The Chym hydrological model applied to the production of flood maps: a case study for the ALLIANZ Insurance Company.

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Fourth Workshop on
Water Resources in Developing Countries:Hydroclimate Modeling and Analysis Tools

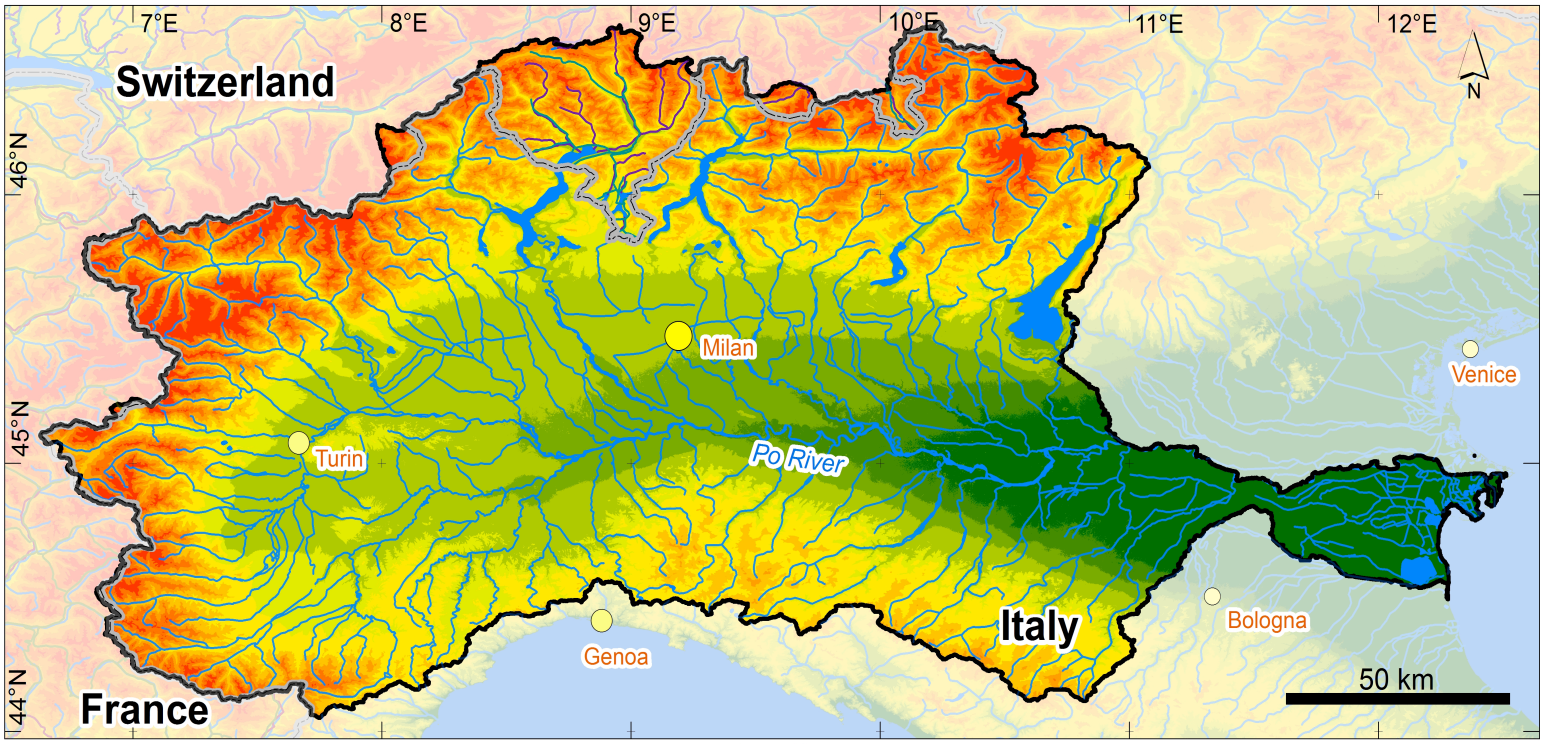
Outline:

- **Method to build the SDHs** ✓
- **Application over the Po river basin**
- **The hydraulic model Lisflood-fp**
- **Example of application of Lisflood**
- **An integrated hydrological (CHyM) and hydraulic (Lisflood-fp) approach**

