

Topical Discussion Meeting report

A Topical Discussion Meeting aims at active participation or interaction between the participants. The participants work and discuss on a predefined theme or problem heading towards an outcome or target. A working meeting is a 1h 15min informal afternoon meeting with NO abstract submission form and therefore NO poster contributions.

Name of the meeting: **MODEL VALIDATION FOR THE BENEFIT OF SPACE WEATHER OPERATIONS: SURFACE CHARGING AND INTERNAL CHARGING**

Conveners: Yihua Zheng (NASA/GSFC), T. Paul O'Brien (Aerospace Corp), Yuri Shprits (GFZ German Research Center and UCLA)

Data – Time – Room: Thursday November 8th, 17:15-18:30 MTC 00.03

Nr of participants: ~30

Objective of the TDM

The Space Radiation and Plasma Effects focus team from the International Forum for Space Weather Modeling Capabilities Assessment (<https://ccmc.gsfc.nasa.gov/assessment/>) has identified two sets of physical quantities for assessing model performance, one from an engineering perspective, and the other from a science perspective.

This topical discussion meeting focuses on space environment models relevant to surface charging and internal charging, and aims to discuss all the necessary steps/practices in making further progress.

Topics include event selection criteria, such as the occurrence of interesting spacecraft events/anomalies or extreme flux value; the best choice of metrics, from among a plethora of available options; how to quantify model uncertainties; and which effect model to use for unifying the translation from the pertinent environment parameters to impact analysis.

Focal Points for discussion (Yihua)

- Parameters used for validation: are we settled?
- Metrics: any additions?
- Uncertainties: how to measure?
- Extreme events (starting with extreme flux values)?
 - The July 2004 period for GEO orbit?
 - The Oct – Nov period of 2003 for LEO and MEO orbit?
- Invitation to Join the effort (data including s/c charging cases, flux measurements, running your model...)

Some discussion highlights

1). Paul O'Brien gave a brief summary of the working team effort and put it into perspectives. Showed the two sets of quantities for surface charging and internal charging and the set of the events for validation studies.

Surface Charging

- 16 - 20 March 2013
- 31 May - 2 June 2013

Internal Charging

- 15 April - 15 May 2017
- 3 - 23 September 2017

	Effect Metric	Science Metric	Time Period (Space Weather)
Surface Charging	>10 keV e- flux	>10 keV e- flux; Te; Ne	seconds
Internal Charging	>100 fA/cm ² [100 mils]	1 MeV and >2 MeV e- flux	24-hour, 48, 72-hr averaged

2). Yuri Shprits showed a couple of slides (with a cool movie of the VERB (Versatile Electron Radiation Belt) model result) and emphasized fair comparison among models. Data assimilative models can not include observations that are close to the points/orbits of comparison.

3). Dave Pitchford talked about lower energy electrons and surface (or at least shallow) charging ESD (electrostatic discharge) anomalies. He wanted to emphasize these because these are often overlooked.

Dave's take/opinion (quoted)

“-I am not at all happy with the ‘models’ and technical requirements/ specifications that we give industry to try to get our spacecraft robust to surface charging issues;
-we are procuring spacecraft with dielectric / patch based phased array antenna arrays and in my opinion this raises the stakes as regards surface charging issues.”

He showed that arcjet plume can have effects on surface charging and his surface charging cases correlate well with Supermag index (which indicates a strong association with substorm/substorm-like processes).

4). Eammon Daly (together with slides from Alex Hands) showed

- Internal charging is highly complex and very much material dependent: different materials irradiated at the same current level reveal the very wide range in charging kinetics.
- Different effect codes can significantly overestimate or underestimate peak E-field (risk of ESD).
- REEF (Realistic Electron Environment Facility) data can be used as independent validation for other codes in development (e.g. ONERA THEMIS code, others invited for comparison)
- User friendliness of tools (such as the interface for using an effect engineering code for impact translation, and others involved in this type of model validation) is very important.

There were also good discussions with the audience in general. Plan to move ahead with the validation and also involve more model developers and users.

Main conclusion of the meeting

This TDM leads to the conclusion that model validation with users' need in mind is critical despite multitude of complications involved in satellite charging effects. We should carry on with the identified physical quantities and metrics and make further progress.

Annexes
presentations