

Exploring primary production and nutrient cycling in the Delta using a coupled hydrodynamic-biogeochemical model

CALIFORNIA WATER AND ENVIRONMENTAL MODELING FORUM

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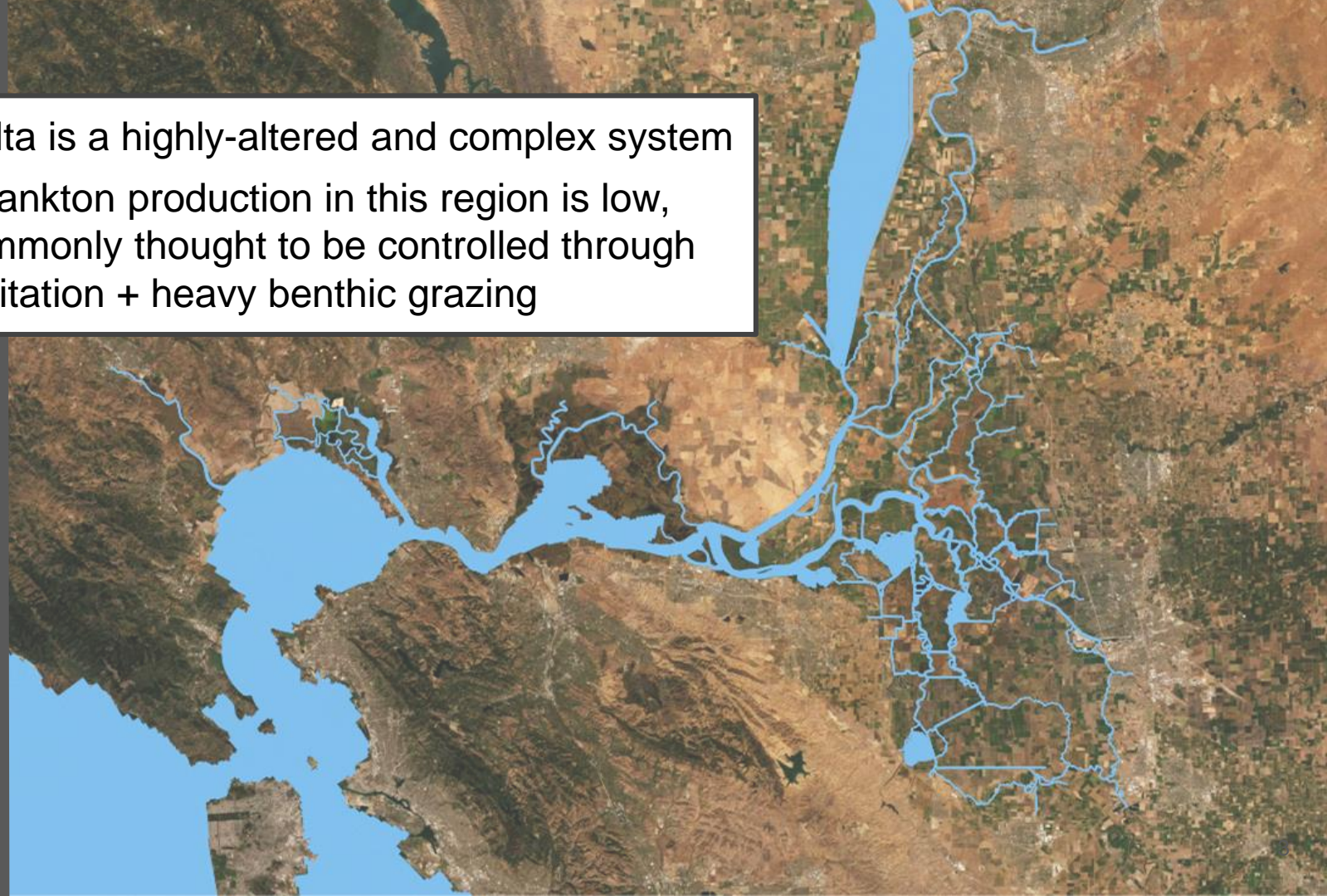
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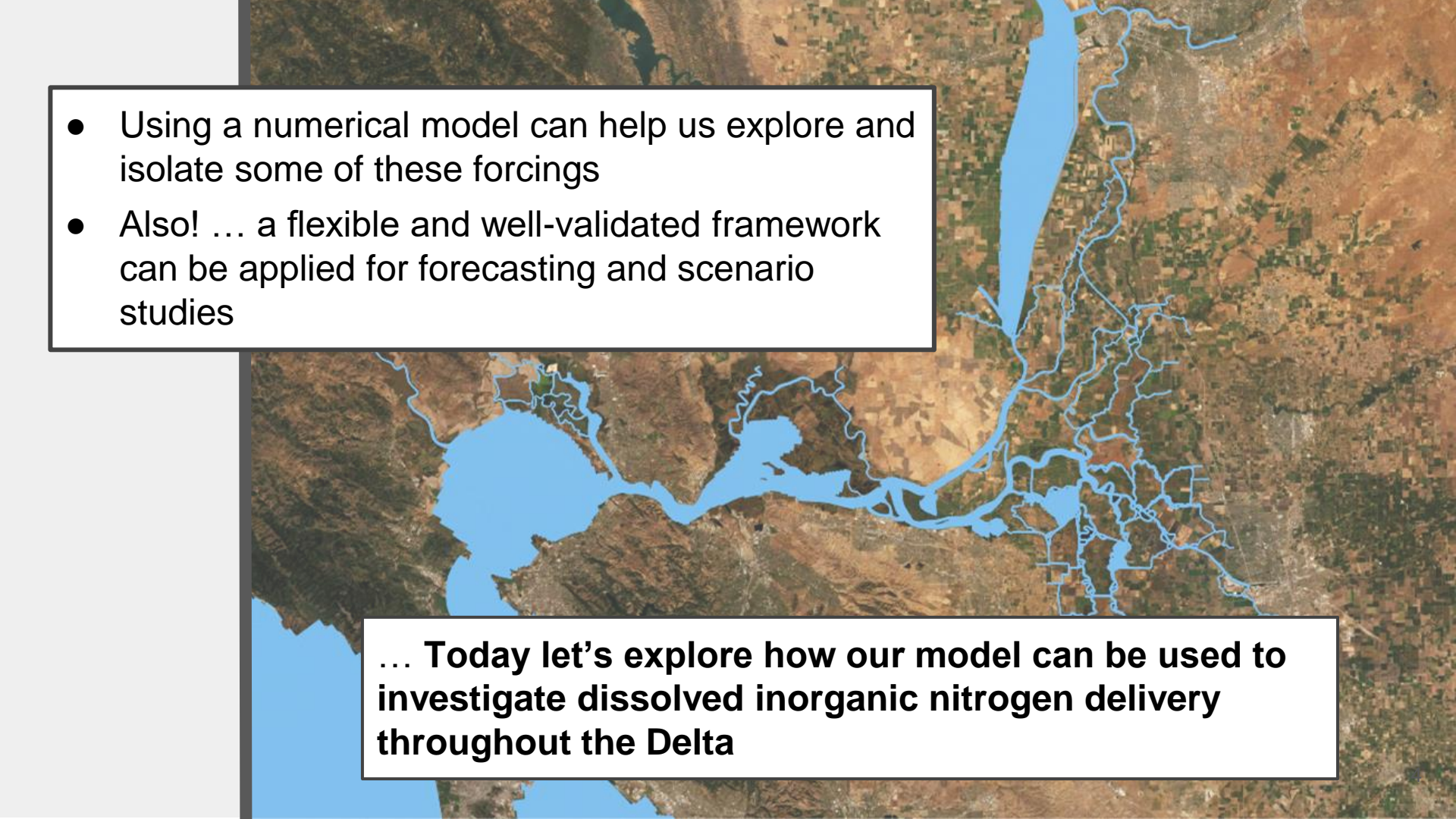
A satellite-style map of the San Francisco Bay-Delta region. The land is shown in shades of brown and green, representing vegetation and terrain. A complex network of blue lines and shapes is overlaid on the map, representing the waterways, including the San Francisco Bay, the Sacramento-San Joaquin River Delta, and various smaller channels and reservoirs. The blue overlay highlights the interconnectedness of the water system.

