Lisa Data Analysis in France (LIDA)

AI in CNES

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AI in CNES

- Since 2018: an « unspecialized » team of 4 people
- Federate actors of AI in CNES (with domain specific AI teams in different fields)
- Enhance communication across fields
- Enhance training (different levels : manager, engineer, expert, mini internal training)
- Propose, set up and maintain tools useful for AI activities (GPU, ANACONDA, Jupyter…)

- HPC means in CNES. Among others: 12000 computation cores, 48 GPUs, 8.5 Petabytes (storage)

Where we use AI in CNES

In every field but more specifically :

- **Earth Observation**
- **Medical**
- **Signal analysis**
- **Scientific mission**
- **Space Operations**

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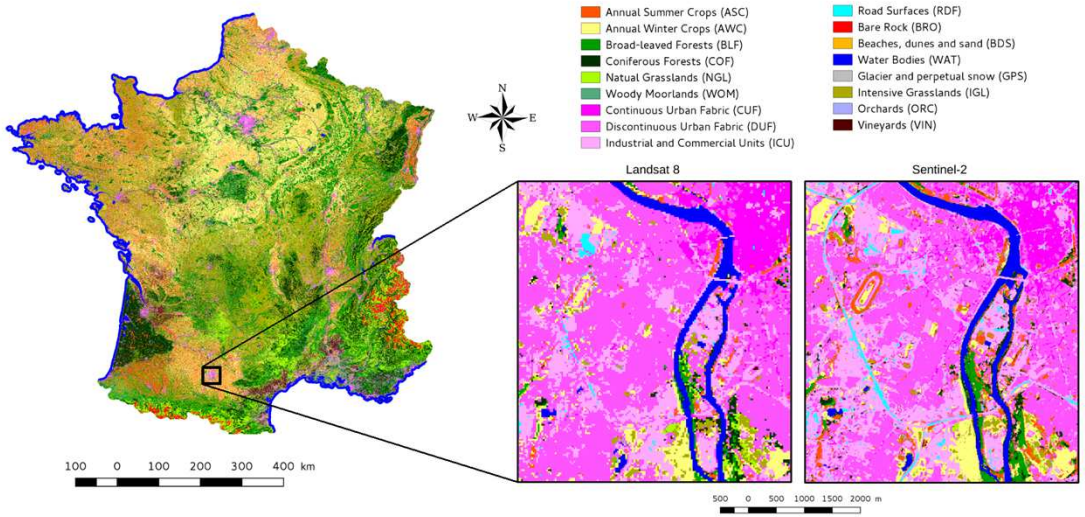
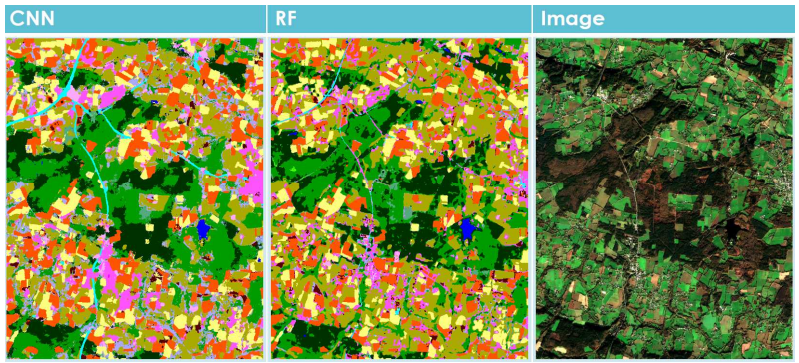
Earth Observation – Ground classification

France land cover classification, from Landsat 8 to Sentinel-2.



Comparison of Deep Learning and Classical ML



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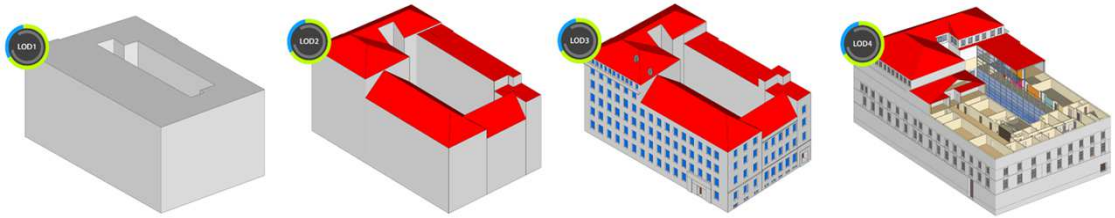
Earth Observation – Cars detection

