September 2009 Sea Ice Outlook: August Report
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Stratospheric dynamics and sea ice extent

September 2009 Sea Ice Extent Estimate
Comparable to the 2008 minimum in sea ice extent, or ~4.6–4.7 · 10^6 km^2.

Rationale
An update to differences between surface winds and SLP, and vortex splitting and minimum sea ice extent composites for June 2009, illustrates distinct patterns in the Beaufort, East Siberian, Kara and Barents Seas, and exhibits conditions in June 2009, that are favorable to ice export through Fram Strait, in contrast to those for May 2009. The presence of a SLP high also establishes conditions conducive to ice convergence to the north of the Canadian Archipelago.

Methods
In this study an update is provided for the difference between surface winds and SLP, and composites for years associated with vortex splitting events and record lows in September ice extent for June 2009, (Figures 4 and 5 in the July sea ice outlook submission). As in the July submission, surface winds and SLP were obtained from the NCEP reanalysis dataset provided by the NOAA/ESRL Physical Sciences Division.

Composites for vortex splitting events include the years 1979, 1985, 1988, 1989, 1999, 2001, as defined in Charlton et al. (2007), while composites based on record minima in sea ice extent in September include the years 2002, 2005, and 2007,in accordance with time series for monthly records of sea ice extent (http://earthobservatory.nasa.gov/Features/WorldOfChange/sea_ice.php). The year 2009 is characterized by a vortex splitting event (Manney et al., 2009).

Figures
1. Difference in June 2009 vector winds and sea ice extent and vortex splitting composites.
2. Difference in June 2009 SLP and sea ice extent and vortex splitting composites.

Results

Difference in June 2009 surface winds and vortex splitting and sea ice extent composites.

In June 2009, northerly winds predominate near Fram Strait, while easterly winds exist in the Beaufort Sea region (Figure 1). Differences between surface vector winds and those for years characterized by vortex splitting composites (middle panel, Figure 1) exhibit distinct spatial patterns in the western Arctic. Similarity in surface wind patterns in June 2009, and those observed in vortex displacement composites (Figure 5, previous submission) indicate mechanisms that generate surface wind patterns comparable to those anticipated from vortex displacement events. It should be noted however, that maximum stratospheric predictability of surface events occurs during winter over two months (Baldwin et al., 2003) so that similarity between anticipated surface wind composites for years associated with vortex splitting events such as 2009 should not be expected following spring. Distinct spatial patterns in differences between surface winds and minima in sea ice extent composites (right panel, Figure 1) exist in the Beaufort, East Siberian, Kara, and Barents Seas and suggest that significant ice retreat may not occur in these regions. However, and in contrast to the May, 2009 conditions, comparatively small differences between surface winds and sea ice minimum composites underline the presence of northerly winds in Fram Strait and increased ice export due to advection by winds in summer. Northerly winds to the north of the Canadian Archipelago associated with the SLP high in this region may also contribute to ice convergence along the coast if persistent throughout the summer.

Difference in June 2009, SLP and vortex splitting and sea ice extent composites.

A SLP high predominates to the north of the Canadian Archipelago in June 2009, (Figure 2). Comparison with the vortex splitting SLP composite (middle panel, Figure 2) shows positive values extending from the Beaufort Sea across the pole to Fram Strait, in contrast to SLP conditions during May 2009. It is interesting to note that the June 2009 SLP pattern resembles the SLP pattern evident in years characterized by vortex displacement events (compare with Figure 6, previous submission) although as previously noted, maximum stratospheric predictability of surface events occurs during winter over two months. Positive values in the difference plots for SLP and sea ice extent composites indicate a strengthened SLP to the north of the Canadian Archipelago and Greenland and increased convergence in these regions. Moreover, comparison of SLP in June 2009, and minimum sea ice extent composites highlights an absence of the meridional pattern established by the SLP high (low) over the Beaufort Sea (Siberia) associated with a record reduction in ice extent in 2007, as outlined in Overland (2009). In particular, positive difference values over Siberia in June suggest a weaker SLP low than for years exhibiting a record low in ice extent.

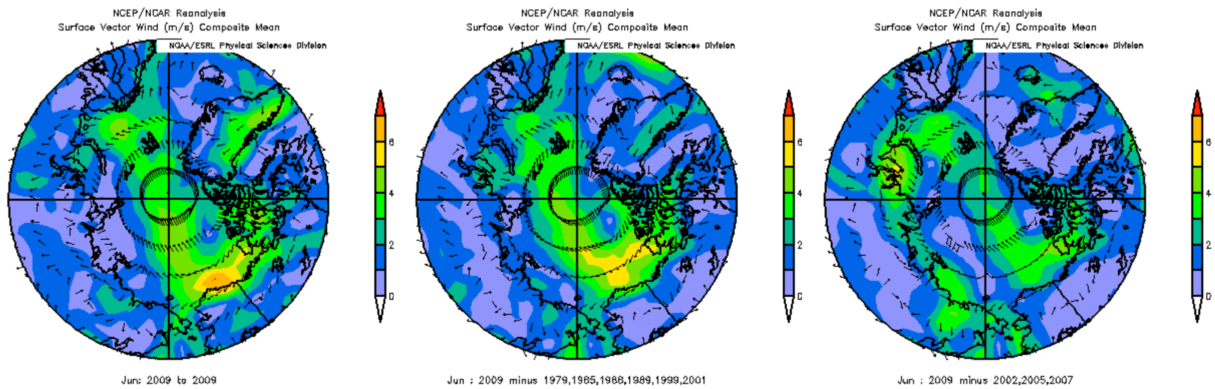

Figure 1. (Left) June, 2009 surface winds, and difference between June, 2009 and composite vector winds for (middle) vortex splitting events, and (right) minima in sea ice extent. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at http://www.esrl.noaa.gov/psd/

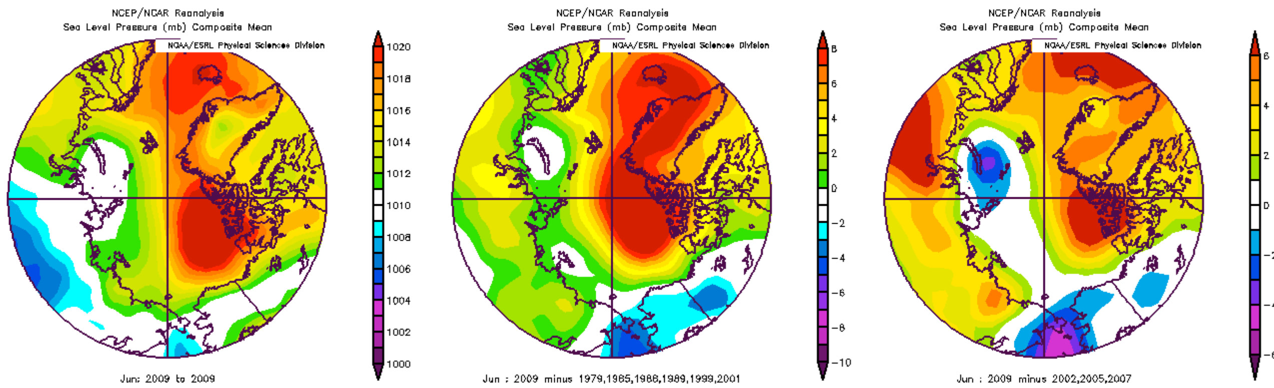

Figure 2. (Left) June, 2009 SLP and difference between June 2009, and composite for (middle) vortex splitting events and (right) minima in sea ice extent. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at http://www.esrl.noaa.gov/psd/.