ONE METHOD TO INCLUDE LEVEE BREACHING IN FLOOD RISK ASSESSMENT

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In France, Government should assess flood risk through the elaboration of PPRI (prevention plan for flood risk). The flooded areas will generally be shared into areas with high risk in which it is forbidden to build houses, areas with moderate risk in which specific building rules should be applied and areas with low risk. To determine the boundaries of the flooded areas, the historical higher flood or the 100-years' flood if higher is selected as reference. However, the construction or rise of levees along a river in order to protect built-up areas can change the level of risk. The simplest way is not to consider levees; the main disadvantage of this approach is that it would block development of already built-up areas that have been successfully protected for long years. Thus, a more realistic approach is to consider the various possibilities of levee breaching and to integrate this additional hazard in the risk assessment based on the flow passing without breaching. Thus, scenarios of breaching events and estimate of their consequences are necessary.

We restrict to the case of a flood occurring along a river for which part of the floodplain is protected by levees. In this case, three processes should be modelled:

- the flow inside the main channel and the part of the flood plain that is not protected;
- breaching of the levee;
- flooding of the protected area.

These three processes are coupled because the opening of a breach will modify the flow inside the main channel and the flow conditions upstream and downstream the breach influence the evolution of the breach and of the flow through the breach.

Downstream from the breach, the flooding is similar to a dam-break wave propagation in a dry valley. The main difference is generally the absence of favoured propagation direction because a priori no channel was initially present in the floodplain. In such conditions, present state of the art will lead to select two-dimensional shallow water equations to model such a process in the more convenient way.

However, such a calculation requires a long time of calculation (typically, several hours or days) and cannot be multiplied too much. Thus, for risk assessment, the practical method used for elaborating convenient scenarios is also important.

Generally, a lot of scenarios have to be studied in order to reach a comprehensive assessment for a complete reach of a river. Thus, it seems advisable to proceed by successive steps:

- some simplified methods or assessments should permit to reach an overview;
- then, more complex calculations will permit a detailed risk assessment in some locations.

For the fist step, Cemagref developed a specific software named CastorDigue (Simplified calculation for the treatment of the wave created by the breaching of a dike).

The problem is reduced by distinguishing four areas, each one being described by a simplified model:

- the river main channel including by a series of cross sections;
- the breach area described by a trapezoidal cross section for the levee and a rectangular cross section for the breach itself (except at the beginning of piping in which the breach section is circular);
- the near-field area in which a two-dimensional propagation occurs on an inclined plane;
- the far-field area in which the propagation turns to be one-dimensional.

In any case, the advantage of CastorDigue or a similar tool stands in proposing a framework for building a lot of scenarios, for instance, by changing one parameter only.

For the second step in which detailed calculations of some flood events including breaching are necessary, 2-D shallow water equations coupled with a breaching model can be used. Sensitivity analysis that is necessary in view of the uncertainty of some parameters, can be included either in the first step or in the second step for one or two parameters that influence the results strongly.