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Challenges Facing the U.S. Space Weather Public-Private Sector Partnership

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America's reliance on technological systems that are vulnerable to space weather is growing at a rapid pace. Because such vital everyday technology as electric power grids, satellites, and navigation and communication systems are affected by space weather, it is essential to have the best possible space weather services. Currently the federal government provides the bulk of available space weather products and services, with a few services provided by the private sector. A partnership between the two sectors has been slow to develop and currently faces several challenges.

Ideal space weather services would have the ability to (1) create an accurate historical record of past space weather conditions; (2) provide reliable estimates for the current state of the space environment; (3) supply methods to forecast future conditions in near-Earth space; (4) offer sound advice on space weather and its applications; and (5) launch investigations into specific scientific problems within the space environment.

At present, the National Oceanic and Atmospheric Administration's Space Environment Center (NOAA/SEC) provides real-time monitoring and forecasting of solar and geophysical events. The center also conducts research in solar-terrestrial physics and develops techniques for forecasting solar and geophysical disturbances. The SEC and the U.S. Air Force jointly operate the Space Weather Operations Center, which is the national and international warning center for disturbances that can affect people and equipment working in space. The joint operations center also provides forecasts, warnings, and alerts of solar and geomagnetic activity to users in government (civil and military), industry, and the private sector.

In the past decade, commercial space weather vendors have emerged from the private sector to provide a variety of value-added products and custom-tailored information services. These vendors recently named themselves the Commercial Space Weather Interest Group (CSWIG) and identified their primary objectives, which are to foster growth in operational space weather services and to establish cooperative relationships with government agencies and facilities. CSWIG is interested in identifying and establishing best practices in the space weather community, including identifying and advancing new space weather observation systems, developing forecasting technologies, and informing potential customers about their services.

The Public-Private Sector Partnership Challenge

For the past 40 years the SEC and its governmental predecessors have provided daily solar-geophysical forecasts. In the mid 1990s, however, private vendors expressed an interest in providing space weather services. At the same time, government edicts and congressional interest in private sector promotion led the SEC to develop "vendor services" and begin holding meetings to discuss the two groups' mutual needs and concerns. From the beginning, vendors wanted a clear, defined sense of what the SEC planned to do and what opportunities there were for vendors. At a vendor meeting during the 1999 Space Weather Week, the SEC defined the dilemma as a chicken-and-egg problem, stating that "we are willing to let vendors take over services, but they may not be ready to do so; if we then provide the services, the vendors can't get a start [into the market]."

This dilemma has initiated many debates over their respective roles, or as the SEC describes it, the "line in the sand." Many private-sector vendors feel that they are unable to enter the market as long as the SEC provides too many free services to users. For example, the SEC currently offers space weather data and information useful for navigation, radio, electric power, and satellite operations at no cost on its Web page. Vendors have frequently questioned the amount of information provided to potential customers and are concerned that such noncommercial (free) services from the government can hinder their space weather applications. They have advised the government to carefully consider requests for additional free services and to consider the input of the commercial vendor community before launching new applications. This represents a major challenge for the SEC: making sure that its users' needs are filled without providing tailored products that would interfere with private sector services. For example, in the case of publicly available SEC data used by high-frequency (HF) radio users, it is not clear if there is a profitable market for tailored HF radio space weather services. However, there is an emerging market for commercial space weather services, and with the current efforts toward improved space weather forecasting in the private sector and an improved quantification of economic impacts, CSWIG is likely to develop as a successful entity.

In addition to the SEC's uncertain "line in the sand," vendors face the challenge of building the space weather market and developing the associated technology needed for maintaining a space weather industry. Vendors require specialized knowledge of their customers, including their needs and technology systems. This is a challenge since many of these customers are not even fully aware of space weather risks and impacts on their operations. While some vendors may be able to simply repackage SEC products, those who represent CSWIG have affirmed that they do not merely repackage existing SEC information, but instead generate specialized products using their own environmental models.

Means of Public-Private Cooperation

The SEC has proposed methods for encouraging vendors to enter the market, including its announced intention of an informal partnership where it will test products and then turn further development over to vendors. For example, the SEC recently produced the Ionospheric D-Region Absorption Prediction model as a test product. The model can help users identify space weather conditions that might hinder high-frequency radio applications. Although any vendor is welcome to add value to the model and offer it to users, the SEC has no way to evaluate the market for such a product or to determine whether there is enough interest to warrant users paying for such a service. The SEC can verify interest in its online products, but it is up to the vendors to locate a market for their value-added products.

One kind of contractual partnership the SEC offers is a Cooperative Research and Development Agreement (CRADA). NOAA awarded the first SEC-issued CRADA to Sterling Software in 1997 to assist in developing a rapid prototyping center to validate numerical models and data and to transition the models into operational use. This agreement represented the first public-private partnering to provide a potential new space weather service. The second CRADA was awarded in 2000 to Federal Data Corporation (now Space Environment Technologies) to develop a solar irradiance model. CRADAs are attractive to vendors because it allows them to have a direct link to SEC scientists and an office at the SEC to help transition research into operations. However, vendors are required to invest their own time, patience, and money to develop the products. Another contractual partnership is a Small Business Innovative Research (SBIR) grant, a highly competitive award through NOAA that provides money to pursue product development. There have only been a few SBIRs supported at the SEC in the past. Currently, Metatech Corporation holds a SBIR grant to develop a ground-level assimilative model of geomagnetic field disturbance conditions.

Given the unpredictable future of science and technology today, both the SEC and private sector vendors realize the challenges implicit in defining the possible endeavors that they can undertake in the future. What might seem like a general product today could be a tailored product in the future, and vice versa. The recent NRC report, *The Sun to the Earth-and Beyond: A Decadal Research Strategy in Solar and Space Physics*, briefly discusses the challenge of determining the appropriate roles for the public and private sectors in space weather services, pointing out that private sector policies on matters such as data rights, benchmarking criteria, and intellectual property rights and responsibilities can be very different from policies in the government. So transitioning knowledge and models between the sectors can be difficult and certainly requires further discussion. Overall, each sector is dependent on the other, and only through continuous, open communication will the groups achieve their mutual goal of providing excellent space weather services.

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