Sea ice outlook 2011

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1 Extent Projection

We estimate a September 2011 monthly mean extent of **4.8 ± 1.7 million square kilometers**.

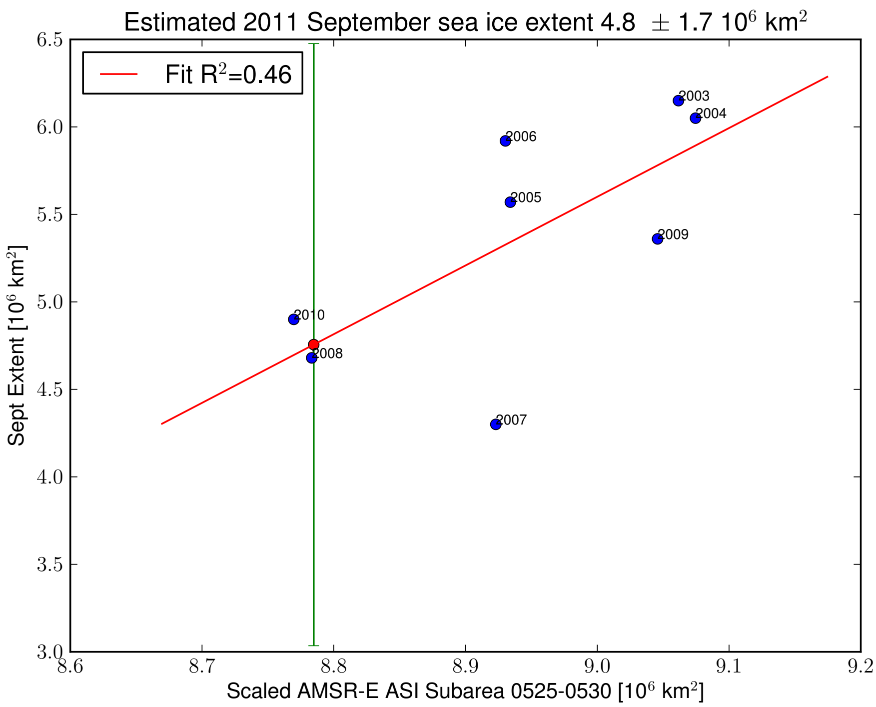

Figure 1: September 2011 sea ice extent estimate.

2 Methods and Techniques

The estimate is based on AMSR-E sea ice concentration data on a 6.25 km grid derived using the ARTIST sea ice (ASI) algorithm (Spreen et al., 2008; Kaleschke et al., 2001). We used two different sea ice concentration data sets, one based on reprocessed gridded level 3 AMSR-E brightness temperatures for the years 2003-2011 (`ftp://ftp-projects.zmaw.de/seaice/AMSR-E_ASI_IceConc/`), the other is based on near-real-time AMSR-E level 1a raw observation data (see Figure 2). Since level 3 data are available only with some delay, level 1 data are used for near-real time processing.

A five day median filter is applied to the data to reduce the atmospheric influence and coastal spillover effects (Kern et al., 2010; Maaß et al., 2010). Thus, any dates given below are not exactly for the individual day but include the previous four days.

To obtain an estimate we regress the ice area from the Arctic subregion shown in Figure 3 with the previous years and their September mean extents. As shown in Figure 3, the considered region contains the central Arctic and some of the Arctic marginal seas but excludes the multiyear sea ice region north of Greenland and the North Pole. To be able to regress the original AMSR-E sea ice area with the mean September sea ice extent two scalings are applied. First the 11-15 September five day median filtered sea ice area of the Arctic subregion for years 2003 to 2010 are regressed with the according mean September sea ice extent taken from NSIDC (Fetterer et al., 2002, updated 2009) (Figure 5). And second the near real time and reprocessed AMSR-E ice concentrations are scaled to each other to account for the small differences between the two datasets (Figure 6). Using these scalings the mean September sea ice extent is estimated from the current five day median sea ice area and the sea ice area of the same five day period of years 2003 to 2010 (Figure 1).

3 Rationale

A hindcast experiment for last year was conducted to test the performance of the method, that has already been applied to AMSR-E level 1b data last year. The correlation between September mean extent and the selected training area increases as the time difference decreases. In 2010, the correlation R^2 increased from insignificant values earlier in Spring to values above $R^2 \approx 0.4$ at the end of May (Figure 7).

