Role of the ocean in transient climate change

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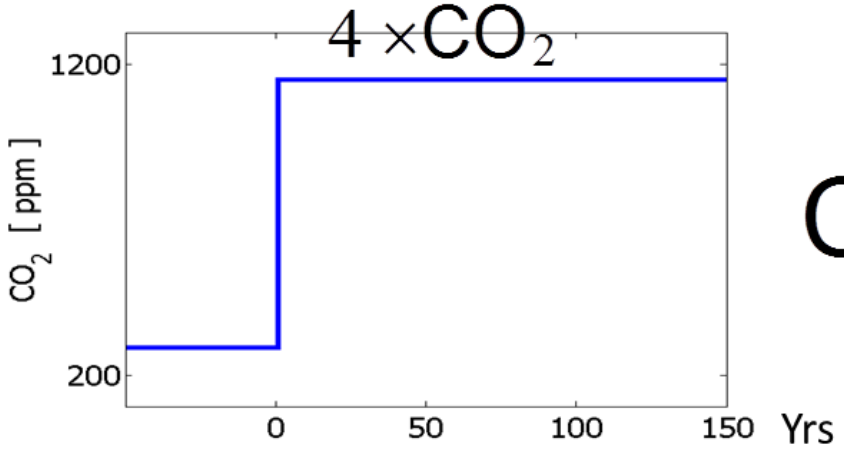
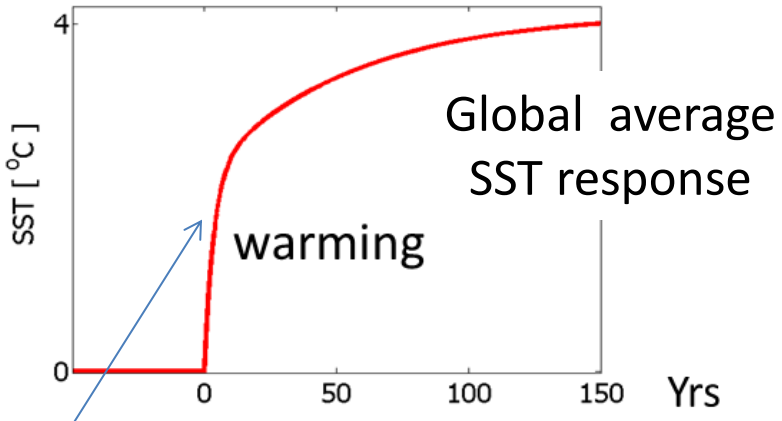
Climate Response Functions



