Sea Ice Pan-Arctic Outlook, July 2012

July Report based on June Data

Contribution by Walt Meier, Julienne Stroeve, Mark Serreze, Ted Scambos
National Snow and Ice Data Center

Projection

Our projection for the September 2012 Arctic sea ice extent is **4.58 ± 0.54 million square kilometers** based on a statistic method of climatogical ice extent loss rates over last five summers.

Executive Summary

This statistical method uses previous years' daily extent change rates from July 1 through September 30 to calculate projected daily extents starting from June 30. The September daily extents are averaged to calculate the monthly extent. Rates from recent years are more likely to occur because of the change in ice cover. Thus, the official projection is based on the rates for 2002-2011, yielding a **September 2012 average of 4.58 million square kilometers**; the range however is still quite large with **a standard deviation of 540,000 square kilometers**. Using all years (1979-2011) yields a slightly higher estimate of 4.93 million square kilometers, but a smaller range of 486,000 square kilometers. Two out of the 33 scenarios (using rates from 2007 and 2008) would yield a new record minimum September extent. This suggests the **chance for a record low this year is ~6%**, though this probably underestimates the probability because recent years have tended to follow faster decline rates. For example, decline rates for the past five years (2007-2011) yield a projection of 4.28 million square kilometers, which would match the current record low of 4.30 million square kilometers in September 2007. Thus, **a new record low September extent this year is unlikely, but not out of the realm of possibility**. However, there is a **very high probability that this year will be among the five lowest** of the satellite record.

Method/Technique

This is a purely statistical method that applies daily rates of extent change from all previous years to project 2012 daily extents from the June 30, 2011 daily extent. This results in an ensemble of 33 (1979-2011) daily extent timeseries from July 1 to September 30. The daily extents for each September are averaged to yield 33 monthly September extent estimates. The method presented here is similar to the NSIDC method used in the June Outlook but relies only on changes in extent whereas the earlier submission included the influence of ice age (and hence thickness). Thickness/age is an important constraint on potential ice loss, but over a shorter forecast period late-June extent is better correlated with the September extent and thus becomes suitable for a projection. The fact that the extent-based estimate is consistent with the original age-based estimate indicates that the melt season is generally progressing as expected so far.

Rationale

The rationale for this method is that by the end of June, the sun is beginning to set and solar insolation is decreasing. Thus, the potential range of the ice extent evolution begins to become constrained and range of extents will encompass the likely actual trajectory this year. Comparison with previous years' rates and climatological averages of year ranges are assessed to yield a most likely range.

Forecast Skill

The limitation in the method is that there are no physics involved and the assumption must be made that conditions this year will be enveloped by conditions over the previous 33 summers. However, this is not the case as we know that sea ice is younger and thinner than in previous years. Thus any estimate is more likely to be too high rather than too low. Another limitation is that with two or more months left in the melt season, there is still a lot of variability in the weather – winds, clouds, temperatures, etc. Thus it yields a wide range (standard deviation) in estimates. This range will shrink in coming days and weeks as the availability of solar insolation continues to decrease and the end of the melt season closes in.

However, this method provides an envelope of potential extents that should be reasonably constrained because it encompasses ice losses due to a variety of weather conditions through the remainder of the melt season. Though it does not provide an estimate that is highly precise, it does provide an envelope of possibilities that is very likely to encompass this year's conditions.

Detailed Results

The estimates range from just under 6 million square kilometers (using 2001 rates) to under 4 million square kilometers (using 2007 or 2008 rates). Table 1 below shows the number occurrences (out of 33 total years, 1979-2011) of various ranges of September 2012 extent outlooks. There are a couple things of note in the table. First, the average is considerably lower using the recent years, which is not surprising. Four of the 5 occurrences of extents > 5.5 million square kilometers and 9 of 10 with extents of 5.0 – 5.5 million square kilometers result from using pre-2002 rates. Eight of the ten most recent years yields a 2012 extent below 5.0 million square kilometers and the two potential record-breaking rates have happened in the past five years. These all suggest that the statistics are not stable and that a faster rate (and lower September extent) is more likely than a slower rate of decline.

Range/Category (million sq km)	*All Years (1979-2011) 33 total years*	*Recent Years (2002-2011) 10 total years*
Average [St. Dev.]	4.95 [0.49]	4.58 [0.54]
Maximum [Year]	5.91 [2001]	5.53 [2006]
> 5.5 (# occurrences)	4	1
5.0 – 5.5	9	1
4.5 – 5.0	14	3
4.0 – 4.5	3	3
< 4.0	2	2
Record Low (< 4.30)	2	2
Lowest 5 (< 5.39)	26	9

Minimum [Year]	3.66 [2007]	3.66 [2007]

Table 1. Average, maximum, minimum and ranges of potential extents based on extent rates from all 33 years (middle column) and the most recent years (right column).

