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RELATIONSHIP BETWEEN THE UPPER OCEAN AND SEA ICE DURING THE ANTARCTIC MELTING SEASON (ABSTRACT)

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During the Antarctic ice-melting season, sea ice concentration and thickness data were collected with the video monitoring system aboard the icebreaker SHIRASE, along with the monitoring of temperature and salinity in the upper ocean. Spatial resolution of the data is about 200 m for the ice concentration and about 2 km for the temperature and salinity. On the basis of these data, relationships among sea ice concentration, temperature, and salinity are investigated. In the region away from the ice-free ocean (ice interior region), ice concentration is negatively correlated with temperature and positively correlated with salinity for the spatially averaged data along the cruise track, which suggests that the local balances of energy and salt nearly hold in a bulk area. At the ice margin, ice concentration is negatively correlated with both temperature and salinity, suggesting that the local balances are overwhelmed by the effects of ice advection. The XBT profiles at the ice margin also show that a considerable amount of sea ice was advected into the ice-free ocean and subsequently melted there. It is pointed out that a polynya works as an "ice-melting factory" in summer; it absorbs solar radiation during the period of opening and then melts the ice advected there. From a heat budget analysis and the ocean structure in the melting season, we propose a simple ice/upper ocean coupled model in which sea ice melts on the bottom and lateral faces. The relations among ice concentration, temperature, and salinity derived from the model are consistent with the observed relations in the ice interior region. The negative feedback effect on the upper ocean temperature explains that the temperature-concentration plot shows a similar relation for any region. The salinity-concentration relation depends on the spatial scale more strongly than the temperature-concentration relation.

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