



TRISHNA DOWNSTREAM PROGRAM

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Context



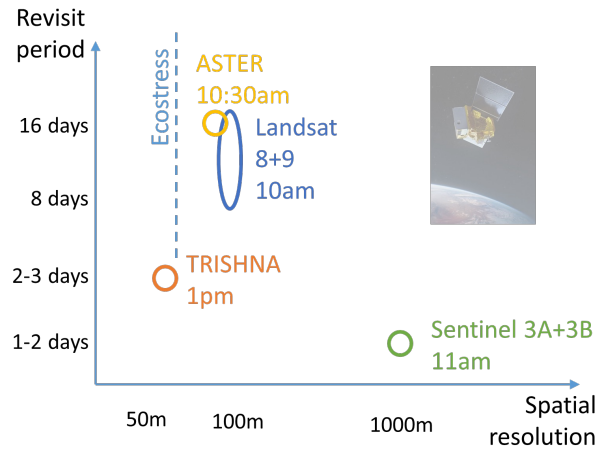
TRISHNA has been designed to get a better understanding in various domains:

- Ecosystem stress and water use
- Coastal and inland waters
- Urban microclimate monitoring
- Solid Earth
- Cryosphere
- Atmosphere

During TRISHNA days in 2022, potential applications had also been presented in these various fields

Context

TRISHNA brings new features (resolution, revisit) with opportunities for new applications



Previous missions

- Landsat 8 (2013), Landsat 9 (2021)
- Sentinel 3A (2016), Sentinel 3B (2018)
- ASTER onboard Terra (1999)
- Ecostress onboard the ISS (2018)

TRISHNA Products

L2a: LST/SST, land surface emissivity, surface reflectance, ...

L2b: daily ET, daily water stress, surface albedo, NDVI, fCOVER, LAI, energy budget at time of acquisition, ...

TRISHNA will open the path for SBG and LSTM (latter will be operational). So preparing for TRISHNA also means preparing the next 10+ years of continuous TIR observations.

SBG : Surface Biology and Geology, VIS+SWIR+TIR, ground/water temperature, snow reflectivity, active geologic processes, vegetation traits, and algal biomass, 60m, 3 day revisit, ~2027.

LSTM : Land Surface Temperature Monitoring, VIS+VNIR +SWIR+TIR, agriculture management, 50m, 3 day revisit, ~2028-30 (2).

Context (based on the work of Sylvain Lenfle, Human and Social Scientist)

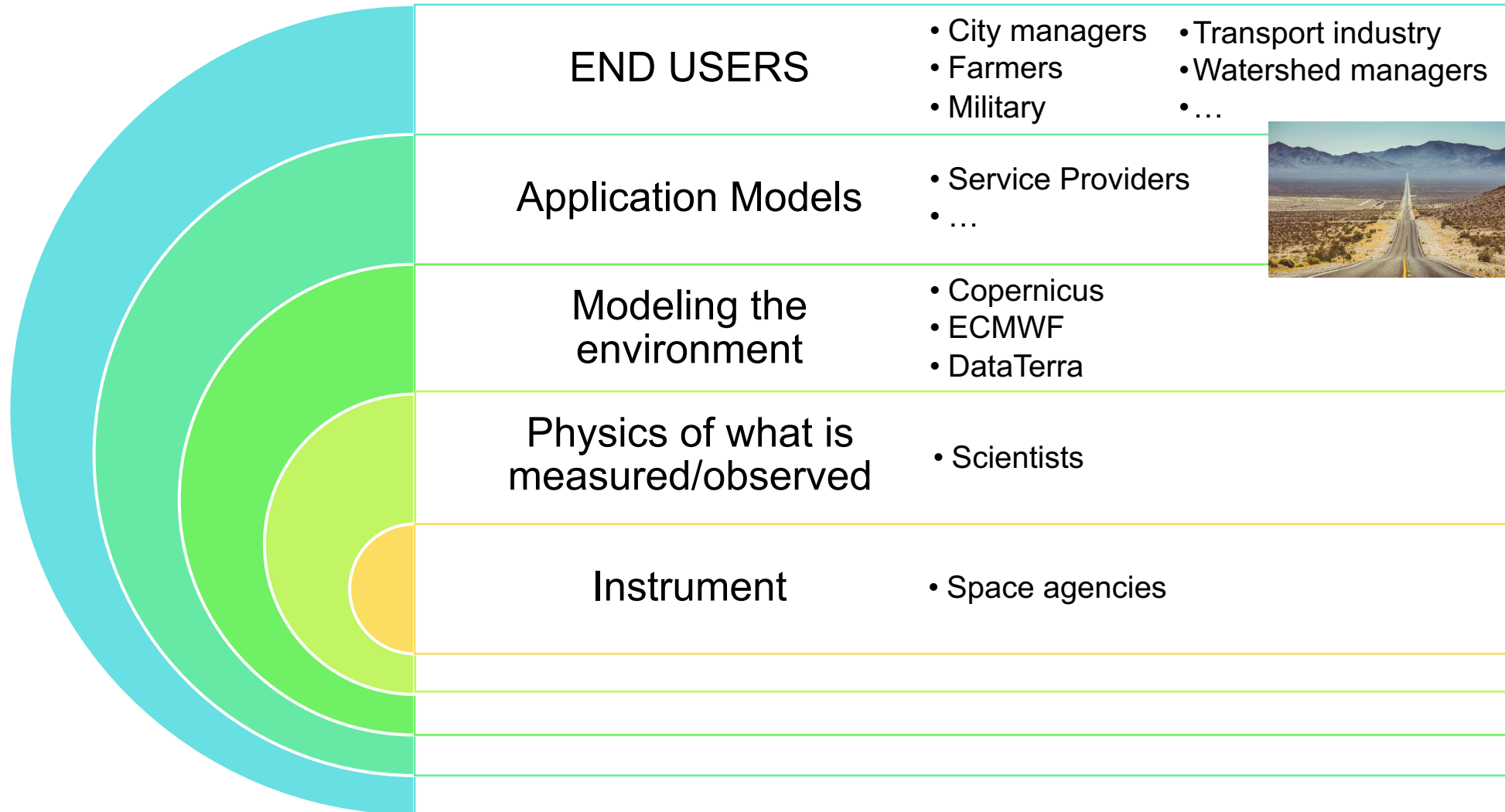
Data/Products are a solid foundation. Making them available is not good enough to answer a specific issue, even through the best data portal or platform:

- Separate how data become added-value products, and how they are brought and used to help taking the best decision for the user
- Service providers are essential to bring the right information in the best possible way that fits the user needs at the proper level of details.

It would be illusionary to think that making an image available (best case scenario, it is optical and can be related to what we see with our own eyes; TIR images on the other hand...) to a non-specialist such as a city manager or a farmer:

- It needs proper interpretation and tuning depending on the application and to be able to answer their needs: do I need to plant more trees in this street to cool down the temperature, how much irrigation is enough and when to optimize my crop yield, ...

Context (based on the work of Sylvain Lenfle, Human and Social Scientist)



“Death Valley”, where CNES is putting a lot of effort these last few years through multiple programs such as:

- SCO
- France 2030
- Downstream programs “Ambition Aval”

⇒ Support and encourage companies to reach the end users, provide the proper level of info to answer their needs

TRISHNA downstream program

Main objective: support companies, services providers, to build new applications and services using TIR satellite observations in response to end-user needs.

identify end-users > collect end-user needs > develop a service to answer those needs

- RFI was published in May 2022, asking companies to describe the services they envisage that answer their client, or targeted users, needs.
- CNES provides financial and/or technical support. All developments will be carried by the companies to build their service.
- We also have a downstream program for CO3D (2 pairs of satellites, launch date mid-2024, optical stereo to derive 3D products at world scale, 1m resolution), and we can see a great potential to **combine 3D + TIR**, especially in urban areas so we encouraged companies to submit projects merging 3D + TIR.
- Main challenge: we do not have TRISHNA data yet!
 - TRISHNA simulations can be an option, but very dependent on the use case and instruments specifications are to be finalized (too early)
 - Use “proxy” data already available: Landsat 8 & 9, Sentinel 3A & 3B, Aster, Ecotress
- Focus is given now on the use of TIR data, future focus could be on the combination of simultaneous VIS+TIR

RFI with TIR data

29 projects have been received with 9 TIR and 13 TIR + 3D combined



- Ecosystem stress and water use
 - Ecosystem stress
 - Irrigation optimization
 - Wine crops
- Coastal and inland waters
 - Water quality
 - Flooding
- Urban microclimate monitoring
 - UHI monitoring
 - Thermal comfort
 - Urban vegetation
- Solid Earth
 - Earthquake
- Cryosphere
 - Snow pack state
- Atmosphere
- Forests
 - Trees health monitoring
- Fires
 - Risk management/prediction
 - Monitoring
- Environment
 - Illegal dumps
 - Disaster monitoring & damage mapping

RFI with TIR data

Evaluation based on technical proposition, clear description of user need, and availability of “proxy” data



Ecosystem stress and water use

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- Irrigation optimization
- Wine crops

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ITT to be published in May/June 2023

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Future topics of interest – needs more prior investigation