Based on all years, there is a 2 in 33 chance of a new record, or about 6%. However, those two occurrences are using rates from the last 9 years (2007 and 2008), suggesting that the probability of a record is higher than 6%. However, 2007 and 2008 are notable outliers, even among recent years, so the probability is not as high as might be indicated using only more recent years (i.e., rates from 2 of the last 5 years set a record, or a 40% chance). Based on a subjective interpretation of these statistics and a qualitative assessment of the state of the ice cover and the weather patterns so far this year, the chances are deemed here to be ~20% for a record low September extent.

Regardless of whether a new record low occurs, it is very likely that this year's extent will be among the five lowest in the satellite record. Over all years, 26 of the 33 years yield a "bottom 5" extent, including 9 out of the last 10 years. The one recent year that doesn't exceed the 5th lowest (5.39 million square kilometers in 2009), using 2006 rates would have the 6th lowest extent (5.53 million square kilometers.

An image of the trajectories of sea ice extent for the remainder of the melt season (through September 30) is provided in Figure 1. For clarity trajectories are provided for the two average periods and selected other years, including the projections based on 2007 and 2001 rates, which lead respectively to the lowest and highest potential September 2012 extent. It is clear that no trajectory approaches the average climatological values, even for years not shown. The maximum projected September average (using 2001 rates) is over a half million square kilometers below the 1979-2011 average of 6.52 million square kilometers.

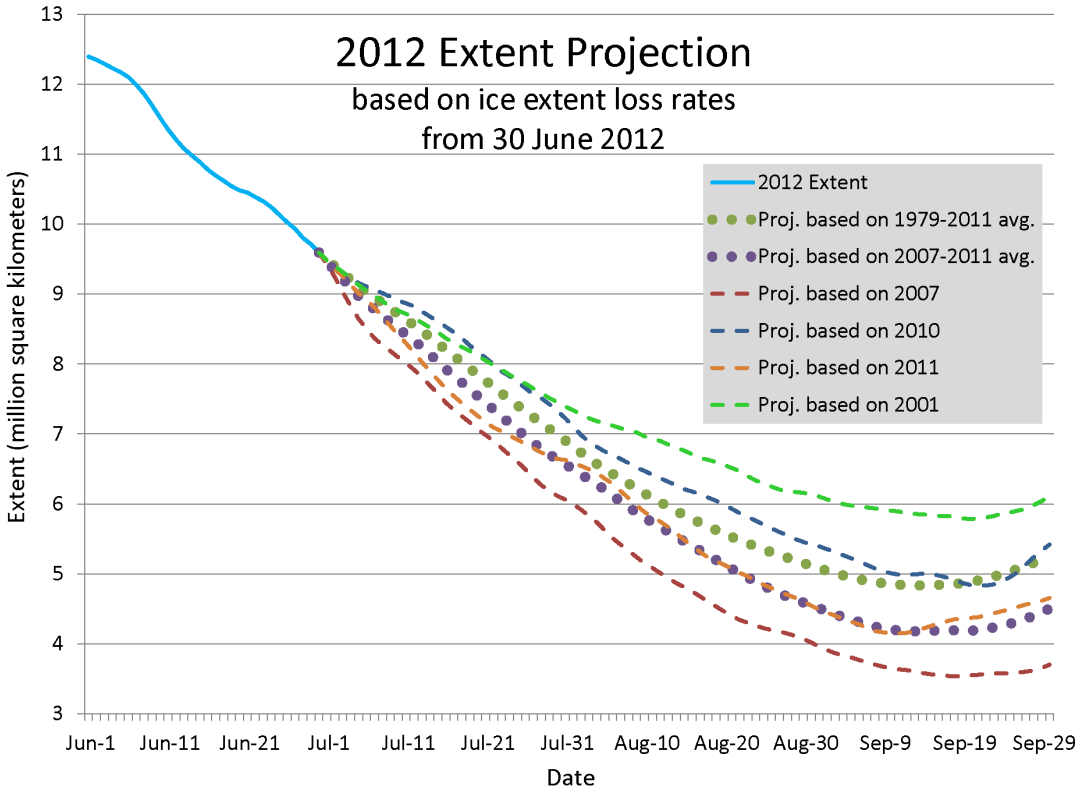

Figure 1. Sea ice extent projected trajectories from 30 June 2012 using decline from different years and climatological averages.