Thoughts on the Future DoD Space Environment Architecture

Rachel Hock-Mysliwiec

Chief, Atmospheric & Solar-Terrestrial Impacts Section

Space Vehicles Directorate, June 2020

Space Environment and the Joint Fight

The joint warfighting environment through 2030 demands next-generation DoD space environment capabilities

Counterinsurgency / Counterterrorism

A2/AD Environments / Multi-Domain

Communications

ISR

Safety of Flight

PNT

Polar Operations

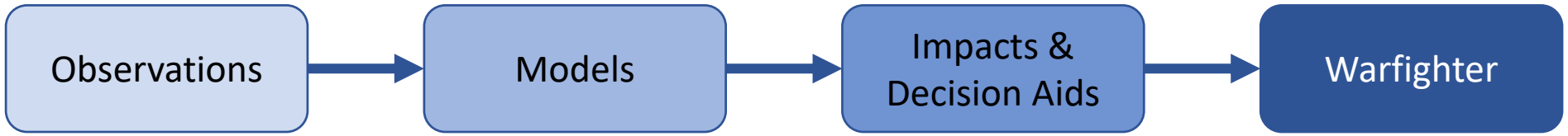
Ballistic Missile Defense

Capabilities Identified in "DoD Space Weather 2028"

- High-altitude air crew dose
- HF communications
- Radar auroral clutter
- Large-area surveillance systems
- Space-to-ground EMI
- Space-to-ground comm planning
- Ground-based geolocation systems
- Space-based geolocation systems
- Satellite anomaly attribution
- Spacecraft safety of flight

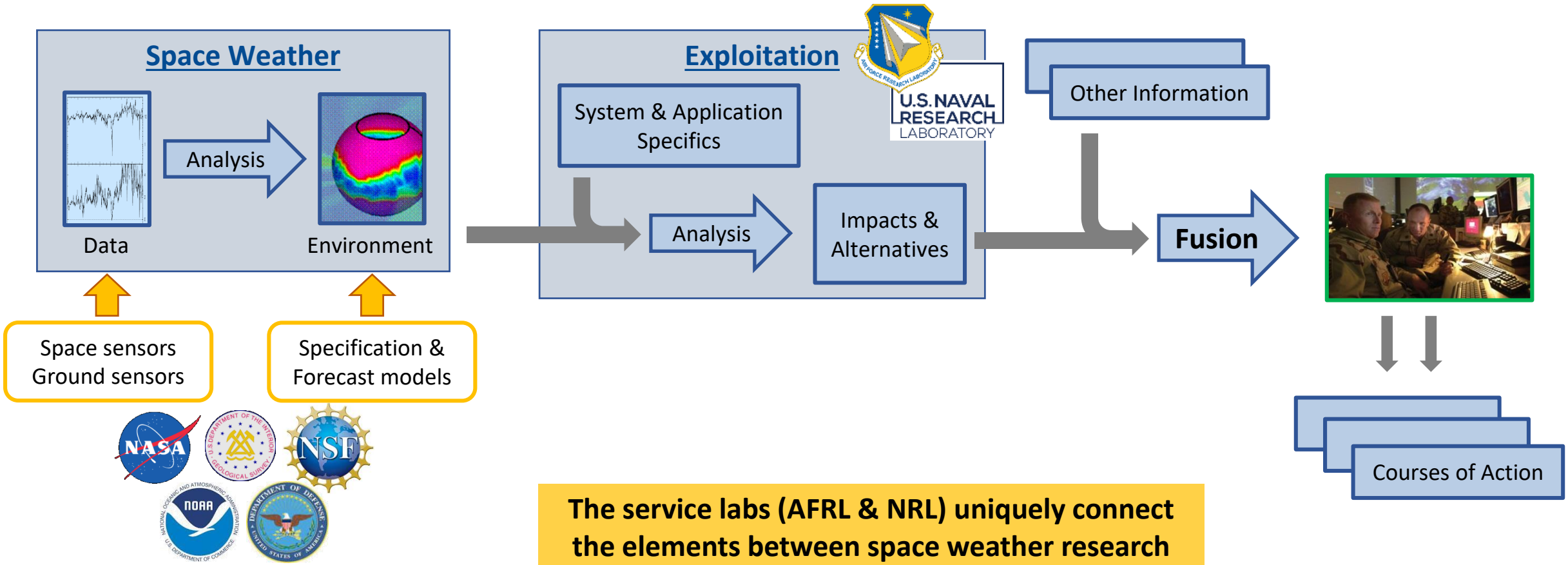
DoD Space Environment Challenges

- Integration
  - Need to move away from weather for weather's sake
  - Work from the right to define necessary space environment observations & models



