Thundathil, R., T. Schwitalla, A. Behrendt, S. K. Muppa, S. Adam, and V. Wulfmeyer, 2020: Assimilation of lidar water vapour mixing ratio and temperature profiles into a convection-permitting model. *J. Meteor. Soc. Japan*, **98**, 959-986. https://doi.org/10.2151/jmsj.2020-049

Plain Language Summary: Ground-based lidar instruments measure profiles of atmospheric moisture and temperature with very high quality and resolution. We show that these data improve the forecasts of the Weather Research and Forecasting (WRF) model. Our model has a grid resolution of 2.5 km, which permits to resolve deep convection. In order to use the new data, we developed a forward operator for the direct assimilation of water vapour mixing ratio (WVMR), a primary variable in the prognostic equations of the WRF model.

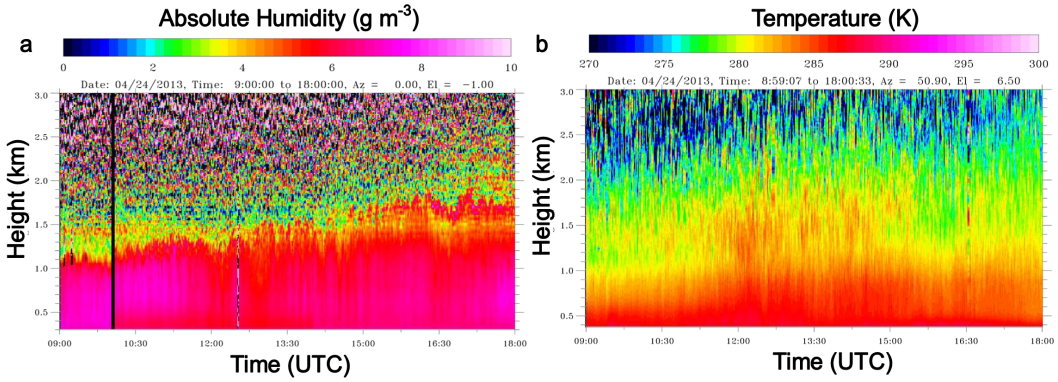

Figure 1. (a) Absolute humidity time series from the differential absorption lidar (DIAL) and, (b) temperature time series from the Raman lidar of University of Hohenheim, between 09 and 18 UTC on 24 April 2013.

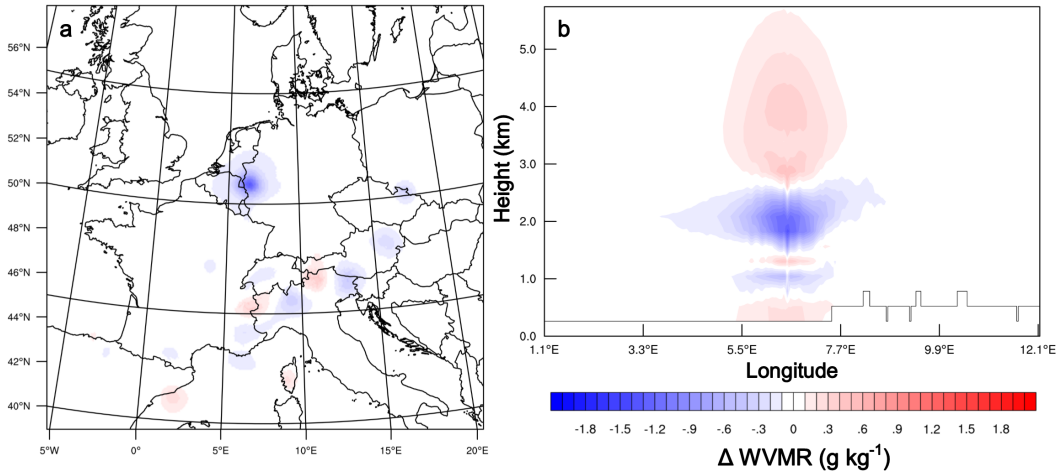

Figure 2. (a) Horizontal and (b) vertical cross sections of the model changes due to the assimilation of the lidar data for 09 UTC.

- Assimilation of temperature and moisture lidar profiles improved the model significantly.
- A new forward operator for WVMR assimilation avoids relative humidity conversion and thus allows maximum use of the observations eliminating undesirable cross sensitivity to temperature.
- The impact of a single lidar profile spreads over an area with a radius of 150 km showing the potential of a network of lidars for better operational weather forecasts.