

## ***Sea ice outlook in 2012 (August Update): Summer atmospheric and sea ice dynamical contributions to fall sea ice extent***

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Estimate for sea ice extent for September, 2012; comparable to the 2011 minimum in sea ice extent, or 4.33 million square kilometers.

### Executive Summary

It is hypothesized that the 2012 fall sea ice extent will attain values comparable to those of 2011 based on a heuristic assessment of sea ice and surface atmospheric dynamics, with regional losses governed by local wind and ice conditions.

### Rationale

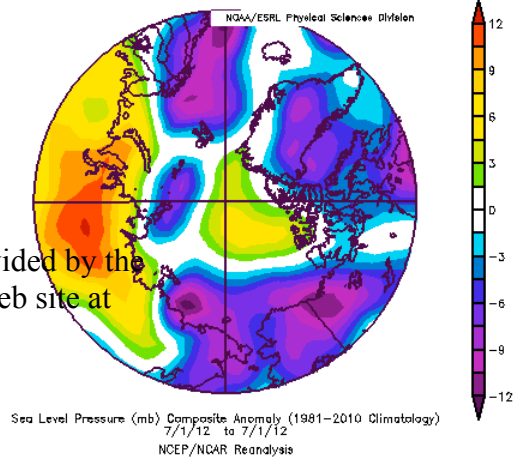
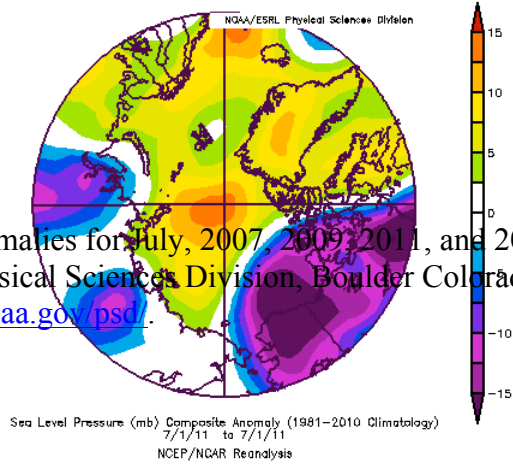
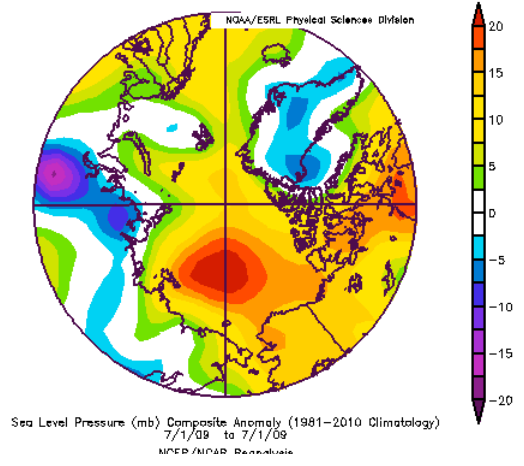
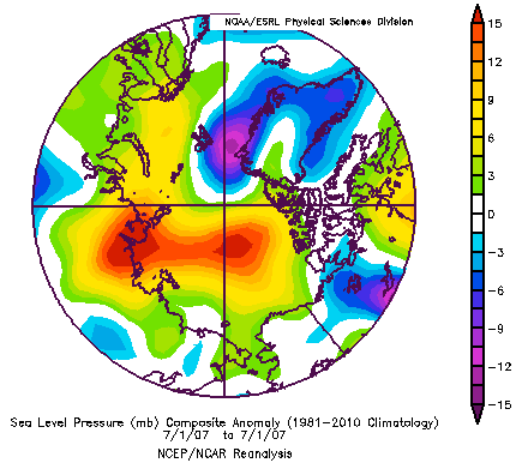
A quadrupolar configuration in SLP anomalies in July, 2012 compared to the dipolar configuration observed during years exhibiting a record reduction in sea ice extent, namely 2007 and 2011, indicates conditions that may inhibit ice transport from the western to the eastern Arctic, particularly from the Chukchi and East Siberian Seas. A decrease in sea ice concentrations throughout the Arctic pack and loss in ice thickness at the periphery of the ice pack indicate increased sensitivity of the ice cover to atmospheric forcing and attendant deformation and ridging. A predominantly cyclonic ice drift regime in July, 2012 further suggests divergence in the ice pack, while regional variability in SLP and ice drift conditions indicate barriers to transport that will hinder export through Fram Strait. Persistence of SLP extrema will determine ice dynamical contributions to fall sea ice extent.

