Transport processes: Time scale correlation between flow and scalar concentration

Chris Enright

CWEMF DSM2 Workshop

February 6, 2007

Or, how Geometry “filters” estuarine drivers (tides, river input)

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Transport processes

- For modeling purposes, validate that DSM2 transports salt etc. for the right reason…
- Reasons: Advection and dispersion

Advective Transport

- Correlation between net flow and net scalar concentration
- Mostly from river input and spring-neap estuary fill-drain cycle
- **Advective Flux = <Qt><Ct>**

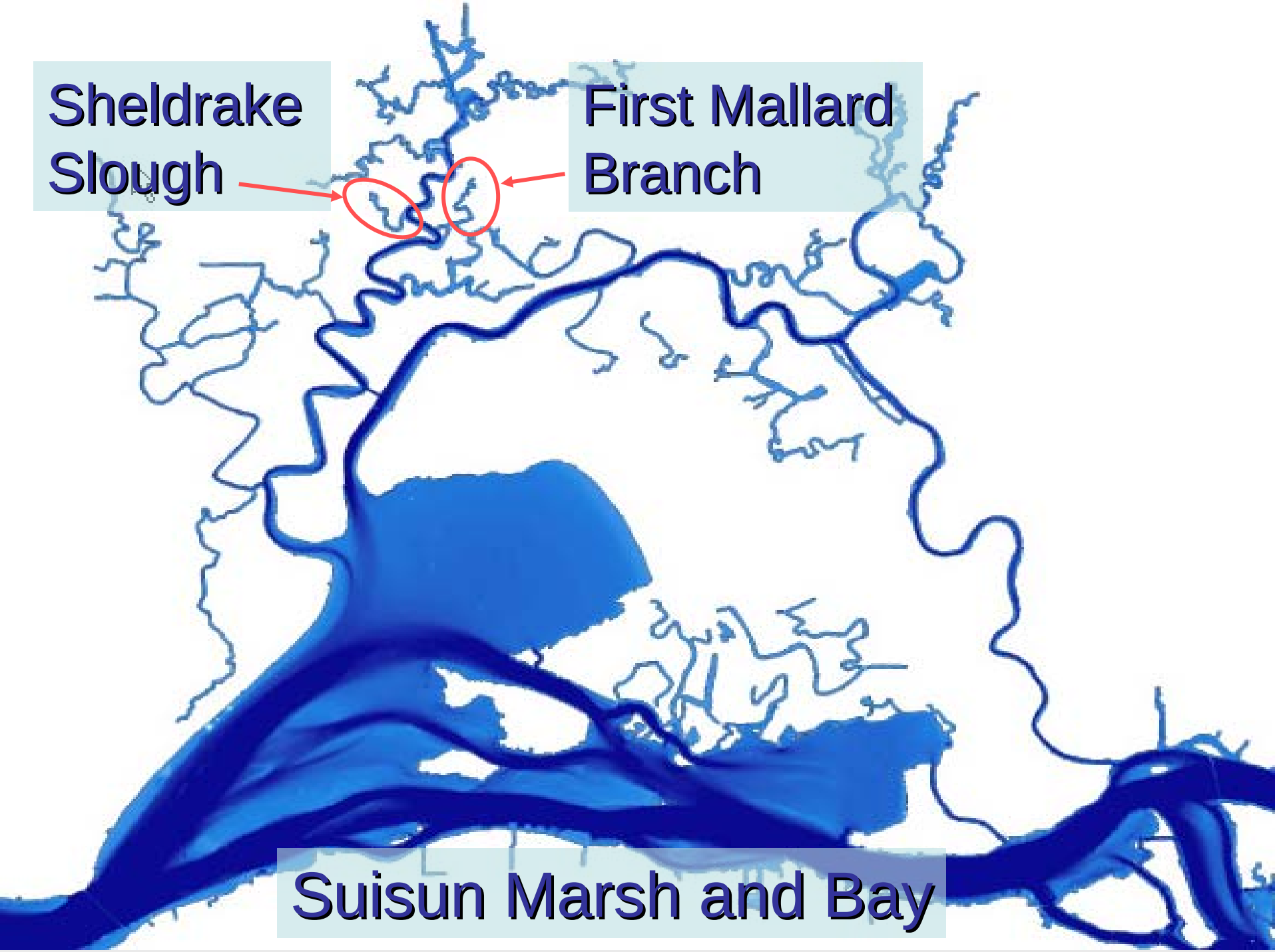
Dispersive Transport

- Correlation between tidal flow and tidal scalar concentration
- Driven by tide
- **Dispersive Flux = <Q’t*C’t>**

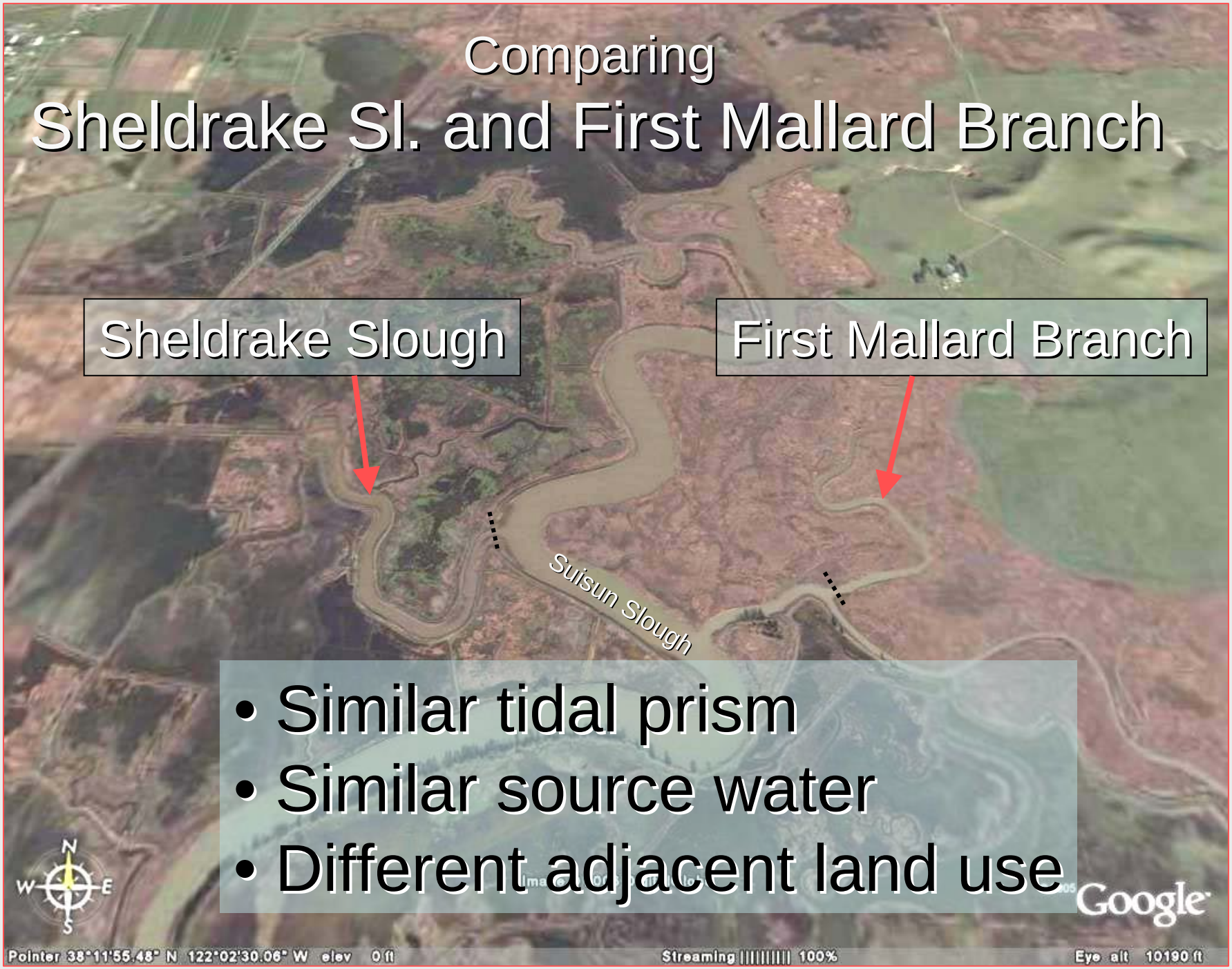
Total Flux

- Superposition of advective and dispersive flux.
- Total Flux = advection + disperion

  <Qt*Ct> = <Qt><Ct> + <Q’t*C’t>
- Compute with model output and field data and compare.

