# SABER ASTRONAUTICS

*The Democratization of Space*

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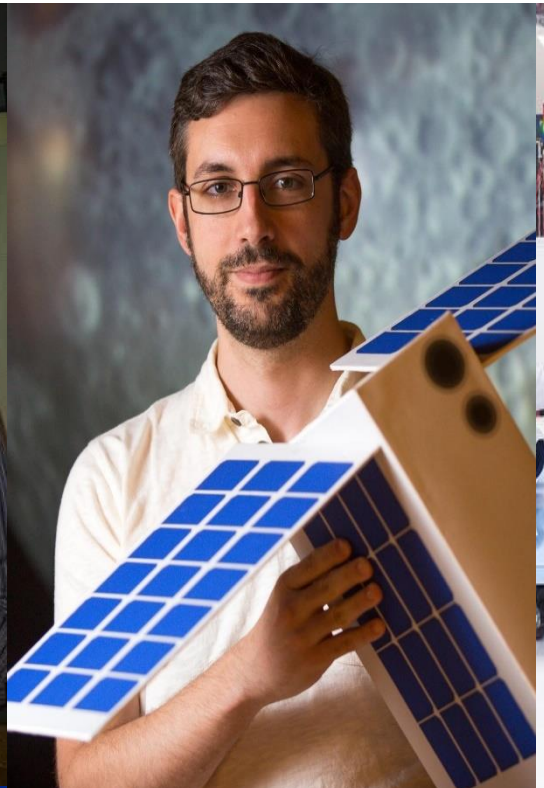
# Anyone can play

Anyone

**That means ANYONE**



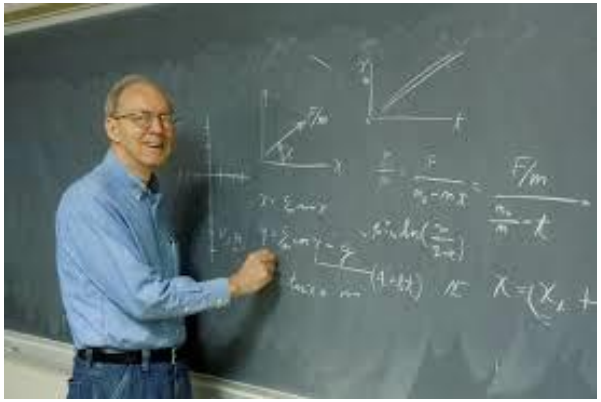
# But a traditionalist culture

1. Bespoke “gotta be smart”

+

2. Nationalistic

= Info and tech Silos



*New entrants from non-traditional space*

*Solid engineers… but no flight experience*

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# The Problem

*Goal: Keep our spacecraft alive to do its job*

# The process is like this:

*“You have to knead your own bread to make a sandwich”*

Satellite Design
Mission Planning
Dish commands
Satellite commands
Error/Alert tracking
Conjunctions
Databasing
Diagnostics
SSA