### Discussion

SLP anomalies highlight the prevalence of a dipolar configuration over the Arctic Ocean in July, 2007 associated with the record loss of sea ice in fall, 2007 (Figure 1). By contrast SLP anomalies in July, 2009 are characterized by positive anomalies in SLP and negative anomalies over land. A dipolar pattern in SLP anomalies exists in July, 2011, establishing conditions conducive to ice advection out of the Beaufort Sea region, as is outlined in the NSIDC Arctic sea ice news and analysis update (<http://nsidc.org/arcticseaicenews/>), whereas a quadrupolar configuration exists in July, 2012 that may inhibit ice transport from the western to the eastern Arctic, particularly from the Chukchi and East Siberian Seas. Investigation of surface winds and their anomalies further illustrates increased wind-driven advection through Fram Strait, Bering Strait and the Canadian Archipelago in July, 2012 (Figure 2).

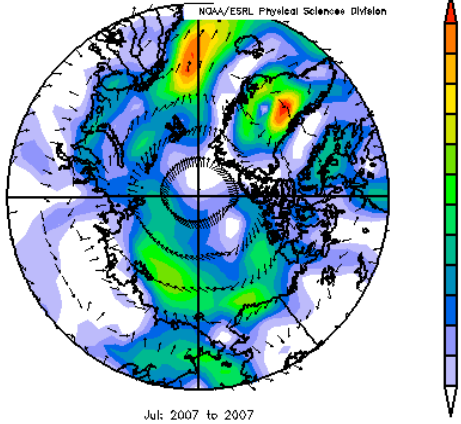
Comparison of sea ice concentrations at the end of July, 2011 and 2012 indicates increased ice loss in the Beaufort Sea region and the prevalence of lower ice concentrations at the periphery of the ice pack, particularly to the north of Bering Strait and the Barents and Kara Seas (Figure 3). Nowcast images of sea ice thickness show the northward migration of a tongue of comparatively thick (~3 m) to the west of Banks Island in July, 2012 relative to July, 2011, and the existence of ice less than 1.5 m thick at the ice edge, with implications for wind-driven ice drift and attendant ridging and sea ice deformation that will influence fall sea ice extent.

As for the June SIO assessment, daily maps of surface winds, SLP, and nowcast ice drift data illustrate regional differences in atmospheric forcing of sea ice in 2011 and 2012 (Figures 5 and 6). Noteworthy is the establishment of a well-defined anticyclonic regime over the Arctic Ocean in mid-July, 2011 followed by a transition to a cyclonic regime and reversal in the Beaufort Gyre at the end of July, 2011 that facilitates ice transport from the western to the eastern Arctic through Fram Strait. As for June, 2012, increased variability in ice drift is observed in July 2012, and in early July is characterized by a tripolar cyclonic configuration aligned with the SLP pattern, which contributes to ice divergence. Increased advection and ice export through Fram Strait are observed in mid-July, while at the end of July alignment of ice circulation with SLP low regimes over the Arctic Ocean establishes ice drift conditions that hinder transport from the western to the eastern Arctic and export through Fram Strait. The loss of coherence in the ice cover in July, 2012 suggests increased sensitivity to wind forcing and potential for sea ice deformation contributions to sea ice extent. Persistence of the SLP extrema and position of their gradients relative to the shoreline will govern sea ice dynamical contributions to fall sea ice extent.

