OCEAN:ICE

PolarRES
Exploring future polar climates

# Developing a new model set-up for Antarctica: HARMONIE-Climate

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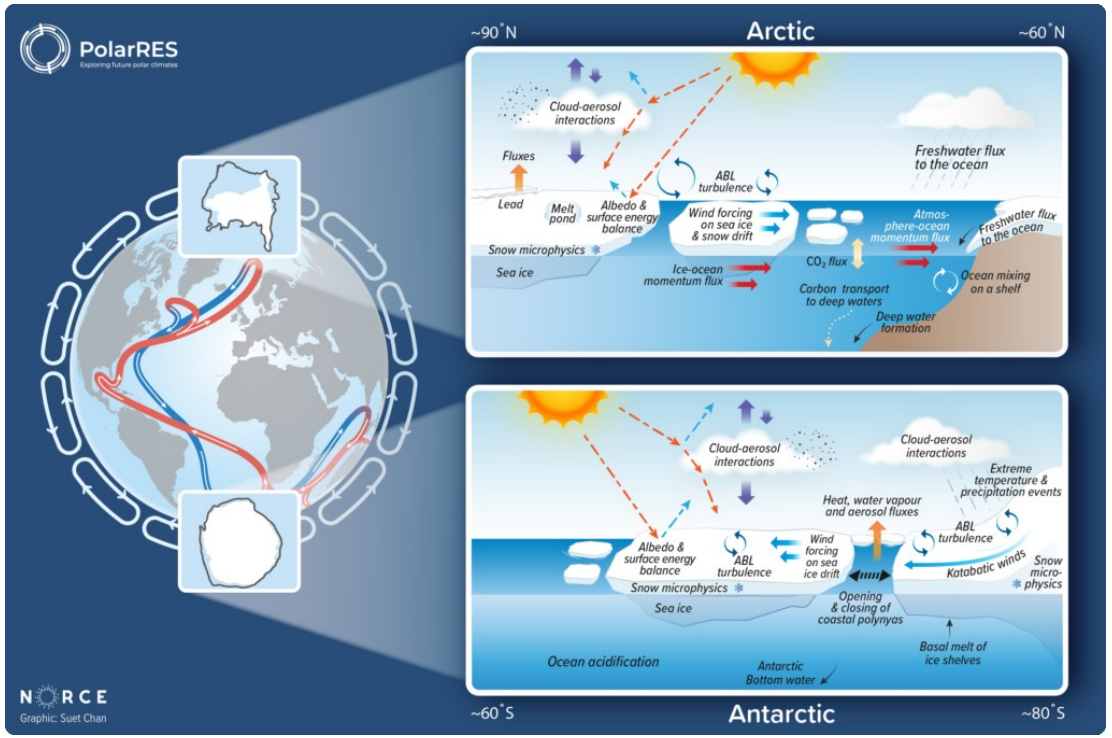
# Introduction




https://polarres.eu/about/

- PolarRES involves an ambitious set of numerical simulations at a high resolution
- It aims to enrich our understanding of the interacting nature and feedback of Polar processes

# Objective

- To evaluate a new high resolution regional climate model, it is configured for Antarctica

