



On the superposition of mean advective and eddy-induced transports in global ocean heat and salt budgets

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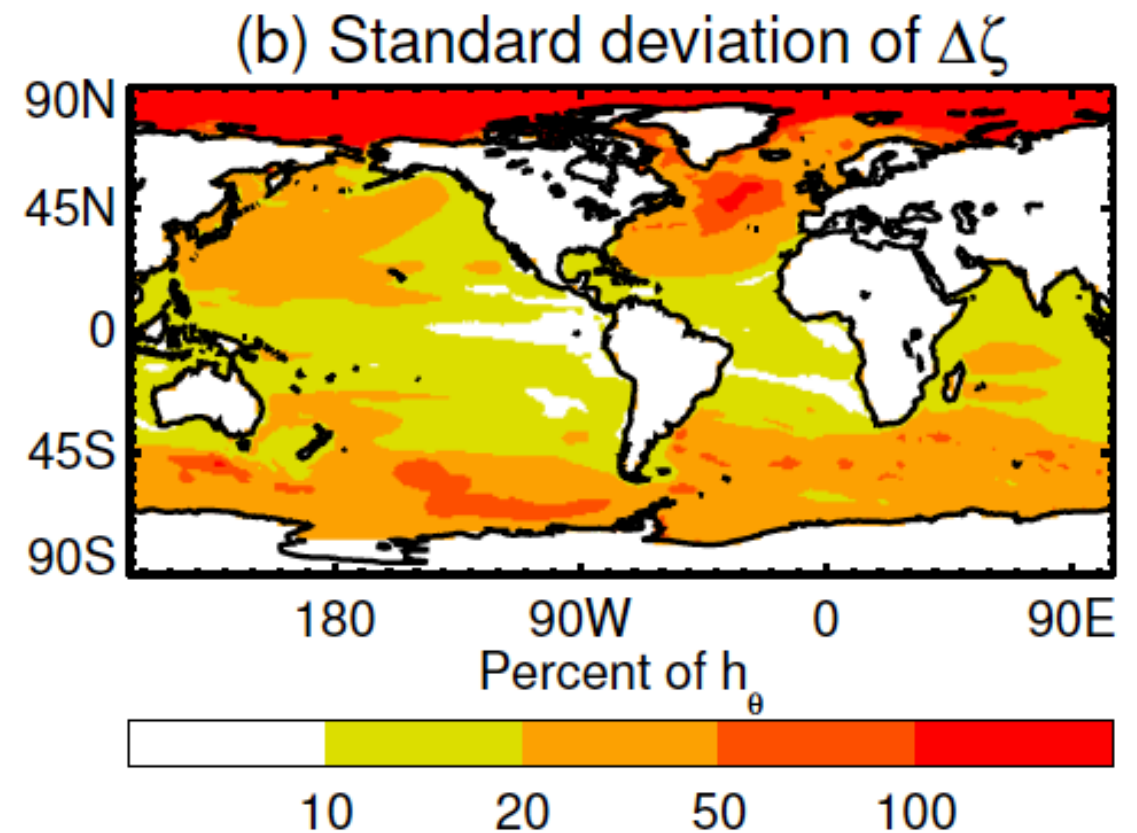
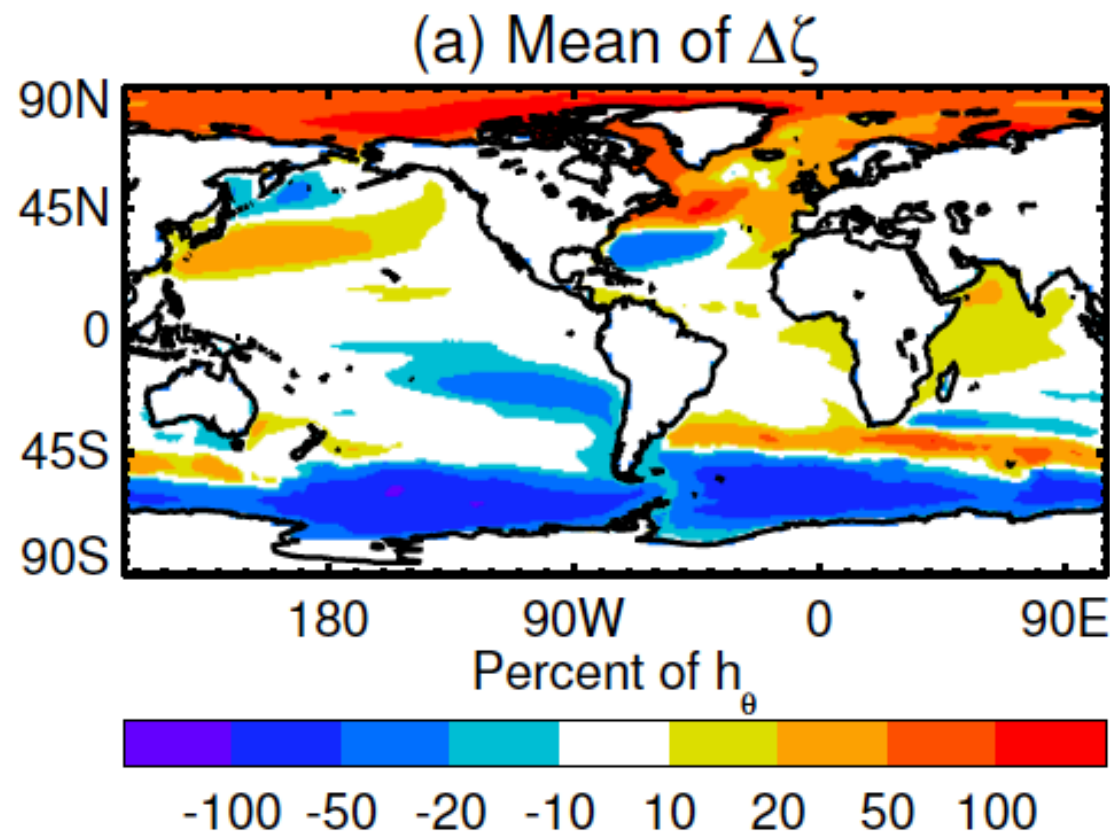
Will Hobs

