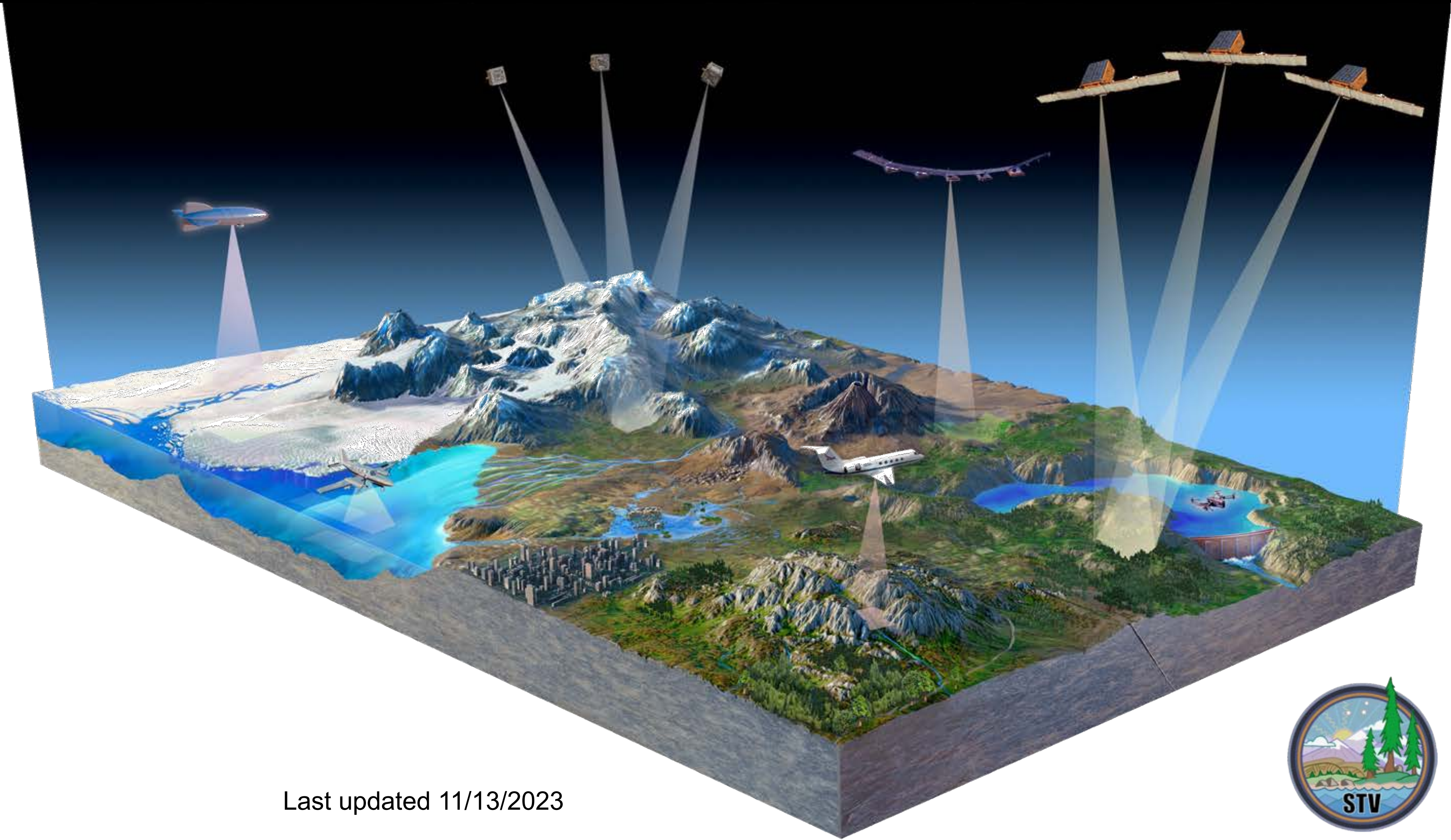
Toward an Observing System Architecture for Surface, Topography and Vegetation



