Completing river networks with only river segment observations via hydrology-aware ODETLAP

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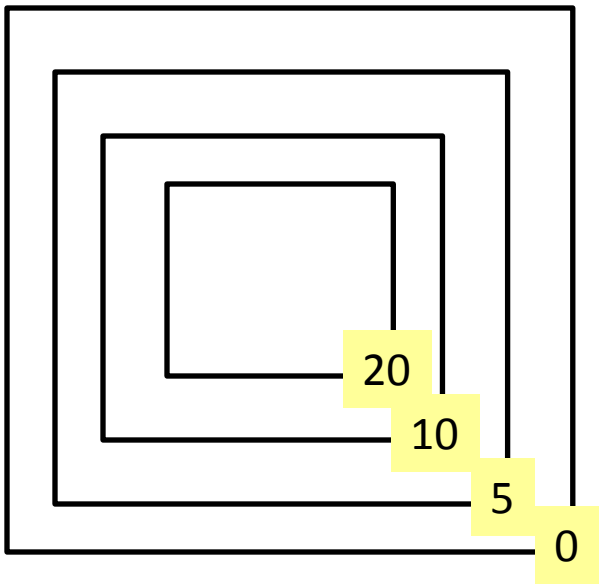
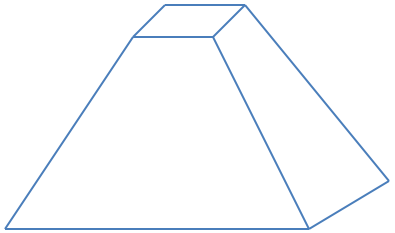
Previous success - contour

