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Key Points:
- Stakeholders need a clear and simple input that they can easily use and understand
- Early warning will allow stakeholders to start preparations for mitigation procedures
- Simple indicators tuned to stakeholder needs can be used

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Discussions on Stakeholder Requirements for Space Weather-Related Models

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Abstract Participants of the 2017 European Space Weather Week in Ostend, Belgium, discussed the stakeholder requirements for space weather-related models. It was emphasized that stakeholders show an increased interest in space weather-related models. Participants of the meeting discussed particular prediction indicators that can provide first-order estimates of the impact of space weather on engineering systems.

On 27 November 2017, participants of the European Space Weather Week in Ostend, Belgium, met to discuss the stakeholder requirements for space weather-related models. Organizers of the meeting solicited a number of invited presentations. Each presentation was followed by comments and extensive discussion.

The presentations began with an overview of governmental, commercial, and intergovernmental stakeholder needs and requirements. This overview included a number of parameters and effects discussed in numerous previous space weather-related publications (e.g., Allen et al., 1989; Baker & Lanzerotti, 2016; Lopez et al., 2004). It was noted that while predictive capabilities and space weather products continuously improve, there are still gaps in these capabilities such as the prediction of solar energetic protons and galactic cosmic rays away from 1 astronomical unit.

Contrary to common belief, a recent survey of stakeholder needs emphasized that governmental and commercial stakeholders were eager to participate and share information (Abt Associates, NOAA, 2017). Better communication with stakeholders will be critical for steering scientific efforts toward applications and transitioning research to operations. This can be achieved by adding stakeholders to projects' steering committees, participating in Institute of Electrical and Electronics Engineers conferences, and occasionally visiting stakeholders in person.

It was emphasized that stakeholders need a clear and simple input that they can easily use and understand. Stakeholders are often reluctant to devote time and effort to understand how to interpret space weather data and may be confused when large amounts of data are provided. It is clear that analysis of satellite anomalies and power grid impacts are both complicated by differences in the design of each individual system. However, simple and in many cases rather crude "rules of thumb" can be used to guide impact assessments. An example of such a rule was presented for power grids, in which the intensity of the geoelectric field of 0.1 V/km represents benign conditions, 1 V/km represents dangerous conditions, and 10 V/km represents critically dangerous conditions that can cause system malfunctions. A similar approach can be used for other space physics applications. Often, the challenge for the modelers of the space environment is to integrate the results of their model with the engineering design. Similar rules of thumb or indicators tuned to stakeholder needs can be used to make results of space physics models useful to a broad range of stakeholders. Examples of such indicators are SPACESTORM risk indicators (http://www.risk.spacestorm.eu/) and the set of matrices developed for space weather applications by the Community Coordinated Modeling Center at the National Aeronautics and Space Administration (https://ccmc.gsfc.nasa.gov/assessment/communications.php).

Stakeholders prefer to use predictions that clearly specify prediction uncertainties. They also prefer to use predictions that utilize available observations by means of data assimilation such as data assimilative

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radiation belt predictions (http://rbm.epss.ucla.edu/realtime-forecast/ or http://www-app3.gfz-potsdam.de/RBM/Forecast/Forecast_UTC_latest.png).

Stakeholders often require predictions that present a significant challenge to the space physics community. For example, stakeholders require long-term predictions for the orientation of the interplanetary magnetic field, which are currently not available. In many situations, it may be possible to instead provide an early, low confidence warning that will be followed up by a more precise forecast or nowcast when observations of solar wind at L1 point become available. The early warning will allow stakeholders to start preparations for the mitigation procedures while still giving them an option to cancel possible protective procedures if the magnetic cloud misses the Earth or has a predominantly northward orientation of the interplanetary magnetic field.

References

Abt Associates, NOAA National Weather Service (2017). Social and economic impacts of space weather in the United States.

Allen, J., Sauer, H., Frank, L., & Reiff, P. (1989). Effects of the March 1989 solar activity. *Eos*, *70*(46), 1479.

Baker, D. N., & Lanzerotti, L. J. (2016). Resource letter SW1: Space weather. *American Journal of Physics*, *84*(3), 166–180.

Lopez, R. E., Baker, D. N., & Allen, J. H. (2004). Sun unleashes Halloween Storm. *Eos*, *85*(11), 105.