NSF Support for Space Weather Operations & Research Infrastructure

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Space Weather Research

PFISR

$$\frac{\partial \rho}{\partial t} + \nabla \bullet \left[\rho \vec{u} \right] = 0$$

$$\frac{\partial \left(\rho \vec{u} \right)}{\partial t} + \nabla \bullet \left[\rho \vec{u}\vec{u} + \left(p + \frac{B^2}{8\pi} \right) \overleftrightarrow{I} + \frac{1}{4\pi} \vec{B}\vec{B} \right] = 0$$

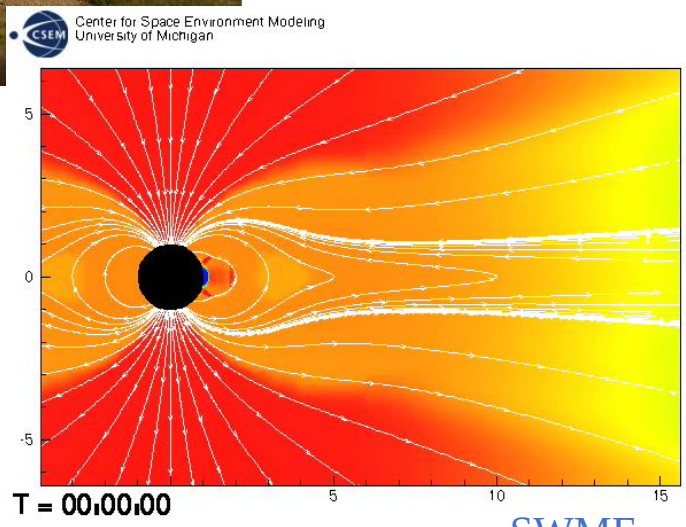
$$\frac{\partial \vec{B}}{\partial t} + \nabla \bullet \left[\vec{u}\vec{B} - \vec{B}\vec{u} \right] = 0$$

$$\frac{\partial \left(\rho E \right)}{\partial t} + \nabla \bullet \left[\vec{u} \left(\rho E + p + \frac{B^2}{8\pi} \right) - \vec{B} \left(\vec{u} \bullet \vec{B} \right) \right] = 0$$

$$\nabla \bullet \vec{B} = 0$$

$$p = \left(\gamma - 1 \right) \left[E - \frac{1}{2} \rho u^2 - \frac{1}{2} B^2 \right]$$

Alfvén



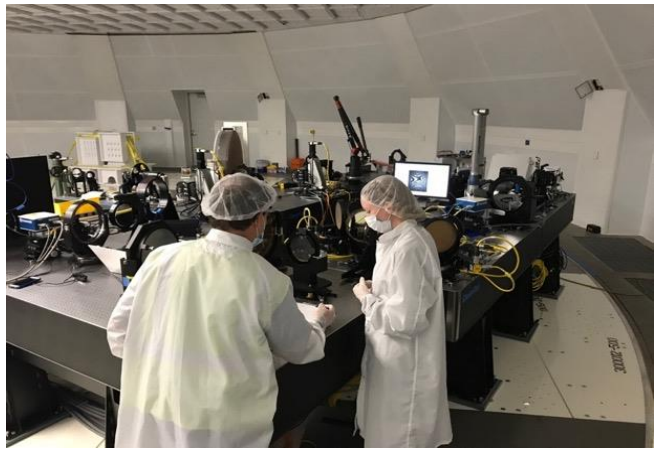
SWMF

- Support investigators using observations, modeling, and theory to advance fundamental understanding of space weather and related processes

