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MECHANISMS FOR THE SEASONAL CYCLE IN THE ANTARCTIC COASTAL OCEANS (ABSTRACT)

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Seasonal variations of the Antarctic coastal oceans has not been well understood owing to logistical difficulties in observations, especially during the ice-covered season. Recently, 'Weddell Gyre Study' and 'Japanese Antarctic Climate Research program' have revealed the following seasonal variations in the Antarctic coastal ocean. First, the thickness of the Winter Water (WW) layer, characterized by cold, fresh, oxygen-rich water, exhibits its maximum in the austral fall and its minimum in the austral summer. Second, the Antarctic Coastal Current has maximum westward velocity in fall and a minimum in summer. Further, the sea-level variations at Syowa Station suggest a large seasonal variation in a barotropic flow.

We have investigated the seasonal response of the coastal ocean to atmospheric forcing, using a numerical model, to clarify the mechanisms for these seasonal variations. The model is a three-dimensional OGCM, similar to that of Bryan and Cox. The model is forced both by the wind stress and the surface fluxes of salt and heat with their seasonal variations. The results of the model, with some theoretical interpretation, suggest the following mechanisms for the seasonal variations. The circulation in the Antarctic Ocean is mainly driven by wind forcing, slightly modified by thermohaline forcing. The seasonal response is interpreted as the sum of the wind-driven circulation associated with the curl of the wind stress and coastal downwelling associated with easterly wind at the coast. Because of the weak stratification, the former response is fairly barotropic. The variation in the coastal current is mainly caused by spin-up of the wind-driven gyre associated with the wind change, which is manifested by barotropic Rossby waves. The variation in downwelling or the WW thickness is interpreted as an internal Kelvin wave response.

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