MODELING EFFECTS OF BASIN HYPSOMETRY ON LONG-TERM SEDIMENT DYNAMICS AT INLETS

INLET GEOMORPHOLOGY WU

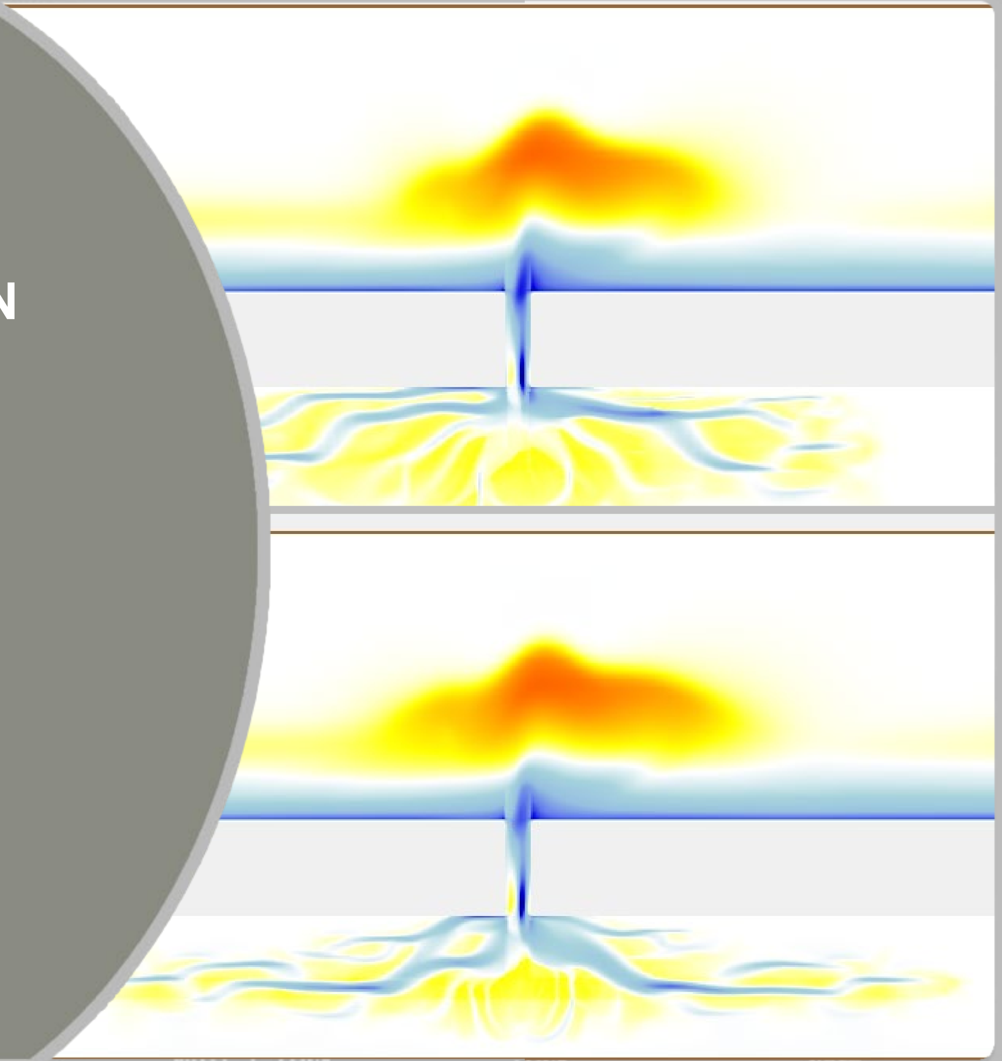
Richard Styles, Mitchell Brown, Douglas Krafft