# Simulation and analysis setup

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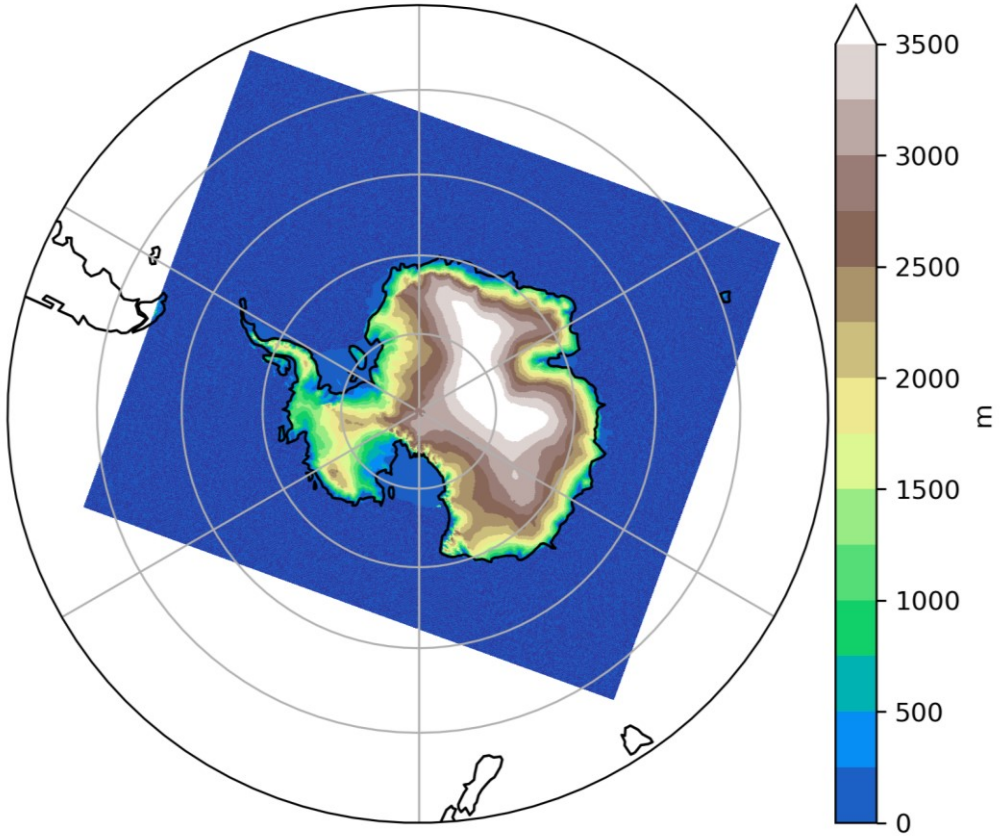
- HARMONIE Climate cycle 43 (HCLIM43) at 11km $\Delta x$
- Polar stereographic projection
- ALADIN atmospheric physics
- SICE with thermodynamic sea-ice thickness and snow on sea-ice
- Spectral nudging on vorticity, divergence and temperature
- Driven by ERA5 (period 2000-2001)

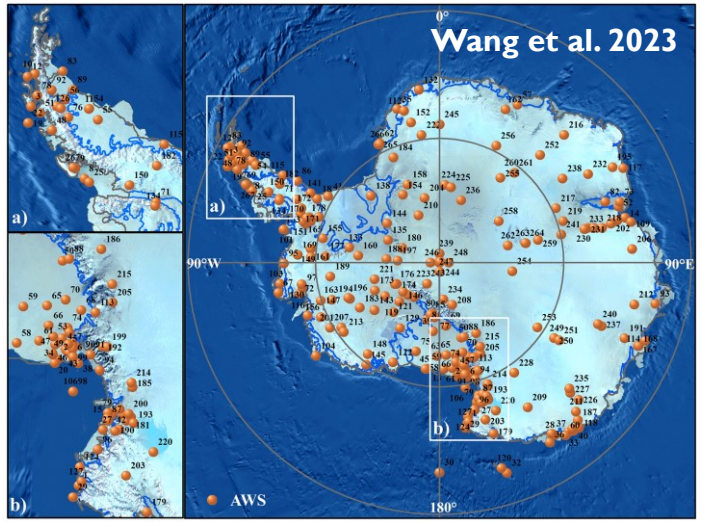
# Domain




Antarctic domain: 739x637 grid points (~2.3 times EUR11)

# Data

- AntAWS integrates measurements of tas, ps, RH, and wind speed / and direction from 267 Antarctic AWSs for1980-2021




Wang, Y.; Zhang, X.; Ning, W.; Lazzara, M. A.; Ding, Minghu; Reijmer, C. H.; Smeets, P. C. J. P.; Grigioni, P.; Heil, P.; Thomas, Elizabeth R.; Mikolajczyk, D.; Welhouse, L. J.; Keller, L. M.; Zhai, Z.; Sun, Y.; Hou, S. The AntAWS dataset: a compilation of Antarctic automatic weather station observations (2023) Earth System Science Data, volume 15, issue 1, pp. 411 – 429. https://doi.org/10.5194/essd-15-411-2023

