Impacts of river segmentation strategies on reach-averaged product uncertainties for the upcoming Surface Water and Ocean Topography (SWOT) mission

Renato P.M. Frasson, Rui Wei, Toby Minear, Stephen Tuozzolo, Alesio Domenechetti, Michael Durand

Objective: detect and measure water surface elevation

Desirable characteristics: Simulations covering a variety of discharges with a long domain spamming several reaches (50 km and longer)

Terrain DEM (high resolution ~3m for realistic layover simulation)

DEM of the water surface (e.g. derived from a hydraulic model)

Water mask

operating the SWOT instrument simulator, Toby Minear for the original HEC-RAS model of the Sacramento River, and Guy Schumm and Alesio Domenechetti for the original hydraulic model of the Po River.

Swath characteristics

- Common smoothing technique
- 10 km Gaussian averaging window:
  - Height accuracy: 10 cm*
  - Resolution: 10 m to 60 m x 6 m
  - Latitudes from 78ºS to 78ºN
  - *when averaged over >1km

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Swath edge

- Break up points of the water surface
- Inflection points
- Discontinuities and swath edges
- Sinuosity method
- Vectorization of the pixel cloud
- Reach definition strategies

Synthetic SWOT measurements

Jet Propulsion Lab’s SWOT Hydrodynamical simulator

Geophysical data processing

- Interferogram formation
- Height reconstruction

- Vector fields
- Constructs baseline from coordinates, velocity vectors
- Builds swath grid

Classification errors

- Building points
- Interferogram formation
- Classification errors
-Instrument and media errors

Data requirements

- Raw DEM (high resolution ~3m for realistic layover simulation)
- DEM of the water surface (e.g. derived from a hydraulic model)
- Water mask

- Topography

Results

- Sacramento River study area
- Po River study area

- Sacramento River
- Po River

Errors per overpass
- Sacramento River
- Po River

Average discharge, m³/s

Average reach length, km

Simulation length: 1 year

Discharges: 700 m /s to 4770 m /s

9 overpasses

Simulation length: 6 months

Sacramento River

- Sacramento River
- Po River

Average discharge, m³/s

Average reach length, km

Simulation length: 1 year

Discharges: 700 m /s to 4770 m /s

9 overpasses

Conclusions

- Longer reaches: smaller errors. However, wider rivers, which are less affected by random errors, had a more stable response to reach lengths

- Sinuosity method: less variability in reach length than hydraulic controls. Few short reaches produced by the HC method could dominate pass-based error statistics, especially for narrow rivers under low discharges.

- Biases caused by terrain layover dominated height error statistics for the Sacramento River. Correction methods eliminating pixels with high likelihood of layover could result in improvement.

Imagery

- Water surface
- River nodes

Methods

- Vectorization of the pixel cloud
- Reach definition strategies

Conclusion

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