Project: **677**

Project title: **Evaluierung der Atmosphärenchemie in MECO(n)**

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Report period: **1.1.2014 – 31.12.2015**

The project contained three work packages. Due to the lack of funding the third work package could not be realised in the years 2014/2015.

WP(1): Simulations of tracer transport and mixing processes

The analyses of tracer transport and mixing processes started in and reported for 2013 continued in 2014/15. After the completion of a PhD thesis (Hofmann, 2014) the simulations including the passive tracers and full chemistry studies in the global and the regional model model instance have been repeated. For a peer-reviewed publications this was judged to be necessary due to several reasons: After the finalisation of the ESCIMo simulations, the chemical tracers are now more consistently initialised using the recently calculated ESCiMo simulation RC1SD-base-10a (Jöckel et al., 2015). Additionally the improved emission data set used in ESCiMo could be applied. Last but not least, the regional model was updated to the most recent model version (COSMO v5.0).

In the framework of a case study, stratosphere-troposphere-transport (STT) along a tropopause fold has been analysed using the MECO(n) system. Therefore, an artificial tracer is initialised in the stratosphere in the global EMAC (1.125°) instance, as well as in the regional COSMO/MESSy instance (0.125°).

Figure 1 shows time series of the artificial, stratospheric tracer (top) and ozone (bottom) for EMAC (left) and COSMO/MESSy (right) at Jungfraujoch in Switzerland. While the stratospheric tracer approaches ground level in COSMO/MESSy with mixing ratios above 18 ppbv in COSMO/MESSy, the mixing ratios in EMAC are obviously lower and the strong gradient is missing. This strong gradient, which extends over the entire troposphere, is also visible in the ozone distribution (bottom). Hereby, the increase in ozone around 26 March 15 UTC can be associated to stratospheric air masses, descending along the tropopause fold (Fig. 1, contours) into the troposphere.

The comparison of simulated and observed ozone (not shown) has highlighted the advantage of the COSMO/MESSy instance, which is able to reproduce ozone enhancements occurring due to STT correctly in time, place and amplitude.

WP(2): Simulation of a measurement campaign

During the international aircraft measurement campaign DEEPWAVE (Deep Propagating Gravity Wave Experiment) in July 2014, one flight has been performed to investigate STT in the vicinity of tropopause folding events over New Zealand. Using the model system MECO(n) enables the release of artificial, passive tracers under defined conditions which are helpful to determine the origin of different air masses, time scales and regions of exchange.

In Figure 2, the measured tracers ozone (left) and N_2O (right) are shown along the flight track (green contours). Since N_2O is a tropospheric tracer, which is almost homogeneous distributed in the troposphere, it is compared with the simulated artificial, tropospheric tracer. In contrast, ozone as a tracer with primary sources in the stratosphere, is compared with an artificial stratospheric tracer. The modeled and measured tracers coincide quite well: Almost every time the measured tracers show a stratospheric signal (less values in N_2O resp. high ozone values) the corresponding, simulated tracer shows also a signal.

Due to lacking financial resources and thus less PhD students as well as master students engaged with the investigation of measurement campaigns by far less campaigns have been simulated than anticipated before.