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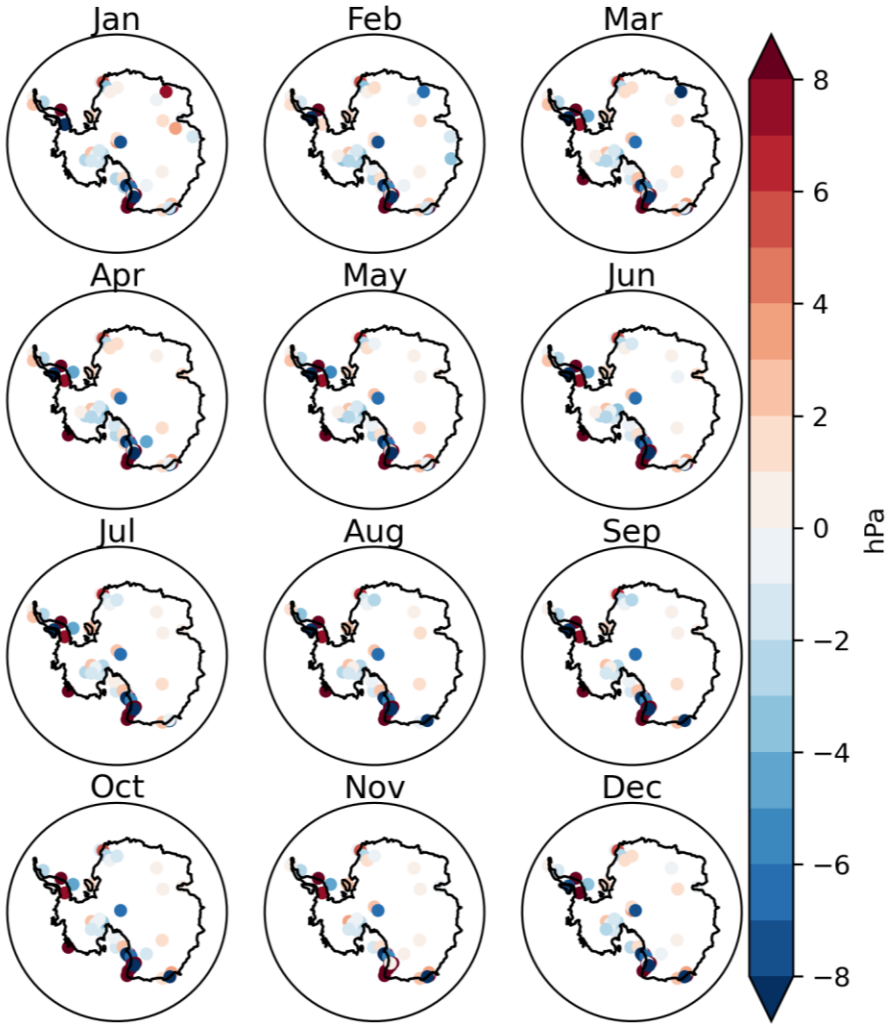
# Antarctic evaluation

