

# Review: An integrated hydrological and hydraulic modelling approach for the flood risk assessment over Po river basin.

## General Comments

This paper presents very interesting work on the topic of flood risk assessments using novel hydraulic and hydrological modelling techniques. The paper is well written, referenced and structured. The results are presented clearly, and are honest (perhaps even modest) about their performance. However, while the methods are innovative, the major contribution developed is described as “an innovative approach which reshapes the digital elevation models”. Despite this being the crux of the work, this digging method is not described at all, other than calling it an ‘ad-hoc’ process in the abstract.

The resolution used was 90m, and the main purpose of the method is to “apply it also in those regions where there is [limited information]”. In regions with limited information, river channels are very likely to be less than 90m wide, so this raises some difficult questions about the ‘digging’ process. Due to the lack of explanation on this vital component, I am suggesting this paper needs ‘major revisions’ before it can be accepted. However, in reality, it is only this point that needs to be revised, rethought and clearly explained. For example, a simple fix would be to conclude the innovation of the work as a ‘an innovative combined hydraulic and hydrological modelling process’ which shows good results. In this case, however, the computational efficiency and performance advantages over other methods (such as JRC) should be clearly explained.

Some smaller specific comments are given below.

## Specific Comments

Title: “...over THE Po River basin”.

Page 1, Line 27: “the results ARE less satisfactory...”

P2 L37: “which mandate is” (English)

P2 L41: “for A few regions of the globe”

P2 L70: I am not sure if these drawbacks are relevant. 1D schemes are rarely described as computationally expensive. Also, the fact that areas between cross-sections are not represented is true of any model that uses discretisation (i.e. all numerical models). A 2D model also discretises an area into uniform blocks that don’t represent variation within the blocks.

P4 L122: I assume D8 relates to the deterministic eight nodes method (Martz and Garbrecht 1992), but this should be stated and referenced.

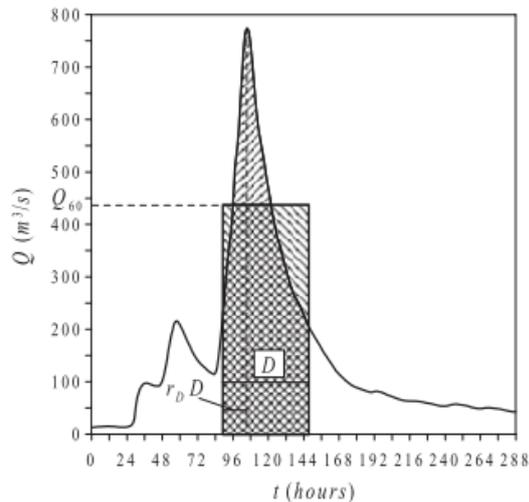
P4 L125: No mention is made as to how CHyM handles evapotranspiration.

P4 L130: Although 9 domains were simulated in the overall project work done, I don’t think it is relevant to the story here, which focuses on the Po / Tanaro. This is also true for Figure 1.

P4 L131: “The domains are matching the...” I think ‘match’ is better here, but in general the sentence is a bit long and awkward, and could be rethought.

P6: L170: “(flatter) rising (falling) limbs of...” The authors are trying to be less verbose here, but the resulting is just confusing. Perhaps ‘vice-versa’?

P6 L176: Even though I am familiar with Maione’s work, this description was hard to follows. Perhaps it could be explained with reference to the diagram below;



P7 L196: Apologies if I am incorrect here, but as I understand it, CA hydraulic modelling is simply finite volume modelling in which the volumes are balanced over a group of neighbouring cells for each cell, rather than over the whole domain. Given that the definition of a cellular automaton is (basically) a set of rules for a domain of grid cells, surely all 2d hydraulic models could not be called ‘cellular automata’, and the name is not required.

P7 L208: “..., as expected, ...” or “...(as expected)...”

P9 L 213: interested river network? This sounds strange

P9 L214 “the following section” is ambiguous here, as it does not refer to the actual next (sub)section 2.4.

P9 L242: As mentioned above, does a 90m DEM allow for this digging? What is the ‘ad-hoc’ process? Does this work-around mean the process is only suited to the presented application?

P10 L268: The SDHs are built using observed data, so how exactly does using a model validate them?

P10 L272: This should be ‘area under the curves’ However, given this is Q for a set period, I think it would be better to simply use ‘total volume’ as the metric.

P12 Figure 7: This figure is poor. The elevation legend has no units, and has too large a range. The flood legends are similar in both the aerial and GIS images, but represent different things.

P12 L287: Where is it catalogued as such? 100 year rainfall or 100 year level at a certain location?

P13 L294: I think the problems of SAR should be mentioned (double-bounce etc.) as they can be seen in the satellite image.

P13 L317: How are the AdbPo maps produced?

P15 L328: This part raises more questions about the dug channels. Why was 1.5 years chosen? Why not do a second 'dig' in the areas between main levees (or minor levees) to the same conveyance as the protection level. In other words, why not dig a conveyance of 200yrs in the area of Fascia B?

P16 Conclusion: As Maione's RP method is used in the overall combined method presented, it is limited to producing flood maps, which should be mentioned. Furthermore, such maps don't allow for spatial homogeneity issues (for example, a 100yr event doesn't produce a 100yr level at all locations).

P16 L360: The fact that the method is developed for regions with limited information seems to be mentioned here for the first time.

P16 L362L: Which hydrographs?