FORCING

CO_2



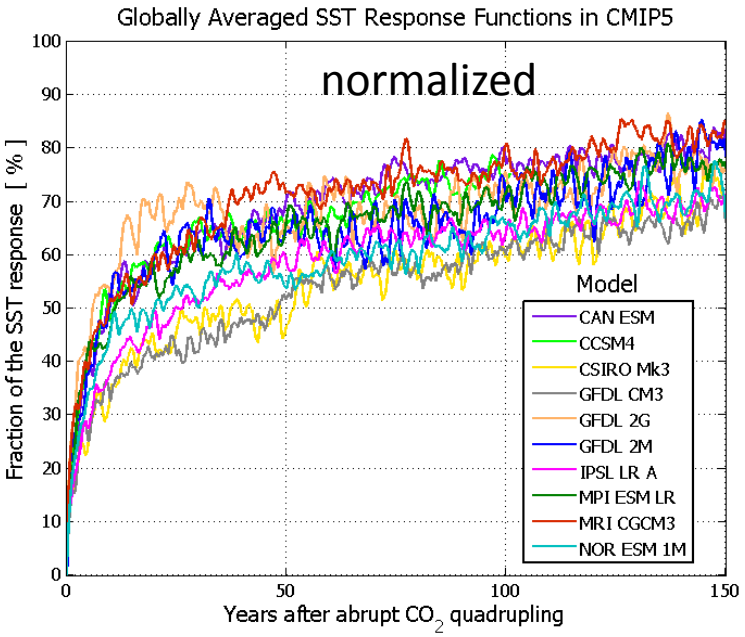
RESPONSE

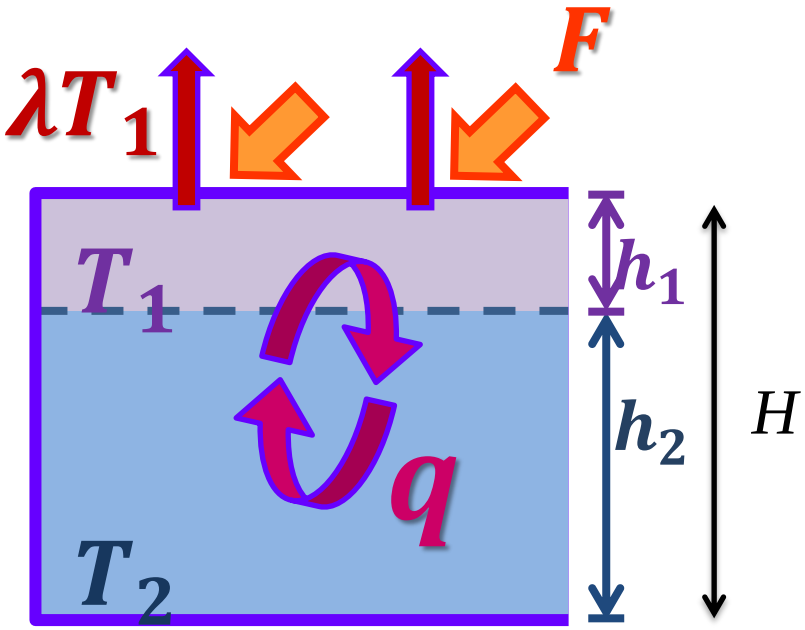
Ocean dynamics is central to shaping the transient response on decadal timescales

Can we determine what 'kind' of ocean dynamics is involved in sequestering heat in IPCC-class ocean models?

GHG Response Functions

Run out coupled A-O-ICE climate model to equilibrium.
Then instantaneously perturb GHG forcing and study evolution to new equilibrium



