# SPACE LAUNCH AND REENTRY ACTIVITIES FROM EUROPE'S SPACEPORT (CSG) IN FRENCH GUIANA – INTEGRATION INTO NAT AIRSPACE

ICAO, Paris, 13-14 May 2024, Léonard Buchaillot, Flight Safety Division, Kourou
FRENCH GUIANA

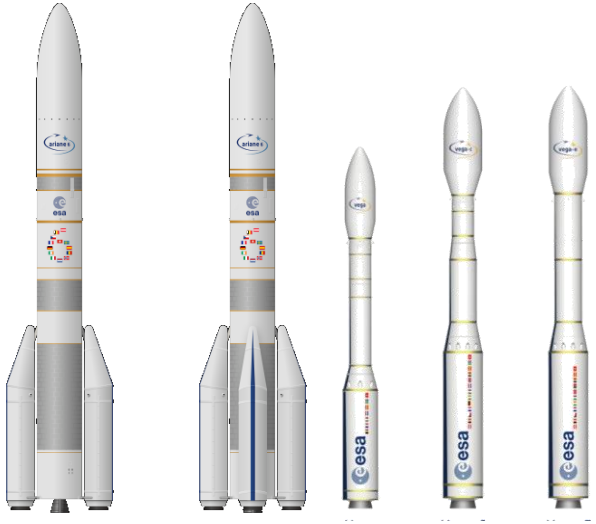
# SUMMARY


- **INTRODUCTION**
- **THE FLIGHT SAFETY DEPARTMENT WITHIN THE SUBDIRECTORATE, RESPONSIBILITIES**
- **ACTIVITIES AND ROLES**
  - Launch Campaign Preparation
  - Launch Operations & Awareness
  - Air Traffic Protection
- **TYPE AND FREQUENCY OF ACTIVITY**
- **PROSPECTS AND ENHANCEMENTS**
  - ADIONA Software