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Last updated 11/13/2023

NASA Project Life Cycle

PREFORMULATION	FORMULATION		APPROVAL/KDP-C	IMPLEMENTATION			
Pre-phase A Preformulation	**Phase A** Concept and technology	**Phase B** Preliminary design and technology completion	NASA sets Agency Baseline Commitments for cost and schedule	**Phase C** Final design and fabrication	**Phase D** System assembly, integration, test, launch, and checkout	**Phase E** Operations and sustainment	**Phase F** Closeout
	Formulation costs			*Development costs*		*Operations*	

Program Pre-Formulation:

Pre-Phase A: Concept Studies

Program Formulation

Phase A: Concept and Technology Development

Phase B: Preliminary Design and Technology Completion

Program Implementation:

Phase C: Final Design and Fabrication

Phase D: System Assembly, Integration and Test, Launch

Phase E: Operations and Sustainment

Phase F: Closeout

STV Decadal Timeline *(Approx)*

Now Incubation

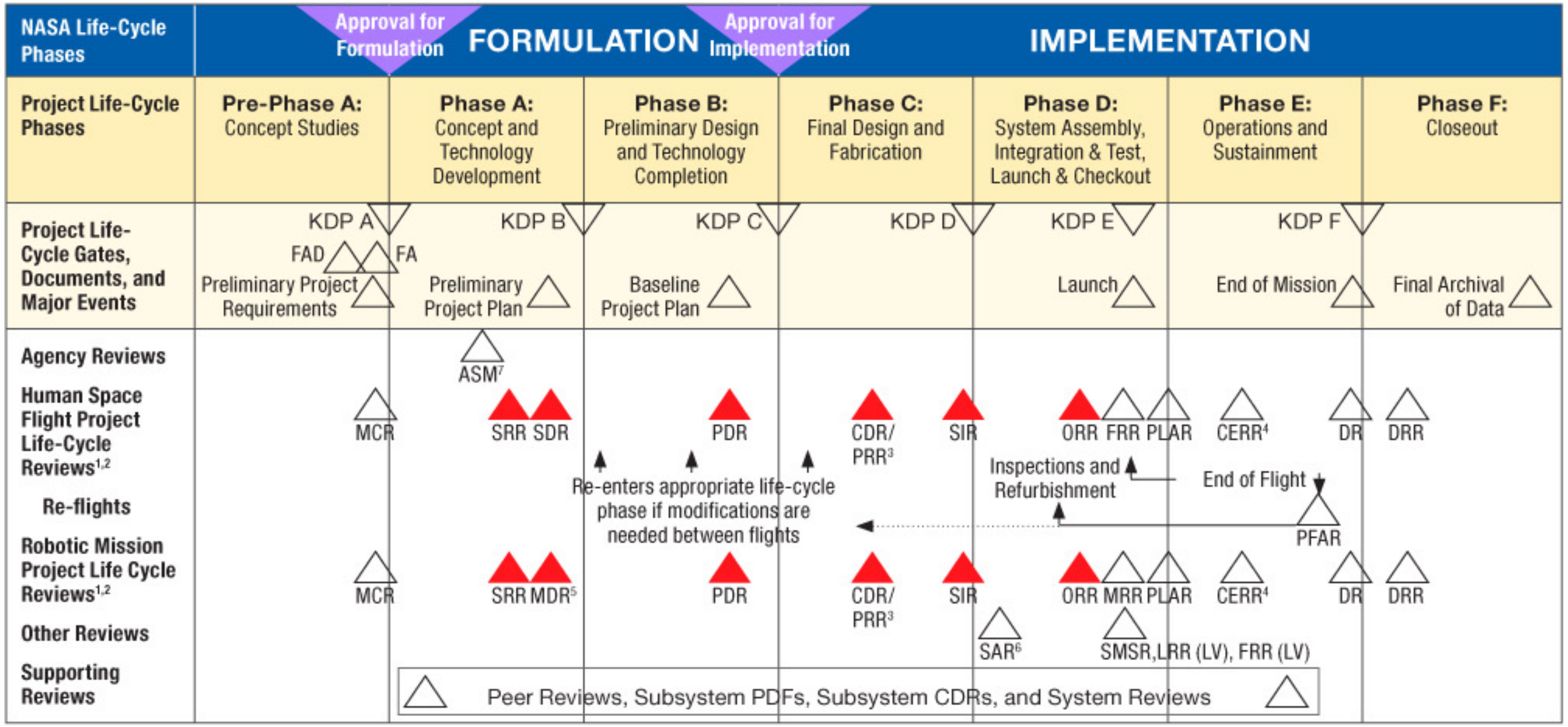
2025+ White Papers Submitted to National Academy