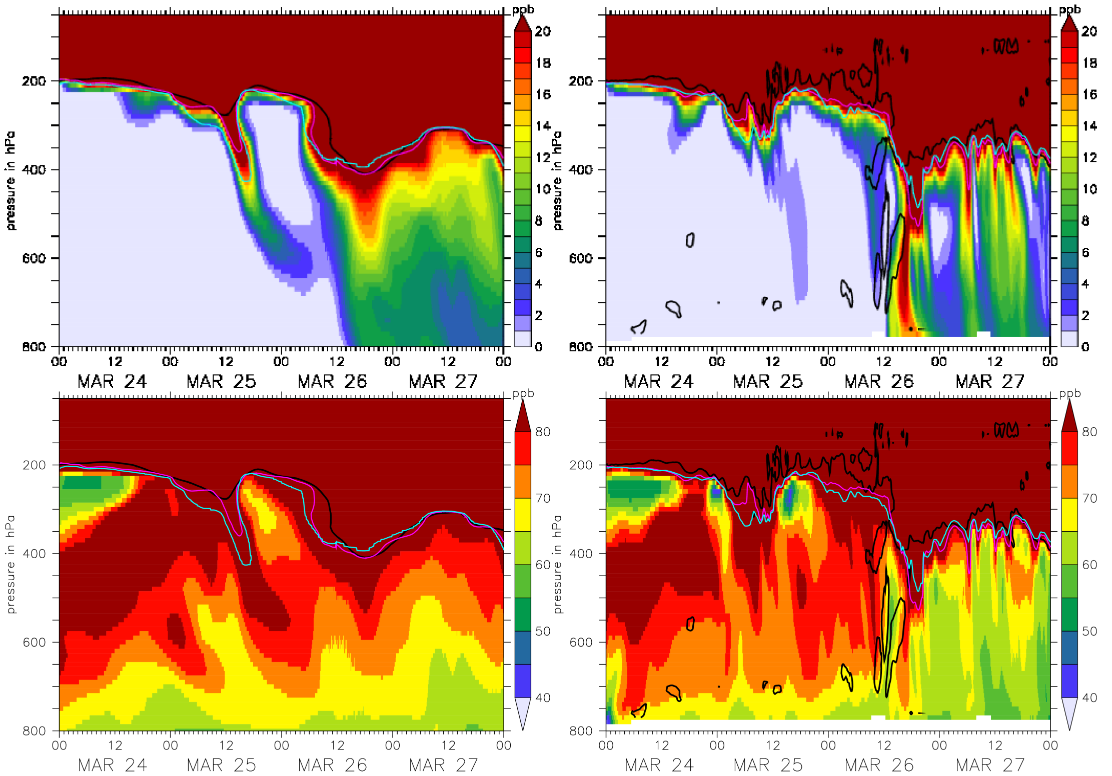

Figure 1: Time series of tracer at Jungfraujoch. Mixing ratios of an artificial, stratospheric tracer (STRATO2pvu, top) and ozone (bottom) for EMAC (left) and COSMO/MESSy (right) are shown (colour, in ppbv). Contours are drawn of PV = 2pvu (black), ozone = 100 ppbv (cyan) and STRATO2pvu = 25 ppbv (pink).

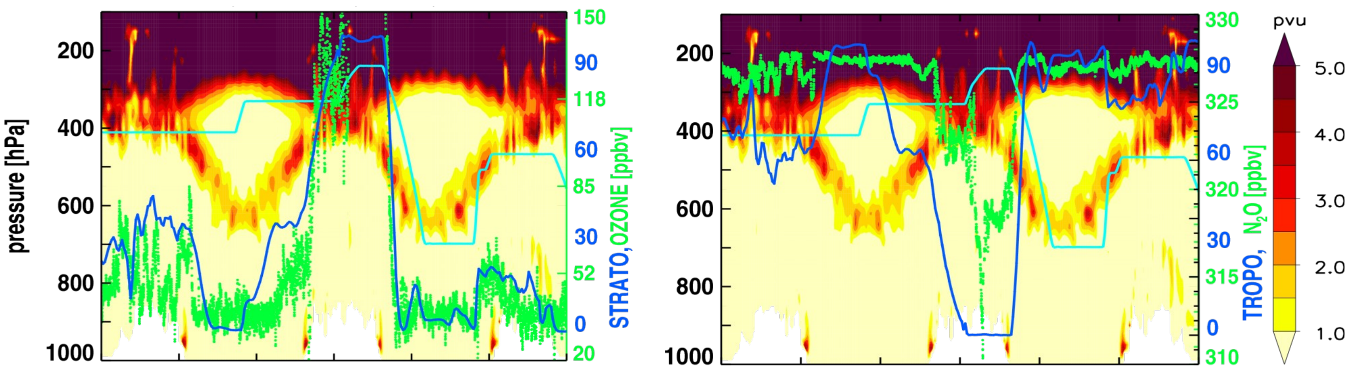

Figure 2: Variables along the flight track in COSMO/MESSy: PV (in colour, [pvu]), flight track (cyan contour), measurements (green contours, ozone (left) and N2O (right)) and simulated, artificial tracers (blue contours, stratospheric tracer (left) and tropospheric tracer (right)).

Literature:

Hofmann, C.: Austauschprozesse an Tropopausenfalten extratropischer Zyklonen, Ph.D. thesis, Johannes Gutenberg-Universität, URL http://ubm.opus.hbz-nrw.de/volltexte/2014/3926/ (2014)

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