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Summer Retreat of Arctic Sea Ice: Role of Winds

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Interrelationships between year-to-year variations in September Arctic sea ice extent and summer sea level pressure and surface air temperature at high northern latitudes are examined making use of microwave satellite imagery and atmospheric data for the period 1979-2006. Linear trends and year-to-year variability about the linear trend lines are considered separately: the latter gives a clearer indication of the physical linkages between fields. Years with low September sea ice extent tend to be characterized by anticyclonic circulation anomalies over the Arctic, with easterly wind anomalies over the marginal seas where the year-to-year variability of sea ice concentration is largest. It is hypothesized that the summer circulation anomalies cause sea ice extent principally by way of the Ekman drift in the marginal seas. The associated surface air temperature anomalies also tend to be largest over the marginal seas, with positive anomalies over the regions of reduced sea ice.

The unprecedented retreat of first-year ice during summer 2007 was enhanced by strong poleward drift over the western Arctic induced by anomalously high sea-level pressure (SLP) over the Beaufort Sea that persisted throughout much of the summer. Comparison of the tracks of drifting buoys with monthly mean SLP charts shows a substantial Ekman drift. By means of linear regression analysis it is shown that Ekman drift during summer has played an important role in regulating annual minimum Arctic sea-ice extent in prior years as well. In combination, the preconditioning by events in prior years, as represented by an index of May multi-year ice, and current atmospheric conditions, as represented by an index of July-August-September SLP anomalies over the Arctic basin account for $\tilde{6}0\%$ of the year-to-year variance of September sea-ice extent since 1979.