An initial outlook at the austral summer 2021-2022 sea-ice forecasts in the Southern Ocean

Coordinating Seasonal Predictions
of Sea Ice in the Southern Ocean

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

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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 realistic prediction exercises, focusing on summer, and aligned with the Year Of Polar Prediction (YOPP)'s Special and Targeted Observing Periods (SOPs and TOPs). A TOP is scheduled for austral fall 2022.

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, 2019, 2020) for the predictions of past years.

Forecasting sea ice during austral summer 2021-2022

We issued a call on November 22th, 2021, to collect forecasts covering the period December 1st 2021-February 28th 2022.

So far, we have **received 14 submissions (236 forecasts) and would like to thank all contributors for their participation.** We expect two to three additional submissions within the next days. New submissions will be displayed in future reports but, in any case, they will not use data past December 1st 2021.

We asked contributors to provide, in order of descending priority, (1) the total Antarctic sea-ice area ("SIA") for each day of December-February, (2) the sea-ice area per 10° longitude bands ("rSIA") for each day of December-February, (3) the sea-ice concentration ("SIC") for each day of December-February, and (4) the mean grid cell sea-ice thickness ("SIV") for each day of December-February.

Table 1. Information about contributors to the summer 2021-2022 coordinated sea ice forecast experiment.

	Contributor name	*Short name (in figures)*	*Forecasting method*	*Nb. of forecasts*	*Init. date*	*Diagnostics provided*
1	Sandra Barreira	barreira	Statistical model	1	Dec. 1st	SIA+SIC
2	CanSIPSv2	CanSIPSv2	Coupled Dynamical Model	20	Nov. 26th	SIA+rSIA
3	CMCC	cmcc	Coupled Dynamical Model	50	Oct. 31st	SIA+rSIA+SIC
4	CNRM	CNRM	Coupled Dynamical Model	51	Dec. 1st	SIA+rSIA+SIC+SIV
5	FIO-ESM	FIO-ESM	Coupled Dynamical Model	1	Nov. 1st	SIA
6	GFDL	gfdl	Coupled Dynamical Model	30	Nov. 30th	SIA+rSIA+SIC
7	Lamont Sea Ice Group	Lamont	Statistical model	1	Nov. 1st	SIA+rSIA+SIC*
8	Meier	Meier-NSIDC	Statistical model	1	Dec. 1st	
9	Met Office	MetOffice	Coupled Dynamical Model	42	Dec. 1st	SIA+rSIA+SIC
10	NASA-GSFC (Alek Petty)	NASA-GSFC	Statistical model	1	Nov. 30th	SIA
11	Nico Sun	NicoSun	Statistical model	3	Nov. 30th	SIA+SIC+SIV
12	Sintexf2 (JAMSTEC)	SINTEX-F2	Coupled Dynamical Model	24	Nov. 30th	SIA+rSIA
13	Sun Yat-sen University	SYSU	Statistical model	1	Nov. 30th	SIA+rSIA
14	UCLouvain	ucl	Ocean—Sea Ice Model	10	Nov. 1st	SIA+rSIA+SIC+SIV

*received as monthly data, interpolated daily

Circumpolar sea-ice area

Fig. 1 shows the total sea-ice area (SIA) forecasted for each day of December-January-February. 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