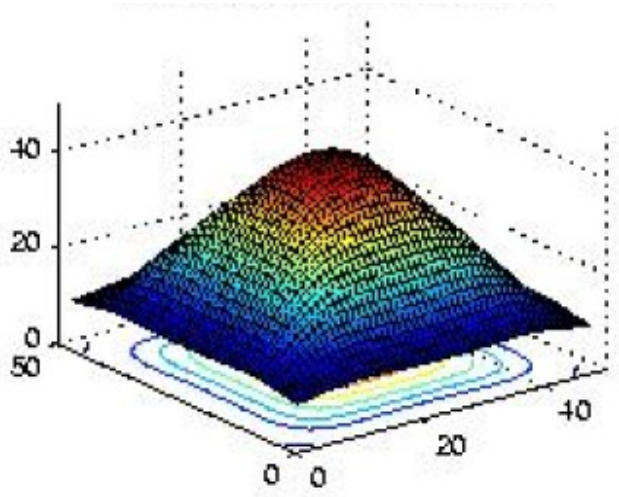
Contour data



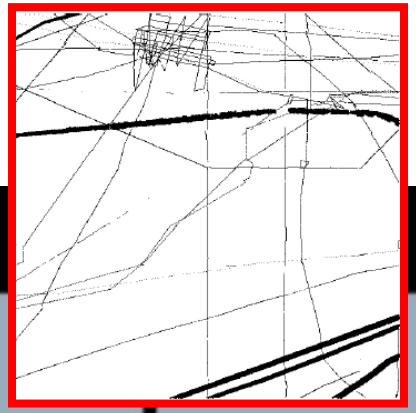
Other algorithm



ODETLAP result



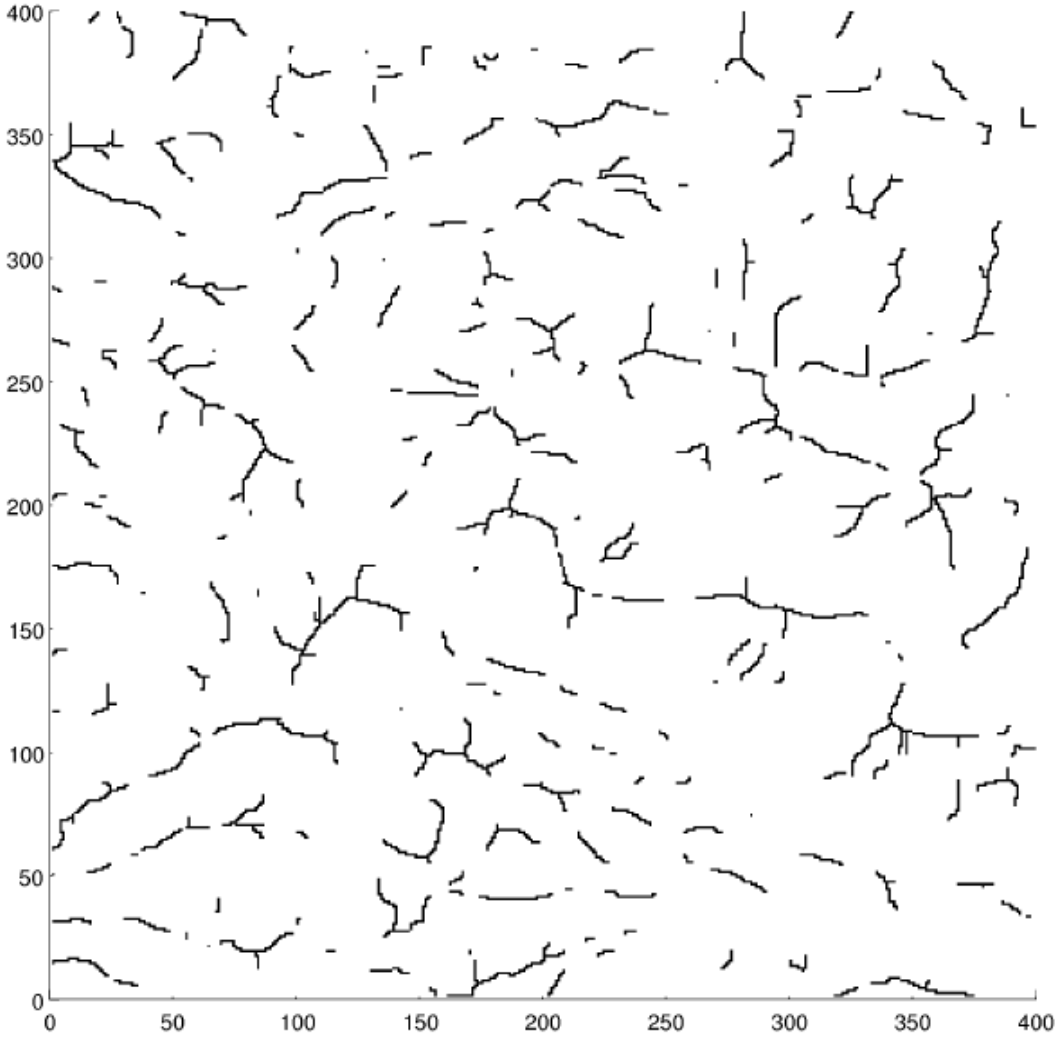
Previous success - bathymetry



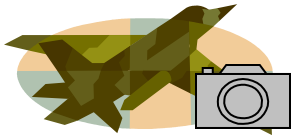
Locations with bathymetry heights

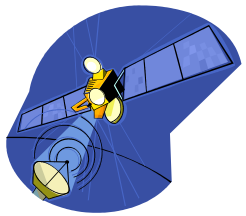
Tsz-Yam Lau, You Li, Zhongyi Xie, and W. Randolph Franklin. ***Sea floor bathymetry trackline surface fitting without visible artifacts using ODETLAP***. In ACMGIS 2009.

