

EGU23-12978, updated on 25 Apr 2024

<https://doi.org/10.5194/egusphere-egu23-12978>

EGU General Assembly 2023

© Author(s) 2024. This work is distributed under the Creative Commons Attribution 4.0 License.



SPECIES: a balloon-borne and airborne instrument coupling infrared lasers with Optical Feedback Cavity Enhanced Absorption Spectroscopy technique for atmospheric in-situ trace-gas measurements

Valéry Catoire¹, Patrick Jacquet¹, Michel Chartier¹, Daniele Romanini², Gisèle Krysztofiak¹, Irène Ventrillard², and Claude Robert¹

¹LPC2E, CNRS - Université Orléans - CNES, 45071 Orléans cedex 2, France (valery.catoire@cnrs-orleans.fr)

²LIPhy, CNRS – Université Grenoble Alpes, Grenoble, France

The balloon-borne and airborne instrument SPECIES (SPECtromètre Infrarouge à lasErs in Situ) recently built in our laboratory will be described. This is a mid-infrared absorption spectrometer, including four channels by coupling Interband or Quantum Cascade Lasers (ICLs or QCLs) to Optical-Feedback Cavity-Enhanced Absorption Spectroscopy (OF-CEAS). Using cavities of 50 cm length, this leads to very high resolution ($< 0.005 \text{ cm}^{-1}$) spectra and very long optical paths ($> 5 \text{ km}$) and thus, low detection limits for the trace gases to be measured. It can contribute to the detailed description and understanding of the functioning of the free troposphere and stratosphere in terms of composition, chemical reactivity and circulation of air masses by carrying out fast ($< 2 \text{ s}$) in-situ measurements of reactive trace gases and greenhouse gases among CO, NO_x, CH₂O, ¹²CO₂, ¹³CO₂, CH₄ and N₂O, at very high spatial resolution, i.e. a few meters vertically or hundred meters horizontally. Mini-SPECIES is the lightened version of SPECIES, comprising two lasers coupled to two cavities and reduced electrical power, which allows its integration in aircraft or its operation for long-duration stratospheric balloon flights ($> 4 \text{ days}$). High accuracies are obtained when calibration in flight, or at ground before and after the flight, is performed against standards. In addition to providing reference measurements for calibration/validation of space missions, these performances can lead to in-depth characterization of particular atmospheric processes.