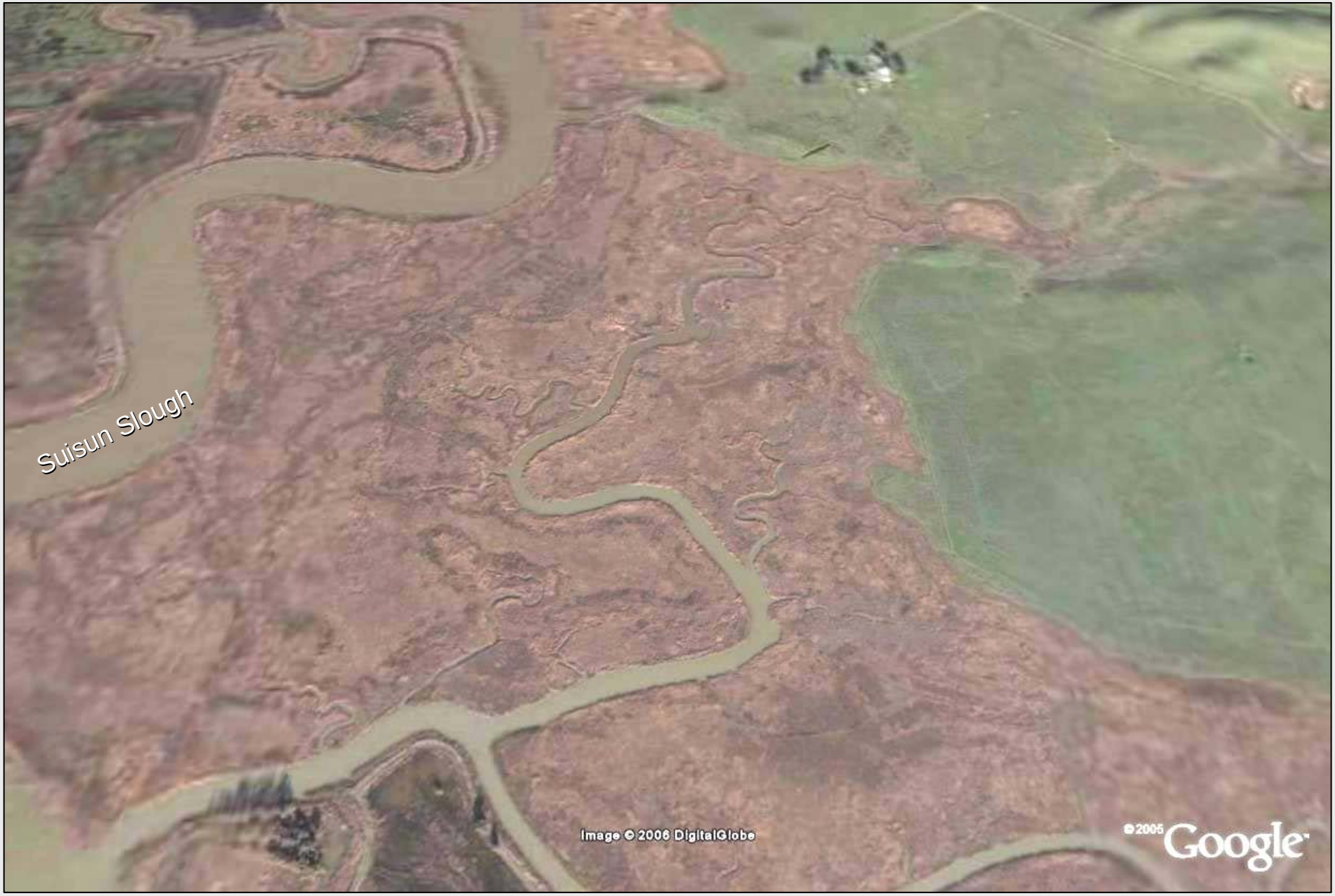

Sheldrake Slough
First Mallard Branch
Suisun Marsh and Bay

Comparing
Sheldrake Sl. and First Mallard Branch



- Similar tidal prism
- Similar source water
- Different adjacent land use

First Mallard Branch



First Mallard Branch

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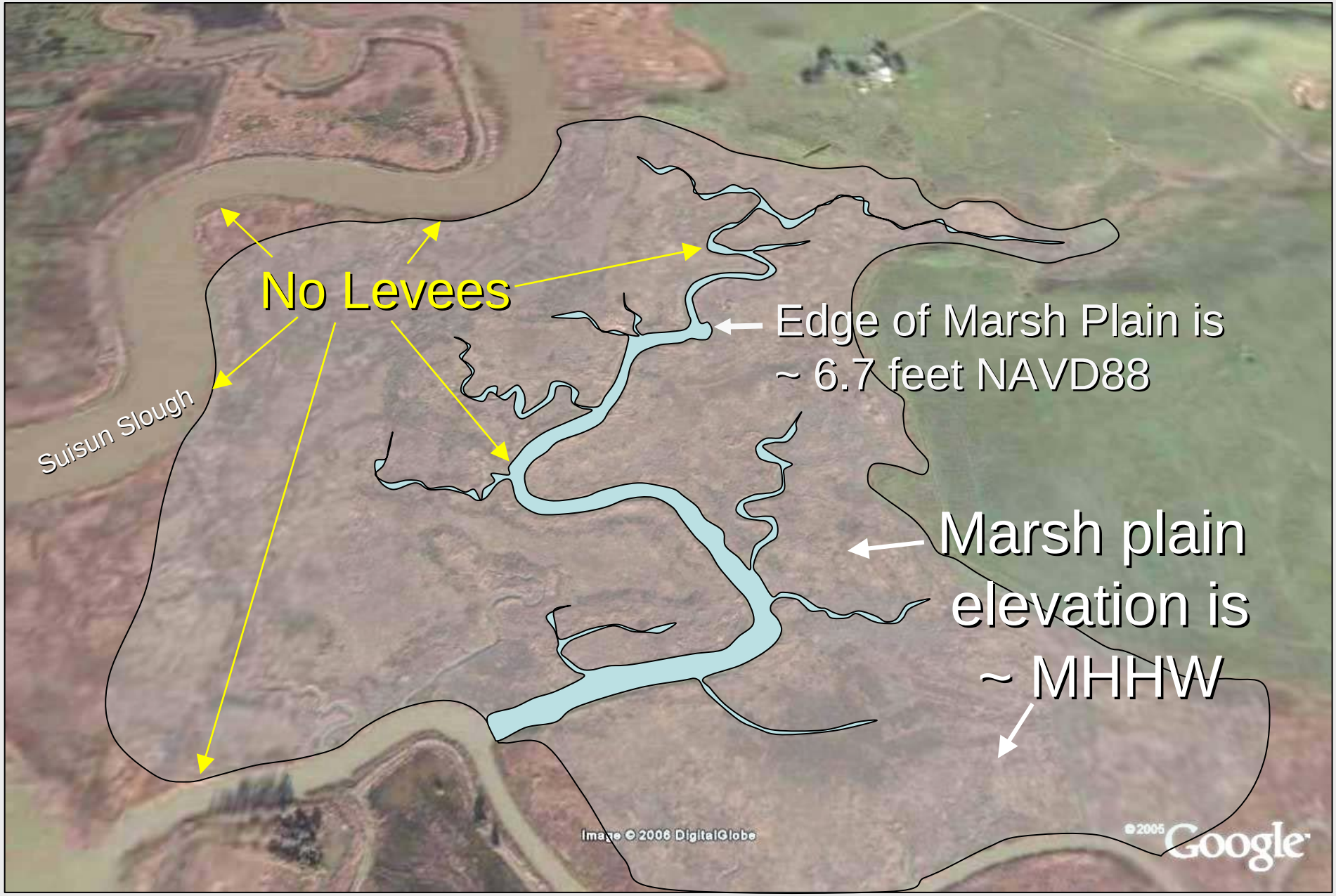
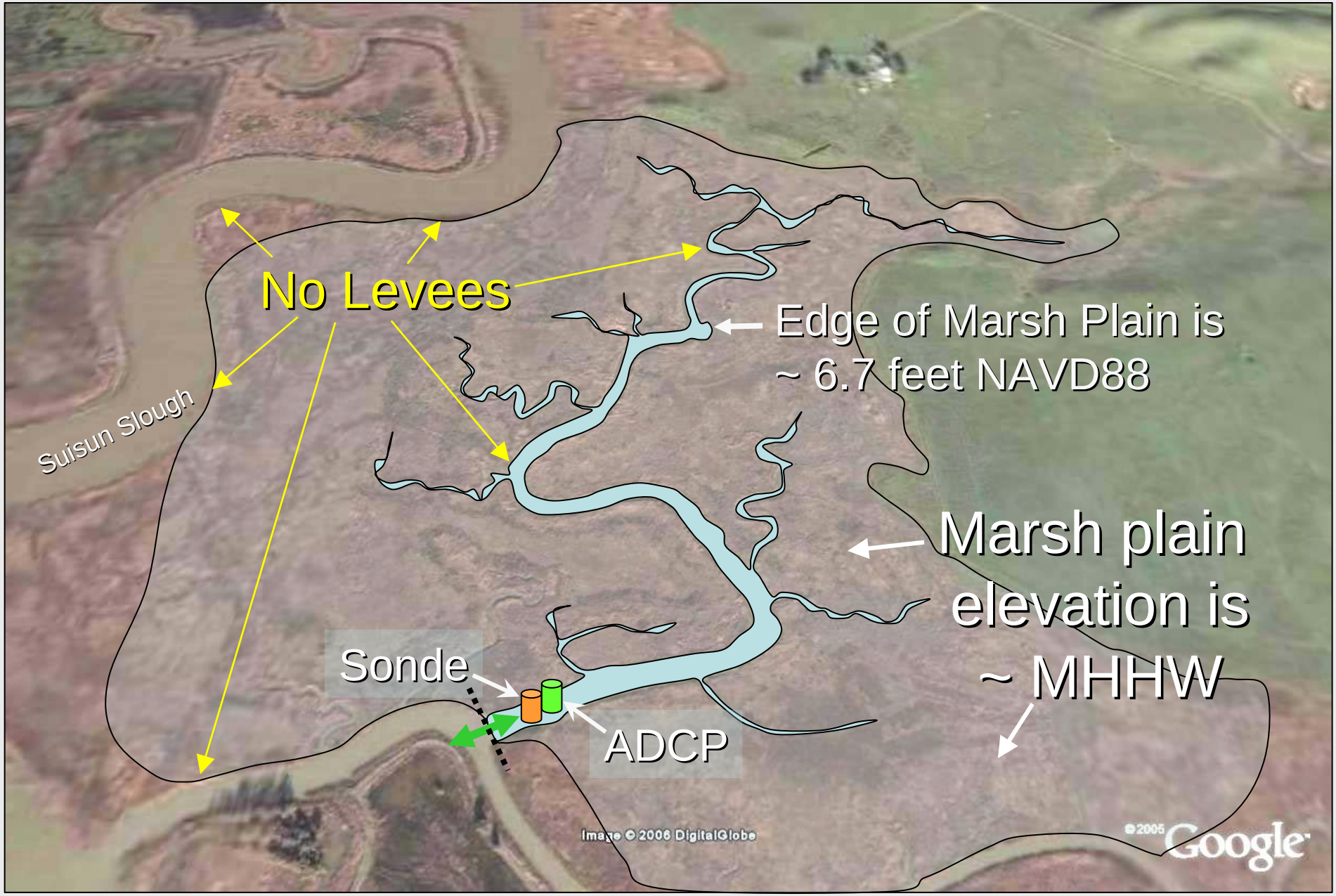


