Towards a high-resolution MAR-NEMO coupling to explore atmosphere-ocean-ice interactions in the Arctic

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OBJECTIVES

High resolution modeling of the Poles

- *WP3* : long-term climate projections
- *WP4* : improvement of AOI interaction processes understanding

→ Coupled system simulations: MAR + NEMO

MODEL DOMAINS AND SET UP

6-hourly large scale forcing: **ERA5**

- Pressure, Temperature, Humidity, Wind speed
- SST, SIC

MAR

Modèle Atmosphérique Régional

25 km

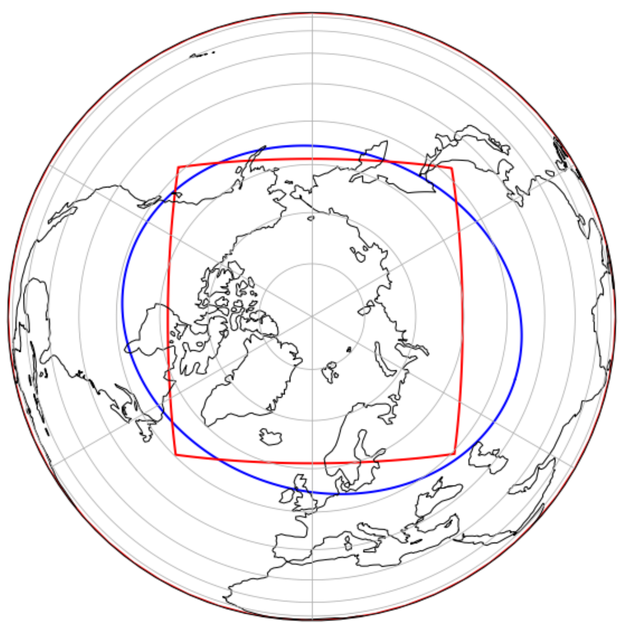

Figure 1. MAR (Red square) and NEMO (Blue oval) domain extension.

Atmospheric forcing: **ERA5**

Ocean forcing at the boundaries: **NEMO global**, 2 deg. of resolution

NEMO + SI³

Nucleus for European Modeling of the Ocean

¼ of deg. of lon. and lat.
Open boundaries

MAR EVALUATION

The evaluation of pan-Arctic MAR simulations at 25 km resolution shows fairly good results when compared to *in situ* observations for 2m-temperature, wind speed, and surface pressure. Biases in modeled pressure (see **Fig. 2.A**) are explained by the elevation difference between the smoothed MAR topography and the elevation of the corresponding weather stations. MAR tends to have a negative temperature bias, except for Alaska, although the bias is small when compared to the corresponding standard deviation (see **Table 1**). Temperature biases are smaller in absolute value in the cold and stable Arctic regions (Alaska, Canada, Greenland, and Russia) than in Norway and Iceland, which are surrounded by Atlantic waters.

