Global Climate Forum

Coastal impact modelling with the diva++ library

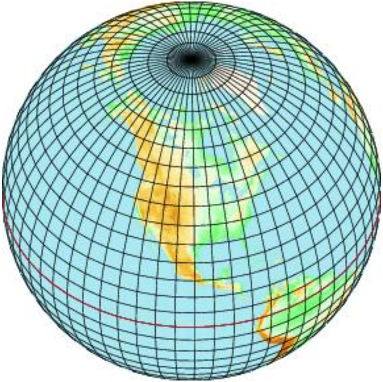
Session 2 - 24/08/23

Daniel Lincke

Fall/Winter 2023/2024

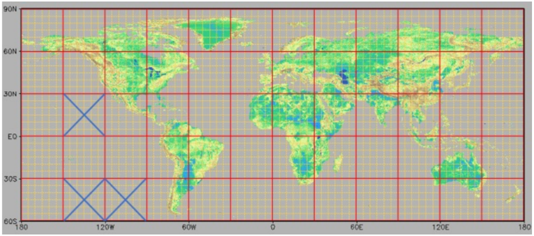
Recap and remarks

- Grid cells do not necessarily have the same metric measures (e.g. area)



- all grid cells have same geographic areas, but different metric area

Recap and remarks



- Example: meritDEM
- all meritDEM grid cells have measure 3 arcsec * 3 arcsec, thus area 9 arcsec^2
- metric measure between 90m*90m and 30m*90m (approx.)
- useful for calculations: Great-circle distance

Recap and remarks

- Grids can be cirular: last and first column are neighbour columns
- first and last row do not have neighbour rows in the relevant direction
- anoying notational detail: grids cells are adressed (row, column) but mathematical notion adresses points (x,y) which coresponds to (column, row).
- Grids can have more advanced topologies. Neighbourhoods have to be adjusted accordingly (triangulation - 12-Neighbourhood) - beyond our scope.

Hydrologic connectivity

Example form last lecture (DEM data):

0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	0	1	2	3	4	5	6	7	8	9	10

Hydrologic connectivity

Example form last lecture (DEM data):

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

Example form last lecture (DEM data):

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

- Grid cell (4,6) has elevation 0.5

Hydrologic connectivity

Example form last lecture (DEM data):

	0	1	2	3	4	5	6	7	8	9	10
0	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$
1	$\perp$	2.0	2.2	0.9	1.1	1.4	1.4	1.3	$\perp$	$\perp$	$\perp$
2	$\perp$	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	$\perp$
3	$\perp$	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	$\perp$
4	$\perp$	$\perp$	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	$\perp$
5	$\perp$	$\perp$	2.9	2.2	1.5	1.2	1.4	1.2	$\perp$	$\perp$	$\perp$
6	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$	$\perp$

- Grid cell (4,6) has elevation 0.5
- But all neighbours have higher elevation

Hydrologic connectivity

- in a coastal model its not the elevation of grid cells does not determine their exposure to flooding
- it is rather the height a water level needs to have in order to reach a grid cell
- this heigth is called hydrologic connectivity

Hydrologic connectivity

Definition

In a coastal model cm the hydrological connectivity is for a grid cell (i,j) is defined as

$$
\begin{aligned}
hc_{cm} \quad &: \quad G \rightarrow \mathbb{R}^{\perp} \\
hc_{cm}(i,j) \quad &= \quad \begin{cases} \perp & \text{if } CM(i,j) = (cl, \perp) \\ \min\{\max_{elevation}(p) : & \\ \quad p \text{ path from } (i,j) \text{ to a coastline grid cell}\} & \text{otherwise} \end{cases}
\end{aligned}
$$

That is, the hydrologic connectivity is the minimal maximal elevation on any path from the grid cell to the coastline. In order to be able to reach grid cell (i,j) an extreme water level event with must have at least this water level.

Hydrologic connectivity

Claim: the hydrologic connectivity of grid cell (4,6) in the data presented before is 1.1

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

- how can the hydrologic connectivity be determined systemetically?
- determine all paths from a grid cell to the coast is not promising (see exercises)
- instead a simple flooding algorithm can be used
- idea: flood the area considered with higher and higher water levels and record which grid cells run full.

