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Effect of phase angle on estimation of Earth reflectance

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The Deep Space Climate Observatory (DSCOVR) was launched in February 2015 to a Sun-Earth Lagrange-1 (L1) orbit, approximately 1.5 million kilometers from Earth towards the Sun. It observes the full, sunlit disk of Earth from a unique vantage point with the two instruments: the Earth Polychromatic Imaging Camera (EPIC) and the NIST (National Institute of Standards and Technology) Advanced Radiometer (NISTAR). The Earth-observing geometry of the EPIC instrument is characterized by a phase angle between 4° and 12°. After March 2020 the range of phase angles for DSCOVR EPIC and NISTAR has been substantially decreased towards backscattering reaching 1.95 degrees in December 2020. This provides a unique opportunity to study correlation between Earth reflectance and phase angle. The dependence of reflection on scattering angle (180^o – phase angle) is shown separately for ocean and land areas, for cloudy and clear pixels, while cloudy pixels are also separated to liquid and ice clouds. A strong increase of reflectance towards back-scattering direction observed for all wavelengths. The spectral signature of the dependence indicates the strongest increase at near IR (780 nm) where contribution from vegetation dominates. Surface Bidirectional Reflectance Factor (BRF) acquired by EPIC and Terra MISR sensors over the Amazon basin is used to demonstrate the bi-directional effects of solar zenith and scattering angles on variation of reflected radiation from rainforest. NISTAR observations also demonstrate an increase with scattering angle for all bands but the strongest one is for B-band radiance (0.2–4 μm).