



THE NORTHSTAR SYSTEM: A NEW ERA IN EARTH OBSERVATION

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WHY NORTHSTAR? WHY NOW?

NORTHSTAR

NORTHSTAR



Global challenges
Limited solutions



Measure and monitor

Increase Awareness

Timely, rich, precise
knowledge



Sustainable Future
Resource management

DEMANDS OUTSTRIPPING ANSWERS

COORDINATED EFFECTIVE ACTION PLANS



MOTIVATION FOR NORTHSTAR

Need for remote sensing of the Earth is growing more urgent

- Global population will reach 10 billion by mid-century
- Food supplies must increase by 70% while arable land is getting more scarce
- 4 billion people will live in conditions of significant water stress

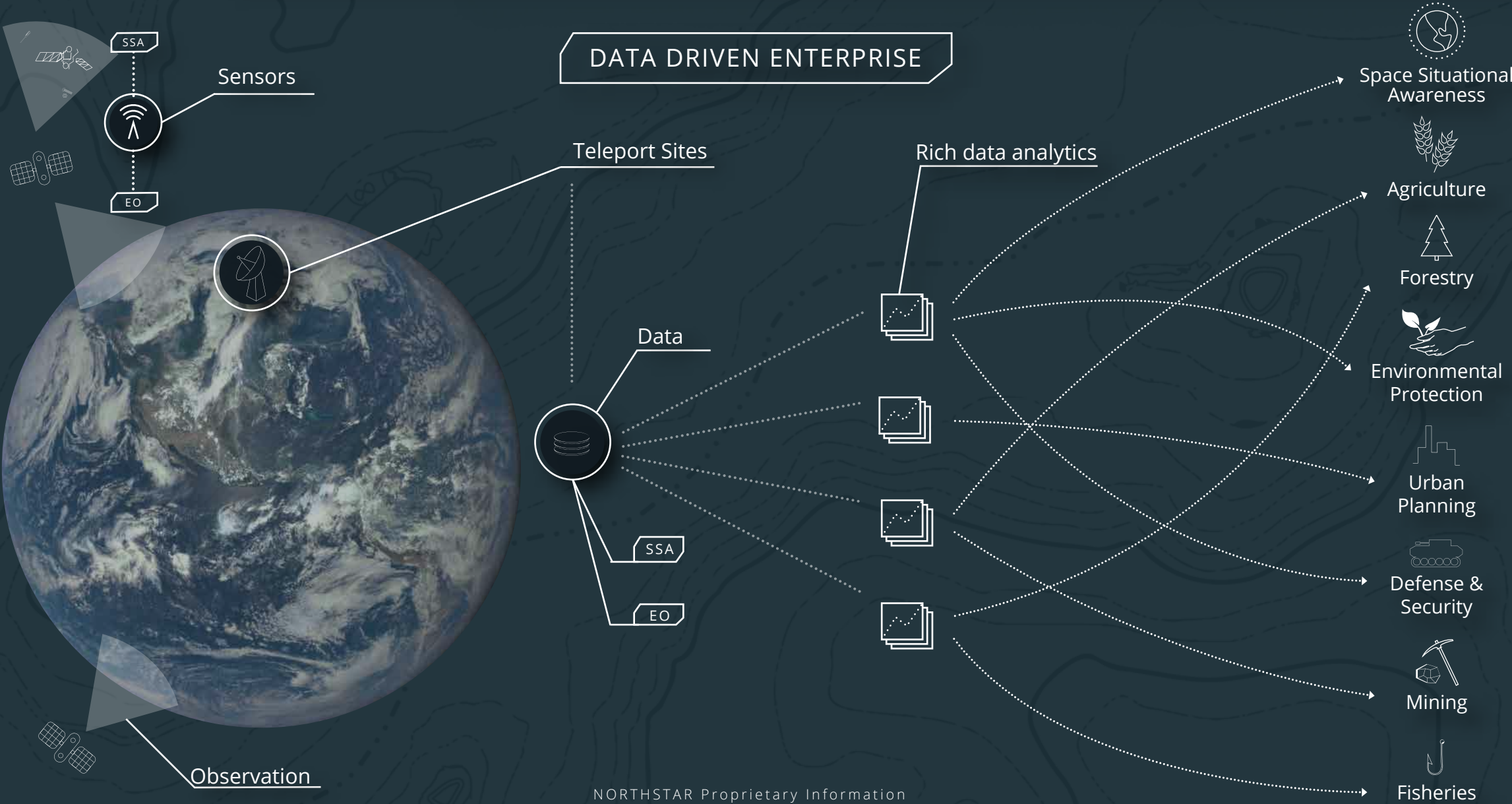
Requirements are getting more demanding

- Global coverage
- More frequent updates
- Richer content
- Directly relevant, actionable information

