

# Inlet Morphology for Coastal Engineering



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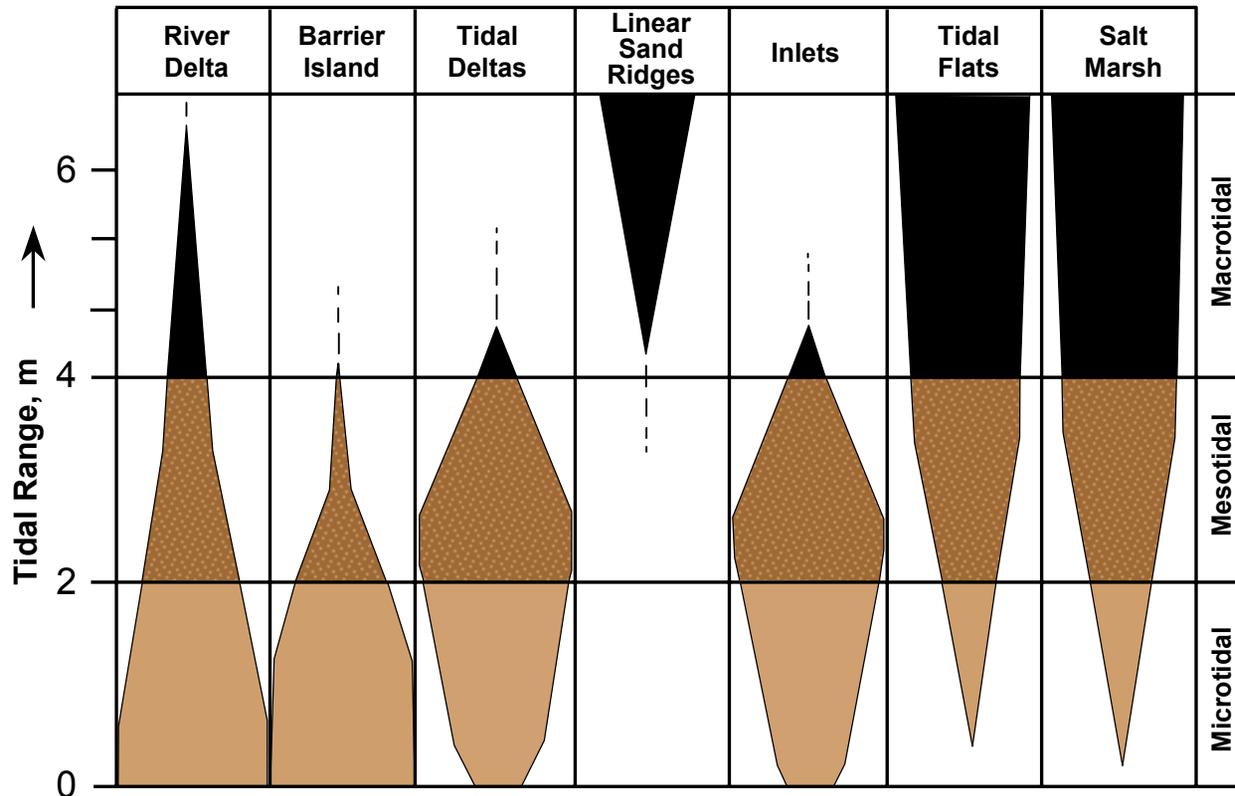
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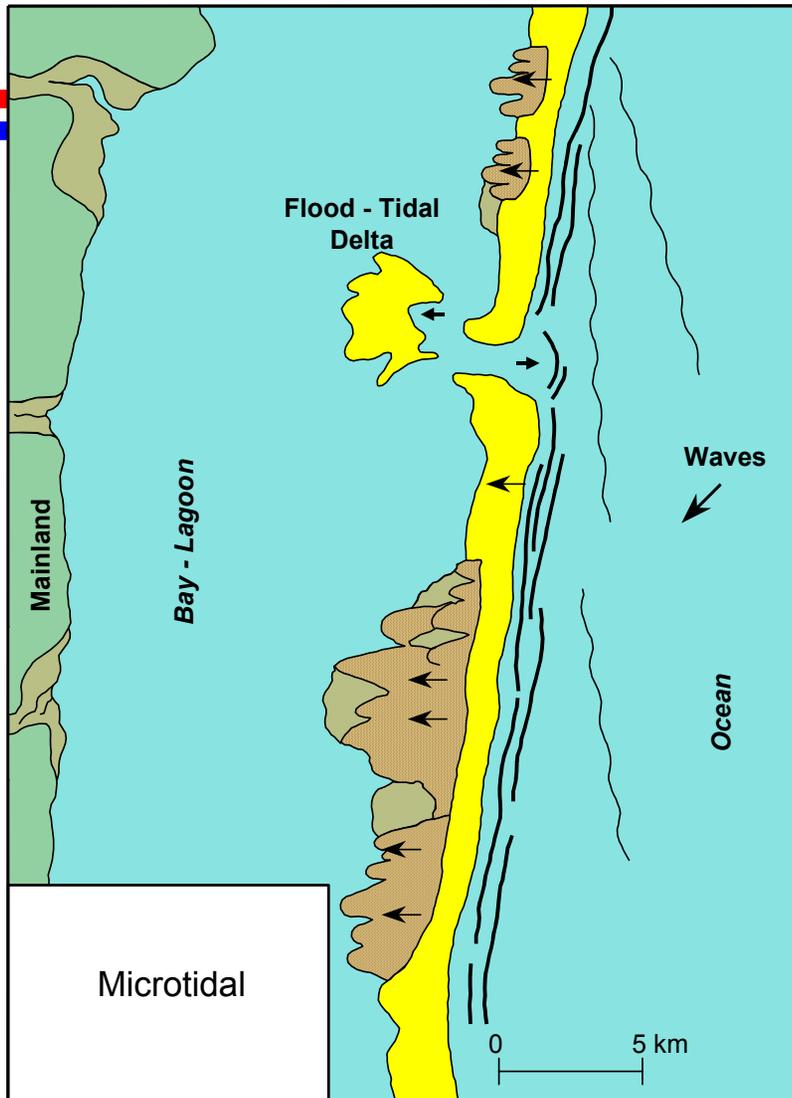
# Descriptive Coastal Morphology Classification

*(Depositional Coasts)*



*Traditional descriptive classifications based on qualitative observations and tidal range*

# Microtidal Barrier Islands and Tidal Inlets



## *Idealized Morphologic Features*

- Narrow linear barriers
- Open water bay-lagoon system
- Fringing tidal flats and marsh
- Barrier overwash by storms
- Inlet breaching by storms
- Inlets migrate if not stabilized
- Shoals from littoral sand source
- Intertidal flood shoal
- Submerged ebb shoal
- Barriers incorporate flood shoals
- Inlets may generate liner shoals