The prediction skill depends on the selected training area. The skill increased when we removed some of the seasonal ice covered areas in our analysis.

From this hindcast experiment we deduce that reliable forecasts seem to be possible in mid-June. Some predictive skill exists already at the end of May (Figure 4).

With the additional processing steps we considerably reduce the observational noise and improve the prediction skill as compared to our 2009 attempt using SSM/I data. The higher spatial resolution of AMSR-E compared to SSM/I allows to better resolve small scale sea ice openings like coastal polynyas. The size and number of these openings might inhere some predictive capability for the sea ice minimum. Which could explain parts of the improvement achieved in comparison to using SSM/I data.

4 Executive Summary

Our outlook is based on statistical analysis of satellite derived sea ice area. We introduced following improvements: high resolution (AMSR-E) sea ice concentration data, a time-domain filter that reduces observational noise, and a space-domain selection that neglects the outer seasonal ice zones. Thus, small scale sea ice openings like coastal polynyas that might inhere some predictive capability for the sea ice minimum can be better utilized.

References

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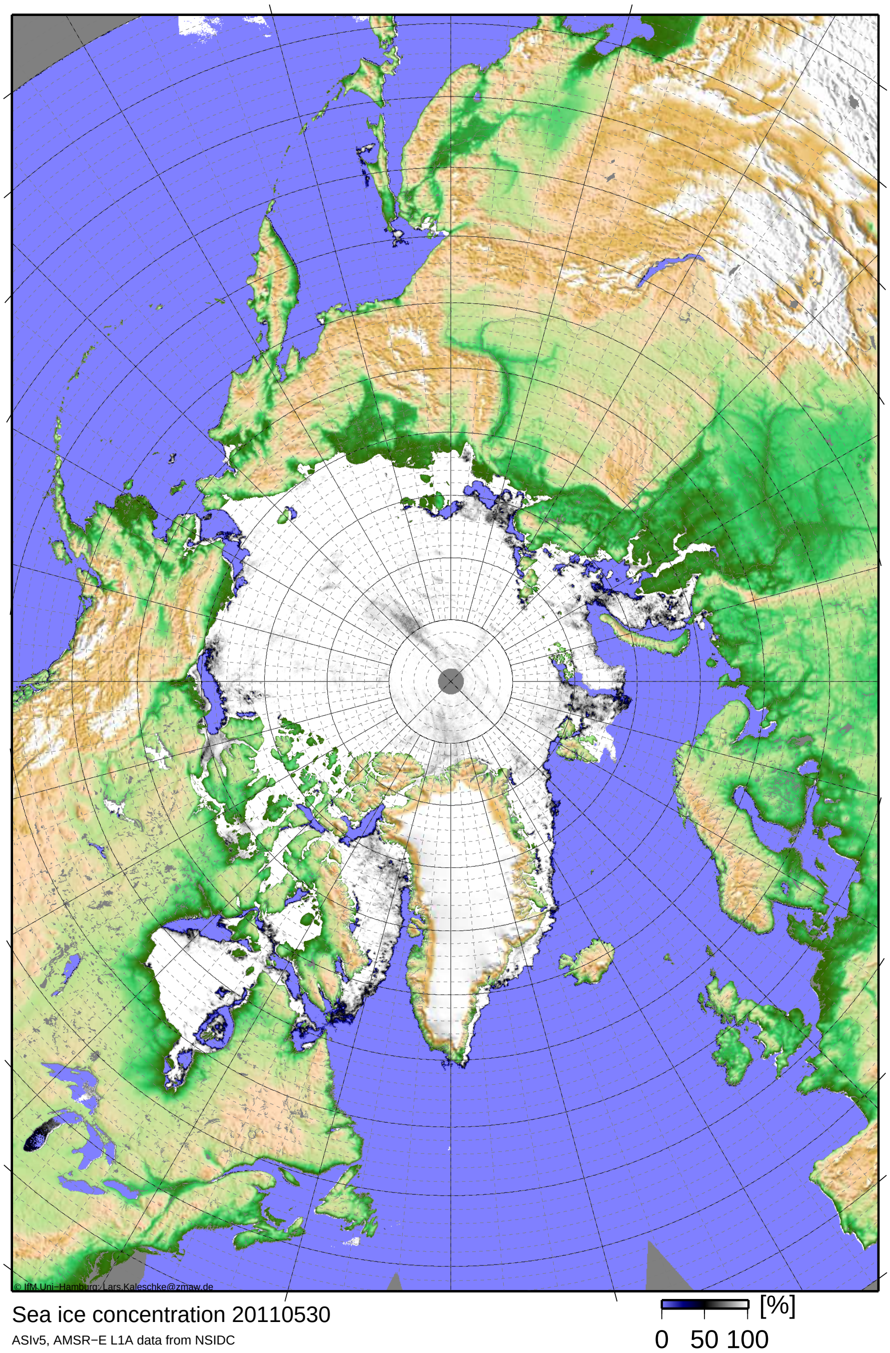

