constellr
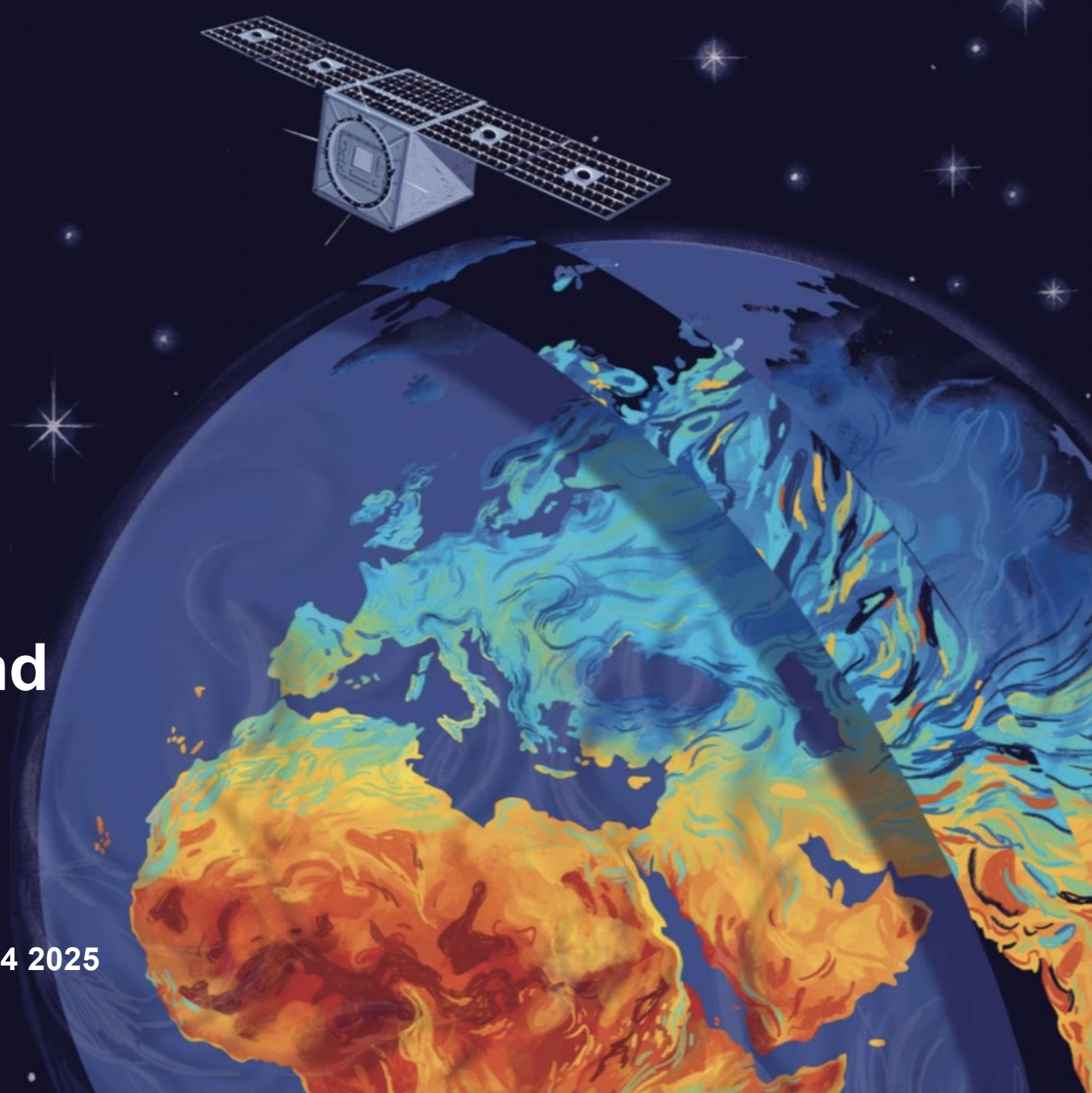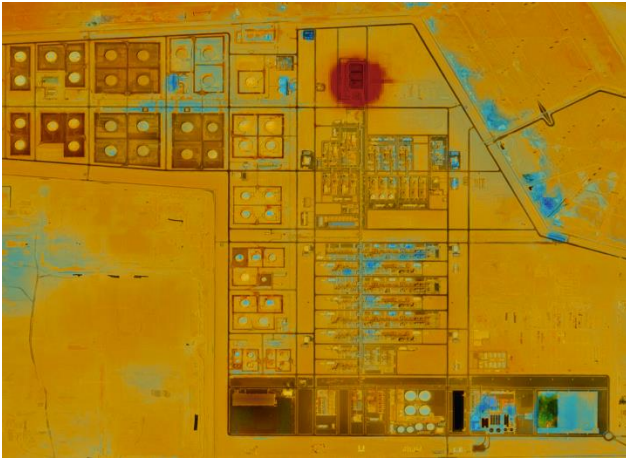
constellr … thermal intelligence, products and usecases

Andreas Brunn | Daniel Spengler | ISPRA | Sept 04 2025
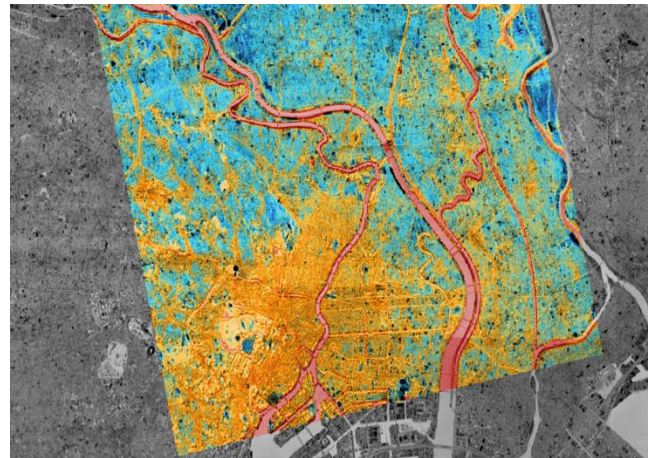
Thermal Intelligence - the new sensing layer for change detection

Detect anomalies before they escalate

➢ Overheating, leakage, and energy loss often go unnoticed until it's too late
➢ Infrastructure failures in power, water, and defense systems result in costly disruptions and security risks

Reliable 24/7 data including nighttime*

➢ Most satellite systems can't provide reliable data after sundown
➢ Enables persistent monitoring around the clock with insights at critical moments of the day

Surface insights, not just images
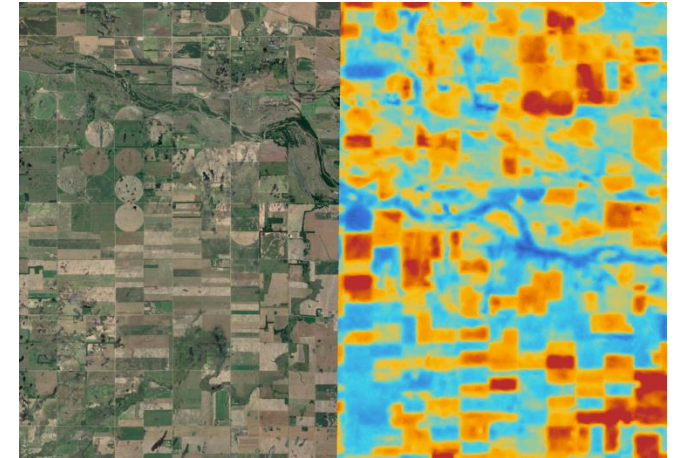
➢ Optical imagery captures how things look - but not how they function
➢ Leaders lack actionable insight into hidden stress across farmland, cities, and supply chains

