An initial outlook at the austral summer 2018-2019 sea-ice forecasts in the Southern Ocean

Coordinating Seasonal Predictions of Sea Ice
in the Southern Ocean for 2017-2019

F. Massonnet, P. Reid, J. Lieser, C. M. Bitz, J. Fyfe, W. Hobbs

December 12, 2018

Primary contact:

francois.massonnet@uclouvain.be

The Sea Ice Prediction Network South

The Sea Ice Prediction Network South (SIPN South) is an international project endorsed by the Year of Polar Prediction (YOPP). Its goal is to make an initial assessment of the ability of current systems to predict Antarctic sea ice globally and regionally, with a focus on the summer season. The project has three strategic objectives:

1. Provide a focal point for seasonal outlooks of Antarctic sea ice (winter and summer), where the results are exchanged, compared, discussed and put in perspective with those from the Arctic thanks to interactions within the (Arctic) SIPN,
2. Provide news and information on the state of Antarctic sea ice, highlight recent published research, report ongoing observational campaigns and disseminate upcoming events (conferences, workshops, webinars, et cetera),
3. Coordinate a realistic prediction exercise targeting austral summer 2019, in conjunction with the Year Of Polar Prediction (YOPP)'s Special Observing Period that will take place in November-February 2018-2019.

We remind the reader that SIPN South is not an operational forecasting exercise. A brief assessment of forecast skill was performed in Massonnet et al. (2018) for the predictions of February 2018 collected last year.

Forecasting sea ice during austral summer 2018-2019

Austral summer 2018-2019 will be particularly rich in terms of Antarctic observations, as the Year Of Polar Prediction Special Observing Period is taking place between November 16th, 2018 and February 15th, 2019. Since the inception of SIPN South, it was decided to align a prediction exercise with this Special Observing Period. We issued a call on October 31st, 2018, to collect forecasts covering the period December 1st 2018-February 28th 2019.

So far we have **received 10 submissions and would like to thank all contributors for their participation.** We expect two additional submissions within the next days. These new submissions will be displayed in future reports but, in any case, they will not use data past December 1st. We take note that requesting contributions for the 1st of the month is not ideal for those groups producing monthly forecasts initialized at the beginning of each month, and will change our guidelines next year accordingly.

We asked contributors to provide, in order of descending priority, (1) the total Antarctic sea-ice area ("SIA") for each day of December-February 2018-2019, (2) the sea-ice area per 10° longitude bands ("rSIA") for each day of December-February 2018-2019 and (3) the sea-ice concentration ("SIC") for each day of December-February 2018-2019. All contributors were able to submit (1), four submitted (1) and (2), and four submitted (1), (2) and (3). Two submissions consisted in monthly mean forecasts. These forecasts were interpolated to daily resolution in order to facilitate intercomparisons. Seven groups used fully coupled dynamical models and three groups used a statistical model trained on past data.

Table 1. Information about contributors to the summer 2018-2019 coordinated sea ice forecast experiment.

	Contributor name	*Short name (in figures)*	*Forecasting method*	*Nb. of forecasts*	*Initialization date*	*Diagnostics provided*
1	Naval Research Lab	nrl	Coupled dynamical model	9	Oct. 31st, 2018	SIA + rSIA + SIC
2	Nico Sun	Nico-Sun	Statistical model	3	Nov. 30th, 2018	SIA
3	NASA-GMAO	nasa-gmao	Coupled dynamical model	10	Nov. 27th, 2018	SIA + SIC
4	FIO-ESM	FIO-ESM	Coupled dynamical model	1	Nov. 1st, 2018	SIA
5	ECMWF	ecmwf	Coupled dynamical model	50	Dec. 1st, 2018	SIA + rSIA
6	Lamont Sea Ice Group	Lamont	Statistical model	1	Oct. 31st, 2018	SIA + rSIA + SIC (monthly, interpolated daily)
7	Alek Petty	Petty-NASA	Statistical model	1	Nov. 30th, 2018	SIA (monthly, interpolated daily)
8	Modified CanSIPS	Modified-CanSIPS	Coupled Dynamical Model	20	Nov. 30th, 2018	SIA
9	Met Office	MetOffice	Coupled Dynamical Model	42	Nov. 25th, 2018	SIA + rSIA + SIC
10	CMCC	CMCC	Coupled Dynamical Model	50	Nov. 1st, 2018	SIA