Figure 2: AMSR-E sea ice concentration for May 30th 2011 based on level 1a data and processed with ASI algorithm.

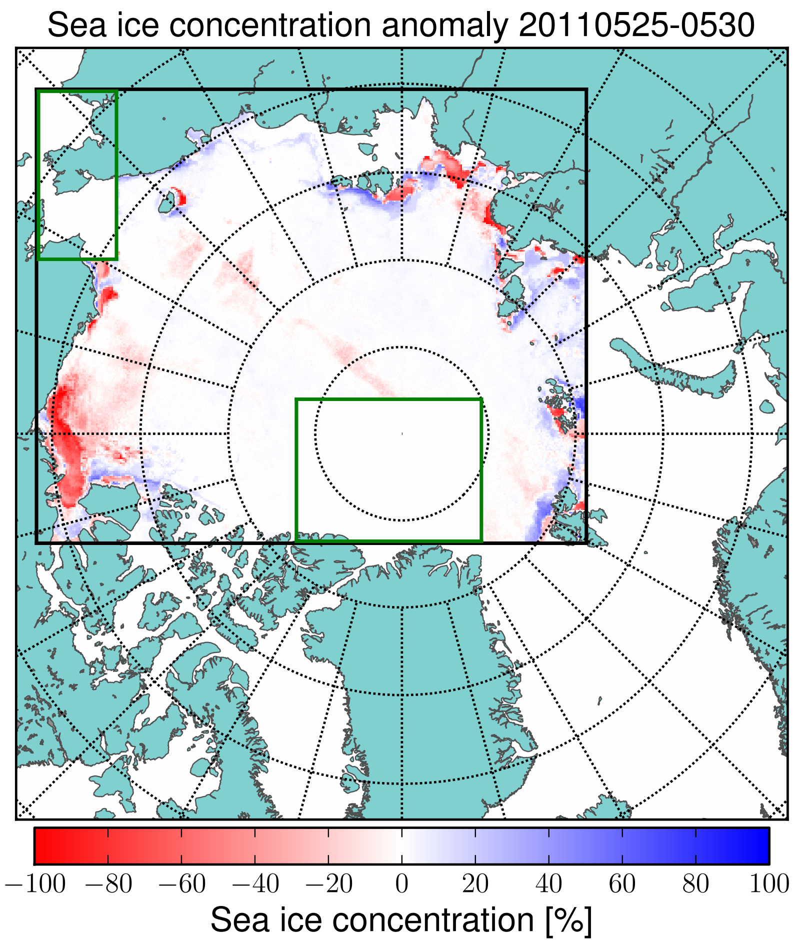

Figure 3: 2011 sea ice concentration anomaly derived from AMSR-E ASI data. The anomaly is calculated with respect to the years 2003–2010. The black rectangle indicates the subset for calculation of the ASI AMSR-E sea ice area. The green rectangles indicates areas that are not taken into account.

