

- **Richard Fisher – Living With a Star (Plenary)**
- **Michael Hesse – Model Selection Issues (Plenary)**

## **Operational Issues**

- **Stephen Quigley – USAF Research-to-Operations**
- **Ariel Acebal – USAF Operations**
- **Terry Onsager – NOAA Operations**



## **Highest Priority Operational Needs (Not in Priority Order)**

- **Geomagnetic A, K, and Probability forecasts**
- **Solar Proton Event forecasts**
- **Auroral electrojet map, location and intensity (real-time and future)**
- **Magnetopause crossing forecasts based on L1 data**
- **Energetic electron prediction (timing, fluxes, fluences, and spectra)**
- **Routine numerical guidance for all forecast quantities (e.g., climatological forecasts of flares, geomagnetic indices and probabilities, and F10.7)**
- **Real-time quality diagnostics of products**

## **High Priority Operational Needs (Not in Priority Order)**

- **Short-term (days) F10.7 forecasts**
- **Ionospheric maps of TEC and scintillation (real-time and future)**
- **Geomagnetic storm end-time forecast**
- **Short-term (days) X-ray flare forecasts**
- **Geomagnetic activity predictions (2-5 days) based on CME observations**
- **Geomagnetic activity predictions based on coronal hole observations**
- **EUV index**
- **Radiation belt index**
- **Improved image analysis capability**



## **Identify Candidates and Foster Development of New Models**

- **Collaborate with the international research community**
- **Participate in International Space Environment Services (ISES) Regional Warning Center Workshops**
- **Support Space Weather Week and Prediction Challenges**
- **Participate in Community Coordinated Modeling Center**



## **Internal SEC Process for Selecting New Models**

- Solicit questionnaire from modeler – available on Web
- Internal evaluation of models based on three main categories:
  - Strategic Importance to SEC
  - Operational Significance
  - Implementation Readiness
- Estimate cost/benefit to transition to operations
- Make recommendation to management for selection
- Develop test product and begin long-term validation
- Evaluate for final transition to operations



# Model Evaluation

**Model evaluation requires consideration of operational needs and capabilities, as well as consideration of scientific validity.**

- Scientific Validation
  - Provided by the researcher
  - Gives a “proof-of-principle” for the model
  - However, it typically is limited to a few specific conditions,
  - Often does not allow quantitative inter-comparison with other models
- User-Oriented Evaluation
  - Evaluate the relevance for operational needs
  - Determine usability within real-time operations
  - Estimate improvement to current capabilities



## Transition to Operations: What is Required?

The transition process requires many stages, and must involve scientists, programmers, and users of the model output.

- Define a “concept-of-operations”
  - How will the model be run, what actions will be taken, and what contingency actions are needed?
- Run models in a real-time, operational environment
- Begin long-term validation
- Create user interface to provide required functionality
- Create test products for end-user evaluation
- Determine how new procedures mesh with current operations
- Modify user-interface, visualization, concept-of-operations, ...
- Provide user training and documentation



## Operational Execution: What is Required?

**Operational execution requires a continuing effort, involving scientists, programmers, forecasters/users, and researchers.**

- Maintain a controlled software configuration and concept of operations
- Obtain a continuous measures of performance
  - Long-term assessment of model capabilities
  - Establishes metrics to evaluate new models and/or data
- Make long-term validation available to the relevant research and user communities
- Support operational systems, including data ingest, model execution, user-interface, validation, and archival



## Software Infrastructure for Multiple Models

**Effective use of multiple, evolving models is enhanced by sharing an underlying software environment that is flexible and generic**

- All models have unique features
  - Complexity, inputs, outputs, visualization, validation
- All models can benefit from some common software services
  - Manual and event-driven model initiation
  - Access to archival and real-time databases
  - Verification of inputs and outputs
  - Views of inputs and outputs
  - Issue output to users
  - Log events and errors
  - Archive information





## **Models Currently Under Consideration**

- **Background Solar Wind (Wang-Sheeley/Arge & Pizzo)**
- **Magnetopause Location (Shue/Detman)**
- **Auroral Electrojets (Real-time AMIE/MHD/...)**
- **Solar Spectrum (Solar2000)**
- **Storm-time Neutral Density**
- **Coupled Thermosphere/Ionosphere**



## Questions

- **How do we keep track of and prioritize operational requirements in the selection of models?**
- **How can we best simplify the tasks of the RPCs in transitioning models to operations?**
- **What short-term goals can we establish to demonstrate the success of the CCMC?**
- **How do we ensure buy-in by both the science and operations communities?**
- **Should the CCMC eventually become a clearinghouse for research models with space weather potential?**



## Recommendations

- **Model Selection for the CCMC:**
  - **Models that overlap interests in the operations and research communities should be given high priority**
- **Metrics:**
  - **Metrics with operational value should be applied to the CCMC models**
- **Validation:**
  - **Validation results should be made publicly available, together with validation performed external to the CCMC**
- **Formalize the Operations Working Group**

