The initial states influence on the NAO index predictability for the 2009–2010 winter in seasonal forecasts of the INM RAS climate model

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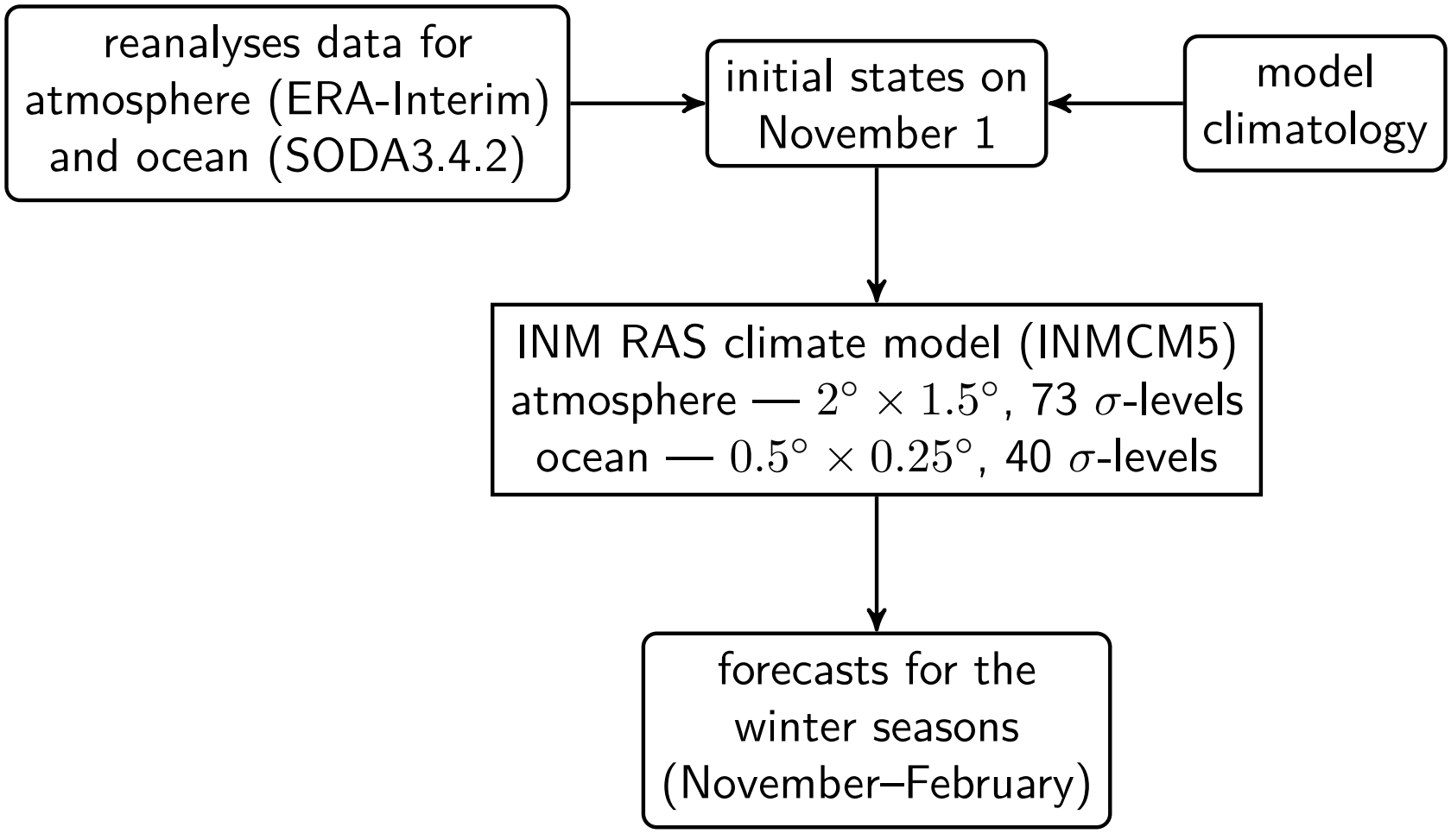
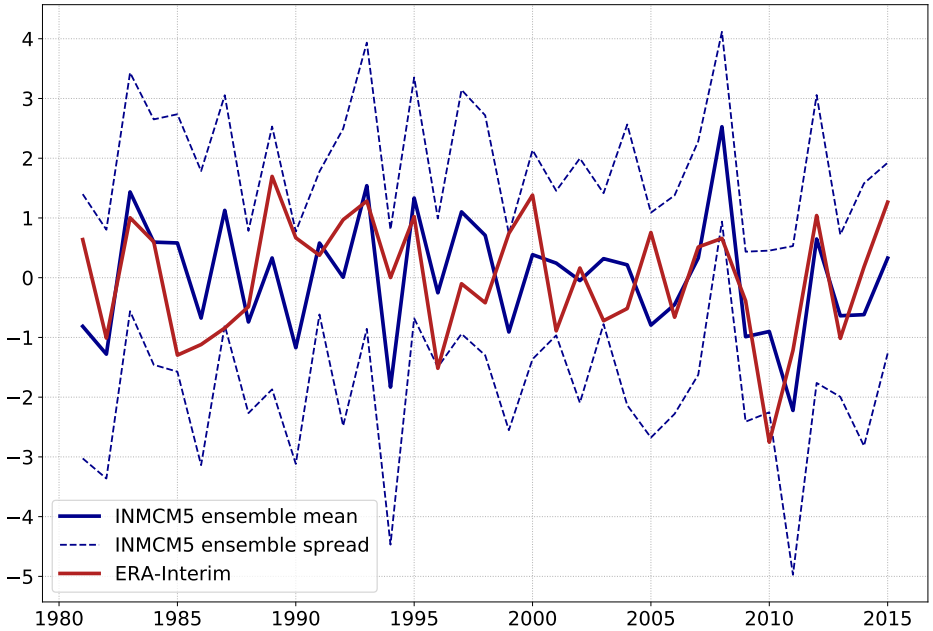
INM RAS climate model seasonal forecasts



