

Modeling Toolkit To Assess Effects of Changing Plume Characteristics

**Commission Briefing
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Historically, Management of Wastewater Plumes in the Ocean Has Focused on “End- of-Pipe” Acute and Toxic Effects

- Clean Water Act (CWA) defines a suite of water quality goals that are required to be met outside a **nearfield** “zone of initial dilution”

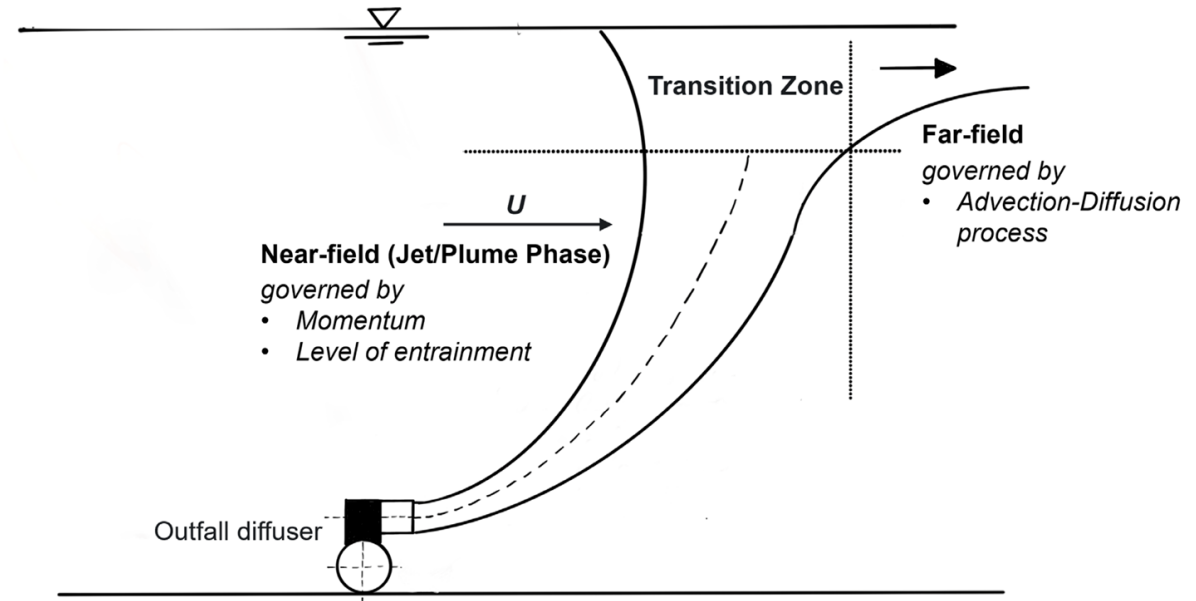


Figure 1: Schematic representation of the conceptual model for a typical buoyant effluent discharge.

- EPA-supported “Plumes” model has been industry standard for mixing zone analysis to meet CWA standards for decades
 - Dr. Phil Roberts has been the grandfather of this work

But....

We also want to assess far-field fate, transport and biological effects of plume contaminants

.....And have been developing and applying ROMS-BEC for these applications

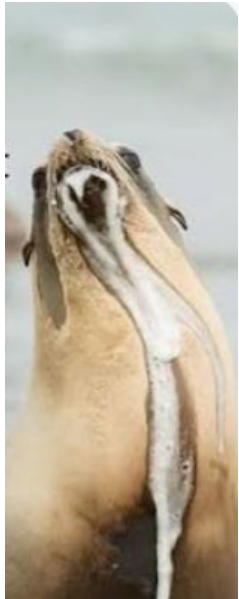
Microplastics



Acidification



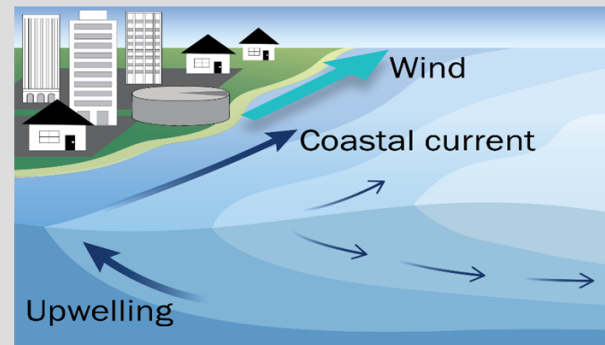
Toxic HABs



ROMS

Regional Ocean Modeling System

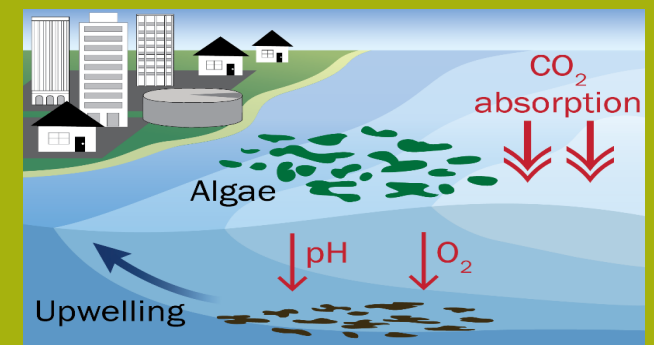
A physical circulation model that predicts how ocean water circulates