Current and other planned systems do not meet all these needs

EARTH INFORMATION & INTELLIGENCE

NORTHSTAR



EARTH INFORMATION & INTELLIGENCE

TRADITIONAL OBSERVATION



Low spatial resolution

Minimal spectral resolution

Poor temporal resolution

Limited data analysis possible

Uncertain decisions



NORTHSTAR EI²

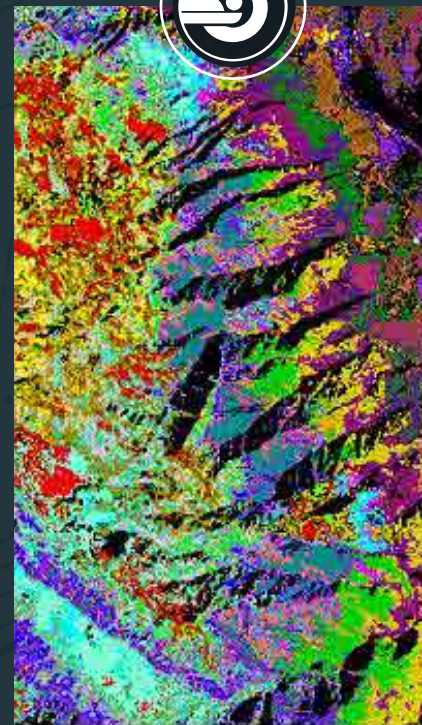


High spatial resolution

Full hyperspectral imagery

Frequent revisit intervals
(High temporal resolution)

Clear action plans





WHAT IS NORTHSTAR?

A complex System of Systems to produce suites of high quality, market-specific information products derived from remote sensing data

- Generate our own unique data
- Data fusion and analytics with other sources

A commercial enterprise based from the very outset on thoroughly researched requirements from NorthStar's potential customers obtained through Voice of the Customer Analyses

- Oil & Gas, mining, forestry, water management, agriculture, insurance, civil government organizations, defense and intelligence

Includes an optical sensor on the zenith deck supporting a Space Situational Awareness mission [tracking orbital debris and events in near-Earth space]

SYSTEM FEATURES

MULTIPLE INDEPENDENT REVENUE STREAMS

SSA

Space object tracking

EO

Agriculture

Forestry

Environmental protection

Urban Planning

Defence & Security

Mining

Fisheries

INFRASTRUCTURE

Sensors

Data Centre

AGILE Centres

Teleport Sites

SOC

KEY DESIGN DRIVERS

Customers require frequent revisits (hours to days, not days to weeks)

→ Mission cannot be accomplished with one or a small number of satellites

Customers require deeper information content

→ Hyperspectral [HS] sensors must be involved

→ HS sensor → High SNR → Large aperture optics

→ Mission requires larger satellites

Customers require detailed, relevant, actionable information

→ Imagery not enough; analytics tailored to specific markets necessary

NorthStar design:

- Constellation of 40 satellites hosting hyperspectral, thermal IR, and optical sensors
- Ground support infrastructure including high northern latitudes
- Primary Data Center and business operations headquartered in Montreal, QC
- Remote application development centers around the globe



KEY ENGINEERING CHALLENGES

For Hyperspectral sensors in particular, “SNR is king”

