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New developments in laser spectroscopy for water vapor isotopic measurement along the Dumont-d'Urville – Dome C transect

Content

Water isotopes measurements in polar ice cores are key to reconstruct past climatic variations. However, an increasing number of studies show that the relationship between surface temperature and water isotopic composition is not straightforward because snow isotopic composition is influenced by many factors in addition to local temperature of condensation (evaporation origin, trajectory of moist air, post deposition effects). In order to refine this interpretation, parallel observation of water vapor and surface snow isotopic composition in polar regions, at the site of ice core drilling is essential.

Measuring atmospheric water isotopic composition is however an important challenge, especially in dry places like the East Antarctic plateau where water mixing ratio can be as low as 10 ppmv. Laser spectrometers based on the cavity ring-down spectroscopy (CRDS), commonly used for field measurement, fail to precisely measure water vapor isotopic composition for the lower range of water mixing ratios recorded in East Antarctica.

The optical feedback cavity enhanced absorption spectroscopy (OF-CEAS) technique, recently implemented for atmospheric isotopic measurement, offers a good alternative for low humidity detection. We present here results obtained with this OF-CEAS technique, which shows an improved limit of detection compared to usual CRDS commercial instruments, while keeping a high stability, and a low humidity dependence.

This work is part of the AWACA ERC project, in which we intend to install several of these analyzers based on the OF-CEAS technique, in three remote sites situated along the Dumont-d'Urville – Dome C transect, in addition to the two staffed installations at Dumont-d'Urville and Dome C. The instruments will operate autonomously and continuously measure the isotopic composition of water vapor and snow precipitation, during three years, with a yearly maintenance and calibration.

Primary authors: Dr CASADO, Mathieu (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, F rance); Dr FOURRÉ, Elise (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, F rance); Dr LANDAIS, Amaëlle (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, F rance); Dr LAUWERS, Thomas (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, F rance); Dr ROMANINI, Daniele (CNRS, LIPHY, 38000 Grenoble, F rance); CATTANI, Olivier (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, France); JAULIN, Kévin (AP2E); JOSSOUD, Olivier (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, France); Dr MASSON-DELMOTTE, Valérie (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, France); PRIÉ, Frédéric (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif--sur-Yvette, France); Dr STOLTMANN, Tim (AP2E)

Presenter: Dr LAUWERS, Thomas (Laboratoire des Sciences du Climat et de l'Environnement – IPSL, UMR 8212, CEA-CNRS-UVSQ, Gif-sur-Yvette, France)

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