L-Band Geophysical Model Function for Retrieval of Sea Surface Salinity and Wind from SMAP Data

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NASA's Soil Moisture Active Passive (SMAP) mission, the first Earth Science Decadal Survey mission, was launched January 31, 2015 to provide high-resolution, frequent-revisit global mapping of soil moisture. SMAP has two instruments, a polarimetric radiometer and a multi-polarization synthetic aperture radar. Both instruments operate at L-band frequencies (~ 1GHz) and share a single 6-m rotating mesh antenna, producing a fixed incidence angle conical scan at 40^0 across a 1000-km swath and a 2-3 day global revisit. The radiometer has been operating since April 2015 with no issues. However the radar also started operation in April, but ceased operation on July 7. We have performed the matchup of the SMAP radiometer and radar data with the ocean wind from the National Center for Environment Predictions (NCEP), HYCOM's sea surface salinity, and Reynolds sea surface temperature. We find that the SMAP geophysical model functions (GMF) are in excellent agreement with that derived from Aquarius data. We applied the L-band GMF derived from Aquarius and SMAP data to the retrieval of sea surface salinity (SSS) and ocean surface wind retrieval by leveraging the QuikSCAT algorithms to account for the two-look geometry (fore and aft looks from the conical scan) and dual-polarization observations. The retrieval algorithm has been applied to about six months of SMAP radiometer data and 2 months of radar data. Comparison with the European Center for Medium-Range Weather Forecasting (ECMWF) wind speed suggests that the SMAP' radiometer wind speed reaches an accuracy of about 0.7 ms^{-1}. The preliminary assessment of the SMAP SSS products gridded at 50 km spatial resolution and weekly intervals is promising. The spatial patterns of the SSS agree well with climatological distributions, but exhibit several unique spatial and temporal features. The temporal evolutions of freshwater plumes from several major rivers, such as the Amazon, Niger, Congo, Ganges, and Mississippi, are all consistent with the timing of rainy and dry seasons, indicated in the SMAP's soil moisture products. Rigorous accuracy assessment will be performed by comparison with in situ SSS data from buoys and ARGO floats. We have also applied the GMF to the retrieval of wind speed for tropical cyclones, and the maximum wind speed estimated from SMAP are in general consistent with the hurricane track analysis.