Andy Hogg

Nic Hannah

and others

Long standing problem: Large spread in CMIP sea level projections



Gregory et al., 2016



- Thermal expansion of the seawater corresponds to ~30-50% of the sea level changes
- Ocean heat uptake efficiency corresponds to ~50% of the uncertainties
- Lack understanding of the processes behind ocean heat uptake and transport

Understanding physical process in ACCESS-OM2 (steady state): ocean heat budget

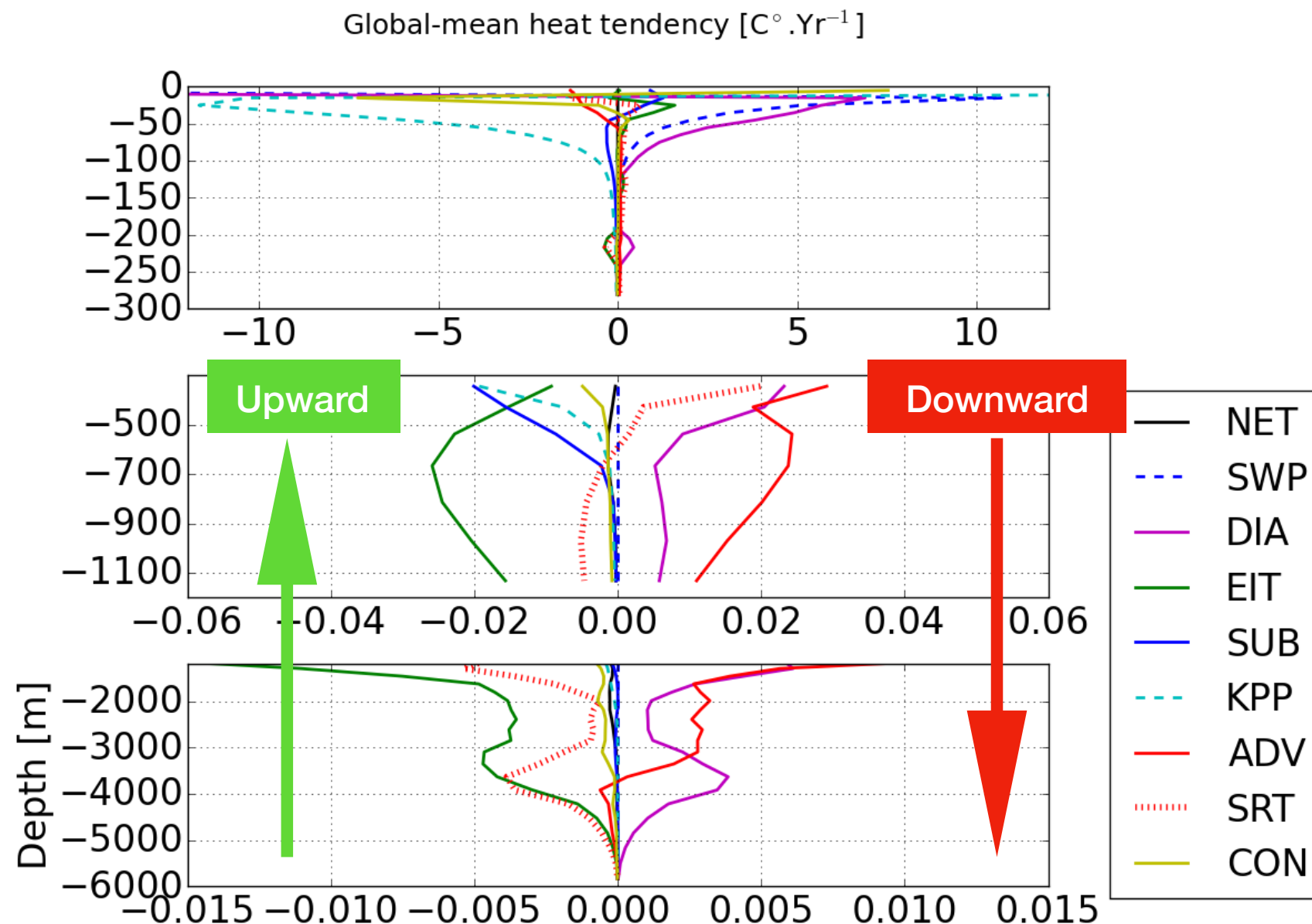
$$C_p \rho_0 \partial_t \Theta dz = -\nabla_s F dz$$

$$F = \text{ADV} + DIA + KPP + SWP + EIT + SUB + CON + PME + RIV + FRZ$$

- Explains ocean heat content changes due to different processes (explicit/parameterised)

- ADV = mean advection  resolved
- DIA = diapycnal diffusion
- KPP = nonlocal KPP
- SWP = shortwave penetration
- EIT = eddy-induced transport
- SUB = submescale eddies  parameterised
- CON = convection
- PME = precipitation minus evaporation
- RIV = river runoff
- FRZ = frazil formation