BEC

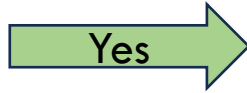
Biogeochemical Elemental Cycling Model

Predicts how human & ocean nutrient fuel plankton blooms that consume oxygen and lower pH

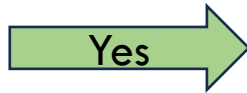


Can We Get Clarity on How to Best Use These Tools in a Complimentary Way?

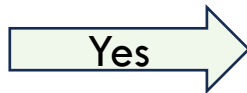
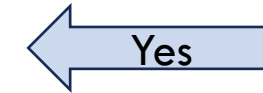
**EPA
Plumes**



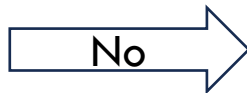
Establish legal **near-field** mixing zones



Engineering design and testing of pipes and diffusers



Far field contaminant dispersal



Far-field biogeochemical transformations and
biological impacts



**UCLA
ROMS
(+BEC)**

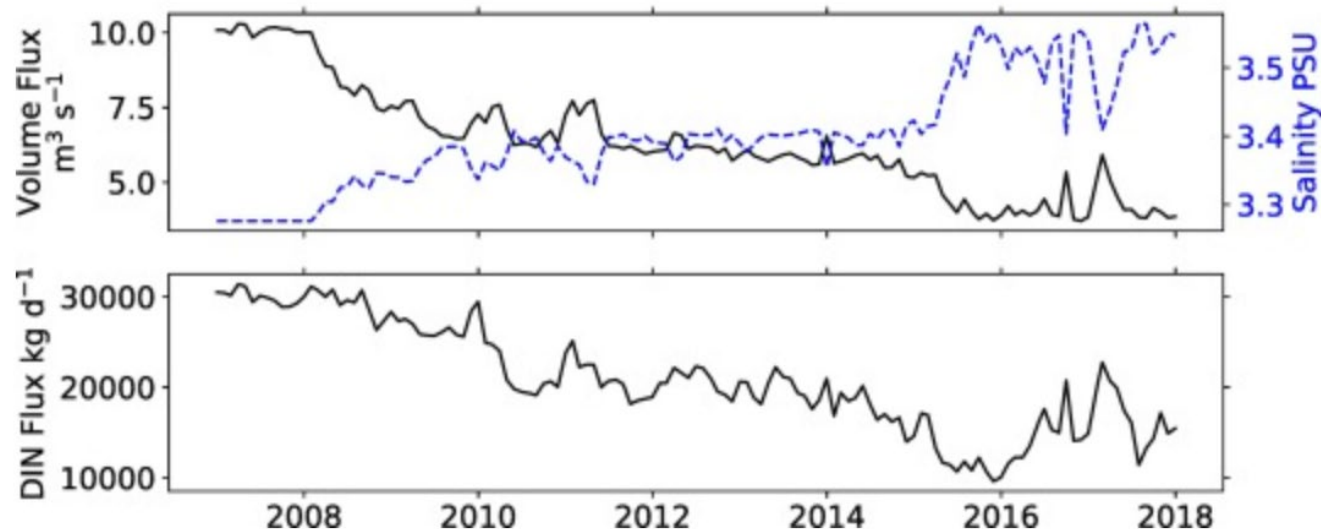
*Expert Panel: Validate ROMS-BEC near-field mixing for applications from
plume to far-field scales*

We Are Partnering with OC San to Evaluate ROMS-BEC for Plume Modeling

With a Study to Investigate the Effects of OC GWRS Implementation Effects on Ocean Water Quality

OC has implemented the Groundwater Replenishment System (GWRS) to increase potable water supplies.