Traditional use of AI in remote sensing :

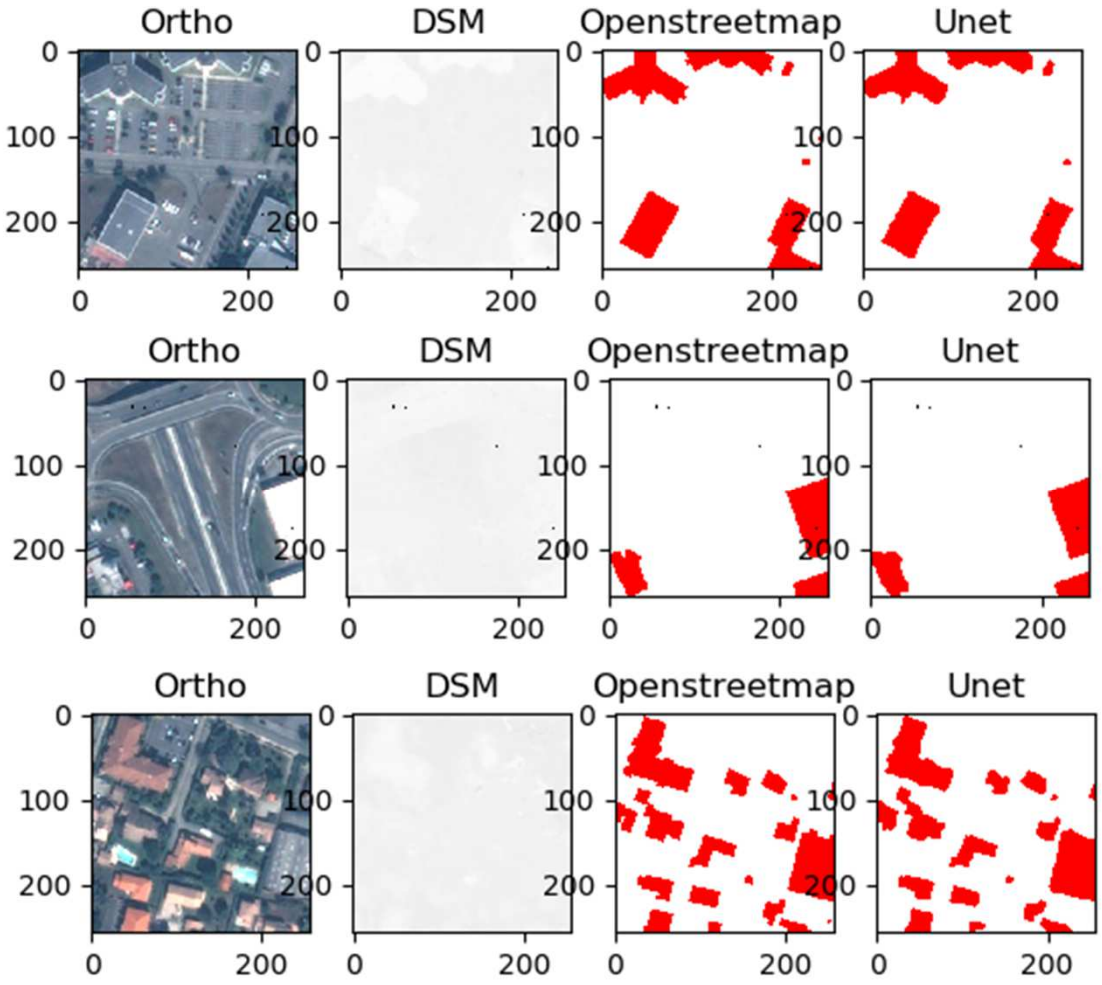
- Also often used for boat/plane detection
- Multiple benefit (both civilian and military)

