Comparing Natural and Modified Sloughs in Suisun Marsh:

Geometry Begets Variability

Delta Vision Blue Ribbon Task Force
March 20, 2008

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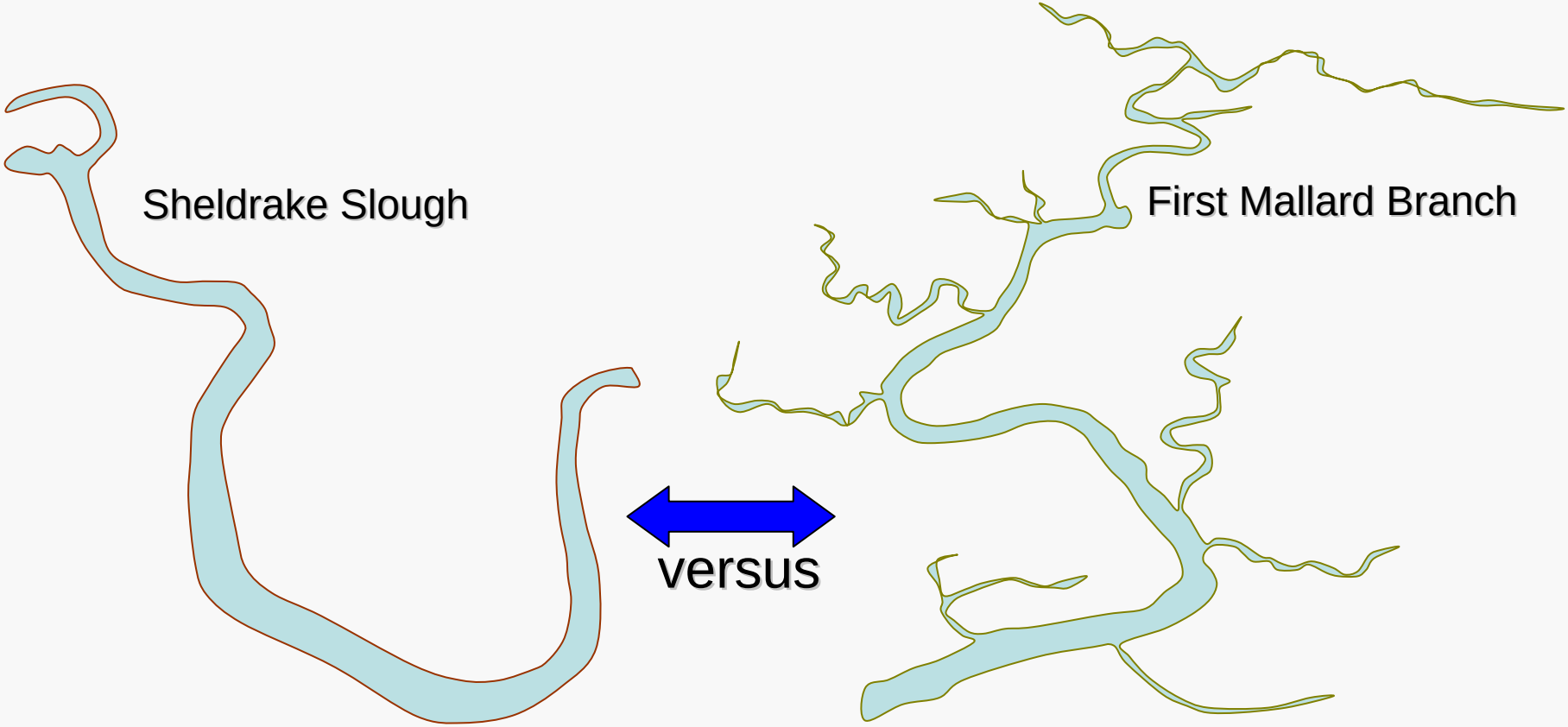
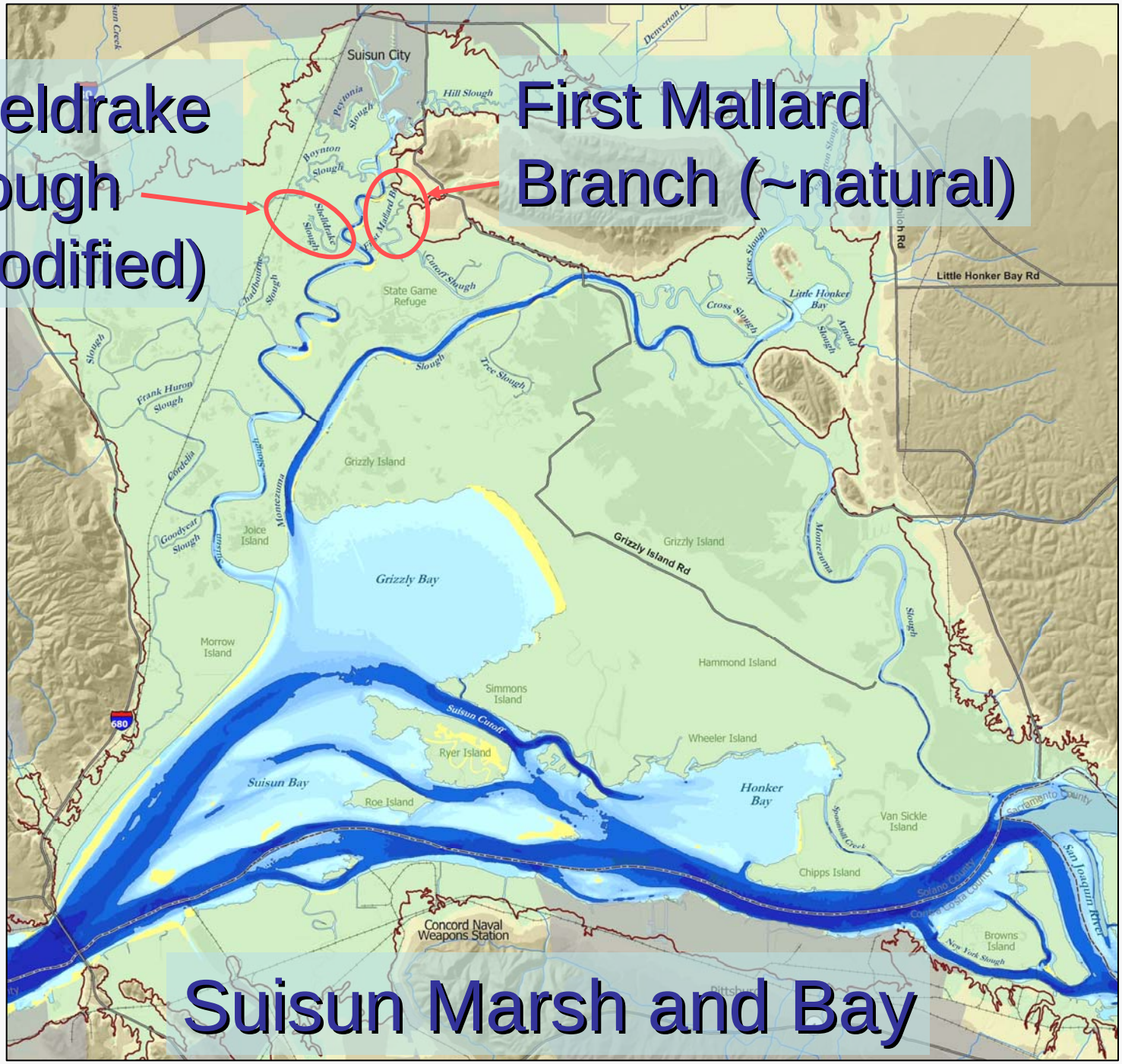
Jon Burau, USGS

Bottom line at the top

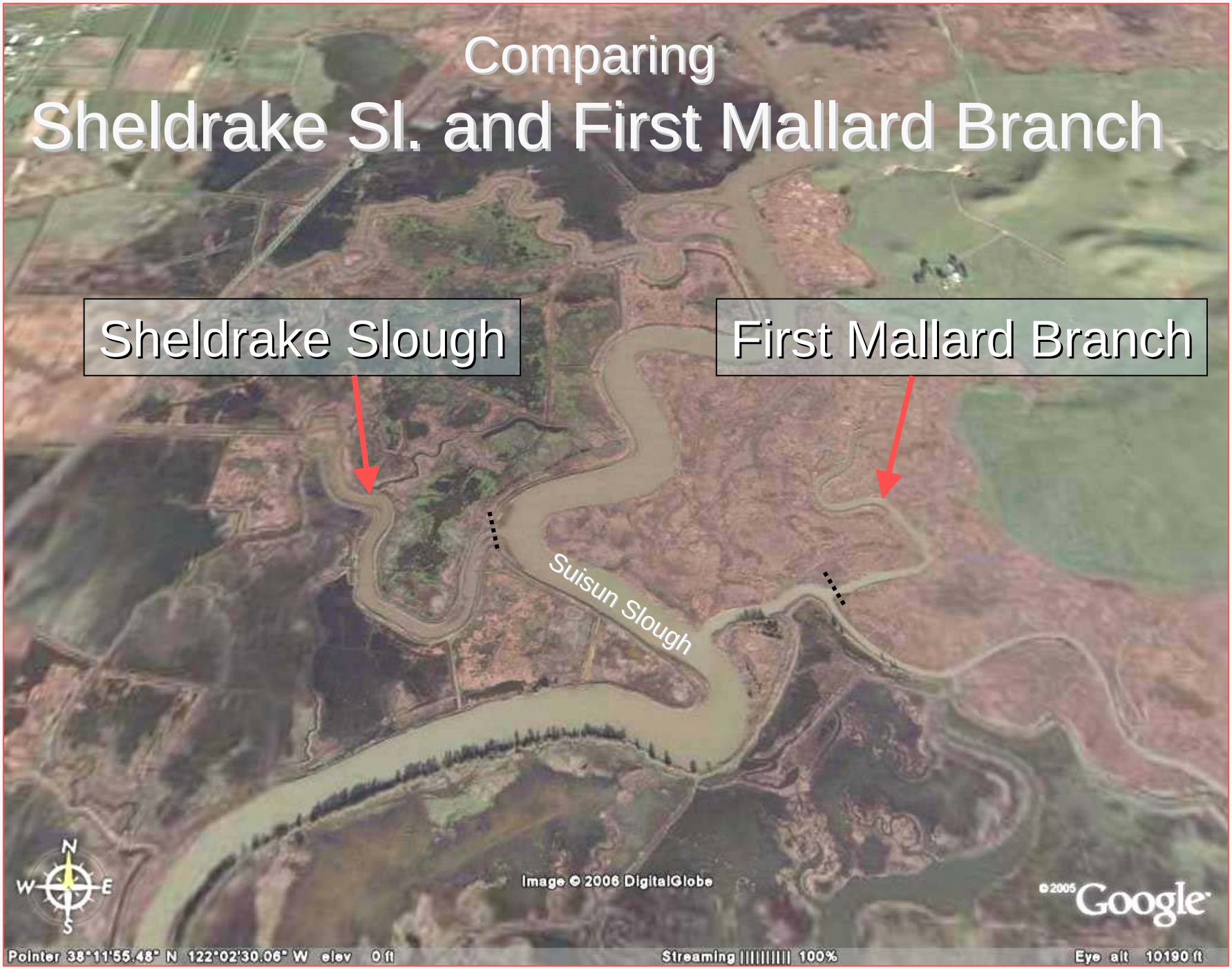
- Landscape geometry “filters” estuarine drivers.
- More complex geometry begets more variable process response.
- Physical, chemical, and biological processes are more variable in natural tidal creek systems .
- Corollary: Native plants/fishes evolved in a more variable environment.

We will compare these two shapes, or “geometries”




Sheldrake Slough (modified)
First Mallard Branch (~natural)
Suisun Marsh and Bay
Suisun City
Hill Slough
Peytonia Slough
Boynton Slough
Sheldrake Slough
First Mallard Br
Cutoff Slough
State Game Refuge
Chadbourne Slough
Frank Huron Slough
Cordelia
Goodyear Slough
Suisun Slough
Montezuma Slough
Tree Slough
Grizzly Island
Joice Island
Grizzly Bay
Morrow Island
Grizzly Island Rd
Little Honker Bay Rd
Little Honker Bay
Cross Slough
Nurse Slough
Arnold Slough
Hammond Island
Simmons Island
Suisun Cutoff
Ryer Island
Wheeler Island
Suisun Bay
Roe Island
Honker Bay
Van Sickle Island
Chipps Island
Sacramento County
Solano County
Contra Costa County
San Joaquin River
Browns Island
New York Slough
Concord Naval Weapons Station
680

