URBAS_Radar – a statistical approach to radar climatology

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1 Introduction

The project URBAS (urban flash floods) funded by the German Federal Ministry of Education and Research (BMBF) addresses the problem of flash-floods in urban areas. As there is a lack of adequate warning systems, emergency maps or protection systems for that type of event, 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. One of the main focuses is a risk assessment of selected communes in case of such an event. Further details about this project can be found at ERAD2006-P-00081. The sub-project URBAS_Radar covers the meteorological aspects in this project and focuses on the spatial distribution of convective events using a statistical approach based on radar data.

2 Data basis

Conventional radar data offers continuously spatial distributions of rain echoes. A statistical approach only based on these reflectivities is difficult and not very significant. High reflectivities indicate convectivity but the identification of convective cells is more complicated. 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, heavy precipitation or gusts.

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Fig. 1. Section of a CONRAD radar image (left) compared to the latest corresponding reflectivity image (PPI).

Figure 1 shows an example of CONRAD data. A section of a usual PPI on the right hand side is opposed to the corresponding CONRAD-image on the left hand side. Cell cores were identified, numbered, characterized and tracked (30 min each). Additional warnings for each cell as well as its history and forecasted location in 30 or 60 minutes can also be seen (cf caption). The light-grey and grey pixel-fields indicate moderate (> 28 dBZ) and intense convective precipitation. For the latter a pixel is flagged if its rainrate exceeds 12 mm in 30 minutes, calculated by a standard Z-R-relationship.

Six years of CONRAD data starting in 2000 is available for the 100 km range of all 16 weather radars of the DWD and provides the basis for this statistical approach.
3 Suitability of radar data for a statistical approach

The quality of radar data decreases with distance from the radar and the height of beam above ground level increases. Heavy convective cells can cause attenuation which leads to an underestimation of echoes from outer ranges as well as partly screening. All these effects must be taken into account when interpreting operational radar images and their statistical evaluation. To avoid additional compositing problems, each radar is regarded independently from the others, in a first step. Nevertheless, radar offers the most precise distribution of areal precipitation. So, there are some restrictions but it seems worth to analyse radar data statistically.

4 First results

The aim of this approach is to locate preferred areas of convection. As an example for possible analyses the frequency of occurrence of intense convective precipitation warnings is shown below (fig. 2).

Figure 2 is based on more than five years of CONRAD data from the Munich weather radar starting in 2000. The Alps are situated 60 km south of Munich, the northern part of the radar image is more or less a flat area. Several hot-spots of heavy precipitation appear, especially in the southern and south-western part. The influence of the Alps 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.

But how significant is figure 2? It is well known that the location of the Munich radar is not ideal so there are some clutter problems and shading effects. Figure 3 can be used as a first guess for radar quality. It shows the frequency of occurrence of pixels of moderate rain.

5 Future plans

Further investigation needs to be conducted on the data quality of each radar. An interpretation of results such as figure 2 is only reasonable knowing limitations of the data basis used.

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

References

http://www.urbanesturzfluten.de/