System must achieve high SNR, high revisit rates with and an acceptable GSD

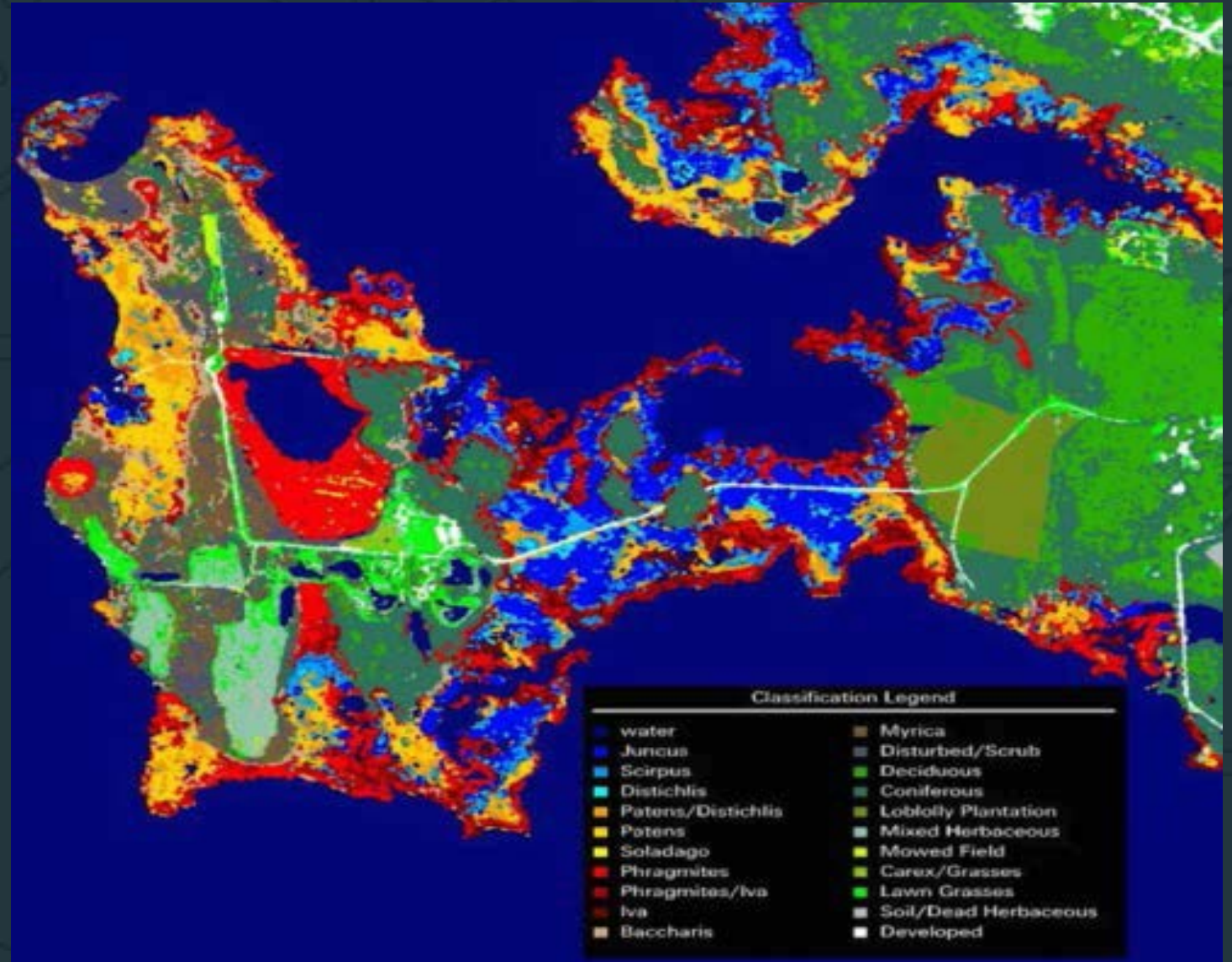
- Orbit altitude must support all three parameters

Baseline targets

- Orbit altitude of 550 km
- GSD of 8 to 10 m
- 6 deg FOV yielding ~ 60 km swath width
- Min HS SNR of 300 with goal of 400 across band from 400 to 2400 μm

