

Research To Operations (R2O) Activities, a Natural Conclusion of Research

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Abstract: *The transitions of academic models from research to operations have been recognized as an important and needed element of the research process that would improve the inefficient knowledge transfer currently existing in Space Weather. These activities require an organizational structure and a clear financial commitment from the interested institutions, barely existing today --*

In order to satisfy current and future societal and technological needs, a clear path from research to operations should be established. However, there is no such a community supported path, and not even clear funding for transition and transition-related activities. As the Assessment Report on the National Space Weather Program (NSWP) (http://www.nswp.gov/nswp_acreport0706.pdf) found: “There is an absence of suitable connection for “academia-to-operations” knowledge transfer and for the transition of research to operations in general”.

The definition of a standard process for defining metrics, model selection requirements, and of a transition process should involve the wider community, academia, government and private enterprise, along with the users or customers of the final products. Reaching, in this way, a broad acceptance of the general process, would facilitate the selection and transition activities. With this goal in mind, a series of community and interagency workshops should be organized to initiate the communication on this topic and to establish a working relationship that would further the desired community support.

In this context, it is useful to establish a clear distinction between “academic” and “operational” real-time models, and requirements for transition of academic models to operations. “Academic” models are assumed to be intended for the understanding of physical processes, cause-effect relations, etc. Academic models are not designed for production of customer-oriented products, even if they have been implemented as real-time models. “Operational” models offer products on which third parties rely to conduct their businesses. An operational product requires validation, full documentation, reliability, and some degree of standardization (among other requirements), whereas an academic model does not. An academic model serves the purposes of the scientists, and can be adjusted at will to fit the researcher needs. Academic models, however, can be transitioned into operations, and the process to do it, the transition process, includes the fulfillment of a series of requirements discussed by Araujo-Pradere (2009).

Even before a model is selected for transition to operations, a selection process should be defined in such a way that all the academic models with results similar to what is needed are considered. A good starting point is the need for a particular product, which is often clearly expressed by interested customers, and, if published to the broader community, could become the metric against which models can be designed and tested. As a part of the selection process, and to be refined after a selection is made, an important step should be a careful verification -benchmarking, standard test suites, comparison with first principle simulations, etc.- and validation -comparison studies of modeled and measured time series in global sense (prediction efficiencies, distribution functions) and in dichotomous sense- process (the frequently mentioned V&V). During the transition process, the behavior of the model during failures and specific events must be characterized, along with the uncertainties and errors inherent to the model. A transitioned model must be accompanied by full documentation, including a description of input/output and “how-to”, of physics and methods, results of the V&V process, etc.

Generally, the transition process should consider the frequently intense process of training the users to work with the model output, from the forecasters (in the case of the Space Weather Prediction Center) to private companies interested in the use of the model.

The activities described here are essential for establishing an efficient transition process. These activities require a level of financial support and organizational structure scarcely existing now. The organization of a series of community and interagency workshops will create the right space for discussions and collaborations, and will convey a message to funding agencies to start thinking of R2O (as well as O2R) processes as a fundamental part of our scientific labor, and therefore, worth to be supported in all extension.