Comparing
Sheldrake Sl. and First Mallard Branch



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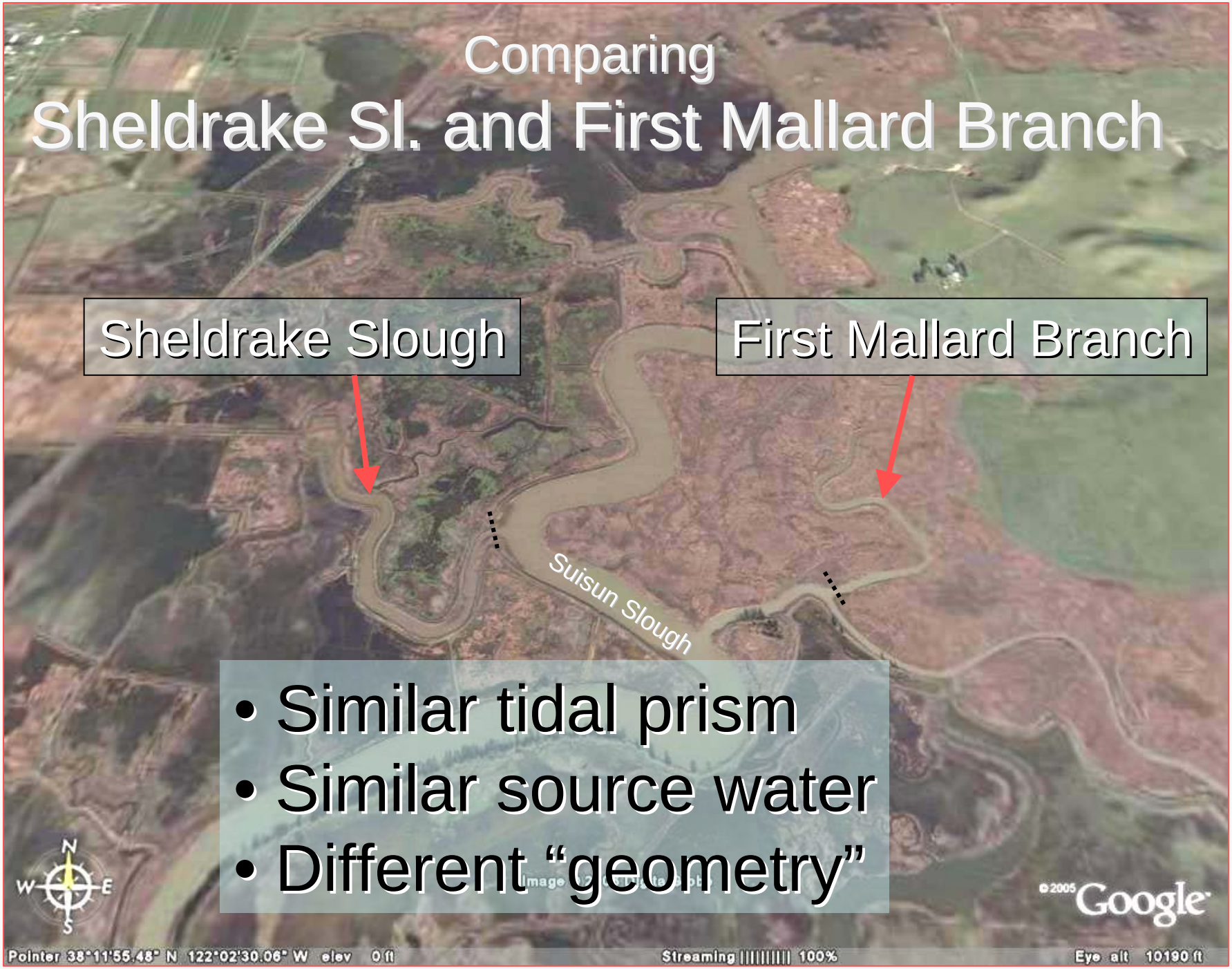
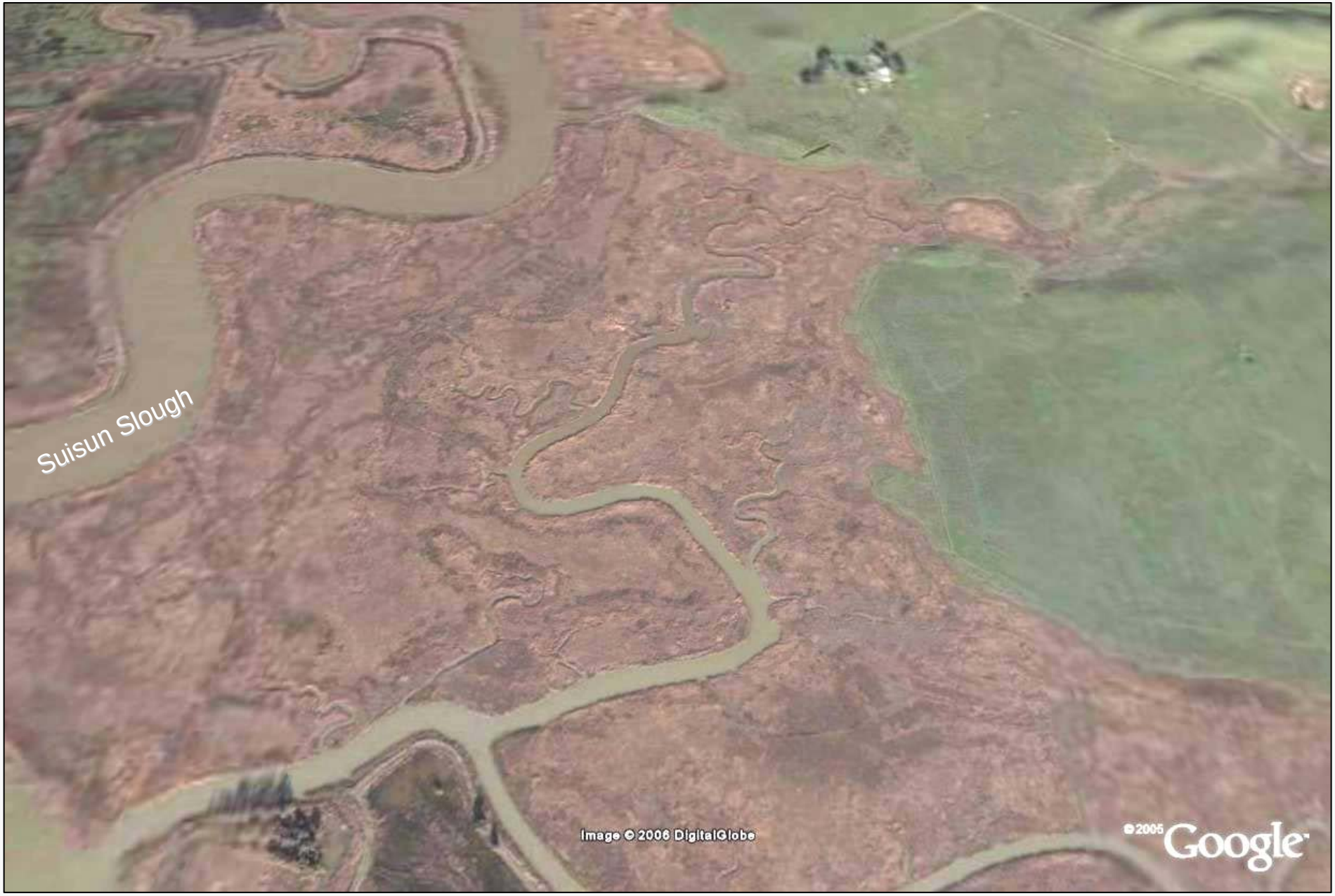


- Similar tidal prism
- Similar source water
- Different “geometry”

First Mallard Branch



First Mallard Branch

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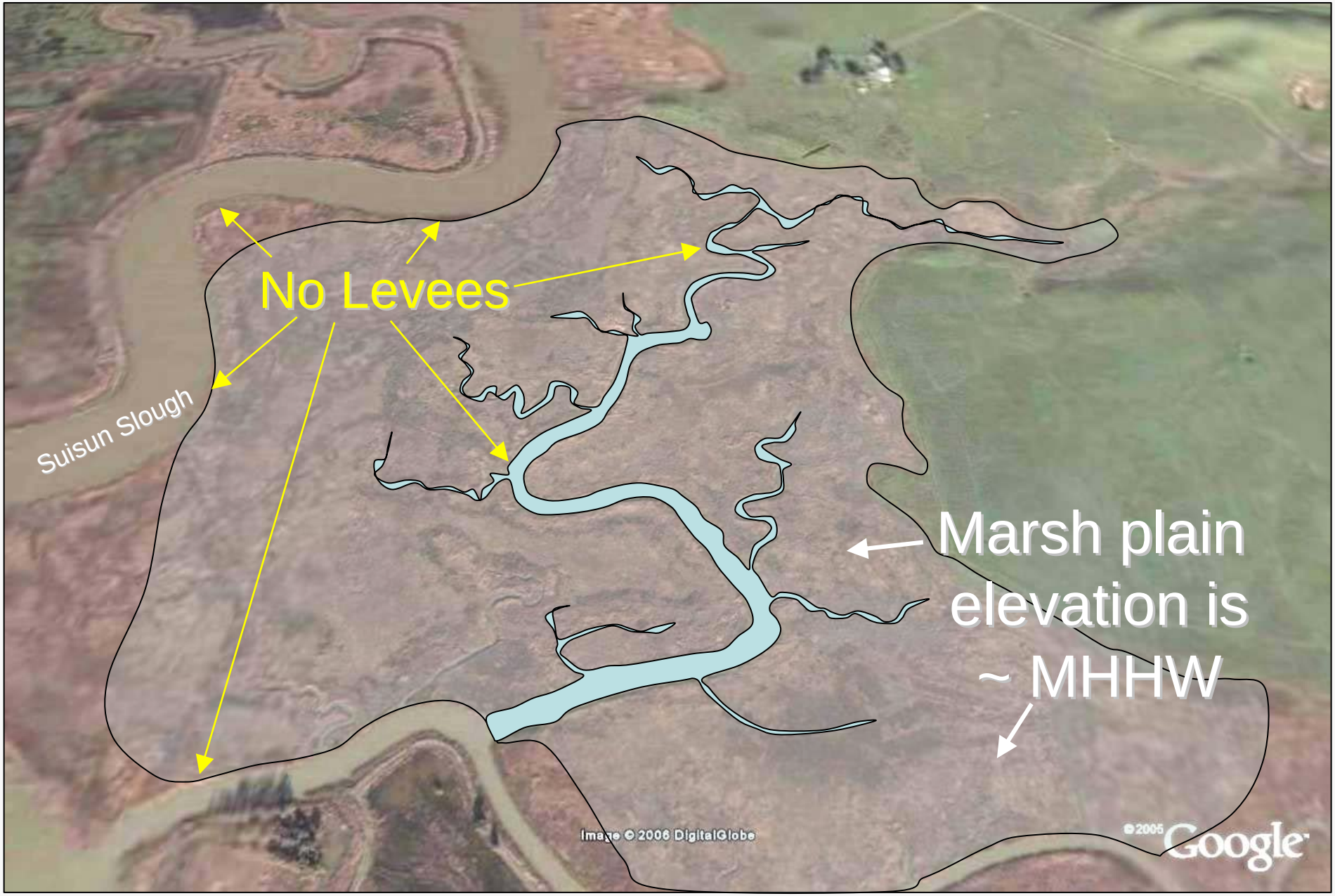

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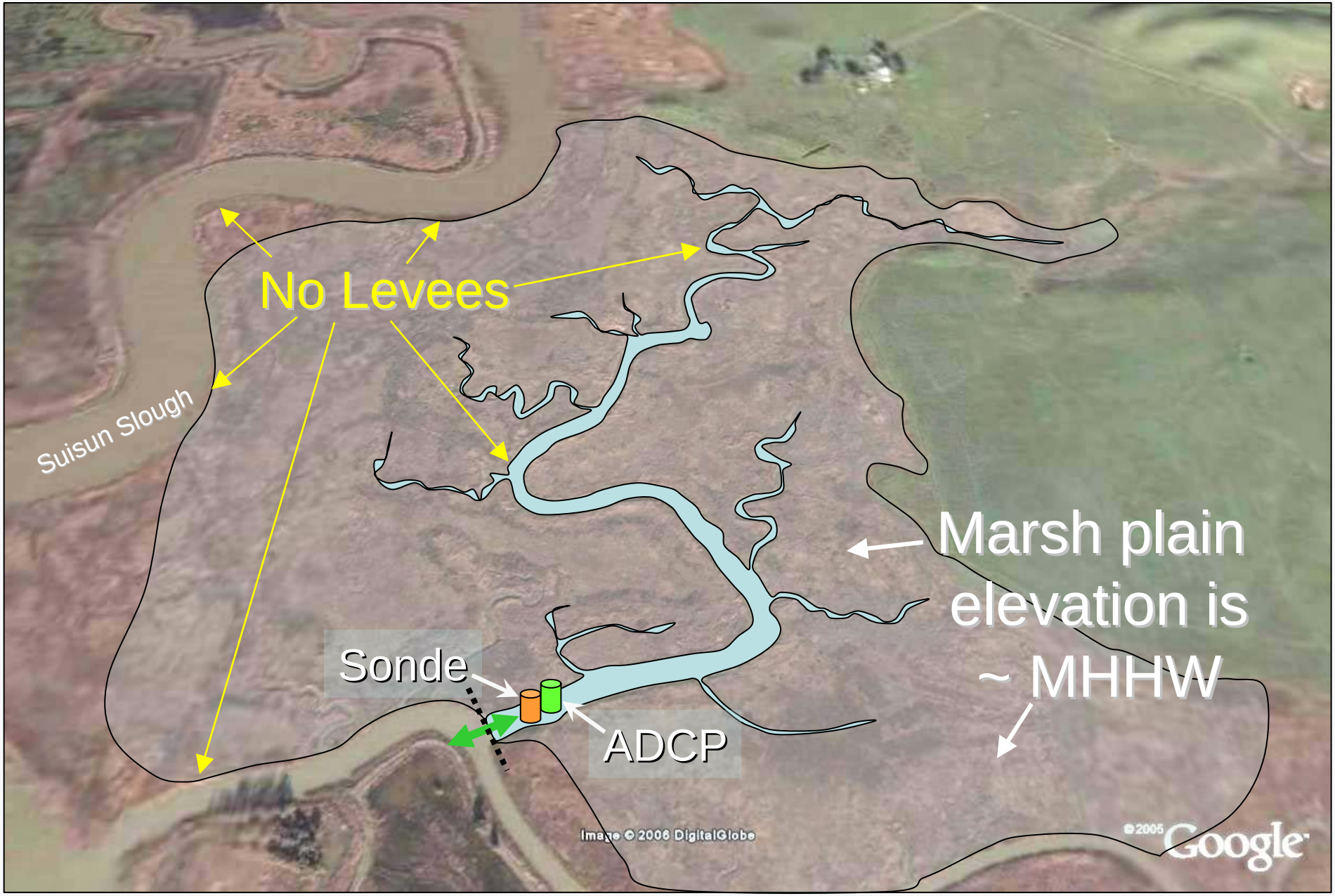

Sheldrake Slough

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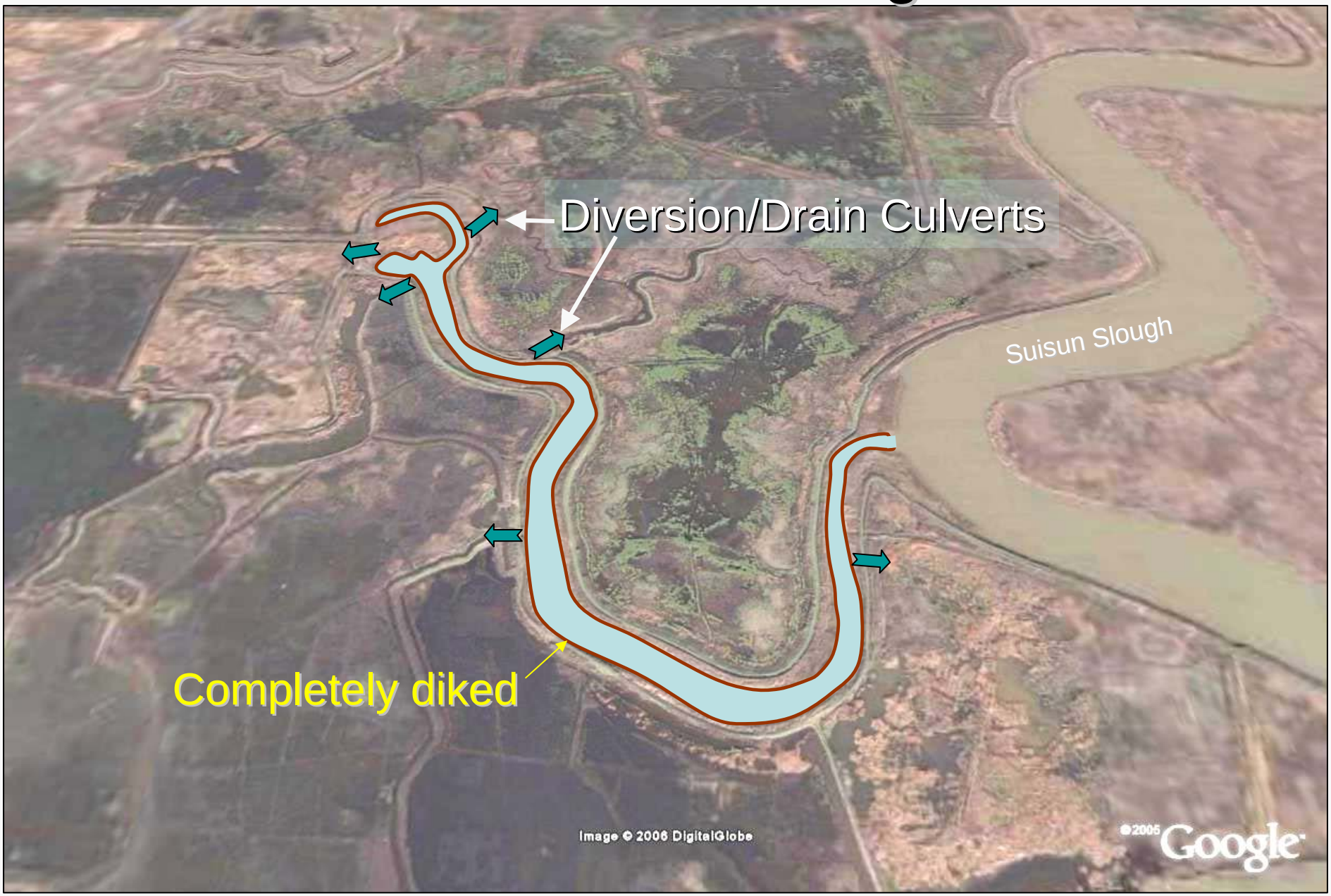