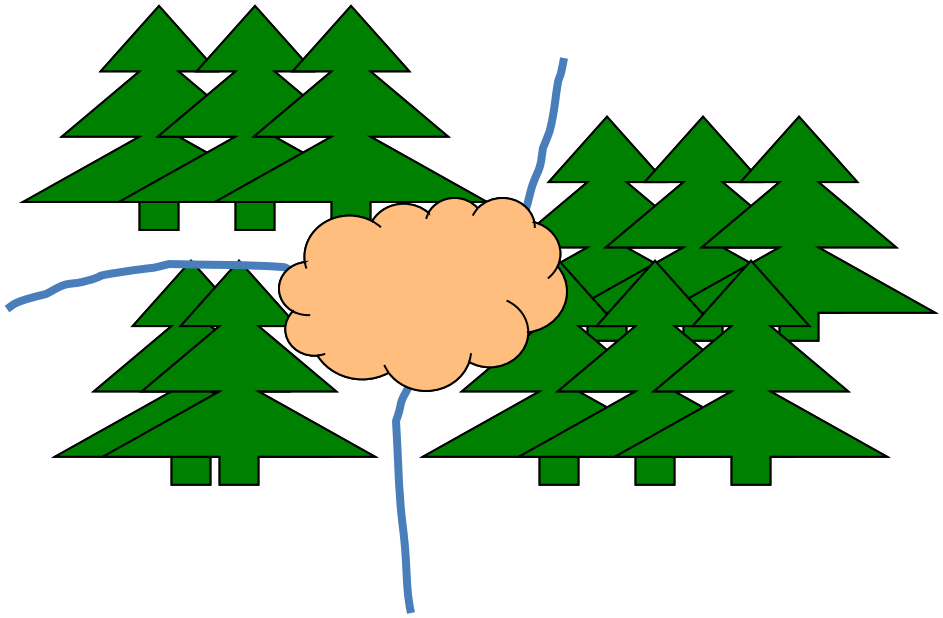
River data we have



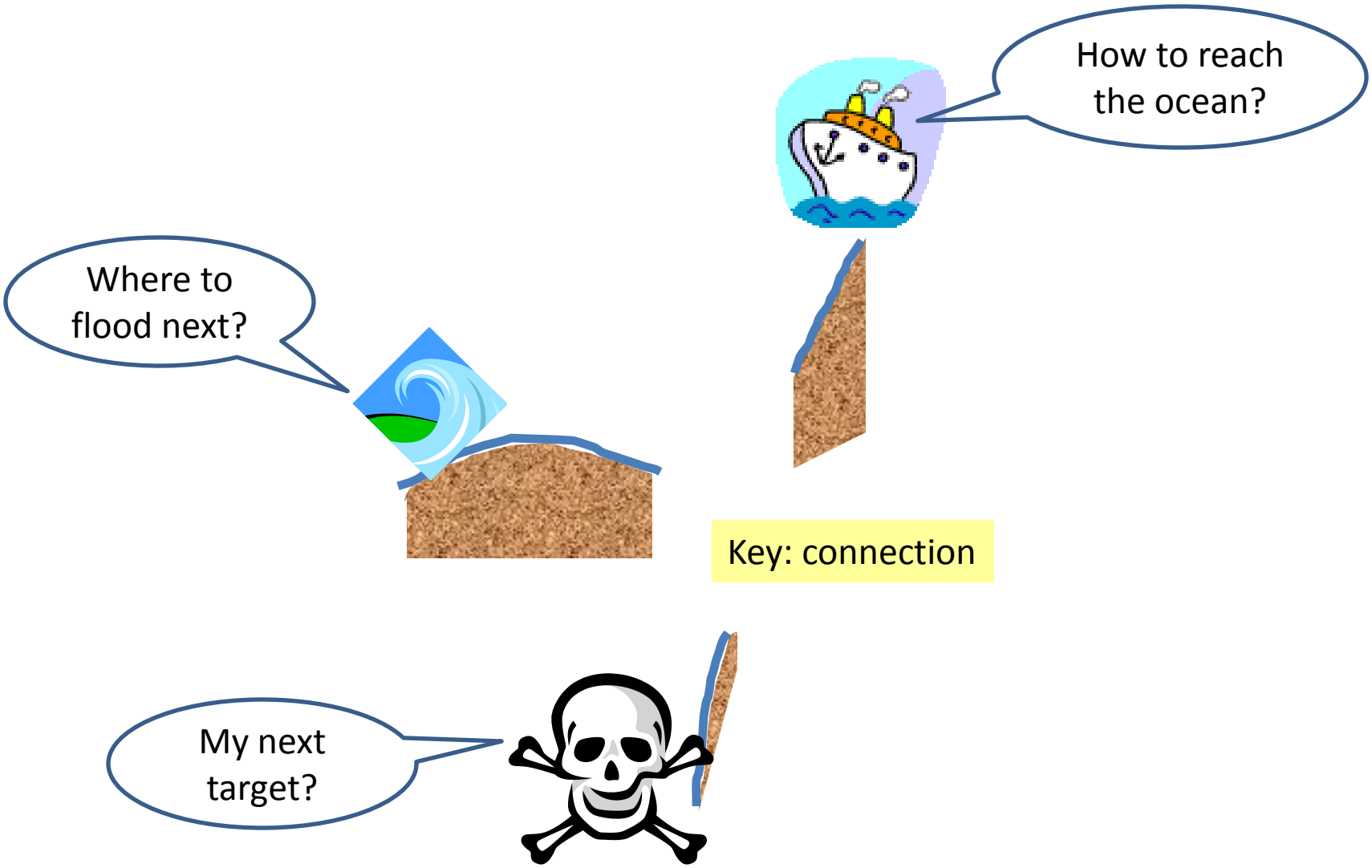
