THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

Bringing Space Weather Technology to the Warfighter

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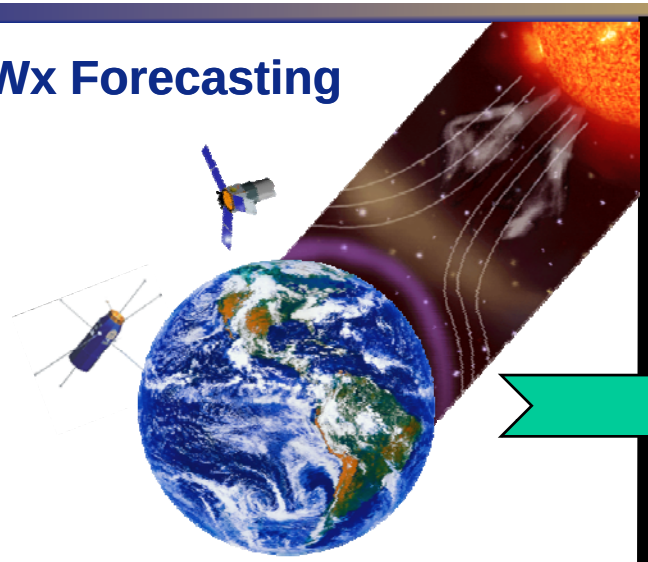
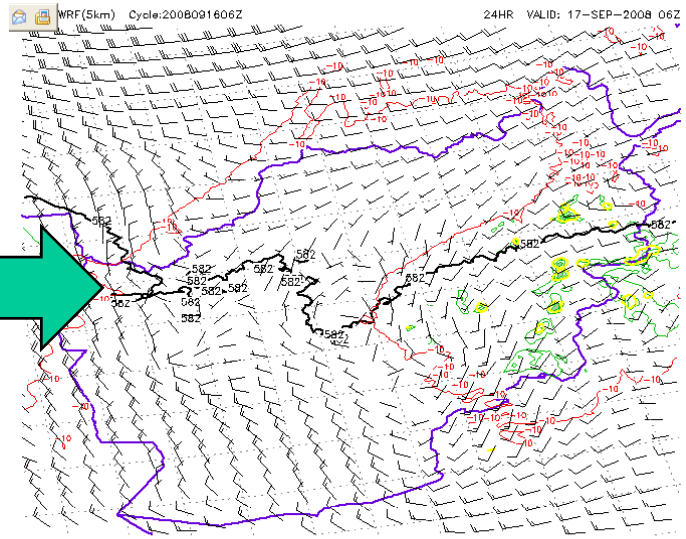
Space Weather Forecasting 10-year Vision

Space Wx Forecasting



- Currently in the era of specification
  - Climatology for satellite design
  - Post-anomaly resolution
- Predictive decision aids increasingly required
  - More dependence on space
  - More sensitivity to environmental effects

