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A decade of continuous high altitude atmospheric CO_2 isotope ratio (δ13C, δ18O) measurements at Jungfraujoch, CH

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Long-term observations of greenhouse gases provide direct information about their variability and rate of change in the atmosphere. Coupled with atmospheric modelling, these measurements allow identifying specific source and sink regions and processes, especially when co-located observations of stable isotope ratios are available. Here, we present a unique data set of continuous and high-resolution atmospheric carbon dioxide (CO_2) concentrations and δ13C and δ18O isotope ratio measurements spanning over a decade. The measurements are simultaneously performed by a quantum cascade laser absorption spectrometer (QCLAS) [1,2.3] at the High Altitude Research Station Jungfraujoch (Switzerland, 3580 m asl), which is part of the European Integrated Carbon Observation System (ICOS). While the stable isotopes of CO_2 are typically measured off-line by isotope ratio mass spectrometry (IRMS) in discrete air samples, we demonstrate that real-time observations have additional value by capturing hourly and diurnal variations and thereby providing additional insights into the dynamics of atmospheric CO_2. Furthermore, the high data density allows robust statistical filtering [4]. Moreover, backward Lagrangian particle dispersion modelling [5] can be applied to identify background conditions as well as to allocate specific source/sink regions affecting the time series at Jungfraujoch. QCLAS time-series are in excellent agreement with discrete bi-weekly flask samples, analyzed by IRMS at the Max Planck Institute of Biogeochemistry in Jena, which supports the high quality of the laser spectroscopic data. Furthermore, the continuous time series allow deriving recommendations for cost-effective discrete monitoring at ICOS stations. Our synthesis illustrates the potential of this unique data set. Ongoing classification and clustering of the data based on atmospheric transport model simulations is aiming at determining the isotopic signatures of pollution and depletion events and associated implications for the sources and sinks of CO_2.

REFERENCES

[1] Tuzson, B., et al., 2008: High precision and continuous field measurements of δ13C and δ18O in carbon dioxide with a cryogen-free QCLAS, Appl. Phys. B, 92, 451-458.
[2] Tuzson, B., et al., 2011: Continuous isotopic composition measurements of tropospheric CO_2 at Jungfraujoch (3580m a.s.l.), Switzerland: real-time observation of regional pollution events. Atmos. Chem. Phys. 11: 1685–1696.
[3] Sturm, P., et al., 2013: Tracking isotopic signatures of CO_2 at the high altitude site Jungfraujoch with laser spectroscopy: Analytical improvements and representative results, AMT, 6, 1659-1671.
[4] Ruckstuhl, A. F., et al., 2012: Robust extraction of baseline signal of atmospheric trace species using local regression, AMT, 5, 2613-2624.
[5] Stohl, A., et al., 2005: Technical note: The Lagrangian particle dispersion model FLEXPART version 6.2, ACP, 5, 2461-2474.