Circumpolar sea-ice area

Fig. 1 shows the total sea-ice area (SIA) forecasted for each day of December-January-February 2018-2019. We stress that SIA is not a very physical diagnostic, but it gives a first impression on how the forecasts behave. In this figure, we have also plotted for reference the sea-ice area from two observational references, the NSIDC-0081 product (Maslanik and Stroeve, 1999) and the OSI-401-b product (Tonboe et al., 2017). The SIPN South forecasts appear to be biased high at the time of initialization, for reasons that will be investigated later on. The summer minimum is predicted to occur later than the observed minimum of last year (Fig. 2). However, last year, most forecasts also had their minimum later than the minimum that was actually observed.

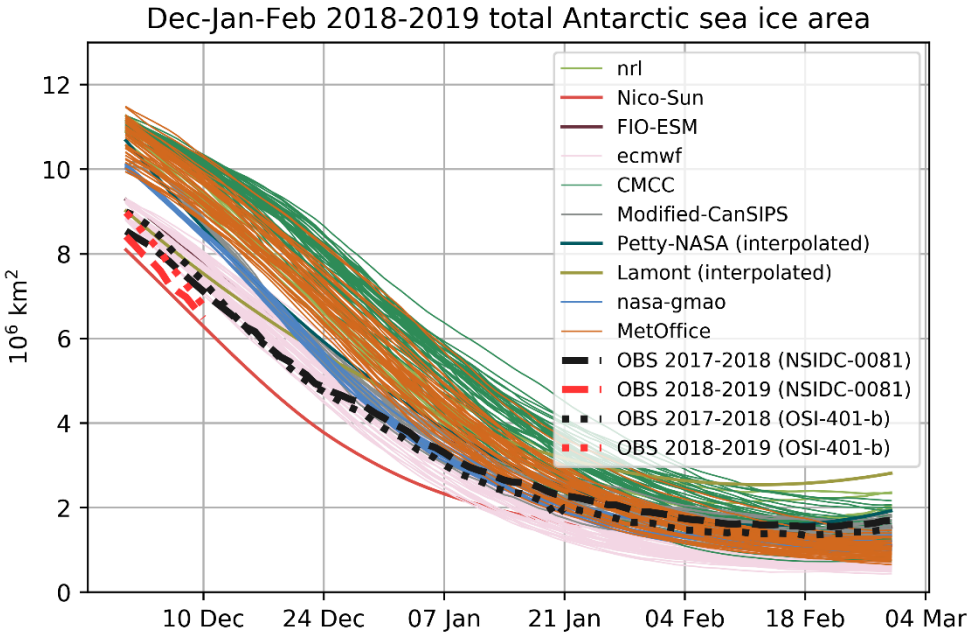

Figure 1. Total (circumpolar) Antarctic sea ice area of the 10 forecasts for each day of December-February 2018. The black dashed lines are two observational references (Maslanik and Stroeve, 1999; Tonboe et al., 2017) for last year and the red lines for the first ten days of December 2018.