SBG User Needs and Valuation Study – NASA, Dec 2021, by RTI

Application Area	Key Potential Users of SBG Data/Products	Key Potential Use Cases of SBG Data/Products
<p>Urban Heat and Health</p>	<p>Cities—Large city governments NGOs—Urban forestry, heat health, cool surfaces Companies—Building cool-roof and reflective surface providers Planners—Urban development, consultants Utilities—Electric, water companies Healthcare systems—Public health agencies, insurance providers, hospitals</p>	<p>Heat alerts and maps, high-resolution urban maps for heat alerts and policy making Targeting heat mitigations, siting cool buildings, cool roads, urban vegetation Mapping programs, heat health and mitigation management, policy, impacts, monitoring, reporting, and verification (MRV) for programs Albedo/reflectivity/emissivity studies, urban infrastructure/surface surveys</p>
<p>Forest Management</p>	<p>Landowners (Large/Private)—Vertically integrated corporations, timber investment management organizations (TIMOs) Managers (Private)—Consulting foresters, land management companies Manufacturers (Private)—Forest products Consortia (Academia)—Industry research Managers (Government)—State foresters Corporations (Large/Private)—Corps with no-deforestation or lower greenhouse gas (GHG) commitments NGOs—Forest, watershed conservation Landowners (Small/Private)</p>	<p>Forest inventories, land/wood baselines and supply assessments Species classification, substand classification and invasive or understory composition Forest health, tree canopy height, phenology/leaf out timing, insects/disease Carbon market/offsets, MRV for owners/NGOs Disturbance and regeneration, deforestation, disease, storm/fire; replanting, regrowth Functional diversity, functional properties across time and ecosystems/habitats</p>
<p>Coral Reef Ecosystems</p>	<p>Governments—National and state NGOs—Relocation, restoration, conservation, economic development, tourism Universities Companies—Relocation, insurance, reinsurance, tourism</p>	<p>Marine spatial planning, location and condition of reefs Restoration and replanting, site and monitor Capture bleaching events Condition and composition, health, resiliency across time Disturbance, nutrient and pollution influx, wave action, temperature, acidification</p>
<p>Global Food Security</p>	<p>Humanitarian Aid Agencies (Gov't/NGO)—Major international food aid organizations Nations (Government)—Agriculture (Ag) statistic bureaux Corporations (Large/Private)—Multinational agriculture products companies Companies (Small/Private)—VASPs, crop consultants, digital agriculture tool developers NGOs—Food security and aid nonprofits Food Security Researchers (Academic/Gov't)—Experts in hyperspectral/RS Ag, hazards Finance (Private/NGO)—Forecast-based financing, crop insurance groups</p>	<p>Global/regional agriculture statistics, estimates of crop yield and productivity Land and field assessments, cropland, crop type classification, monitoring Hazard events/trend monitoring, onset, extent, and prediction of drought, floods, and anomaly detection Land quality surveys, for suitable land, soil maps, for conversion, regenerative Ag Carbon markets, improved indicators and models for soil carbon, certification, MRV Food insecurity interventions, regional models for improved interventions</p>
<p>Biodiversity and Conservation</p>	<p>Conservation NGOs (Large)—Global conservation nonprofits Conservation Agencies (Gov't/NGO)—Major international sustainable development organizations Nations (Gov't)—Conservation agencies Corporations (Large/Private)—Multinational consumer products companies Companies (Small/Private)—VASPs, environmental services, consultancies Biodiversity Researchers (Academic/NGO)—Experts in ecology/biology</p>	<p>Deforestation and degraded land, monitoring major crop plantations and natural forests National surveys, mapping baselines and establishing high-value conservation areas Species classification, plant/crop classification, baselines, invasive/understory composition Agroforestry and carbon offsets, MRV of suppliers and smallholders to support sustainable practices Habitat management, conservation land management and geo-accounting</p>

RTI interviewed many different end-users and service providers in order to map the future key users and use cases of SBG data and products.

We can find a lot of common topics and a common will to support the creation of new applications and services to answer these identified needs expressed by end users.

⇒ Great opportunity of collaboration between TRISHNA, SBG and LSTM teams

TRISHNA downstream program

- A possible outcome of the first RFI and the first projects out of the ITTs could be a new product, new feature like NRT with a quicker algorithm, more insight on alternative algorithms to retrieve ecosystem stress, etc...
- The overall goal of TRISHNA downstream program is to stimulate companies and support the creation of new applications and services in response to end-users needs by using TIR (+VIS) data in preparation of TRISHNA, but also in preparation of the future missions SBG and LSTM.
- More generally, CNES and the French Government are putting a lot of effort on applications and services development through different current programs (SCO, “Ambition Aval” – TRISHNA downstream program, France 2030) with different strategies on the way of collecting the needs and on how to answer them.

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