- **Community modeling effort**

- Three domains (San Francisco Bay, Delta, S. San Francisco Bay)
- Variety of open-source reports available online

- The Delta is a highly-altered and complex system
- Phytoplankton production in this region is low, and commonly thought to be controlled through light limitation + heavy benthic grazing



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- A satellite image of the Sacramento-San Joaquin River Delta in California, USA. The image shows a complex network of rivers and channels. A semi-transparent blue overlay is applied to the map, representing a numerical model of the river system. The blue overlay follows the main channels and branches of the river network, highlighting the areas where the model is being applied. The background is a natural satellite view showing brown and green terrain, with some urban areas visible.
- Using a numerical model can help us explore and isolate some of these forcings
 - Also! ... a flexible and well-validated framework can be applied for forecasting and scenario studies

... Today let's explore how our model can be used to investigate dissolved inorganic nitrogen delivery throughout the Delta



**Our model set-up
(DFLOW-FM + DELWAQ)**

Model domain:

Delta, San Francisco Bay, coastal ocean

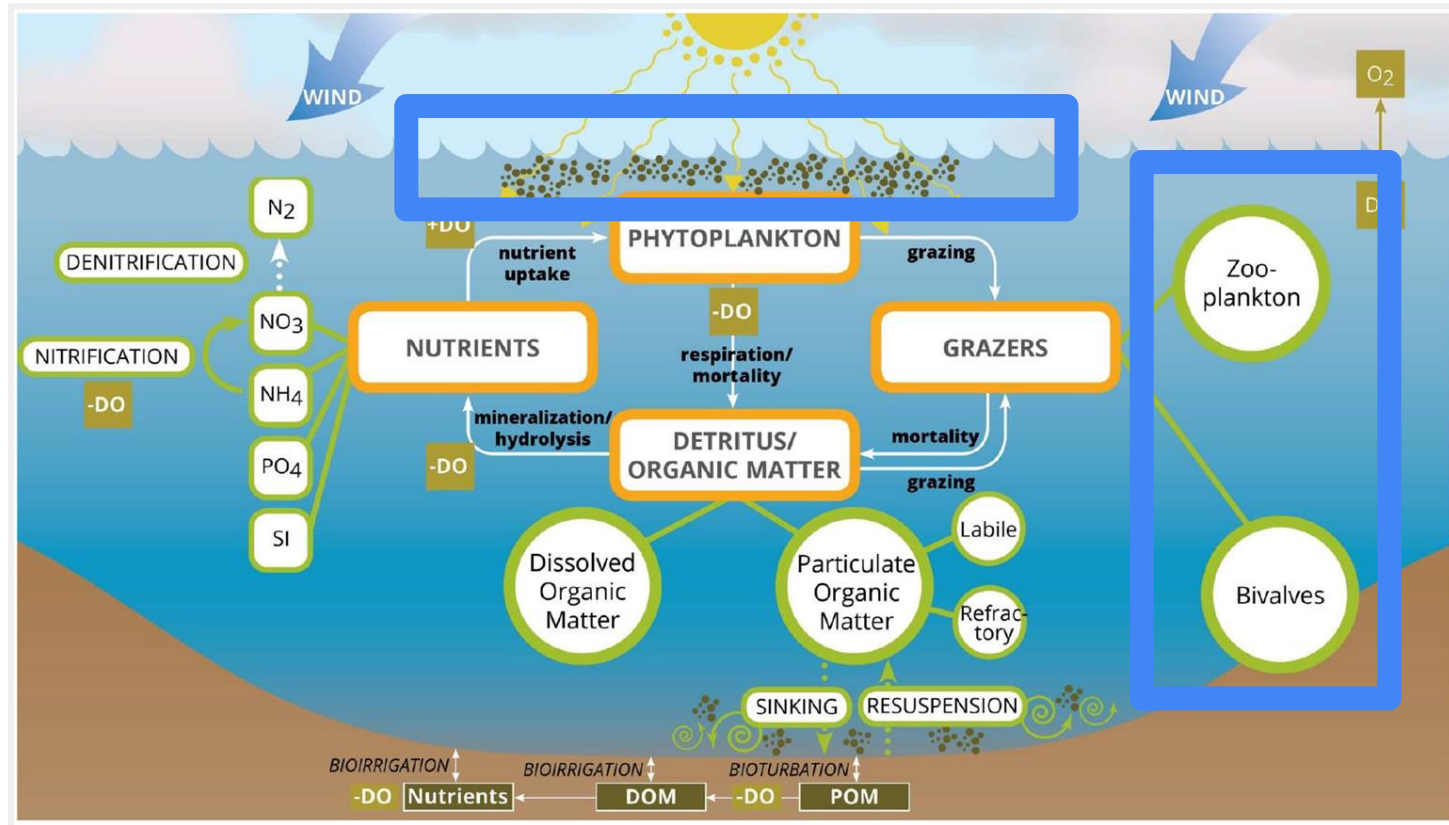
Model grid:

~75,000 horizontal cells,
10 vertical layers

Water years simulated:

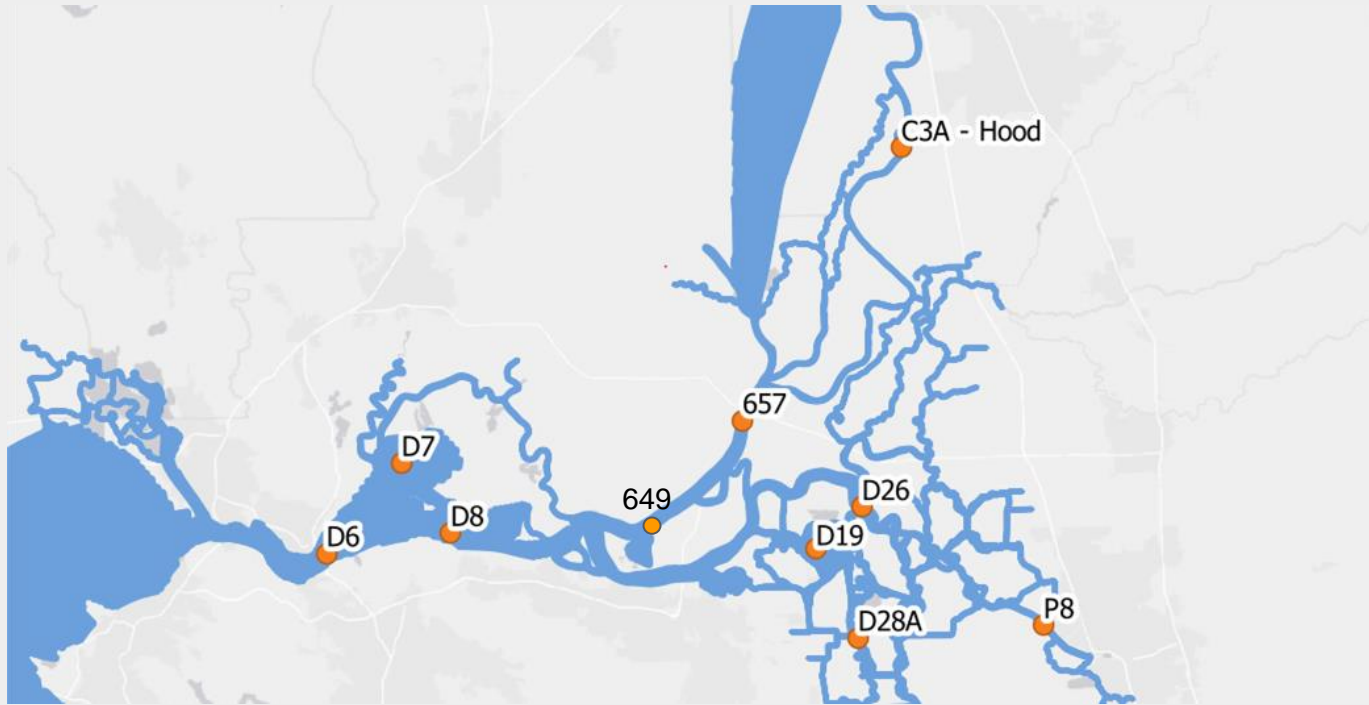
WY2011, WY2016

Key processes represented in our biogeochemical model



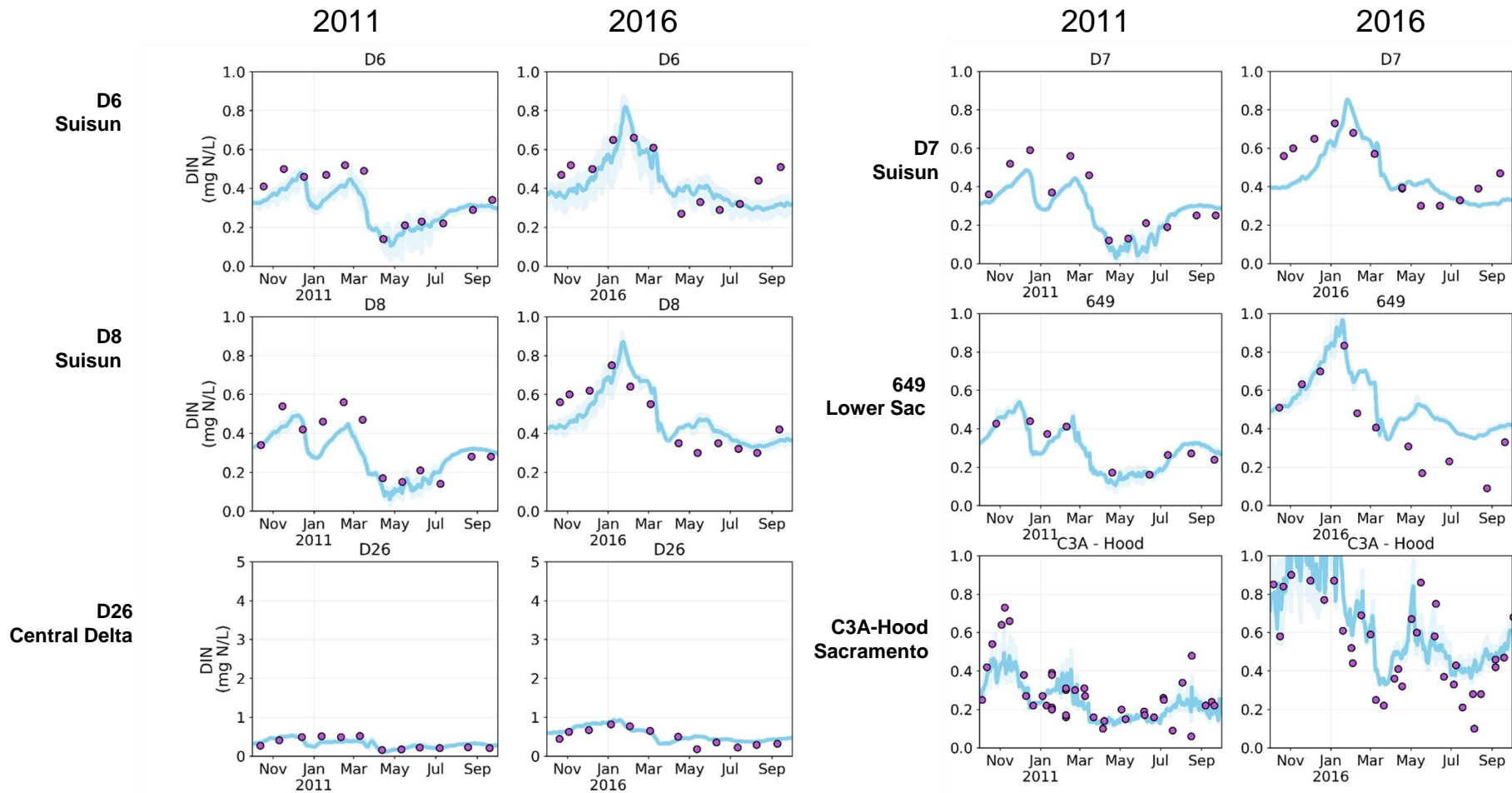
Biogeochemical Model Validation:

Discrete monthly data (EMP + USGS)



DIN: WY2011 + WY2016, subset of stations

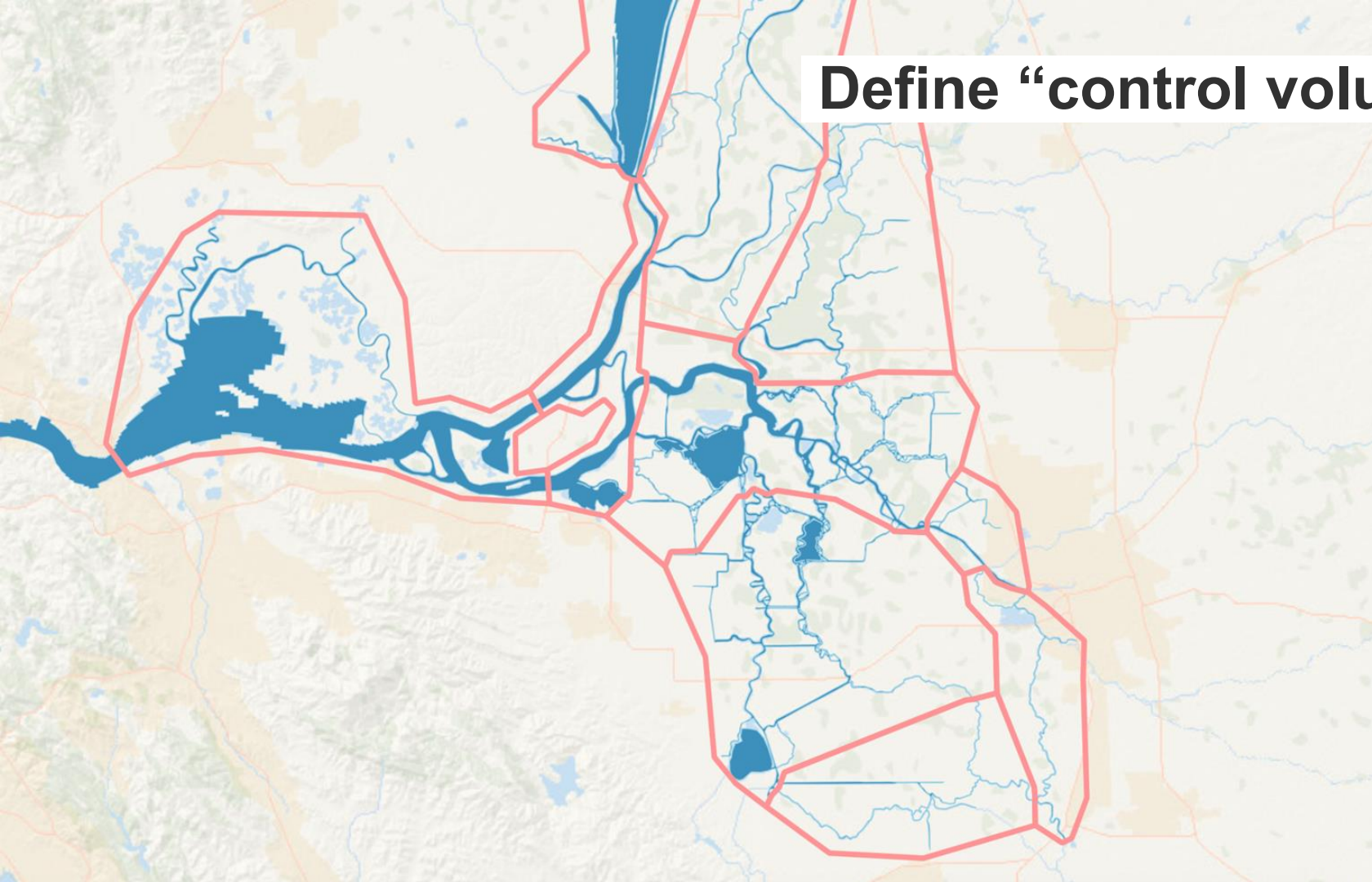
* DIN = NO₃ + NH₄



A topographic map of a river basin, likely the Chesapeake Bay region, showing a network of rivers and streams. A large, irregularly shaped area is shaded in a dark blue color, representing a model result or a specific management zone. The map includes contour lines, a grid of orange lines, and various shades of green and brown representing terrain and vegetation. The text is overlaid on a semi-transparent grey bar at the bottom of the map.