A satellite mission

# Operational Complexity - Sats

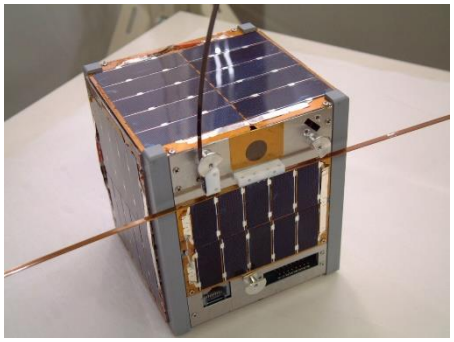
1996

NASA ACE
1600 words
760kg

2013

SkySat
10000 words
83kg

2019



1U Cubesat
50-80 words
1.2kg

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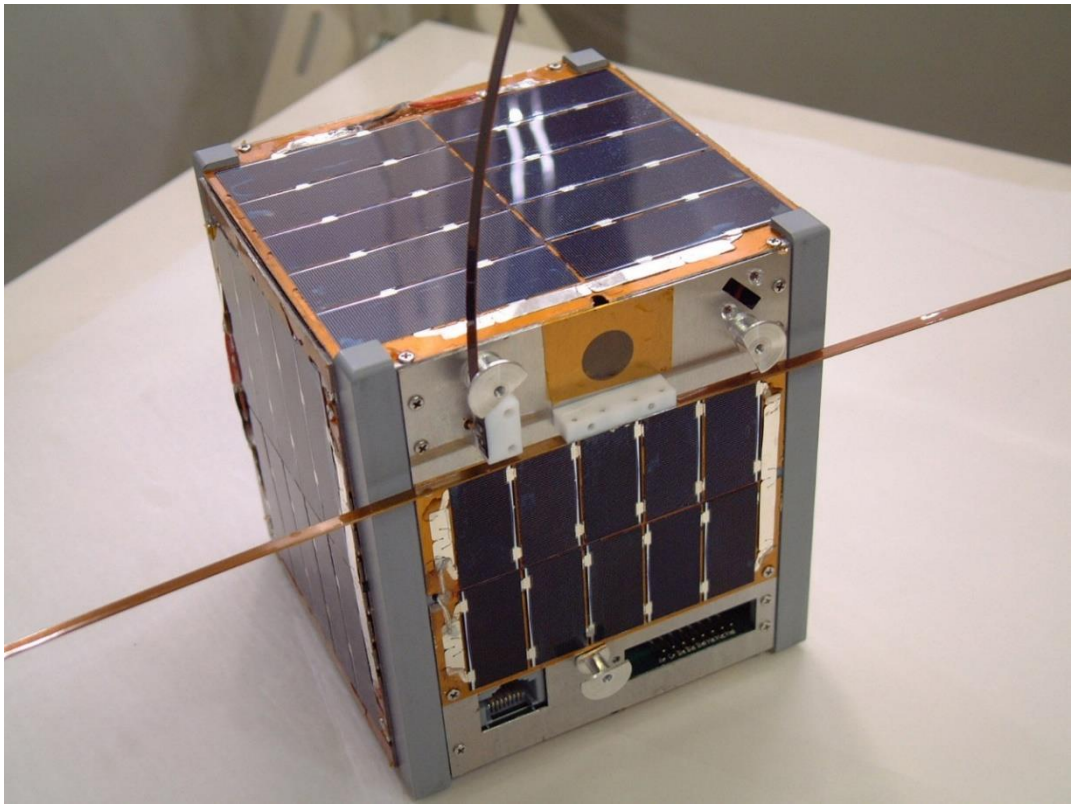
# Awareness: Diagnostics

*Because every minute of satellite downtime is millions in lost revenue*

**A single CubeSat: 100 sensors, infinite problems**



**What caused the damage?**

$2^{n(n-1)/2}$ causes

$2^{4950}$ possibilities!

**Okay, lets just say "infinite and move on"**

# Now multiply that by 100

# Operational Complexity - MCC

Taking advantage of Moore's Law



Situational Awareness

FDIR
Space Wx
Orbit Analysis
Conjunction

Mission Ops

Maneuvers
Macros
Approval
Execution

SATCOM

Dish Control
Link Budget
Link Analysis
Transmission

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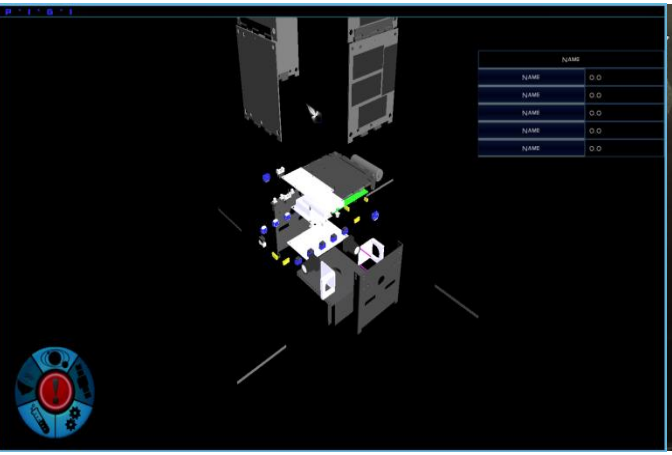
# MISSION SOFTWARE

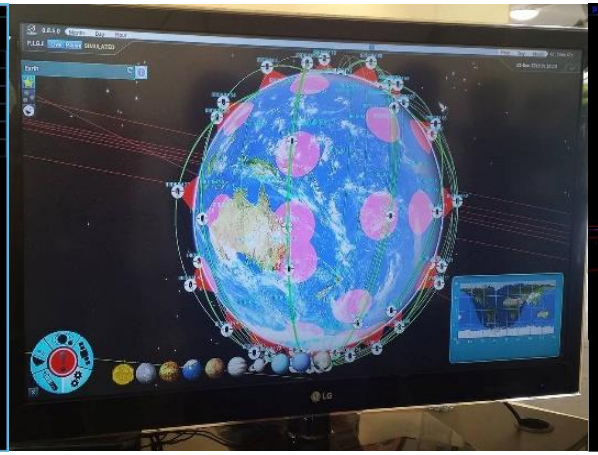
# Mission Ops: Software (PIGI)

