Probabilistic Radar-Based Precipitation Nowcasting

Masterthesis by

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Abstract

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Introduction

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Data

2.1 DWD Radar Data

Boostedt DWD radar site: 54.0055° N, 10.04683° E, 124.6 m height
Precipitation scan: 0.5° ,following orographie (150 km range) 250m range gates, 1° azimuth steps 5 minute time resolution C-Band 100 km x 100 km box around PATTERN radar position taken from the whole radar image

2.2 PATTERN Radar Data

PATTERN Hamburg radar position: 53.56833°N, 9.97997° E, 80m height
60m range gates, 1° azimuth steps (20 km range) 30s time resolution X-Band

Chapter 3

Methodology

3.1 Prognosis Model

3.1.1 Setting of Parameters

3.1.2 Gridding and Coordinate Transformation

Both the DWD and PATTERN radar data are initially in a polar grid around their respective radar stations. For simplicity and nesting/comparability between both radars, the data is transformed and gridded to a Cartesian grid.

This is done by using the Transverse Mercator projection transforming the polar grid coordinates to a Cartesian grid. The Transverse Mercator projection divides the Earth into 60 zones with 6° longitude in width. This reduces the distortion due to the curvature of the earth. Hamburg and its surrounding area lies in the EPSG zone 32632.

$$Z = 10 \cdot \log_{10}(z) \tag{3.1}$$

$$z = aR^b \tag{3.2}$$

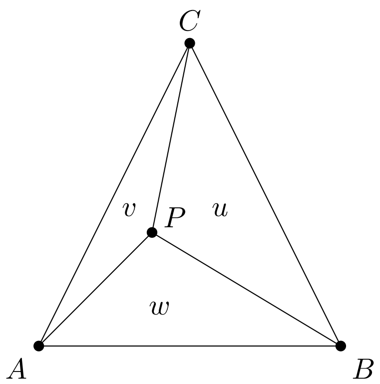
$$R = \frac{Z}{a}^{\frac{1}{b}} \tag{3.3}$$

a and b are empirically-derived parameters. DWD and PATTERN use following values for different radar reflectivities:

$$\begin{aligned}
&Z \leq 36.5\text{dBZ}: && a = 320, b = 1.4 \\
&36.5\text{dBZ} < Z \leq 44.0\text{dBZ}: && a = 200, b = 1.6 \\
&Z > 44.0\text{dBZ}: && a = 77, b = 1.9
\end{aligned} \tag{3.4}$$

3.1.3 Interpolation Methods

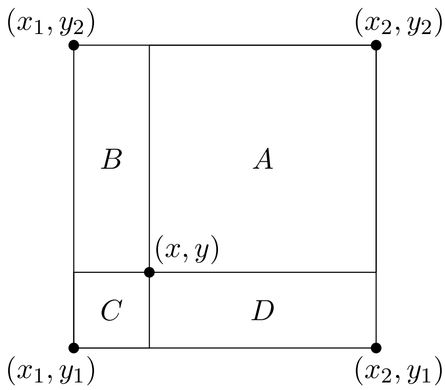
Barycentric Interpolation



$$\begin{aligned}
u &= \frac{\Delta BCP}{\Delta ABC} \\
v &= \frac{\Delta CAP}{\Delta ABC} \\
w &= \frac{\Delta ABP}{\Delta ABC}
\end{aligned} \tag{3.5}$$

$$f(x, y) = Uf(x_1, y_1) + Vf(x_2, y_2) + Wf(x_3, y_3) \tag{3.6}$$

Bilinear Interpolation



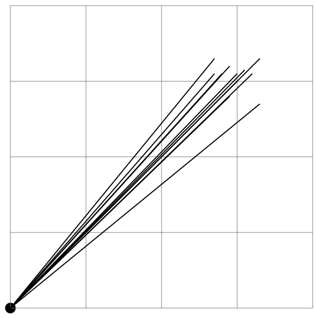
$$f(x, y) = Af(x_1, y_1) + Bf(x_2, y_1) + Cf(x_2, y_2) + Df(x_1, y_2) \tag{3.7}$$

3.1.4 Displacement Detection

Least square correlation

$$\sum_{ij}(c-d)^2 \tag{3.8}$$

3.1.5 Importance Sampling



3.2 Evaluation Methods

Chapter 4

Results and Discussion

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Conclusion and Outlook

Chapter 6

Acknowledgement

Chapter 7

Eidesstattliche Versicherung

Ich versichere an Eides statt, dass ich diese Arbeit selbstständig verfasst und keine anderen als die angegebenen Hilfsmittel benutzt habe. Insbesondere habe ich keine im Literaturverzeichnis nicht genannten Internet-Quellen benutzt. Diese Arbeit habe ich vorher nicht in einem anderen Prüfungsverfahren eingereicht und die eingereichte schriftliche Fassung entspricht der Fassung auf dem elektronischen Speichermedium. Ich stimme einer Veröffentlichung dieser Arbeit zu.

Simon Michel
Hamburg, November 19, 2018