Our changing estuaries: lessons learned from the Columbia River, and beyond

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CMOP
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North America's Coasts in a Changing Climate, CEC-JPAC/CCPC/CCPM Meeting, Nov 2014

Context

- Coastal communities are key to today's society. In the US alone, they:
  - are home to 123M people (40% of the total population)
  - generate 45% (US $6.6T) of the national GDP and 51M jobs
- The 10 most populated water basins in the world represent 10% do the global GDP, and are expected to grow to represent 25% in 40 years
- **Estuaries** (where freshwater meets ocean water) ...
  - connect water basins and coastal communities
  - provide key economic & ecological services, locally & globally
  - are increasingly vulnerable to both climate change (including sea level rise) and local stressors
  - are too often insufficiently understood and difficult to predict

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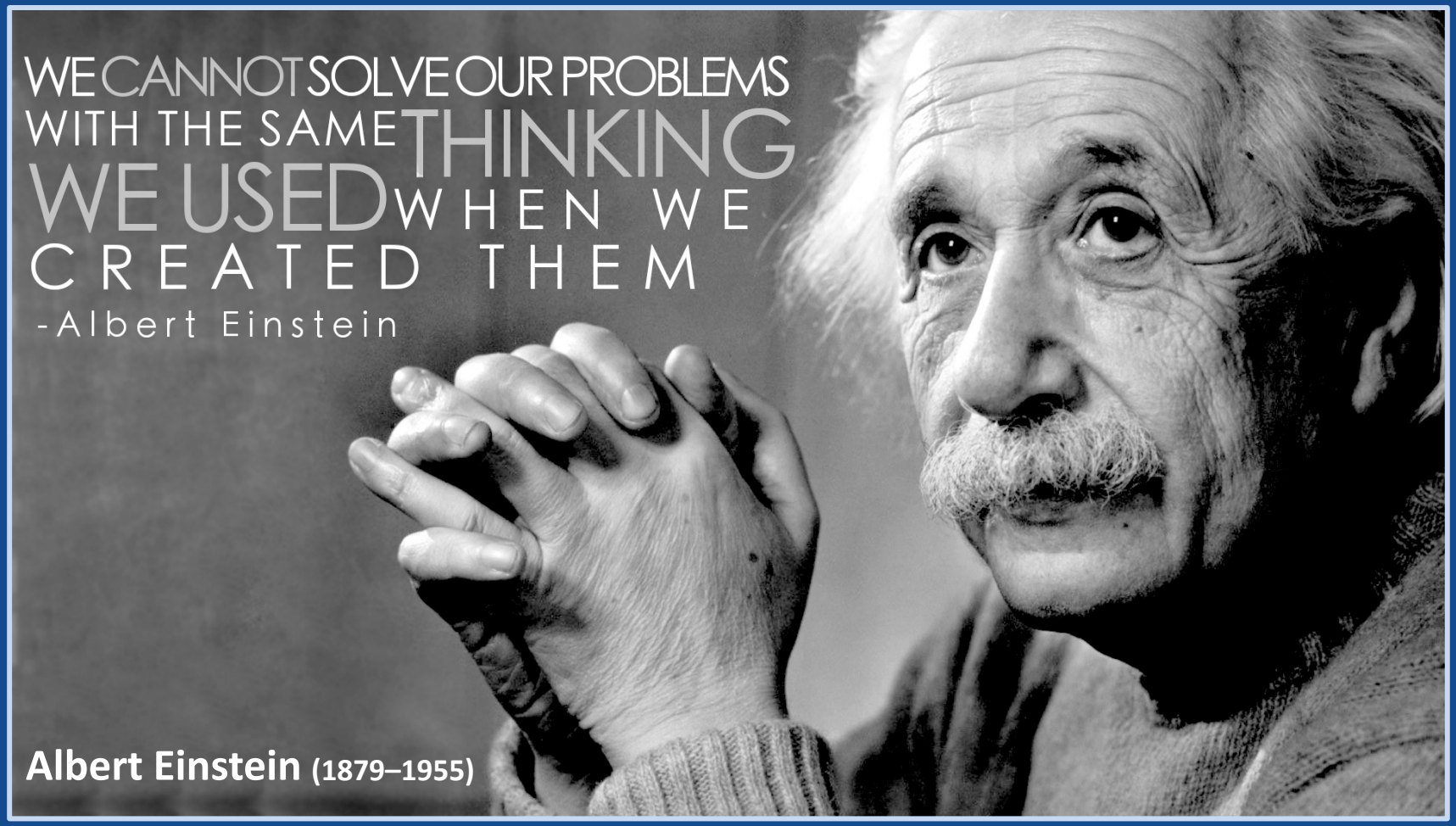

Managing estuaries and their services, under a changing local & global context, requires novel thinking

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CMOP …

… is a *NSF Science and Technology Center (STC)* that

- brings a team science approach to the study of estuaries
- enables and explores the power of data-rich collaborative environments
- uses the Columbia River estuary as testbed

Science and Technology Centers

Centers of excellence, with 4 synergistic mandates:

- **Research**
- **Education**
- **Knowledge Transfer**
- **Broadening Participation**

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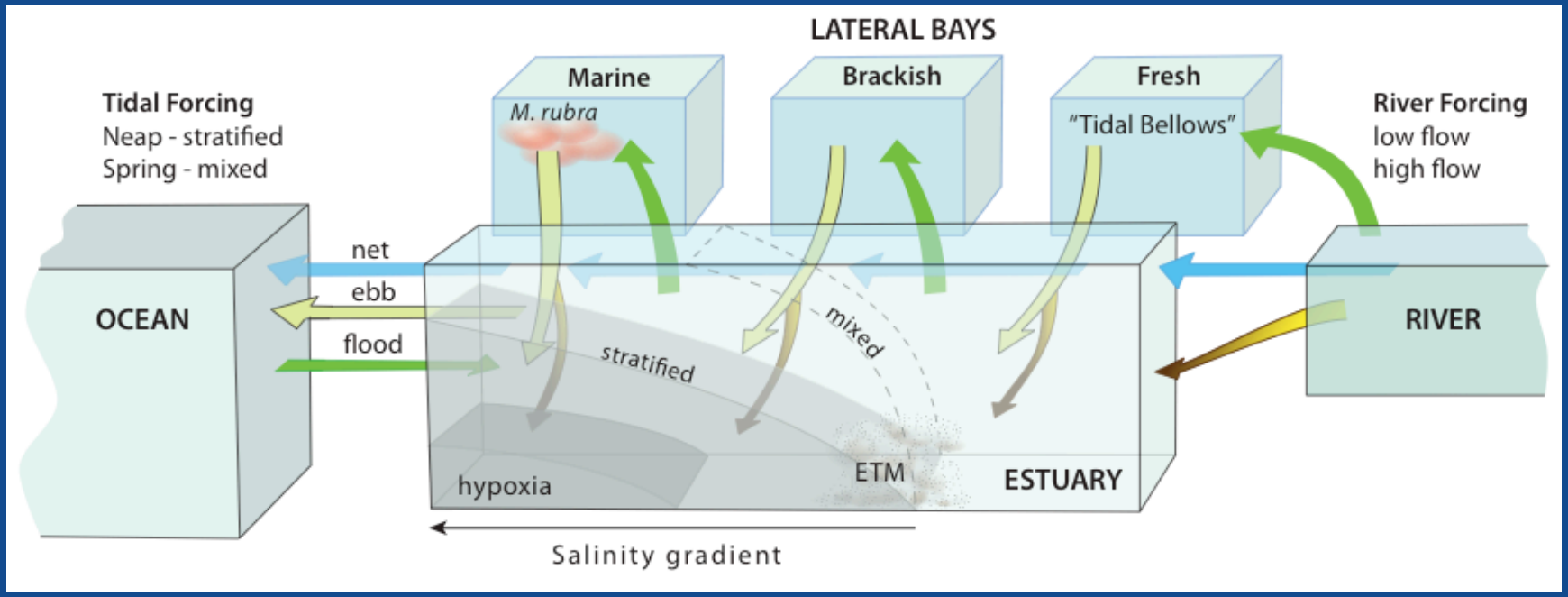
About the Columbia River