*First light, uncalibrated image of HiVE, Tokio in Q1 2025

Cross-Domain capabilities enabled by constellr

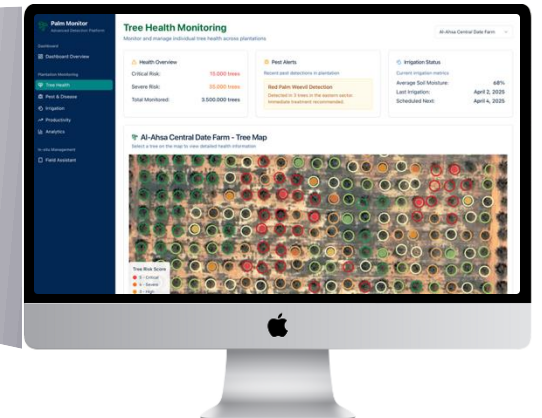**From defense intelligence to food security, from infrastructure protection to planetary resilience…**
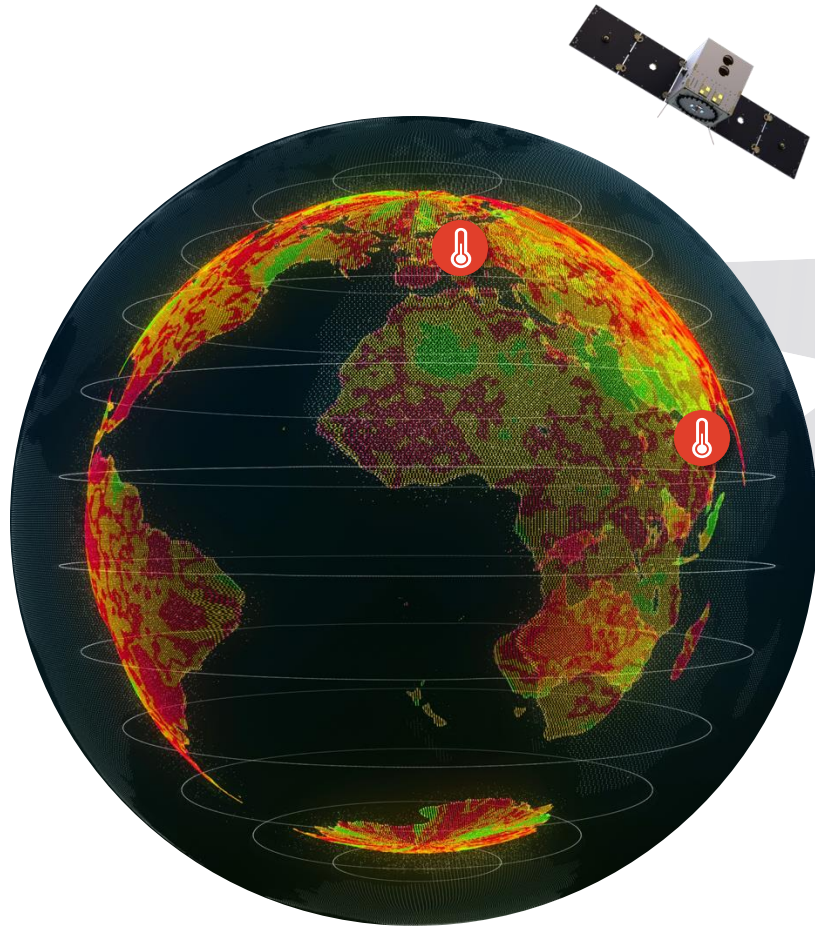
Security & Defense

Reveal industrial activity day and night, monitor critical infrastructure, and support early warning.

Agriculture

Detect crop stress 10-14 days before visual symptoms emerge, enabling early intervention.

More insights powered by constellr

Infrastructure

Detect power plant anomalies before damages & outages occur

Urban Planning

Map urban heat islands & cooling performance at the block-level

Logistics

Monitor road navigability, pipeline flux, and heat-related rail disruption

Supply Chain

Forecast yield & regional crop risk to inform procurement and pricing decisions

Thermal remote-sensing for environmental monitoring

4
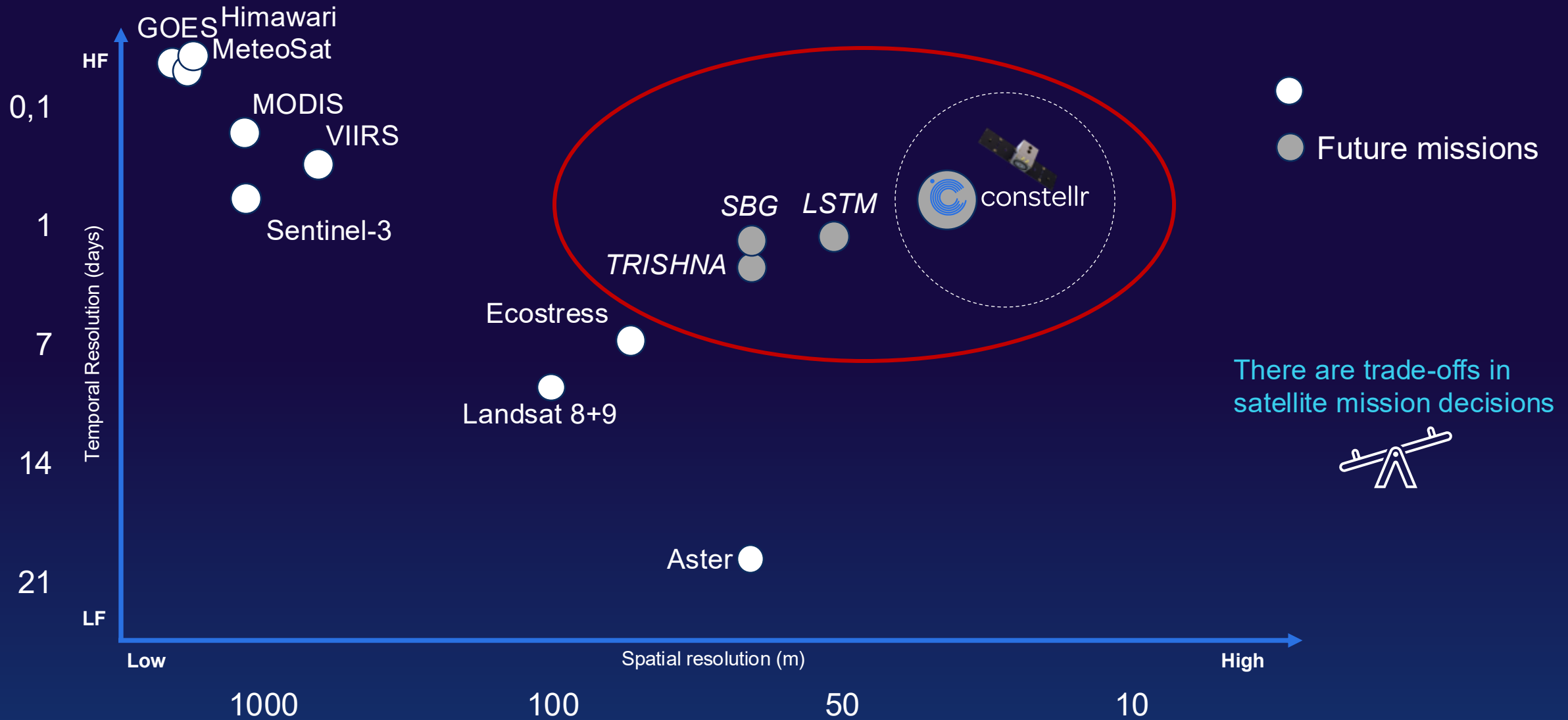
High-Precision Versatile Ecosphere Monitoring Mission (HiVE)