First Mallard Branch



Sheldrake Slough

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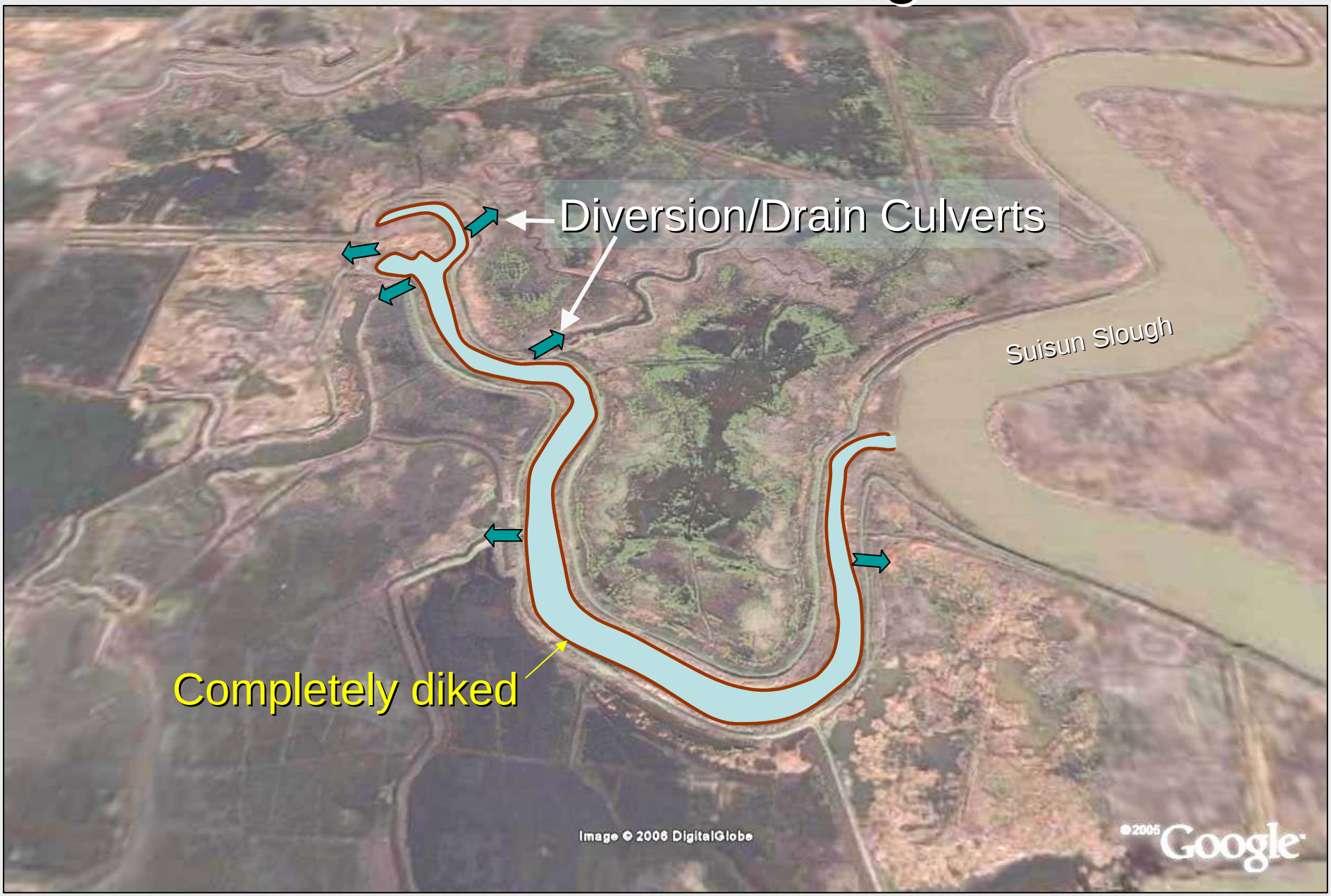
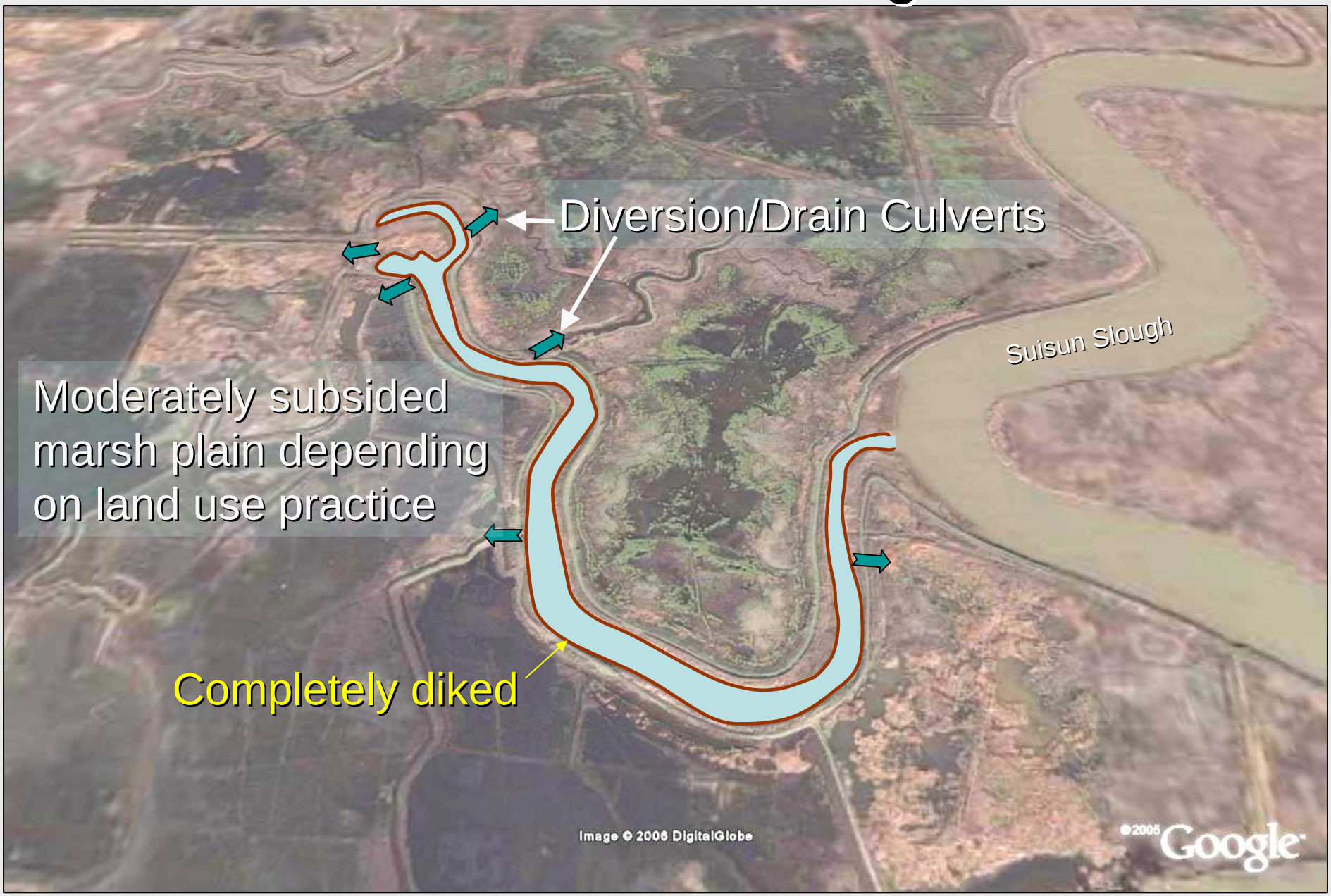
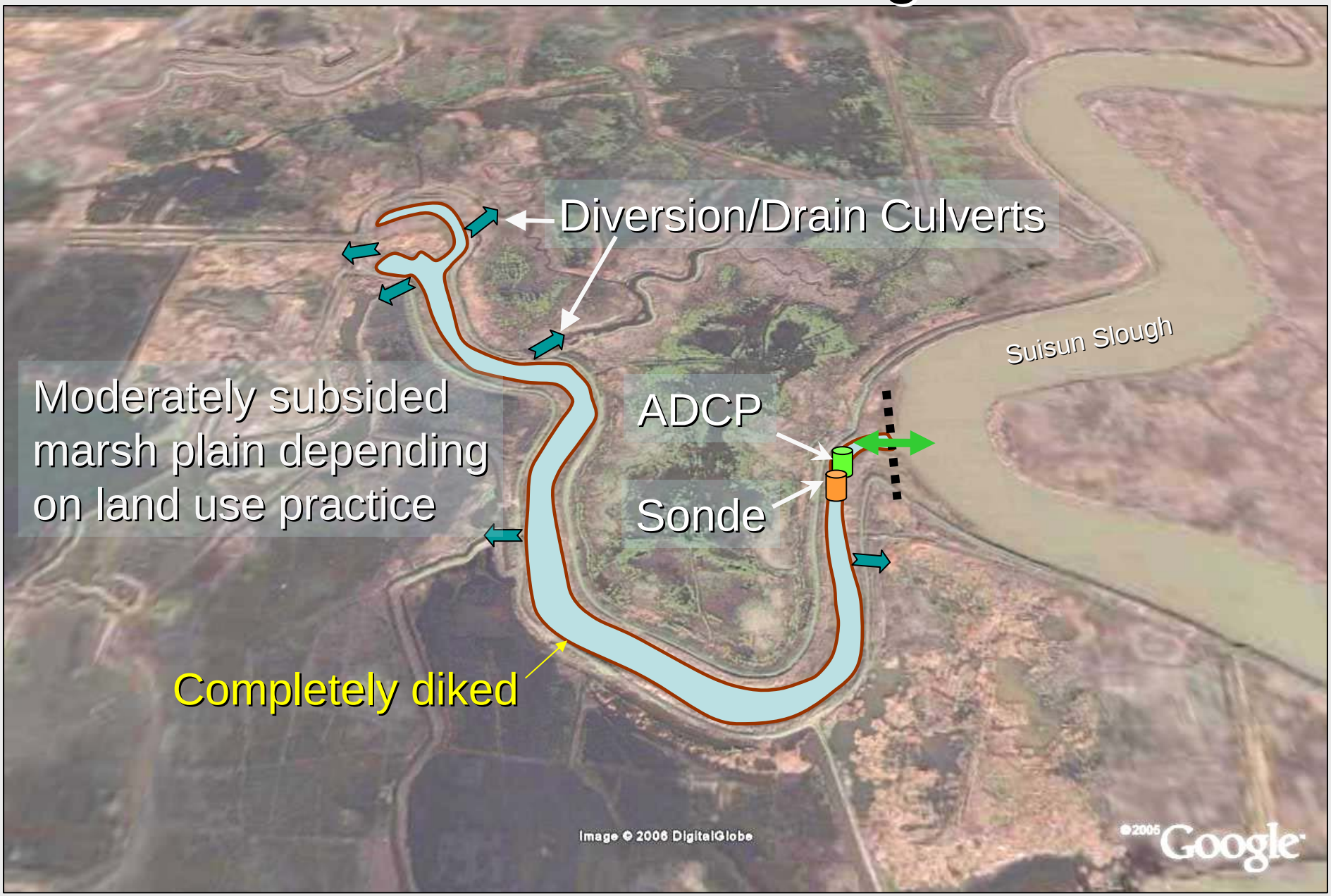
Sheldrake Slough



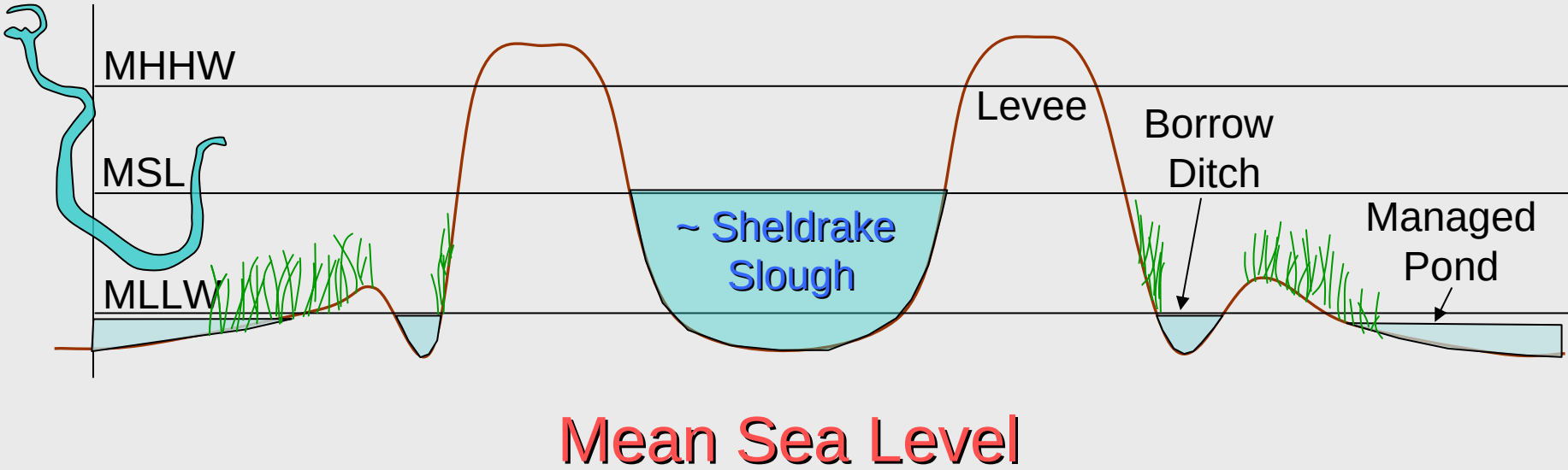
Sheldrake Slough



Sheldrake Slough



Comparing Typical Cross-section Hypsography



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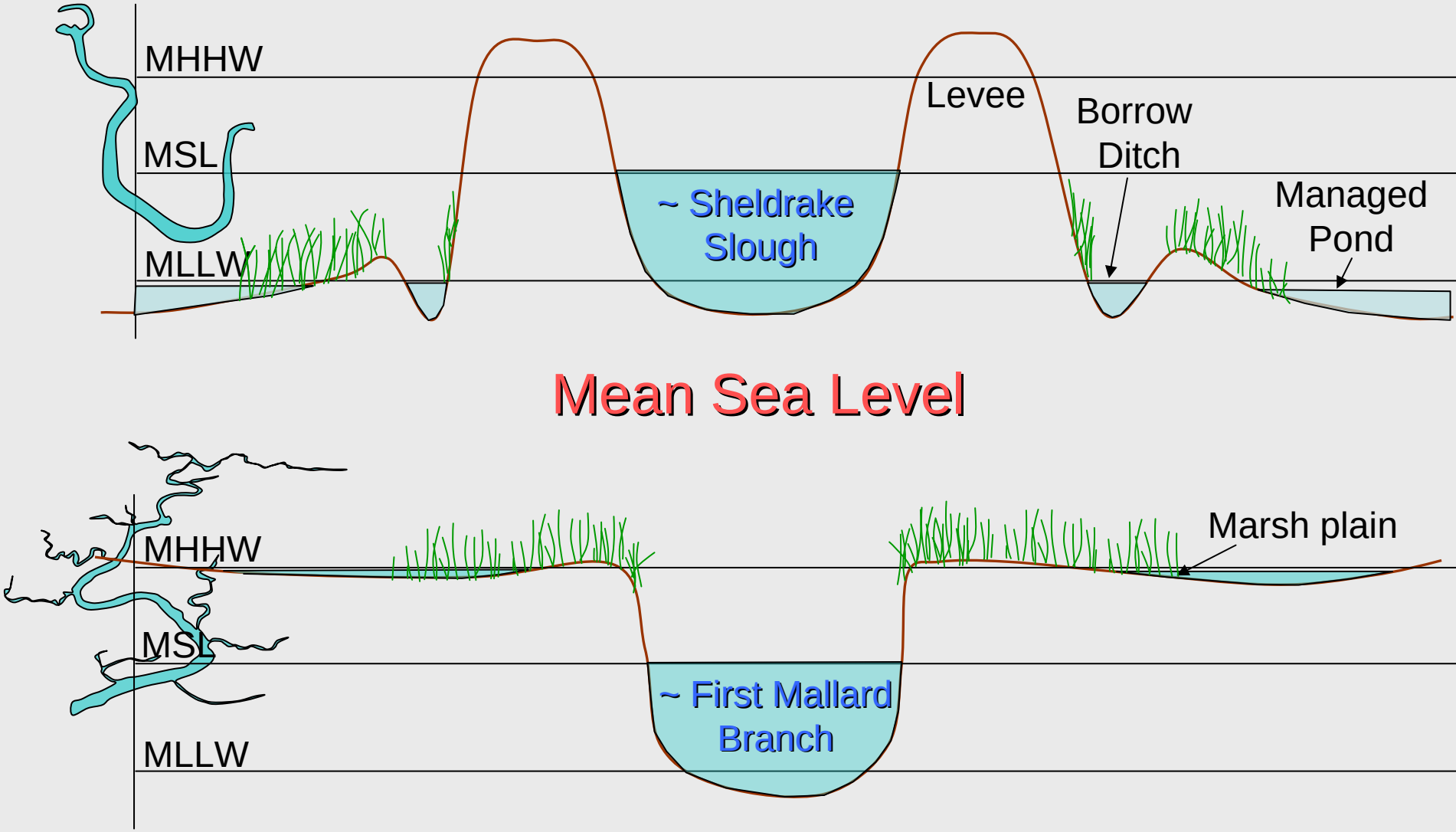