Hydrologic connectivity

Algorithm: compute the hydrologic connectivity for a coastal model cm

- create a container C1 that contains all elevation values that are coastline, a containers C2 with all grid cells that have data values in the elevation and are not coastline and an empty container C3
- determine all elevation data of the grid cells from cm, unique them and sort them in increasing order in a container VC
- while VC is not empty:
  - use the first value of VC, remove it, and determine all grid cells from C1 that are mapped to elevation el and move them into an intermediate container C
  - repeat until C does not growth anymore:
    - for all grid cells c in C: find all 8-Neighbours of c in C2 that are mapped to an elevation $\leq$ el. Set their elevation to *el* if it is smaller than *el*. Move found grid cells (and their possibly modified elevation mapping) from C2 to C.
  - move all 8-Neighbours of grid cells in C that are in C2 into C1.
  - move all grid cells of C into C3.

Hydrologic connectivity

lets flood:

0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5~~ 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6~~ 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

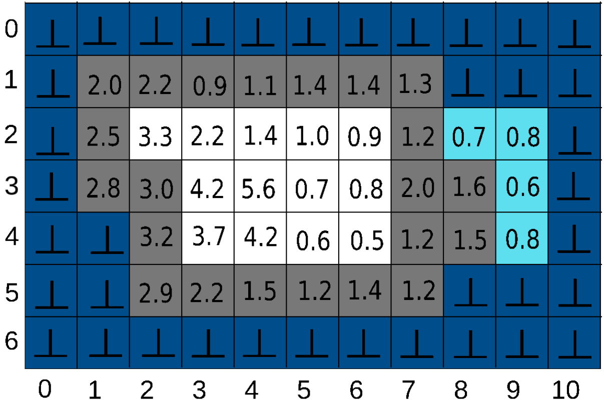
~~0.5 0.6 0.7~~ 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8~~ 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9~~ 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

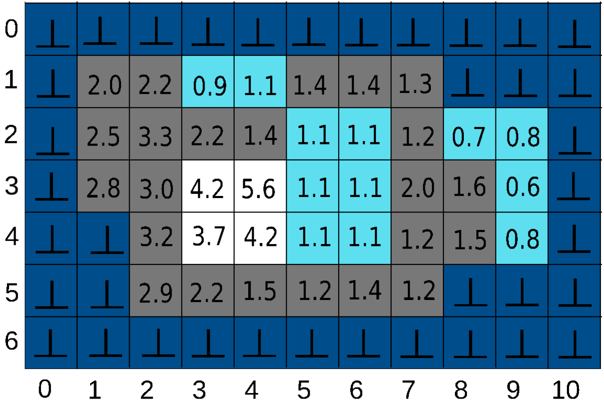
~~0.5 0.6 0.7 0.8 0.9 1.0~~ 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.0	0.9	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	0.7	0.8	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	0.6	0.5	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	0	1	2	3	4	5	6	7	8	9	10

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1~~ 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1~~ 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2~~ 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3~~ 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

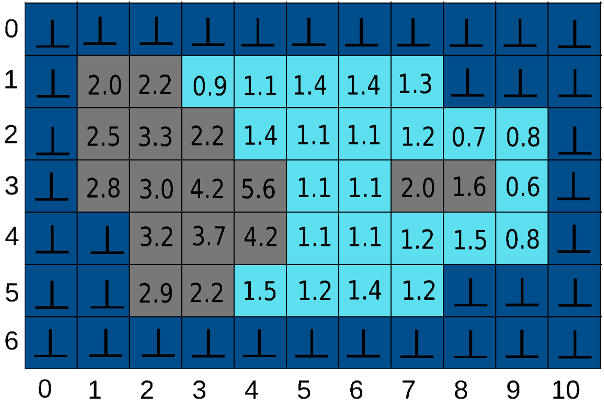
~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4~~ 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