NAO index predictability by INMCM5



DJF NAO index time series calculated on INMCM5[1] and ERA-Interim data

- Correlation coefficient between INMCM5 and ERA-Interim NAO index time series is 0.38
- 2009–2010 winter season has the minimal observed NAO index value
- INMCM5 also shows negative NAO index value for this season

[1] V. Vorobyeva, E. Volodin (2021) Evaluation of the INM RAS climate model skill in climate indices and stratospheric anomalies on seasonal timescale, Tellus A, 73:1, 1–12

Problem statement

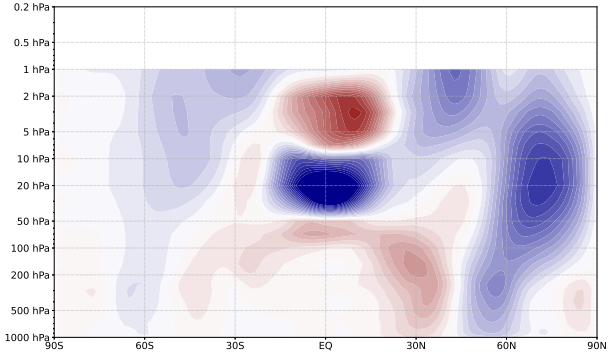
- Several experiments with different initial states configurations are carried out (ATMOC, ATM, ATMONLY, TROPOS)
- Ensemble of 60 forecasts is computed for each experiment
- Initial states are additionally perturbed for each ensemble member
- For the initial states and the forecasting results we consider anomalies — the deviation between parameters and their corresponding means

Experiments design

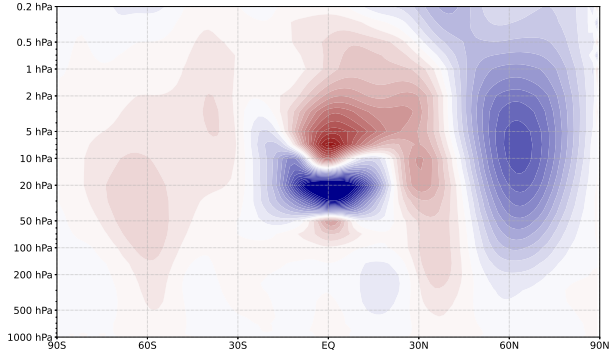
In all experiments except ATMOC the ocean initial state is set as INMCM5 climate averaged. Atmosphere and land surface initial states are set as anomalies relative to INMCM5 climatology:

- ATMOC — anomalies specified for the atmosphere, the land surface and the ocean
- ATM — anomalies specified for the atmosphere and the land surface
- ATMONLY — anomalies specified for the atmosphere
- TROPOS — anomalies specified for the troposphere

