July 2011 Sea Ice Outlook – AWI/FastOpt/OASys contribution

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Experimental setup

For the present outlook the coupled ice-ocean model NAOSIM has been forced with atmospheric surface data from January 1948 to June 22nd 2011. This atmospheric forcing has been taken from the NCEP/NCAR reanalysis (Kalnay et al., 1996). We used atmospheric data from the years 1991 to 2010 for the ensemble prediction. The model experiments all start from the same initial conditions on May 22nd 2011. We thus obtain 20 different realizations of sea ice development in summer 2011. We use this ensemble to derive probabilities of ice extent minimum values in September 2011.

Mean September Ice Extent 2011

The simulated ice extent for all 20 realizations is shown in Figure 1. Since the forward simulation underestimates the September extent compared with the observed extent minima in 2007, 2008, and 2009 by about 0.49 million km^2 (in the mean), we added this bias to the results of the ensemble. It is not clear whether the bias is caused by an imperfect sea ice-ocean model or by imperfect initial or boundary conditions.

The mean September value of the ensemble mean is 5.45 million km^2 (bias corrected). The standard deviation of the ensemble is 0.45 million km^2. Compared to the June outlook the predicted September extent is almost unchanged, and the uncertainty is slightly reduced (0.45 million km^2). The highest value is generated by the forcing of the year 1996 (6.39 million km^2) and the lowest by the forcing of the year 2007 (4.52 million km^2). Note that 2007-forcing yields not the minima on daily time-scales. The monthly mean of 2007-forcing is lowest because the onset of freezing is strongly delayed compared to the other years. On daily timescales the 1993-forcing results in minima in early September which is about 0.3 million km^2 lower than the daily minima in 2007-forcing.

Assuming a Gaussian distribution we are able to state probabilities (percentiles) that the sea ice extent in September 2011 will fall below a certain value.
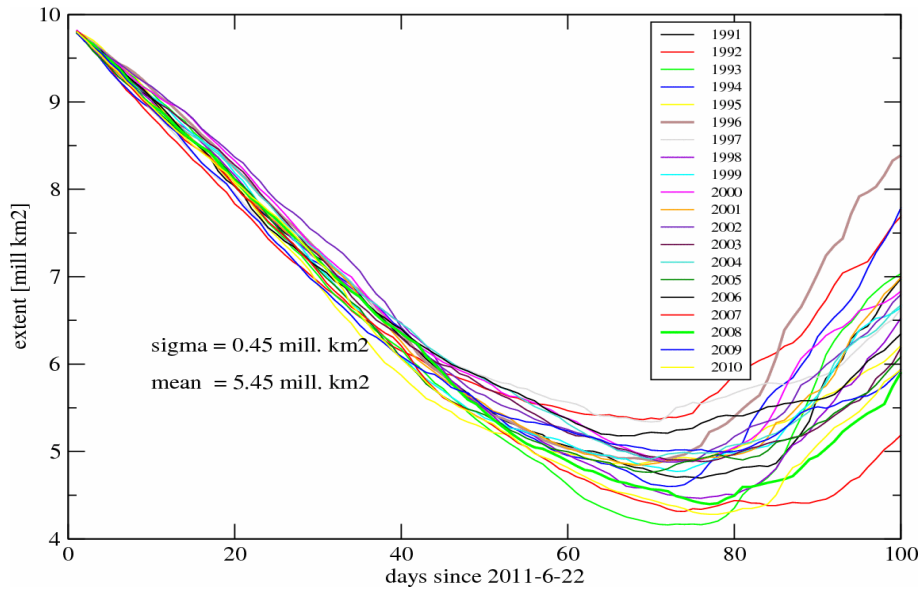
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Figure 1: Simulated evolution of the ice extent [million km²] when forced with atmospheric data from 1991 to 2010 until end of September. The the abscissa gives the days since the initialization of the forecast on May 22nd 2011. The range from day 71 to 100 is used for the calculation of the September mean. Model-derived ice extents have been adjusted assuming a bias (see text).

The probability deduced from the ensemble that in 2011 the ice extent will fall below the three lowest September minima:

probability to fall below 2007 (4.28 mill. km² - record minimum) is about 1%,
probability to fall below 2008 (4.67 mill. km² - second lowest)   is about 8%,
probability to fall below 2009 (4.90 mill. km² - third lowest)   is about 14%.

With a probability of 80% the mean September ice extent in 2011 will be in the range between 4.9 and 6.1 million km².

References:

Kalnay et al. (1996), The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470.