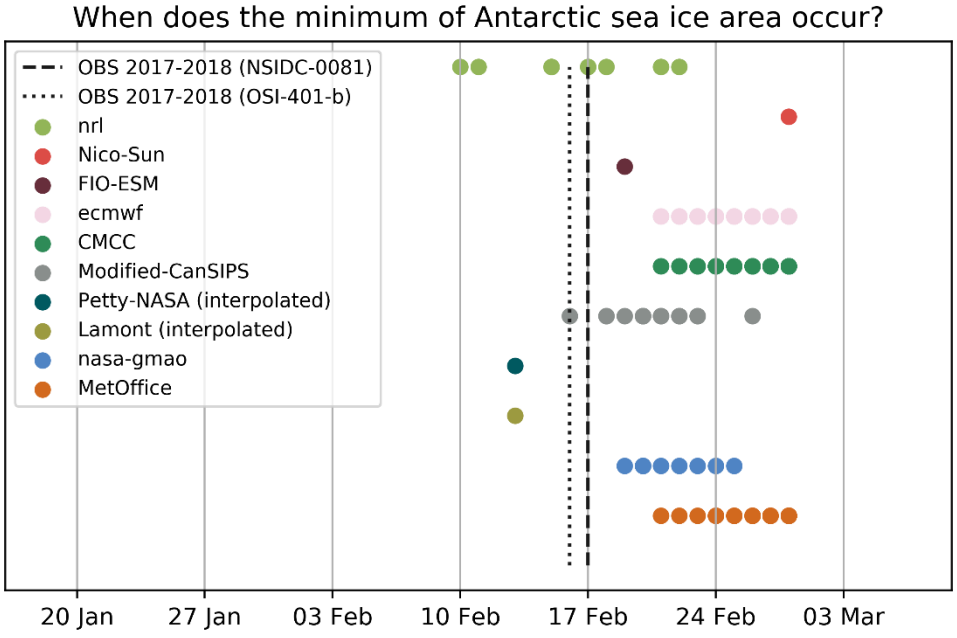

Figure 2. Timing of the seasonal (February) Antarctic minimum sea-ice area of the forecasts. Two observational references (Maslanik and Stroeve, 1999 and Tonboe et al., 2017) are shown for last year. To filter the effects of synoptic variability on total sea-ice area, the minimum was determined from a quadratic fit of the daily February sea-ice area time series.

Spatial information

Five groups submitted the spatial information of daily sea-ice concentration for each day of December-February 2018-2019. Groups provided several members (from 1 to 50) in order to sample uncertainty associated to the (unpredictable) evolution of the climate system, so that each member of a given model could be seen as a possible realization of that model. Fig. 3 displays the ensemble mean of monthly mean sea-ice concentration for February 2019, together with the sea-ice edge lines (15% sea-ice concentration contours) for each member. Sea-ice presence is forecasted in the Weddell Sea along the Antarctic Peninsula in all contributions. This is a region where the ice is climatologically present. There is high inter-model uncertainty regarding the presence of ice in the Ross Sea in February 2019. Last year, the NASA-GMAO correctly predicted a massive retreat of sea ice in that region, which will again be free of ice according to that prediction system.

