



***Integrity ★ Service ★ Excellence***

# **AFRL Space Weather Open Standards and Data Repository Initiatives**

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# Outline



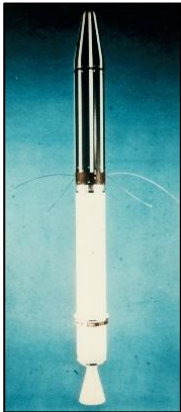
- The Air Force Research Laboratory and Space Weather
- The Case for Open Data Repositories
- Standards and Information Agility
- Next Steps



# AFRL Space Weather



▲ **1949-present:** Sacramento Peak Observatory, New Mexico, solar telescopes



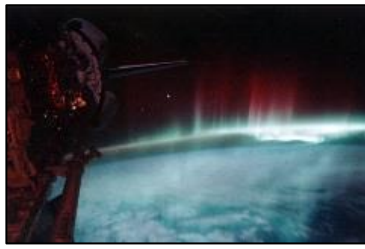
**1958:** Micro-meteoroid detector on Explorer 1 ▼

**1971:** Cannonball-2, atmospheric drag observations ►

**1963-present:** Arecibo ionosphere, deep space observations ▼



**1984:** Auroral photography experiment on STS-41G ►

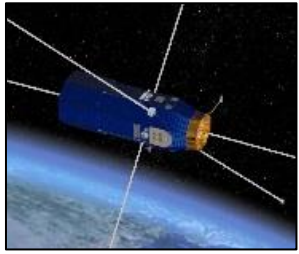


◀ **1990-91:** CRRES discovery of radiation belt injections

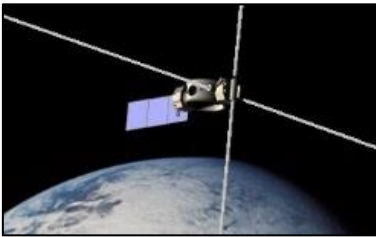
**2003-11:** SMEI solar ejection monitor on Coriolis ►



◀ **1996:** TSS-1R tethered satellite and SPREE experiment on STS-75



**2018:** DSX high power VLF transmissions in radiation belt slot region ▼



◀ **2008-15:** C/NOFS observations of ionospheric scintillation



1950



1960



1970



1980

1990



2000

2010

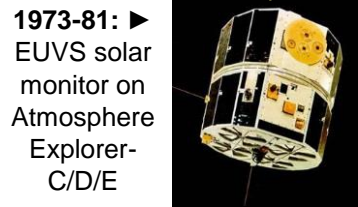


▲ **1957-58:** International Geophysical Year monitoring, Greenland

◀ **1950:** Aerobee sounding rocket, solar constant measurement



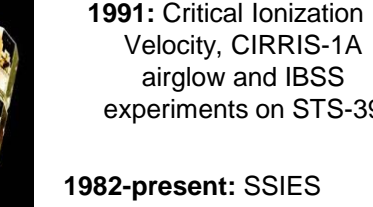
**1962:** STARAD satellite ▲ observes Starfish radiation belt decay



**1973-81:** ► EUVS solar monitor on Atmosphere Explorer-C/D/E



**1979-86:** ▲ SCATHA explores spacecraft charging and mitigation



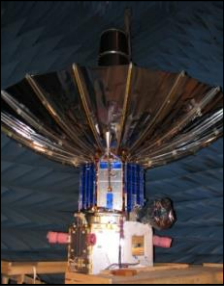
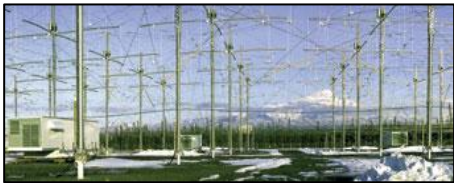
**1991:** Critical Ionization Velocity, CIRIS-1A airglow and IBSS experiments on STS-39



**1982-present:** SSIES ionosphere observations from DMSP ▼



**1990-2014:** ► HAARP ionospheric heating experiments, Alaska



◀ **2011-14:** CEASE space environment sensor on TacSat-4

▼ **2013:** MOSC ionospheric chemical release from rocket, Kwajalein





# AFRL's Role in National Space Weather



*The Air Force Research Laboratory is a core-funded DoD space weather science and technology investment*

- Basic Research – AFOSR
- Applied Research and Advanced Technology Development – Space Vehicles Directorate
- Subject Matter Expertise Support to Major Commands, Program Offices, and Operational Units