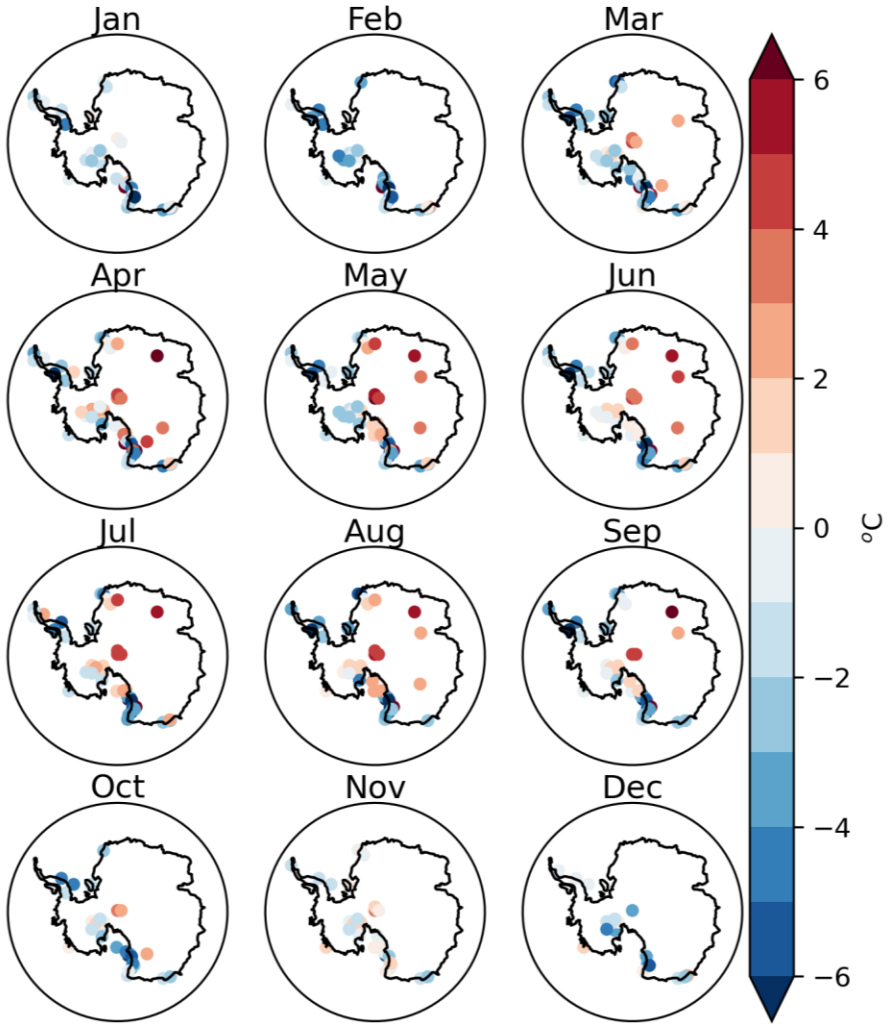
# Monthly bias of surface pressure




HCLIM – AntAWS

- For surface pressure, the bias is small, lower than 3 hPa almost all year, except for the Ross Sea and the Antarctic Peninsula

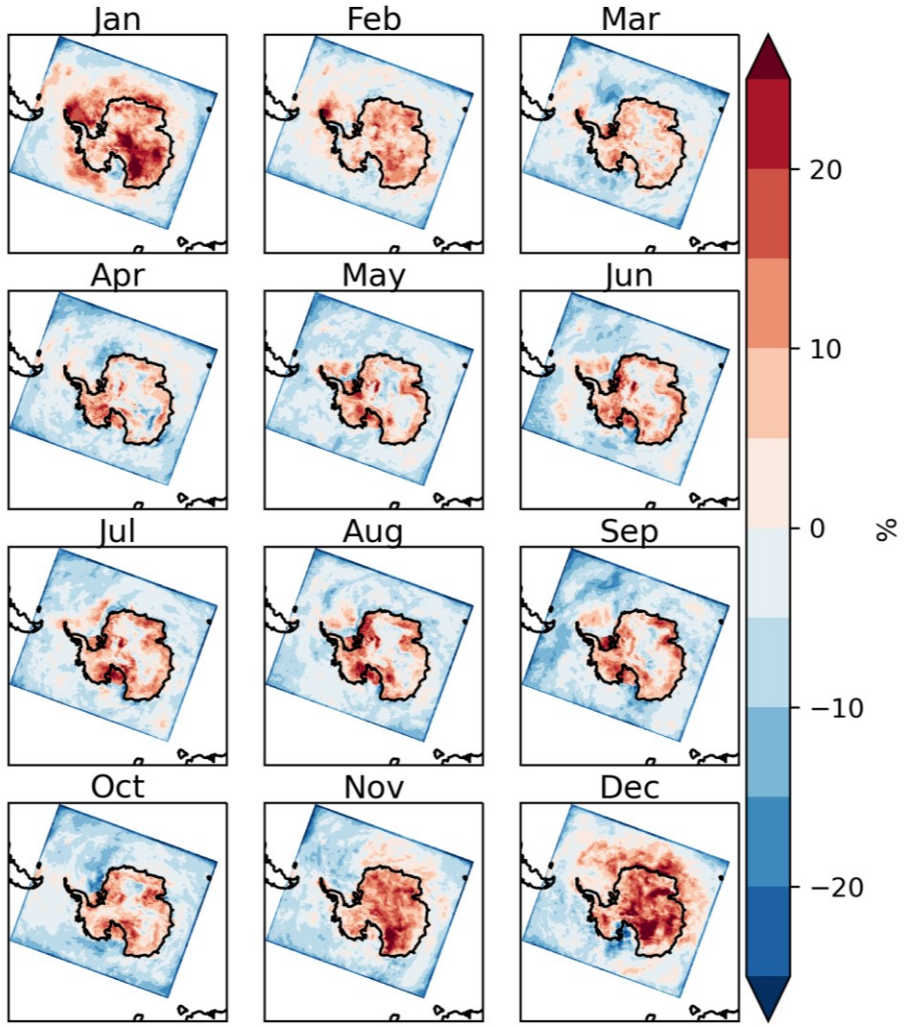
# Monthly bias of surface air temperature




