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SPECIES: a multi-channel infrared laser spectrometer with optical-feedback cavity-enhanced absorption for in-situ balloon-borne and airborne measurements

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Over the last decades, thanks to significant technological advances in measurement techniques, our understanding of the chemistry and dynamics of the upper troposphere and stratosphere has progressed significantly. However some key questions remain unsolved and new ones arise in the climate change context. The full recovery of the ozone layer in a period of halogens decrease and N₂O increase (and the delay of this recovery), the impact of the climate change on the stratosphere and the role of this one as a feedback are very uncertain. To address these challenges, one needs instruments able to measure a wide variety of trace gases simultaneously with a wide vertical range, combined to chemical and dynamical modelling at different scales. LPC2E and LIPHY laboratories are developing a new balloon-borne and airborne instrument: SPECIES (SPECTromètre Infrarouge à lasERS in Situ). Based on the Optical Feedback Cavity Enhanced Spectroscopy (OF-CEAS) technique combined with mid-infrared quantum or interband cascade lasers (QCLs or ICLs), this instrument will offer unprecedented performances in terms of vertical extent of the measurements, from ground to the middle stratosphere, and number of molecular species simultaneously measured with sub-ppb detection limits (e.g. O₃, N₂O, HNO₃, NH₃, H₂O₂, HCl, HOCl, CF₂O, CH₄, CH₂O, CO, CO₂, OCS, SO₂). Due to high frequency measurement (>0.5 Hz) it shall offer very high spatial resolution (a few meters).