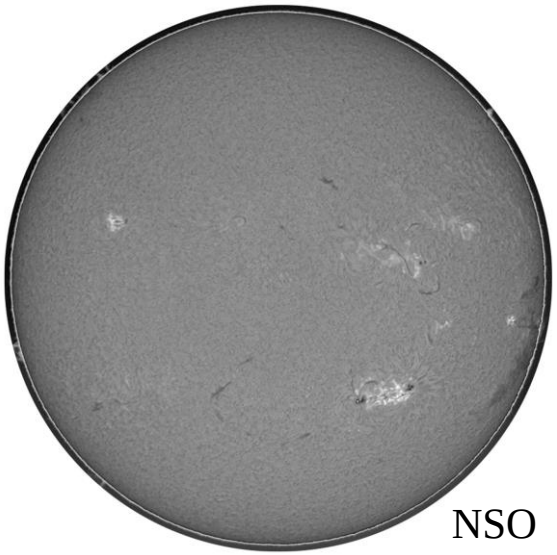
ISR Cornerstones

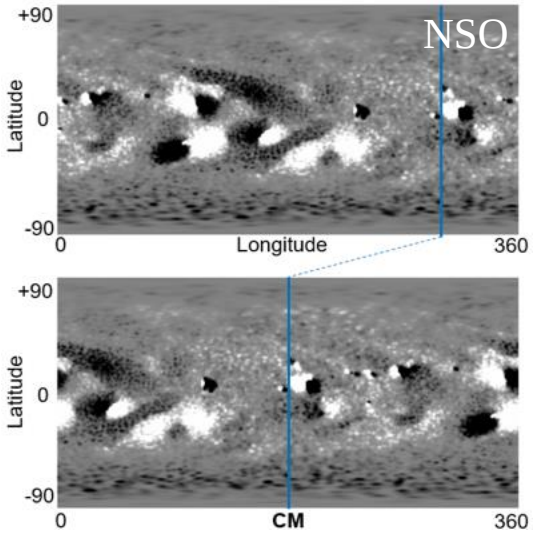
DKIST Update

- Telescope on schedule and within budget
- Telescope optics (M1-M10) in place and aligned
- Sunlight down to Coudé instrument lab
- Challenges
  - Delivery and integration of instruments
  - Completion of facility thermal systems
- Start of operations likely delayed due to COVID-19



