

**An Analysis of Coordinated Observations from NOAA's Ronald Brown Ship and G-IV Aircraft in a Landfalling Atmospheric River over the North Pacific during CalWater-2015**

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## ABSTRACT

To gain a more complete observational understanding of atmospheric rivers (ARs) over the data-sparse open ocean, we used a diverse suite of mobile observing platforms deployed on NOAA's *Ronald H. Brown* (RHB) research vessel and G-IV research aircraft during the CalWater-2015 field campaign to describe the structure and evolution of a long-lived AR modulated by six frontal waves over the northeastern Pacific on 20-25 January 2015. Satellite observations and reanalysis diagnostics provided synoptic-scale context, illustrating the warm, moist southwesterly airstream within the quasi-stationary AR situated between an upper-level trough and ridge. The AR remained offshore of the U.S. West Coast but made landfall across British Columbia where heavy precipitation fell. Forty-seven rawinsondes launched from the RHB provided a comprehensive thermodynamic and kinematic depiction of the AR, including uniquely documenting an upward intrusion of strong water-vapor transport in the low-level moist southwesterly flow during the passage of frontal waves 2 through 6. A collocated 1290-MHz wind profiler showed an abrupt frontal transition from southwesterly to northerly flow below 1 km MSL coinciding with the tail-end of AR conditions. Shipborne radar and disdrometer observations in the AR uniquely captured key microphysical characteristics of shallow warm rain, convection, and deep mixed-phase precipitation. Novel observations of sea-surface fluxes in a midlatitude AR documented persistent ocean-surface evaporation and sensible-heat transfer into the ocean. The G-IV aircraft flew directly over the ship, with dropsonde and radar spatial analyses complementing the temporal depictions of the AR from the RHB. The AR characteristics varied, depending on the location of the cross section relative to the frontal waves.