

INTRODUCTION

Local to regional climate anomalies at different timescales are to a large extent determined by the state of the atmospheric circulation. Therefore, knowledge of past large-scale Sea Level Pressure (SLP) over longer timescales is of great importance in order to understand past variations of temperature and precipitation. Gridded data sets of the atmospheric circulation over larger geographical areas provide more internally consistent and spatially coherent insights into climatic variability than (univariate) circulation indices (e.g. the North Atlantic Oscillation). In order to capture also the pressure conditions over the oceans and particularly the position, strength and variations of the Azores High and the Icelandic Low, information from marine areas are crucial. In this study, marine wind information derived from ship logbooks (2) and terrestrial instrumental station pressure series are combined for the first time to obtain an improved, seasonally resolved SLP field reconstruction over the North Atlantic, Europe and the Mediterranean back to 1750.

DATA AND METHODS

The following data pre-processings have been applied to ensure an optimal use of the two data sources:

1) Instrumental station pressure series are checked for quality and homogenised if necessary.

2) Wind information from CLIWOC (1750-1849, (2)) and ICOADS (1850-2002, (3)); both aggregated into 8°x8° gridboxes) are preprocessed to ensure similar quality. This is achieved by sampling the full ICOADS dataset according to the average availability in the CLIWOC period (“degradation”) and by using only the years with at least three records available (“optimisation”).

To obtain a climate field reconstruction, these data were related to the gridded SLP reanalysis by (4) over the 1887-2002 period using multivariate regression of the leading principal components. See Fig. 1 for an overview.

RESULTS

Fig. 2 illustrates the performance of our SLP reconstruction during three winters with distinctively different data availability: While there are many logbooks (blue shaded boxes) but hardly any instrumental series (red dots) available in winter 1750 (top left), only a few CLIWOC wind data (blue shaded boxes) but many instrumental series are prevalent in 1830 (middle left). A spatially well distributed predictor network is found for winter 1843 (bottom left). These changes in the predictor network are clearly reflected in the skill values (right column) indicating high skill over the regions of good data availability. Accordingly, reduced skill is found over Eastern Europe in 1750 and over the North Atlantic in 1830. Nevertheless, the obtained SLP fields (Fig. 2, middle column) are dynamically reasonable, since winter 1750 was a wet (dry) and warm winter in Scandinavia (Europe), while winter 1830 (1843) was one of the coldest (warmest) European winters over the past 500 years (5,6).

CONCLUSION

This study clearly shows the potential of ship logbook based wind information to significantly improve reconstructions of past atmospheric circulation particularly over the open sea where usually only limited data are available. Therefore, better representations of the driving centers of atmospheric circulation (Azores High and Icelandic Low) can be achieved which is of particular use in dynamical studies relating changes in temperature and precipitation to the state of the atmosphere. There are huge amounts of yet undigitised ship log information particularly in British archives with the potential to improve and extend SLP reconstructions even further back in time.

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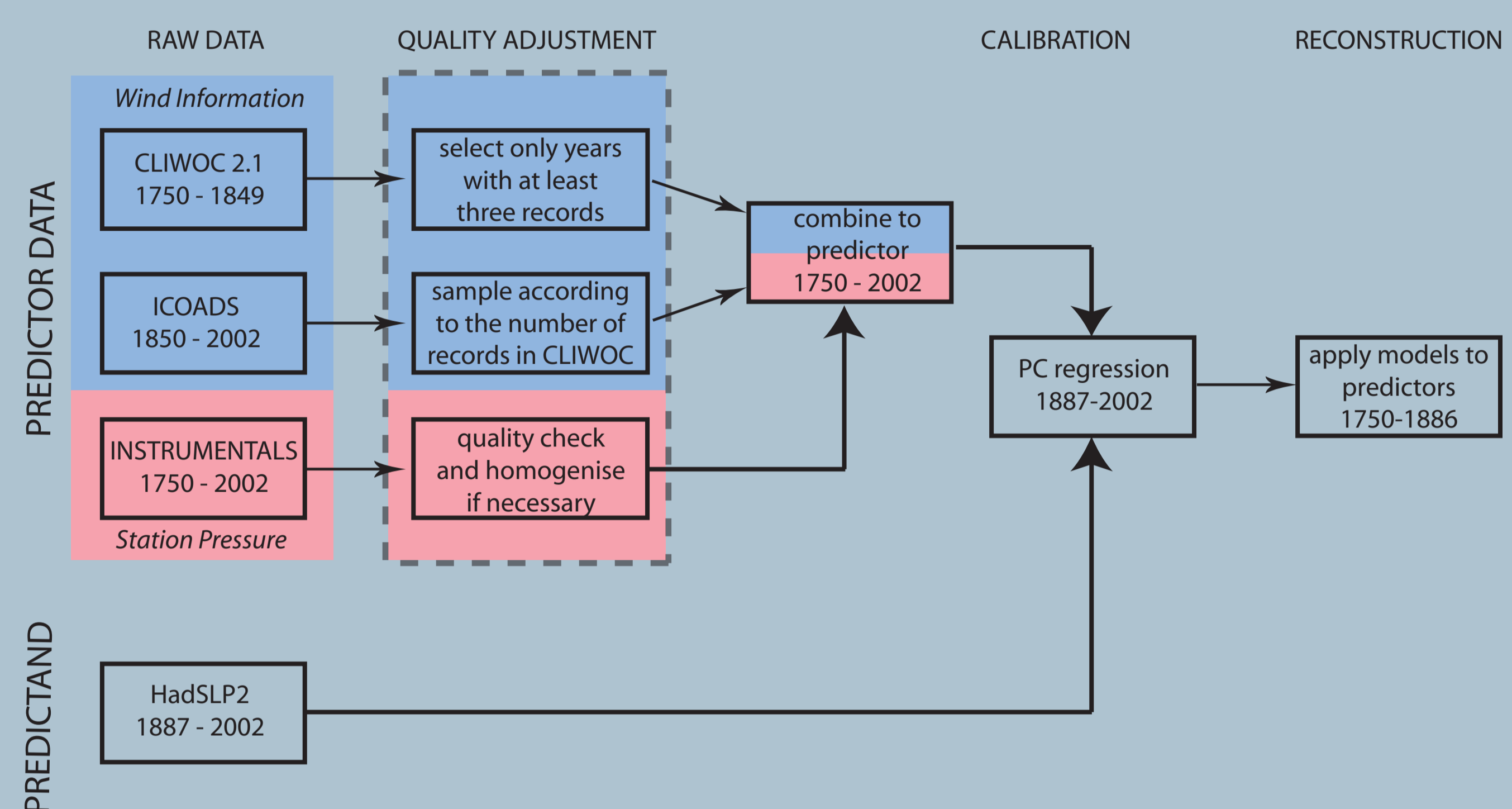