Clouds and tree canopies



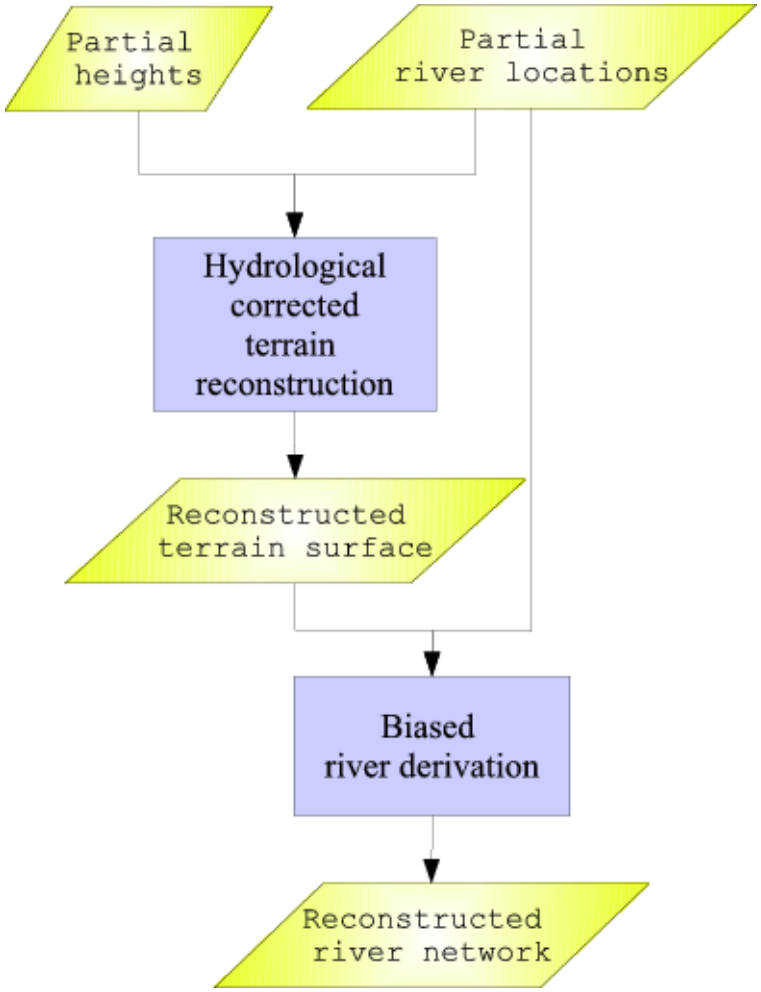




Connection is the key!