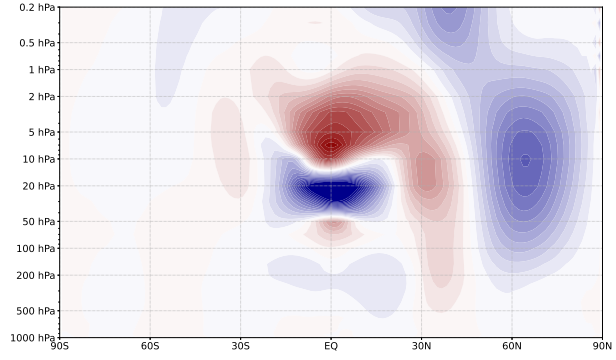
DJF U-wind speed anomalies based on INMCM5 forecasts



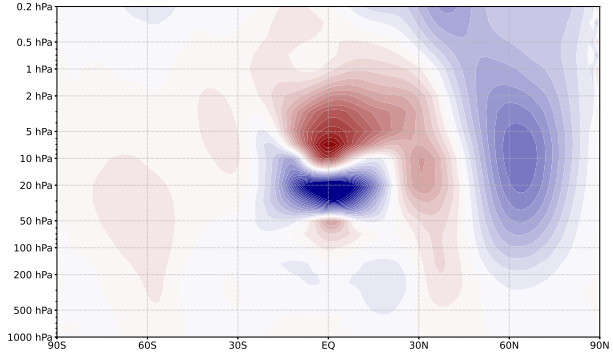
ERA-Interim



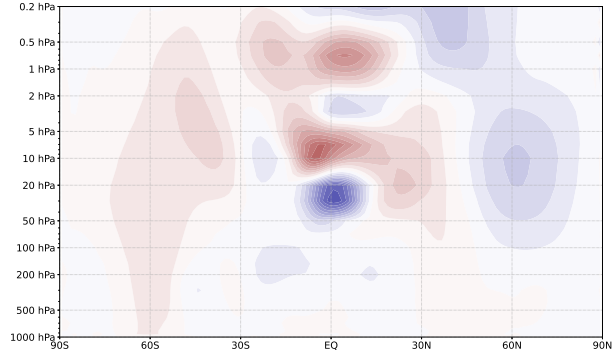
ATMOC



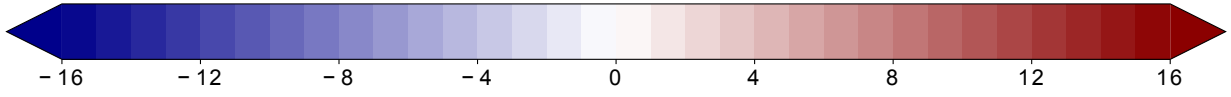
ATM



ATMONLY



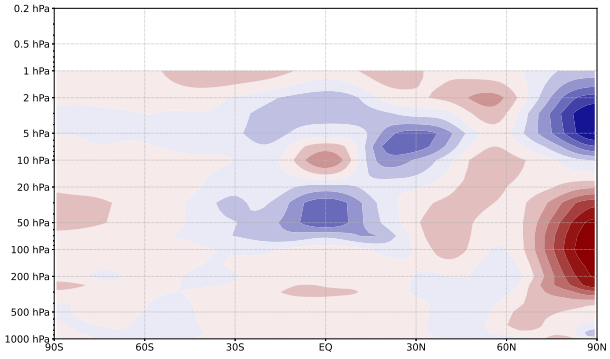
TROPOS



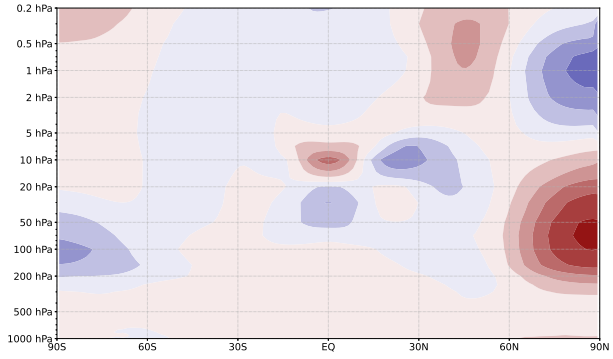
Zonal averaged DJF U-wind speed anomalies for ERA-Interim and INMCM5 experiments

