

The Role of “Operations-to-Research (O2R)” in the Space Weather Enterprise

(A Synopsis in preparation for the O2R Workshop in Boulder CO, August 16-17, 2016)

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In October 2015, the National Science and Technology Council in the Office of the President released the National Space Weather Strategy and National Space Weather Action Plan (SWAP). The actions described in those documents “...will facilitate the integration of space-weather considerations into Federal planning and decision making to achieve preparedness levels consistent with national policies, and enhance the resilience of critical technologies infrastructures to the potentially debilitating effects of space weather on the people, economy, and security of the United States.” Two of the actions in the plan were specifically directed at Research to Operations (R2O) and Operations to Research (O2R). Collectively, these actions provide a unique opportunity for the research and operations communities, including international participation, to work together and to express and advocate for what is needed to support a nation that is vulnerable to space weather conditions.

Action 5.6.2 (O2R) is directed to DOC and DOD, in collaboration with NASA and NSF, to “...develop a plan (which may include a center) that will **ensure the improvement, testing, and maintenance of operational forecasting models**. This action will leverage existing capabilities in academia and the private sector and enable feedback from operations to research to improve operational space-weather forecasting.”

Whereas research funding in the U.S. is directed at improving fundamental understanding of the solar-terrestrial environment, which could lead to future advances in operational capabilities, little civilian funding currently exists that targets the direct improvement of products and services. As indicated in Action 5.6.2, a new plan is needed to improve operational forecasting models and tools, and this involves the funding of activities outside the mandates of NASA and NSF.

This document is focused on the O2R activity, but also on the connections between R2O and O2R. Research to Operations (R2O) and Operations to Research (O2R) are sometimes spoken in the same breath. While together they involve a continuum of closely linked activities, in a feedback loop with one leading to the other—research to operations to research and so on--there are significant distinctions between the two. Below we will describe the basic features of both R2O and O2R and how they work in concert to advance the space weather enterprise. In addition, we will elucidate the goals and possible outcomes of the O2R Workshop to be held in Boulder on August 16 and 17.

Research is the foundation for new and improved space weather models and services. Fundamental research, such as that supported by NASA and NSF, results in an improved understanding of the Sun and solar-terrestrial interactions that produce everyday space weather, as well as extreme events. Research also leads to new observations and to models that capture our understanding of the Sun-to-Earth physical system. A fraction of these research contributions may improve operations, but almost always-additional applied research is needed to evaluate and tailor models and observations, and the products derived from these capabilities, to address user needs. In brief, this is the R2O process.

Once new models, observations and tools are used in an operational environment there is a need for continual validation, upgrading, and improvements to support evolving customer needs with

actionable and accurate forecasts, warnings, alerts and information. The O2R process includes forecasters and users informing the research community about their experience with operational models and tools. This information will help to guide the research community to address critical gaps in current operational capabilities. In contrast to R2O that assesses scientific models that could potentially support operational needs, O2R focuses directly on the improvement of current operational models, tools and products. Accomplishing this requires targeted activities and funding distinct from basic research, including: prioritizing the limitations in current products and services, funding directed research to improve products and services, and allowing broad access to operational models and data for developing and testing improvements. Although many aspects of O2R funding are distinct from current basic research funding provided by NASA and NSF, it is envisioned also that there will be opportunities for joint funding of research and model development in areas where overlaps exist.

The goals of the O2R workshop are to:

- Inform and involve all sectors of the space weather community, including government agencies, academia, private enterprise, and space weather customers, in the O2R planning process
- Identify the elements of an O2R grants/contracts program required to improve operational models and products, and establishing a visiting scientist program and forecaster training program to support the improvement of products and services that includes operational models, observations and tools
- Gather community input for defining a plan for a facility/capability needed to realize the space weather O2R objective in response to the National Space Weather Action Plan

The O2R meeting will introduce specific examples of gaps in forecasting capabilities where O2R activities can contribute to improvements and include panel presentations and audience discussion to hear the breadth of opinions and ideas on topics including: agency and community perspectives on the R2O and O2R process, O2R analogs in terrestrial weather that can provide advice and lessons learned for a space weather capability, a grants/contract program that will help identify and fill in the gaps between what is supported by the research community and what is needed for operations, and a culminating discussion to define a space weather O2R capability.

References:

Links to the National Space Weather Strategy, National Space Weather Action Plan, and the OSTP Fact Sheet: New Actions to Enhance National Space-Weather Preparedness.

https://www.whitehouse.gov/sites/default/files/microsites/ostp/final_nationalspaceweatherstrategy_20151028.pdf

Link to the O2R Meeting website that includes the meeting agenda and other materials can be found at:

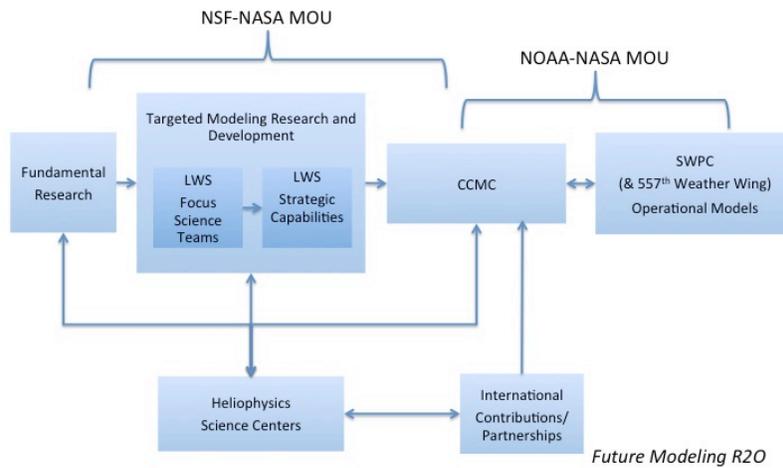
<http://www.swpc.noaa.gov/content/o2r-workshop>

Figure: The attached figures illustrate notional concepts for R2O and O2R capabilities for discussion at the workshop.

NOTIONAL STRAWMAN PROPOSALS FOR R2O AND O2R

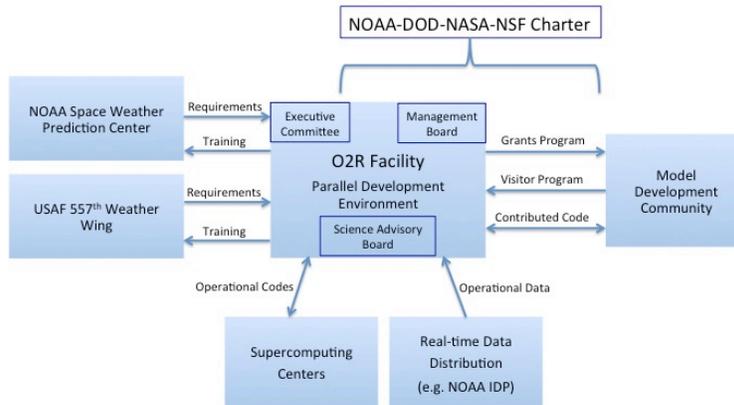
[SWAP Action 5.6.1]

Future modeling R2O Concept of Operations



[SWAP Action 5.6.2]

Modeling O2R Notional Concept of Operations



Future Modeling O2R