Geophysical Research Abstracts
Vol. 12, EGU2010-10556, 2010
EGU General Assembly 2010

More evidence for very short-lived substance contribution to stratospheric chlorine inferred from HCl balloon-borne in situ measurements in the tropics

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Hydrogen chloride (HCl) has been measured in situ for the first time in the tropical tropopause layer (TTL) and the stratosphere (Teresina, 5.1°S-42.9°W), with the SPIRALE balloon-borne instrument, an infrared tunable diode laser spectrometer. Two series of vertical profiles obtained at three year interval (June 2005 and June 2008) are presented, from 15 to 31 km height, with very high vertical resolution (5 m). These measurements allow us to study the HCl content of the TTL and the tropical middle stratosphere as well as to estimate the contribution of very short-lived substances (VSLS) to total stratospheric chlorine. Upper limits of HCl vmr as low as 20 pptv in June 2008 and 30 pptv in June 2005 are inferred in the upper part of the TTL, neither influenced by tropospheric nor stratospheric air according to backward trajectory calculations. Taking into account the recently reported VSL source gas measurements obtained in similar conditions (Laube et al., Atmos. Phys. Chem., 2008) and the main intermediate degradation product gas COCl2 (Fu et al., Geophys. Res. Lett., 2007), a total VSLS contribution of 85±40 pptv to stratospheric chlorine is inferred. This refines the WMO (2007) estimation of 50 to 100 pptv, which was not taking into account any HCl contribution. In addition, comparisons of HCl measurements between SPIRALE and the Aura-MLS satellite instrument in the tropical lower and middle stratosphere lead to a very good agreement. The previous agreement between MLS-deduced upper stratospheric total chlorine content and modelled values including 100 pptv of VSLS (Froidevaux et al., Geophys. Res. Lett., 2006) is thus supported by our present result about the VSLS contribution.