- A river-dominated, mesotidal estuary, subject to seasonal coastal upwelling
- Compressed salinity intrusion
  - Four distinct circulation regimes, responsive to river flows and tides
  - Buffering capacity: a few biological hotspots play a disproportionate role in biogeochemical cycling of the estuary

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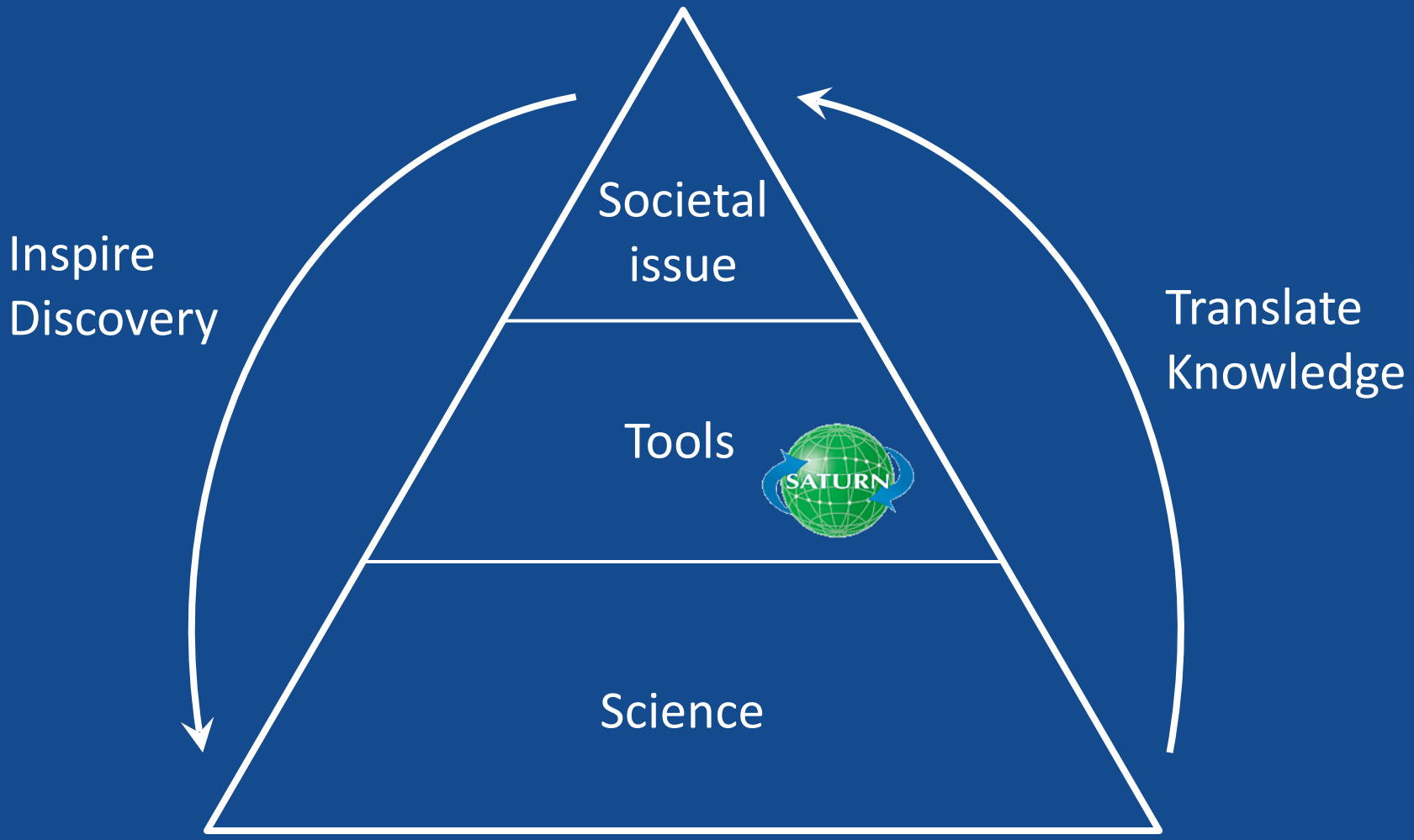
About the Columbia River