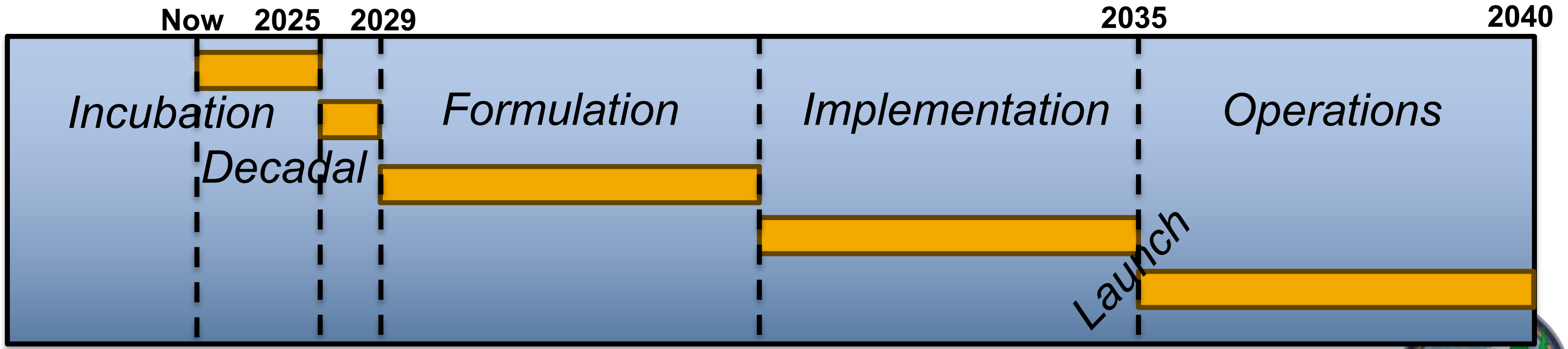
2027 Decadal survey comes out with STV as a *designated observable*

2029 Funding for Mission Phases A-E

2035 Launch

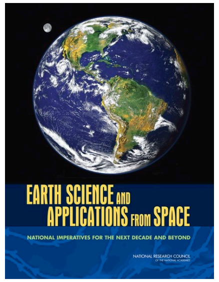
2038-2040 Mission End



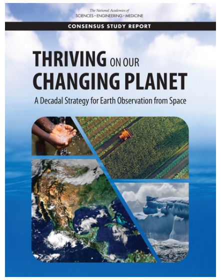


Decadal Report

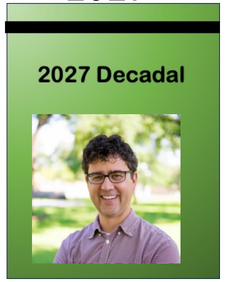
2007



2017



2027



Per-Thread STM

- **Science Modeling**
  - How do source terms present themselves?
  - How do measurements inform science models and their uncertainty?
  - How do we validate observables?

- **Instrument Modeling** – how do we observe, measure and characterize
  - Approaches
  - Timing
  - Completeness over mission life

- **Mission Thread Value** - How do these source term measurement feed understanding via Earth System Models?

