

Combining ground-based and satellite remote sensing for improving the derivation of atmospheric stability

Due to difficulties in forecasting, even with current high-resolution models, locally influenced weather such as severe summer-time convective storms or cool season lifted stratus or ground fog can pose serious danger to the air traffic and ground transportation infrastructure. Often thermodynamic and dynamic atmospheric (in)stability - especially in the boundary layer where observations from satellite are hardly reliable - play an essential role for the evolution of the weather event.

In order to overcome this observation gap, we propose an observing network of ground-based microwave profilers with high potential for retrieving the thermodynamic stability of the lowest few km of the atmosphere. Microwave profilers are highly suited for continuously monitoring the temporal development of atmospheric stability (i.e. Cimini et al. 2015, AMT) before the initiation of deep convection. However, the vertical resolution of microwave temperature profiles is best in the lowest kilometer above the surface, decreasing rapidly with increasing height. In addition, humidity profile retrievals typically cannot be resolved with more than two degrees of freedom for signal, resulting in a rather poor vertical resolution throughout the troposphere. Typical stability indices (i.e. K-index, Lifted Index, Showalter Index, CAPE,..) rely on temperature and humidity values not only in the region of the boundary layer (850 hPa) but also at 700 hPa, 500 hPa, in between these levels or even higher above. In this study, satellite remote sensing (i.e. SEVIRI radiances from the geostationary METEOSAT) is used to complement observations from a virtual ground-based microwave radiometer network provided by the COSMO model of DWD. We present a combined retrieval showing uncertainty reductions resulting from sensor synergy for different weather scenarios within the network. We hypothesize that ground-based and satellite remote sensing synergetic techniques possess a high potential for improving weather forecasting and nowcasting applications.