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Bias estimation of Doppler radar radial winds

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A Doppler radar measures one component of the wind vector in the radial direction. The variational data assimilation technique provides a framework for using the radial wind observations in numerical weather prediction (NWP) models, both in data assimilation and in model validation. The direct use of the Doppler radar radial winds has the benefit of making use of the nonlinear information of the observed wind field.

The bias estimation for Doppler radar radial wind observations requires special attention because of the measurement technique. Calculating bias by aggregating observation minus NWP model counterpart values for different azimuth directions will result in near zero bias even in the presence of systematic differences in the observed and model wind speed and direction.

A method which enables estimation of the bias in wind speed and direction for Doppler radar radial wind observations is presented. The method, in short, is as follows. The azimuth angles of the radial wind observations are rotated towards a reference wind direction to make the observations from different times and radars comparable with each other. The bin-averaged observed wind is calculated for each azimuth bin. Fitting the radial wind curve to the bin-averaged observed wind values gives an estimate for the horizontal wind speed and direction. The same procedure is applied for the radar radial wind model counterparts. The difference in the fitted radial wind curve amplitudes indicates bias in the wind speed and the difference in the phases indicates bias in the wind direction.

The use of the bias estimation method is illustrated by validating two High Resolution Limited Area Model (HIRLAM) versions, which differ in the parameterization of the rotation angle of the surface stress. For comparison, the validation is done also applying radiosonde wind data.