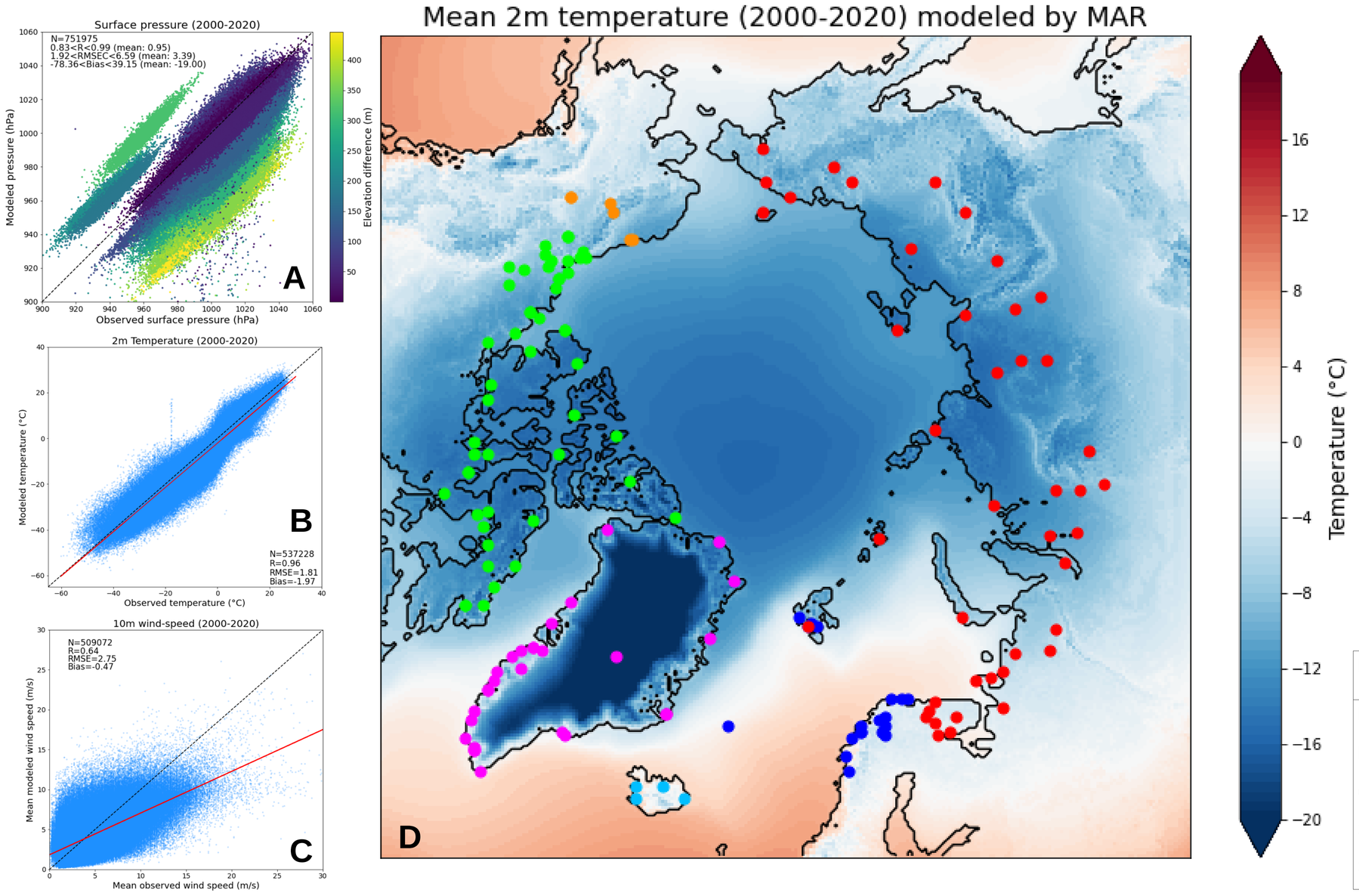

Figure 2. Comparison between daily modeled and observed **A)** surface pressure (hPa), **B)** 2m-temperature (°C), and **C)** wind speed (m/s). Colors in **A)** are difference in elevation (m) between observation site and MAR grid cell. RMSEC is the centered RMSE. Bias, R, and RMSE are expressed in the range of values obtained when calculating these statistics for each individual station. **D)** Mean 2m-temperature as modeled by MAR at 25 km forced with ERA5 for 2000-2020 (shade). Localization of observations used to evaluate the MAR model (dots). Colors correspond to the region in **Table 2**.

TAKE HOME MESSAGE

The MAR-NEMO coupling will allow better representation of the Arctic climate and its atmosphere-ocean-ice interactions.

So far, MAR forced with ERA5 shows good performance in representing present-day pan-Arctic climate.

The NEMO set up is in progress.

Region	AK	CA	GR	IL	NO	RU
Bias	0.29	-0.47	-1.70	-2.59	-3.27	-1.79
RMSE	5.58	4.41	4.12	3.29	4.49	4.93
Correlation	0.94	0.96	0.95	0.95	0.94	0.96
STD (obs)	14.46	14.64	8.05	4.95	7.36	14.08
STD (mod)	13.38	15.02	9.44	5.93	8.26	14.65

Table 2. Mean bias, RMSE, correlation, observed std (obs) and modeled std (mod) for each region of **Fig. 2.D**. AK=Alaska, CA=Canada, GR=Greenland, IL=Iceland, NO=Norway and RU=Russia.

References:
Huot. (2021). Influence of small-scale processes on ocean-cryosphere-atmosphere interactions off Adélie Land, East Antarctica
Fettweis et al., (2017). Reconstructions of the 1900-2015 Greenland ice sheet surface mass balance using the regional climate MAR model. Cryosphere.

Acknowledgments: thanks to Brice Noël, Alison Delhasse and Quentin Glaude for their help with this poster