# Microtidal Barrier Islands and Tidal Inlets

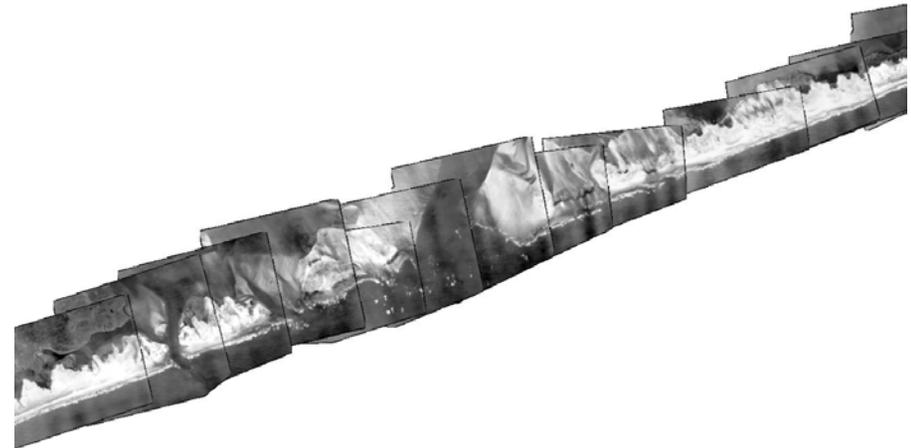
## *Inlet Morphologic Evolution*



*Moriches Inlet , Long Island, NY, 1998*

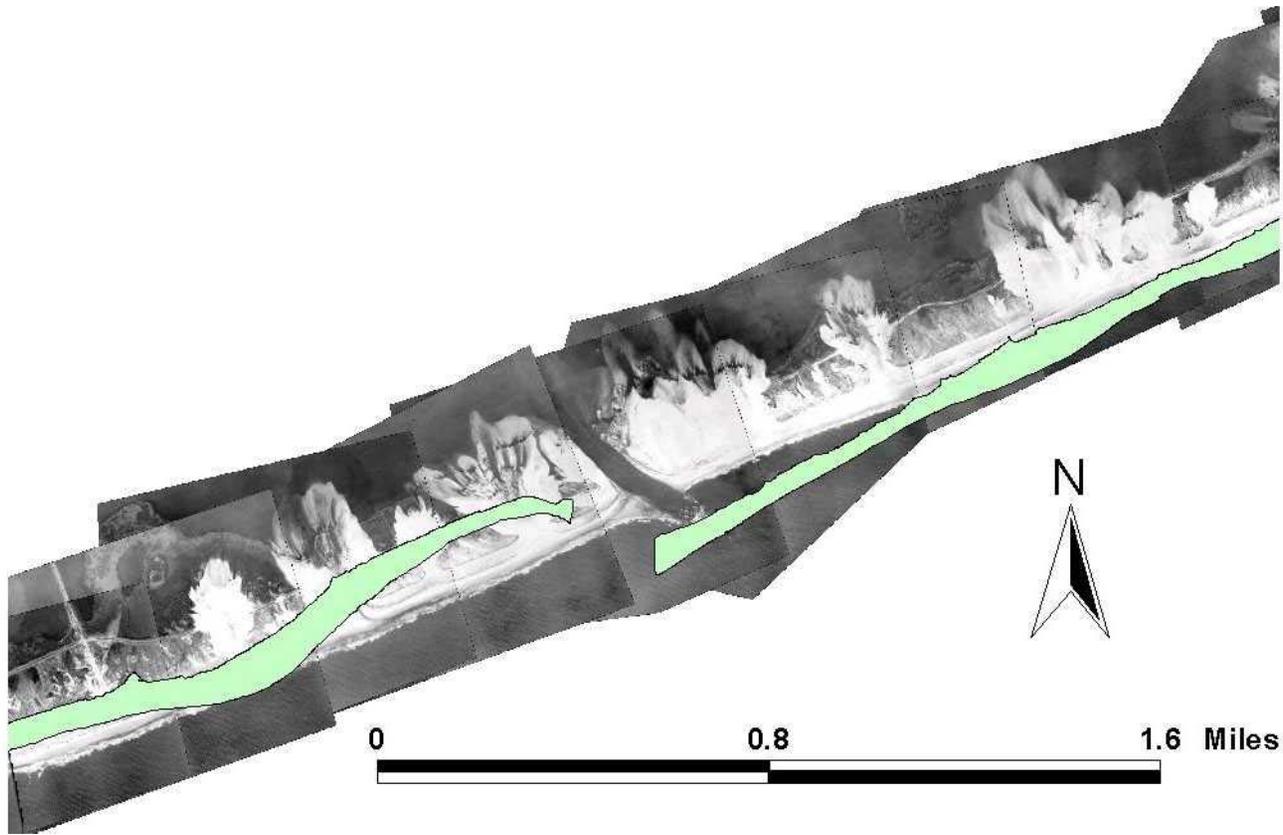


*Moriches Inlet, September 1938*



# Microtidal Barrier Islands and Tidal Inlets

## *Inlet Morphologic Evolution*



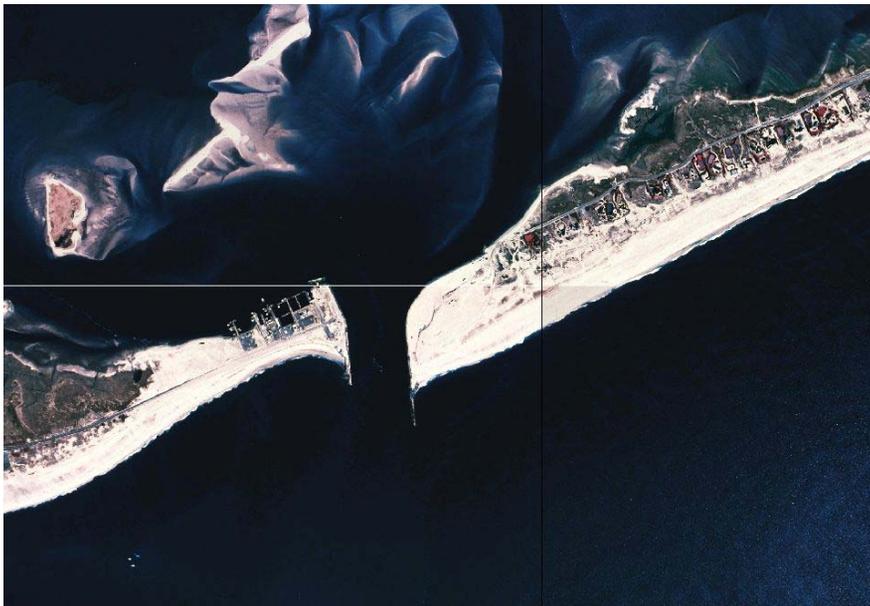
*(Video Clip shows evolution from 1938 - 2000)*

