### Supplementary Material 1: Flow distribution algorithm

As all the cells have identical areas, the volume computation can be simplified and the method is described as flow thicknesses for each cell and between cells. The algorithm is composed of the following steps for each cell of the domain:

1. The average of the flow thickness *(hc*), the elevation *(zc)*, and the run-up height of the central cell *c* and of the flow thickness () and altitude () of the neighboring cells *l* (l) is computed as follows:

with *N*(*c*) the group of active neighbors of central cell *c*, and card(*N*(*c*)) the number of active cells in *N*(*c*).

1. Then, an iterative elimination process begins: neighboring cells that have a physical state higher than this average are eliminated and the average is recalculated with the remaining cells until no more cells are removed.
2. At the end, the remaining cells are active for receiving an outflux from the central cell computed as follows: