June 2014 Sea Ice Outlook – AWI/OASys contribution

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June, 2014

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1. Extent Projection

We estimate a monthly mean September sea-ice extent of 3.72 +- 0.42 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 7th 2014. 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 7th 2014. The model system is unchanged since the last year's outlook (see the reports). 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.

We use atmospheric forcing data from each of the years 1994 to 2013 for the ensemble prediction and thus obtain 20 different realizations of sea ice development for the summer of 2014. The use of an ensemble allows to estimate a probability of sea-ice extent minimum value in September 2014. The simulated ice extent for all 20 realizations is shown in Figure 1 for the period from June (initialization) until end of September.
The ensemble mean of the (bias corrected) mean September value is 3.72 million km². The ensemble standard deviation is 0.42 million km^2 which we provide as uncertainty estimate of the prediction. Some remarks on Figure1:

1. The lowest daily values are yielded for forcing from 1994. However the freezing starts early in September in that year resulting in a monthly mean of about 4 mill. km^2
2. The years 2012, 2007 and 2008 give the lowest monthly mean values (2.85, 3.08, 3.22 mill. km^2).

3. The higest monthly mean value is archieved with forcing from 1996 (4.56 mill. km^2).

The robustness of the forecast with respect to the ensemble size and composition was explored by calculating the ensemble mean and standard deviation for a 10 year (2004 to 2013) subset of the our 20 year set. The differences are small (3.57 +- 0.39 million km^2), suggesting a high impact on the prediction from factors other than the forcing, e.g. the initial sea ice state.

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

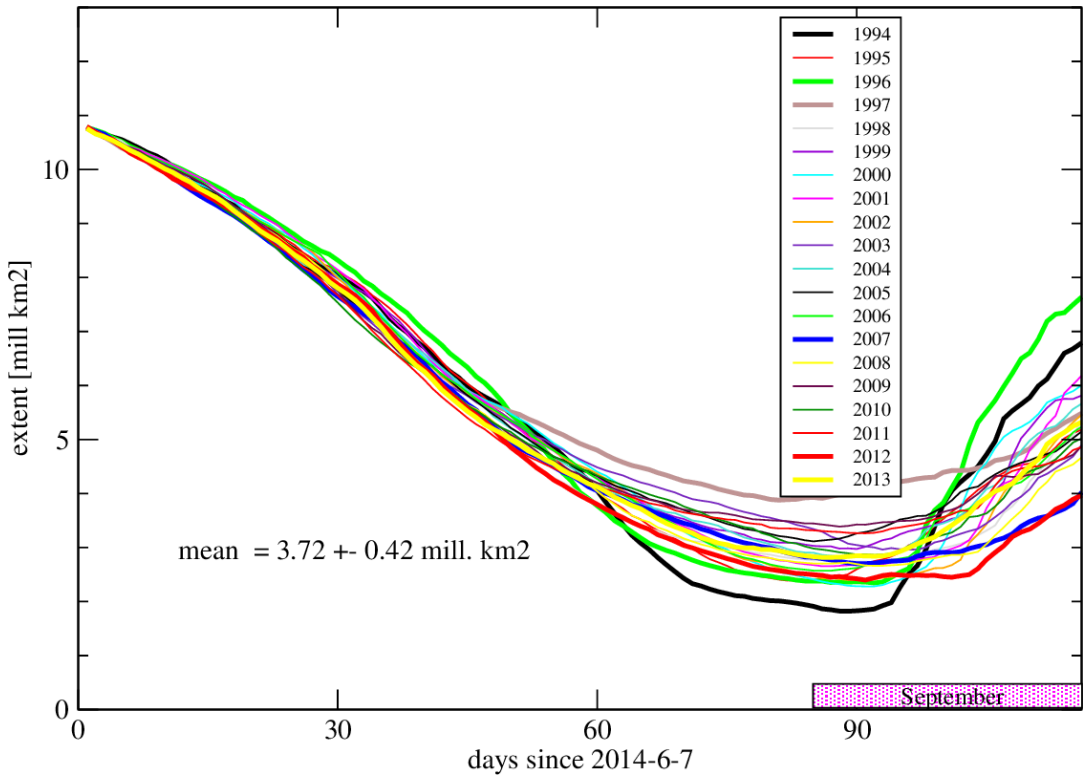

Figure 1: Simulated evolution of the ice extent [million km2] when forced with atmospheric data from 1994 to 2013 until end of September. The abscissa gives the days since the initialization of the forecast on June 7th 2014. Model-derived ice extents are averaged over day 87 to 116 (magenta box) and have been adjusted assuming a bias (see text).