SPACE WEATHER The International Journal of Research and Applications AGU

International Standards Will Enhance Space Weather Management

W. Kent Tobiska

18 June 2008

In the decade since the National Space Weather Program (NSWP) Implementation Plan (see http://www.nswp.gov/images/nswpip2000.pdf) was drafted and then published (2000), and the NSWP Assessment Committee produced its 2006 follow-on report (http://www.nswp.gov/nswp_acreport0706.pdf), an updated vision has been needed to guide our nation's space environment activities as the decade near solar maximum begins. This vision must include two parts: placing space weather management at the forefront of activities to go beyond the ongoing specification and prediction efforts, and working to create international space environment standards so that space activities are conducted with safety, efficiency, and the maximization of space commercialization.

Why space weather management? There have been notable successes during the past decade in the development of operational space environment systems. Examples and dates of systems implemented by the U.S. Air Force (USAF) and the U.S. National Oceanic and Atmospheric Administration (NOAA) include the Magnetospheric Specification Model (MSM) of the Earth's magnetosphere, 2000; SOLAR2000 (S2K) solar spectral irradiances, 2001; High Accuracy Satellite Drag Model (HASDM) neutral atmosphere densities, 2004; Global Assimilation of Ionospheric Measurements (GAIM) ionosphere specification, 2006; and the Hakamada-Akasofu-Fry (HAF) solar wind parameters, 2007. Commercial operational systems include Communication Alert and Prediction System (CAPS) ionosphere, high-frequency radio, and scintillation S4 index prediction, 2008, and GEO Alert and Prediction System (GAPS) geosynchronous environment satellite charging specification and forecast, 2008. New capabilities for USAF operational atmosphere densities will be provided in the Jacchia-Bowman 2006/2008 (JB2006/2008) neutral atmosphere, 2009, while total ionizing radiation dose for air crew personnel will be available through NASA's Nowcast of Atmospheric Ionizing Radiation for Aviation Safety (NAIRAS), 2010.

Progress toward the development of operational space weather prediction and monitoring systems is steady. However, agency and commercial assets in the United States will soon reach a state where specification and prediction will become ubiquitous and where coordinated management of the space environment will become a necessity. Such coordination must occur within the context of new air and space traffic management systems, which will manage continued government launches, commercial space tourism, and the growing satellite debris environment. Not only are agencies such as the U.S. Department of Defense (DOD), NASA, NOAA, and the U.S Federal Aviation Administration (FAA) important for providing programmatic directions, but also international organizations such as the Inter-Agency Space Debris Coordination Committee (IADC) and the International Standards Organization (ISO) must lend their expertise. The risk of not integrating, within larger systems, our increasing capacity to operationally monitor and predict space weather will lead to added costs, damage of assets, and lost opportunities to use space for improving conditions on 21st-century Earth.

Nations and regional organizations outside the United States are developing their own systems. For example, the European effort is growing substantially (see http://www.spaceweather.eu/). With growing international activity, international standards for the space environment are required and will be vital for successful space weather management. Such standards serve as a reference framework, or a common technological language, between suppliers and their customers, which facilitates trade and the transfer of technology.

Compliance with an international standard means compliance with a set of requirements that facilitates the exchange of data or products among diverse communities. The work of preparing international standards is normally carried out through the ISO (http://www.iso.org/iso/home.htm) technical committees and their working groups that are convened under the direction of member bodies. The main task of technical committees is the preparation of draft international standards. In the course of developing a standard, there may not be consensus to proceed to publication. Alternative documentation routes exist for providing technically accepted guidelines that are not international standards but that are useful for user communities. These types of documents include technical specifications (TS) or technical reports (TR), both of which require a consensus vote by member countries even though they are used as "best practices" rather than standards.

ISO Technical Committee 20 (TC20) organizes all standardization issues related to aircraft and space vehicles. There are six active subcommittees (SC) in TC20. Two subcommittees work with space issues and are considered sectoral committees. They have large areas of responsibility distributed among several working groups (WGs). Of the two space subcommittees, Space Data and Information Transfer Systems (SC13) and Space Systems and Operations (SC14), the latter organizes the standardization of the space environment (natural and artificial) under its Working Group 4 (WG4).

Since 1993 WG4 has been active in developing consensus on international space environment standards. Two space environment standards have now been published (IS 15390:2004 "Galactic cosmic ray model" and IS 21348:2007 "Process for determining solar irradiances"). Three more documents will be published by 2009: TS 16457 "Earth's ionosphere model: International reference ionosphere and extensions to the plasmasphere;" IS 22009 "Model of the Earth's magnetospheric magnetic field;" and IS 15856 "Simulation guidelines for radiation exposure of non-metallic materials." Three additional documents are also in the process of development (Working Draft (WD) 10788 on lunar simulants; WD 10905 on lunar dust creation, suspension, and transport; and WD 11225 as a guide to reference and standard atmosphere models).

Topics under active discussion for possible standardization include space environment effects on space materials; the Earth main magnetic field; methods for estimation of future geomagnetic activity; a guide to solar reference spectra and irradiance models; the solar energetic particle event environment; a geomagnetic cutoff model for solar energetic protons and galactic cosmic rays (GCR); a probabilistic model for solar energetic particles and heavy ions; a guideline for selection of confidence levels in statistical models of solar proton flux; a trapped electron flux model for geostationary Earth orbits; the AE9 and AP9 radiation models; the radiation environment of Moon and Mars; meteoroid and debris environmental models starting from 2000 kilometers above geosynchronous orbit down to low-Earth orbit; and the Earth atmosphere density above 120 kilometers.

The existing and future standards are a start for enabling safety, efficiency, and commercialization of space activity within the context of managing the adverse effects of space weather. The international space physics community is encouraged to actively participate in discussions that are developing these standards and to provide critiques through Committee on Space Research (COSPAR) scientific congress sessions, which will be held at their upcoming Montreal meeting, in July 2008.

Though significant progress has been made toward developing international standards for research and operations, the space weather community must move fast to cover the wide range of topics in the field and to nail down specifics within those topics. This will not only help research efforts, making studies more comparable across national boundaries, but will also increase the efficiency of space weather management on national and international scales.

W. Kent Tobiska is the president and space weather division chief scientist at Space Environment Technologies, located in Pacific Palisades, Calif. He is an active space weather scientist and the U.S. lead delegate to ISO for the space environment.

Citation: K., W. (2008), International Standards Will Enhance Space Weather Management, *Space Weather, 6*, S06001, doi:10.1029/2008SW000410.