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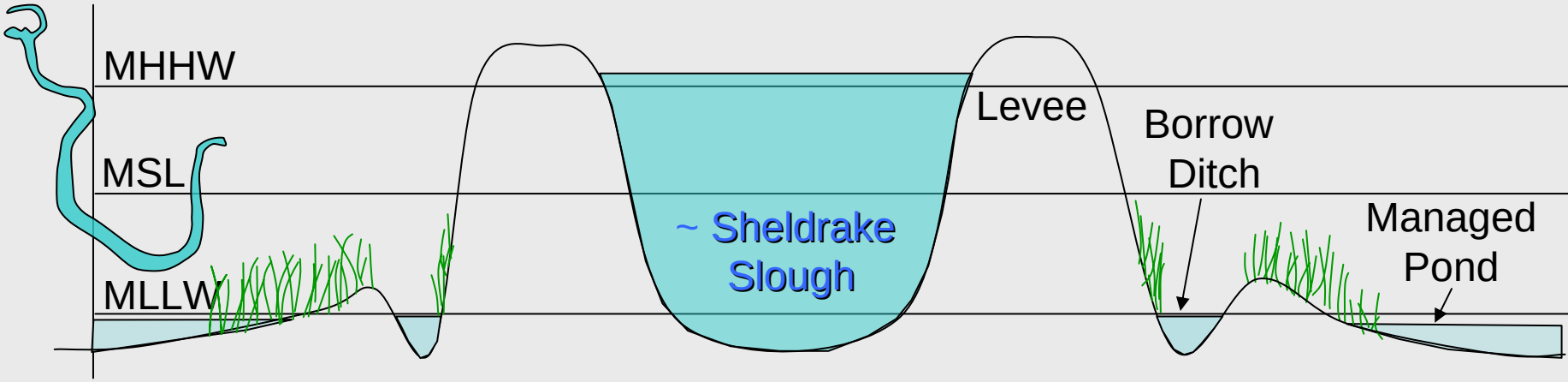
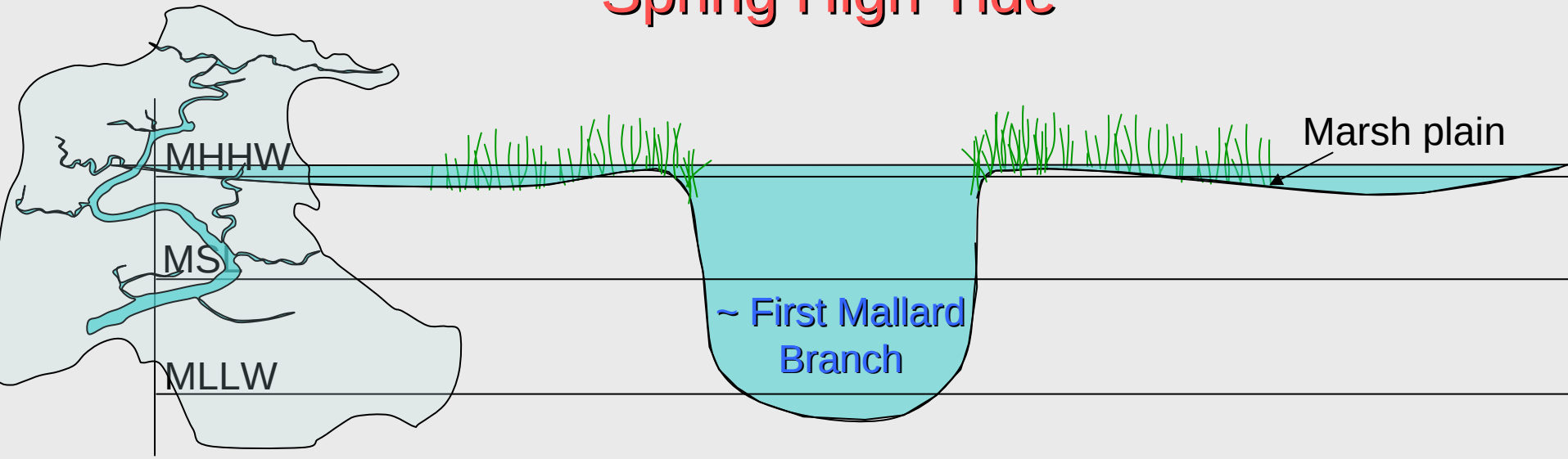
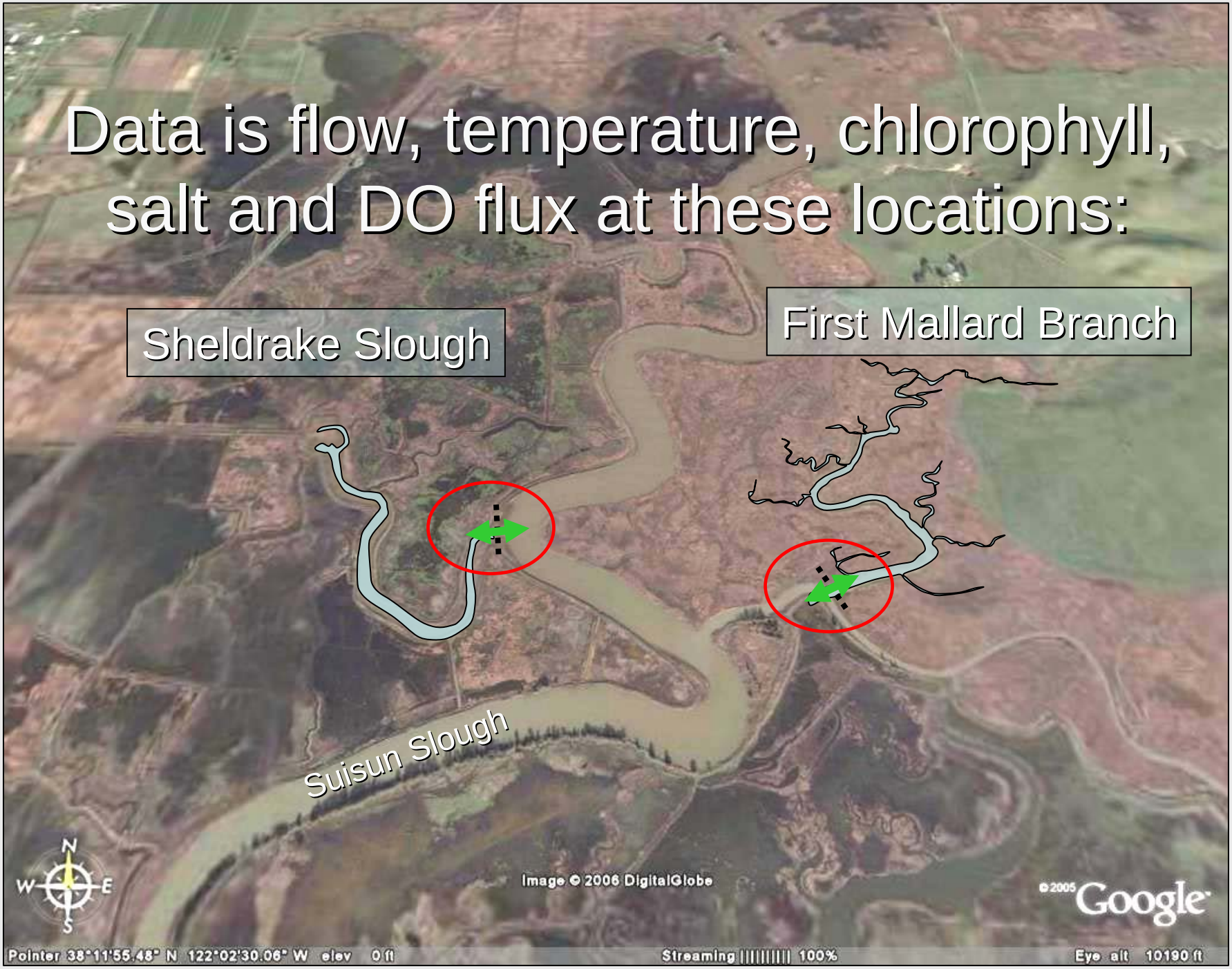


