September 2009 Sea Ice Outlook: July Report

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1. Extent Projection
   We estimate that the September monthly mean sea ice extent will reach a new record minimum of 4.16 million square km (Figure 1, right).

2. Methods and Techniques
   This estimate is based primarily on statistics of the spatial distribution of the sea ice of different ages as estimated from a Drift-age Model (DM), which combines buoy drift and retrievals of sea ice drift from satellites (Rigor and Wallace, 2004, updated), and the expected sea ice concentration at each grid cell based on the age of sea ice in September from 1979–2008. The DM model has been validated using independent estimates of ice type from QuikSCAT (e.g., Figures 2 and 3; and Nghiem et al. 2007), and *in situ* observations of ice thickness from submarines, electromagnetic sensors, etc. (e.g., Haas et al. 2008; Rigor, 2005).

   This year we have emphasized the spatial distribution of sea ice types in our outlook, rather than just the fractions of sea ice types over the whole Arctic Ocean as we did last year.

3. Rationale
   The evolution of the concentration of sea ice and the retreat of sea ice extent during summer is strongly dependent on the initial (end of winter) thickness of sea ice across the Arctic Ocean. We use the age of sea ice as a proxy for sea ice thickness. In comparison to 2007 and 2008, there is much more FY ice (darker blues) in the Beaufort and Chukchi seas in 2009 (Figure 1), which we expect to precondition this area for more extensive retreat than in 2007 and 2008. The age of sea ice in the Transpolar Drift Stream is also younger in the areas north of the East Siberian Sea (~80N 150E), which also preconditions this area for more retreat compared to previous years.

   Although there is some FY ice in the area near the North Pole (Figure 2), this area also gets much less sunlight, thus is less likely to melt out.

   Some uncertainty exists in this (and other) outlooks related to variations in wind which redistributes sea ice across the Arctic Ocean, and the advection heat into the area during summer. Since we do not estimate the age of sea ice in the Canadian Archipelago, we add 0.5 million sq. km to the area bounded in yellow in Figure 1, right. Depending on inter-annual variability of sea ice conditions in the archipelago, this is another source of uncertainty.

Figures

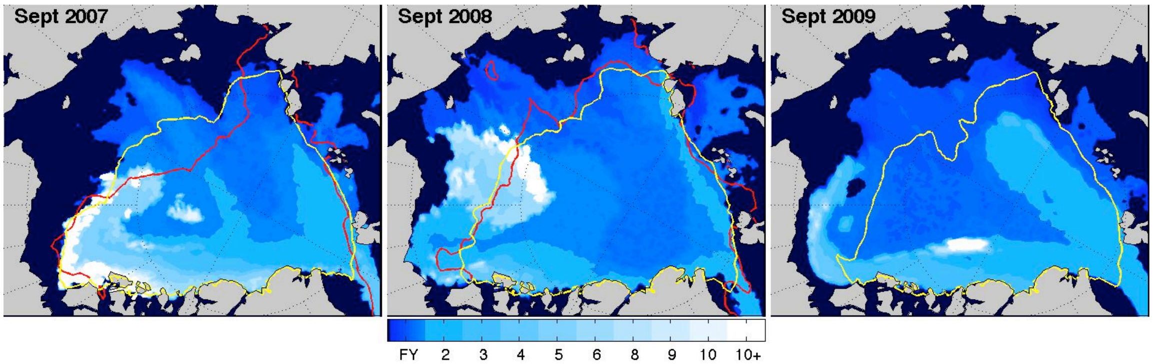

Figure 1. Maps of the age of sea ice for September 2007 and 2008, and the expected distribution of the age of sea ice in September 2009 based on June data. The red line shows the observed 15% sea ice concentration line that we use to define sea ice extent, while the yellow line shows the expected 15% sea ice concentration line based on the age of sea ice.

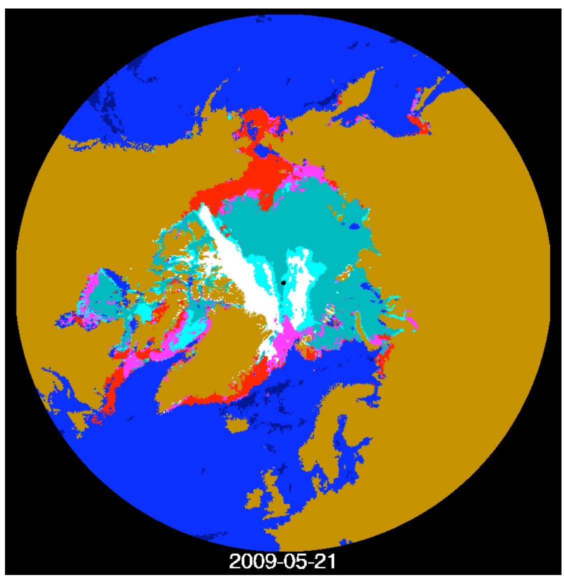

Figure 2. Maps of arctic sea ice distribution based on QuikSCAT for May 21, 2009. The colors show perennial ice (white), mixed ice (aqua), seasonal ice (teal), ice with current melting surface (red), and ice with melted surface within the previous ten days (magenta). The extent of perennial ice was about the same on 1 May 2009, and 1 May 2008, while there is more second year ice in 2009, due to more ice surviving summer 2008. Springtime perennial ice extent was the lowest in 2008, as observed by QuikSCAT data in the decade of 2000s and by the buoy-based estimates in the last half century.

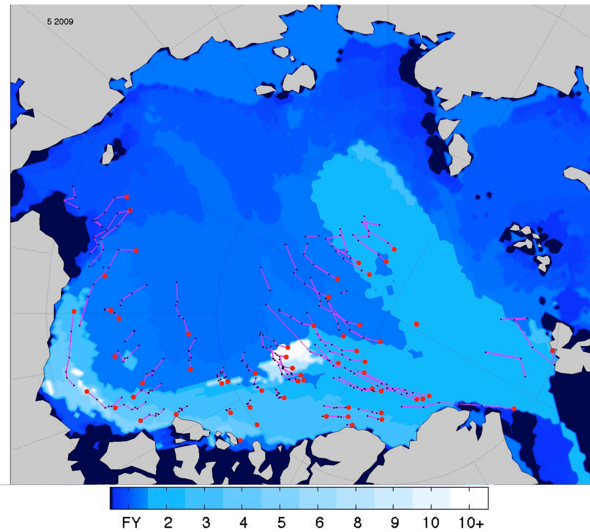

Figure 3. Map of the age of sea ice (in years) based on the buoy Drift-age Model for April 2009. Note the correspondence between the areas of FY and MY ice (ice older than 1 year) shown on this map and Figure 2.