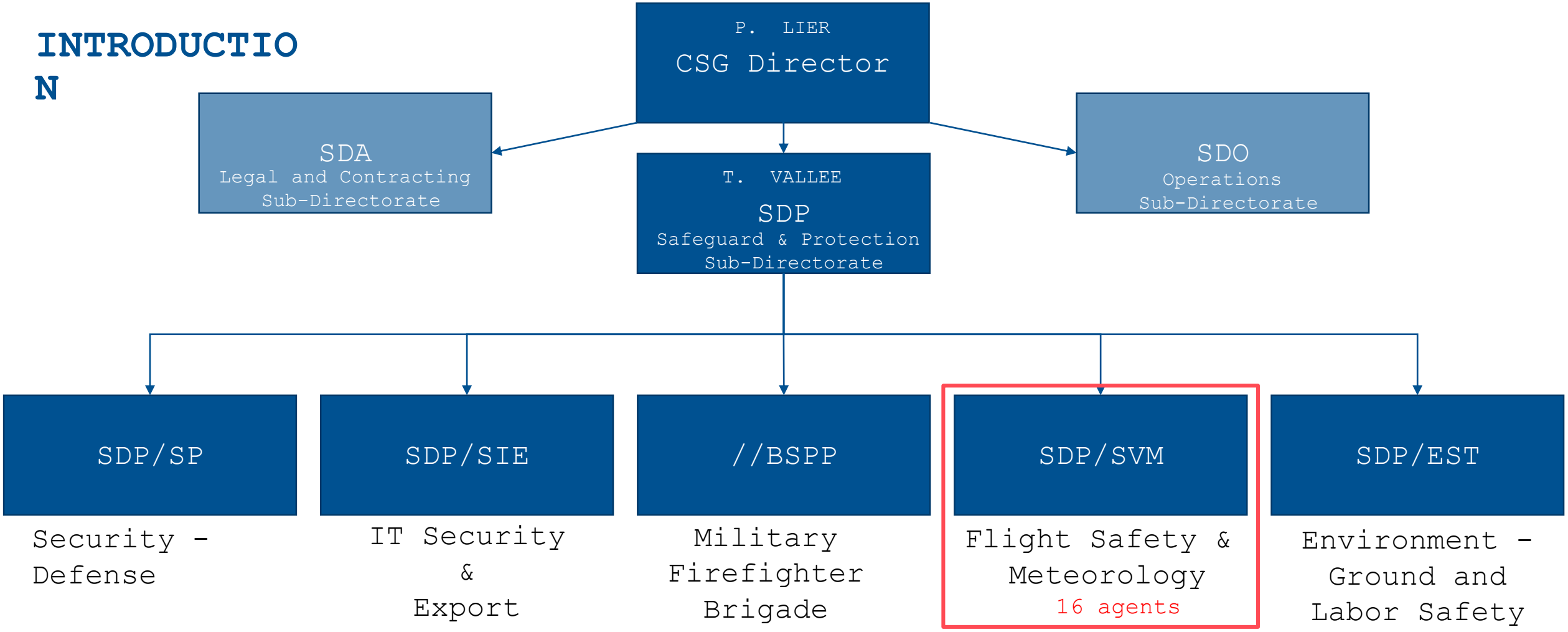

 

# Advantages of CSG for Launch Operators and Flight Safety


- Wide range of launch azimuts from equatorial to polar orbits.
- Launch pad located far away from high-density population areas.
- Wide opening to the ocean offering a considerable amount of unpopulated space for launcher parts fallback areas and mitigation of risks in case of launcher failure.
- No major air or maritime traffic in the near and intermediate range.



# INTRODUCTION



# Operations overview for SDP & SDO Su

T. VALLEE

SDP
Safeguard & Protection
Sub-Directorate

J. MONGIS

SDO
Operations
Sub-Directorate

- SDP :
  - Ground Safety
  - **Flight Safety**
  - Protection of CSG and surroundings (Ground, Air, Sea military forces)
  - Crisis Management Cell (Civil Protection actors)
  - Evacuation of all sensitive sites
  - Presence of State Representatives
  - Permanent information flow
  - Hotline to higher Management branches + International Relations
  - Weather reports for all critical operations (transfers, integrations, launch)

And more…

- SDO:
  - Radar, Telemetry, Telecommand station test, activation on range and downrange (worldwide stations network)
  - Technical Officers in Control Room (Telecom, TM, Range Operations, Tracking,…)
  - Director of Operations interfacing all operational officers
  - Interface with satellite clients and Launch Operators
  - Streamlines action timeline of all actors on base (agency, industrials): who does what and when during launch sequence
  - Manages major milestones on base (Rehearsals, Launch campaign milestones, integration,…)

# The Flight Safety Department, Responsibilities

**Flight Safety department:**

- French Guiana => French governed territory => French jurisdiction => French Authority officiates => CNES; the French Space Agency for space matters
- Controls the compliance of every mission with regards to the French Space Operations Act (FSOA/LOS - called 'Space Law') to ensure during flight, that the protection of people, properties and environment is guaranteed at all times on ground, sea, air and space (ISS, Tiangong) , by delegation of the French government
    - Checks the compliance of the mission (trajectory, ...) submitted by the launch operators.
    - Checks the compliance for the flight safety-concurrent systems of the launcher, submitted by the operators and/or manufacturer.
    - Ensures all concurrent systems' readiness
- Monitors the launch vehicle in flight to ensure protection of populations, environment and assets.

**Flight Safety at CNES/CSG is an independent entity:**

Dedicated Safety Officers are ultimately responsible for ensuring the safety by delegation of the head of CNES.