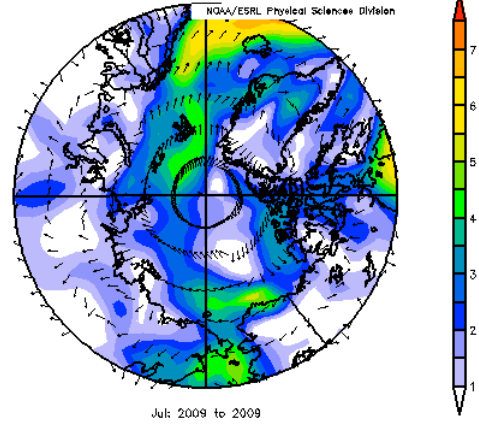


1. SLP anomalies for July, 2007, 2009, 2011, and 2012. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at [www.esrl.noaa.gov/psd/](http://www.esrl.noaa.gov/psd/).

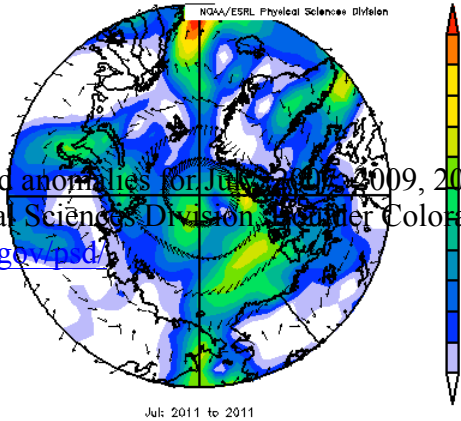
NCEP/NCAR Reanalysis  
Surface Vector Wind (m/s) Composite Anomaly 1981–2010 climo  
NOAA/ESRL Physical Sciences Division