- ATMOC, ATM and ATMONLY simulate DJF U-wind speed anomalies in Northern Hemisphere with good agreement with ERA-Interim

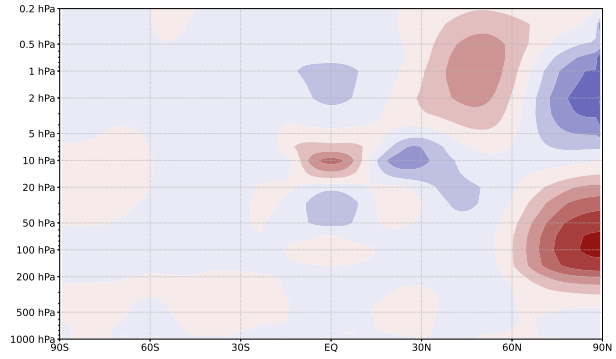
DJF temperature anomalies based on INMCM5 forecasts



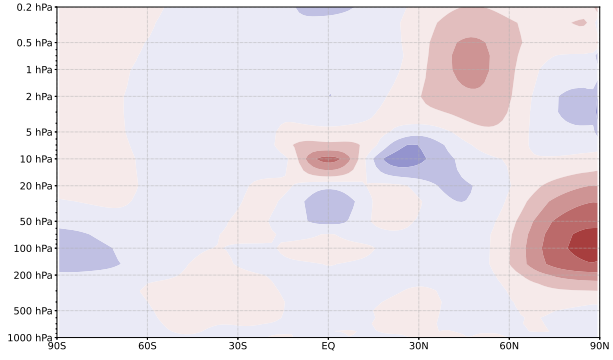
ERA-Interim



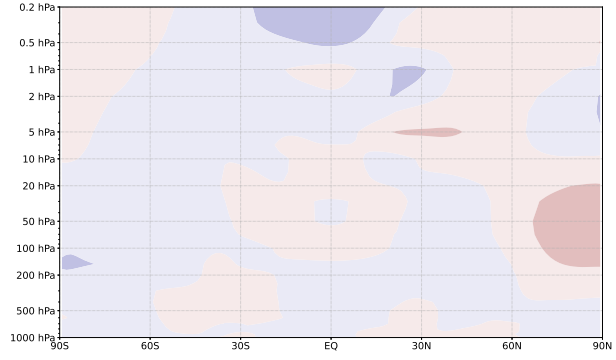
ATMOC



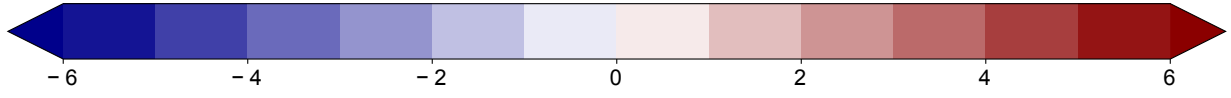
ATM



ATMONLY



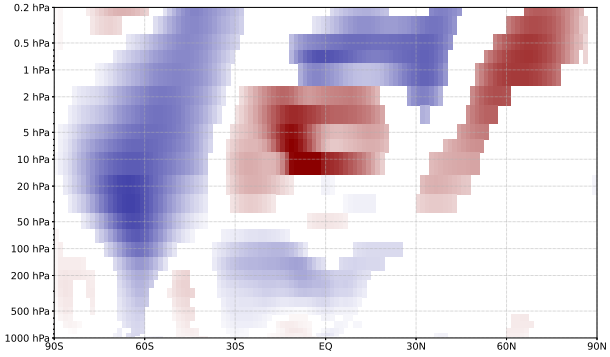
TROPOS



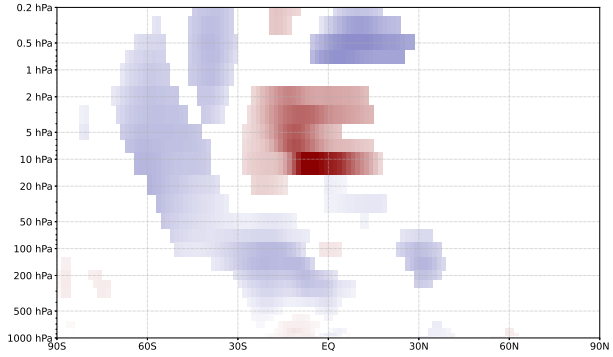
Zonal averaged DJF temperature anomalies for ERA-Interim and INMCM5 experiments