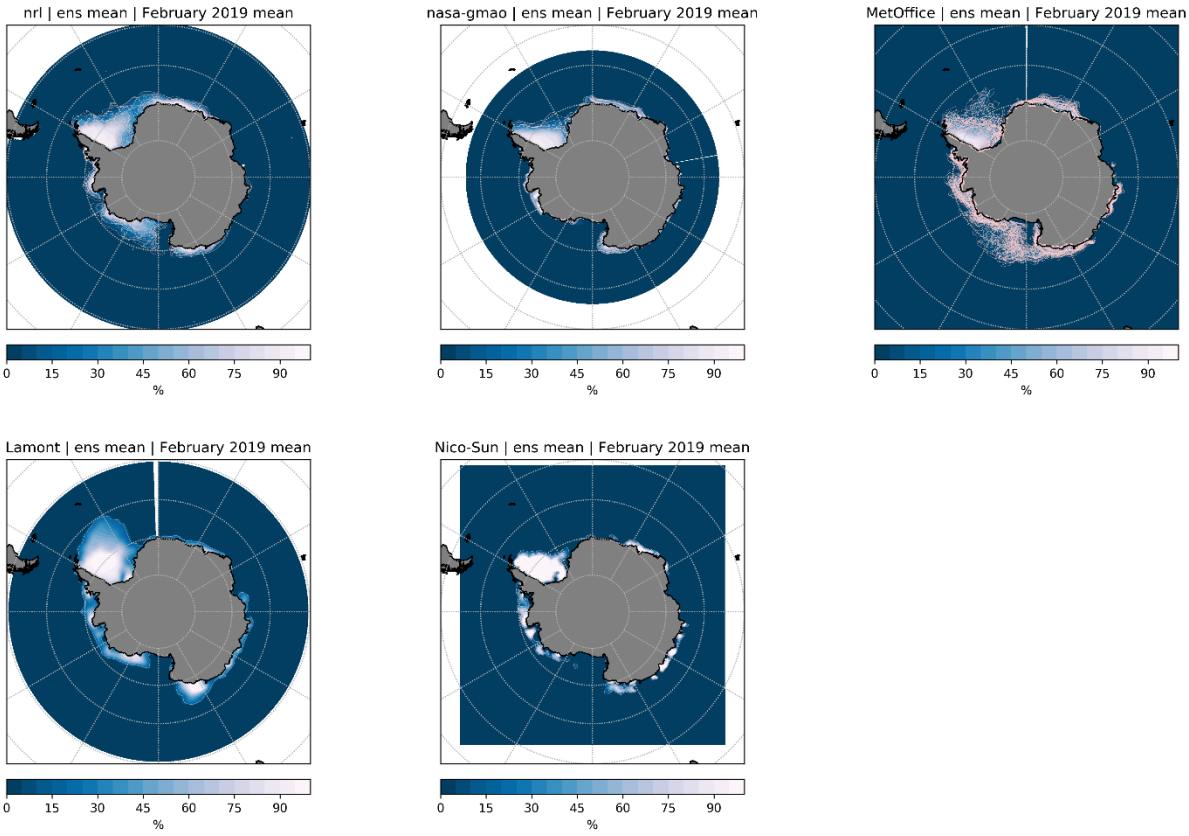

Figure 3. Ensemble mean of February 2019 monthly mean sea ice concentration, as forecasted by the five groups that submitted daily sea ice concentration information. The very thin salmon lines are the ice edge position for each forecast member, determined as the 15% contour line of the monthly mean sea ice concentration for the member.

