Study of the PDO index predictability for 1 to 5 years with INMCM5

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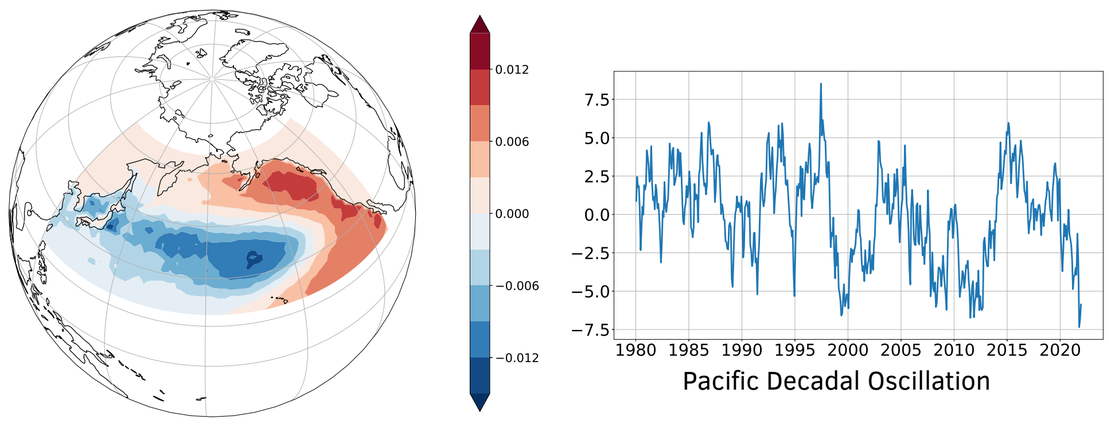
Introduction



The leading EOF

PDO is recurring change in ocean and atmospheric climate in the mid-latitude Pacific Ocean. During positive phase, the western Pacific becomes colder and part of the eastern Pacific becomes warmer; during negative phase, the opposite pattern occurs.

The PDO index is defined as the projection of monthly mean sea surface temperature anomalies on their first EOF in the North Pacific.

Task description

reanalyses data for atmosphere and land surface (ERA5), and ocean (SODA3.4.2) → initial states on November 1 ← model climatology

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INMCM5
atmosphere — $2^\circ \times 1.5^\circ$, 73 σ-levels
ocean — $0.5^\circ \times 0.25^\circ$, 40 σ-levels

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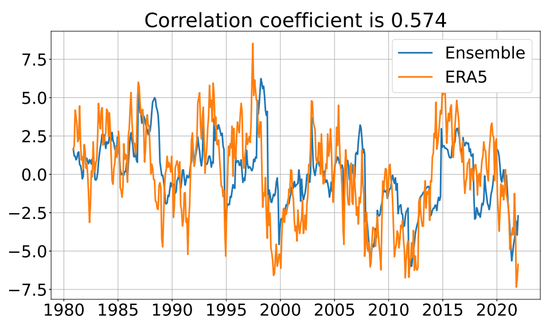
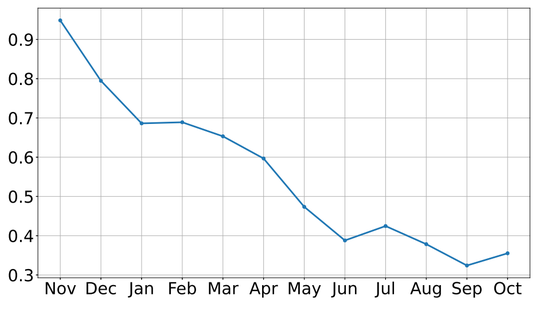
hindcasts for 62 months, 10 ensemble members with small perturbations in the initial state of the atmosphere

First year forecast



PDO based on reanalysis and ensemble data.

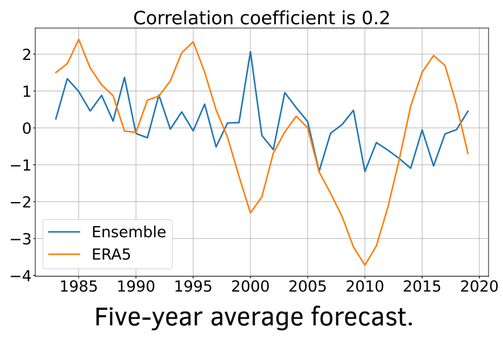


Dependence of the correlation coefficient on the month.

We observe correlation decrease from nearly 1.0 in November to 0.355 in October. This indicates a moderate decline in consistency between forecasted and actual PDO index values over the annual forecast period of the model.

Link to this poster

1-5 years forecast

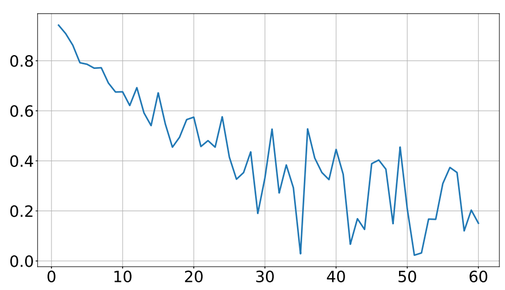


Five-year average forecast.

Year	Correlation coefficient
1	0.535
2	0.21
3	0.108
4	0.089
5	0.003

Correlation coefficients show that for the first two years of forecast, the statistical relationship between predicted and actual PDO-index is fairly well. This indicates a good predictability of PDO-index for this period.

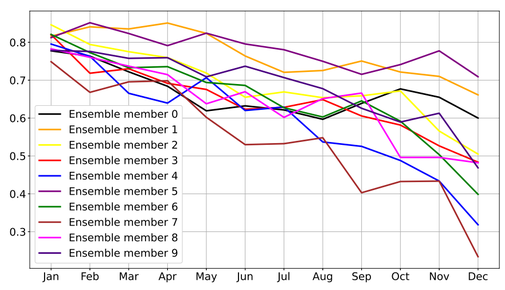
Inertial forecast



Dependence of the correlation coefficient on the earliness of the forecast.

There is a better correlation than for the forecast made with the model. However, when number of months increases from 1 to 24, the correlation will generally decrease monotonically, and when the number of months increases further, the correlation starts to fluctuate.

Potential predictability



Dependence of the correlation coefficient on the month for different ensemble members.

The resulting correlation coefficients for the first year are higher than the correlation coefficient between the ensemble prediction and the actual PDO index (0.574). This indicates that the INMCM5 climate model has the potential for improvements in PDO index prediction.

Conclusion

1. The INMCM5 climate model can predict the PDO index reasonably well for a period of up to two years.
2. The inertial forecast gives a better correlation with the actual PDO index values. However, a significant decrease in correlation is also observed for a period of more than two years.
3. There is potential for improving the INMCM5 model for predicting the PDO index.

References

[1] Volodin E. M., Mortikov E. V., Kostrykin S. V. Simulation of the present-day climate with the climate model INMCM5

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