baltrad

Data quality in the BALTRAD+ Project

J. Szturc[1], D. Michelson[2], J. Koistinen[3], G. Haase[2], M. Peura[3], R. Gill[4], M.B. Sørensen[4], K. Ośródka[1]

[1] Institute of Meteorology and Water Management, Poland
[2] Swedish Meteorological and Hydrological Institute
[3] Finnish Meteorological Institute
[4] Danish Meteorological Institute

jan.szturc@imgw.pl

Part-financed by the European Union
(European Regional Development Fund)

ERAD 2012, Toulouse, 27 June 2012

baltrad

BALTRAD+

The BALTRAD+ project „**An advanced weather radar network for the Baltic Sea Region: BALTRAD**” (2012-2014) is a continuation of BALTRAD (2009-2012). The project is carried out in the frame of Baltic Sea Region Programme 2007-2013 financed by the European Union.

It is aiming at real-time exchange of weather radar data. For more details – presentation 10.2 of Daniel Michelson on Thursday.

Since in a modern weather radar network processing of radar data alone is insufficient, the most sophisticated correction algorithms are incorporated into the BALTRAD system.

baltrad

Correction chain of volume of 3-D radar reflectivity data

- **Technical calibrations**, such as instrumental accuracy, network power levels, antenna pointing angles, etc.
- **Diagnosis of non-meteorological echoes** (ground clutter, biological, interferences, etc.) and type of precipitation, especially hail.
- Correction of the effects of “Doppler snake” on reflectivity data (due to high Doppler filtering).
- **Analysis and correction of beam blockage** (partial and total) due to terrain obstacles.
- **Diagnosis of the probability of beam overshooting**, which depends on distance to radar site and on the actual height of the VPR.
- **Path attenuation in precipitation** and due to wet radar radome.
- Correction of intra-volume advection and fall velocity due to ”time stamp”. If possible each individual elevation scan should be independently time stamped.
- **Diagnosis of the strength of convection** based on VPR, bright band recognition, or using external data, e.g. updraft effects visible on DSD.
- Probabilistic diagnosis of the occurrence of overhanging precipitation in the lowest elevation, based on radar-derived VPR or NWP information.
- **Diagnosis of precipitation type** and particle size distribution (PSD) in the volume scan (”bin situ” – related to measured bins).

baltrad

Quality algorithms for ground level conditions (especially for QPE)

- **Correction of the effects of the VPR** in reflectivity data (bright band correction and extrapolation from the lowest elevation to the ground).
- Modification of reflectivity data due to hail for QPE.
- Correction due to falling velocity and horizontal advection to represent time stamp conditions at ground level.
- Advection-based creation of virtual measurements at denser time intervals than the actual scanning interval, i.e. horizontal motion analysis of precipitation patterns and then interpolation the field applying it.
- **Hydrometeor type analysis** at ground level: vertical correction of the “bin situ” hydrometeor type applying data from AWS data, NWP models, or satellite observations.
- **Dynamical conversion of radar reflectivity into the quantity of interest** (rainfall intensity, snowfall intensity, visibility, etc.) – e.g. *R-Z* relationship.
- **Rain gauge adjustment of radar data** (e.g. weighted multiple regression) and combination of the both data kinds.

baltrad

Quality algorithms included into the BALTRAD toolbox

1. Integrated
2. Being integrated
3. To be defined

baltrad

QA integrated into the BALTRAD toolbox (I)

☑ **Monitoring of radar calibration stability**

Tool implemented in the toolbox so far is code contributed by KNMI (Holleman et al., 2010) through the use of signals from the sun:
(i) determination of antenna azimuthal and elevation angle accuracies,
(ii) absolute calibration levels based on external solar flux measurements.