Make Space as easy as driving a car

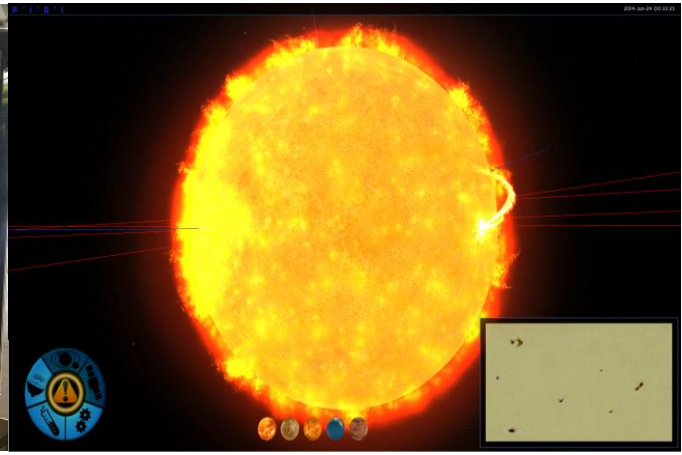
Point and Click Ops



Large Constellations



Integrated Space Weather



**Easy to Train**
**Situationally Aware**
**Operate more satellites with fewer people**

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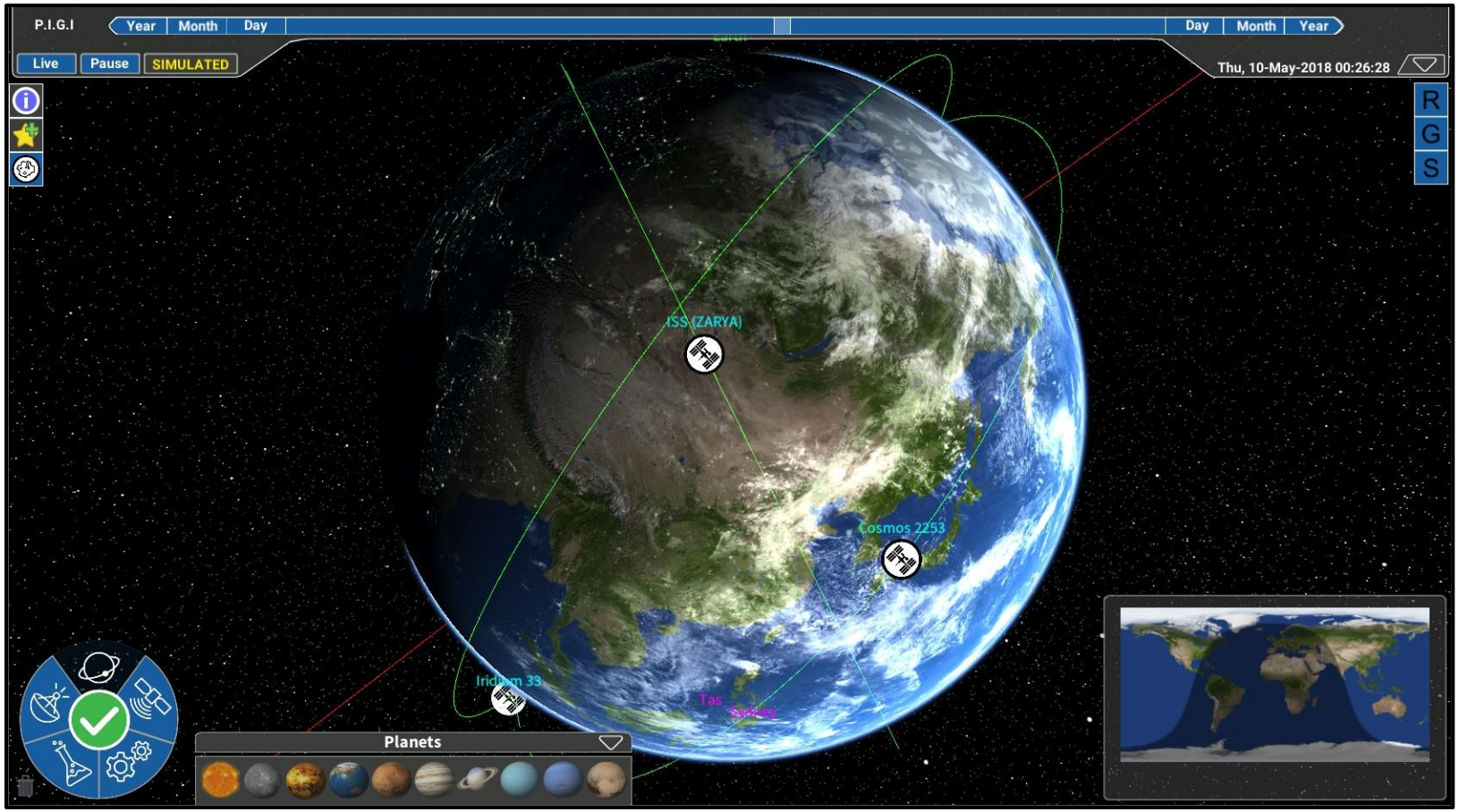
# A Single Unified Interface