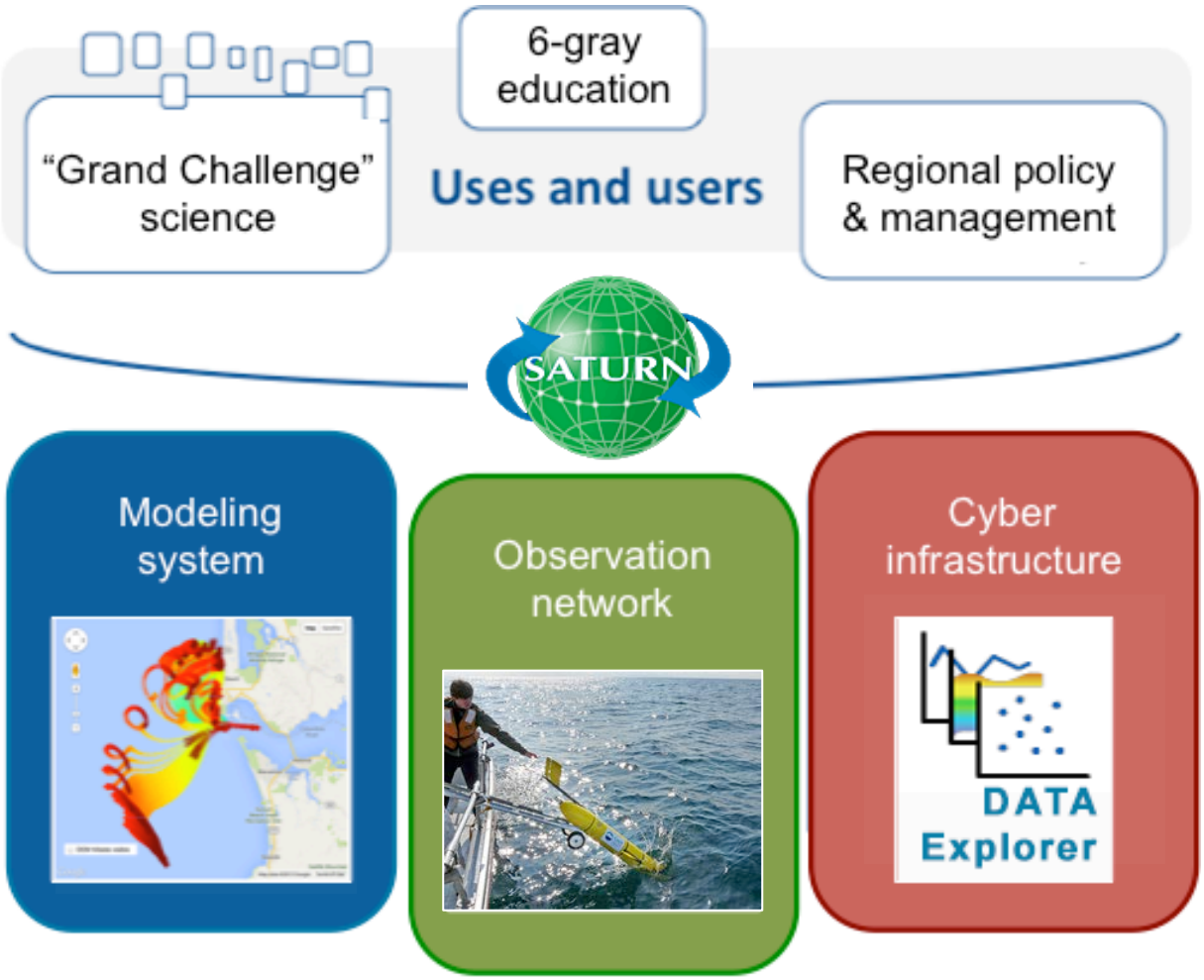
- Major freshwater plume, responsive to river flows and coastal winds
- Important nursery habitat and migration corridor for juvenile salmon
- Delicate balance among navigation, hydropower generation & flood protection, ecosystem function, and salmon protection & recovery
- Key legal framework includes:
  - Endangered Species Act
  - 1855 Columbia Basin Treaties
  - 1964 US-Canada Columbia River Treaty

Approach


Inspire
Discovery
Societal
issue
Tools
SATURN
Science
Translate
Knowledge

Approach

A "collaboratory" for the Columbia River



http://www.stccmop.org/saturn

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USGS science for a changing world

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IOOS

LOBO

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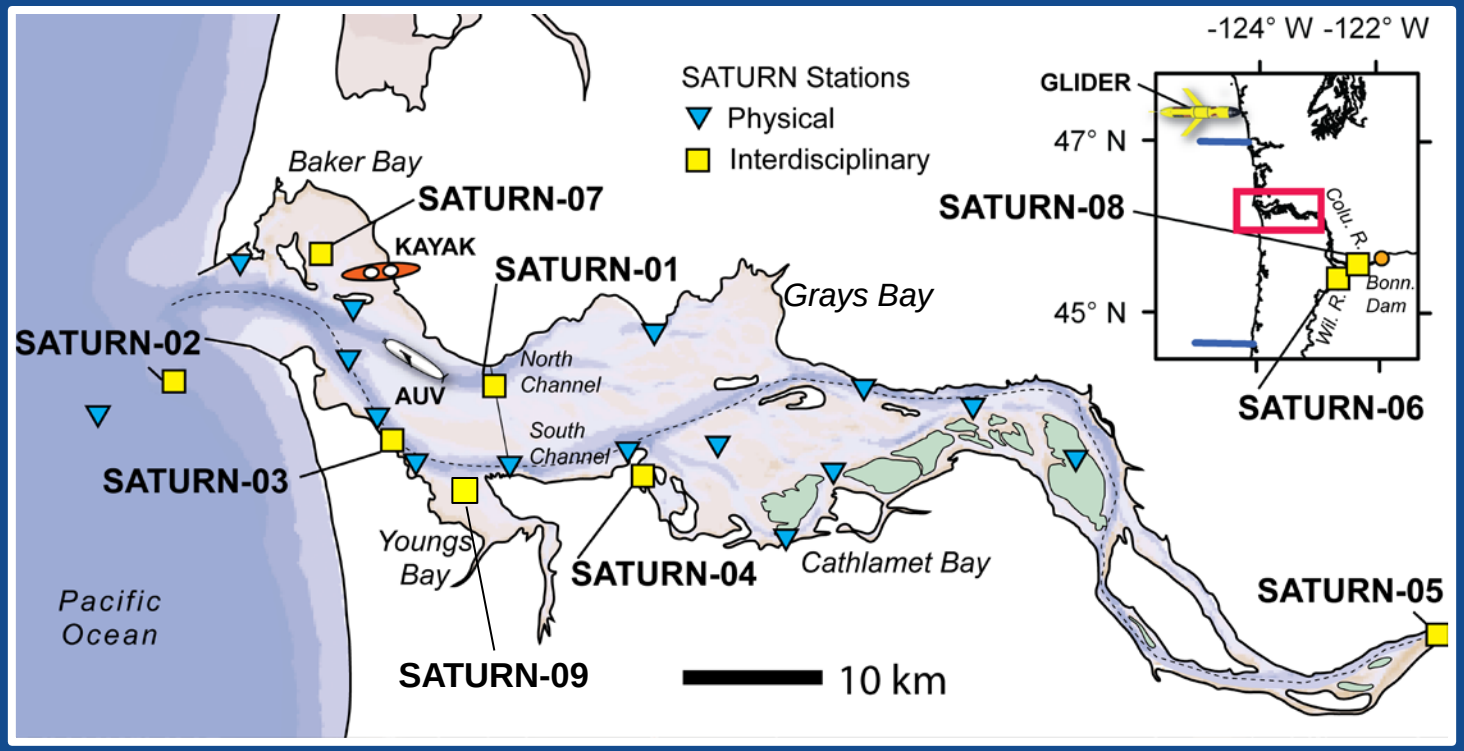
Observation network

Salinity, temperature, velocities, turbidity, chlorophyll, CDOM, DO, nitrate, phycoerythryn, pH, pCO2, ESP, …



Endurance stations

- Interdisciplinary stations (01-09)
  - Profiler (01)
  - Dock-access stations (03, 04)
- Physical stations