HCLIM – AntAWS

- HCLIM shows a warm bias from March to September, in comparison to the weather stations

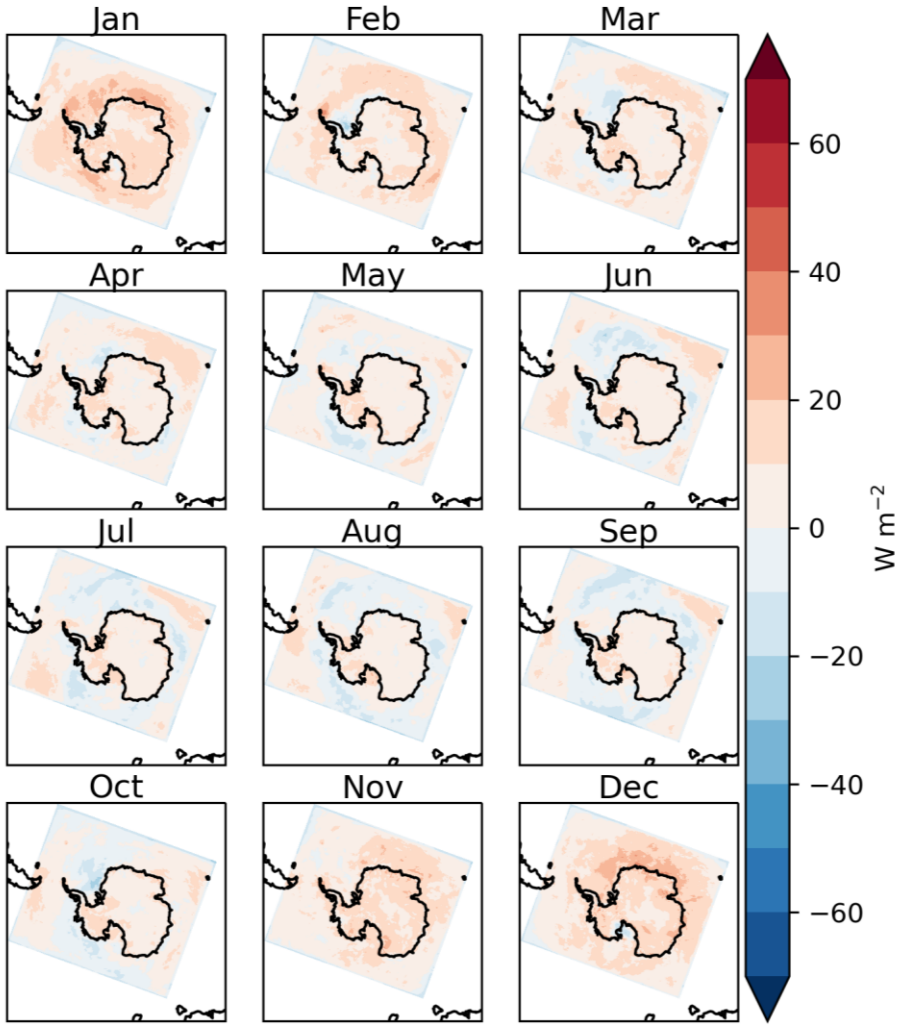
# Monthly bias of total cloud cover




HCLIM – ERA5

- HCLIM overestimates the total cloud cover over the continent

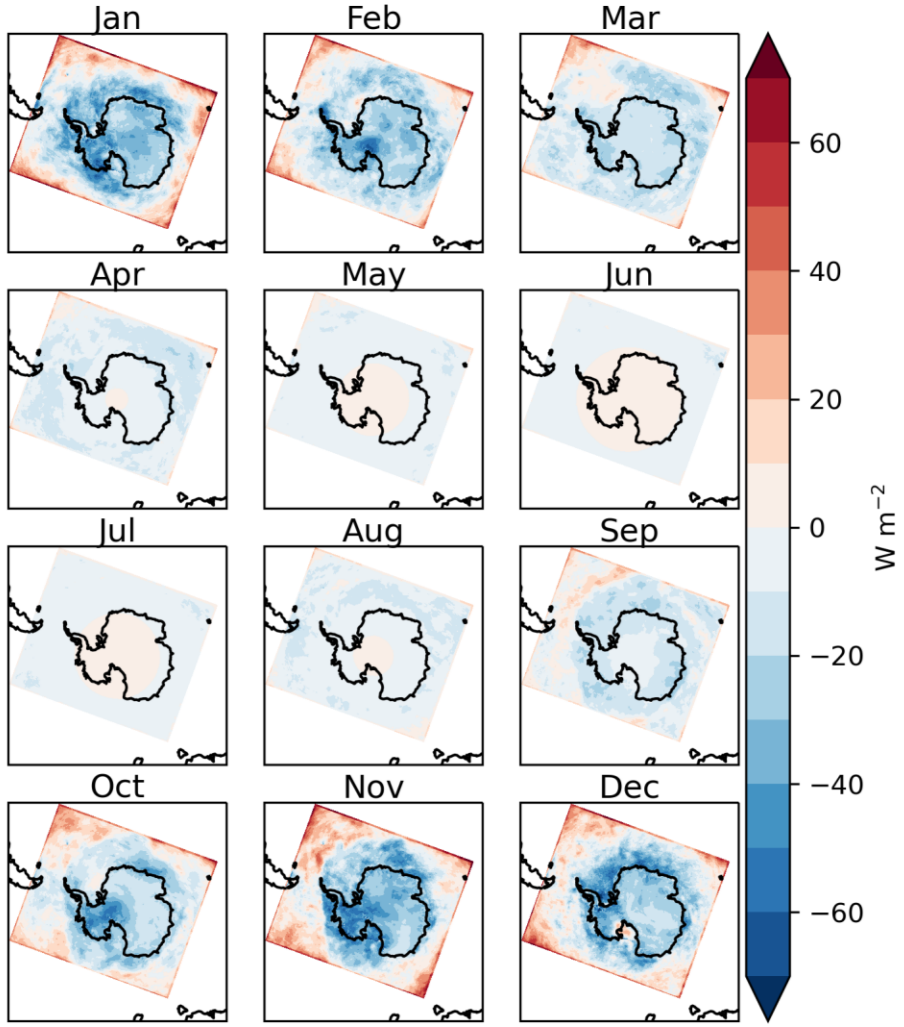
# Monthly bias of surface downward longwave radiation




HCLIM – ERA5

- HCLIM overestimates the surface downward longwave radiation, causing surface air temperature to increase

# Monthly bias of surface downward shortwave radiation




HCLIM – ERA5

- HCLIM underestimates the surface downward shortwave radiation in summer

# Preliminary conclusions

- HCLIM shows good performance in reproducing most of the observed regional patterns of pressure and temperature over the Antarctic domain
- We found a positive bias in temperature over the Antarctic domain, which is being investigated
- Future work: We will continue testing and improving the simulations over the domain before running the long simulations

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# Thank you!

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# Parametrizations

| Parameterization and dynamics | ALADIN |
|---|---|
| Dynamics | Hydrostatic (Temperton et al., 2001) |
| Radiation | RRTM_LW, SW6 (Mlawer et al., 1997; Iacono et al., 2008; Fouquart and Bonnel, 1980) |
| Turbulence | CBR (Cuxart et al., 2000); mixing length from Bougeault and Lacarrere (1989) |
| Microphysics | Lopez (2002); Bouteloup et al. (2005) |
| Shallow convection | KFB (Bechtold et al., 2001; Bazile et al., 2012) |
| Deep convection | Bougeault (1985) |
| Clouds | Smith (1990) |
| Orographic wave drag | Catry et al. (2008) |

