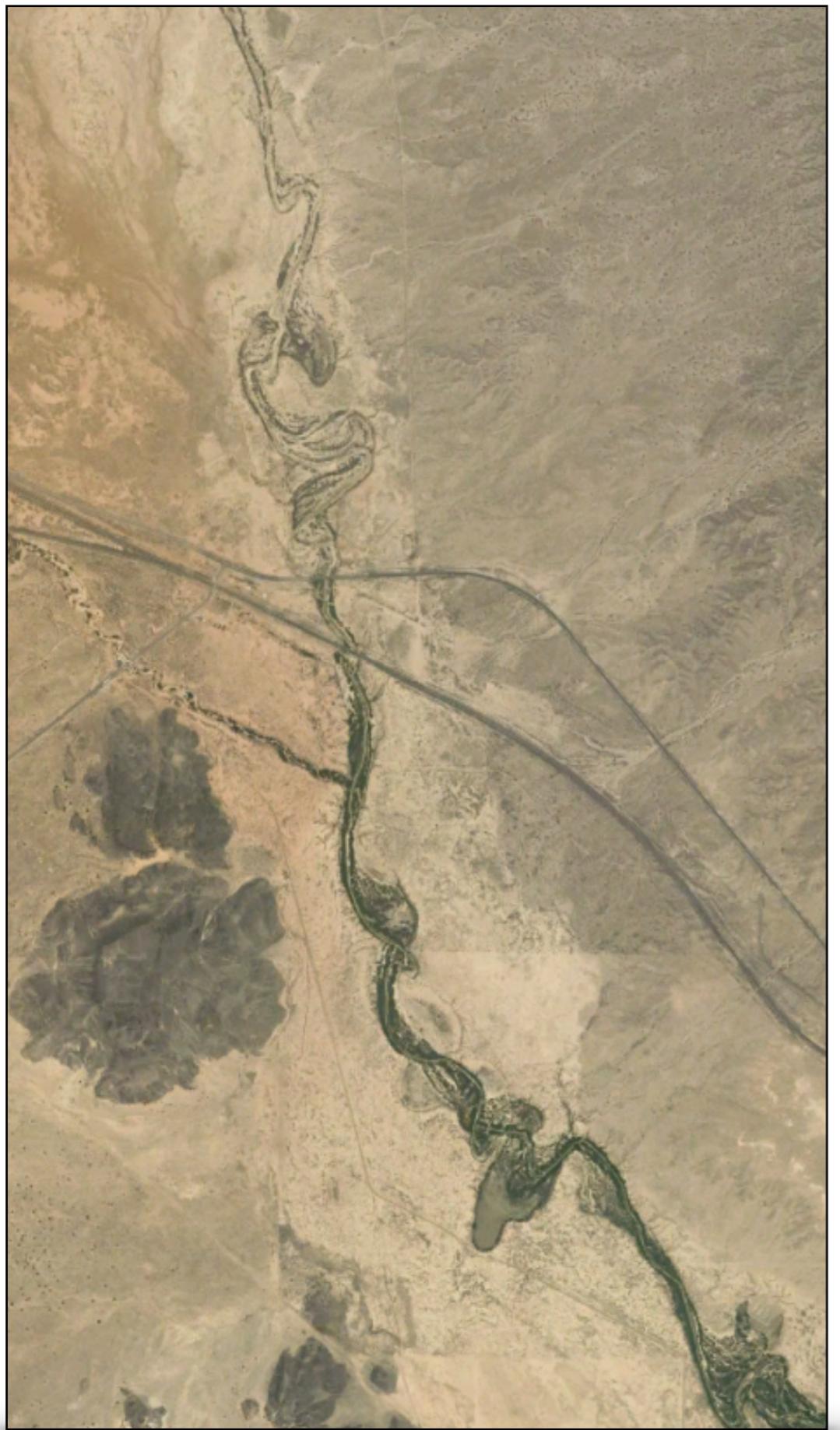


Predicting the influence of floodplain vegetation on the geomorphic effects of large floods

Mariela C. Perignon









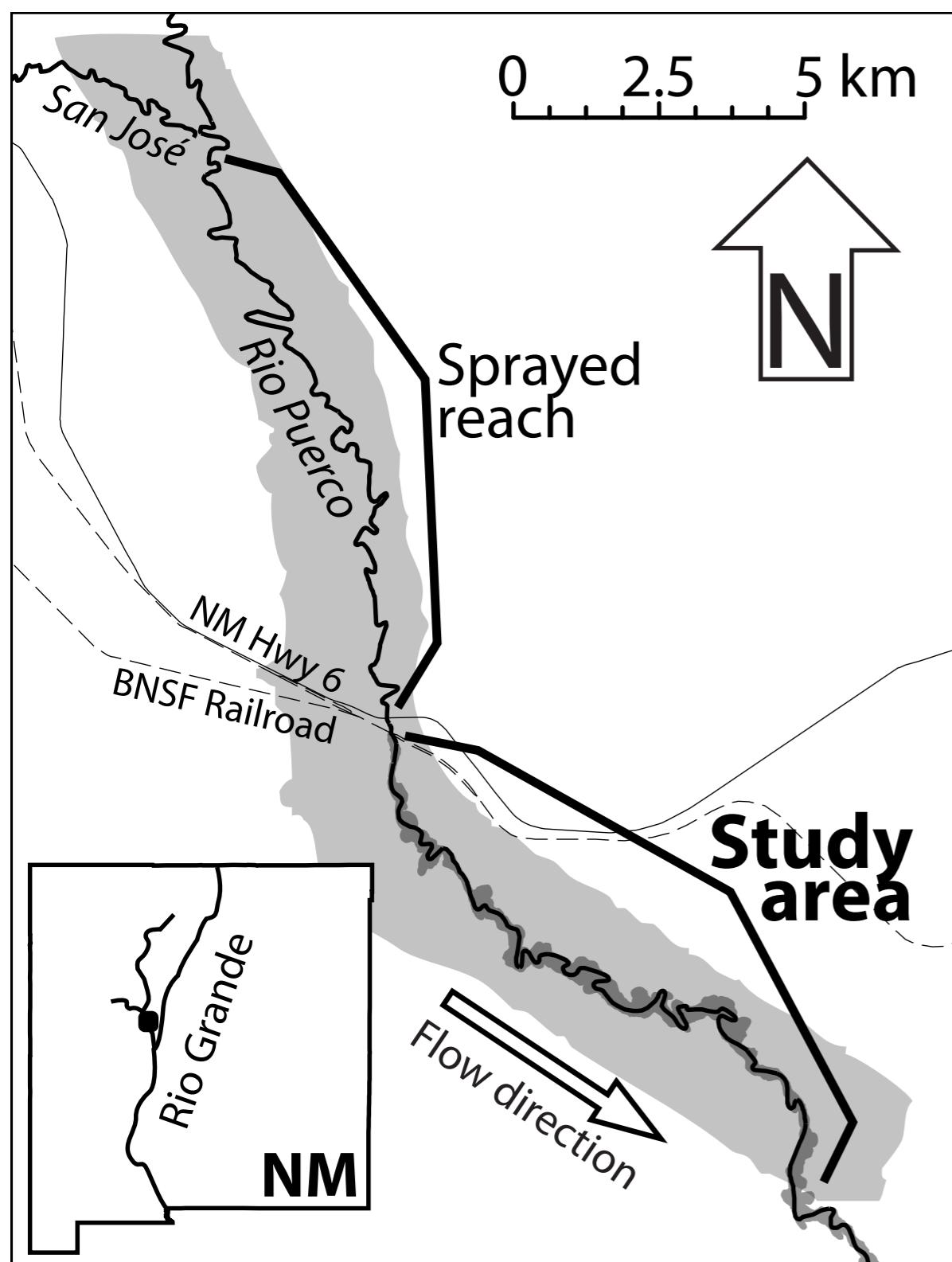


1. Rio Puerco as a natural experiment
2. Structure of morphodynamic model
3. Numerical experiments
4. Rio Puerco simulations



Rio Puerco, NM

“Before”



“Before”

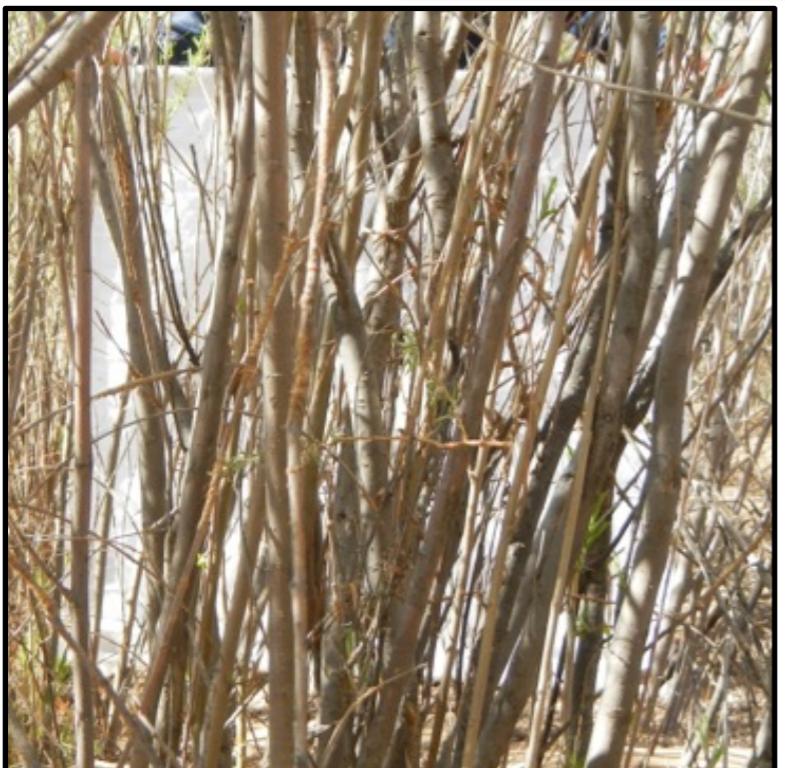
1m



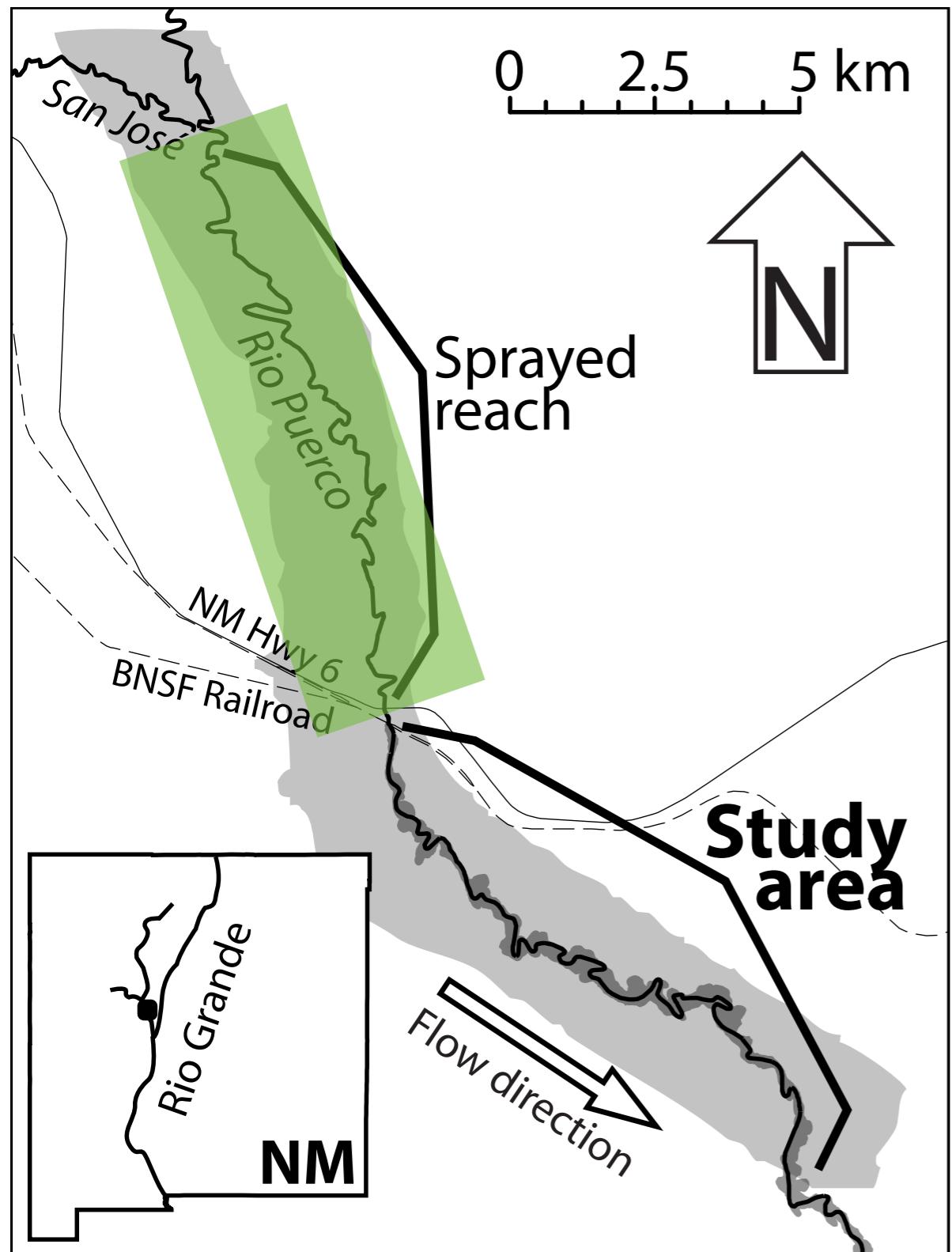
Tamarisk (saltcedar)
Tamarix ramosissima

Sandbar willow
Salix exigua

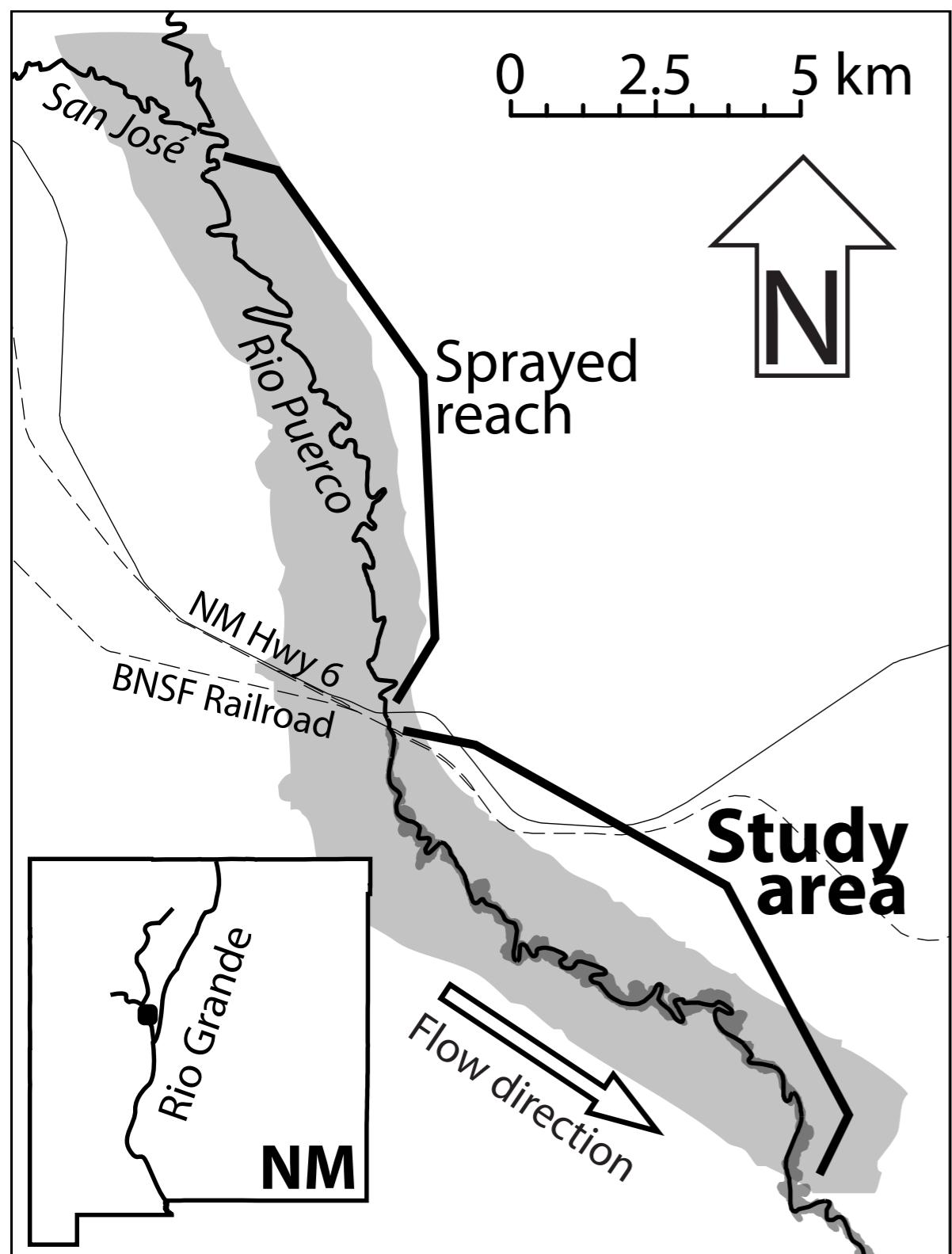
1m



“Before”



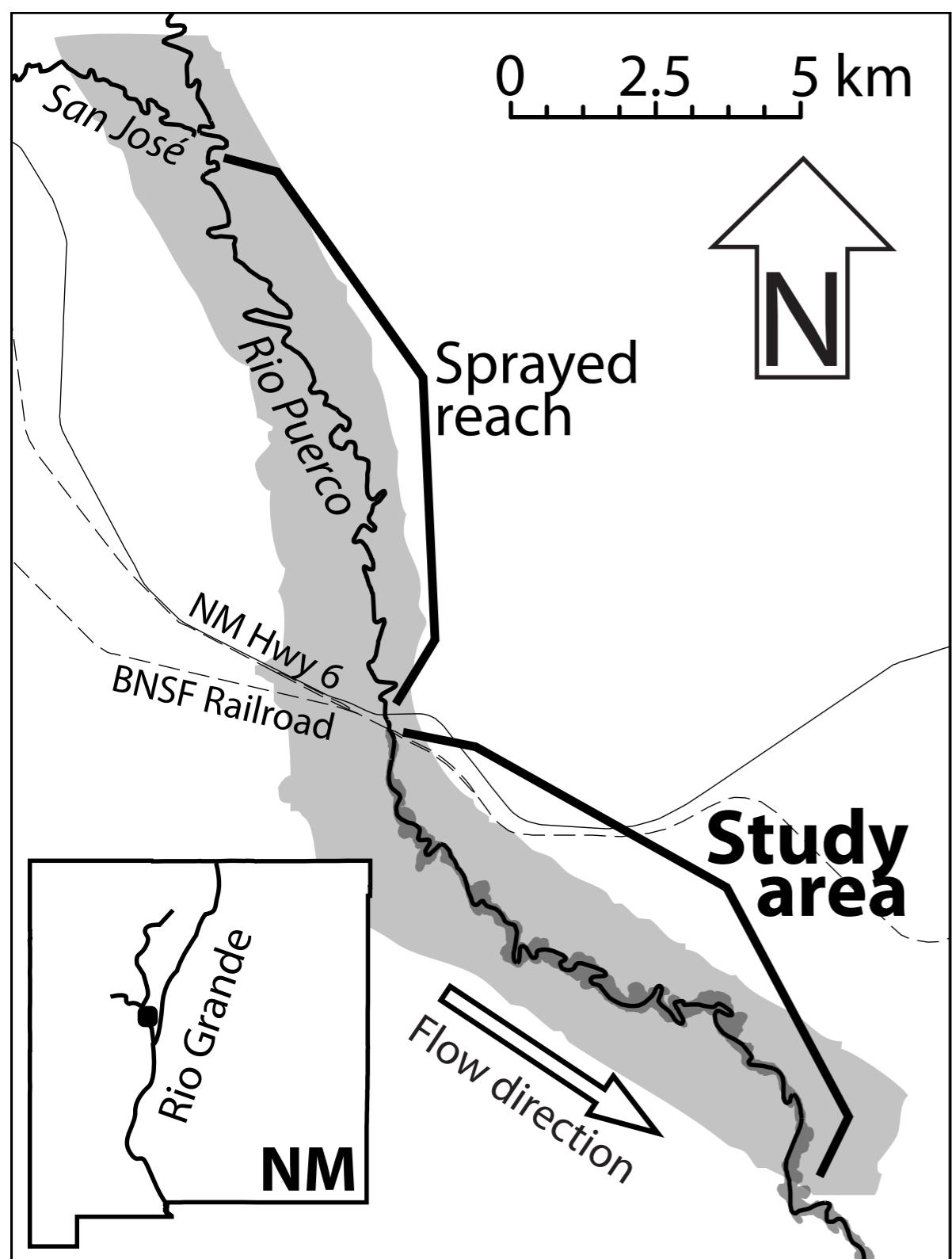
“Before”



**2003:
Herbicides sprayed**

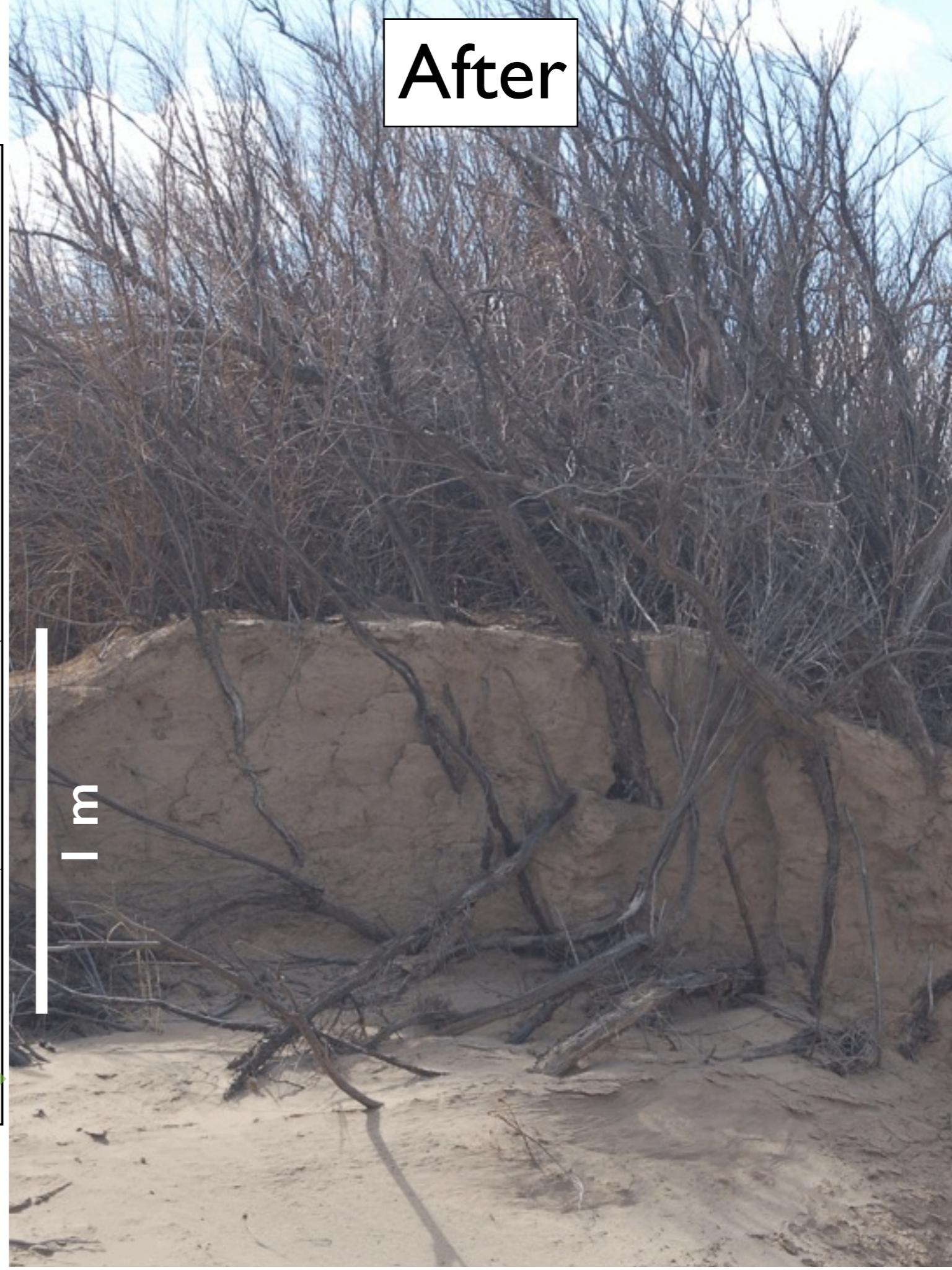
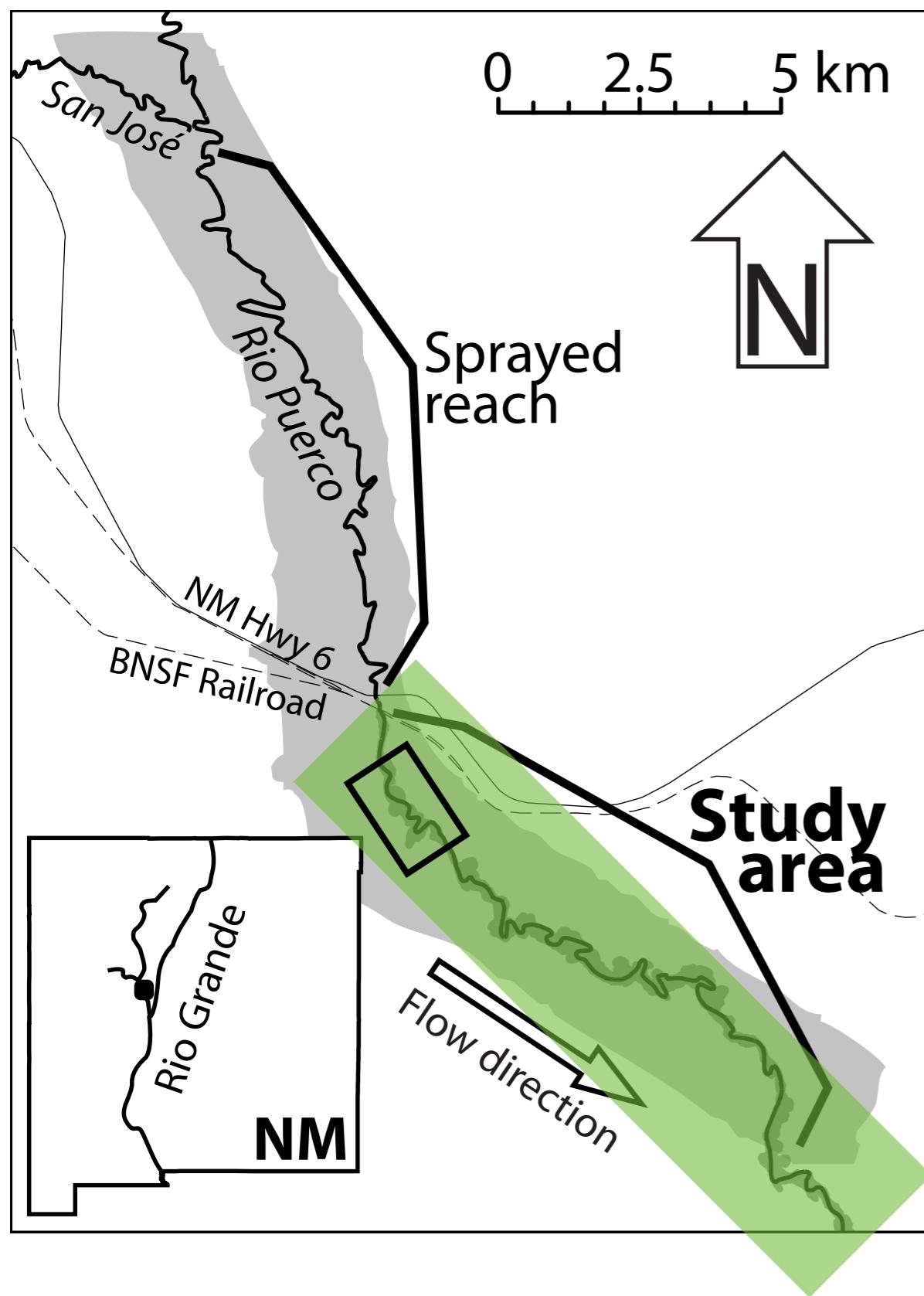
**2006:
Largest flood in
30 years**

After

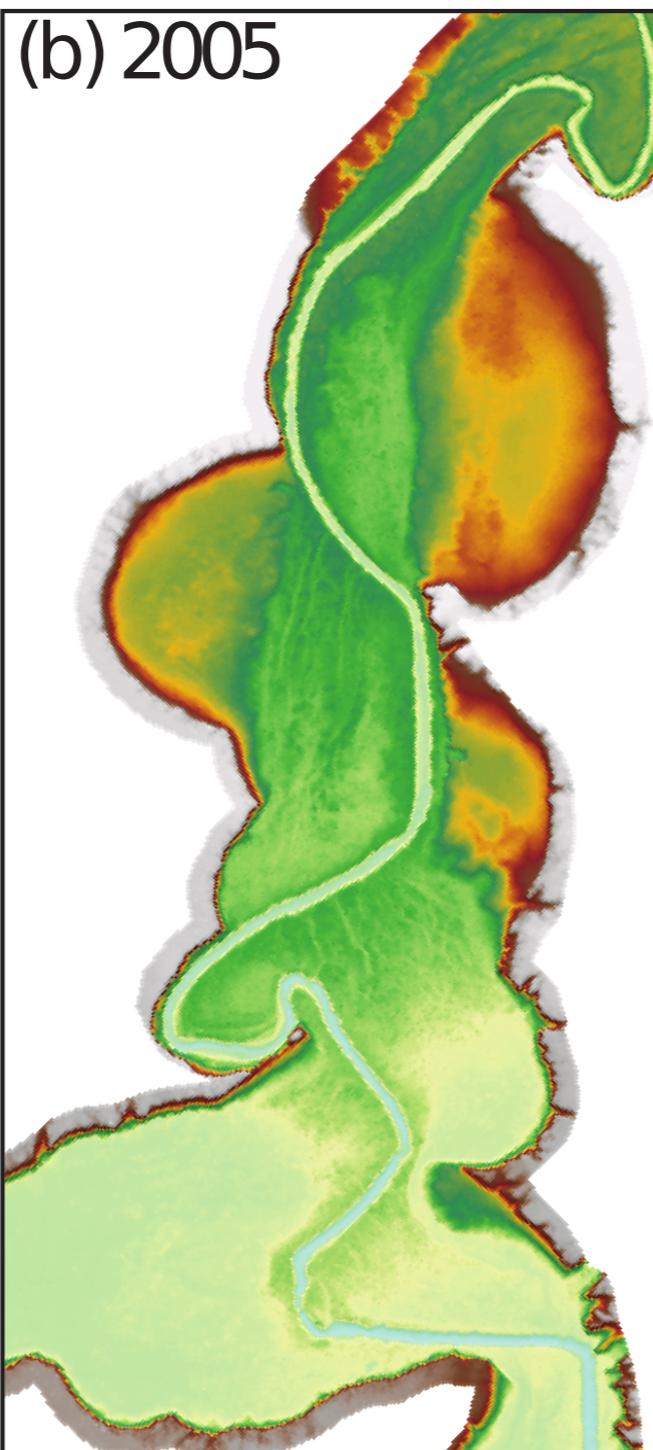


(Vincent et al, 2009)

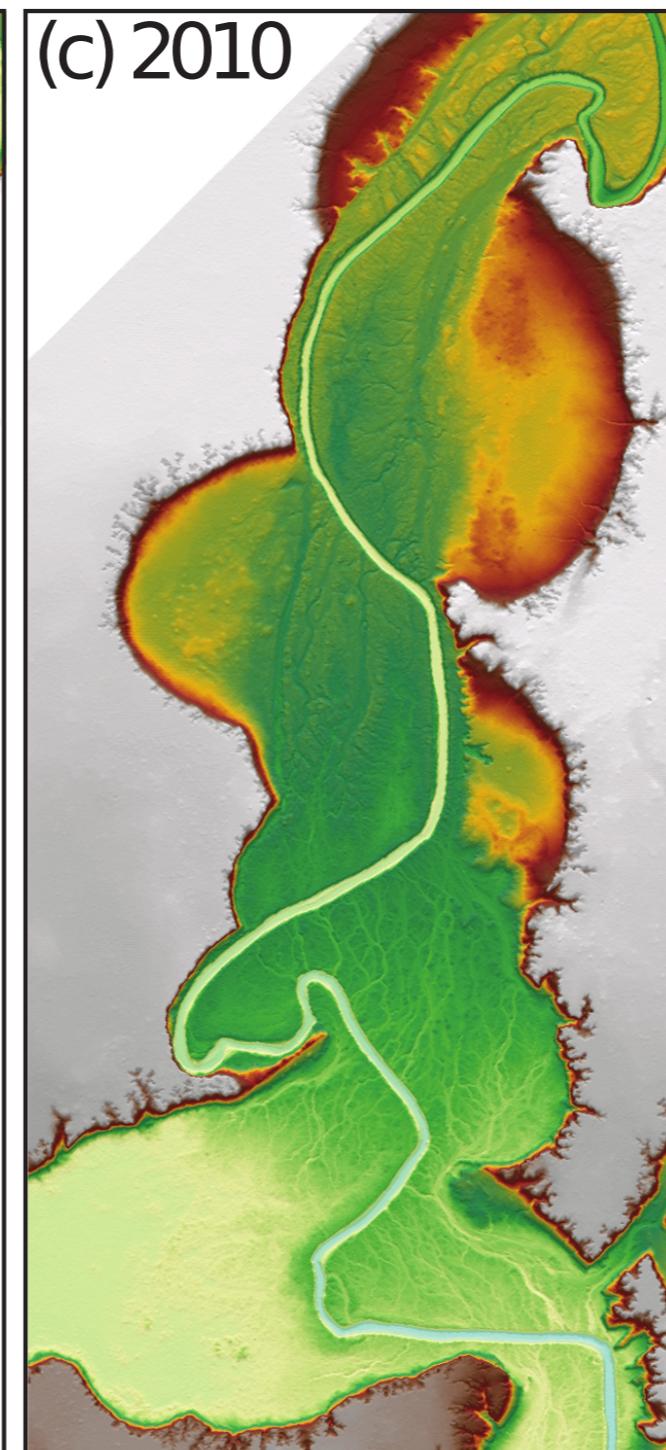




**Pre-flood
LiDAR**



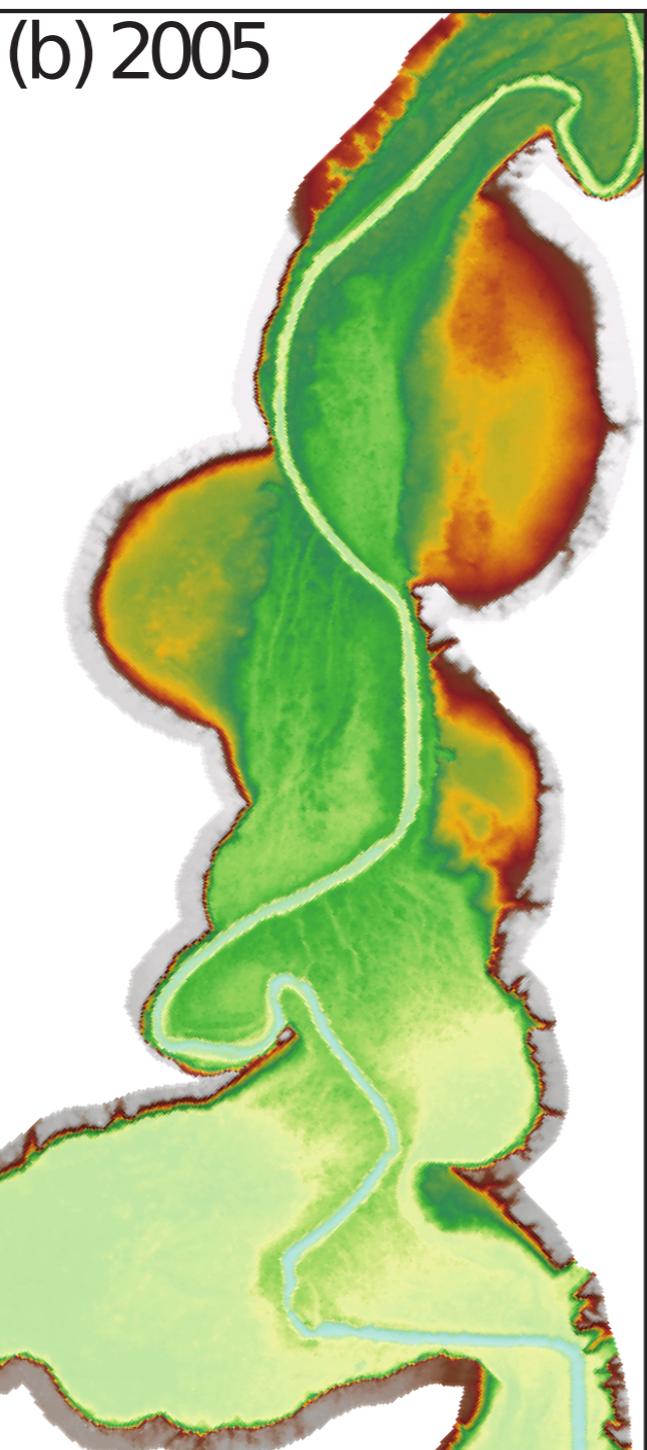
**Post-flood
LiDAR**



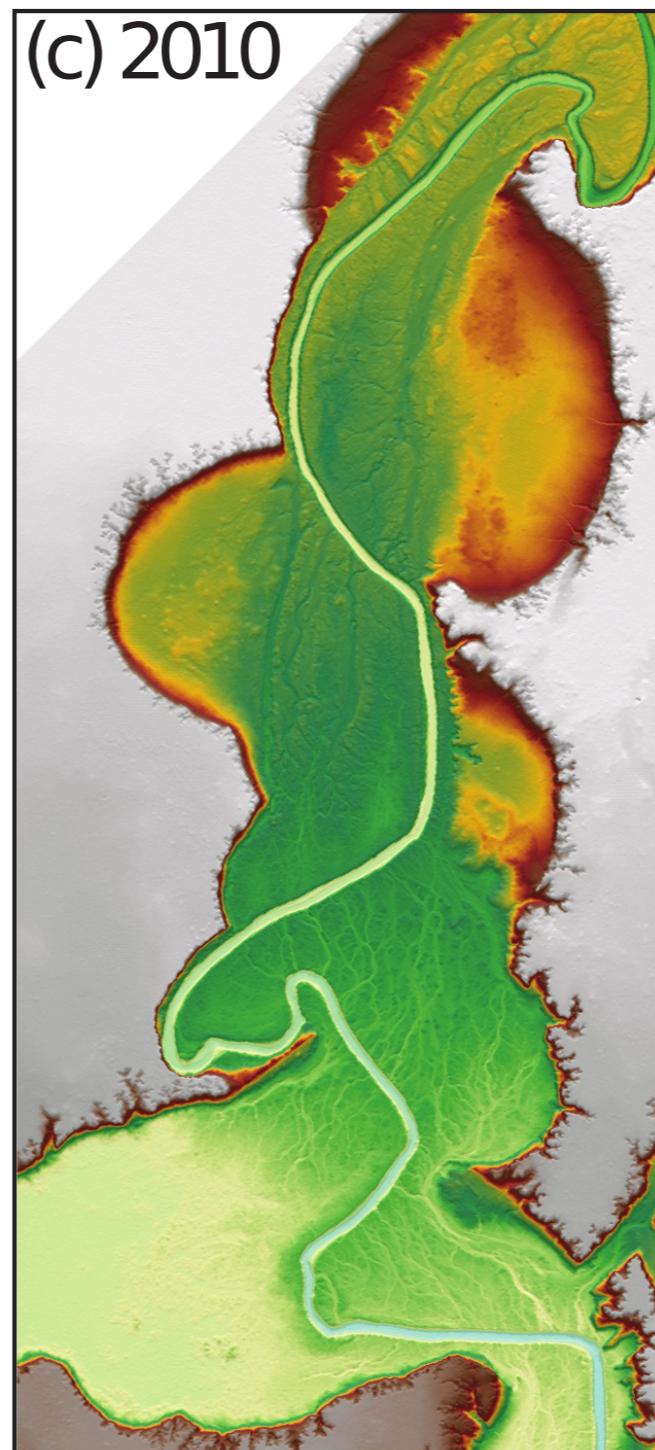
0 125 250 500 m Perignon et al, 2013

1523 1529 1535
Elevation (m)

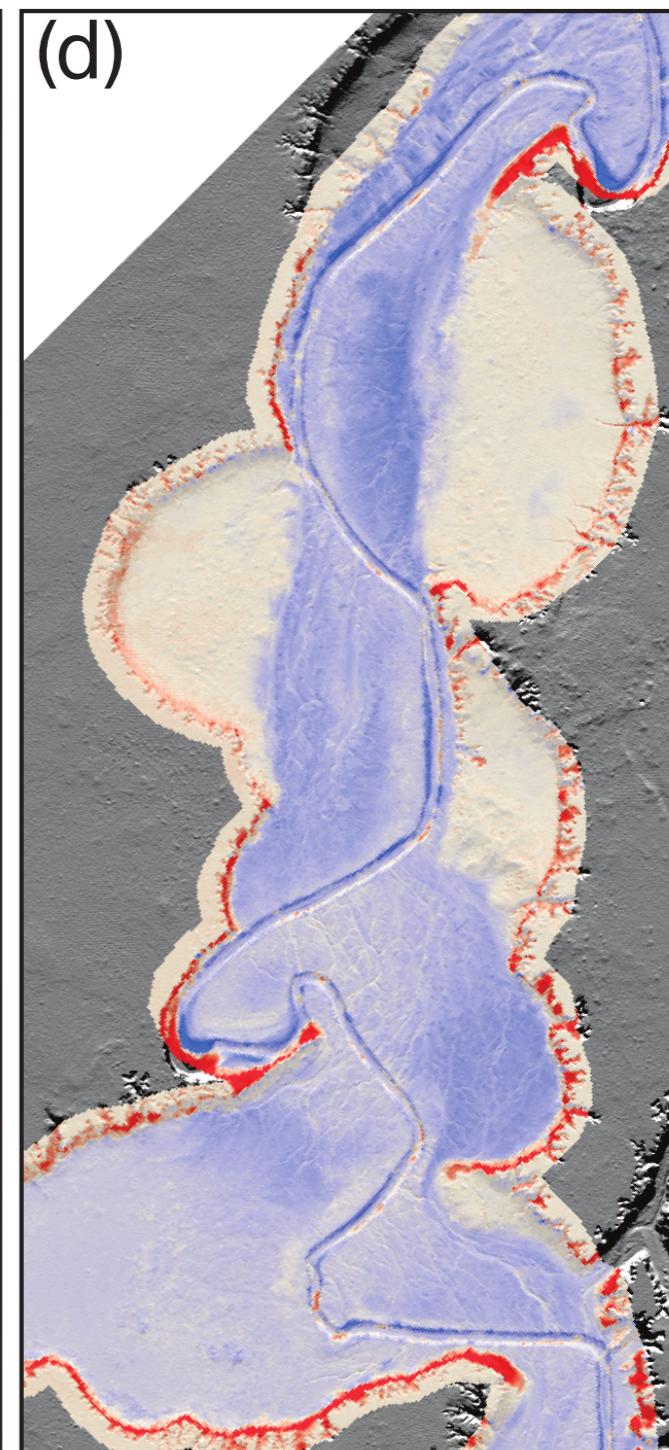
Pre-flood
LiDAR



Post-flood
LiDAR



**Elevation
change**

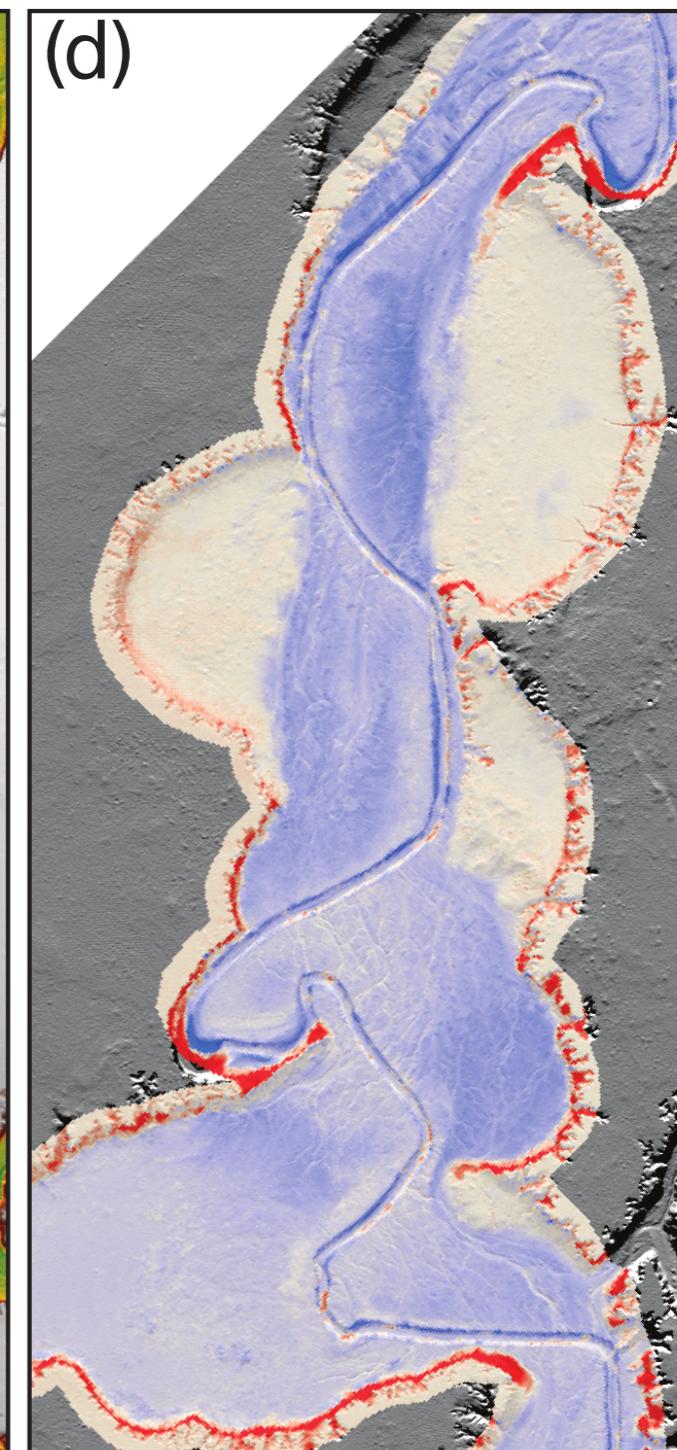
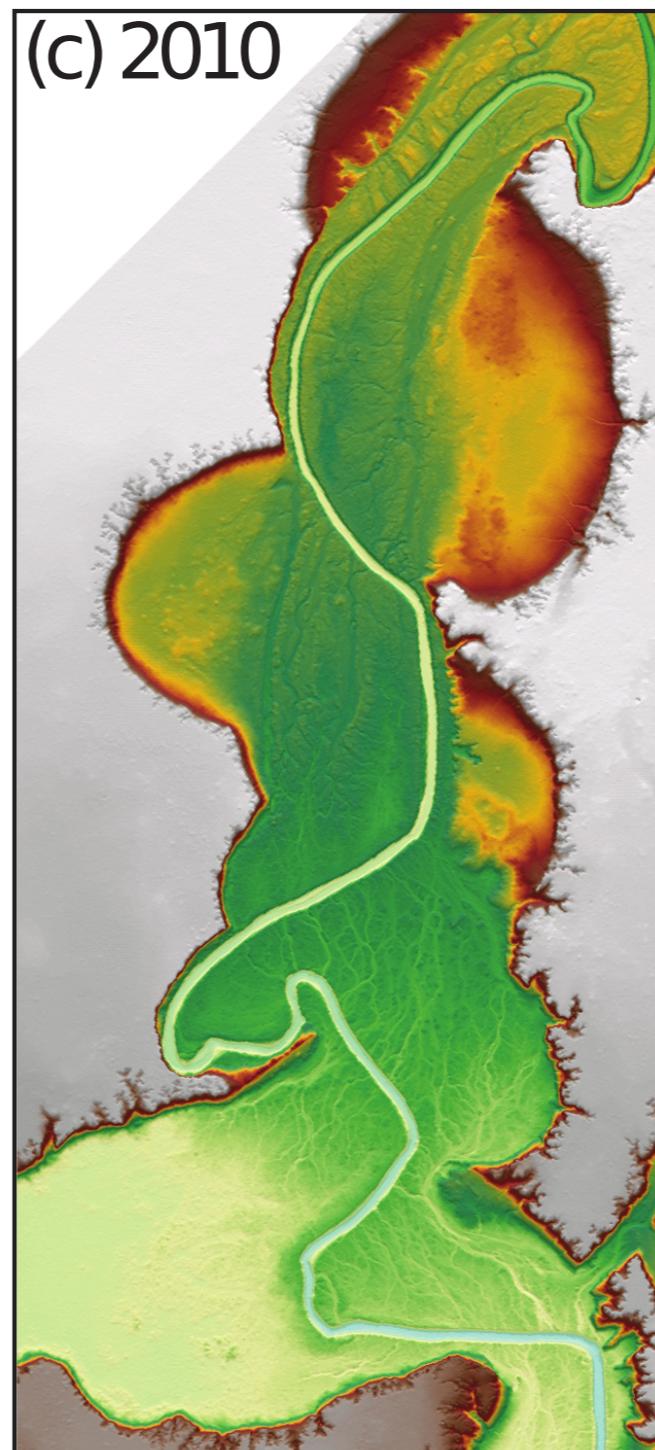
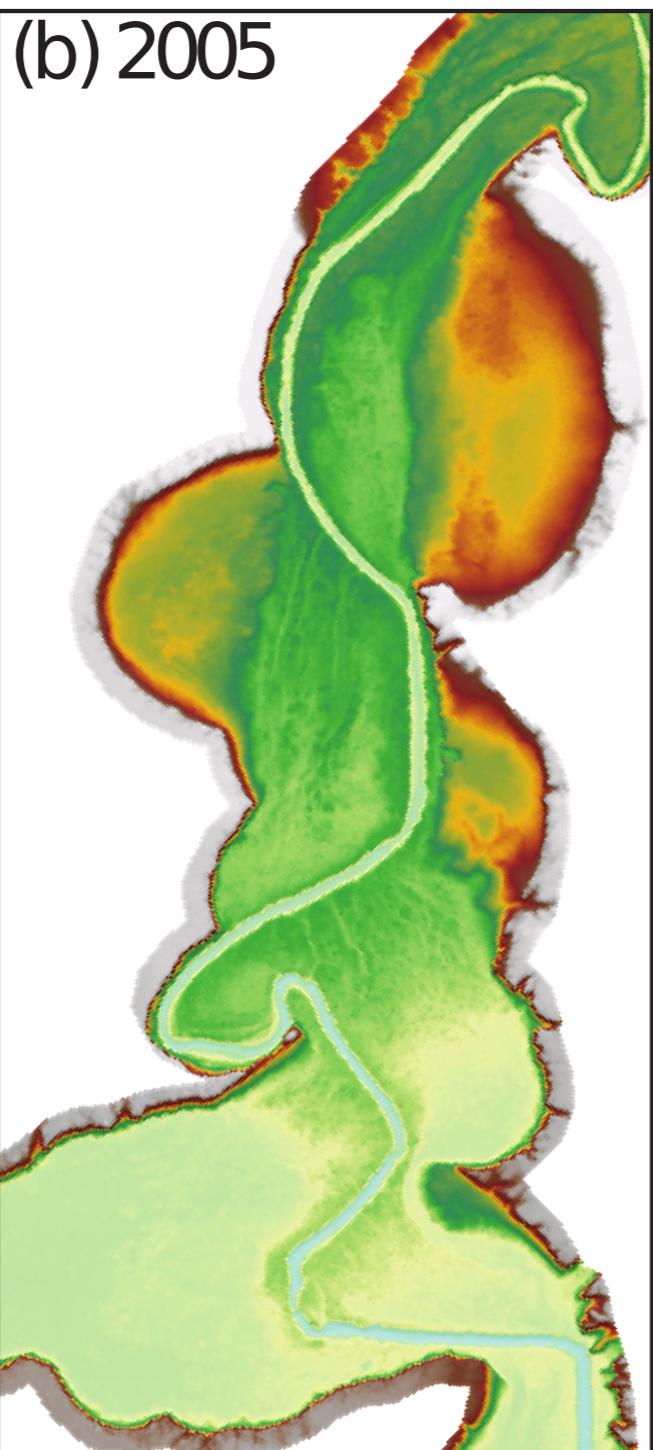


Vegetation

Pre-flood
LiDAR

Post-flood
LiDAR

Elevation
change



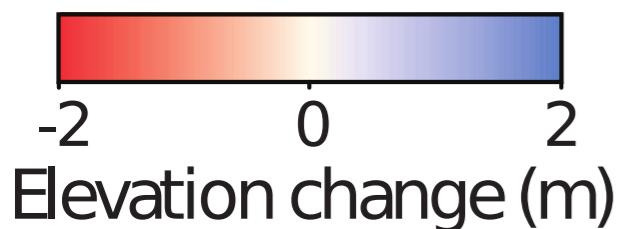
0 125 250 500 m



1523 1529 1535
Elevation (m)

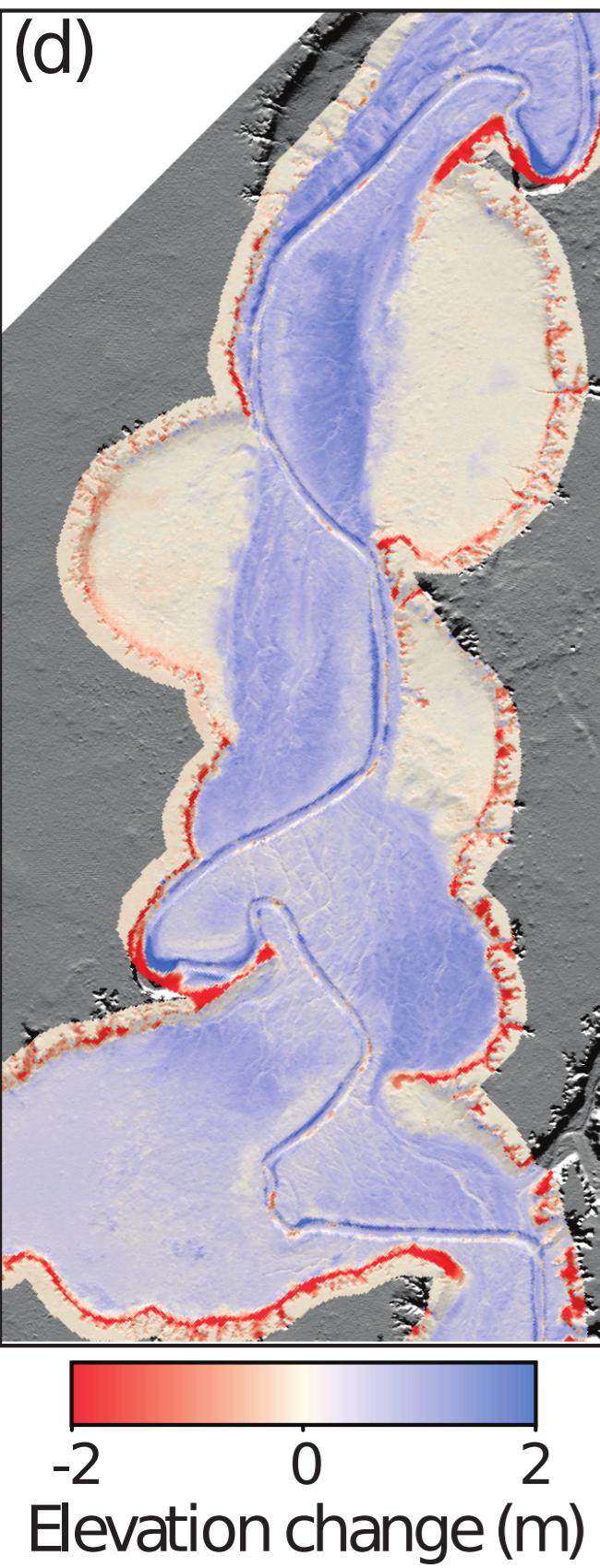
-2 0 2
Elevation change (m)

(d)



- Deposit thickness correlates with:
 - Distance from source (for 3.2 km)
 - Presence of vegetation
- Similar mean thickness for all veg types, coverages $>\sim 25\%$
- Highly variable thickness in tamarisk, 1-10 meter scale
- Uniform thickness in willows

(d)



The model should:

- Hit high-water marks
- Reproduce bulk erosion/deposition patterns, volumes
- Capture patch-scale deposit thickness vs. vegetation relations
- Match differencing (including local variability)

Model structure:

- Hydrodynamics: ANUGA

(Rigby and van Drie, 2008)

- Sediment transport:

(Simpson and Castelltort, 2006; Davy and Lague, 2009)

- Separate erosion and deposition (no transport capacity)
- Track concentration
- Momentum source/sinks:

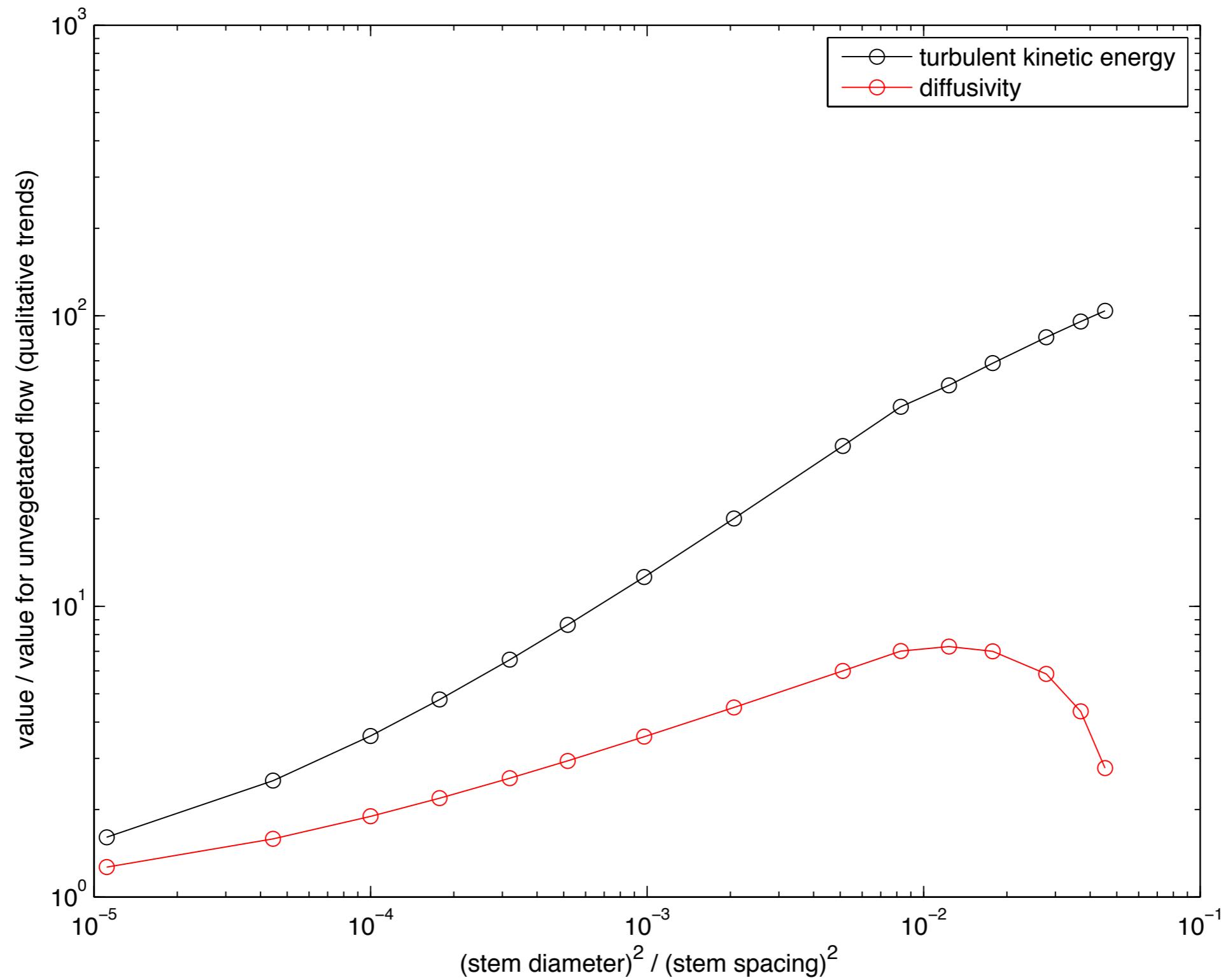
Bed topography, friction loss, turbulent diffusion, concentration gradients, sediment exchange with bed

- Vegetation:

(Kean and Smith, 2004; Nepf, 2009)

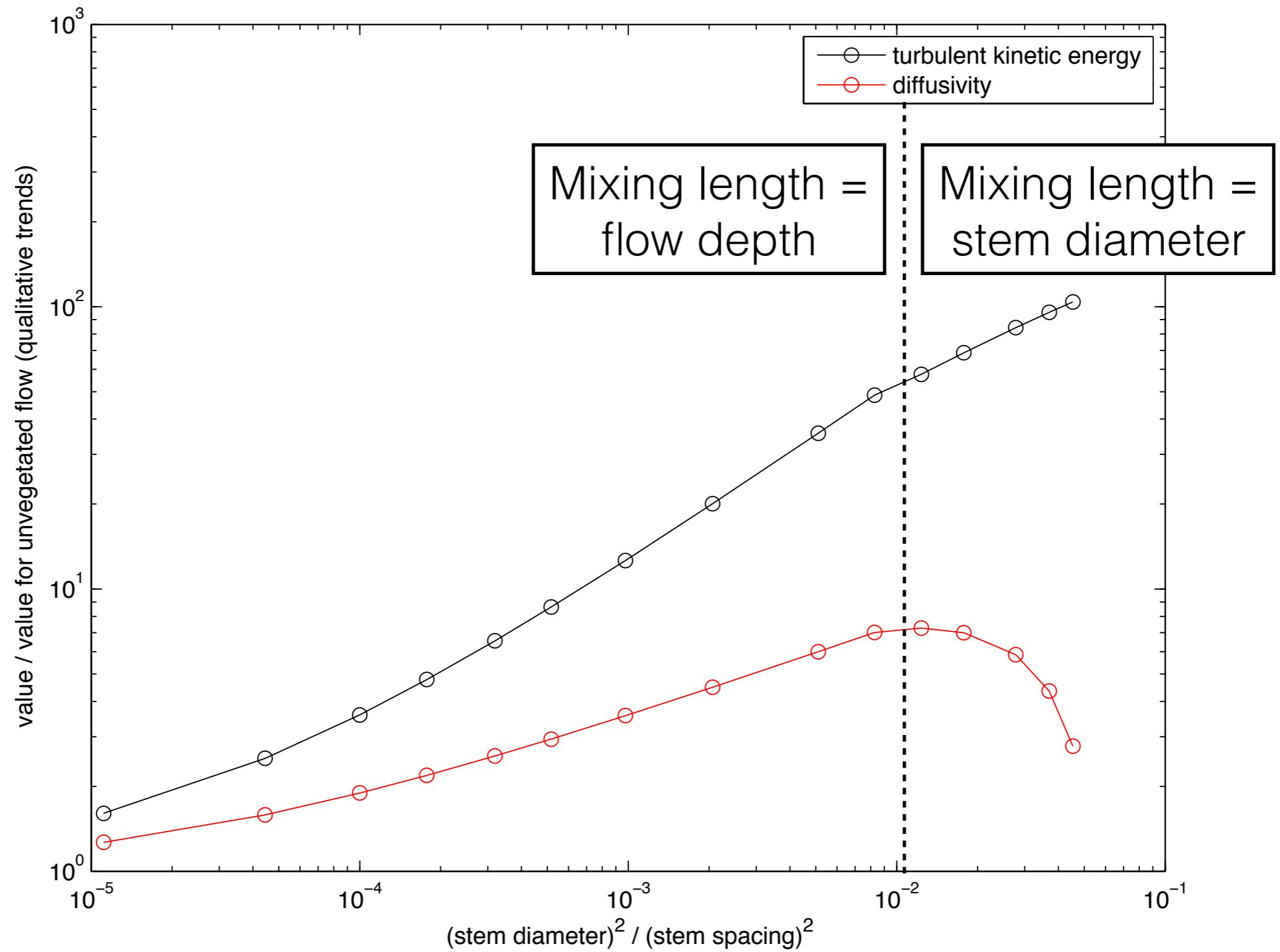
- Drag on cylindrical stems
- Diffusion, kinetic energy from turbulence in wakes

Numerical experiments: vegetated ramp

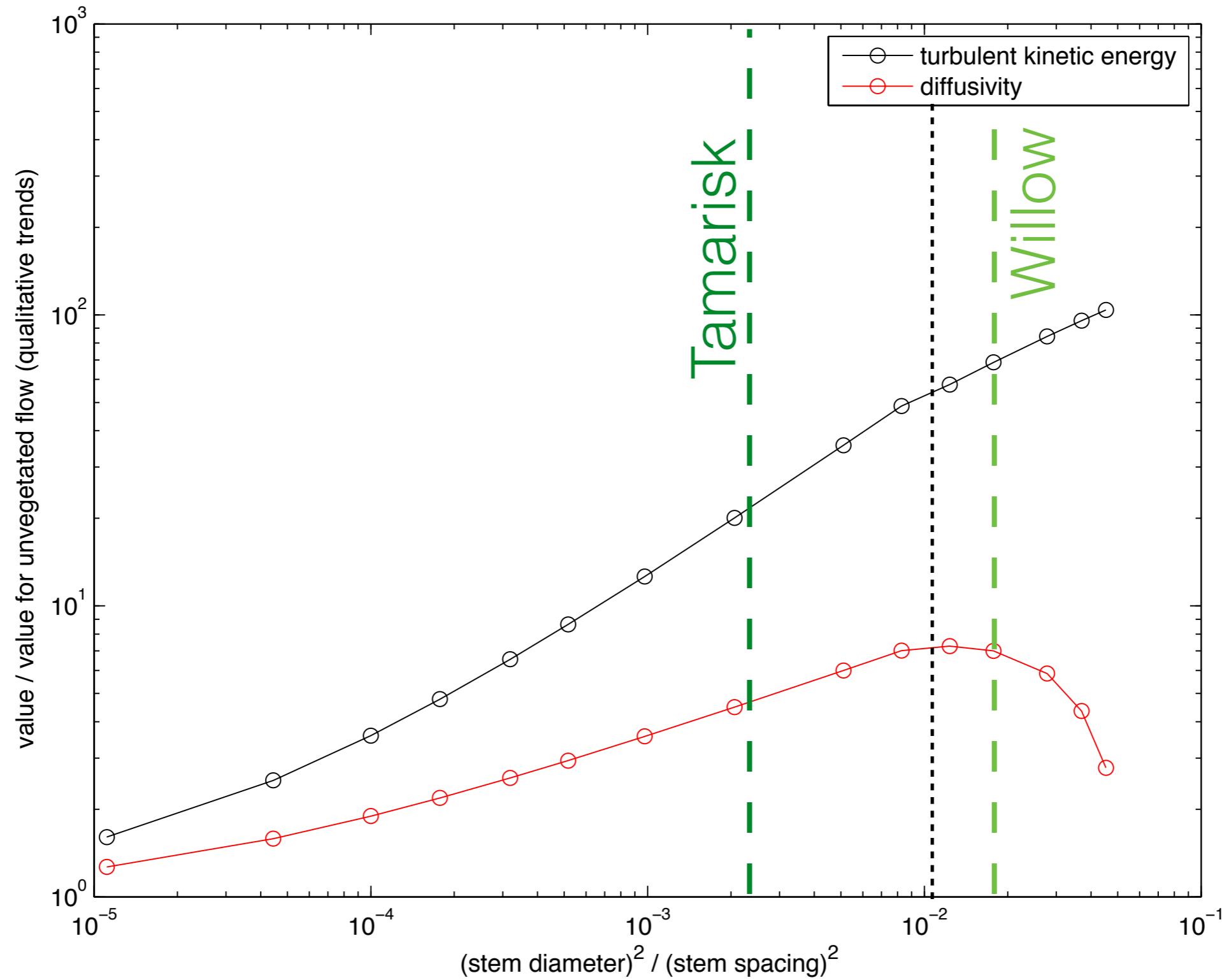


d	0.01 m				
L	3.1 m	1 m	0.31 m	0.1 m	0.03 m

Numerical experiments: vegetated ramp

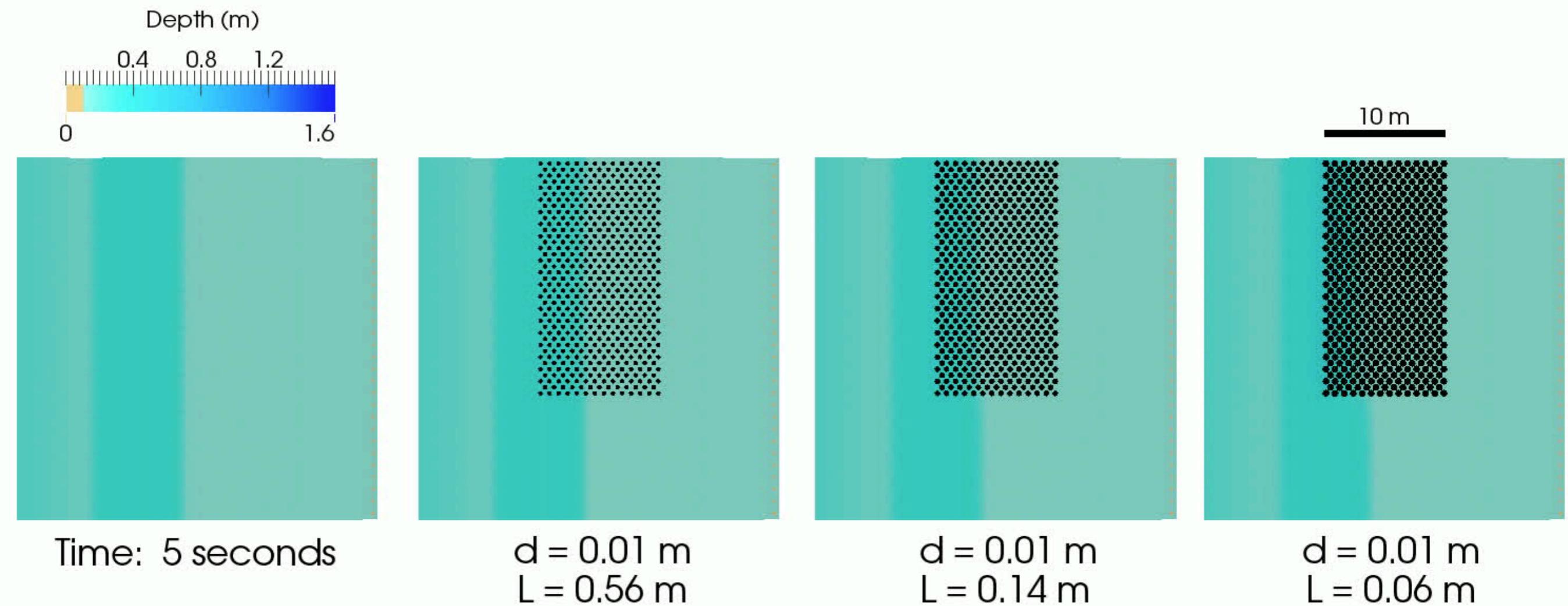


Numerical experiments: vegetated ramp

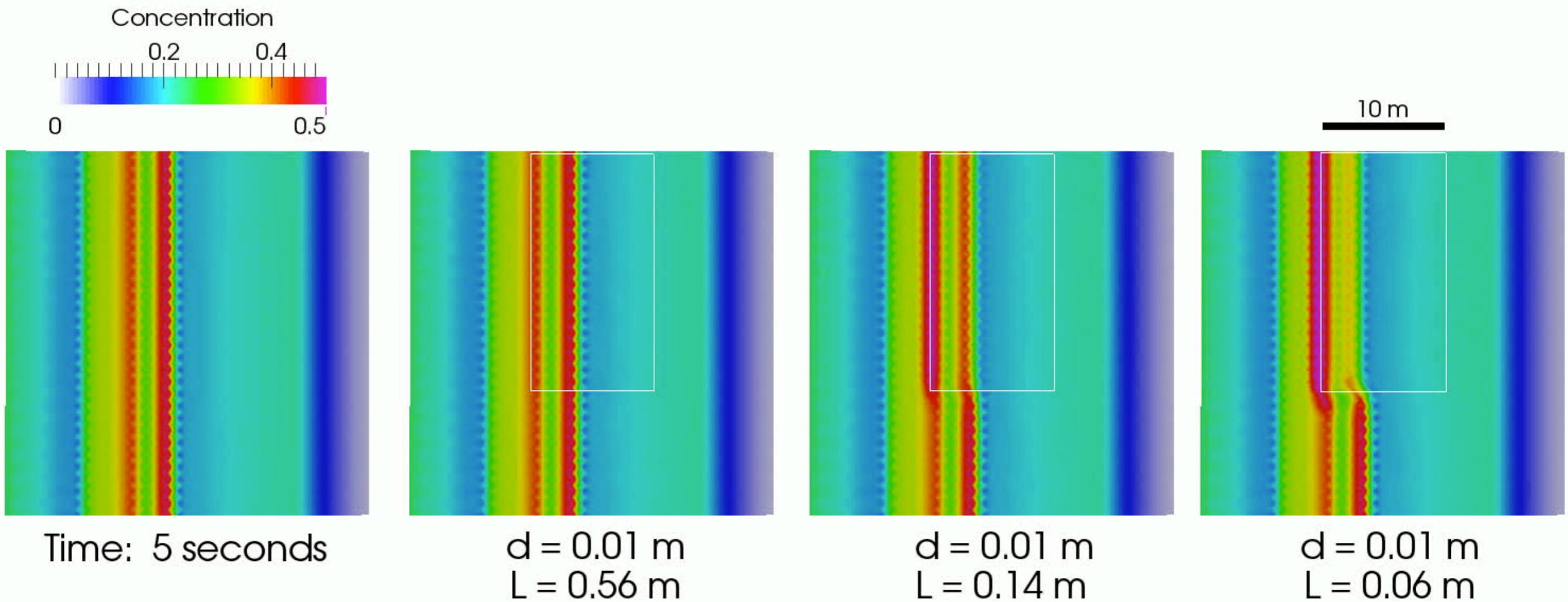


d	0.01 m				
L	3.1 m	1 m	0.31 m	0.1 m	0.03 m

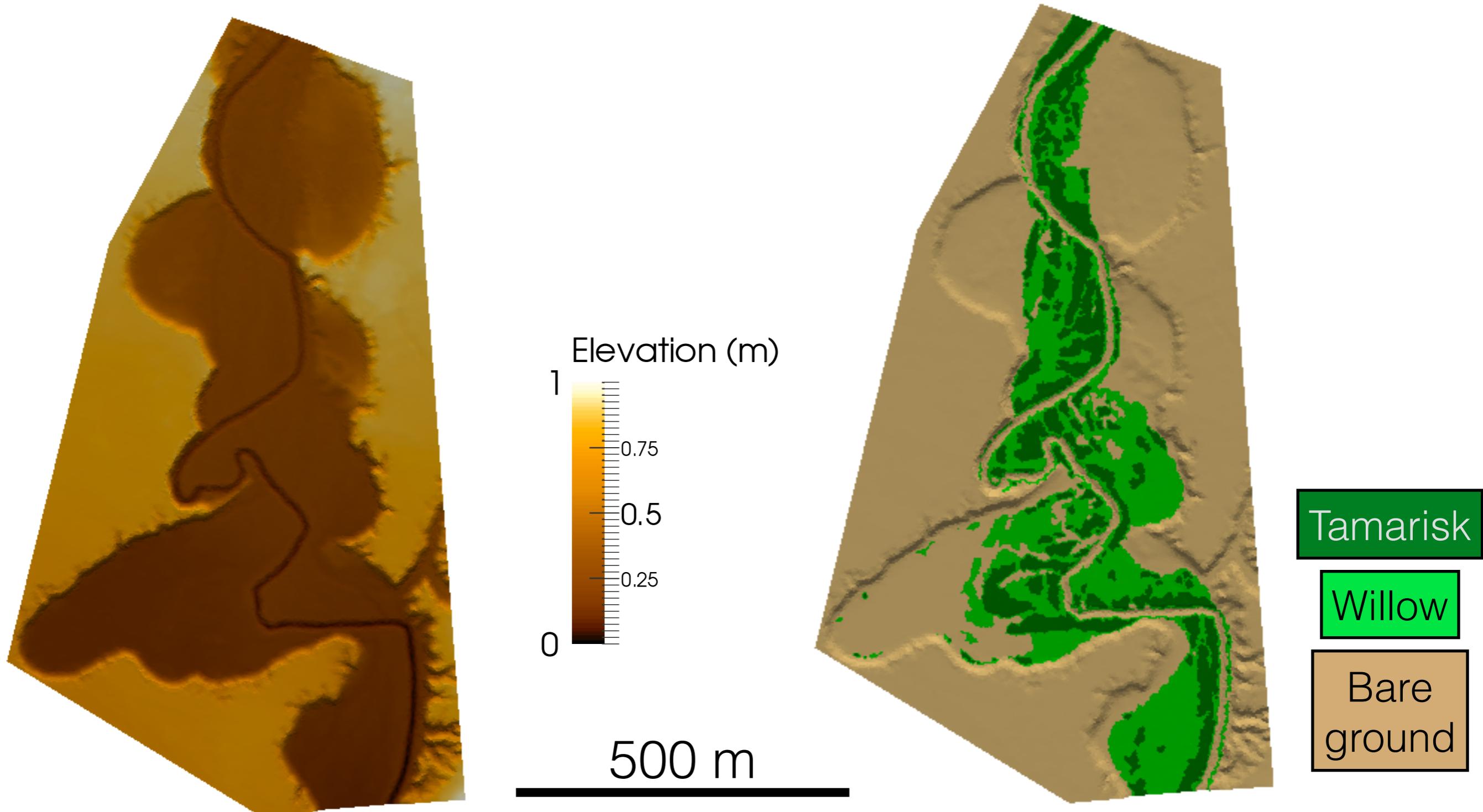
Numerical experiments: vegetation patch



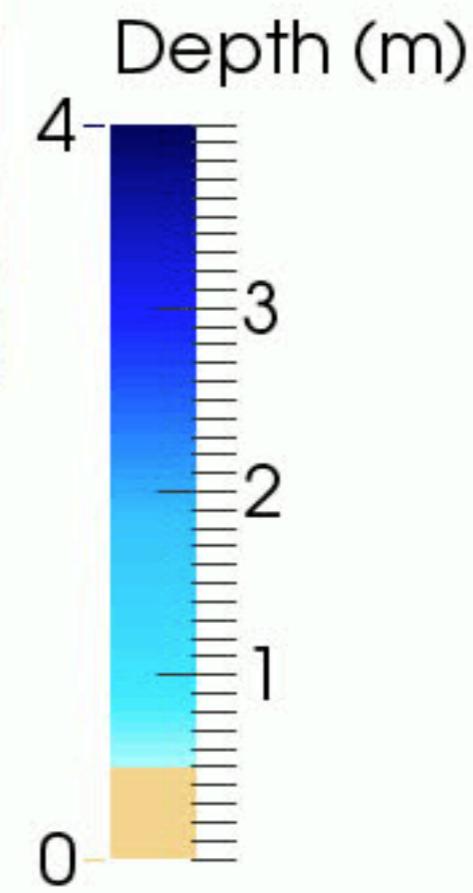
Numerical experiments: vegetation patch



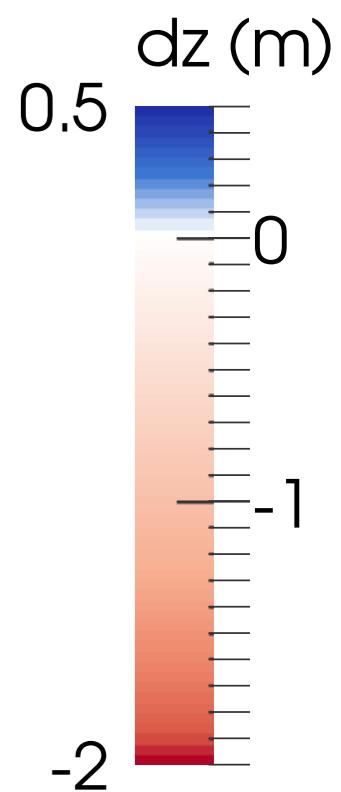
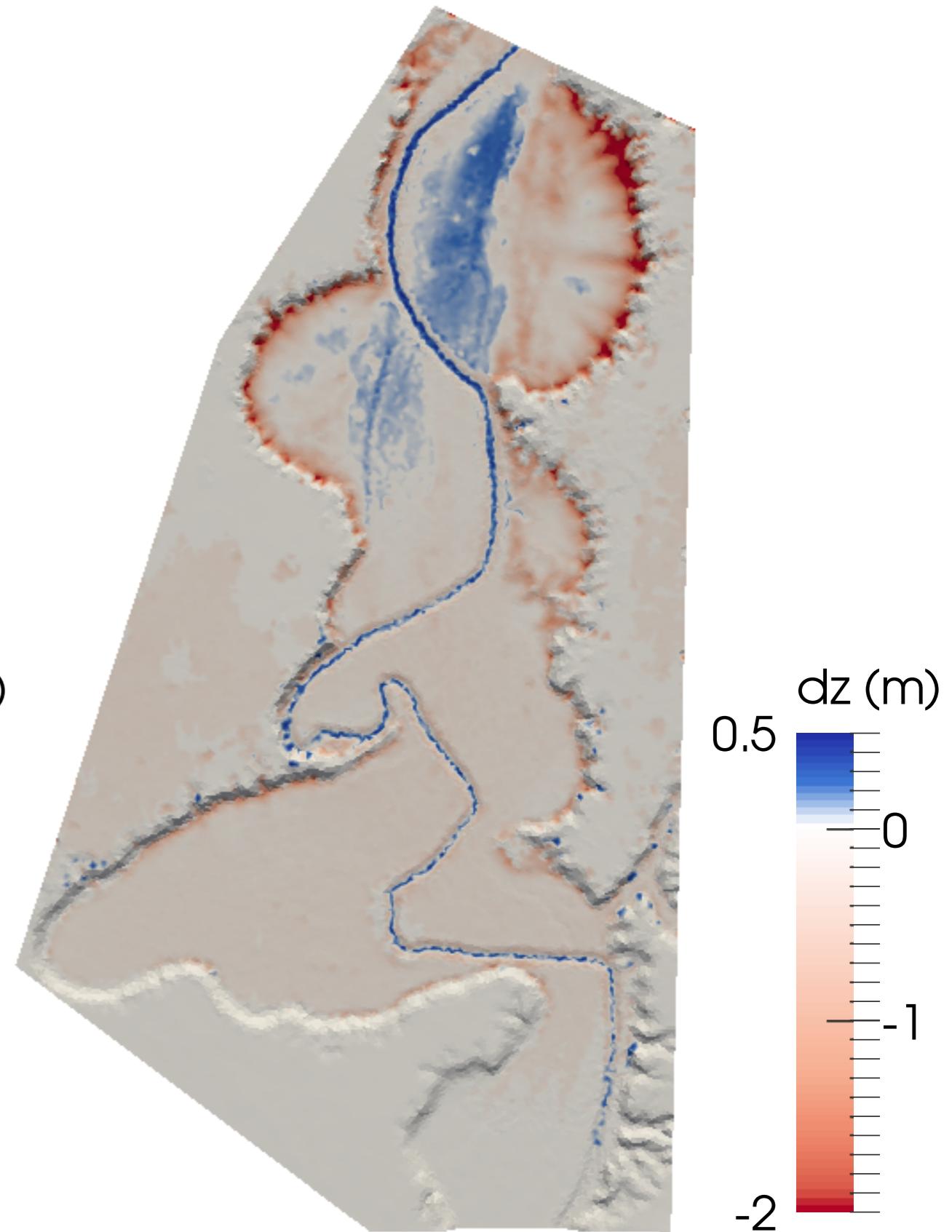
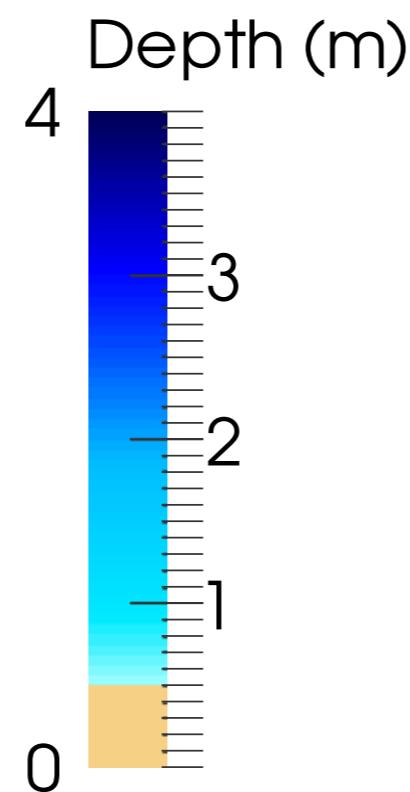
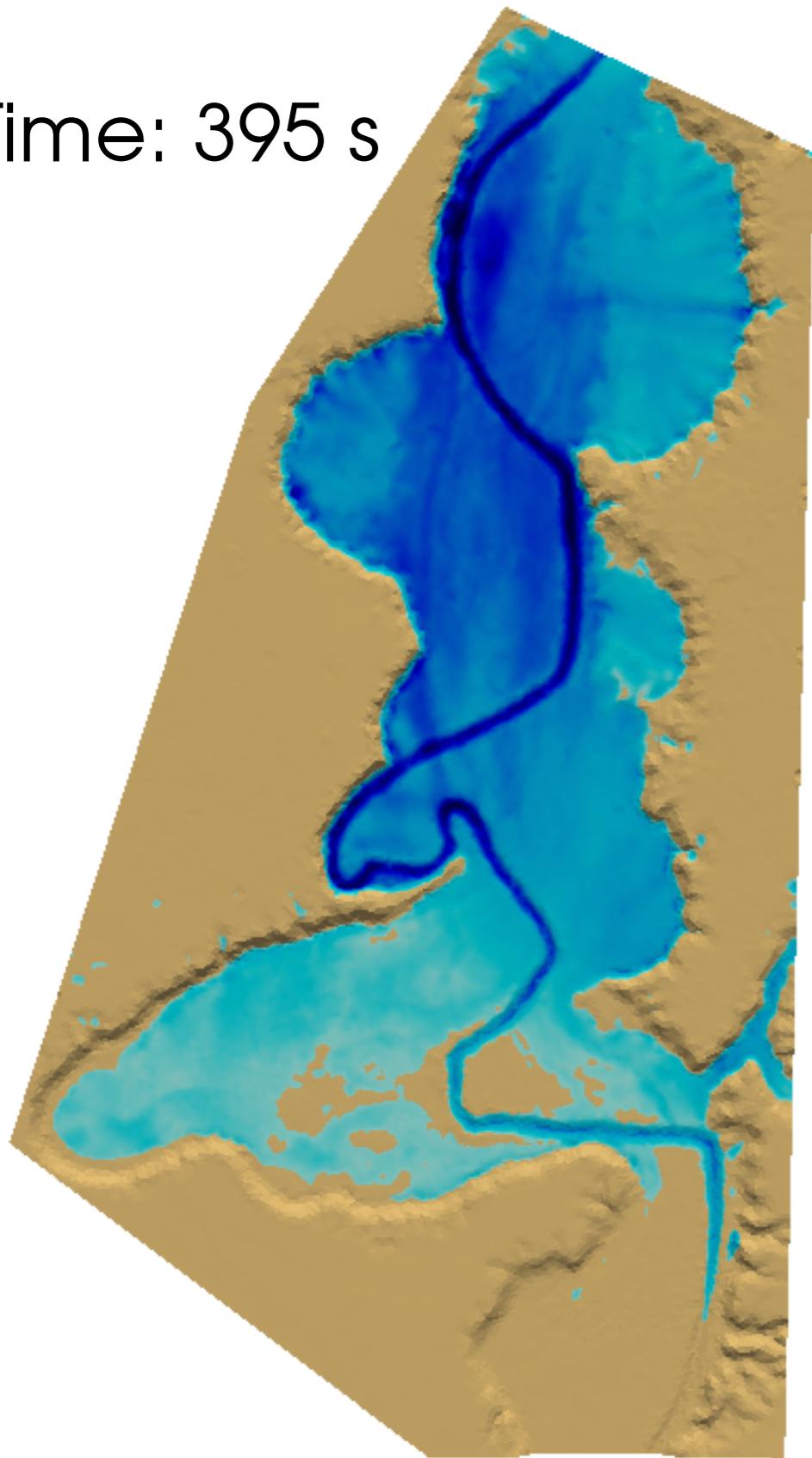
Event hind-casting: 2006 Rio Puerco flood



Time: 0 s



Time: 395 s



- Sub-grid scale processes affect reach-scale patterns
- Model results can be affected by details in the morphology
- Need to test against natural experiments





← 2006



2013

2006