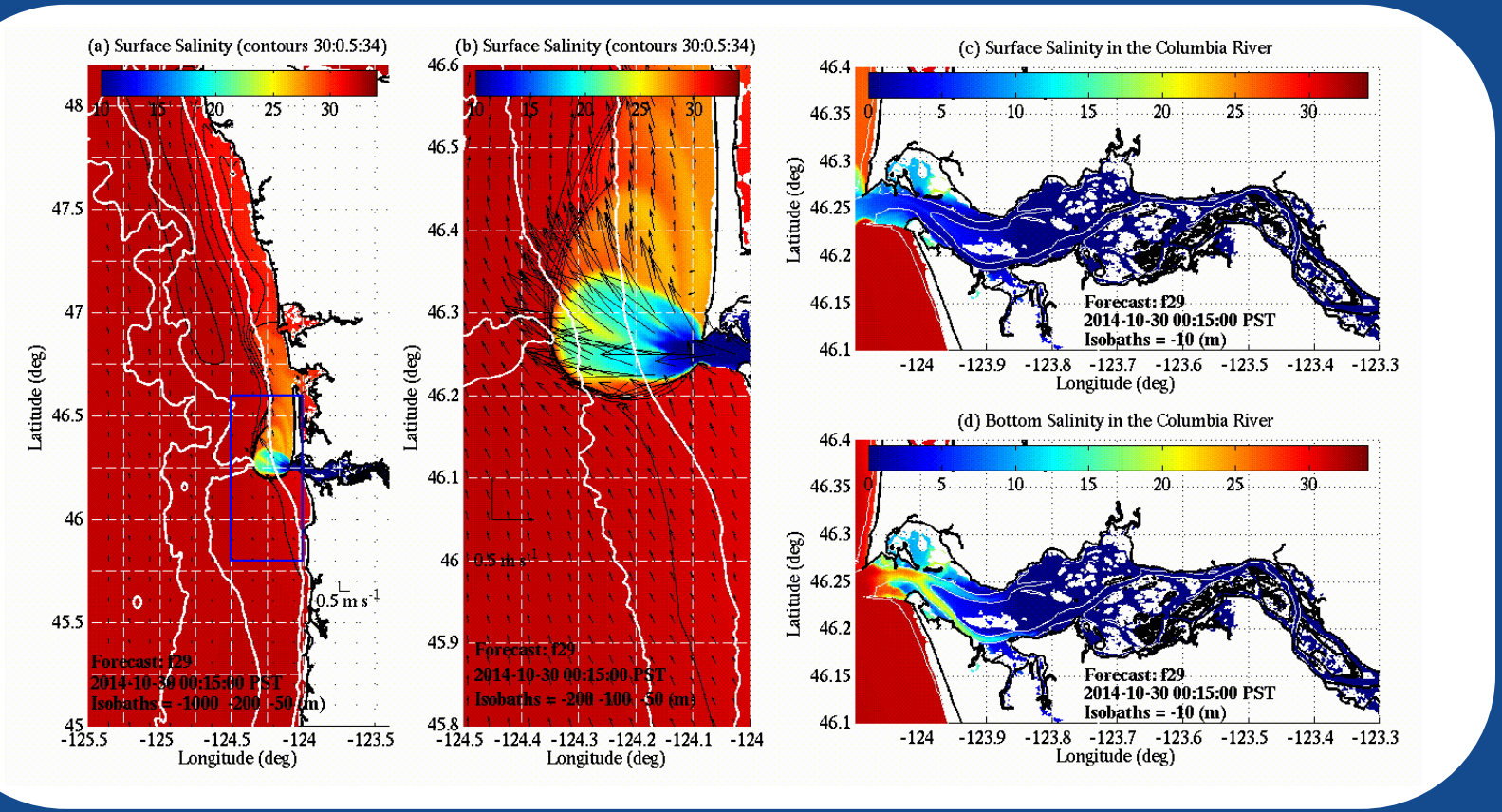
Pioneer array

- Cruises
- AUVs and glider, “kayak”
- Bottom node
- Airborne RS

Modeling system

Interdisciplinary simulations (skill assessed and improved with the benefit of observations) to meet diverse needs

- Daily forecasts
- Long-term simulation databases (currently 1999-2013)
- Simulations for process studies
- Simulations for scenarios of change



Approach

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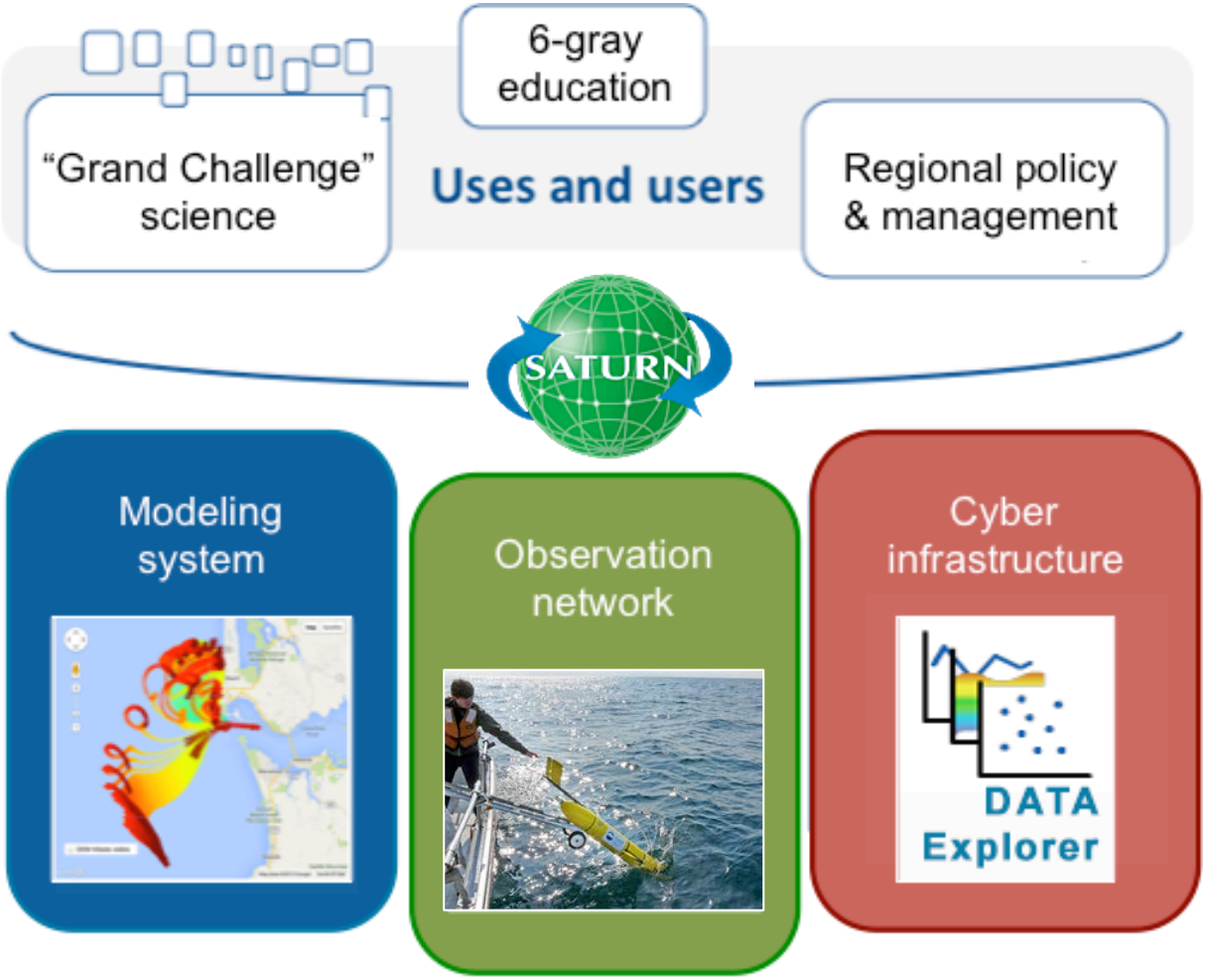

