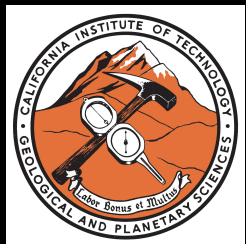
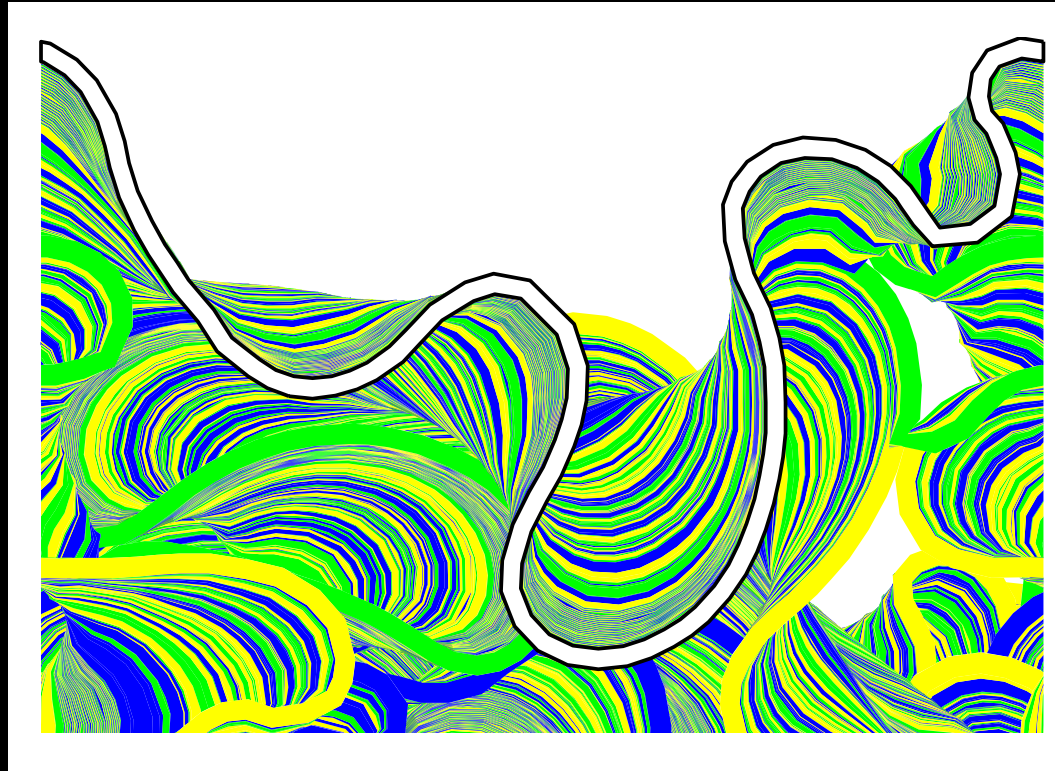


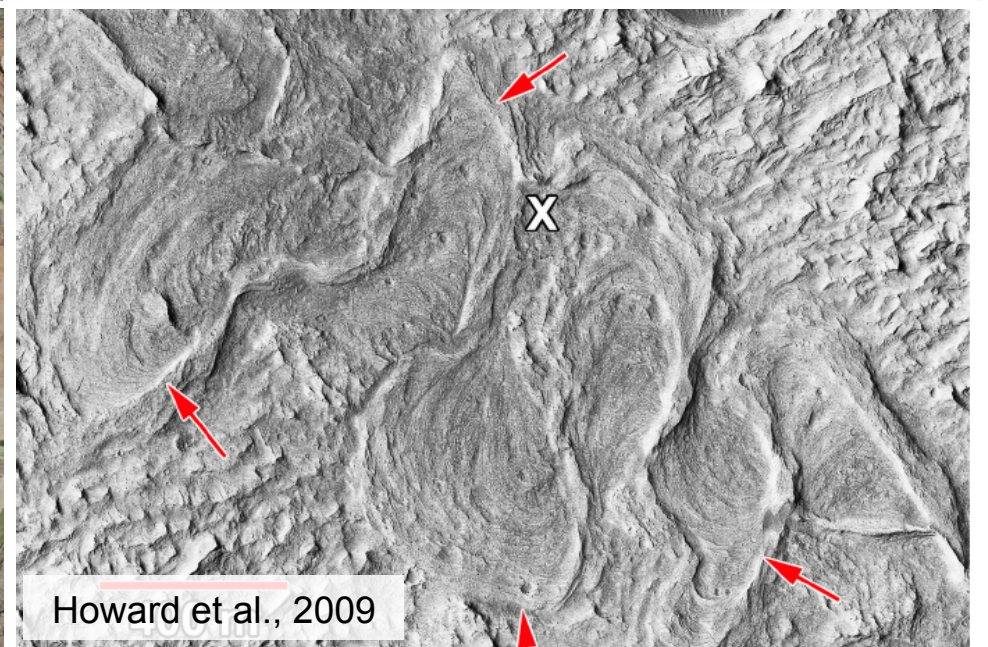
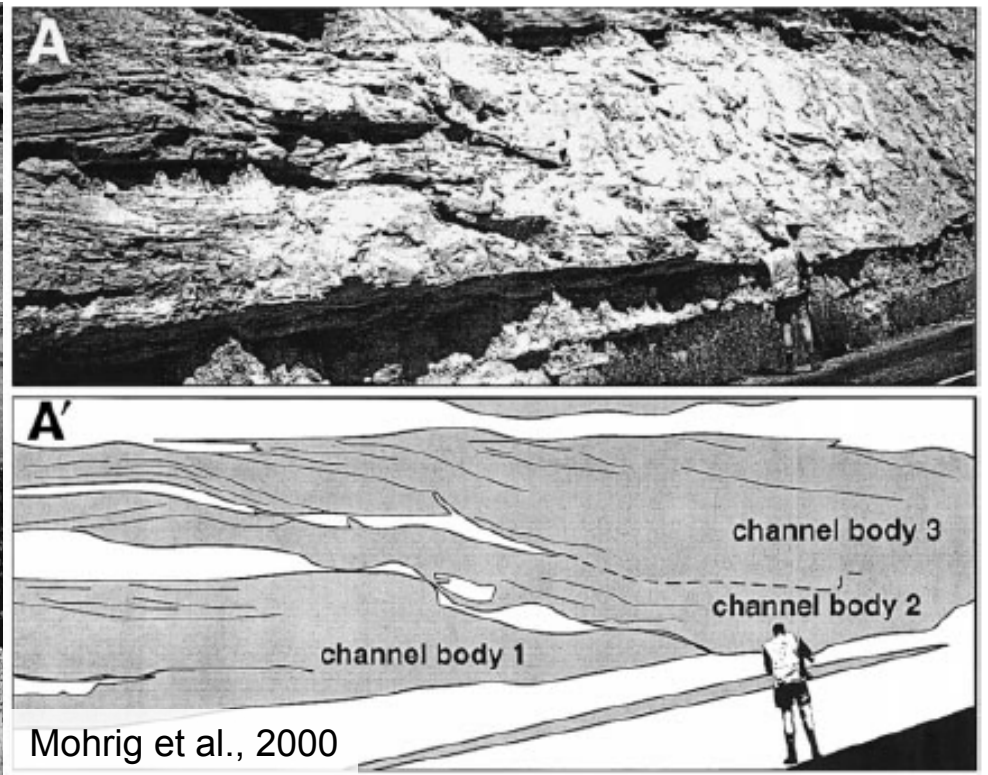