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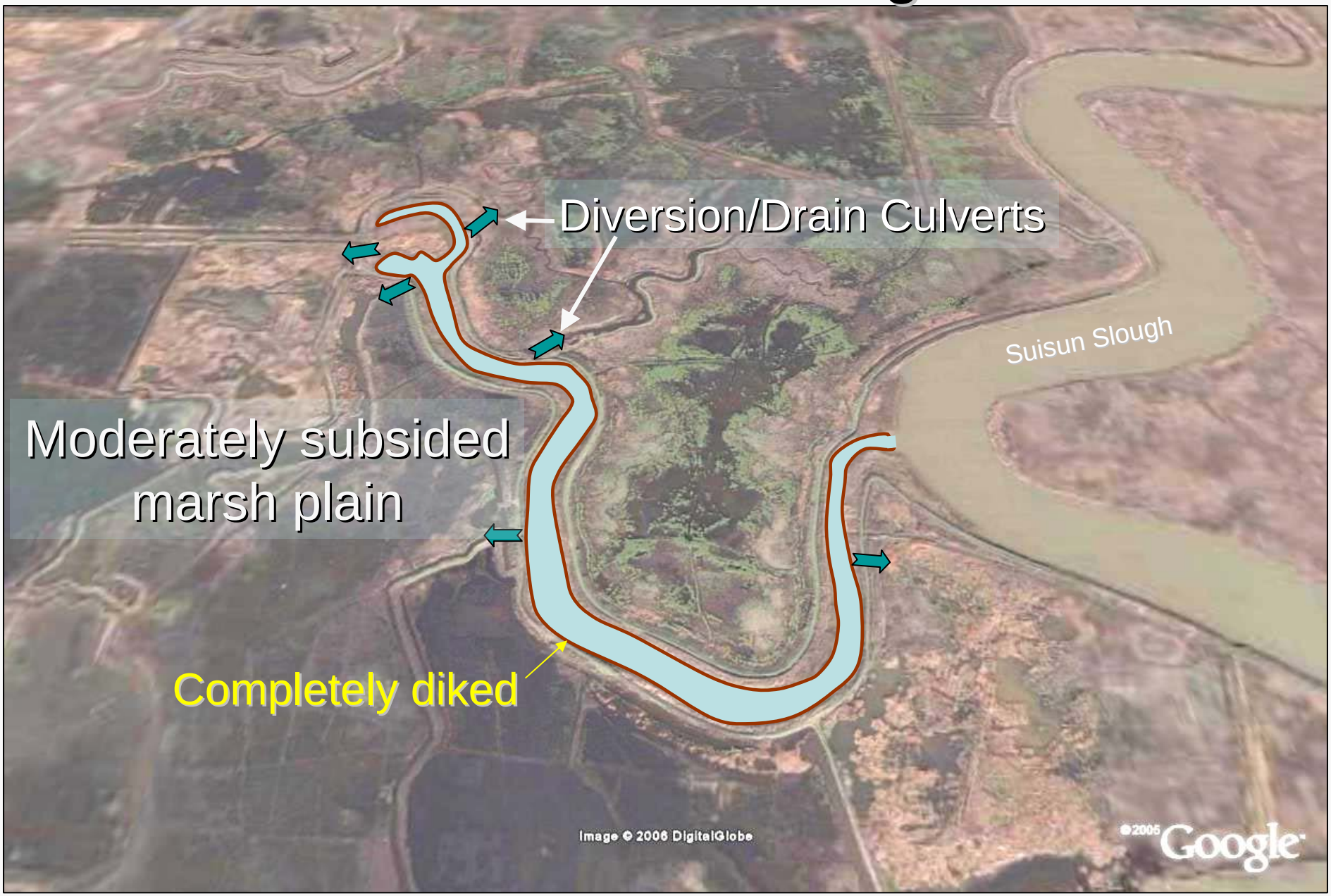

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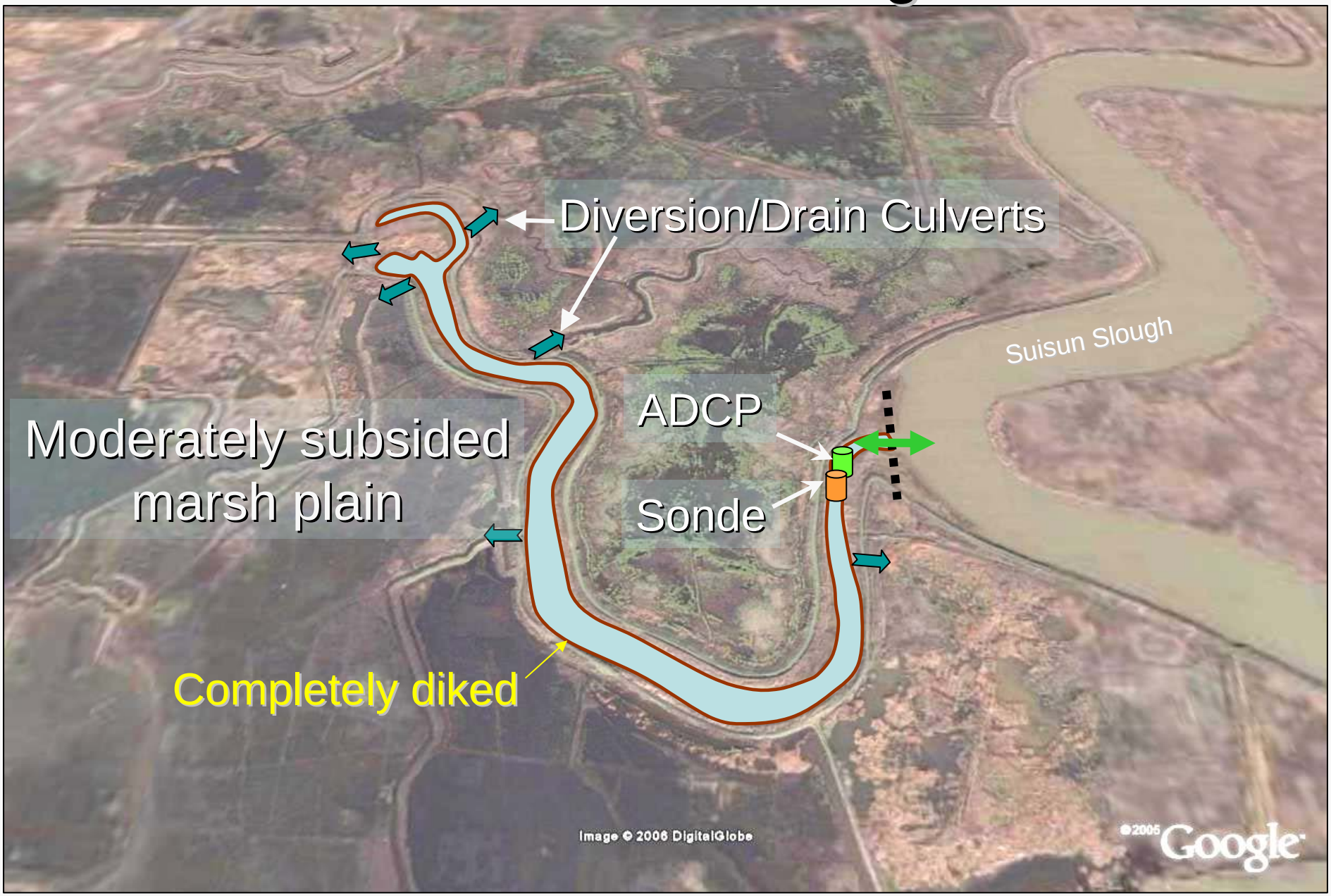
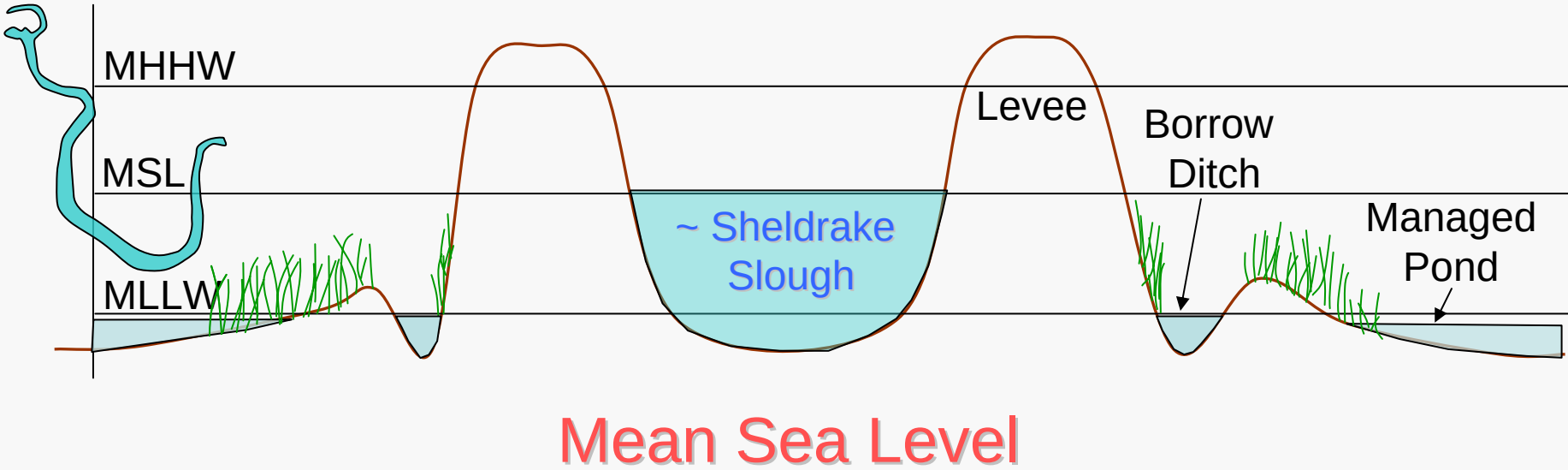


Comparing Typical Cross-section Hypsography



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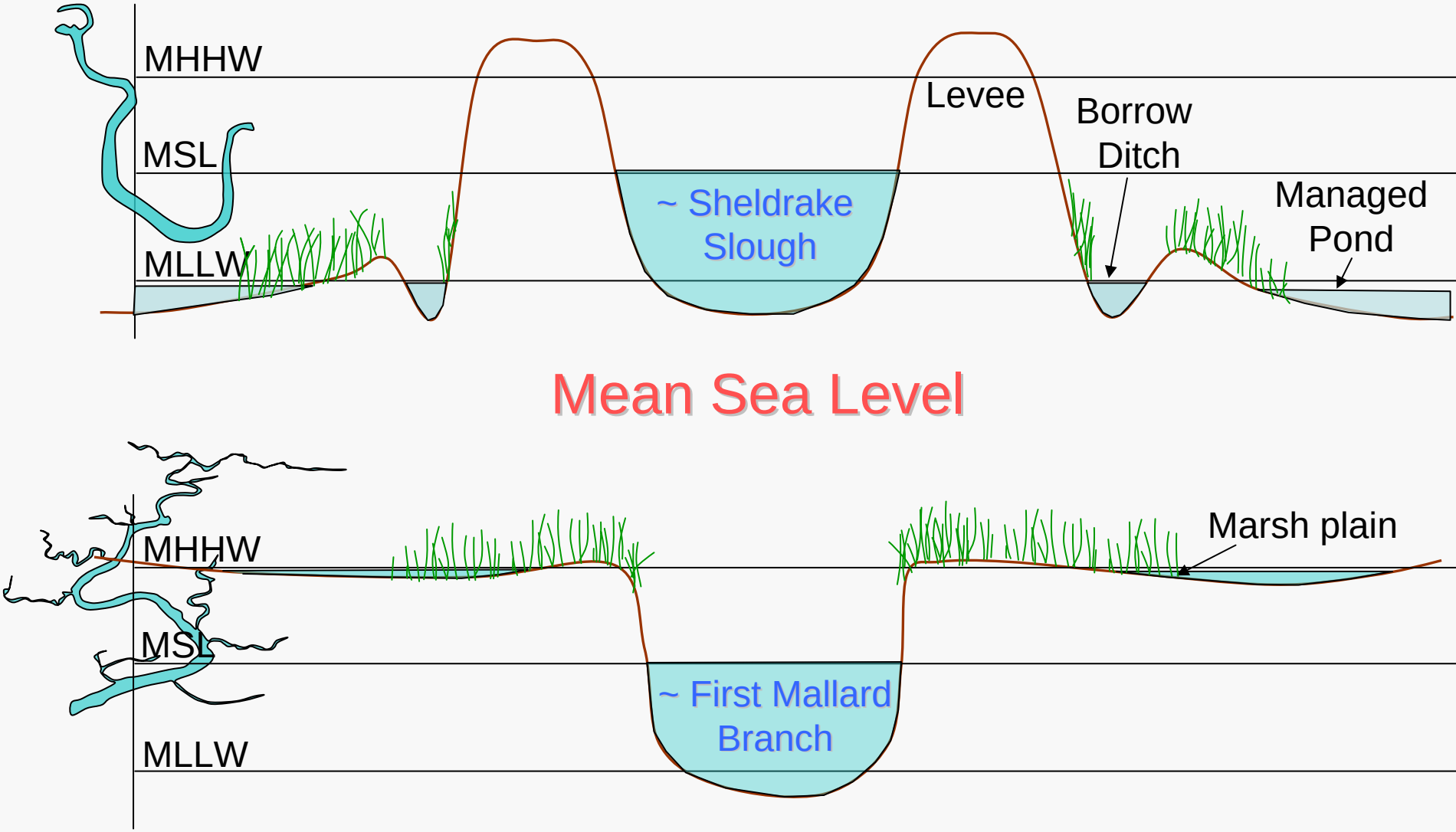

