Expert Meeting on

Improving Space Weather Forecasting in the Next Decade

10 - 11 February 2014

Vienna, Austria

Meeting Summary

Background

Space weather originates at the Sun due to its magnetic variability. Solar variability (plasma, particles, and electromagnetic emissions) occurs at all timescales - seconds, hours, decades, to millennium, - the most common one being the 11-year sunspot cycle. The short and long-term variability in the form of solar storms have significant effects on Earth's upper atmosphere and the near-Earth space radiation environment. For example, the variability of the ionosphere affects the propagation of radio waves, causing GNSS position errors and interruptions in HF communications. The United Nations has supported the International Heliophysical Year and the International Space Weather Initiative (ISWI) to deploy new arrays of instruments to study the entire heliophysical system from the Sun to the ionosphere. This was accomplished through a cooperative program between instrument providers and instrument host institutions. In the future these arrays will provide data for space weather forecasting and nowcasting.

Space weather forecasts have been available for some time. However, during the past decade new sources of data have become available both from space and ground-based instruments. New data from space-based instruments onboard SOHO, Hinode, STEREO, and SDO have greatly improved the understanding of space weather, in terms of forecasting and basic physical understanding. In addition, STEREO observations of the vast region between the Sun and Earth have demonstrated the importance of viewing Earth-affecting CMEs away the Sun-Earth line. New theoretical models have provided improved forecasts as well as insight into the physics of solar and ionospheric phenomena including influences from the troposphere.

There has been significant effort in the last few years to reduce the cost of space missions. As part of this trend, the delegates noted the rapid development of cubesat technology, and the growing capabilities of these small satellites for providing space weather data. In parallel there is an increasing ability for the miniaturization of the instrumentation needed. These developments could provide the path for less-expensive observations relevant to space weather.

Space weather is inherently an international endeavor. Space weather events which affect Earth are large-scale and typically affect multiple nations simultaneously. In addition, space weather events drive the entire radiation environment in a large region surrounding Earth where the orbiting satellites of all nations are positioned. Because of this the mitigation activities in response to space weather forecasts are of great international interest.

The purpose of this meeting was to look at the future of space weather forecasting and to formulate recommendations that will lead to improved forecasts in the next decade. It is anticipated that all or some of these recommendations will be implemented as part of the regular agenda item on Space Weather of the Scientific and Technical Subcommittee on the Peaceful Uses of Outer Space (COPUOS).

Recommendations

The delegates to the Expert Meeting on Improving Space Weather Forecasting in the Next Decade unanimously

- Encourages the continued support for research in Heliophysics both as a scientific endeavor that enables a detailed understanding of the phenomena, and as a tool that can be exploited for space weather applications; The relevant agencies are encouraged to work together to ensure that both of these efforts are adequately supported, for the benefit of science and society;

- Recognizes the success of observations in recent projects, and critical information gained from them, and recommends an urgent strategy to ensure that there is continued access to observations of transients in the inner heliosphere, in particular, the Earth-directed events;

- Recommends continuation of the deployment of new instruments and instrument arrays through the ISWI, along with education and public outreach;

- Recommends that information relevant for space weather from all sources be freely and openly shared, including data, calibration, analysis tools, and best-practices for operation;

- Recommends that data products be standardized to allow the data to be easily ingested into research and forecast models, and systems for automated data processing be developed to autonomously identify significant events;

- Supports the development, validation and transition of research-based models for forecasting and nowcasting;

- Recommends that data products and analysis tools from space-based and ground-based instrument arrays be coordinated to maximize their utility for space weather research and for operational forecasting;

- Recommends that the space weather science/requirements for the forecasting of space weather at other planets be developed with special emphasis toward supporting the robotic exploration of these planets;

- Recommends that studies of comparative astrophysics of Sun-like stars be used to provide more realistic limits on the magnitude of extreme solar events;

- Encourages a central facility for sharing and hosting of data from space- and ground-based instruments relevant for space weather research and forecasting facilitated via existing virtual observatories;

- Encourages establishing an international organization for the sharing and hosting of standardized models related to space weather forecasting and that the models be made available to the general scientific community.