36th Conference on Radar Meteorology
Breckenridge, CO, USA
16. – 20. September 2013, Poster 363

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Hydrometeor Classification and Quantitative Precipitation Estimation from Quality Assured Radar Data for the DWD C-Band Weather Radar Network

Jörg Steinert, Manuel Werner and Patrick Tracksdorf

*At the moment, the DWD weather radar network is upgraded to dual-polarization. Currently, it consists of 9 single-polarimetric and 5 dual-polarimetric C-Band weather radars (see Fig. 1). At the final stage, there will be 17 dual-polarimetric radars. To benefit from the enhanced capabilities, new algorithms for quality assurance (**QA**), hydrometeor classification (**Hymec**), and quantitative precipitation estimation (**QPE**) have been developed. These schemes are organized in an algorithm chain, called **QualityHyPE**, which was implemented in **POLARA**, a software framework newly developed at DWD. QualityHyPE will reach operational state in April 2014.*

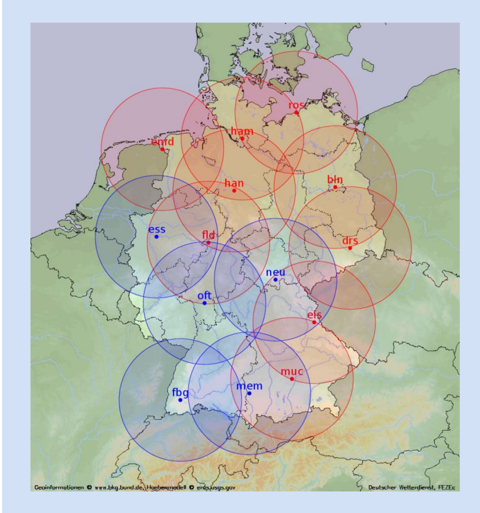

Fig. 1: DWD operational weather radar network with single-polarimetric radars (red), dual-polarimetric radars (blue) and circles, showing the coverage of the terrain-following precipitation sweep with a radius of 150 km.

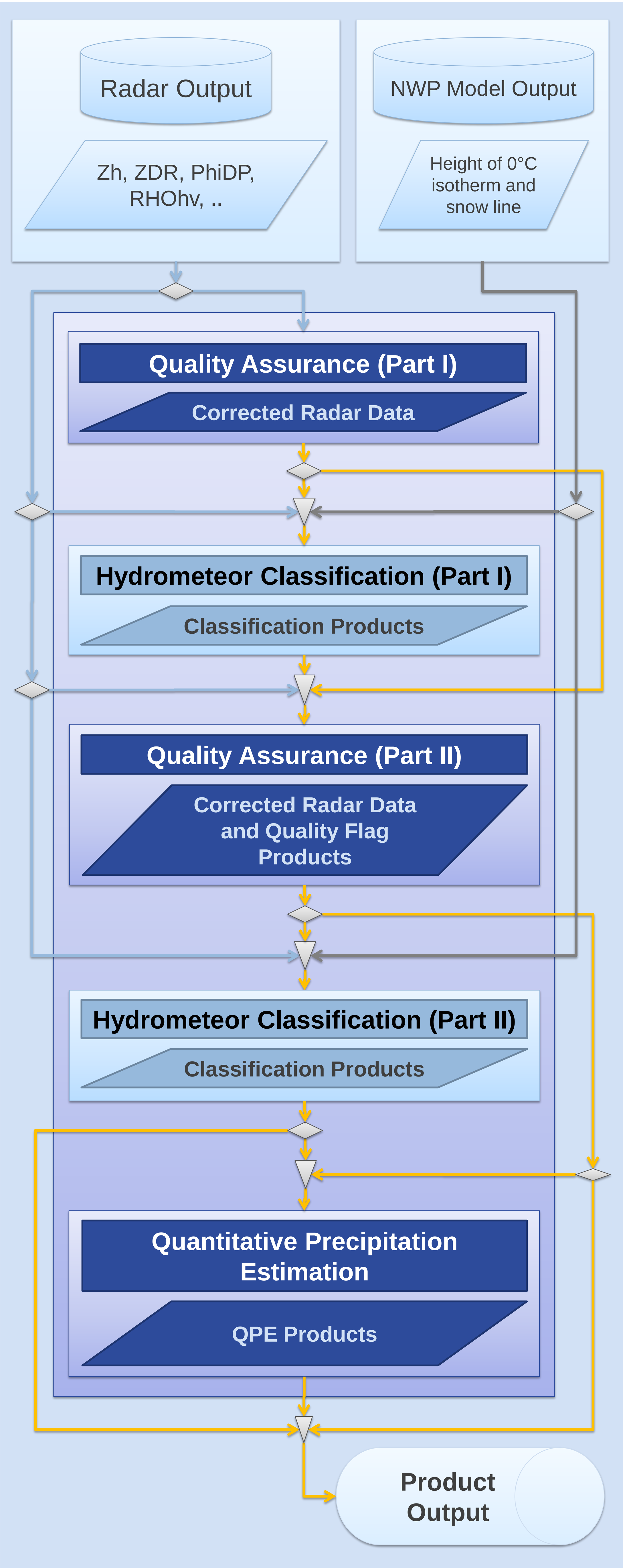

Fig. 2: Algorithm structure and data paths within and outside QualityHyPE.

