MuonSpace

Earth Intelligence for a safe and resilient world.

Presentation to NASEM CESAS March 20,2024

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Muon Space **designs, builds,** and **operates** satellite constellations for revolutionary Earth Intelligence

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100+ years of leadership across missions Small and Large, Exquisite and Agile.

Skybox, JPL, Climate Corp, Ball, Planet, Loon, Loft, Spire and more…

Jonny Dyer

CEO

- CTO, Skybox (Acquired by Google, $500M)
- Senior Director, Lyft L5
- MethaneSat Advisor

Greg Smirin

President

- CEO, Scuba Analytics
- COO, The Climate Corp (acquired by Monsanto, $1.1B)

Dan McCleese

Chief Scientist

- NASA JPL Chief Scientist
- Director, JPL Innovation Foundry
- Chair, Science Advisory Group, MethaneSat

Paul Day

VP Eng

- CPO, Loft Orbital
- PgM Lead, Apple
- Production Lead, Skybox

Tracy Morgan

VP Business Development

- Sr. Director, Sierra Nevada Corporation
- VP Programs, ManTech

Pascal Stang

CTO

- Vehicle Tech Lead, Loon
- Director AV Platform, Lyft
- Avionics Arch., Skybox

Reuben Rohrschneider

Chief Mission Architect

- Principal Sys. Eng, Ball
- Chief Engineer, MethaneSat

Kim Broadbeck

VP of People

- SVP of People, HouseCanary
- VP of People, Strava

ANDURIL · Ball · cruise · THE CLIMATE CORPORATION · Google · LOON · LOCKHEED MARTIN

lyft · NASA · planet · SPACEX · spire · SNC SIERRA NEVADA CORPORATION · Terra Bella

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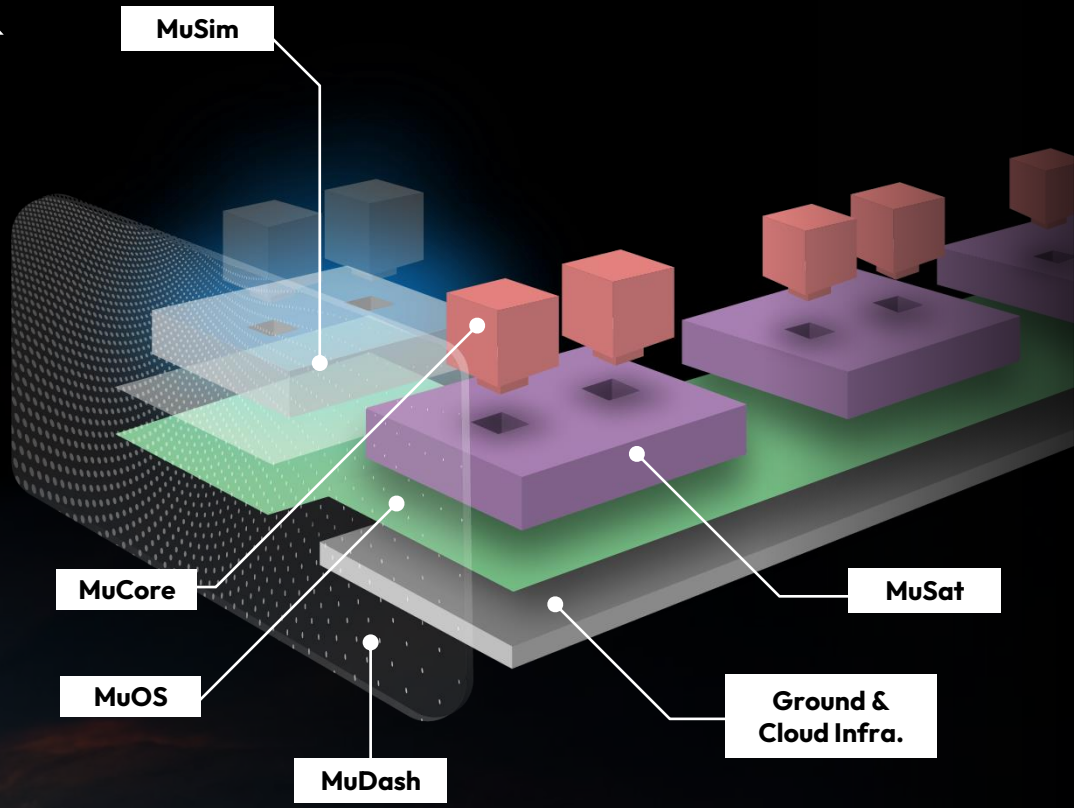
Muon's Full-Stack Constellation IP

Whole > ∑ Parts

Muon's technology replaces **people** and **paper** with tightly integrated **Simulation**, **Satellites**, **Sensors** and **Automation**.