# “Space Cockpit”

US DoD application of PIGI

$2m contracts from USAF

Integrate data streams for SSA

Experiments for PIGI in Virtual Reality space ops

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# AWARENESS

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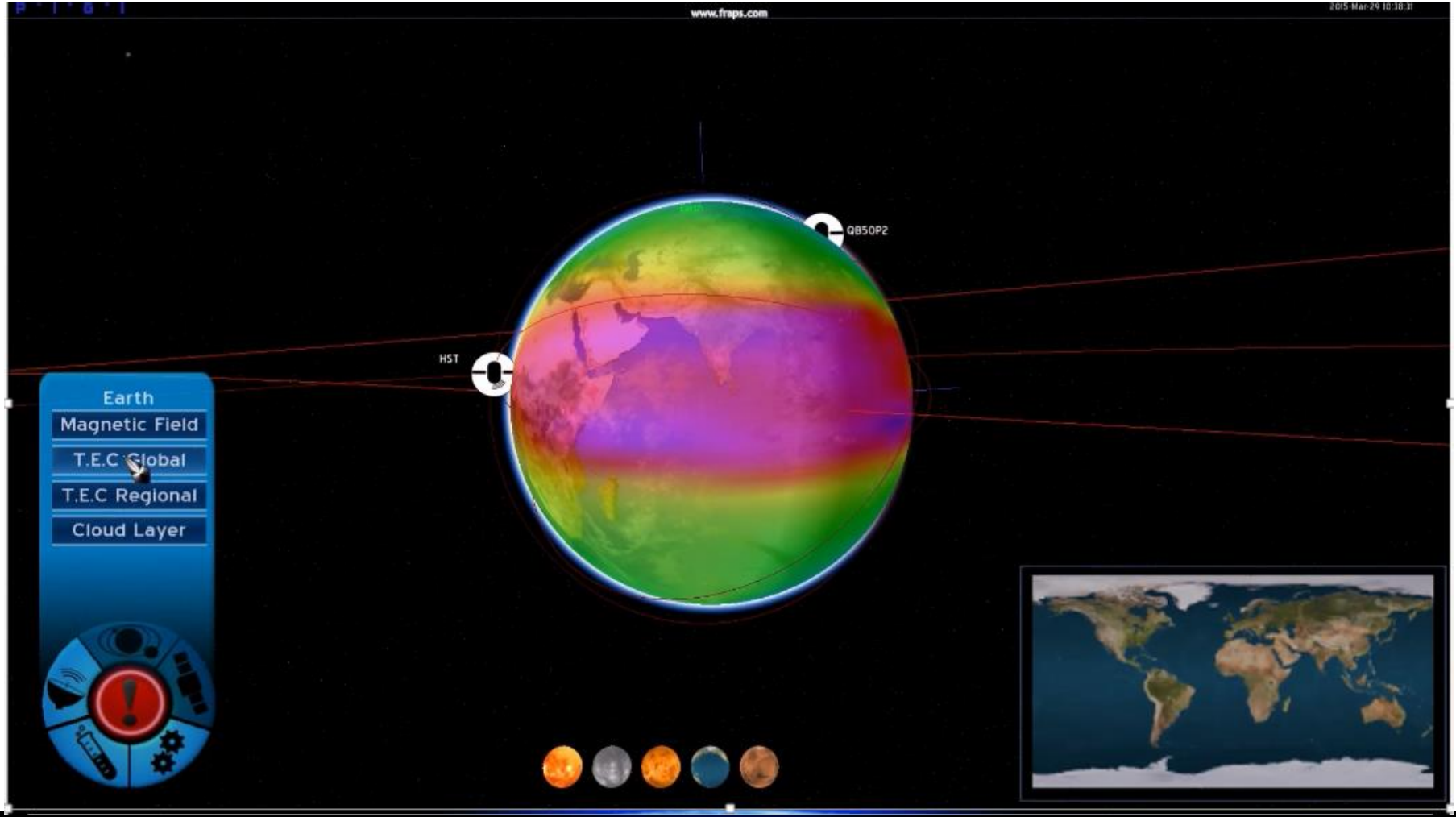
# Space Weather