*AFRL invests in, creates, and matures technology toward space weather operations*

- Grants, contracts and other agreements
- In-house research
- Program office-funded maturation and prototyping



AFRL is key bridge between the research community and DoD operations





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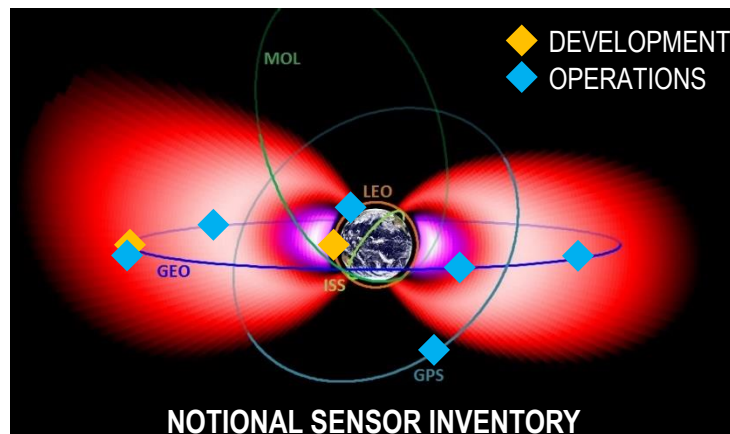
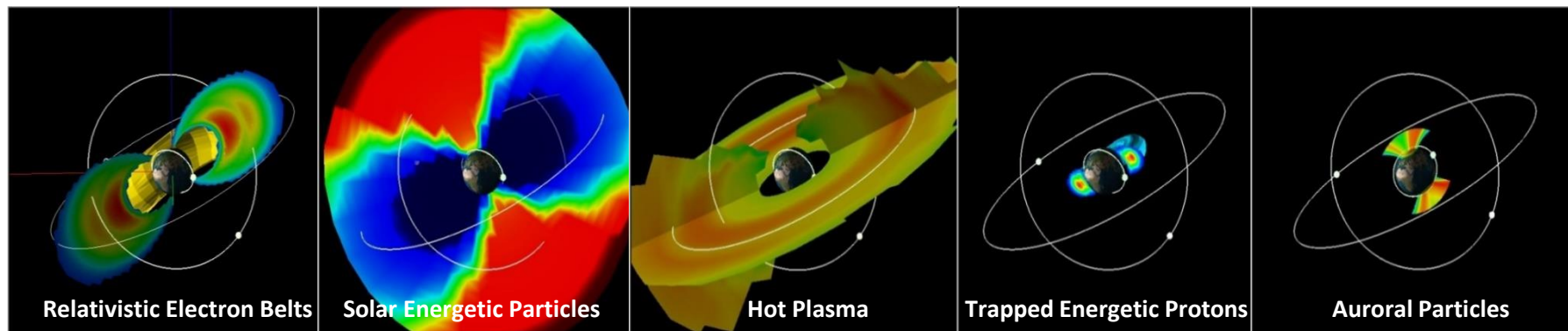


# The Case for Open Data Repositories

The DoD operates specification and forecast models for the near-Earth radiation environment

Model upgrades require:

- Drawing on state-of-the-science
- Maturing new models toward ops
- Integrating with operational baseline



Restricted data sources pose challenges:

