A Linear Stochastic Analysis of Model Diversity in AMOC Dynamics

Cécile Penland[1], Douglas MacMartin[2], Chesley McColl[1,3], Laure Zanna[4], and Eli Tziperman[5]

[1] *NOAA/ESRL/Physical Sciences Division, Boulder, CO*; [2]*California Institute of Technology, Pasadena, CA*; [3]*CIRES, University of Colorado, Boulder, CO*; [4]*University of Oxford, Oxford, UK*, [5]*Harvard University, Cambridge, MA*

The variability of the Atlantic Meridional Overturning Circulation (AMOC) differs greatly among the separate coupled General Circulation Models (GCMs). Physical reasons for these differences are still poorly understood.

In this study, we use statistical techniques explicitly employing linear assumptions in order to analyze the widely different characteristics of AMOC. Two such techniques, Linear Inverse Modeling (LIM) and frequency-domain Transfer Function Analysis (TFA) have previously been applied to the analysis of the AMOC in General Circulation Models (e.g., Tziperman et al. 2008; Hawkins & Sutton 2009; Zanna et al 2011; MacMartin et al. 2013). These studies have not exploited the physical basis of the stochastic forcing inherent in the assumptions behind such analyses to explain these differences.

We present preliminary results weighing the relative importance of heat flux (HF) and fresh water flux (FW) to the AMOC and the time scales on which they operate. We first describe the deterministic (on interannual to decadal timescales) interactions between HF, FW and AMOC in terms of interference of eigenmodes. Then, using the balance between stochastically generated variability and dissipative deterministic dynamics, we diagnose how much of the difference in AMOC variability is due to differences in internal oceanic dynamics vs. differences in stochastic forcing by the atmosphere.