[ik ga er even van uit dat je de kin wave formules van de website hebt gehaald: <http://blogs.itc.nl/lisem/basic-theory/overland-flow/>

Flooding module in LISEM

Flooding in openLISEM follows a 1D/2D approach. The order of processes is as follows. Runoff water is accumulated on a predefined flow network with a kinematic wave procedure. The flow network is provided by the user and is usually based on the flow direction in a 3x3 cell window following the steepest slope. The kinematic wave converges water to a single outflow point where it leaves the catchment. The kinematic wave is an iterative procedure using the user defined timestep of the model, which is usually in the order of 5-60 seconds. Furthermore it is possible to define a channel network, for manmade channels or natural riverbeds. In cells which contain a channel, part of the runoff water is diverted to the channel, and the channel captures rainfall directly. The amount of water reaching the channel depends on the runoff velocity, the timestep and the size of the gridcell compared to the channel size. The channel characteristics are defined by a series of maps for width, depth, bed slope angle, channel wall angle, manning’s n, and cohesion. The channel can be made impermeable or can infiltrate water. Once there is water in the channel, the kinematic wave is executed a second time for the channel alone, using a channel network map, to route the water to the outlet.

Finally, when the discharge wave reaches a height that is larger than the channel depth, the water overflows back onto the adjacent surface. Depending on the amount of overflow substantial flooding can take place. The flooding is done using an opensource “FullSWOF” method proposed by Delestre et al. (2009) [zie deze referenties: <http://www.univ-orleans.fr/mapmo/soft/FullSWOF/#publi> ] based on the classical system of Saint-Venant equation for shallow water floods. The term shallow in this case refers to the assumption that the flooding can be estimated with on average flow velocity and does not need to take vertical velocity changes in to account. The method uses an explicit numerical solution with a varying timestep, where the timestep is adjusted to meet stability criteria. The method is fast and robust with a high precision. The flood module is executed as many timis as needed to “fill up” a LISEM time step. Typically a LISEM timestep is 10 seconds, while the flood module runs at timesteps fluctuate between 5 to 0.5 seconds (depending on the local circumstances). The timestep used for the entire flood domain is the smallest timestep occurring in the flood domain, so the gridcell with the smallest timestep determines the solution.

openLISEM is currently in a beta stage concerning this flood module. Both the kinematic wave and the fullswof method have very small mass balance eroors, but the coupling of the two methods in LISEM is still under construction. There are two coupling mechanisms:

1. It is assumed that the water in the channel cells themselves, instantaneously reaches an equilibrium between the water level in the channel and the flood water level in the strip of land adjacent to the channel. This assumes therefore that the channels are not too narrow compared to the cellsize and timestep. This resulting water level is then used to execute the flood module
2. It is assumed that runoff water reaching the flood boundary has some momentum and takes some time to mix. Water is turbulent everywhere (this has been checked with Reynolds numbers) and the turbulence together with the momentum causes a certain mixing distance. To simulate this additional friction during the mixing a simple assumption has been made: the manning’s n of the flooded area is temporarily increased, with a factor depending on the flood depth D (in m):

N\_effective =n\_local\*exp(1.5\*D)

Thus the kinematic wave for overland flow will change in the flood domain to have a rapid decrease of velocity where the flood water is deeper.

These two assumption on the 1D-2D connection are still under review and being tested.