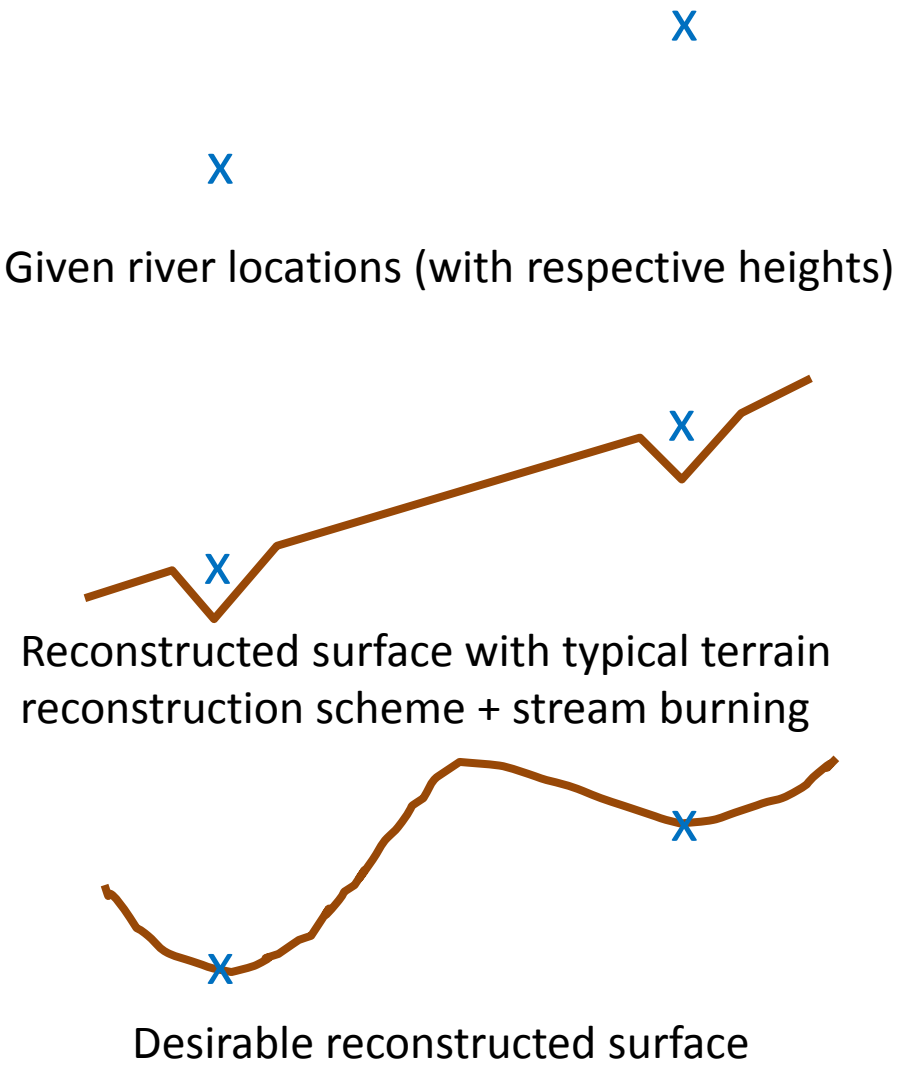
Induced terrain solution framework



T. Lau & W. Franklin. *Completing fragmentary river networks via induced terrain*. Autocarto 2010.

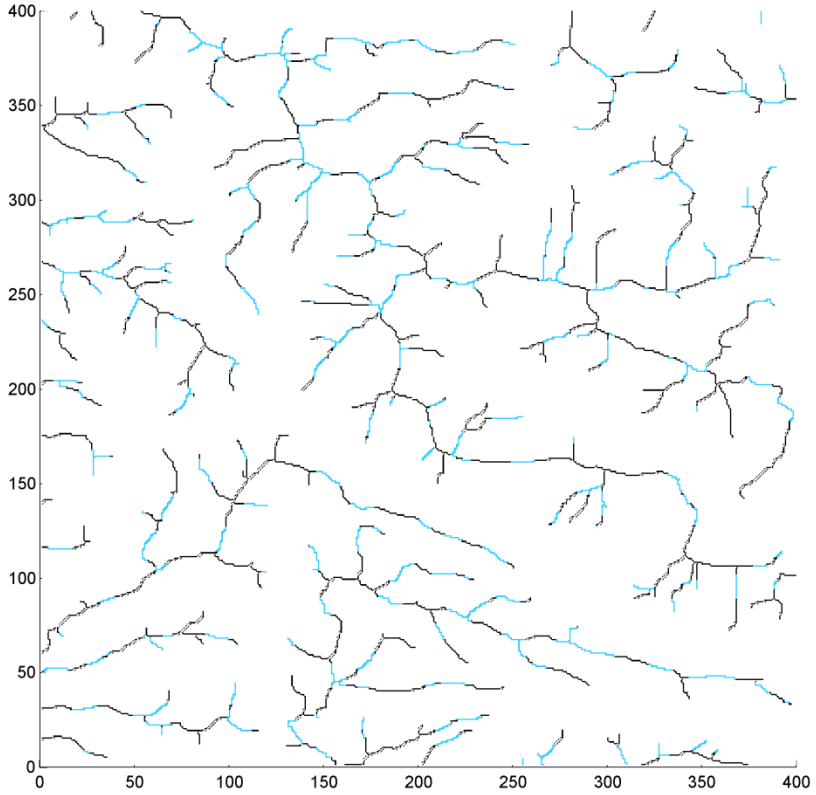
Challenge

- Typical terrain reconstruction with stream does not create inclined planes that
  - grow to all possible directions
  - get as far away as possible

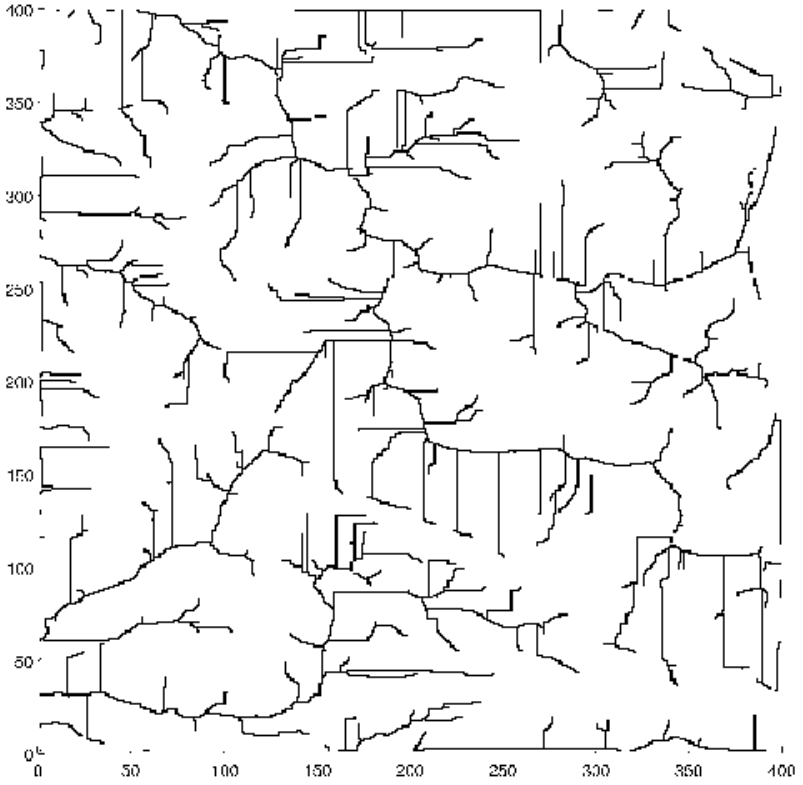


Challenge

- Chaotic connections



Given river locations (black)
Missing river locations (light blue)



Reconstructed river network with NN-SB

Our solution: ODETLAP

- Basic version
  - n^2 unknowns $\{z_{i,j}\}$
  - Exact equations for all the k known-height positions $z_{i,j} = h_{i,j}$
  - Averaging equations for all n^2 positions

$$z_{i,j} = (z_{i-1,j} + z_{i+1,j} + z_{i,j-1} + z_{i,j+1})/4$$

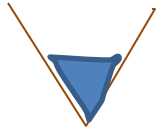
  - Weighting between the two sets of equations