HiVE consists of a constellation of Thermal Infrared Satellites

Status	Launch: FM1 Jan 2025, FM2 Jul 25
Orbit	SSO, 540 km, LTDN 10:30 pm / 1:30PM
Technology	**Cryo-cooled**, four-band LWIR 10 band MS VNIR
Revisit time	From 4 days (1 sat) to daily (5 sat)
Swath	**18.5 km LWIR** / 20km VNIR
GSD (nadir)	**30 m LWIR** / 10 m VNIR
Field of regard	600 km (by pointing off-nadir)
NEDT	30 mK
L2 LST uncertainty	**< 2.0 K**
Total Mass	~ 120 kg

Bands

| Instrument	# of bands	Wavelength range (μm)	Synergy to other missions
VNIR	10	Multispectral 0.44 – 0.94	Sentinel-2
LWIR	4	8.6 (c) – 0.3 FWHM 9.2 (c) – 0.3 FWHM 10.6 (c) – 0.5 FWHM 11.75 (c) – 0.5 FWHM	LSTM+TRISHNA (aligned) LSTM (aligned) LSTM+TRISHNA (slightly shifted) LSTM+TRISHNA (slightly shifted)
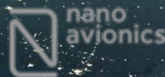
Platform rendering © NanoAvionics (2023)

OHB Fraunhofer KONGSBERG nano avionics EXOLAUNCH

eesa European Innovation Council

Scalable high-resolution surface temperature data has been inaccessible – until now!

Regional insights

Public Data

Proprietary Data
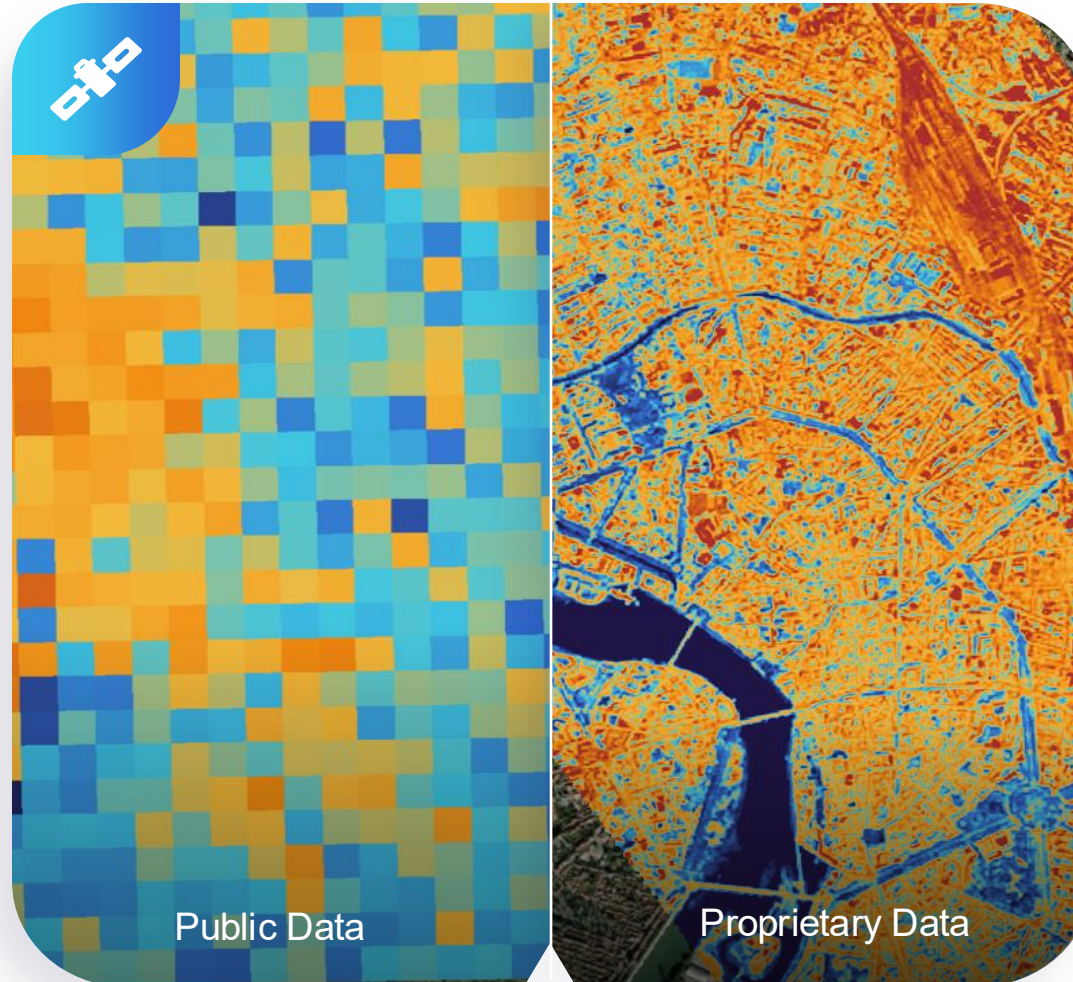
Field level intelligence

Product portfolio: constellr 2025 product offerings

LST*fusion*

- 30m spatial resolution
- Fused data sources
- Large area coverage
- Daily data availability
- Time-series ready

for reliable large scale monitoring
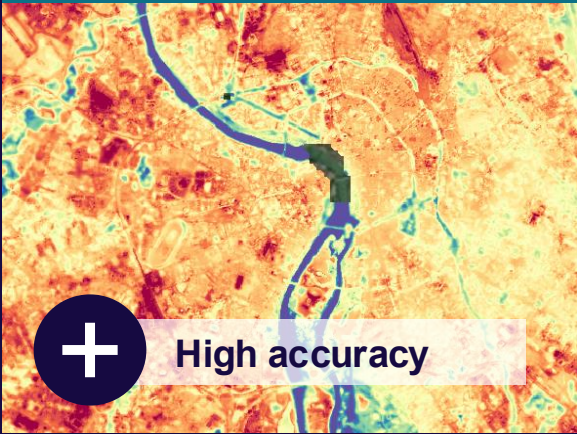
+ Large coverage & continuity

LST*precision*

- 30m native resolution
- Proprietary data
- High temperature sensitivity
- up to sub-daily revisit
- Time-series ready

for high-value asset monitoring

+ High accuracy

LST*zoom*

- 10m spatial resolution
- Proprietary & complementary data – sharpened
- up to sub-daily revisit
- Time-series ready