Earth Observation – AI4GEO

Find 3D buildings on satellite imagery



ai4ge



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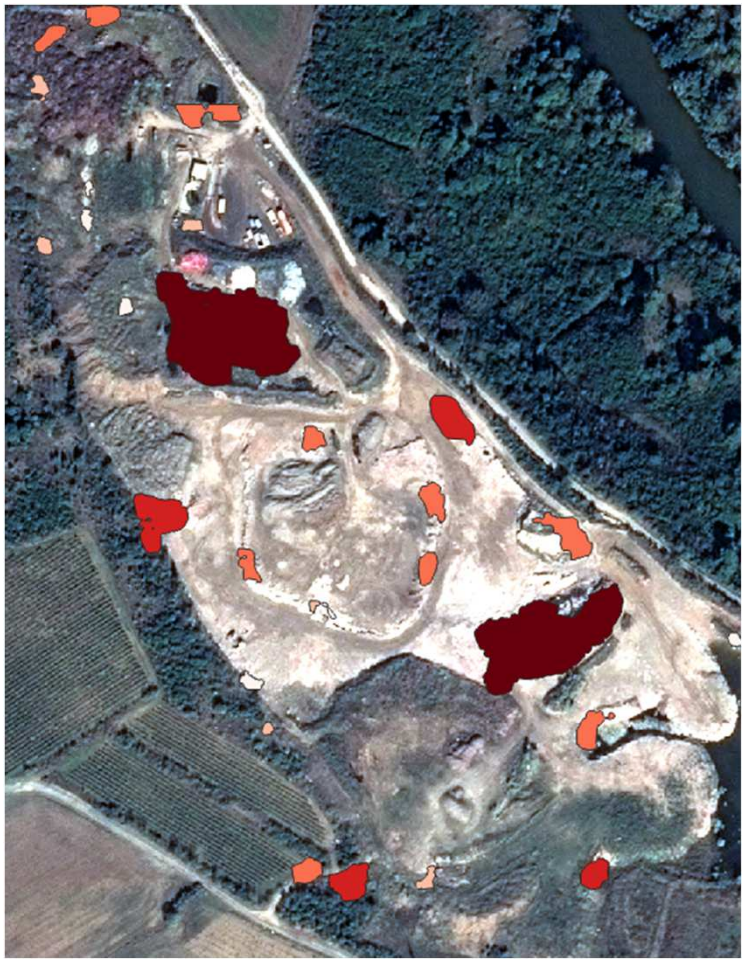
Information extraction

Earth Observation – Environment – Illegal dump:

- **Analysis of the environmental impact:**
  - Coupling of detections with geographic databases
    - Calculation of distance from residential areas, schools, etc.
    - Use of digital terrain models to identify run-offs that can generate pollution



Earth observation lab

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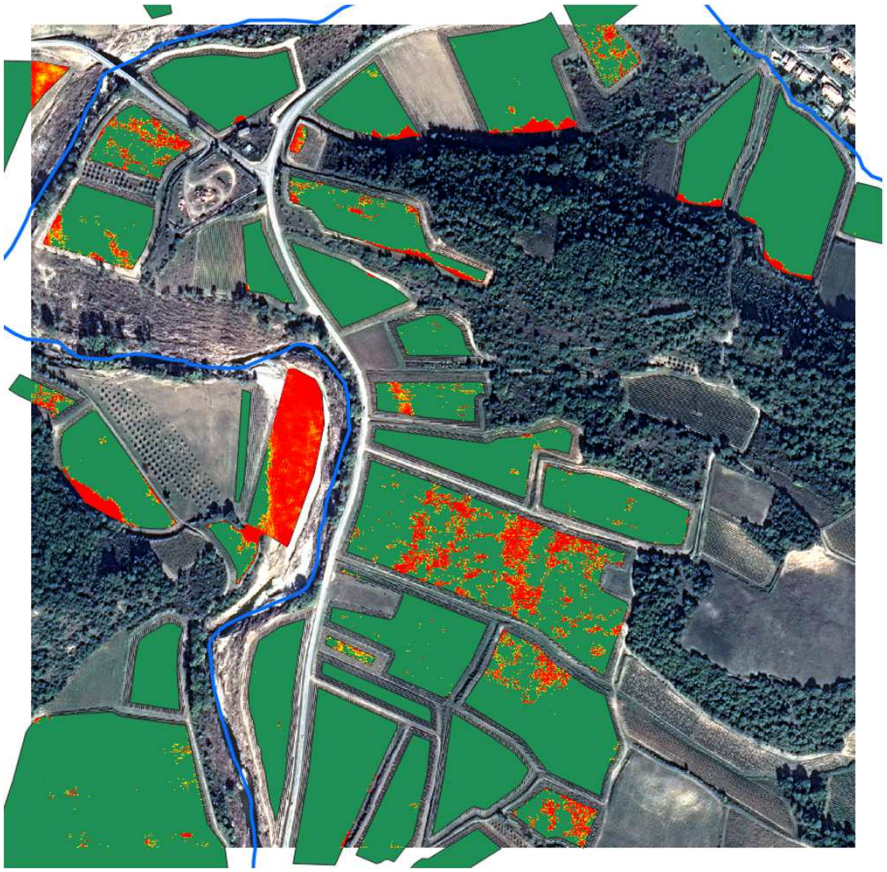
Earth Observation – Environment – Aude flooding :