- ATMOC and ATM simulate DJF temperature anomalies in Northern Hemisphere with good agreement with ERA-Interim

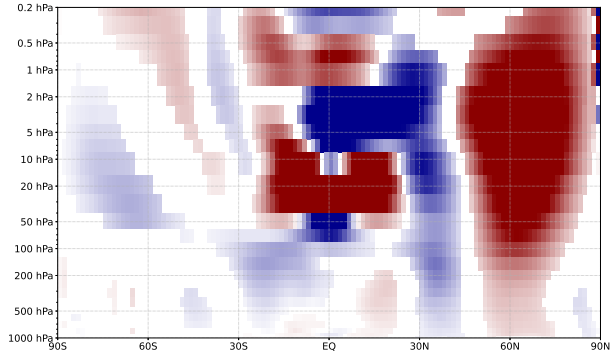
U and T anomalies difference at 5% significance level



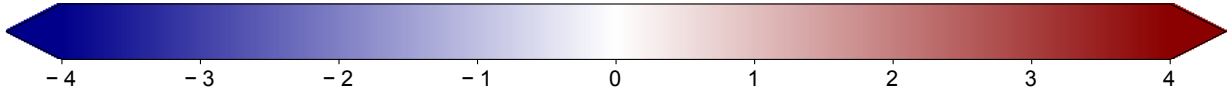
