NSF Perspectives on SWORM

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Fundamental Research

• Basic research in solar and space physics is critical for progress on space weather specification and forecasting capabilities.

• Space Weather is a highly immature science understanding of very many of the fundamental physical processes and interactions are rudimentary at best.
NSF Participation SWORM

• Goal 1 Benchmarks (6,12, and 24 months timelines)
  – Phase 1: Initial benchmarks based on existing studies
  – Phase 2: Development of scientifically and statistically rigorous benchmarks
    • (12 months) Developing plans for engaging the scientific community – in collaboration with NASA

• Goal 4 Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure
  – Supporting role in 4.2.6 (12mo), 4.2.2 (36 mo)

• Goal 5 Improve Space Weather Services through Advancing Understanding and Forecasting
  – (5.3, 5.4, 5.5 - 5.5.1 NSF led 12 mo deadline, 5.6)
  – 5.5.1 Document R&D priorities
    • This is where basic research comes in to play
  – 5.6.1 / 5.6.2 activity
    • Strengthening ties with NASA through new MOUs
    • Co-conveners of an O2R workshop led by NOAA

• Goal 6 Increase International Cooperation (6.2, 6.4)
Solar, Space Physics & Aeronomy at NSF

- Division of Atmospheric & Geospace Sciences
- Division of Physics
- Computer & Information Science
- Division of Polar Programs
- Division of Astronomical Sciences
Space Weather throughout NSF

- **NCAR: High Altitude Observatory:**
  - Mauna Loa Solar Observatory; Spectro-polarimetric instrumentation; Solar modeling; Global ionosphere and upper atmosphere model development, including WACCM-X.

- **Division of Polar Programs:**
  - Neutron monitor network in Arctic and Antarctic ("Ice Cube"); Antarctic component of SuperDARN as well as other ground-based instruments that provide observations for geospace research.
Space Weather Throughout NSF

• **Division of Astronomical Sciences:**
  – The National Solar Observatory (NSO) operates solar telescopes, including DKIST under construction, and conducts solar physics research.
  – The GONG network in collaboration with NOAA is used operationally: provides synoptic (full disk) information of flares, filaments, prominences, and the fine structure of active regions as well as the global magnetic field of the Sun.

• **Division of Mathematical and Physical Sciences:**
  – NSF/DOE Partnership in Basic Plasma Science and Engineering
  – Space Plasma Processes
Space Weather in AGS

- **CEDAR, GEM, and SHINE Programs**
  - Facilitate research collaboration on coupling and interaction
- **NASA/NSF Collaborative Space Weather Modeling**
  - Supports large-scale space weather modeling efforts that require collaborative community teamwork
- **Community Coordinated Modeling Center, Goddard**
  - Support the development of models for transition to operations
- **AMPERE, SuperDARN and SuperMAG**
  - Global networks of space weather relevant observations
  - Exploring real-time capabilities
- **Potential Future Developments**
  - Enhanced global network
  - New advanced instruments, e.g. CoSMO
  - **Collaborative efforts to address large cross-disciplinary problems, e.g. Heliophysics Science Centers**
R2O/O2R for Space Weather

• The focus of the community is largely on R2O for models given the youth of the science.
• O2R is important for the space weather enterprise.
• The establishment of an O2R center as presented would help strengthen the links between the scientific and the operational communities.
• This would create a pathway for joint NSF-NOAA-DOD targeted research programs with the dual purpose of enhancing physical understanding and improving operations.
NSF can support O2R through joint funding of research projects

• Can fund are projects that overlap with O2R
• Can potentially co-fund projects with NOAA, DOD, and NASA that have components such as:
  – New observations that lead to operational improvements (Explore the value of Global Network data or new observing capabilities (i.e. neutral) for operations)
  – Data assimilation and data fusion techniques
  – New physical understanding that lead to operational model improvements
  – Code optimization, efficiencies, and robustness
Broader Impacts

• Science results that lead to operational improvements is a broader impact.

• Grassroots engagement to train students, forecasters, the public, etc. on scientifically correct use of tools.

• Establishing new collaborations with operations staff
Thank you!