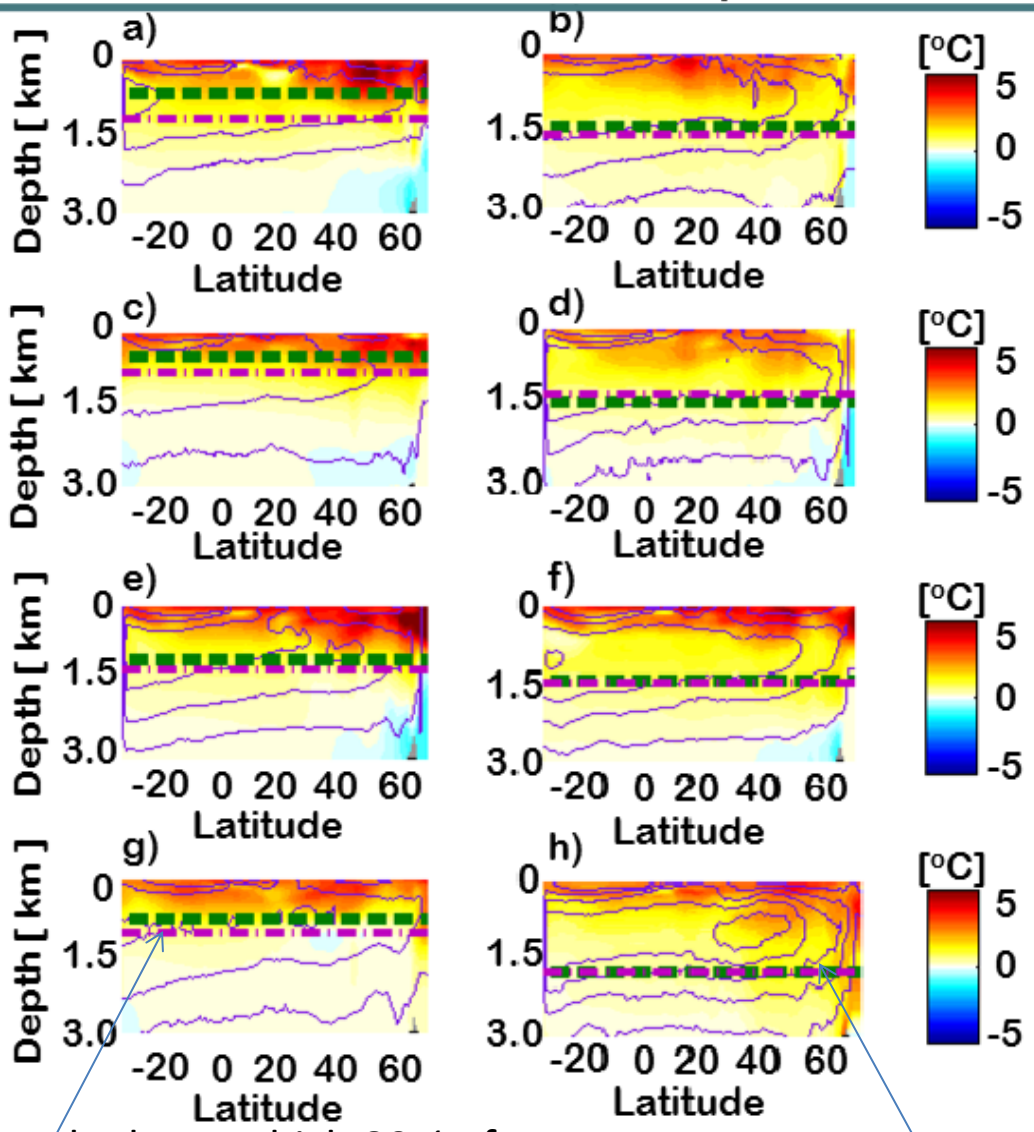


Gregory, 2000; Winton et al, 2012; Kostov et al, 2014

Fast timescale $\tau_1 \approx \lambda + Q$ - few years

Slow timescale $\tau_2 \approx \lambda Q r/(\lambda + Q)$ - decades

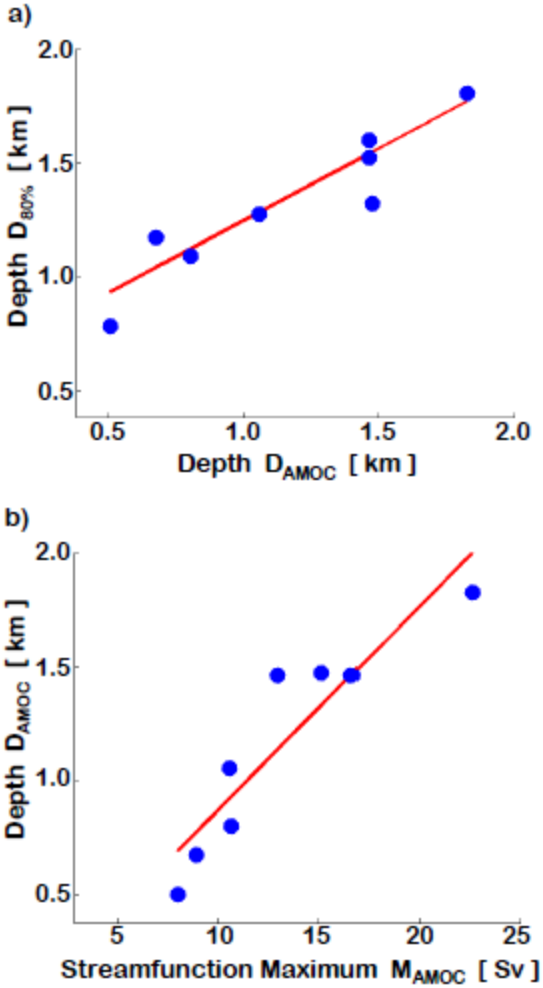
Variations in AMOC across models account for model spread



Depth above which 80% of the heat is contained (magenta)

Depth of AMOC (green)