Tropospheric Wx Forecasting

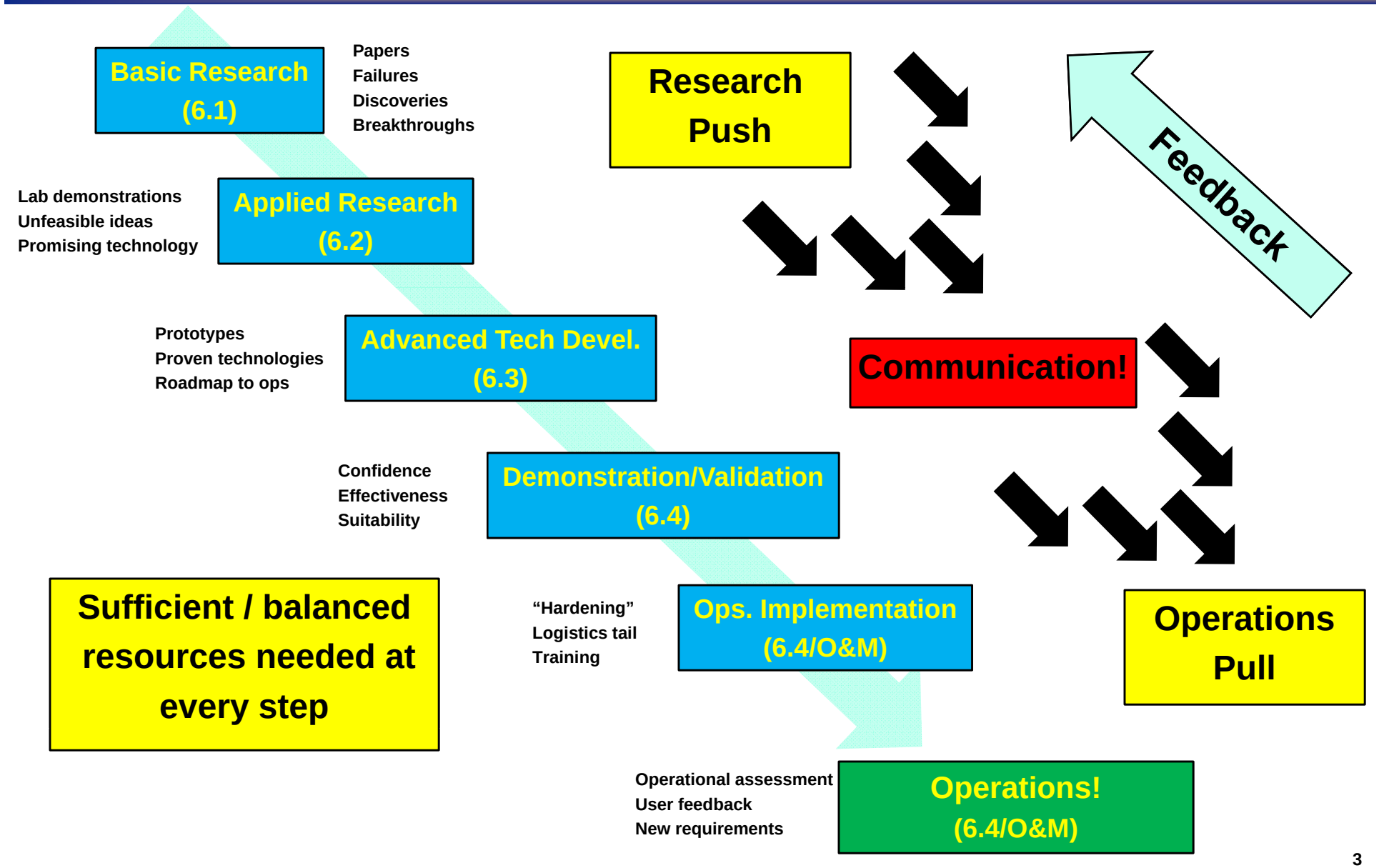


24-hr fcst of 500mb winds/clouds over SW Asia

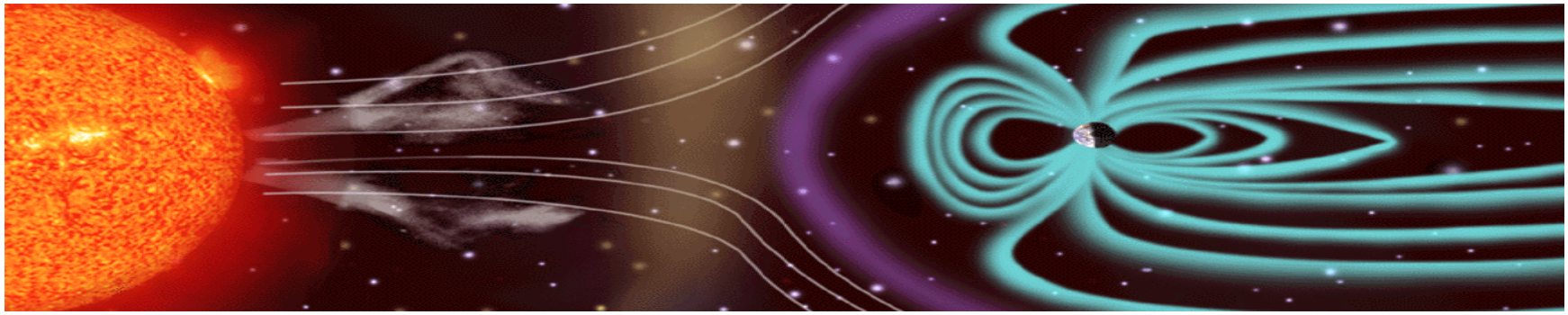
- Lots of data!
- Robust operational numerical weather prediction
- Impacts well known
- Culture of considering weather effects (e.g., ATOs)
- Infrastructure to support rapid data dissemination

Vision: Dynamic data-driven models to provide products with real military utility delivered to warfighter

DoD Transition Process



Sun-to-Mud Coupling
State of the Science



Solar Interior
- MHD dynamics
- Emerging magnetic flux
- Backside imaging (helioseismology)

Photosphere & Chromosphere
- Mag. Field
- Solar Energetic Particles (SEPs)
- Flares / Coronal Mass Ejections (CME)
- Coronal holes / solar wind
- Radio Bursts
- X-ray/EUV emissions

