

Sea Ice Outlook 2014, August contribution

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Type of prediction: statistical

Prediction (from August 1): 4.78 ± 0.34 million km²

Prediction (from August 10): 5.11 ± 0.13 million km²

Summary of method:

Statistical method that uses an average of daily-observed extent change rates to calculate a projected trajectory of daily extents for July through September. Daily extents from September are average to calculate the submitted monthly estimate.

Executive Summary:

This method uses daily extent change rates to project the 2014 extent on July 31 through the end of September. The daily September extents are averaged to create monthly averages. The prediction uses the years 2007-2013 as the basis for the extent, as more rapid recent rates likely better reflect the potential trajectory of this year's decline. This results in a projection of 4.78 million km² with a range of 0.34 million km², based on the standard deviation of the extent rates. This represents an adjustment upward and a narrow range from the July estimate of 4.52 million km² ± 0.49 million km².

UPDATE: Since the beginning of August, the extent decline has been particularly slow. Thus, while the official contribution estimate for August is 4.78 million km², the slowing trend in the extent decline suggests a higher September extent. Using data from August 10, the estimate for September extent is now 5.11 million km² ± 0.13 million. A record low this year is deemed to be not possible.

Overview:

Daily sea ice extent data are used to calculate daily change rates for each year in the satellite record (1979-2013). These daily change rates are then sequentially added to the July 31, 2014 extent data, producing simulated 2014 trajectories through September based on each of the previous years.

Rates have been faster in recent years, thus 2007-2013 values are used to calculate the Outlook value, as these are more likely reflective of current conditions. This yields a projection of 4.78 million km² with a range of 0.49 million km², based on the standard deviation of the extent rates. The lowest projection, based not surprisingly on 2012 rates, is 4.16 million km² (Figure 1). The highest projection since 2007 is from 2009 rates, 5.28 million km². The highest projection since 1979 is 5.71 million

km², from 1980 rates. Updating through August 10, the estimate revise to: 4.87 million km² for 2012, 5.21 million km² for 2009, and 5.91 million km² for 1980.

No rates yield an extent anywhere close to the 2012 record low September extent. Given the slow down between August and August 10 and the limited window remaining in the melt season, a record low will not be reached this year. Similarly, no rates (even from the slowest years) yield a September extent near the 1981-2010 average of 6.52 million km².

Method:

For 1979 to 2013, daily extent change values are calculated for each day of the year based on the change in the extent between the previous day and the current day. For the August Outlook, the July 31, 2014 sea ice extent is used as an initial condition. Then the daily extent change values for August 1 to September 30 are added sequentially to calculate simulated 2014 extents, as in the following equation.

$$Extent_{Day_n} = \sum_{1 Jul}^{Day_n} \Delta Extent_{Day_n - Day_{n-1}}$$

This is done for each year, creating extent trajectories for August 1 to September 30, 2014, based on each previous year, yield 35 estimates of extent through August and September. Trajectories from select years and average periods are shown in Figure 2. The daily September extents are then averaged to calculate the monthly September average.

Discussion:

The extent change rates vary from day to day, with periods of acceleration and deceleration. Some years, such as 2012 experience periods of rapid ice loss, while others have periods of slow or no loss. In addition, the timing of the daily minimum extent affects the September average. In some years, the minimum occurs early in September and then extent begins increasing, while in others the minimum occurs later in the month. The loss rates are affected by the synoptic weather conditions and the state of the sea ice. A thinner ice cover will experience greater loss under the same weather conditions because it is more easily melted completely. The rapidly changing Arctic sea ice, particularly over the past several years, makes projection difficult with this method, particularly so far from September. This is shown in the wide standard deviation range of nearly a half million square kilometers, even for the past seven low extent years (2007-2013). However, the method does provide an envelop of reasonably possible September extents. Closer to September, the envelop narrows as the range in extent rates narrows and the

effect of different rates on the September extent is attenuated (due to fewer days for differences to accumulate). Thus, while perhaps not particularly useful (at least in terms of providing a forecast with usable error bars) at this stage, the method indicates the narrowing envelop of possible outcomes as September approaches.