How can we **translate** model results to management-relevant questions?

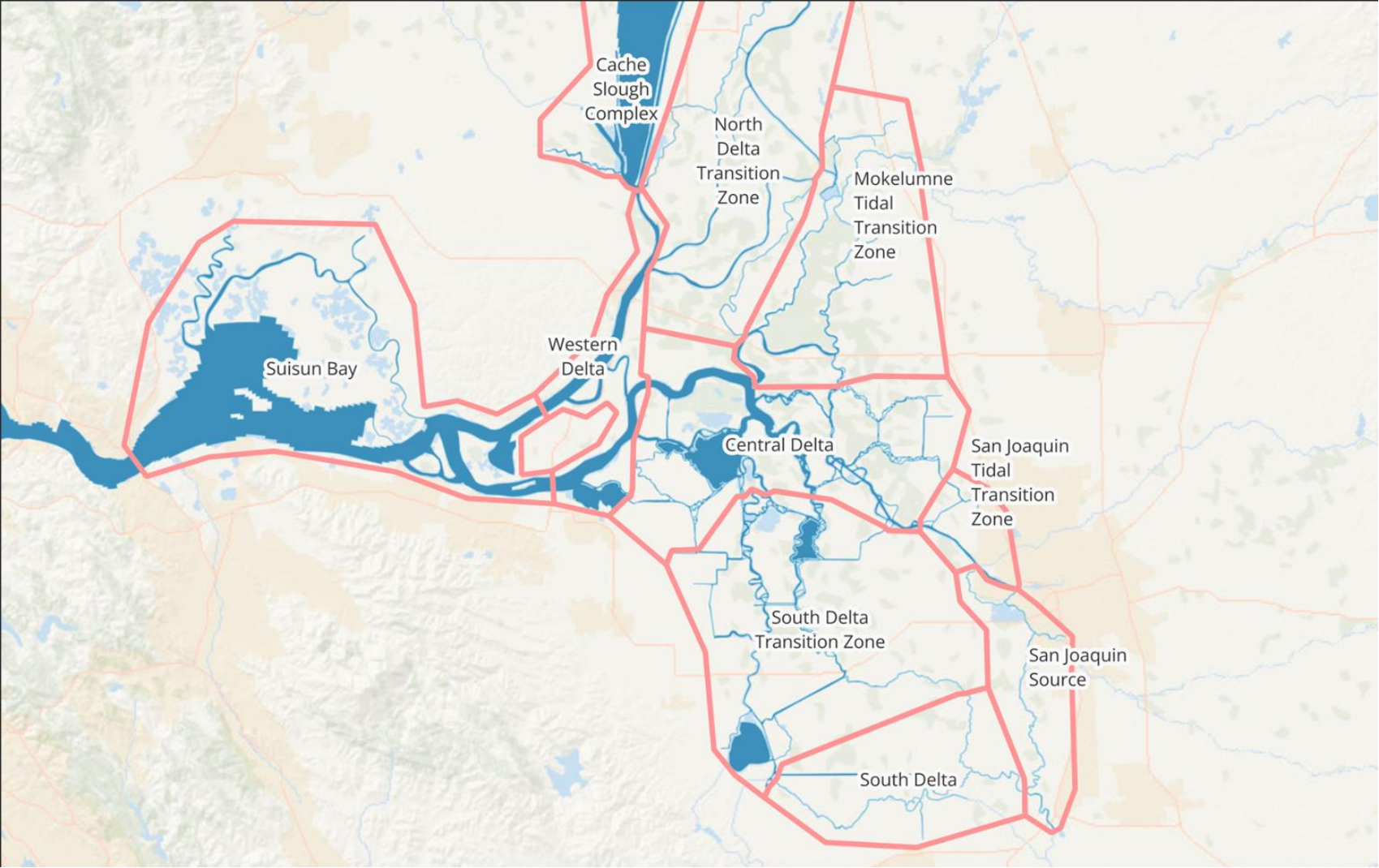
Define “control volumes”