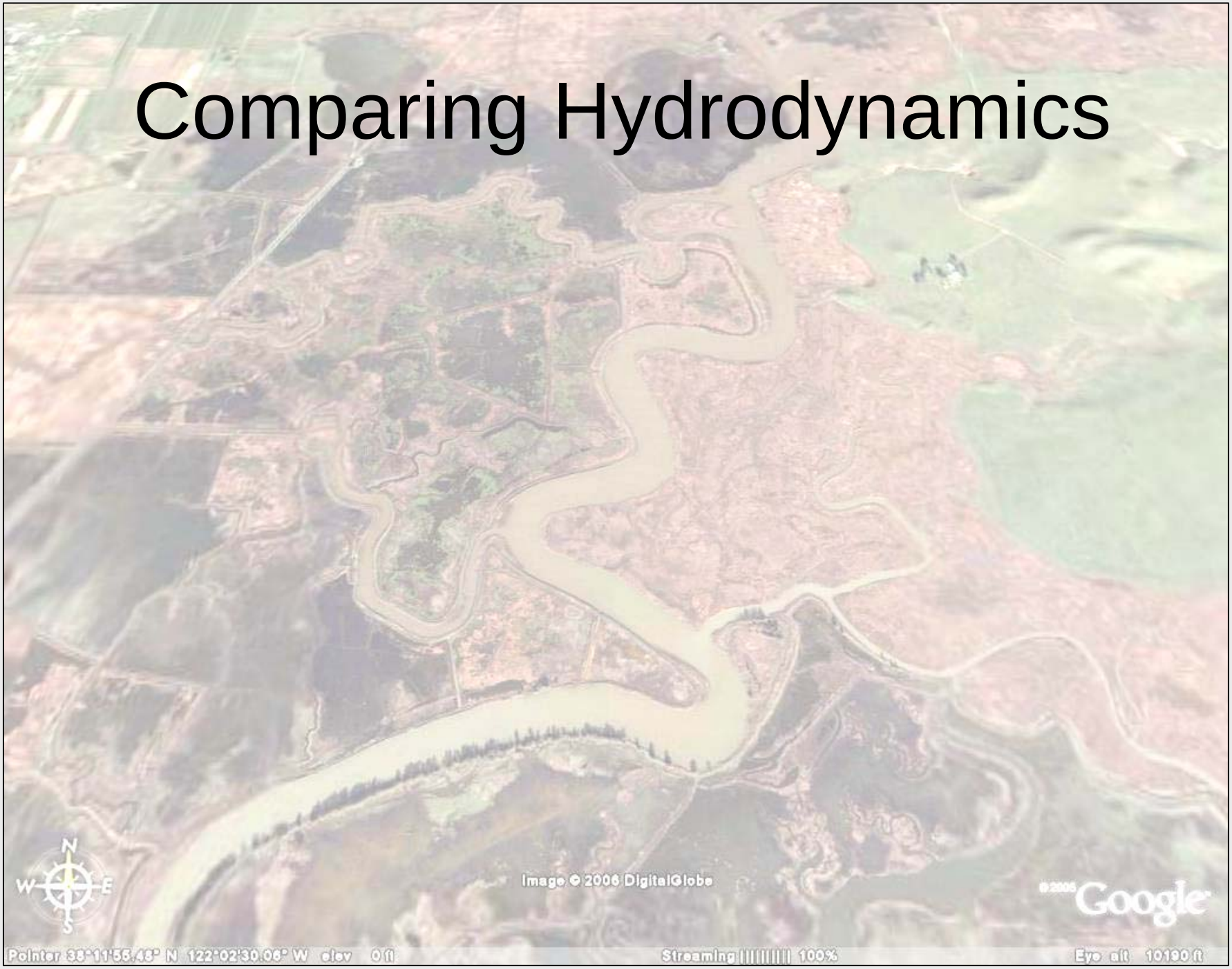
Spring High Tide



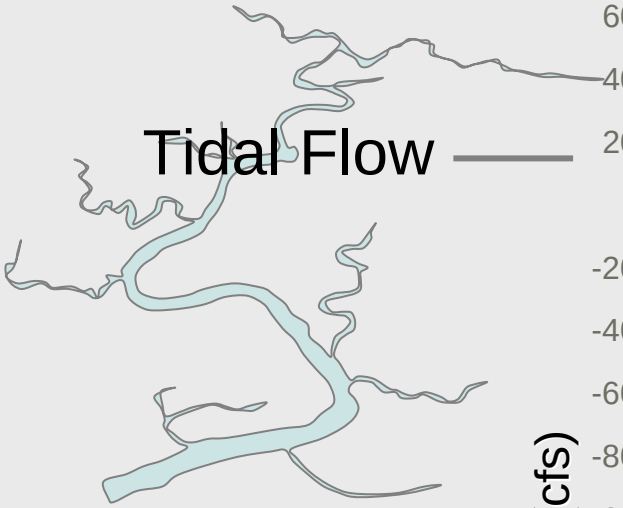
Data is flow, temperature, chlorophyll, salt and DO flux at these locations:

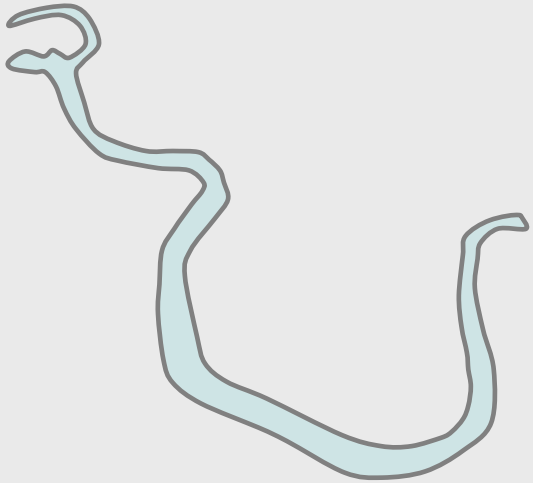


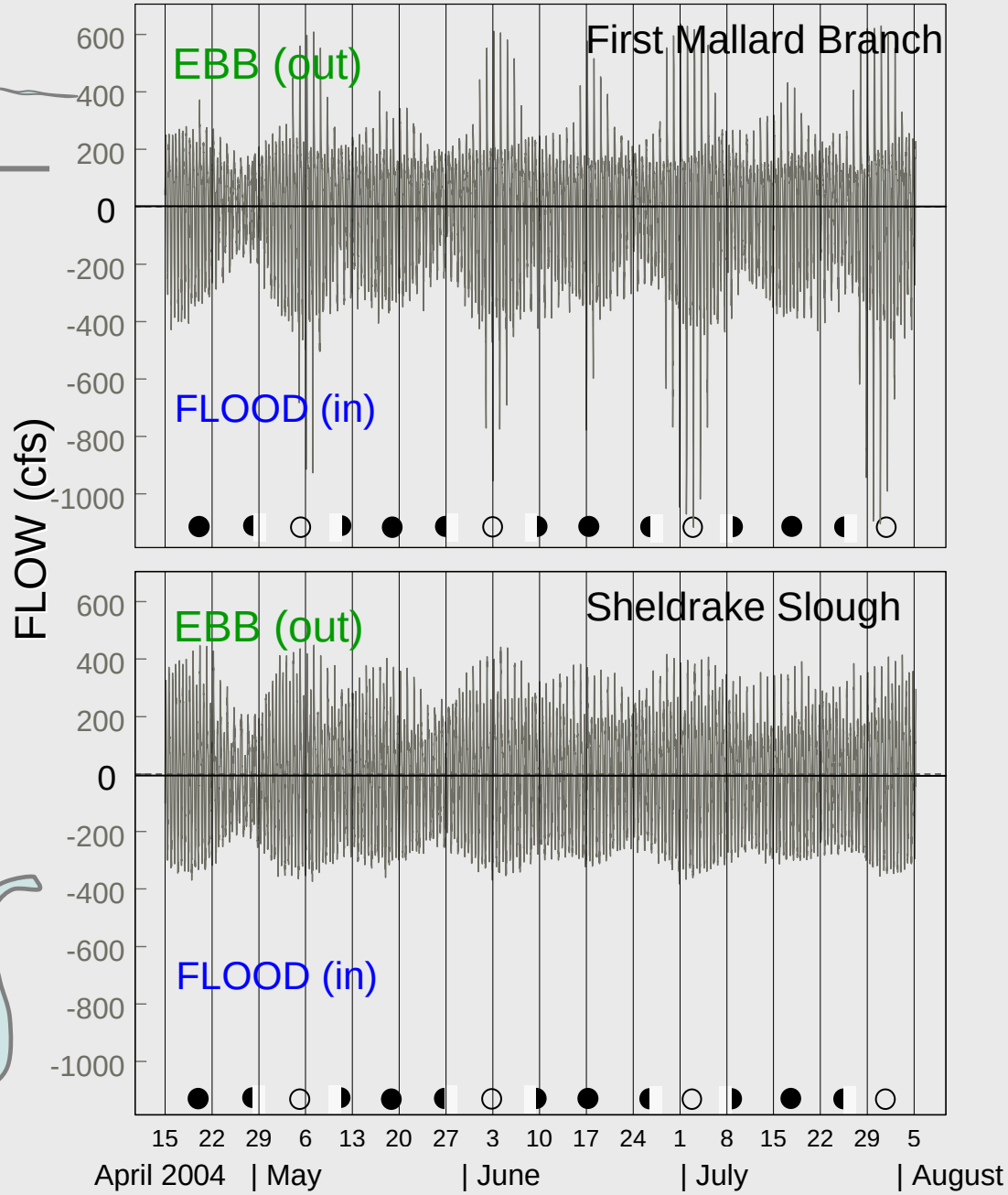
Comparing Hydrodynamics



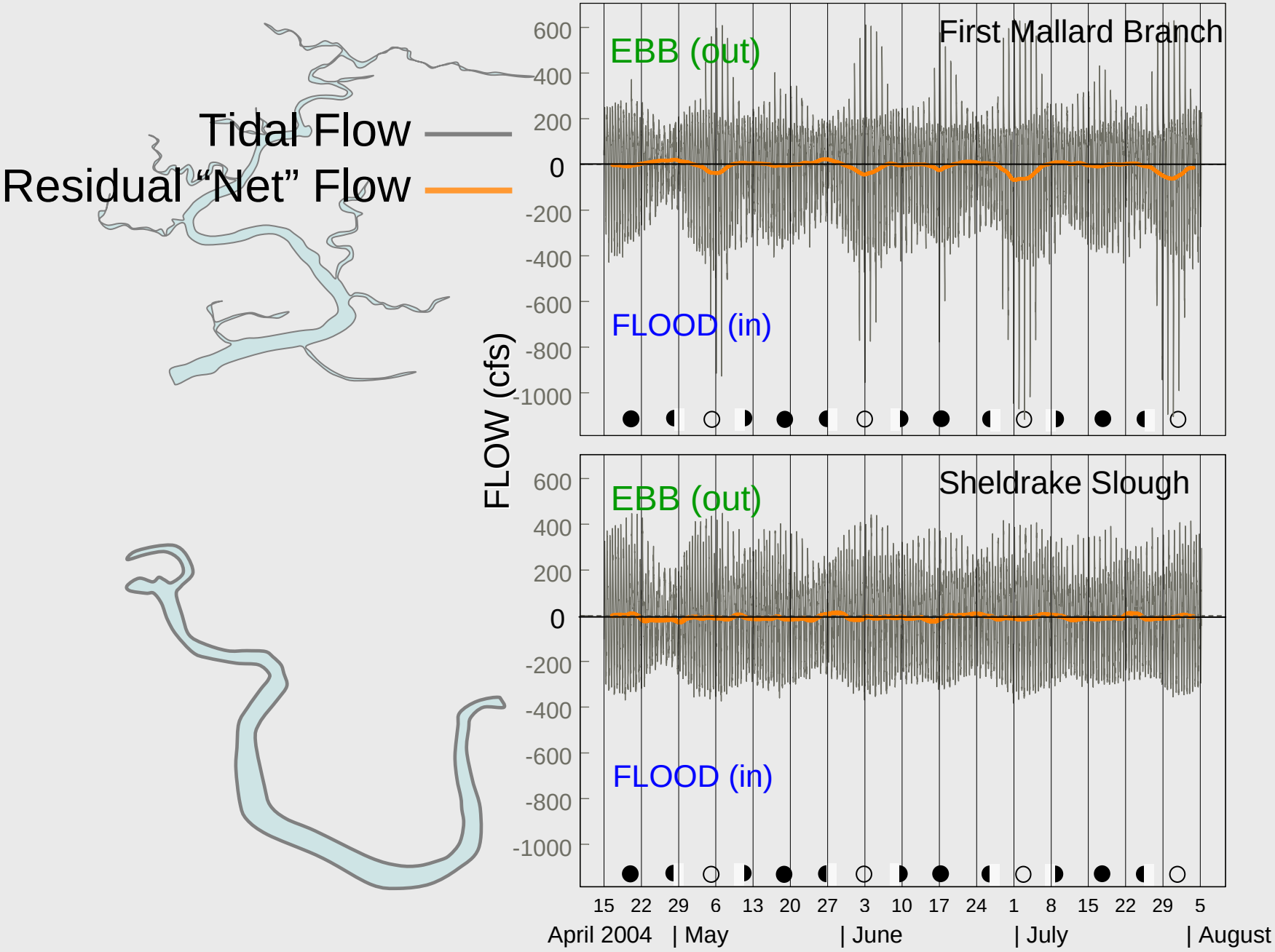
Tidal Flow


Tidal Flow




First Mallard Branch
EBB (out)
FLOOD (in)
Sheldrake Slough
EBB (out)
FLOOD (in)
FLOW (cfs)
600
400
200
0
-200
-400
-600
-800
-1000
15 22 29 6 13 20 27 3 10 17 24 1 8 15 22 29 5
April 2004 | May | June | July | August