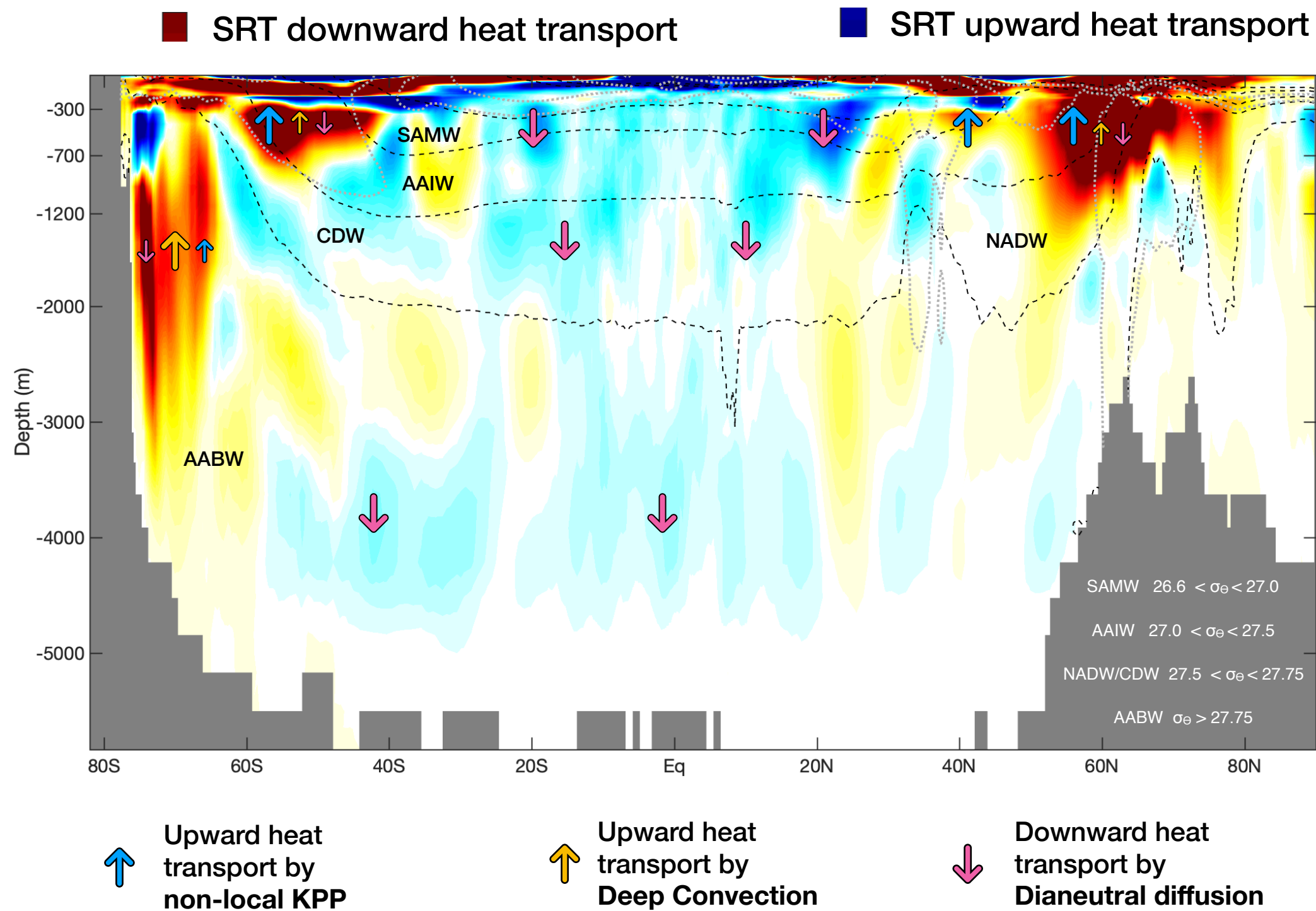
Global vertical heat balance: **EIT** \rightleftharpoons **ADV**



- New framework: Super Residual Transport (SRT): $\text{ADV} + \text{EIT}$

Two depth regimes: mixed layer & ocean interior

Super-residual framework



Impact of the framework

- Link between largest processes and small-scale mixing
 - formation and spread/destruction of dense water masses
- Intermodel comparison - independent of model resolution
 - Large-scale and mesoscale processes combined
 - Eddy-permitting -> inconsistency resolved or parameterised
- Calibration of simple climate models: advective-diffusive balance