AFRL

Geospace Environment Impacts and Applications

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Space Doctrine

<u>DOD DIRECTIVE 3100.10 SPACE POLICY</u>, August 30, 2022
Improve intelligence, space domain awareness (SDA), and command and control capabilities … to detect, track, characterize, warn, attribute, and respond to space-related behaviors and activities that threaten the interests of the United States.

<u>SPACEPOWER Doctrine for Space Forces</u>, June 2020
SDA extends across the physical, network, and cognitive dimensions of space operations.

Operating in the physical environment of space requires a timely awareness of space weather, lighting conditions, and gravitational topology.

This includes the frequency, location, access, and power of EMS links along with the physical and logical pathways required to transmit information across space architectures.

Electromagnetic Spectrum Operations

Electromagnetic Spectrum Operations (EMSO) are coordinated military actions to exploit, attack, protect, and manage the electromagnetic operational environment (EMOE) to achieve the commander's objectives.

Within EMSO reside the specialties of electromagnetic warfare and electromagnetic spectrum management.

EMSO planners should include the effects of atmospherics and **space weather** on both the EMOE and friendly/adversary EMS-dependent systems. The various types of atmospheric conditions and phenomena can positively or negatively affect these systems. Some atmospheric effects are well known and are categorized by season and location. Planners should consult with the CCMD meteorological, oceanographic, and space staffs to determine the type of support available for their operation.
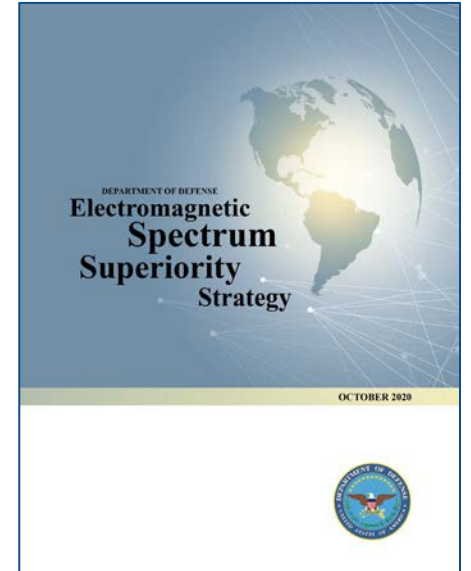
"Operational"

Operational in general refers to a model that is currently meeting an actioned requirement.

That requirement can simply be 'make output routinely available'.

A more useful definition would include a requirement that defines a particular metric that is explicitly validated with output relevant to the operational context.

A useful operational model has users that rely on the model output to do their job.

DoD Space Weather Capability Desires

1. Rapidly assess environmental role in satellite anomalies

2. Rapidly assess environmental role in space-to-ground electromagnetic interference

3. Rapidly assess environmental role in ground-to-space electromagnetic interference

4. Actionable environmental forecasts for spacecraft safety of flight and launch commit

5. Accurately specify and predict performance of large-area surveillance systems

6. Accurately predict ionospheric impacts to space-to-ground links for communications planning

7. Accurately specify and predict performance of ground-based geolocation systems

8. Accurately specify and predict performance of space-based geolocation systems

9. Accurately specify and predict radar auroral clutter impacts

10. Accurately predict performance of high-frequency communications systems

DoD Space Weather Recommendations

Solicit and gather end user needs to synthesize into stakeholder requirements through operationally relevant use cases

Supported Weapon System

Purpose

Dependencies

Risk Assessment

Threshold/Objective Metrics

Timeline, Funding, Personnel

Independent Assessment

Sponsorship

Transition Path / Program of Record

Requirements

Future S&T

Perspectives on Technology Transition

Understand the required temporal and spatial representation
Develop quality-controlled data sets appropriate to the end use
Explicitly factor in all latencies

Reliability, scalability, usability, sustainability, maintainability, testability

Take already mature and vetted capabilities and combine them, "Harvest"
Quick wins and offramps within S&T programs

Minimum TRL 5: Component and/or breadboard validation in a relevant environment

A R2O proposal need not specifically call out new S&T, it can be a demonstration.
There will inevitably be gaps to fill and polish to apply to existing 'mature' capabilities, especially considering operational realities associated with specific transition.

Questions?