Temporal Variability of the Upper Ocean Southeast the Kerguelen Plateau

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Abstract: XBT/XCTD observations from four cruises across the Southern Ocean from Fremantle, Australia to Prydz Bay, Antarctica were analyzed to examine the upper ocean thermohaline structure in the southeast Indian Ocean and its temporal variability. These transects were occupied in March 1998, November 1998, March 2000, and March 2002. Two polar fronts, separated by a few degrees of latitude, appear in the region southeast the Kerguelen Plateau. The primary polar front is characterized by a strong horizontal thermal gradient extending deep in the water column, while the secondary polar front is identified by the 2?C isotherm at Tmin depth and has a relatively shallow frontal expression.

A strong temporal variation is found in the upper ocean thermal structure in the polar ocean southeast the Kerguelen Plateau. The depths of the mixed layer and Tmin layer increase with time. The mixed layer temperature decreases while the Tmin temperature increases in the same time. In addition, the length of ice-free period prior to each XBT/XCTD sampling and surface wind forcing, calculated as the friction velocity cubed during the ice-free period, increase from 1998 to 2002. The analysis suggests that the longer ocean is exposed to the atmosphere and the stronger wind stirring, the more enhanced is the turbulent mixing. This results in a deeper mixed layer depth and more entrainment of colder water from the Tmin layer to the mixed layer. This surface forcing also enhances internal diffusive processes that mix the Tmin water with the warmer waters above and below the Tmin layer. The surface forcing apparently dominates in determining the upper ocean thermal structure in this polar region.

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