

**P2.8 A REVIEW OF OPERATIONAL WEATHER RADAR NETWORKING IN GERMANY  
- PRODUCTS AND APPLICATIONS -**

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**1 INTRODUCTION**

Beginning in the 1980s the German Meteorological Service (Deutscher Wetterdienst, DWD) installed a network of modern weather radar systems in entire Germany during the last decade to receive area covering radar data of precipitation as well as wind information in a high spatial and temporal resolution for reducing the data gap between ground-based in-situ observations and satellite information. This radar data is an important part of the operational data collection network for climatological purposes and for weather surveillance and nowcasting.

**2 NETWORK STRUCTURE**

**2.1 Radar Sites And Technical Equipments**

The network consists of 16 C-band radar systems, most of them equipped with doppler facilities, which are automatically operated at unmanned sites. The radar sites were selected to have a mostly full coverage of Germany for the 125 km range used for estimating precipitation rates and totals.

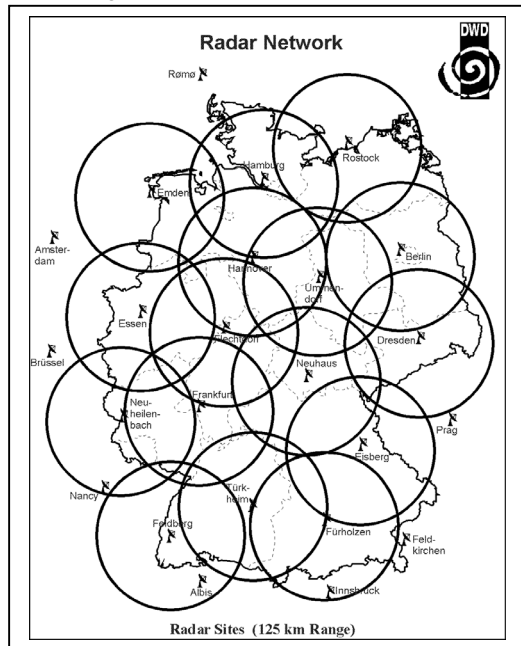


Fig. 1: Map of the radar network in Germany.

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Although the network consists of radar sensors made by two different manufacturers all systems are equipped with identical signal processing units, radar computer and radar application software for data processing. With these devices and a built-in-test-equipment (BITE) a uniform monitoring of the radar network is possible.

**2.2 Data Distribution System**

The access of all radar systems to a high speed telecommunication network is a basic prerequisite to provide the users with single site and composite radar products in due time. Based on a ring structure of the main communication network of the DWD (DWDnet) all systems transmit the radar products to different users in regional forecast offices and to the central office for compositing, archiving and individual use.

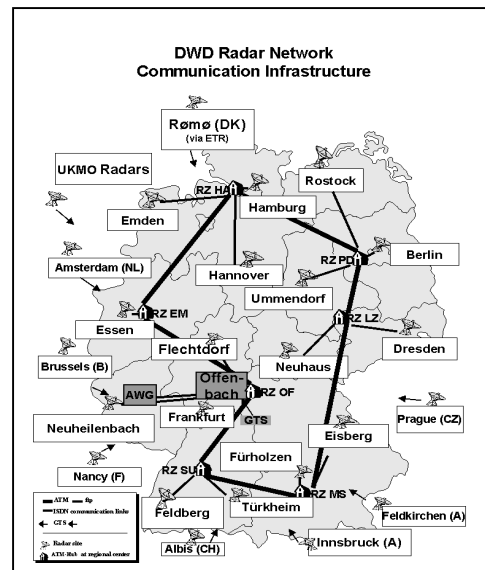


Fig. 2: Communication infrastructure of DWD radar network including international data links.

The access to all radar sites from DWD's radar control center (Hamburg) allows continuously remote monitoring with an automated system and - if necessary - remote error handling even during non-office hours and at weekend.

According to the international standards of the European OPERA group (OPERA – Operational Programme for the Exchange of weather RADar information) European-wide operational exchange of radar products is basically performed via GTS links.

