Hydrol. Earth Syst. Sci. Discuss., 10, C2143–C2146, 2013
www.hydrol-earth-syst-sci-discuss.net/10/C2143/2013/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Socio-hydrology: conceptualising human-flood interactions" *by* G. Di Baldassarre et al.

L. Raso

l.raso@tudelft.nl

Received and published: 31 May 2013

The article 'Socio-hydrology: conceptualising human-flood interactions', by Baldassarre et al., presents a conceptual model that emulates the evolution of a society and its flood protection strategy. This is a dynamic process where awareness influence protection and vice versa, therefore system dynamics is an appropriate approach to model it. Despite its simplicity, the model gives some insight in the process, and interesting results. As the authors already stressed in the article, this is a conceptual work. It contains various simplifications and it has no claim of predictive capability. For this reason, my comments are about the qualitative, conceptual aspects, and about the importance of identifying the main assumptions.

My first comment is about the relations between levees construction, awareness, and flood events. In the model, the amount by which levees are raised, R, depends directly on the hydrological variables representing the flood, F. However, floods itself does not rise levees. In my opinion, the conceptual process is the following. Flood events rise awareness in the society and the decision maker. The decision maker choses to increase protection and reduce flood risk. In the paper, awareness (M) and R are directly linked to flood events (F). Flood is the only driving force leading to higher awareness (equation 4d), then R is also univocally linked to M. However, this in not always valid. In general, awareness can increases even without a flood events. The system already contains the variables, it is just to change their relations. In this case, also the arrow connecting flooding to levees in Figure 2 should be removed.

The parameters ϕ_P represents the rate at which new properties can be built. ϕ_P is considered constant. However, most of the people generally survives the flood, whereas the buildings, where they live in, do not. Therefore, after a flood event, there is a peak in demand of new houses. A Constant ϕ_P is equivalent to assuming that all those affected by the flood leave the city (or they all die), whereas it is mostly a relocation. To model the "relocation" process, the variable G, a variable representing general city dimension, must be split into two variables, "houses" and "people", making the demand for new houses dependent on the number of people without one. This adds some complexity to the model. However, the relocation after a flood is an process that influences the other variables and the other processes of the model. For this reason I think that it is important enough to be taken into account.

Another aspect where the paper can be improved is in the statement of the main assumptions. This is important because assumptions define the extent to which the model is applicable. Assumptions can be deduced from the equations, but it is preferable to define them explicitly before, at least the main ones. Some of the hidden hypothesis that I have identified are: i) The system is isolated; No information from other systems. Society learns from its own disasters only. ii) The society is homogenous, and can be treated as single entity. iii) There is a unique decision maker, a central authority that decides zoning and levees, able to enforce its decision. This assumption neglects that house location is also an inhabitants' choice, that is another important distributed driving force. In some societies this force is even stronger than the prescription of the authority. iv) Steady economic structure; Society always gets the same benefits from the river proximity, implying no change in the economic structure. v) Steady technology. No evolution of levees, constant decay of protection level k_T. There are probably more hidden hypothesis, and it is important to define them clearly. My suggestion is to do this in a dedicated part, before introducing the model.

In conclusion, I would like to point out an interesting result worth to be commented. In Figure 3, plot d., the red line, representing the "low-cost levees society", grows less than the others. This is in contrast with classic economic theory, where less expensive levees should make the society better-off. In this case, it is the "high-cost levees society" (green line) that is more prosperous. If a society's objective is its growth, this can be interpreted as irrationality of the "low-cost levees society". From the plotted data, this seems due to the fact that, in the high-cost levees setting, relocation is preferred to building levees. Plot c shows a higher and stable distance from the river of the "high-cost levees society". A possible interpretation is that, when society's memory is short and levees decay is fast, relocation is a better protection strategy. In this case, people move to less risky area. Rising levees offers a temporary solution, but as time goes on, society forgets the risk, does not maintain levees and risk increases again. Therefore, when flood happens, "low-cost levees society" suffers a loss. On the other hand, relocation is a slow process (slower than people's forgetfulness and levees decay). Therefore "high cost-levees society", relocated in a high protected area, is safe, even if not aware of the risk any more. In figure 4, where levee protection decay is slower, the "cheap-dikes society" grows more than the others. In this case they lose awareness, but they are safe anyway, because levees lifetime is also longer than awareness. This suggest further comments on the difference between "one-time" protection measures and protection measures that require maintenance.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 4515, 2013.