GONG

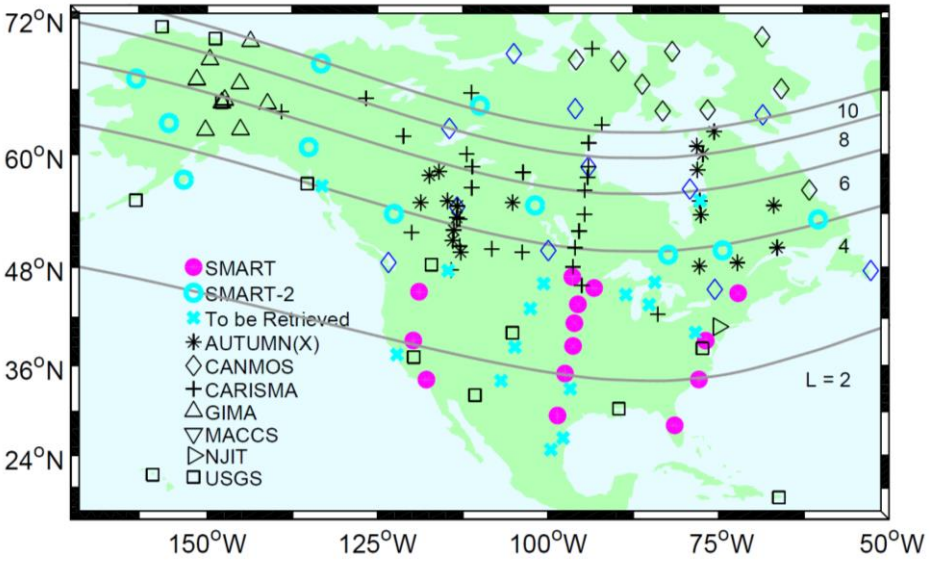


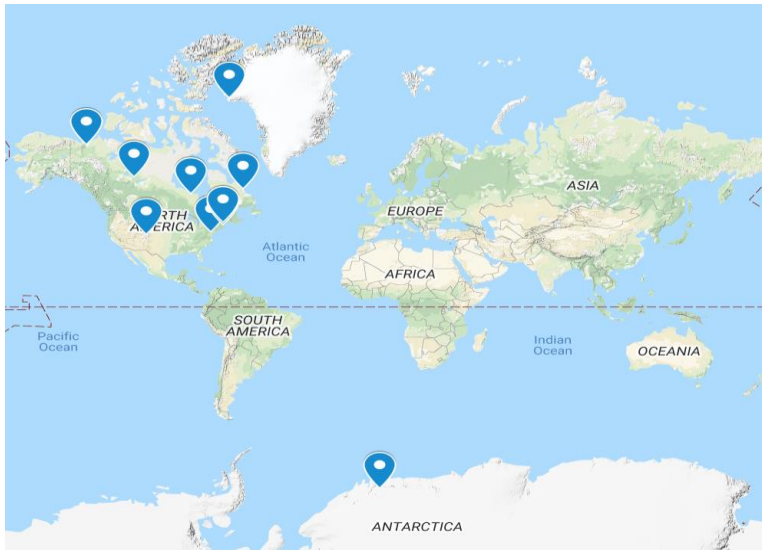


- Global Oscillations Network Group
  - 6 Instruments deployed across the globe
  - Originally designed for helioseismology studies of solar interior
  - MOU between NSF and NOAA supports data input into the operational forecast system

Ground based monitoring

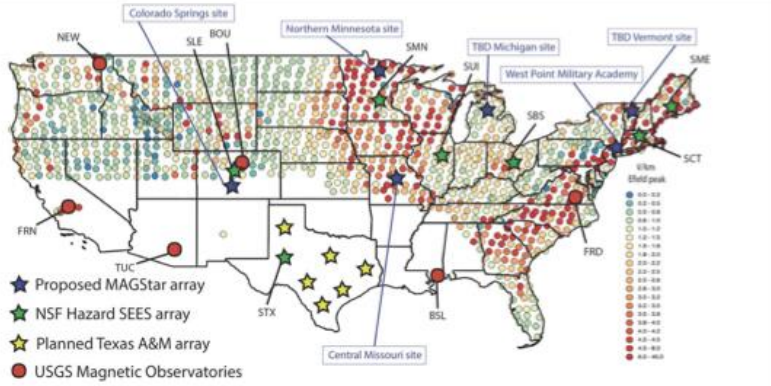
- Magnetometers
  - NSF supports several groups efforts to monitor the Earth's magnetic field
  - Can provide input to geo-electric field modeling





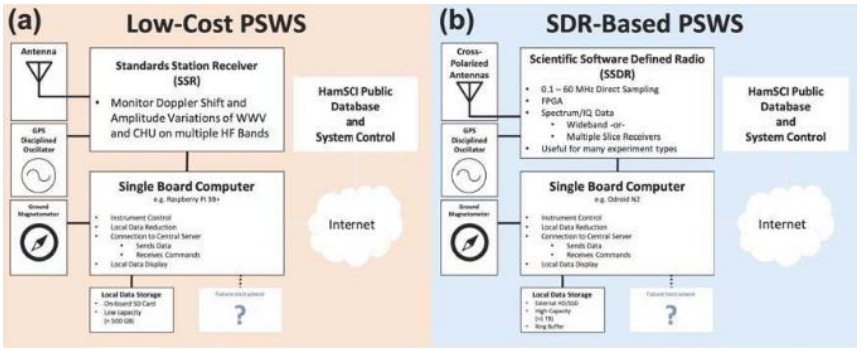
- Neutron Monitors
  - NSF supports research into GCR and SEP through support of 10 stations
  - Can provide useful information for aviation radiation environment