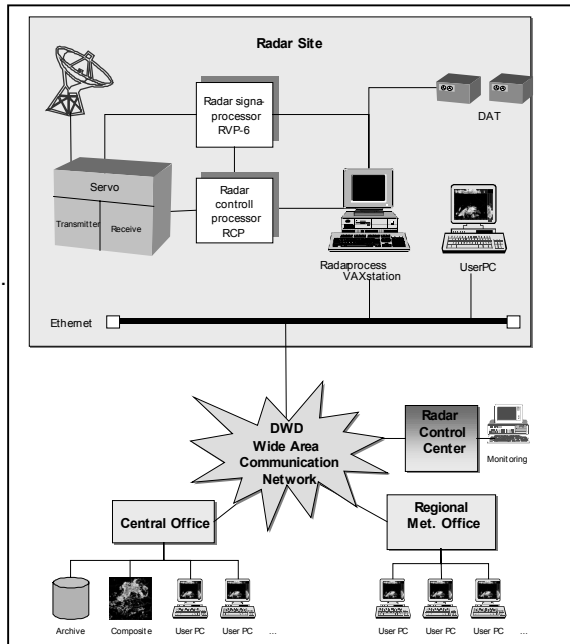


Fig. 3: Basic components of a DWD radar site with scheme of the network structure.

### 3 OPERATIONAL RADAR PRODUCT GENERATION

Each radar system in the network operationally performs identical scans for recording volume and near-surface data of reflectivity and velocity. Every 15 minutes a volume scan is performed scanning 18 elevation angles and additionally, every 5 minutes low elevation scans collect near-surface data.

#### 3.1 Standard Single Site Radar Products

Based on the two different scans several products are locally generated at each radar site. For most of the products clutter echoes are removed by using doppler and statistical clutter removal algorithms.

From the volume scan the following products are operationally generated (pixel resolution: 2km \* 2km):

- Reflectivity products (near-surface reflectivity (see fig. 4) including severe weather warning indicators; 12 level CAPPI)
- Echo top product
- Doppler wind products (vertical wind profile, horizontal radial velocity in preselected heights).

The low elevation scan provides the following products (spatial resolution of images 1 km \* 1 km):

- Near-ground instantaneous precipitation rate
- Precipitation totals of different accumulation intervals.

These radar products are operationally disseminated to the numerous offices of the DWD and to externe

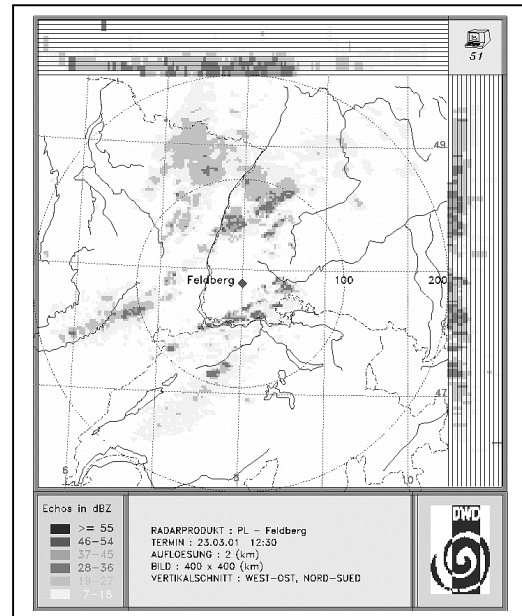


Fig. 4: Basic single site radar product showing reflectivity nearest to the ground with additional information of the vertical extension of these radar echoes in the side projections.

users for post-processing and displaying the radar images on different computer systems (PCs, meteorological workstations combined with other data (e.g. satellite images, ground observations, model output data, lightning information).

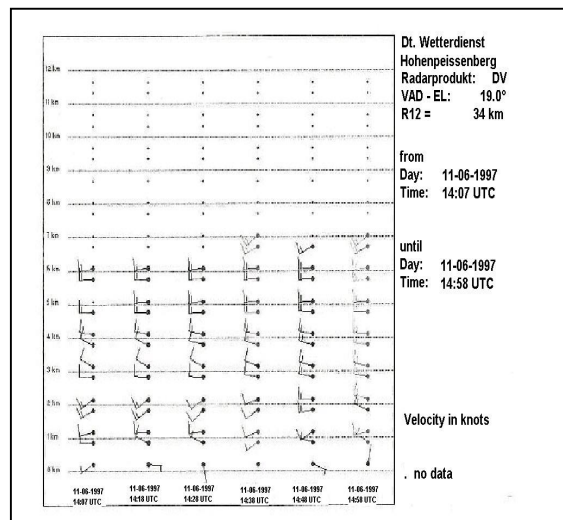


Fig. 5: Vertical wind profile (based on VAD algorithm).