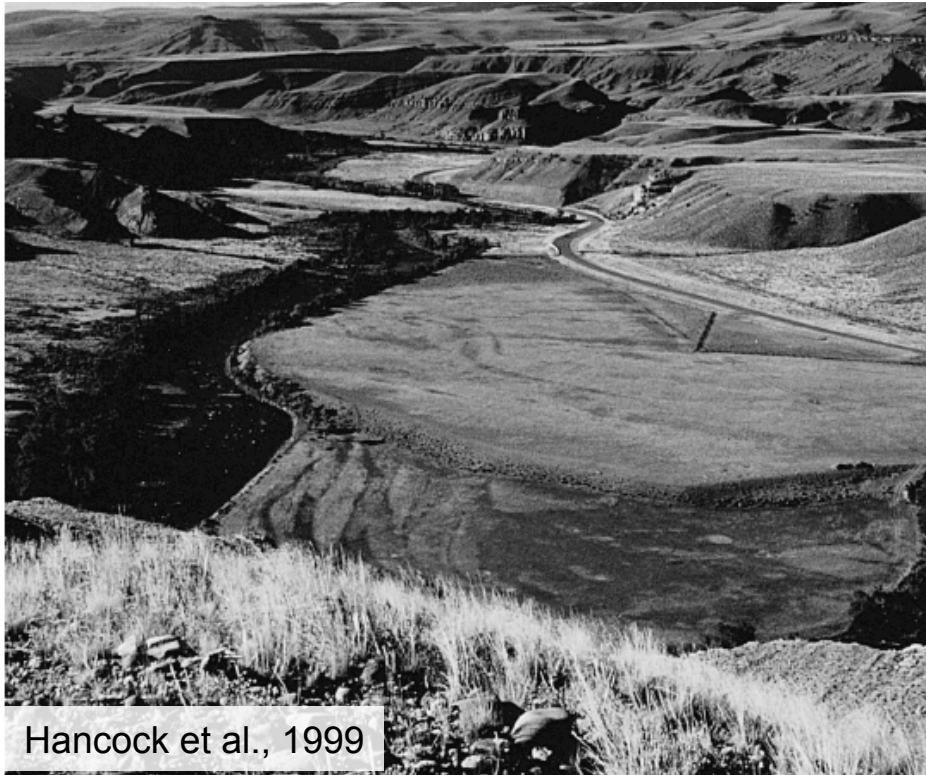
# A vector-based approach to bank-material tracking in coupled models of meandering and landscape evolution