Wetland Vegetation Mapping

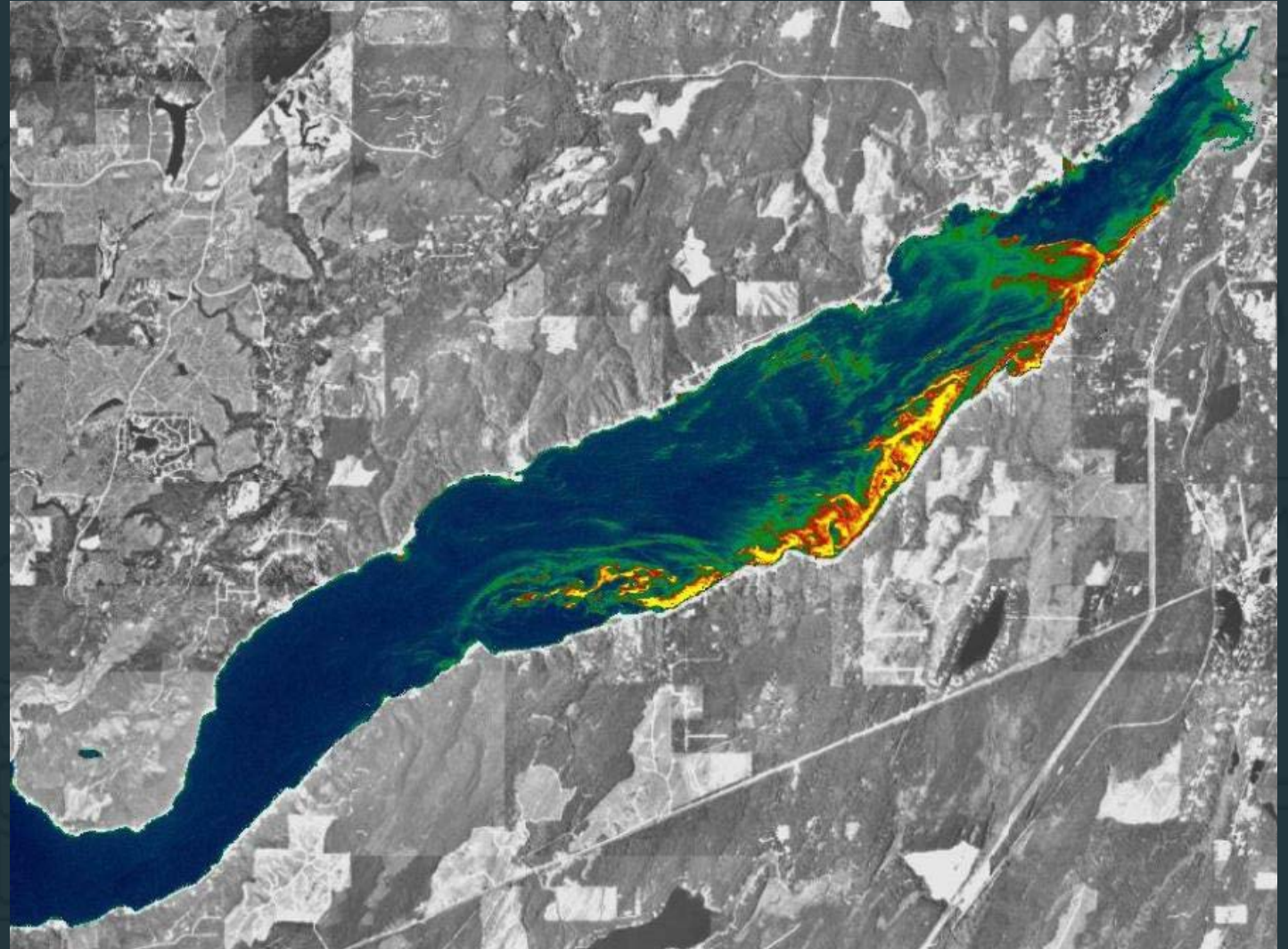
- Environmental stress
- Flood prediction model
- Biomass and speciation



NORTHSTAR PRODUCT EXAMPLES

Water Quality

- Relative water quality status (e.g., eutrophication)
- Absolute constituent concentrations (chlorophyll and turbidity)
- Coral reef and littoral zone mapping and characterization