After 100 years



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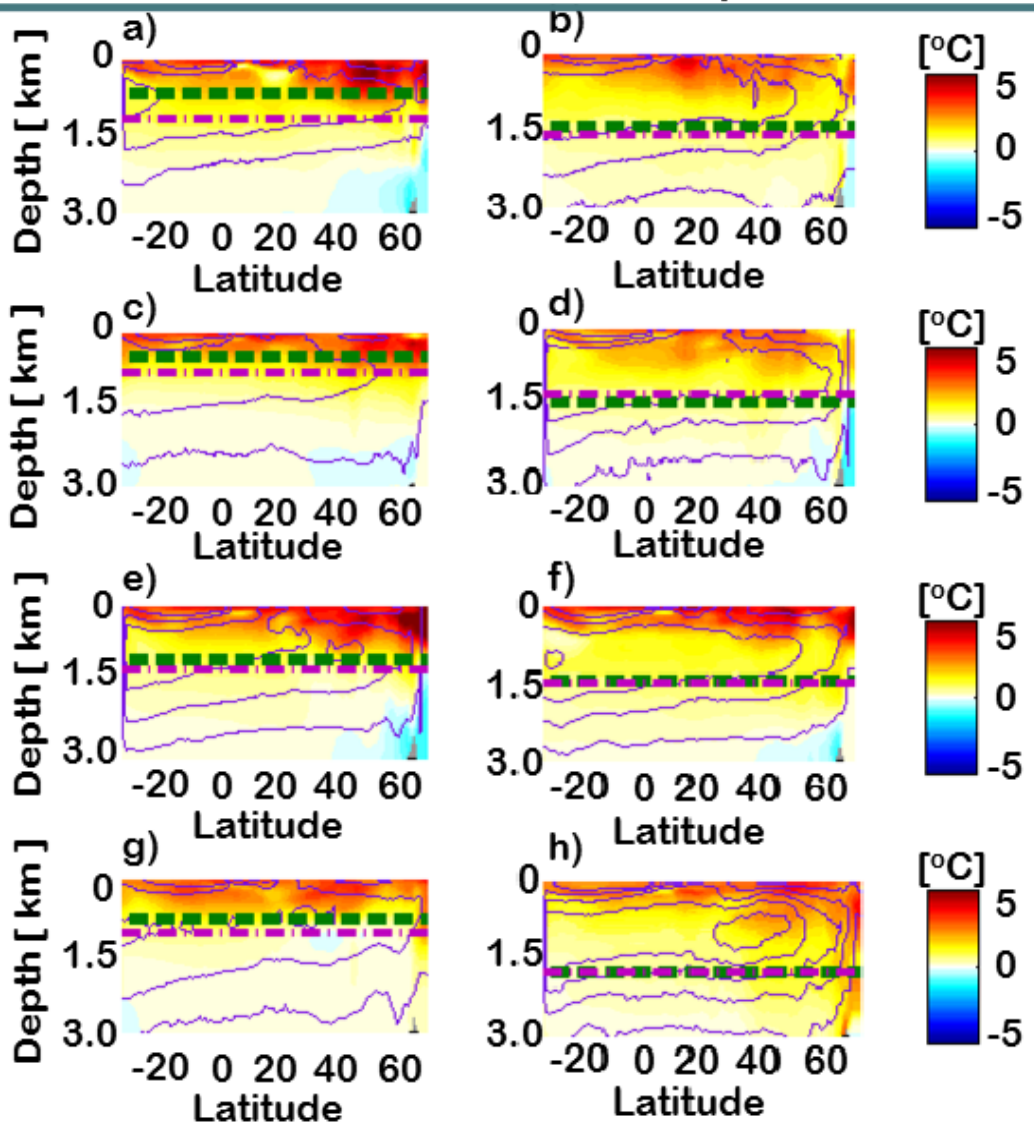
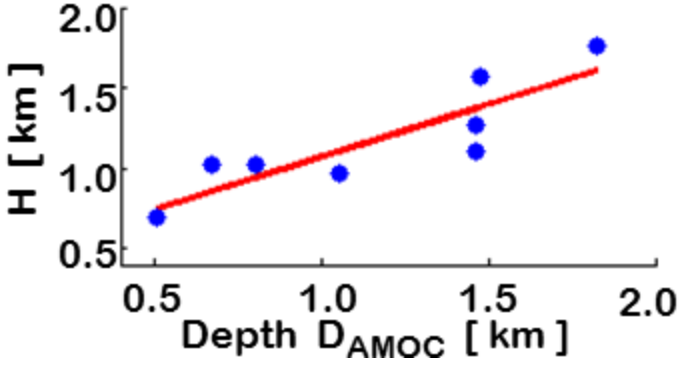
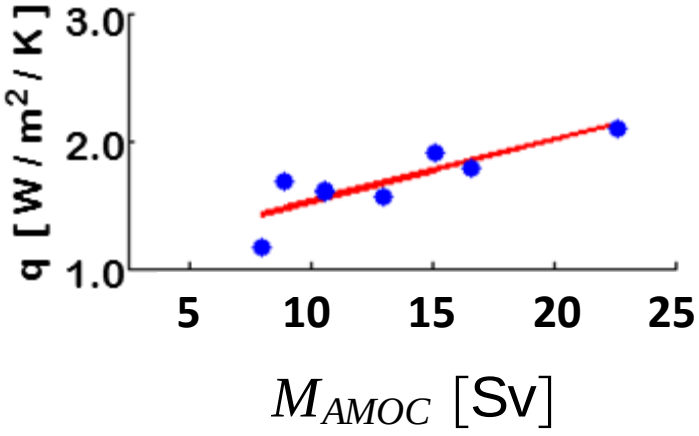


