Simulation of the Lower Stratosphere using COSMO-ART: Validating the Temperature
J. Eckstein, R. Ruhnke

COSMO-ART:
- Regional chemistry-transport model
- Gas phase chemistry (via KPP) and aerosol processes

Developments in COSMO-ART to simulate the UTLS
- Extended vertical grid
  - Top layer at 35 km (COSMO standard: ~ 23 km)
  - 61 layers (COSMO standard: 41 layers)
  - Better resolution in the troposphere and stratosphere
  - Much smaller damping layer starting at 30 km
- Extension of the chemistry to include processes of the stratosphere (yet to be completed)
  - Gas phase chemistry
  - Heterogeneous processes on supercooled ternary solution droplets (PSC type 1b) by including the model by Carslaw et al. (1995, J. Phys. Chem.)
- Photolysis calculated online (see poster by J. Schröter)

Motivation for an extension of the vertical grid
- Small scale processes and those in the area of strong gradients in the UTLS (tropopause, edge of the polar vortex) has to be simulated with a high resolution model.
- Modelling support for high resolution measurements with aircraft like CARIBIC and HALO
- Preparing COSMO-ART for the transition to ICON-ART

This study: Validation of temperature in the polar UTLS with data from radiosondes
- 12 synoptic radiosonde stations measuring at 0, 12 UTC
- Domain over Europe with a focus on northern latitudes (to prepare for the simulation of PSC)
- Two time spans: Winter 2009/10 (Nov. 09 - May 10) and summer 2012 (Aug. - Sept. 12)
- Three sources for boundary values: - ERA-Interim: 0.75°, 60 levels
  - ECMWF: 2°, 91 levels
  - NCEP: 2°, 28 levels
- 6 runs in total

Results: Validation of the Temperature
- Influence of the boundary is small up to 30km.
- Measurements are reproduced. Modeled mean temperatures are slightly lower but higher in great heights (0.5K max) when compared to the analyses.
- Reanalysis of NCEP is up to 7K warmer than ECMWF products in 34km height.

Comparing aircraft measurements
- Example of a flight of CARIBIC
- Summer 2012: First flights of HALO
- Top: Measurement and COSMO-ART output for two flights of HALO. On 26.09.2012 over the Norwegian Sea (left) and on 23.09.2012 to Svalbard (right). The COSMO-ART output is interpolated to the location of the aircraft.
- Middle: Vertical profile section along the flight paths provided by the model, corresponding to the two flights above.
- Right: Paths of the flights

Data: personal communication by A. Zahn
Sonde data source: ESRL database