# Space Wx prediction example

*saberdata.space*

- Use Cases

  Satellite Diagnostics

  SATCOM

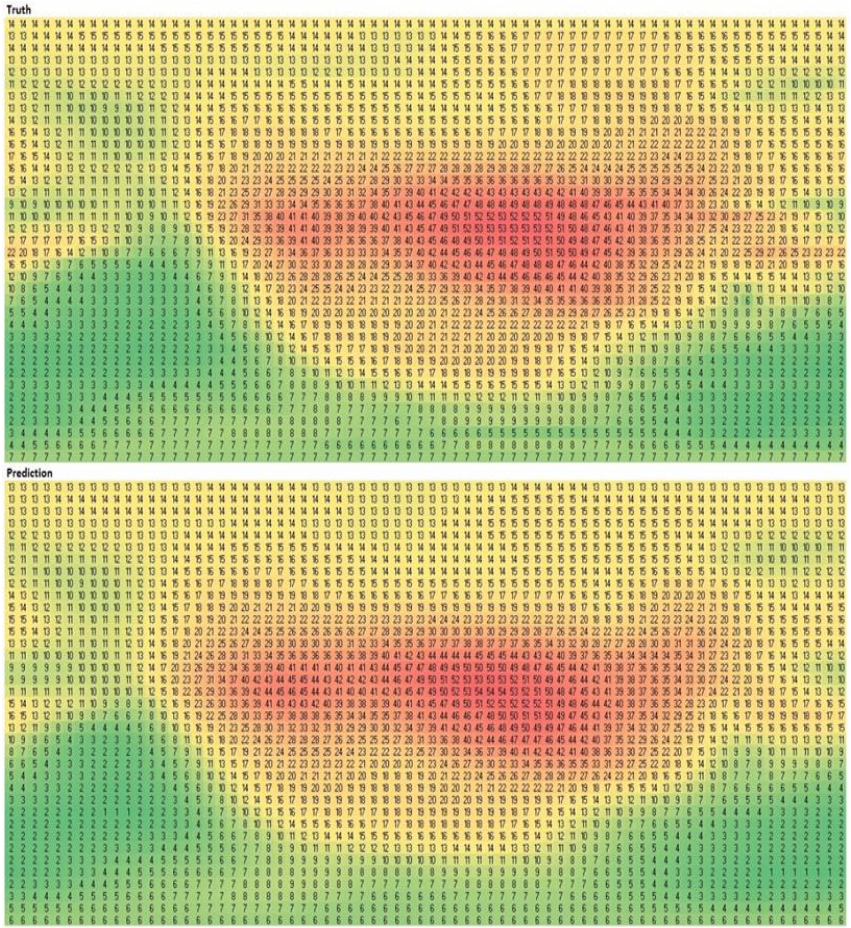
  ADF

- Space Weather integration module

  Predict 1-3 hours ahead

  Accuracy 92%-94% (e-)

