Hydrol. Earth Syst. Sci. Discuss., 9, C5185–C5190, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C5185/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A framework for global river flood risk assessments" *by* H. C. Winsemius et al.

H. C. Winsemius et al.

hessel.winsemius@deltares.nl

Received and published: 7 November 2012

Mr. Neal provided us with a number of useful comments, in particular related to the flood downscaling part of the presented flood risk framework. We thank Mr. Neal very much for these comments. We feel that some of the comments are related to potential future work. We are very interested to follow up on the suggestions of Mr. Neal and are happy to seek collaboration on parts where there is mutual interest.

Below, we answer to the specific comments, brought forward by Mr. Neal.

Abstract L7: In a flood risk context is 1 km really high resolution? And P9614 L4, is 1km an "appropriate resolution".

Indeed we realize it is important to state that 1km is only a high resolution from the perspective of a global scale assessment, where large scale decisions are of interest to the end user. In fact, we have identified a number of potential end users in the introduction, who would benefit from this resolution. We have also had several discussions with representatives of these institutes, who have been highly receptive to the approach. If highly localized flood risk assessments are of interest, much higher resolution would be required. For instance, if the envisaged end user is a local disaster management unit, information on the accessibility of certain roads and buildings may be required, leading to much higher requirements for the resolution of flood risk estimates. Another example is the design of infrastructure such as dikes, and dams; such assessments would require local scale studies. In our revisions, we will avoid the term "appropriate" and elaborate more accurately what the usefulness of 1 km resolution is and for which targeted end user this is useful.

Section 2.2.3 P9620 L14: Could you comment on how appropriate these climate models are for simulating extremes.

Climate model projections are inherently uncertain. This is why a multi-model ensemble would be required to yield more reliable estimates of possible future flood risk conditions. We have so far only run 2 different GCM projections. Therefore, this should be seen as a demonstration of the framework's capabilities rather than a real case study. Furthermore, GCM projections contain errors in the probability distributions of their output variables, in particular of rainfall. Therefore we performed bias correction. This has been carried out in two steps: first the amount of wet days were corrected, as GCMs are notorious for producing false drizzle. Then, a correction on the monthly mean rainfall was established. We will provide some more description of this correction procedure in our revised manuscript.

Section 2.3.1 P9625 L25: I might have missed something but I don't understand what "world-region resolution population" means. Could you elaborate?

The IMAGE model produces outputs averaged per world-region. IMAGE contains 24 world regions. We will describe this in the revisions.

Section 3.1 Fig.3: Would a zoomed in map of an urban area and its surroundings help the reader to visualise the results and the interaction between the hazard and exposure data?

We feel that zoomed in visualisation of urban areas would give a false sense of accuracy. We state in the paper that the framework is meant for large-scale assessments only. So we prefer to keep the figures as they are now. I hope the reviewer acknowledges the level of accuracy of the framework. What we can do is give some point indications of the large cities in the maps. These will be added to the spatial figures.

P9630 L19:20: "Our inundation algorithm is based on the principle that floods are generated by backwater from large rivers." I didn't understand this sentence and am not convinced it defines what the flood downscaling methods actually does very well. Do you mean that the flooding is assumed to be due to excess river discharge?

Yes, this is what we mean. We somehow wish to clarify that we do not account for any conservation of momentum within the inundation algorithm itself. Flow through the floodplain compartment itself is only simulated at the coarser scale of the simulations. At the finer scale of 1 km, the associated floodwaters inundate cells starting from the river cells upwards, drowning the topography from the downstream connected rivers.

P9631 L4: "this could be a logical explanation for the" do you mean "this could explain the"

Yes, we will revise the sentence

Section 3.1: Is there any value in comparing the pdf of flood flow volumes to some gauge data at a few points. Alternatively, if a similar analysis has been conducted previously it might be worth referencing this work somewhere in this

section to justify not repeating it.

We will include some references to validation of the individual components in the revised manuscript. PCR-GLOBWB has not been calibrated, but it has been validated on discharge (Van Beek et al., 2011) and on GRACE (Wada et al., 2012). Generally, the model showed fair to good performance and no tuning was carried out in order to maintain the same globally consistent parameterization. In the commented manuscript, we introduced variable inundation extent in the floodplain as used earlier in Petrescu et al. (2009). While this implementation shows more realistic travel times and flood attenuation than routing without explicit consideration of flood plains, further validation is ongoing. On the impact side, Jongman et al. (2012a) estimated global economic and population exposure to flooding over the period 1970-2050, based on changes in socioeconomic conditions only. In the current paper, we build on this by adding a component to assess changes in hazard, and we also introduce a depth component to represent vulnerability. However, future studies should focus on improving the assessment of vulnerability, as demonstrated by Jongman et al. (2012b) in a recent comparison of several European damage assessment methods.