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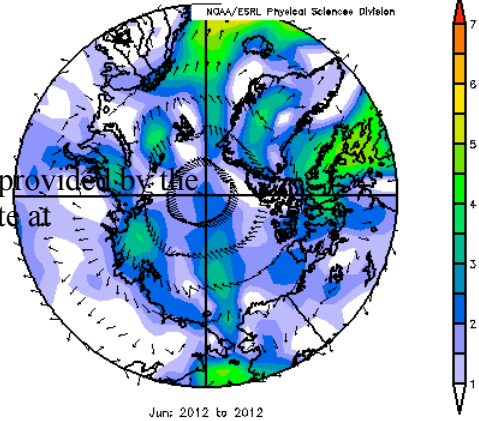
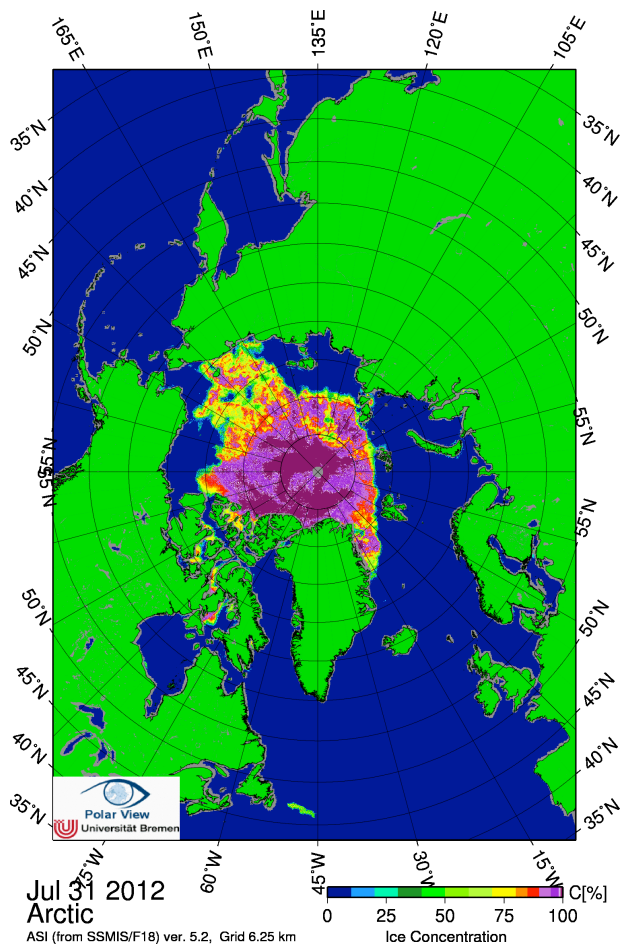
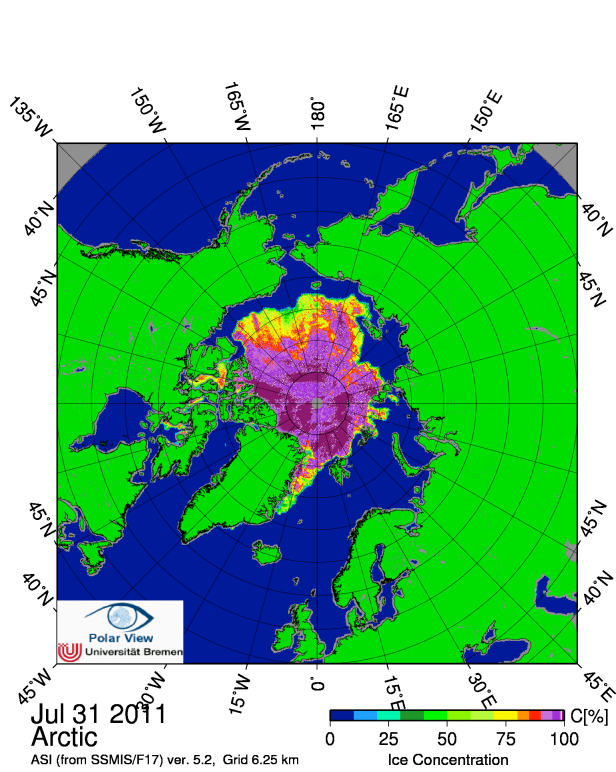
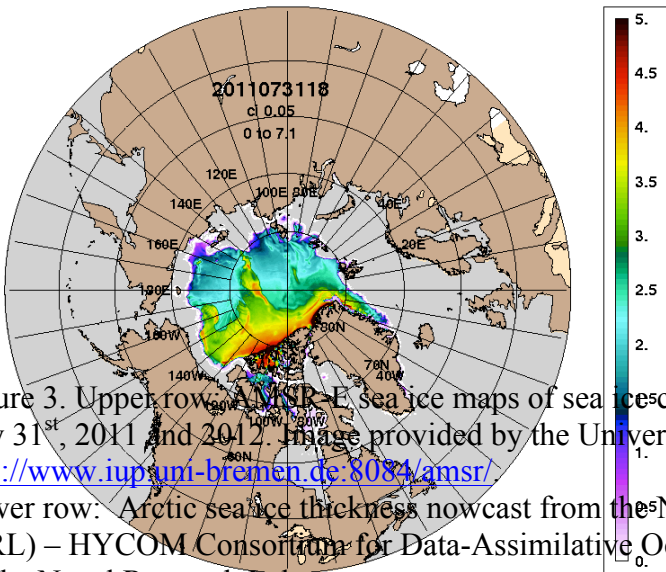


Figure 2. Surface wind anomalies for July 2007, 2009, 2011, and 2012. Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at <http://www.esrl.noaa.gov/pod/>