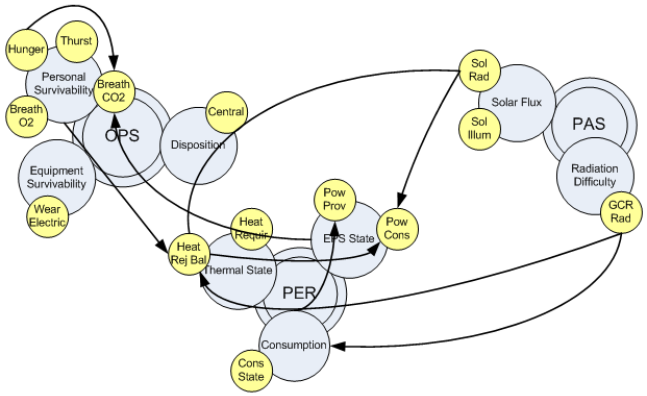
  Gap filling NASA ACE & DISCOVR

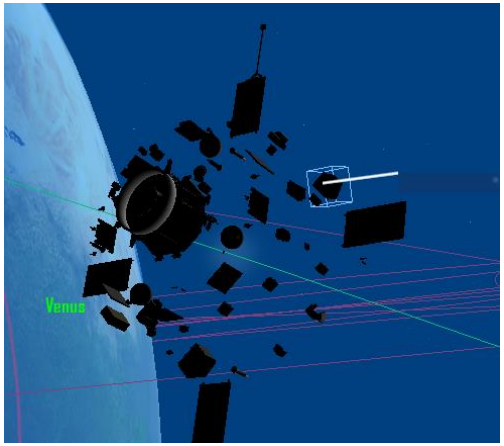


# Awareness: AI Diagnostics

*A decade of machine learning heritage*





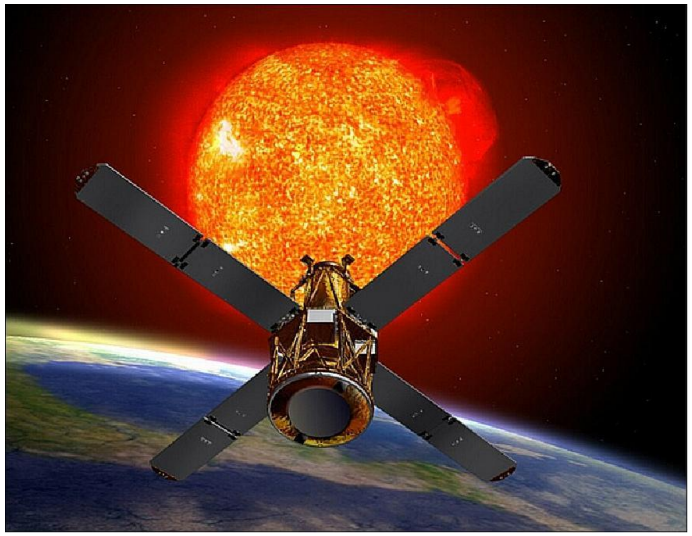



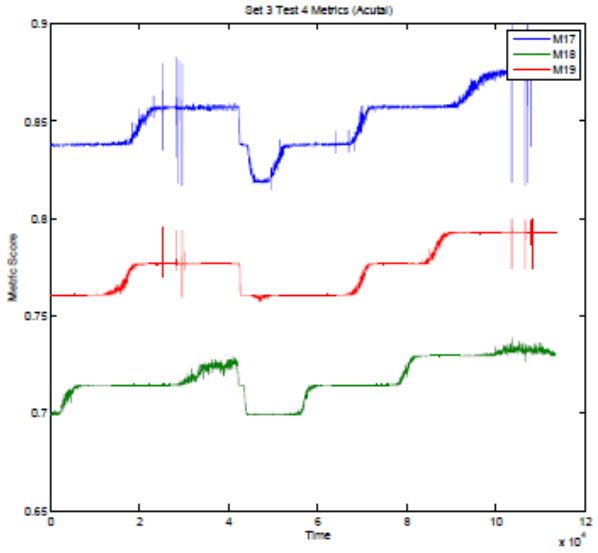
# Awareness: AI Diagnostics

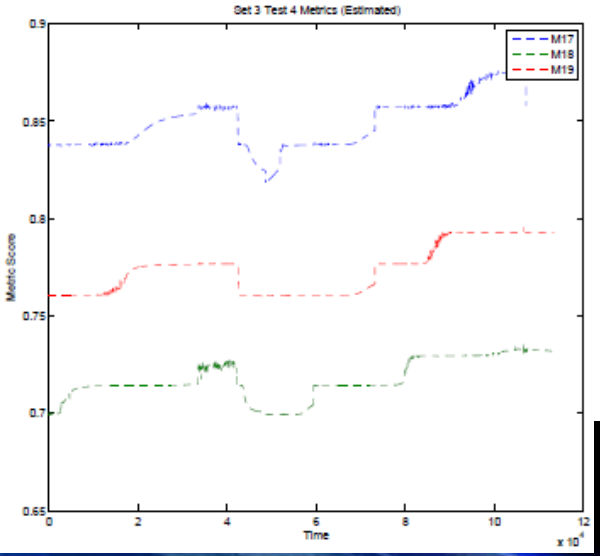
## Model cause-and-effect

- Spacecraft Telemetry (Customer)
- Space weather (NOAA/SEC)
- Operational parameters