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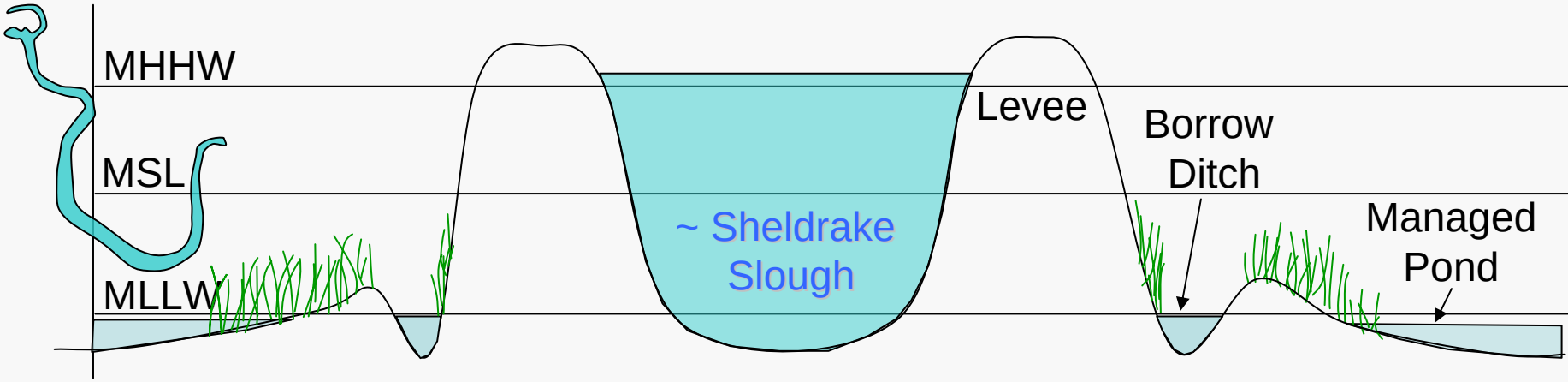
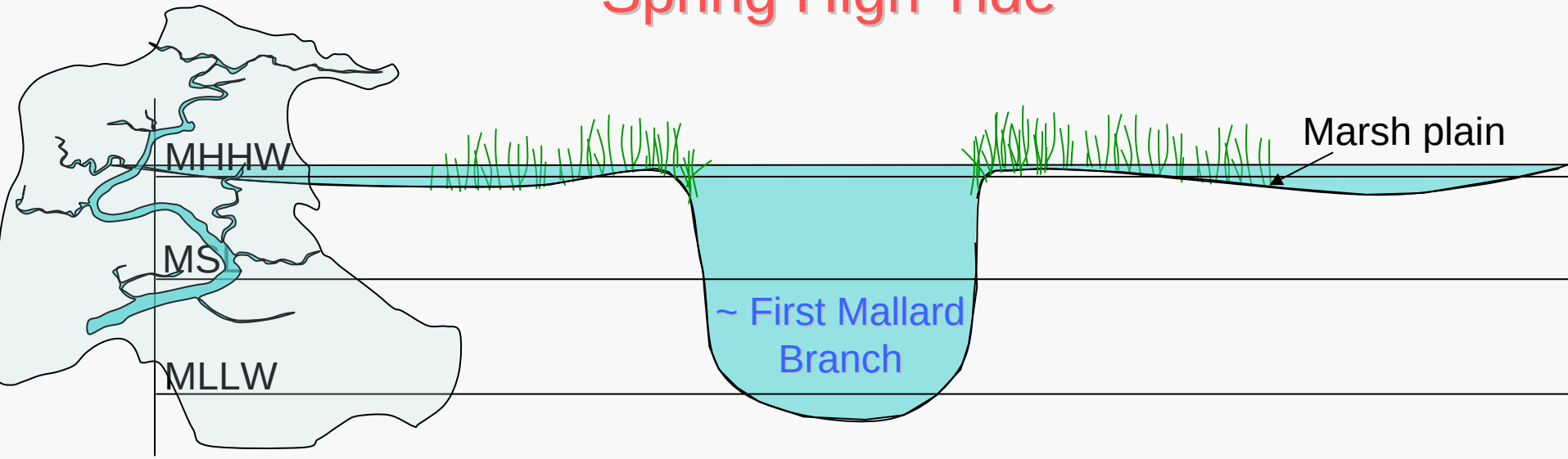
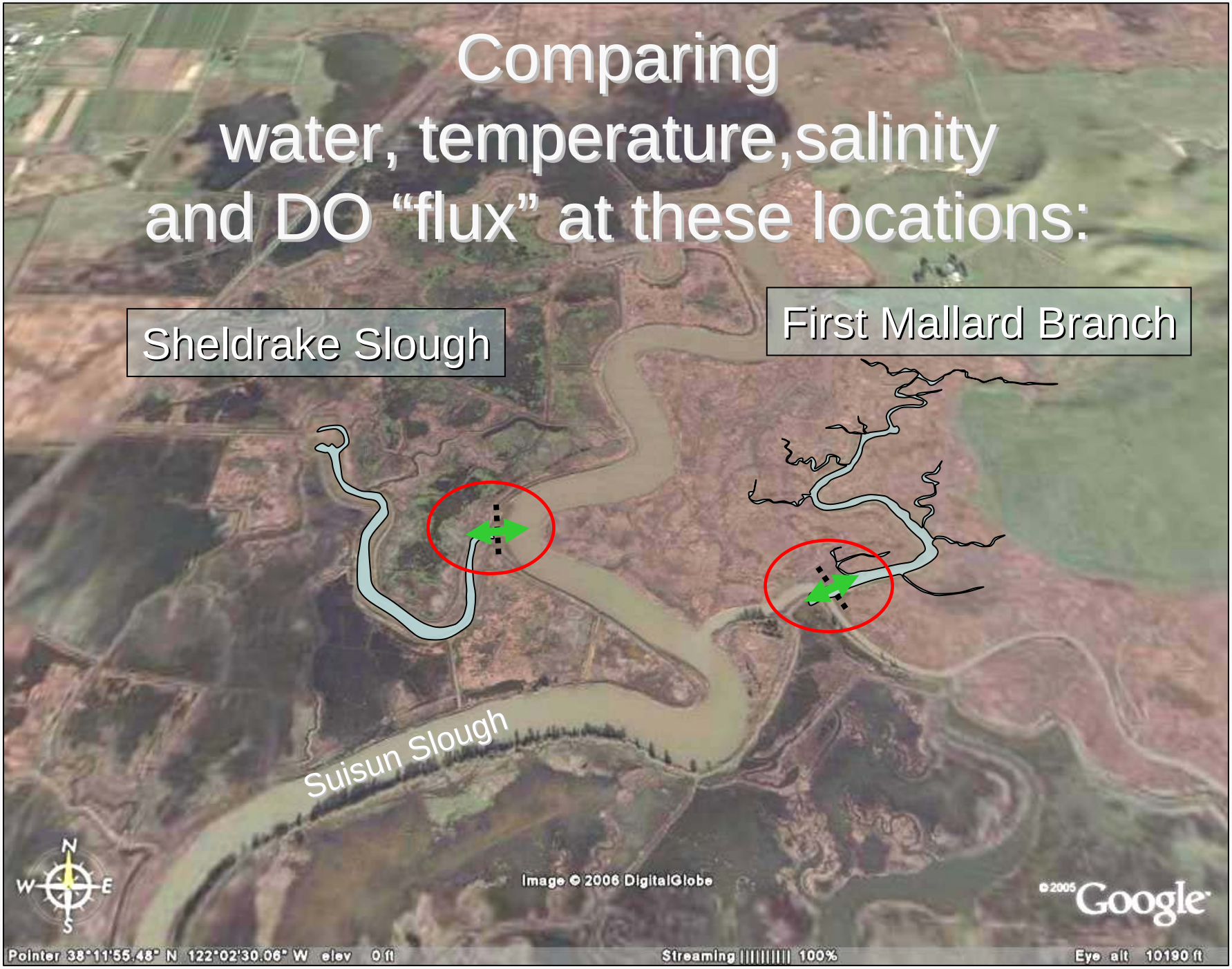


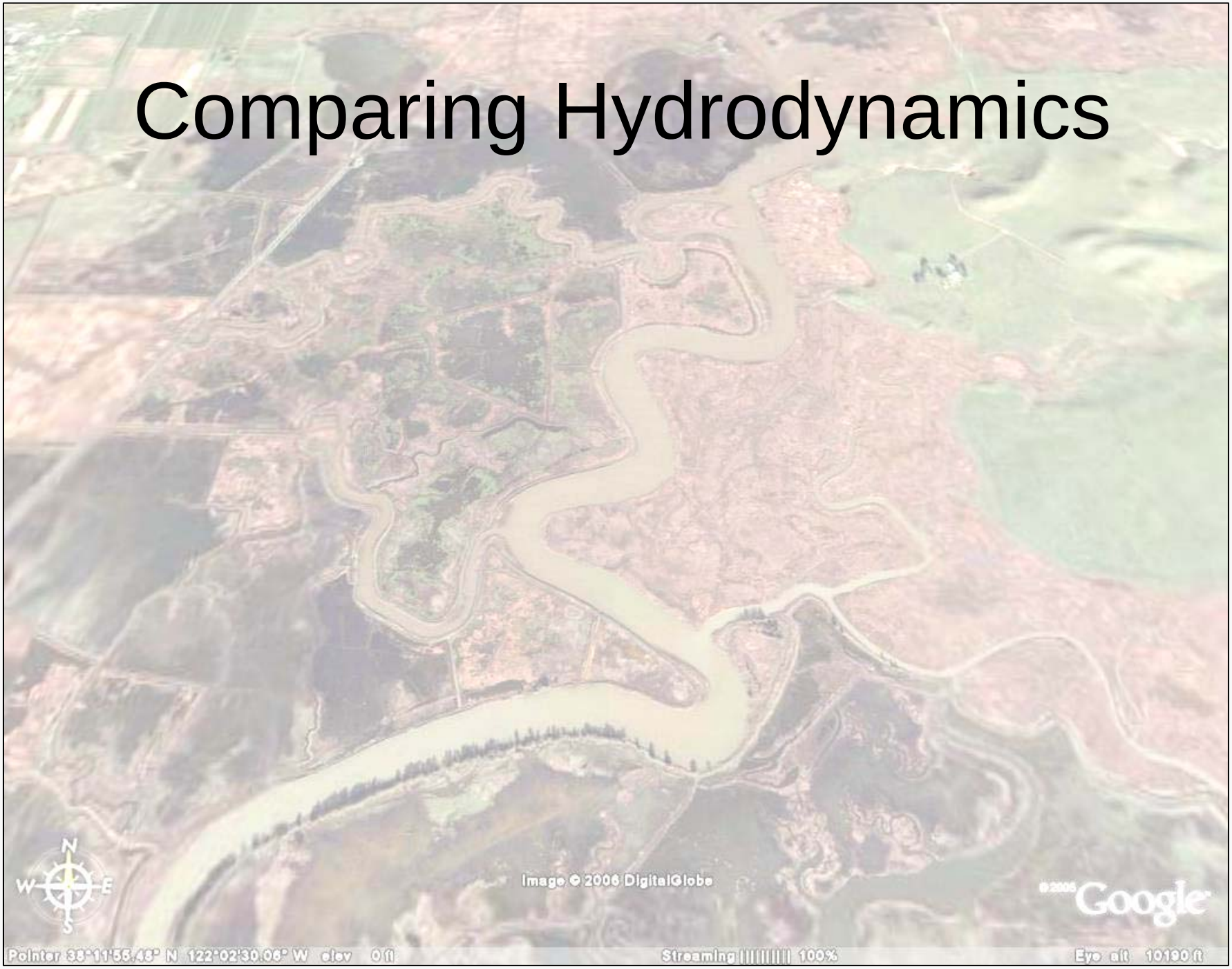
Spring High Tide



Comparing water, temperature,salinity and DO “flux” at these locations:

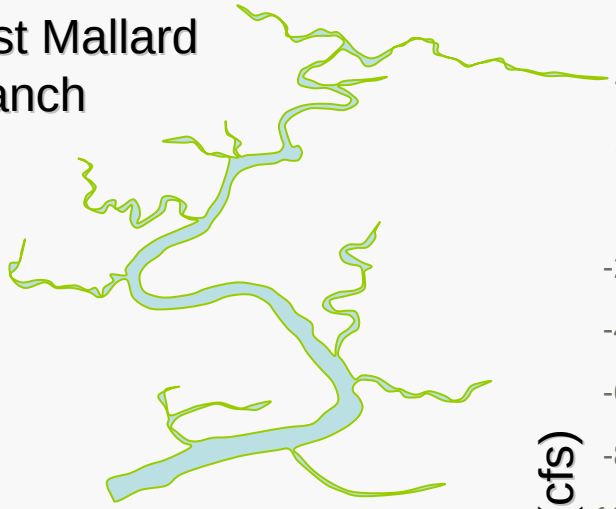


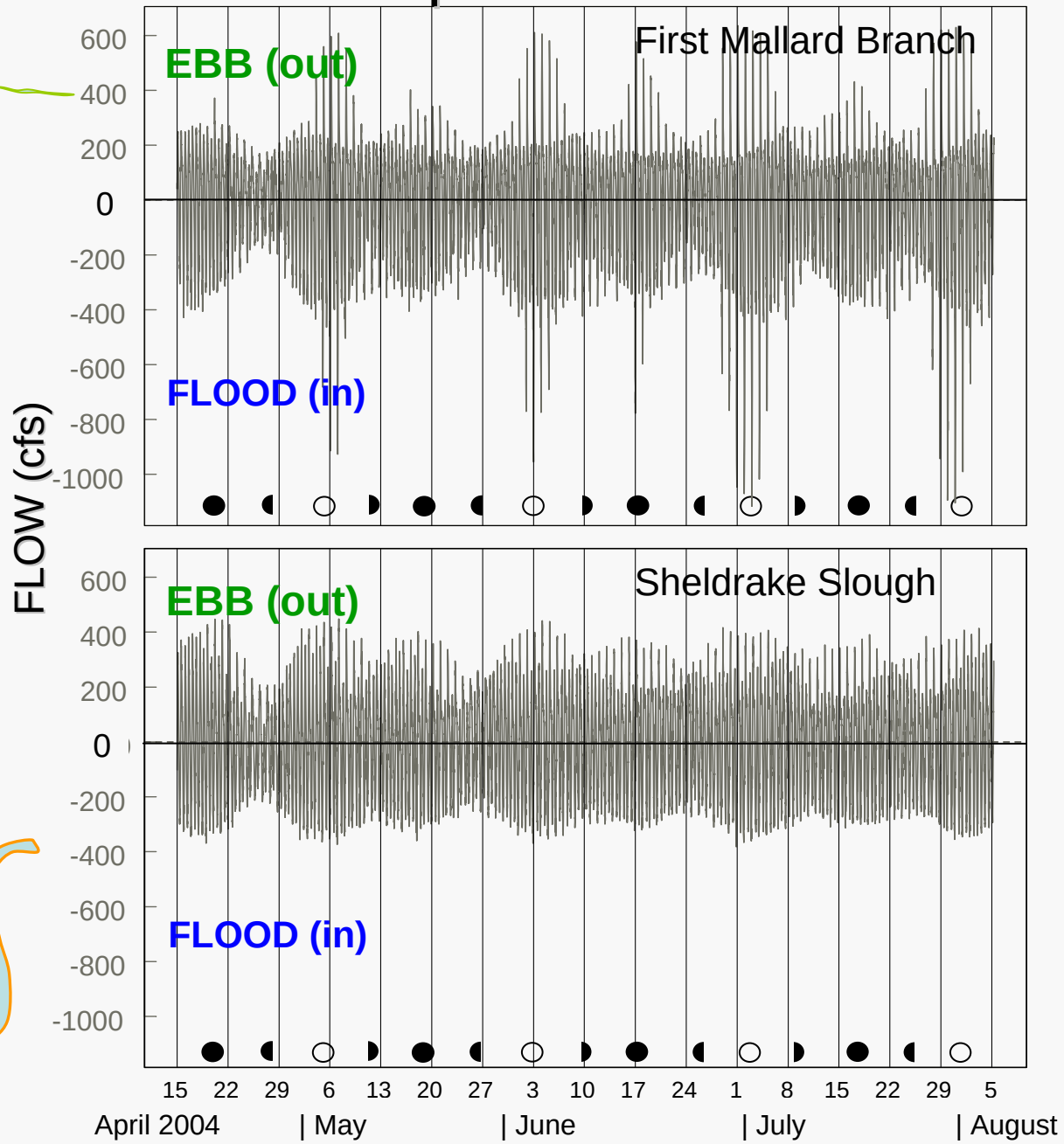
Comparing Hydrodynamics



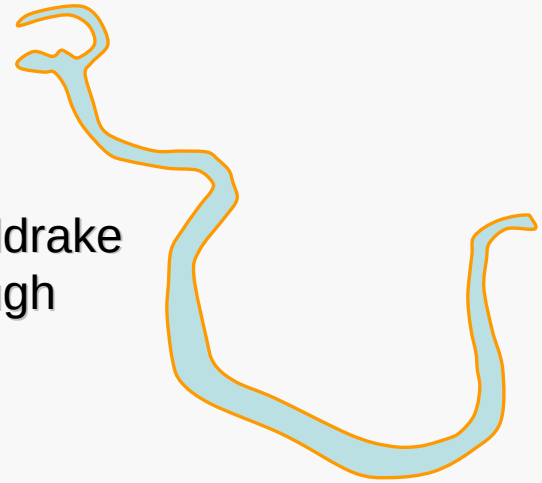
Compare Tidal Flow

First Mallard Branch





Sheldrake Slough



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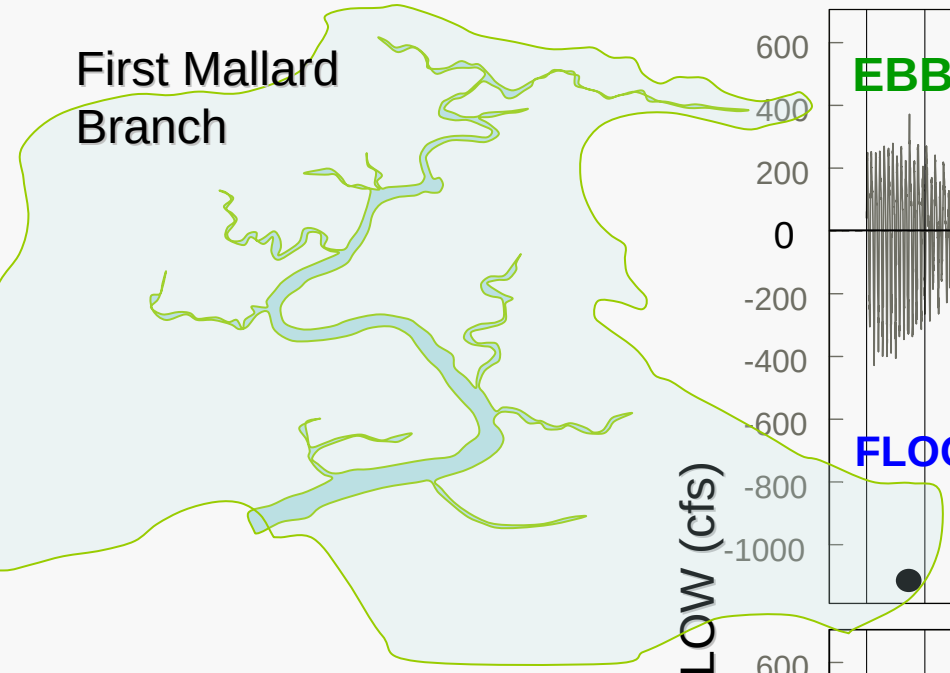
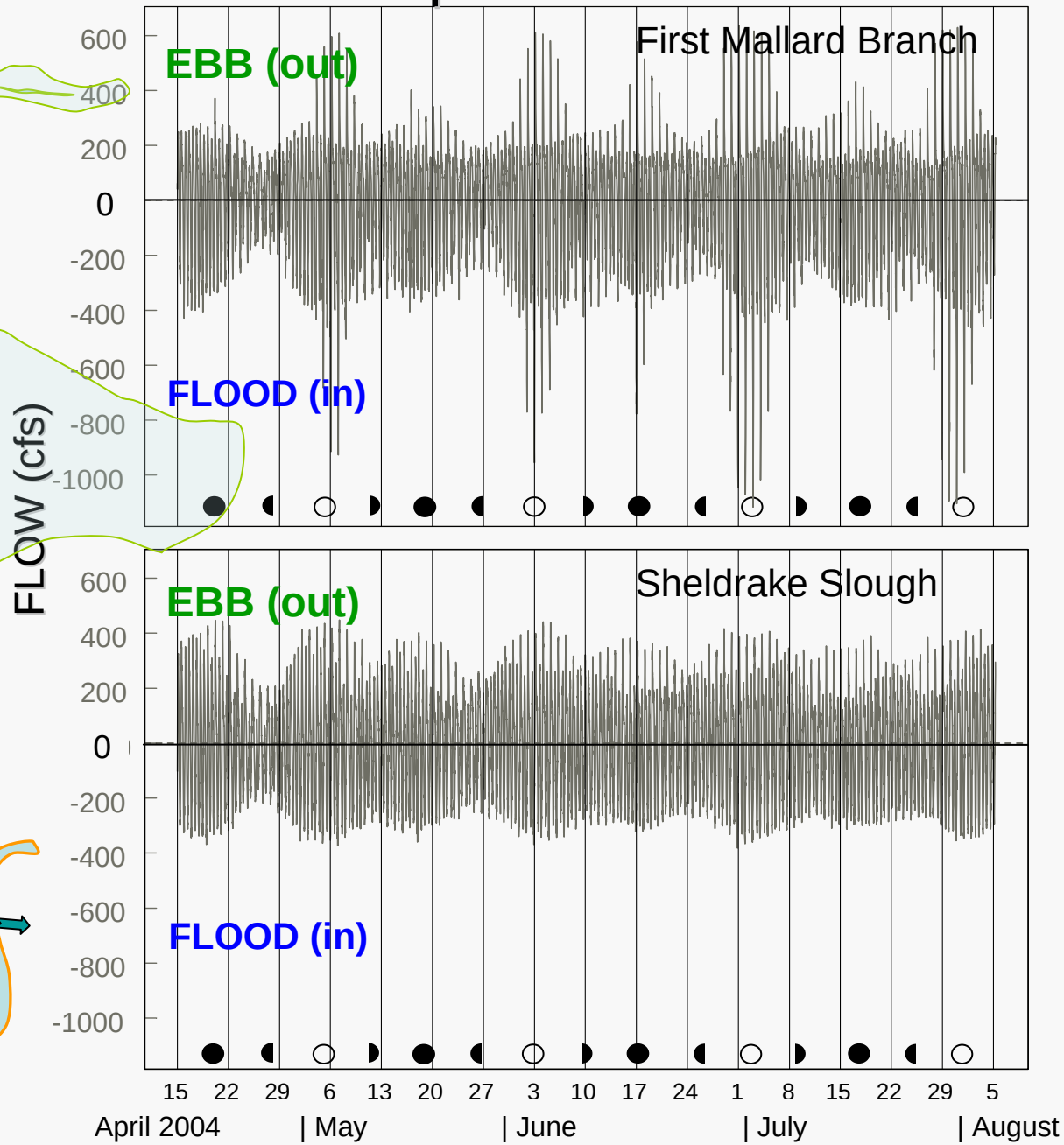
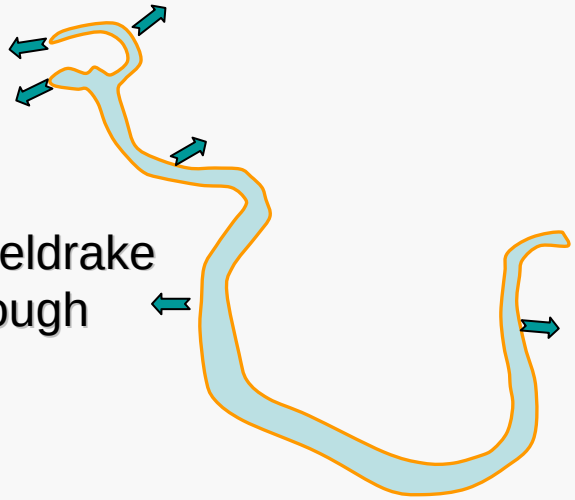




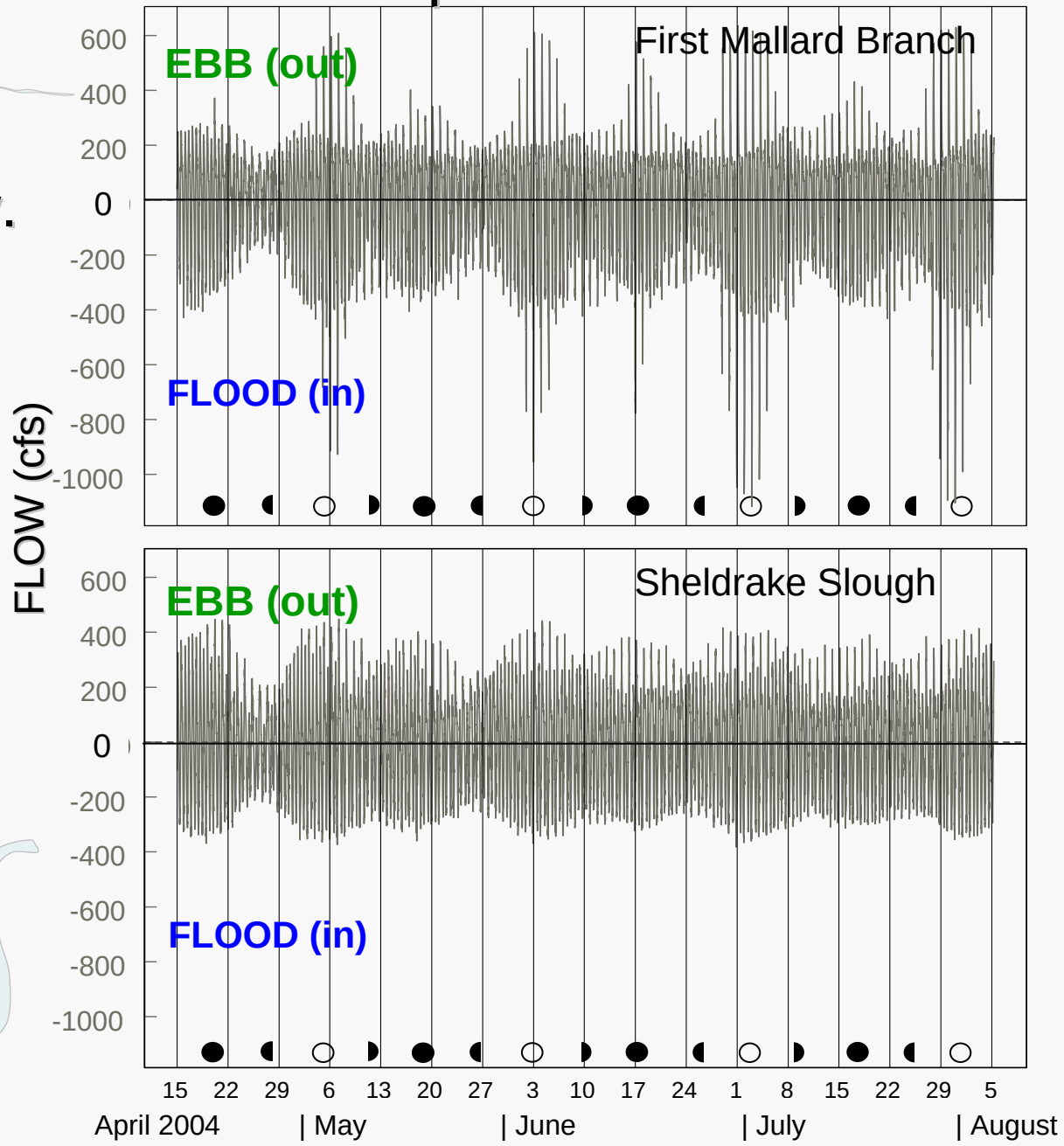


Key Ideas:

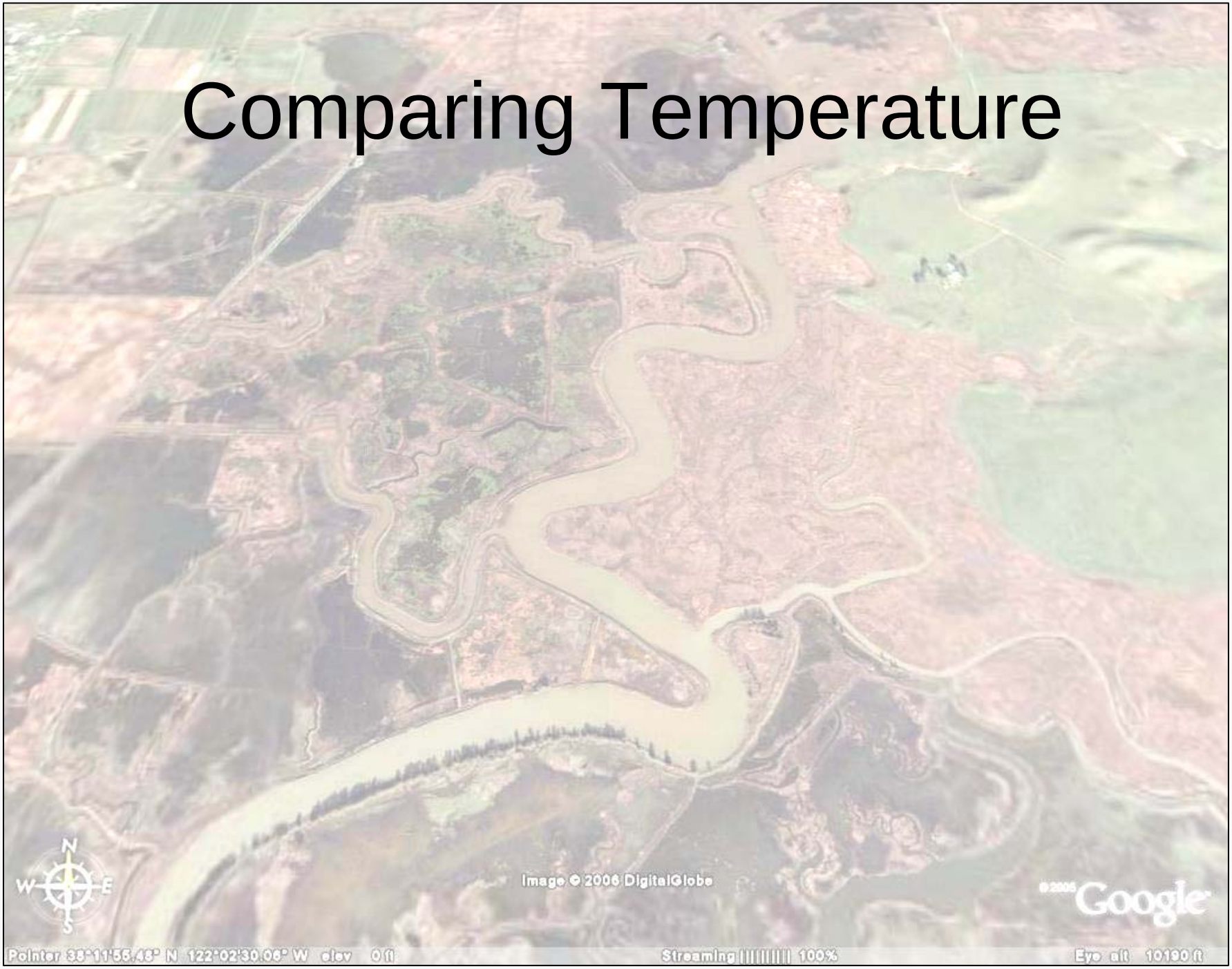
1. Tidal flow pattern responds to geometry.

2. Flow on tidal and spring-neap timescale is more variable in the natural slough

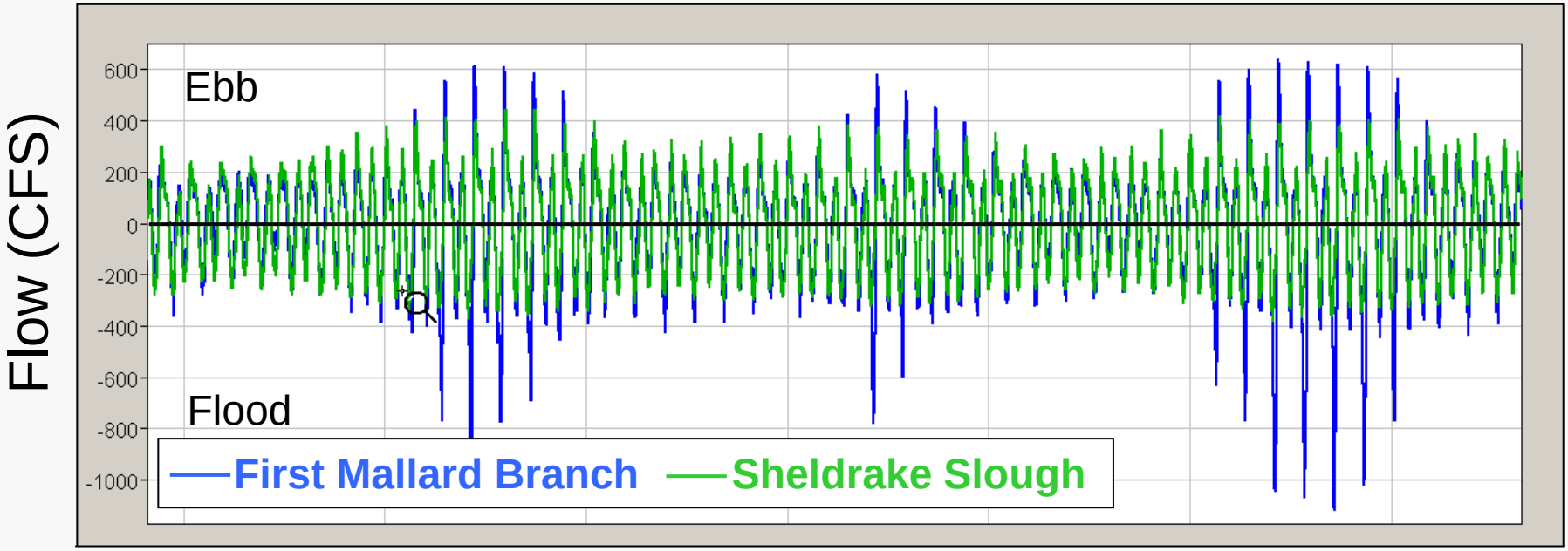
Compare Tidal Flow



Comparing Temperature



Flow and Temperature Variability



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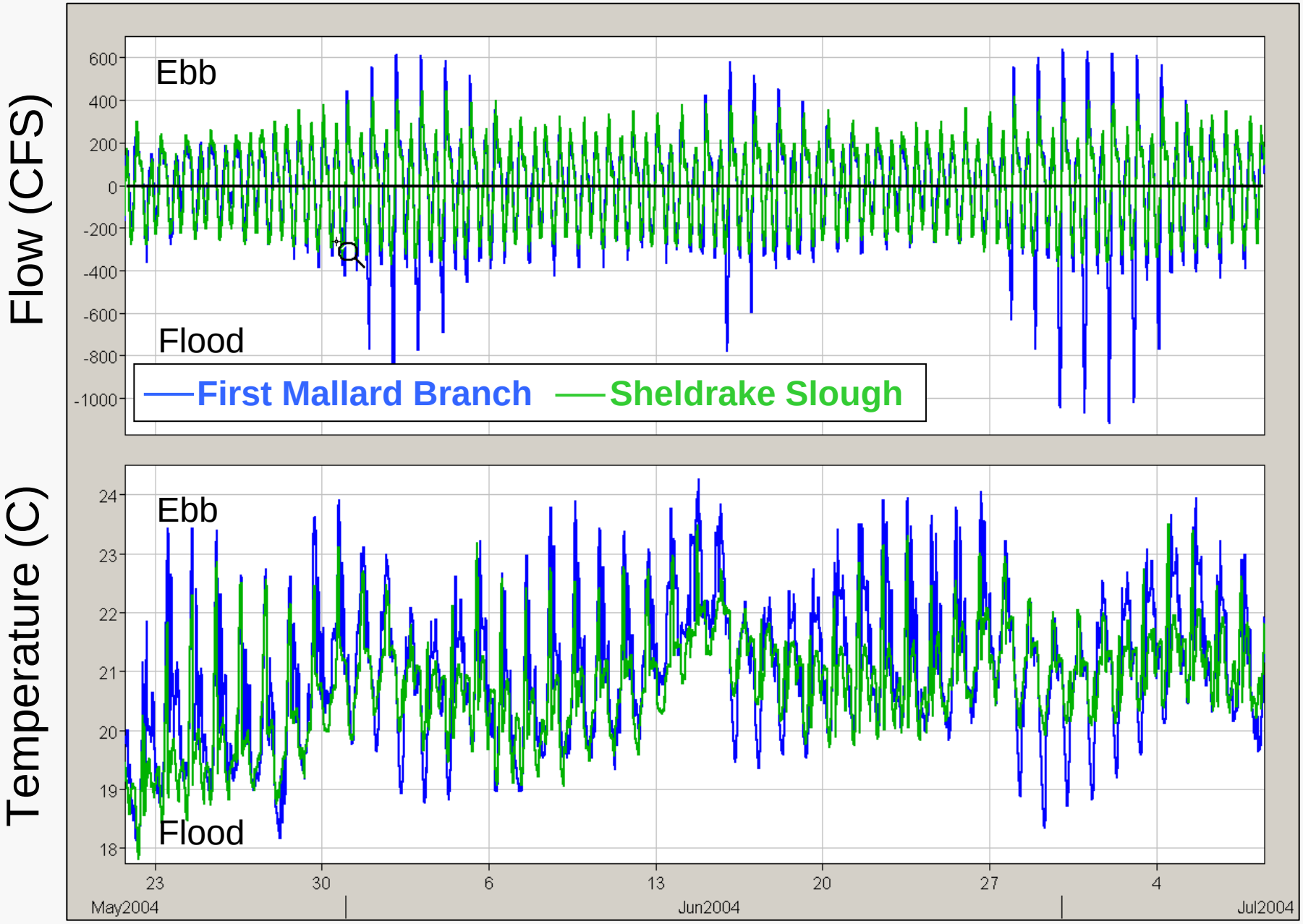

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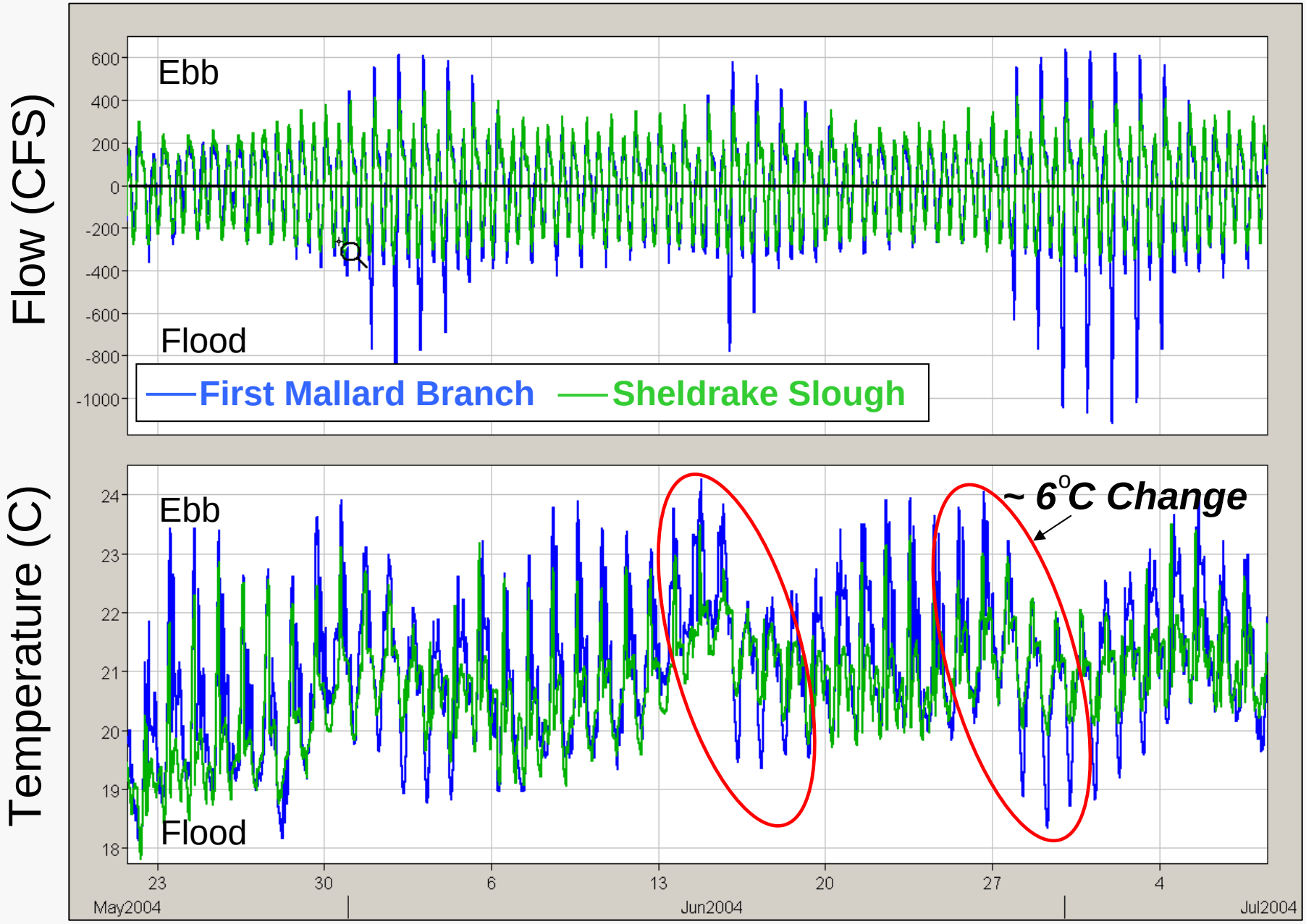