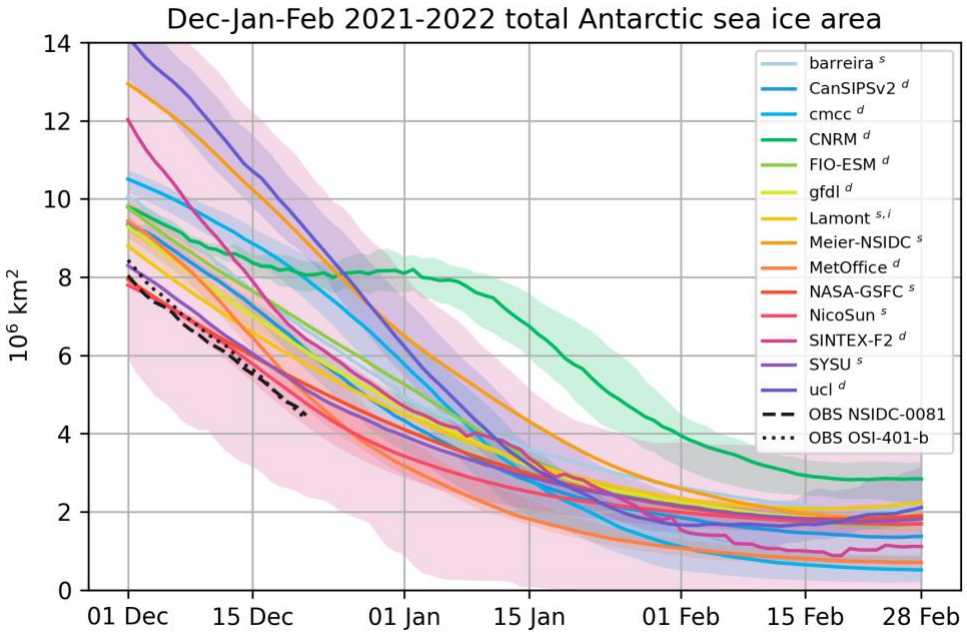

Figure 1. Total (circumpolar) Antarctic sea ice area of the forecasts for each day of December-February 2021-2022. The superscripts in the legend indicate whether the submission is based on a *s*tatistical or a *d*ynamical approach.The black dashed lines are two observational references up to Dec. 22, 2021.

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 behavior of the CNRM curve is due to post-processing applied to the raw forecast (V. Guemas & L. Batté, personal communication).