Information extraction

Results of detection of "degraded" vineyards – flooding of the Aude (11/2018)



Area from graphic plot register (RPG), eroded and near watercourses in green, degradations with yellow, orange, red colour code

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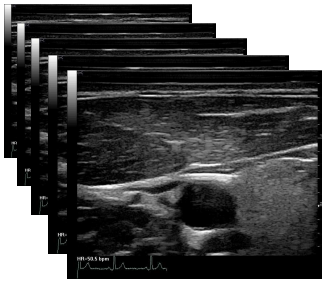
Medical – Echo Finder :

Information extraction
Autonomous

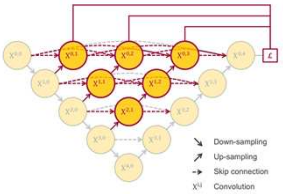
1 : Learning phase

Ultrasound images acquisition



Ultrasound data bank for each organ

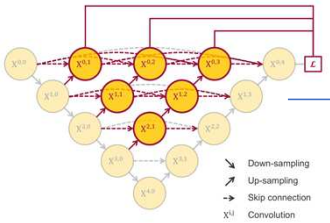
Feed to the
AI network



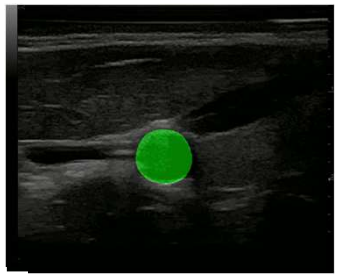
AI network setup specific to each organ

2 : organ detection phase

Input real time jugular



Real time segmentation



carotid

optical nerve

portal vein

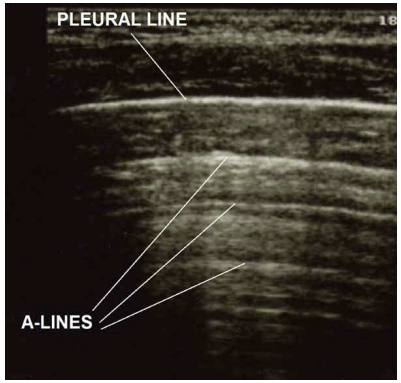
jugular

heart

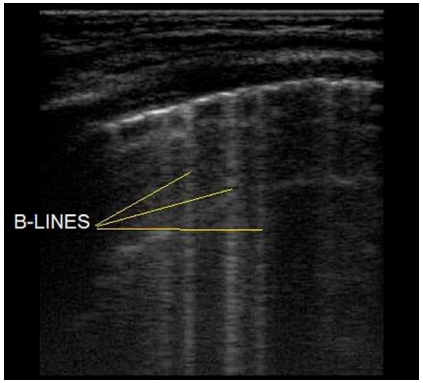
Medical – Lung ultrasound

Ultrasound developed to fight against Covid-19 and other lung infection :

- In collaboration with University Hospital Center of Toulouse
- Qualitative/quantitative detection of lung damage
- Autonomous and portable solution
- How ? Detection of patterns (A/B/C)