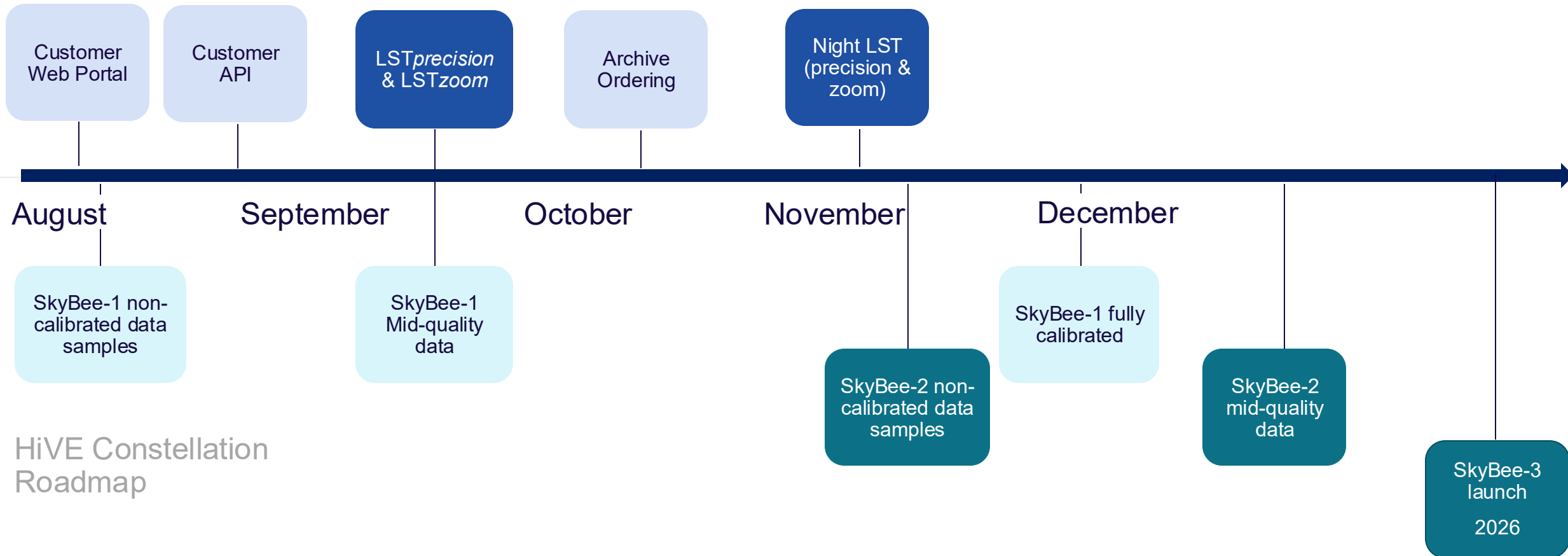**for zooming-in on anomalies**

+ Best resolution

More information available on **constellr Knowledge Center**: https://constellr.github.io/product-lst/

Characteristics	LSTprecision	LSTzoom	LSTfusion
Spatial resolution (1)	30m	10m	30m
Swath	17.5km		various
Scene Size	15km x 15km		110km x 110km
Frequency (2)	2025: every 4 days 2026: every 2 days 2027: daily		2025: every 8 days 2026: daily 2027: hourly & forecast
Coverage	worldwide tasking		Q2 2025: EU, corn belt Q3 2025: India Q4 2025: worldwide
Local acquisition time (3)	Q3 2025: 10:30h Q4 2025: 10:30h & 13:30h 2026: 01:30h, 10:30h, 13:30h, 22:30h		various 2025: Data delivery for 10:30h UTC 2027: hourly at mid-hour
Type of images	2025: day imagery 2026: day & night imagery		
Availability	2025 - ongoing	2025 - ongoing	2014 - ongoing
Launch Date	Q3 2025	Q3 2025	Mid Q2 2025
Acquisition Angle	up to 30°		various, anisotropy correction planned
Temperature accuracy (4)	1-2K @ 0,03K NETD	<4K (goal)	<5K
Latency (5)	2025: <3 days 2026: <24 hrs 2027: <12 hrs		2025: <3 days 2026: near-real-time (NRT)
Calibration & Validation	- in-situ data validation following industry standards, Opt-MPC validation, - Patented cross calibration of HiVE with highly accurate calibrated public missions		

Technical Roadmap: Product delivery and HiVE capabilities

Product Roadmap

| Customer Web Portal | Customer API | LST*precision* & LST*zoom* | Archive Ordering | Night LST (precision & zoom) |

August   September   October   November   December

SkyBee-1 non-calibrated data samples

SkyBee-1 Mid-quality data

SkyBee-2 non-calibrated data samples

SkyBee-1 fully calibrated

SkyBee-2 mid-quality data

SkyBee-3 launch 2026

HiVE Constellation Roadmap

Web Portal & APIs: seamless access to thermal data

Order, download, and integrate constellr's thermal data directly into your workflows
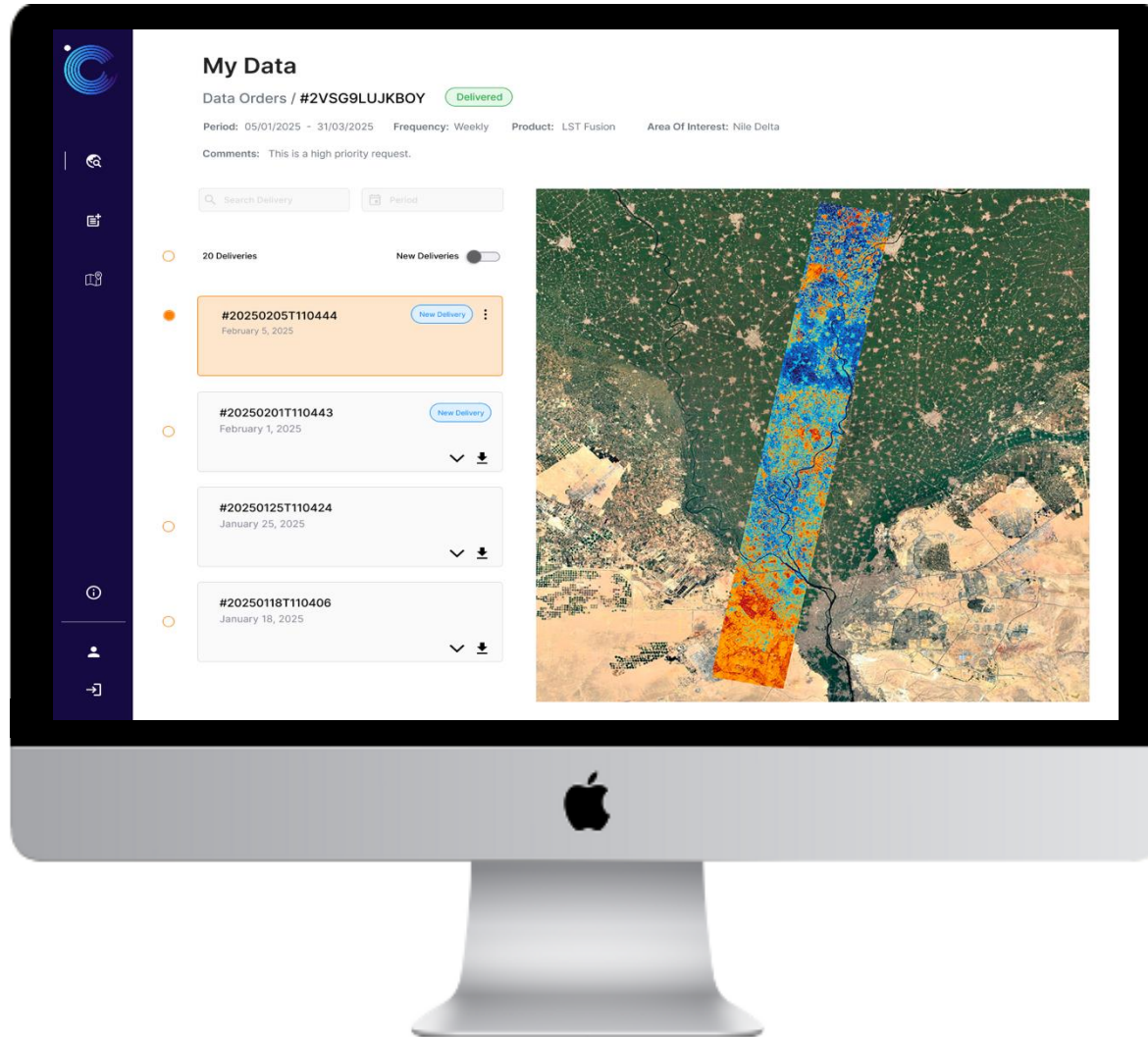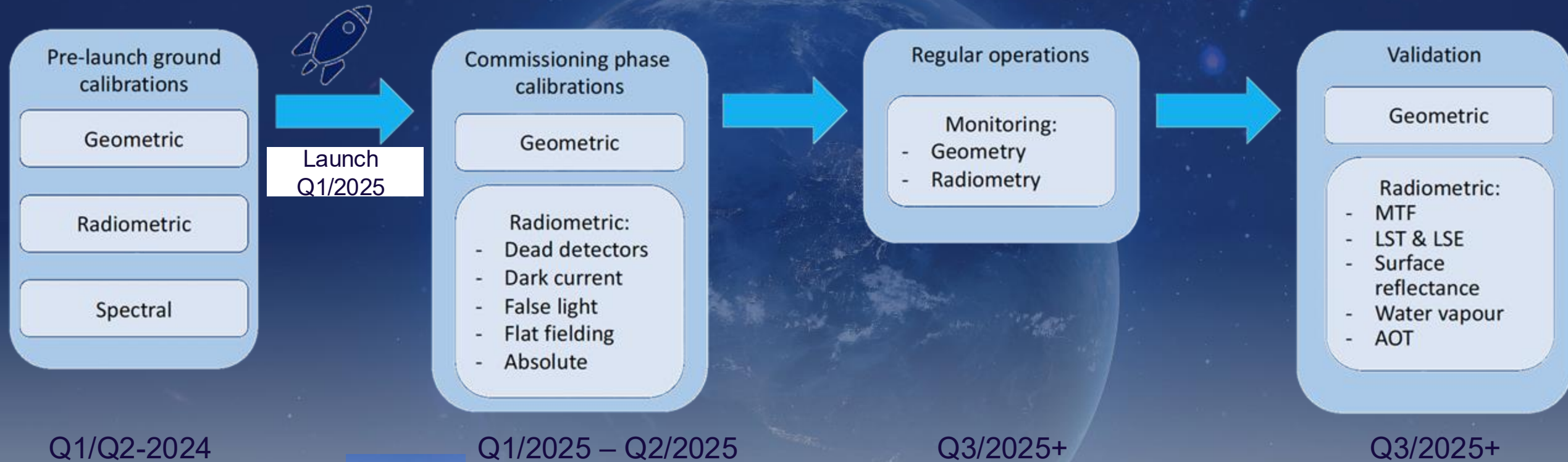

