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Impact of ocean resolution and mean state on the rate of AMOC weakening.

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Does resolution affect the rate of AMOC weakening?

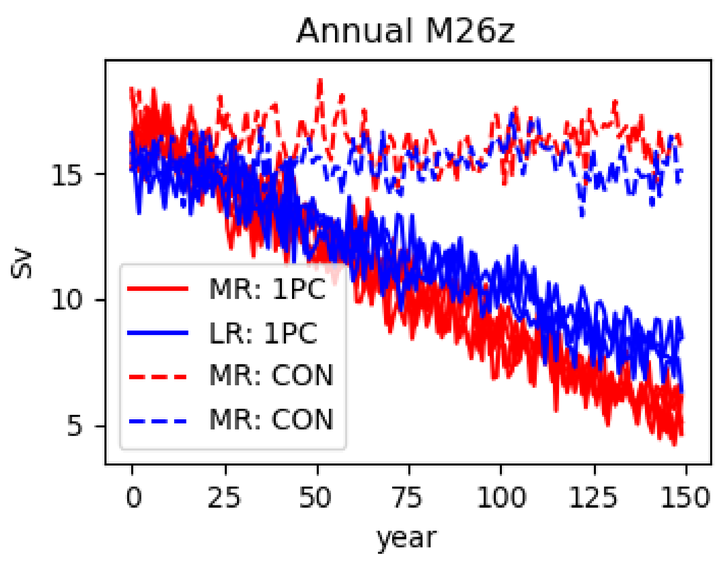
Medium resolution HadGEM3 has a stronger AMOC in the control and a greater weakening, both absolute and fractional weakening.

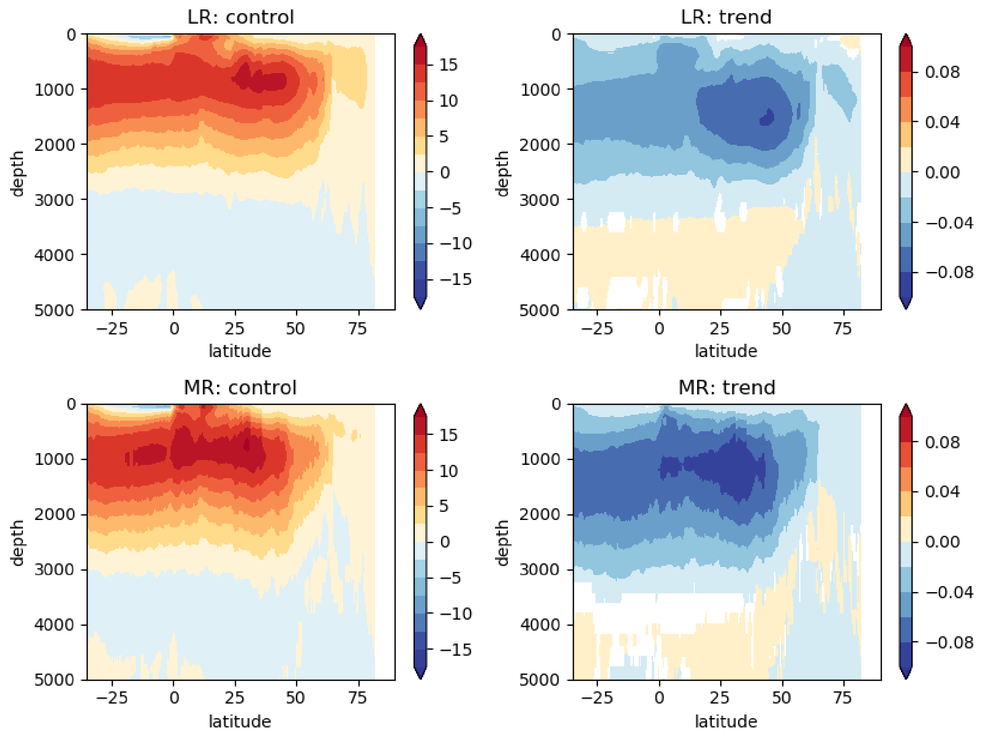
CMIP6 models: HadGEM3-GC3.1

-LR = N96 ORCA1
(1 degree ocean)

-MR = N216 ORCA025
(0.25 degree ocean)

Use 1% CO2 increase scenarios.





Where do AMOC changes originate?