The Algorithm Chain QualityHyPE

QualityHyPE is part of the radar post-processing algorithm suite processed at DWD's central office. Therein, the building blocks QA, Hymec, and QPE are organized in an interleaved workflow as shown in Fig. 2. Corresponding to DWD's scan strategy (Poster 329), QualityHyPE is applied to every 5-minute-block of radar data.

Quality Assurance

The quality assurance component of QualityHyPE is composed of two parts.

Part I consists of the following steps:

evaluation of online radar status information, application of thresholds (SQI, RHOhv, …), detection of spoke and ring artifacts, detection of second trip, detection of certain types of corrupt images, detection of radial velocity aliasing, correction of radial velocity dual-PRF unfolding errors, correction of spectral width for antenna rotation, clutter detection, calculation of KDP, calculation of offset- and clutter-corrected ZDR, and speckle filtering.

The subsequent initial hydrometeor classification is then equipped with a pre-corrected Zh, ZDR, and KDP.

Part II is mainly dedicated to the path attenuation correction of Zh and ZDR. The used algorithm is a kind of an adaptive diff. propagation phase - reflectivity method applied to contiguous ray segments of common hydrometeor type. The final output then consists of quality products for each reflectivity and radial velocity data sweep containing a set of quality flags for each individual range bin (see Fig. 3 (right)). Moreover, attenuation corrected versions of the pre-corrected Zh (Fig. 3 (left)) and ZDR from Part I are provided.

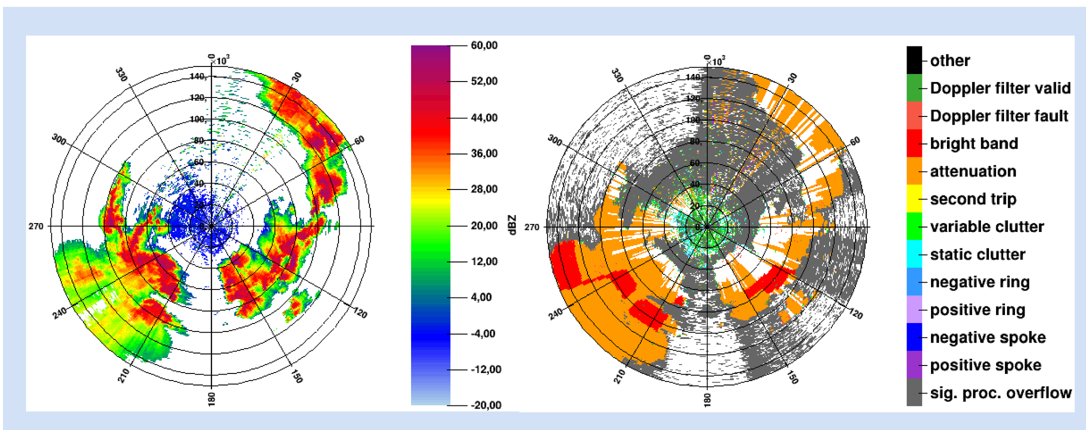

Fig. 3: Attenuation corrected Zh (left) and quality flag product of the reflectivity (right). (Weather case recorded on 06.08.2013 at 08:00 UTC by radar Memmingen (WMO: 10950) with a "terrain-following" elevation).

Hydrometeor Classification

According to data availability, the classification is done on Zh (single-polarimetric radar/mode) or on Zh, ZDR, RHOhv, and KDP (dual-polarimetric radar/mode). Furthermore, a melting layer detection is applied before the hydrometeor classification, where both algorithm pieces are realized in fuzzy-logic with the possibility to deliver the detection probability for the single classes.

To improve the discrimination between liquid and solid phase hydrometeors, NWP output (0°C isotherm) is used.

Part I: Input parameters are the corrected radar data (e.g. neglecting of spokes, rings and correction for clutter) after QA Part I. The resulting classification product is passed to QA Part II (attenuation correction), solely.

Part II: The classification uses the quality assured data (output of QA Part II). The final classification product is given to the subsequent QPE algorithm as well as to other users.