# Microtidal Barrier Islands and Tidal Inlets

## *Inlet Morphologic Evolution*



*Shinnecock Inlet,  
September 2000*

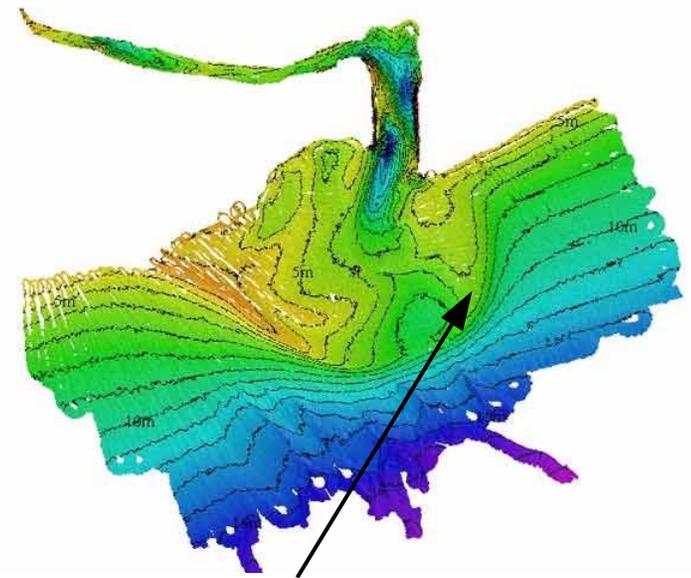


*Shineecock Inlet,  
September 1938*



# Microtidal Barrier Islands and Tidal Inlets

## *Ebb Shoal Morphology*



*Ebb shoal  
Shinnecock Inlet*



# Microtidal Barrier Islands and Tidal Inlets

## *Flood Shoal Morphology*

### *Shinnecock Flood Shoal*



*Spillover Lobe*

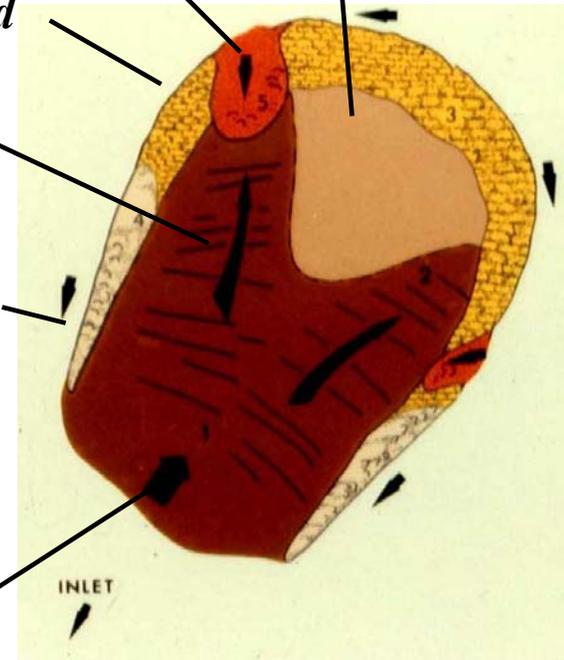
*Tidal Flat*

*Ebb Shield*

*Flood Channel*

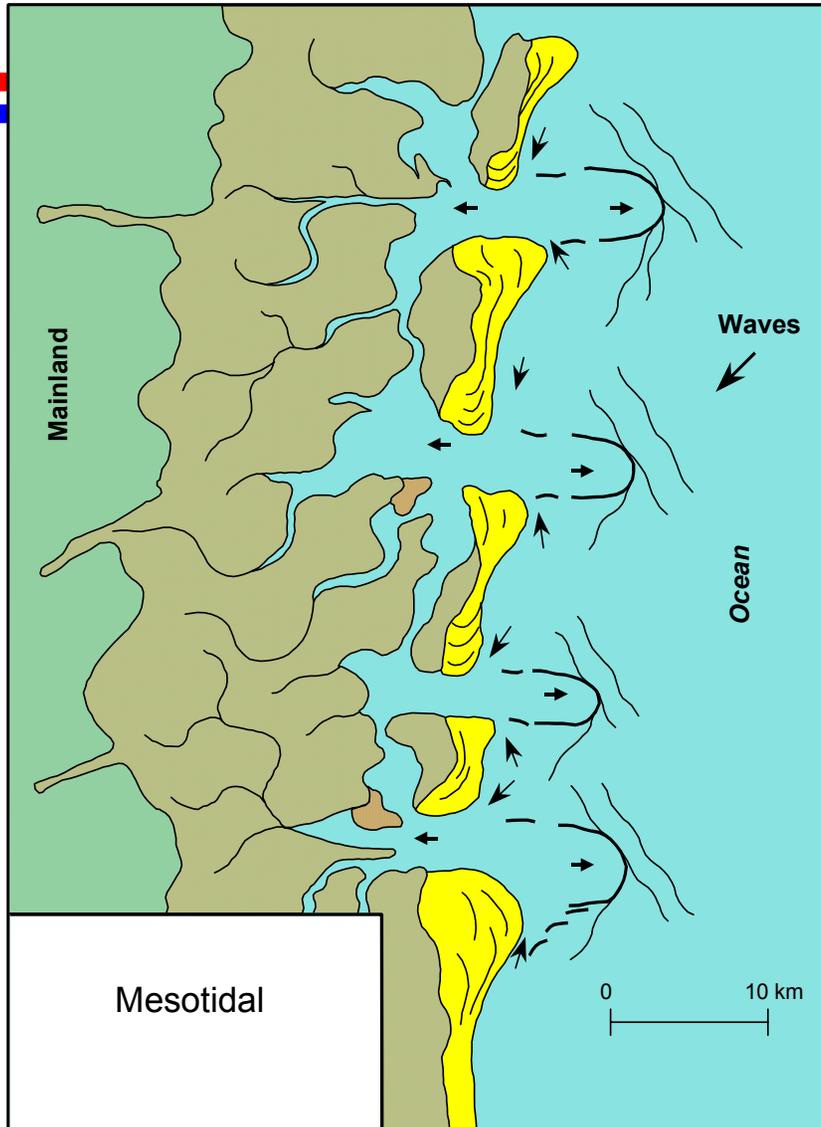
*Ebb Spit*

*Flood Ramp*



*Idealized Flood Shoal*

# Mesotidal Barrier Islands and Tidal Inlets



## *Idealized Morphologic Features*

- Wide beach ridge barrier
- Tidal flats/marshes in back bay
- Inlet throat deep and fixed
- Barrier can prograde seaward
- Shoals from back bay sand source
- Ebb shoal volume can be large
- Minimal flood shoal volume
- Outer bar sand bypassing

# Mesotidal Barrier Islands and Tidal Inlets

*Example of a mesotidal coastal morphology*



*Beach ridge barrier islands, tidal inlets, and salt marshes of the Georgia coast*

# Mesotidal Barrier Islands and Tidal Inlets

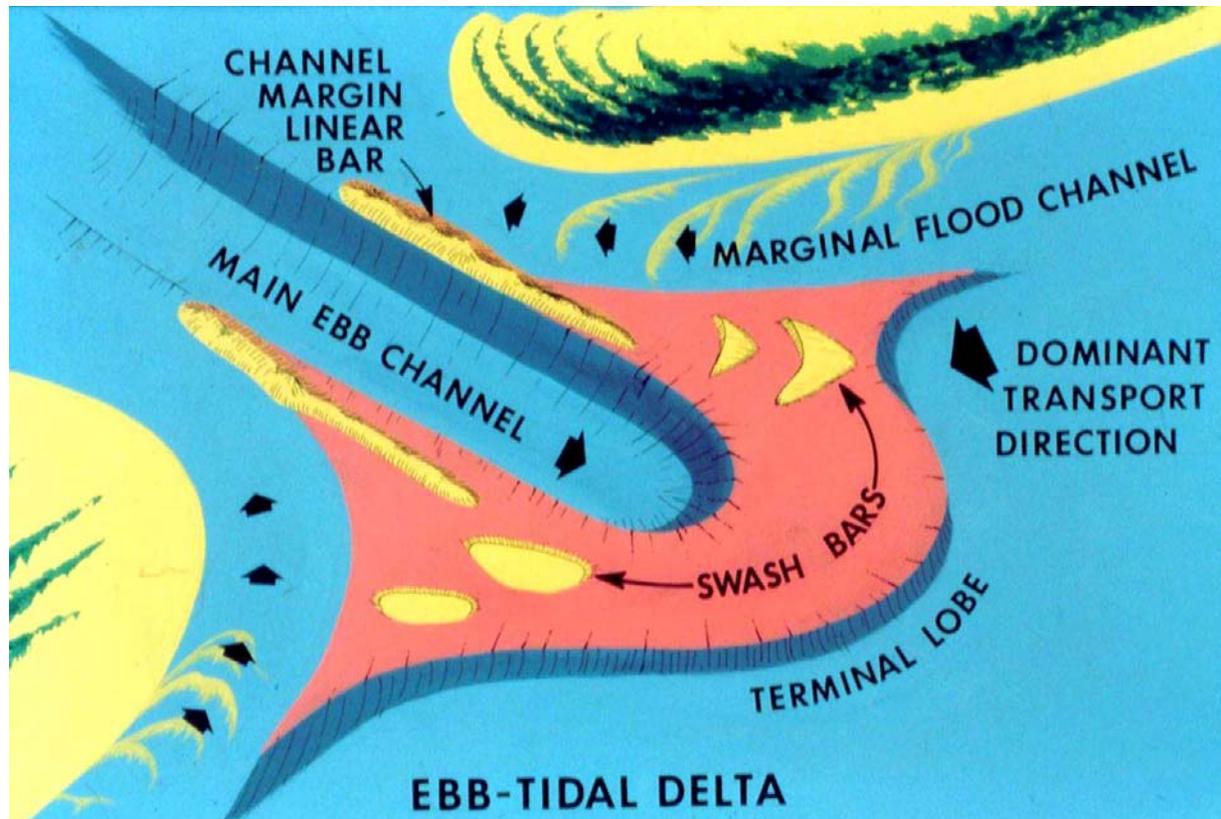
*Example of a mesotidal coastal morphology*



*Dewees, Capers and Price Islands,  
South Carolina*

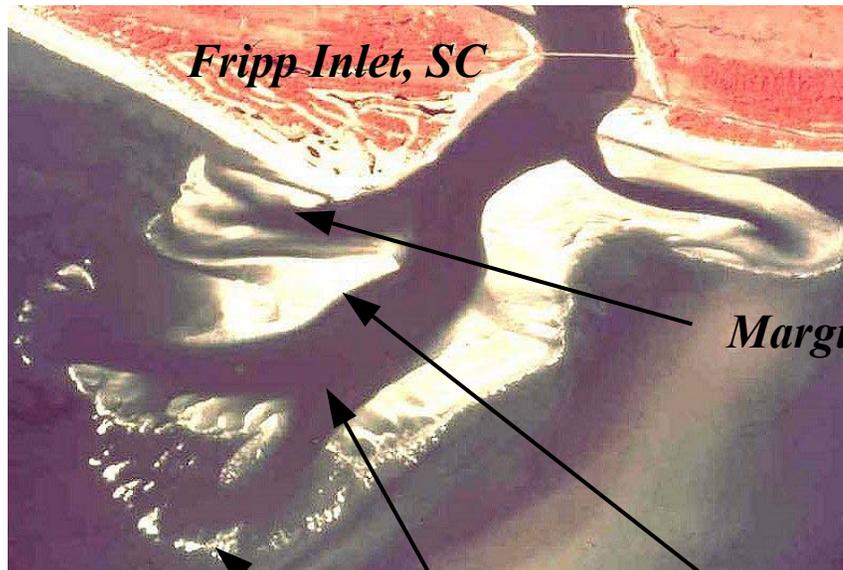
# Mesotidal Barrier Islands and Tidal Inlets