U, ATM – ATMOC

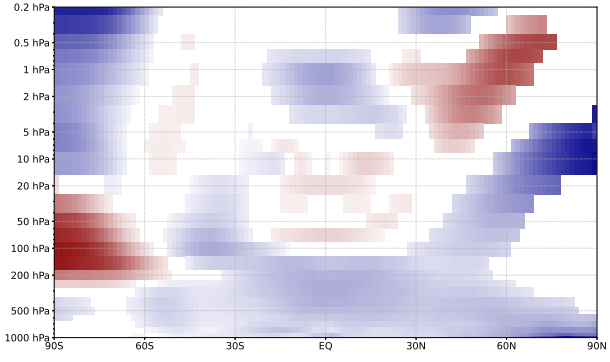


U, ATMONLY – ATMOC

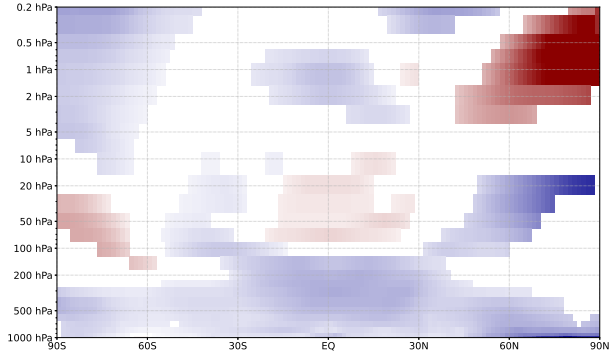


U, TROPOS – ATMOC

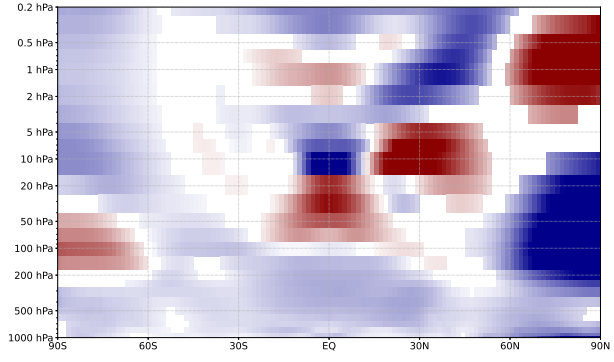




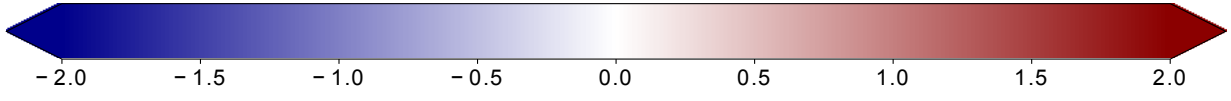