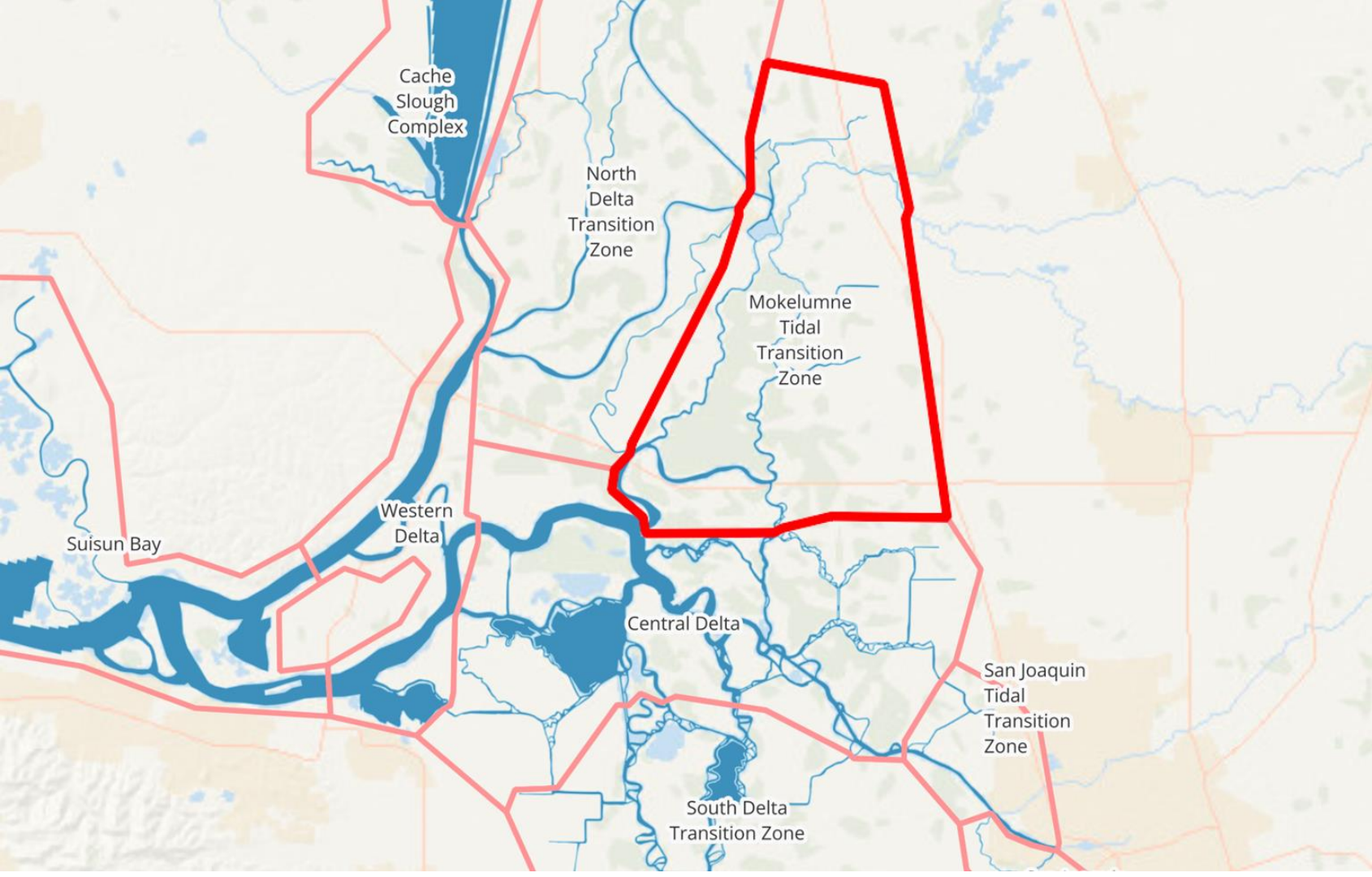


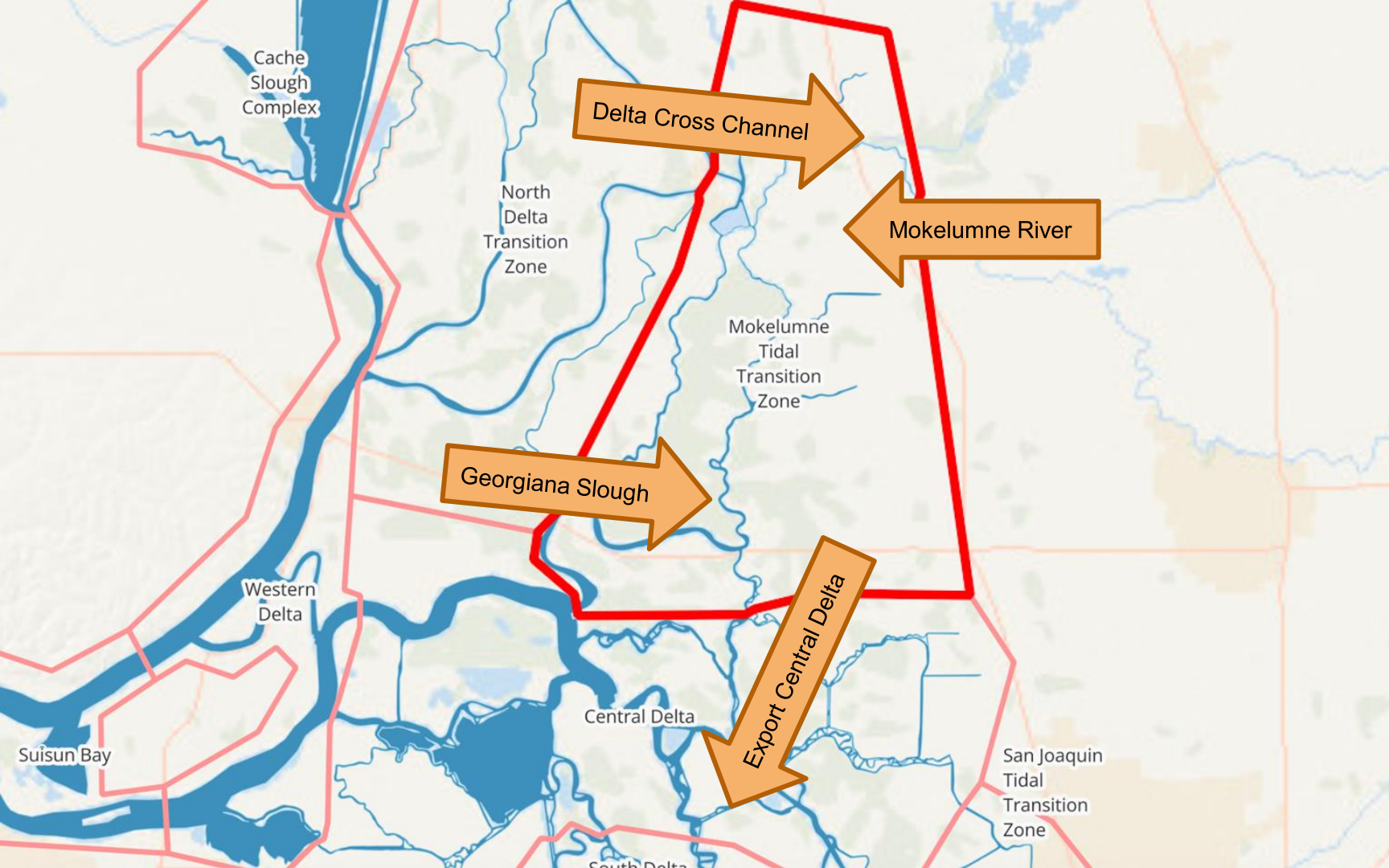
A topographic map of a river network, likely the Chesapeake Bay region, with several irregular red polygons overlaid on the water bodies. These polygons represent control volumes for scientific study. The map shows the main river channel and its tributaries, with a large reservoir or bay on the left side. The background is a light-colored topographic map with green and brown tones.