District PDT Members

Tom Smith, POH; Kelly Legault, SAJ

Kathy Griffin
HQ Navigation Business
Line Manager

Eddie Wiggins
Technical Director



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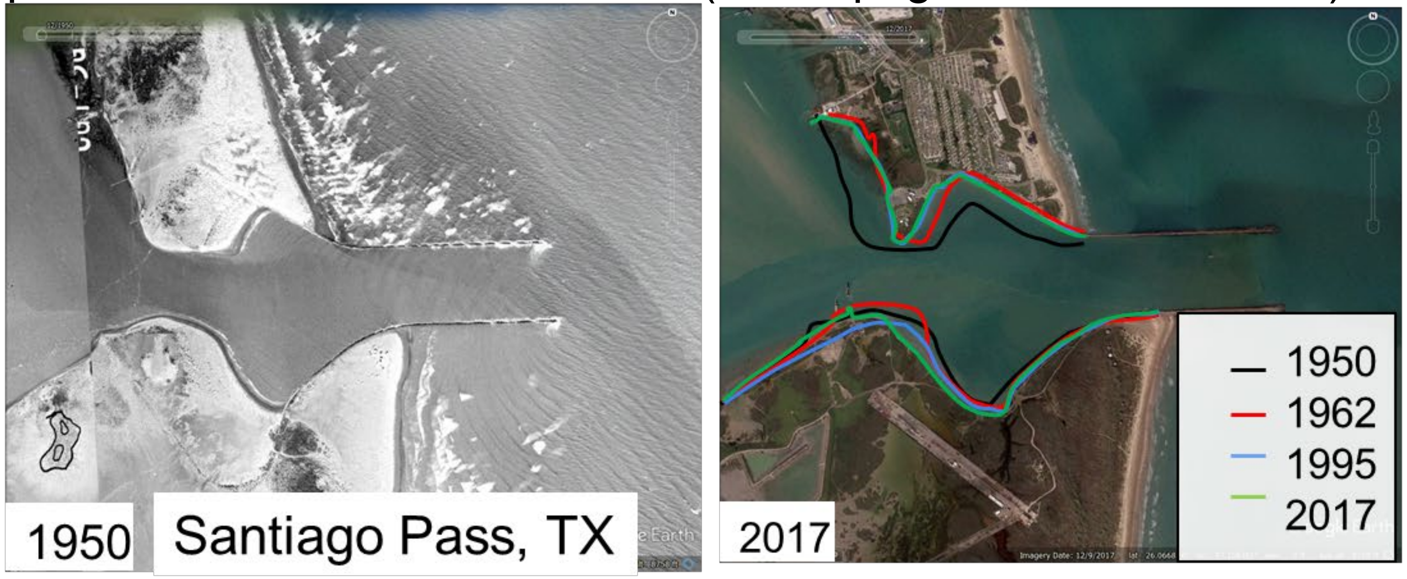
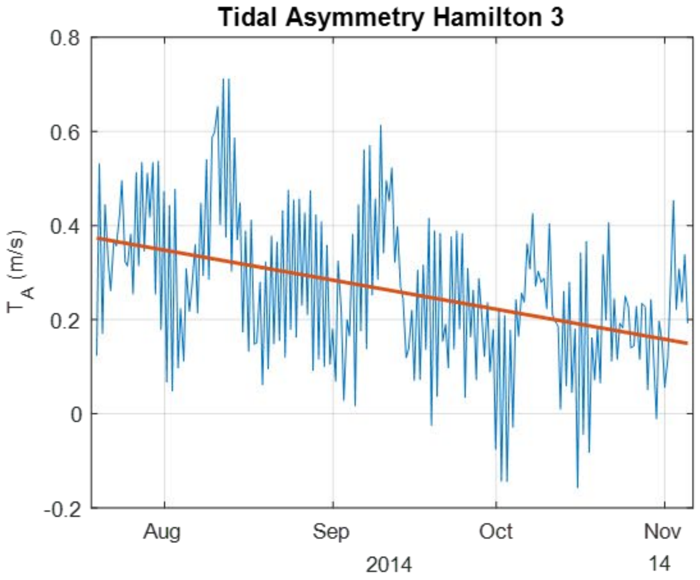
“Investigate the effect of sediment supply and bay hypsometry to changes in sediment transport characteristics”

- Existing theory suggests a primary factor controlling hydrodynamics and, by analogy, sediment transport is hypsometry
- One factor not previously explored is sediment availability, which can alter bay morphology and hypsometry leading to potential feedbacks that could modify hydrodynamics of the system.
- Continuing evolution of land use practices (armoring, reclamation) combined with sea level change may alter coastal inlets/bays from present day configurations and associated sediment transport characteristics.
- Need to develop approaches to asses inlet/bay system likelihood of undergoing changes in sediment transport patterns due to these influences (anthropogenic, sea level rise)