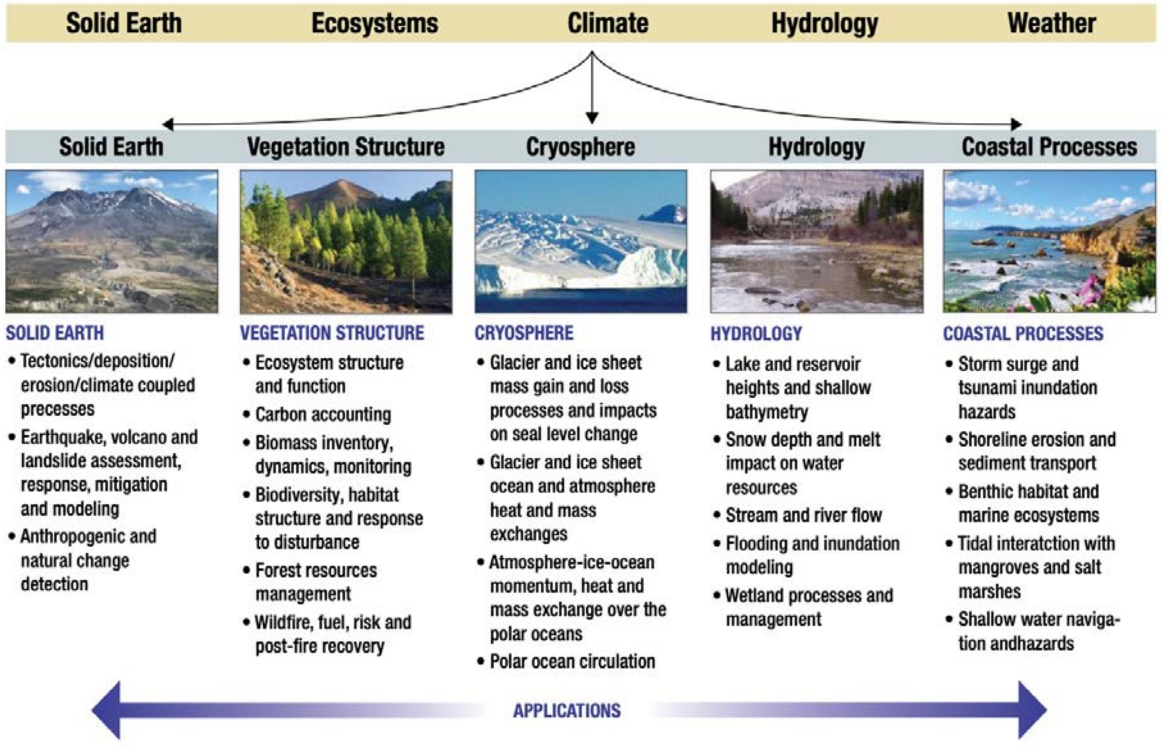


TABLE 5-1. Key advantages and disadvantages for lidar, radar and stereo technologies.

Sensor	Key Advantages	Key Disadvantages
Lidar	• High vertical accuracy • Detection of ground through vegetation • Vegetation structure • Day and night operation	• Coverage • Cloud cover • High power • Limited detection of ground through very dense vegetation
Radar	• Coverage • Day and night operation • Operates through clouds	• Complex to infer vegetation structure and underlying topography • Changing snow, firn and ice dielectric properties makes height measurements very challenging • High power
Stereophotogrammetry	• High spatial resolution • Low power • High maturity • High reliability	• Day only operation • Cloud cover • Limited detection of ground through dense vegetation