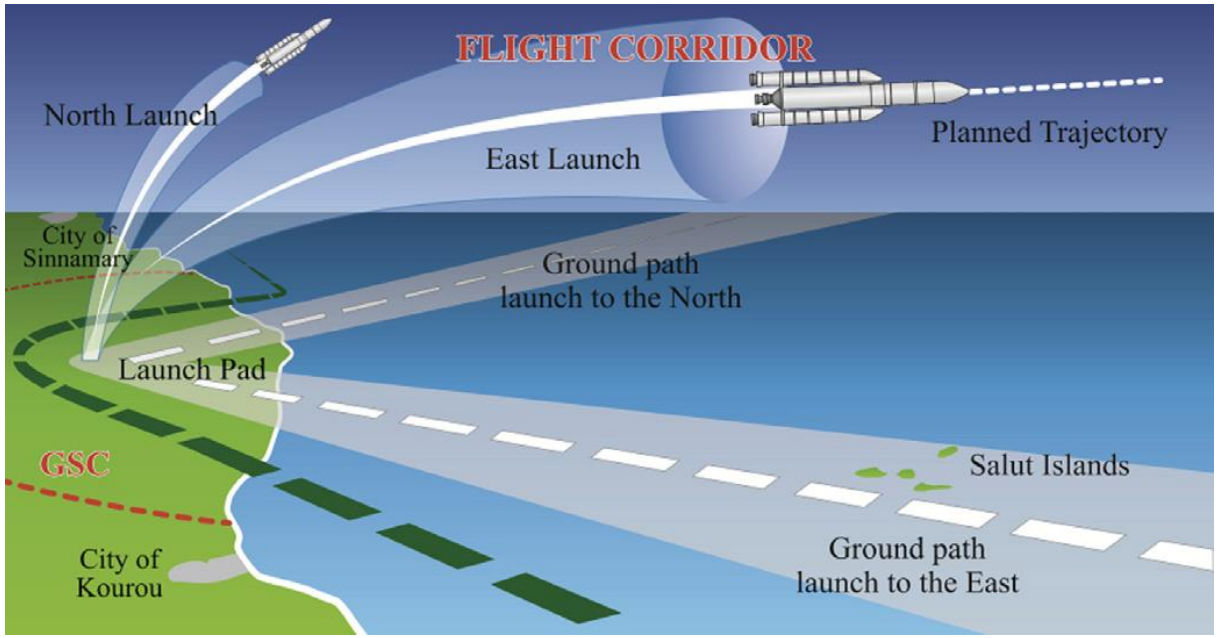
**12 engineers and experts with the same operational assignment, different activities as referents/experts:**

- Neutralization systems
- RF and Communications
- Localization Chains
- Launcher's specialists
- Flight Safety Software Development
- Future Operations Methods
- Downrange Crisis Management
- **Air, Maritime, Space Traffic Safety**
- Law Interfaces

# Launch Campaign Preparation & Operations

**Before the flight, based on planned nominal trajectory:**

- Definition of a safety-qualified flight corridor for the launcher
- Setup of all concurrent systems (telemetry, tracking and telecommand)
- Compatibility with:
  - launcher mission
  - safety of people and properties whatever the launcher failure scenario is (protection against thermal blast, overpressure, projection of debris & toxicity)