Application: The Po River

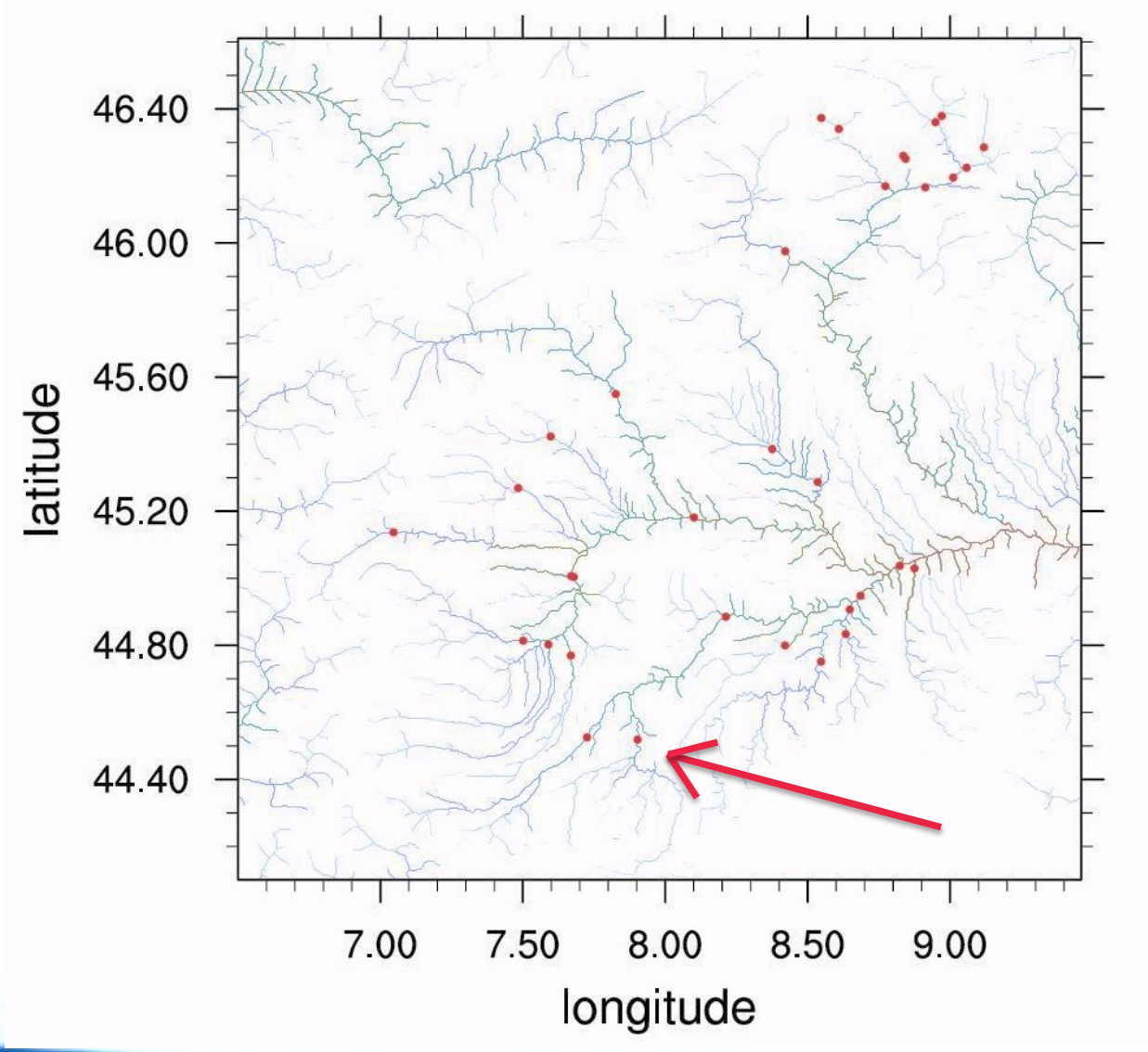
Allianz

Application: The Po River

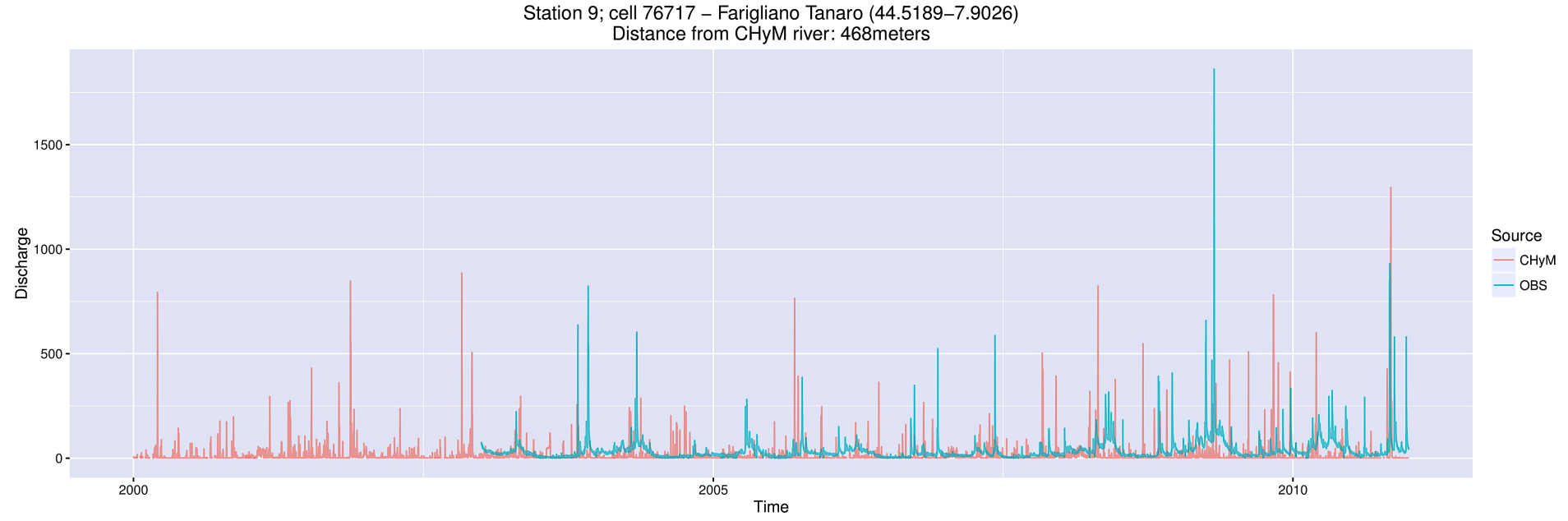


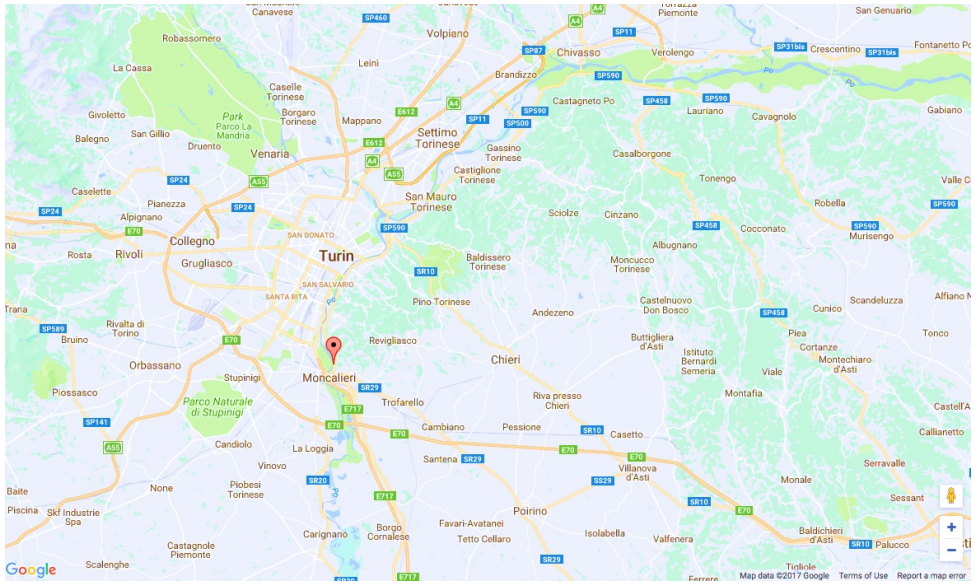
Purpose: to produce flood risk maps associated to different return periods.

