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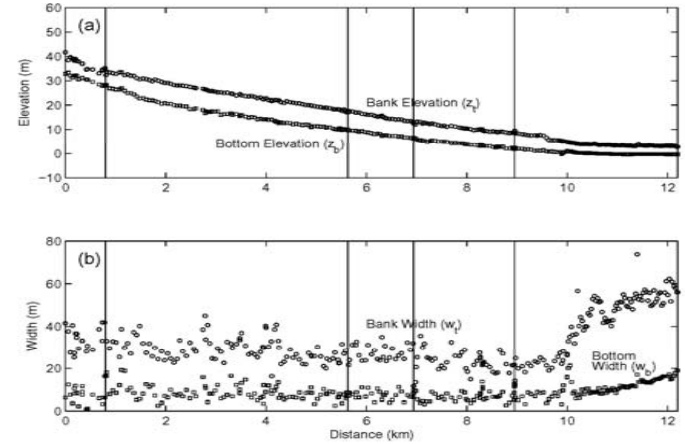
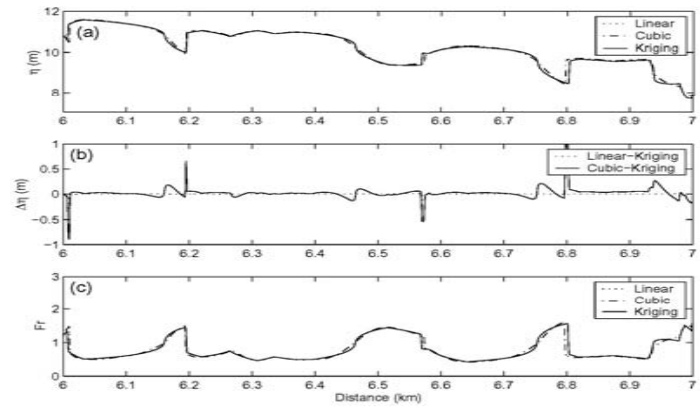
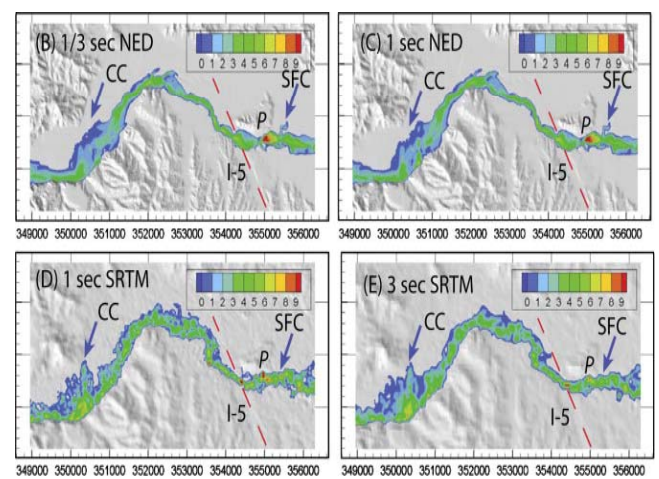
Modeling Channel and Floodplain Hydrodynamics in Support of the SWOT Mission

Big Picture

- Going beyond river slopes—spatial variability of river water surface elevation @50-100 m will reveal information about:
  - (a) river/floodplain flows (1D and 2D)
  - (b) flow regime such as uniform flow, critical flow, gradually varied flow
  - (c) flow constraints such as topography/bathymetry, levees, weirs, and dams.
- Upshot
  - More robust discharge estimation methodologies
  - Improved characterization of rivers/floodplains for analysis of transport and hazards globally
  - Potential for a new class of global hydrologic models segmented by storage and control functions







Godunov-based finite volume schemes resolve transcritical flows and wetting/drying over arbitrary topography