- Agility
  - Respond to novel data types and providers
  - Rapidly incorporate emerging capabilities
  - Support new customers and end users

Recent Successes: Energetic Charged Particles



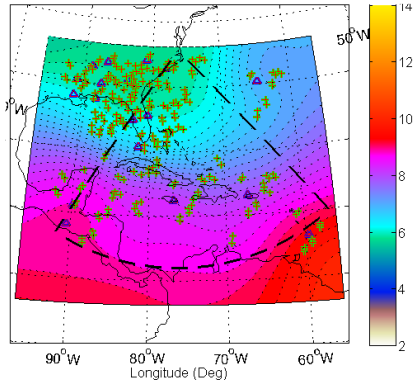
The service labs (AFRL & NRL) uniquely connect the elements between space weather research and operational applications.

Recent Successes: HF Propagation Tool

Tx/Rx Specification

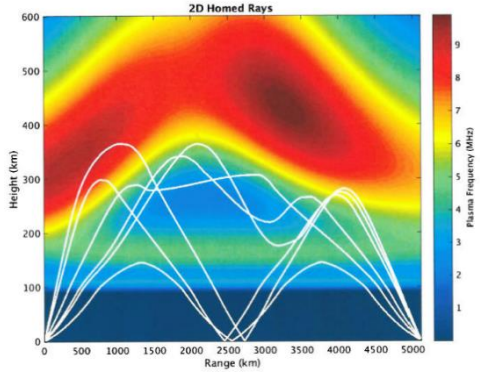
+

Ionospheric Specification



+

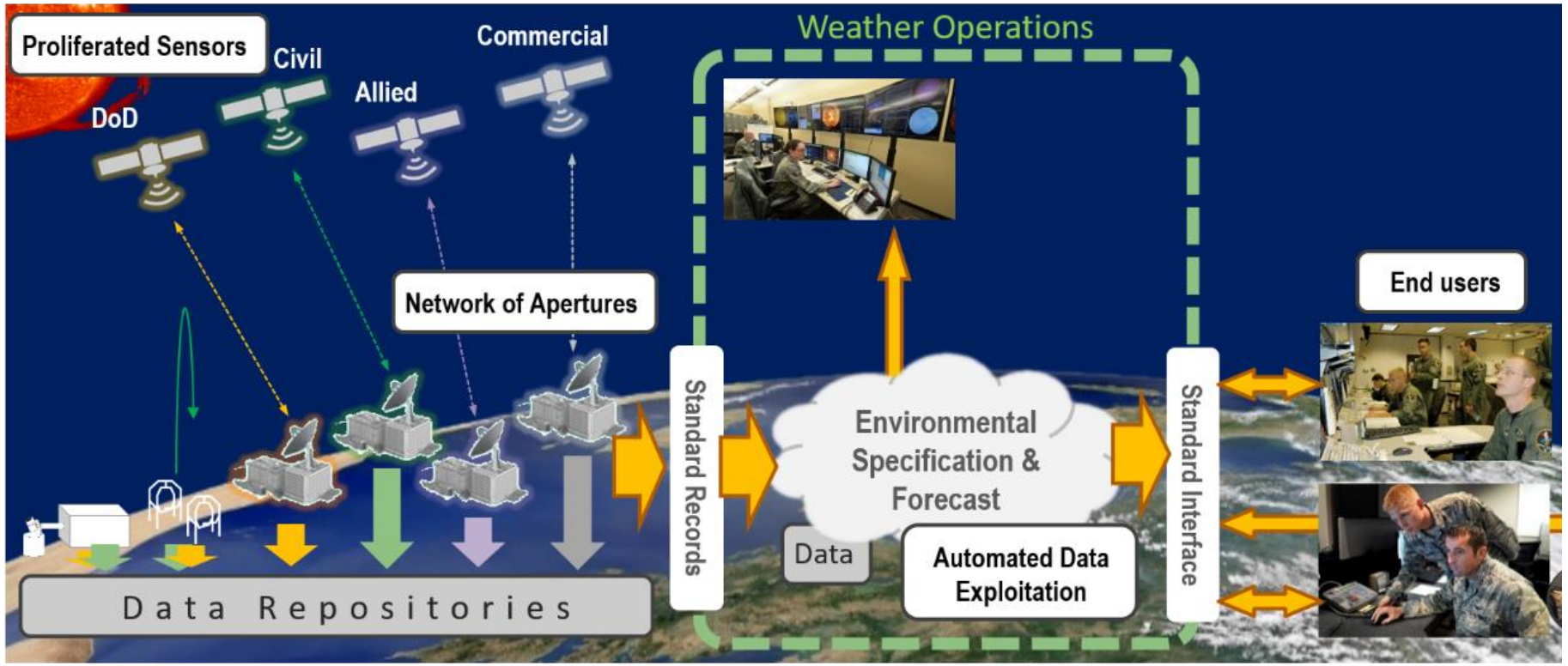
HF Propagation Calculation



Useful Tools

- Prototyping multi-purpose HF propagation tool
- Modular software simulation of HF skywave propagation & HF system performance
  - Ionospheric characterization
  - Numerical raytrace
- Modular architecture allows tailoring of output products for different users

Next-generation Space Environment Support



- Proliferated sensors, including use of commercial & allied data
- Cloud-based services
- Information agility (standard interfaces, quality control, automation)

Potential Pathways for Proliferated Sensors

- Transport Layer
  - Network of interconnected LEO satellites
  - Potential to address latency issues
- Low SWaP Sensors