Thus, the current projection indicates that a record low September extent not possible as the unprecedented rates of extent loss required for the limited remaining summer period are not physically possible. A period of rapid ice loss cannot be completely ruled out. For example, in 2012, a record was not seen as particularly likely (by this method) until a cyclone in early August greatly accelerated loss rates for several days. However, even with a period of relatively rapid ice loss, there is not enough time in the melt season to reach near record low levels.

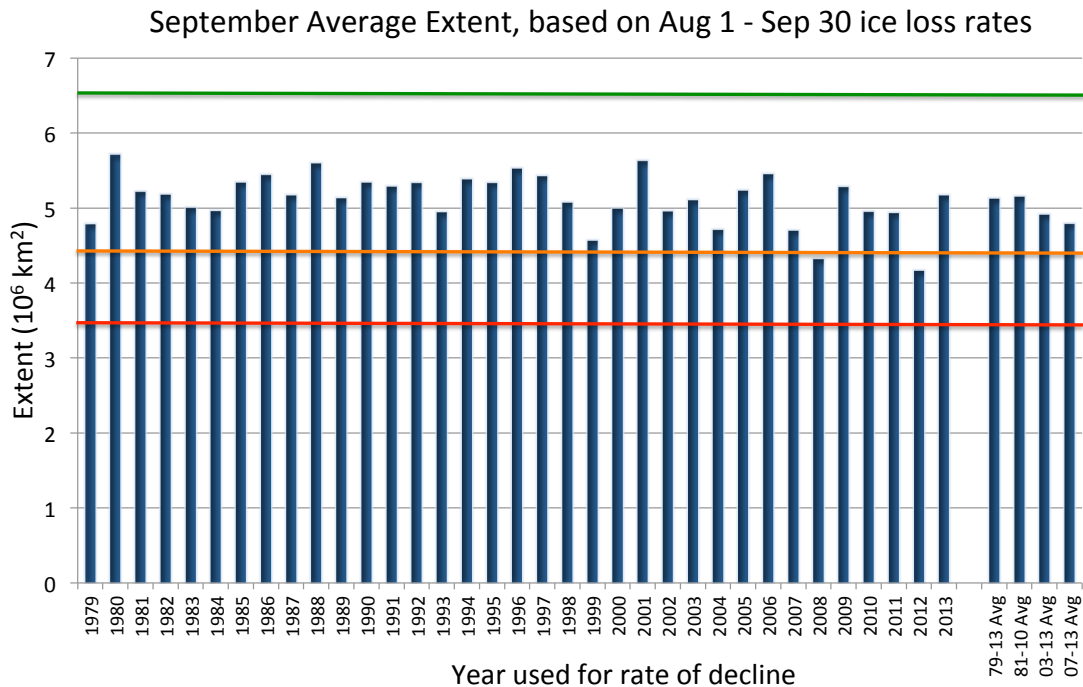


Figure 1. September average sea ice extent based on each year of extent decline rates and (on right) averages over different year ranges. The actual 1981-2010 average extent (green), 2007 extent (orange), and record low 2012 extent (red) are shown as horizontal lines.

