Towards a U.S. Framework for Continuity of Satellite Observations of Earth's Climate and for Supporting Societal Resilience

KISS Study Website
https://kiss.caltech.edu/programs.html#satellite_observations

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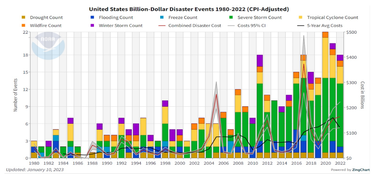
THE STUDY



1 Introduction

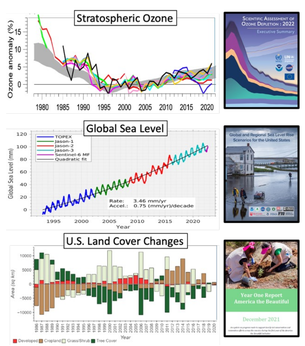
Finding 1.1 - There is growing urgency for improved public and commercial services to support a resilient, secure, and thriving U.S. population and economy, particularly in the face of mounting decision-support needs for environmental stewardship and hazard response, and for climate change adaptation and mitigation actions (e.g. FFAPCS, 2023).

Finding 1.2 - Space-based Earth observations represent an essential component of the infrastructure needed to support the delivery of critical environmental science and decision-support information with local, national, and global utility.

Finding 1.3 - Many quantities measurable from satellites that have been shown to have scientific and/or decision-support value do not have a plan for sustained observations.

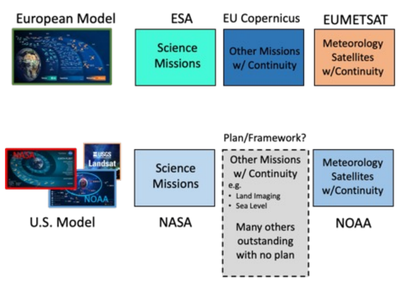
Finding 1.4 - The U.S. does not have a systematic, overarching plan or framework for identifying, prioritizing, funding, and implementing *additional* sustained Earth observations to support our nation's science, policy, and societal resilience goals.

Motivation



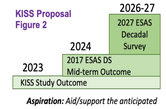
Questions for the U.S. Concerning Sustained Observations

- Apart from weather, what are our national priorities for sustained Earth observations?
- What paradigm will the U.S. use as the basis for setting these national priorities?
- What organization or body will be chartered to develop these priorities for the U.S.?
- What is our national approach to implementing sustained observations that meet these priorities, including the information production and delivery services?

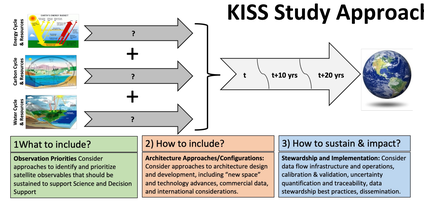


KISS Study Proposal

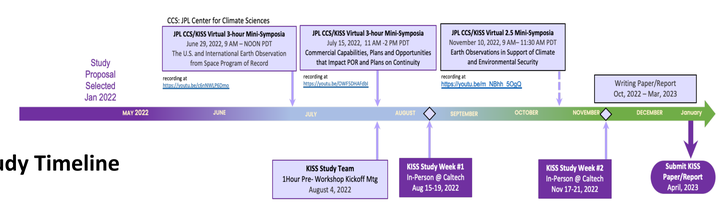
The goal of this study program is help accelerate discussions and plans for a greater and more impactful U.S. contribution to the global climate observing system. *In this context, "climate" includes observations that support climate science and process understanding, as well as monitoring for situational awareness, climate services, impact response, adaptation, and mitigation assessments.*



