Name of research institute or organization:

EMPA, Swiss Federal Laboratories for Materials Science and Technology

Title of project:

Carbon monoxide and molecular hydrogen at Jungfraujoch

Project leader and team:

Dr. Martin K. Vollmer, project leader
Dr. Martin Steinbacher, Dr. Stefan Reimann

Project description:

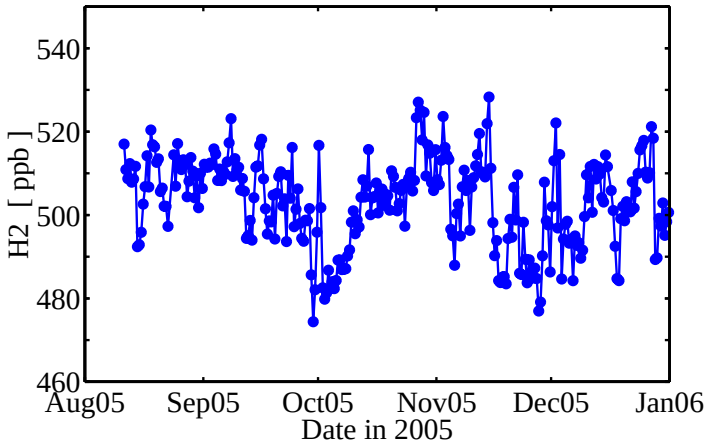
Molecular hydrogen (H_2) has recently become a trace gas of wider scientific interest for various reasons among which is the ongoing discussion on switching our fossil-fuel based economy to a hydrogen-based economy. Such a potential change may result in drastic changes of the atmospheric H_2 budget. However to better predict the impacts of enhanced anthropogenic H_2 usage to the atmospheric H_2 budget, better constraints on the currently poorly known budget are a prerequisite. For this reason attempts are being made to better understand and quantify sources and sinks of H_2 to the atmosphere.

Starting in early 2005, an instrument for the measurement of H_2 and carbon monoxide (CO) was installed at Jungfraujoch. The instrument is a modified RGA-3 (reduction gas analyzer 3, trace analytical) and uses a technique based on gas chromatographic separation followed by mercury oxide reduction and ultra-violet light absorption detection. The modifications of the instrument include the installation of a multiposition selector valve, a nafion drier, a thermally-insulated sample loop, and an internal pressure reducer. Custom-made software is used to control this fully-automated instrument and to store the data. Air sample measurements are currently made every 30 min and are bracketed by standard gas measurements. Nonlinear instrument response was characterized using a dynamic dilution technique coupled with control CH_4 measurements (Vollmer and Steinbacher, internal note) and our results are corrected accordingly. Measurement precisions are about 1.2 % for H_2 and ~1.0 % for CO. Results for CO are linked to the Empa-2001 calibration scale while for H_2, a set of standards is currently used to define an internal scale which we plan to link to an absolute scale. As for CO, our measurements complement two other CO measurement techniques currently operative at Jungfraujoch (Steinbacher et al., 2005).

H_2 results for Aug – Dec 2005 at Jungfraujoch are shown in Figure 1. These data exhibit moderate variability with occasional pollution events which coincide with CO pollution. However there are some events where H_2 (high concentrations) and CO (low concentrations) show opposite behavior indicating transport of CO-depleted air masses. The timeseries is still too short to see any potential interannual trend or a seasonal variability.

CO results are also shown in Figure 1 (right) for the same time period. They show some pollution events and a general increase towards the end of 2005 as part of the seasonal cycle of atmospheric CO. Comparison with CO measurements using GC-

FID (after converting CO to CH_4 via nickel catalyst) technique show good agreement with our RGA-3 results.



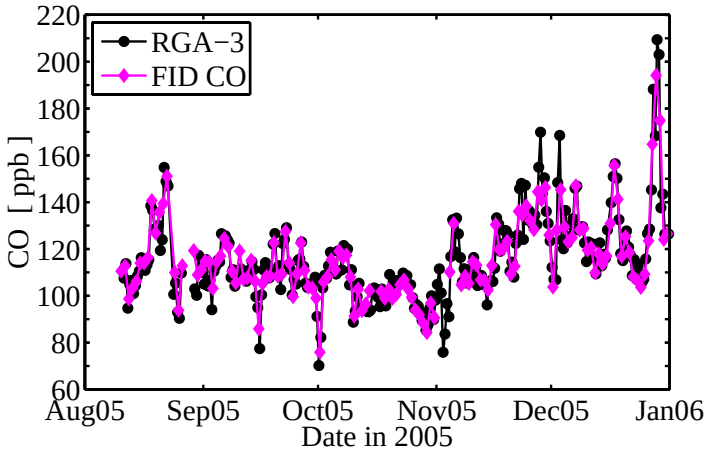


Fig. 1. Atmospheric molecular hydrogen (left) and carbon monoxide (right) at Jungfraujoch given as a mixing ratio in ppb. Data were averaged in 12 hr bins. The CO data are compared with results from a GC FID equipped with a CO-methanizer.

Key words:

Molecular hydrogen, H_2, carbon monoxide, CO

Scientific publications and public outreach 2005:

Conference papers

Steinbacher, M., M.K. Vollmer, and S. Reimann, CO measurements at the high-alpine site Jungfraujoch, Switzerland, Proc. Joint WMO/GAW-Accent Workshop on the Global Tropospheric Carbon Monoxide Observation System, Quality Assurance and Applications, Dubendorf, Switzerland, 24 -- 26 October 2005, Empa Dubendorf, 49-51, 2005.

Address:

EMPA, Section 134
Ueberlandstrasse 129
8600 Dubendorf

Contacts:

Martin K. Vollmer
Tel.: +41 44 823 4242
Fax: +41 44 821 6244
e-mail: martin.vollmer@empa.ch
URL: http://empa.ch/abt134