Key Features:

- **Secure access**: High security standards
- **Flexible delivery**: Direct API integration for automated workflows
- **Custom ordering**: Select AOIs, products, and time frame with ease
- **Rapid turnaround**: Data delivered within hours of acquisition by 2026
- **Proven reliability**: Platform trusted by governments, defense, and enterprise users

# How to measure with precision? Cal/Val strategy

The use case we originally chose to commercialise are large commercial opportunities with proven benefits from our data

	Agriculture		Urban health

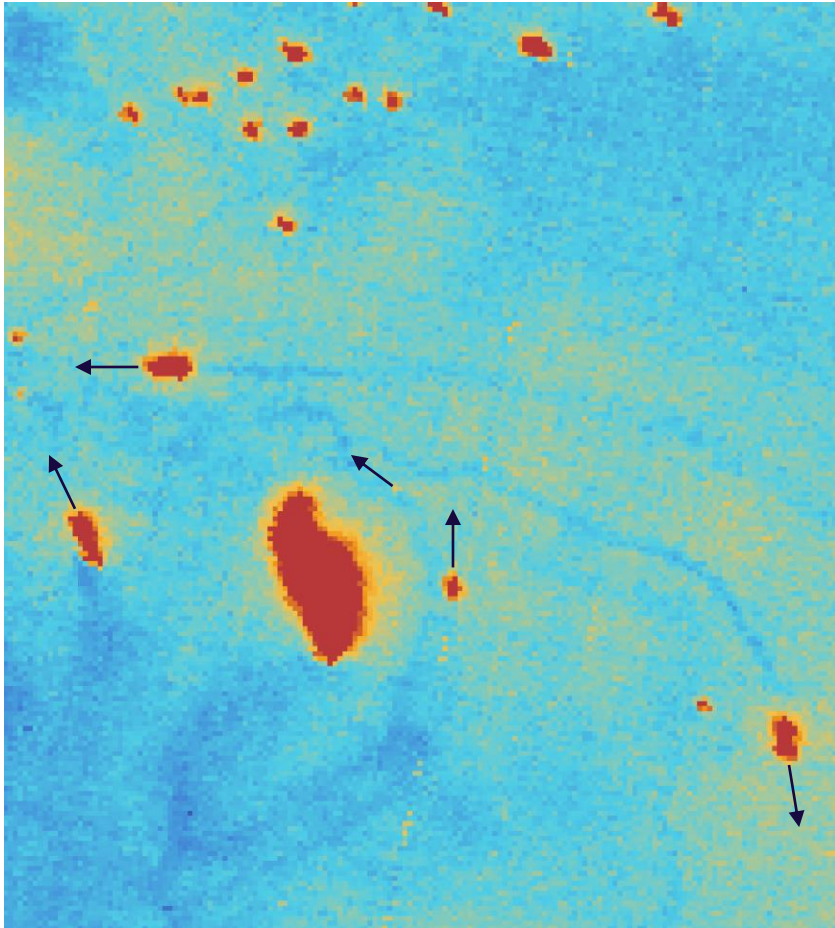|	Agriculture lead generation	Food chain resilience	Urban cooling
Use case			
Value creation	• Large agri-players often lack the info that allows them to sell the right product for field treatment • Our data allows to understand in-field dynamics – allowing for targeted sales of the right product	• Large FMCG as beer brewers often have specific feedstock requirements (e.g., hops) • Predictive yield models allows them to balance supply chains pro-actively at lower cost	• Cities are confronted with higher temperatures but do not know how to act • Our data allows to plan and invest in cool areas where ROI is highest

Thermal Intelligence: seeing what conventional sensors miss

Large-area scan: From port development to illicit vessel detection - insights beyond visible imagery