It has been implemented in three phases over 18 years, recycling 100% of reclaimable wastewater and reducing nitrogen load by 40%



Scoped OC San Project Has Three Components

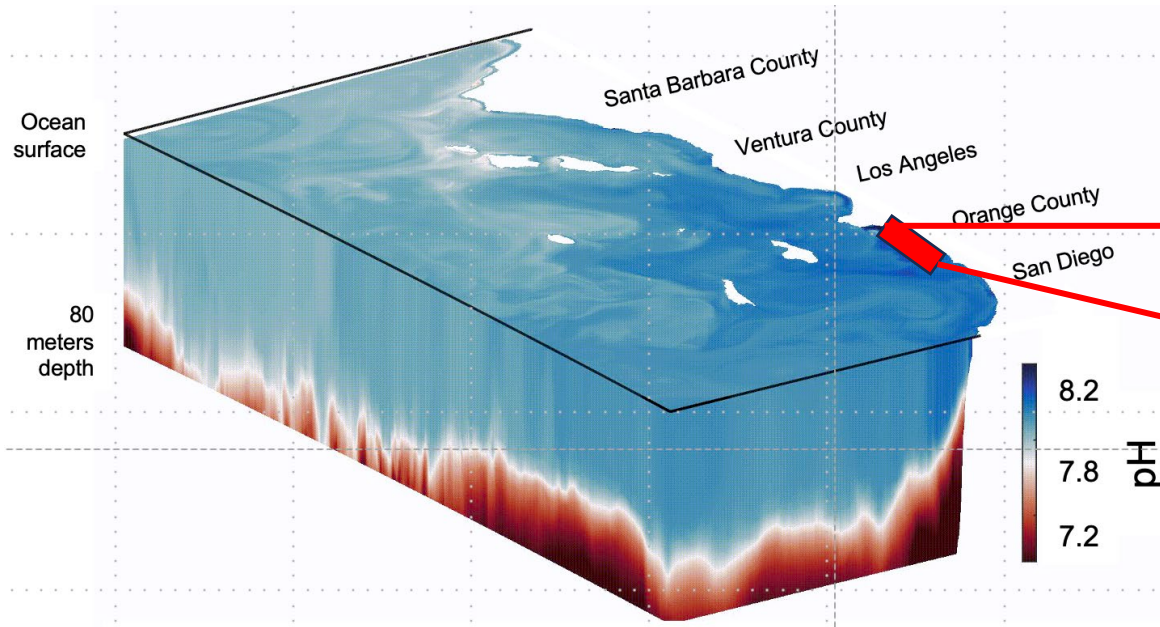
1. ROMS-BEC plume model setup and simulations
2. Model evaluation
3. Model application for plume fate and far-field biological effects