ARCC0.08-03.5 Ice Thickness: 20110731



ARCC0.08-03.5 Ice Thickness: 20120731

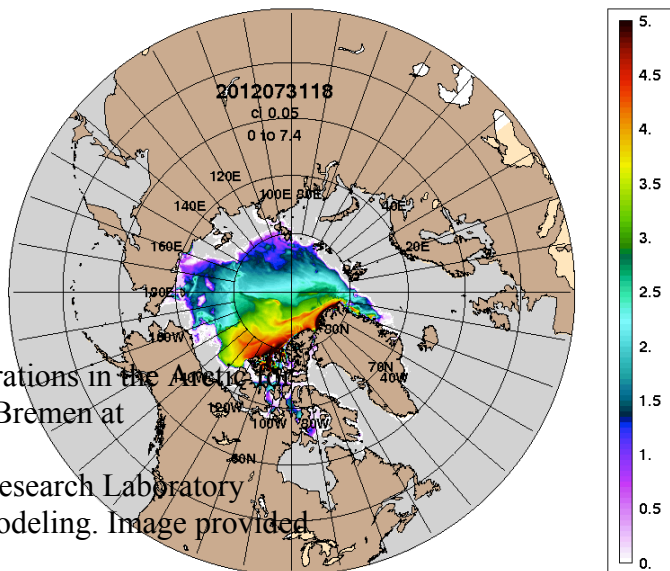
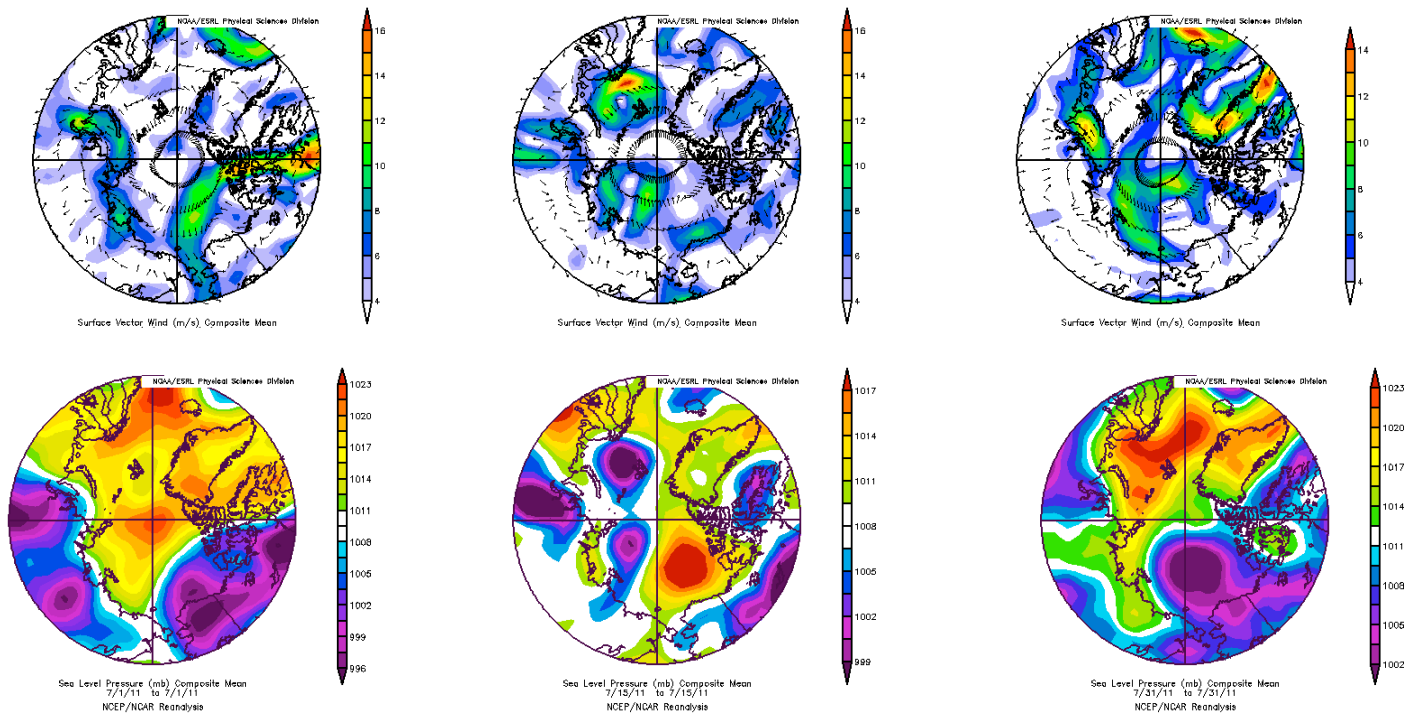