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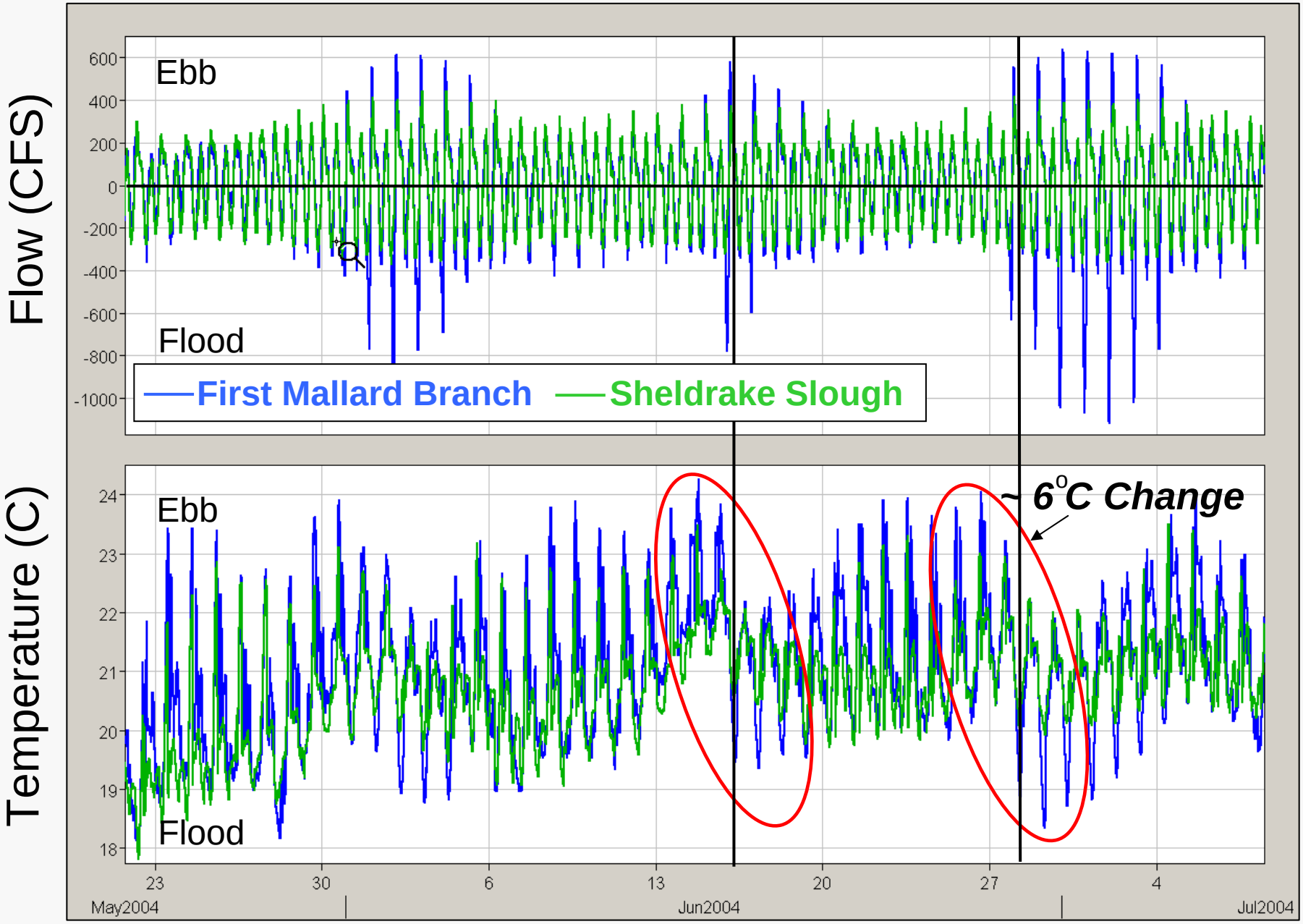
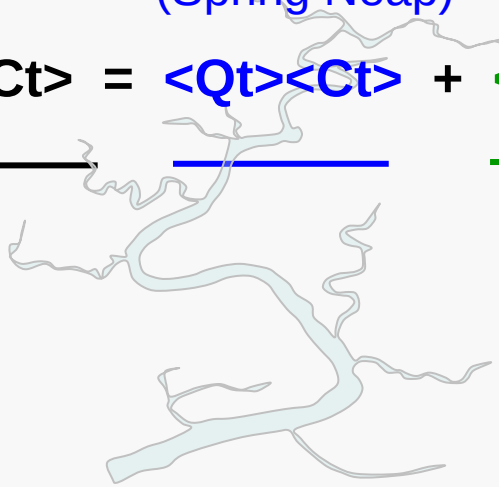


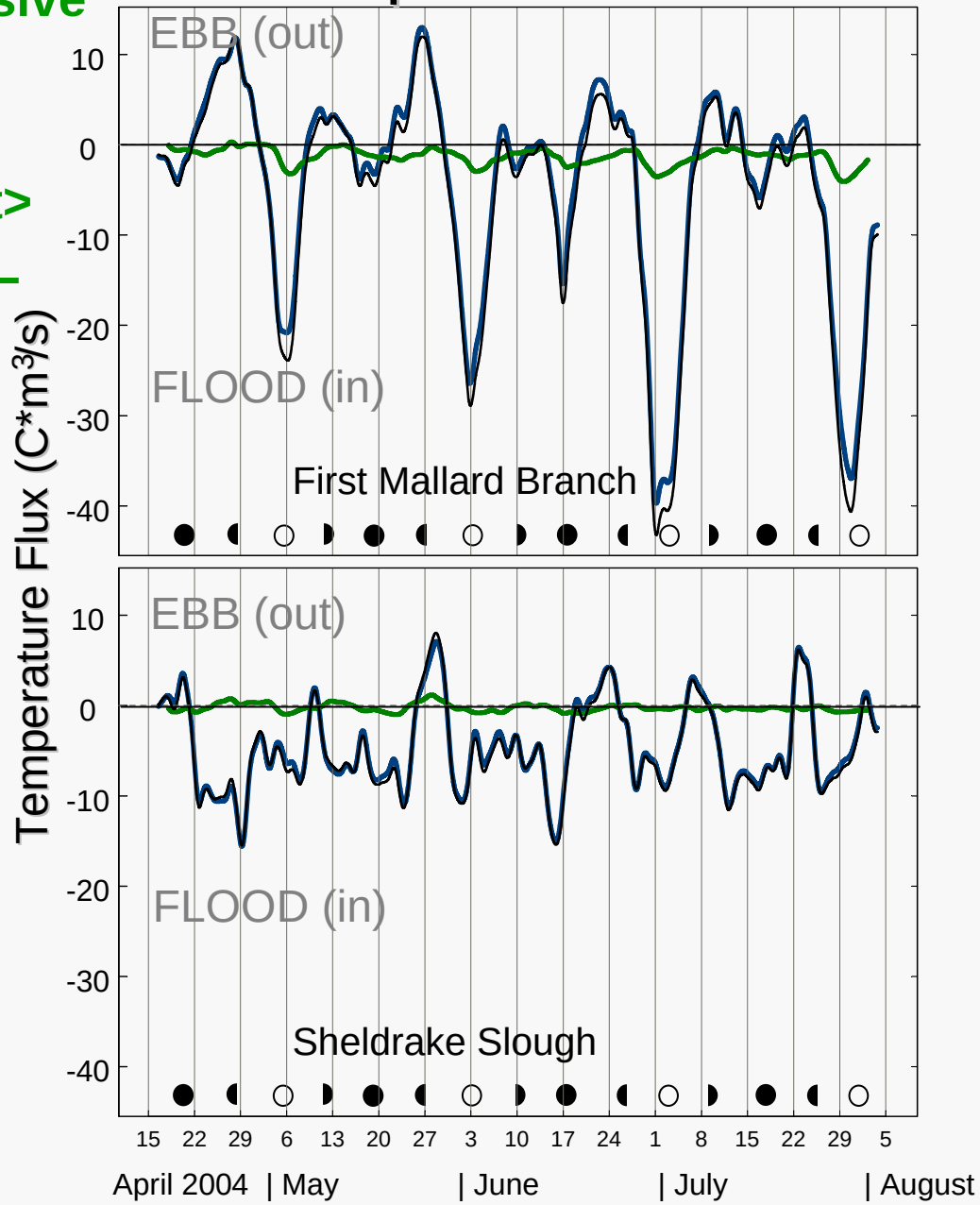
Temperature Flux

Total Flux = Advective Flux + Dispersive Flux

(Spring Neap) (Tides)

<Qt*Ct> = <Qt><Ct> + <Q't*C't>



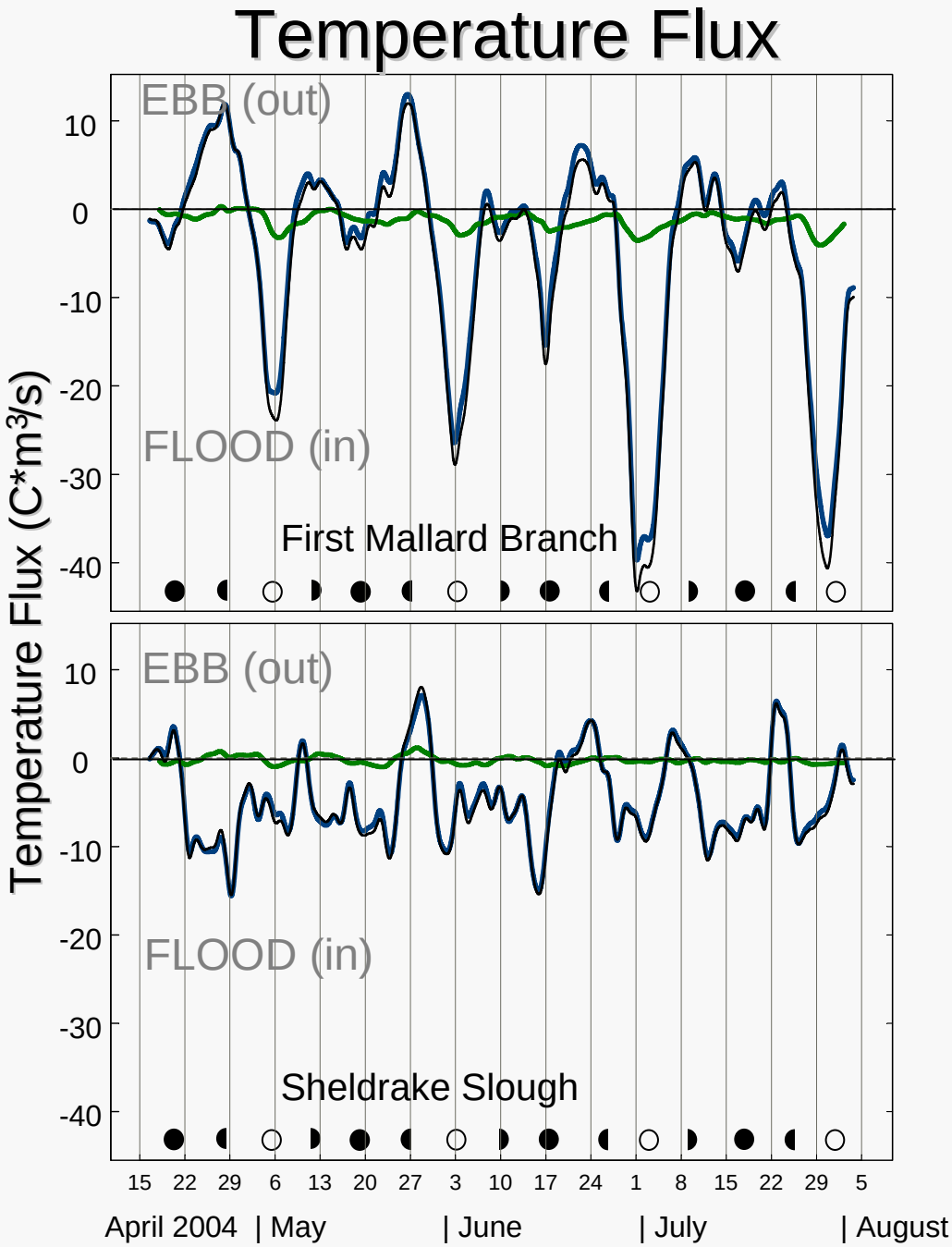


Key Ideas:

Temperature variability is influenced by marsh plain connectivity.

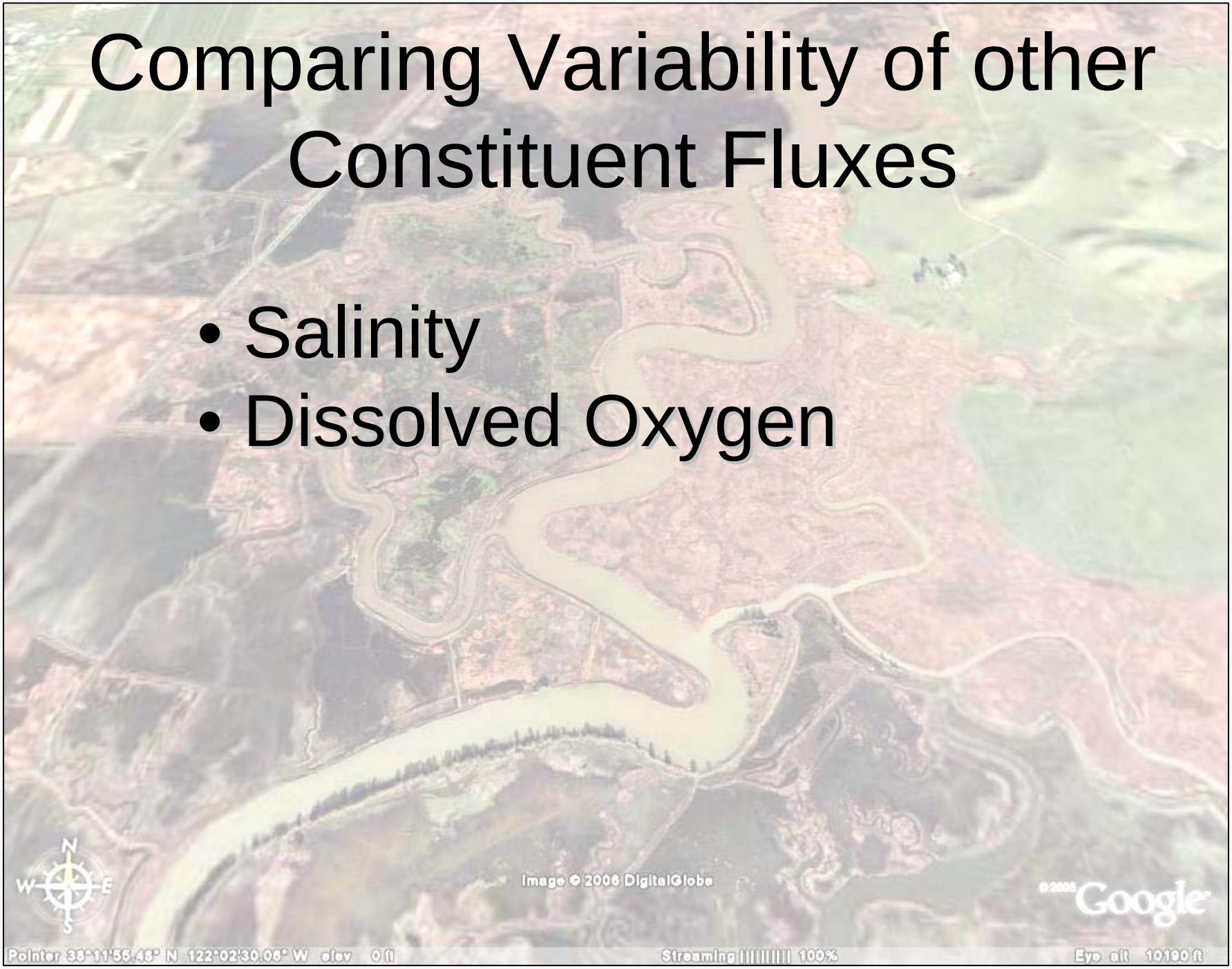
The natural slough generates more variable temperature response.

