PERFORMANCE CHARACTERISTICS OF THE NPOESS MICROWAVE IMAGER/SOUNDER (MIS) RADIOMETER

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ABSTRACT

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) is currently developing the next generation operational microwave imaging and sounding radiometer, the NPOESS Microwave Imager/Sounder (MIS). The NPOESS MIS will continue the legacy measurements of the DMSP Special Sensor Microwave Imager/Sounder (SSMIS) including its Upper Atmospheric temperature Sounding (UAS) on the second MIS flight model (FM2). The first NPOESS MIS is scheduled to fly as part of the second NPOESS mission. It will fulfill 18 environmental data records (EDR) including sea surface wind speed and direction, soil moisture and sea surface temperature (SST). Accordingly, MIS will be an integral part of the NPOESS mission supplying all weather surface and atmospheric measurements.

Performance priorities for the MIS sensor are subdivided into five categories: 1) Core imaging capability representing the legacy SSM/I imaging channels plus the 10-GHz vertically- and horizontally-polarized channels as found on the Tropical Rainfall measuring mission (TRMM) Microwave Imager (TMI), 2) Atmospheric Temperature and Moisture Sounding capabilities at the performance level of SSMIS, 3) all weather sea surface temperature including 6-GHz vertically- and horizontally-polarized measurements with RFI mitigation to ensure uncontaminated brightness temperature over land, 4) Polarimetric channels for retrieval of sea surface wind vector and 5) upper atmospheric temperature profile.

The sensor scan and data sampling design of MIS is a critical aspect of all performance categories, and have been simulated in detail in the process of defining the sensor specification. For Environmental Data Records (EDRs) utilizing only frequency bands in common with the SSMIS (18 - 183 GHz vertically- and horizontally-polarized channels), the swath width is >1700 km consistent with the SSMIS. For EDRs utilizing the MIS 10-GHz vertically- and horizontally-polarized channels the swath width is > 1600 km, while for those utilizing the MIS 6-GHz and polarimetric channels swath width is >1500 km. The relatively wide swath for these EDRs, e.g. sea surface temperature and sea surface wind direction, was achieved by increasing the MIS off-nadir angle above the SSMIS value of 45° by ~2°. Additional characteristics of the MIS Antenna feeds include Nyquist sampling in two dimensions for all channels below 37 GHz. A design goal for all channels that are not Nyquist sampled in the cross-scan direction, incidence angles are aligned to within 0.02° in order to minimize re-sampling errors associated with the creation of collocated retrieval cells from the multiple channels. The 'single pixel' sampling rate is set to allow Nyquist sampling in the along-scan dimension for all channels.

The Temperature and Moisture sounding capability of MIS continues the conical atmospheric temperature and moisture sounding measurements performed by the SSMIS. However, due the low operational readiness state of the legacy UAS capability, the MIS FM1 will not have atmospheric temperature sounding capability beyond ~10mb altitude. A detailed trade study was carried out to determine the optimal receiver architecture and requirements for the UAS component of MIS intended for FM2 and later units. The UAS trade studies address the advantages and disadvantages of circularly-polarized measurements of the O_2 rotational complex vs. linearly-polarized measurements as well as receiver architectures utilizing one vs. two antenna feedhorns.

This paper will describe characteristics and priorities of the MIS scanning and antenna subsystems along with the MIS receiver characteristics.