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MuSat-2 launched March 4
<9 months after MuSat-1.

First light payload data in last week

Five Gen2 satellites booked for 2025 launch

Six Gen3 satellites booked for 2026 launch

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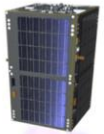
Modular spacecraft & payload platform

Common hardware & software building blocks



	MuSat gen1	MuSat gen2 (2025)	MuSat gen3 (2026)
Launch Mass	100 kg	200+ kg	500+ kg
Payload OAP	30W	200W	1kW
Data Delivery	100 GB / day	700 GB / day	2 TB / day

Costs to orbit support similar to cubesats 10 yrs ago - large constellations of capable satellites

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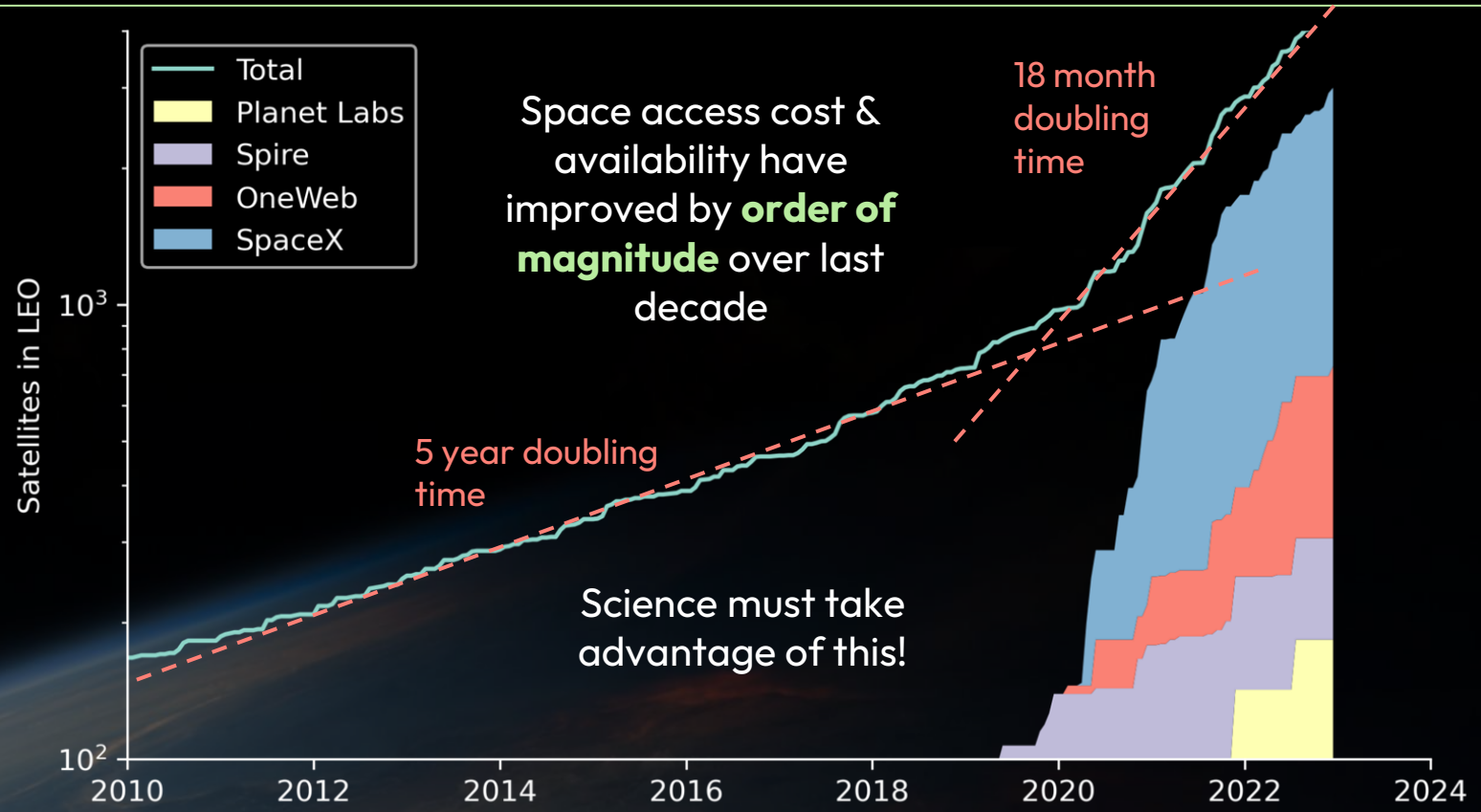
Three Opportunities

