Geophysical Research Abstracts
Vol. 17, EGU2015-4675, 2015
EGU General Assembly 2015

Recent increase of ethane detected in the remote atmosphere of the Northern Hemisphere

Bruno Franco (1), Whitney Bader (1), Benoît Bovy (1), Emmanuel Mahieu (1), Emily V. Fischer (2), Kimberly Strong (3), Stephanie Conway (3), James W. Hannigan (4), Eric Nussbaumer (4), Peter F. Bernath (5,6,7), Chris D. Boone (7), Kaley A. Walker (3,7)

(1) University of Liège (ULg), Astrophysics and Geophysics, InfraRed Group of Atmospheric and Solar Physics, Liège, Belgium (bruno.franco@ulg.ac.be), (2) Department of Atmospheric Science, Colorado State University, Fort Collins, CO, USA, (3) Department of Physics, University of Toronto, Toronto, Ontario, Canada, (4) National Center for Atmospheric Research, Boulder, CO, USA, (5) Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA, USA, (6) Department of Chemistry, University of York, York, UK, (7) Department of Chemistry, University of Waterloo, Ontario, Canada

Ethane (C_2H_6) has a large impact on tropospheric composition and air quality because of its involvement in the global VOC (volatile organic compound) – HO_x – NO_x chemistry responsible for generating and destroying tropospheric ozone. By acting as a major sink for tropospheric OH radicals, the abundance of C_2H_6 influences the atmospheric content of carbon monoxide and impacts the lifetime of methane. Moreover, it is an important source of PAN, a thermally unstable reservoir for NO_x radicals.

On a global scale, the main sources of C_2H_6 are leakage from the production, transport of natural gas loss, biofuel consumption and biomass burning, mainly located in the Northern Hemisphere. Due to its relatively long lifetime of approximately two months, C_2H_6 is a sensitive indicator of tropospheric pollution and transport.

Using an optimized retrieval strategy (see Franco et al., 2014), we present here a 20-year long-term time series of C_2H_6 column abundance retrieved from ground-based Fourier Transform InfraRed (FTIR) solar spectra recorded from 1994 onwards at the high-altitude station of Jungfraujoch (Swiss Alps, 46.5° N, 3580 m a.s.l.), part of the Network for the Detection of Atmospheric Composition Change (NDACC, see http://www.ndacc.org). After a regular 1994 – 2008 decrease of the C_2H_6 amounts, which is very consistent with prior major studies (e.g., Aydin et al., 2011; Simpson et al., 2012) and our understanding of global C2H6 emissions, trend analysis using a bootstrap resampling tool reveals a C_2H_6 upturn and a statistically-significant sharp burden increase from 2009 onwards (Franco et al., 2014).

We hypothesize that this observed recent increase in C_2H_6 could affect the whole Northern Hemisphere and may be related to the recent massive growth in the exploitation of shale gas and tight oil reservoirs. This hypothesis is supported by measurements derived from solar occultation observations performed since 2004 by the Atmospheric Chemistry Experiment – Fourier Transform Spectrometer (ACE-FTS) instrument and at other NDACC sites, namely Toronto (44° N) and Thule (77° N). Indeed, the recent rates of changes characterizing these data sets are consistent in magnitude and sign with the one derived from the FTIR measurements at Jungfraujoch. In contrast, the C_2H_6 time series from Lauder (45° S) shows a monotonic decrease over the last two decades.

Investigating both the cause and impact on air quality of the C_2H_6 upturn should be a high priority for the atmospheric chemistry community.

Acknowledgments:

The University of Liège contribution has mainly been supported by the AGACC-II project of the SSD program of the Belgian Science Policy Office (BELSPO, Brussels). Additional support was provided by MeteoSwiss (GAW-CH), the Fédération Wallonie-Bruxelles and the F.R.S. – FNRS. We thank the International Foundation High Altitude Research Stations Jungfraujoch and Gornergrat (HFSJG, Bern). E. Mahieu is Research Associate with F.R.S. – FNRS. We are grateful to the many colleagues who have contributed to the FTIR data acquisition at the Jungfraujoch station. The Atmospheric Chemistry Experiment (ACE), also known as SCISAT, is a Canadian-led mission mainly supported by the Canadian Space Agency and the Natural Sciences and Engineering

Research Council of Canada. We thank D. Smale from NIWA Lauder for producing and making public the ethane time series at Lauder in the framework of NDACC.

References:

- Aydin M, Verhulst KR, Saltzman ES, Battle MO, Montzka SA, Blake DR, Tang Q, Prather MJ. Recent decreases in fossil-fuel emissions of ethane and methane derived from firn air. Nature 2011;476:198-201. doi:10.1038/nature10352.
- Franco B, Bader W, Toon GC, Bray C, Perrin A, Fischer EV, Sudo K, Boone CD, Bovy B, Lejeune B, Servais C, Mahieu E. Retrieval of ethane from ground-based FTIR solar spectra using improved spectroscopy: recent burden increase above Jungfraujoch. JQSRT, 2014, under review.
- Simpson IJ, Sulbaek Andersen MP, Meinardi S, Bruhwiler L, Blake NJ, Helmig D, Rowland FS, Blake DR. Long-term decline of global atmospheric ethane concentrations and implications for methane. Nature 2012;488:4904. doi:10.1038/nature11342.