Advances in Nighttime Satellite Remote Sensing Capabilities via the NPOESS/VIIRS Day/Night Band Low-Light Visible Sensor and Tracing Evolution of These Capabilities Over Lifetime of IGARSS

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The National Polar-orbiting Operational Environmental Satellite System (NPOESS) program will feature the first fully calibrated low-light visible-band sensor available for operational applications. The ‘Day/Night Band' (DNB) sensor, included on the Visible/Infrared Imager/Radiometer Suite (VIIRS), draws heritage from the Defense Meteorological SatelliteProgram‘s (DMSP) Operational Linescan System (OLS). Improvements in the DNB to calibration, spatial resolution, radiometric resolution, and instrument baffling, combined with its collocation among multi-spectral VIIRS bands, represent a paradigm shift to capabilities offered heretofore by the OLS. In particular, the DNB will offer remarkably advanced capabilities for nighttime environmental characterization (via measurements of reflected moonlight) in comparison to the current NOAA Polar-orbiting Operational Environmental Satellite (POES) system and its primary optical-spectrum sensor, the Advanced Very High Resolution Radiometer (AVHRR) which is confined to infrared-only measurements during nighttime portions of its orbit.

This talk provides a brief overview of the NPOESS/VIIRS DNB, its anticipated capabilities in terms of ‘shedding light' on nighttime parameters via measurements of either reflected moonlight or natural/anthropogenic visible light emissions, and some research and development preparations being done in advance of the first instantiation of the VIIRS/DNB on board the NPOESS Preparatory Project (NPP) satellite. Capabilities illustrated, based largely on qualitative OLS imagery, include characterization of clouds/fog, dust/aerosols, snow cover, fires, lightning, sea ice, urbanized settlements, and even some forms of marine bioluminescence. Since there is no “lunar constant,” DNB measurements of moonlight will not be useful for quantitative applications without time-varying information on the downwelling, top-of-atmosphere lunar irradiance. Thus, a new tool for calculating the lunar spectral irradiance (convolved to the DNB sensor response function) over the course of the NPOESS mission and beyond has been developed. This tool will enable conversion of moonlight radiance into units of reflectance, necessary for relating the DNB measurements to physical atmospheric/surface parameters. This will allow for development of DNB retrievals and other products that would otherwise be impossible. Finally, we will present some preliminary results on nighttime lunar availability, necessary for operational use of the data, based on simulated NPOESS orbits coupled to predicted celestial geometry and the lunar model mentioned above.

Measurements in this environmental regime have been done before the NPOESS VIIRS sensor

was devised. So we also will present a brief description of the evolution of these measurements during the evolution of the IGARSS society.