Our solution: ODETLAP

- Hydrology-aware version (HA-ODETLAP)
  - n^2 unknowns $\{z_{i,j}\}$
  - Exact equations for all the *k* known-height positions $z_{i,j} = h_{i,j}$
  - **Modified** averaging equations for all n^2 positions

$$z_{i,j} = (z_{i-1,j} + z_{i+1,j} + z_{i,j-1} + z_{i,j+1})/4f$$

    - f = 1 if not given river location, > 1 otherwise
  - Weighting between the two sets of equations

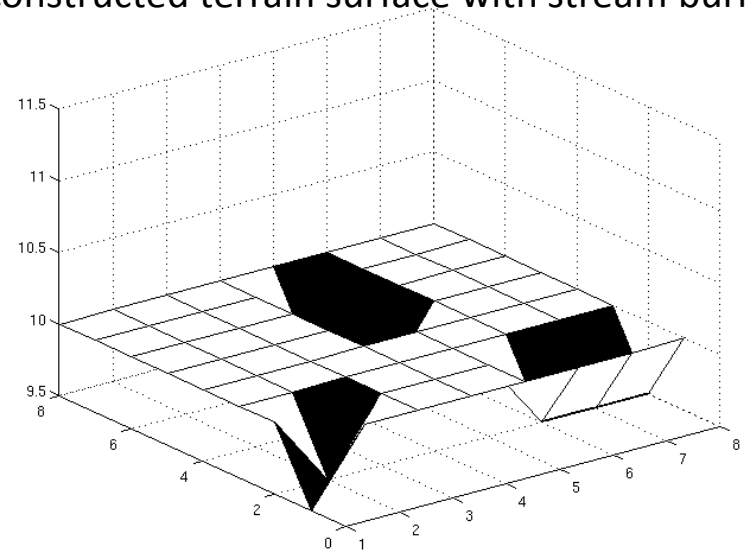


HA-ODETLAP effect illustrated

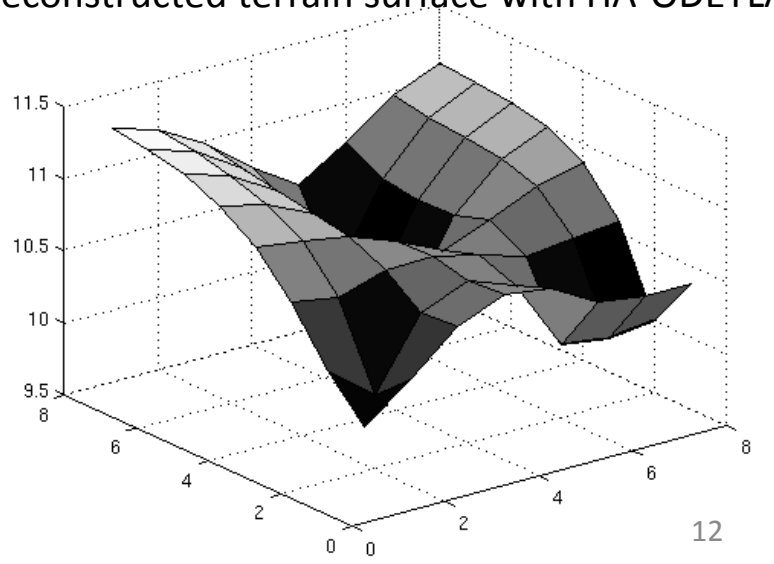
Given river locations
and respective heights

