

RELATION BETWEEN MELTING OF THE
ANTARCTIC ICE SHEET AND SHIFT
OF THE POLAR FRONT FROM
1979-1989 (ABSTRACT)

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In the study of the global climatic change, many observations and estimations of the amount of ice-sheet melting in the Antarctic have been carried out, but persuasive estimates have not been obtained yet. We have used the oceanographic data in the JARE Data Reports on oceanography 1979-1989. From the data analysis, we have estimated the polar front shift and the excess amount of melting ice in the Antarctic.

In the Japanese Antarctic Research Expedition, the research vessel follows the same track across the Southern Ocean every year. So it is convenient to use the oceanographic data for finding the change of chemical constituents in the ocean water year after year. We plotted oceanographic data, such as pH, salinity, temperature, NO₃-N, NO₂-N, NH₃-N, dO₂, SiO₃-Si, PO₄-P, as a function of latitude. We found that the positions of the ocean fronts in the Southern Ocean along 110°E can be estimated using chemical constituents changes in the water.

We chose salinity and concentration of silicate as indicators of the position of the ocean front. Salinity changes abruptly at the Subtropical Front, and concentration of silicate does at the Polar Front. We estimated relative positions of the ocean fronts every year graphically. Ocean fronts fluctuate year after year, but as a secular trend, the Polar Front seems to be shifting slightly northward, 6-10 km Y⁻¹. The Subtropical Front has been shifting slightly southward at about the same rate over the last ten years.

Assuming that the northward shift of the Polar Front is caused by the excess melting of ice sheets in the Antarctic, we can estimate the amount of ice melting. If the melt water mixed with upwelled ocean water of about 34.8‰ salinity generates Antarctic Surface Water of 34.2‰ salinity, the amount of melting ice may be estimated as about 160 Gt Y⁻¹. This corresponds to about a 0.4 mm Y⁻¹ sea level rise. This compares to the IPCC assessment of sea level rise due to Antarctic ice melting of 0-0.45 mm Y⁻¹, out of a total sea level rise of 1.0±0.5 mm Y⁻¹.

(Received April 7, 1993; Revised manuscript received June 16, 1993)