ORDEM 3.1 Development Status

P. Anz-Meador[1], A. Manis[2], and M. Matney[3]

[1]Jacobs, 2224 Bay Area Blvd., Houston, TX 77058, [2]HX5-Jacobs JETS Contract, 2224 Bay Area Blvd., Houston, TX 77058, [3]NASA Johnson Space Center, Mail Code XI4-9E, Houston, TX 77058

ABSTRACT

In this presentation we shall review NASA Orbital Debris Engineering Model (ORDEM) scope, intended use, and version history; development of the latest version, v. 3.1; provide a current development status; and discuss current deployment plans. We will also place ORDEM in context with other NASA and US models as well as the ESA MASTER model, ORDEM's closest analogue model.

Like its predecessor ORDEM 3.0, ORDEM 3.1 is data-driven. Small particles in and transiting low Earth orbit (LEO), roughly less than three mm characteristic sizes, are dependent upon in situ measurements for their detection, assessment, and characterization. The US Space Transportation System (STS) orbiter vehicle, the Space Shuttle, provided the in situ environmental component for ORDEM 3.0 via analysis of its windows and radiators and will do so as well for ORDEM 3.1 using enhanced analytical techniques. We intend to use information derived from our analysis of the Hubble Space Telescope's Wide-Field Planetary Camera-2 (WFPC-2) radiator's cratering record to provide validation of the model to the greatest degree possible. Larger LEO particles, fragments, and intact objects are characterized using data from the Haystack Ultrawideband Satellite Imaging Radar (HUSIR), formerly Haystack, and Haystack Auxiliary Radar (HAX) to (effectively) sizes of 10 cm. Objects larger than approximately 10 cm in LEO are characterized for modeling purposes using the US Space Surveillance Network catalog and its associated Radar Cross Section catalog. Finally, objects in Geosynchronous Orbit (GEO) are characterized using data collected by the Michigan Orbital Debris Survey Telescope (MODEST) in campaigns spanning 2004-2009; validation is provided by 2013-2014 MODEST campaign data.

Observational data and modeling provide the basis by which statistical inference extends the data into un-sampled regions, and establish ORDEM's populations. In addition to a background population, special populations are separately composed; the most important are the major debris clouds associated with the FY-1C, Iridium 33, and Cosmos 2251 debris clouds and the Sodium-Potassium (NaK) population resident in LEO. This presentation shall review our current assessments and findings of these ensembles.

The ORDEM 3.1 model architecture is not modified from its form or function embodied in ORDEM 3.0. Major features are modeling the LEO (including elliptical orbits transiting LEO) and GEO environments for debris larger than 10 μm and 10 cm respectively; characterizing debris smaller than 10 cm by low, medium, or high mass density; output means and associated uncertainties; and providing operational modes for both satellite designer and owner/operators (Spacecraft mode) and those planning ground-based observing campaigns (Telescope mode).

In conclusion, this presentation shall provide the orbital debris community a summary and current status of ORDEM 3.1 and our current schedule for making the model publicly available.