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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Integration of four X-band radars into the existing C-band network

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SINFONY (Seamless INtegrated FOrecastiNg sYstem)

- Pilot project at DWD to develop a seamless ensemble prediction system for convective-scale forecasting with forecast range up to 12 hours. Focus on summertime convection.
- Integrates NOWCASTING- and NWP-Ensembles into combined/blended forecast products.

SINFONY
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Project Description

The German Weather Service (Deutscher Wetterdienst – DWD) operates a network of 17 C-band radars and in the following months will start to install four additional X-band systems in the urban areas of Karlsruhe, Nürnberg, Halle, and Bremen. The goal is to extend the coverage of the network and improve the early detection of thunderstorms that could potentially cause flash floods.

As an initial step, we run the quality control for X-band observations provided by GAMIC GmbH and compare them against C-band observations of our network. This process is fundamental to ensure consistency between the two sources.

Consequently, we estimate the parameters of the Z-R relationships for C-band by employing the T-matrix simulations [1]. The Z-R relationships for X-band are calculated in a reverse process.

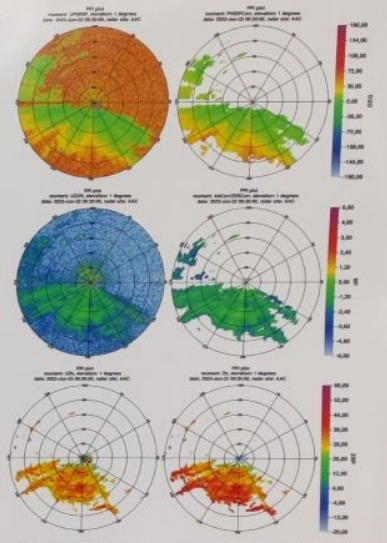
Radar - Network of Deutscher Wetterdienst

Radar network of the German Weather Service (Deutscher Wetterdienst – DWD). The blue points indicate the existing C-band stations, and the red points show the X-band stations to be installed. The observation radius of the prior is 160 km, while this distance is reduced to 100 km for the latter.

Quality Assurance

All algorithms for the quality assurance were developed within the in-house POLARA framework, using the equations described in [2–4]. Reference data from the X-band radar of GAMIC GmbH in Aachen were employed for the examination of the quality of the algorithms. The raw and corrected differential phase, differential reflectivity, and reflectivity are compared to initially evaluate the quality-assurance processing chain.

- The textured differential phase, which indicates no echoes, is successfully removed
- The marginally negative differential reflctivity denotes precipitation other than rainfall
- The attenuation correction results in reflectivity differences greater than 10 dBZ
- Most of the noise around the radar is removed
- The raw observations are relatively clean because of the a-priori SNR tresholds

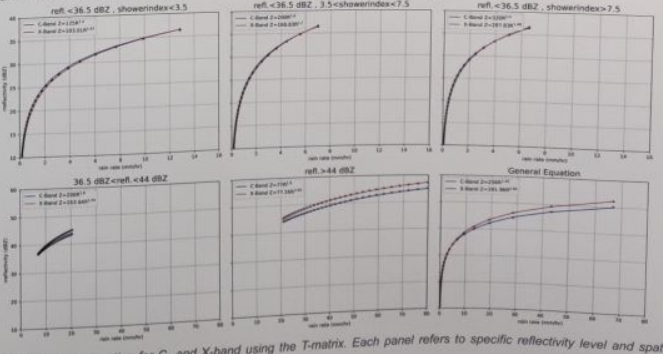


The figures to the left show the raw differential phase, differential reflectivity, and reflectivity, while the figures to the right show the corresponding corrected moments.

Z-R Releationships Estimation

The rain rate is calculated using 6 distinct equations, depending on the reflectivity level and spatial homogeneity. The use of the T-matrix has huge potential and allows for transition between two bands. At this point we focus on the Z-R relationships, but is planned to extend to the calculation of the membership functions for the hydrometeor classification

- High showerindex is associated to high spatial inhomogeneity of the rain
- There are no significant differences between C- and X-band for the low-reflectivity spectrum
- The contrasts are more pronounced for reflectivities greater than 45 dBZ
- As expected, X-band almost always yields higher reflectivities



Z-R relationships estimation for C- and X-band using the T-matrix. Each panel refers to specific reflectivity level and spatial homogeneity (showerindex).

Outlook

- The initial results are very promising despite the limited experience in the quality assurance
- The high SNR threshold does not allow to fully evaluate the process
- More X-band observations are necessary to evaluate the estimated relationships
- Disdrometers are yet to be employed in a later step

References

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3) Park, S. G., Maki, M., Iwanami, K., Bringi, V. N., & Chandrasekar, V. (2005). Correction of radar reflectivity and differential reflectivity for rain attenuation at X band. Part II: Evaluation and application. Journal of Atmospheric and Oceanic Technology, 22(11), 1633-1655.
4) Van de Beek, C. Z., Leijnse, H., Stricker, J. N. M., Uijlenhoet, R., & Russchenberg, H. W. J. (2010). Performance of high-resolution X-band radar for rainfall measurement in The Netherlands. Hydrology and Earth System Sciences, 14(2), 205-221.

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