



# **NOAA Space Weather Prediction Center View of NASA's Community Coordinated Modeling Center**



**H.J. Singer and R.Viereck -- 2016 CCMC Workshop  
Annapolis, Maryland-- April 11, 2016**

**CCMC and SWPC --  
Working together in partnership  
with complementary missions,  
capabilities and ideas to fit  
together pieces of the model  
transition to operations puzzle.**



Credit: [www.castlellc.com](http://www.castlellc.com)

## **Outline**

- Complementary Organization Missions**
- Past Collaborations and Outcomes: Geospace Model Example**
- Present Activities**
- Future Challenges and Opportunities**



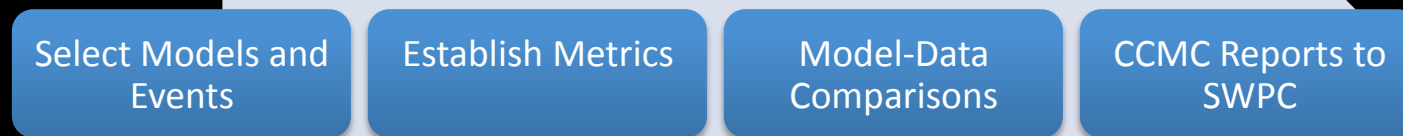
# Complementary Agency Missions



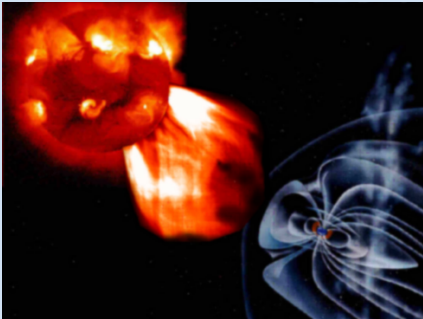
- **Community Coordinated Modeling Center**
  - **Mission:** The CCMC is a multi-agency partnership to enable, support and perform the research and development for next-generation space science and space weather models.
  - **Services include:** test and evaluate models in support of the needs of science users and space weather forecasters; **support Space Weather forecasters through transitioning of research models to operations**, through model evaluations, and through the provisions of forecasting tools
- **Space Weather Prediction Center**
  - **Mission:** To **deliver space weather products and services** that meet the evolving needs of the nation.
  - **Services include:** It is the nation's official source of space weather watches warnings and alerts.. SWPC provides real-time monitoring and forecasting of solar and geophysical events which impact satellites, power grids, communications, navigation, and many other technological systems. SWPC also explores and evaluates new models and products and transitions them into operations.

# Geospace Models: Transition to Operations

- **Goal:** Evaluate Geospace models (MHD and empirical) to determine which model(s) are ready for transition to operations
- **Focus:** Regional K and dB/dt (important to electric utilities)
- **Partnership:** Evaluation at NASA/Goddard CCMC working with SWPC, modelers and science community



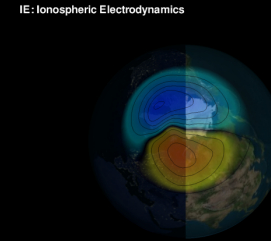
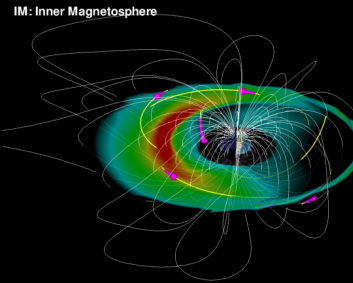
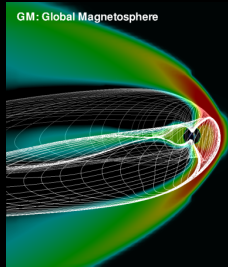
SWPC Selection FY 14: U. Of Michigan (MHD); VT (Weimer Empirical)  
based on CCMC reports, internal and external advice, and following considerations:



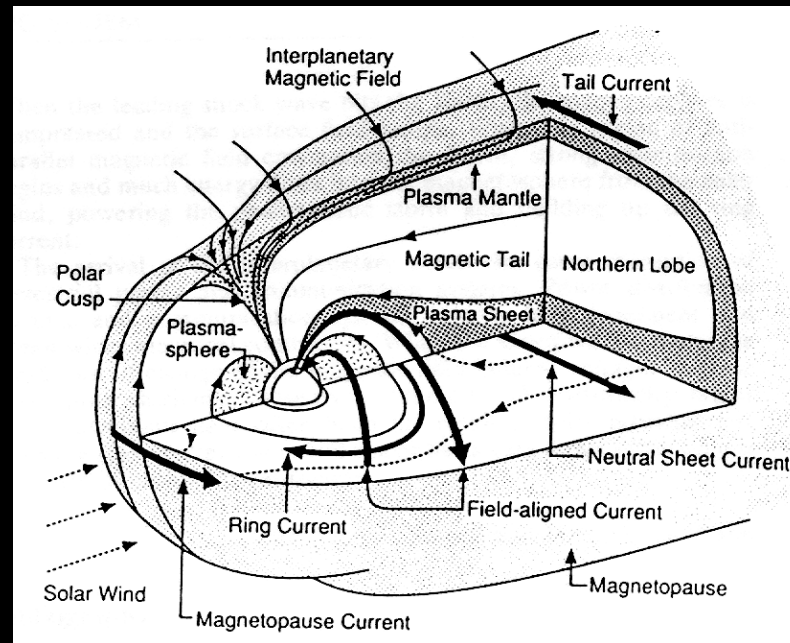
Solar Influences on Geospace Predicted with Geospace Models using Solar Wind Input

- Strategic Importance
- Operational Significance
- Implementation Readiness
- Cost to Operate, Maintain, and Improve