***Time Invariant general solution***
***92-98% accuracies***
***Lasts for years***



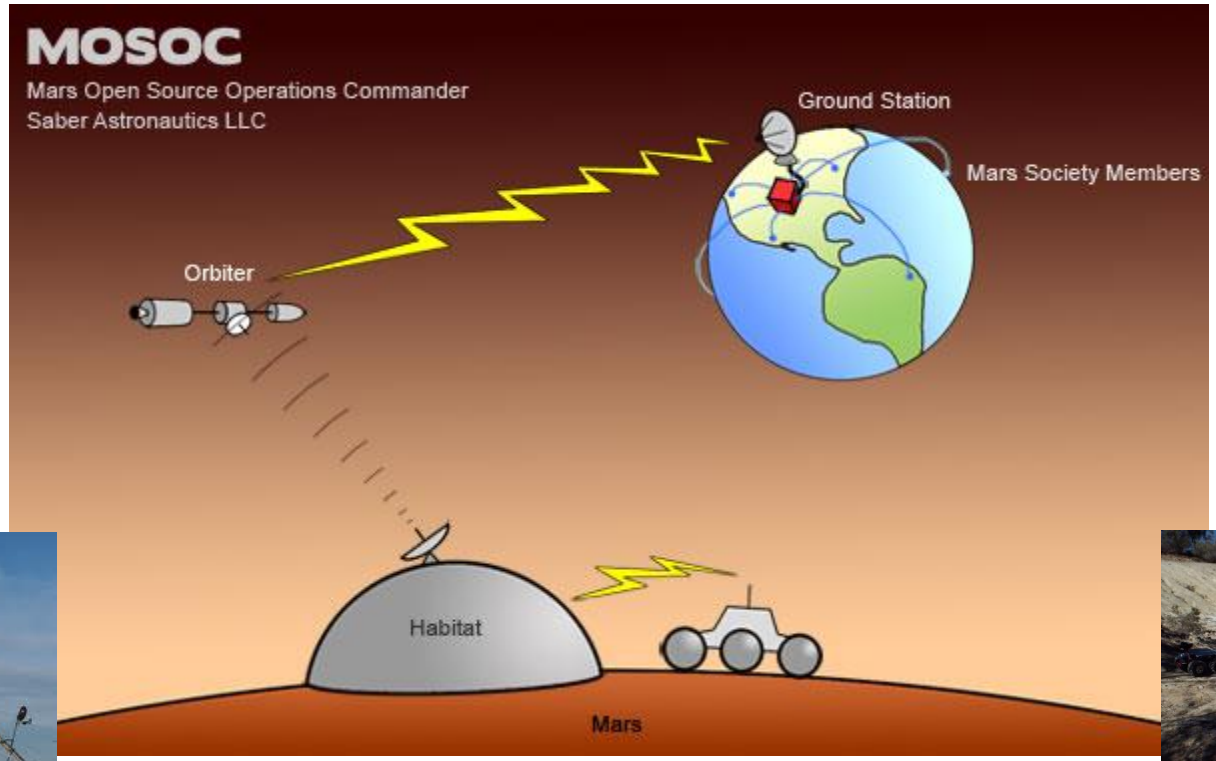


# Mars base integration

*Mars base trial with Saber as the MCC*

Sensors on people, rovers, and systems
Machine learning model to detect damage in all as a complete system




