



SMAP Faraday Rotation

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Figure 1

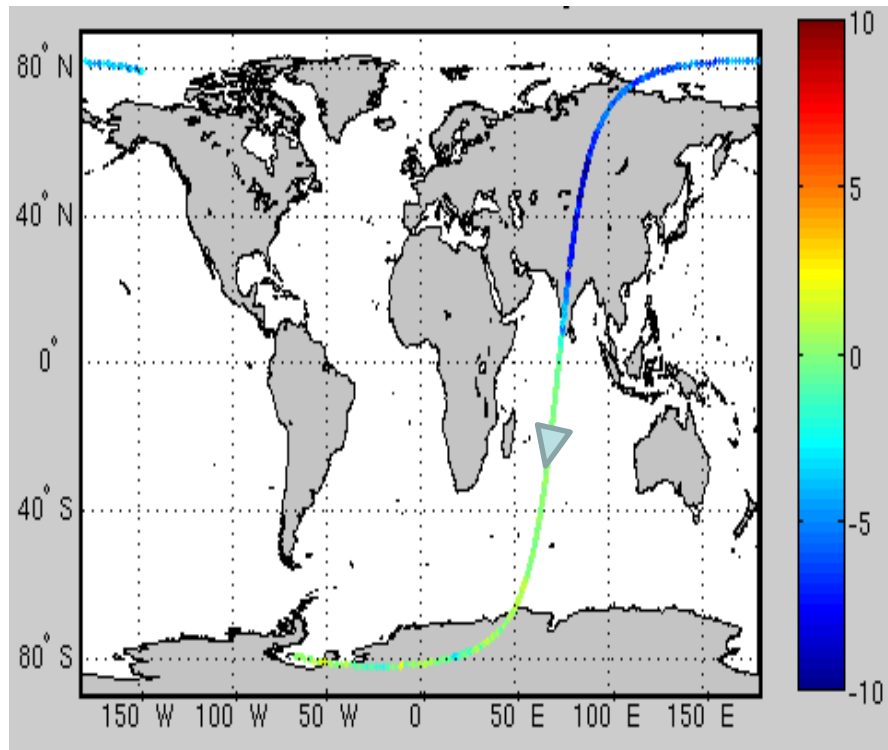


Figure 2

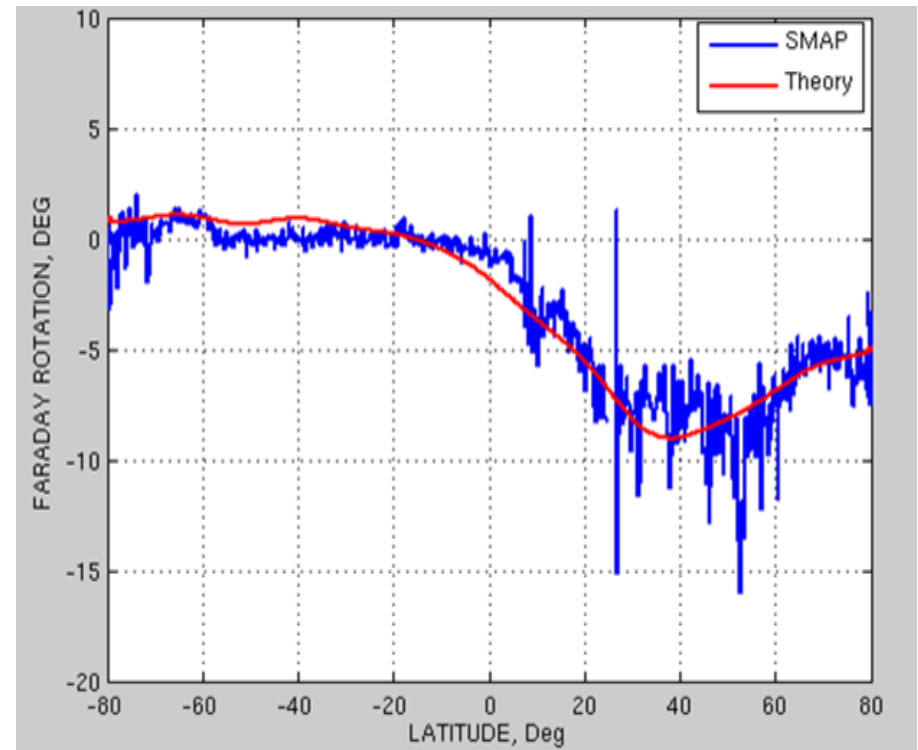
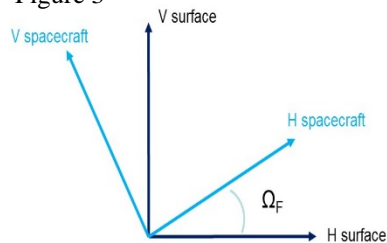


Figure 3



Faraday rotation is a change in the polarization as signal propagates through the ionosphere. At L-band it is necessary to correct for this change and measurements are made on the spacecraft of the rotation angle. These figures show that there is good agreement between the SMAP measurements (blue) and predictions based on models (red).





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References:

- S.H. Yueh, "Estimates of Faraday Rotation with Passive Microwave Polarimetry for Microwave Remote Sensing of Earth Surfaces", IEEE TGARS, **38** (#5), pp 2434, Sept, 2000
D.M. Le Vine et al, "Impact of Antenna Pattern on Measurement of the Third Stokes Parameter from Space at L-Band, IEEE TGARS, **49**(#1), pp 406, Jan, 2011
D. M. Le Vine et al, "Aquarius Third Stokes Parameter and Initial Results", IEEE GRSL, **10** (#3), pp 520, May, 2013
D. M. Le Vine, S. Abraham and J. Peng, "Faraday Rotation Correction for the SMAP Radiometer", IEEE TGARS, 54(#4), pp 2070, April, 2016

Data Sources:

NASA's Soil Moisture Active Passive Mission
Aquarius Sea Surface Salinity Mission

Technical Description of Figures:

Figure 1: Graph showing the SMAP satellite in a descending orbit.

Figure 2: Graphical analysis of Faraday rotation angle retrieved from SMAP data (blue) and the theoretical prediction (red). Aquarius demonstrated the algorithm for measuring the rotation angle in situ (i.e. at the spacecraft) over the ocean for applications to the measurement of salinity [Le Vine, et al, 2013] and Aquarius data over land demonstrated some of the problems associated with the algorithm over land (e.g. noise at positive latitude) [Le Vine et al, 2011].

Figure 3: The polarization rotation angle, Ω_F , is measured using the ratio of the third Stokes parameter, T3, and the second Stokes parameter: $Q = T_v - T_h$ (Yueh, 2000): $\Omega_F = -0.5 \text{ Atan} [T3 / (T_v - T_h)]$

Scientific significance, societal relevance, and relationships to future missions:

Faraday rotation is an important source of error in remote sensing at L-band. Research is underway to verify that the technique for measuring the rotation angle in situ using the ratio of the third and second Stokes parameter can be used by SMAP to make corrections for application to remote sensing of soil moisture [Le Vine et al, 2016].

