Radar Data Exchange and Common Quality Control tools in RC LACE

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and many others

1 Introduction

The common action inside LACE was started around 2012 to collect and pre-process RADAR reflectivity and radial wind observations for DA purposes. However the local efforts have been progressed a lot, but the use of a foreign RADAR observations was very difficult due to differences of data content, file formats and other technical issues. In order to overcome on these problems for a predefined period (May-June of 2012) RADAR data samples were collected from all LACE centres asking the same file format (OPERA HDF5) and raw content. After preliminary investigations it turned out that different meteorological services and their local implementation of OPERA HDF5 (due to own softwares for coding or radar manufacturers) provides different data content and coding under same name as OPERA HDF5 format. In 2013 the differences among raw RADAR samples were reported and sent back to LACE centres to improve deviations from standards for future data exchange. At the same time the collected samples were tested with INCA2 Quality control and CONRAD tool. In 2014 the investigation is being continued by solving data content discrepancies directly in the INCA2 QC. The main focus of this report is to present the

ability of the recently established radar QC in RC LACE countries. The main assumption was that we never solve 100% of problems in HDF5 radar files and therefore we must control their content.

2. Local installation of INCA2 and CONRAD tools

The new version of INCA2 and CONRAD software was implemented and were installed on Hungarian computers where RADAR DA studies and RADAR samples have been taken place as well. With this installations the portability of the two softwares has been tested and the work with the complete RADAR samples can be started (the collected RADAR sites is plotted on 1. figure).

Figure 1. RADAR stations studied in common RADAR data exchange

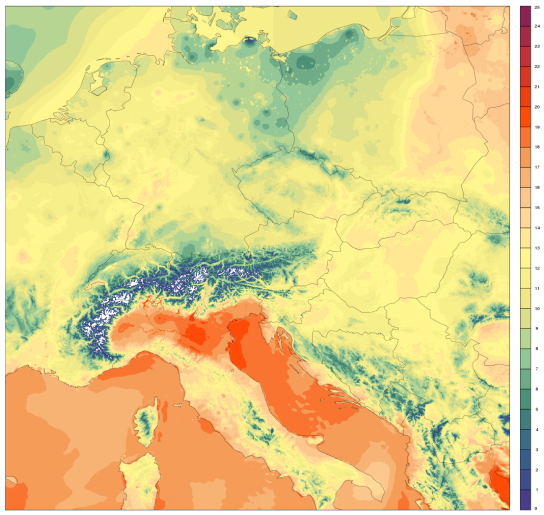
As it was mentioned before the main design change in INCA2 was the output of INCA2. Now it is not only precipitation analysis and precipitation analysis QC coefficients for whole domain, but also for each input radar the new single radar OPERA HDF5 file is created which include QC fields as new moments. This new design change allow which radar data is used in LAM model assimilation. Also main new feature allows use predefined metadata which describe radar site in INCA2 namelist file. It is important to watch the

single radar files before unexpected local modification which may lead to revocation of whole DA.

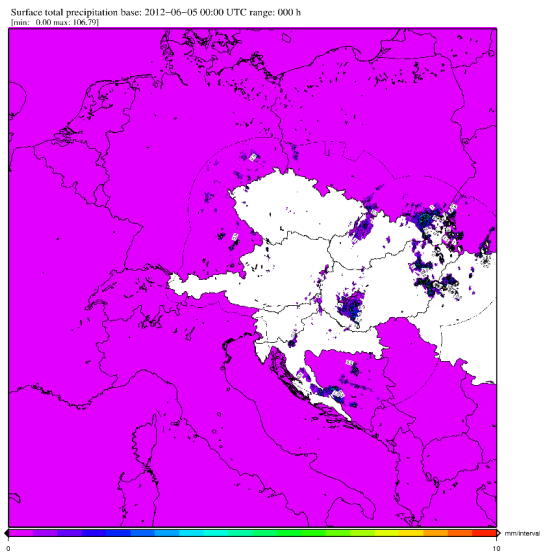
Previously this predefined radar metadata were controlled in our local implementation of CONRAD, but as experience with experiments showed that it must be controlled one step before in INCA2.

3. The work with INCA2 and CONRAD

The common QC tool, the INCA2 is well designed to control RADAR reflectivity through it precipitation module. It should be mentioned that INCA2 is not removing any information from the observations, but create quality flags, quality indexes to identify the suspicious data signals. INCA2 has a predefined domain where the nowcasting analysis is done and where the quality control is being processed.



