High-Resolution Wet-Tropospheric Path Delay Corrections for Coastal and Inland Water Altimetry using Wide-Band Airborne Microwave and Millimeter-Wave Radiometers

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Current satellite ocean altimeters include nadir-viewing, co-located 18-34 GHz microwave radiometers to measure wet-tropospheric path delay. Due to the area of the surface instantaneous fields of view (IFOV) at these frequencies, the accuracy of wet path retrievals is substantially degraded near coastlines, and retrievals are not provided over land. The principal objective of this research is to assess the ability of higher-frequency radiometers to meet the needs of NASA's Surface Water and Ocean Topography (SWOT) mission concept recommended by the U.S. National Research Council's Earth Science Decadal Survey, planned for launch in 2019-2020. The primary objectives of SWOT are to characterize ocean sub-mesoscale processes on 10-km and larger scales in the global oceans, and to measure the global water storage in inland surface water bodies, including rivers, lakes, reservoirs, and wetlands. Therefore, an important new science objective of SWOT is to transition satellite radar altimetry into the coastal zone. A viable approach to meet these needs is the addition of wide-band millimeter-wave window channels at 90-170 GHz with internal calibration, yielding finer spatial resolution for a given antenna size. The addition of millimeter-wave channels near 90, 130 and 166 GHz to current Jason-class radiometers is expected to improve retrievals of wet-tropospheric delay in coastal areas and to enhance the potential for inland water retrievals.

To reduce the risks associated with wet-tropospheric path delay correction over coastal areas and fresh water bodies, we are developing an airborne radiometer with 18.7, 23.8 and 34.0 GHz microwave channels, as well as millimeter-wave window channels at 90, 130 and 166 GHz, and sounders near 118 and 183 GHz for validation of wet-path delay. For nadir-viewing space-borne radiometers, two-point internal calibration sources at microwave frequencies have been extended to the millimeter-wave frequency channels at 90-170 GHz. This instrument development and airborne flight demonstration will (1) assess wet-tropospheric path delay variability on 10-km and smaller spatial scales, (2) demonstrate millimeter-wave radiometry using both window and sounding channels to improve both coastal and over-land retrievals of wet-tropospheric path delay, and (3) provide an instrument for calibration and validation in support of the SWOT mission.