## *Idealized Ebb Shoal Morphology*



# Mesotidal Barrier Islands and Tidal Inlets

## *Idealized Ebb Shoal Morphology*



*Marginal Flood Channel*

*Swash Bars*

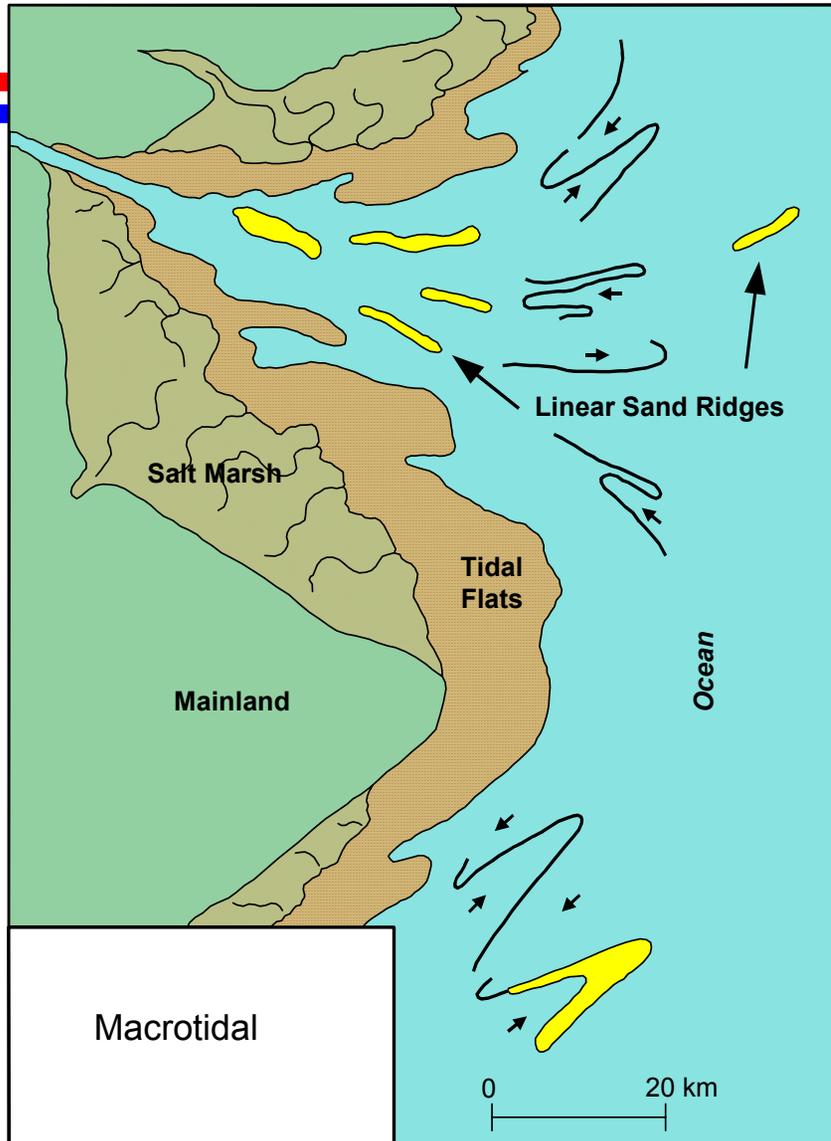
*Main Ebb Channel*

*Terminal Lobe*



*Channel Margin Linear Bar*

# Macrotidal Coastal Morphology

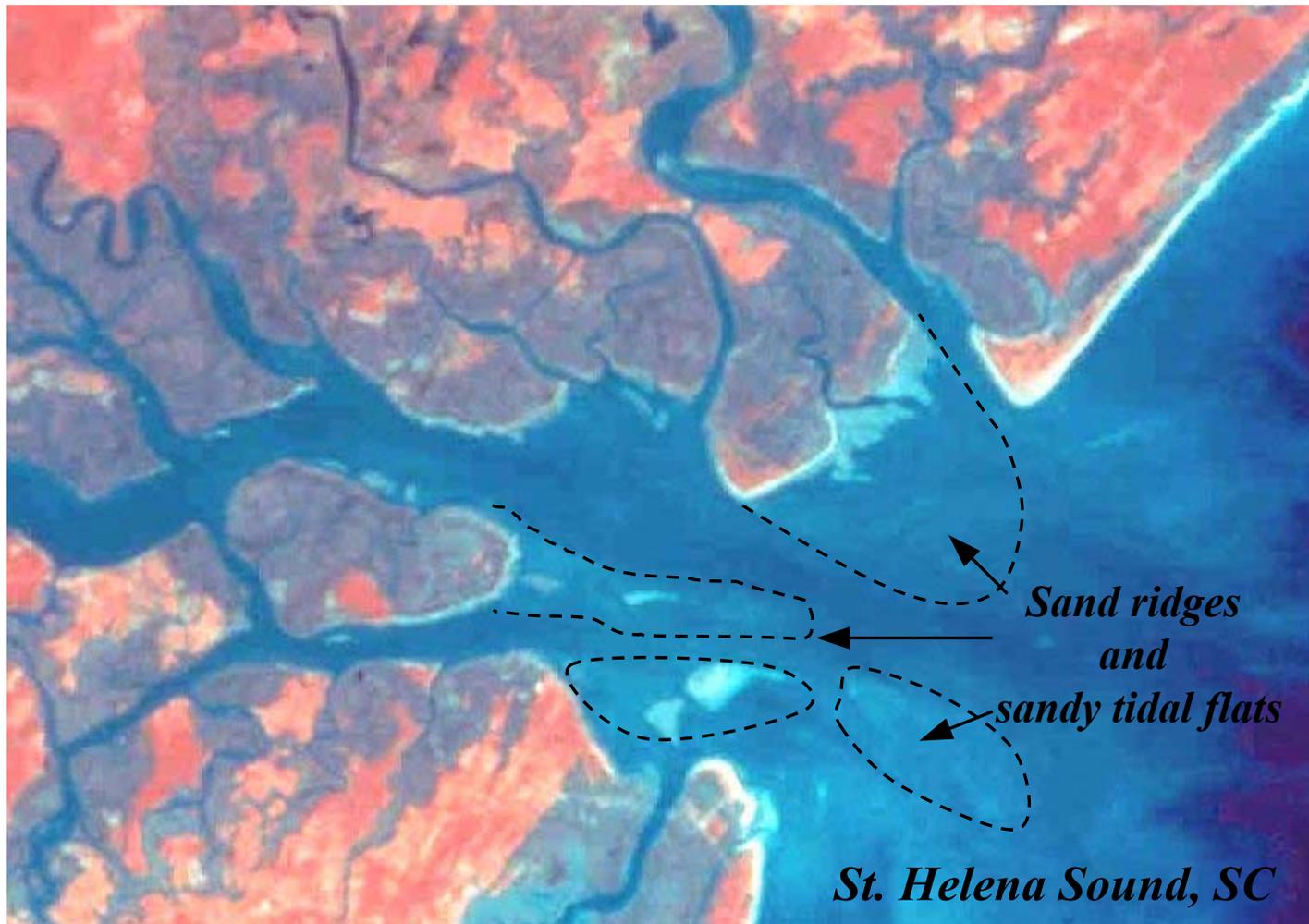


## *Idealized Morphologic Features*

- Funnel-shaped embayment
- Tidal flats and salt marshes
- Limited or no barrier development
- Tidal sand ridges rather than barrier islands
- May be associated with tidally influenced river delta