**During the flight (as examples):**

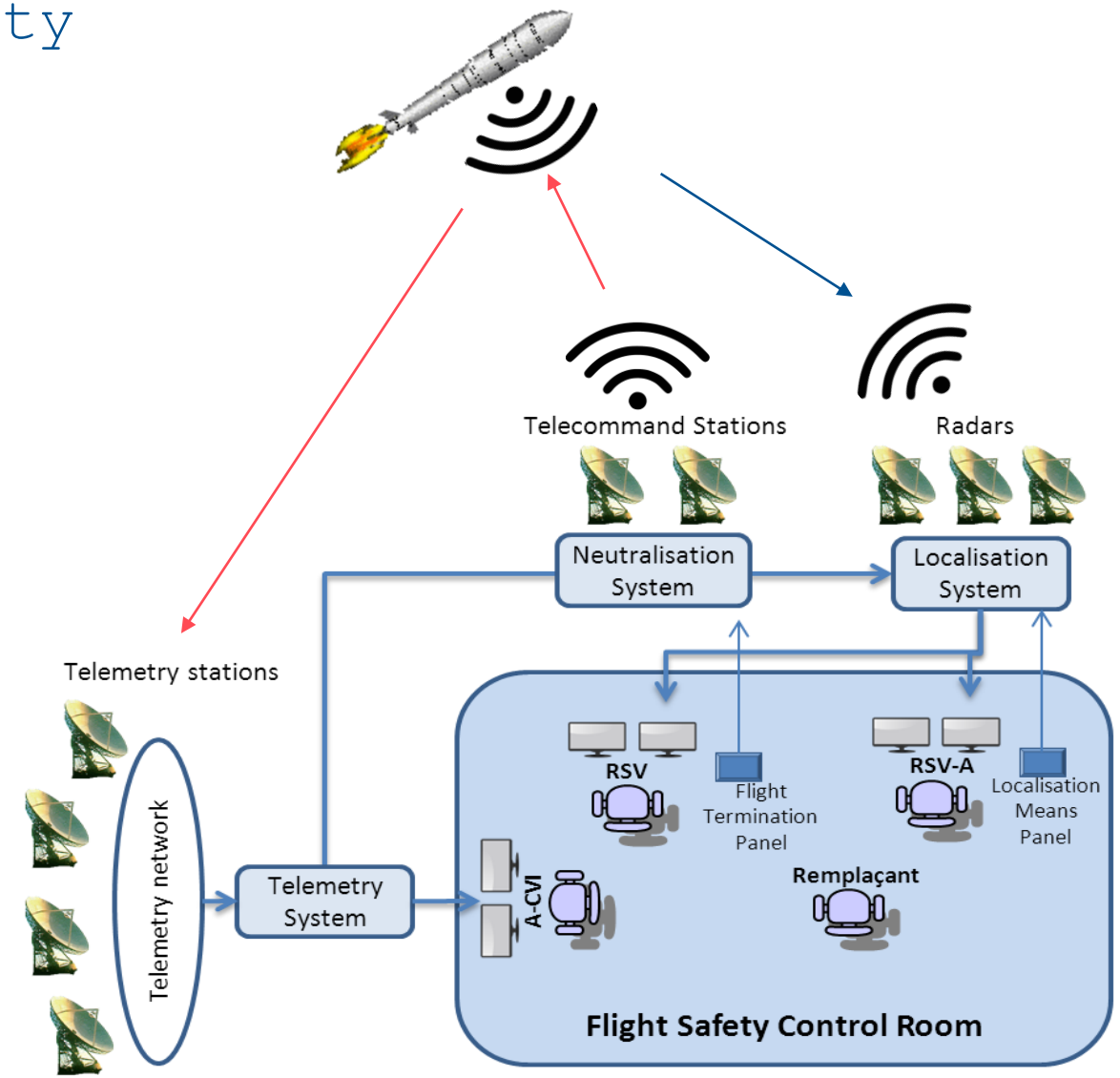
- should the launcher cross the limit of this safety corridor
- or, should the launcher lack energy to reach orbital characteristics

→ Flight Termination is sent from ground by the Flight Safety Team

# Launch Operations for Flight Safety

- Flight Safety Officer (RSV)
- Deputy Flight Safety Officer (RSV-A)
- Telemetry Safety Officer (ACVI)
- Instructor, Safety Weather Compliance Officer (Remplaçant)

- **Flight divided into 2 major parts:**
  - Intervention and Safety Mission (MSI)
    - Telecommand station within range of launcher
    - Possibility to Intervene
    - No Land Overfly
  - Surveillance and Alert Mission (MSA)
    - Telecommand station out of range
    - Observation until orbital parameters reached
    - Awareness until all constituent bodies are deorbited/ decommissioned



# Launch Operations

- **Flight Safety monitors launch sequence:**
  - Separation of stages
  - Ignition of upper stages
- **Example with Ariane 5 Solid Boosters:**

# Analysis and Declaration of Fallback Zones

- **In the process:**
  - Reception the launcher's trajectory from the launch operator and determine the fallback zones from the different rocket stages.
  - Authority (CNES) analyzes & verifies format of the nominal Fallback Zones (ZR) of the rocket stages
  - Delimitation and Mapping of the zones (fichiers .kml)
  - Superposing these zones onto EEZ, FIR and Territorial Waters (+ marine areas, offshore P/F, etc) in the world and verify the compliance of the rocket's trajectory with the French Space Operations Act's ('Space Law') jurisdiction:
    - No TW impact
    - No land impact
    - Guaranteeing the protection of Marine protected areas
    - Avoiding dense offshore platform areas and dense marine traffic

- Information are then sent out to all organisms subjected to the declaration of NOTAMs: mainly the FIRs, but also global stakeholders (IATA, CADENA, EUROCONTROL,…).

