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Hydrology and Earth System Sciences Discussions

Interactive comment on "On the benefit of high-resolution climate simulations in impact studies of hydrological extremes" *by* R. Dankers et al.

R. Dankers et al.

rutgerdankers@gmail.com

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Response to the interactive comment by Anonymous Referee 1

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R. Dankers, L. Feyen and O.B. Christensen, 15 May 2009

Reviewer 1 has a major concern about our paper since the hydrological model that we used does not take into account river regulation and lake storage. The reviewer

thinks this has an important effect on the simulation of maximum flows and assumes this leads to large errors. Such large errors can also be seen in some river basins in Figure 1 and reviewer 1 states these make the results of the study 'questionable'.

We agree with the reviewer that the normalised root mean square errors (nRMSE) that are shown in Figure 1 are sometimes larger than we would have hoped for – even although in this paper we mainly compare differences between three different experiments, and these differences are independent of the model performance. However, the large errors than can be seen in Figure 1 are not only the result of the hydrological model not taking into account river regulation. In fact, the main reason for any bias in the discharge simulations can be expected to be bias in the climate input. Several studies (e.g., Wilby, 2005) have showed that uncertainty in the hydrological model is generally lower than the uncertainty of the climate input. Yet, we cannot and should not close our eyes to the fact that also the hydrological model introduces error in the simulations. This was the background of our note on the hydrological model in the paper, but if this is not clear from the original text we propose to phrase more explicitly that the errors are first and foremost indicating bias in the climate simulations.

Furthermore, we would like to point out that the LISFLOOD model has been calibrated using observed discharges, and presumably this corrects to some extent any errors that may arise by not modeling lakes and reservoirs explicitly. River regulation is therefore not completely neglected, as the reviewer claims. The model does have an option to simulate lakes and reservoirs (as described by Van der Knijff et al., 2008). The main reason for not including it in the present study is a deplorable lack of relevant data at European scale. This means it not only affects our simulations, but other studies as well (e.g. Arnell, 1999; Lehner et al., 2006). Following the other suggestion of the reviewer, though, would make large-scale hydrological modeling in Europe almost impossible.

The second concern of reviewer 1 is about our use of the Nash-Sutcliffe coefficient (i.e. a day-by-day comparison) when comparing the three model experiments, driven by the HIRHAM regional climate model at three different resolutions. As we explain in the paper, such a comparison is senseless when comparing the simulations with the observations, as the regional climate model does not aim to simulate the historical weather. However, such a restriction does not apply to the intercomparison of the three RCM experiments, as they were all forced by the same boundary conditions. Using the Nash-Sutcliffe therefore provides a much more detailed and direct comparison of the simulation and timing of all peak flows in the three model experiments. The fact that some events are 'completely absent in either of the experiments' (as shown in Figure 5) may not have been noticed had we used the same approach here as in the comparison with the observations. It is exactly these differences in peak flows (in timing as well as in magnitude) that we are looking for as they are brought about by the differences in resolution used in the HIRHAM simulations. Our approach therefore provides a more thorough comparison of the three experiments.

Please note also that the Nash-Sutcliffe coefficient should not be interpreted here in the classical sense. In our case a low value does not mean a 'bad' model performance, but indicates important differences in the simulation of peak flows, due solely to the different horizontal resolution in the climate input.

Finally, the reviewer asks us to explain how the LISFLOOD model was parameterised. The following explanation is taken from Dankers and Feyen (2008) that we can include in the current manuscript, if the reviewer considers it useful.

The current Europe-wide set-up uses a 5-km grid and input parameters on soil and land use derived from European databases. The model parameters that control infiltration, snowmelt, overland and river flow, as well as residence time in the soil and subsurface reservoirs, were estimated by calibrating against historical records of river discharge in 231 catchments and subcatchments. The calibration period varied between the different catchments depending on the availability of discharge

measurements, but all spanned at least 4 years between 1995 and 2002. The meteorological variables used to force the model in the calibration exercise were obtained from the Meteorological Archiving and Retrieving System (MARS) database (Rijks et al., 1998). For catchments where discharge measurements were not available simple regionalization techniques (regional averages) were applied to the model parameters.

References

Arnell, N.W.: A simple water balance model for the simulation of streamflow over a large geographic domain, J. Hydrol, 217, 314-335, doi:10.1016/S0022-1694(99)00023-2, 1999.

Dankers, R. and Feyen, L.: Climate change impact on flood hazard in Europe: An assessment based on high resolution climate simulations, J. Geophys. Res., 113, D19105, doi:10.1029/2007JD009719, 2008.

Lehner B., Döll, P., Alcamo, J., Henrichs, T., and Kaspar, F.: Estimating the impact of global change on flood and drought risks in Europe: a continental integrated analysis, Climatic Change, 75, 273-299, doi: 10.1007/s10584-006-6338-4, 2006.

Rijks, D., Terres, J.M., and Vossen, P. (Eds.): Agrometeorological applications for regional crop monitoring and production assessment, Tech. Rep. EUR 17735 EN, E.C. Joint Res. Cent., Ispra, Italy, 1998.

Van der Knijff, J. M., Younis, J., and De Roo, A. P. J.: LISFLOOD: a GIS-based distributed model for river basin scale water balance and flood simulation, Int. J. Geogr. Inf. Sci., doi:10.1080/13658810802549154, in press, 2008.

Wilby, R.L.: Uncertainty in water resource model parameters used for climate change impact assessment, Hydrol. Process., 19, 3201-3219, doi: 10.1002/hyp.5819, 2005.

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