Ajay B. S. Limaye  
California Institute of Technology  
*CSDMS Annual Meeting 2014*







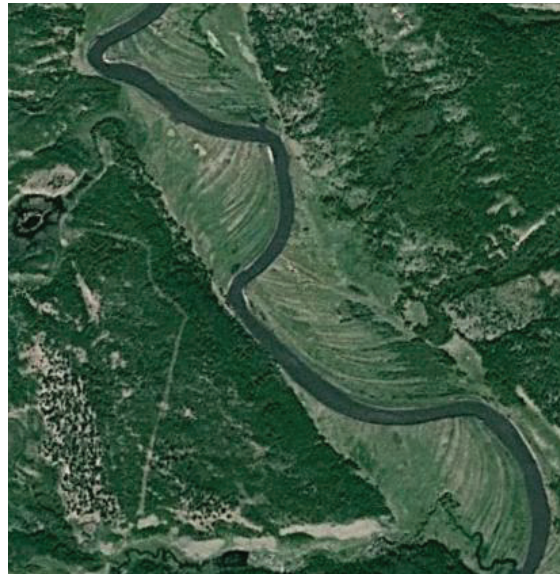


# Bank properties change how rivers meander

---



Colorado R., Texas

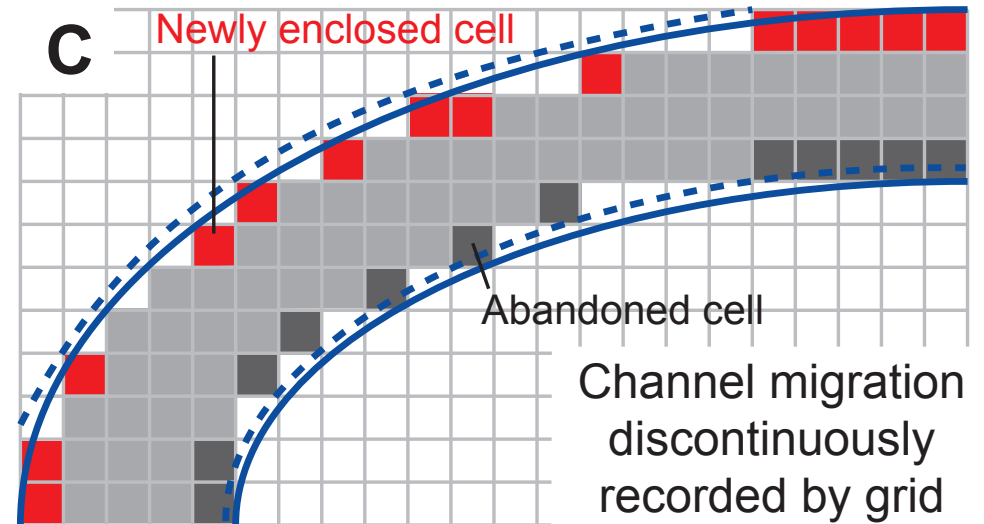
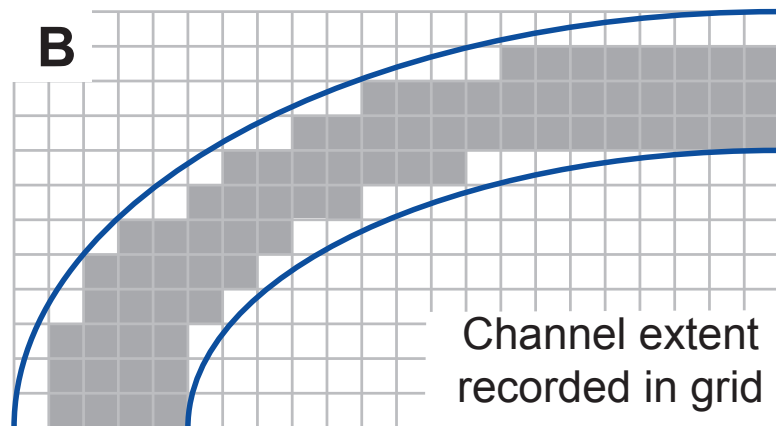
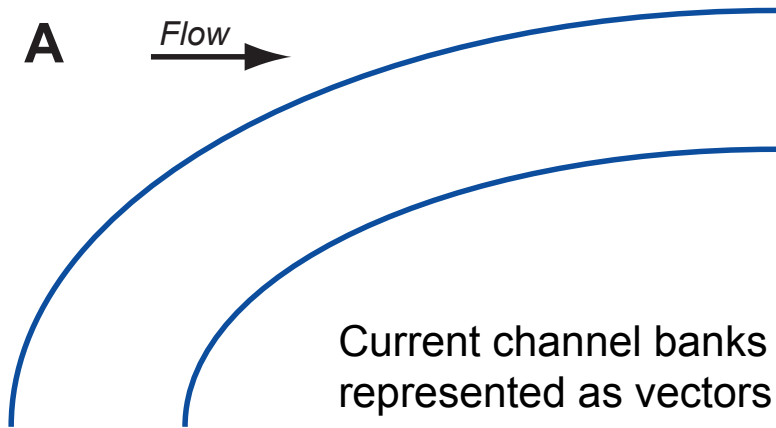


Beaver R., Alberta,  
Canada



San Juan R., Utah

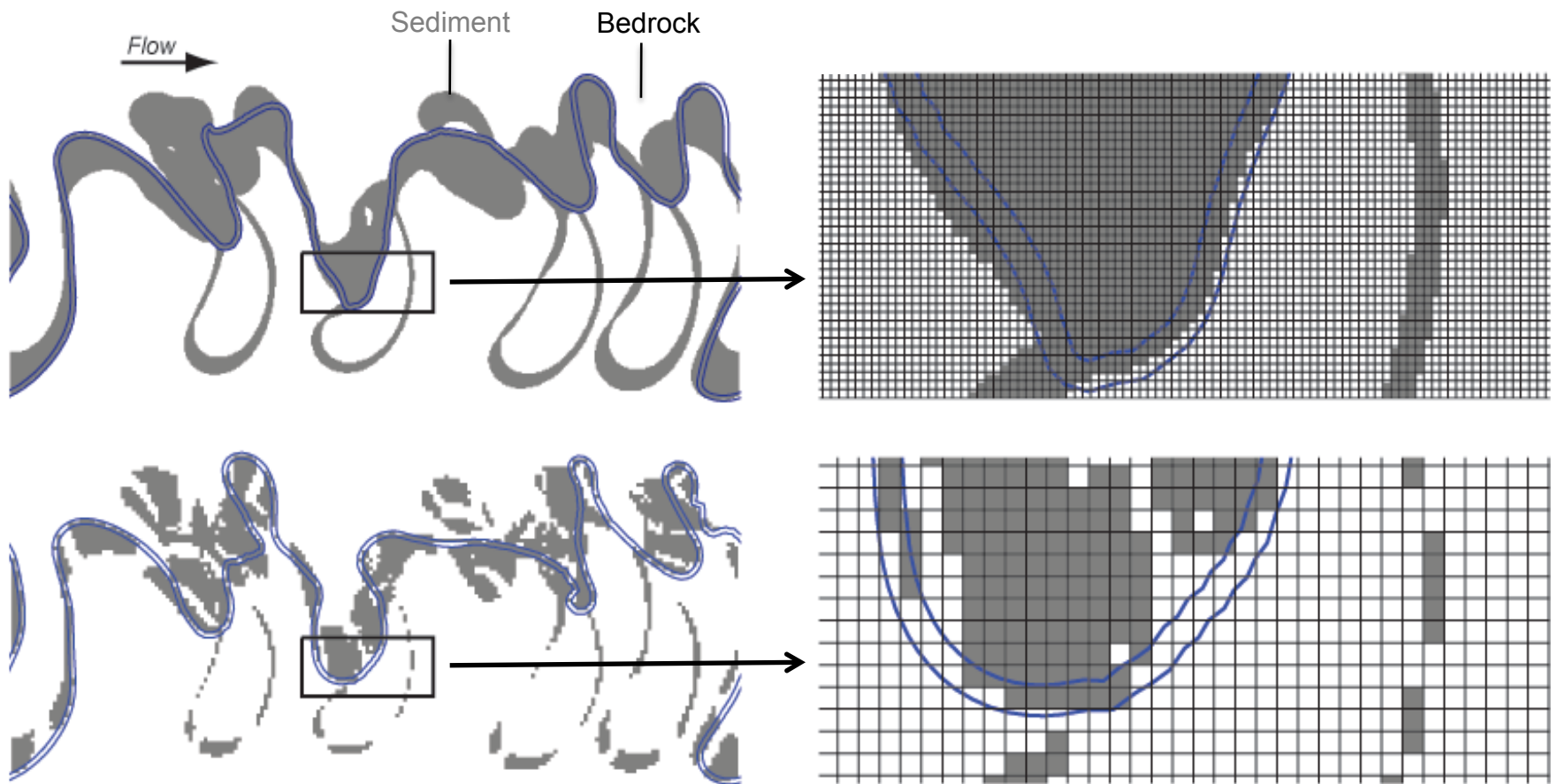
# Existing approaches to tracking bank properties use grids