In Fig. 4 an example of the hydrometeor classification from Part I (Fig. 4 (left)) and Part II (Fig. 4 (right)) is plotted. In this figure the increase of melting particles and the decrease of areas assumed as graupel after the attenuation correction can be observed.

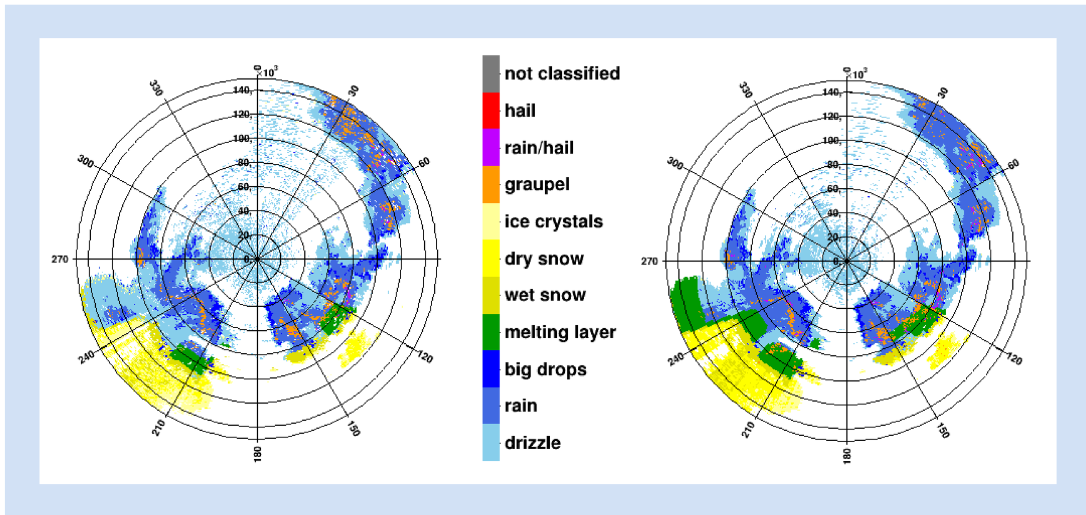

Fig. 4: Hydrometeor classification before (left) and after (right) attenuation correction of the same weather case as in Fig. 3.

Quantitative Precipitation Estimation

The quantitative precipitation estimation is based on quality assured (QA Part I) and attenuation corrected (QA Part II) radar data (single- and dual- polarimetric radar/mode) and the hydrometeor classification product (Hymec Part II) as shown in Fig. 2. Apart from a basic "reference" algorithm realizing a standard reflectivity to rain rate relationship and the DWD "state-of-the-art" algorithm realizing multiple "refined" reflectivity to rain rate relationships, there is also an algorithm which utilizes the hydrometeor classification product and (if possible) the polarimetric measurements. Fig. 5 shows the output of the DWD state-of-the-art algorithm (right) and the shower index (left) used to choose the refined reflectivity to rain rate relationships.

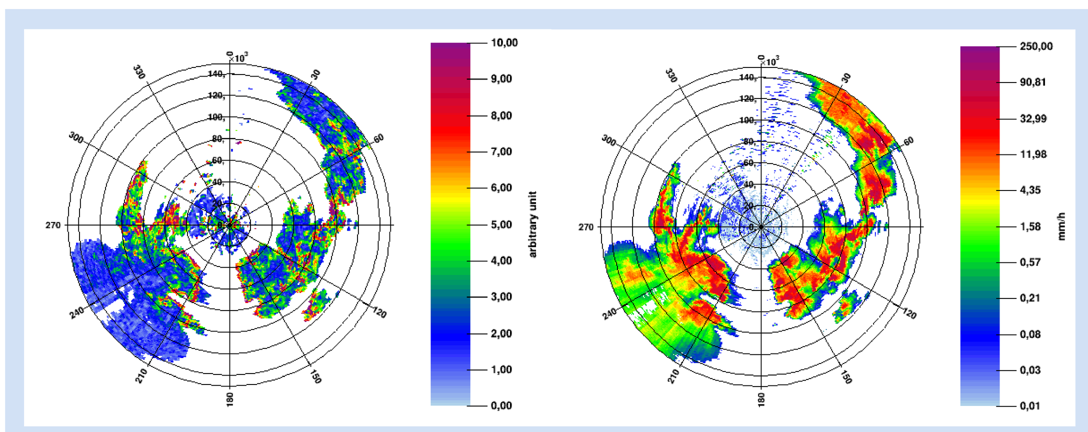

Fig. 5: Supporting parameter "shower index" (left) and quantitative precipitation estimation (right) of the same weather case as in Figs. 3 and 4.

Research and Development, Radar Meteorology
Jörg Steinert (joerg.steinert@dwd.de), Manuel Werner, Patrick Tracksdorf