Available (working) stations

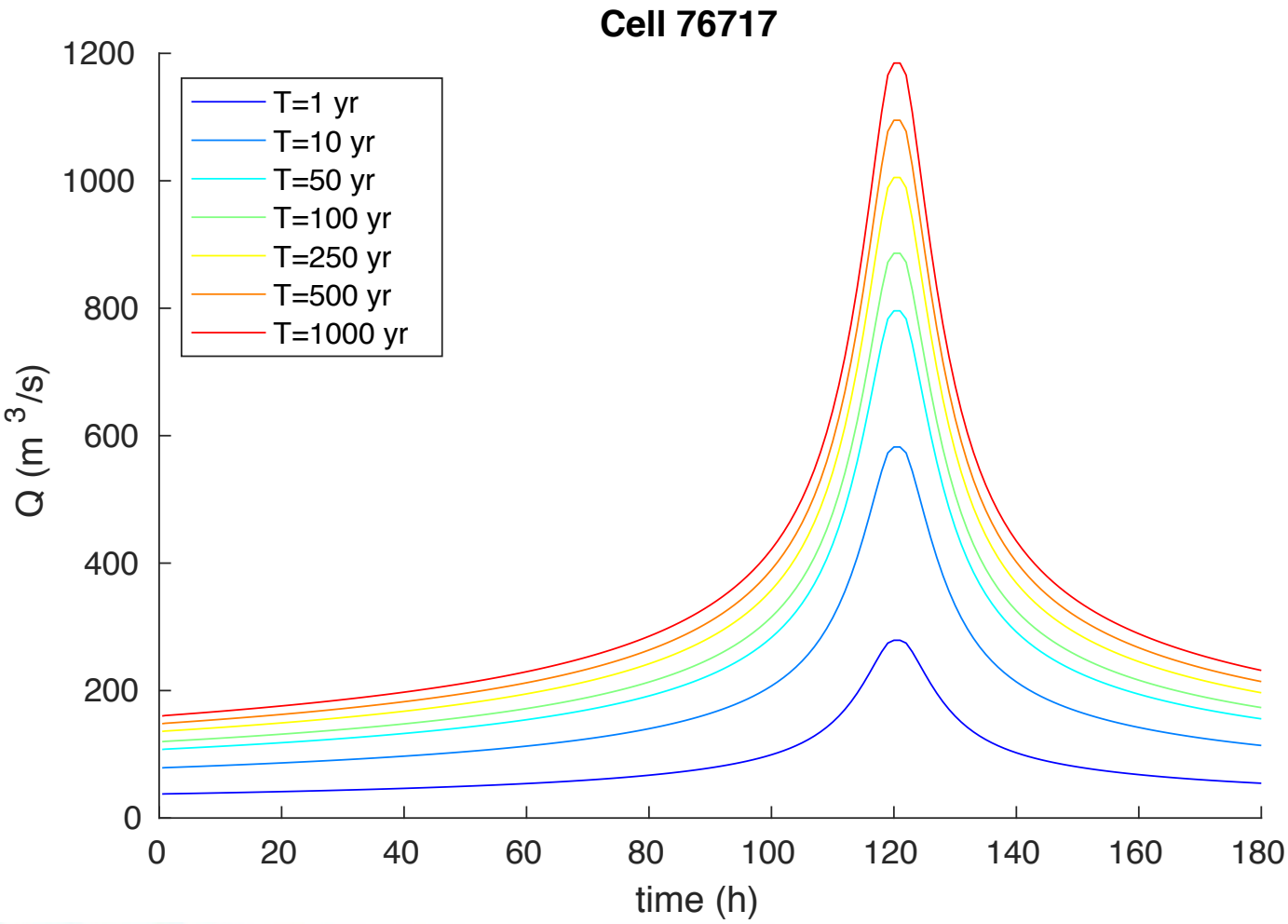


Example: Moncalieri





SDH with observational data



Hydraulic modelling of floodplains

- In order to simulate the flow on the floodplain we need an **hydraulic model**
- Flow is controlled by topography and friction
- Flow leads to complex spatial patterns of water depths

LISFLOOD-FP

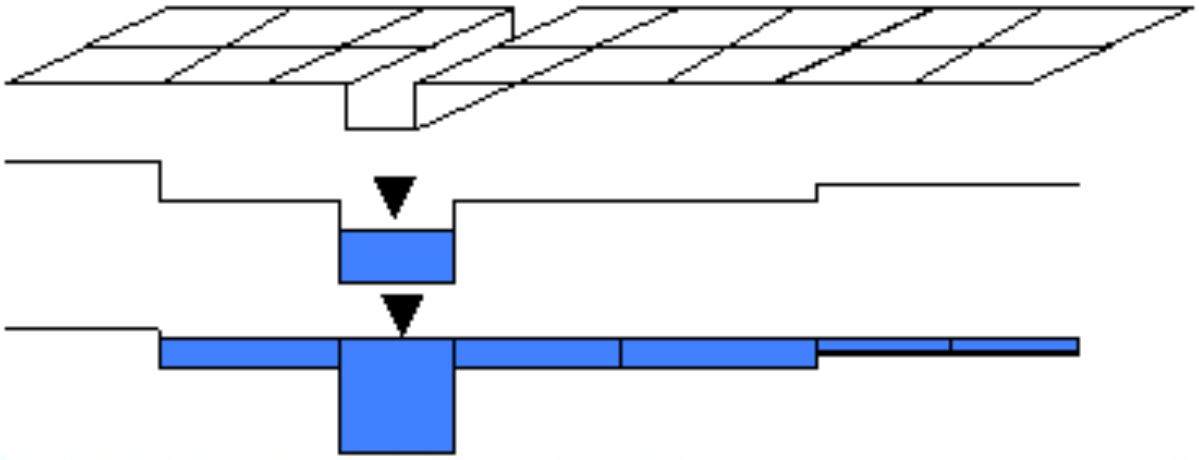
- 2D floodplain inundation model developed at Bristol University.
- Capable of simulating grids up to 10^6 cells for dynamic flood events.
- Predicts water depths in each grid cell at each time step (over fluvial, coastal and estuarine floodplains).

University of BRISTOL

Bates, Paul D., and A. P. J. De Roo. "A simple raster-based model for flood inundation simulation." Journal of hydrology 236.1 (2000): 54-77.

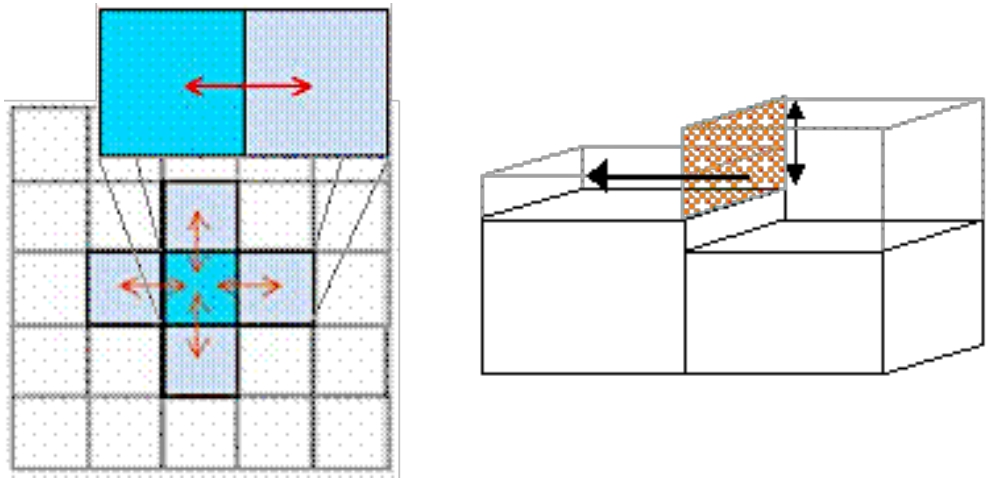
LISFLOOD-FP

- Coupled 1D/2D hydraulic model based on raster Digital Elevation Model (DEM);
- 1D hydraulic routing procedure for channel flow to capture the downstream propagation of the flood wave;
- 2D model of propagation of the flood wave over the floodplain.