Fig. 1: Scheme of the data pre-processing and reconstruction methodology applied to reconstruct seasonal North Atlantic, European, and Mediterranean SLP back to 1750. The predictor data (wind information derived from logbooks, blue; instrumental station pressure series, red) were pre-processed to assure a good quality. See text for details. The predictor and predictand (4) are related to each other during the calibration period 1887-2002 using ordinary least square regression of the leading EOFs. The derived models are finally applied to the predictor data in the period 1750-1886.

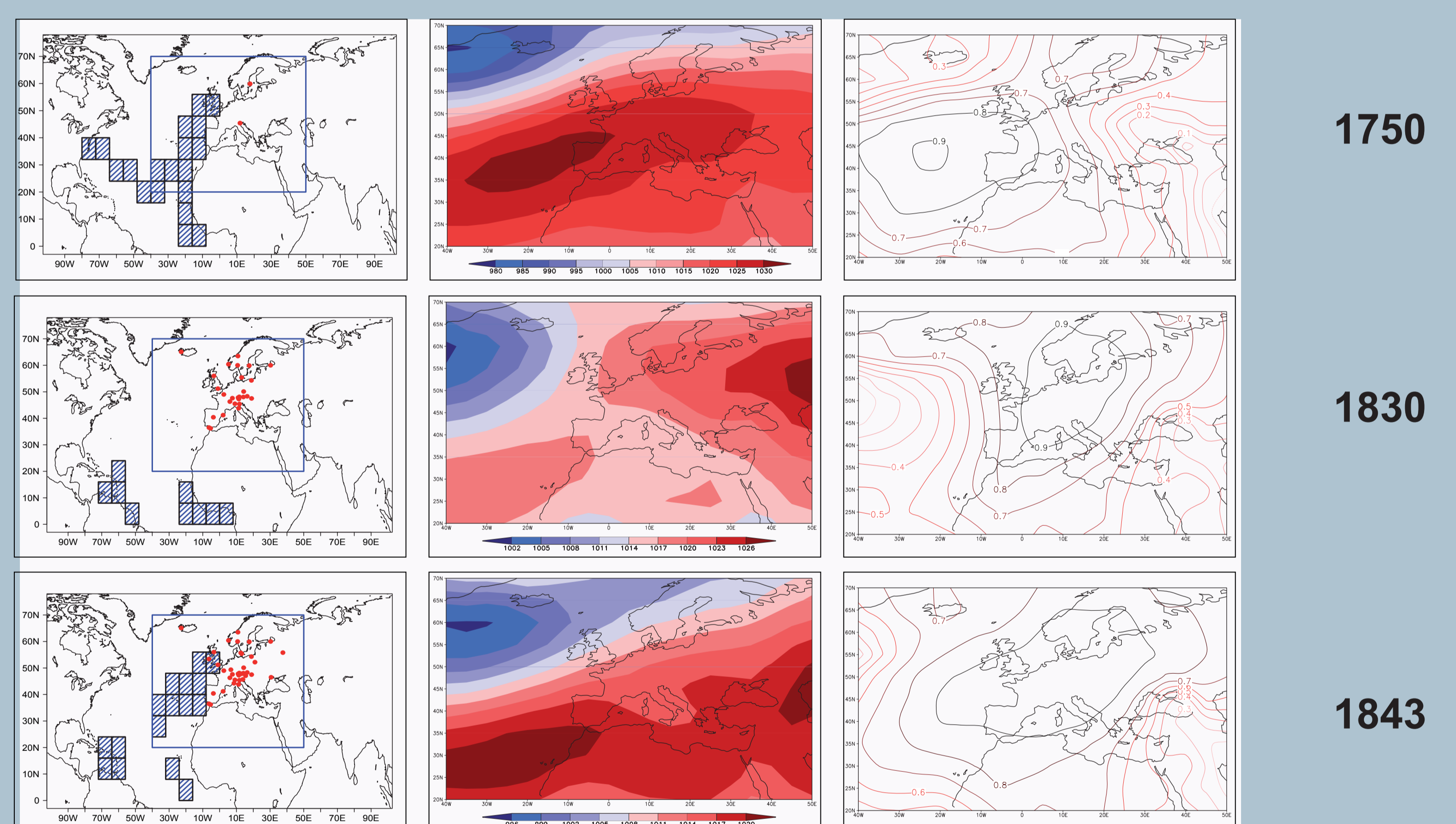


Fig. 2: Predictor network (left column; blue shaded boxes denote CLIWOC wind information, red dots refer to instrumental station pressure series), reconstructed SLP field (middle column), and reconstruction skill expressed as Reduction of Error values (right column) for winters 1750 (top row), 1830 (middle row) and 1843 (bottom row).

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