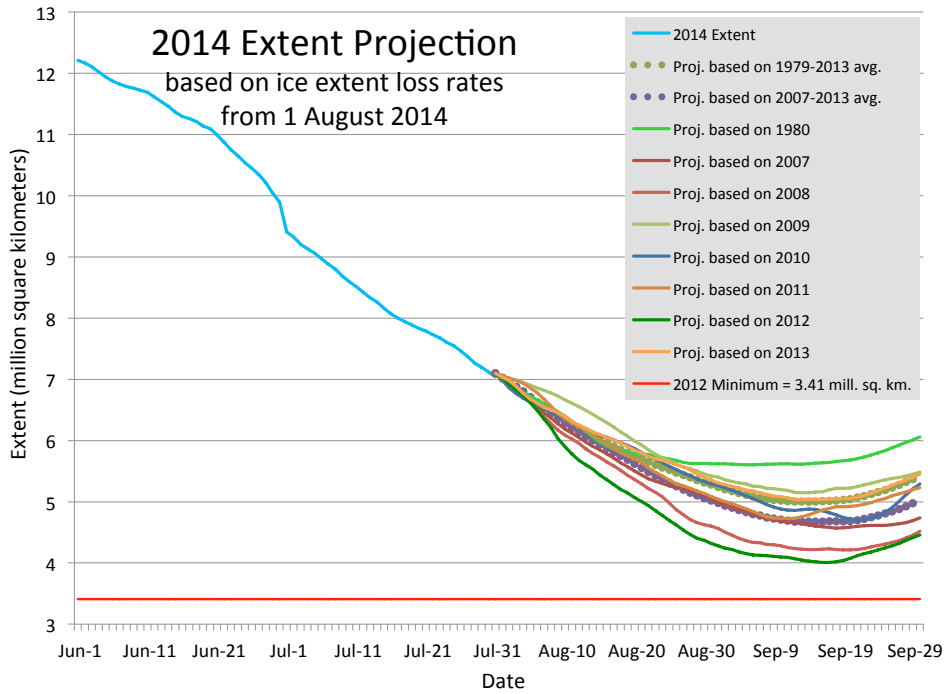


Figure 2. Trajectory of daily sea ice extent for 2014 based on selected years' decline rates beginning from August 1, plus the 2012 record low daily extent (straight red line).

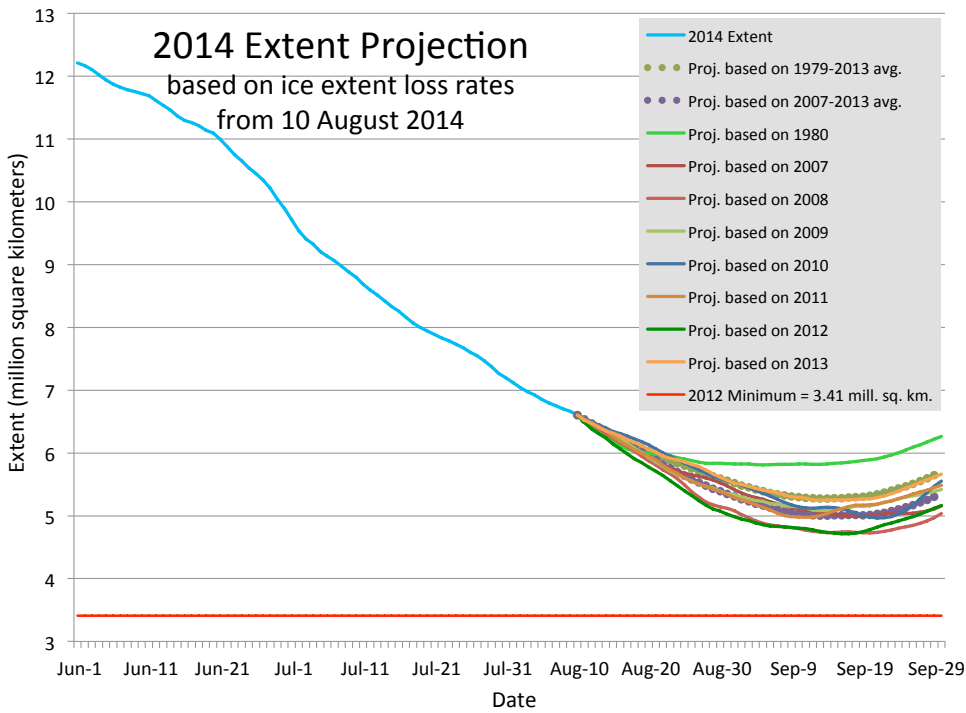


Figure 2 (UPDATED). Trajectory of daily sea ice extent for 2014 based on selected years' decline rates beginning from August 10, plus the 2012 record low daily extent (straight red line).