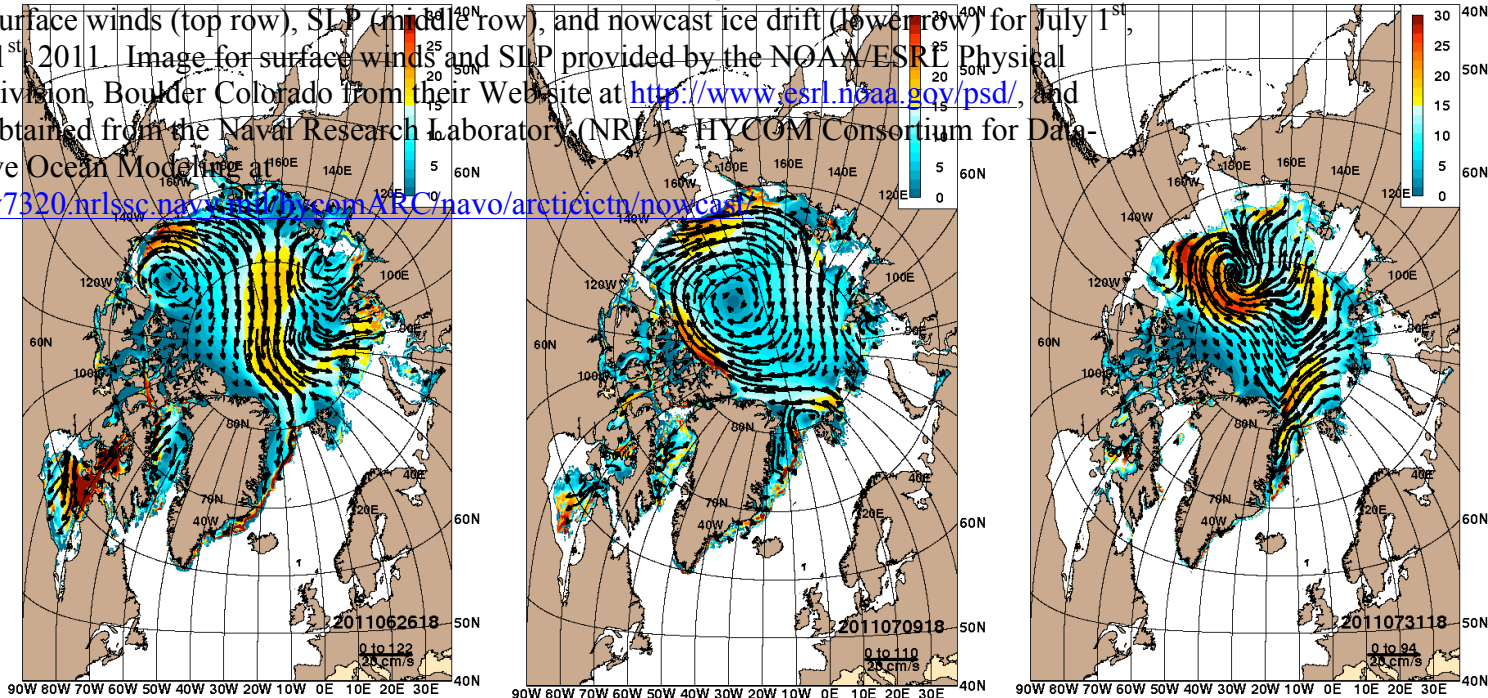
Figure 3. Upper row: AMSR-E sea ice maps of sea ice concentrations in the Arctic on July 31<sup>st</sup>, 2011 and 2012. Image provided by the University of Bremen at <http://www.iup.uni-bremen.de:8084/amsr/>. Lower row: Arctic sea ice thickness nowcast from the Naval Research Laboratory (NRL) – HYCOM Consortium for Data-Assimilative Ocean Modeling. Image provided by the Naval Research Laboratory at <http://www7320.nrlssc.navy.mil/hycomARC/navo/arcticictn/nowcast/>.