Spatial information

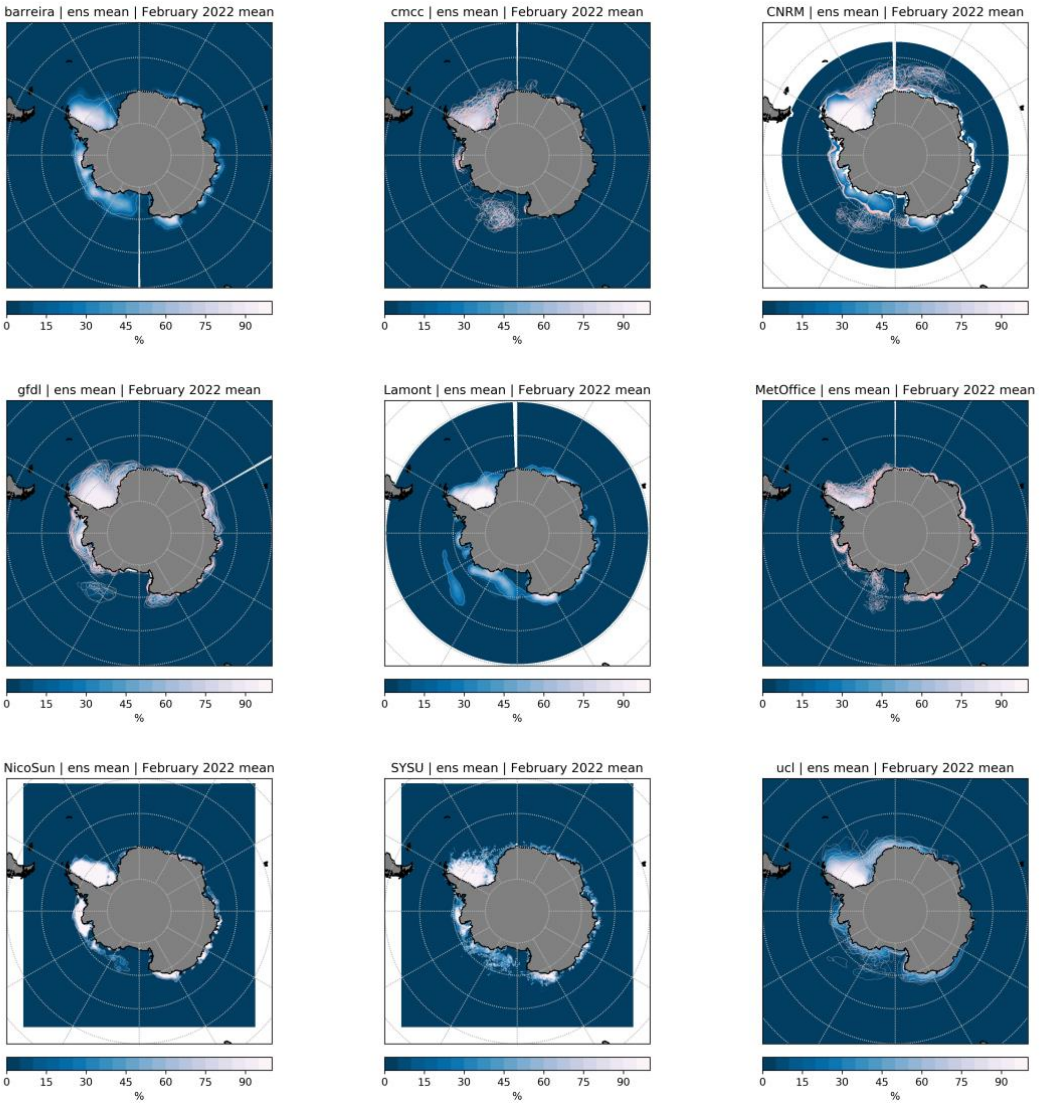

Figure 2. Ensemble mean of February 2022 monthly mean sea ice concentration, as forecasted by the nine groups that submitted daily sea ice concentration information. The very thin salmon lines are the ice edge position for each forecast member, determined as the 15% contour line of the monthly mean sea ice concentration for the member.

Nine groups submitted the spatial information of daily sea-ice concentration for each day of December-February. Groups provided several members (from 1 to 51 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. 2 displays the ensemble mean of monthly mean sea-ice concentration for February 2022, 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, as for previous years.