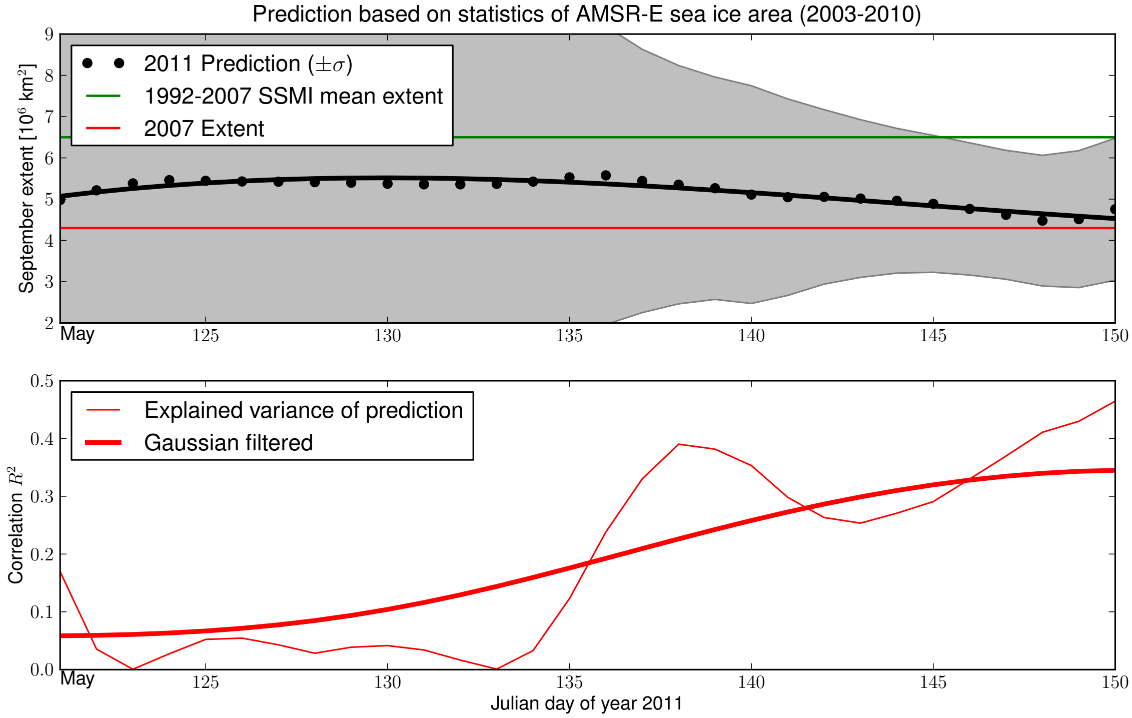

Figure 4: Time series of estimated September sea ice extent and explained variance of the estimate. This graph is the result of the method shown in Figure 1 applied for every day since May 1st 2011. The black line in the upper panel denotes a smooth spline approximation of the daily estimates.