Define “control volumes”

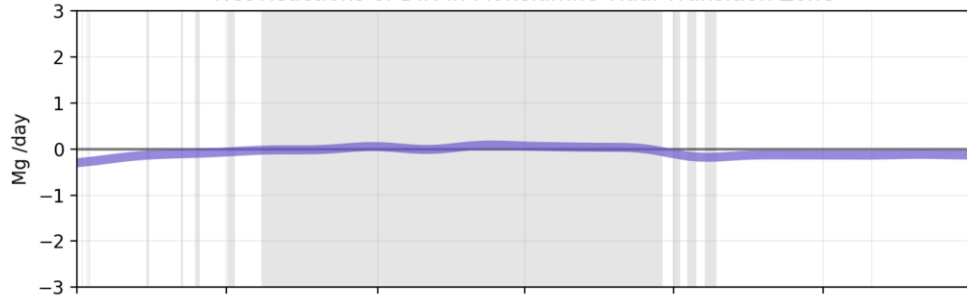
- Allows us to examine mass fluxes of nutrients & phytoplankton
- Can isolate regions of interest under scenario studies



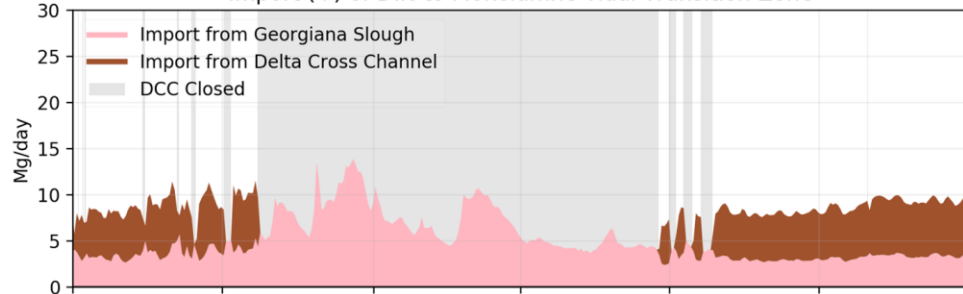




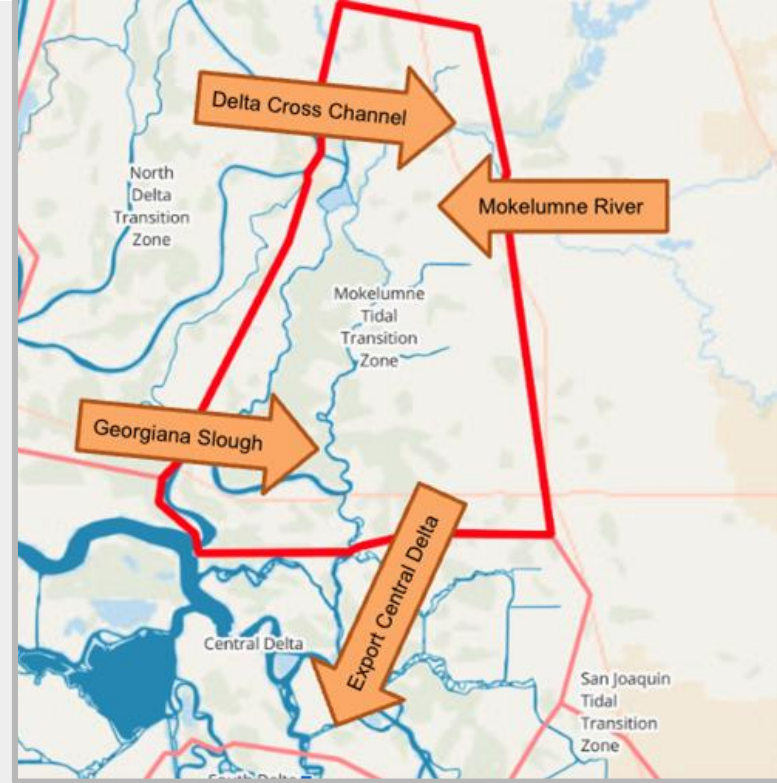
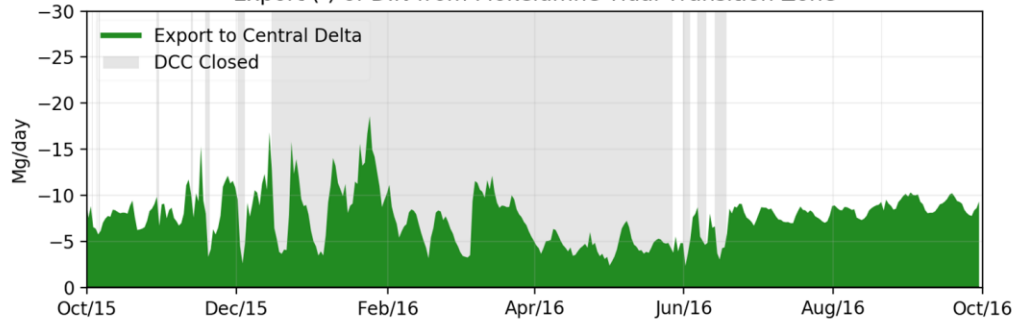
Net Reactions of DIN in Mokelumne Tidal Transition Zone