Section 3.2 P9632: Is it possible to do a more targeted test of the of damage and inundation estimates by running the actual events through the cascade? Alternatively you could look at specific components of the cascade. For example, define the river discharges based on gauge observations (if available) to cut out the hydrological component or define the inundation extents based on DFO data before running the rest of the cascade. This would allow you to specifically test the risk and flood downscaling modules against EM-DAT? I'm not suggesting a comprehensive uncertainty analysis because I don't think there is the space here, just something to show that the estimates of historical events are reasonable (or limited in some way that could be improved upon in the future). Section 4.3: It might be worth pointing out that standard practice here would be to compare the proposed downscaling method to a hydraulic model. I guess this has

not been done already? Also, do you have an idea of what physical factors might affect the accuracy of the downscaling? For example, are flatter rivers easier?

As we pointed out to referee 1 we will try to prepare an actual event for further validation. The referee also suggests to establish damage estimates based on Dartmouth Flood Observatory data to remove uncertainties from some of the components. However, the damage estimates are not only a function of inundation extent, but also of inundation depth. Data from the Dartmouth Flood Observatory (DFO) only contains flood extents, therefore a rigid validation with these data is not feasible. To run the inundation algorithm with observed discharges at one single gauge is not possible, because a discharge value does not directly give information on what happens upstream and downstream of the gauge in terms of flooding. This has been accounted for by using the flooded water volumes from the global dynRout model instead. If we wish to run a downscaling with discharges, we would require the use of a dynamic model, rather than a static one, such as the one suggested by Neal et al. (2012). We would like to emphasize that we have put forward a framework in which components may be enhanced and exchanged. We would very much like to further this work, for example using the flood algorithm presented by the referee, (Neal et al., 2012) in collaboration with the referee. If you are interested, please let us know!

Section 4.5 P9638 L12:18: This paragraph is quite general and makes a number of statements about factors that typically have an impact on flood extent. This section should be supported with a few references.

The statements were from prof. Robert Brakenridge of the Dartmouth flood observatory. We are not fully sure if there is a proper reference to a paper or conference contribution. We will ask prof. Brakenridge for a reference. If such a reference is not available, we will clarify that this information was from personal communication.

References:

Jongman et al 2012 a: Jongman, B., Ward, P.J., Aerts, J.C.J.H., 2012. Global exposure

to river and coastal flooding – long term trends and changes. Global Environmental Change, 22, 823-835, doi:10.1016/j.gloenvcha.2012.07.004.

Jongman et al 2012b: Jongman, B., Kreibich, H., Apel, H., Barredo, J.I., Bates, P.D., Feyen, L., Gericke, A., Neal, J., Aerts, J.C.J.H., Ward, P.J., 2012. Comparative flood damage model assessment: towards a European approach. In press, Natural Hazards and Earth System Sciences.

Neal, J. Schumann, G., Bates, P.: A sub-grid channel model for simulating river hydraulics and floodplain inundation over large and data sparse areas, Water Resources Research, in press, doi:10.1029/2012WR012514.

Petrescu, A. M. R., L. P. H. van Beek, J. van Huissteden, C. Prigent, T. Sachs, C. A. R. Corradi, F. J. W. Parmentier, and A. J. Dolman (2010), Modeling regional to global CH4 emissions of boreal and arctic wetlands, Global Biogeochem. Cycles, 24, GB4009, doi: 10.1029/2009GB003610.

van Beek, L. P. H., Y. Wada, and M. F. P. Bierkens (2011), Global monthly water stress: 1. Water balance and water availability, Water Resour. Res., 47, W07517, doi:10.1029/2010WR009791

Wada, Y., L. P. H. van Beek, and M. F. P. Bierkens (2012), Nonsustainable groundwater sustaining irrigation: A global assessment, Water Resour. Res., 48, W00L06, doi: 10.1029/2011WR010562.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 9611, 2012.