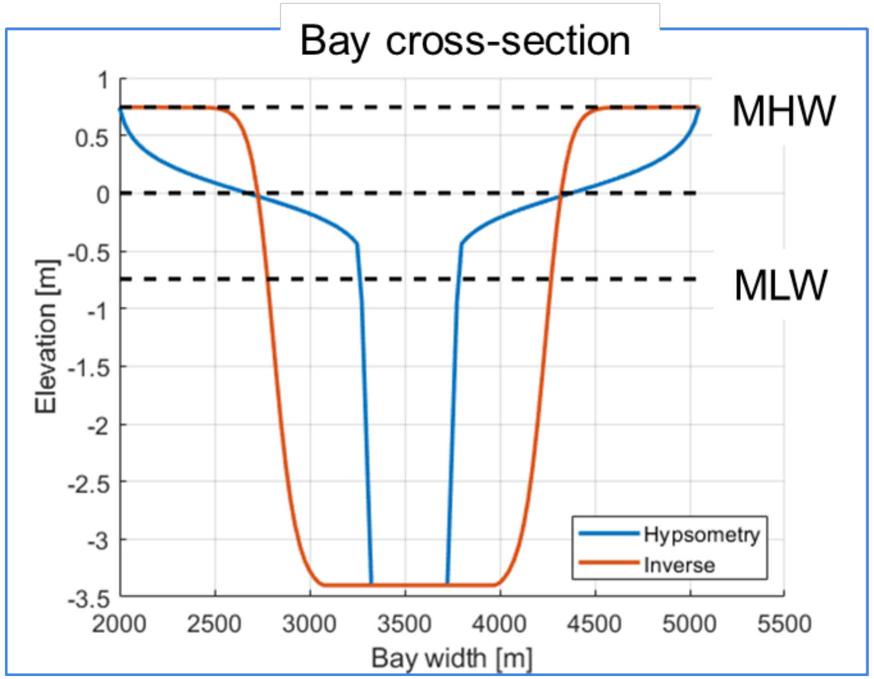


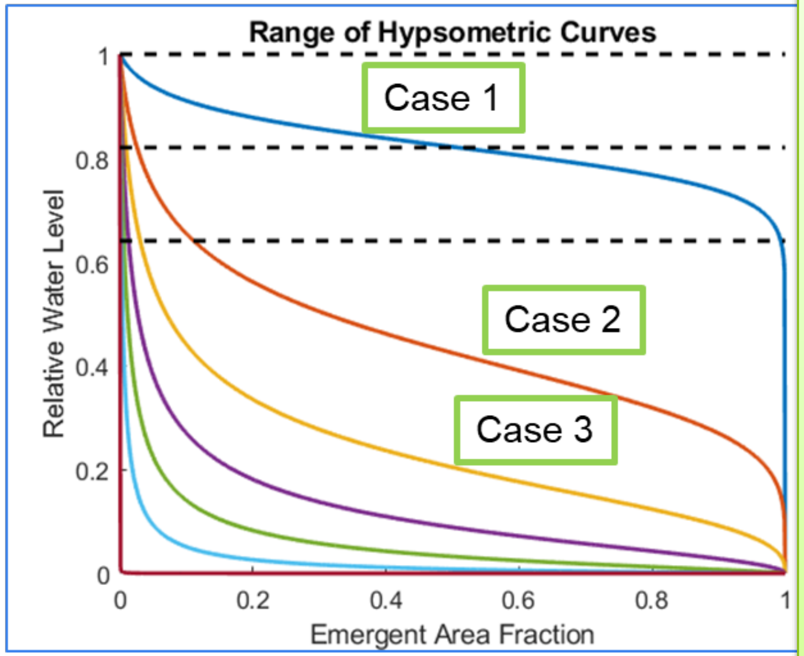
Santiago Pass, TX


Tidal Asymmetry Hamilton 3

Hypsometry

1. Minimal tidal flats with large inter-tidal storage “bathtub”
2. Extensive inter-tidal flats minimal inter-tidal storage (creek networks)
3. Transition between the two cases


Bay cross-section

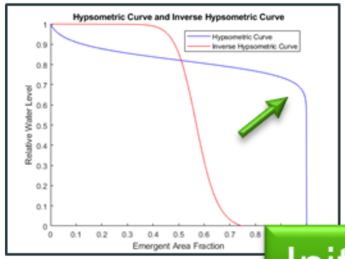

Range of Hypsometric Curves

Methodology

- Run 200 ‘effective’ years using a Morphology Acceleration Factor of 10
- 20 years of wave conditions at 2-hour intervals
- Idealized grids forced with tides based on harmonic constituents for Humboldt, CA and Mouth of Columbia River (Astoria, OR)
- 4-different hypsometric curves implemented

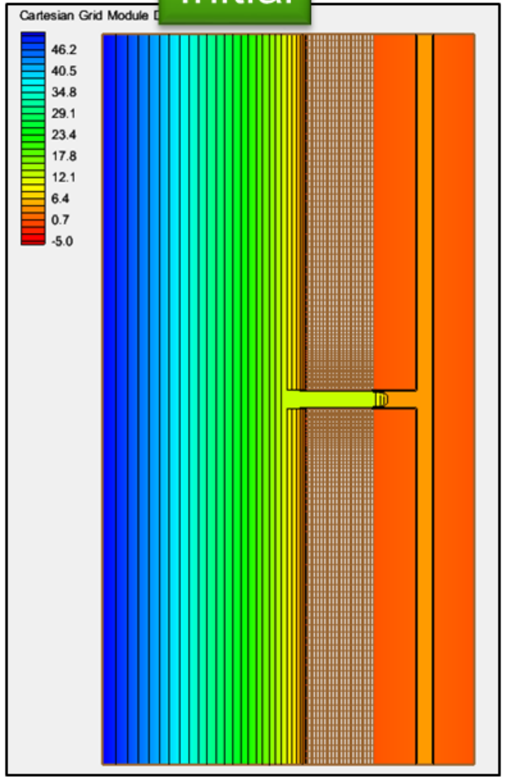
FY19 research – Variation of Hypsometry Curves on **Bar Built** Bay (Humboldt)

after ~130 'effective' years of sediment transport with tides & waves using acceleration factor