Labels on image: Cool spots, Oil refinery, Beyond visible material classification, Vessel detection, Port development
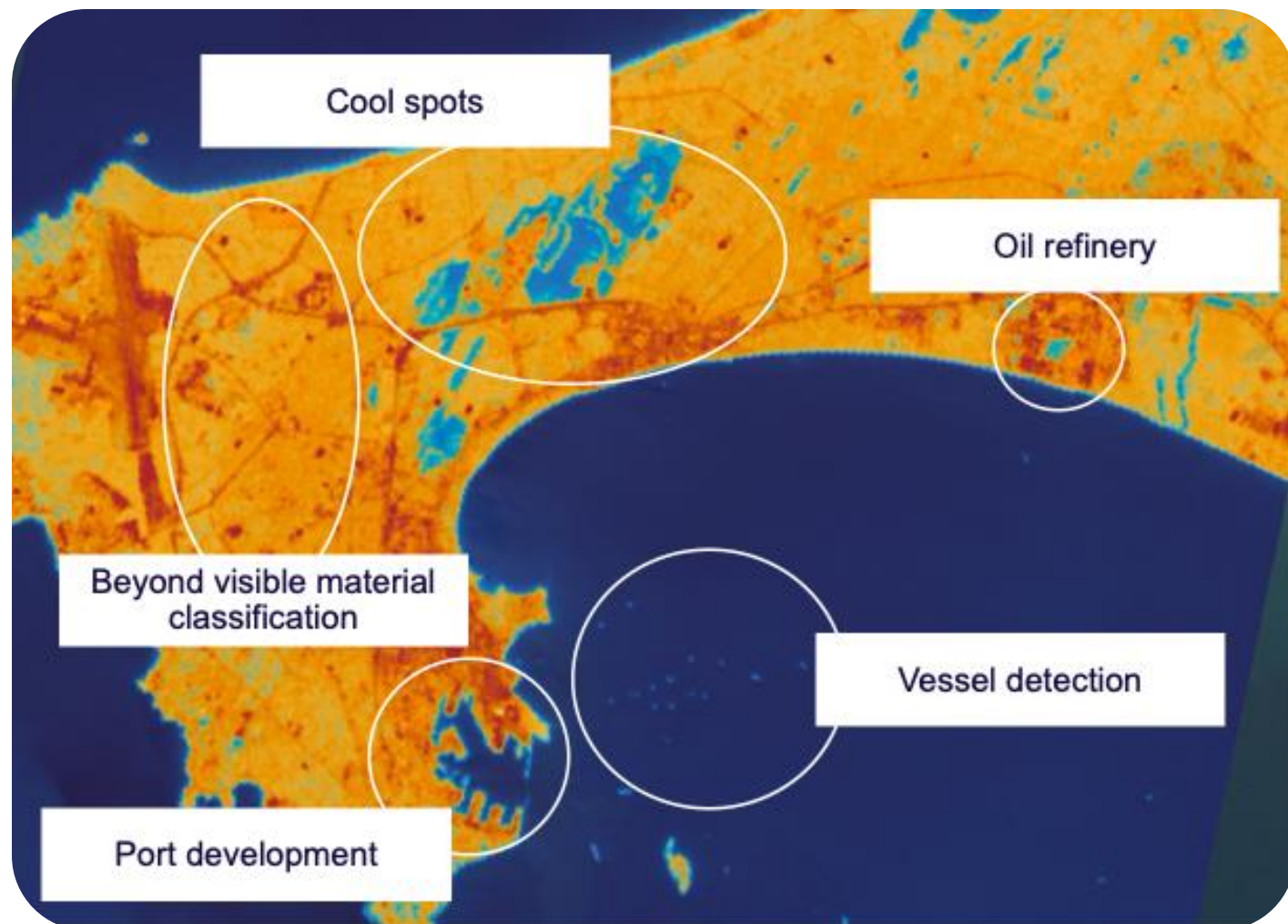
- **Limitations of traditional sensors:** Optical & SAR struggle at night, detecting hidden activities or activity change

- **Thermal advantage:** Detects heat signature changes on land & sea - up to 10x10 m.

- **Over Dakar, thermal data revealed:**
  - Hidden maritime activity / dark vessels
  - Industrial heat sources (oil refineries)
  - Urban & port development
  - Material classification beyond visible spectrum

- **Relevance for Japan:** Same capabilities apply to detecting dark vessels, safeguarding coastal waters & industrial activity monitoring & identification

City of Dakar captured by constellr's Skybee-1 - June 10th, 2025, 11:54h local time (uncalibrated data)

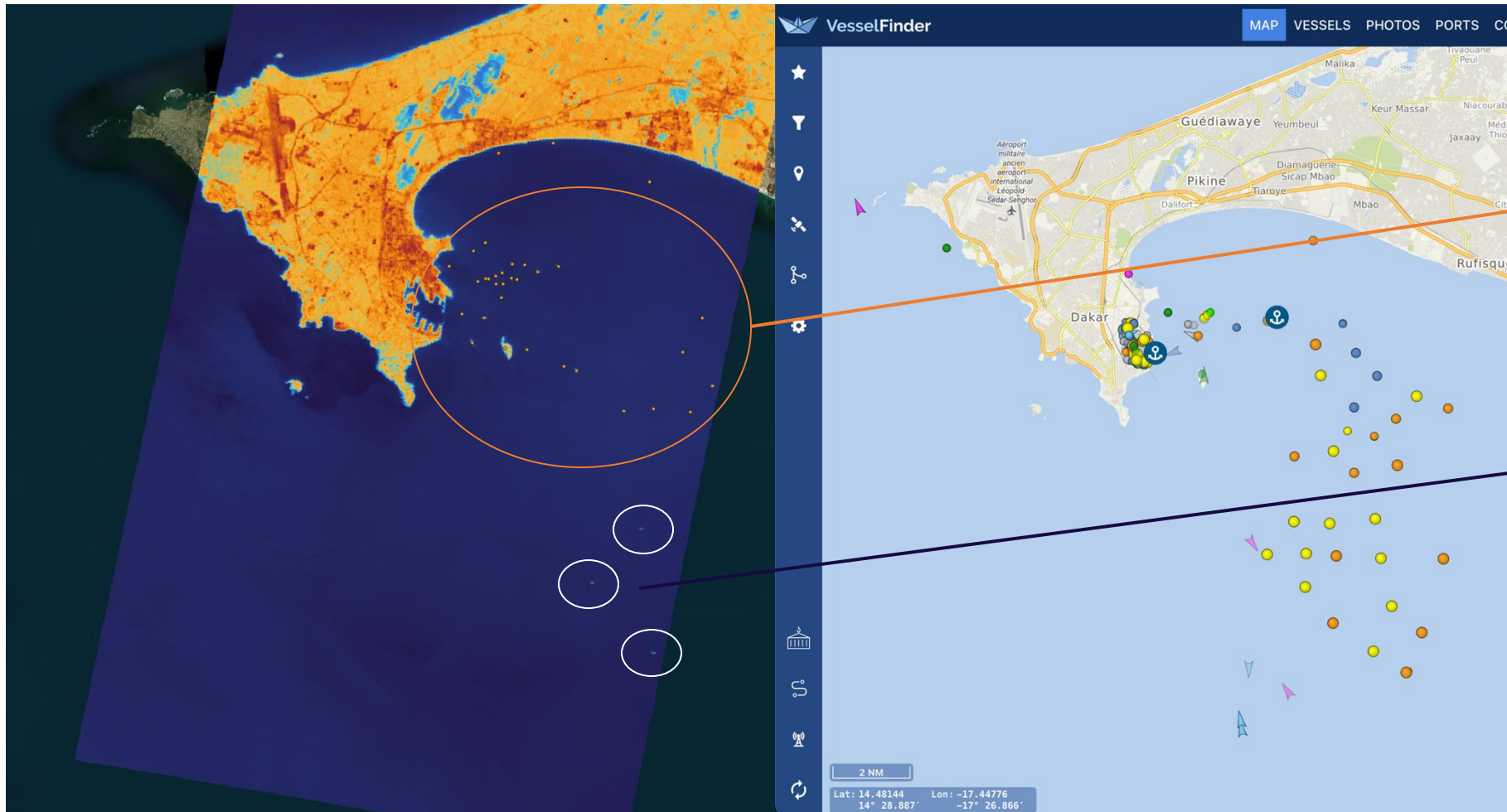# Vessel detection: night movement & direction analysis possible

