SOLAR STORM-LUNAR INTERACTION MODELING: A FOCUS STUDY BY THE DREAM LUNAR SCIENCE INSTITUTE, W. M. Farrell[1,7], R. M. Killen[1,7], G. T. Delory[2,7], L. V. Bleacher[1,7], J. S. Halekas[2,7], D. Krauss-Varben[2,7], P. Travnicek[2,7], M. I. Zimmerman[1,7], D. M. Hurley[3,7], T. J. Stubbs[1,4,7], M. Sarantos[1,4,8], N. Gross[5,7], D. A. Glenar[6,7] A. P. Jordan[7,8], H. E. Spence[7,8], T. L. Jackson[1,7], J. E. Bleacher[1,7], N.E. Petro[1,7], and the DREAM Lunar Science Institute, [1.] NASA/Goddard SFC Greenbelt MD, [2.] Univ. of California at Berkeley, Berkeley, CA, [3.] Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [4.] Univ. of Maryland Baltimore Co., Baltimore, MD, [5.] Boston University, Boston MA, [6.] New Mexico State University, Las Cruces, NM, [7.] NASA's Lunar Science Institute, NASA Ames Research Center, Moffett Field, CA, [8.] Univ of New Hampshire, Durham NH.

Introduction. In June of 2011, team members and collaborators of the DREAM lunar science institute had an intramural workshop on the 'seleno-effectiveness' of solar storms at the Moon.

It is well known in the space weather community that the high energy radiation and intensified plasma from a solar storm has an effect on the terrestrial magnetosphere, including compressing the frontside magnetic field region, elongating the geomagnetic tail, creating intense aurora and forming magnetospheric and ionospheric current systems. These geo-effects all have some level of impact on human systems, the exact nature and intensity still being under investigation.

By analogy, lunar space plasma and surface interaction specialists suspect that solar storms and coronal mass ejections (CME) have an effect at an exposed rocky body like the Moon, but the exact nature of that effect has not been fully investigated. Such an investigation would examine the basic processes occurring on exposed rocky bodies and would feed forward into improvements in design of human systems going to both the Moon and exposed small bodies.

One of the objectives of the DREAM institute is to examine extreme events at the Moon, including the effect of a solar storm and CME at the Moon. This examination would occur by interconnecting available space weather and lunar data sets with the extensive and detailed DREAM exosphere, plasma, and surface interaction models.

Event Selection. The team spent the summer of 2010 identifying an ideal space weather event for study. It was decided by the 'Extreme Event Selection Committee' that an excellent candidate CME passage was the set of events that occurred in early May 1998. These events were ideal because they had been previously studied by the space weather community in regards to their interaction at Earth, and because Lunar Prospector was in lunar orbit with the magnetometer and electron reflectometer systems for direct lunar observations of surface electrical effects.

Model and Data Cross-Connection. The primary challenge of the solar storm-lunar interaction modeling effort was the interconnection or interplay between data and models. All model Curators agreed to start and stop times and also agreed to exchange or interconnect their output products. As such, once one model was run, the output of that model would be used as the input for another model, etc. For example, a model of the expected increase in sputtered ions was produced and this fed forward as an input to 2D and 3D hybrid plasma codes to determine in a self-consistent way the resulting ion trajectories in the larger lunar environment during the solar storm.

Engaging the Public. In parallel with this effort, the DREAM E/PO team included 10 high school student and 2 teachers to participate in the workshop. The schools involved were Eleanor Roosevelt HS in Greenbelt MD and Seton-Keough HS in Baltimore MD. In preparation, the DREAM E/PO team developed a 16-week course that included on-line reading material emphasizing topics such as solar storms, CMEs, solar wind, lunar geology, solar wind plasma perturbations created by the Moon, surface interactions, and lunar exosphere. The syllabus can be found at http://ssed.gsfc.nasa.gov/dream/DREAM/syllabus1.html. A set of bi-monthly face-to-face and webinar interactions also occurred between the students and DREAM scientists to provide a timely, dynamic exchange of information and ideas.

Results. This presentation will review the major results of DREAM's solar storm-lunar interaction modeling effort to date. A set of surprising results were found including an increase in sputtered components, enhanced near-Moon plasma densities, anomalous surface charging, and a set of expected effects on human systems. Also, the team debated the ideal location for human explorers to hide and remain shielded during a solar extreme event. The primary results of the workshop are now part of an upcoming special topical issue for Journal of Geophysical Research – Planets which is currently open for the acceptance of new papers:

http://www.agu.org/journals/je/callforpapers.shtml.