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Impact of Sea Ice Cover on Upwelling in the Alaskan Beaufort Sea

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Wind-driven upwelling along the continental slope of the Alaskan Beaufort Sea profoundly impacts various aspects of the ecosystem of the western Arctic Ocean. Here we use hydrographic and velocity data from a two-year mooring array deployed across the shelf break and slope east of Pt. Barrow, AK to study how the presence of ice influences the upwelling. We divide the record into three ice seasons – open water, partial ice, and full ice – and characterize the oceanographic response to easterly wind events. The basic response is similar in all seasons: Roughly 8 hours after the beginning of the storm, the shelf break current reverses followed by upwelling of saltier water 18 hours later. There are, however important seasonal differences. The reversal of the boundary current, the salinity and temperature anomalies, and the secondary circulation are all largest during times with partial ice cover, while the upwelling response is damped under full ice cover. The upward displacement of isopycnals occurs nearly simultaneously throughout the water column, but during the full ice season it takes roughly 24 hours longer for the isopycnals to reach their maximum vertical extent. The secondary circulation is, for all three seasons, consistent with a two-dimensional Ekman cell with balanced cross- shelf flow. Occasionally the landfast ice extends far enough seaward to cover the entire shelf. This fundamentally alters the secondary circulation patterns but does not prohibit the upwelling entirely, consistent with previous modeling.