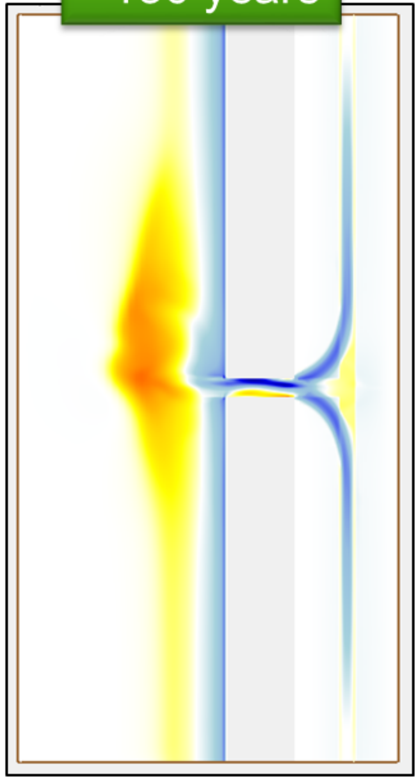


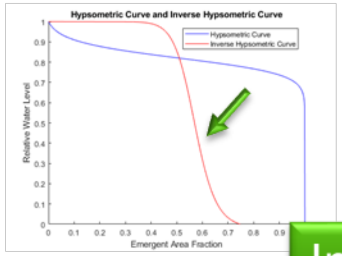
Hypsometry

Initial



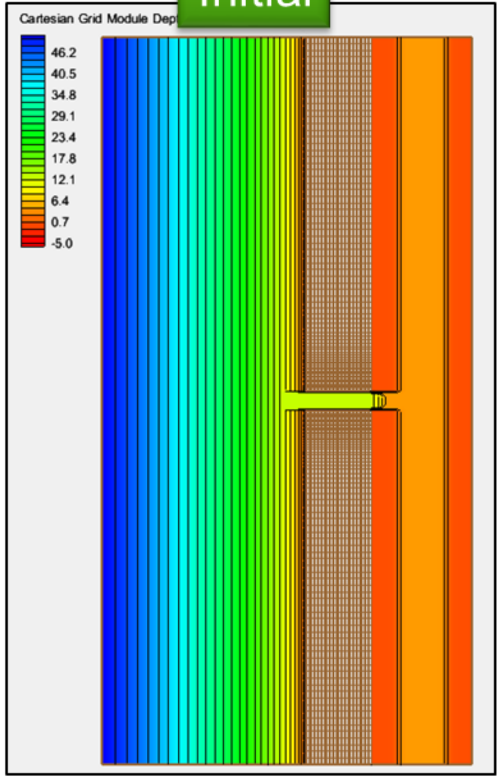
~130 years



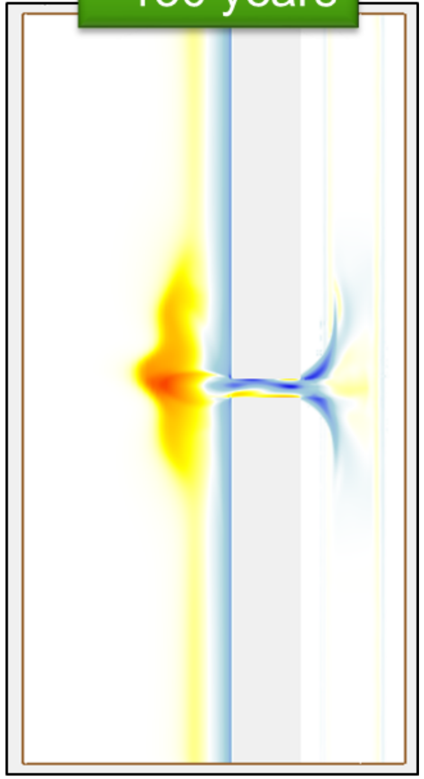


Inverse Hypsometry

Initial