A



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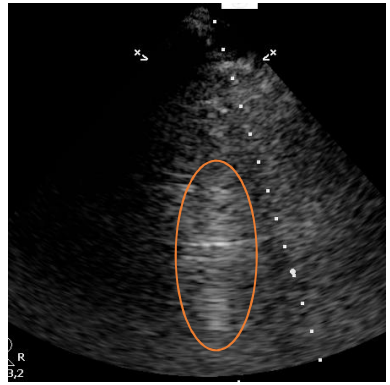
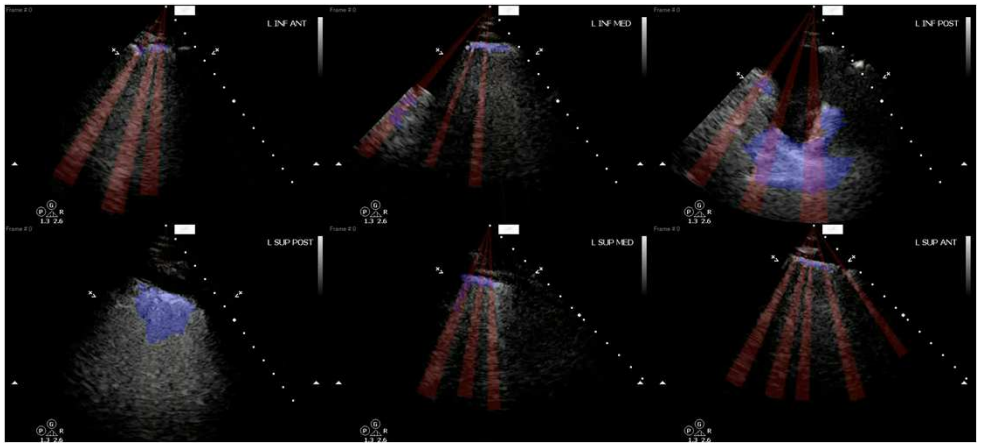


C



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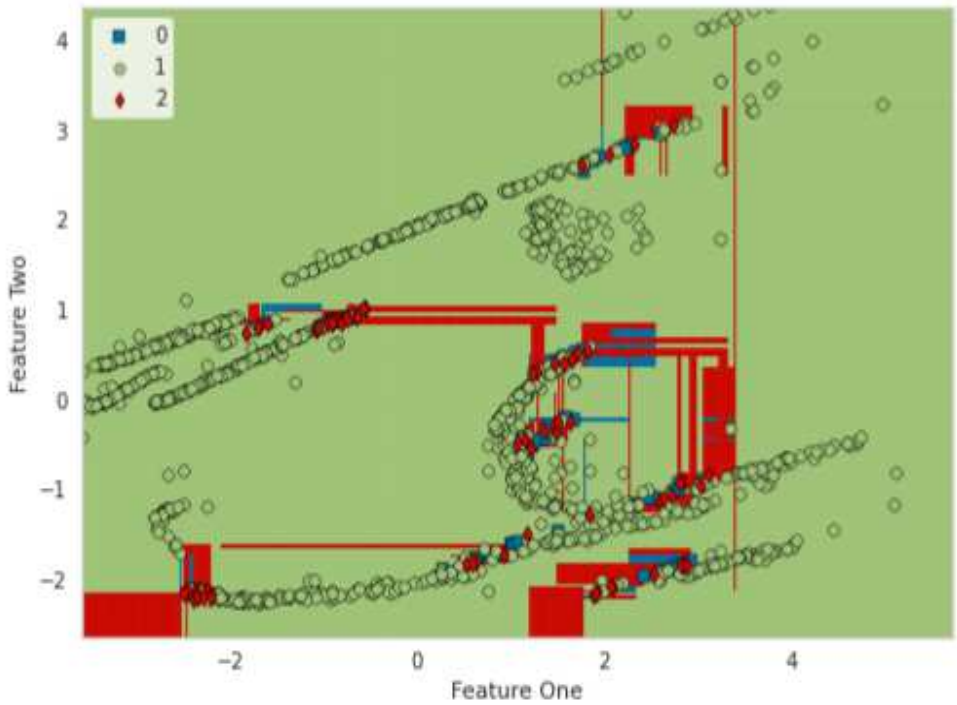
Signal analysis – GNSS multi-path

Remove multi-path signals in order to get « real » signal

- Find presence of deterioration induced by the environment
- Better positionning of vehicle