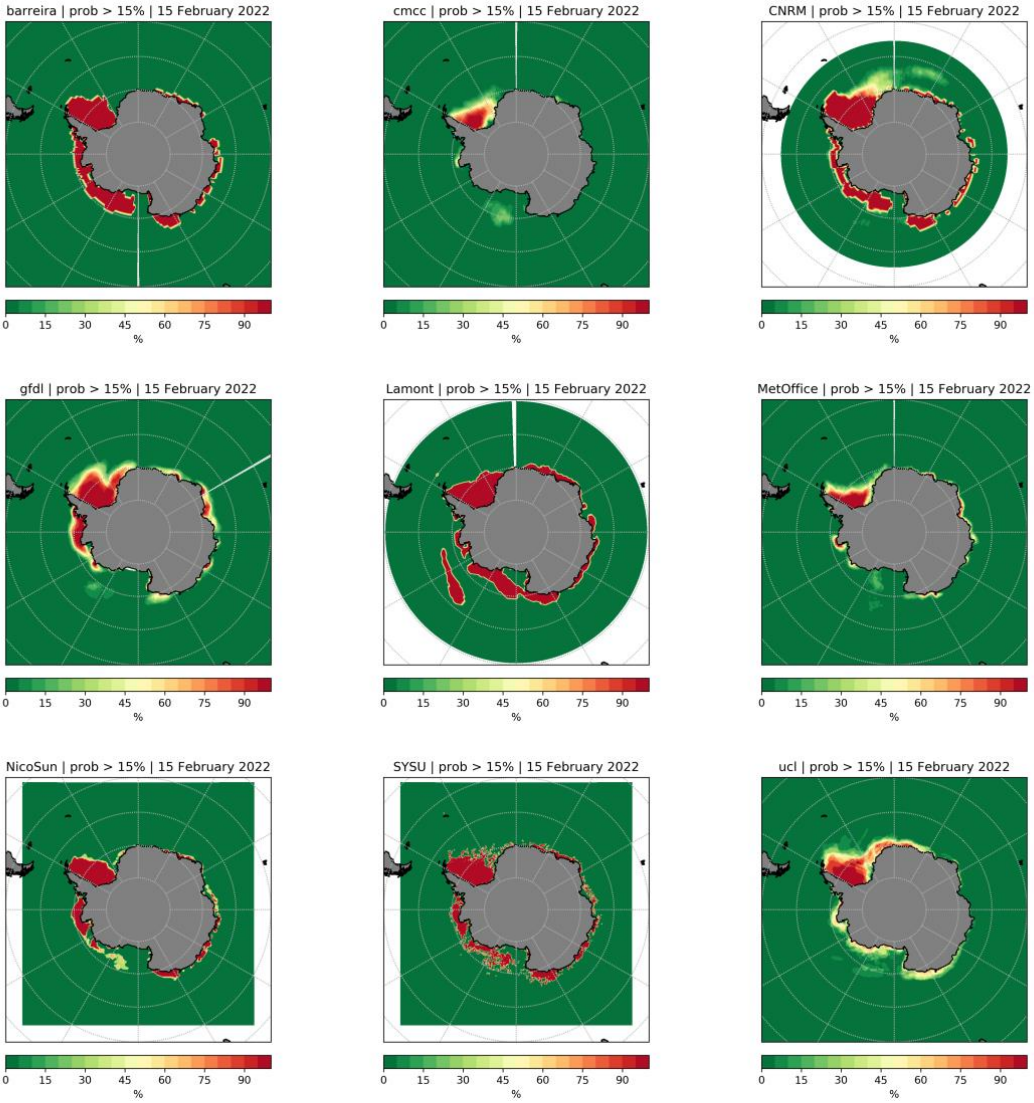

Figure 3. Probability of ice presence for the 15th of February 2022, as forecasted by the groups that submitted daily sea ice concentration information. The probability of presence corresponds to the fraction of ensemble members that simulate sea ice concentration larger than 15% in a given grid cell, for that day.

The maps of ensemble February mean sea-ice concentration (Fig. 2) 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. 3). 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.

Next steps

After February 2022, we will evaluate the forecasts with two observational references. A more detailed analysis of this first exercise will be published in Spring 2022.

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 develop_2021-2022

References

Maslanik, J., Stroeve, J., 1999. Near-Real-Time DMSP SSMIS Daily Polar Gridded Sea Ice Concentrations, Version 1 [NSIDC-0081]. https://doi.org/10.5067/U8C09DWVX9LM

Massonnet, F., Reid, P., Bitz, C.M., Fyfe, J.C., Hobbs, W.R., 2019. Assessment of summer 2018-2019 sea-ice forecasts for the Southern Ocean.

Massonnet, F., Reid, P., Bitz, C.M., Fyfe, J.C., Hobbs, W.R., 2018. Assessment of February 2018 sea-ice forecasts for the Southern Ocean.

Tonboe, R., Lavelle, J., Pfeiffer, R.H., Howe, E., 2017. Product User Manual for OSI SAF Global Sea Ice Concentration (Product OSI-401-b).

To know more about SIPN South:

Website:

https://fmassonn.github.io/sipn-south.github.io/

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 past experiments:

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/

— (2019). "Assessment of Summer 2018-2019 Sea-Ice Forecasts for the Southern Ocean". https://eprints.utas.edu.au/29984/

— (2020). “Assessment of Summer 2019-2020 Sea-Ice Forecasts for the Southern Ocean”. https://fmassonn.github.io/sipn-south.github.io/doc/2019-2020/SIPN-South_2019-2020_postseason.pdf