From Space Weather Modeling to Forecasting:

Community Recommendations on Transitions to Civilian Operations

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Background to Community Discussions

- SWPC initiative to establish a Development Testbed Center to promote transitions of models to operations (announced Oct 2008)
- AFWA & SWPC request NCAR study of DTC implementation:
  - *Space Weather Prediction Testbed* (SWPT)
  - Study reports completed 28 February 2009
- Broad community interest & discussion
  - Community white paper
- Open community workshops
  - January 14, 2009 (Phoenix AMS)
  - March 5-6, 2009 (UNH)
  - Developed significant consensus; clarified options & issues
- Documents:
  http://artemis.sr.unh.edu/~jraeder/WikiPages/index.php?n=Main.Meeting-R2O-2009

Community Meetings

Phoenix January 14, 2009

Rashid Akmaev (SWPC)
Richard Benhke (NSF)
Barbara Brown (NCAR RAL)
Geoff Crowley (ASTRA)
William Denig (NOAA NGDC)
Gennie Fisher (AMS)
Tim Fuller-Rowell (SWPC)
Tamas Gombosi (U. Michigan)
Michael Hesse (NASA CCMC)
Rudi Komm (NOAO
Sreela Nandi (NOAA)
Dusan Odstrcil (U. Colorado)
Jack Quinn (Boston University)
Geoff Reeves (LANL)
Matt Sattler (AFWA)
Robert Schunk (Utah State University)
Stan Solomon (NCAR HAO)
Kent Tobiska (SET)
Louis Uccellini (NOAA NCEP)
Rich Wagoner (NCAR RAL)
Simon Wing (APL)
Mike Wiltberger (NCAR HAO)
Larry Zanetti (APL)

UNH March 5-6, 2009

Spiro Antiochos (NASA GSFC)
Odile de La Beaujardiere (AFRL)
Doug Biesecker (NOAA SWPC)
Tamas Gombosi (U. Michigan)
Charles Goodrich (NASA HQ)
Micael Hesse (NASA CCMC)
Joe Huba (NRL)
Janet Johnston (AFRL)
Vania, Jordanova (LANL)
Judith Lean (NRL)
Dusan Odstrcil (U. Colorado)
Stephen Quigley (AFRL)
Jack Quinn (Boston University)
Jimmy Raeder (U. New Hampshire)
John Retterer (AFRL)
Bob Schunk (Utah State University)
Stan Solomon (NCAR HAO)
Kent Tobiska (SET)
Michael Wiltberger (NCAR HAO)
Dick Wolf, Dick (Rice University)
Jie Zhang (George Mason University)

Guiding Considerations (1 of 2)

- There is an urgent national need to facilitate the operational use of models developed within the research community.
  - *Something* is needed
- There are many ways that SWPT functions could be implemented.
  - Relative advantages & disadvantages in several areas.
  - Implementation decisions should benefit from broad inputs, fully explore options and tradeoffs.
- At threshold of qualitatively different approach to forecasting.
  - Introducing global environmental models from which diverse forecast products are (or can be) derived.
  - Transitioning is different from "handing off" a model with small number of fully-defined directly-useable outputs.

Guiding Considerations (2 of 2)

- *Sustaining* improvements is critical.
  - A model transition is one step up a long staircase.
  - Power lies in model & forecast-product advancements over many years.
  - Success requires enabling and supporting continued improvement.
- Successful transitions will require modeler participation.
  - Should be funded by operational agencies.
  - SWPT initiative appears to provide an important step in this direction.

Specific recommendations & comments:

- Establishing a transition center
- Operating to achieve and sustain productive transitions

Recommendations for Establishing a SWPT

- Competitively bid the SWPT implementation in order to:
  - Identify full range of options;
  - Allow full consideration of tradeoffs.
- Consider carefully the distribution of scientific expertise.
  - To what degree does expertise and intellectual leadership reside within NOAA versus being delgated to a SWPT?
- Design management & advisory structure to encourage scientific advice.
  - Integrating Science Advisory Panel with Executive Board would promote efficient Panel advice to support informed Board decisions.
- Structure transition process to take advantage of all capabilities:
  - Commercial, academic, national laboratories, civilian government, military.

Operating a SWPT (1 of 3)

- Address Intellectual Property issues clearly, up-front.
  - Legitimate IP concerns (competitive advantage, publication, model revision) are a potential barrier to model transitions from the research community.
  - These issues could be largely resolved by licensing (or other means) that explicitly define how a model and its results may be used.
- Make public the assessment metrics and associated data.
  - Allows developers, CCMC, AFRL, commercial enterprises, to compare against operational state-of-art and to target improvements to capabilities of established importance.
  - Forecast community must establish metrics that accurately reflect needs.
- Allow flexibility pathways for diverse model types and forecast needs, e.g.,
  - Models-to-SWPT from CCMC, AFRL, developer, commercial enterprise;
  - Direct developer-to-operations interactions in some cases;
  - Partnerships involving combinations of above are likely and desirable.

Operating a SWPT (2 of 3)

- Support needed developer participation
  - Transitioning global environment models to forecast products is not a one-way “handoff”.
  - Forecast experience inevitably raises subtle model questions and suggestions for changes.
  - Mechanisms for two-way interaction are needed and must be funded.
- Disseminate basis for model selection.
  - Maintains perception of fairness & developer understanding of need.
  - Information drawn from CCMC, AFRL, NRL, scientific studies, etc.
  - Easier for 2nd generation models with well established forecast metrics.
- Support transitions for variety of model types.
  - Improved forecasts require many model types, e.g., physics-based, assimilative, empirical, and hybrid combinations.

Operating a SWPT (3 of 3)

- Enhanced coordination may improve rate of progress.
  - Many key elements supported across multiple agencies, e.g., model development, acquiring observational inputs, etc.
  - Increased agency collaboration could more efficiently allocate the limited resources.
- Staffing and resource limitations at government operational forecast centers are an important bottleneck.