1. Space Access
2. Constellations
3. Iteration and learning rate

Access


Total
Planet Labs
Spire
OneWeb
SpaceX
Satellites in LEO
10^3
10^2
2010
2012
2014
2016
2018
2020
2022
2024
Space access cost & availability have improved by **order of magnitude** over last decade
5 year doubling time
18 month doubling time
Science must take advantage of this!

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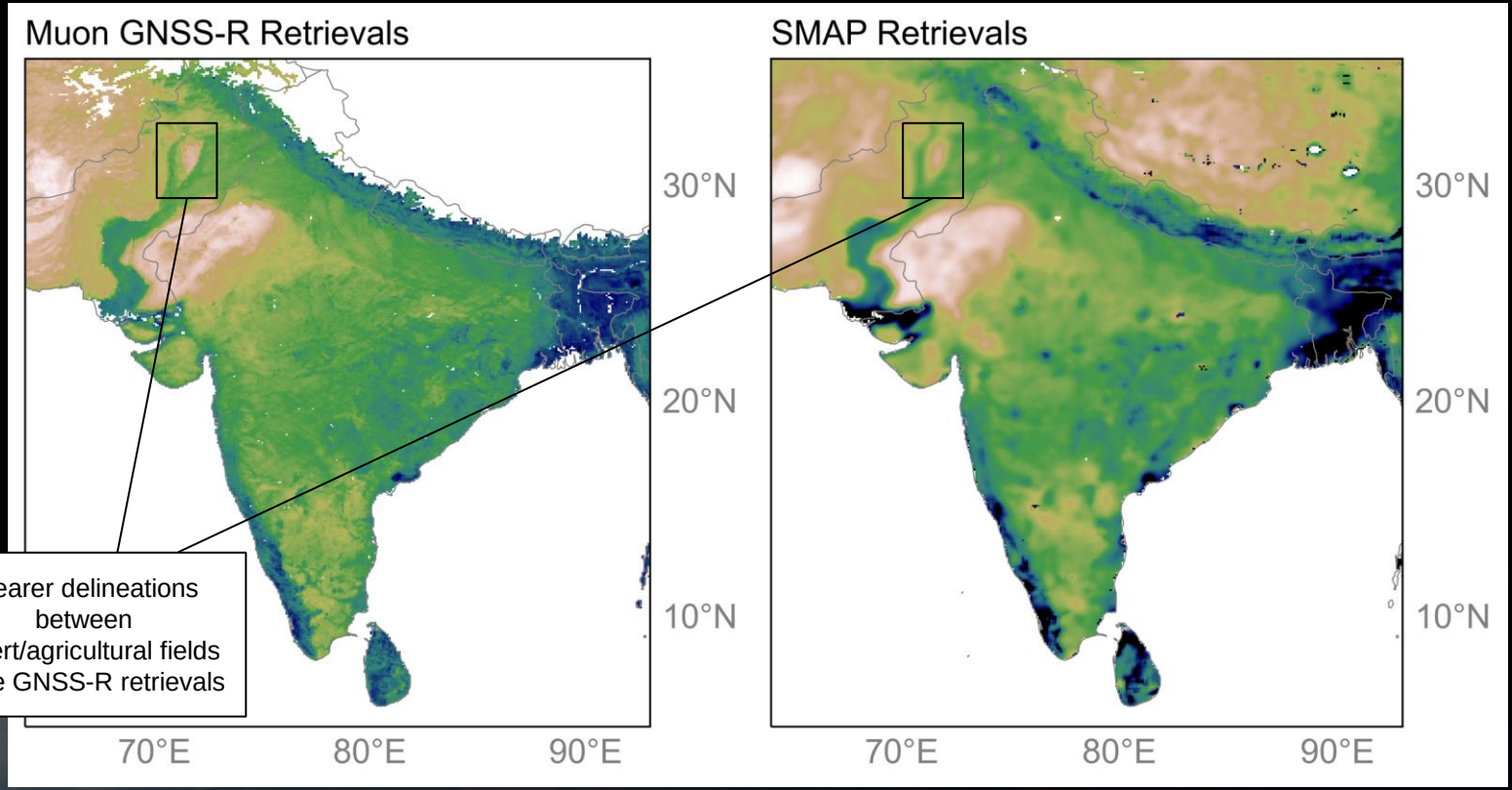
Constellations

