Corresponding Author: Marie Zahn
marie.j.zahn@jpl.nasa.gov
Career Status: Postdoc
Affiliation/Country: NASA Jet Propulsion Laboratory/Caltech, USA

Presentation Type: In Person, Oral

Topic: Recent ocean salinity science advances

Title: Riverine Freshwater Effects on Fall Sea Ice Freeze-Up in the Beaufort Sea

Abstract: The Mackenzie River is the largest North American source of freshwater into the Arctic Ocean and discharges warm water in the spring that initiates coastal sea ice melt. However, the influence of its freshwater discharge on fall sea ice advance has not been investigated. In the Arctic, ocean salinity is a primary control on upper ocean stratification and therefore modulates vertical heat exchange and sea ice formation. Here, we introduce a new pan-Arctic high-resolution coupled ocean-sea ice model dataset and use it alongside satellite observations to investigate how freshwater from the Mackenzie River controls early fall sea ice formation in the Beaufort Sea. Both satellite and model results consistently show the early development of an "ice bridge" across the Mackenzie River plume that connects the offshore ice edge to the coastline. Enhanced freshwater input strengthens near-surface salinity stratification, shoals the mixed layer, and reduces upper-ocean heat content, resulting in earlier sea ice formation by three weeks compared to adjacent saltier waters. Differences in freezing point associated with salinity variations account for only a 1–2 day shift in freeze-up timing, demonstrating that stratification-driven suppression of ocean heat, rather than thermodynamic freezing-point effects, is the dominant mechanism. These findings highlight the strong influence of terrestrial freshwater discharge on sea ice advance and suggest that continued increases in Arctic runoff may alter sea ice phenology. Our results support the hypothesis of NASA's SASSIE (Salinity and Stratification at the Sea Ice Edge) project and provide a physical basis for the upcoming FRESH campaign. They further suggest that incorporating sea surface salinity observations into forecast models may improve sea ice predictions.

Author 2: Severine Fournier
NASA Jet Propulsion Laboratory/Caltech, US

Author 3: Ian Fenty
NASA Jet Propulsion Laboratory/Caltech, US

Author 4: Mike Steele
University of Washington, US

Author 5: Mike Wood
San Jose State University, US

Author 6: Peter Gaube
University of Washington, US