# Michigan Geospace Model



**Contributing current systems: Magnetopause, Field-aligned, Ring Current, Ionospheric Currents**

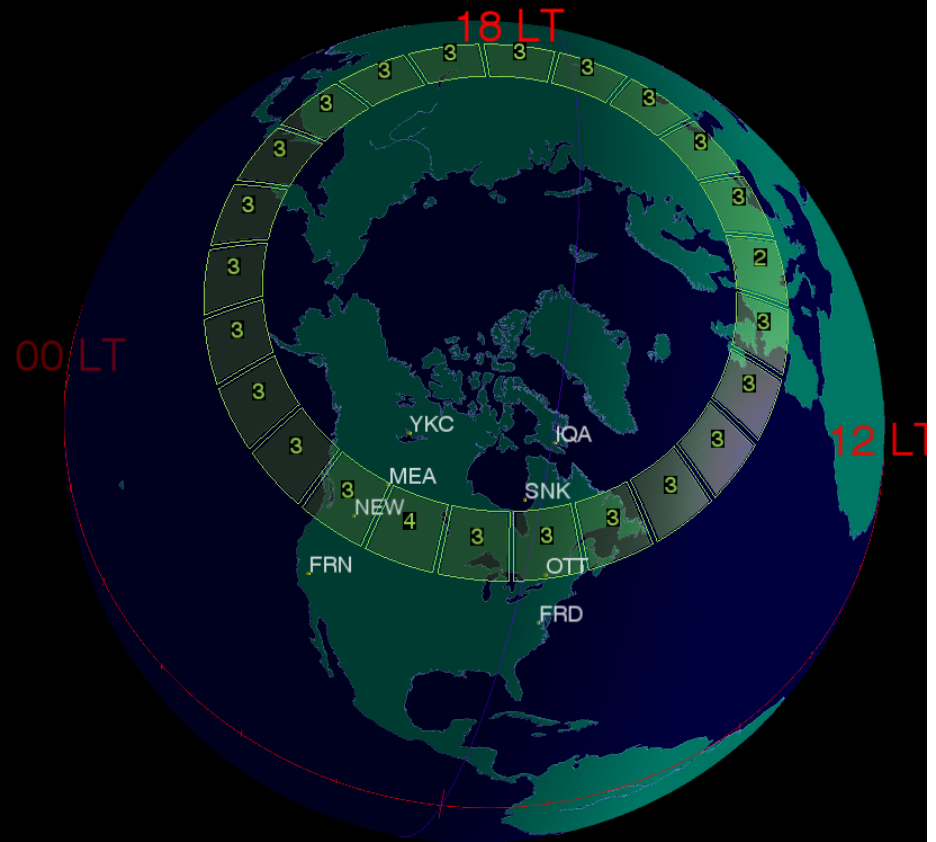
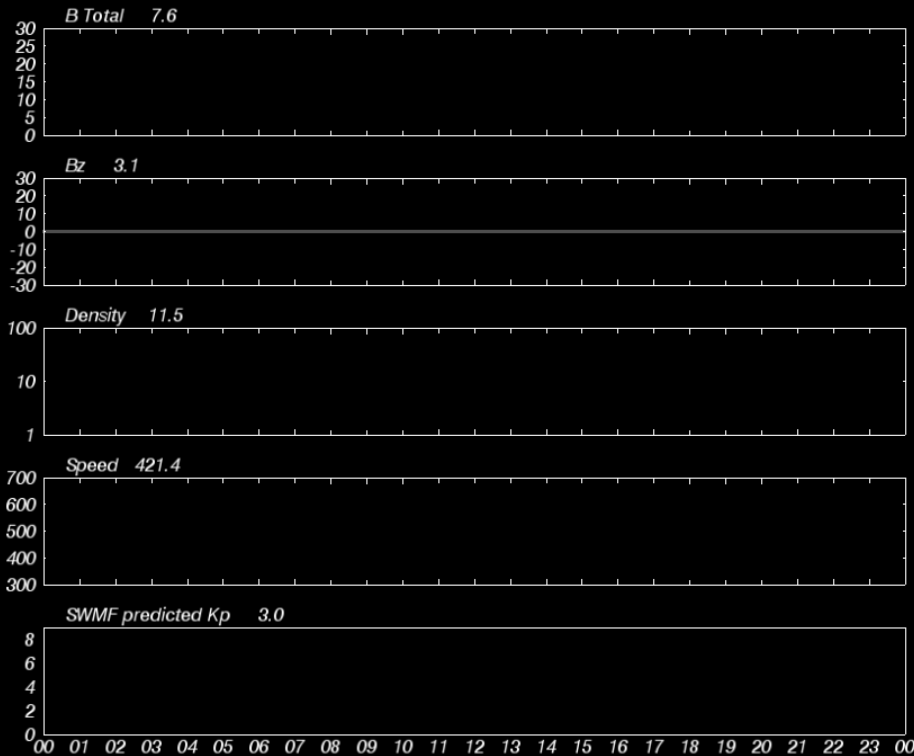