Constellations provide unique and transformative capabilities for remote sensing

Two Examples

1. Signals of opportunity (SoOp)
2. Thermal / IR constellation for Fire

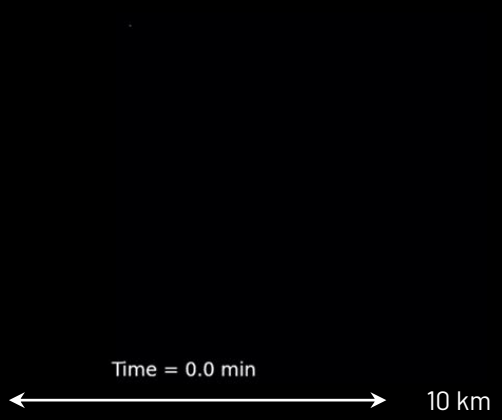
Example 1 – SoOp



(both are gridded to 9 km)

Simulated Scene Observations

Raw
Temperature,
No Delivery
Latency



Muon IR
80m (avg)
15 min

VIIRS
375m
12hr
(3hr shown)

GOES-R
2km
5 min

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Iteration and Learning

Trial and error is as essential to Science as Engineering

We now have the tools to 10x the cadence of iteration for science

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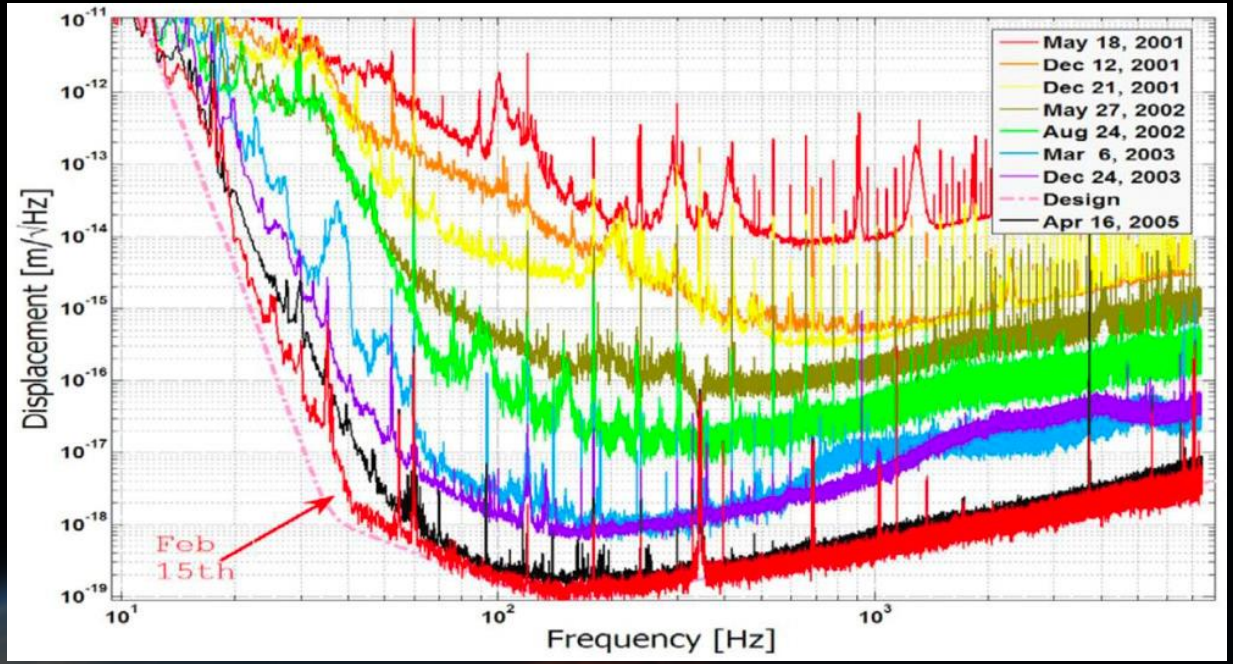
Iteration & Science