Import (+) of DIN to Mokelumne Tidal Transition Zone

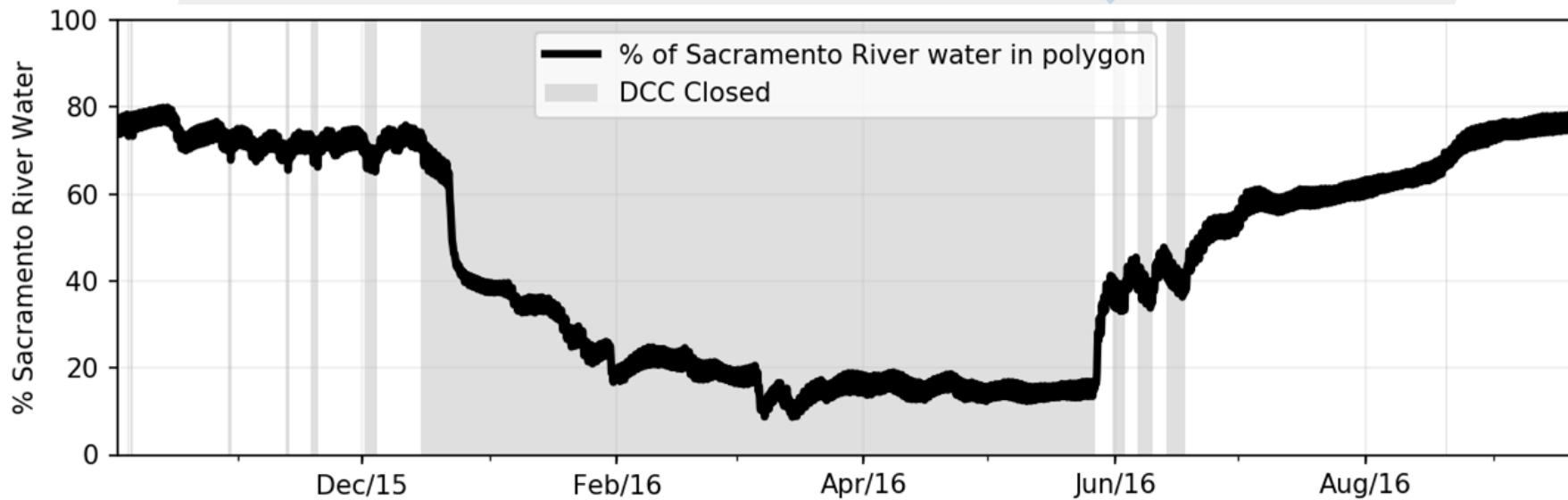
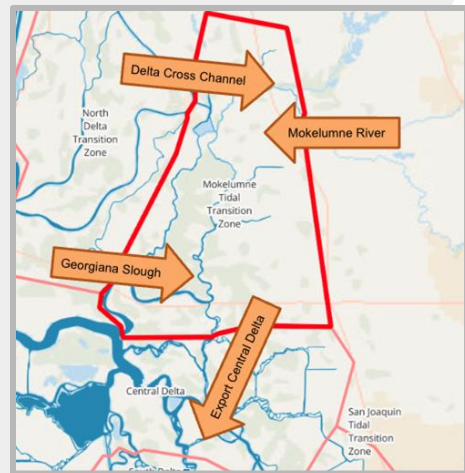


Export (-) of DIN from Mokelumne Tidal Transition Zone

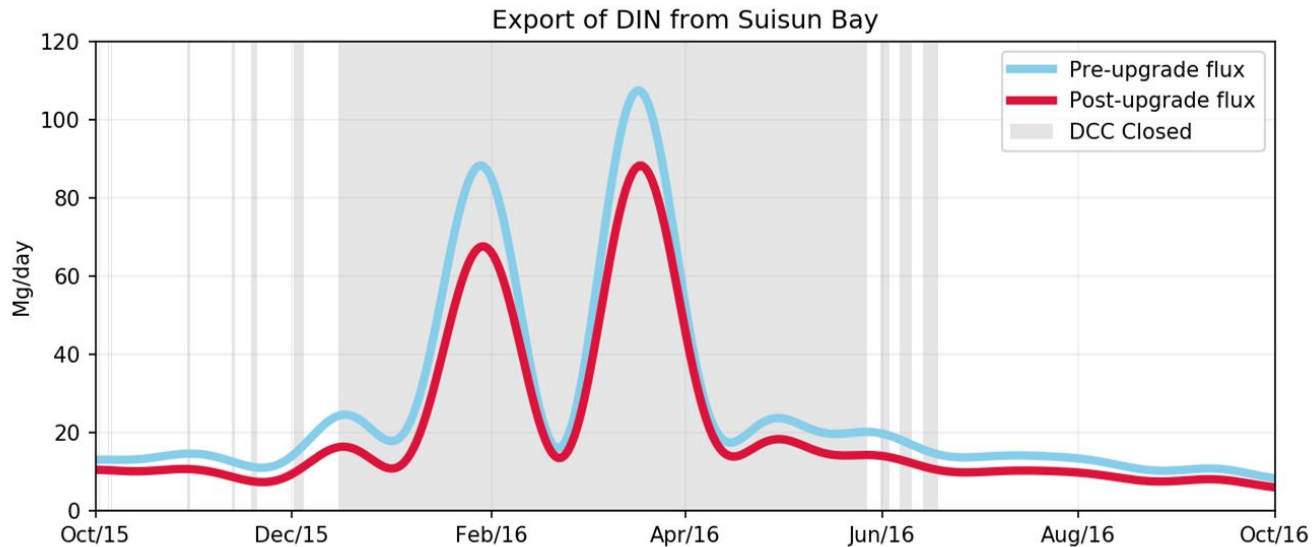


→ We can examine how operational changes affect nutrient delivery to regions of the Delta

→ Quantify how the Delta Cross Channel affects circulation throughout the interior Delta



.... Or how system upgrades like Regional San affect net export from the Delta





Two “bigger questions” to think about ...

1 - How can we **validate** a numerical model for management-related questions?

2 - How can we **translate** model results to be relevant for management questions?



1 - How can we **validate a numerical model for management-related questions?**

- Validate across a range of time scales with different data
- Important to be critical of models and investigate that you're not getting the “right” output for “wrong” reasons.

2 - How can we **translate model results to be relevant for management questions?**

- Relating model results to mass fluxes + system-level transport
- Other thoughts?

Thank you!

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