Vertical wind profile: Comparing regional reanalyses, LIDAR, and mast observations

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Numerical weather prediction, renewable energy, aeronautical meteorology: For a variety of applications the vertical wind profile needs to be known as accurately as possible. Knowing the true vertical wind profile would improve numerical weather prediction, would enhance renewable energy production estimates, and reduce aviation risks. Unfortunately, wind profile measurements provided by weather masts are spatially rare and limited to the lower atmosphere. An additional/alternative source of the vertical wind profile are Doppler lidars. Operated in the Doppler beam swinging mode the backscatter signal is affected by horizontal wind speed. Using this part of information retrievals are used to derive vertical wind profiles of the horizontal wind. Another source of vertical wind profiles are reanalyses. Reanalyses combine numerical weather prediction models and observations to provide a best estimate of the atmospheric flow in the past. Reanalyses have the advantage to provide the wind speed on a homogeneous grid in space and time. Recently new high resolution regional reanalyses are developed whose quality still needs to be quantified.

We present results from regional reanalyses developed within the Hans-Ertel Centre for Weather Research. The high resolution reanalyses COSMO-REA6 (6 km horizontal resolution, 40 vertical layer) and COSMO-REA2 (2 km horizontal resolution, 50 vertical layer) are based on the NWP model COSMO. REA6 covers the EURO-CORDEX region and REA2 an extended COSMO-DE domain. The coarser reanalysis is available from 1995 to 2015 and the finer from 2007 to 2013.

The central part of this contribution is to quantify the uncertainty of wind profiles provided by lidars and regional reanalyses. Therefore, reanalyses and wind lidar profiles of the horizontal wind speed are compared to weather mast measurements. A first assessment considers annual and daily cycle comparisons. Since wind profiles depend primarily on atmospheric stability , sthe perfomance is quantified for selected stability conditions. For a realistic assessment of the results, the local conditions around the weather masts are taken into account.