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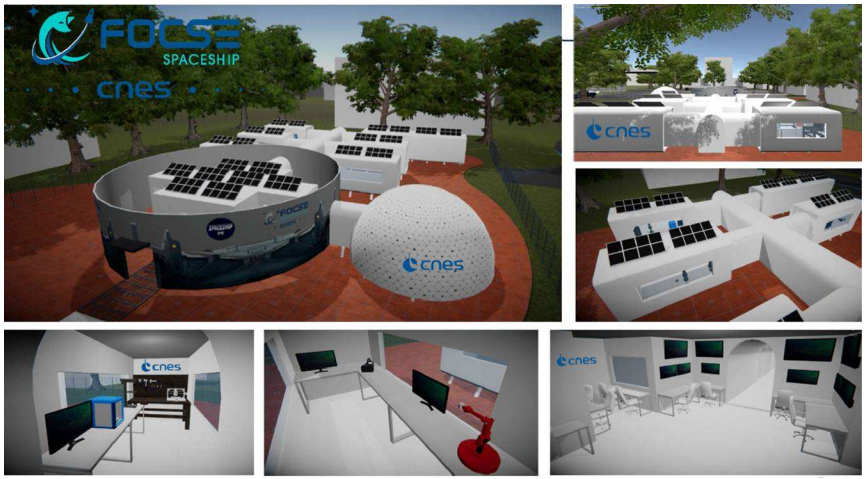
Scientific mission - SpaceShip



SpaceShip – Lunar / Martian base

- Automatic base management: ressources, anomaly prediction
- Autonomy of the colony : medical
- Digital Twin

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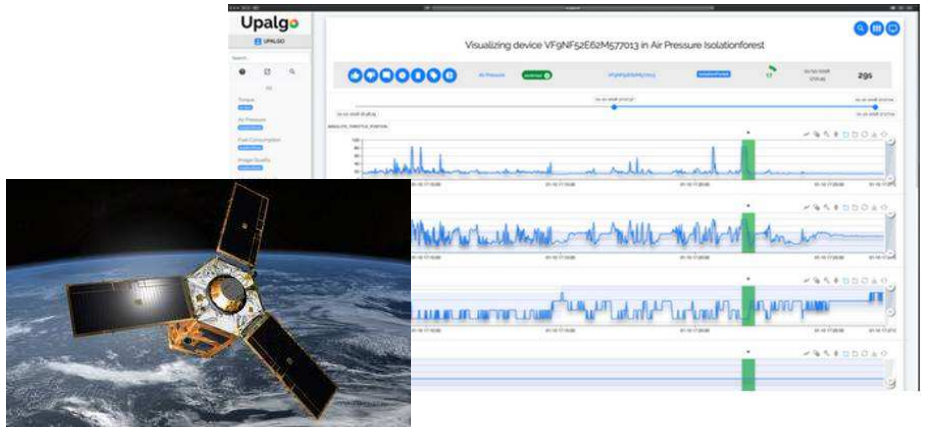
Space Operations - Nostradamus:

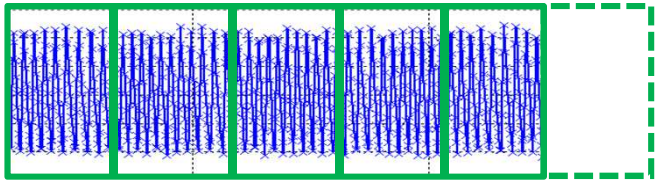
Detect weak signals, precursor of anomalies :

- Monitor PLEIADES satellite telemetry
- Find weak signals undetected by simple thresholding
- Implemented currently on PLEIADES but may be used globally