LIGO Sensitivity History

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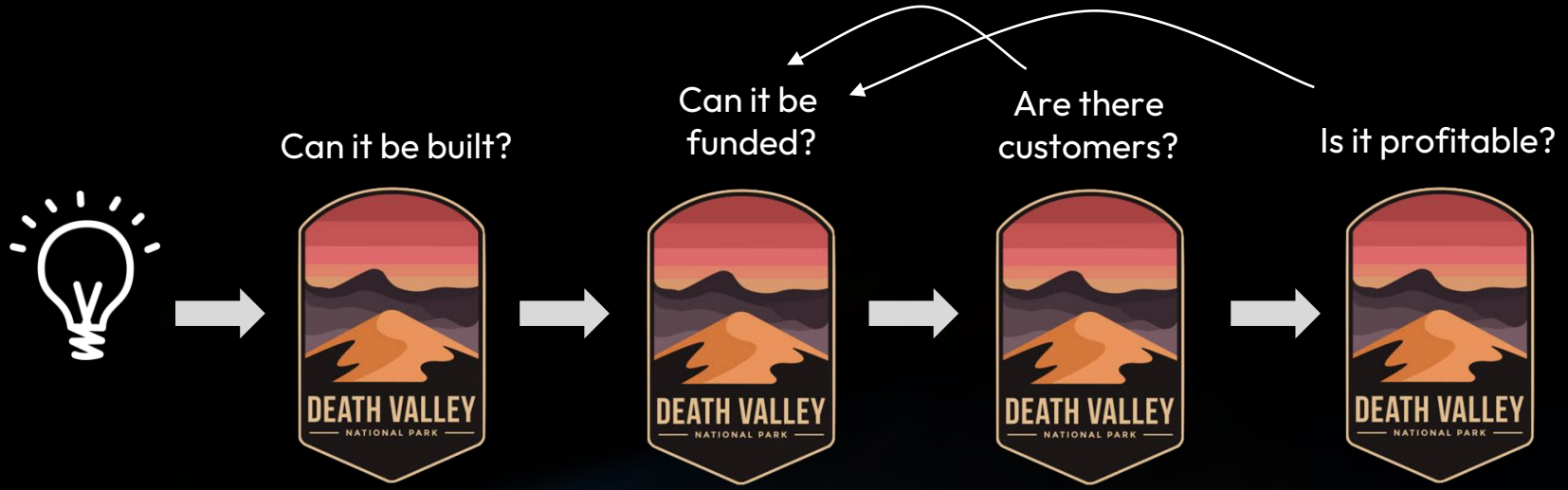
Two Challenges

1. Valleys of Death
2. Trust & Partnership

Valleys of Death



Private investment bets that these valleys can be crossed.

Public / private partnership is very powerful but only works when there is intentionality in building bridges across these valleys

Trust and Partnership

Relationship start way too late

- ➔ PI <-> Industry
- ➔ Agency <-> Suppliers

Data buy model discourages joint development & steering

- ➔ Gov side - no real mechanisms to engage meaningfully before data evaluation (at which point the choices are all made)
- ➔ Commercial side - few mechanisms to get onboarding funding in the formulation, tech development phases

Result - few/poor partnership opportunities and lack of trust

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A Success Story

NASA COTS (the linked report is really worth reading)

NASA was charged with "*stimulating commercial enterprise in space by **asking American entrepreneurs** to provide innovative, cost-effective commercial cargo and crew transportation services to the international space station*"

*NASA acted as an **investor** and **advisor** with three different and distinct companies in the space transportation industry to promote the development of U.S. space transportation capabilities on the frontier of human exploration*

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A Success Story

By virtually any measure, COTS was a huge success. What were the key elements and how could they applied to Earth and Space Sciences?

- **Paid progress milestones** during development (before flight)
  - Competed, performance-based, fixed priced milestone payments
  - Demo flights for companies that made it through dev. gates
- **Services-oriented** procurement after development
- **Commercial friendly** - allow both small and large companies to compete
- **Committed partnership** - tie funding to delivery & limit termination for convenience
- **Creative license** - Focus on specifying only mission-level requirements and not over-specing low level implementation
- **Think like an investor** - business training for NASA managers

This approach could be applied to science programs unlocking private sector innovation and investment

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Recommendations

1. Look past the current “data buys” to a **more integrated COTS-like competed procurement** for science needs
2. Find opportunities for **much earlier engagement** between science PI’s, program offices and private companies
3. Make more transparent science priorities and associated funding opportunities to **encourage private investment in the right places**
4. Establish program requirements to **evaluate alternate approaches** for science objectives