☑ **Anomaly (non-precipitation echo) detection and removal**

The original algorithm (ROPO) was developed by FMI (Peura, 2002) and it has been used operationally for over 10 years there. This algorithm provides a set of image analysis based algorithms for identifying and removing specks, clutter, biometeors (birds, insects), and echoes from external emitters.

baltrad

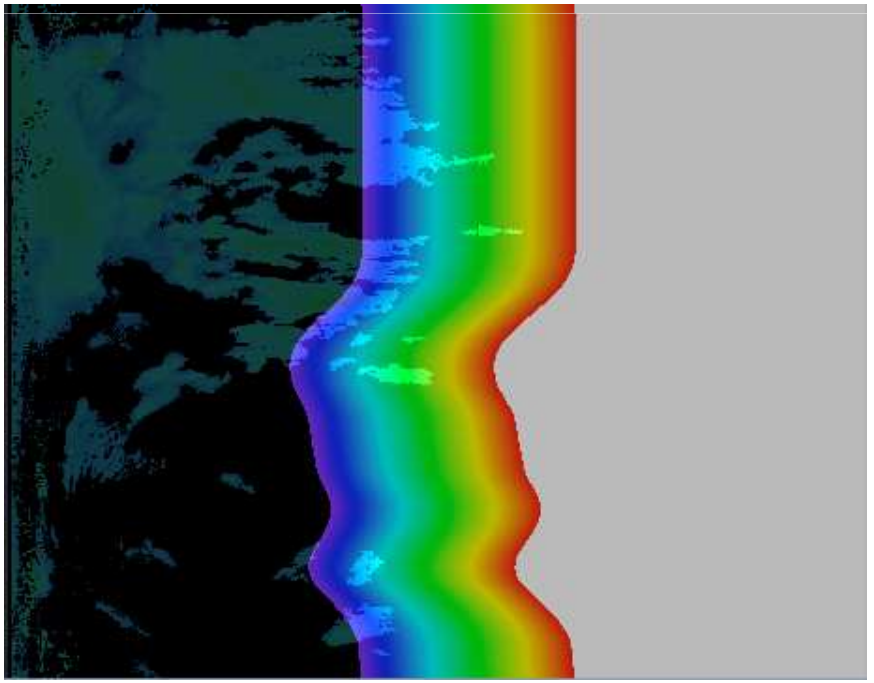
QA integrated into the BALTRAD toolbox (II)

☑ **Beam blockage analysis and correction**

Algorithm developed by SMHI, uses a geometric beam propagation model that oversamples the radar's polar geometry in relation to the topography, as a means of resolving small-scale effects impacting on beam blockage.

☑ **Probability of overshooting**

It is a purely radar-based algorithm from FMI based on an elaborated analysis of the echo-top field (Koistinen and Hohti, 2010).