Requirements and Prioritization

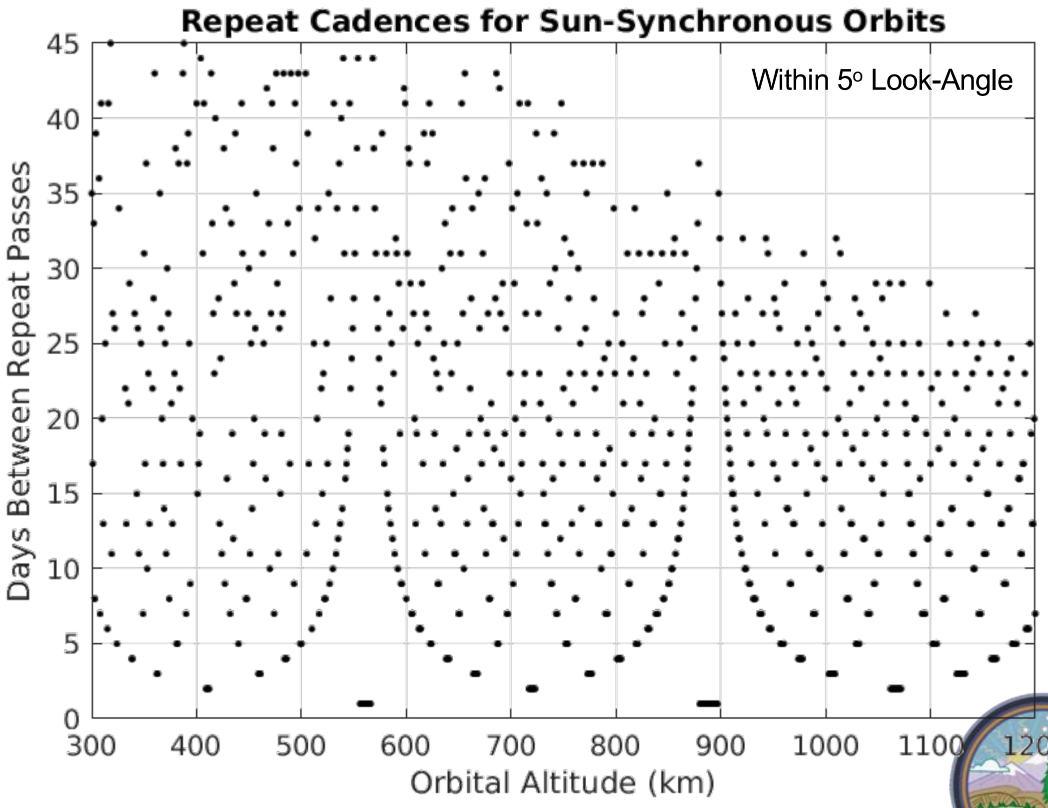
- Map Into Measurement Needs
  - Mission Thread based breakdown
  - Key Science Data Products and Quality Objectives

- Advance Technology Readiness

- Do Not Forget Ground Development
  - Mission Planning and Scheduling
    - Mission Thread Dependent
    - World mapping vs targeted observations
  - Science Data Processing & Fusion
  - Science Product Archive / Dissemination / Access