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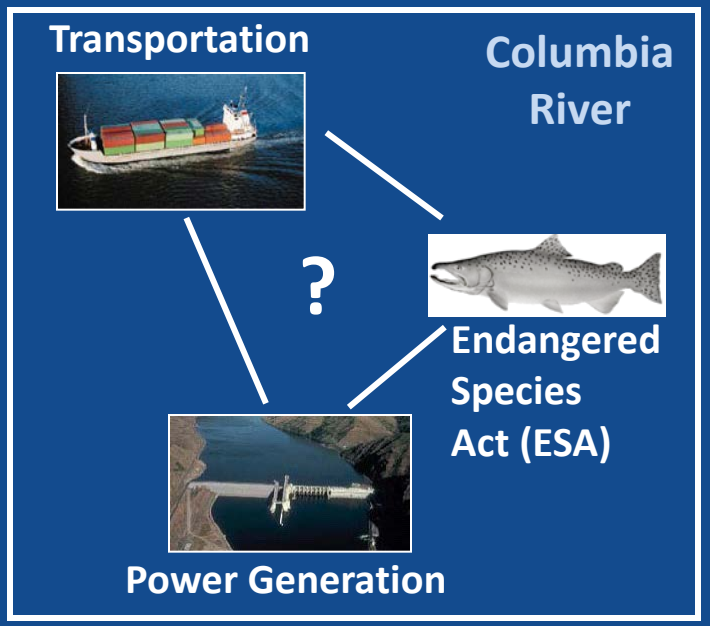
Columbia River Channel Improvement Project

Re-consultation, monitoring, closure

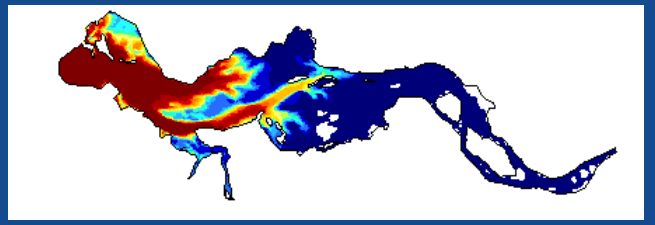
NOAA • USACE • PoP • …

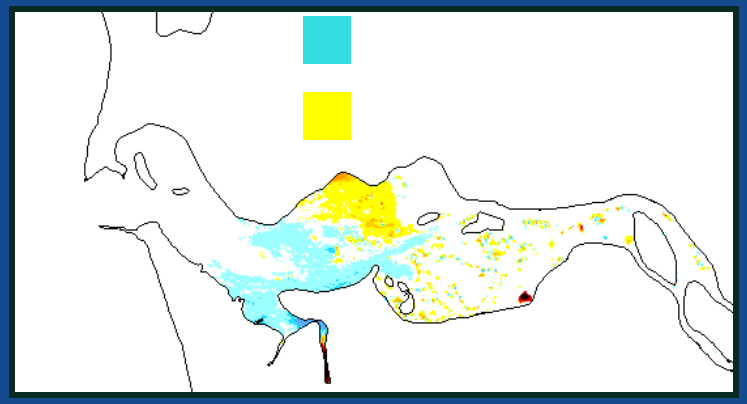
Issue: Channel deepening re-consultation