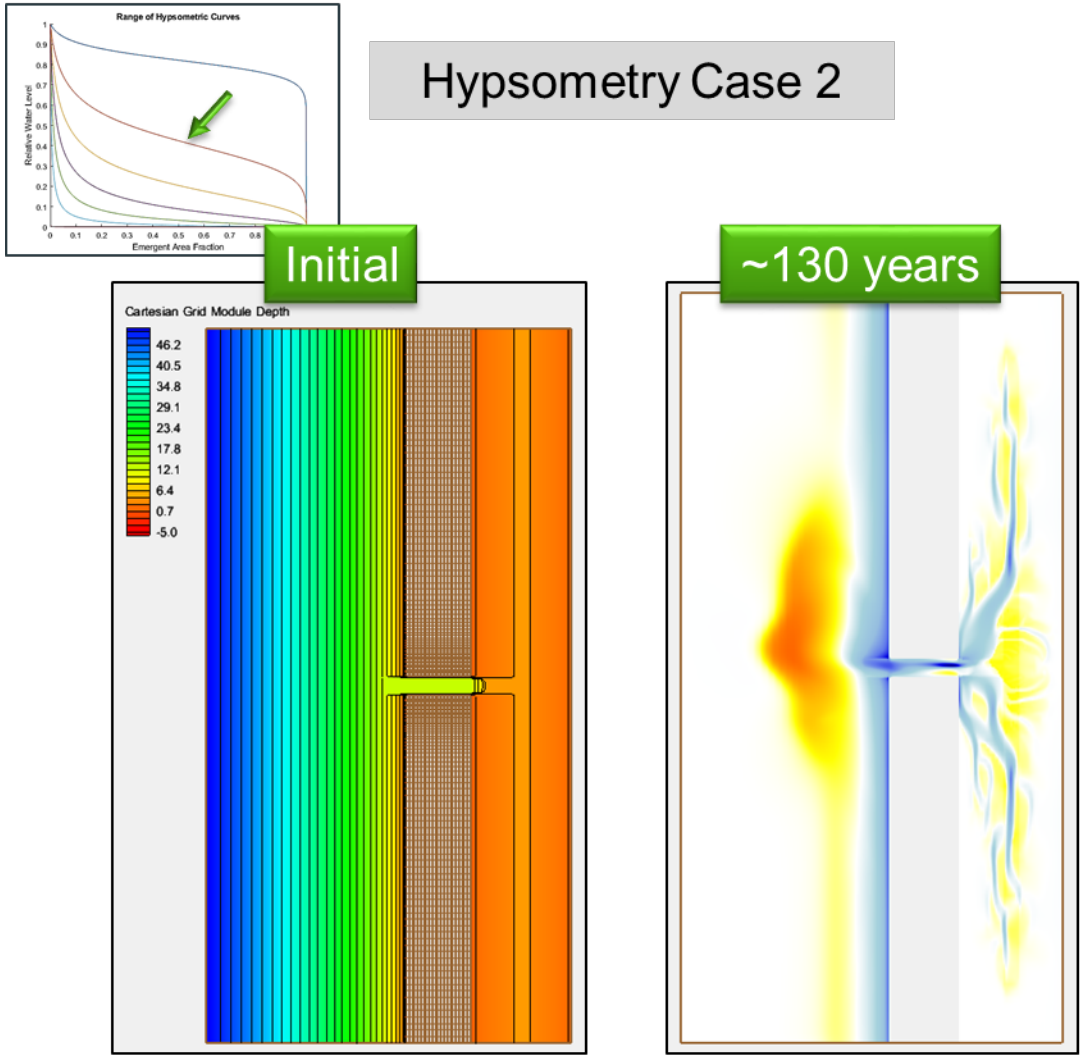


~130 years



FY19 research – Variation of Hypsometry Curves on Bar Built Bay

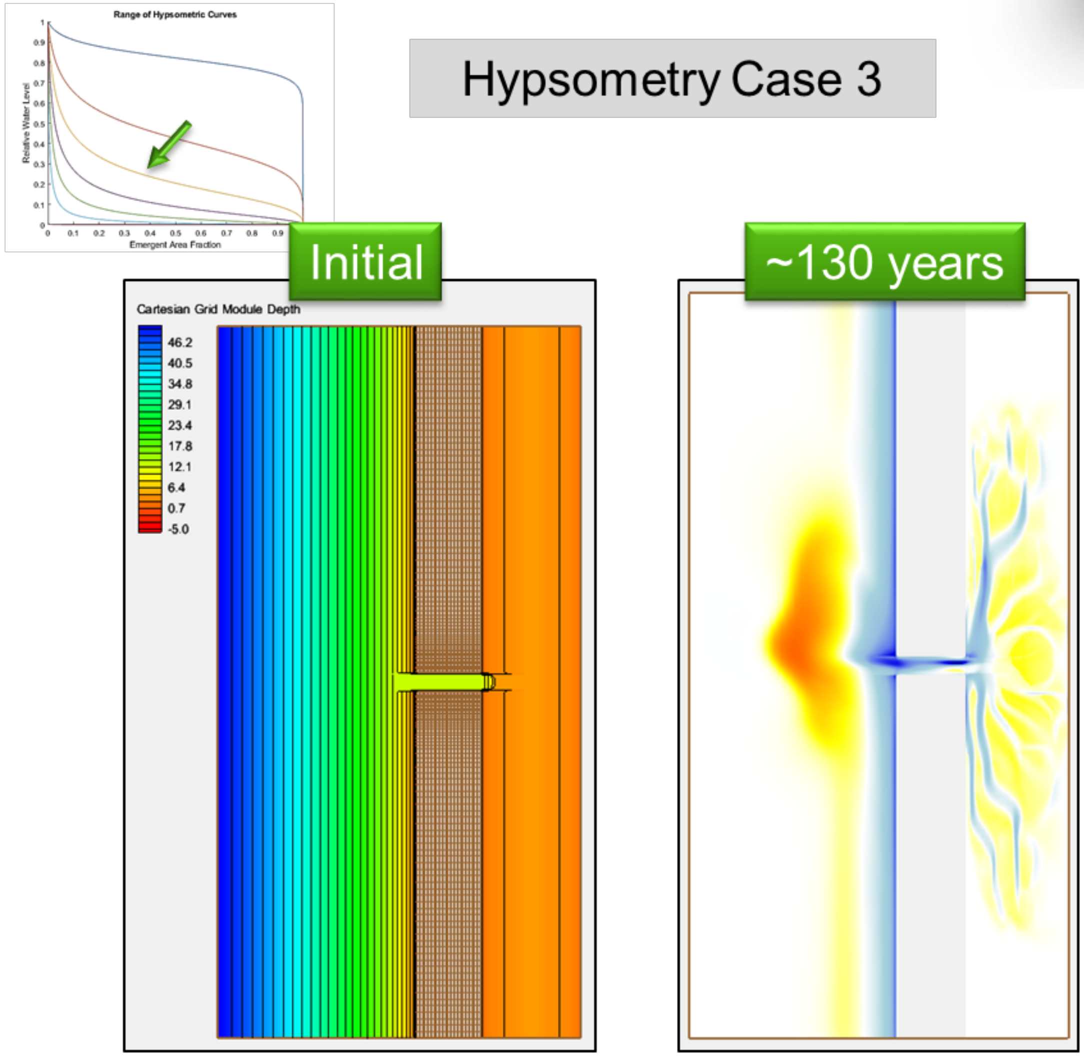
after ~130 'effective' years of sediment transport with tides & waves using acceleration factor



