NSF Perspectives on Space Weather Science

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The Space Weather Enterprise is a Global Challenge

- Impacts effect the entire planet and are rarely localized to a single country or continent.
  - Image shows Ionospheric irregularities extending from Africa to South America
- Modern global and technology-dependent society is highly susceptible to space weather impacts
  - Power grids, communications, satellites, pipeline, guidance & navigation, etc.
- Technological requirements of the society demand a Space Weather Ready Nation
- But, we are not there.
NSF Contributions to a Space Weather Ready Nation

- Space Weather research was first supported by NSF (1995)
- NSF participates in 4 of the 6 NSWAP goals
- Our role is to support the space weather enterprise by funding basic and fundamental research across several NSF directorates.
- We will be requesting community input on benchmarks and research priorities through a series of RFIs and workshops.
  - Please provide your valuable input in this important process
Interagency Collaborations

• The NSF/NASA-funded Community Coordinated Modeling Center (CCMC) is the repository for community models.
  – The CCMC-SWPC (NOAA Space Weather Prediction Center) relationship provides a pathway to transition research models to operations.

• NSF and NASA collaborate currently on Space Weather Modeling/ Strategic Capability. FY17 is the last year of this.

• Ongoing NSF/DOE Basic Plasma Physics Partnership (20+ years)

• Prioritization Challenges
  – Joint NSCI Pilot Program with NASA anticipated in FY18
  – Heliophysics Science Centers with NASA
  – O2R Pilot Program with NASA and NOAA
NSF – Supported Space Weather Observations

- Support SW observations in all aspects of the Geospace system
  - Sun – MLSO, Big Bear, DKIST (On track for first light in 2019-2020)
  - Magnetosphere – AMPERE, magnetometer chains
  - Ionosphere – SuperDARN, ISRs
  - CubeSats
  - Magnetotelluric Survey
NSF CubeSat Program

- Geospace section has pioneered CubeSats for space weather research, now a disruptive technology
- We are the primary source for student training in this area
- Currently reevaluating the program to engage other STEM disciplines and to determine how best to support the advancement of the technology.
- Planning for a new solicitation in FY18
Space Weather Modeling

- Geospace section funds the basic research that advances modeling of the complete Sun to Earth system.
- Many of the premier models that are now operational at NOAA have been developed with NSF support.
- The connection to operations (R2O2R) is growing in importance for the community.

**Geospace Model**
(operational at NOAA)

[Diagram showing plasma density with labels for different regions: high density/low speed, high density/high speed, etc., and the Sun and Earth as central points in different views (top and side).]
Conclusions

• Space Weather is a global 24/7 challenge.
• NSF recognizes that R2O2R is important to advance the field worldwide.
  – It is crucial for improving predictive capabilities and fundamental research.
• We remain committed to supporting the curiosity driven science that will lead to new innovations that will propel the Space Weather Ready Nation forward.
Questions?
Trends in CubeSats

Achieving Science with CubeSats: Thinking Inside the Box, NAP 2016