Headquarters U.S. Air Force

Integrity - Service - Excellence

U.S. Department of Defense
Space Weather Services

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Overview

- Why Space Weather Important to DoD
- Sensor-to-Operator Chain
- Space Weather Application
- Space Environment
- Space Weather Community
- National Space Weather Action Plan Engagement
- Summary
Space Environment

IONOSPHERE
- Electromagnetic Radiation
- Scintillation
- High Energy Particles
- Solar Radio Burst

MESOSPHERE

THERMOSPHERE
- 25+ Satellites

RADIATION BELTS
- 30+ Satellites

MAGNETOSPHERE
- 50+ Satellites

Geomagnetic Storming

SEAMLESS ENVIRONMENT
Why Space Wx Important to DoD?

Global Power/Reach
- Need to characterize the HF communications at high latitudes for airlift and global strike operations
- Potential weapon GPS errors

Air Ops
- Ionospheric modeling needed for successful Command and Control (C2) HF communications
- Potential weapon GPS errors

Global Vigilance
- Characterizing the cosmic ray flux are critical to estimated the radiation dose for high altitude pilots
- Determination of SATCOM communications interference
Why Space Wx Important to DoD?

Characterization of space weather environment for:
- Space track radar interference
- Geolocation
- Missile early warning
- Satellite anomaly assessments
- Satellite orbital decay

- Ionospheric specification for Joint Terminal Attack Controller (JTAC) directing Close Air Support via HF Comm
- HF Radio Blackout

- Ionospheric models provides HF communication radio blackout impacts for Army convoy operations
- Need GPS error determination for infantry navigation via hand-held GPS
Space Weather Observing for Military Operations

- What is the DoD perspective on space weather observing?
  - Operational requirement vs Research need
    - Sensor design, sustainability, lifespan
  - Assured availability
    - Sustained operational data sources
    - Dedicated communications
    - Access across all phases of military operations
  - Accredited systems
    - Usable on DoD/AF IT networks
    - Releasable to partners

Relevant, Reliable, Responsive Obs Feeding Sensor-to-Operator Chain
Sensor-to-Operator Examples

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SOON – Hα

Forecaster analysis & sunspot classification

AF Space forecast space wx & impacts

20th Space Control Sq alerted to space object tracking impacts

ISTO – Radio Frequency Beacon over flight signals

UHF Satellite Communications Scintillation Map

Combined Air Operations Center (CAOC)
Theater Intelligence, Surveillance Reconnaissance collection

Uninterrupted RQ-1 SATCOM data link to CAOC

NEXION – derived profiles

Models – Global analysis, Integration, and Modeling (GAIM) assimilates obs

Impact products – HF illumination

Naval Special Warfare Rigid Hull Inflatable Boat C2 via HF Comm

SENSOR

SPACE WEATHER DATA & PRODUCTS

OPERATOR
Space Weather Application

- **557th Weather Wing Space Weather Operations Center (SpaceWOC)**
  - Mission-tailored unclassified and classified analysis, forecasts, warnings
  - Disseminate system-impacting space weather
    - DoD operators and decision makers
    - National agencies
  - Anomaly assessment support

- **Joint Space Operations Center (JSpOC)**
  - C2 system executing USSTRATCOM space control mission
  - Focal point for space force integration & employment in military ops
  - Detect, track, and identify all artificial objects in Earth orbit

Mission Focused DoD & USG Operational Support
Space Weather Community

- DoD actively engaged in global community
- Training
  - Space weather course (2 weeks) at 557 Weather Wing
  - Students from France, Italy, Netherlands, Germany – working to bring in Japan and South Korea
- Cooperating in operations
  - NOAA SWPC – analysis and forecasting
  - Engaging with UK, South Korea on Ops Centers stand-up
  - Data sharing via web services – national & int’l partners
- Energizing research and development relationships
  - Government Labs
  - Academia
  - Commercial Sector
DoD NSWAP Engagement

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- Co-lead or Supporting Agency for 34 NSWAP tasks
  - Drawing expertise from range of DoD organizations – AFRL, NRL, AFOSR, SMC, AFSPC, JSpOC, 557 WW
  - Task 5.3.5 lead sustaining ground-based solar radio obs

- Developing Annex covering items not contained in NSWAP that impact military operations (e.g., geolocation)

- White House Situation Room
  - Classified support to POTUS & National Security Council during events impacting national & international critical infrastructure or security

- Executive Order (13744)
  - Developing preparedness CONOPS and checklist in collaboration with FEMA to coordinate Federal assets/activities in response to and to protect against impending space weather events
Summary

- Air Force committed to space weather observing...now & future
- Team with national & international community for DoD Support
- Sensor-to-Operator – accurate, timely, relevant impacts delivered

“Air Force weather enables Joint Warfighters to anticipate and exploit the weather...for air, ground, space, cyberspace and intel operations.”

– AFW Mission