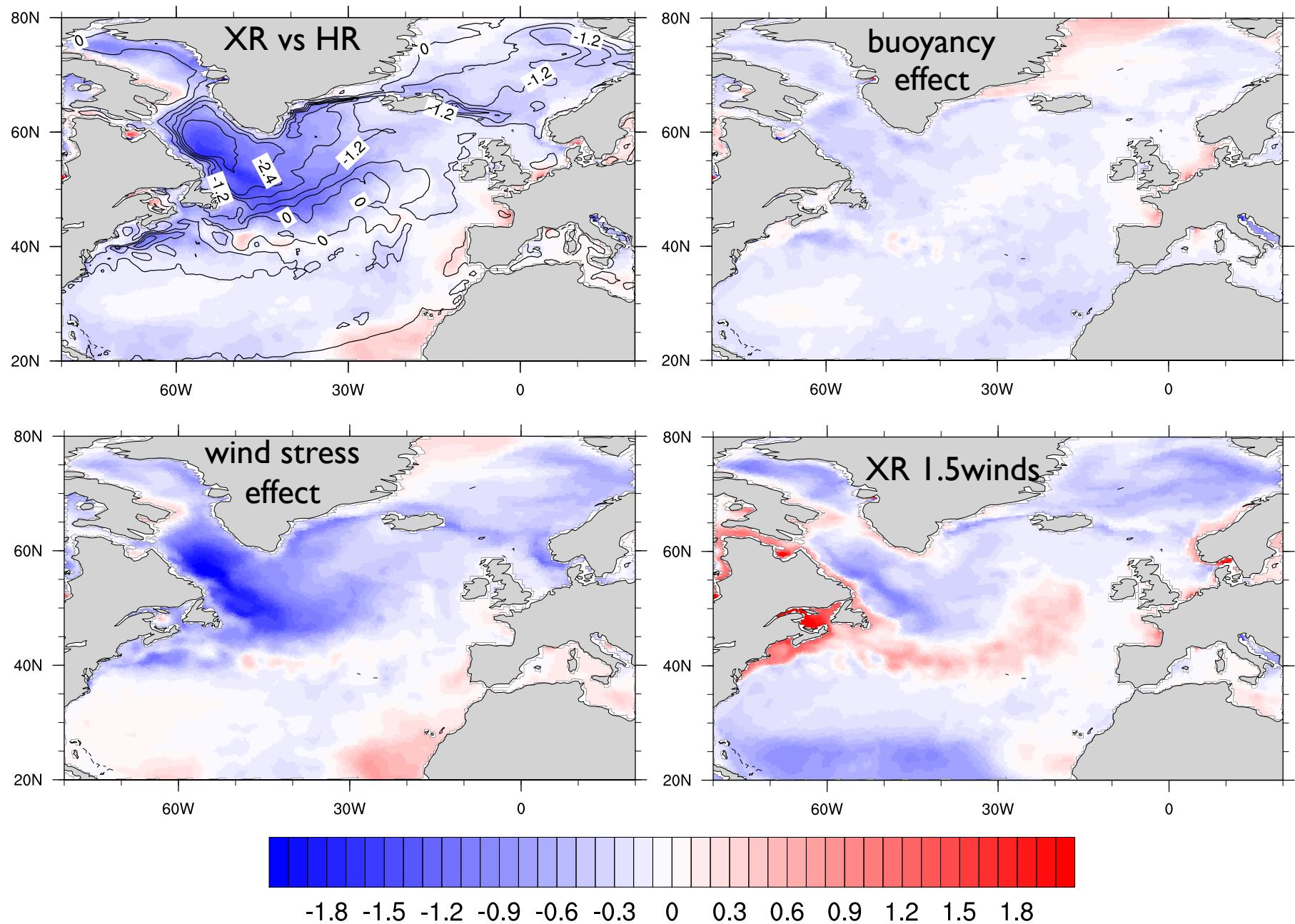
# Proposed AMOC weakening mechanism:



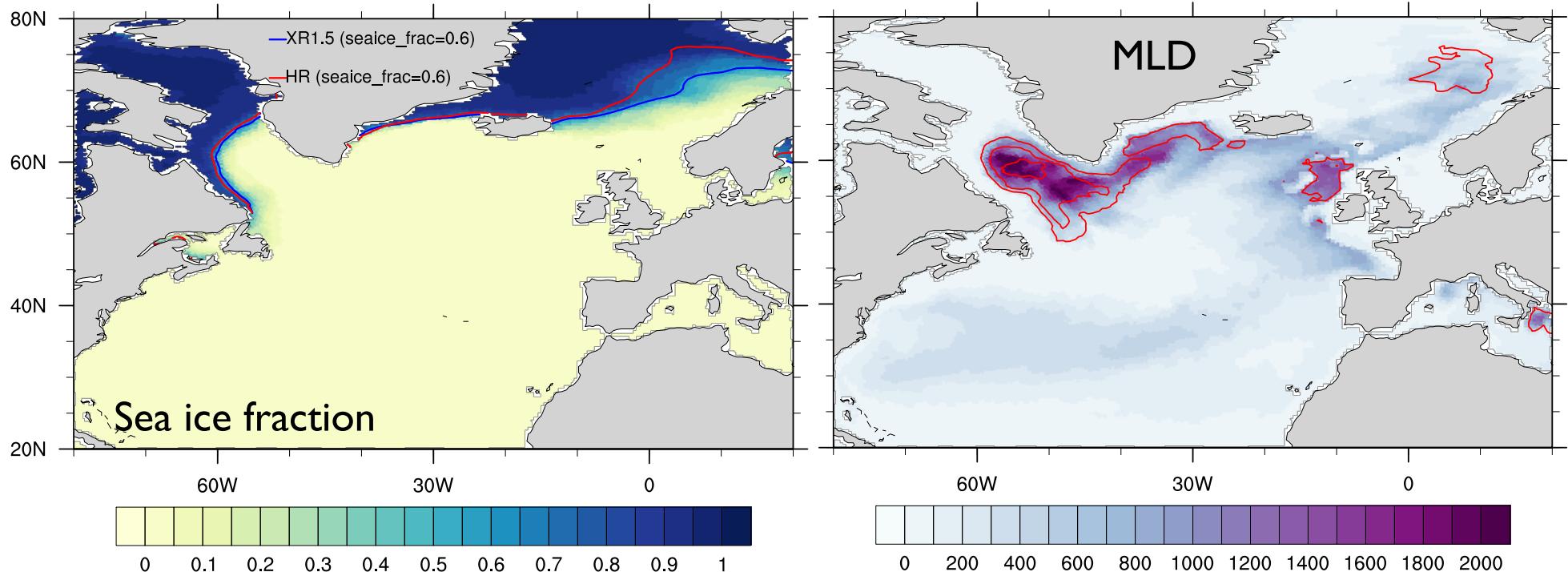
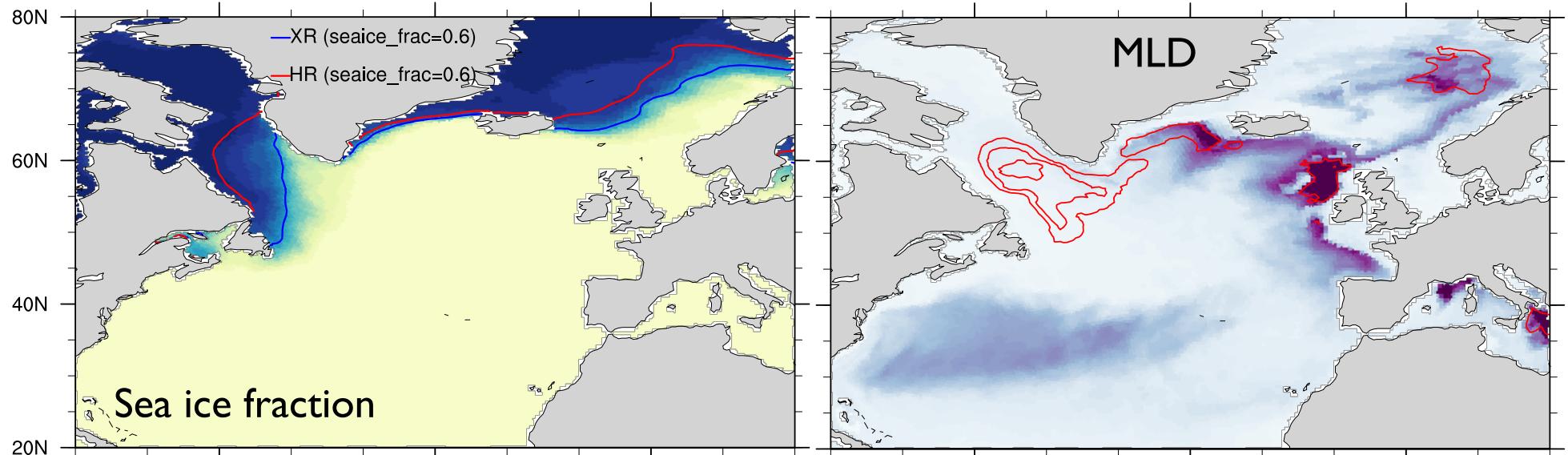
# Proposed AMOC weakening mechanism:

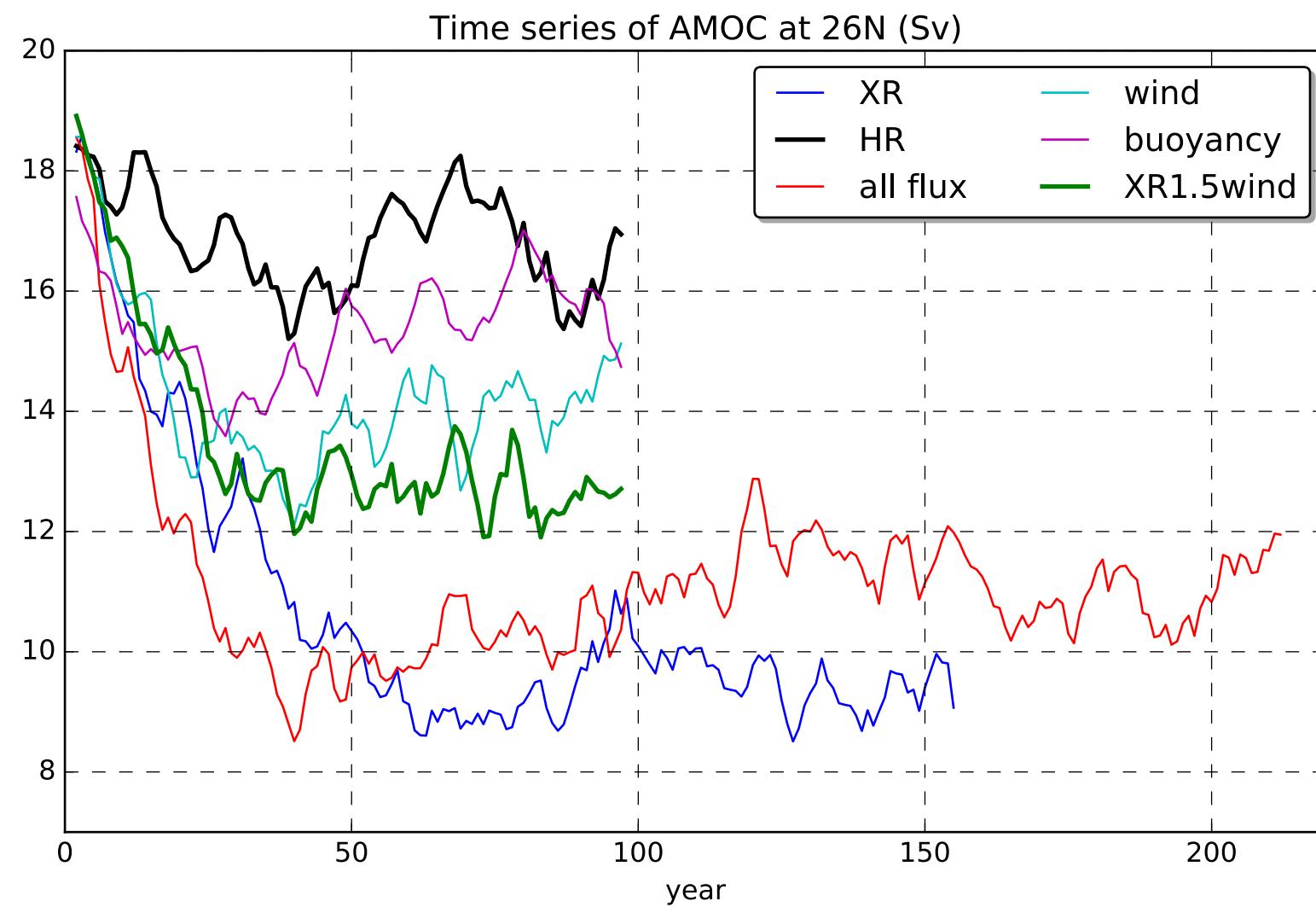


# Effect on surface salinity



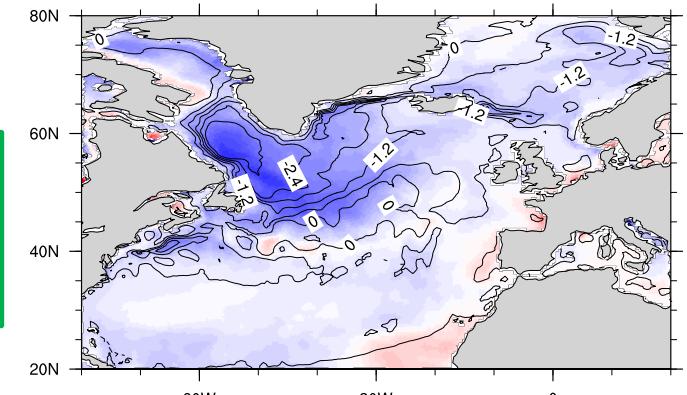
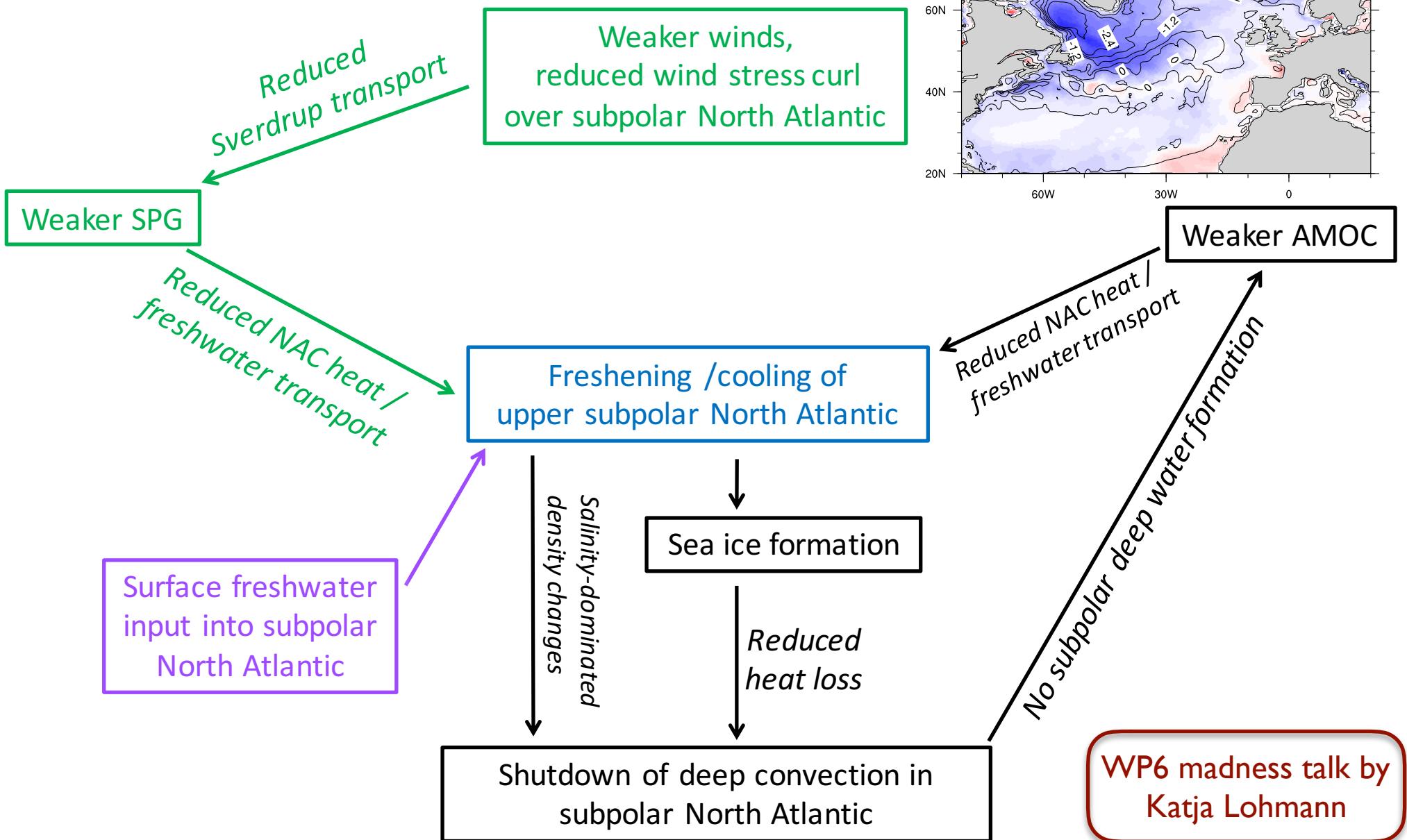
# Impact on sea ice and deep convection:





# Summary:

- ♦ Slowdown in AMOC with increased atmospheric resolution from T127 to T255
- ♦ Winds play a major role



**THANK YOU!**