# NOTAM Request

- NOTAMs are valid from the scheduled launch day on until 10 days after the originally scheduled launch date unless a protocolary note is issued to the FIRs for them to cancel the NOTAMs after a successful launch.
- The launch operator provides a launch window, in which the danger zones that will be subject to NOTAMs, is delivered.
- The launch can be scrubbed in the last seconds. If the launch is delayed for more than 10 days after the originally scheduled launch date:
  - Re-declaration of NOTAMs is being made with the same duration as mentionned under keypoint 1 above.

- **Sample: VV23 Launch (10/2023)**

- Launch date confirmed to authorities after successful LRR
- Hazard areas cleared after successful launch at the end of specified time

| *Dangerous Zone* | *Zone Boundaries* | *Day Activation* | *Time Activation* | *Impacted FIR* |
|---|---|---|---|---|
| **SOR 4**<br>(FORBIDDEN) | **REFERENCE** | 04 October 2023 - 09:00 UTC<br>to<br>15 October 2023 - 02:06 UTC | Continuously | **SOOO** |
| **SOD1 & SOD2** | **REFERENCE** | 05 October 2023<br>to<br>15 October 2023 | Each day<br>From 00:36 UTC to 02:06 UTC | **SOOO** |
| **ZA/VV23**<br>P80 Falling Area | **0858N5250W**<br>**0858N5245W**<br>**0758N5245W**<br>**0758N5250W** | 05 October 2023<br>to<br>15 October 2023 | Each day<br>From 00:36 UTC to 02:06 UTC | **SOOO** |
| **ZB/VV23**<br>Z23 + Fairing Falling Area | **1846N5415W**<br>**1847N5406W**<br>**1701N5354W**<br>**1700N5404W** | 05 October 2023<br>to<br>15 October 2023 | Each day<br>From 00:36 UTC to 02:06 UTC | **TTZP**<br>**KZWY** |
| **ZC/VV23**<br>Z9 Falling Area | **8132N13053W**<br>**8209N12936W**<br>**8033N17503E**<br>**8002N17723E** | 05 October 2023<br>to<br>15 October 2023 | Each day<br>From 01:44 UTC to 03:00 UTC | **PAZA**<br>**CZEG**<br>**UHMM** |
| **ZD/VV23**<br>AVUM Falling Area | **1050S9036E**<br>**1105S9157E**<br>**2516S8847E**<br>**2503S8719E** | 05 October 2023<br>to<br>15 October 2023 | Each day<br>From 03:45 UTC to 05:01 UTC | **YMMM** |

