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Dating ice cores by local insolation tuning

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Ice cores are providing a wealth of past climatic and environmental information. Nevertheless an accurate chronology is needed for interpreting the paleoclimatic record and understanding the relation between insolation and climate. In 2002, a new domain of research in this area has been stimulated by the work of M. Bender [1] linking the record of O2/N2 ratio in the air trapped in the Vostok ice with the local insolation. Bender proposed to use this property to date in an absolute manner the long ice records, opening the way to estimate accurately leads and lags between local climate recorded in Antarctica and Northern Hemisphere solar forcing. Since then the method has been tested on several ice cores and the air content in ice has been proposed as another proxy of local insolation. Air content and O2/N2 ratio records show differences in their orbital signature (dominant precession for O2/N2 and dominant obliquity for air content) and the dating obtained by using each of the proxies has not yet been tested on the same ice core.
We present here a new air content record from the Vostok ice core and compare it with the published Vostok O2/N2 records by using the same spectral analysis methods over the same time period in order to assess how robust is the spectral difference observed between the two properties. We will choose the most appropriate insolation targets for accounting for the spectral characteristics of O2/N2 and air content and finally compare the two chronologies derived from air content and O2/N2 in the Vostok ice core. The uncertainties and current limitation of the method will be presented. The results obtained strongly add credibility to the air content and O2/N2 ratio of the air trapped in ice as reliable and complementary tools for accurate dating of existing and future deep ice cores.

[1] Bender, M.: Orbital tuning chronology for the Vostok climate record supported by trapped gas composition, Earth Planet. Sci. Lett., 204, 275-289, 2002.