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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

# Radar-Based Precipitation Climatology for Germany – First Results and Future Directions

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The radar based QPE method RADOLAN (Radar Online Adjustment: http://www.dwd.de/RADOLAN) by Deutscher Wetterdienst (DWD) has been already operating since 2005. On the basis of quantitative radar measurements – available every five minutes (s. fig. 1) - and hourly rain gauge measurements temporally and spatially high-resolution precipitation analyses are produced in real time. Especially the German flood forecasting authorities and the DWD warning management are using these radar based QPE for their purposes.

Because of the valuable database first reanalyses and evaluations for climatological applications are made. Extreme precipitation statistics with hourly radar based QPE data in a spatial resolution of one km² are realized for the **metropolitan area of Cologne**.

**Basis:** Hourly adjusted radar data (so-called RW-product) from June 2005 to December 2011

**DWD weather radar network**

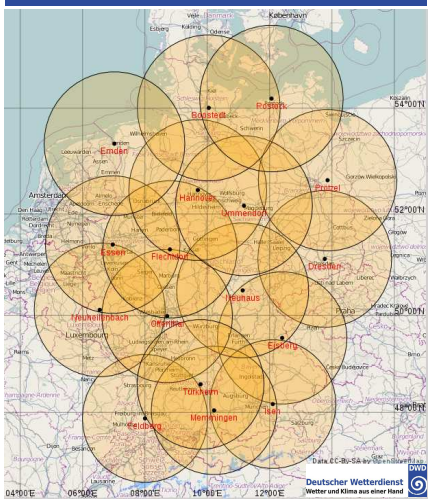


*Fig. 1: Weather radar network including 17 C-band doppler radar systems with circles of 150 km radius for radar based quantitative precipitation estimates (Status: September 2014); currently being replaced by new dual-pol doppler radar systems (Project RADSYS-E, 2008-2014).*

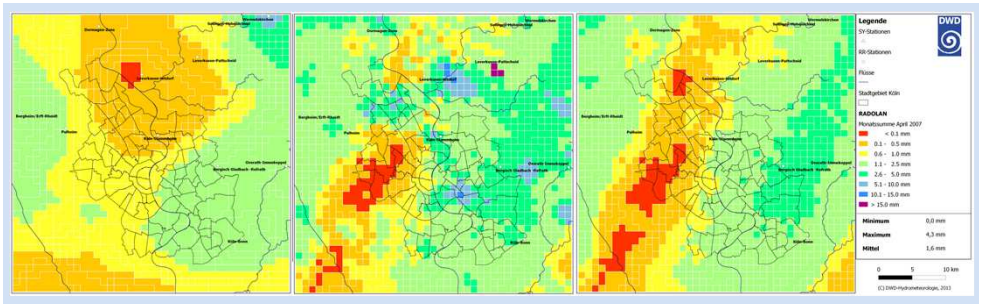

*Fig. 2: The impact of the ex post corrected gauge-adjusted analysis is exemplary shown for the month April 2007, in which sparse precipitation has happened: Precipitation totals in the metropolitan area of Cologne based on interpolated gauge data (left), the online gauge-adjusted radar data (middle) and the ex post corrected gauge-adjusted analysis (right).*

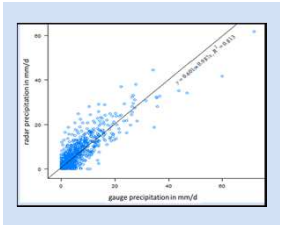

*Fig. 3: Correlation of the daily precipitation values at station Bergisch-Gladbach-Refrath with the ex post corrected gauge-adjusted radar data. The very high correlation of 0,9 illustrates the high quality of the ex post corrected gauge-adjusted radar data.*

## Working steps:

- Ex post correction of false radar echoes (method used by the quantitative radar nowcasting procedure RADVOR (s. fig. 2))
- Professional control of all data ≥ 15 mm/h to eliminate QPE which are not reliable due to other artefacts
- Comparison with gauge data, which are not available for the online radar adjustment (s. fig. 3)
- Calculation of the extreme precipitation statistics for each radar pixel within the metropolitan area of Cologne with duration periods between one and 72 hours and return periods between 0,5 and 20 years (referred to the German DWA-technical rule DWA-A 531)
- Comparison of the extreme precipitation statistics with the German gauge-based method of KOSTRA-DWD-2000
- Comparison of statistical parameters of gauge-based precipitation measurements from 1951 to 2000 as against the time period from 2005 to 2011 (s. tab.)

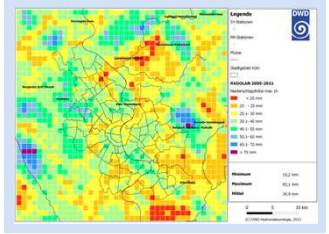

*Fig. 4: Greatest hourly precipitation value measured by radar-based QPE in the time period of June 2005 to December 2011 in the metropolitan area of Cologne for each radar pixel; absolute maximum of 83,1 mm/h on 2008/07/26 at 16:50 UTC nearly Horrem/Erft; for comparison: absolute maximum measured by a rain gauge in the same area and time period: 24,0 mm/h.*

## Results:

- Considerably higher one-hour maximum values from radar data (s. fig. 4)
- Considerably higher variations of the radar-based precipitations but in average slight decrease of the extreme precipitation statistic (s. fig. 5)
- Higher statistical parameters in summer for gauge-based precipitation from 2005 to 2011 as against from 1951 to 2000 (basis for KOSTRA-DWD-2000; s. tab.)
- Several regions have stronger precipitations as neighbouring regions (**other precipitation climatology?**) → existance of special geographic or meteorological conditions or is the short time period of 6,5 years too sensitive to rare extreme events and the spatial distribution of the maxima is determined by random single events?!

| time period → / ↓ parameter | year (06-11) | winter (06-11) | summer (05-11) |
|---|---|---|---|
| minimum | -2,23 | -9,62 | 9,39 |
| average | 0,38 | -2,08 | 12,01 |
| maximum | 4,07 | 1,14 | 13,15 |
| max. number of days ≥ 20mm/d | 14,41 | 6,06 | 26,47 |

*Tab.: Percental change of four statistical parameters for the metropolitan area of Cologne based on gauge-based precipitation analysis according to the method REGNIE (green numbers: slight decrease; red numbers: essential increase of ≥ 10%); reference: 1951 to 2000 .*

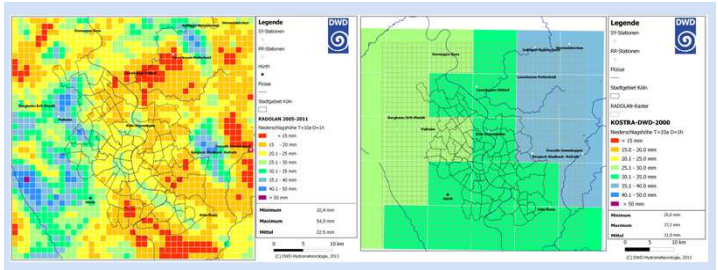

*Fig. 5: Extreme precipitation statistics for the time duration 1h and the return period 10a on the basis of gauge-adjusted radar data from June 2005 to December 2011 (left) resp. on the basis of rain gauges from 1951 to 2000 referred to KOSTRA-DWD-2000 (right).*

**Outlook:** The reanalysis of RADOLAN with the data since 2001 will provide an improved data base applying the actual RADOLAN procedure adapted for climatological applications. Thereby, further algorithms correcting well known artefacts of the radar measurement (e.g. attenuation, fast moving precipitation cells), are developed and implemented into the reanalysis program.

## References

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