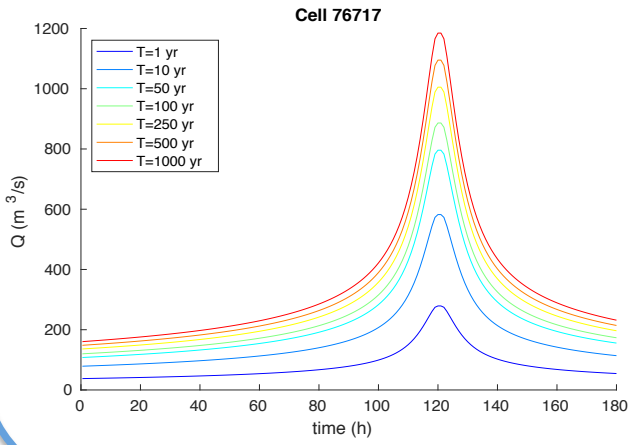
LISFLOOD-FP sub-grid 2D

Floodplain flows are described in terms of continuity and momentum equations, discretized over a grid of square cells



Assumed that the flow between two cells is simply a function of the **free surface height difference** between those cells, the grid scale Manning's **friction coefficient** for the floodplain and **local water acceleration**.

Synthetic Design Hydrograph



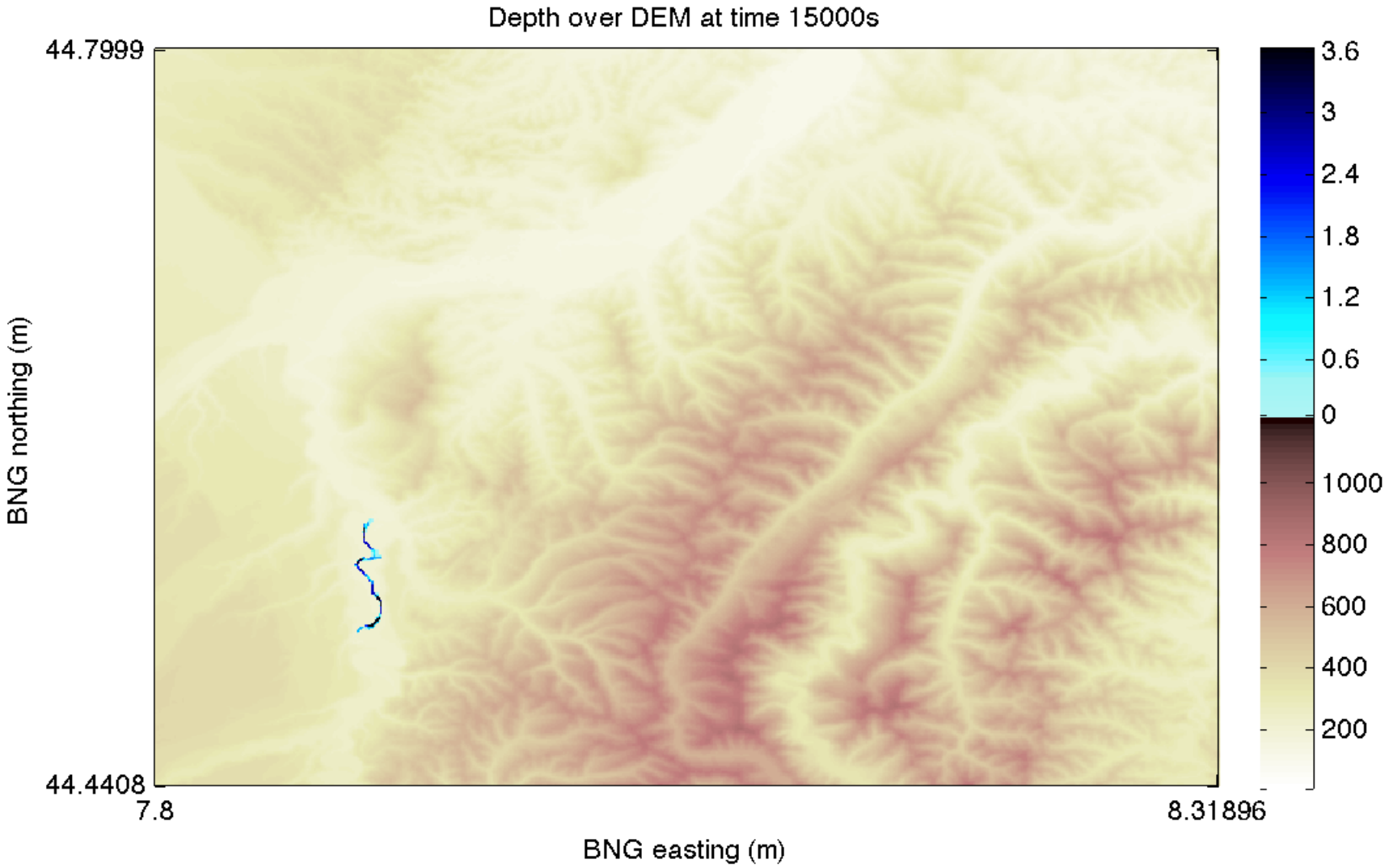
LISFLOOD-FP

HydroSHEDS vf DEM 90 m

B. Lehner et al (2008)

River widths & depths

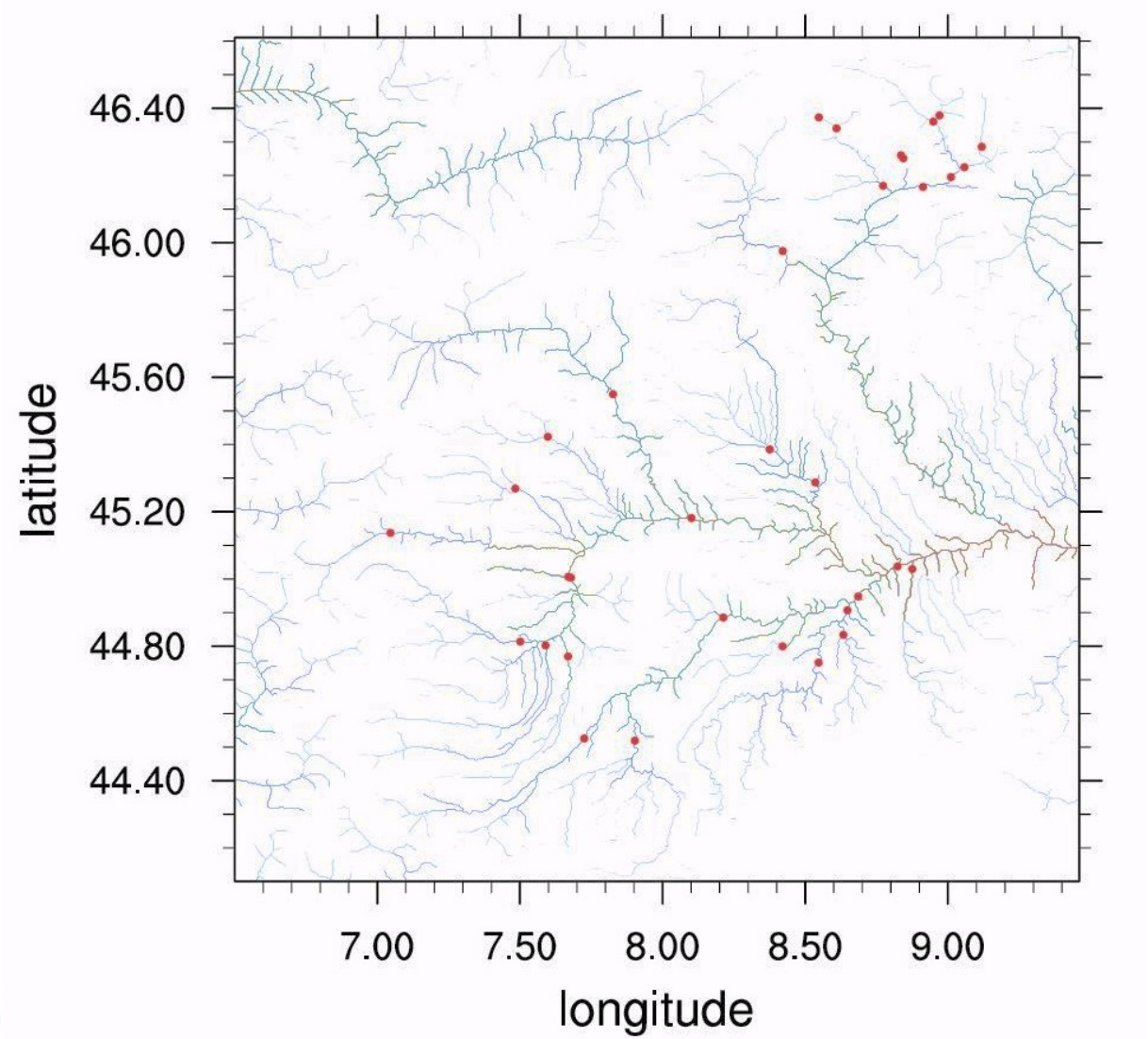
K. Andreadis et al (2013)


Depth over DEM at time 15000s
44.7999
44.4408
7.8
8.31896
BNG northing (m)
BNG easting (m)
3.6
3
2.4
1.8
1.2
0.6
0
1000
800
600
400
200

