Arctic2k: Spatiotemporal Temperature Reconstruction

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Sami Hanhijärvi
Department of Environmental Sciences, University of Helsinki, Finland; sami.hanhijarvi@helsinki.fi

The Arctic2k Working Group aims at elucidating the variability of the arctic climate in the past to provide a reference context for the recent rapid warming in the region. Thirteen Working Group members attended the workshop, reviewed the collected proxy records and the preliminary temperature reconstructions made thereof, and prepared the groundwork for a publication on results and methods.

While the arctic region was found to feature many proxy records covering much of the area between 60° and 80° northern latitudes, records further north are virtually non-existent. When the collected records were subjected to the stringent selection criteria set in the previous Working Group workshop (Hanhijärvi 2011), the number of acceptable records was reduced by a large fraction. Furthermore, the temporal extent of the selected records is generally short, so that the coverage diminishes rapidly when going back in time. Figure 1 shows the spatial and temporal extent of proxy records used for the Arctic2k project. Both spatial and temporal sparsity had to be taken into account when carrying out the reconstructions.

The correlations between the gathered proxy record data were presented and analyzed, and the amount of shared signal between the records compared. The same procedure was repeated with the NASA GISS instrumental temperature station data (Hansen et al. 2006) and between the proxy records and instrumental data. The analyses displayed significant correlations between many of the records, indicating that the reconstructions will reflect a real climate behavior.

The proxy data are inherently heterogeneous and the records have different temporal resolutions. Interpolation was discussed and was shown to be a suboptimal solution for unifying the temporal resolution. Instead it was suggested that the proxy records are used in their original resolution while considering each sample (e.g. slice of a core) of a proxy record to represent a time frame, and to use reconstruction methods that can handle such data.

Two new methods, PaiCo (Pairwise Comparisons) and MuReMo (Multi-Resolution Monotonic), were presented, both of which can handle data of various resolutions in their original format. Furthermore, both methods use the assumption that the transfer functions from climate parameter to proxy are monotonic, instead of linear, unlike all other approaches. PaiCo is a new, yet unpublished method that can calculate the most likely common climate parameter time series from a collection of proxy records. MuReMo combines the idea of PaiCo with the Bayesian model of BARCAST (Tingley and Huybers 2010) to reconstruct spatiotemporal fields. The qualitative properties of these methods compare favorably with the existing methods, and will thus be used for calculating the climate reconstructions. Preliminary results were coherent with the existing knowledge about the arctic climate, and therefore considered promising.

The next research milestone of the working group is to finalize the reconstruction of the arctic temperatures during the past 2000 years. As Kaufmann et al. (2009) have already presented a similar reconstruction, it was decided that an important goal would also be the calculation of a spatial temperature field for the Arctic. This will build upon the previous knowledge and reveal spatial climate patterns.

References

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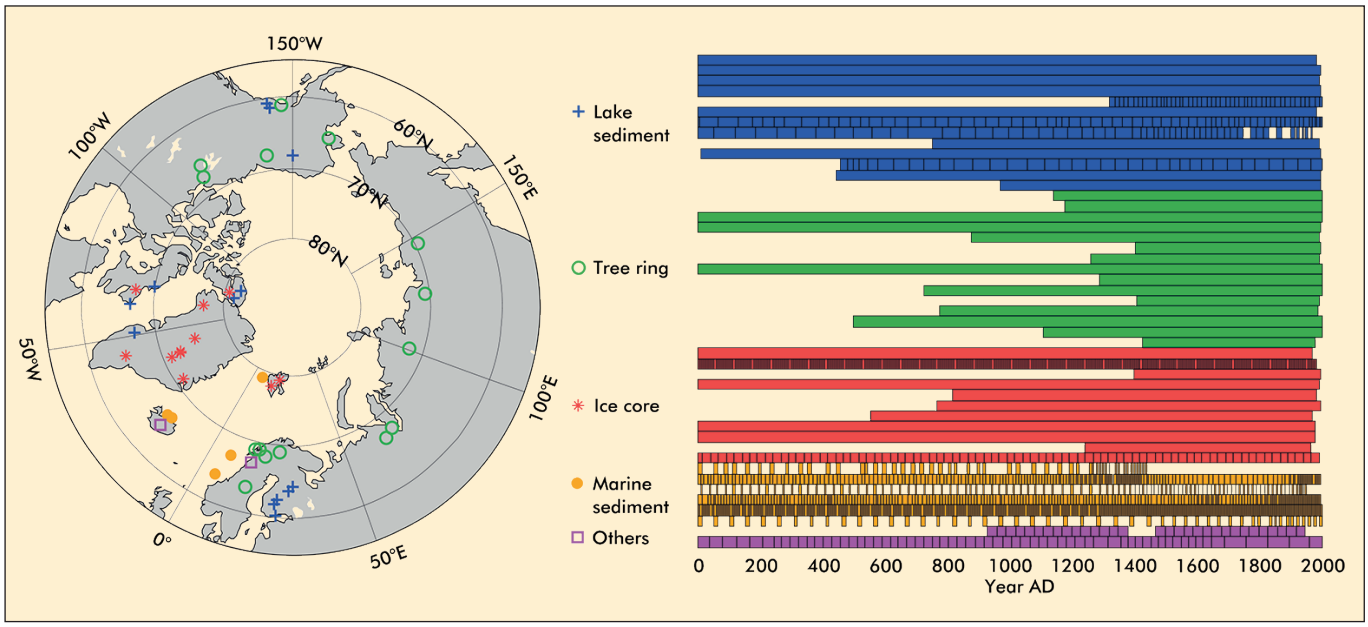

Figure 1: Spatial and temporal distribution of the Arctic2k proxy records. Single solid box in temporal extent signifies annual resolution. Otherwise, each box represents the time frame of a single value of a single proxy record. Records have been truncated prior to 1 BC. All proxy series in this figure are or will be archived on the NOAA paleoclimatology database.