



# Assessing wetland resilience in the Columbia River estuary

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**Past**: Feedback between increases/decreases in water level and increased/decreased deposition have allowed wetlands to keep pace (Baker et al. 2010; Peterson et al., 2014)

**Present**: Borde et al. (2020) described current relationships between plant communities and local hydrology (frequency of inundation, tidal datums, etc.)

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<u>Annual Rate of Water Level Change (ΔWL)</u>

<u>Annual Accretion Rate (Δz)</u>





Annual Rate of Water Level Change ( $\Delta$ WL)

Sea level rise is faster than in the past **Riverflow magnitude and timing** 

- Changes to basin precipitation
- Dam operations (flood risk, treaty, etc.)

## Annual Accretion Rate (Δz)



### ~70% decrease in sediment supply to the estuary

# Accretion ( $\Delta z$ )

A resilient wetland needs:  $\Delta WL \sim \Delta z$ 

## <u>Surface Elevation Tables (SETs)</u>

- "gold standard"
- 10 least-disturbed wetlands
- From the mouth to Sauvie Island (~150 rkm)
- Measure 4x per year
- Oldest since 2018

## Sediment stakes (SS)

- •
- •



(Photos courtesy Shanon Dell)



PNNL Reference Site Study (see also Diefenderfer et al. 2021) AEMR restoration and reference site monitoring data Sediment stake pairs co-located with SETs (PNNL long-term monitoring, ongoing)

# Accretion ( $\Delta z$ )

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mm/yr

## Sediment stakes (SS)

- •
- •
- •

Good agreement between SET and SS accretion rates, when:

- co-located carefully in heterogeneous topo (e.g. in/out pans)
- SET pins are analyzed • separately
- measured carefully, with • same procedure and by the same folks
- there are no cows



**Comparison of SET and SS Accretion Rates** 

PNNL Reference Site Study (see also Diefenderfer et al. 2021) AEMR restoration and reference site monitoring data Sediment stake pairs co-located with SETs (PNNL long-term monitoring, ongoing)

# Changing water levels: SLR + future riverflows

- Hydrodynamic model: Delft3D-Flexible Mesh
- Bonneville Dam (rkm 240) to 30km off the coast
- Primary tributaries: Sandy, Willamette, Lewis, Cowlitz Rivers
- ~100m resolution in the estuary, ~1km offshore
- 25 vertical levels
- Water level, velocity, bed stress, salinity, suspended sediment
- SLR: 0, 0.5, 1.0, 1.5m
- Future riverflows: 10th, 90th %ile and median flows
   @ Bonneville for SCP 4.5 from RMJOCII (USACE 2020)



# A resilient wetland needs: ΔWL ~ Δz

# **Changing water levels: SLR**

- SCP2-4.5 'Intermediate' scenario NAVD88
- April-June 2009
  - Current 2yr flow
  - Growing season (ish)



# **A** resilient wetland needs: $\Delta WL \sim \Delta z$



# **Changing water levels: SLR + future riverflows**

- RMJOC II 10<sup>th</sup>, 90<sup>th</sup>
   %ile, and median
   flows at Bonneville
- SSP2-4.5
   'Intermediate' scenario
- April-June 2009
  - Current 2yr flow
  - Growing season (ish)



# A resilient wetland needs: ΔWL ~ Δz

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# Modeled ΔWL High 1.5m, 2120 Medium 1.0m, 2095 Low 0.5m, 2070 SLR + FF 120 140





# Questions? Maggie.mckeon@pnnl.gov