constellr HiVE 03.06.2026, uncalibrated TIR
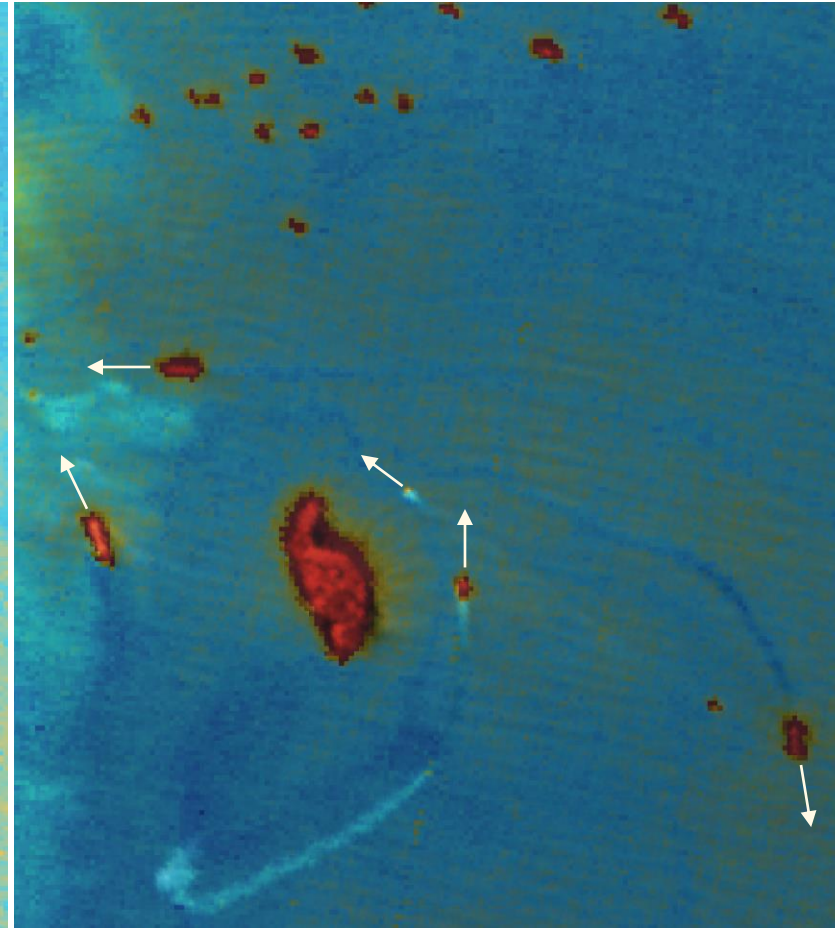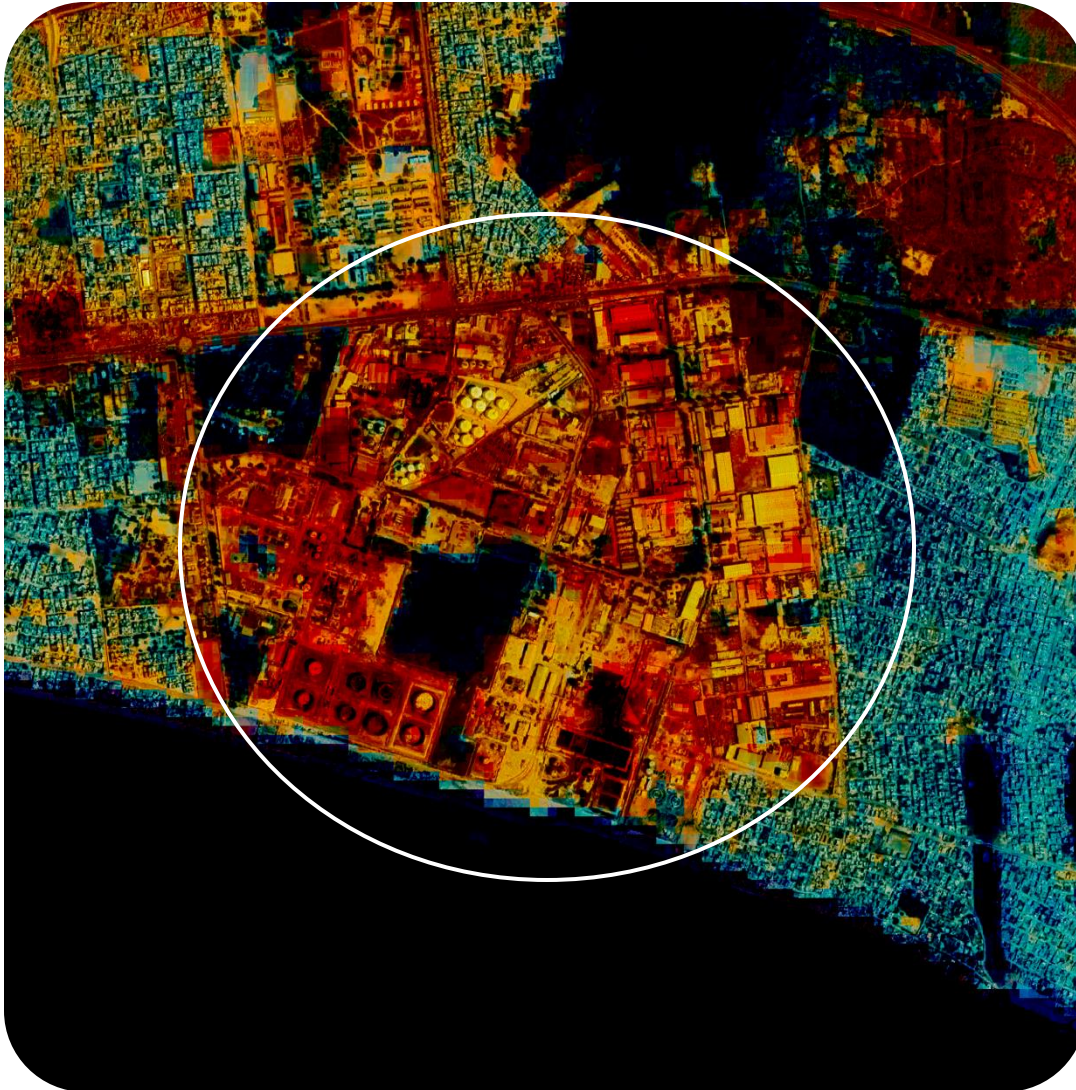
constellr HiVE 03.06.2026, combined RGB/TIR

Vessel detection: we detect ships not seen with AIS tracking

Vessels **visible** in AIS tracker

Vessels **NOT visible** in AIS tracker

Near Real-Time Heat and Activity Status – Senegal Refinery

City of Dakar captured by constellr's Skybee-1 - June 10th, 2025, 11:54h local time (uncalibrated data)

- **Thermal data enables industry monitoring by:**
  - Determining the operational status of facilities in near real time
  - Distinguishing active vs. idle equipment
  - Identifying production intensity via heat patterns
  - Detecting anomalies in industrial processes
  - Tracking changes over time with **actual temperature measurements** - unlike SatVu and others, which infer temperature rather than measuring it directly

- **Relevance to Japan:** Supports monitoring of refineries, manufacturing plants, and energy facilities for safety, maintenance, and security.
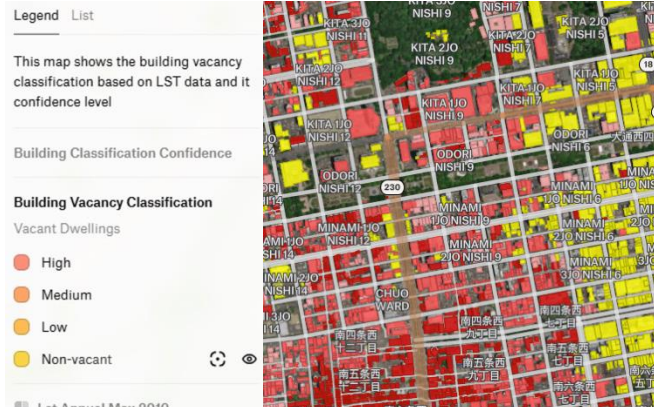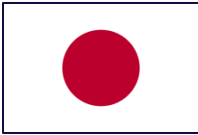
City of Sapporo: thermal insights for vacancy analysis

