SEA ICE OUTLOOK
2016 Report

Template with Core Requirements
for Pan-Arctic Contributions

Please note: *Two separate Outlooks are provided in this submission. For the July report Ionita and Grosfeld applied the same analysis for two different sea ice extent data sets: 1) National Snow & Ice Data Center (NSIDC) and 2) Bremen University (IUP).*

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2. * Do you want your contribution to be included in subsequent reports in the 2016 season?

_______ Yes, use this contribution for all of the 2016 SIO reports (this contribution will be superseded if you submit a later one).
__x______ No, I/we plan to submit separate contributions for subsequent reports.
________ No, I only want to participate this time.

3. *"Executive summary" of your Outlook contribution: in a few sentences (using 300 words or less) describe how and why your contribution was formulated. To the extent possible, use non-technical language.

Sea ice in both Polar Regions is an important indicator for the expression of global climate change and its polar amplification. Consequently, a broad information interest exists on sea ice, its coverage, variability and long term change. Knowledge on sea ice requires high quality data on ice extent, thickness and its dynamics. As an institute on polar research we collect data on Arctic and Antarctic sea ice, investigate its physics and role in the climate system and provide model simulations on different time scales. All this data is of interest for science and society. In order to provide insights into the potential development of the seasonal signal, we developed a robust statistical model based on ocean heat content, sea surface temperature and atmospheric variables to calculate an estimate of the September minimum sea ice extent for every year. This is applied for the year 2016 the first time and we will provide updated results every month for the sea ice outlook report.

4. *Type of Outlook method:

___dynamic model _**X**__statistical ___heuristic ____mixed or other (specify)

5. *Prediction of September pan-Arctic extent as monthly average in million square kilometers. (To be consistent with the validating sea ice extent index from NSIDC, if possible, please first compute the average sea ice concentration for the month and then compute the extent as the sum of cell areas > 15%.)

For the July report we have applied the same analysis for two different sea ice extent data sets: 1) Bremen University (**IUP**) (http://iup.physik.uni-bremen.de:8084/ssmis/) and 2) National Snow & Ice Data Center (**NSIDC**) (https://nsidc.org/data/seaice_index/). Despite the same used climatological data sets, we applied two different sea ice extent indices. Theses indices differ from month to month by up to 0.6 million km² due to different retrieval algorithms, special resolutions and different coast line representations. Hence, especially during the summer melting season a different variability is detected, leading to slightly different stability maps of the climatological variables.

September 2016 Sea Ice extent based on **Bremen University** data**: 4.25 million km^2** (Figure 1)
Lower uncertainty bound: 3.53 million km^2
Upper uncertainty bound: 4.97 million km^2

September 2016 Sea Ice extent based on **NSIDC** data: **3.89 million km^2** (Figure 2)
Lower uncertainty bound: 3.23 million km^2
Upper uncertainty bound: 4.56 million km^2

11. *Short explanation of Outlook method (using 300 words or less). In addition, we encourage you to submit a more detailed Outlook, including discussions of uncertainties/probabilities, including any relevant figures, imagery, and references.

The forecast scheme for the September sea ice extent is based on a methodology similar to one used for the seasonal prediction of river streamflow (Ionita et al., 2008, 2014). The basic idea of this procedure is to identify regions with stable teleconnections between the predictors and the predictand. The September sea ice extent has been correlated with the potential predictors from previous months, up to 8 months lag, in a moving window of 21 years.

Ionita, M., M. Dima, G. Lohmann, P. Scholz and N. Rimbu, 2014: Predicting the June 2013 European Flooding based on Precipitation, Soil Moisture and Sea Level Pressure. J. Hydrometeorology, 16, 598–614., doi: http://dx.doi.org/10.1175/JHM-D-14-0156.1

Ionita, M., G. Lohmann and N. Rimbu, 2008: Prediction of Elbe discharge based on stable teleconnections with winter global temperature and precipitation, Journal of Climate, 21, 6215–6226, doi:10.1175/2008JCLI2248.1

12. If available from your method for pan-Arctic extent prediction, please provide:

a) Uncertainty/probability estimate such as median, ranges, and/or standard deviations (specify what you are providing).

