Strong alignment among all agencies

- All agencies recognize the need to address space weather research and operations needs

- Challenge is to coordinate efforts to amplify each agency's contributions
  - Communicate goals and priorities – operations and research
  - Establish formal feedback – users, forecasters, modelers
  - Leadership must show commitment

- DoD and civilian perspectives – balance between open access and asymmetric advantage

Excellent examples of what works in the terrestrial weather analog

- Proprietary model issue – balance individual competitiveness with open development
  - Are community models essential? If so, how do we develop them?

- Culture: Recognized repeatedly as a key factor
  - Strong culture of research-operations coordination in terrestrial weather
  - Culture is less developed in space weather
  - Building the culture is a key aspect of success

Community of participants is eager and deep – academia, commercial, government,

- Data and models are widely available

- Significant experience and successes with R2O, e.g., CISM, CCMC
  - CISM example had process ending in operations. Continuous improvement (rather than replacement) of operational models is a relatively new concept.

- Strong interest in contributing, but it isn't clear how. "How can I contribute to SWORM/SWAP?"

- We must not focus only on the middle, overlap region between research and operations. We must focus both on the fundamental science and on the direct applications.

Key quotes:

- “Life was simpler with no funding.” (Lans)

- “There is plenty of sex to go around.” (?)

What are the key space weather needs?

Electric Power

- Induced electric field – probability, location, magnitude, duration
    - Coronal mass ejections
    - Coronal holes
    - Ground conductivity details

Aviation

- HF communication outages – Ionospheric disturbances – probability, location, magnitude, duration
  - X-ray flares
  - >10 MeV protons
  - Auroral activity

- GPS accuracy – Ionospheric disturbances
  - TEC gradients (e.g., WAAS availability)
  - Scintillation

- Radiation - >500 MeV protons

Satellite Industry

- Single-Event Upset environment – probability, magnitude, location, duration
  - >10 MeV protons
  - >10 MeV/n heavy ions

- Deep dielectric charging environment
  - >2 MeV electrons

- Surface charging environment
  - 100 eV – 100 keV electrons

Precision Navigation – GNSS accuracy

- Ionospheric disturbances – probability, magnitude, location, duration
  - TEC gradients
  - Scintillation

R

o

R solar-Terrestrial Physics

R Space Weather O A