Freshwater plays multiple important roles in the Northern Gulf of Alaska (NGA) ecosystem

- Terrestrial runoff contains iron and other micronutrients
- Low-density surface water vertically structures habitat and mediates nutrient fluxes into the euphotic zone
- Spreading of the plume edges entrains nutrients into surface waters, stimulating production
- Fresher waters support distinct planktonic assemblages

Plume inputs are variable but quasi-predictable

Self-organizing map analysis shows the plume exhibits 4 primary modes of freshwater spatial distribution (mediated by wind and discharge rate) with varying frequencies of occurrence (see Reister on-line NGA poster). Freshwater inputs also show a pronounced seasonal cycle, peaking in late summer (Beamer et al. 2016).

Plume edge processes supply growth-promoting nutrients

Fine-scale mapping shows 3-D plume structure. Spreading mid-shelf plume fronts generate turbulent shear as they flow over saline shelf waters; shear mixes macronutrients from below, leading to small-scale phytoplankton blooms at the sea surface.

NGA river plumes promote higher ecosystem production and biodiversity through multiple habitat types and temporally evolving physical disturbances

Coastal freshwater supplies iron, a limiting micro-nutrient in the NGA

Dissolved iron, a limiting micronutrient in the NGA, is provided by river plume and non-point-source freshwater inputs, especially in summer/fall (see Ortega on-line NGA poster).

Dissolved, iron-limited offshore waters stimulates growth of large phytoplankton (diatoms) and alters community composition, as shown at at-sea incubation experiments (Mazur 2020).

Plume creates distinct habitats that increase ecosystem-wide diversity

Plume phytoplankton communities tended to be higher in Synechococcus cyanobacteria, lower in larger phytoflagellates (see Cohen and O’Hara on-line NGA posters).

Microzooplankton (primary consumers in the NGA) showed different community biomass composition in the river plume. Tintinnids (shelled ciliates) and large mixotrophic dinoflagellates (Tripos spp.) were dominant plume members. Plume communities were less distinct in the 2019 marine heatwave year.

References Cited:
- Cohen and O’Hara on-line NGA posters