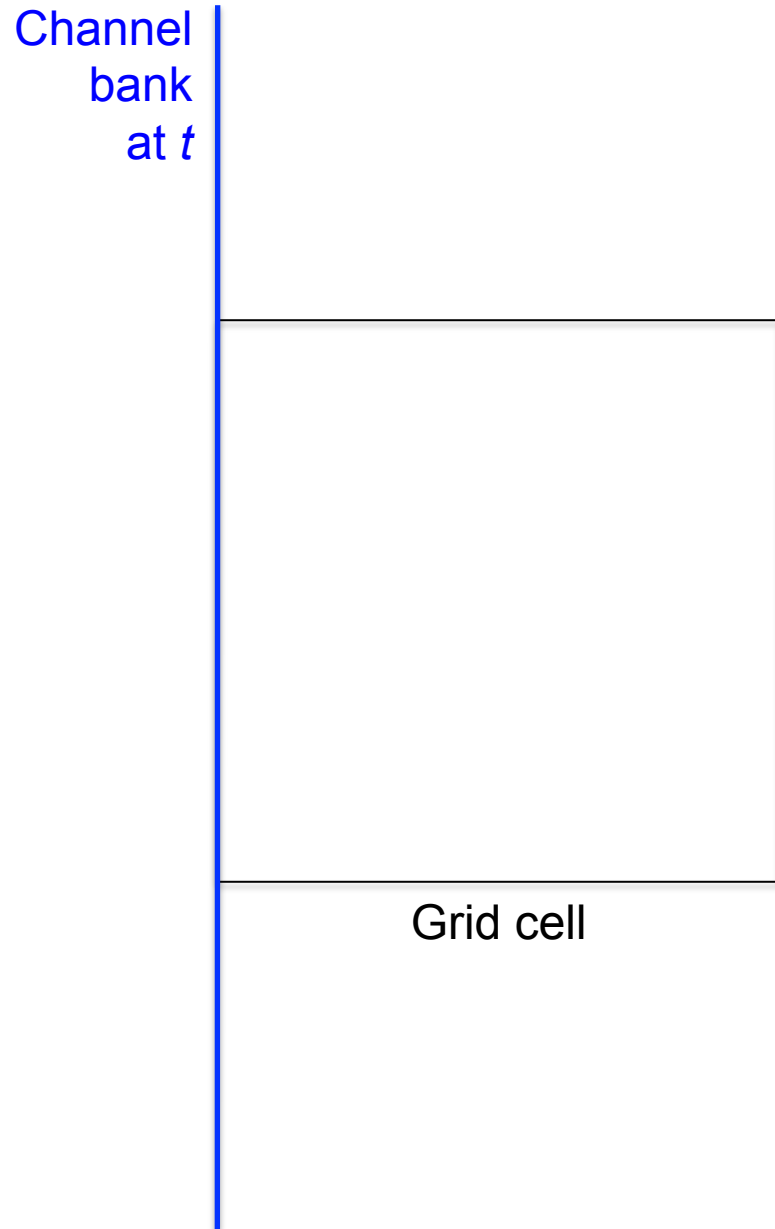


# Problem: When bank strength is spatially variable, different grid resolutions cause different channel trajectories

---

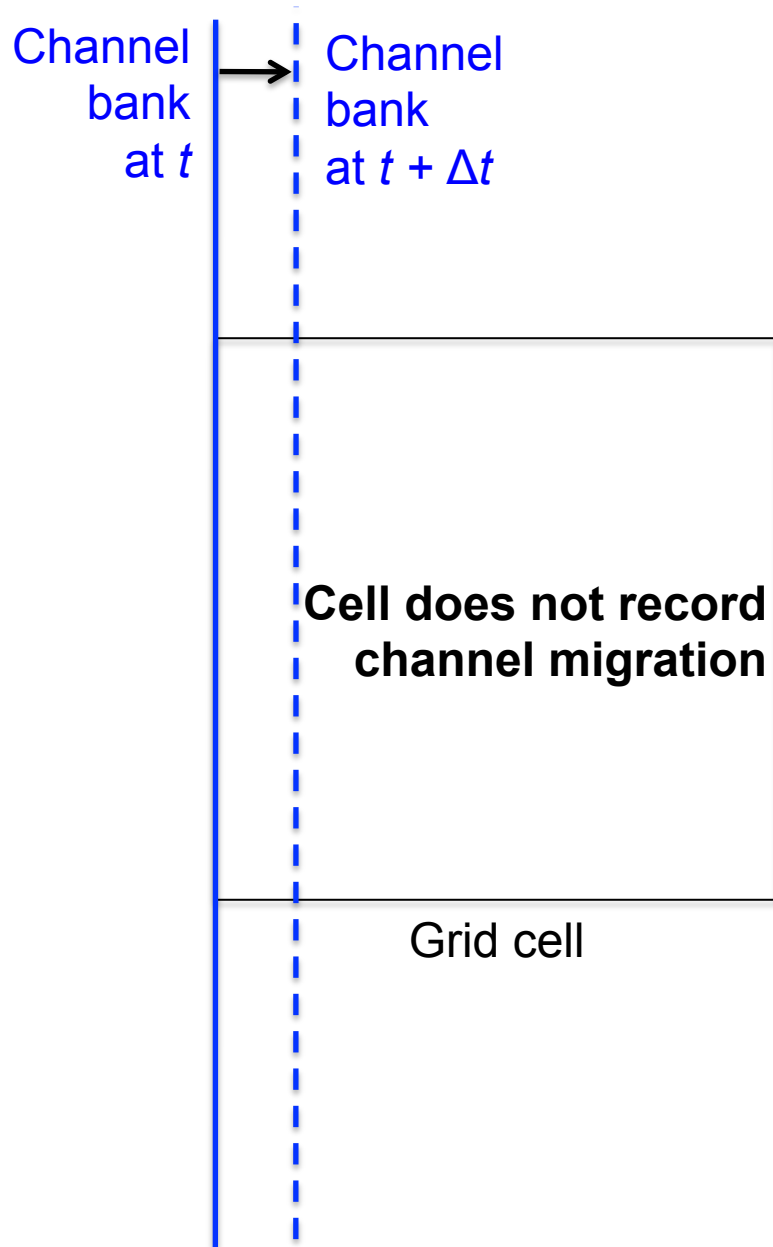


# The necessary grid resolution depends on the channel lateral erosion rate

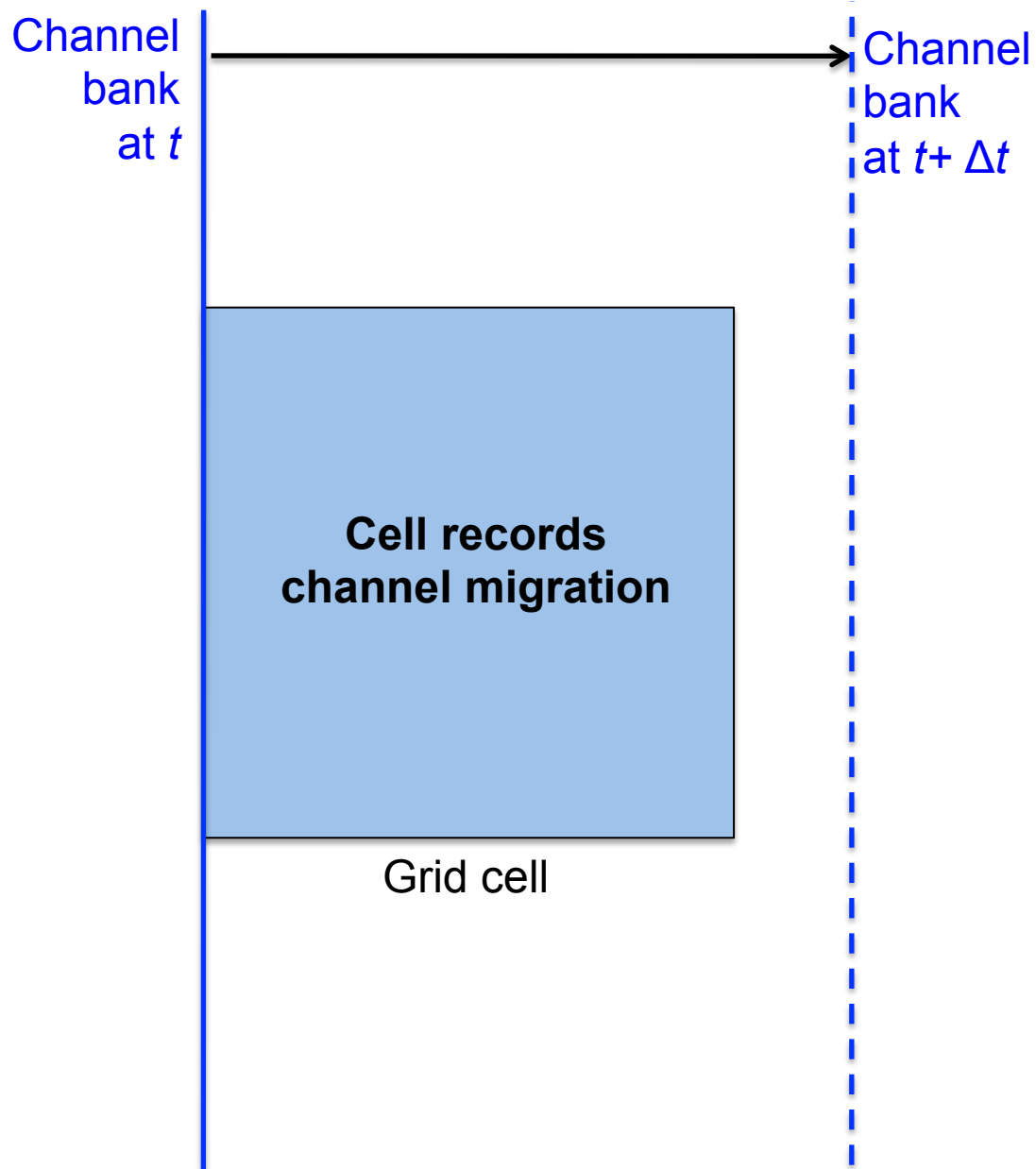




