Abstract View

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Warm-to-Cold Water Conversion in the Northern North Atlantic Ocean

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ABSTRACT

A box Model of warm-to-cold-water conversion in the northern North Atlantic is developed and used to estimate conversion rates, given water mass temperatures, conversion paths and rate of air-sea heat exchange. The northern North Atlantic is modeled by three boxes, each required to satisfy heat and mass balance statements. The boxes represent the Norwegian Sea, and a two-layer representation of the open subpolar North Atlantic. In the Norwegian Sea box, warm water enters from the south, is cooled in the cyclonic gyre of the Norwegian–Greenland Sea, and the colder water returns southwards to the open subpolar North Atlantic. Some exchange with the North Polar Sea also is included. The open subpolar North Atlantic has two boxes. In the abyssal box, the dense overflows from the Norwegian Sea flow south, entraining warm water from the upper-ocean box. In the upper-ocean box, warm water enters from the south, supplying the warm water for an upper ocean cyclonic circulation that culminates in production by convection of Labrador Sea Water, and also the warm water that is entrained into the abyss, and the warm water that continues north into the Norwegian Sea. Our estimates are that 14×10^6 m^3 s^{-1} of warm (11.5°C) water flows north to the west of Ireland, with about a third of this branching into the Norwegian Sea. The production rate for Labrador Sea Water is 8.5×10^6 m^3 s^{-1}), and this combines with a flow of dense Norwegian Sea Overflow waters (with entrained warmer waters) at 2.5×10^6 m^3 s^{-1} to give a Deep Western Boundary Current of 11×10^6 m^3 s^{-1}. The total southward flow east of Newfoundland is this plus 4×10^6 m^3 s^{-1} of cold less dense Labrador Current waters (there is a net southward flow between Newfoundland and Ireland of about 1×10^6 m^3 s^{-1} supplied by northward flow through the Bering Strait, passing through the North Polar Sea to enter the Norwegian Sea.

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