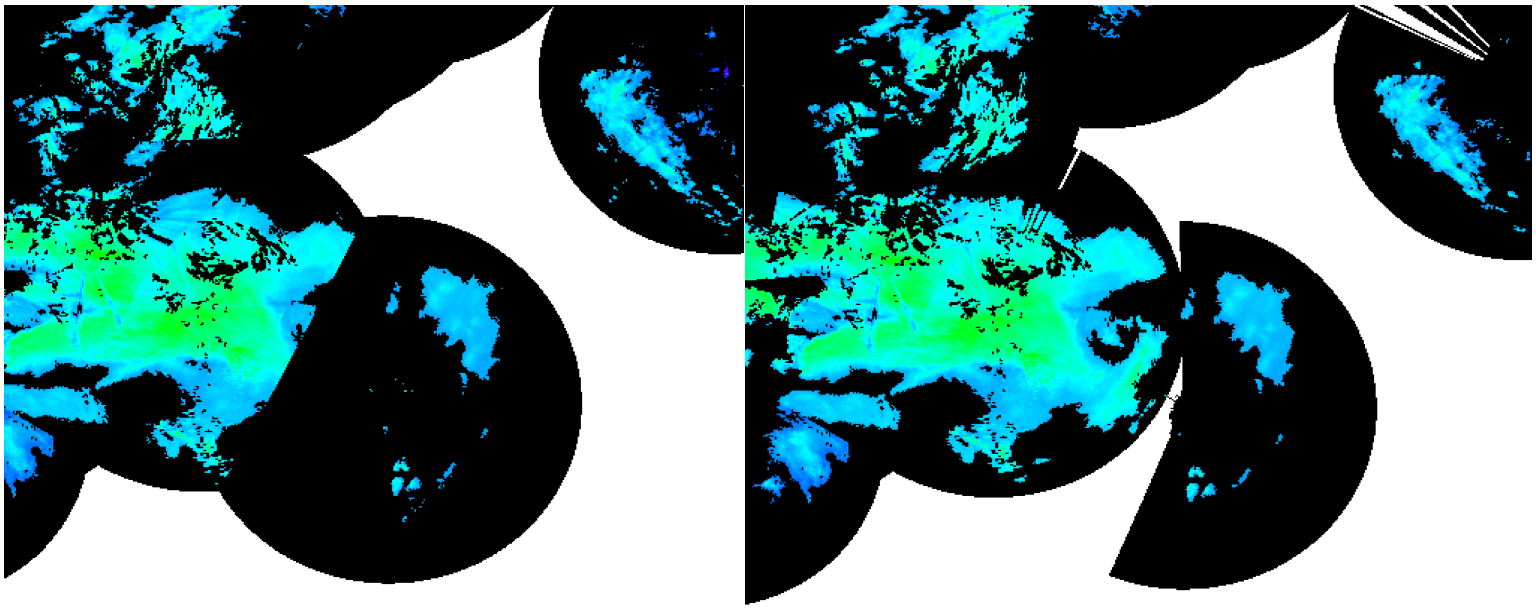


baltrad

QA integrated into the BALTRAD toolbox (III)

☑ **Compositing**

Currently implemented algorithms are nearest radar, lowest value to the Earth's surface, and a constrained maximum value (SMHI).