After 100 years





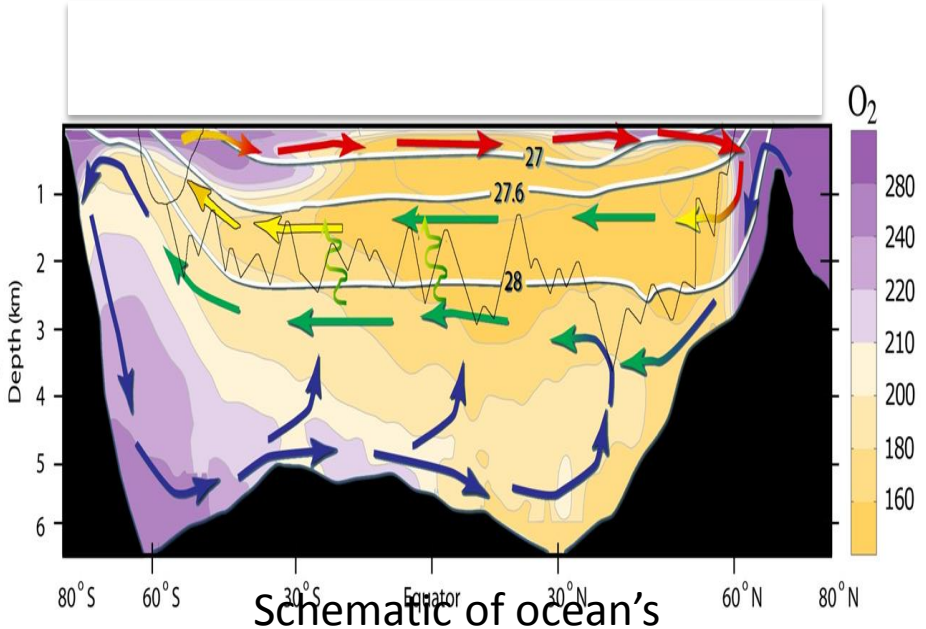
Kostov, Y, Armour, K and Marshall J (2014): Impact of the Atlantic Meridional Overturning Circulation on Ocean Heat Storage and transient climate change.
GRL, March, 2014

Oceans and transient climate response

Dynamics of the upper cell is central to setting transient climate response in non-eddy-resolving ocean models.

Will this be true of eddy resolving ocean models?

Community might be able to afford to carry out transient climate change experiments resolving ocean eddies



Schematic of ocean's overturning circulation