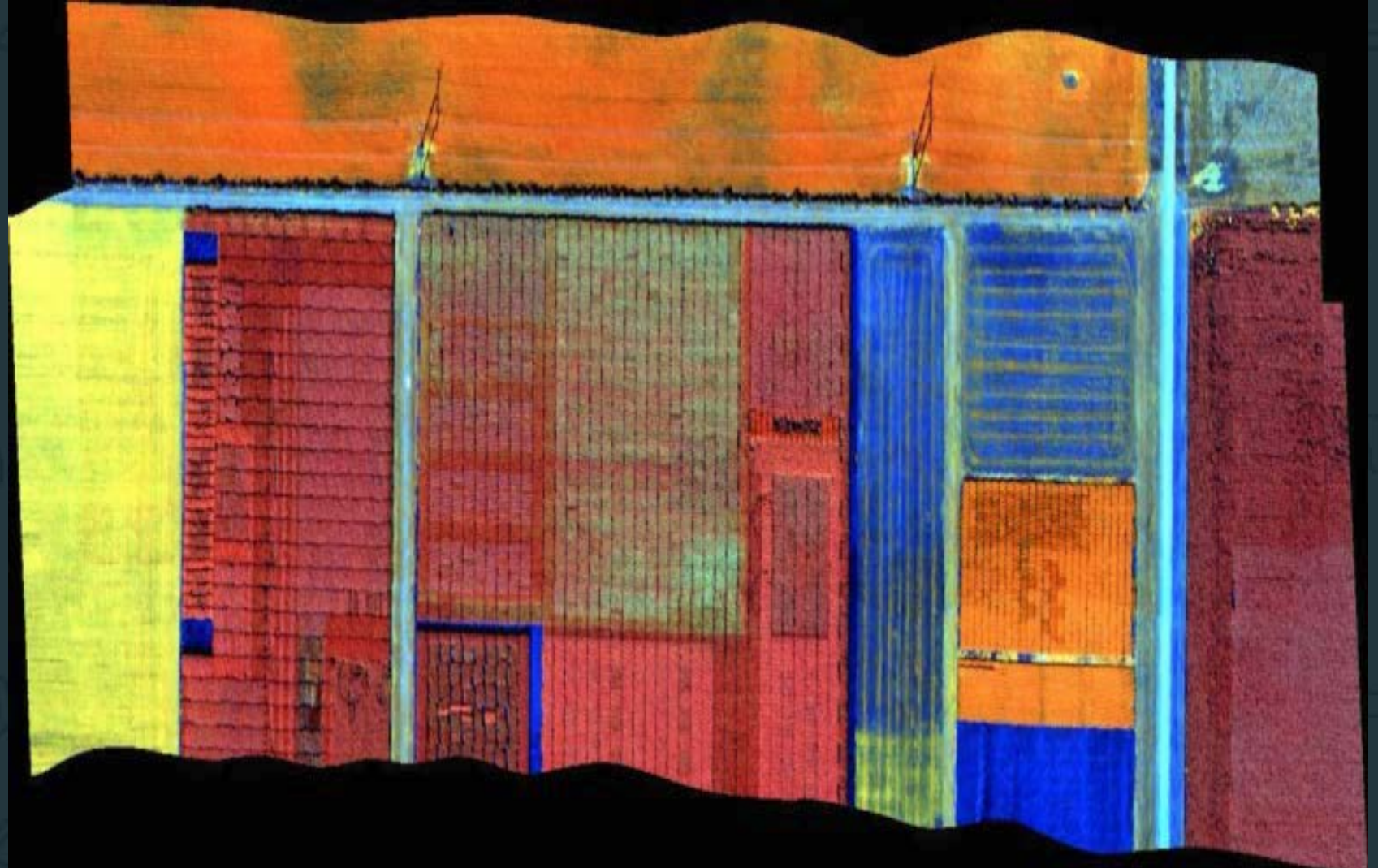




NORTHSTAR PRODUCT EXAMPLES

Agriculture

- Stress monitoring
- Seed stock tracking
- Precision treatment
- Plant moisture
- Production cycles
- Photochemistry indices
- Fertilizer content
- Predictive modeling
- Yield analysis
- Crop damage/insurance



NORTHSTAR PRODUCT EXAMPLES

Forestry

- Forest damage/disturbance
- Fire fuels modeling
- Forest health and stress
- Species inventory
- Fire detection and tracking





SPACE SITUATIONAL AWARENESS

COMPREHENSIVE KNOWLEDGE OF THE POPULATION OF SPACE OBJECTS

Valuable Space Assets

(\$ Billions)

IRIDIUM 33

Conjunction Analysis

Track space debris
and manage space
assets

Space debris

600,000
classified
objects >1 cm

COSMOS 2251



Several major components to the ground system

- Satellite Operations Center [Montreal]
- Data Center [Montreal]
- Remote AGILE Centers [Worldwide]
- Telemetry, Tracking and Control (TTAC) sites for downlinks [Far Northern latitudes]