INCA2 Domain - 1km:1671 x 1766



INCA2 precipitation analysis using RADARs from LACE countries

Figure 2. INCA2

Analysis main inputs are not only radar data, but also NWCSAF and local precipitation stations data. During the Hungarian installation the stations observations from CHMU, OMSZ, SHMU and ZAMG were used. The main advantage was that two sets of NWCSAF satellite products were accessible. One was from OMSZ which is using ECMWF IFS model background information and one was from SHMU which uses ALARO. In selected situations (low clouds, heavy rain) the outputs were partly different and we strongly recommend explore this difference also with use testing model as input NWP model.

The INCA2 precipitation module consist 6 quality indexes. As the output of INCA2 contains different quality flags than quality flags needed for data assimilation, modifications had to be done in order to harmonize the outputs of the INCA2 for the proper input of the data assimilation. This problem is summarized in the figure 4. It was decided to fix this transformation issue through CONRAD which is already responsible for file format conversion. As the first approach it was fixed only for RADAR data where quality issues have been signed by QC.

- OPERA_RADAR_QI_TEST_NUM = 6
- OPERA_RADAR_QI_TEST_NAME_1 = LAPLACE
- OPERA_RADAR_QI_TEST_NAME_2 = RLAN
- OPERA_RADAR_QI_TEST_NAME_3 = ATTEN
- OPERA_RADAR_QI_TEST_NAME_4 = SAFNWC_CT_CTTH
- OPERA_RADAR_QI_TEST_NAME_5 = BEAM_BLOCK
- OPERA_RADAR_QI_TEST_NAME_6 = CLIM

Figure 3. Example from INCA2 settings: Select QC elements in config

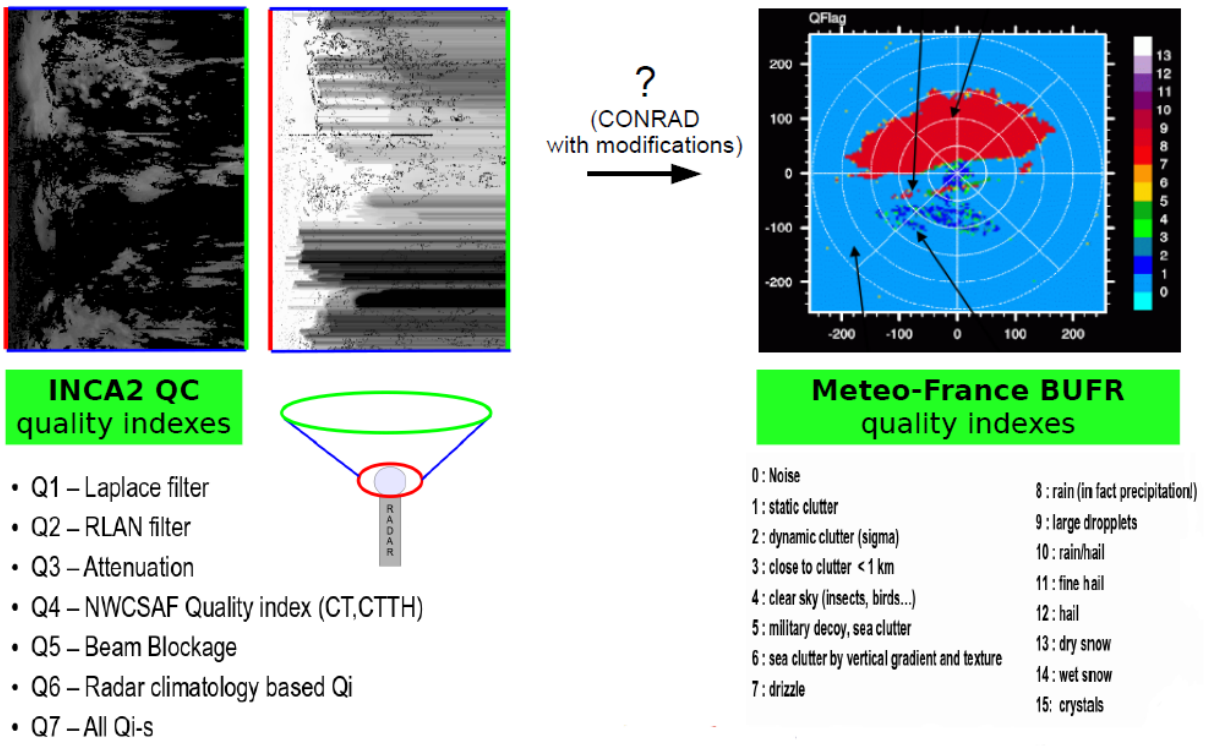


Figure 4. The transformation issue between INCA2 QC and MF BUFR

The CONRAD software is used to make file format conversion from HDF5 to MF BUFR format. Because of the above mentioned problem, investigation was started to fix quality index differences between INCA2 and BATOR. For reflectivity observations it is slightly easier than for radial wind, because only rainy and dry signals are used in BATOR from the 15 available indexes which are also listed in figure 4. In figure 5, the typical settings of CONRAD config and a schematic figure can be seen.

