

## ***Interactive comment on “Reconciling reconstructed and simulated features of the winter Pacific–North-American pattern in the early 19th century” by D. Zanchettin et al.***

### **Anonymous Referee #2**

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Review of

Reconciling reconstructed and simulated features of the winter Pacific–North-American pattern in the early 19th century

by D. Zanchettin et al.

General comment

The paper investigates the PNA variability in several model simulations in connection with a tree rings PNA reconstruction. The tree rings reconstruction shows persistent positive values of the PNA index during early part of the 19th century while slightly

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negative PNA values are obtained in an ensemble of state-of-the-art coupled climate simulations for this period. The authors argue that this disagreement is due to the fact that the anomalous positive PNA values during this period are generated by internal processes which, at least their temporal occurrence, are not reproduced by a small ensemble of climate simulations. The authors perform also a model-data comparison and investigate if it is possible to substantially improve the PNA reconstructions based on local geophysical predictors from northwestern North America. The paper is well-written so I think minor revisions are needed before publication in CP. Bellow there are several comments the authors may want to consider to improve their paper.

Specific comments

1. Pg. 4430. Ln. 23-25 Because the authors argue that volcanic activity can play a role in anomalous positive PNA values from early 19th century, an aspect not discussed in TT2010 paper, it would be useful at this point to have more information in the manuscript about the processes behind volcanic activity and PNA dynamics.
2. Pg. 4430. Ln. 20-25. It is argued that anomalous long period of positive PNA index during early 19th century could be related to both low solar activity (Dalton minimum) and strong volcanic activity. Is this coincidence unique in the observational and simulated periods considered in this study?.
3. Pg. 4432. Ln. 1-5. Usually the anomaly centers of teleconnection patterns in model simulations are located in different positions, according to model characteristics. Therefore is better to define the PNA index according to model characteristics, usually through an EOF analysis of Z500 in the Pacific North American sector. Is the PNA the dominant pattern of Z500 winter variability in the Pacific North American sector in the model simulations? Furthermore, are the results presented in the paper sensitive to the definition of the PNA index?
4. Pg. 4433. Ln. 17-19. Please define clearly the three regions over the North America used for pseudo-reconstructions.

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5. Pg. 4435, Ln. 9-10. It is expected to have a PNA like structure in all models due to the definition of the PNA index. An EOF analysis of Z500 in the Pacific North American region would confirm better if the PNA structure is captured or not in the model simulations.

6. Pg. 4437. The paper is focused on TT2010 PNA reconstruction which is based on three tree ring records. As the relationship between tree ring variability and climate forcing present strong seasonal characteristics, would be interesting to see if significant simulated temperature or precipitation anomalies are recorded over northwestern North America during early 19th century not only in winter (Fig. S11) but also in other seasons. The TT2010 tree rings records are significantly correlated with temperature and precipitation not only from winter but also from other seasons. In fact the highest correlation is obtained for MTE tree ring record and summer temperature (Fig. 2 from TT2010). Therefore the anomalous reconstructed PNA values during early 19th century could reflect also the autumn, spring or summer temperature or precipitation anomalies from the northwestern North America.

7. Pg. 4436: It would be useful to investigate systematically the stability of the correlation of the PNA index and temperature and precipitation from model grid points over northwestern North America by drawing running correlation curves similar to those represented in Figure 5 for climate indices. Selection of the temperature and precipitation anomalies from the grid-points where the correlation is stable, according to a certain stability criteria, as predictors could lead to an improvement of PNA reconstruction.

8. Pg. 4438. It would be useful to give some hints related to physical processes that explain the negative correlation between PNA and NAO in most of the simulations (Fig. 5b).

#### Technical notes

1. Pg. 4428. Ln, 19. Please correct the period of Dalton minimum ( ~ 1790-1830)
2. The labels of the axis from most of the figures are too small. Also there are many

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curves on the same figure and is difficult to identify them only by color.

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