EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations (IP)

Author: Dr. Alex Dinovitser
Australia

# LASERS IN SPACE: THE NEXT GENERATION OF ATMOSPHERIC REMOTE SENSING

**Abstract**

Advances in passive remote sensing have given us a whole new perpective on our planet, however, the need for profiling atmospheric composition and temperature, without weather balloons (radiosondes), remains unresolved. In this paper, we outline the current sate of the art of active atmospheric remote sensing, including Differential Absorption Lidar (DIAL), and its significance for Numerical Weather Prediction (NWP) and climate research. We present several novel elements of a robust DIAL system design, and present the first results from Australia. We provide a road-map for future ground-based observatories, together with the further work towards orbital deployment. We propose a space-compatible, compact and energy efficient design, with an absolute accuracy better than 1%, and a range resolution of 50 meters. Furthermore, we describe DIALs for temperature profiling, and how multiple sensing capabilities can be combined into one instrument. Precise and extensive measurement of atmospheric state and composition with good horizontal and vertical resolution is an ongoing challenge and a significant obstacle to further advancement of both weather forecasting as well as climate models. Quantitative measurement of water vapor is of particular interest for climate research as well as for weather forecasting. The lack of coverage, accuracy and resolution in the current observing systems makes accurate Quantitative Precipitation Forecasting (QPF) a more challenging objective due to the large data gaps in the initial state. Much uncertainty in atmospheric models arises from the way water vapor changes phase, releasing and absorbing heat while driving convection. This simultaneously alters atmospheric radiant emisivity and albedo, which dominates the net radiative cooling of the troposphere. Furthermore, the strong temperature dependence of the saturation pressure and evaporation rate results in positive feedback on climate change driven by other greenhouse gases such as anthropogenic $CO_2$. These phenomena are responsible for much of the complexity in modeling of the hydrologic cycle, aerosol-cloud interactions, the energy budget and its interaction with the other greenhouse gases. For this reason, the skill of short- and medium range QPF is not sufficient to serve many user communities. These deficiencies result in a lack of accuracy and certainty in the prediction of extreme weather events, as well as uncertainties in the current climate models. DIAL is the most promising active laser remote sensing technique, and has been touted for future earth observation from space. Recent advances in laser technology, as well as novel DIAL system design elements, now bring this prospect closer to reality.