



USER PRODUCT SHEET

European Operational Program for Exchange of Weather Radar Information **Maximum Reflectivity Composite (1km; 5min)**

Project	OPERA CIRRUS
Production Centre	Météo France
Application Domain	A high-resolution European weather radar composite
Processing Software	BALTRAD toolbox v2022/02 and OPERA Cirrus compositing code
Product sheet version	2.0 – June 25th 2024

1. Overview

The scope of the OPERA CIRRUS production line is to generate and disseminate a pan-European high-resolution maximum reflectivity composite: at 5-minute interval with a spatial resolution of 1 km and a data latency of less than 10 minutes. This is being set up through the service-oriented operational platform at Météo-France. To generate the reflectivity composite, (1) a subset of software from the BALTRAD project is implemented to ensure a range of pre-processing of incoming radar reflectivity data as well as (2) an updated version of the ODYSSEY software is used to create the maximum reflectivity composite data.

2. Product Audience

This meteorological information is aimed to cater the diverse end-user needs such as the national meteorological and hydrological services (members of the OPERA) as well as to a wide range of end-users of weather information. As a maximum reflectivity product, the primary use of CIRRUS composite lies in nowcasting severe precipitation events.

3. Input Data

The horizontal reflectivity observations are measured by the ground-based C and S band weather radars across Europe (Figure 1) and are available from OPERA network as volume and scan datasets, in real-time through OPERA's CUMULUS/STRATUS service. These volume and scan datasets are delivered to OPERA with a 5-minute sampling interval, with exception of Spanish data. Since available at 10-minute frequency, the latter are subject to extrapolation forward in time, using the Lucas-Kanade (1981) method, to ensure a non-stationary character of the composite over Spain at 5-minute time step. The pre-processing of available reflectivity dataset includes a set of filtering and correction techniques for removing non-precipitation echoes, such as anomaly-removal, filtering by occurrence frequency, beam blockage correction, and satellite filter (see Saltikoff et al., 2019). A choice of the pre-processing modules to be applied to reflectivity data is defined by national data producers.

4. Product Coverage

Spatial coverage over a pan-European region, previously defined in OPERA, is preserved but horizontal resolution has increased to 1 km by 1 km. The grid size of composite domain therefore counts 4400 by 3800 pixels. Temporal coverage is defined as [NT-10min, NT] where NT is Nominal Time of the composite, inside which are start and end date-time of each scan, and it is updated every 5 minutes or 288 times per day.

5. References

Lucas, B. D. and T. Kanade, 1981: *An iterative image registration technique with an application to stereo vision*. Proceedings of Imaging Understanding Workshop, pages 121-130.

Michelson D., Henja A., Ernes S., Haase G., Koistinen J., Ośródką K., Peltonen T., Szewczykowski M. and J. Szturc, 2018. BALTRAD Advanced Weather Radar Networking. Journal of Open Research Software, 6(1), p.12. DOI: <https://doi.org/10.5334/jors.193>.

Michelson D. B., Lewandowski R., Szewczykowski M., Beekhuis H., Haase H., Mammen T., and D. Johnson, 2021: EUMETNET OPERA weather radar information model for implementation with the HDF5 file format Version 2.4, Document on behalf of EUMETNET OPERA, 55p. (www.eumetnet.eu/wp-content/uploads/2021/07/ODIM_H5_v2.4.pdf).

Saltikoff, E., Haase G., Delobbe L., Gaussiat N., Martet M., Idziorek D., Leijnse H., Novák P., Lukach M.; Stephan K., 2019: OPERA the Radar Project. Atmosphere 10, 320. DOI: <https://doi.org/10.3390/atmos10060320>.

6. Contact

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Maximum Reflectivity Composite

Summary

The product is a high-resolution (1km; 5min) 2D gridded Cartesian dataset of maximum reflectivity over Europe, stored in HDF5 format and structured according to the OPERA metadata standard ODIM version 2.4 (Michelson et al., 2021). This file also contains a 2D quality index of the product, ranging between 0 (poorest quality) and 1 (best quality) – please that this index will be revised in a future release. The product is updated every 5 minutes, with availability of less than 10 minutes following its nominal (validity) time.

Production method

Generation of the product involves three processing main steps:

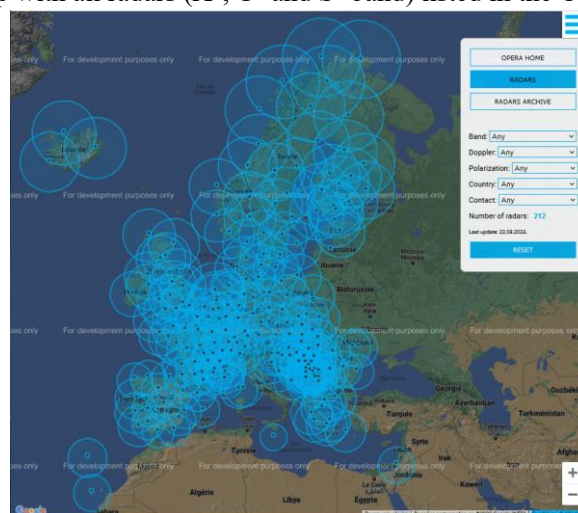
- 1) extrapolation forward in time of input reflectivity data from Spanish national data producer,
- 2) quality-based pre-processing of a selected reflectivity data including the outcome from (1) if available, and
- 3) processing of the datasets generated by the step (2) to create the product from multi-radar radar scans and volumes reflectivity data in polar coordinates.

The mapping technique is used to create the composite, and the maximum reflectivity at a given pixel is obtained by selecting the maximum reflectivity value of all contributing single-scan reflectivity pixels.

Important remarks

- The optimal and timely consistent coverage over the targeted domain depends strongly on availability of real-time radar observations.
- Unexpected delays at the reception of input data files might occur and cannot be compensated for by secondary level treatments.
- Status of major modernisation programmes of national radar networks: Romania – completed but new data will be included into CIRRUS in autumn 2024; Spain – ongoing; Greece – in preparation.
- The pre-processing (filters and corrections) is not applied to all incoming radar data. This means that low reflectivity values, typically representing noise, are not removed over all OPERA member countries. Hence it is recommended to apply an appropriate threshold to obtain a “cleaner” composite. A typical value could be 0.12619 dBZ (equivalent to 0.01 mm/h for the surface rain rate).

Figure 1. Google map with all radars (X-, C- and S- band) listed in the OPERA informative database.



Source of the map: <https://www.eumetnet.eu/activities/observations-programme/current-activities/opera>. Please remember that only reflectivity from C- and S- band radars are considered for the product.