1. Plume Model Set Up and Simulations

Shrink the geographic scope and dial up the resolution

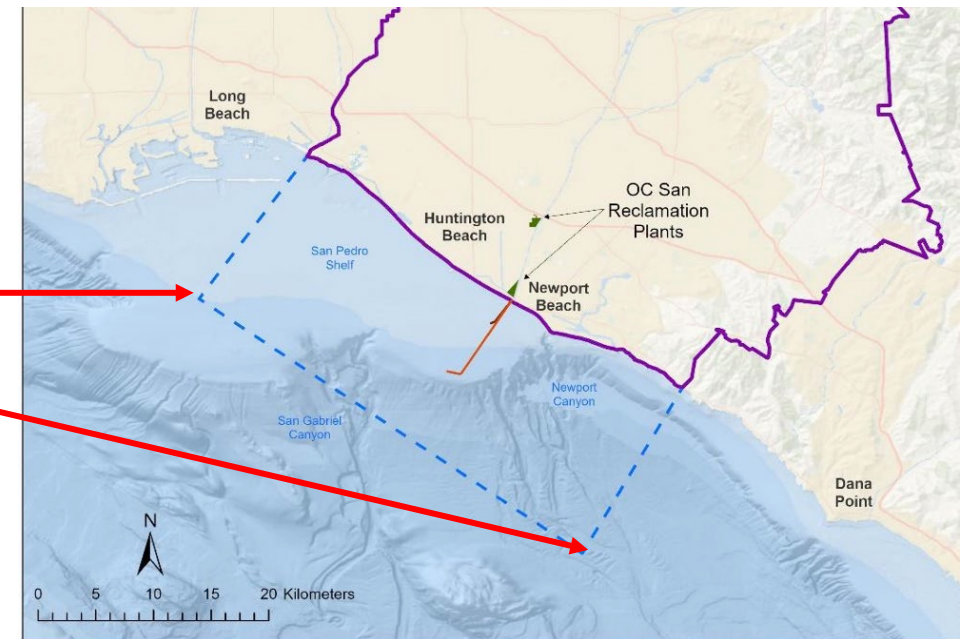
Far Field Model Set Up

300 m resolution, Southern California Bight region



Plume Model Set Up

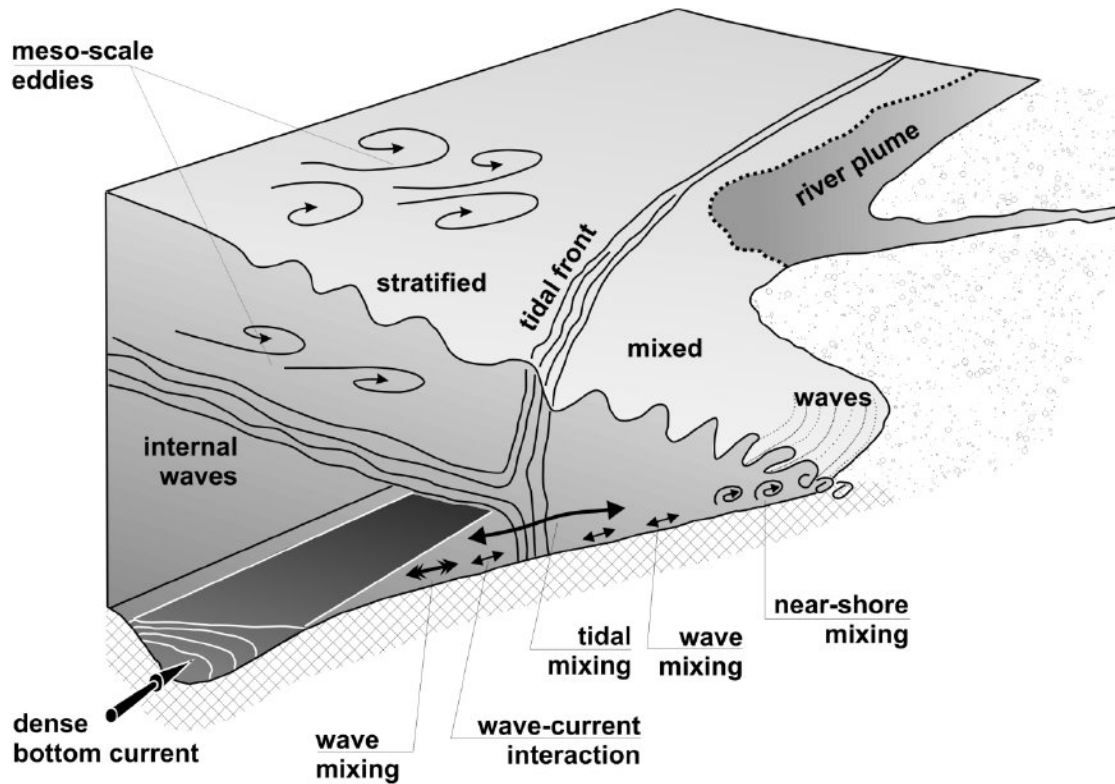
5 to 30 m resolution, Orange County shelf