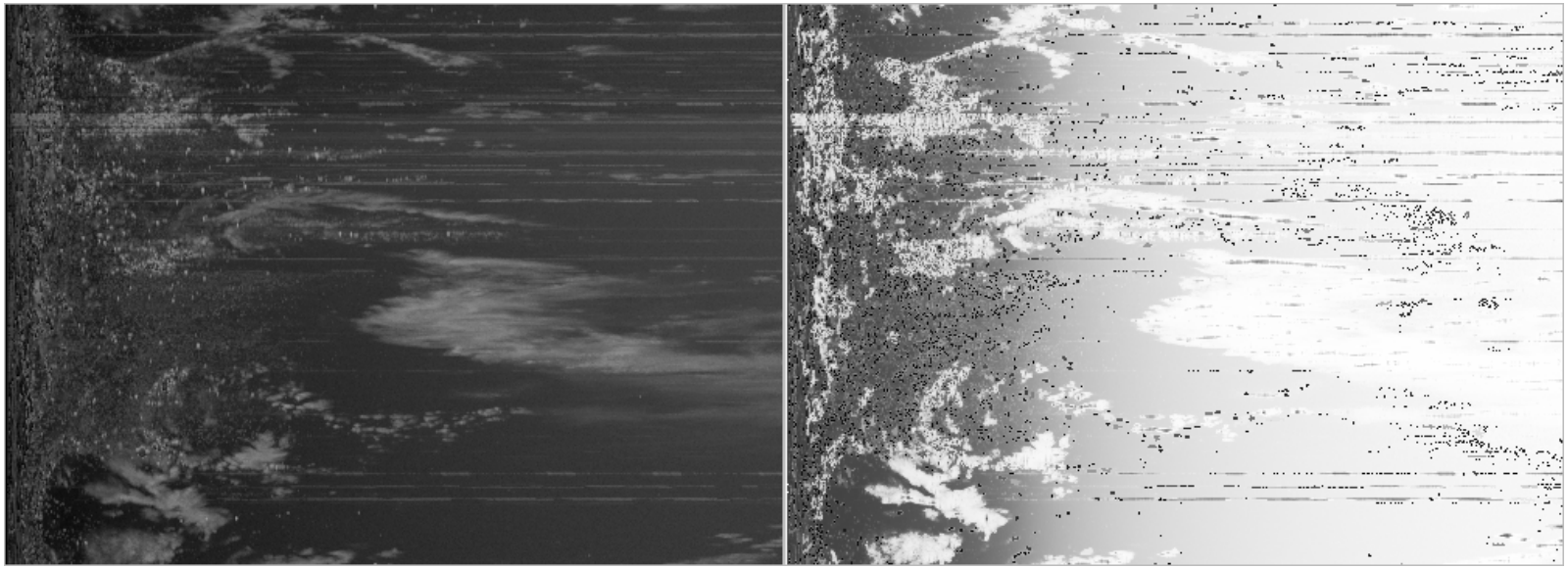


baltrad

QA being integrated into the BALTRAD (I)

- **Rack** (FMI; Peura, 2002)

Anomaly detection and removal. Based on non-polarimetric data the non-meteorological echoes are detected: biometeors, emitters, ships, specks.



baltrad

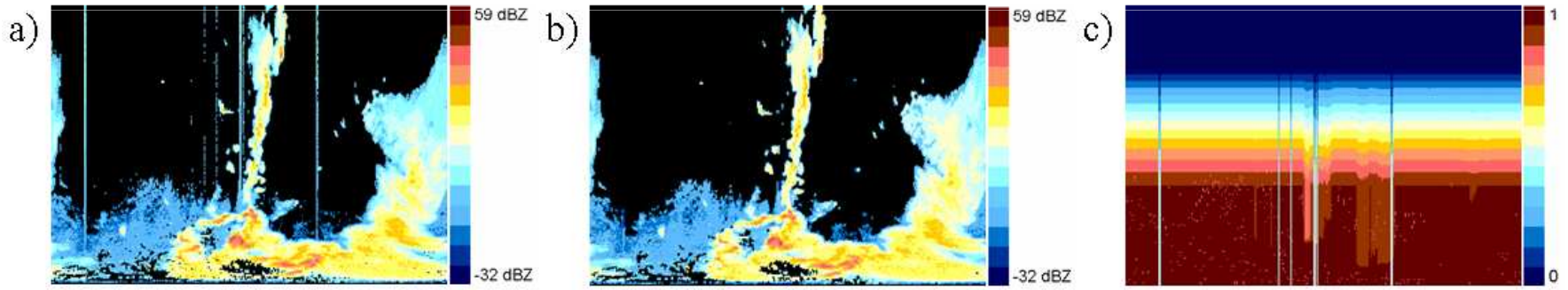
QA being integrated into the BALTRAD (II)

- **RADVOL-QC** (IMGW; Ośródka et al., 2012)

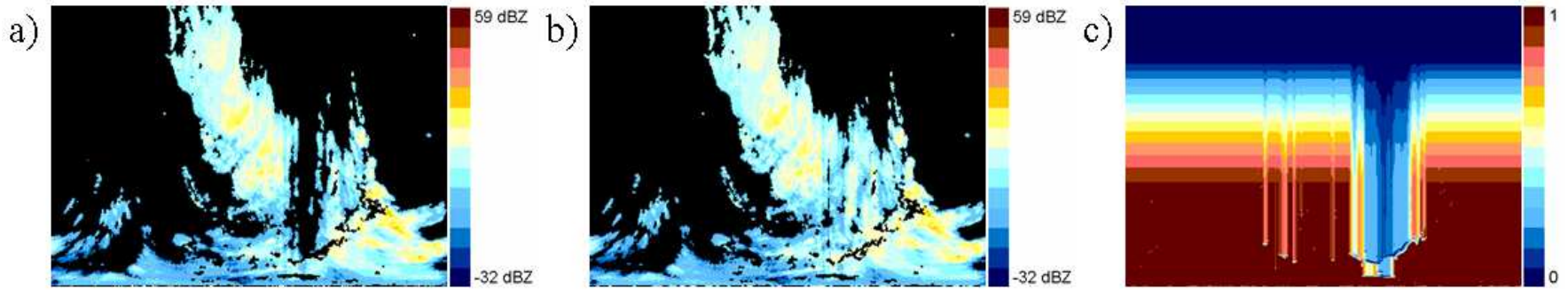
Corrections due to: (i) spike echoes, (ii) speck echoes, (iii) partial and total beam blockage, (iv) attenuation in rain.