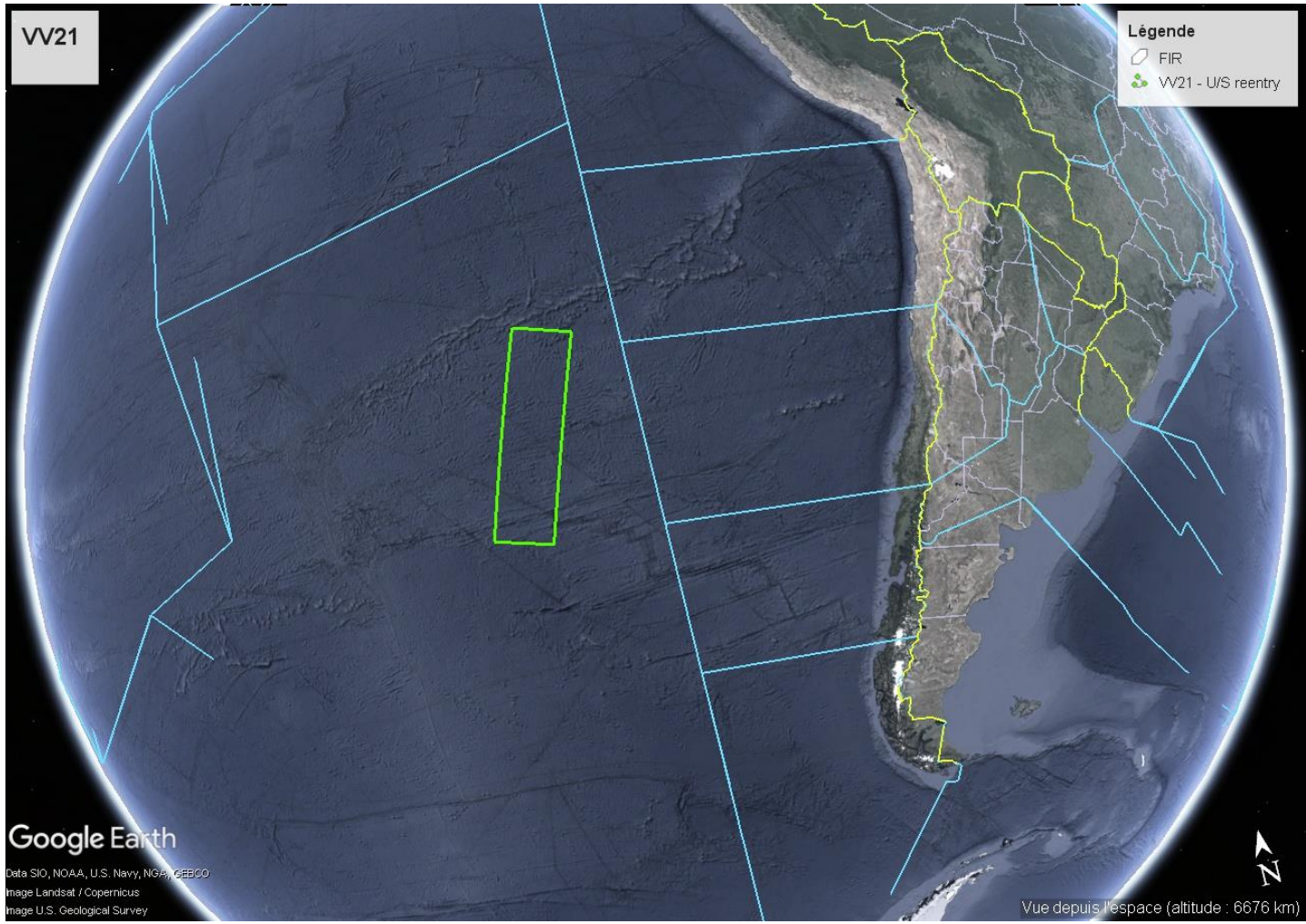
# Meaning and size of Space NOTAM from CSG

- The declared zones solely depict the nominal fallback zones of rocket stages and parts, calculated with a probability of 1.10^-2 (99%).