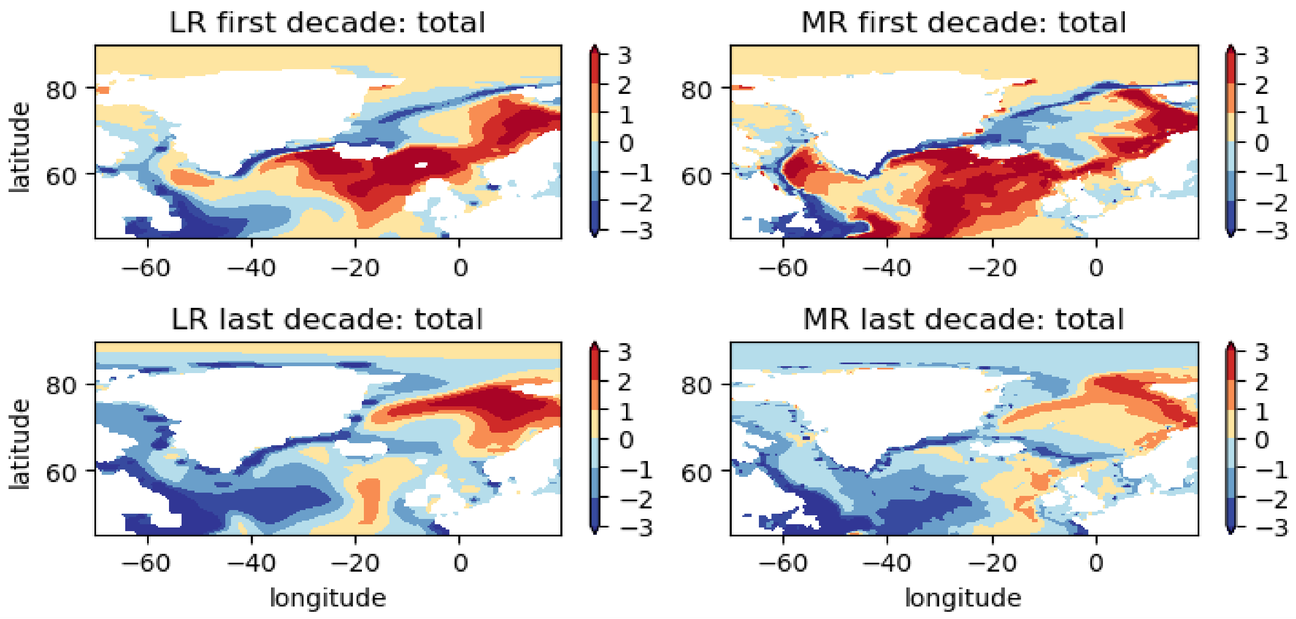
-Overturning in density space is equivalent to transformation of density which largely occurs through surface fluxes

-We use fluxes to calculate implied overturning changes (not shown)

-In 1% run, transformation in western subpolar gyre (WSPG) stops but in GIN seas moves north

-HadGEM3 MR has greater transformation in WSPG so is affected more when it stops than LR

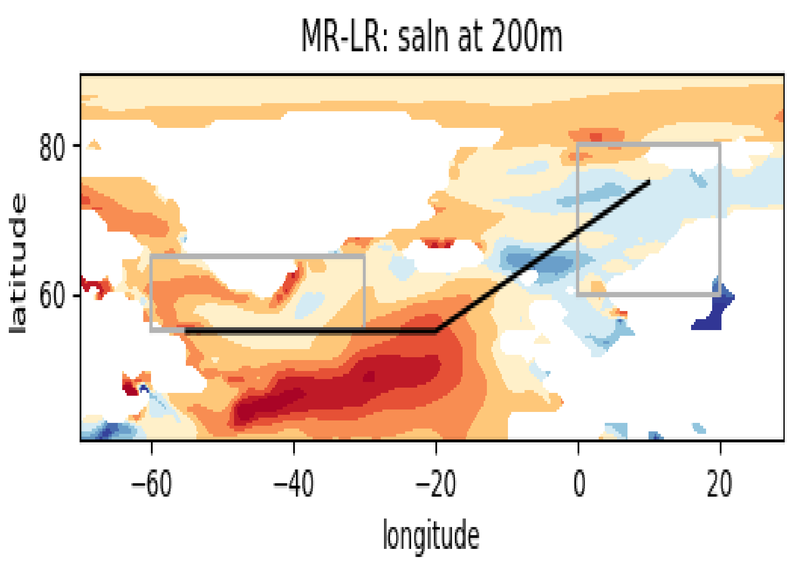
-WSPG transformation stops when reduced northward ocean heat transport reduces ocean-atmosphere temperature gradient

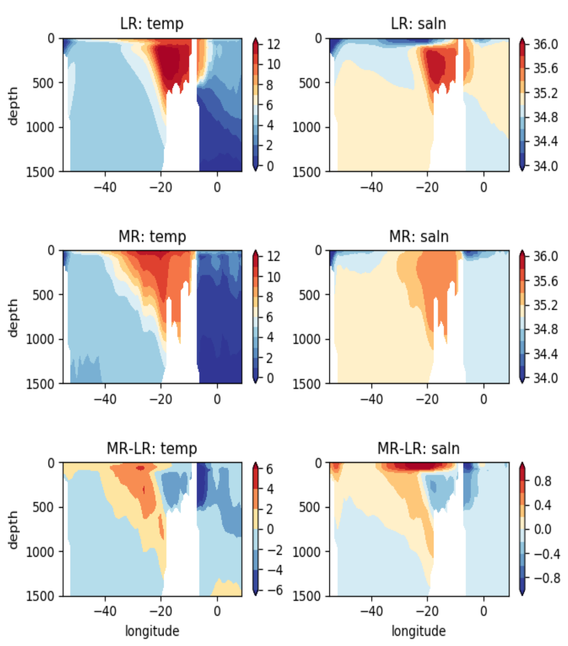


Why does MR model have greater density transformation in WSPG?

-MR model is warmer, more saline and denser in WSPG than LR model. It has a stronger subpolar gyre and more westerly North Atlantic Current

-Leads to warmer, more saline water reaching the WSPG and preconditioning density transformation





Conclusions and future work

-In HadGEM3, model resolution affects AMOC weakening because it influences the mean state which affects the AMOC weakening

-Although the medium resolution model has improved some (but not all) biases, it is unclear which biases control the AMOC response.

-Extending this work to the HighResMIP-PRIMAVERA ensemble shows that models with higher resolution generally have stronger AMOCS and greater weakening in climate change scenarios (with caveat that most of the ensemble uses NEMO ocean model)

-In future we need to try and understand the underlying drivers for the changes in the AMOC mean state. This includes exploring the role of model numerics and overflow representation

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