KISS Study Approach

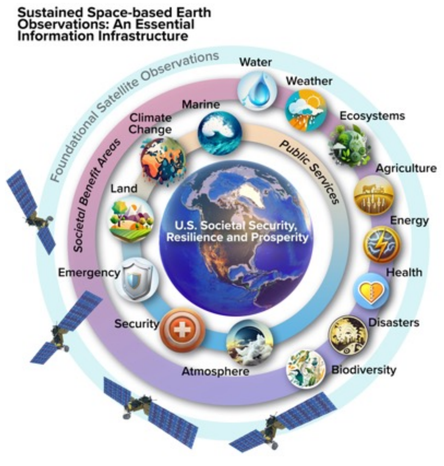


KISS Study Timeline



THE OUTCOMES

Identifying Science and Application Priorities

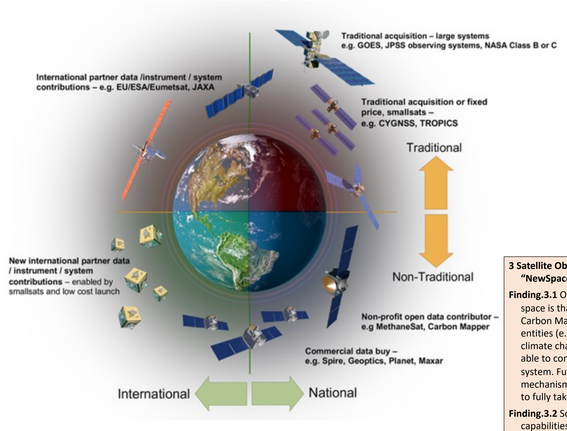


2. Identifying and Prioritizing Sustained Observation Needs

Finding 2.1 - Prioritization of variables requiring continuity of satellite observations is complex and may benefit from consideration across multiple societal sectors and services. The technical requirements on these observations (e.g., temporal and spatial sampling, accuracy, latency) are highly dependent on the specific application sector and/or the underlying supporting science objectives.

Finding 2.2 - Any prioritization framework will: a) have subjective elements, b) be time and context dependent due to changing science and societal benefit needs, technological advances and programmatic opportunities, and c) will likely benefit from periodic reexamination.

Developing Architecture Options & Opportunities



3 Satellite Observing Architectures: Technology, "NewSpace", Commercial and NGO Considerations

Finding.3.1 One impact of the lower cost of access to space is that many new domestic (e.g., NGOs such as Carbon Mapper and MethaneSat) and international entities (e.g., countries that want to help address climate change that previously could not afford to) are able to contribute elements to the Earth observing system. Future U.S. and international coordination mechanisms for Earth observations could be designed to fully take advantage of these types of contributions.

Finding.3.2 Sources of new missions and observing capabilities to address unmet U.S. needs for continuity of Earth observations could be obtained from traditional government acquisition, international partners, commercial entities, NGOs, data purchases, and hybrid solutions (i.e. **Table 1**).

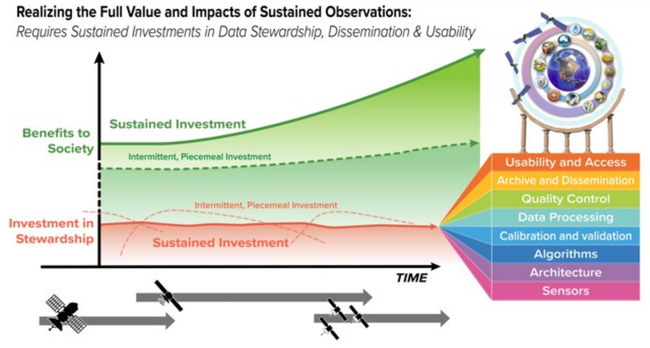
Accounting for Long-term Programmatic and Technical Support

4 Data Stewardship and Information Production, Usability and Dissemination

Finding 4.1 - A framework for successful stewardship of sustained Earth observations requires end-to-end planning with a long-term horizon in mind (i.e., well beyond individual satellite mission lifetimes), a suite of technical attributes that support open and easy access, interoperability of related observations, as well as carefully coordinated and sustained programmatic structures that provide the needed shepherding and support.

Finding 4.2 - For climate datasets, the value to science and society accrues with longevity, so stewardship and the necessary technical and programmatic structures needed to support it, require an enduring commitment that should be independent of individual missions. Investing in data usability, traceability, provenance, and interoperability capabilities can greatly enhance the return on the given civil or commercial investments made to deploy the observing system (**Figure 6**).

Finding 4.3 – While strides have been made by individual U.S. agencies to provide more ready access to Earth observation datasets, full exploitation of the data and associated investments for U.S. civil and commercial interests and services suggests a more holistic stewardship approach providing the means for platforms where observations and models reside together in an easily accessible and manipulatable form and the latest analysis techniques, such as machine learning and artificial intelligence, can be applied to entire observational records.



5. Summary and Path Forward

Finding 5.1 The U.S. could benefit from a systematic and overarching plan or framework for identifying, prioritizing, funding, and implementing sustained Earth observations that are critical for supporting our nation's science, policy, and societal resilience goals.

Finding 5.2 A clear and unified approach to sustained Earth observations and determination of our national priorities for these observations may improve the effectiveness of the varied U.S. investments in Earth observations and associated information systems. Such an approach may also enable the United States to play a larger global leadership role in environmental stewardship, Earth system and climate science, and related public services

KISS Continuity Study Team, Towards a U.S. Framework for Continuity of Satellite Observations of Earth's Climate and for Supporting Societal Resilience, ***Earth's Future***, AGU, Under Review