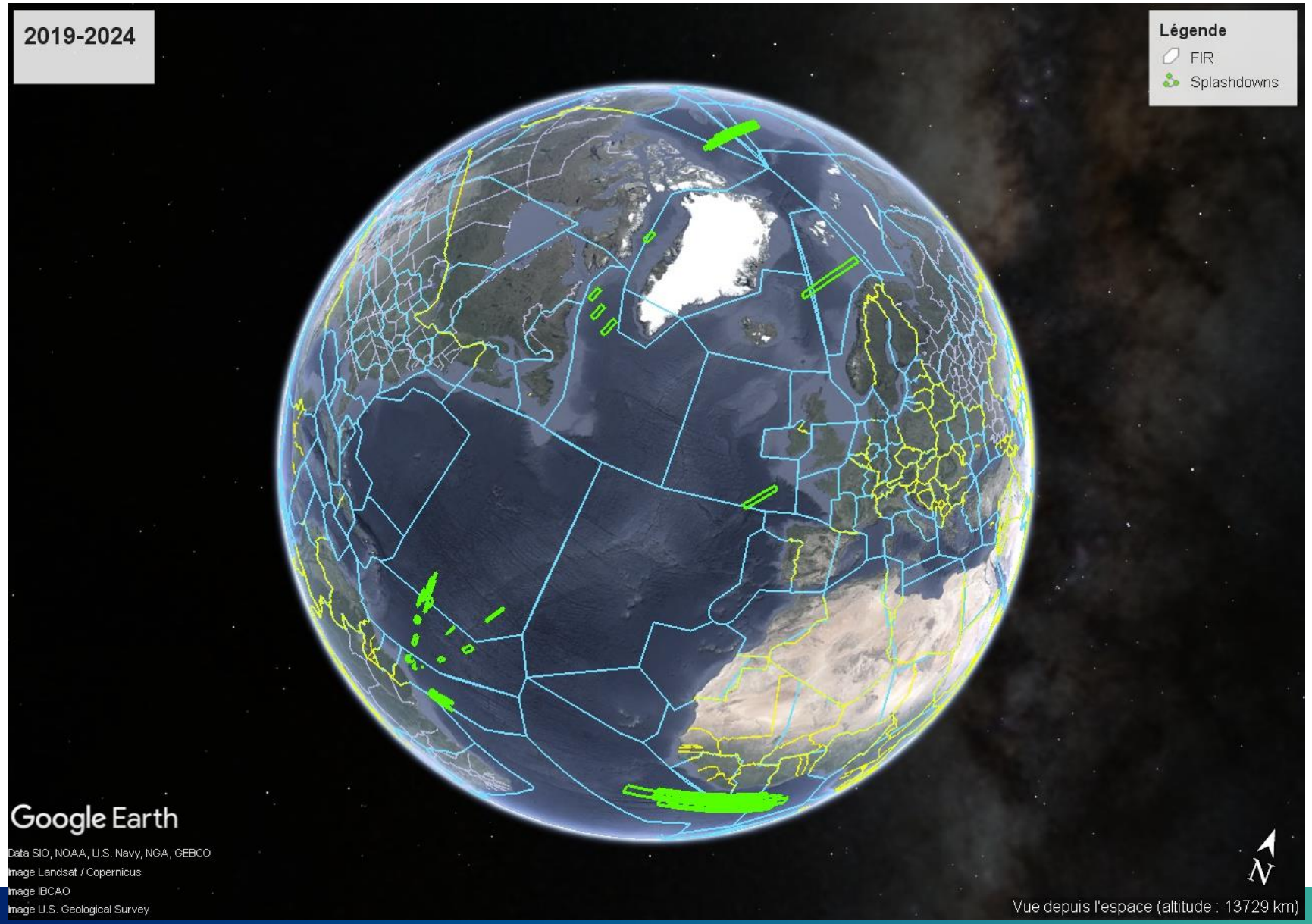
- Parallelepiped delimited with 4 points A, B, C and D situated with geographical coordinates for each rocket's element fallback.

- NOTAMs are declared alongside with NAVAREA Warnings (or AVURNAV in French) to be received by seamen.

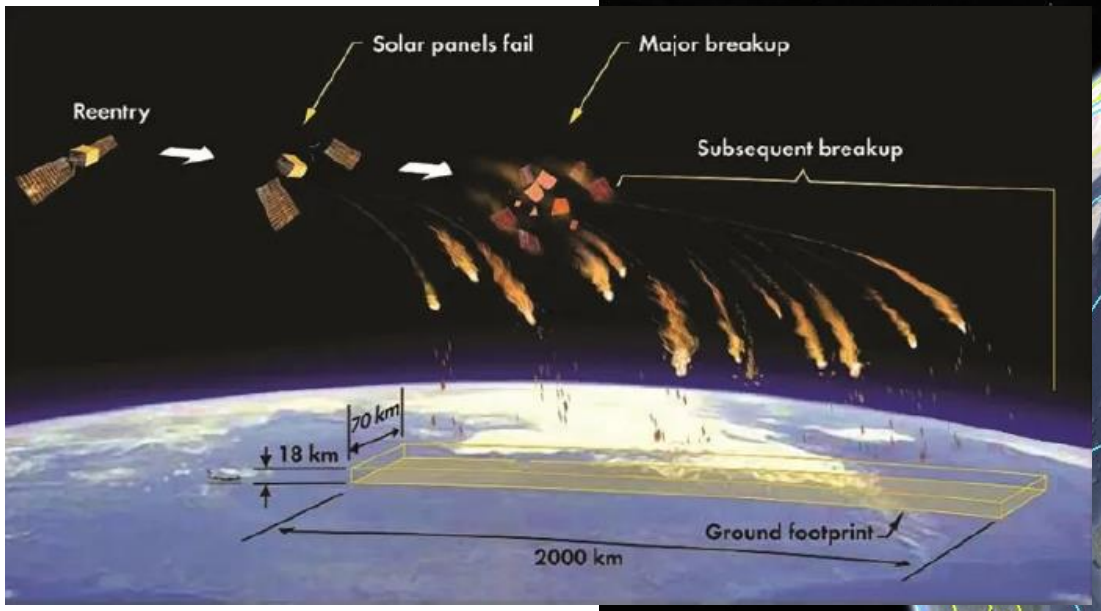
- Size depends on ballistics: separation and fallback/deorbiting…

