July 2013 Sea Ice Outlook – AWI/FastOpt/OASys contribution

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July, 2013

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1. Extent Projection

We estimate a monthly mean September sea-ice extent of 3.96 +- 0.50 million km^2.

2. Methods/Techniques

Sea ice-ocean model ensemble run

3. Rationale

For the present outlook the coupled ice-ocean model NAOSIM has been forced with atmospheric surface data from January 1948 to June 30th 2013. This atmospheric forcing has been taken from the NCEP/NCAR reanalysis (Kalnay et al., 1996). The ensemble model experiments all start from the same initial conditions on June 30th 2013. The model system is unchanged since the last month's outlook (see the June report). Compared to the NSIDC ice extent the simulated extent is underestimated in the mean by about 0.18 million km^2. This bias is added to the ensemble prediction. Likely reasons for the bias are imperfections in sea ice-ocean model and the atmospheric forcing (see below).

We use atmospheric forcing data from each of the years 1993 to 2012 for the ensemble prediction and thus obtain 20 different realizations of sea ice development for the summer of 2013. The use of an ensemble allows to estimate a probability of sea-ice extent minimum value in September 2013. The simulated ice extent for all 20 realizations is shown in Figure 1 for the period from June 30th (initialization) until end of September.
The ensemble mean of the (bias corrected) mean September value is 3.96 million km². The ensemble standard deviation is 0.50 million km^2 which we provide as uncertainty estimate of the prediction. Compared to the June outlook the estimate has increased by about 0.47 million km².

As for the June outlook we employed also a forecast with a reduced ensemble size of 10 years (2003 to 2012). In contrast to the June outlook the difference of the Ensemble means is now considerable (difference between both ensemble means is about 0.3 million km²) but also the smaller ensemble

shows an increase in the mean September extent compared to the June outlook of about 0.3 million km².

Note that for both ensembles the spread in the ensembles is pretty small until mid September (about day 75 in Figs. 1 and 2). All ensemble members give daily-mean minima values lower than about 3.5 milliom km². With the freezing onset the spread increases strongly. Forcing years before the year 2000 show a very strong freezing in the second half of September.

Kalnay et al. (1996), The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470.
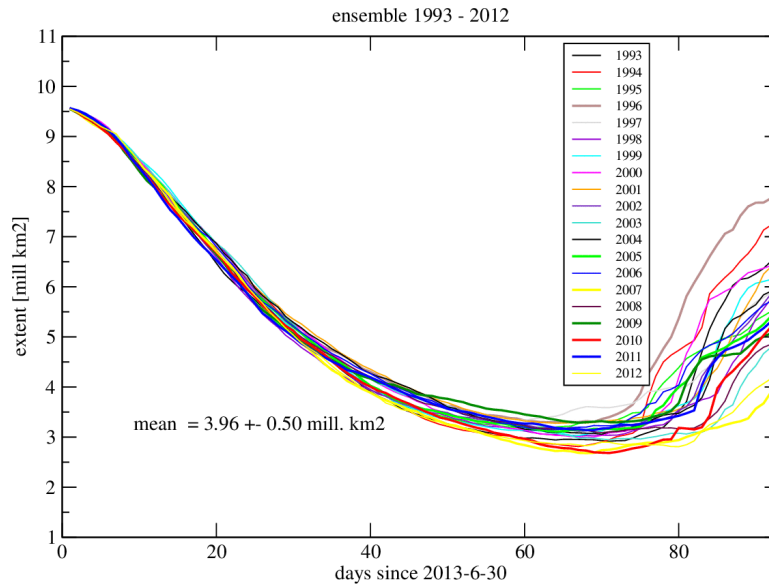
Figure 1: Simulated evolution of the ice extent [million km2] when forced with atmospheric data from 1993 to 2012 until end of September. The abscissa gives the days since the initialization of the forecast on June 30th 2013. Model-derived ice extents are averaged over day 64 to 93 and have been adjusted assuming a bias (see text).
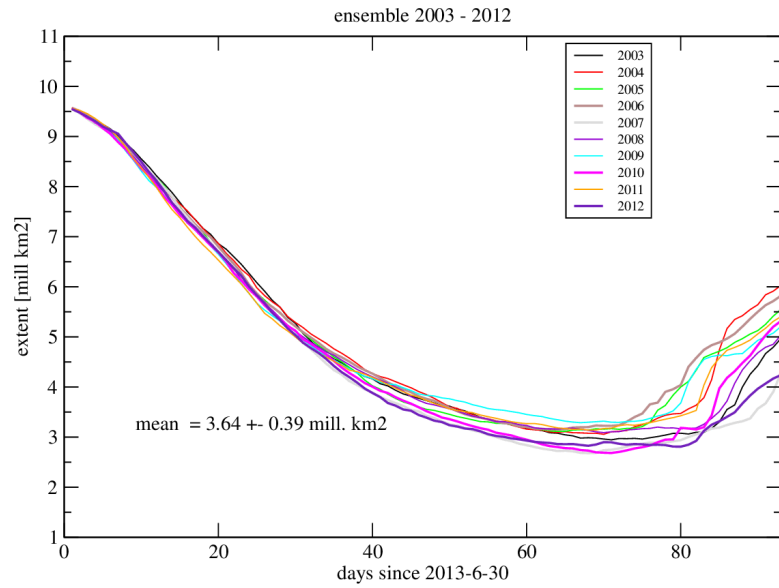
ensemble 2003 - 2012

Figure 2: Simulated evolution of the ice extent [million km2] when forced with atmospheric data from 2003 to 2012 until end of September. The abscissa gives the days since the initialization of the forecast on June 30th 2013. Model-derived ice extents are averaged over day 64 to 93 and have been adjusted assuming a bias (see text).