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The methane record of Daansgard-Oeschger event 17 in Vostok 4G-2 ice core: effects of layered bubble trapping and smoothing

Kévin Fourteau (1), Xavier Faïn (1), Patricia Martinerie (1), Amaëlle Landais (2), Alexey A. Ekaykin (3), Vladimir Ya. Lipenkov (3), and Jérôme Chappellaz (1)

(1) Univ. Grenoble Alpes, CNRS, IRD, IGE, F-38000 Grenoble, France, (2) Laboratoire des Sciences du Climat et de l'Environnement, UMR8212, CEA-CNRS-UVSQ-UPS/IPSL, Gif-sur-Yvette, France, (3) Climate and Environmental Research Laboratory, Arctic and Antarctic Research Institute, St. Petersburg, 199397, Russia

This work aims to characterise and quantify the modification and loss of past atmospheric information recorded in ice cores due to gas trapping mechanisms. For this purpose a very high resolution methane record of the DO event 17 in Vostok 4G-2 ice core has been measured by continuous flow analysis and laser spectroscopy. This is the first time that the gas of a very low accumulation core, about $1.3\,cm.yr^{-1}$ ice equivalent, is measured using a continuous method. The measurements reveal numerous anomalous layers a couple of centimetres thick. These anomalous layers differ in methane mixing ratio from adjacent layers by about plus or minus 50ppbv. Their amplitude and uneven distribution along the ice core can be reproduced by a simple layered bubble trapping model. After removing the layering anomalies, the DO 17 recorded in the Vostok core is clearly smoother than in the WAIS Divide record, a much higher accumulation rate site. This is consistent with previous observations and general understanding, since high accumulation firns sink and densify faster and the trapping phase of gases is less spread over time. However the smoothing of the DO event in the Vostok ice core turns out to be less important and to contain higher frequencies than expected. Finally we developed a method to infer the gas age distribution enclosed in ice cores by comparison with a high frequency atmospheric scenario, such as the WAIS Divide record. This approach allows to constrain gas age distributions in climatic conditions which have no modern analogue.