Hypsometry Case 2

Initial

~130 years



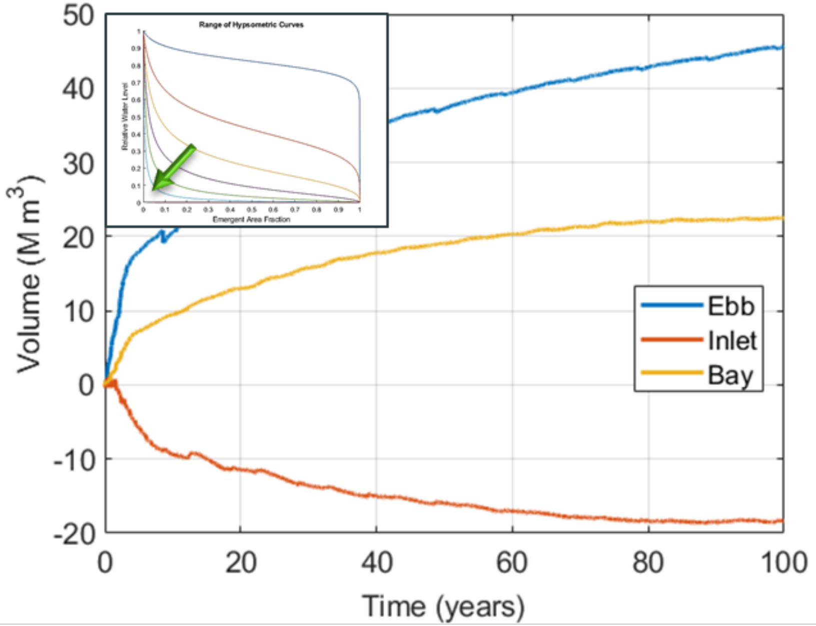
Hypsometry Case 3

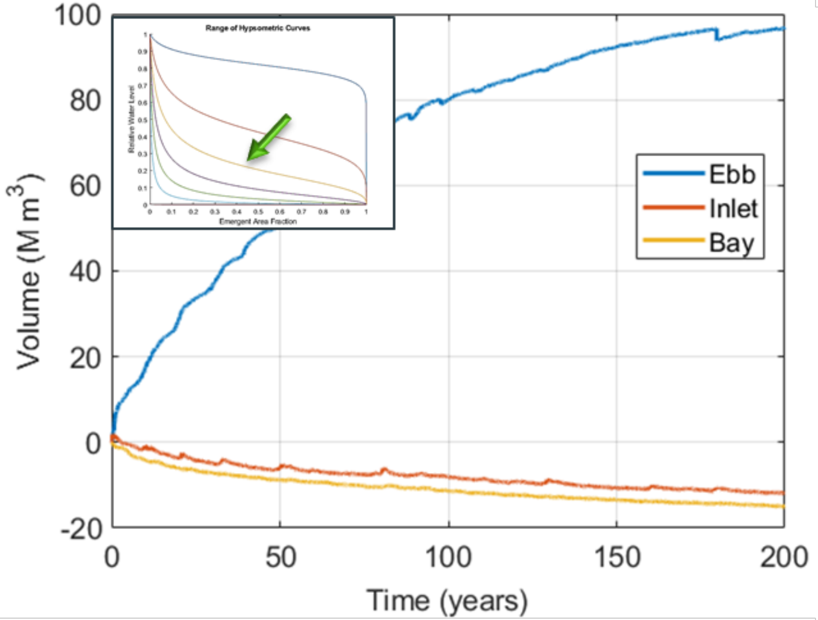
Initial

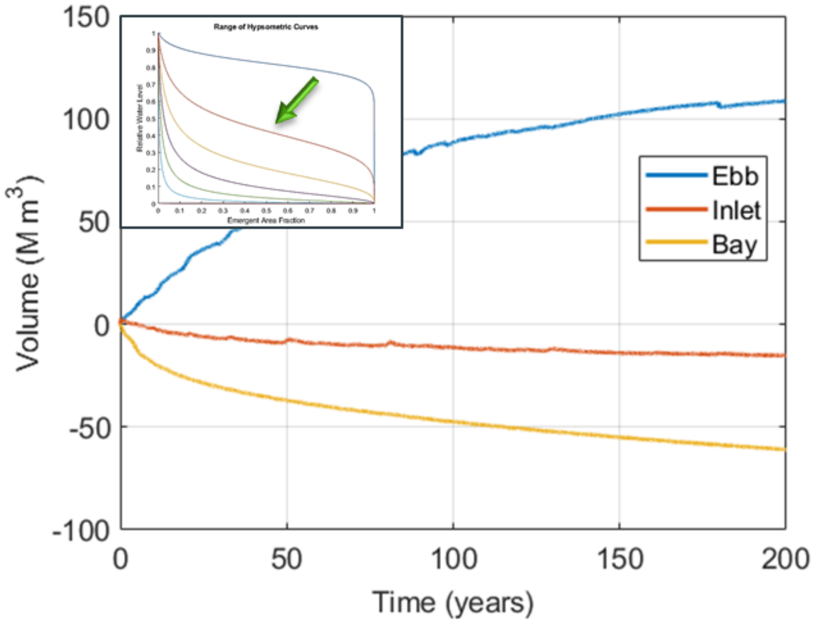
~130 years

FY19 research – Hypsometry and import vs export sediment

- In all cases ebb shoal gains sediment
- In all cases inlet throat loses sediment
- Only the bay w/o tidal flats, i.e., “bathtub” exports sediment
- Transition point from import to export between Case 2 and Case 3