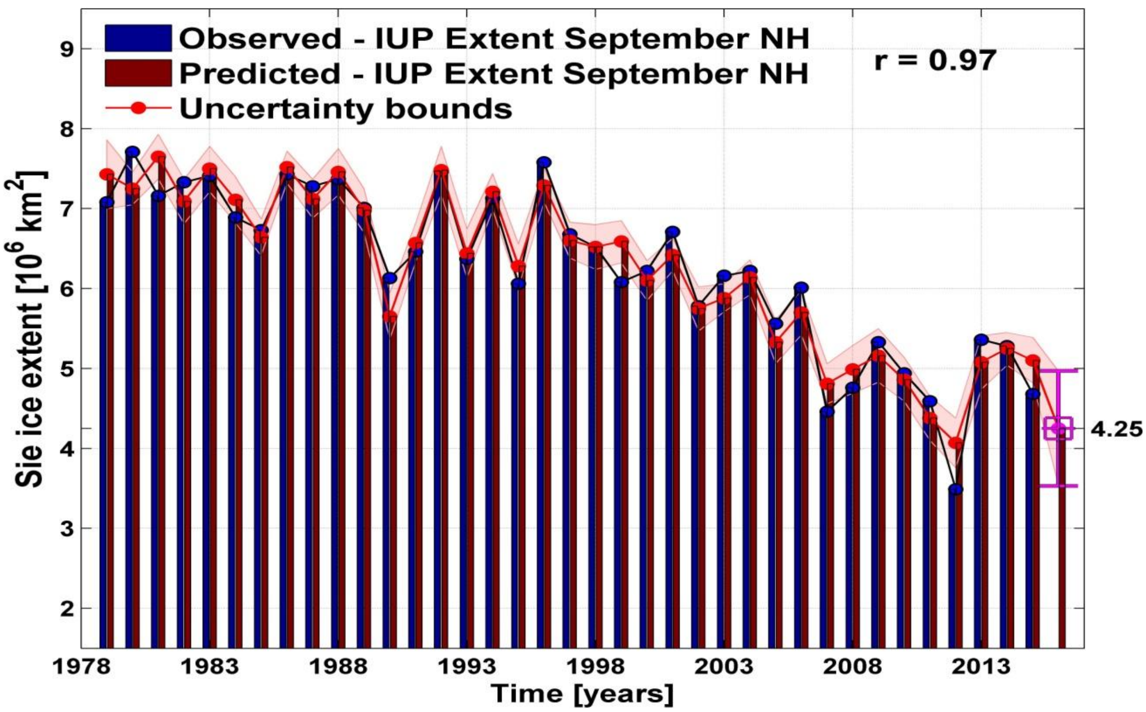

Figure1. Observed (blue) and Predicted (red) September sea ice extent values over the period 1979-2016 based on predictors from the stable regions and based on the **IUP** sea ice extent data. The pink shaded area represents the 95% uncertainty bounds.

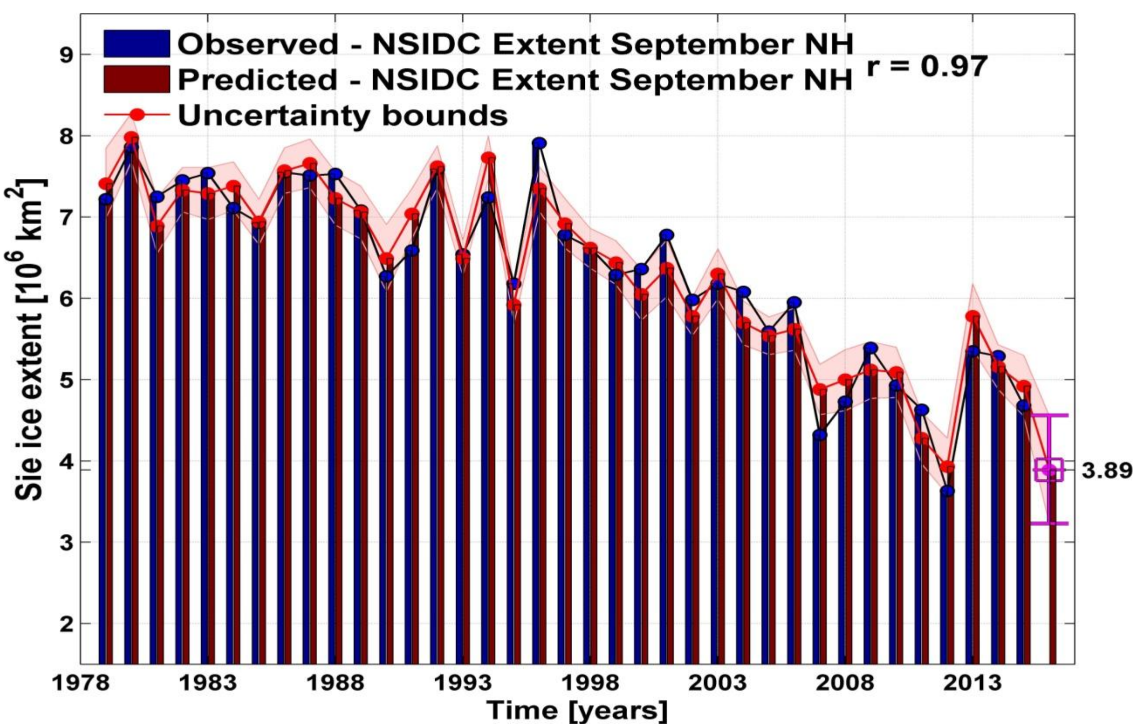

Figure2. Observed (blue) and Predicted (red) September sea ice extent values over the period 1979-2016 based on predictors from the stable regions and based on the **NSIDC** sea ice extent data. The pink shaded area represents the 95% uncertainty bounds.