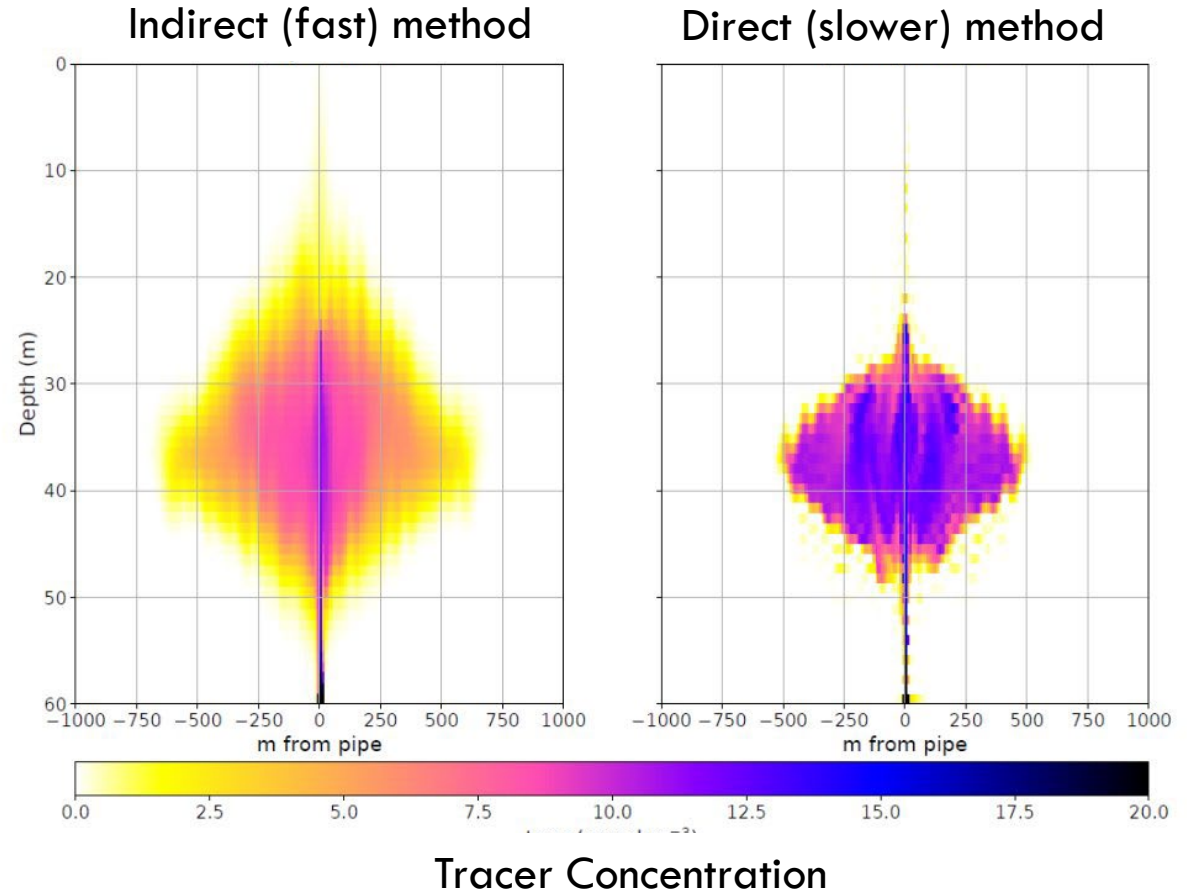
1. Plume Model Set Up and Simulations

"Turn On" Features that Allow for Precise Accounting of Nearshore Physical Processes

Examples of Processes



How Model Equations Are Solved



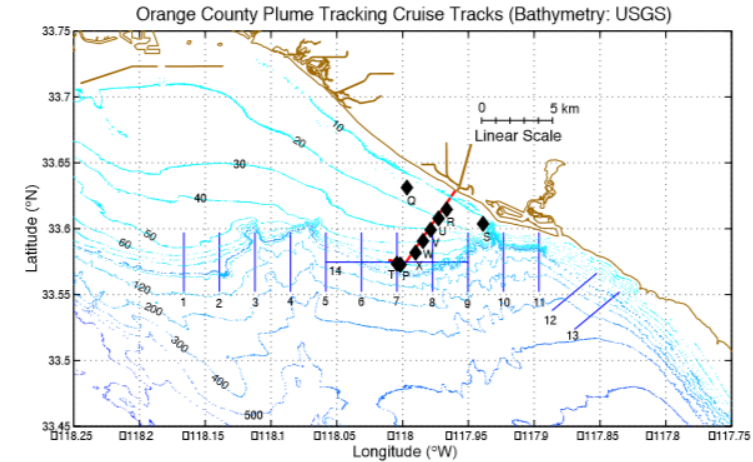
2. Model Evaluation: Skill Assessment

Previously and ongoing...Data vs Model comparisons at regional to subregional Scale

Oxygen Correlation



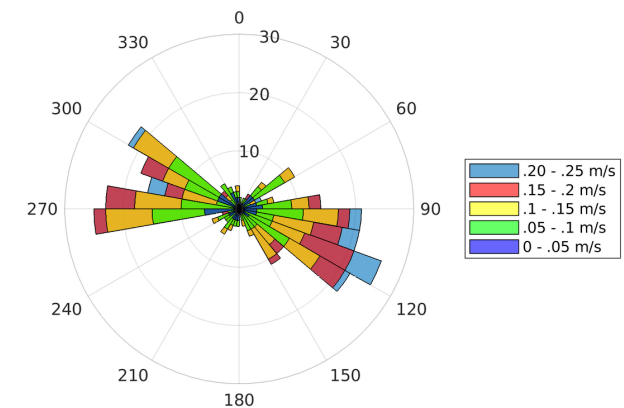
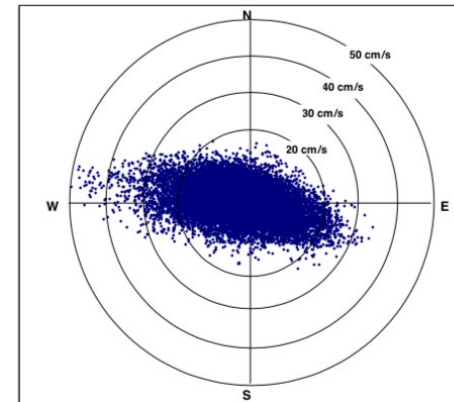
Will Move to Plume Scale Comparisons