Habcom

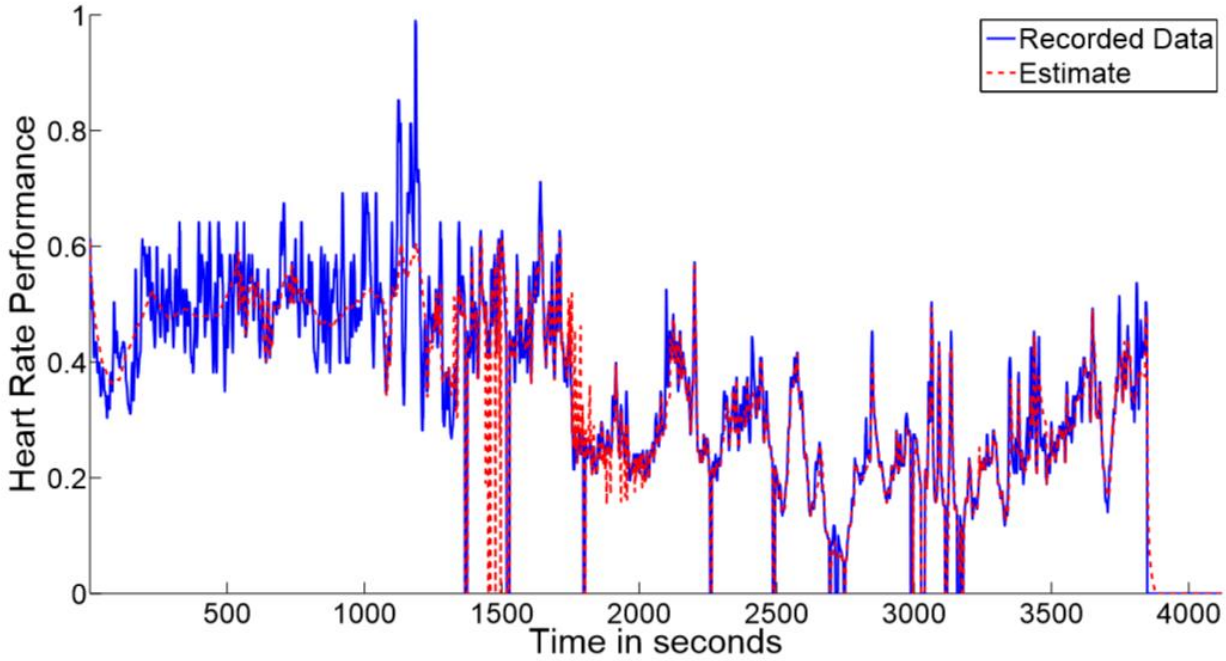
EVA

# Heart Rate modeling

Model is able to detect heart rate model based on performance of the rovers

Detected an actual event (asthma attack) and the recovery from live field data

Applications to astronaut safety and long duration risk mitigation



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# SENSORS

# Signals Intelligence

*Detecting damage in electronic signals*

## **RAAF** EW Signals Threat Identification

- Used machine learning to detect degradation of signal
- Application mitigating ionospheric scintillation, GPS, SATCOM
- Predict outages
- Tested in Field conditions ☺

# Data Fusion

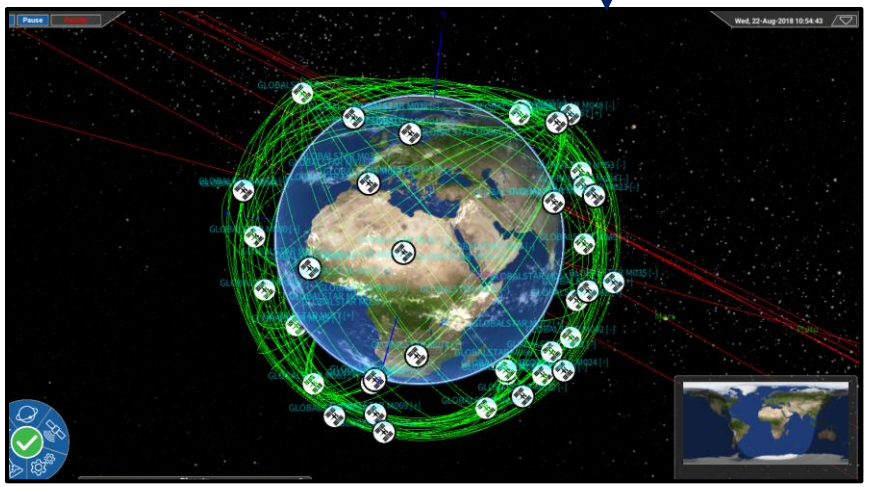
*We do the software, you bring the hardware*

## Data Fusion for SSA sensors

Telescope APIs

Radar plug-ins

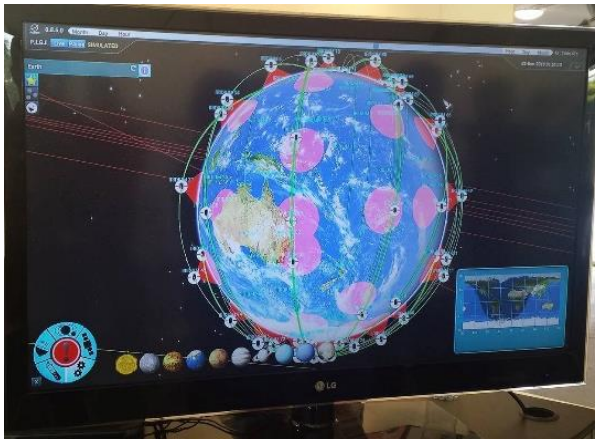
Conjunction Engine



# Responsive Space Ops (RSOC)

*Integration of Ops + Intelligence + Sensors*

## Mission Design

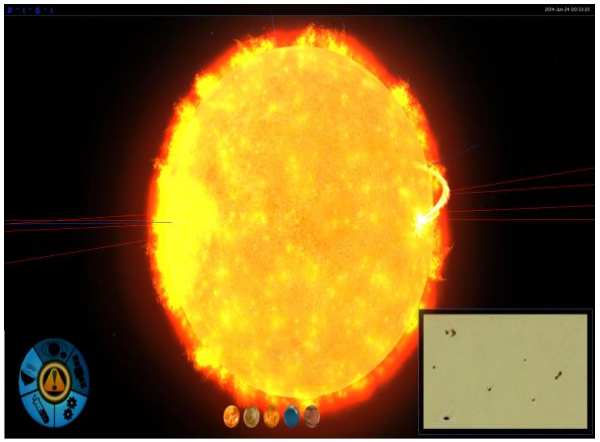


Large constellations
Spectrum allocation
Business planning

## Live Operations

25-dish network
World class automation

## Analytics



SSA
Live data feed