# The necessary grid resolution depends on the channel lateral erosion rate

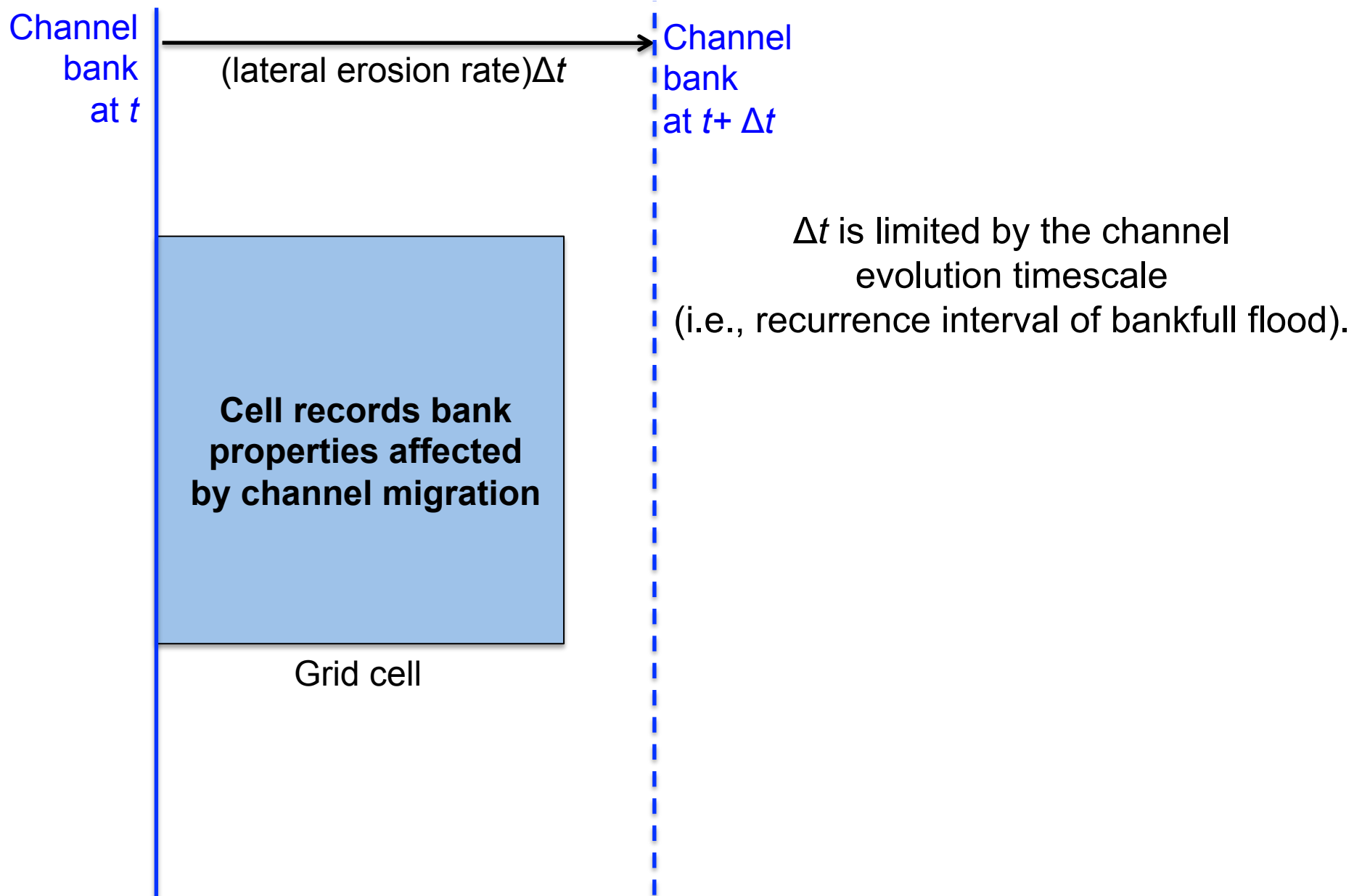


# The necessary grid resolution depends on the channel lateral erosion rate

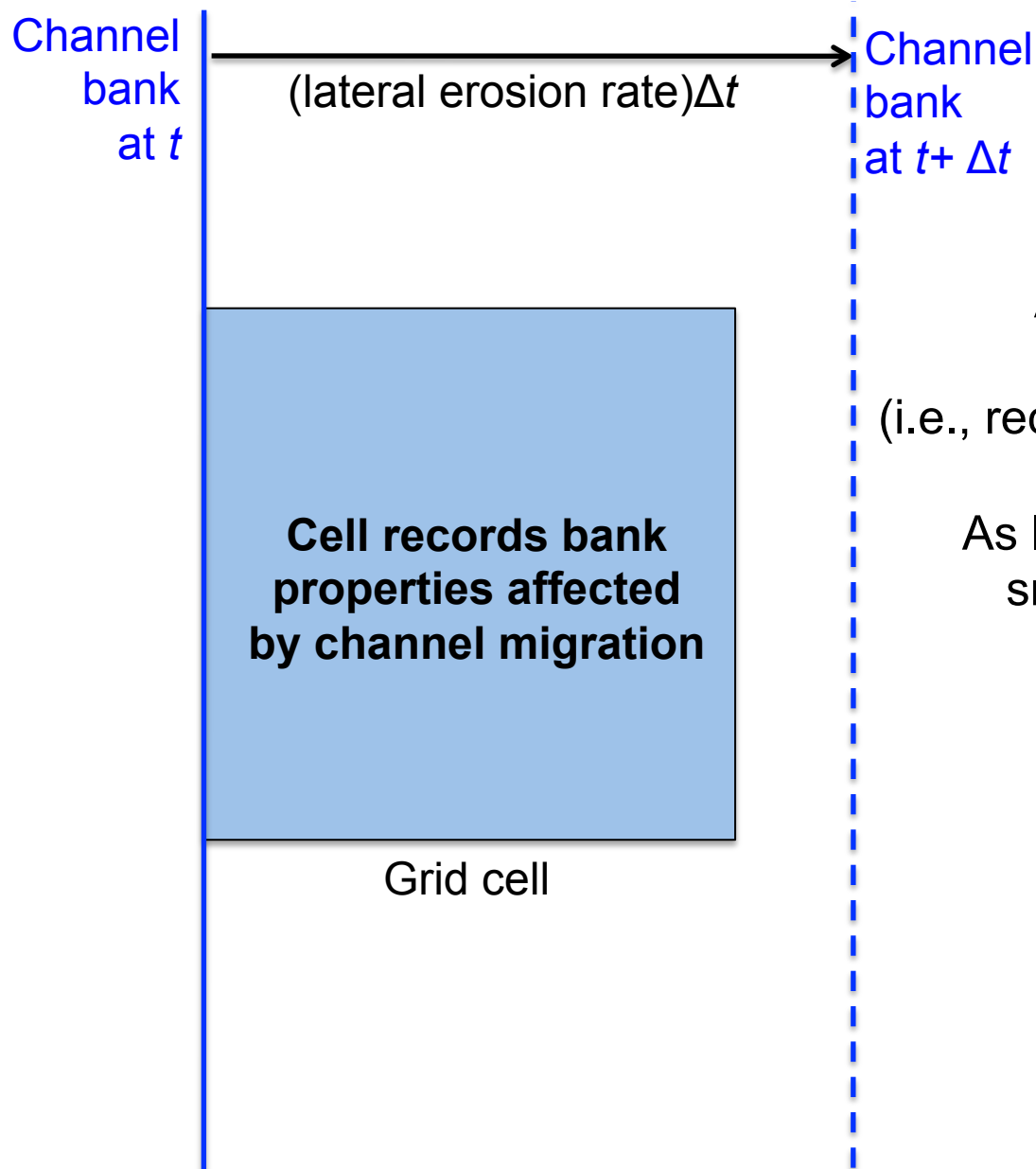




# The necessary grid resolution depends on the