Feasibility study conducted with insurance partner to identify building vacancy using LST data

Building vacancy detection

constellr provides an analysis platform for an insurance company measuring the energy consumption of buildings in the city of Sapporo, Japan.
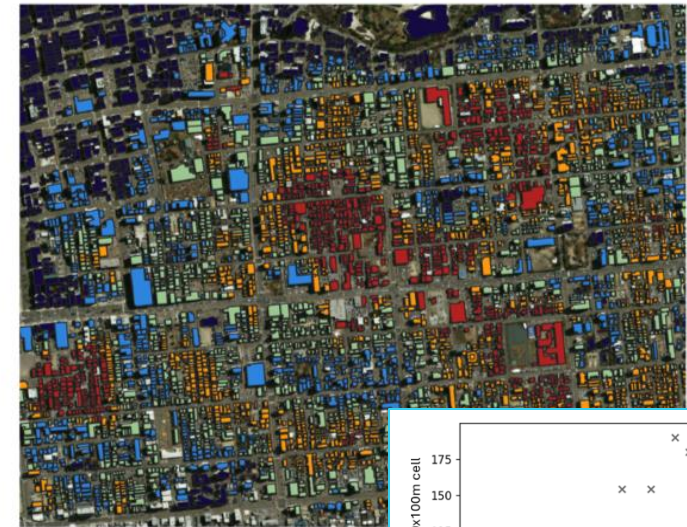
Benefit: Detection of building vacancy.

Legend | List

This map shows the building vacancy classification based on LST data and it confidence level

Building Classification Confidence

Building Vacancy Classification

Vacant Dwellings

- High
- Medium
- Low
- Non-vacant

Lst Annual Max 2019

Winter LST

Summer LST

Thermal delta >8 °C flags unused assets; insurance partner validating loss-prevention value
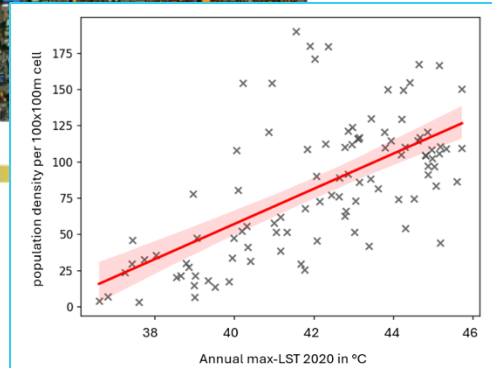
Note: Conducted jointly with a Japanese analytics partner for a top insurer. Initial PoC will expand to 6 cities if successful. Full case study attached separately.

constellr

Terrain Risk Monitoring – Landslides & Volcanic Slopes

Thermal and optical data combined to identify temperature-driven ground changes that could signal landslides, erosion, or infrastructure risks.

Image taken June 3rd 2025, SkyBee-1 LWIR and VNIR side-by-side
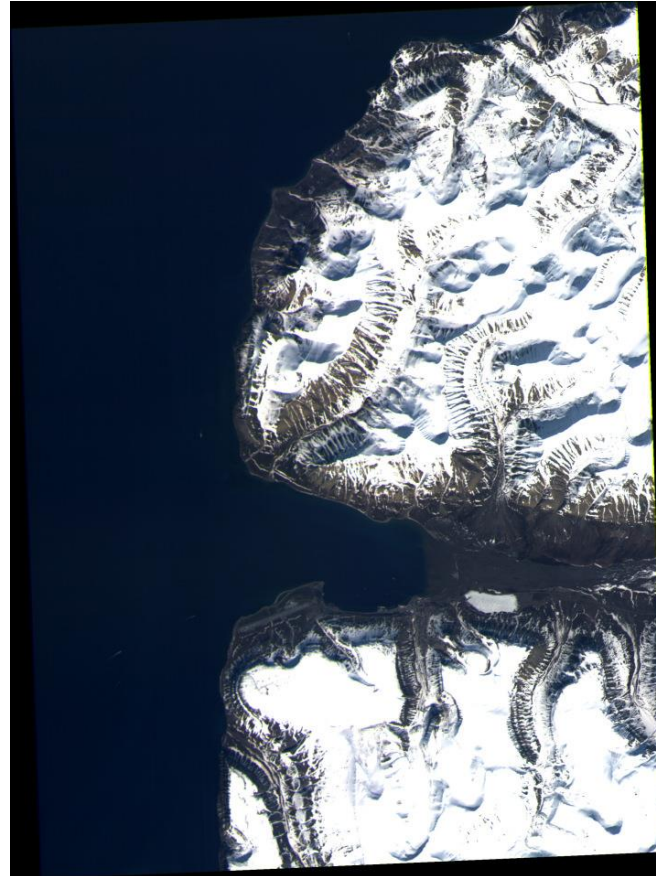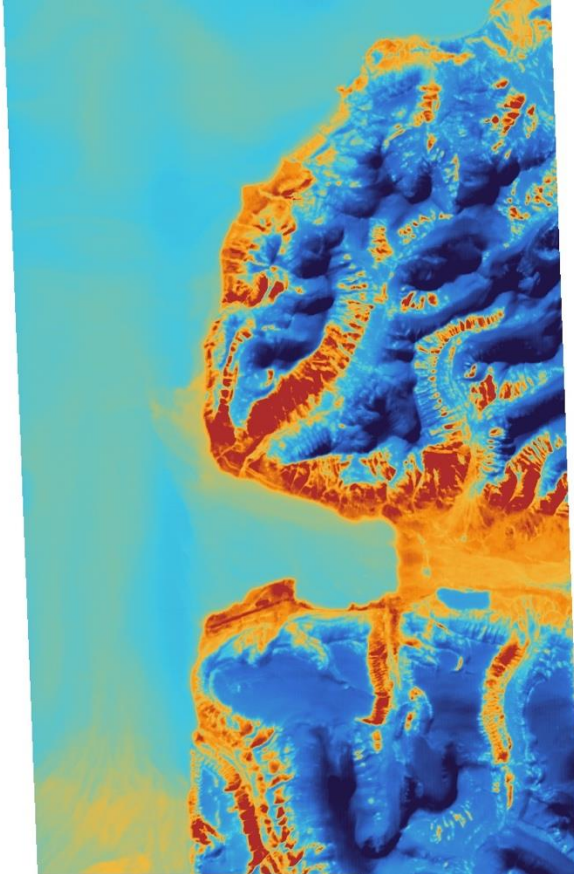
Proactive risk monitoring to:
- Detect subtle temperature variations in soil, rock, and vegetation that can indicate erosion, slope instability, or volcanic activity
- Monitor seasonal changes and extreme weather impacts in Japan's mountainous, volcanic, and coastal regions
- Support disaster prevention planning in typhoon-prone and river-adjacent areas
- Combine thermal and optical data for actionable environmental situational awareness

Data Format/Descriptions in an Ideal World

For the Producer and User

1. Data- and Metadata- format standards are unified/standardized for all kinds of data and clearly described

2. Product bundle requirements clearly defined (e.g. do we need emissivity layers for LST)

3. Performance descriptions are standadized (Use the same standards and referenceinformation in the industry, use the same characteristics)

4. All customers/institutions share the same requirements for data packages (for similar data at least)

5. Affordable performance testing (for commercial missions)

Thank you!