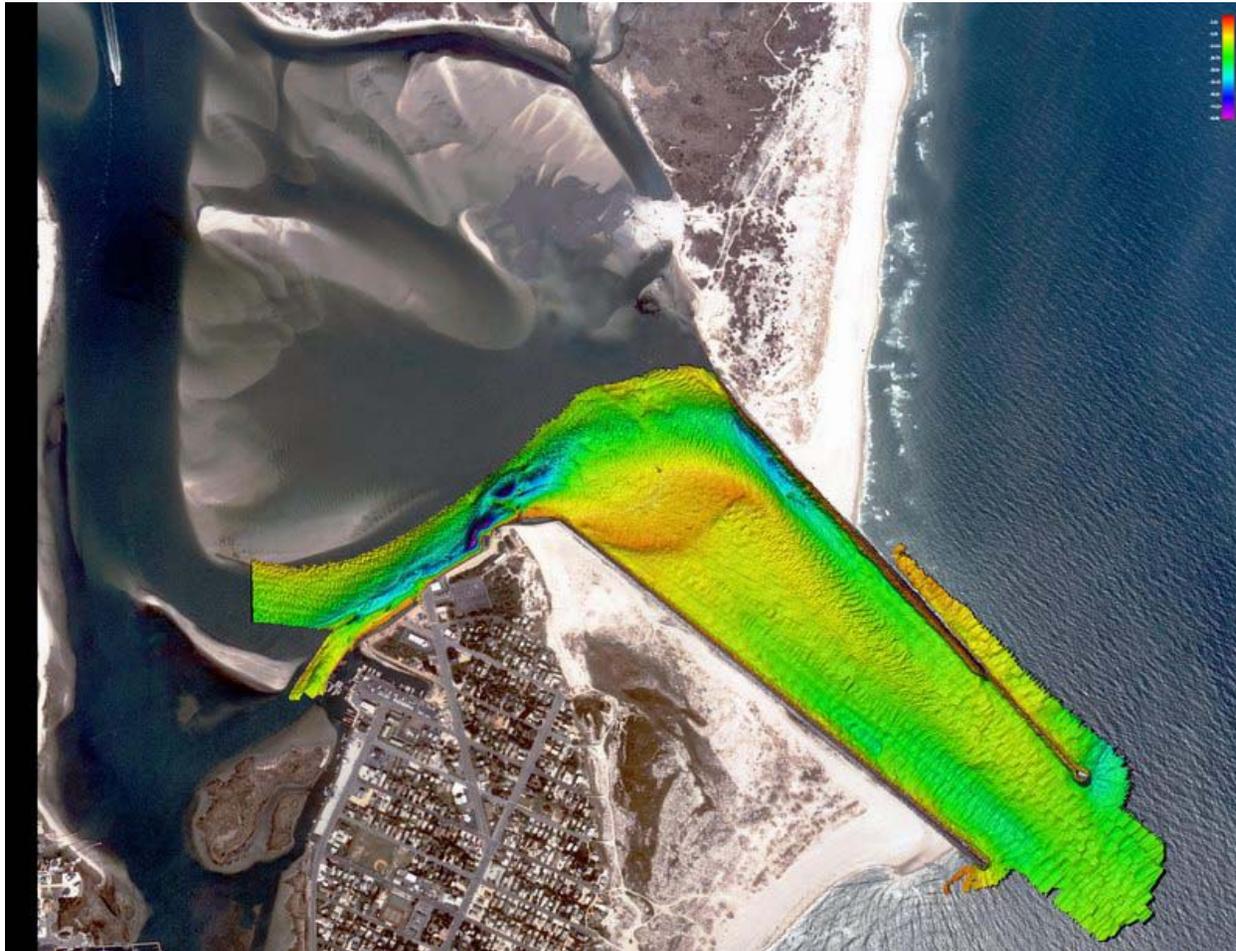
# Macrotidal Coastal Morphology

*Example of a macrotidal coastal morphology*



# Channel Morphology

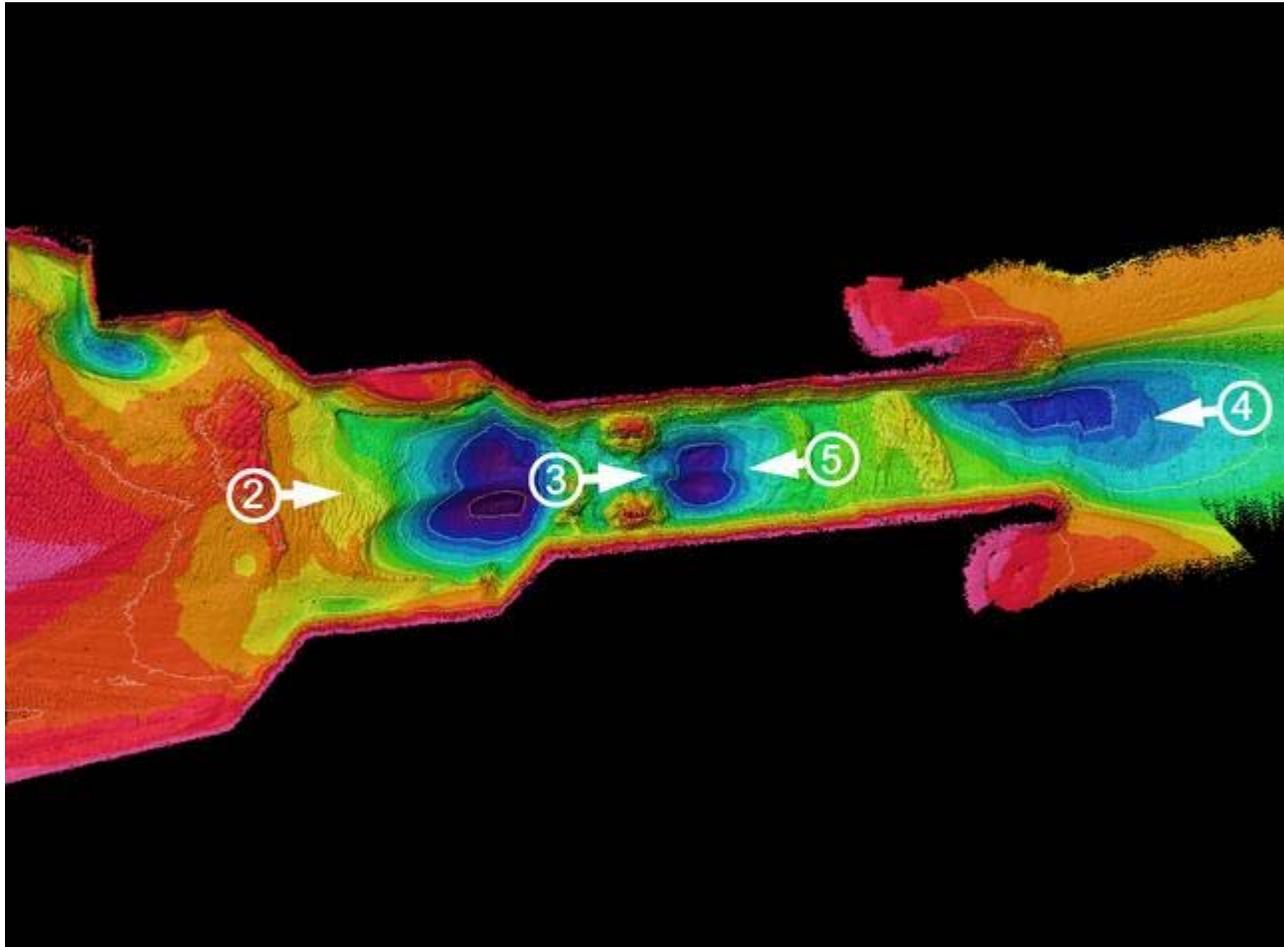
## *Barnegat Inlet, New Jersey*



<http://cirp.wes.army.mil/cirp/gallery/gallery.html>

# Channel Morphology

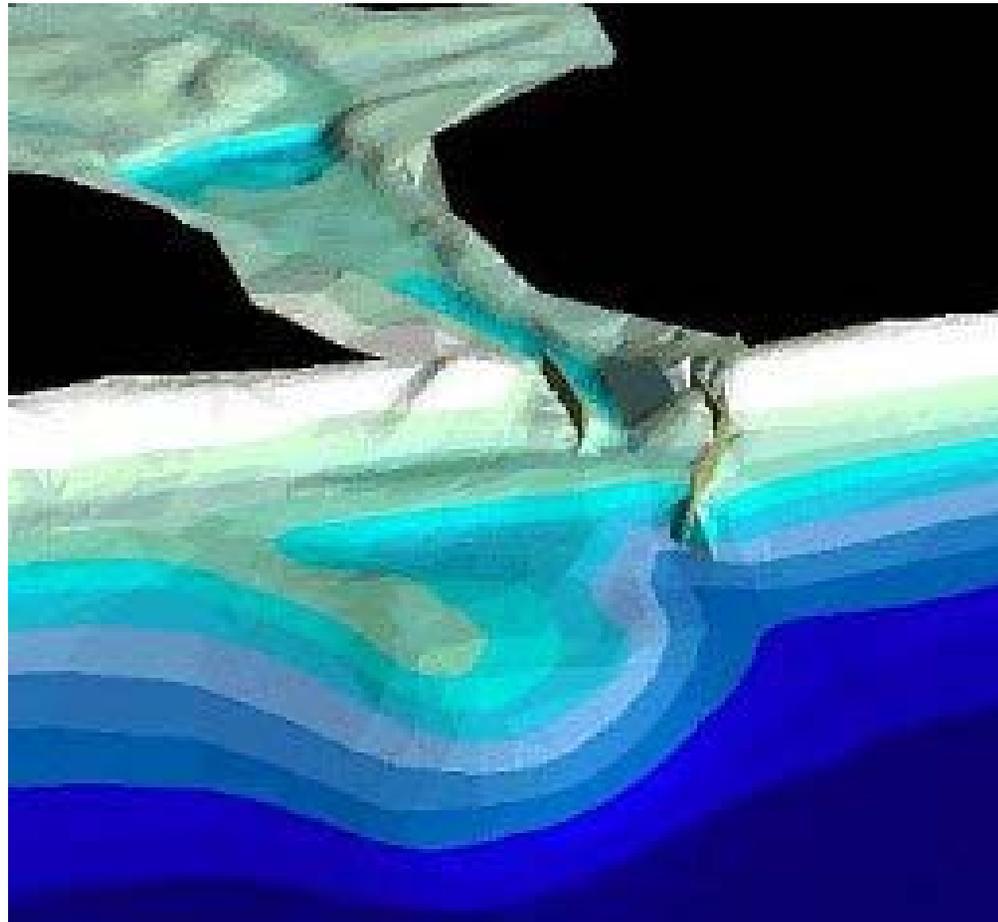
## *Indian River Inlet, Delaware*



<http://cirp.wes.army.mil/cirp/gallery/gallery.html>

# Channel Morphology

## *Sebastian Inlet Florida*



*(Video clip shows inlet fly through)*

# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

## *Factors and Processes Connecting Morphology with Hydrodynamics at Tidal Inlets*



### **1. Ocean Tide, Wave Climate, Storms**

### **2. Inlet/Bay Geometry**

*size -pumping mode or long wave*

*tidal prism*

*tidal range vs inlet depth/ vs tidal flat elevations*

*tidal flats - expandable basin*

### **3. Inlet Hydrodynamics**

*shallow water tides - ebb or flood dominated*

*residual currents, river flow*