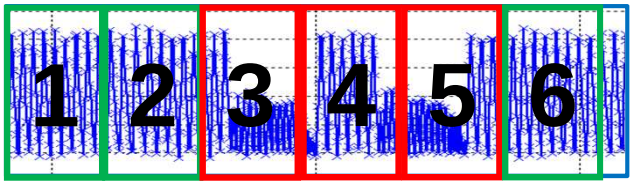
NOSTRADAMUS



Training data: nominal Telemetry

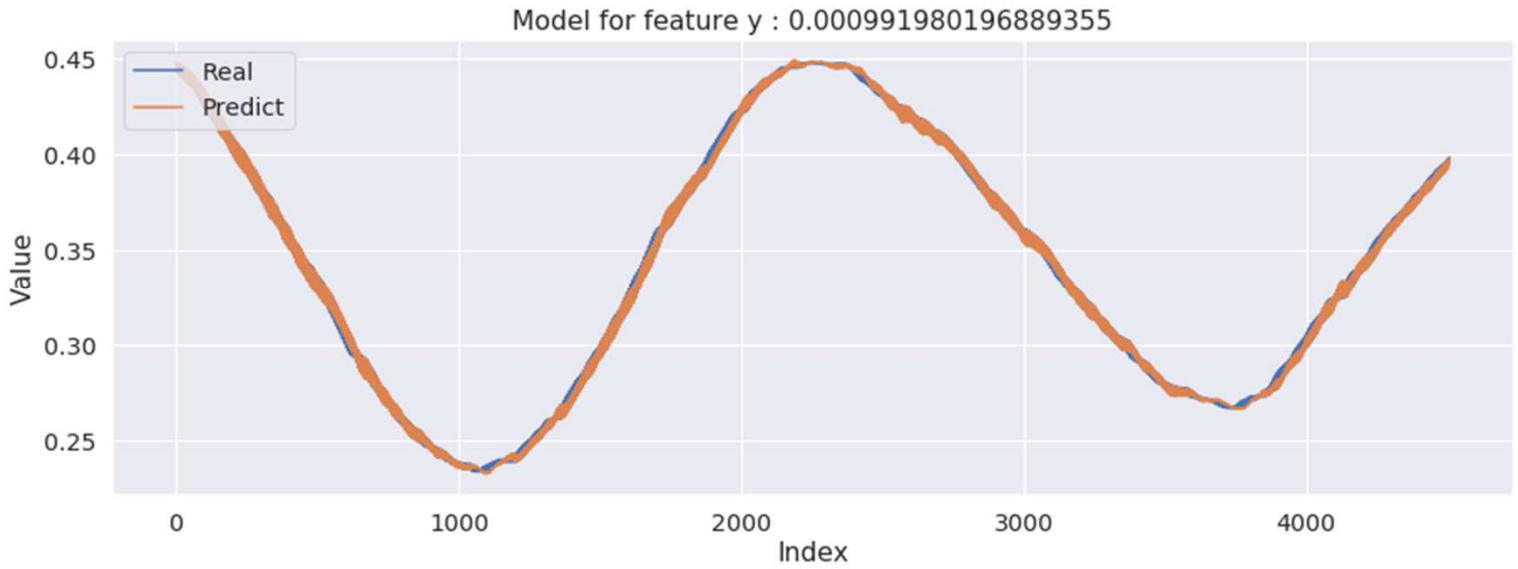


Telemetry to check

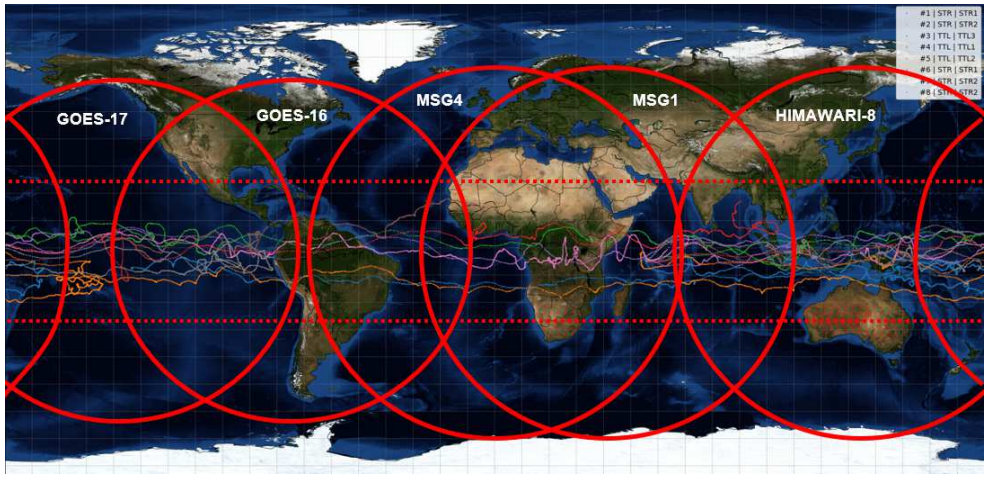


Space Operations - Orbitography

Predict position of earth rotation axis

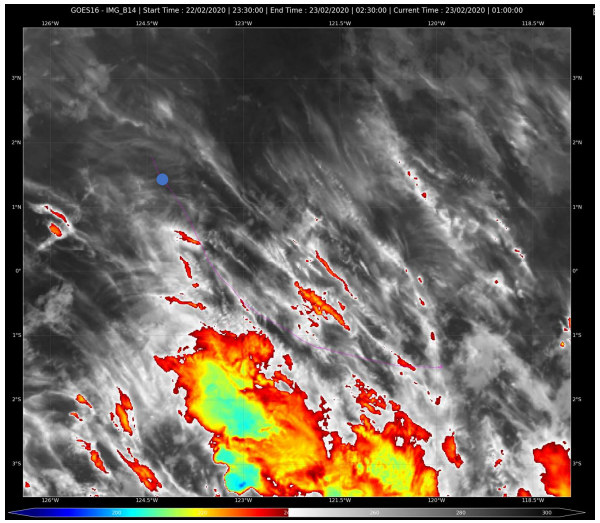


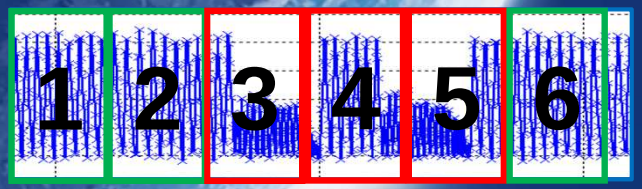
Space Operations – Loss of altitude on balloon

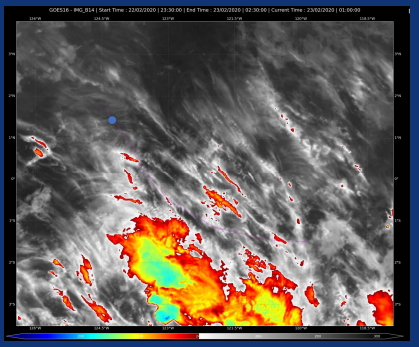


Anomaly forecasting on high altitude balloon :

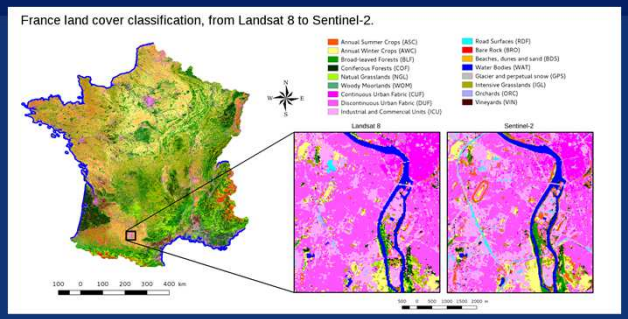
