ADVANCED TECHNOLOGY MICROWAVE SOUNDER (ATMS) ON THE NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)

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ABSTRACT

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) will fly the Advanced Technology Microwave Sounder (ATMS) on the first NPOESS flight, C1 planned for 2013. The NPOESS ATMS on C1 is the second ATMS developed by Northrop Grumman Electronics Systems in Azusa, CA. The first ATMS sensor is currently manifested on the NASA's NPOESS Preparatory Project (NPP) scheduled for launch in 2010. The NPOESS ATMS will contribute to 2 Key Performance Parameters for NPOESS, Atmospheric Vertical Moisture Sounding (AVMP) and Atmospheric Vertical Temperature Profile (AVTP).

Within the NPOESS program, ATMS will provisionally have AVMP and AVTP Environmental Data Records (EDR) associated with the microwave sensor. For NPP, the AVMP and AVTP EDR products are produced by the combination of the Cross-track Infrared Sounder (CrIS) and the ATMS, which is called the Cross-track Infrared Microwave Sounding Suite (CrIMSS).

The ATMS sensor is a cross-track scanning multi-channel radiometer with a swath width of 2503 km sampled in 96 beam positions using a 1.1 degree sampling interval. The sensor consists of 22 channels (ranging in frequency between 23.8 and 183.31 GHz) and the swath width allows contiguous coverage at the equator in the NPOESS orbit. It has nadir footprints of ~75.6, 31.9, 16.0 km for its surface (23 and 31 GHz), temperature sounding (50 – 60- and 89-GHz) and moisture sounding (166 and 183 GHz) channels respectively. Calibration is achieved using an onboard hot calibration target and cold space calibration observation. The instrument mass is ~75 kg and requires ~120 W of power.

The ATMS provides atmospheric vertical temperature sounding profiles up to ~45 km (~1 mb) using several channels near the 11^{-} and 13^{-} O_2 rotational lines near 57.3 GHz along with additional measurements in the region of the 50-60 GHz O_2 complex. The NPOESS ATMS channel set is the same as the original ATMS for NPP. These channels will be considered in selection of the NPOESS Microwave Imager Sounder (MIS) middle and Upper Atmospheric Sounding (UAS) channels. The MIS will fly on NPOESS C2 and later NPOESS platforms. The first MIS will include atmospheric temperature sounding to 10mb, however, the MIS second flight unit will include UAS capability up to ~80 km altitude (0.01 mb).

For moisture sounding, the ATMS includes 5 channels in a double sideband configuration near the 183.31-GHz water vapor absorption line and an additional channel at 166.3 GHz to support the moisture retrievals. The current MIS design includes only 3 channels near the 183 GHz water line and a 166 GHz channel.

This paper will provide an overview of the ATMS sensor that is currently in development for the NPOESS C1 mission, including scanning and measured receiver performance from the receiver Engineering Development Units (EDU). A comparison of the temperature and moisture sounding channel performance of ATMS for NPP and NPOESS will also be presented. And finally, a review of the current requirements and engineering performance estimates for temperature and moisture sounding on MIS to be flown on the NPOESS C1 and C2 missions will be provided and compared to the ATMS channel characteristics.