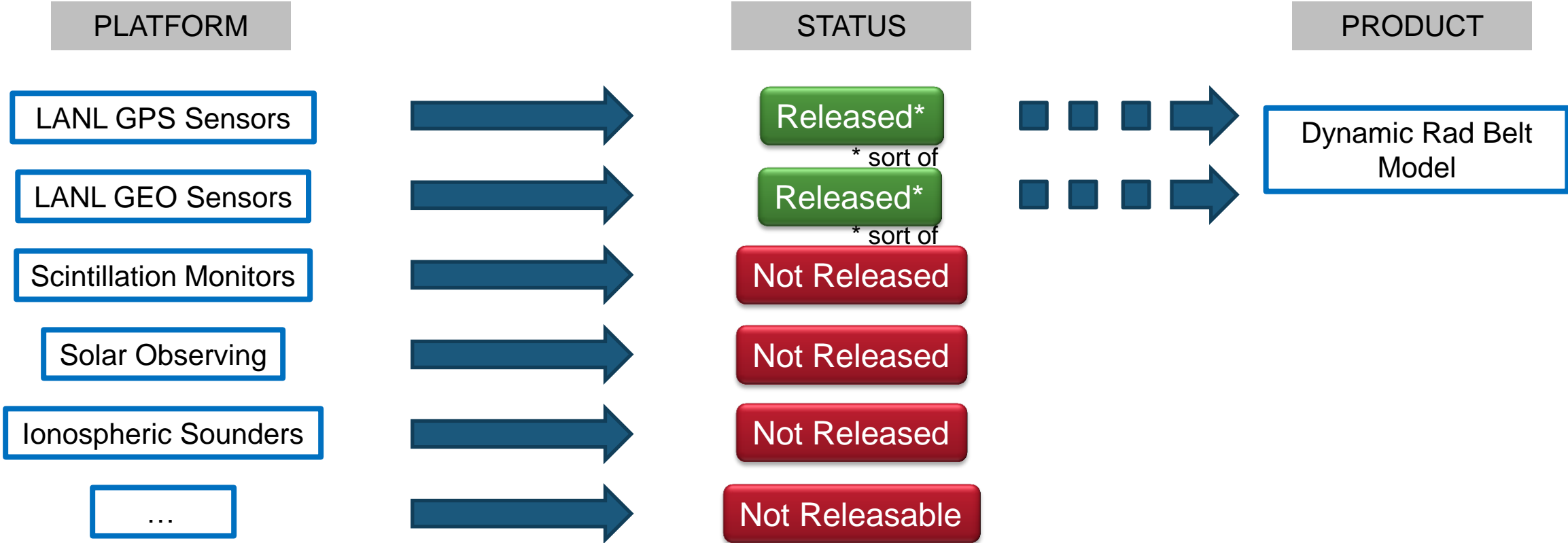
- Models built with fewer or different drivers than available operationally
- Reduced fidelity in regions of interest
- Significant modification or tuning to prepare for use in operations
- Disconnects with respect to data latency, format and content

We can't afford to do everything ourselves. The research community must have access to relevant data sources in order to build next-generation models



# From Hotel California...

DoD collects substantial environmental data with little-to-no sensitivity once it is no longer timely

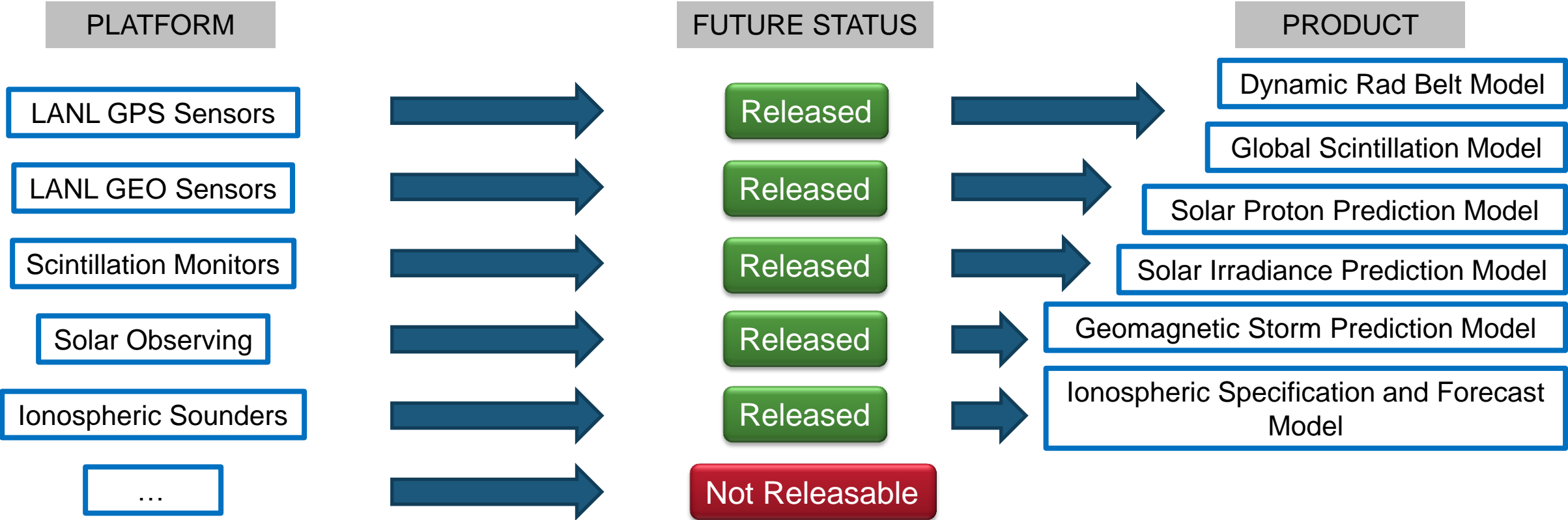


Lack of relevant observations is hindering next-generation model development





# ... to Life in the Fast Lane



More data can be routinely released to support scientific inquiry and model development