Natural slough heat flux is tied to lunar cycle



Comparing Variability of other Constituent Fluxes

- Salinity
- Dissolved Oxygen

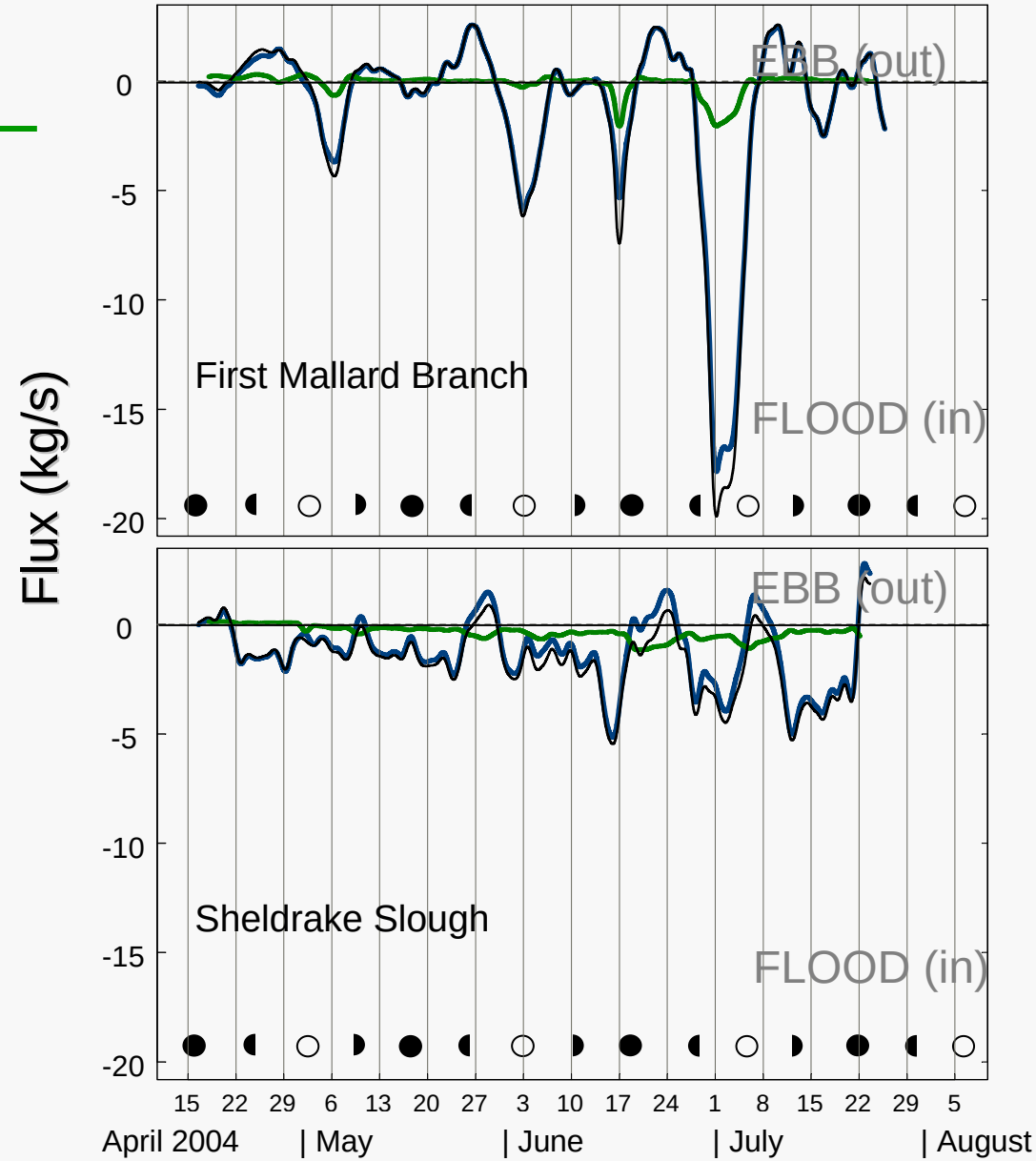


Salt Flux

Total Flux	=	Advective Flux (Spring-Neap)	+	Dispersive Flux (Tides)
<Qt*Ct>	=	<Qt><Ct>	+	<Q't*C't>

1. The natural slough is tied to lunar cycle

2. The natural slough is more variable



Dissolved Oxygen Flux

Total Flux	=	Advective Flux (Spring-Neap)	+	Dispersive Flux (Tides)
<Qt*Ct>	=	<Qt><Ct>	+	<Q't*C't>

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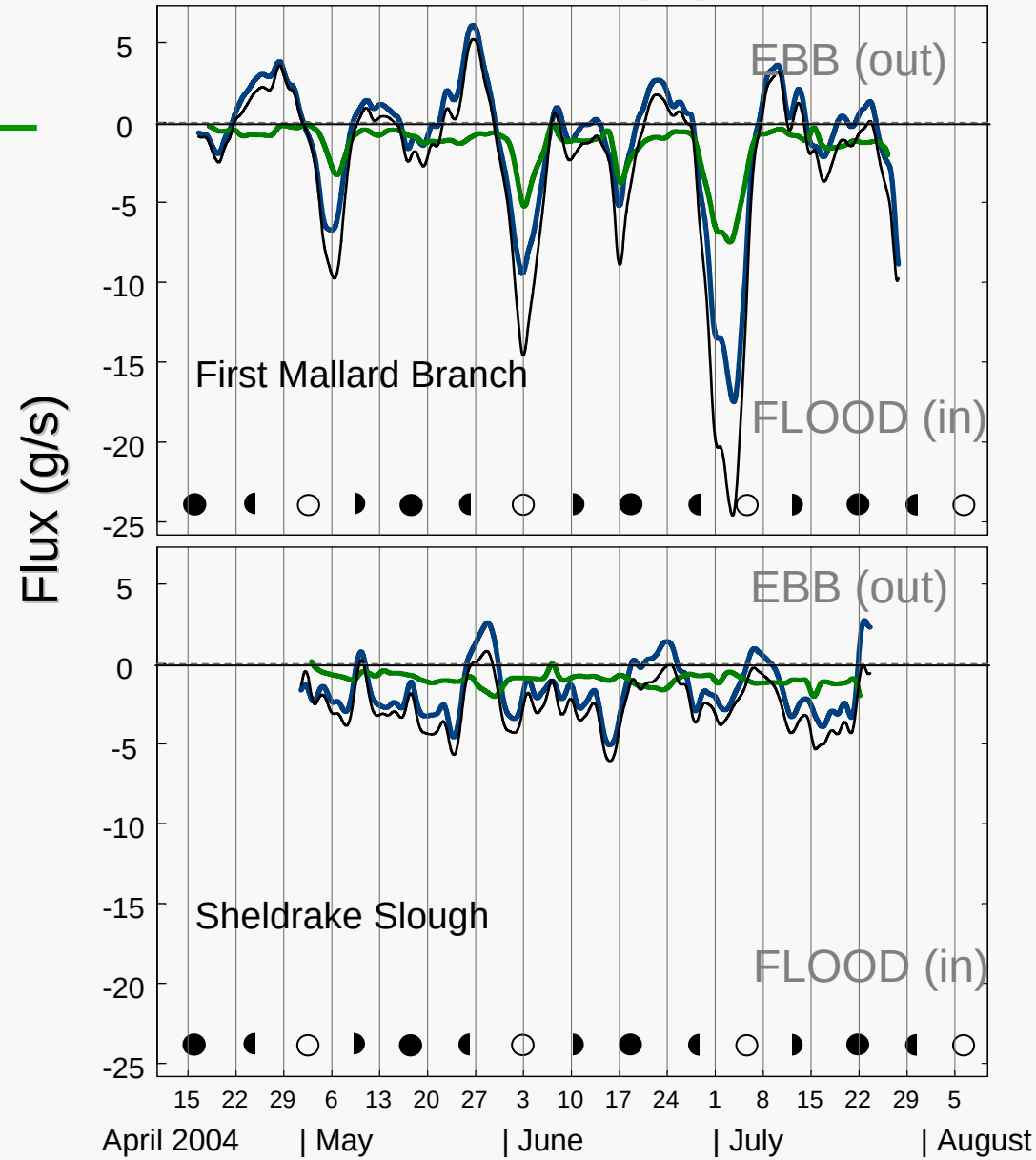


Conceptual Model:

Geometry “filters” estuarine drivers

Drivers
(forcing mechanisms)

- Meteorology
- Tides
- River inputs

→

Linkages
(hydrodynamic processes)

- Advection
- Dispersion
- Gravitational Circulation

→

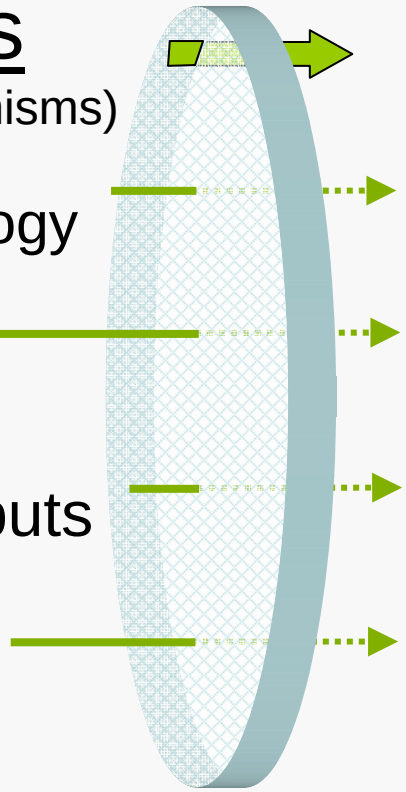
Outcomes
(Chemical/Biological Habitat Characteristics)

Gradients of
- Residence time
- Salinity
- Temperature
- Sediment
- Biota
- Toxics
- etc.

Conceptual Model:

Geometry “filters” estuarine drivers

Geometry
(Like a Filter)



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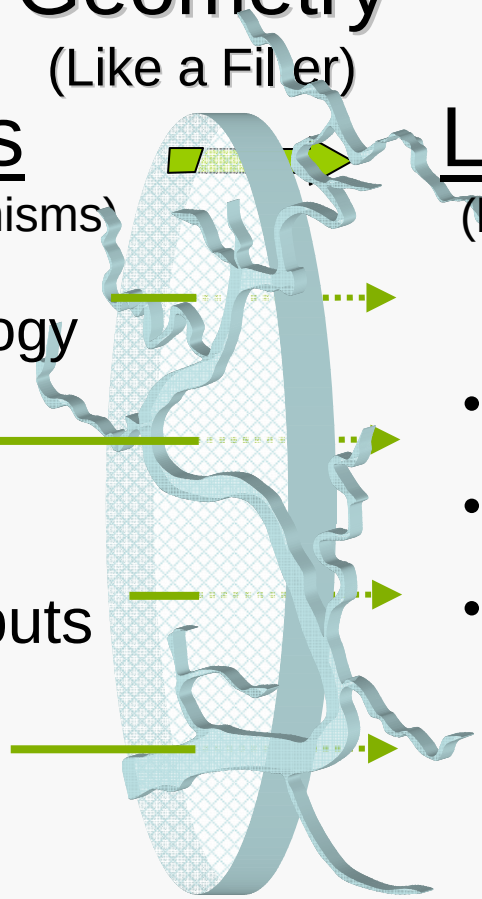

First Mallard Branch

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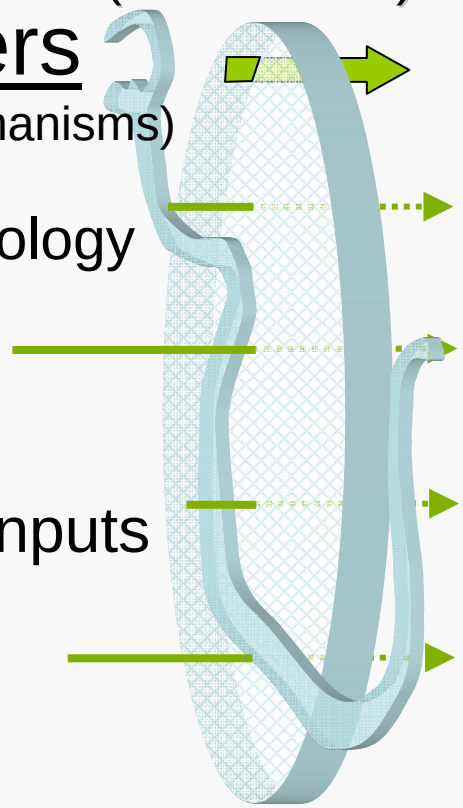

Sheldrake Slough

Linkages

(hydrodynamic processes)

- Advection
- Dispersion
- Gravitational Circulation

Outcomes

(Chemical/Biological Habitat Characteristics)

Gradients of

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- etc.

Summary

- Landscape geometry “filters” estuarine drivers.
- Mature tidal marshes are tightly coupled to the spring-neap cycle.
- More complex “geometry” begets more variable process response.
- Physical, chemical, and biological processes are all more variable in the natural slough.
- Native plants/fishes evolved on the natural template.

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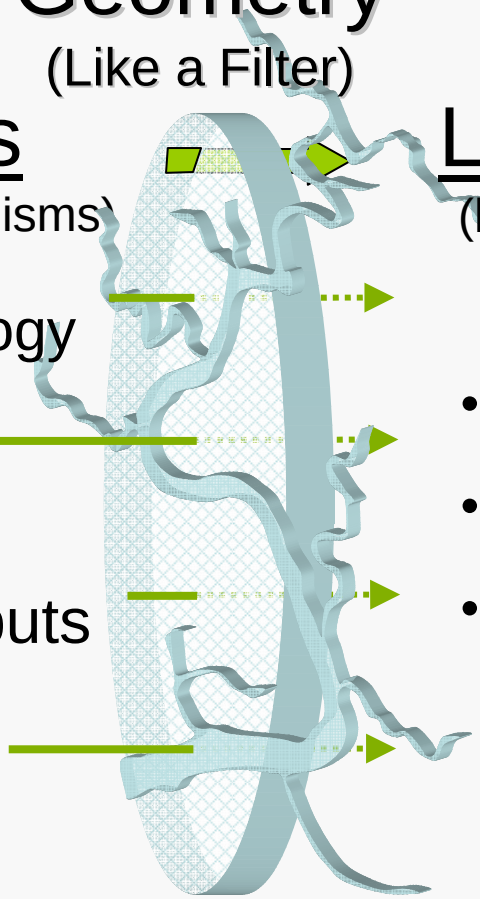
Geometry “filters” estuarine drivers

Geometry

(Like a Filter)



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