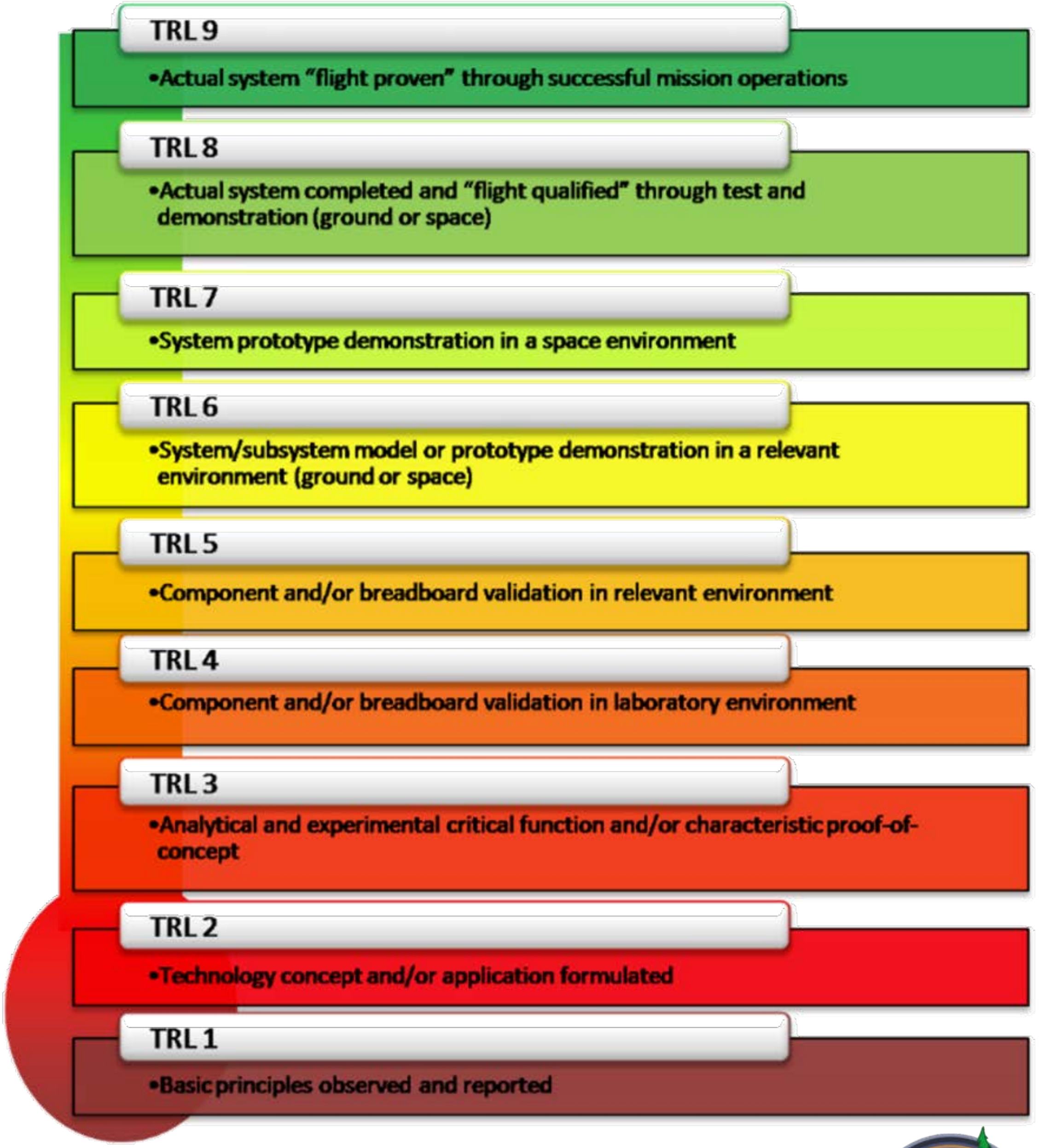
Science Product Performance Combines
- ***Space Segment(s) – ie Instruments***
- ***Concept of Operations***
- ***Mission Planning & Ground Processing***

Parameter		Aspirational			Threshold		
		Median Need (rounded)	Most Stringent Need	Most Stringent Discipline	Median Need (rounded)	Most Stringent Need	Most Stringent Discipline
Coverage Area of Interest	%	90	95	C, H	55	90	C
Latency	Days	5	0.5	SE	60	1	SE
Duration	Years	9	10	SE, C, A	3	3	SE, V, C, CP
Repeat Frequency	Months	0.1	0.03	SE, A	3	0.2	SE
Horizontal Resolution	m	1	1	SE, C, H, A	20	3	SE
Vertical Accuracy	m	0.2	0.03	SE, C, H	0.5	0.1	C
Vegetation Vertical Resolution	m	1	0.5	H, A	2	0.2	CP
Bathymetry Max Depth	m	25	30	C, CP	10	10	SE, C, CP
Geolocation Accuracy	m	1	1.0	SE, V, H, A	5	3	SE, V
Rate of Change Accuracy	cm/yr	5	1	SE, C, A	35	1	SE