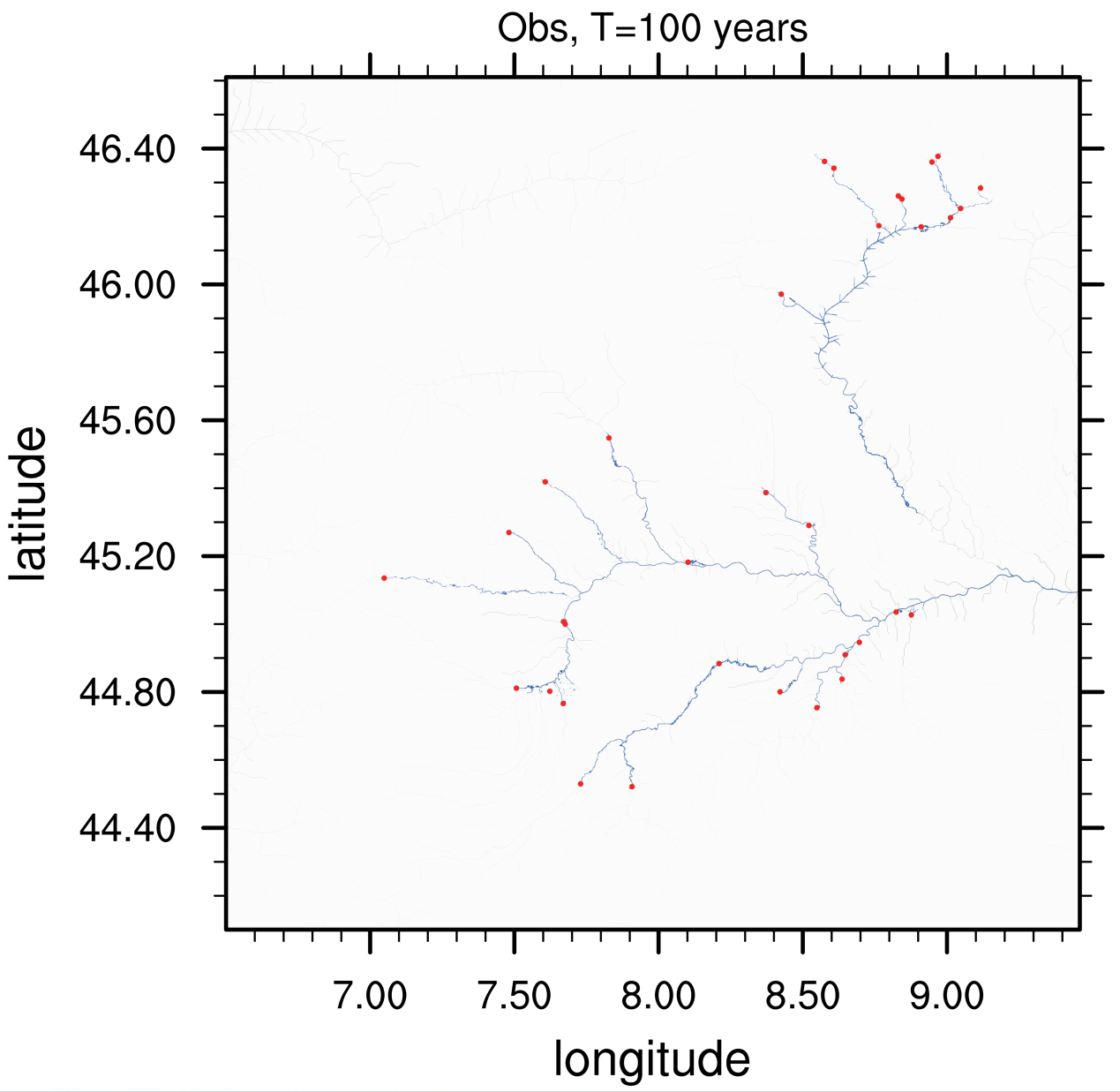
Example with different Return Periods

- link to page

River network and available stations



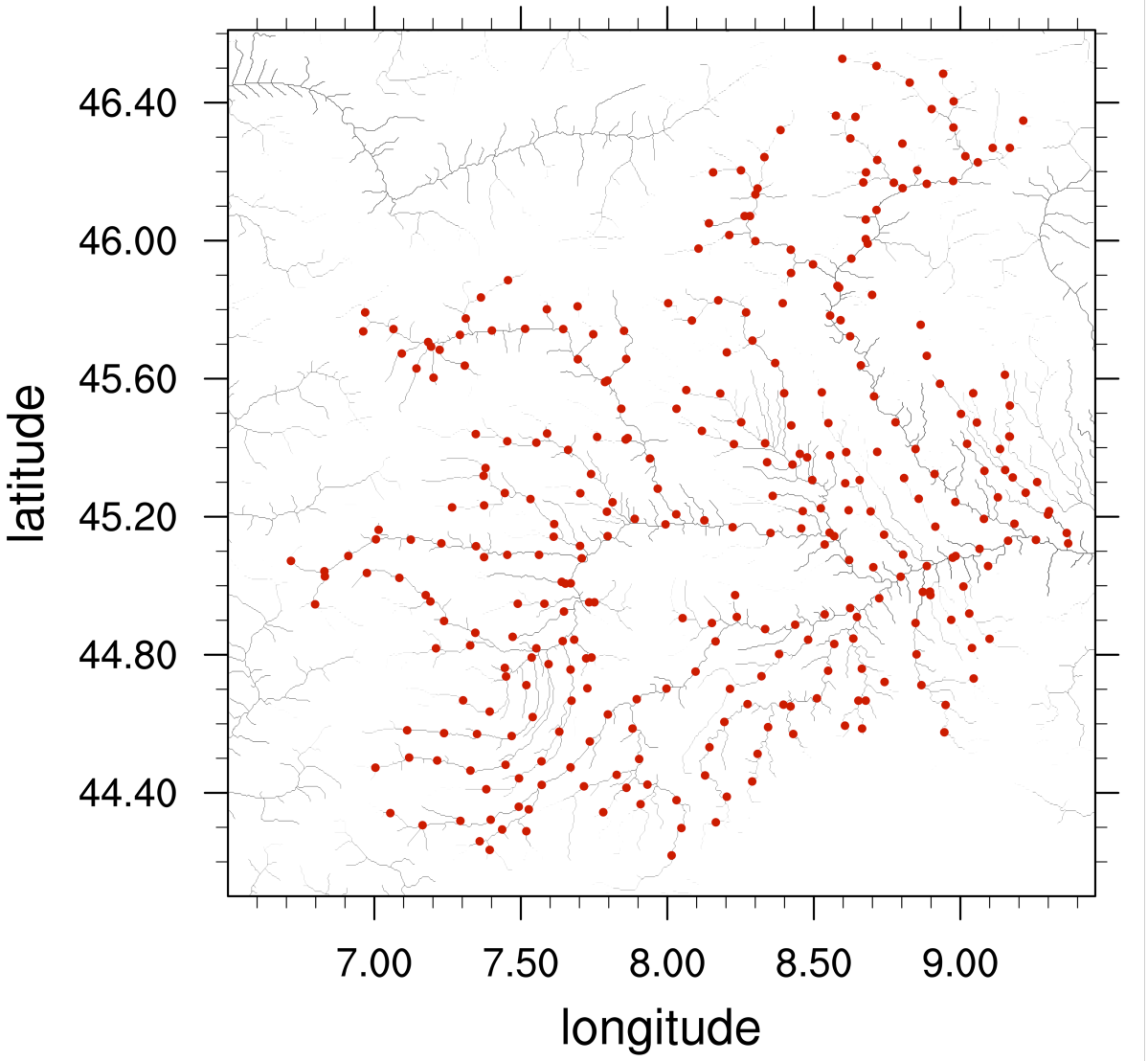
- 90 meters resolution
- 34 Lisflood-fp simulations (one for each station)



The network of the observational stations is not dense enough to simulate the river flow.