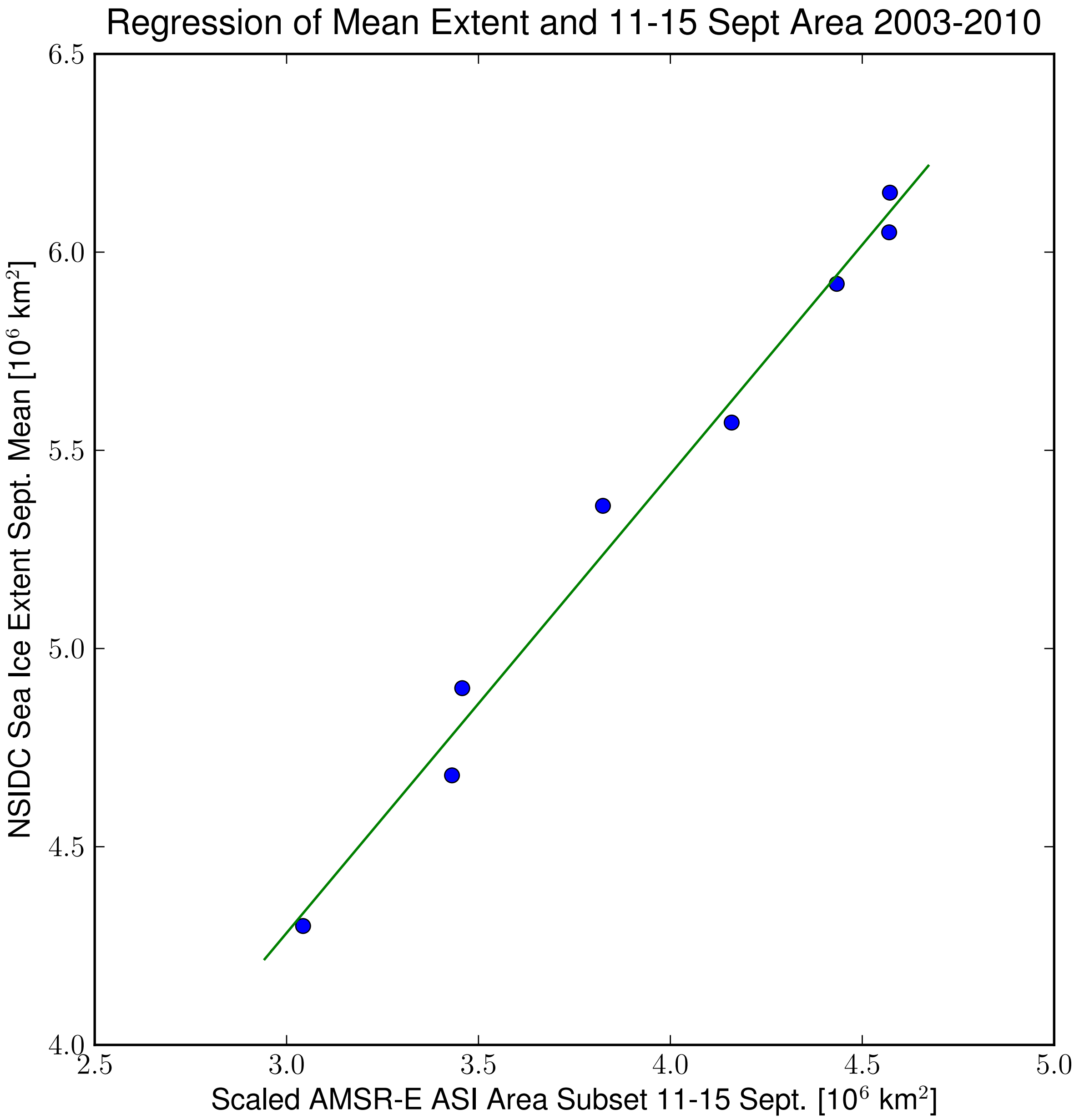

Figure 5: Regression of regional (region shown in Fig. 3) five-day median filtered AMSR-E ASI area and total NSIDC September mean extent.