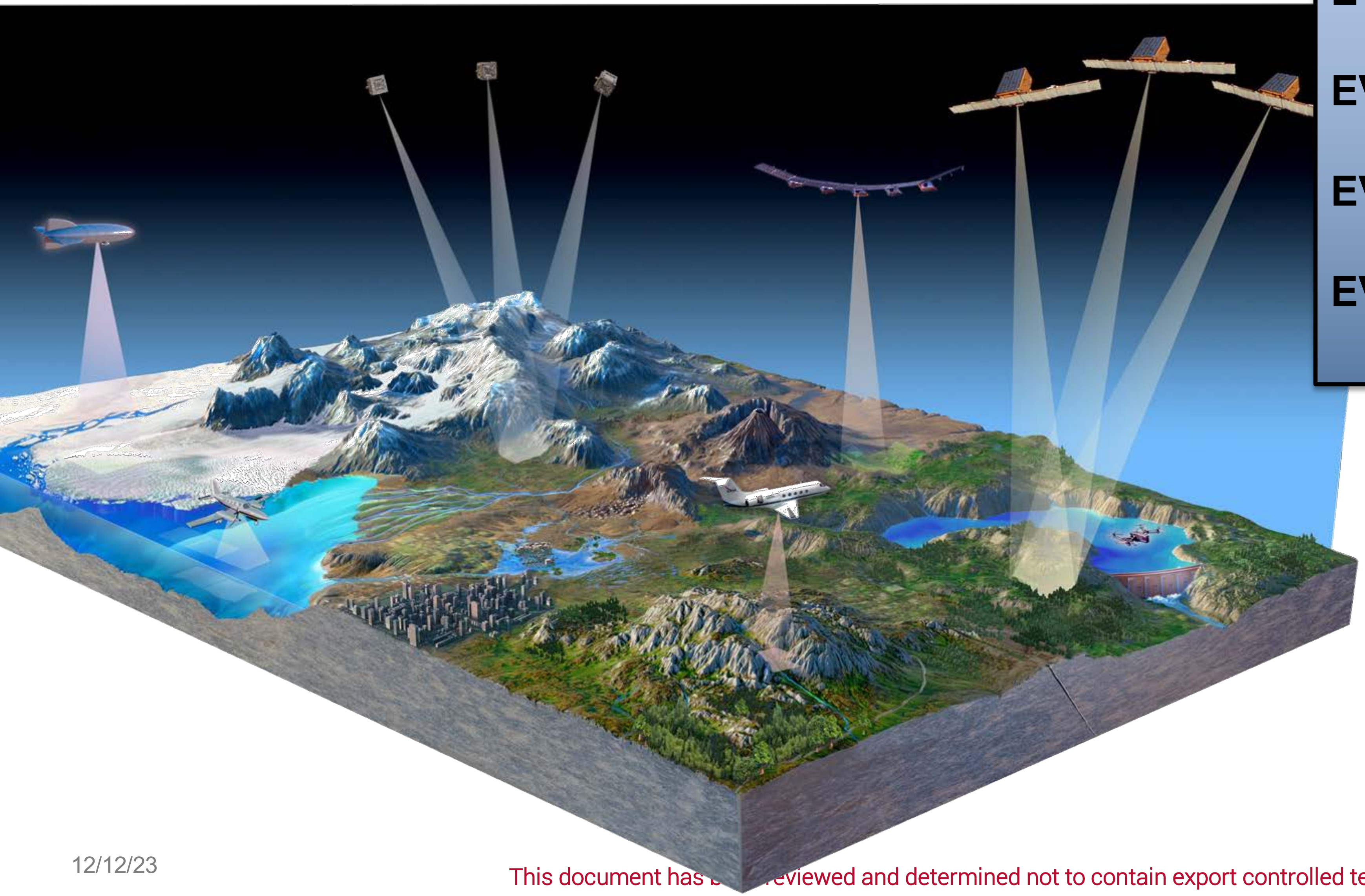
Technology Readiness

- Technology Readiness Levels (TRL) are used to assess the maturity level of a technology. There are nine technology readiness levels. TRL 1 is the lowest and TRL 9 is the highest.
- In general, all technologies must be at least TRL-6 by Mission PDR (KDP-B)
- We have several years to develop lower TRL technologies for a potential 2027 STV Designated Observable mission, but we need to start soon and show a path to completion before
- For earlier opportunities such as Earth Venture, we need to use more mature (existing technologies or those already in development)



More Detailed TRL Definitions: https://www.nasa.gov/wp-content/uploads/2017/12/458490main_trl_definitions.pdf

Earlier Opportunities for STV Data



Upcoming NASA Earth Venture Opportunities

EVC-2 Q4 of FY24 (Continuity)

EVI-7 Q1 of FY25 (Instrument)