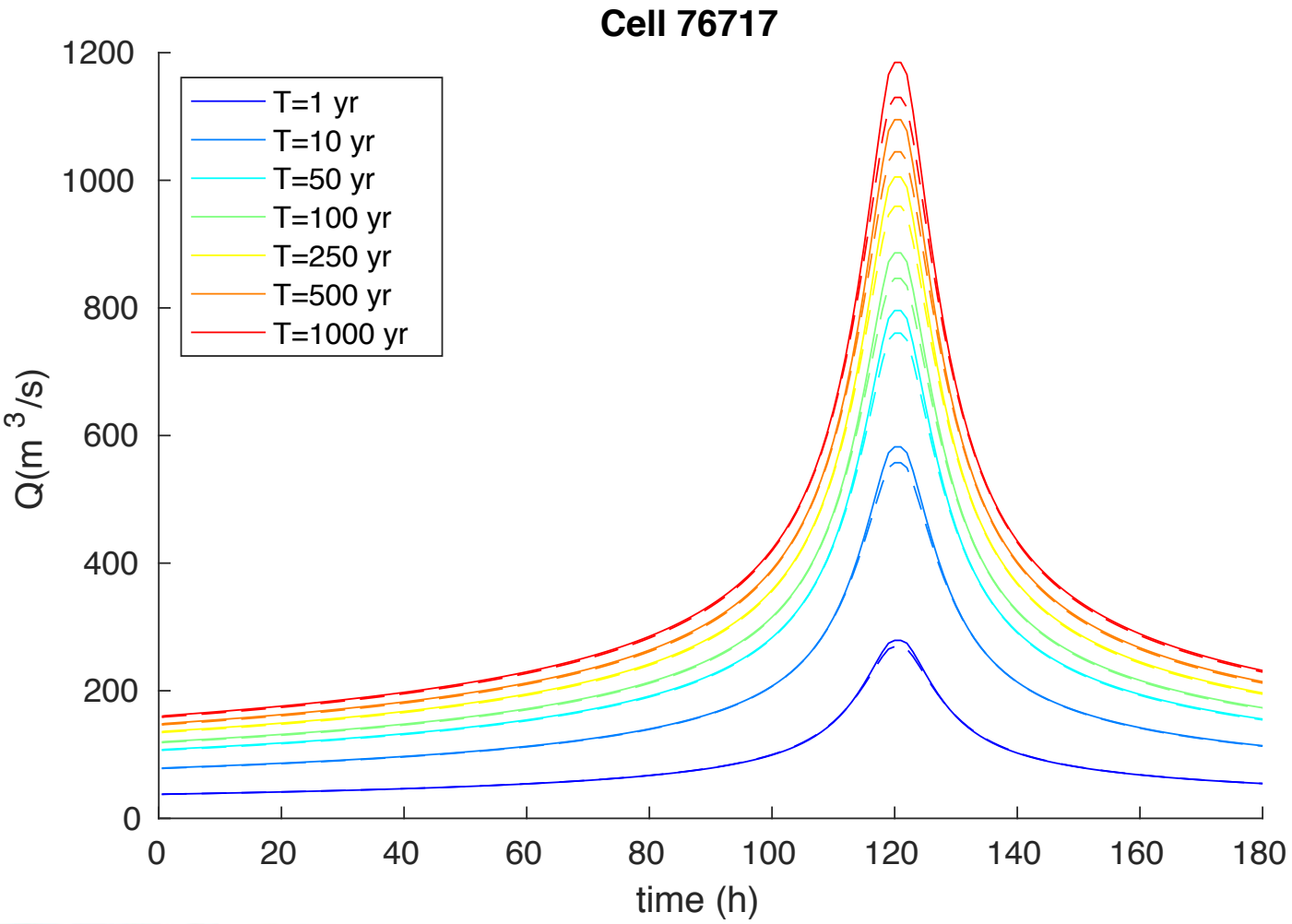
Observations are not sufficient to produce the flood maps.

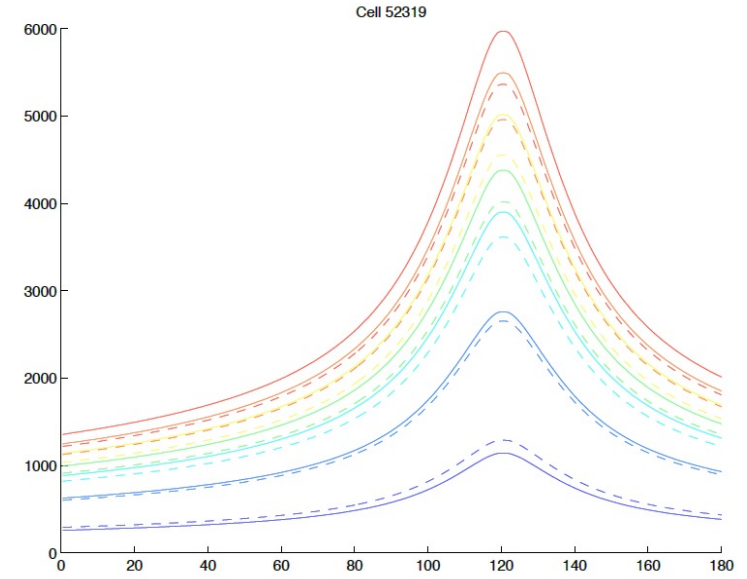
ChYM

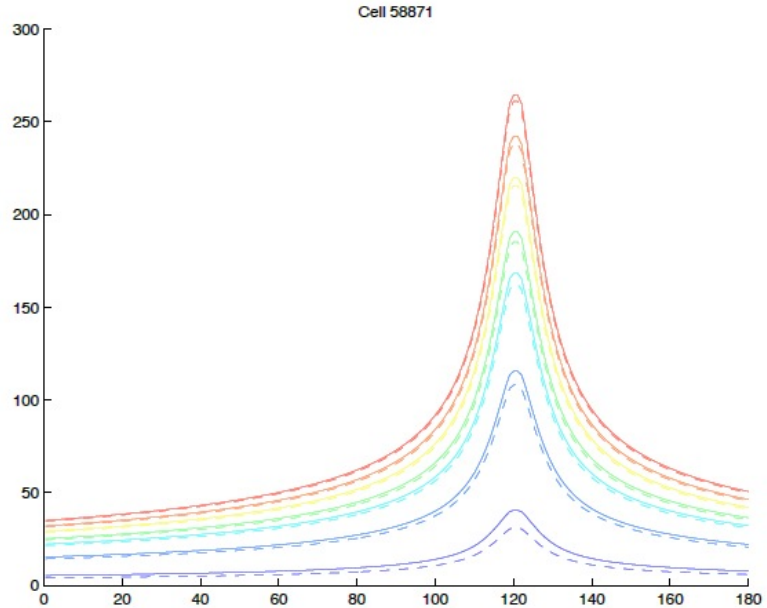


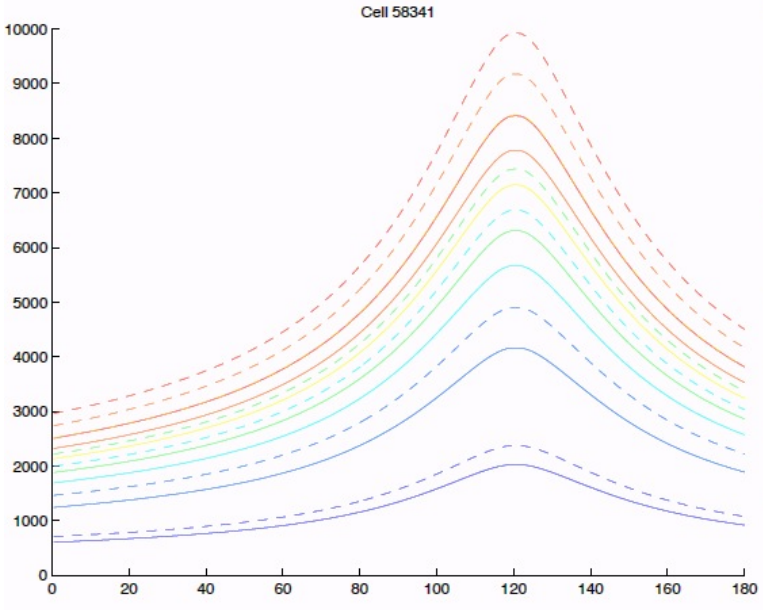
We have created a new set of **simulated stations** (one every 10 km) along the river network and run Lisflood for each station.