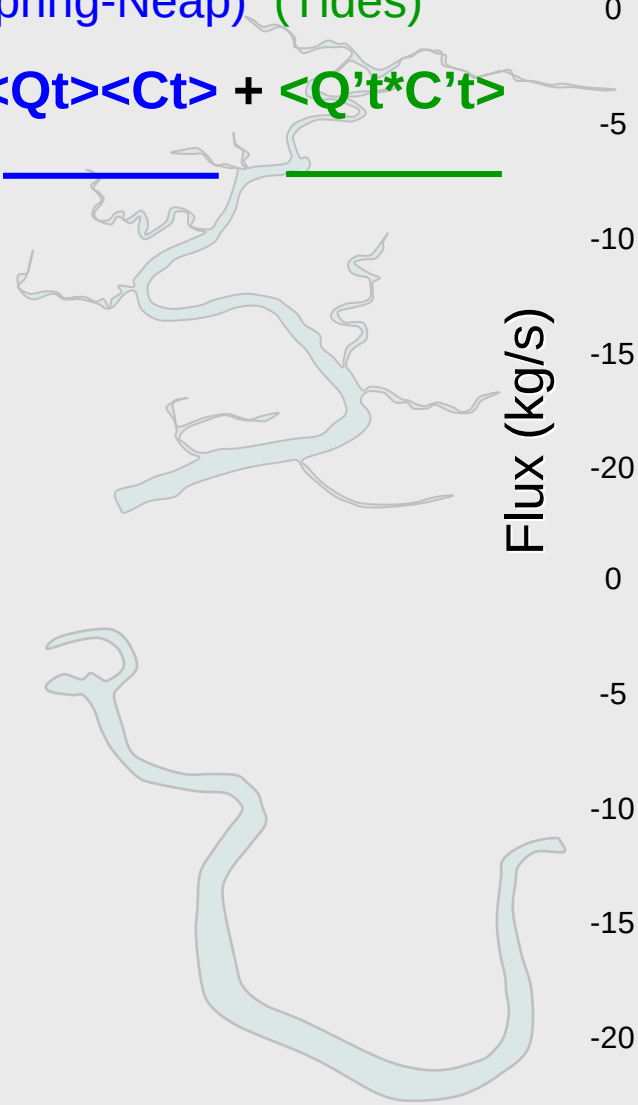
Tidal and Net Flow



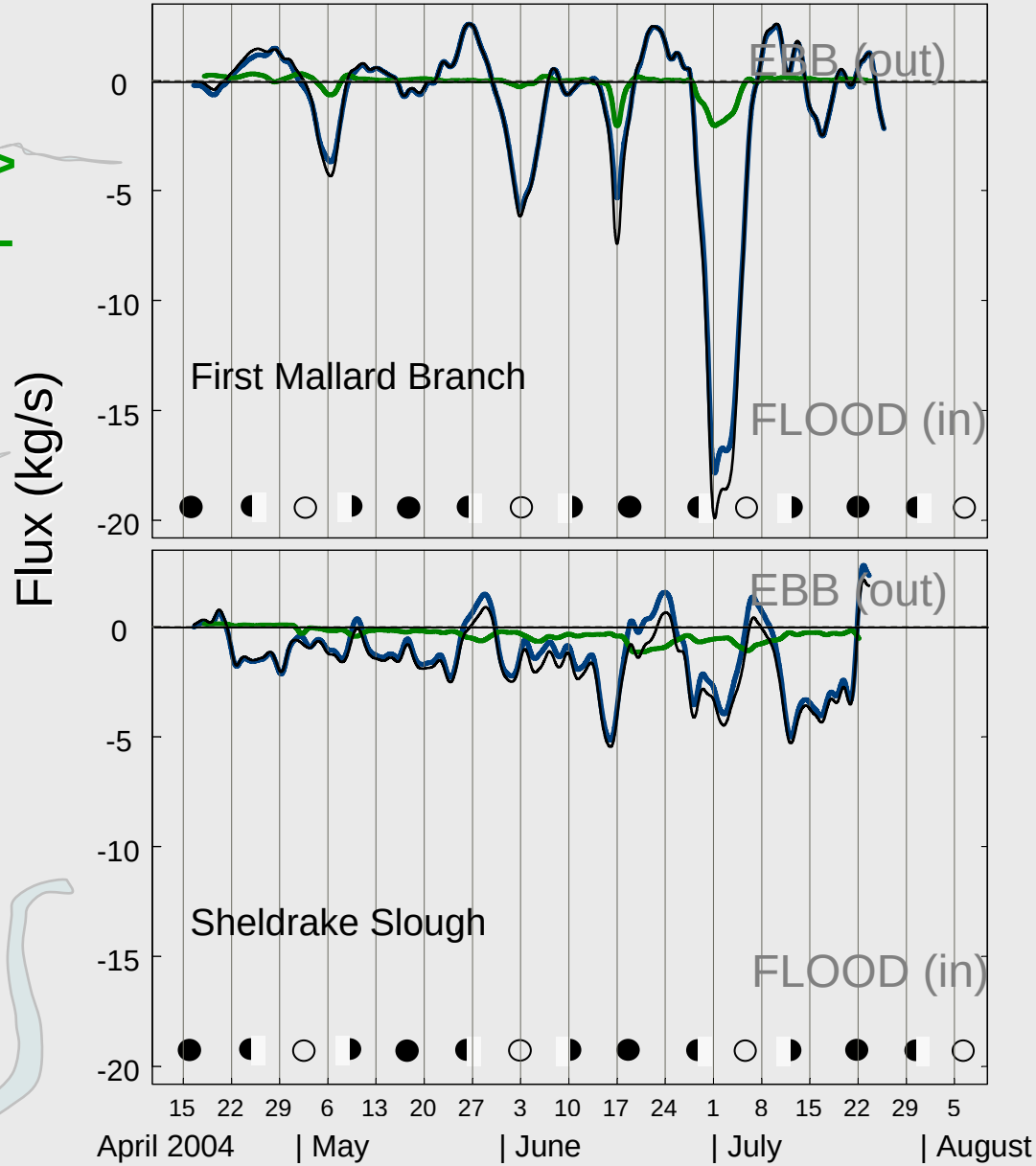
Total Flux = Advective Flux + Dispersive Flux

(Spring-Neap) (Tides)

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



Salt Flux



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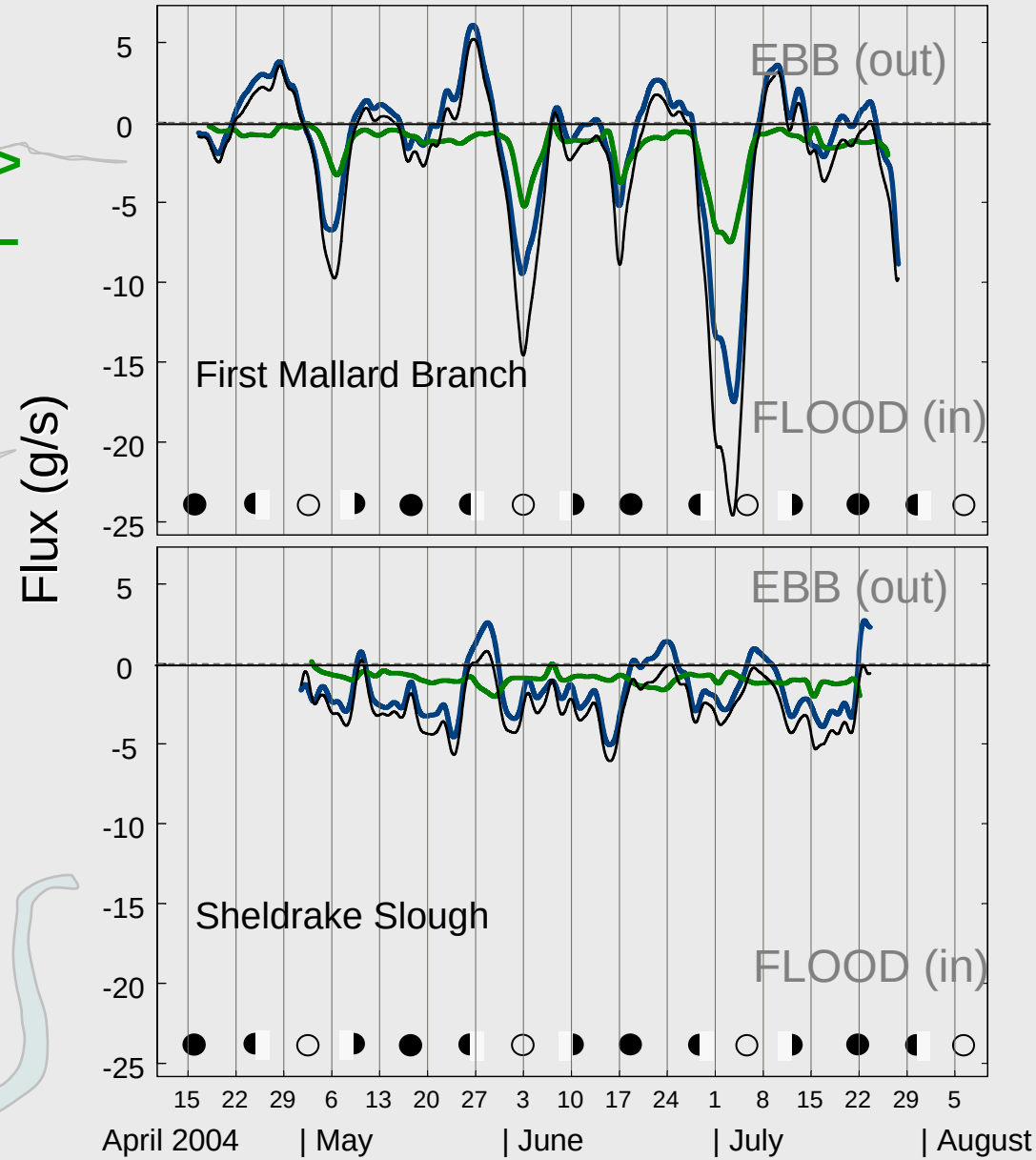
DO Flux



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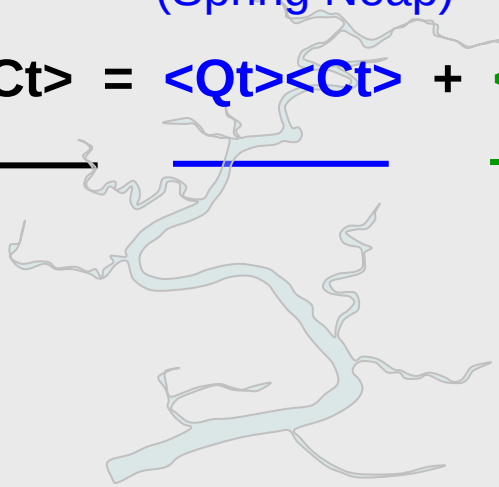
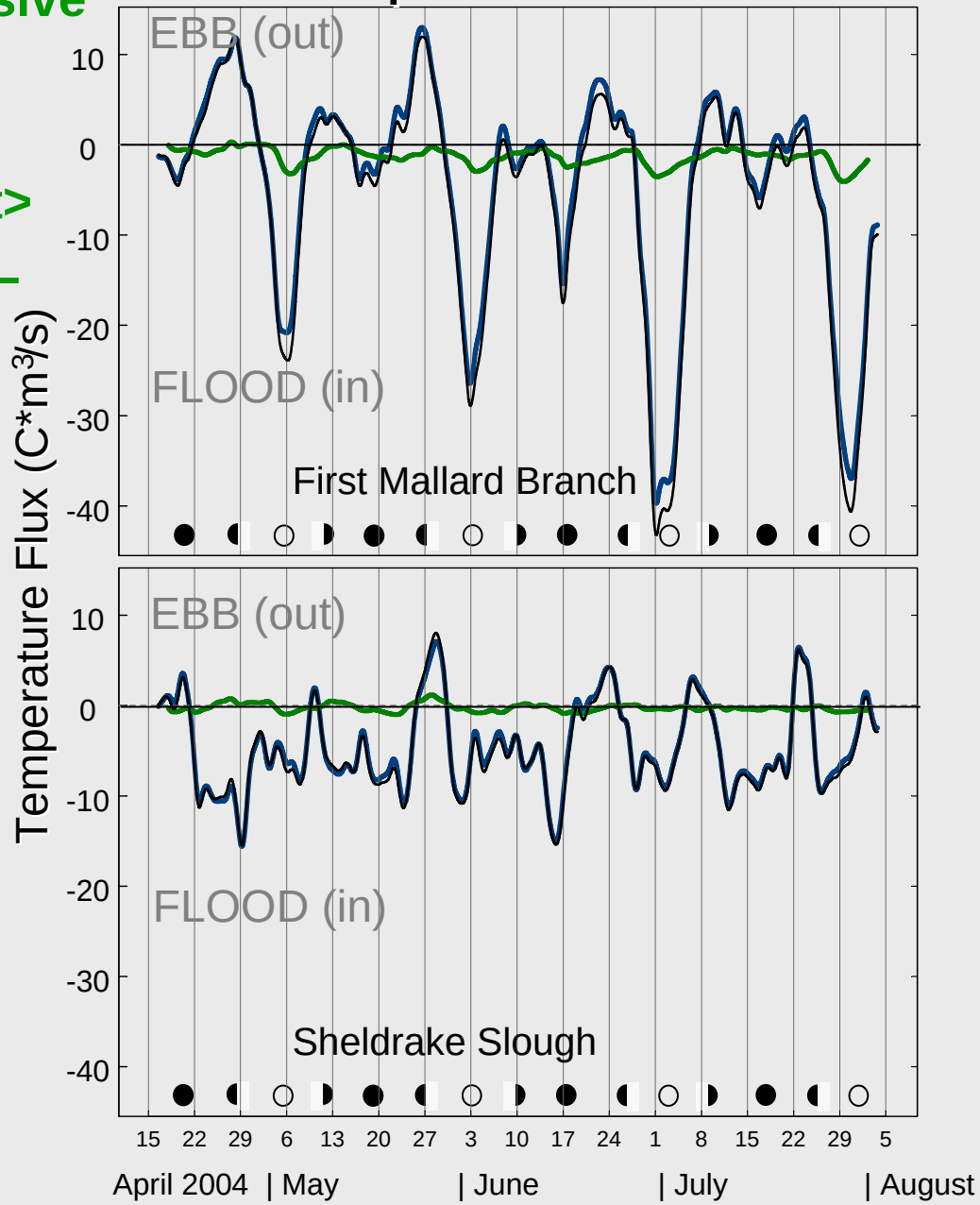


