Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 9, 9523-9544, 2009
www.atmos-chem-phys.net/9/9523/2009/

Ground-based FTIR and MAX-DOAS observations of formaldehyde at Réunion Island and comparisons with satellite and model data

C. Vigouroux[1], F. Hendrick[1], T. Stavrakou[1], B. Dils[1], I. De Smedt[1], C. Hermans[1], A. Merlaud[1], F. Scolas[1], C. Senten[1], G. Vanhaelewyn[1], S. Fally[2,*], M. Carleer[2], J.-M. Metzger[3], J.-F. Müller[1], M. Van Roozendael[1], and M. De Mazière[1]

[1]Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium
[2]Service de Chimie Quantique et de Photophysique (SCQP), Université Libre de Bruxelles (ULB), Brussels, Belgium
[3]Laboratoire de l'Atmosphère et des Cyclones (LACy), Université de La Réunion, France
[*]now at: Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium

Abstract. Formaldehyde (HCHO) columns have been retrieved from ground-based Fourier transform infrared (FTIR) campaign measurements in 2004 and 2007 and from UV-Visible MAX-DOAS measurements in 2004–2005 at the NDACC site of Réunion Island (21° S, 55° E). The FTIR and MAX-DOAS daily mean formaldehyde total columns are intercompared in their common measurement period, from August to October 2004. The ground-based data are also compared to correlative SCIAMACHY data. The comparisons account for the vertical sensitivity differences of the data sets, by including their respective averaging kernels. Complete error budgets are also presented.

The FTIR and MAX-DOAS daily mean total columns agree very well: no significant bias is observed and the standard deviation of the comparisons is only 8%. Both FTIR and MAX-DOAS HCHO total columns are in good agreement with SCIAMACHY values in the 2004–2005 period, with standard deviations of 21% and 31%, respectively. The same seasonal cycle is observed by the different instruments, with a minimum in austral winter and a maximum in February–March.

The FTIR and MAX-DOAS data are confronted with HCHO columns calculated by a global CTM, the IMAGES model. The model underestimates the HCHO columns by 23–29% in comparison with FTIR, and by 15% in comparison with DOAS. This bias might have multiple causes, including an underestimation of OH concentrations in the model (as indicated by a sensitivity study using prescribed OH fields) and/or an underestimated contribution of large-scale transport of HCHO precursors from Madagascar. The latter hypothesis is comforted by the large observed day-to-day variability of HCHO columns, and by the observation that the peak values of FTIR columns can often be associated with free tropospheric transport patterns from source regions over Madagascar to Réunion Island, according to simulations performed with the Lagrangian particle dispersion model FLEXPART.

Final Revised Paper (PDF, 847 KB) Discussion Paper (ACPD)

Citation: Vigouroux, C., Hendrick, F., Stavrakou, T., Dils, B., De Smedt, I., Hermans, C., Merlaud, A., Scolas, F., Senten, C., Vanhaelewyn, G., Fally, S., Carleer, M., Metzger, J.-M., Müller, J.-F., Van Roozendael, M., and De Mazière, M.: Ground-based FTIR and MAX-DOAS observations of formaldehyde at Réunion Island and comparisons with satellite and model data, Atmos. Chem. Phys., 9, 9523-9544, 2009. Bibtex EndNote Reference Manager