Abstract View

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The Effect of the Oceanic Boundary Layer on the Mean Drift of Pack Ice: Application of a Simple Model

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ABSTRACT

Smoothed records of ice drift, surface wind and upper ocean currents at four manned stations of the 1975–76 AIDJEX experiment in the central Arctic have been analyzed to provide a statistical relationship between stress at the ice-ocean interface and ice-drift velocity during a 60-day period when the ice, was too weak to support internal forces. Using interfacial stress calculated from a balance with air stress and Coriolis force on the ice column for times longer than the inertial period, logarithmic linear regression of the stress-velocity samples provided the relation $\tau = 0.010V^{1.78}$, where τ is the magnitude of interfacial stress and V the ice speed relative to the geostrophic current in the ocean. This result is statistically indistinguishable from predictions of a numerical model adapted from Businger and Arya (1974) with surface roughness $Z_0 = 10$ cm. Essential features of the model are dynamic scaling by u_*, u_*^2 and u_*/f for velocity, kinematic stress and length, with exponential attenuation of a linear dimensionless eddy viscosity, viz., $K_* = -k\xi e^{\epsilon\xi}$, where $\xi = fz/u_*$ and k is von Kaa's constant. Currents measured 2 m below the ice confirmed the shape of the τ vs V curve and provided an estimate of the angle between surface stress and velocity. The model was used to qualitatively estimate the effect of a pycnocline at 25 m on surface characteristics. The observed behavior when stratification at that level was most pronounced tended toward slightly higher drag at higher speeds, which is qualitatively consistent with the model results.