Abstract View

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An Eclectic Atlantic Ocean Circulation Model. Part I: The Meridional Flux of Heat

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ABSTRACT

A model of the Atlantic has been formulated that combines ordinary quasi-geostrophic constraints (based upon the dynamic method and Ekman layer) with a great variety of additional information available about the time-average ocean circulation. The goal is to combine very diverse data types and beliefs and to be able to test for compatibility and incremental usefulness as a way around the paucity of conventional data, a lack of which otherwise greatly hinders determination of the circulation.

The approach is axiomatic. Such a model is based here upon the use of linear inequality constraints, which permit the combination of the dynamic method with “core layer”-like constraints, as well as observations of deep water velocities, overflow transports and the like. The model is then exploited to find absolute bounds (maxima and minima) upon the annual mean and seasonal meridional fluxes of heat and the maximum rate of tropical near-surface upwelling. Some latitudes of nearly vanishing mean meridional heat flux are just possible within the imposed constraints, but it appears impossible to reverse the sign of the heat flux at any latitude except in winter. The latitude of maximum possible annual-mean poleward heat flux is 40°N. Based upon a radiocarbon box model, the value of tropical upwelling is much less than published values. The model is very “slack”, i.e., most properties are locally determined rather than being forced by distant constraints.