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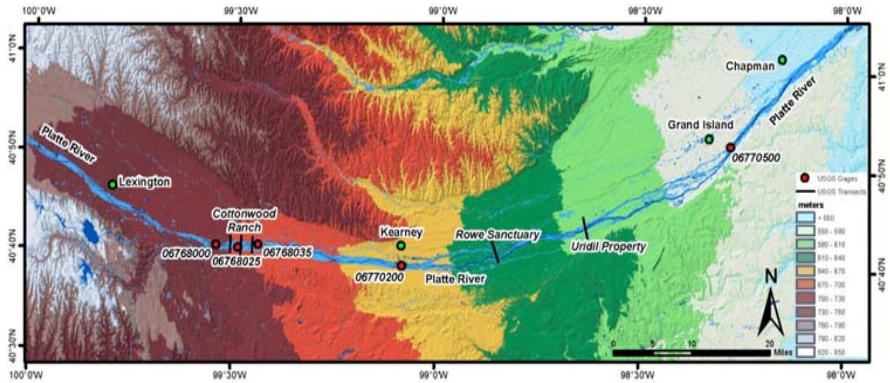
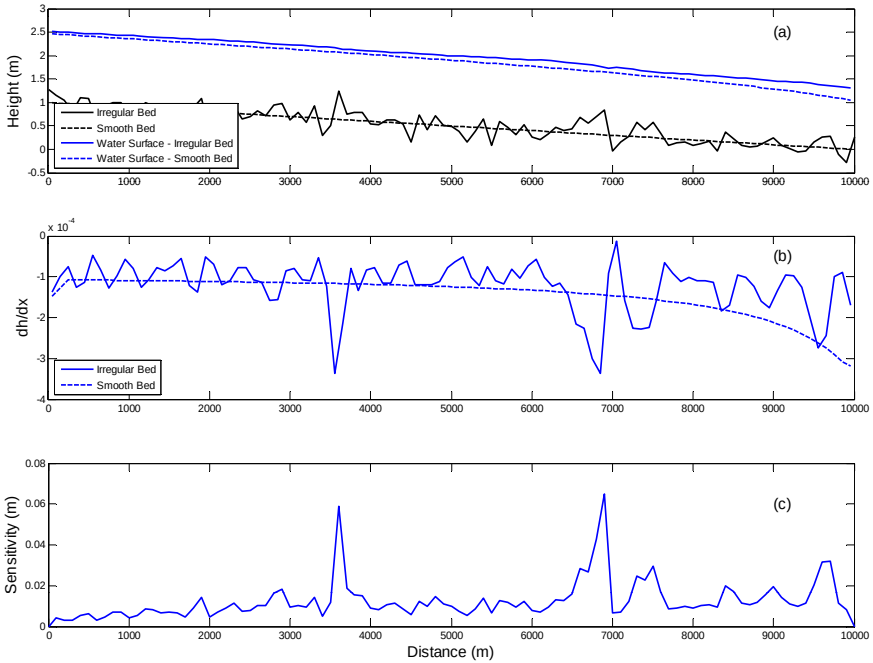
Research Approach and Objectives

- Hydraulic modeling with high-resolution topographic/bathymetric data to resolve 50-100 m variability in surface water heights. (10-20 m unstructured grid)
  - Platte R. dataset
  - Sacramento R. dataset (AirSWOT)
- Study impact of spatial variability on Durand et al. (2010) discharge estimation
  - How do we measure slopes?
- Study link between the spatial variability in water

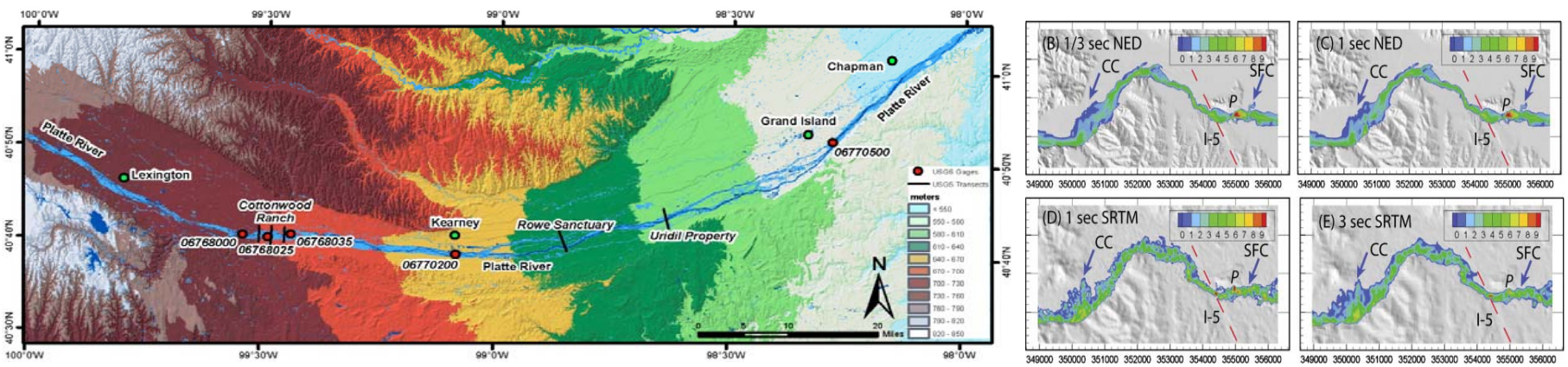


- Test hypothesis that we can use SWOT data to identify "control sections"
  - Uniform flow
  - Critical flow
  - Dams
  - Levees
- Explore potential for a new class of river model segmented according to storage and control functions.
  - Nodes: storage reservoirs
    - River reach
    - Wetland
  - Links: control sections
    - Uniform flow section
    - Critical flow section
    - Hydraulic control structure



Addressing Key SWOT Issues

- Use Virtual SWOT data or AirSWOT data to inventory hydraulic controls on rivers and classify reaches by control for improved discharge estimation
  - Uniform flow: $Q=1/n\ A\ R^{2/3}\ S^{1/2}$
  - Critical Flow: $Q=(gA^3/T)^{1/2}$
  - Gradually Varied Flow: $dh/dx=(S_o-S_f)/(1-Fr^2)$
- Provide a better understanding of what surface water height distributions might look like as a function of site geography (topography/bathymetry). Help discern information from noise.



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