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**Topic:** Critical drivers for ocean salinity science and applications and the future need for high-resolution technologies

**Title:** Sea surface salinity signatures precedent the pineapple express and the implications for rainfall prediction beyond weather time

**Abstract:** Atmospheric Rivers (ARs) are narrow moisture corridors that occupy less than 10% of the surface of the globe but are responsible for more than 90% of poleward moisture transport, and thus influences hydroclimate across the globe. The formation of ARs usually occurs within the warm sector in front of the leading cold front of an extratropical cyclone. These thermodynamic and dynamic processes leave a unique imprint on sea surface salinity (SSS). Globally, the most significant SSS anomaly (SSSA) associated with ARs are located over the Arctic and the eastern North Pacific close to the western coast of the United States (US). For the North Pacific, a patch of fresh SSSA is found right beneath the recurring AR pathway called the Pineapple Express. Alongside the fresh SSSA are two patches of anomalously salty water. This “sandwich pattern” of SSSA has been formed 2-3 weeks prior to the passage of the Pineapple Express, indicating a potential predictive skills from SSSA. Based on the mixed layer salinity budget analysis, we found the high SSSA outside of the Pineapple Express in precedent weeks is attributable to increased moisture export (E-P) over the ocean surface, which serves as a moisture source for the development of ARs. This increased SSSA by moisture export is counteracted by upwelling and mixing of subsurface freshwater due to strong wind from the frontal system associated with ARs. The wind, however, does not significantly modulate SSSA through advection, in that the salinity advection is an order of magnitude smaller than freshwater forcing. The close connection between SSSA, the moisture export mechanisms, and ARs suggests that the precedent “sandwich pattern” in SSSA could provide predictive values for the Pineapple Express and the high-impact hydroclimatic events once made landfall. Analysis of the record-breaking California flood in the winter of 2016/17 suggests that Pineapple Express is the largest moisture delivering system for the flood. In addition, an elevated SSSA~0.2 PSU outside of the AR is identified. Given the lead time, monitoring the “sandwich pattern” of SSSA over the eastern North Pacific will provide predictive values for sub-seasonal prediction of extreme precipitation over the US West Coast.

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