Ground, spatial, time-varying dB, calculated via Biot-Savart integration

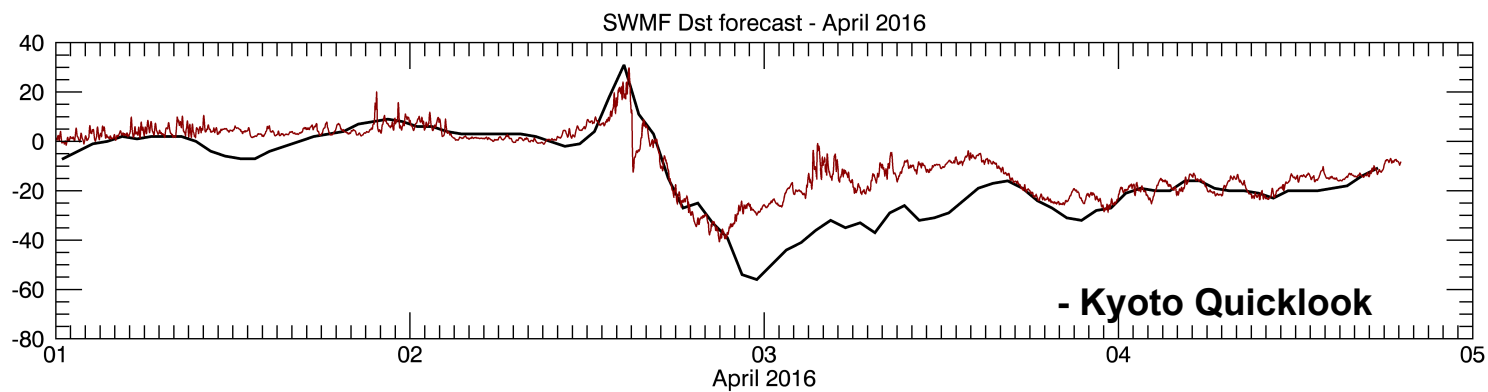
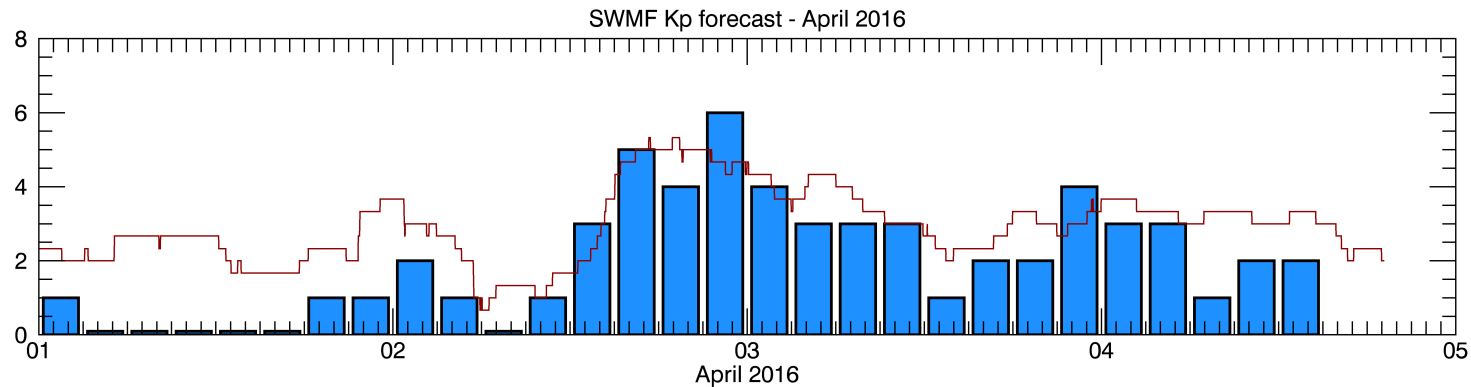


**Initial Test: Real-time operations on NWS supercomputer in 2016.  
Working with U. Mich, NCEP/NCO, and NASA/CCMC.  
Accurate “re-Forecast” of St. Patrick’s Day G4 storm!  
Product : Local Time regional K prediction**

2015-03-17 00:00:00



# Michigan SWMF - Geospace Model Kp and Dst Compared to Observation



- Top: “Kp” (SWMF model red, forecast center Kp blue)
- Bottom: Dst (SWMF model red, observed black)

# Radiation Impacts on Aviation

## A Possible Future Model Assessment?

SWAP Action 4.2.5 Develop or improve models for radiation aviation assessment (October 2017 Identify models)

- ◆ Korean Radiation Exposure Assessment Model (KREAM), Korea Astronomy and Space Science Institute
- ◆ Professional Aviation Dose Calculator (PANDOCA), German Aerospace Center
- ◆ Nowcast of Atmospheric Ionizing Radiation for Aviation Safety (NAIRAS), NASA
- ◆ Warning System for Aviation Exposure to SEPs (WASAVIES), Japan Atomic Energy Agency

Which models will be available at CCMC for assessment for use in space weather operations?