channel lateral erosion rate



# The necessary grid resolution depends on the channel lateral erosion rate

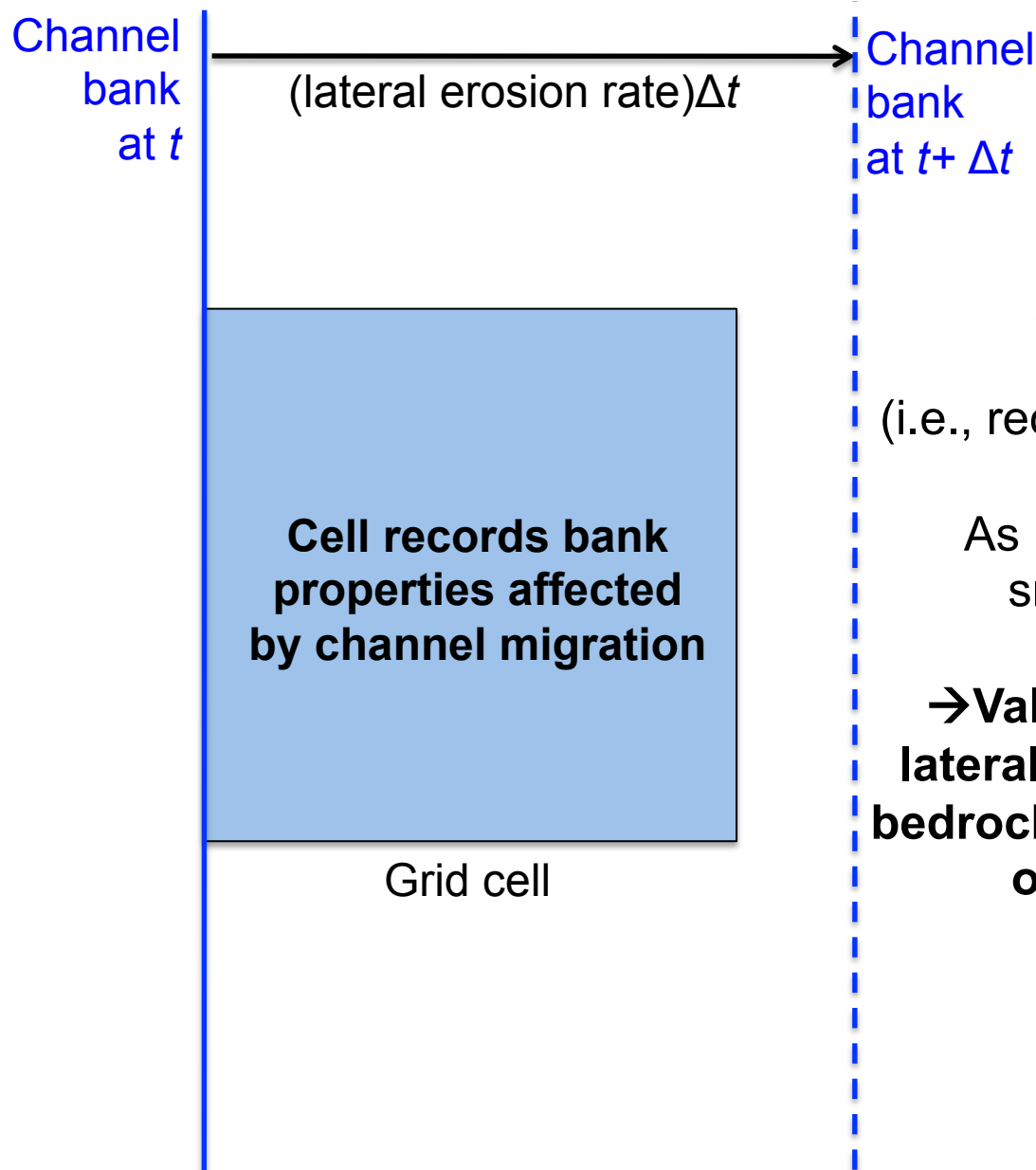


$\Delta t$  is limited by the channel evolution timescale (i.e., recurrence interval of bankfull flood).

As lateral erosion rates decrease, smaller grid cells are needed.



