Abstract View

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An Idealized Model of the World Ocean. Part I: The Global-Scale Water Masses

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ABSTRACT

A primitive equation, three-dimensional numerical model of the ocean, employing idealized versions of the real topography and surface boundary conditions, is used to study the water mass structure of the World Ocean. In particular, the response of the model to three fundamental changes in boundary conditions is investigated in an attempt to identify the mechanisms in the model which are responsible for the establishment of the largest scale features of the global water-mass structure. With the Drake Passage closed, thermohaline driving alone, and a fresh North Atlantic surface salinity specified, only the coarsest aspects of the observed *T* and *S* structure are reproduced and the entire World Ocean below the thermocline is dominated by water formed at the southern boundary. The salinity configuration in particular, lacks much of its observed structure in this case. When the Drake Passage is opened, the resulting circumpolar flow serves to isolate the extreme southern ocean. This allows waters of northern and midlatitude origin to invade the subthermocline zones, producing the familiar tongues of fresh water at intermediate depths. Wind driving further isolates the extreme Southern Ocean and improves the shape and positioning of the fresh water lenses, particularly in the Southern Ocean. Finally, increasing the salinity of water formed at the surface of the northern Atlantic produces distinct salinity maxima in the deep water throughout the World Ocean, bringing the overall salinity structure into broad agreement with observations. Passive tracers are used to establish water mass origins.

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