

What to do with real sinks in a DEM?

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Outline



Most sinks in Digital Elevation Models (DEMs) result from errors in DEM creation. Low accuracy, low resolution and interpolation errors can cause the DEM to contain these cells that have only higher neighbours. However, not all sinks are artefacts: some are part of existing landscape features like ponds, lakes or karst features. In some landscapes, these real sinks are very common. Moreover, dynamic landscape evolution models (LEMs) that redistribute material over the digital landscape in multiple timesteps (e.g LAPSUS) can create sinks from one timestep to the next, for instance when landslides dam a valley.

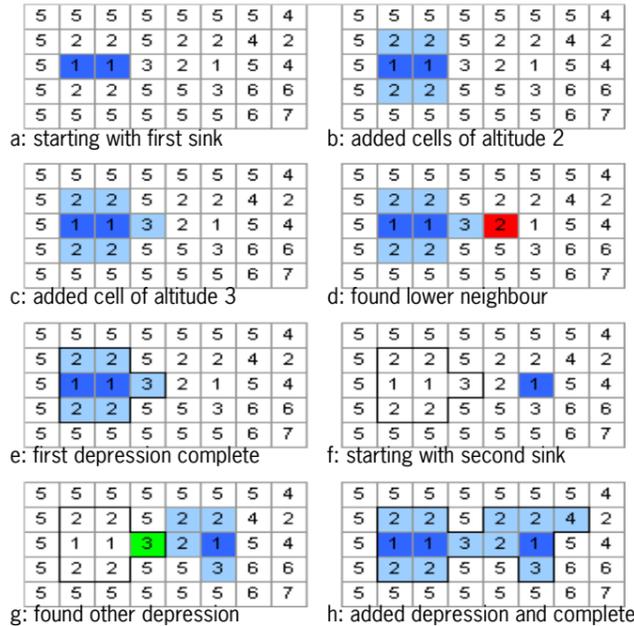
These sinks can have an important role in the landscape: they store water and sediment and reduce erosion. Therefore, LEMs need to be able to deal with sinks and resulting depressions by adapting process descriptions, instead of by adapting DEMs.

Defining depressions

Starting from a sink, we keep adding consecutive lowest neighbouring cells to the depression. The altitude of the last cell added to the depression is stored as its level: *depressionlevel*.

The first lowest neighbouring cell that is *lower* than current *depressionlevel* is no longer added to the depression. The cell that was last added, is stored as the outlet of the depression.

When finding a cell that is already part of another depression, all cells of this other depression are added to the current depression before finding the next lowest neighbour of the depression. Also *depressionlevel* and outlet for the other depression are deleted. In this way, depression with multiple sinks will be defined as a single entity, with one outlet.



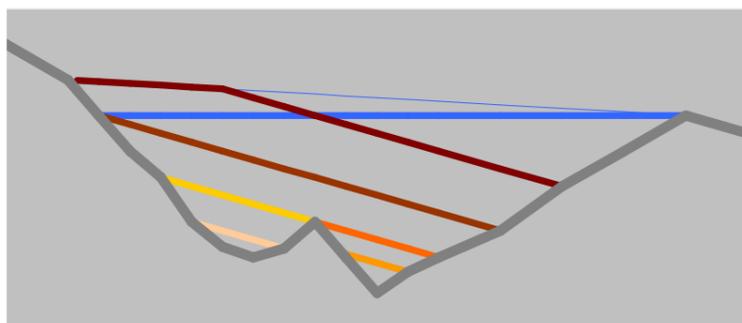
Changing flow routing

This algorithm can be an addition to existing flow routing procedures that are unable to calculate flow through depression towards the rest of the DEM.

Water and sediment entering a cell that is part of a depression are added to depression-wide counters of water and sediment. When all cells surrounding the depression have been analysed, these counters store the total amounts of water and sediment entering the depression.

The amount of water leaving the depression via its outlet equals the total amount of water entering it minus the volume of the depression not occupied by water.

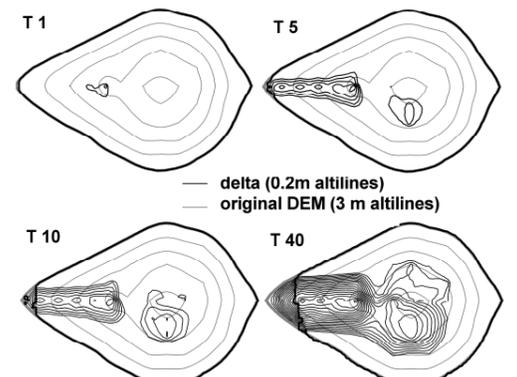
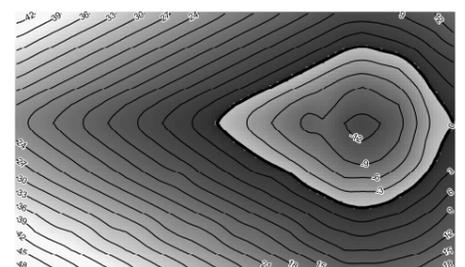
Deposition in depressions



Depending on the amount of sediment available for deposition, a depression can be completely or partially filled.

Completely filling a depression is done to *drainlevel*: a level that is higher than *depressionlevel* by a margin that equals the distance – via depressioncells – to the outlet multiplied with 0.0000001. This ensures a draining surface for the next timestep.

Deposition for a depression that cannot be completely filled, is done separately from all cells on the edge of the depression. Starting at such a cell, we search its lowest neighbour relative to an oblique plane with user-specified tangent. This way, deposition will begin at the first cell where sediment is no longer transported deeper into the depressions. New cells are included in the group of cells that is raised when they are equally high as the others, relative to the oblique plane. Cells are raised to a maximum of *drainlevel*, ensuring a draining surface.



General information

The algorithm is currently operational in C++ as part of dynamic landscape evolution model LAPSUS (www.lad.wur.nl). Ask the author for more information or possibilities to obtain and use the source code.: Reference :