# The necessary grid resolution depends on the channel lateral erosion rate



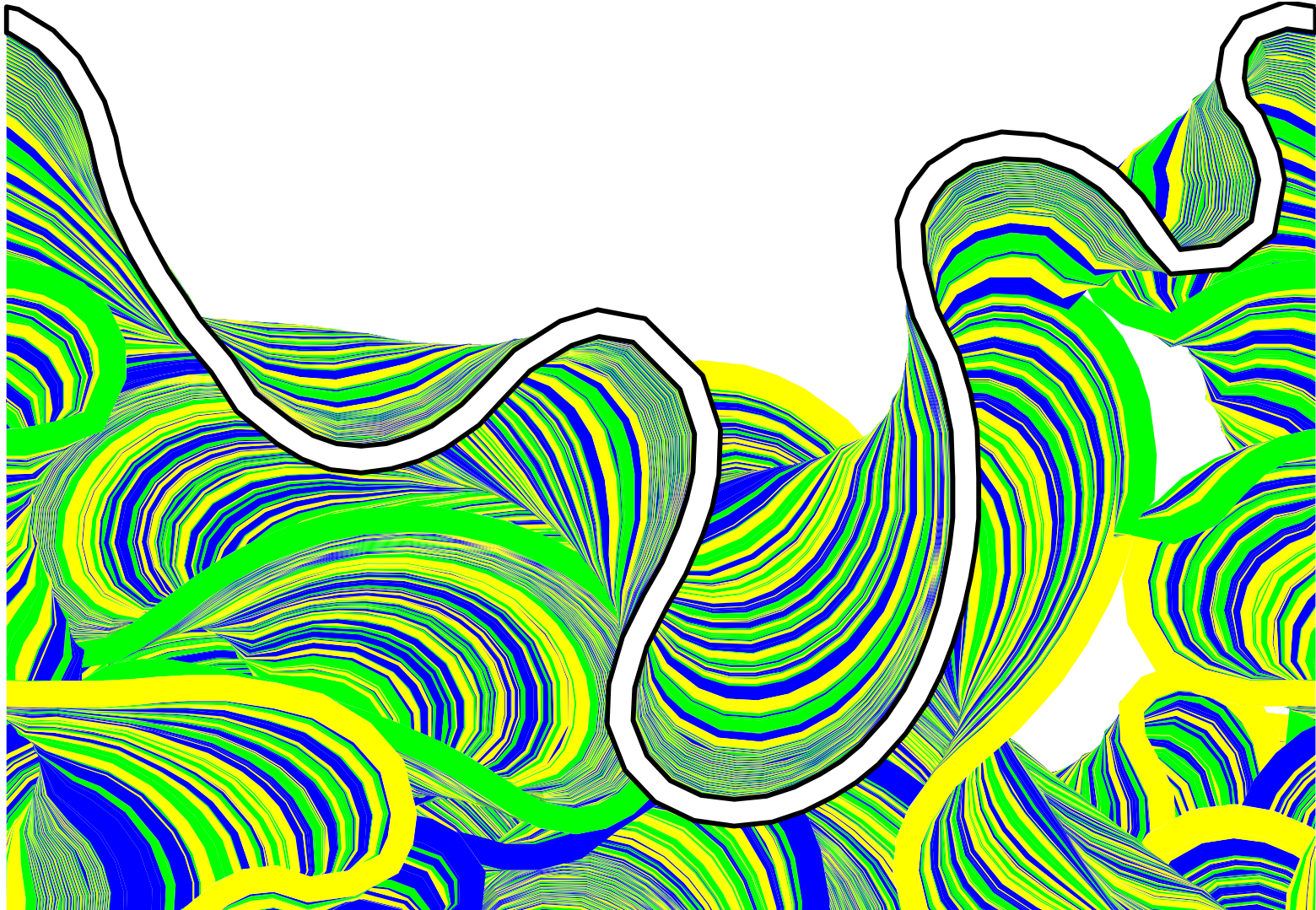
$\Delta t$  is limited by the channel evolution timescale (i.e., recurrence interval of bankfull flood).

As lateral erosion rates decrease, smaller grid cells are needed.