- Dynamic and thermal forces acting on high altitude balloon make flight trajectory predictions very complex and uncertain.
- Under specific conditions, a **sudden loss of altitude** can be observed, correlated with a balloon overpressure anomaly.
- **6h-forecasting pressure anomaly** of CNES high altitude balloon using deep learning.

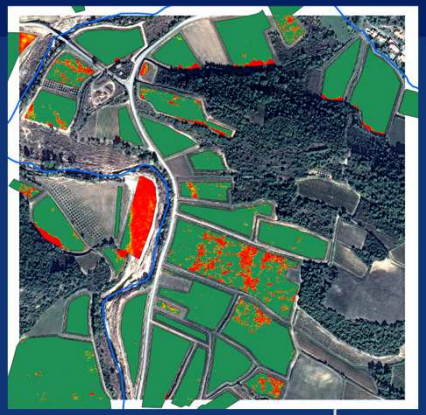


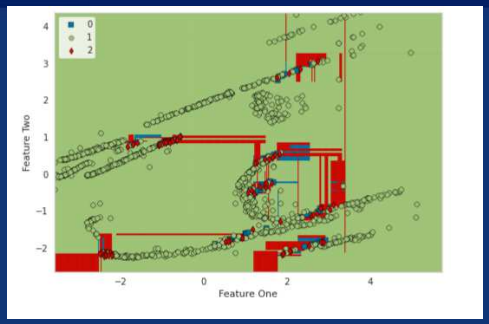




Questions







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