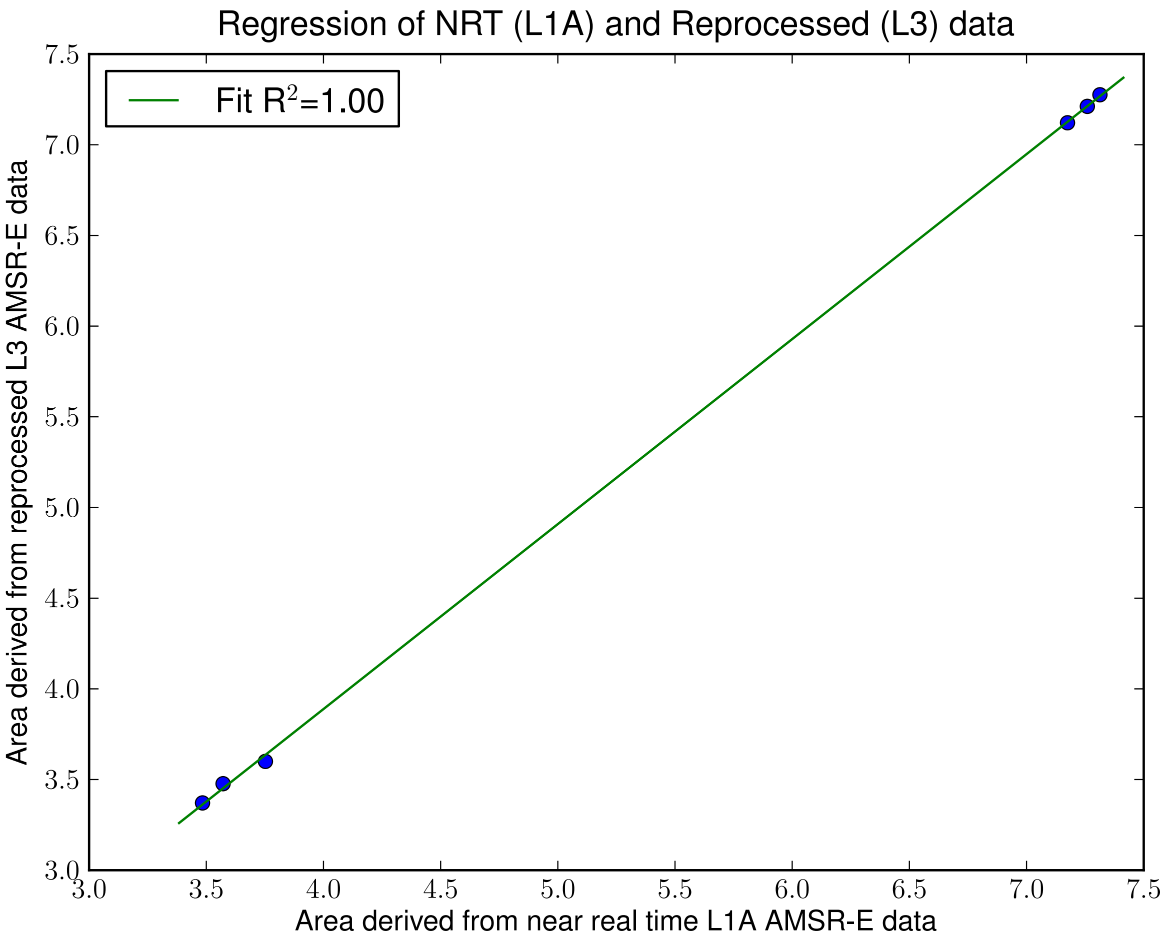

Figure 6: Regression of near real time and reprocessed data.

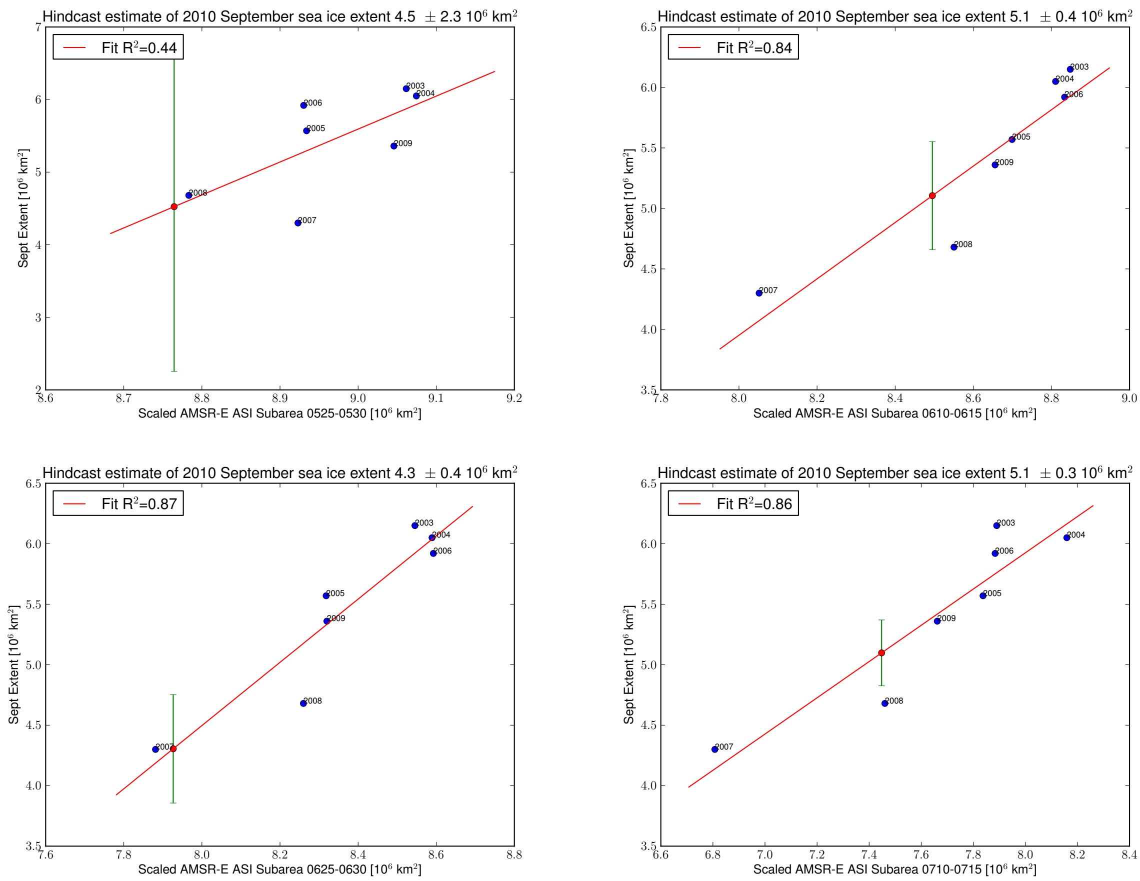

Figure 7: Hindcast prediction for September 2010.