



## **Middle atmosphere variability and model uncertainties as investigated in the framework of the ARISE project**

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The middle atmosphere (from about 10 to 110 km altitude) is a highly variable environment at seasonal and sub-seasonal time scales. This variability influences the general atmospheric circulation through the propagation and breaking of planetary and gravity waves. Multi-instrument observations, performed in the framework of the ARISE (Atmospheric dynamics Research InfraStructure in Europe) project, are used to quantify uncertainties in Numerical Weather Prediction (NWP) models such as the one of the European Centre for Medium-Range Weather Forecasts (ECMWF). This paper presents the potential of routine and measurement campaigns to monitor the evolution of the middle atmosphere and demonstrate the limitations for NWP models to properly depict small-scale atmospheric disturbances. Observations includes continuous lidar and radar measurements conducted over several days at ALOMAR provide a unique high resolution full description of solar tides and small scale structures. Nightly averaged lidar profiles routinely performed in fair weather conditions at the Observatoire Haute Provence (OHP) and Maïdo observatory (Reunion Island) provide year-to-year evolution of stratosphere and mesosphere temperature profiles. Routine meteor radar observations depict the evolution of wind profiles and solar tides in the mesosphere and lower thermosphere. With the recent development of the portable Compact Rayleigh Autonomous Lidar (CORAL) which automatically measures temperature profiles at high temporal resolution, the possibility of combining different instruments at different places is now offered, promising the expansion of multi-instrument stations in the near future. Through a better description of infrasound propagation in the middle atmosphere and stratosphere-troposphere couplings, these new middle atmosphere datasets are relevant for infrasound monitoring operations, as well as for weather forecasting and other civil applications.