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A review of studies about upper atmospheric processes performed in the frame of the ARISE project

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To better initialize weather forecasting systems, a key challenge is to understand stratosphere-resolving climate models. The ARISE project (http://arise-project.eu/) aims to design a novel infrastructure integrating different atmospheric observation networks to accurately recover the vertical structure of the wind and temperature from the ground to the mesosphere. This network includes Lidar and mesospheric airglow observations, complemented by continuous infrasound measurements. Together with additional ground-based wind radar system, such complementary techniques help to better describe the interaction between atmospheric layers from the ground to the mesosphere and the influence of large scale waves on the atmospheric dynamics.
The main results are outlined below.
* Systematic comparisons between Lidar soundings (NDACC, http://ndacc-lidar.org/) and ECMWF upper wind and temperature models (http://www.ecmwf.int/) highlight differences increasing with altitude. On average, the temperature appears to be overestimated in the stratosphere and underestimated in the mesopause.
* Additional microwave sounding technique for measuring the vertical structure of the wind fields was deployed by University of Bern, Switzerland. Significant errors in the zonal wind model are noted above 50 km altitude. The zonal wind main flow appears to be overestimated in the mesosphere.
* Mesospheric airglow measurements (NDMC, http://wdc.dlr.de/ndmc/) can constrain the temperature where uncertainties in the model are the largest.
* Collocated infrasound measurements provide additional useful integrated information about the structure of the stratospheric waveguide. Below 0.5 Hz, most infrasound signals originate from ocean swells. Long-range propagating infrasound travel in the stratospheric waveguide and improved detection capability occurs downwind. Deviations from this trend were related to short time-scale variability of the atmosphere. They are especially strong during Sudden Stratospheric Warming events as observed in January 2013.
* The most intense amplitude modulation of the infrasound from ocean swell occurs in winter. It is related to planetary waves which can be continuously monitored by this way using independent ocean wave models.
Such collocated observations from different complementary sounding techniques offer a unique opportunity to provide detailed information on upper atmospheric processes from seasonal to daily scales, better understand atmospheric coupling processes and their influence on weather and climate.