DASI Awards



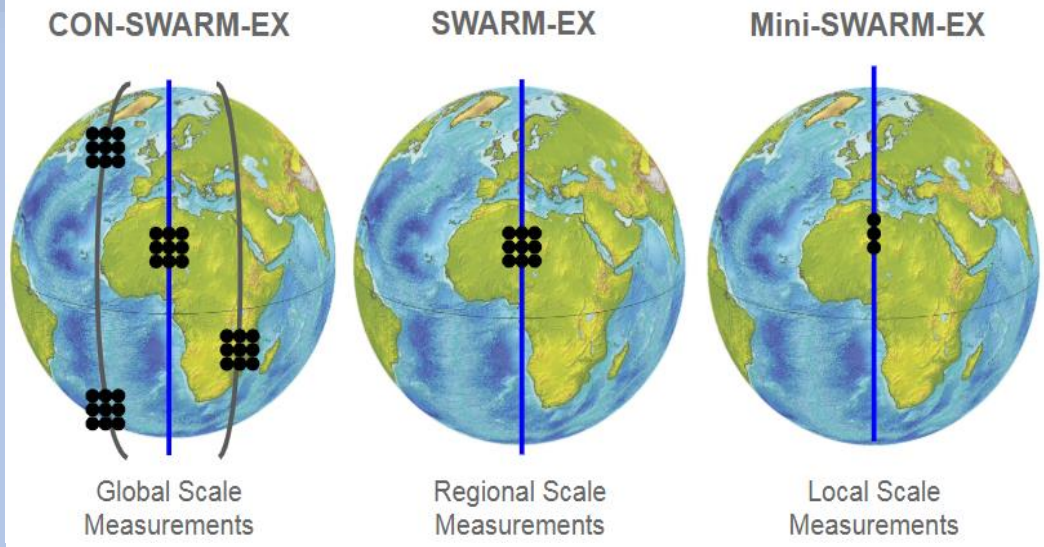
- MagStar
  - PI – Gannon – CPI
  - Add six new magnetometer stations for GIC studies

- Personal Space Wx Station
  - PI – Frissell – U of Scranton
  - Collab with Ham Radio operators for Sp Wx Obs



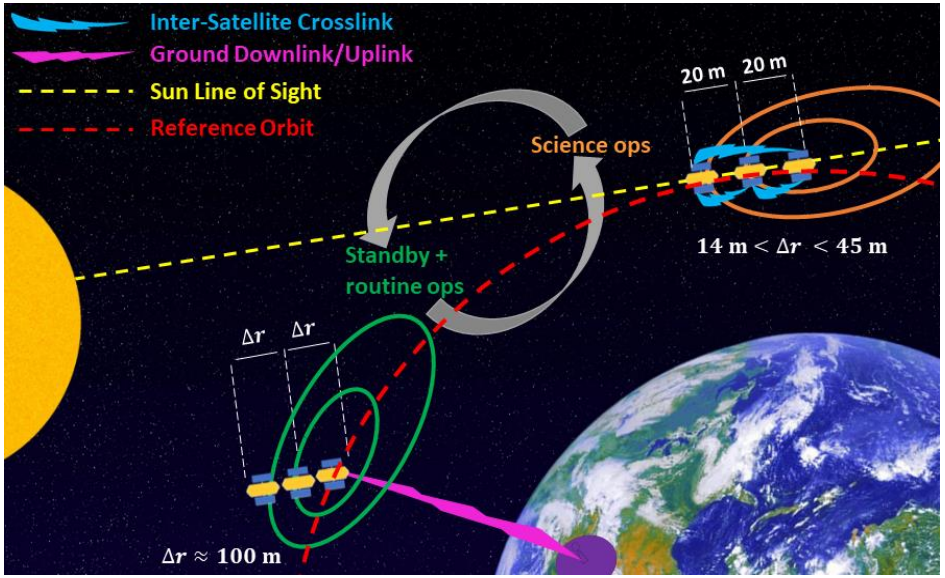
- Space Wx Underground
  - PI – Smith – UNH
  - Uses undergraduate and high school students to develop and deploy magnetometers

New CubeSats



- SWARM-EX
  - PI – Palo – CU
  - Constellation for studies of ionosphere and thermosphere

- VISORS
  - PI – Kamalabadi – UIUC
  - 3 CubeSats acting as single solar telescope to study coronal heating



NOAA-NASA-NSF R2O2R Partnership

- Through a MOU NSF is an active partner in the tri-agency partnership supporting R2O2R activities
  - Currently emphasis on supporting efforts related to the transition of models into operations
  - Need to consider pathways for observing systems
- Support for R2O2R is a way to satisfy the Broader impact criteria required for all NSF awards

Final Thoughts

- NSF's focus is on basic research into the processes that drive space weather
- Support a wide range of observations
- 'SWORM' era is marked by significant cooperation and collaboration between the agencies involved with space weather

Thank you – Questions?

- Happy to provide answers ☺