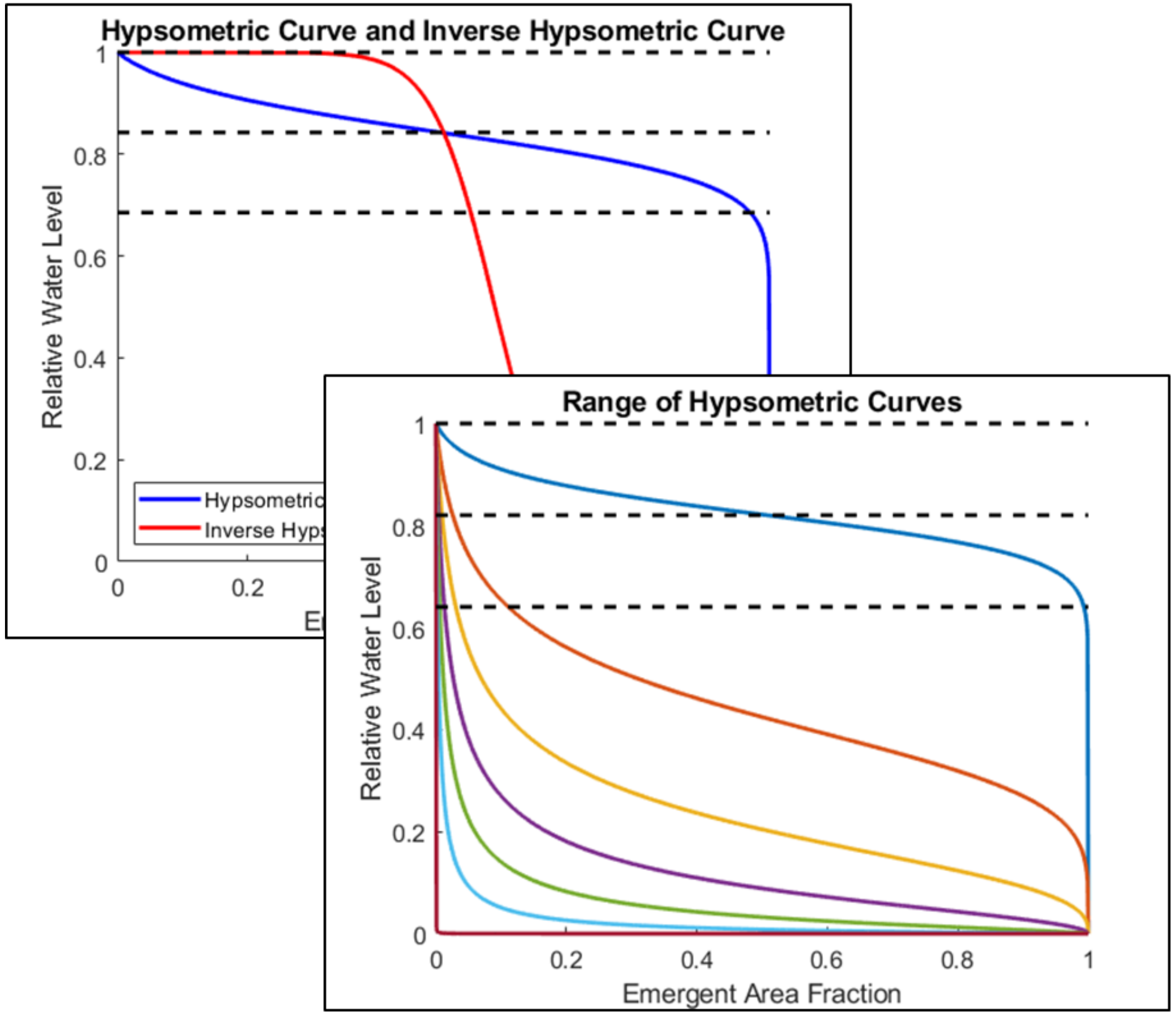




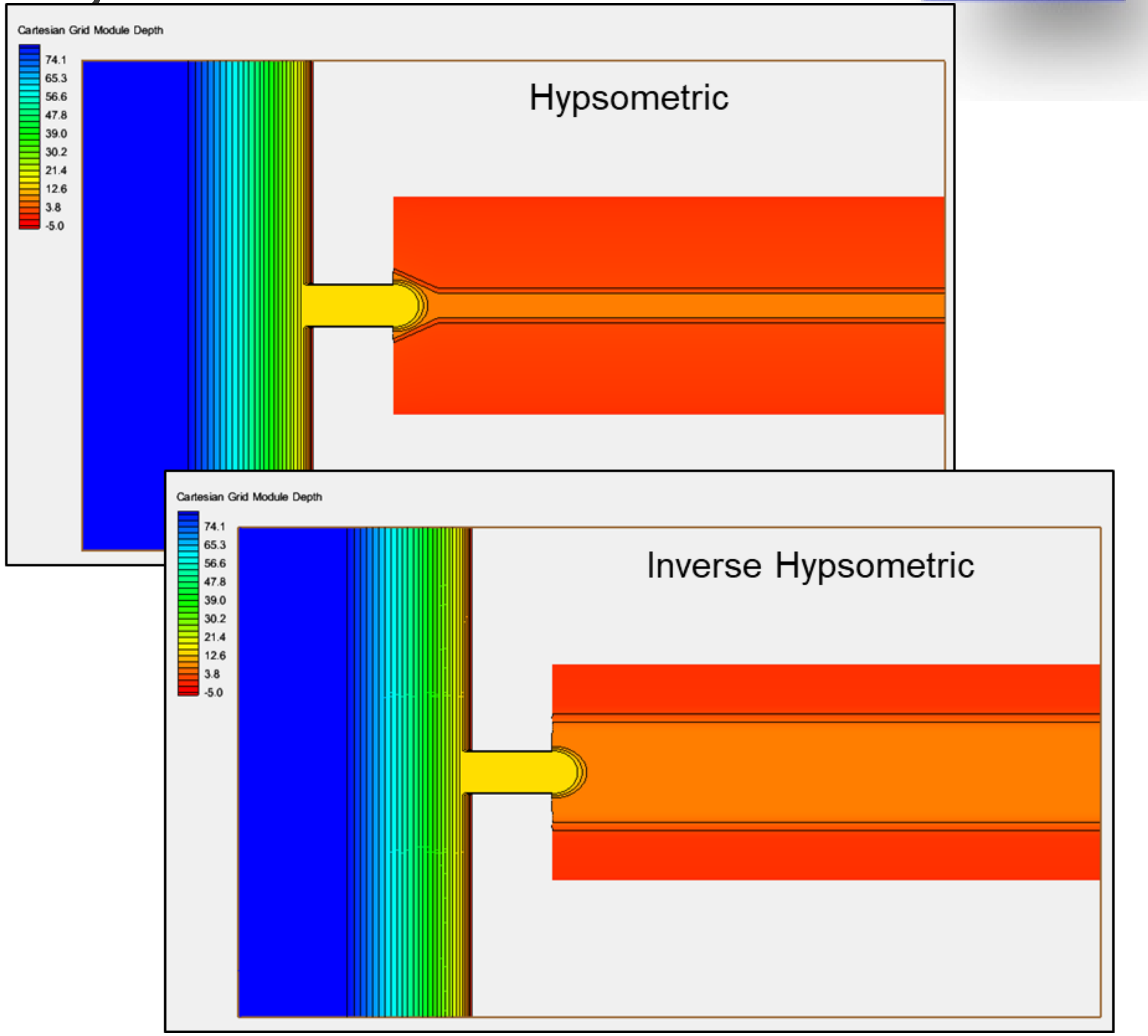


FY19 research – Variation of Hypsometry Curves on Drown River Valley type Bay (MCR)

Similar setup and simulations as with bar built bay – Runs recently initiated


Hypsometric Curve and Inverse Hypsometric Curve

Range of Hypsometric Curves


Hypsometric

Inverse Hypsometric

Summary

FY19

- Model setup including wave representation, wetting/drying, sensitivity to acceleration factor, representation of bay hypsometry function, and determining inlet/bay types.
- Investigated stability issues associated with excessive wetting/drying for the various hypsometric alternatives.
- Quantify sediment import/export based on bay hypsometry

FY20

- **Complete model efforts to examine the effect of hypsometry and sediment supply on sediment import/export for both types of bays: bar built, drowned river valley**
- **Identify real coastal inlets with similar characteristics and apply approach to estimate the conditions that drive reversal in sediment transport.**
- **Present findings at 16th Estuarine and Coastal Modeling Conference (06/2020)**
- **Prepare journal paper for Special Issue in the J. of Marine Science and Engineering**