T, ATM – ATMOC



T, ATMONLY – ATMOC

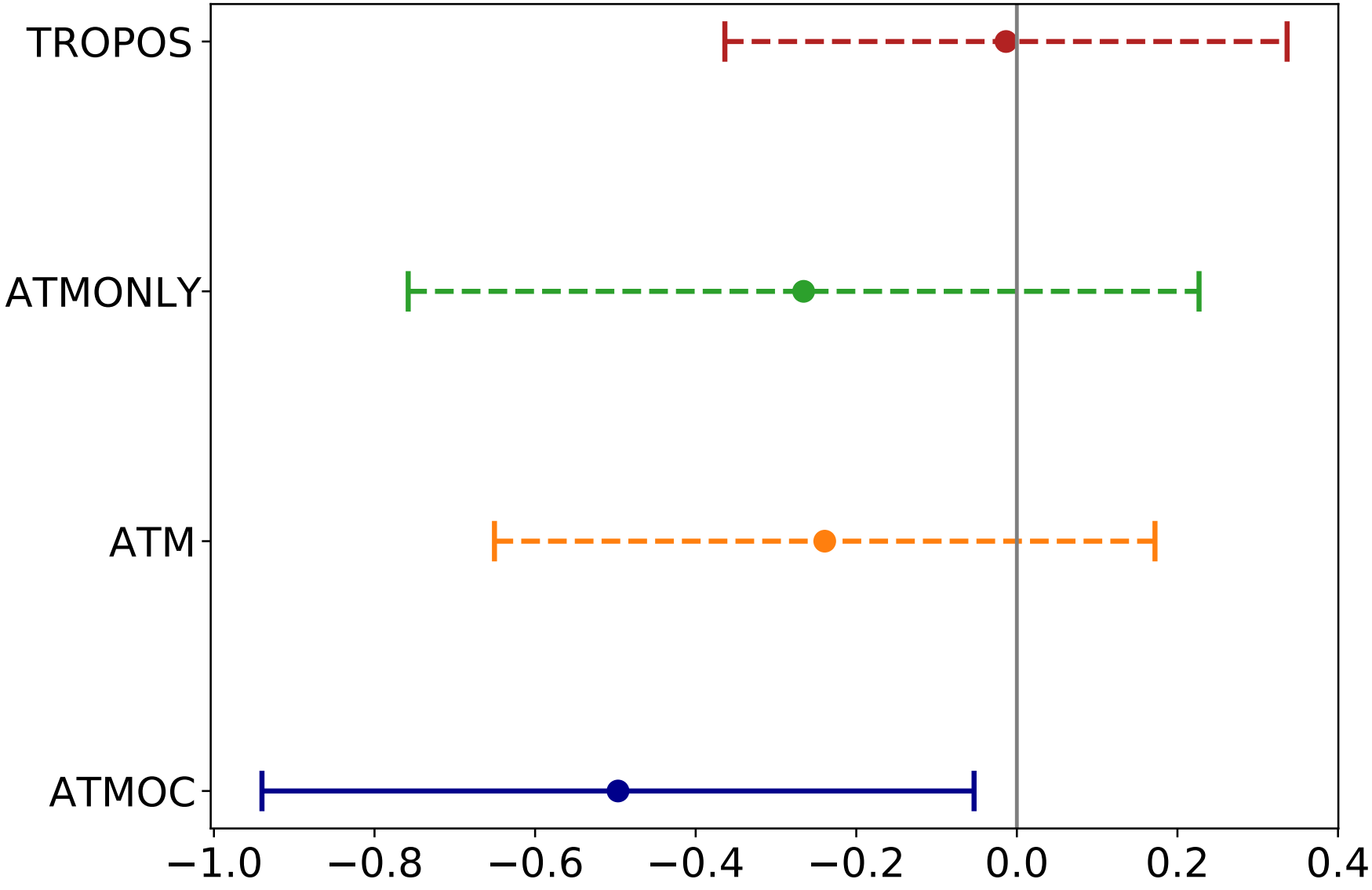


T, TROPOS – ATMOC



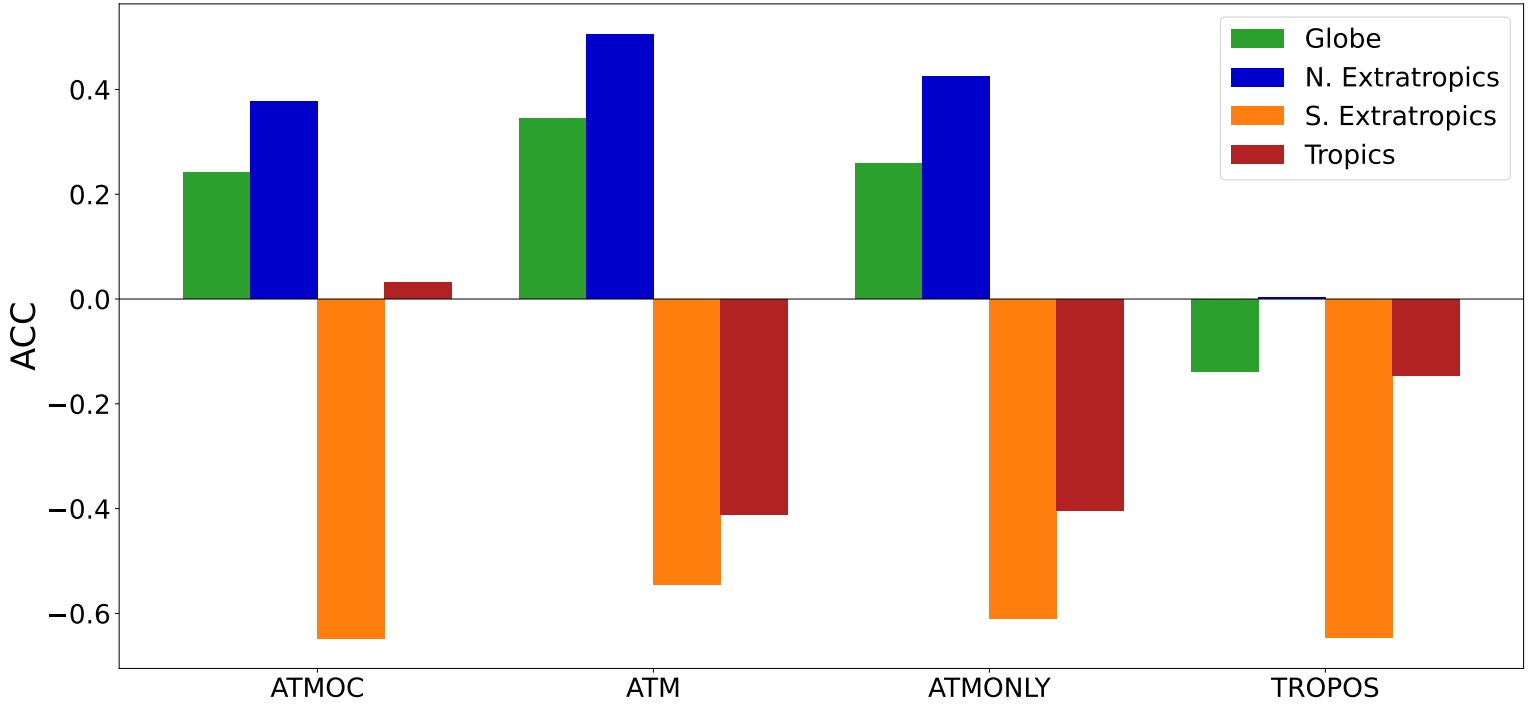
- TROPOS anomalies show significant difference with all ATM experiments anomalies