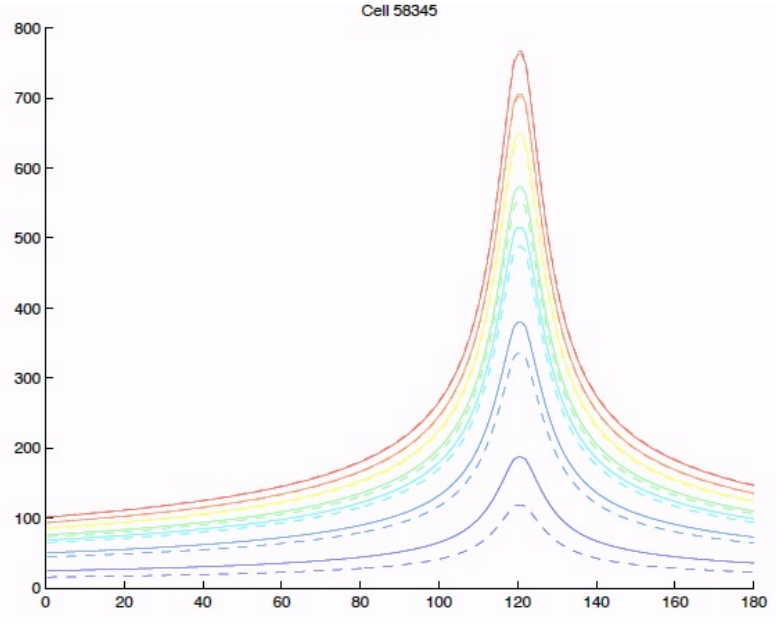
Example: observed vs ChyM



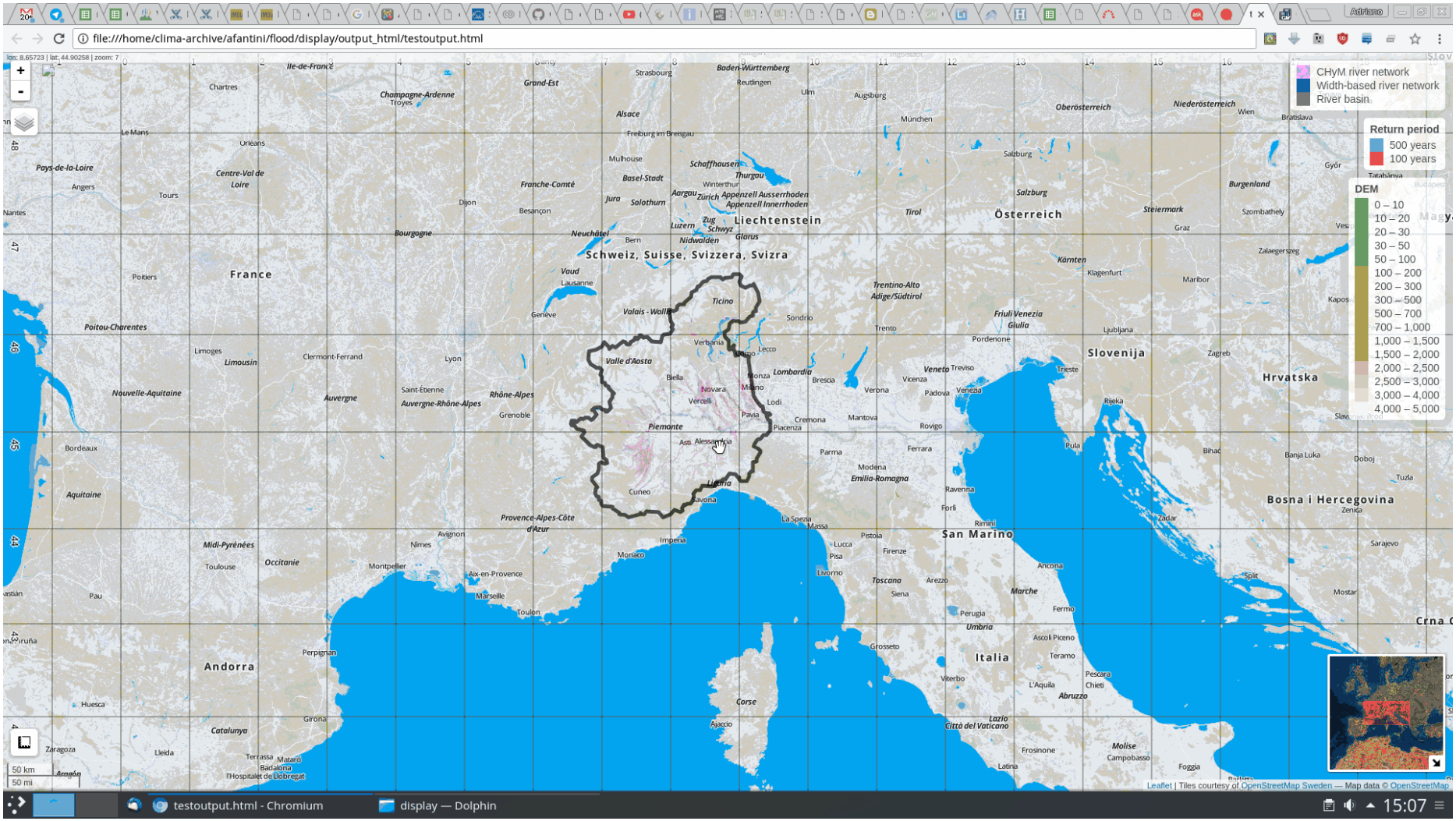

Cell 52319
6000
5000
4000
3000
2000
1000
0
0 20 40 60 80 100 120 140 160 180


Cell 58871
300
250
200
150
100
50
0
0 20 40 60 80 100 120 140 160 180


Cell 58341
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0 20 40 60 80 100 120 140 160 180


Cell 58345
800
700
600
500
400
300
200
100
0
0 20 40 60 80 100 120 140 160 180

Final map overview



Final interactive map

- link to page

- **Andreadis, Konstantinos M., Guy J-P. Schumann, and Tamlin Pavelsky. "A simple global river bankfull width and depth database."** ***Water Resources Research*** **49.10 (2013): 7164-7168.**
- **Lehner, Bernhard, Kristine Verdin, and Andy Jarvis. "New global hydrography derived from spaceborne elevation data."** ***Eos, Transactions American Geophysical Union*** **89.10 (2008): 93-94.**
- **Bates, Paul D., and A. P. J. De Roo. "A simple raster-based model for flood inundation simulation." Journal of hydrology 236.1 (2000): 54-77.**