Society

OHSU



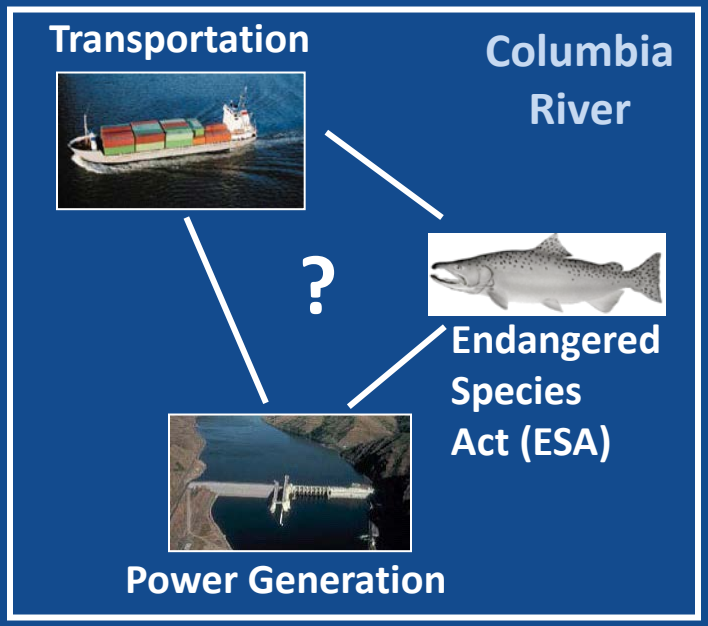


OHSU • NOAA • USACE • PoP • …

Columbia River Treaty Review

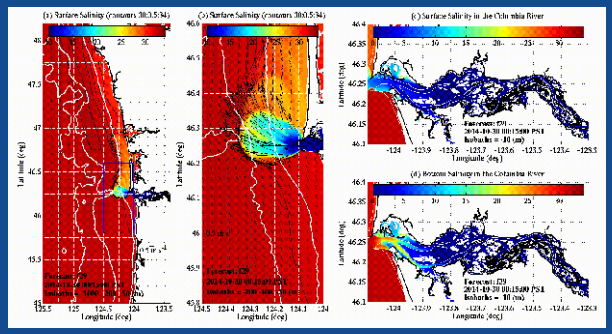
BPA • USACE • Tribes

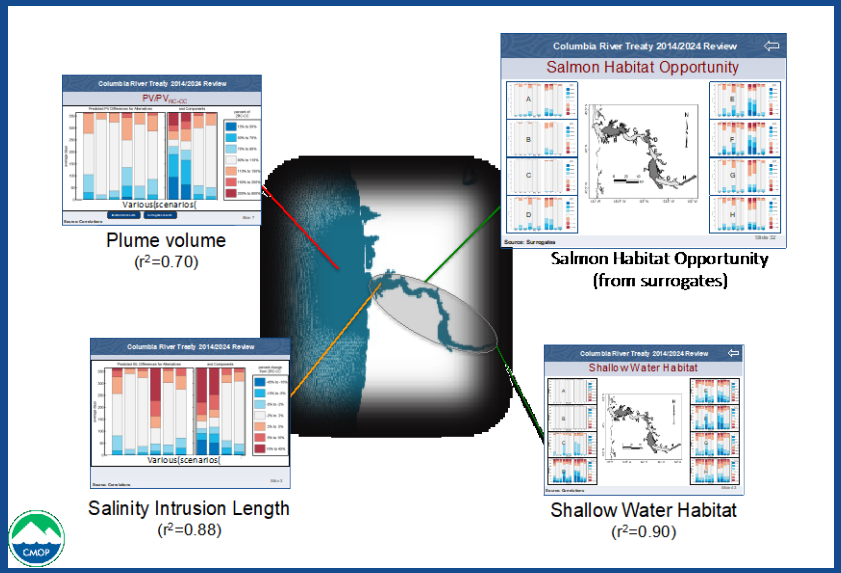
Issue: Need to decide whether the estuary should be a part of the Review



