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Reconstructing the AMV to evaluate the role of internal variability in the last millennium large-scale climatic variations

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Modes of climate variability strongly impact human society. Calculated from instrumental data, they influence meteorological conditions in various regions. Nevertheless, these modes remain poorly known due to the short time frame of the instrumental measurements, which prevents a robust statistical evaluation of their properties (spectrum, stability of teleconnections, ...). Of particular interest, the Atlantic Multidecadal Variability (AMV) is believed to strongly influence the Atlantic bordering regions. Nevertheless, lots of debates remains concerning its characteristics, and notably the role of its internal variability and of the external forcing in its recent variations.
Using the Pages2K database, we propose here new ensemble reconstructions of the AMV index between 850 and 1970. To evaluate robustness of the results, we use various statistical methods, some of them that has not been used yet in climate science. The state-of-the-art regression methods are: Principal Components Regression, Partial Least Square, Elastic Net and Rand Forest. In order to extract the most reliable, the different reconstructions have been compared over a validation period by using random sampling, cross validation algorithms and bootstrap methods. The best reconstruction of the AMV obtained with assembled random forests is based on the internal estimate of the AMV over the historical era, and is therefore significantly different from others that were including the external forcing over the learning period. It shows that the AMV significantly drops after strong volcanic eruptions, while its response to total solar irradiance remains very weak over the whole reconstruction period. Moreover, the reconstruction suggests a strongly positive phase between 900 and 1200, followed by a negative phase until 1450. Since our reconstruction is mainly driven by internal variations, we argue that such intrinsic variations of the climate, possibly related with internal variability of the Atlantic meridional Overturning Circulation, may explain large-scale climatic variations such as the Medieval Climate Anomaly and the Little Ice Age sequences.