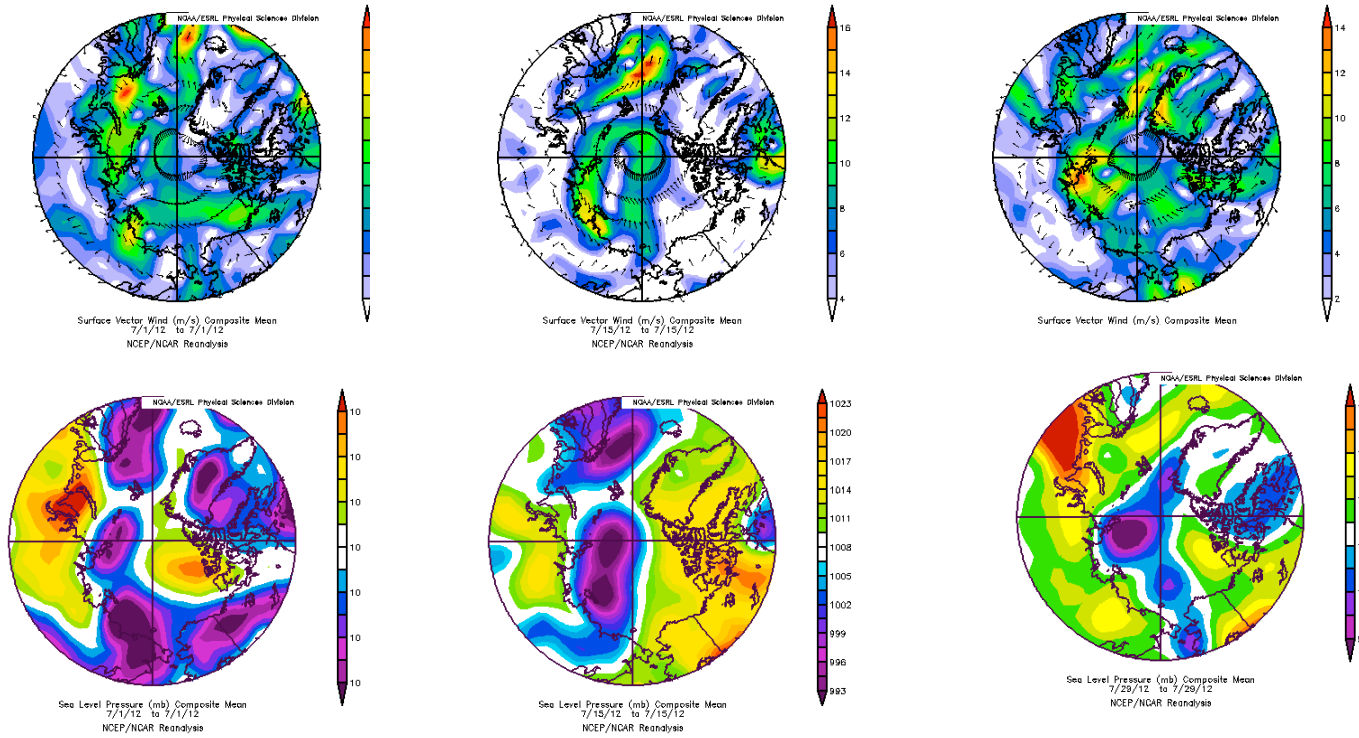




**ARCc0.08-03.5 Ice Speed and Drift: 20110701** **ARCc0.08-03.5 Ice Speed and Drift: 20110711** **ARCc0.08-03.5 Ice Speed and Drift: 20110731**

4. Surface winds (top row), SLP (middle row), and nowcast ice drift (lower row) for July 1<sup>st</sup>, 11<sup>th</sup>, and 31<sup>st</sup>, 2011. Image for surface winds and SLP provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at <http://www.esrl.noaa.gov/psd/>, and ice drifts obtained from the Naval Research Laboratory (NRL) - HYCOM Consortium for Data-Driven Ocean Modeling at [www7320.nrlssc.navy.mil/arc/navo/arcticictn/powcast/](http://www7320.nrlssc.navy.mil/arc/navo/arcticictn/powcast/)





ARCc0.08-03.5 Ice Speed and Drift: 20120701    ARCc0.08-03.5 Ice Speed and Drift: 20120715    ARCc0.08-03.5 Ice Speed and Drift: 20120729