			10				
			10				
			10				
	10				10	10	10
10							

Reconstructed terrain surface with stream burning

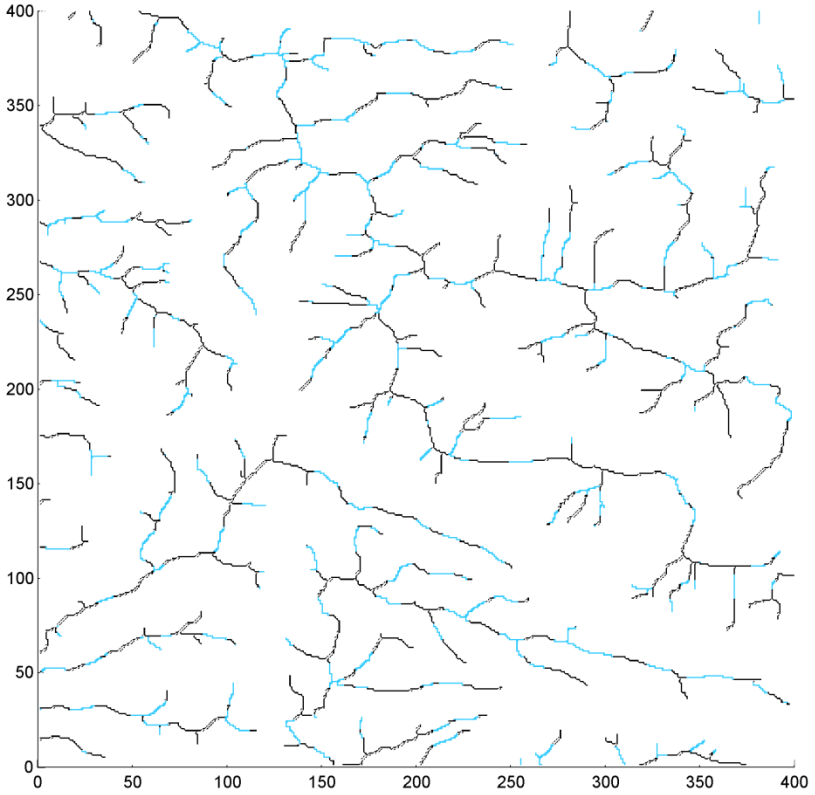


Reconstructed terrain surface with HA-ODETLAP



HA-ODETLAP

- Much better connections



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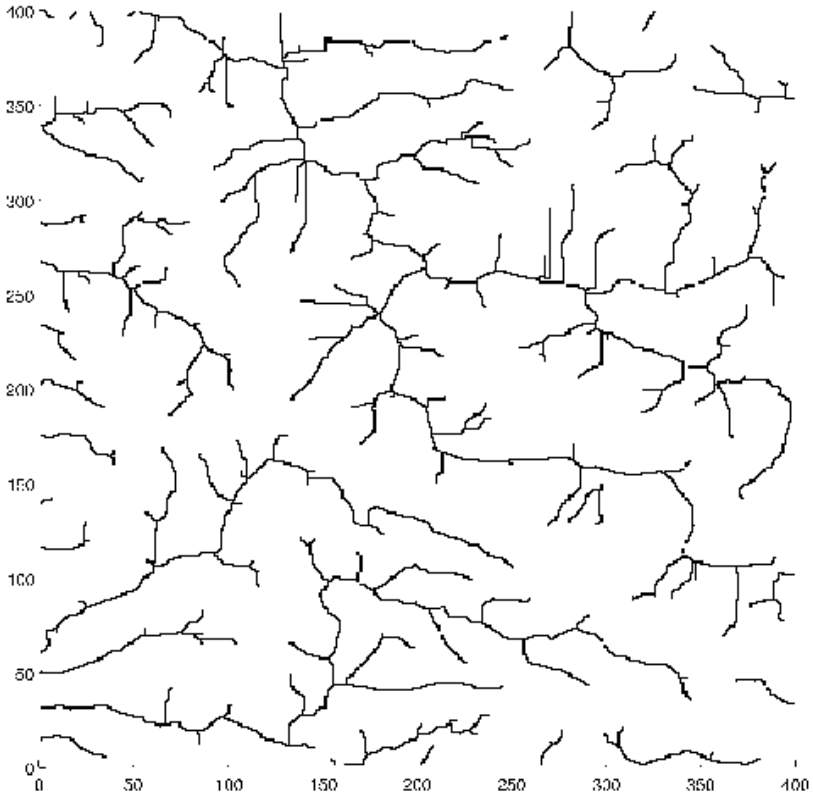

Reconstructed river network

Conclusion

- HA-ODETLAP self-induces an extensive local minima condition at river locations.
- Better terrain model, thus better river reconnections.

			10				
			10				
			10				
	10				10	10	10
10