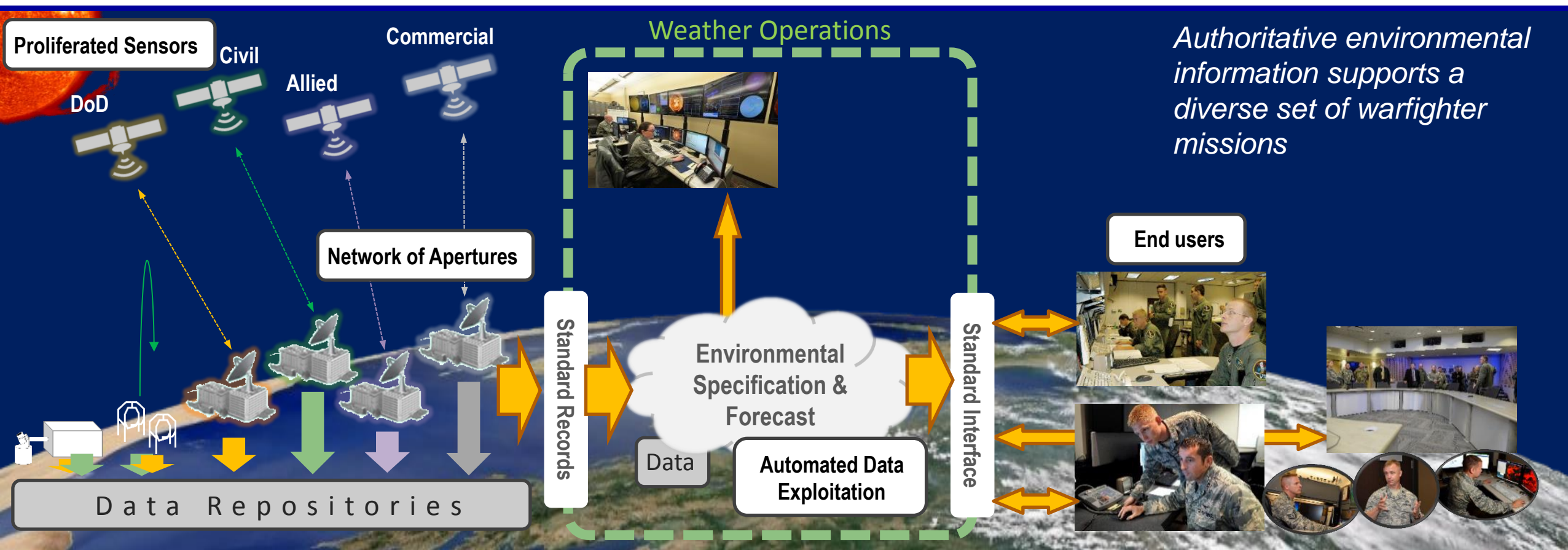
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# Information Agility and Next-Gen Weather Support



Heterogeneous sensor architectures demand standardized records.  
Heterogeneous exploitation tools demand standard interfaces



# DoD Aspects of Standards



*DoD acquisitions are embracing several initiatives for next-generation systems*

- Open architectures
- Government-owned APIs
- Industry-standard technologies



*GUIDANCE*  
**Intellectual Property Strategy**

*There are several concerns specific to DoD systems*

- Security: integrity, availability, confidentiality
- Multiple security enclaves
- Long-term viability of fielded systems



AFRL prototyping enabling movement toward standard records and interfaces



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# Next Steps



*AFRL is testing proposed standard records as part of ongoing prototyping efforts*

- Examining state-of-the-industry for both ontologies and containers
- Focusing on opportunities to subset existing ontologies with minimal need to extend
- Evaluating container suitability for multi-level security operations
- Utilizing test, modify, repeat cycle during prototyping to incorporate lessons-learned before fielding
- Identifying options and costs for routinely contributing unclassified observations to community databases

*A coordinated effort is desired, to ensure maximum interoperability with civil, allied and commercial systems*

- AFRL to provide a straw-man starting point for review
- All stakeholders are welcome to contribute ideas and improvements
- Final specification will be Government-owned, available to all, and readily applied to contracts

All stakeholders are welcome to participate and provide input