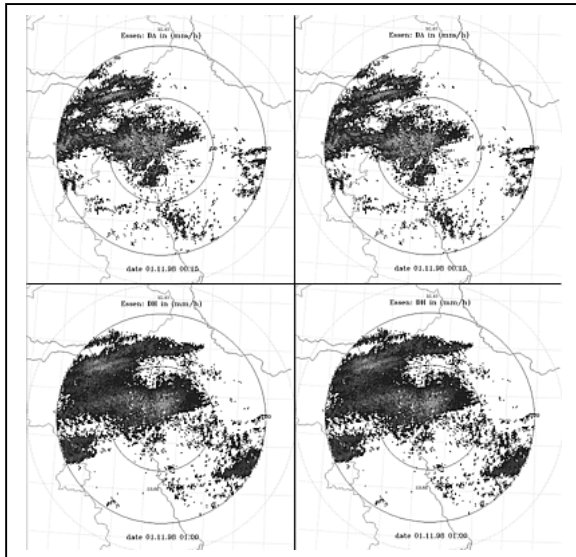


Fig. 6: Local precipitation totals for different accumulation intervals.

### 3.2 Composite Radar Products

At the central office of the DWD operationally composite products are generated by using national and partly foreign radar reflectivity data. National radar data is formatted in BUFR for international European-wide exchange according to the OPERA regulations.

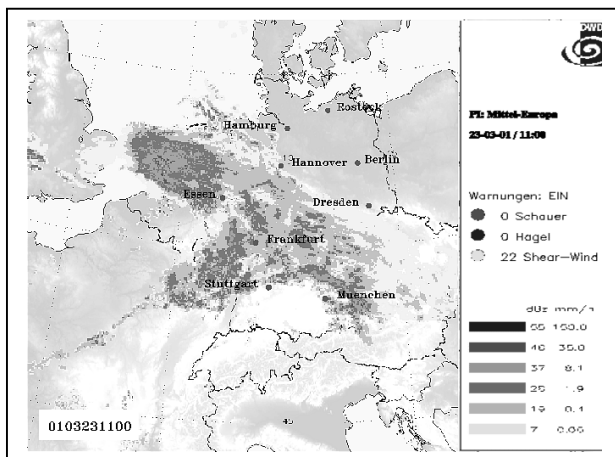


Fig. 7: Central European composite of near-ground reflectivity data including single site images of Germany and neighbouring countries.

Additionally, national composite products of accumulated precipitation data are generated on a non-operational base for special applications.

## 4 APPLICATIONS AND DIFFERENT USERS

Single site radar products and composite

products are used for a number of different wide-spread applications by numerous users of the German radar network.

Four main areas for applying radar information can be identified:

- Weather surveillance and nowcasting including severe weather warning
- Precipitation climatology and hydrology
- Numerical weather forecast model applications (use of radar data for model input (analysis) and model output verification)
- Research purposes on radar meteorology.

According to these different applications of radar information and to the progress in radar data availability a permanently growing number of users within the Deutscher Wetterdienst as well as external users coming from several areas of work is provided with different products of the radar network.

Within the Deutscher Wetterdienst radar information is used for different applications in nearly all business units and departments of the DWD:

- General Forecast
- Aviation Forecast
- Hydrometeorology
- Agricultural applications
- Media applications
- Marine shipping consultancy
- Meteorological analysis and modelling
- Radar meteorological research
- Climate and environment consultancy

Additionally, a number of external customers is provided with radar data and products:

- German military meteorological service and NATO partners in Europe
- European National Meteorological Services
- Aviation flight control offices
- Airlines and airport companies
- Regional water management authorities of the Federal States (e.g. for flood warnings)
- Urban hydrology
- Television and print media companies
- Universities and Research Centers

## 5 FURTHER DEVELOPMENTS

The following developments of the German weather radar network are planned for the next future:

- Improvements of data quality assurance
- Replacement of operational radar computers by UNIX workstations including installation of a new radar application software
- Generation of new radar products according to different user requirements
- Replacement of the old non-doppler radar systems within the next half decade.