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SEA-ICE DYNAMICS IN THE WEDDELL SEA DURING SUMMER 2004

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In late 2004 a multi-national, interdisciplinary study coordinated by the Alfred Wegener Institute for Polar and Marine Research, Germany, was carried out in the Western Weddell Sea. A drifting station, Ice Station POLarstern [ISPOL] formed the core component of this cruise, which aimed to investigate the role of early summer physical and biological atmosphere-ice-ocean interactions in the Western Weddell Sea and their role in global processes. In a joint international effort four organisations contributed to the deployment of a meso-scale buoy array consisting of 23 autonomous ice buoys.

Lagrangian data, available for about 30 days during late November and December 2004, and based on GPS-derived location measurements provide in situ measurements, from which the sea-ice drift and deformation in the Western Weddell Sea has been derived for the summer of 2004. This record is compared to previous measurements in the region to assess the seasonal and interannual variability. Using time-series analysis, such as Fourier analysis, of the derived ice-motion and deformation data, the physical forcing mechanisms, such as due to atmospheric and oceanic forcing, are derived. Rotary spectra are applied to distinguish between tidal forcing and inertial response of the subdaily ice motion.

The overall net translation of the sea ice within the ISPOL region is to the northwest in agreement with the motion of the cyclonic Weddell Sea Gyre. The meridional velocity is about twice the magnitude of the zonal velocity indicating that the mean sea-ice drift is largely forced by the underlying oceanic currents. There is a spatial gradient in the ice-motion field with the sea ice along the eastern edge of the buoy array drifting faster than the ice along the southern and western edge of the array. This is consistent with observed changes in the size distribution of the ice floes in the ISPOL region (see SCAR abstract by Worby et al.), where ice floes encountered along the eastern edge of the buoy array are smaller and disintegrate at a higher rate during the summer than those along the western edge. The area of the pack ice enclosed by the buoy array expands by about 40% during the ISPOL phase. The ice deformation is driven by atmospheric systems moving overhead, and modulated by high-frequency forcing exerted by the ocean.