Society

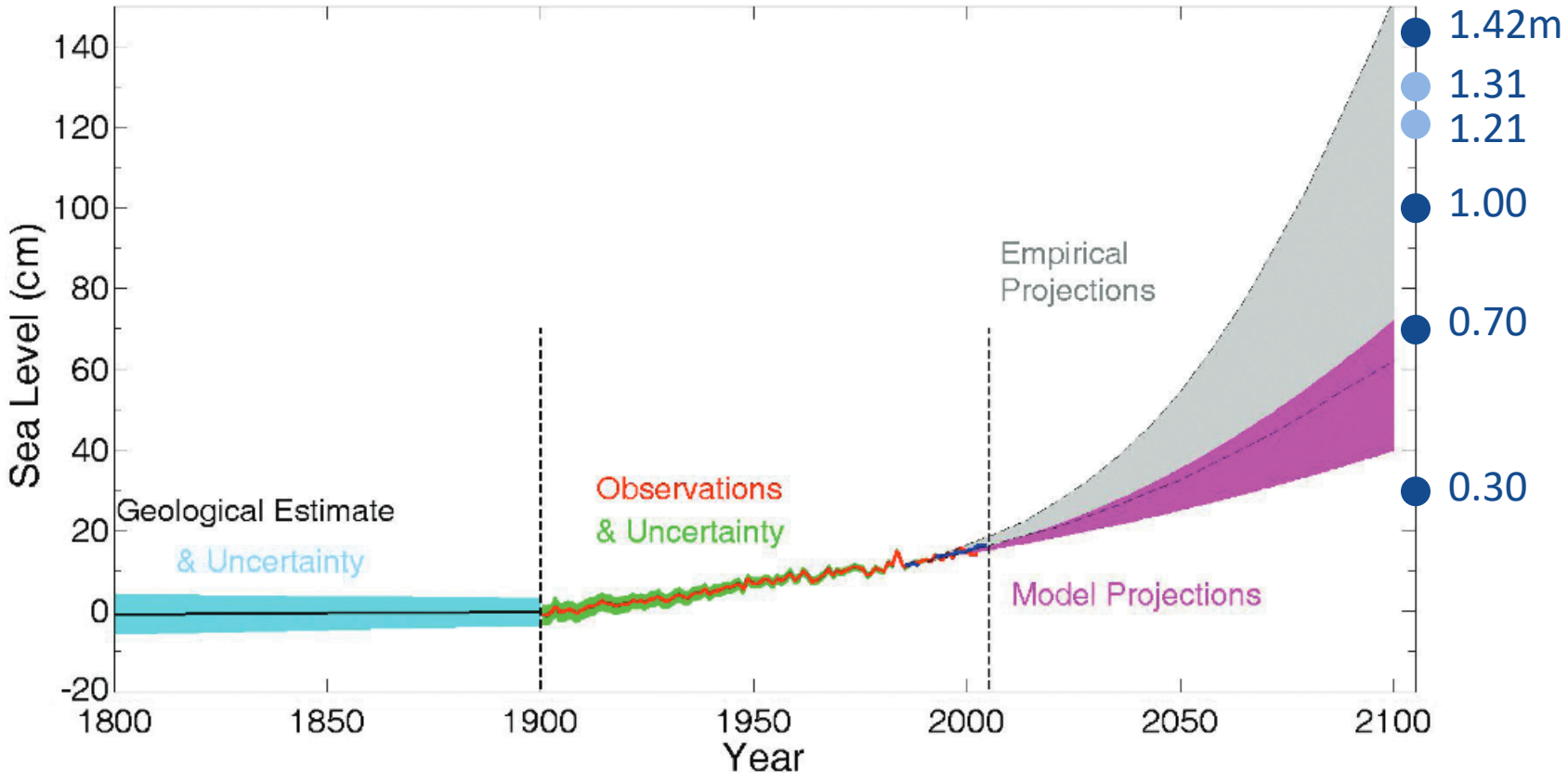
OHSU • USGS





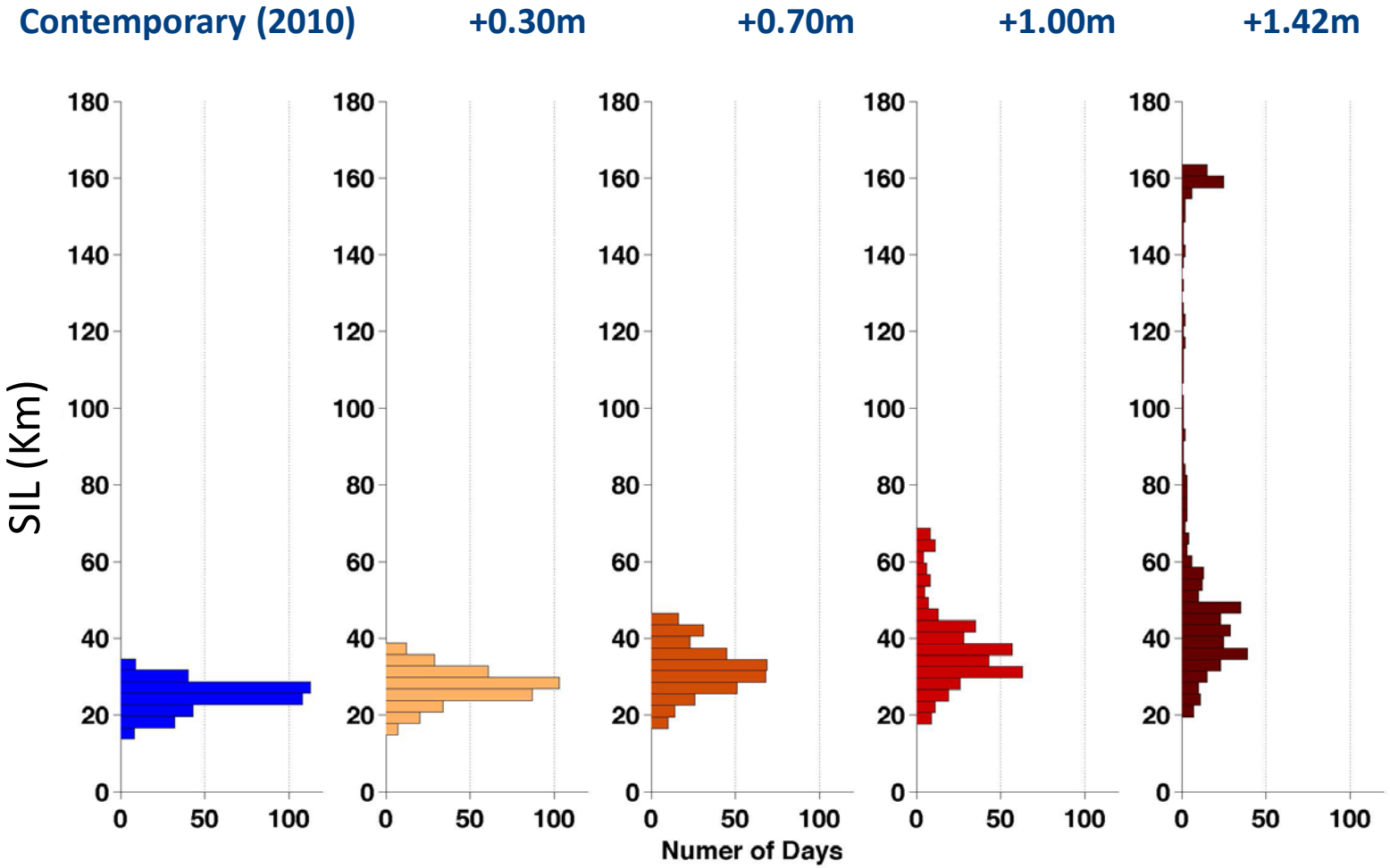
OHSU • BPA • USACE • Tribes • …

Is Sea Level Rise a potentially significant issue?



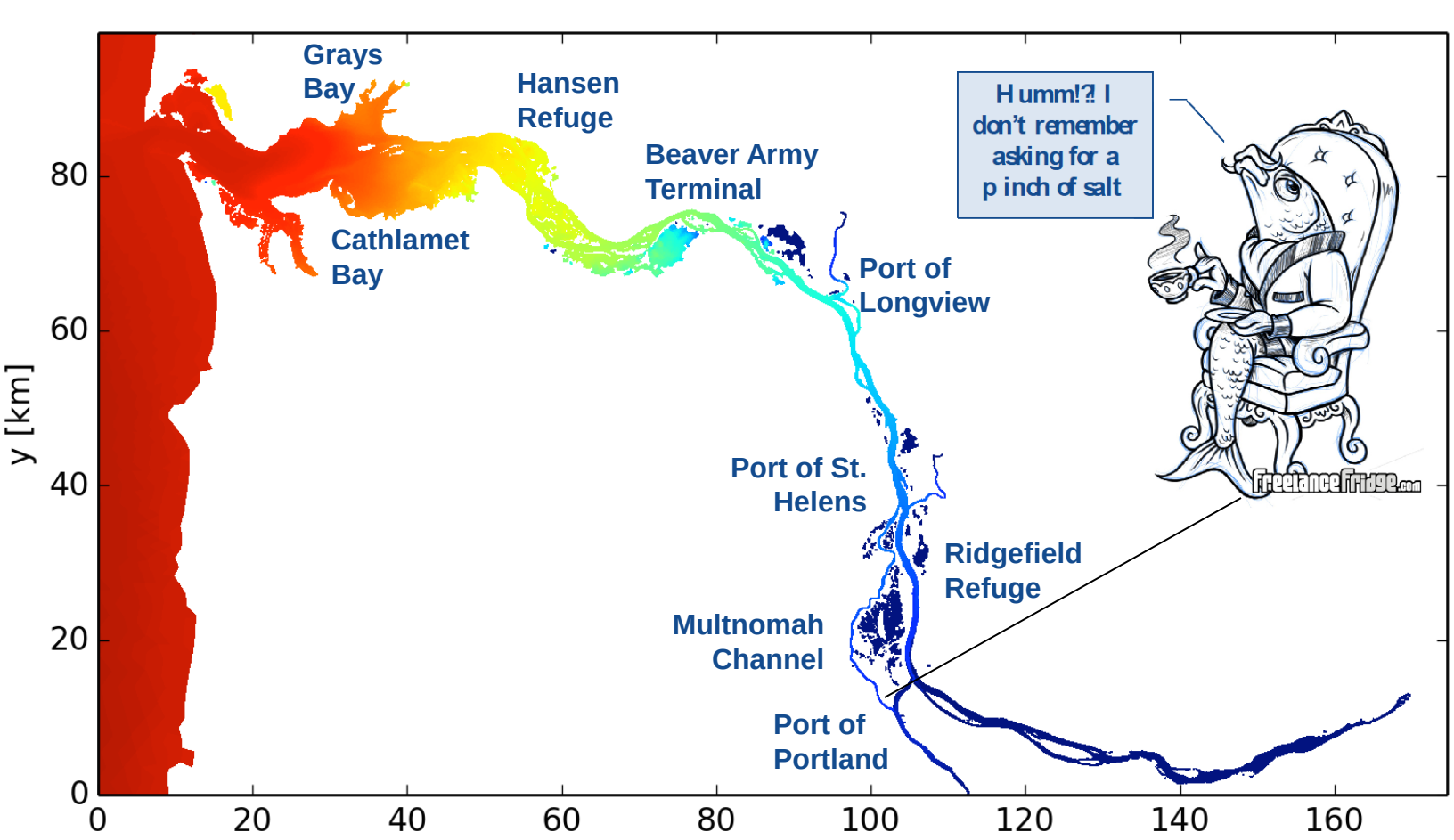
From *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*, The National Academy of Sciences 2012

Consider *Salinity Intrusion Length (SIL)*



Note: Research in progress. All results are preliminary (e.g., they do not include accretion rates, a next step)

There is potential for major impact



SLR (m)

1.42
1.31
1.21
1.00
0.70
0.30
0.00

Note: Research in progress.