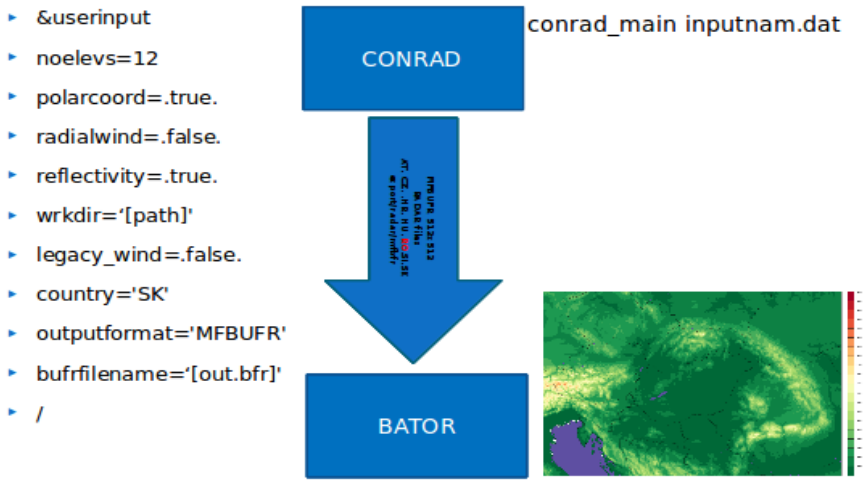


Figure 5. CONRAD settings and schematic way of the format conversion

4. Problem with radial wind QC

In case of the common quality control of RADAR radial wind observations, it is important to see that BATOR is already contains some filters i.e. quality checks which should be harmonize with the use of INCA2. Therefore a more careful tuning of radial wind QC is needed and perhaps new type of quality indexes as well. This issue is under investigation, because it is not certain whether this additional QC elements for radial wind should be taken place e.g. in common QC INCA2 wind module or should be done by BATOR.

We search for recommendations where to start, what we can do to prepare and plan our radar DA activities. Problem is how different phenomenas reveal dependencies and correlations. It looks like the ideal solution is the usage of not corrected radial wind data direct from OPERA HDF5 format into the model and take into account single radar data. Within model calculated background radial wind field for radar site and also simulated reflectivity. Then compare input data against this fields and search

for unrealistic value. We must remember also for PRF of radar when we search for possible solutions.

Actual disadvantages of the INCA2 solutions:

- do not take in account previous state of atmosphere (analysis take account only new observations)
- containment of solution that mean absence of access to other meteorological fields from NWP model for example temperature (important for bright band correction), wind, hydrometeors, ...
- quality control include only predefined observations and input data
- actual solution do not use dual polarization fields
    - differential reflectivity (z_{DR} - ratio between horizontal and vertical polarization) It is different between ice and water particles. For snow, hail close to zero. Also it helps to resolve echo from non-meteorological targets
    - and many others

Actual main tasks are discovered how the existing source code can identify ways to

1. increase maintenance effectiveness and reliability (now we must support nowcasting module INCA2, special version of CONRAD, BATOR. Important step is replace MFBUFR which is output from CONRAD with direct reading HDF5 from BATOR. Already done in HARMONIE code.)
2. mitigate risk of bad identification ground clusters, no-meteorological targets, ...
3. increase operational efficiency (nowadays QC for all RC LACE radars takes the comparable time like DA)

5. Conclusion

In conclusion the collected RADAR samples were studied mostly with respect to reflectivity observations, but more works are needed to find solutions for radial wind. Also it would be important this action with the comparison of different QC available for RADAR data like BALTRAD, PRORAD, etc and get the access to OPERA data and try QC directly to samples downloaded from OPERA datahub. Last but not least the first DA tests with the correct reflectivity should be started as soon as possible. For more information, please contact with Michal Nestiak (michal.nestiak@gmail.com) and Mate Mile (mile.m@met.hu)

6. References

Maps with experiment radars in RC LACE

http://radar.nowcasting.eu/rclaceradar.html

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