*wave-current interaction and jet flow field*

### **4. Sediments - Supply, Size, Composition, Location**

### **5. Sediment Dynamics**

*instantaneous rates/patterns*

*net rates/patterns*

*by-passing/storage/export*

# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets



## ***Linear Basin Systems - ( Microtidal)***

***Low to moderate tidal range - moderate to low  $h_{inlet}/T_{range}$***

***Linear Bay Geometry - non expanding to linear expansion***

***Flood dominated tidal asymmetry or “balanced” flood/ebb***

***Shoals constructed from littoral sediment supply***

***Transgressive barrier island setting - wave and storm constructed***

***Wave-driven sand by-passing***

## ***Expanding Basin Systems (mesotidal)***

***Expandable Bay Geometry-flats and marshes-nonlinear expansion***

***Ebb Dominated tidal asymmetry - high  $A_f/A_c$***

***Shoals constructed mostly from internal sources***

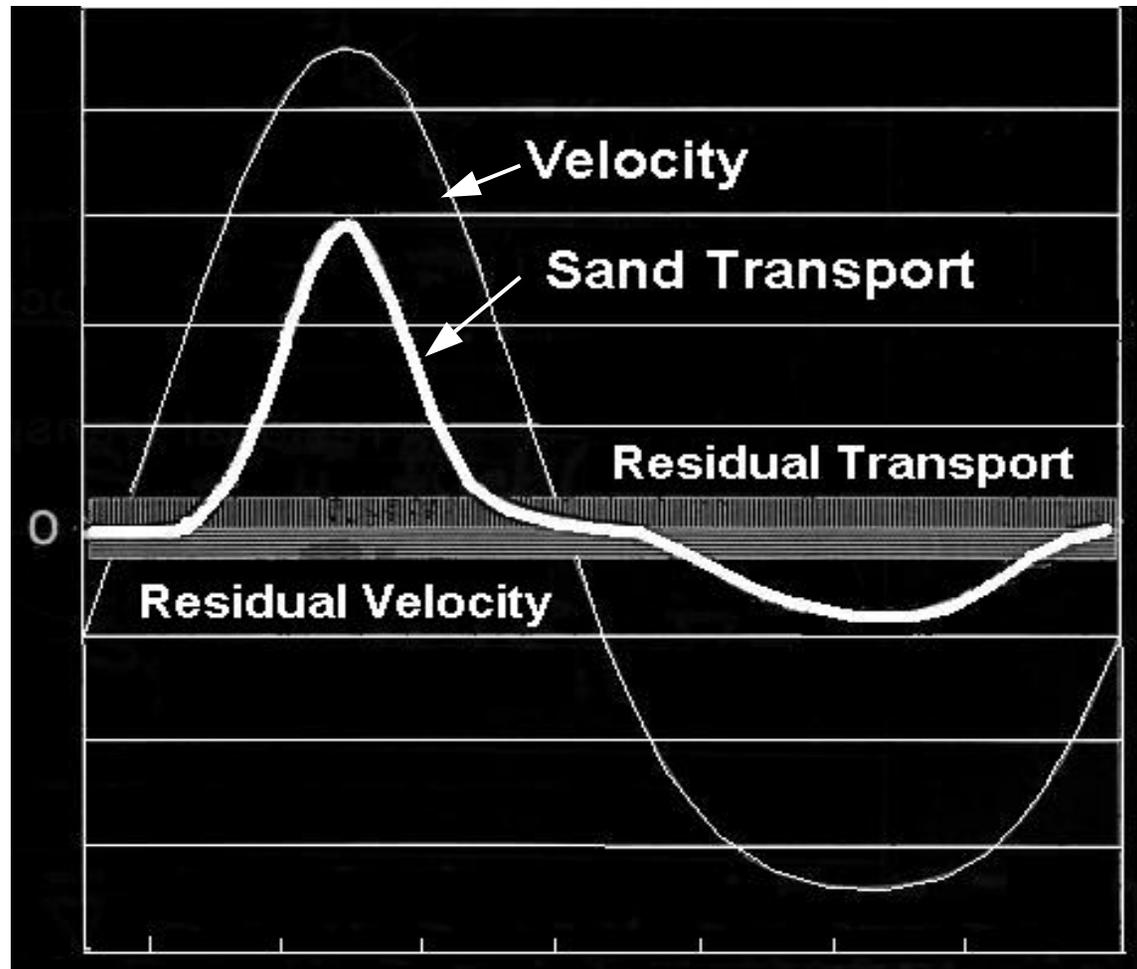
***Regressive barrier island setting - “beach ridge barriers”***