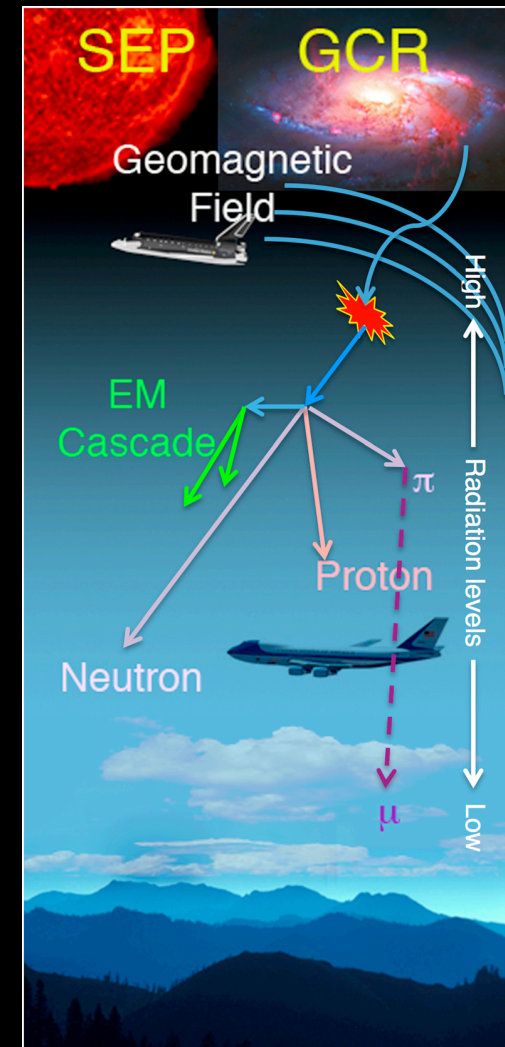


Figure from Tobiska et al. (2015), Space Weather

# Strategic National Risk Assessment

Executed in support of Presidential Policy Directive 8 (PPD-8): Identifies incidents that pose greatest threat to the Nation's security

Threat/ Hazard Group	Threat/Hazard Type	National-level Event Description
Natural	Animal Disease Outbreak	An unintentional introduction of the foot-and-mouth disease virus into the domestic livestock population in a U.S. state
	Earthquake	An earthquake occurs within the U.S. resulting in direct economic losses greater than \$100 Million
	Flood	A flood occurs within the U.S. resulting in direct economic losses greater than \$100 Million
	Human Pandemic Outbreak	A severe outbreak of pandemic influenza with a 25% gross clinical attack rate spreads across the U.S. populace
	Hurricane	A tropical storm or hurricane impacts the U.S. resulting in direct economic losses of greater than \$100 Million
	Space Weather	The sun emits bursts of electromagnetic radiation and energetic particles causing utility outages and damage to infrastructure
	Tsunami	A tsunami with a wave of approximately 50 feet impacts the Pacific Coast of the U.S.
	Volcanic Eruption	A volcano in the Pacific Northwest erupts impacting the surrounding areas with lava flows and ash and areas east with smoke and ash
	Wildfire	A wildfire occurs within the U.S. resulting in direct economic losses greater than \$100 Million