Data Center

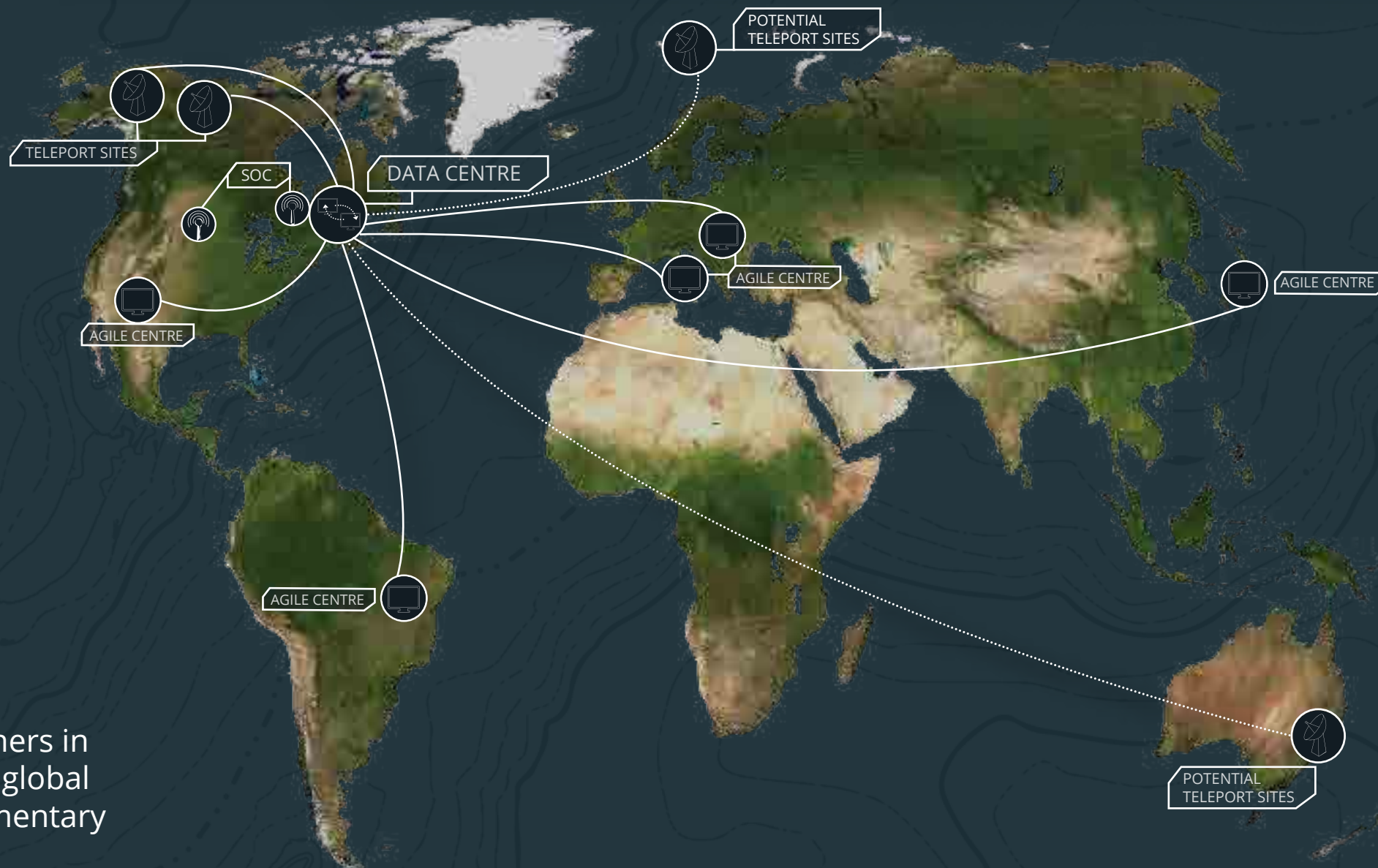
- Owned facilities desirable from a control and data security aspect, but are costly in capital expense and maintenance
- Several commercial operations (e.g., Amazon Web Services) offer scalable, on demand architectures supporting Big Data operations with security certifications acceptable to US DoD and others

AGILE Centers

- “Applications for Global Innovation and Leadership” is a concept to make access to NorthStar data accessible to potential developers and resellers around the globe
- Individuals and organizations can develop their own applications for market areas they are either building or already servicing
- Partners can access NS data, perform their processing, develop targeted information products, and distribute those products to their customer base



NORTHSTAR – A GLOBAL ENTERPRISE



World class partners in
SSA and EO with global
reach & complementary
expertise

- NorthStar addresses major gaps in current / planned Earth Observation satellite systems, as well as adding a unique and groundbreaking addition to SSA
- Constellation of 40 satellites
 - Has Hyperspectral and MS/Thermal IR sensors, and Optical (SSA)
 - Unrivalled revisit times; strong SNR, swath width, GSD
- Key point is Actionable Information Delivery to a Diverse Global Client Base
 - Image Analytics
 - AGILE Centres
 - Applications development in energy, agriculture, forestry, water, mining, defense, etc.
 - **Client Driven**



NORTHSTAR

EMPOWERING HUMANITY TO PRESERVE OUR PLANET
