URBAS_RADAR -
a statistical approach to radar climatology

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Introduction

The project URBAS (prediction and management of flash floods in urban areas) funded by the German Federal Ministry of Education and Research (BMBF) addresses the problem of flash-floods in urban areas. URBAS_Radar covers the meteorological aspects in this project and focuses on the spatial distribution of convective events. It uses a statistical approach based on radar data which is the best available kind of data for the distribution of areal precipitation. Data from the CONRAD cell tracking product, which processes radar data, is used here. The question of data quality for climatological analyses is tackled.

Conclusion

Even if there are some restrictions within radar data like shading or attenuation, "true" areal differences within one radar image become obvious. The absolute frequency of occurence of pixels with medium reflectivities serves as a first guess to detect areas where radar data is influenced by beam blockage or clutter correction. For these analyses data from single radars are used which complicates the comparison between data from different radars but it avoids the compositing problems. The use of radar products like CONRAD instead of raw radar data offers a higher variety of parameters like lifetime or tracks of convective cells even if some assumptions or limititations (class-product) have been taken into account.

URBAS overview

As there is a lack of adequate warning systems, emergency maps or protection systems for urban flash floods, URBAS is to increase knowledge about possible actions regarding the whole cause-and-effect chain from the generation and distribution of precipitation and runoff up to the type and development of losses or risks. A team of hydrologists, meteorologists and specialists for urban development cooperates with different municipalities and cities throughout Germany to approaches this problem. A main objective is, to establish a database of recent events all over Germany to obtain knowledge about occurence, management and damages of these events. More than 15 case studies (see Fig. 1) will be analysed in detail, therefore.

Case studies in Germany

Fig. 1. Selected municipalities for case studies in Germany (altitude coloured)

CONRAD radar image

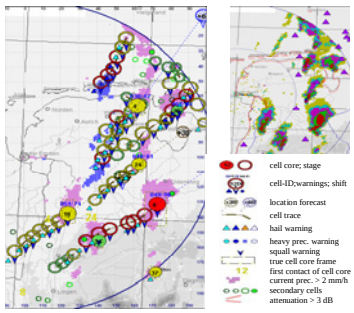

Fig. 2. Section of a CONRAD radar image (left) compared to the latest corresponding reflectivity image.

CONRAD

CONRAD (CONvective development in RADar products) is a cell tracking product which additionally offers a variety of warning features that are useful regarding convection and local risks. It allocates not only the current position and the trace of a convective cell but also warnings of hail, intense precipitation or gusts (see Fig. 2).
Six years of CONRAD data starting from 2000 is available for the 100 km range of all 16 weather radars of the DWD and provides the basis for this statistical approach.

Intense rain

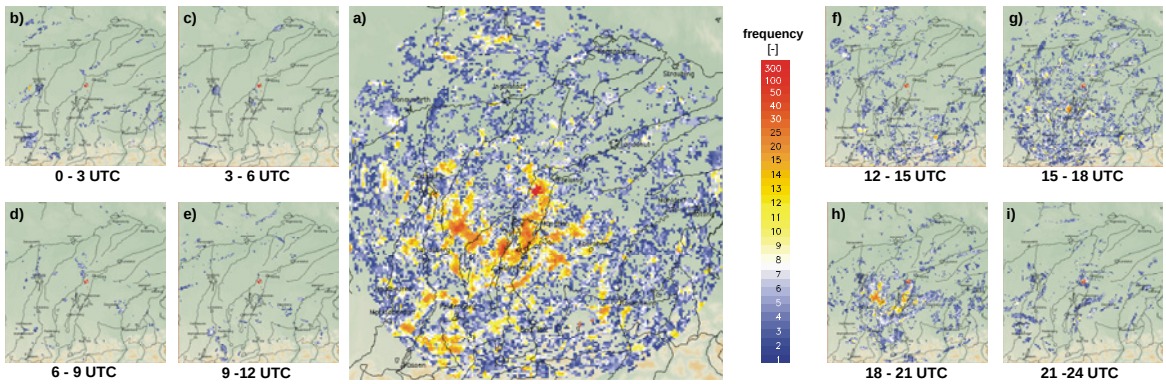

Fig. 3. a) Absolute frequency of occurence of intense precipitation warnings for the operational Munich weather radar from 2000 to 2005.
b-i) same, but separated into 3-hours-intervals

First results

Figures 3 and 4 show some preliminary results of the statistical analysis from the operational Munich weather radar. Figure 3a shows the occurence of intense precipitation warnings. Several hot-spots of heavy precipitation appear, especially in the southern and south-western part. The influence of the alps (60 km south of Munich) cannot be seen directly but it seems that the difference between the northern and the southern part of the image can be ascribed to their influence. Figure 3b-i additionally separates Figure 3a temporally to represent the diurnal evolution of convection. Figure 4 indicates preferred cell tracks in the northeastern direction.

Celltracks

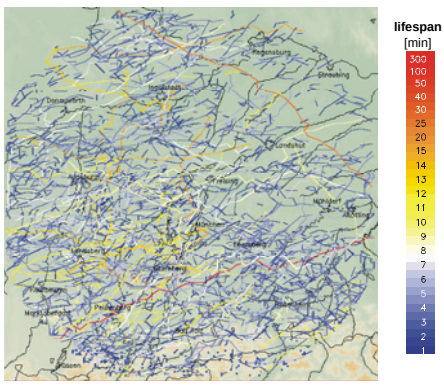

Fig. 4. Tracks of convective cells with their colour coded lifespan for the operational Munich weather radar from 2000 to 2005.

How significant are these results? (QUALITY)

It is well known that the location of the Munich radar is not optimal as there are some clutter problems and shading effects. Figure 5 can be used as a first guess for radar quality. It shows the frequency of occurence of pixels of moderate rain. There are two suspicious patterns of low frequency in this image that must be treated with caution. The first one is the mountain range in the southern part as a result of clutter (correction). The second one is the appearance of beam blockage by the Alps and especially in the northern part caused by obstacles near the radar. Comparison of figures 3 and 4 with 5 reveals areas where this shading may have biased the frequency of occurence of warnings.
The location of the Munich weather radar is by far the most problematical one of all the 16 network weather radars in Germany. But still, large areal differences in the occurence of severe convection exist in figure 2 worth to be meteorologically interpreted even in those problematical sectors.

Moderate rain

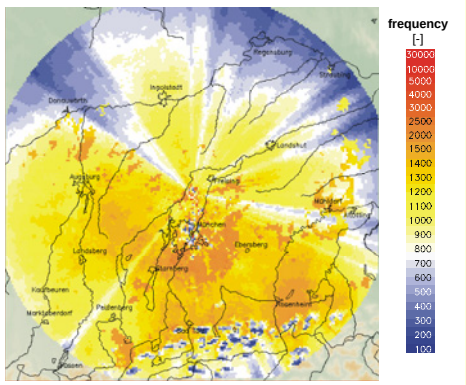

Fig. 5. Absolute frequency of occurence of pixels > 28 dBZ for the operational Munich weather radar from 2000 to 2005.

Future plans

Further investigation needs to be done on the data quality of each radar. An interpretation of results such as figure 3 or 4 is only reasonable knowing limitations of the data basis used.

For the analysis of CONRAD data, cell velocity, traces and lifespan or the occurence of hail will be examined as well as the role of orography, time of day, season or meteorological conditions influencing convectivity.

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