Improving quantitative precipitation forecasting through high-resolution atmospheric modelling

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Introduction

Effective operational flood management requires detailed knowledge of the distribution of precipitation at high spatial and temporal resolution. Within the interdisciplinary EU-IP PREVIEW (PREVention, Information, and Early Warning), it is aimed to achieve more precise flood forecasts through a better identification of precipitation fields and, in turn, to develop adequate and well-adapted prevention measures by working closely together with hydrologists.

Goal

The goal is to provide information about the amount of precipitation during an extreme weather event. It is aimed to perform high resolution simulations (up to 1 km) resulting in a more realistically distributed precipitation because of a more realistic representation of orographic features. The simulations are performed with the standard weather forecasting model (LM) at 7 km resolution and the newly developed local model (LMK) at 2.8 and 1 km of the German Weather Service (DWD).

General set-up

High-resolution model simulations will not exactly describe the atmosphere and , as a result, will not be able to predict the amount of precipitation in a certain area exactly. One approach to add some information about the stability to the simulations is to run several model simulation using slightly altered initial conditions each time. To avoid high computational costs, an ensemble of model simulations is run at a low resolution first, whereas the extreme precipitation relevant ones are rerun at high resolution (Fig. 1).

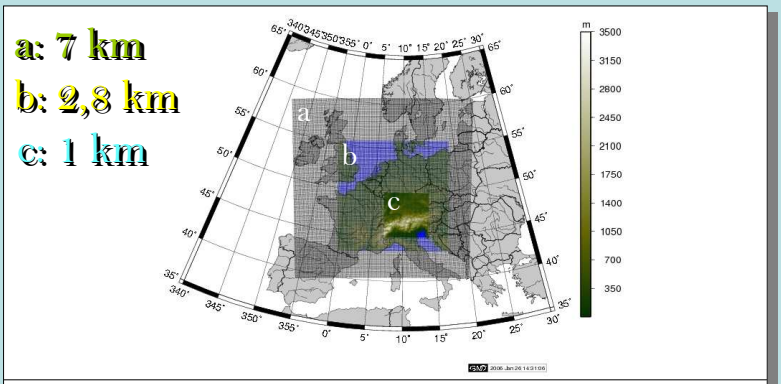

Figure 1: Graphical design of the iterative use of a set of ensembles to quantify the precipitation for extreme weather events.

Figure 2: Part of Europe with embedded research areas: data availability (a), low resolution – 7 km (b), high resolution simulations – 2.8 km/1 km (c).

Research area

This paper focuses on the precipitation distribution in the German part of the river Danube catchment located in the south-eastern part of Germany covering roughly 450x450 km (Fig. 2 – panel c). The usual time scale of a flooding event in such a catchment is several hours to a few days, which acknowledges the urge for an effective operational flood-forecasting system. Within the framework of PREVIEW, close cooperation with hydrological groups is exhibited to gain better understanding of such a system.

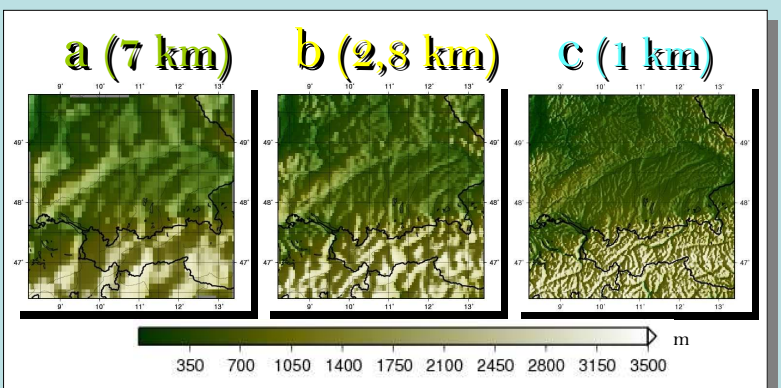

Figure 4: The orography in the area of interest at various resolutions (a: 7 km; b: 2.8 km; c: 1 km)

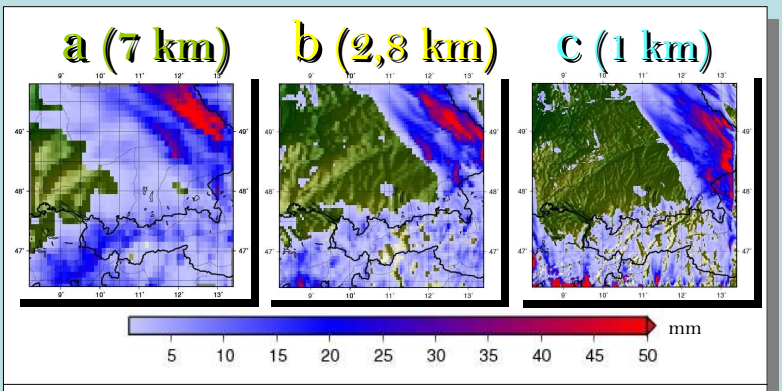

Figure 3: Example of total simulated precipitation (10/08/2002 0:00-15:00) at a 7 km (a), 2.8 km (b), and 1 km (c) resolution.

First results

First results show a significant difference in precipitation distribution between the simulations at a resolution of 7 km, 2.8 km, and 1 km (Fig. 3). One of the reasons for this difference is the much finer resolved orography in the 2.8/1 km simulations (Fig. 4). It is expected that future iterative simulations at a resolution of 1 km will give more information. These simulations will focus more on the river Iller in Bavaria (Germany) and will be able to better locate local maxima during extreme precipitation events.

References

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