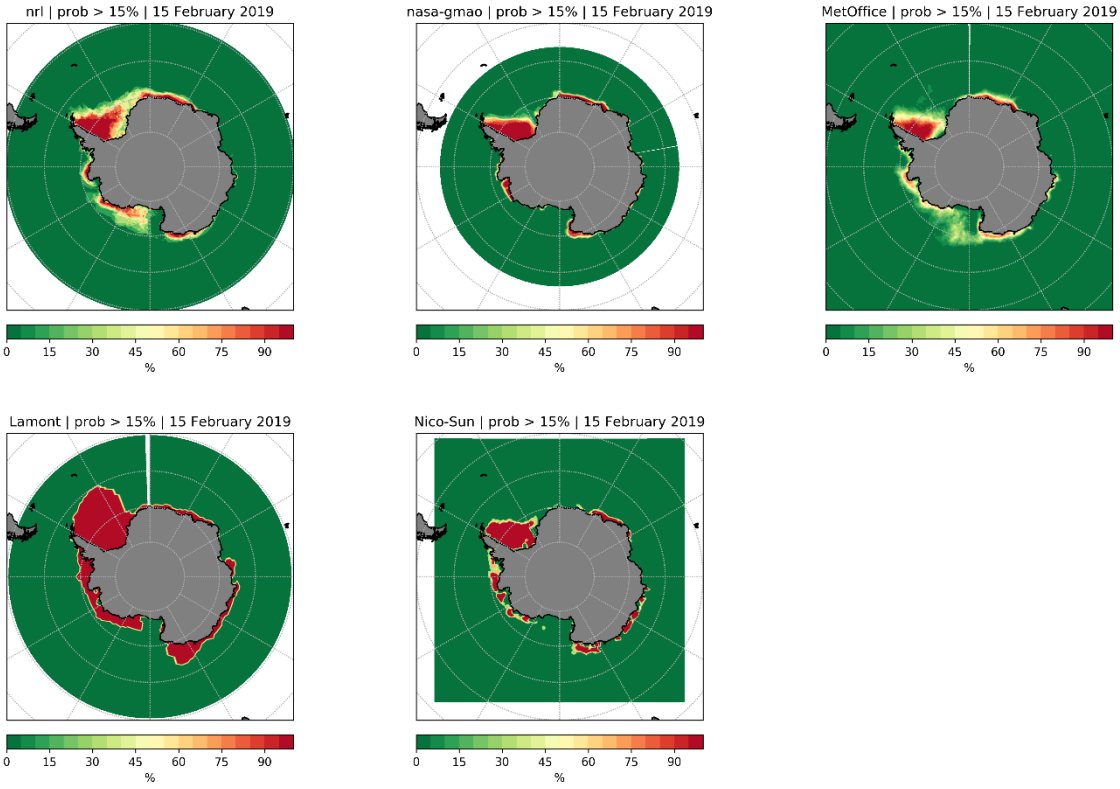

Figure 4. Probability of ice presence for the 15th of February 2019, as forecasted by the five groups that submitted daily sea ice concentration information. The probability of presence corresponds to the fraction of ensemble members that simulate sea ice concentration larger than 15% in a given grid cell, for that day. A dynamic animation of that figure for all 28 days of February is available here.

The maps of ensemble February mean sea-ice concentration (Fig. 3) are useful to appreciate the expected average conditions that could prevail in February, but are difficult to interpret for potential final users of the forecasts. Therefore, we also show the daily probability of sea-ice presence (Fig. 4; a dynamic animation of this figure is available here). Green pixels are those where the ice is extremely unlikely to be present, while red ones are those where the ice is extremely likely to be present. From the forecasts, it can be noted that strategic locations like Prydz Bay (75E, 70S) or the north-western tip of the Antarctic Peninsula are likely to be accessible during February.

Next steps

After February 2019, we will evaluate the forecasts with two observational references. A more detailed analysis of this first exercise will be published in March 2019.

Scripts and data availability

The data presented in this report and the scripts used to generate figures can be retrieved and reproduced by cloning the following Git project:

https://github.com/fmassonn/sipn-south-public/

Branch master, commit
d1693c9bde2ea2c38fbf8a72b666ce0d8bf80be6

List of contributors

Contributor long name	*Contributor short name*	*Contributors*
Naval Research Lab	nrl	Joe Metzger, Neil Barton, Michael Phelps
Nico Sun	Nico-Sun	Nico Sun
NASA-GMAO	nasa-gmao	Richard Cullather, Anna Borovikov, Eric Hackert, Robin Kovach, Jelena Marshak, Andrea Molod, Kazumi Nakada, Steven Pawson, Max Suarez, Yury Vikhliaev, Bin Zhao
FIO-ESM	Qi Shu	Fangli Qiao, Zhenya Song, Xunqiang Yin, Yajuan Song
ECMWF	Steffen Tietsche	
Lamont Sea Ice Group	Lamont	Xiaojun Yuan, Cuihua Li
Alek Petty	Petty-NASA	Petty-NASA
Modified CanSIPS	Modified-CanSIPS	Michael Sigmond, Bill Merryfield, Woosung Lee, Alan Dirkson
Met Office	MetOffice	Ed Blockley, GloSea5 Seasonal Forecast team
CMCC	CMCC	Andrea Borrelli, Antonella Sanna

References

Maslanik, J. and J. Stroeve, 1999, updated daily. Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 1. [NSIDC-0081]. Boulder, Colorado USA. NASA National Snow

Massonnet, F., P. Reid, J. L. Lieser, C. M. Bitz, J. Fyfe, W. Hobbs (2018). Assessment of February 2018 sea-ice forecasts for the Southern Ocean. https://eprints.utas.edu.au/27184/

Tonboe, R., J. Lavelle, R. H. Pfeiffer and E. Howe, 2017. Product User Manual for OSI SAF Global Sea Ice Concentration (Product OSI-401-b). http://osisaf.met.no/docs/osisaf_cdop3_ss2_pum_ice-conc_v1p6.pdf [Accessed May 30th, 2018]

To know more about SIPN South:

Website:

http://acecrc.org.au/sipn-south/

EGU Cryosphere blog article on SIPN South:

https://blogs.egu.eu/divisions/cr/tag/sipn/

Video summarizing SIPN South's first experiment:

https://www.youtube.com/watch?v=MUeWapsdSwQ

Full report of the first experiment:

Massonnet, F., P. Reid, J. L. Lieser, C. M. Bitz, J. Fyfe, W. Hobbs (2018). Assessment of February 2018 sea-ice forecasts for the Southern Ocean. https://eprints.utas.edu.au/27184/