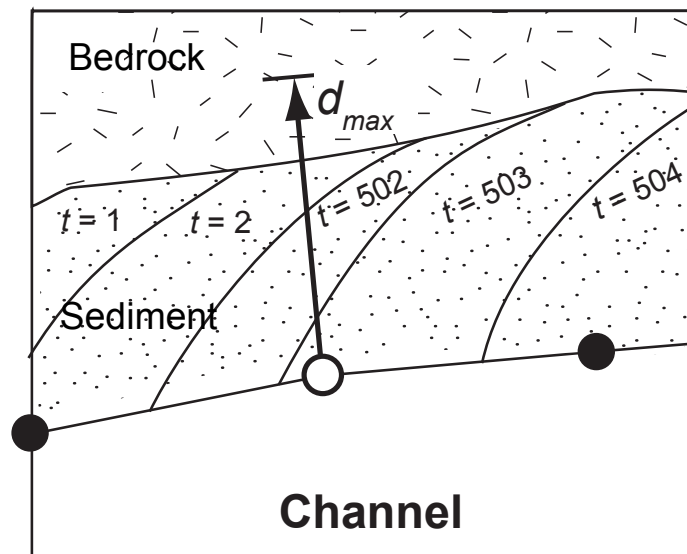
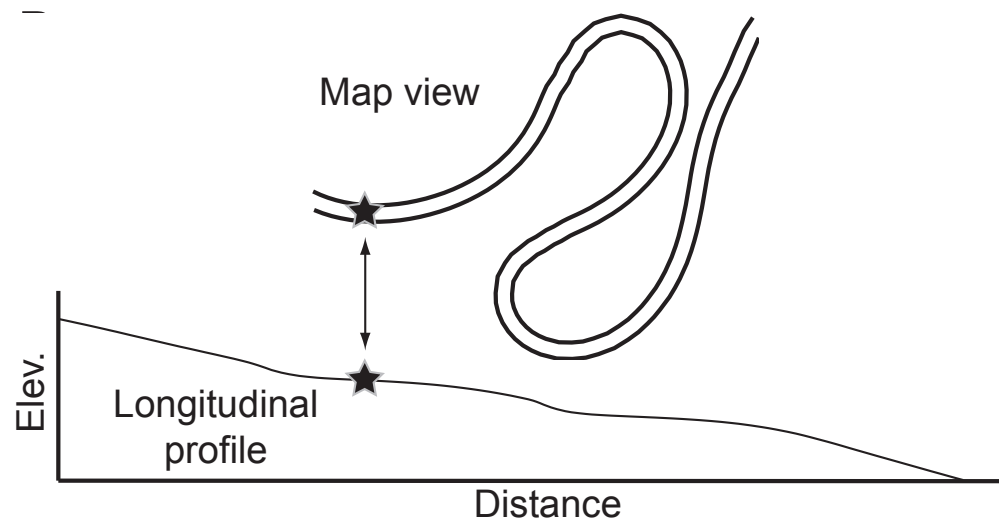
→ Valley-scale simulations and low lateral erosion rates (i.e.,  $< 1$  cm/yr in bedrock) require an impractical amount of memory (i.e., Terabytes).

# Solution: Track bank-material properties using the channel dimensions themselves

---



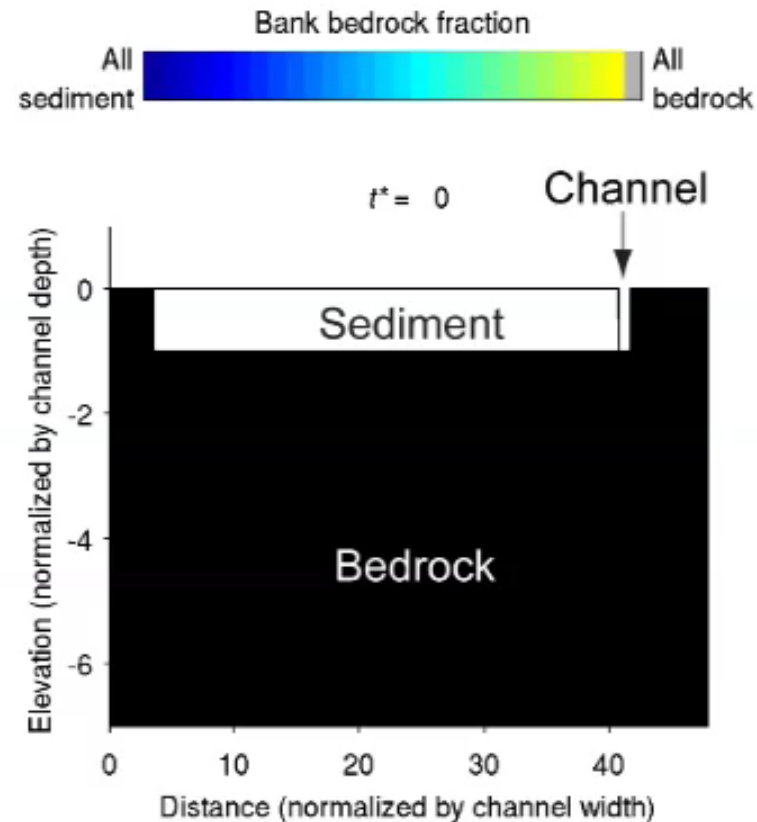
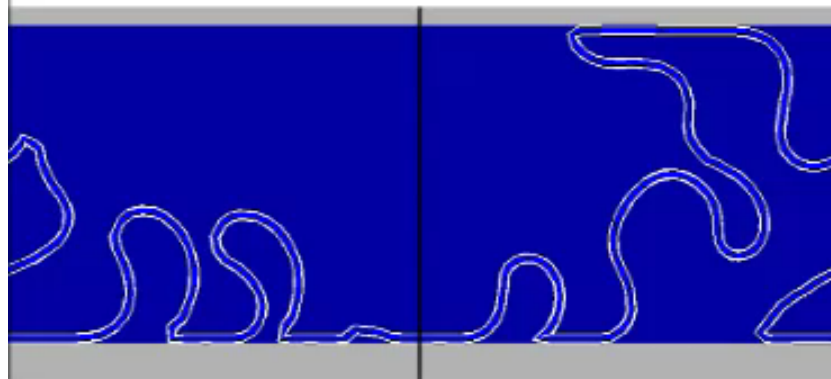
# Solution: Track bank-material properties using the channel dimensions themselves



- Channel geometry is archived as vector data (connected points) at each time step.
- This vector data is used to reconstruct bank-material properties set by channel scour and sedimentation.
- Bank properties are used to scale channel migration rates.

# Application to bedrock river valleys

Simulation for Figure 4B



**Memory use for bank-strength tracking:**  
**~ 1,000,000 MB (using 1 cm-resolution grid)**  
**→ 50 MB (using vector-based tracking)**

# Conclusions

- Bank-material properties can strongly influence river meandering.
- Vector-based bank-material tracking makes simulations for resistant bank materials computationally tractable.
- The principles of the vector-based framework are transferrable to representing topography and stratigraphy in net-depositional settings.