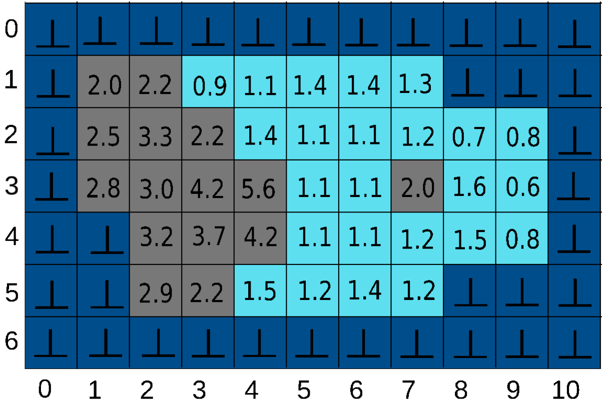
~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5~~ 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6~~ 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

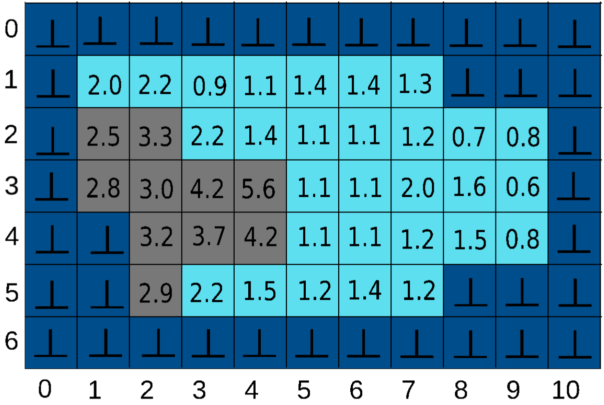
~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0~~ 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2~~ 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

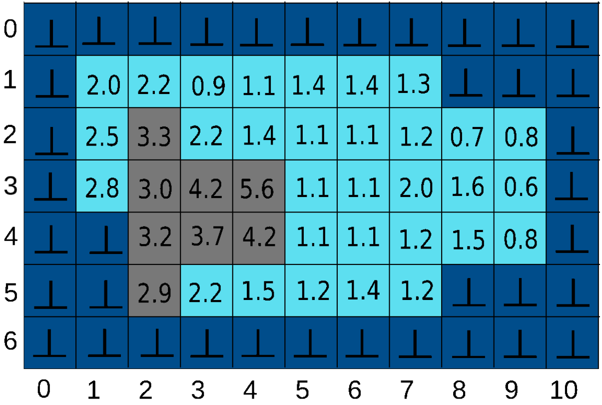
~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5~~ 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8~~ 2.9 3.0 3.2 3.3 3.7 4.2 5.6



Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9~~ 3.0 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0~~ 3.2 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2~~ 3.3 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3~~ 3.7 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7~~ 4.2 5.6

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

lets flood:

~~0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 2.0 2.2 2.5 2.8 2.9 3.0 3.2 3.3 3.7 4.2 5.6~~

	0	1	2	3	4	5	6	7	8	9	10
0	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
1	⊥	2.0	2.2	0.9	1.1	1.4	1.4	1.3	⊥	⊥	⊥
2	⊥	2.5	3.3	2.2	1.4	1.1	1.1	1.2	0.7	0.8	⊥
3	⊥	2.8	3.0	4.2	5.6	1.1	1.1	2.0	1.6	0.6	⊥
4	⊥	⊥	3.2	3.7	4.2	1.1	1.1	1.2	1.5	0.8	⊥
5	⊥	⊥	2.9	2.2	1.5	1.2	1.4	1.2	⊥	⊥	⊥
6	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

Hydrologic connectivity

- the algorithm does not compute the path the defines the hydrologic connectivity
- the algorithm requires linear space (memory) - each gridcell is stored only once
- the algorithm requires quadratic time (worst case)
- the algorithm (and everything that follows) assumes a static inundation (bathtub) which means in principle the water volume available to flood the area is infinite (but the water level is fixed). Dynamic approaches use limited water volume.
- the concept of hydrologic connectivity will be the base of hypsometric profiles (next session)

The end

Thanks.