Quality index (QI) is calculated additionally due to: (v) radar technical parameters, (vi) beam broadening.

Legionowo radar:



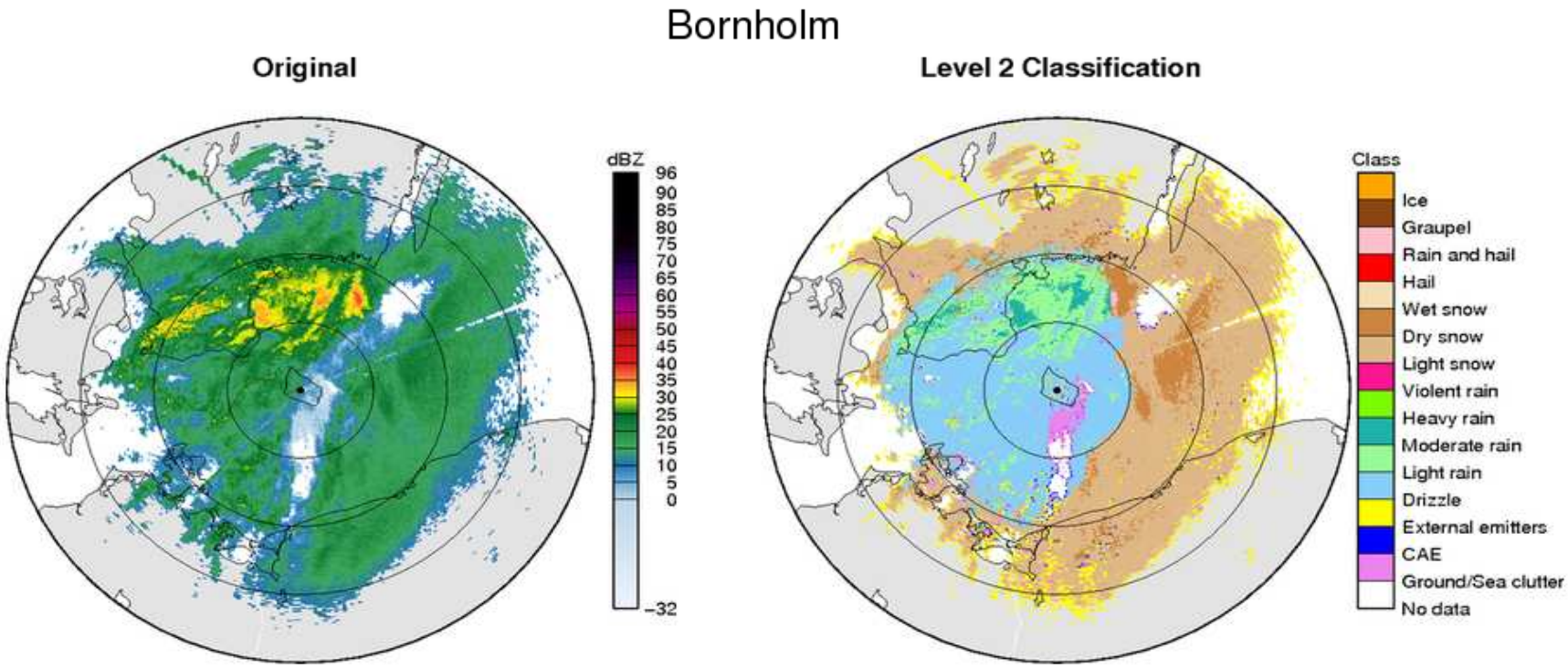
Pastewnik radar:



QA being integrated into the BALTRAD (III)

