The CO_2 – temperature phasing analyzed using the wavelet transform

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Is a PhD foreseen? Yes

It is at our time one of the most discussed physical relationship, not only in the scientific world, but also among the policy makers and the public, given the planetary issues on the future of our climate (see for example the conference on climate at Paris in December 2015). The aim is to understand what is the sensitivity of the climate to a modification of the CO_2 concentration in the atmosphere. Several approaches are possible to validate this relationship and its application to the future, in particular the coming century. Speaking of observations, we have the direct atmospheric measurements since approximately 1850 (the so-called instrumental period) and we also have the climatic archives preserved in the marine, continental or glacial sedimentary layers. The glacial sediments from Antarctica allow reconstructing the atmospheric CO_2 concentrations based on the air bubbles enclosed in the ice. It is a subject for which LGGE has acquired a strong expertise and reputation at an international level.

We have discovered that during the last deglaciation, approximately 20,000 to 10,000 years ago, CO_2 and Antarctic temperature have varied approximately in phase (Parrenin et al., 2013). This observation constitutes an important step toward the understanding of the sensitivity of climate to changes of atmospheric CO_2. We now would like to use a mathematical method called wavelet decomposition (Mallat, 1989) which should allow to understand the phase relationship between CO_2 and Antarctic temperature during various time periods and at various periodicity. It should in particular allow to analyze how the phase relationship varies with the considered periodicity, each periodicity being characteristic of a certain class of climatic mechanisms.

This project could naturally constitute the start of a larger PhD project focused on the improvement of ice core chronologies and on the analyzes of leads/lags in the ice core records. A proposal on this subject will be submitted to the French National Research Agency (ANR). The PhD work will therefore be funded if the proposal is accepted.

Mallat, S. G.: A theory for multiresolution signal decomposition: the wavelet representation, Pattern Anal. Mach. Intell. IEEE Trans. On, 11(7), 674–693, 1989.

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