Observed

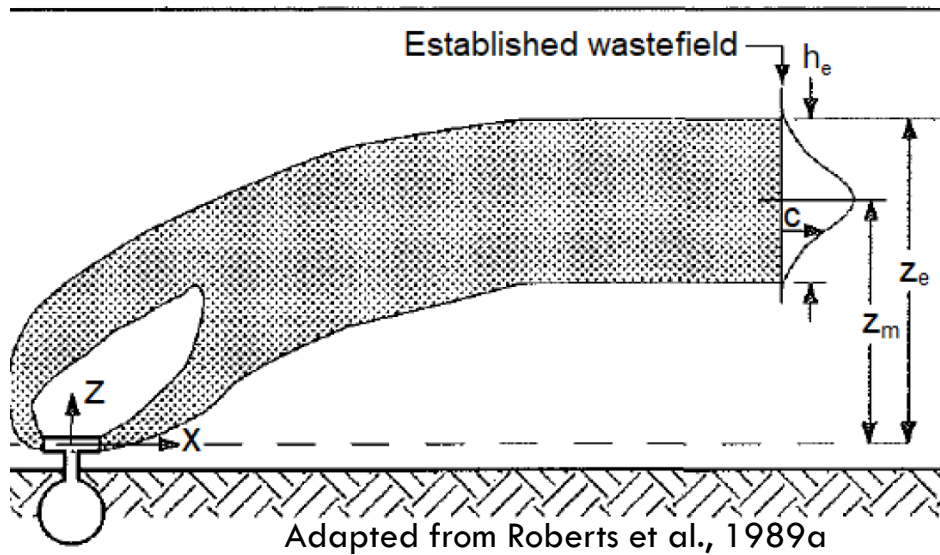
vs

Predicted



2. Model Evaluation: Comparison with EPA Plumes

To Be Conducted in Collaboration with Dr. Roberts



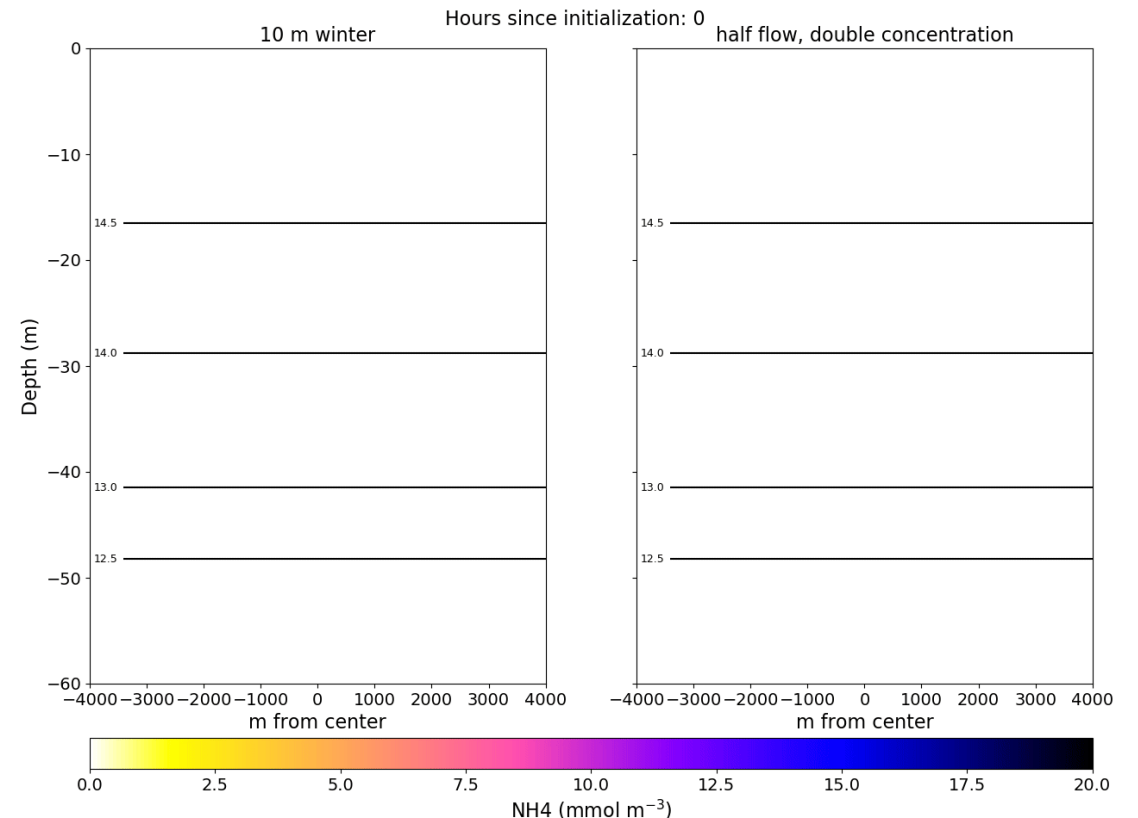
Example Metrics

Near field:

- Plume rise height
- Dilution ratios
- Mixing zone boundaries

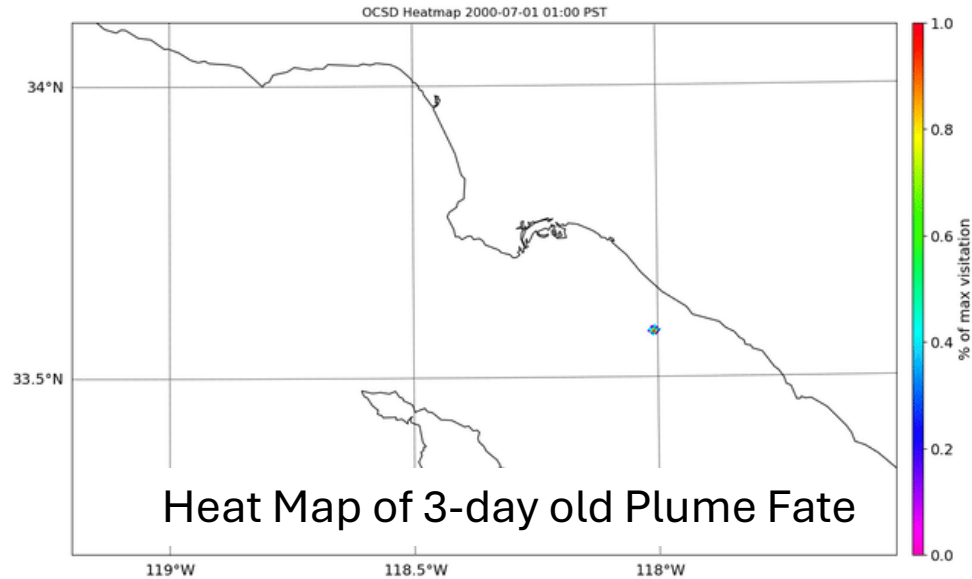
Far field: non-reactive trajectories

- Are the models basically predicting same plume rise height and spread as a function of varying effluent characteristics?
- If they are different, then we need to know why