Heliosphere
- Interplanetary Magnetic Field (IMF)
- Solar Wind
- Shocks/SEPs
- CMEs

Magnetosphere
- IMF
- Magnetic storms/substorms
- Auroral zones/ring currents
- Polar Cap Potential
- Radiation Belts
- South Atlantic Anomaly (SAA)

Thermosphere & Ionosphere
- Plasma bubbles / equatorial anomalies
- Scintillation / density fluctuation
- Neutral winds
- Travelling iono. disturbances
- UV Heating
- Ion chemistry
- Bulk ionosphere

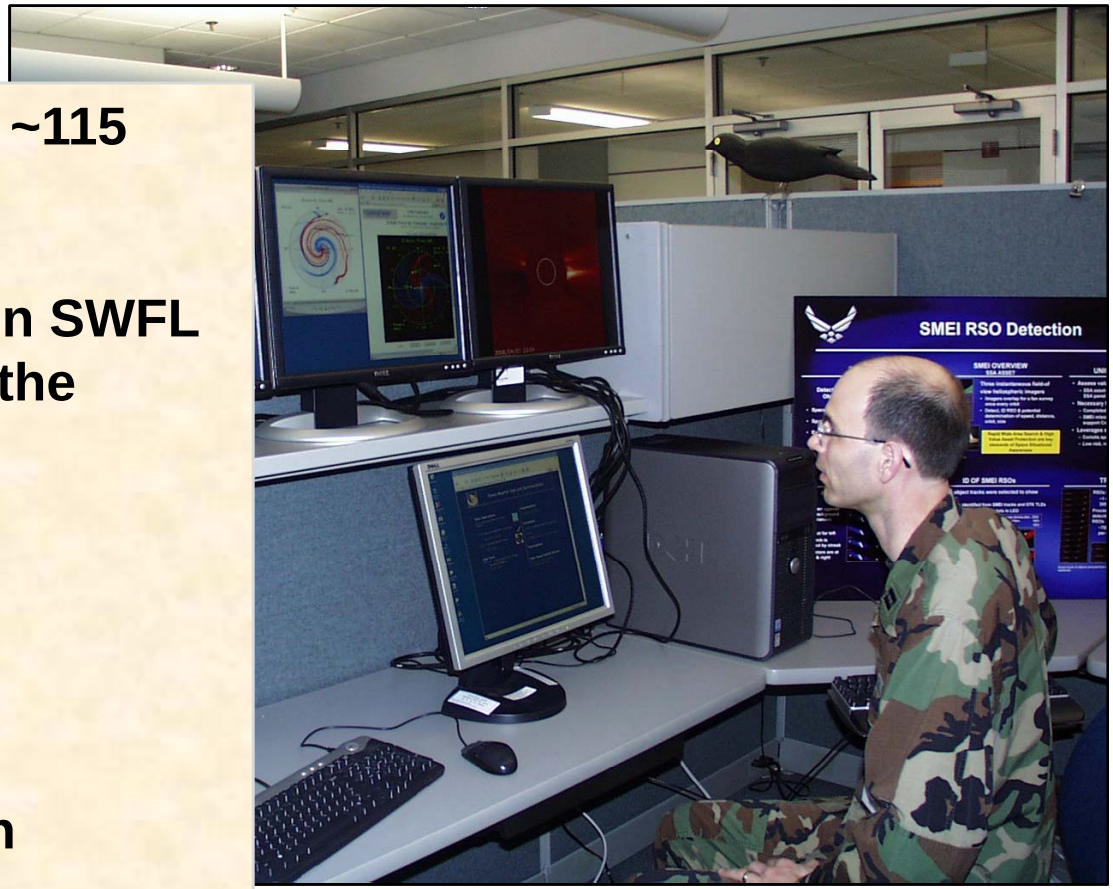
Legend
- 6.1 – TRL 1-2
- 6.2 – TRL 3-4
- 6.3 – TRL 5-6

Driven/Compliant System → **Persistent System**

Covering all the pieces of a very complex system!

AFRL's Space Weather Forecast Laboratory (SWFL)

- Approximately 30 of the ~115 Space Weather Center of Excellence scientist and engineers work directly on SWFL projects and we draw on the efforts of the rest.
- Efforts include
  - Model Validation
  - Model Development
    - New Physics
    - Data Assimilation
    - Probabilistic forecast technique development
  - Scientist Training
  - Communication with Ops



SWFL aimed at Bridging Research-to-Operations "Valley of Death"