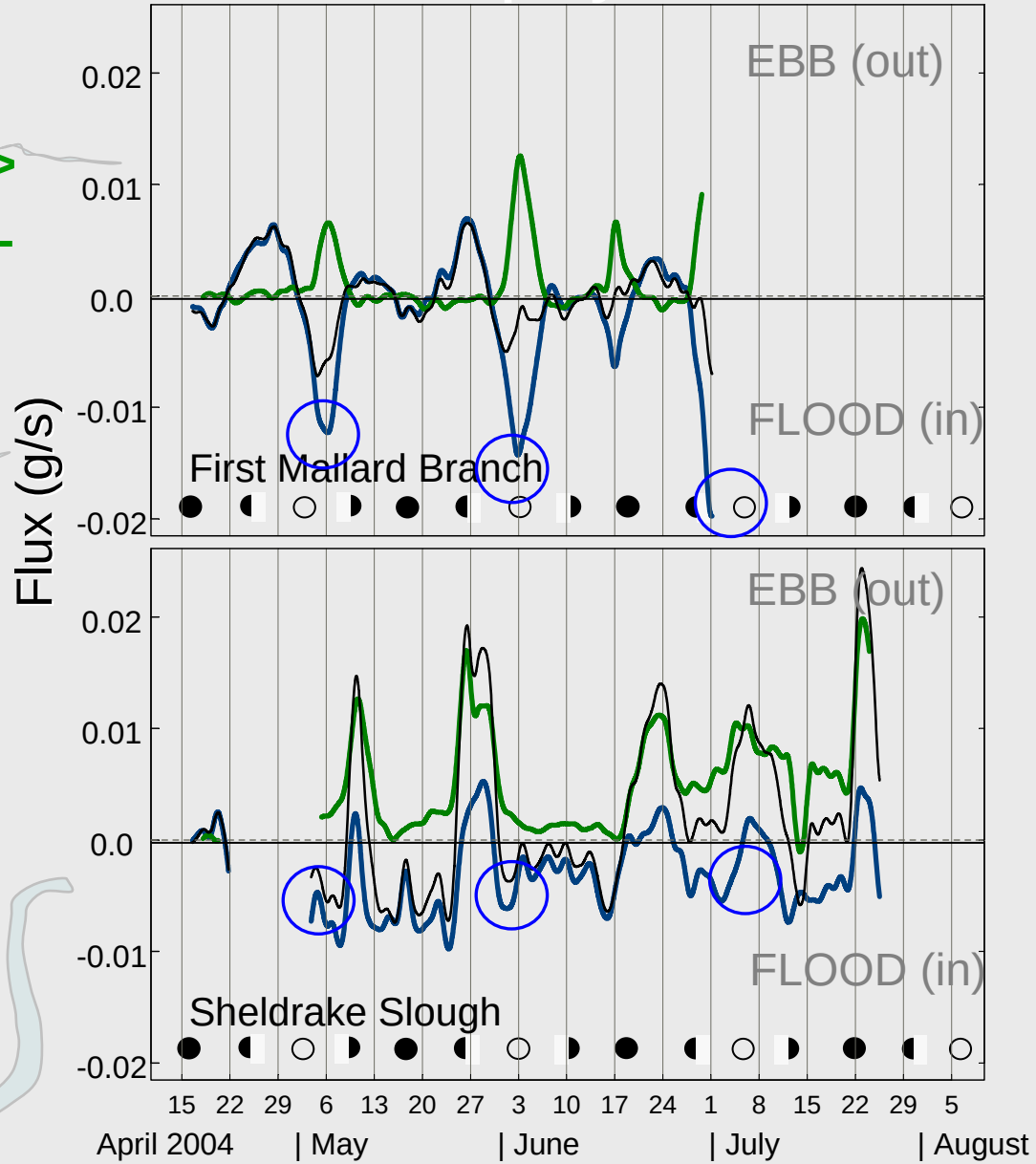
Temperature Flux



Total Flux = Advective Flux (Spring-Neap) + Dispersive Flux (Tides)

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

Chlorophyll Flux



Spring Tide
Advective Flux

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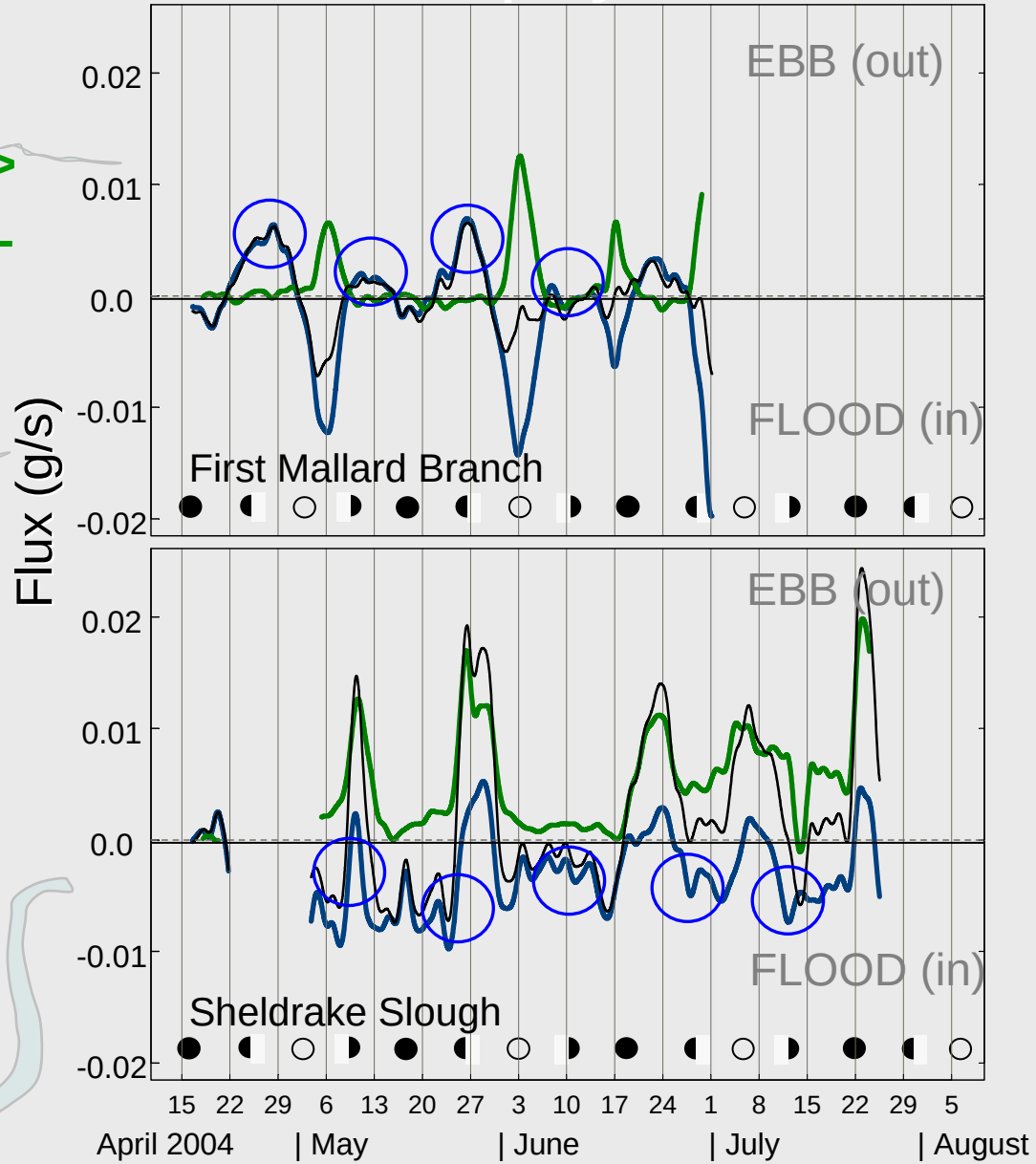
Chlorophyll Flux



Neap Tide
Advective Flux

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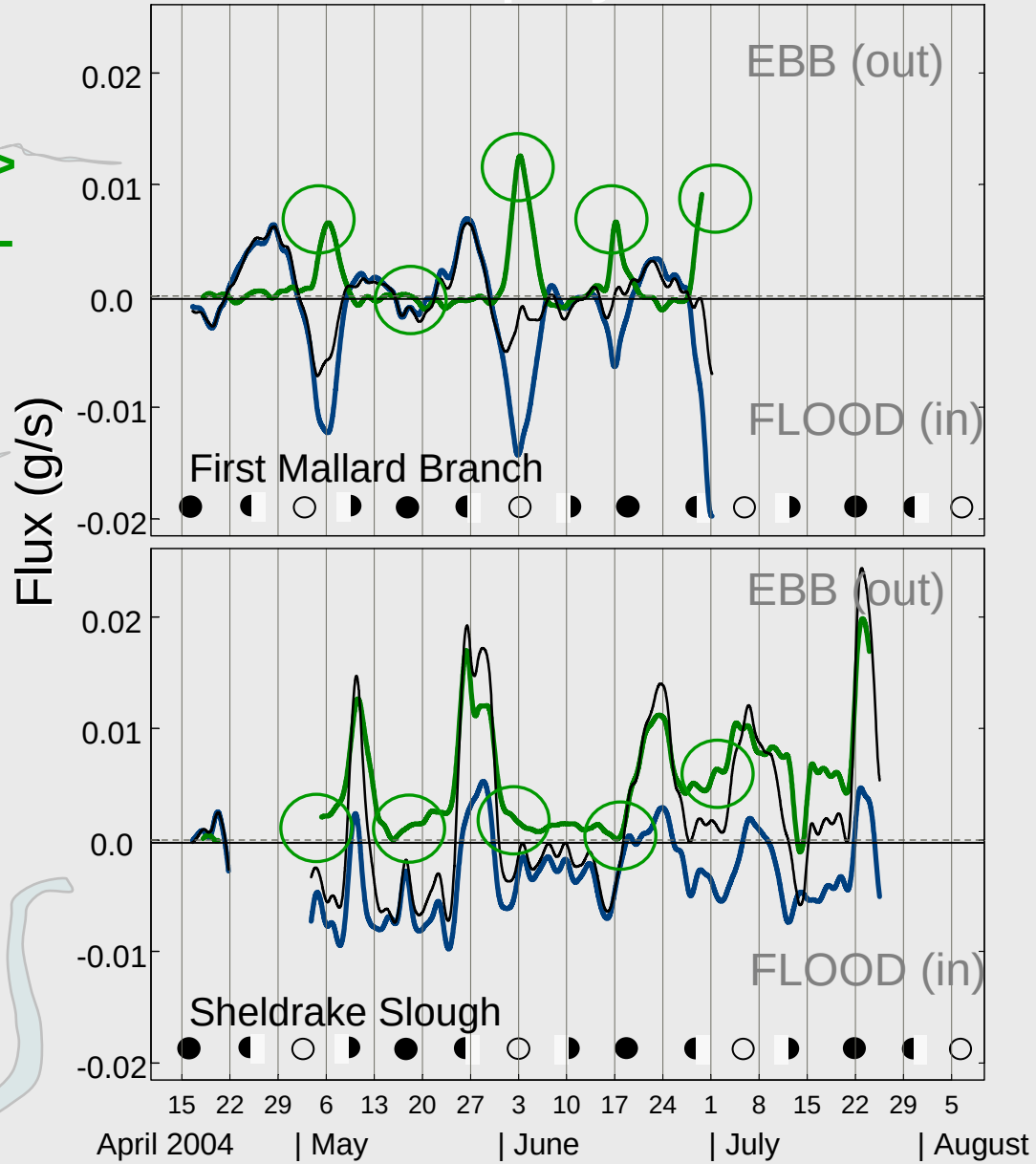
Chlorophyll Flux