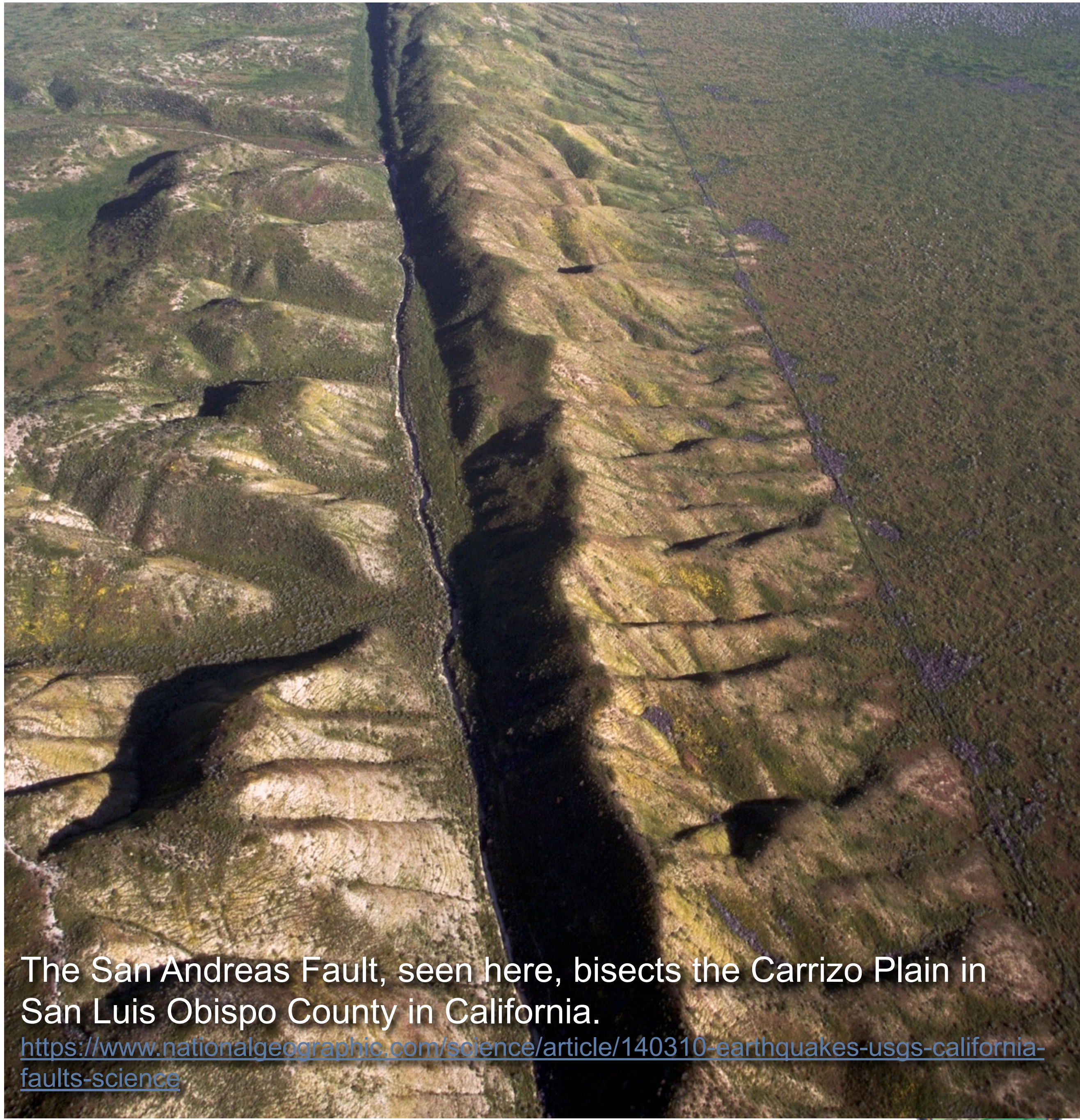
EVM-4 Q4 of FY25 (Mission)

EVS-5 Q4 of FY26 (Sub-orbital)

Next Steps

- Advance maturity of STV Science Needs
- Advance maturity of observational approaches
- Look for additional opportunities
  - How can STV measurements also support aspects of PBL?
- Look at the full NASA and Commercial sensor architecture

Mind the Gap



The San Andreas Fault, seen here, bisects the Carrizo Plain in San Luis Obispo County in California.
https://www.nationalgeographic.com/science/article/140310-earthquakes-usgs-california-faults-science