Belušić, D., de Vries, H., Dobler, A., Landgren, O., Lind, P., Lindstedt, D., ... Wu, M. (2020). HCLIM38: A flexible regional climate model applicable for different climate zones from coarse to convection-permitting scales. *Geoscientific Model Development*, **13**, 1311– 1333. https://doi.org/10.5194/gmd-13-1311-2020

# Monthly bias of tas 2000

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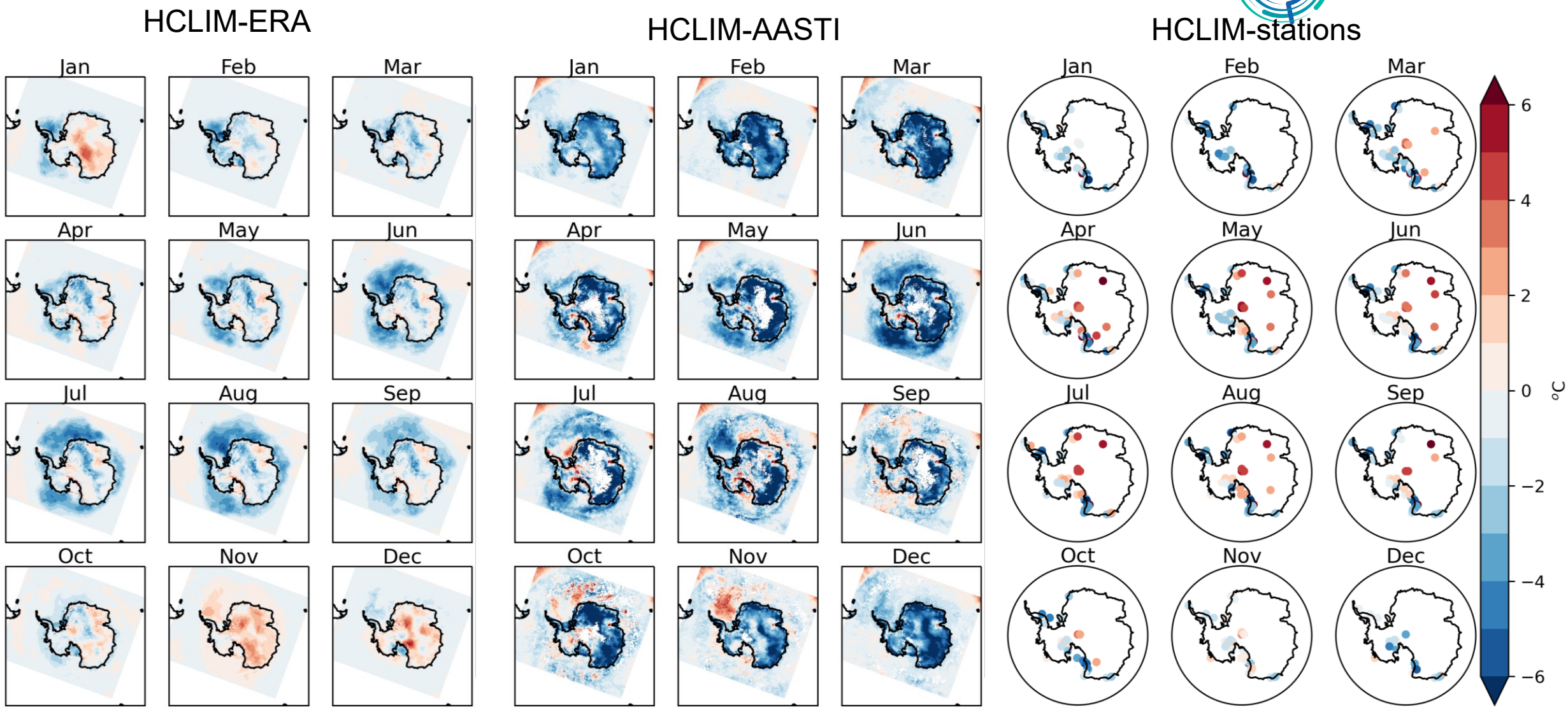

# Monthly bias of sea-ice area percentage 2000

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