***Channel breaching - bar sand by-passing***

# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets



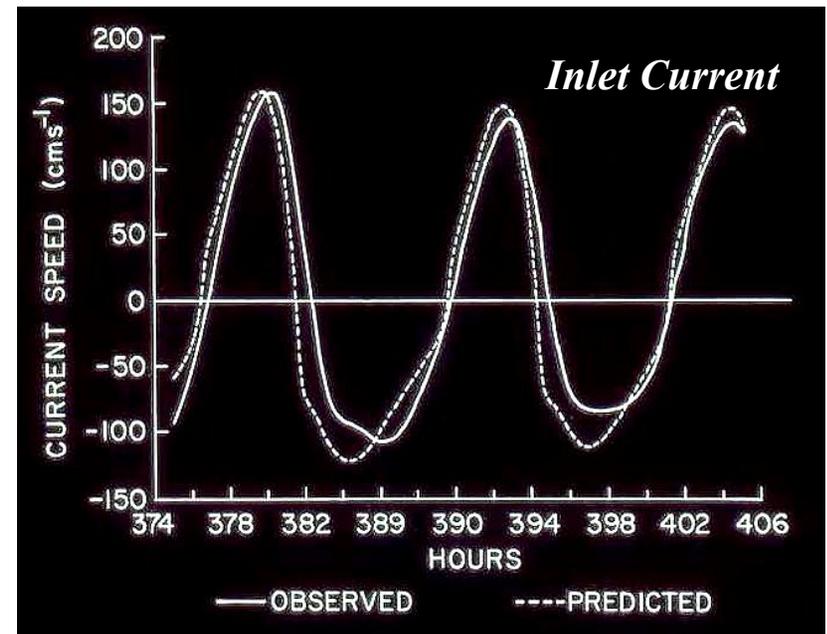
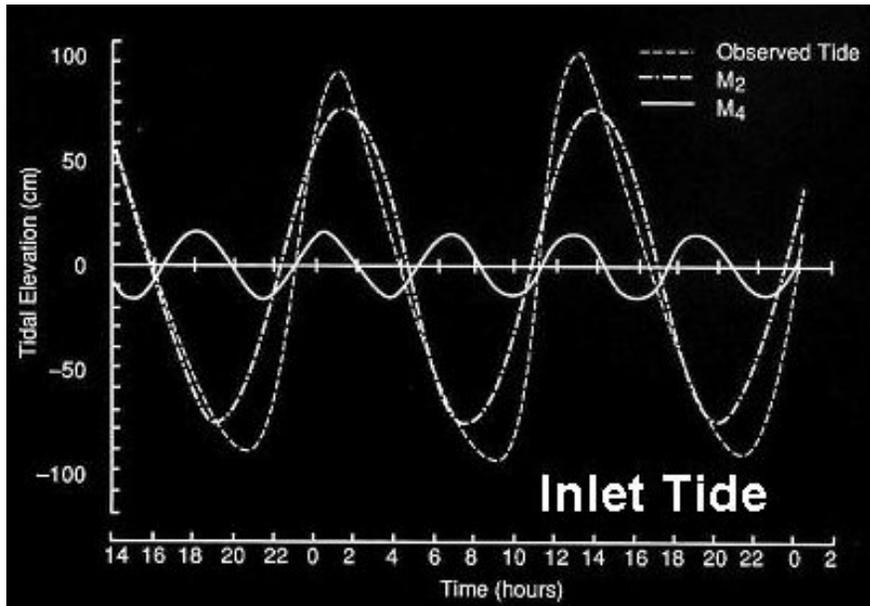
## *Sediment Transport Threshold and Time-Velocity Asymmetry at Tidal Inlets*



# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

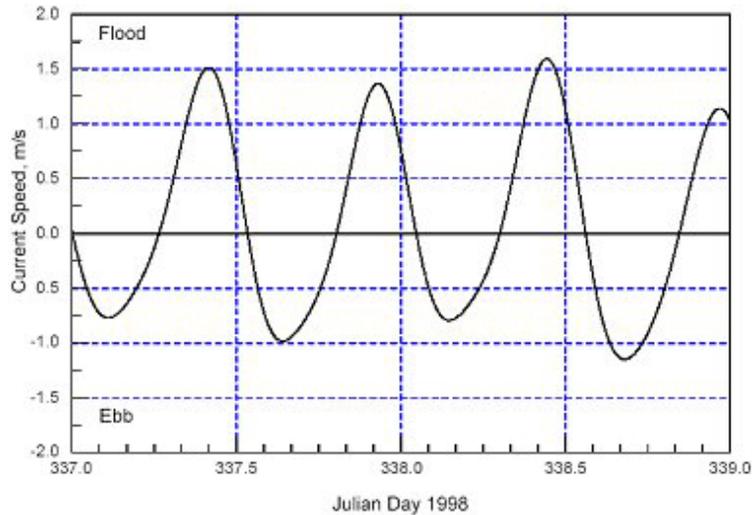
## *Linear Basin Systems*

### *Flood - Dominated Tidal Asymmetry*

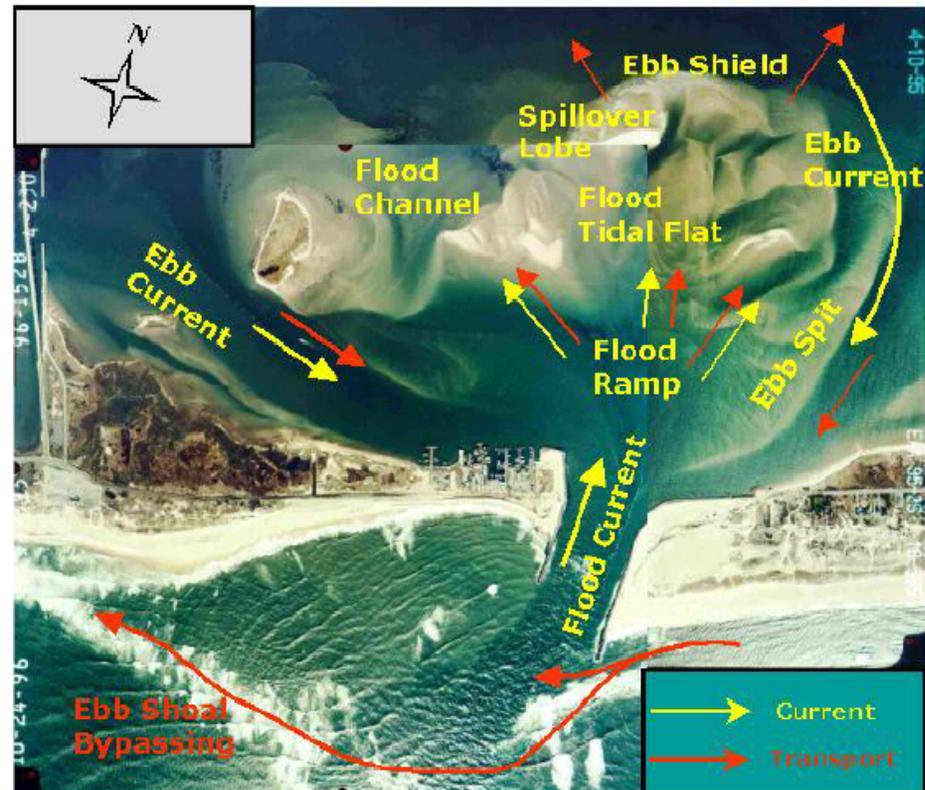


# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets *Linear Basin Systems*

## *Flood Shoal Building at Microtidal Inlets*



*(From Walton, 2002)*



# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

## *Linear Basin Systems*

*Sediment transport pathways and sand bypassing at stabilized microtidal inlets*

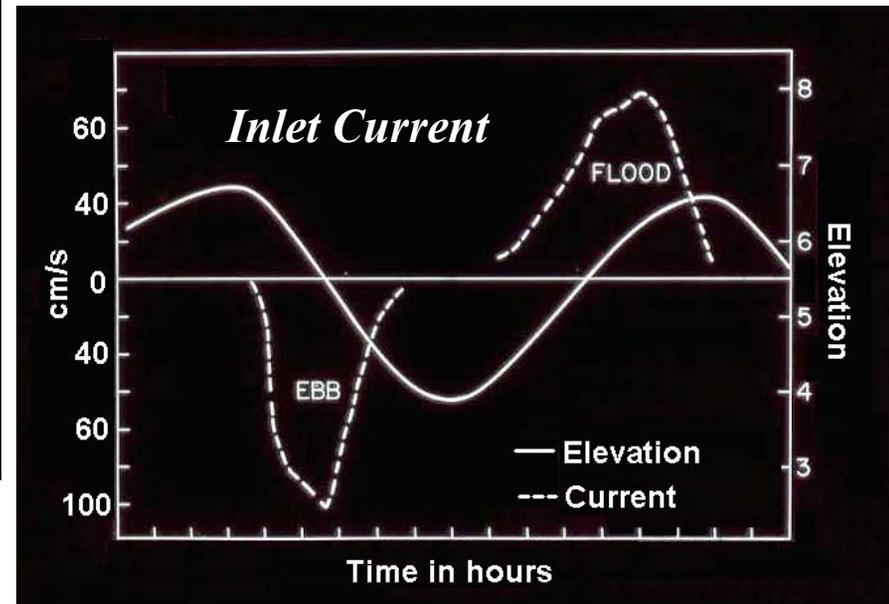
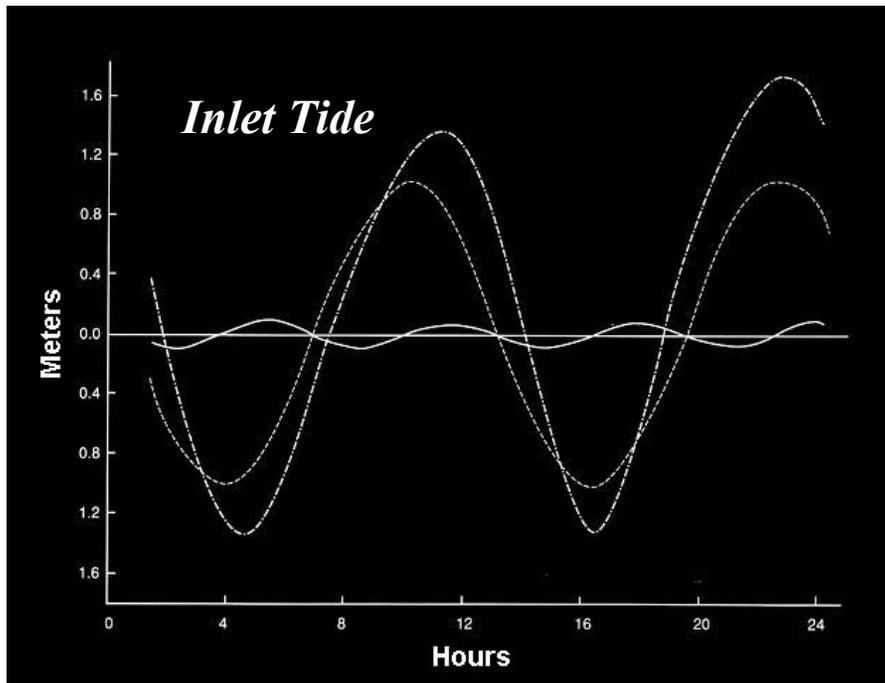


# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

## *Expanding Basin Systems*



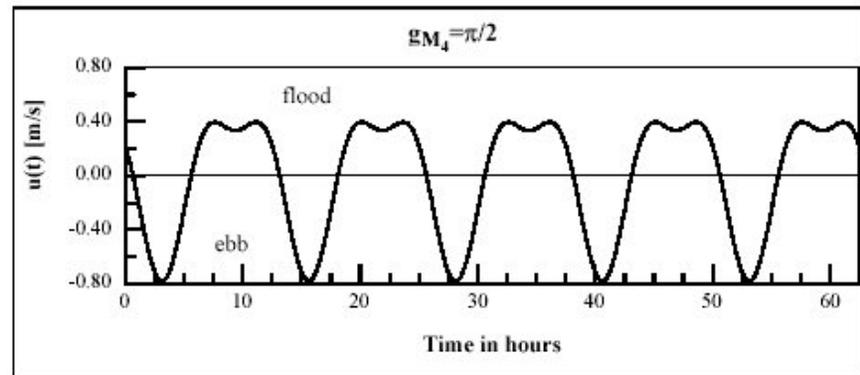
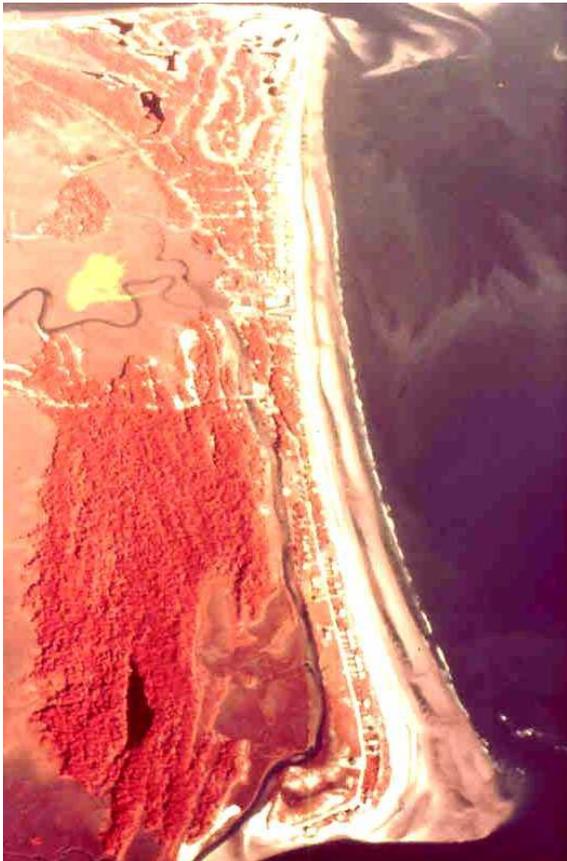
### *Ebb - Dominated Tidal Asymmetry*



# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

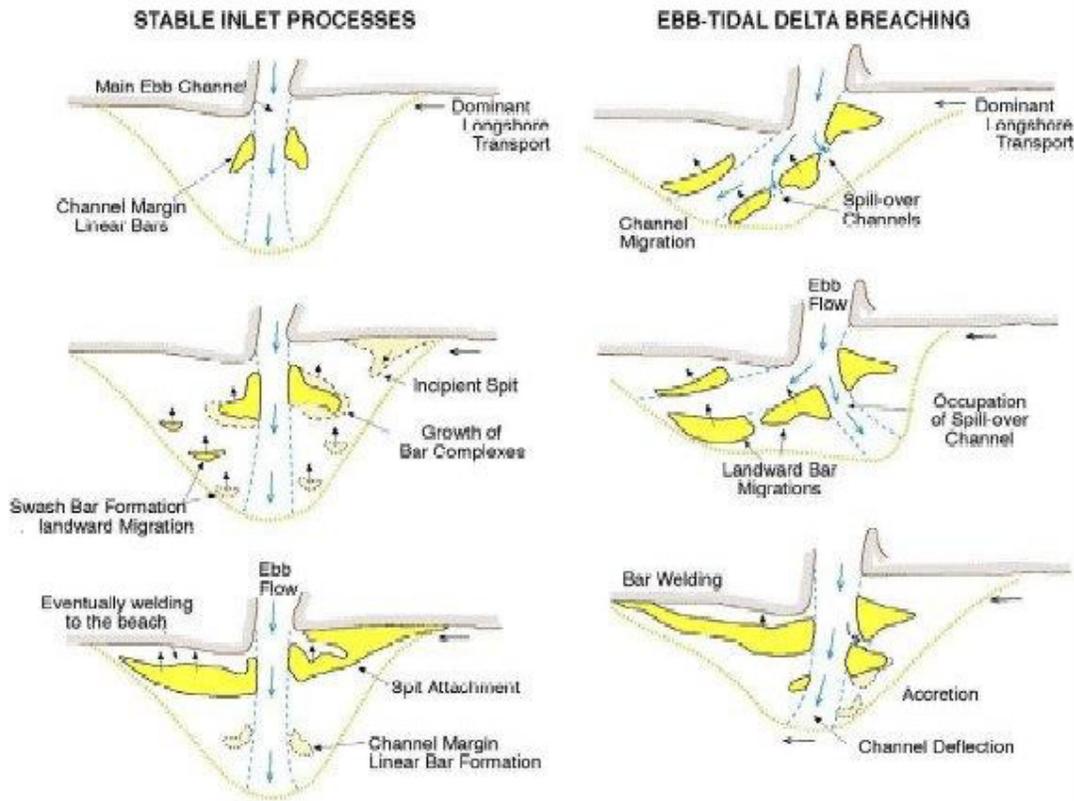
## *Expanding Basin Systems*

### *Ebb shoal building from internal sand source*



# Hydrodynamic-Morphodynamic Interactions at Tidal Inlets

## *Expanding Basin Systems*



### *Inlet-barrier sediment exchange at mesotidal inlets*



*From FitzGerald., Kraus, and Hands, 2000*