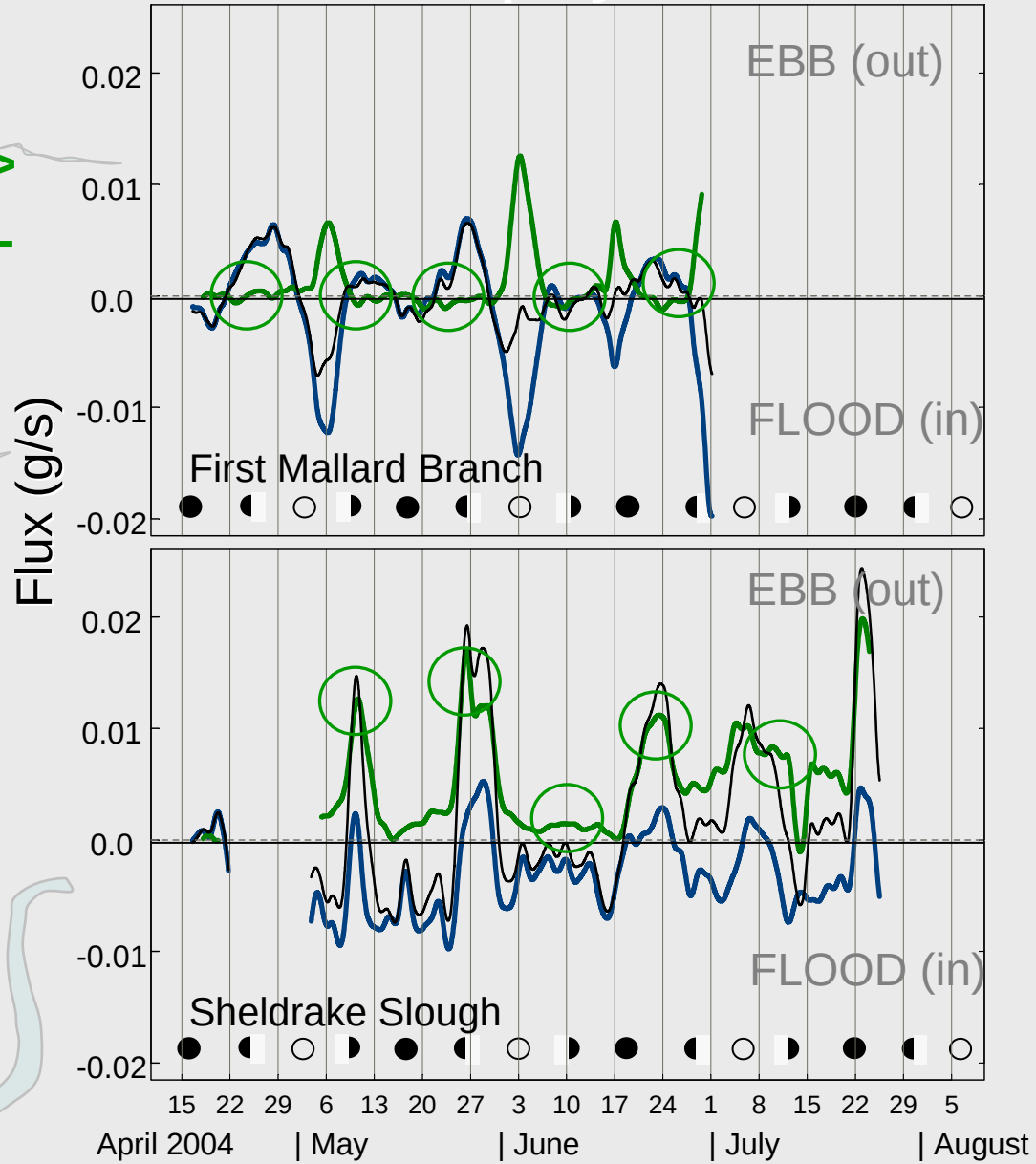
Spring Tide
Dispersive Flux

Total Flux = Advective Flux + Dispersive Flux

(Spring-Neap) (Tides)

$$\langle Qt*Ct \rangle = \langle Qt \rangle \langle Ct \rangle + \langle Q't*C't \rangle$$

Chlorophyll Flux



Neap Tide
Dispersive Flux

Conceptual Model

Drivers
(forcing mechanisms)

→

Linkages
(hydrodynamic processes)

→

Outcomes
(Chemical/Biological Habitat Characteristics)

Conceptual Model

Drivers
(forcing mechanisms)

- Meteorology
- Tides
- River inputs
- Exports/ Diversions/ Drainages

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  - tidal trapping
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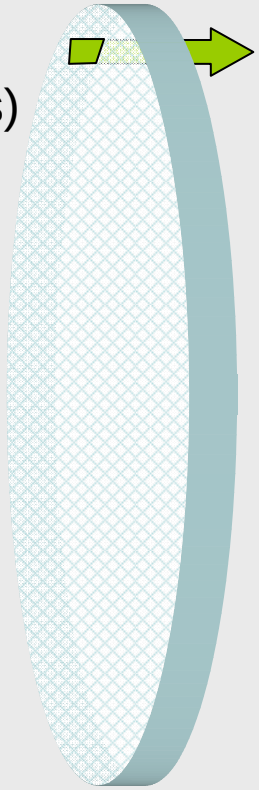
(Chemical/Biological Habitat Characteristics)

Gradients of

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

Conceptual Model

Geometry
(Like a Filter)



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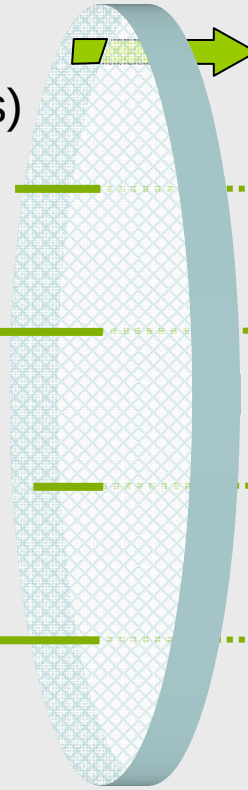

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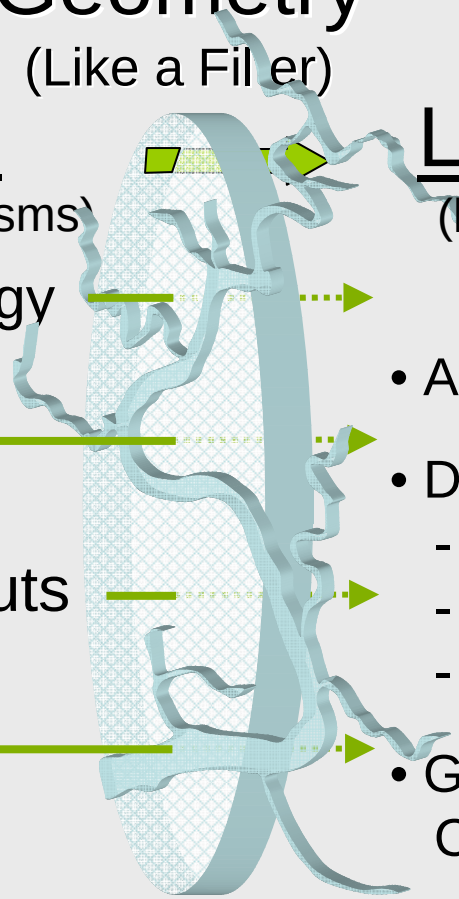

First Mallard Branch

Drivers

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Linkages

(hydrodynamic processes)

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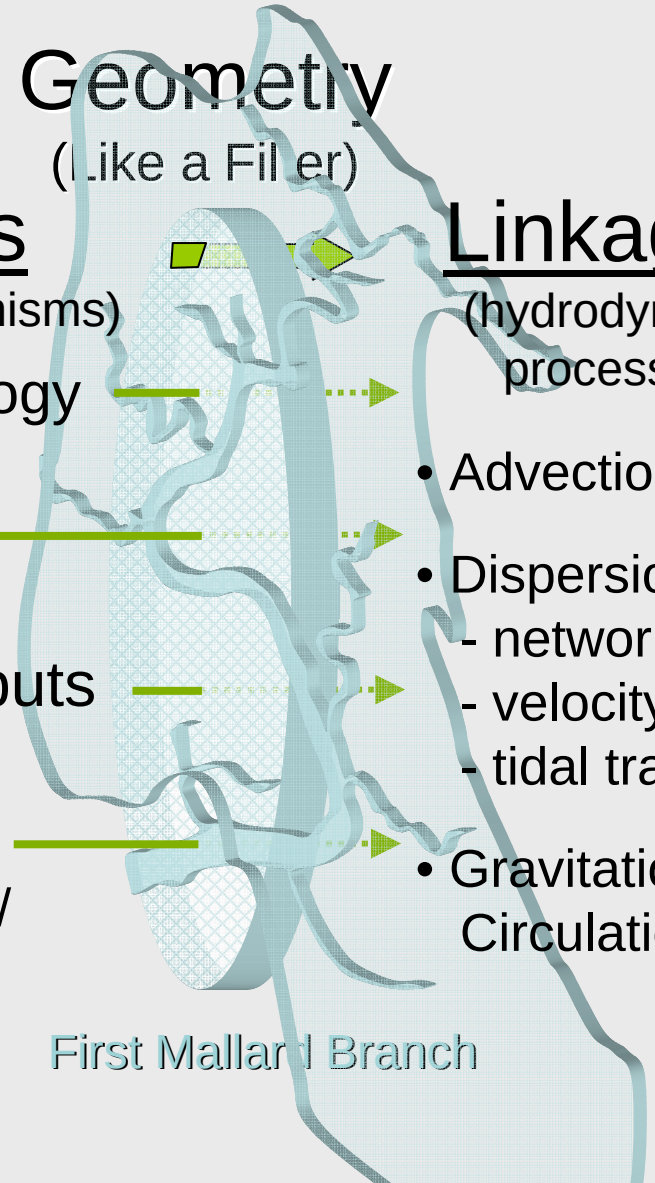
Conceptual Model



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(Like a Filter)

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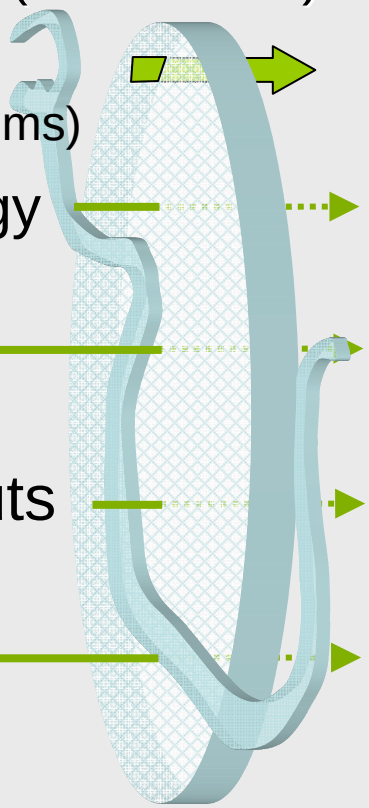

Sheldrake Slough

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Thank you