  - Variometers to *supplement* USGS, CAN, & UK magnetometers
  - Prototyping of energetic charged particle (ECP) sensors
- Commercial data buy/partnerships
  - *Examples*: GNSS RO for TEC observations, scintillation network, space-based magnetometers

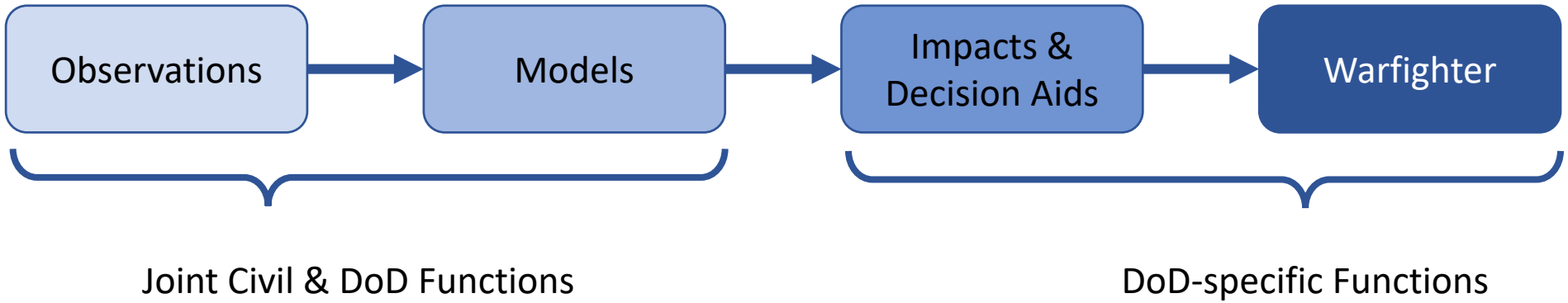
Ground-based Solar Observations

- USAF currently operates the Solar Optical Observing Network (SOON), which has been operating since 1975 and is nearing end of life.
- AFRL has considered what a replacement for SOON *could* be.
- A *collaborative* multi-agency ground-based solar observing network has the potential to be more a cost-savings initiative and could expand both research and operational capabilities.

AFRL's Suggested Guiding Principles

1. Complementary to space-based assets but independently allow space weather operations with acceptable degradation
2. Reduce observatory staffing requirements & operation costs through remote observing & automation
3. Support hosting of scientific instruments & release of operational data (with suitable latency) to scientific community to drive innovation

“Sensor-to-Shooter” Considerations



Should/How can civil and DoD partnerships be strengthened to form shared civil/DoD model development pipeline?

Questions?