- **HMC** (DMI; Gill et al., 2012)

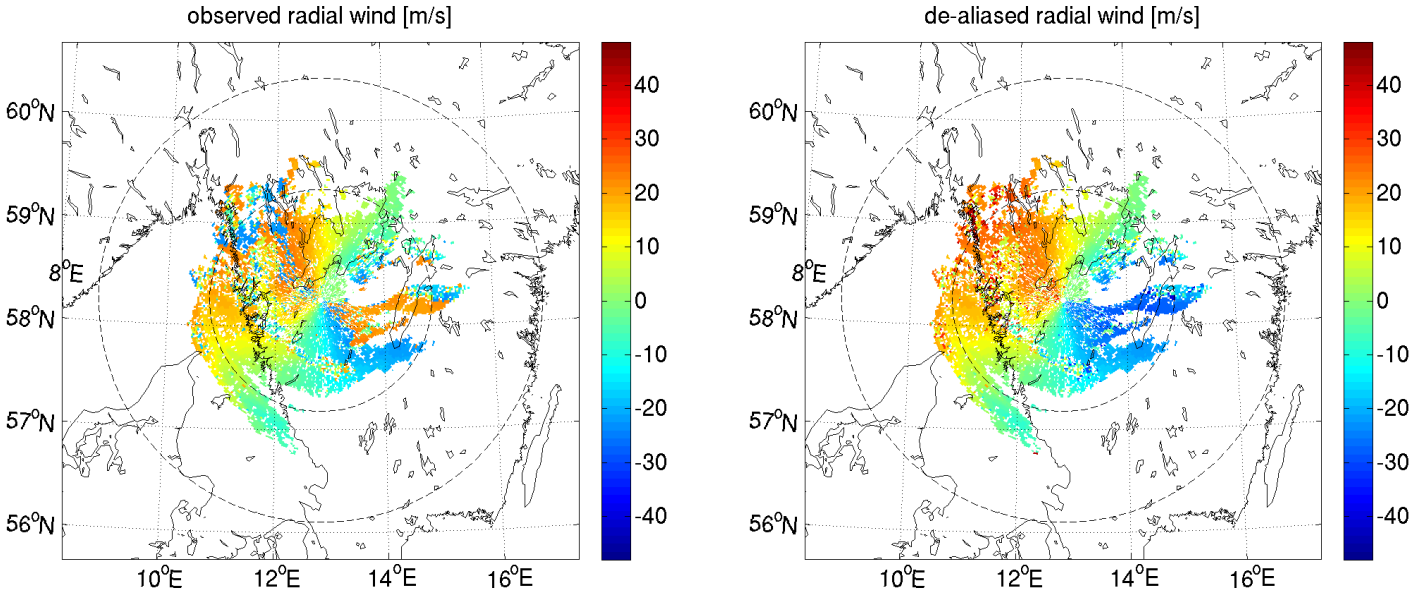
Hydrometeor classification applying dual polarization C-band data. The scheme is based of fuzzy logic.



QA being integrated into the BALTRAD (IV)

- **De-aliasing** (SMHI; Haase and Landelius, 2004)

Based on a linear wind model and designed to eliminate multiple folding. This algorithm does not depend on wind information from sounding or NWP data.



baltrad

QA to be defined (examples)

- Removal of sampling bias: difference between a radar measurement aloft or „bin situ” and conditions at grouind level, using VPR.
- Hydrometeor phase analysis based on 2-m temperature and humidity.
- Correction of bias due to slow falling velocity of snow particles with high horizontal wind speed.
- Etc.

baltrad

For more details during ERAD 2012:

BALTRAD+ project – Michelson et al., **10.2**, Thursday

Radar data compositing – Henja, Michelson, **8A.3**, Wednesday

Geometrically-shaped anomaly removal – Ośródka et al., **59 DQ**

Anomaly removal – Peura, poster **61 DQ**

Hydrometeor classification HMC – Gill et al., **2.6**, Monday

More references you can find in extended abstract.

baltrad

Thank you for your attention!