# Obama Does Space Weather Press Conference on Cyber Security 13 Jan 2015

WH  
.GOV

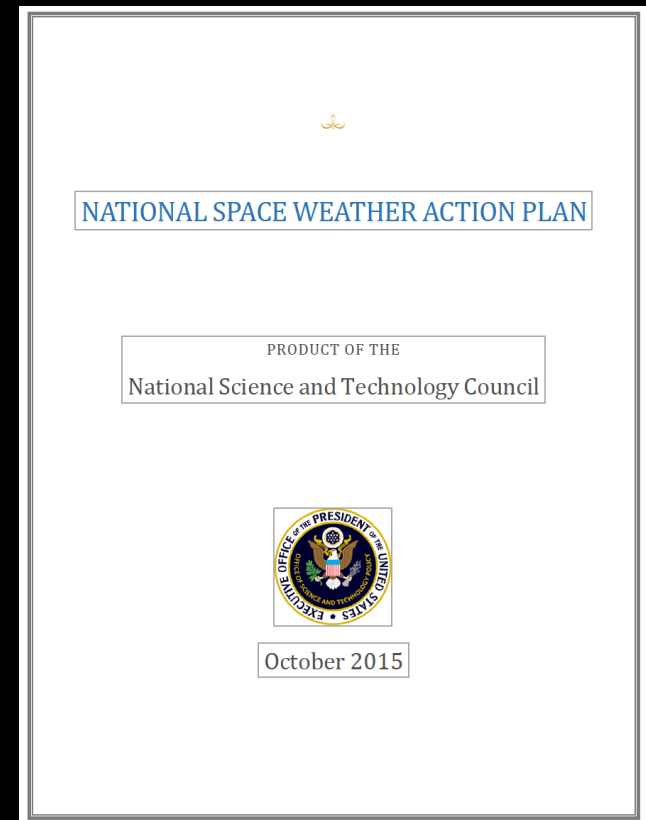
Space Wx  
SWPC  
WSA-ENLIL

↙  
Your model  
here!



# National Space Weather Strategy and Action Plan (Released October 2015) Identifies Needs for R20 and O2R

- Ensuring that this Nation is prepared to respond to and recover from severe space weather storms
- Evaluate potential impact space weather may have on key infrastructures and technologies including the electric power grid, GPS applications, aviation and satellite operations.
- Goal 5.6 Improve Effectiveness and Timeliness of the Process that Transitions Research to Operations





## R20 and O2R Defined

### SWAP Action 5.6

SWAP Action 5.6: Improve the effectiveness and timeliness of the process that transitions research to operations

- SWAP Action 5.6.1: Develop a formal process to enhance coordination between research modeling centers and operational forecast centers.

Deliverable: signed MOUs between research and operations centers

Deadline: April 2016

- SWAP Action 5.6.2: Develop a plan to ensure improvement, testing, and maintenance of operational SWx forecasting models

Deliverable: complete plan for improving O2R functionality

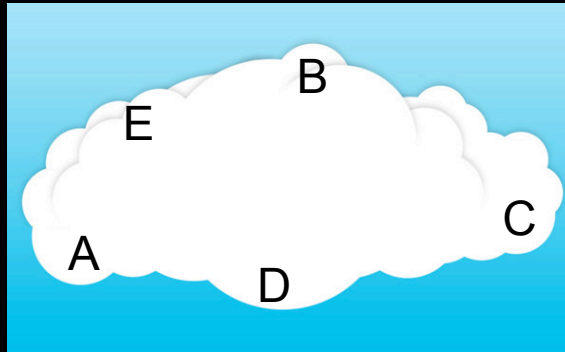
Deadline: April 2016

Progress to date:

- MOU drafted between NASA and NOAA/NWS/SWPC.
- OMB briefed on R20 and O2R concepts by NASA, NSF, NOAA, DOD on 2/29/16.
- Draft white paper on O2R requirements outlined.

# Matching Research Model Capabilities to User Requirements

Multitude of Space Weather Research Models



Model's A, B, C ...  
at CCMC or  
modeler institution  
or commercial  
service provider...



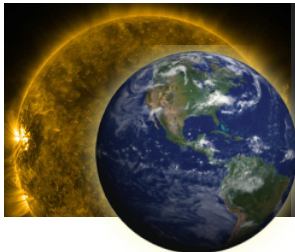
SWPC  
Operations



Focused Customer Requirements

- Power Grids
- Airlines
- GPS...

