High-Frequency Airborne Microwave and Millimeter-wave Radiometer (HAMMR) West Coast Flight Campaign: Integrated Water Vapor and Liquid Water Retrievals

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The High-Frequency Airborne Microwave and Millimeter-wave Radiometer (HAMMR) was developed to demonstrate increased spatial resolution of wet-tropospheric path delay retrieval for high-resolution ocean surface altimeter missions. This improvement is based on the addition of high-frequency millimeter-wave channels to lower-frequency microwave channels. HAMMR is a 25-channel cross-track scanning airborne radiometer that includes low-frequency microwave channels at 18.7, 23.8, and 34 GHz at both vertical and horizontal polarizations, high-frequency millimeter-wave window channels at 90, 130 and 168 GHz and millimeter-wave sounding channels consisting of eight channels near each of 118.75 GHz and 183.31 GHz for temperature and water vapor profiling, respectively. HAMMR was designed and fabricated jointly by Colorado State University's (CSU) Microwave Systems Laboratory (MSL) and the NASA/Caltech Jet Propulsion Laboratory (JPL).

HAMMR was deployed on a Twin Otter aircraft over nearly the entire U.S. West coast during the West Coast Flight Campaign (WCFC) from November 4 to 17, 2014. During the WCFC, the HAMMR instrument flew on the Twin Otter on 11 of the 14 days of the campaign, yielding more than 53.5 hours of data under diverse atmospheric conditions, including clear sky, scattered and dense clouds, as well as surface types, including coastal ocean areas, inland water and land. The WCFC began and ended in Grand Junction, CO. Five flight days out of 11 were devoted to traversing nearly the entire U.S. West coast from Camarillo, CA, to the Canadian border. In addition, during the WCFC, HAMMR performed radiometric measurements over inland water bodies, in particular the San Joaquin River Delta in CA and the Strait of Juan de Fuca (leading to Puget Sound) in WA. Some of the coastal and inland water areas were overflown multiple times at different times of the day to perform measurements under a variety of atmospheric conditions such as clear sky, clouds and fog. Finally, two flight days were devoted to overflights of Lake Tahoe, CA/NV, and Mono Lake, CA. These flights were performed at the same time as the AirSWOT radar overflew the same two lakes.

Antenna temperatures measured by HAMMR during the WCFC were accurately calibrated and geolocated to retrieve wet-path delay with better than 1-mm precision and 150-m spatial resolution. Multiple methods were used for cross-comparison of two-point radiometric calibration of the WCFC data. Results of integrated water vapor and integrated cloud liquid retrieved from antenna temperatures will be presented.