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AirCore-HR: A high-resolution column measurement to enhance the knowledge on the vertical distribution of CO_2 and CH4

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The AirCore-HR (high-resolution) instrument is a simple and innovative atmospheric sampling system inspired from the NOAA AirCore (Karion et al. 2010). It consists of a 300m long coiled stainless steel tube (200m 1/8 in. and 100m 1/4 in. linked together as one). AirCore-HR allows balloon measurements of GHG vertical profiles (CO_2 & CH4) from the surface up to approximately 30 km. It has been developed at LMD in partnership with NOAA and differs from other AirCores by its high vertical resolution: 100m at the surface up to 200m at 8km, then 100m at 8km up to 1 km at 30 km. AirCores rely on positive changes in ambient pressure for passive sampling of the atmosphere and are flown open at one end and closed at the other. The AirCore-HR closes at landing and the sample is measured with a continuous analyser for trace gas mole fraction.

Our instrument was flown for the first time during the stratospheric balloon campaign operated by the French space agency CNES in Timmins (Ontario, Canada) in August 2014 on the "EdS-Stratéole" flight. The multi-instrument Gondola of this flight carried several instruments, including two others that measured CO_2 & CH4 in situ: the Pico-SDLA (based on laser spectrometry) from GSMA, University of Reims & INSU Division Technique and two other AirCores with lower vertical resolution from Frankfurt University. The simultaneous flight of these instruments under the same balloon allows for direct comparison between the different measurements of mixing ratio profiles. We compare profiles from the AirCore-HR and in situ measurements.

Moreover, AirCores provide extremely innovative means of observation that will provide a priori knowledge on the variations of methane and carbon dioxide for spaceborne total column measurements or model simulations. Here, we show the usefulness of the high vertical resolution in the upper troposphere and stratosphere for interpreting observations of total and partial column of methane and carbon dioxide from current and future spaceborne missions such as: ACE-FTS, IASI, AIRS, GOSAT, or MERLIN as well as from atmospheric transport models.