Need to select from the menu of models  
those that can demonstrate satisfying a customer need

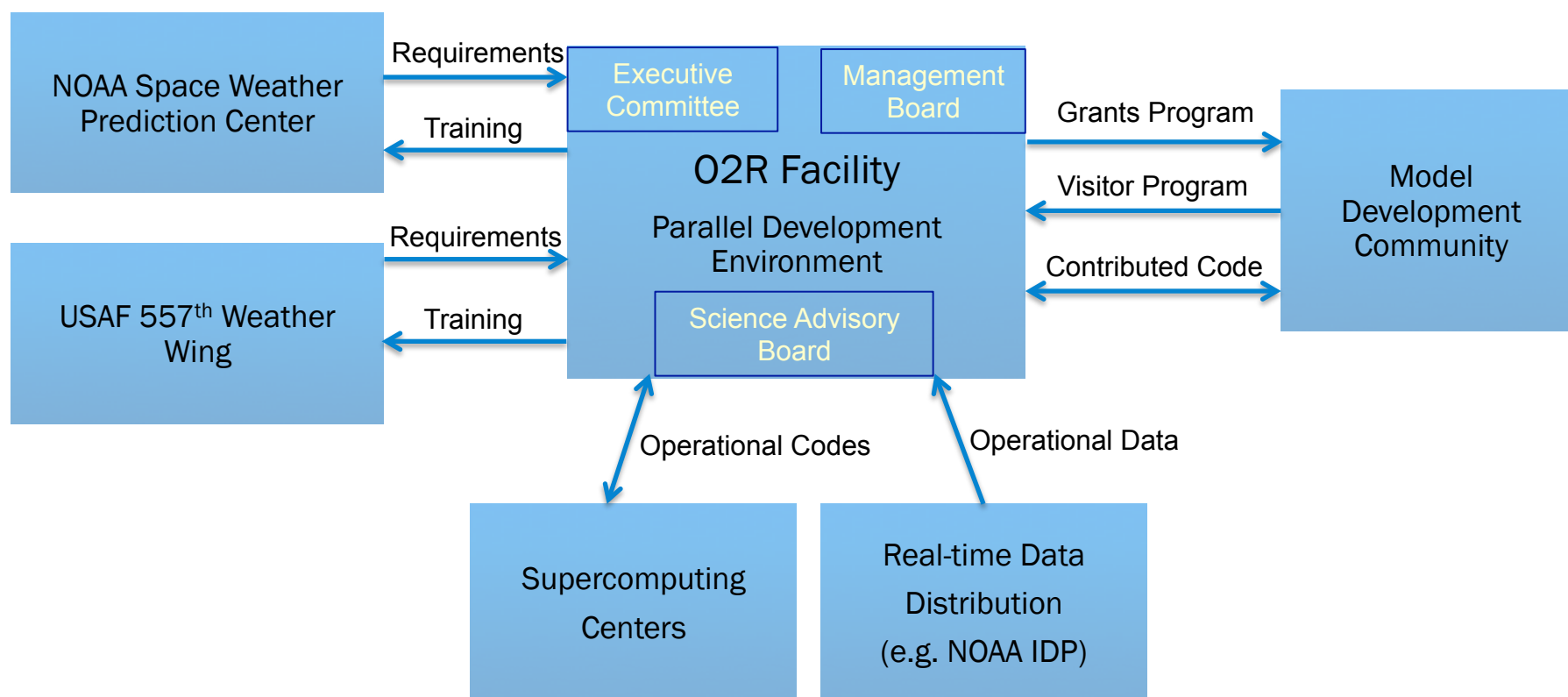


# NOAA's O2R Vision

## Bridge between Ops and Research Communities

Operations

Research



Terrestrial weather analogs: JCSDA, NCAR DTC, CTB, NCGPS project, etc.



# **R2O and O2R**

## **Some Lessons Learned and Conclusions**

- ◆ **Work with the experts for R2O: model developer, CCMC, other gov't agencies, commercial service partners**
- ◆ **Identify and transition models focused on user needs**
- ◆ **Science continues to advance: stay informed, participate and continue communications with community after model selection**
- ◆ **Encourage research agencies to continue to support model development**
- ◆ **Provide opportunities for comparing results of operational models and research models**
- ◆ **O2R results contribute to improved scientific models**
- ◆ **While models have been developed over decades, for R2O it is important to bring together all the pieces: operational needs and metrics, community partnerships, modeler participation, ...**

**BACKUP**