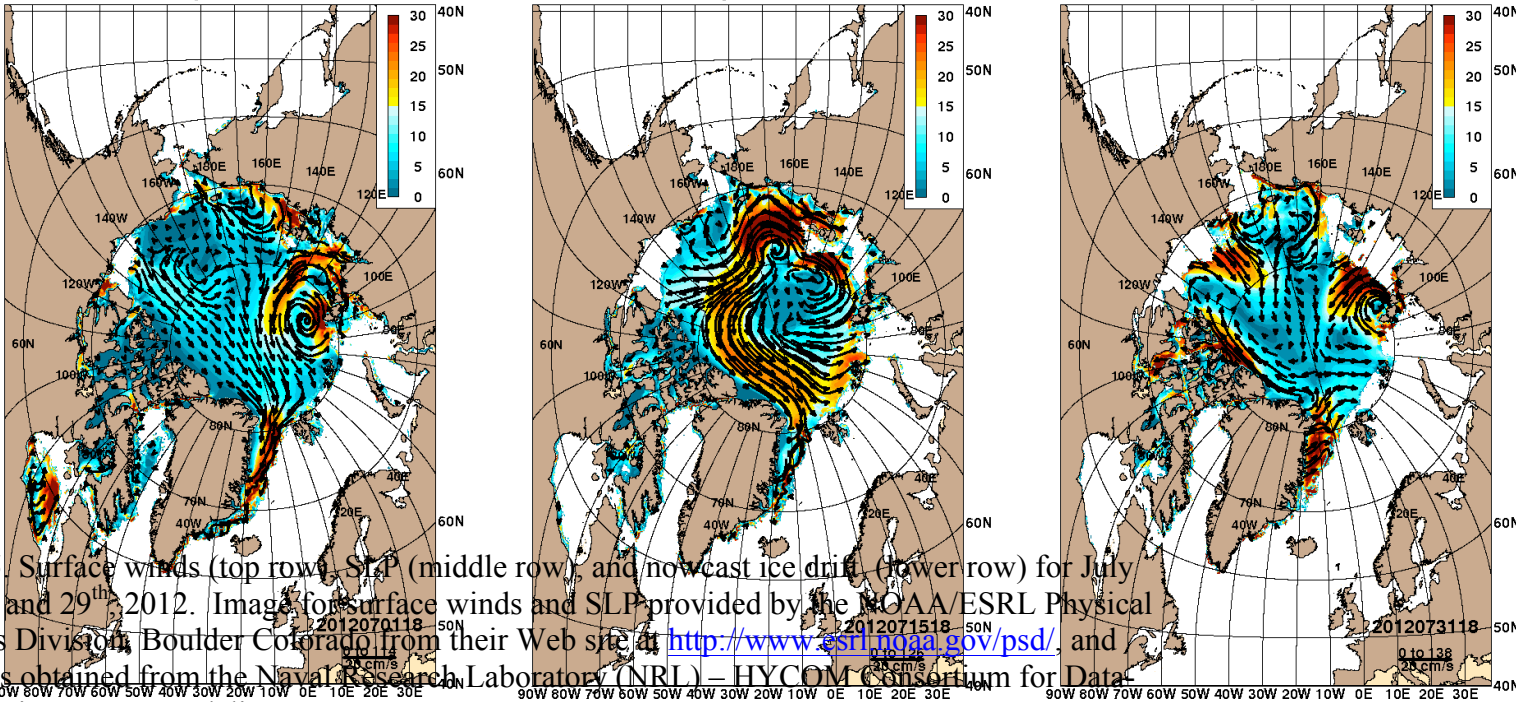


Figure 5. Surface winds (top row), SLP (middle row), and nowcast ice drift (lower row) for July 15<sup>th</sup>, and 29<sup>th</sup>, 2012. Images for surface winds and SLP provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at <http://www.esrl.noaa.gov/psd/> and ice drift nowcasts obtained from the Naval Research Laboratory (NRL) – HYCOM Consortium for Data Assimilative Ocean Modeling at <http://www7320.nrlssc.navy.mil/hycomARC/navo/arcticictn/nowcast/>.