NAO index calculated on INMCM5 experiments data



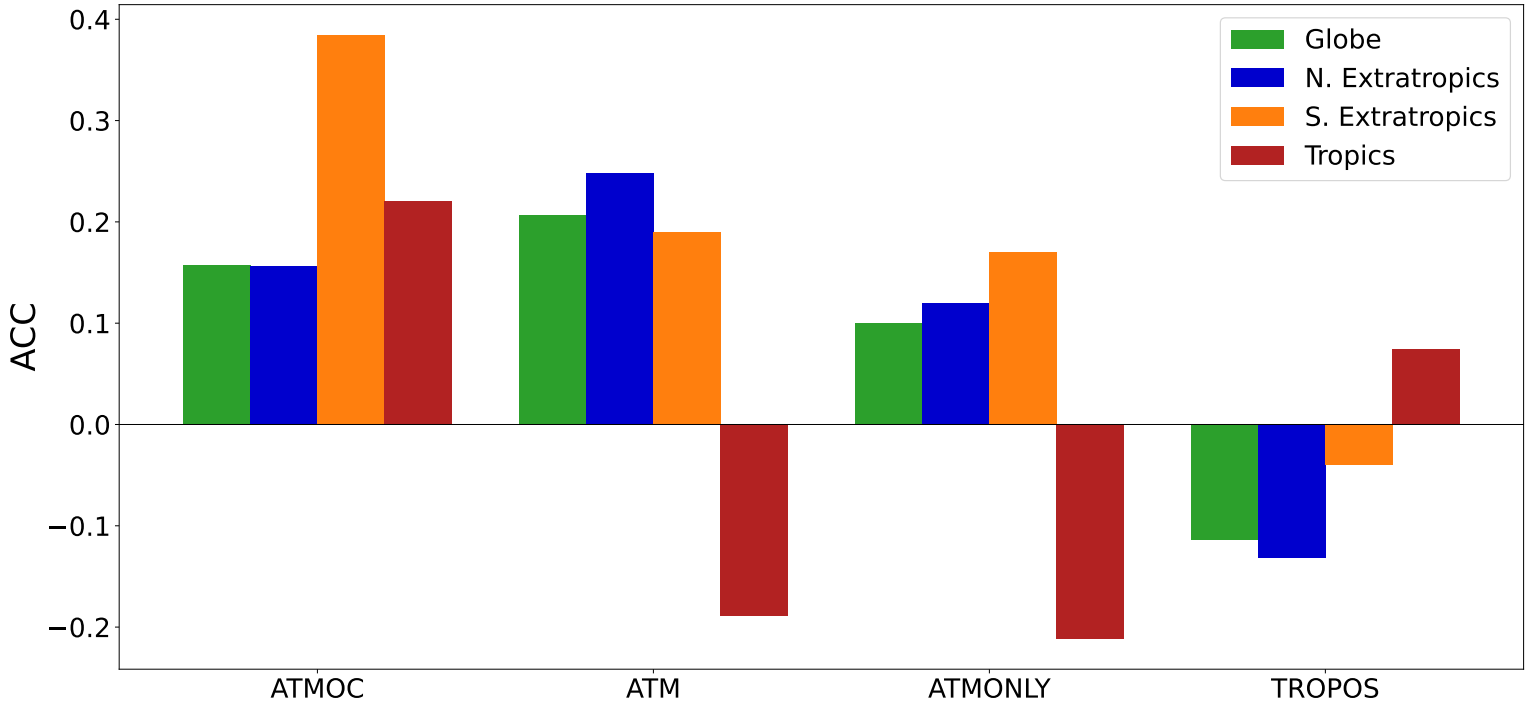
95% confidence intervals for INMCM5 ensemble mean DJF NAO index values

Quality assesment for SLP in different experiments



	ACC					RMSE				
	Nov	Dec	Jan	Feb	Win	Nov	Dec	Jan	Feb	Win
ATMOC	0.54	0.13	−0.06	**0.33**	0.24	3.44	**3.52**	3.83	**4.50**	3.21
ATM	0.55	**0.48**	**0.14**	0.07	**0.34**	3.43	**3.16**	**3.65**	4.70	**3.14**
ATMONLY	**0.56**	0.26	0.04	0.12	0.26	**3.41**	3.37	3.75	4.68	3.20
TROPOS	**0.06**	**0.09**	**−0.17**	**−0.03**	**−0.14**	**4.32**	3.50	**3.85**	**4.76**	**3.44**

Quality assesment for T2m in different experiments



	ACC					RMSE				
	Nov	Dec	Jan	Feb	Win	Nov	Dec	Jan	Feb	Win
ATMOC	0.39	−0.03	**0.23**	**0.24**	0.16	1.43	**1.88**	**1.60**	**1.87**	1.53
ATM	0.33	**0.11**	0.20	0.24	**0.21**	1.41	**1.67**	1.61	1.89	**1.49**
ATMONLY	**0.44**	−0.05	0.10	0.08	0.10	**1.33**	1.75	**1.66**	1.95	1.53
TROPOS	**0.16**	**−0.24**	**0.06**	**0.01**	**−0.11**	**1.55**	1.76	1.66	**1.97**	**1.58**

Conclusion

- Comparison of ATMOC and ATM experiments shows that the anomalies of the ocean initial state are not the main source of the predictability of the NAO index
- Comparison of ATM and ATMONLY experiments shows that the anomalies of land surface initial state have no effect on the NAO index predictability
- TROPOS experiment demonstrates that initial state anomalies in the stratosphere are responsible for the NAO index predictability for the 2009–2010 winter season
- ATM experiment shows the best quality of SLP and T2m winter forecasts both over the Globe and in the Northern Extratropics

Thank you for attention!