PREDICCS: A SPACE RADIATION PREDICTION TOOL FOR LUNAR, PLANETARY, AND DEEP SPACE EXPLORATION. H. E. Spence[1], N. A. Schwadron[1], M. Gorby[1], C. Joyce[1], M. Quinn[1], M. LeVeille[1], S. Smith[1], J. Wilson[1], L. Townsend[2], and F. Cucinotta[3], [1]Space Science Center, EOS, University of New Hampshire (8 College Road, Durham, NH 03824, Harlan.spence@unh.edu), [2] University of Tennessee, Knoxville, TN, [3] NASA Johnson Space Center, Houston, TX.

Introduction: We describe the PREDICCs space radiation prediction and forecasting tool and provide early results from recent and historic lunar, planetary, and deep space applications. While robotic missions routinely explore beyond near-Earth space, where the dual cocoons of Earth's strong magnetic field and thick atmosphere protect us from galactic cosmic rays (GCR) and solar energetic particles (SEP), only a scant few manned Apollo missions ever ventured further outward and faced the risks to astronauts of space radiation omnipresent in deep space. At geostationary orbit distances and beyond (i.e., all locations greater than a tenth of the distance to the Moon), GCRs pose a relatively weak but incessant source of energetic ionizing radiation. The GCR component varies slowly with the solar cycle (in anti-phase) and presents a radiation dose risk for all long-duration missions, with higher risk at solar minimum when GCR intensity maximize. In deep space, SEPs ride on top of this slowly varying radiation dose, delivering episodic intervals of powerfully intense radiation from somewhat lower energy particles accelerated during solar explosive events. Though short in duration (typically hours to days), SEPs can deliver as much equivalent dose as GCR does in months to a year. Risks of GCR and SEPs exist for both robotic and manned missions. For instance, during the Apollo era, the March 1972 SEP event delivered a powerful dose of ionizing radiation at the Moon, but which fortunately occurred between two Apollo missions. A similar event during the Mars Odyssey mission crippled the MARIE instrument. .

PREDICCS: Motivated by this radiation risk, enabled by advanced scientific understanding of the underlying physics of SEPs and GCR variability, and supported by NASA's ESMD and SMD funds, we have developed the PREDDICs space radiation prediction and forecasting tool. We leverage the Earth-Moon-Mars Radiation Environment-Module (EMM-REM) developed under the NASA Living With a Star (LWS) program and extend it to predict the dose, dose rate, and equivalent dose owing to GCR and SEPs throughout the inner heliosphere. The PREDDICs model has been validated through incorporation of and comparison with radiation measurements near Earth and also at the Moon with the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument on NASA's Lunar Reconnaissance Orbiter (LRO) mission. In this presentation, we provide a summary of the PREDICCs model, and then show how the model can be and is being used to predict and forecast the radiation environment throughout the inner solar system. We will show comparisons between predictions and CRaTER observations not only at the Moon, but also predications for other exploration destinations, such as Mars, where with the successful landing of Mars Science Laboratory, we will be able to further validate the model through comparison with such radiation detection instruments as RAD and DAN.