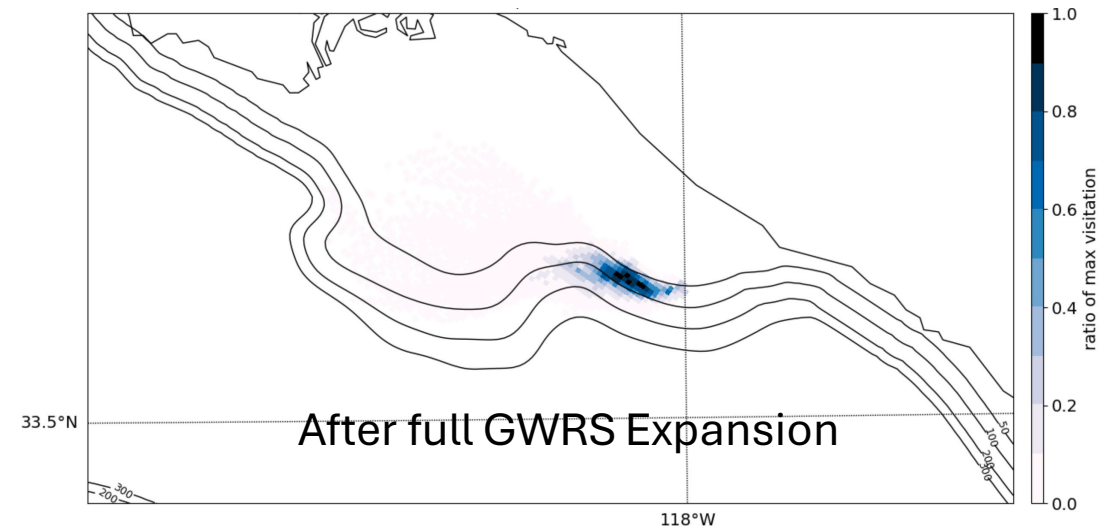
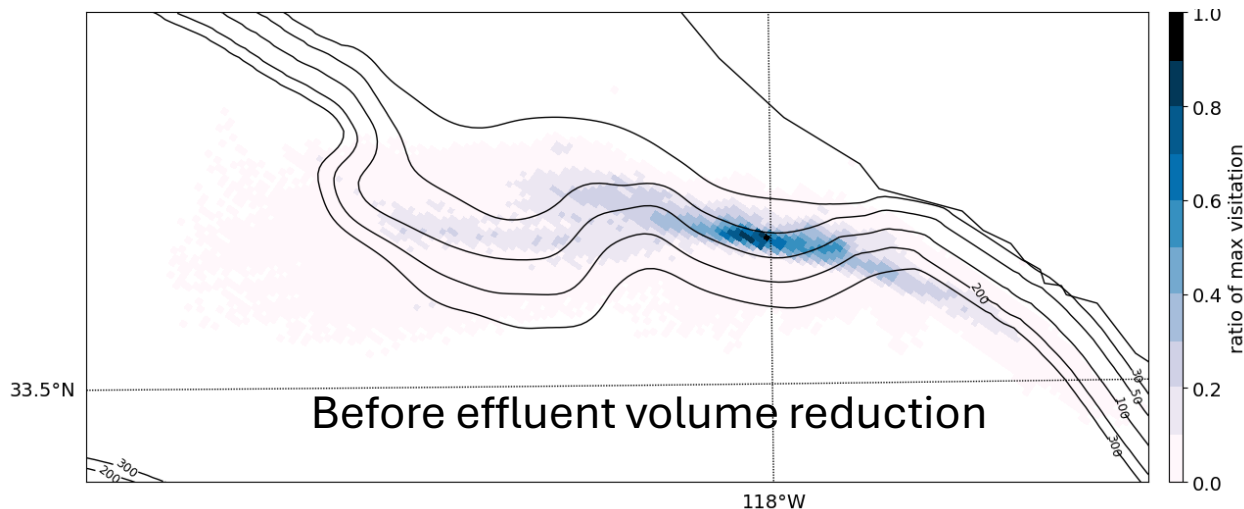
3. Model Applications: Track Plume Contaminant Fate

Mock Example of Plume Contaminant Heat Map



*Guide decisions on
.... improved monitoring program to
detect plume and its biological effects*

*...or diffuser design with realistic
conditions*



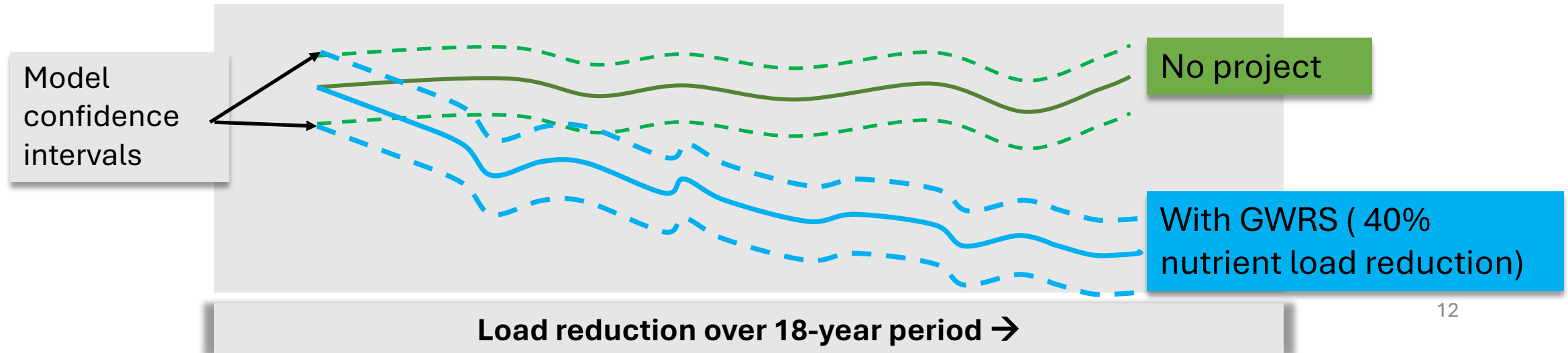
3. Model Applications: Far Field Effects

1. What is the effect of OC San effluent nutrient loading on ocean chemistry and biological effects?

... before implementation of GWRS?

...during and after progressive expansion of GWRS?

2. At what point of OC San nutrient load reductions are the changes detectable when factoring an envelope of model uncertainty?



Benefits Of Collaboration to the Commission

- Clarifying the uncertainties in ROMS applications from plume to subregional scales
- Discussion how to use Plumes and ROMS in a complementary fashion
- Application case studies can guide future applications