All results are preliminary

Salinity (psu)

0 4 8 12 16 20 24 28 32

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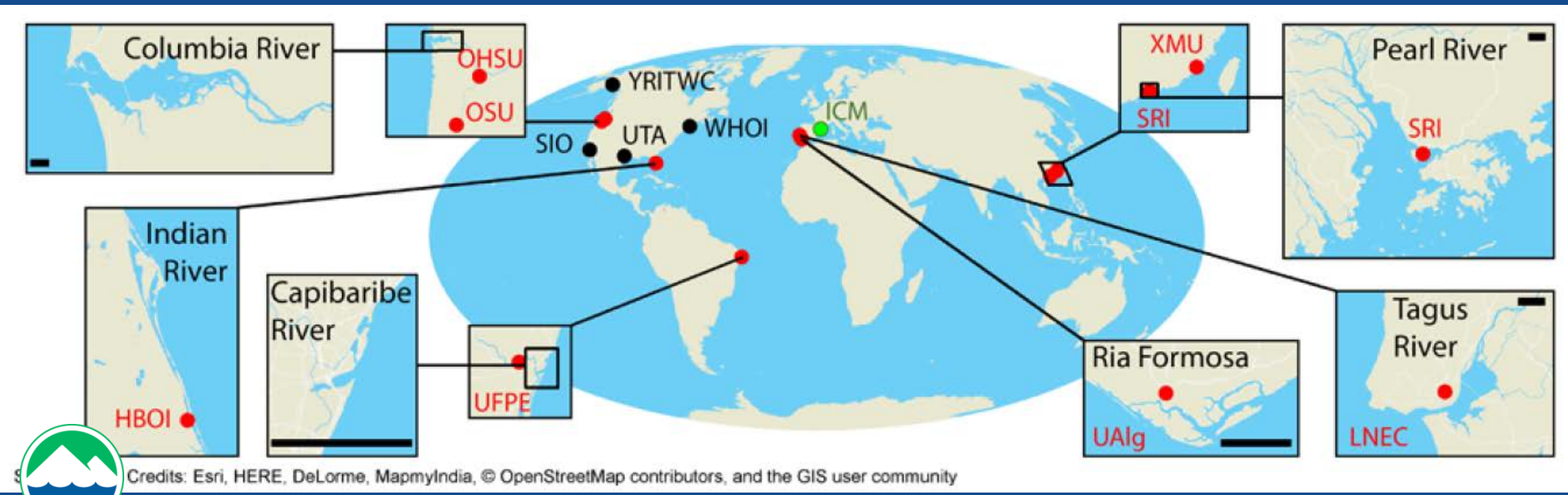
Estuaries as a global resource

- Estuaries worldwide provide key global services that are highly vulnerable to climate change and economic development
- CMOP, SIO and HBOI are catalyzing an international partnership (*Our Global Estuary*) to understand estuaries globally
  - Proposal pending to NSF/PIRE: Progressively build global capacity to understand carbon & nitrogen cycles in "all" estuaries, and monitor and predict their change due to SLR, using cross-estuary comparisons that leverage and expand both local expertise and shared tools



Tier 1 estuaries for the NSF/PIRE proposal

Synthesis

- The SATURN collaboratory is changing science and management practices for the Columbia River estuary
  - There is enormous power in data-rich collaborative environments, where people, models and observations sustainably come together to produce knowledge and anticipate change
- Sea level rise is among the potentially most impactful changes ahead for the Columbia River estuary
  - **Warning:** The magnitude of SLR impacts is only in exploratory stages of assessment, and estimates could still change very significantly
- The power of collaboratories is globally needed and replicable
  - Replication requires an engaged international partnership, global capacity building, and site-specific customization to respect different culture, uses, and means (the vision for Our Global Estuary)
  - **CEC-JPAC/CCPC/CCPM could play a significant role in implementing and taking advantage – in North America – of Our Global Estuary**

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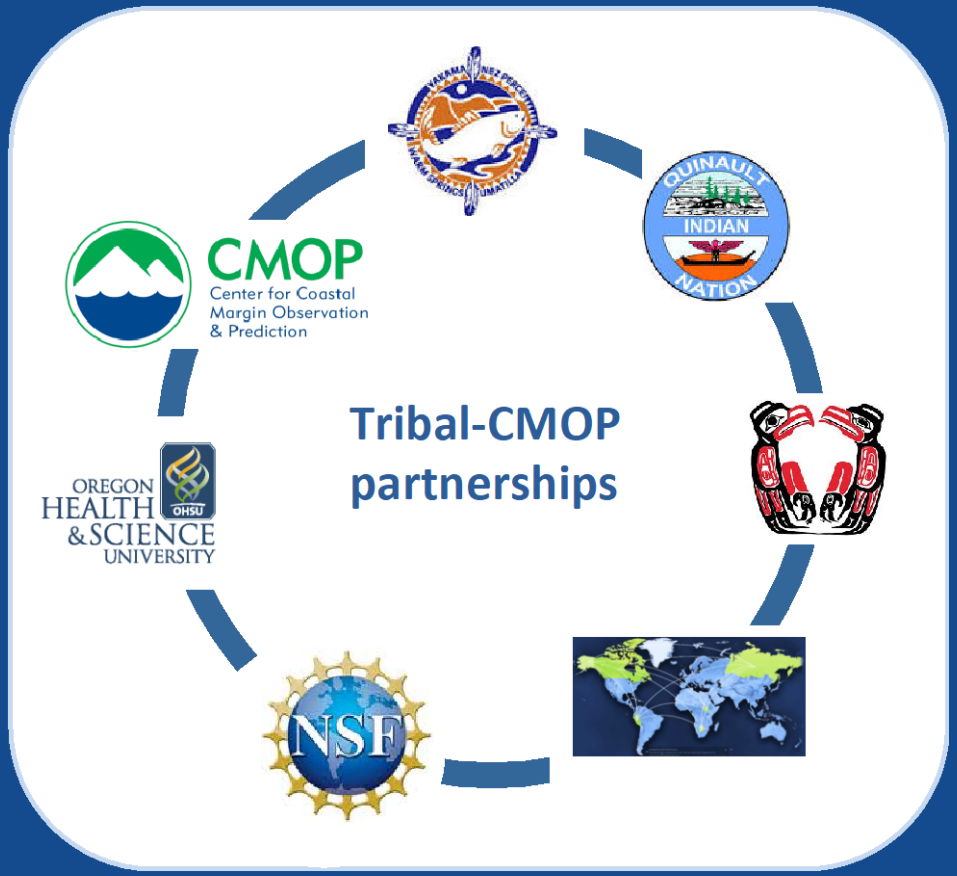
Happy to address any questions



Building bridges, finding solutions

Disclaimer

All opinions are those of the presenter, and should not be interpreted as opinions or endorsements of the National Science Foundation or of any other funding agency, partner institution, or collaborator