Sea Ice Pan-Arctic Outlook, July 2013

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Projection

Our projection for the September 2012 Arctic sea ice extent is **5.07 ± 0.48 million square kilometers** based on a statistic method of climatogical ice extent loss rates over last six 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 2007-2012, yielding a **September 2013 average of 5.07 million square kilometers**; the range however is still quite large with **a standard deviation of 480,000 square kilometers**. Using all years (1979-2012) yields a slightly higher estimate of 5.76 million square kilometers, with a range of 486,000 square kilometers. None of the 34 scenarios would yield a new record minimum September extent. This suggests the **chance for a record low this year is small**, though this probably underestimates the probability because recent years have tended to follow faster decline rates. Decline rates from the record low yeas of 2007 and 2012 yield the lowest extents, 4.47 and 4.45 million square kilometers respectively, but neither approaches the 2012 September extent. Thus, **a new record low September extent this year is unlikely, but cannot be completely ruled in light the recent extreme low years**. However, there is roughly a **50% 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 2013 daily extents from the June 30, 2013 daily extent. This results in an ensemble of 34 (1979-2012) daily extent time series from July 1 to September 30. The daily extents for each September are averaged to yield 34 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 34 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 over 6.7 million square kilometers (using 2001 rates) to 4.45 million square kilometers (using 2012 rates). Table 1 below shows the number occurrences (out of 34 total years, 1979-2012) of various ranges of September 2013 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. This suggests that the statistics are not stable and that a faster rate (and lower September extent) is more likely than a slower rate of decline. Based on all years, there is only a small chance of a new record low. However, rates from more recent years are faster, suggesting that the probability of a record is higher than the statistics indicate.

Range/Category (million sq km)	All Years (1979-2012) 34 total years	Recent Years (2007-2012) 6 total years
Average [St. Dev.]	5.76 [0.49]	5.07[0.54]
Maximum [Year]	6.73 [2001]	5.88 [2010]
> 5.5 (# occurrences)	28	1
5.0 – 5.5	3	2
4.5 – 5.0	1	1
4.0 – 4.5	2	2
< 4.0	0	0
Record Low (< 3.41)	0	0
Lowest 5 (< 4.93)	3	3
Minimum [Year]	4.45 [2012]	4.45 [2012]

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).

Regardless of whether a new record low occurs, it is reasonably likely that this year's extent will be among the five lowest in the satellite record. While only 3 of the 34 years yield a "bottom 5" extent, all three have occurred in the last 6 years.

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 2012, 2007 and 2001 rates, which lead respectively to the lowest and highest potential September 2013 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 1981-2010 average of 6.52 million square kilometers.
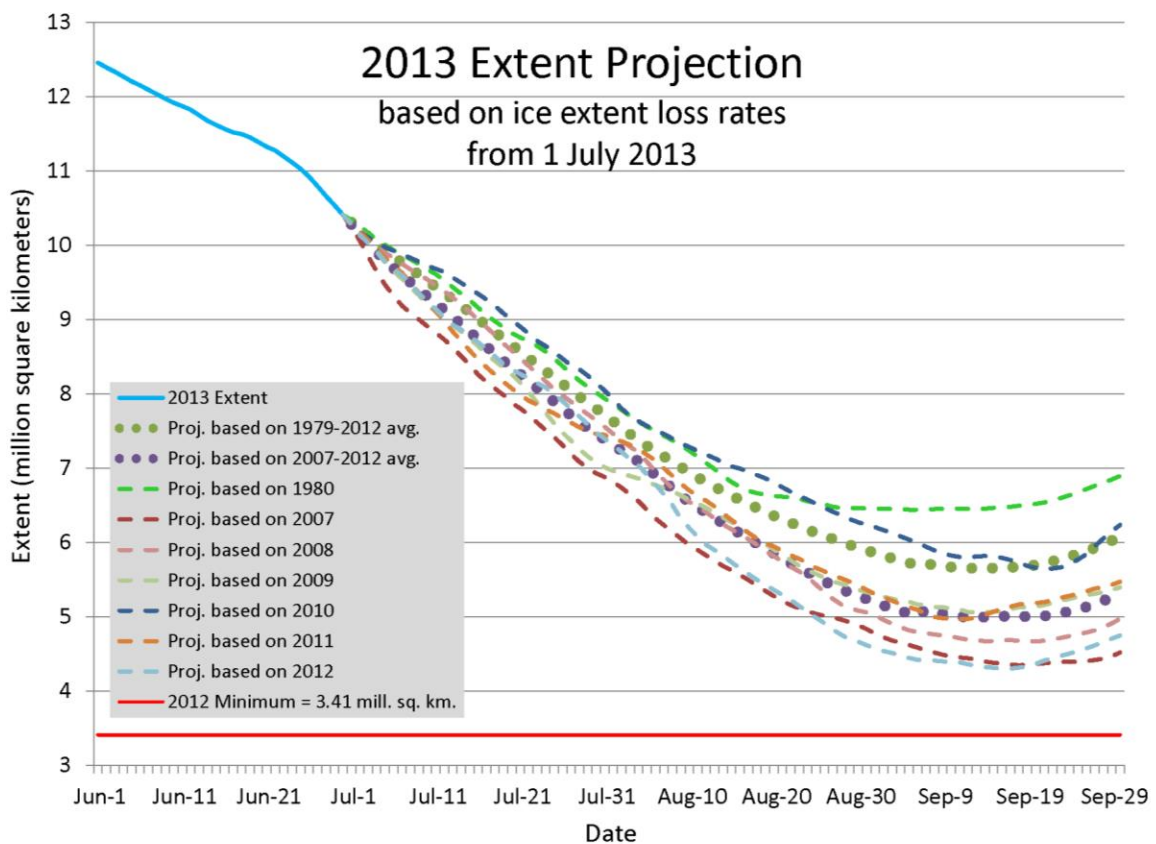
Figure 1. Sea ice extent projected trajectories from 30 June 2012 using decline from different years and climatological averages.