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Neural Networks applied on multi-proxies from coral skeleton

A. Juillet-Leclerc (1), S. Thiria (2)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Gif sur Yvette, France, (2) LOCEAN, Paris, France (Anne.Juillet@lsce.cnrs-gif.fr)

In Tropical Ocean, instrumental seasurface temperature (SST) and salinity (SSS) measurements are limited to the last 50 years. It is in this area where the dramatic climatic change, El Niño-Southern Oscillation (ENSO), takes place. The mechanism of this climatic event that has global incidences is not yet identified. In order to encompass instrumental data and better understand the interannual fluctuations as well as interdecadal ones we need accurate "proxies". Coral skeleton provides the best-suited material: it is made of aragonite which allows several geochemical tracers to be recorded, a monthly resolution is possible and the time covered by these data sets may be several centuries. The most critical point in term of accuracy is the conversion of geochemical data into environmental parameters. Up to now, empirical relationships preliminary established from calibrations, were used. But, this material is deposited under biological control and captures both biological and environmental parameters. No proxy is a pure environmental tracer; all of them include several biological and external factors.

All the proxies measured on a single colony are submitted to the same biological filter. This is the reason that we choose a Neural Network (NN) to separate the factors from seven proxies measured on a single coral. This treatment may be applied for long records, the monthly resolution providing enough data. The first step is the NN learning over a period displaying instrumental data for each environmental parameter. It provides a calibration which remains hidden but which allows to reconstruct the past conditions. However, NN is not really regarded as a black box, because in parallel we look for understanding the mechanism of aragonite deposit. These studies drove us to realize that the geochemical records are not linear during the time, which has been confirmed by statistics.

This new approach is illustrated by the conversion of multi-proxies (oxygen and carbon isotopes, trace elements and density) measured on a coral core from Fiji into interannual and seasonal SST and interannual SSS. However, this method could be also adapted to other multi-proxies systems.