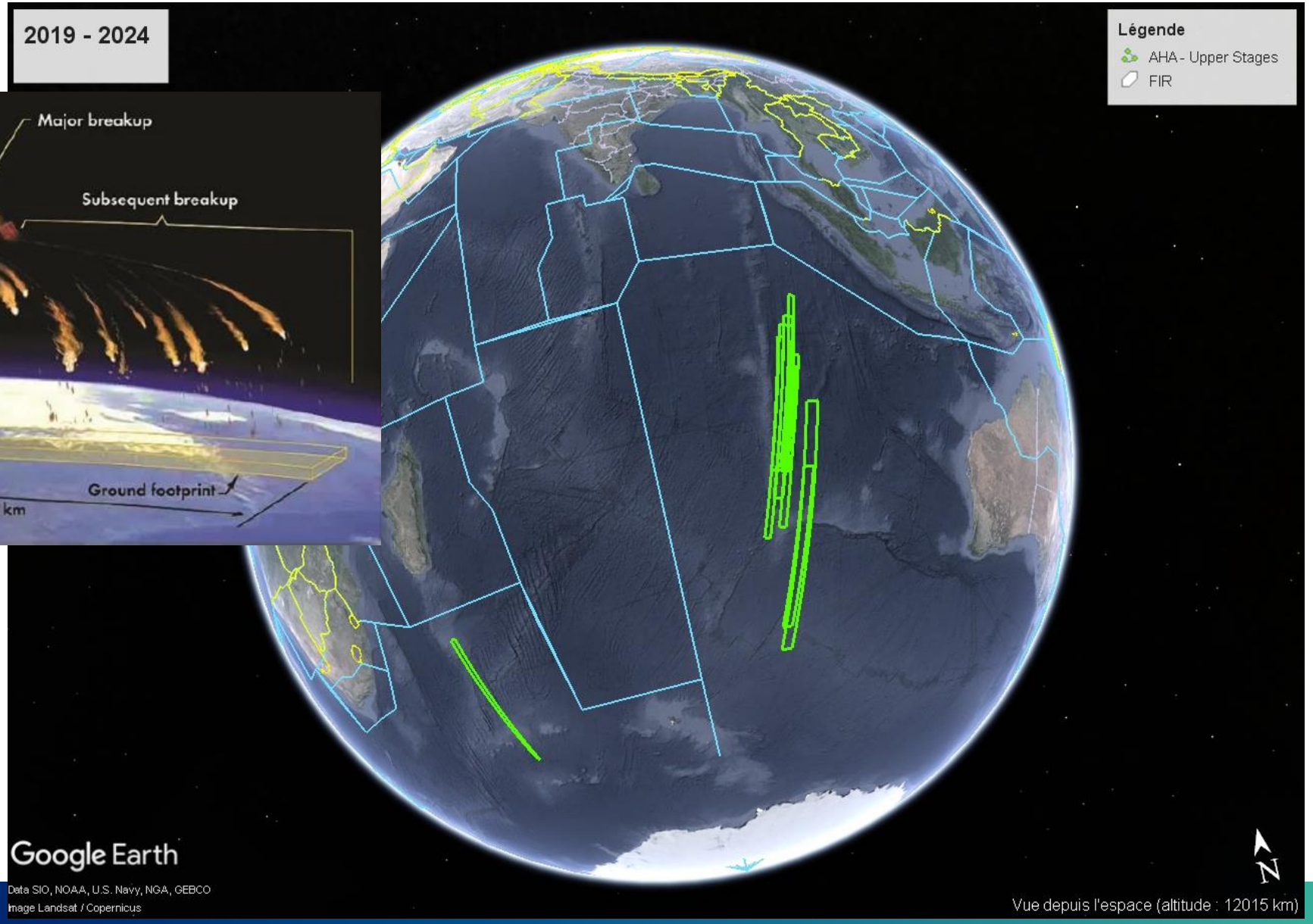


# Stages Splashdowns, near and intermediate range - since September 2019



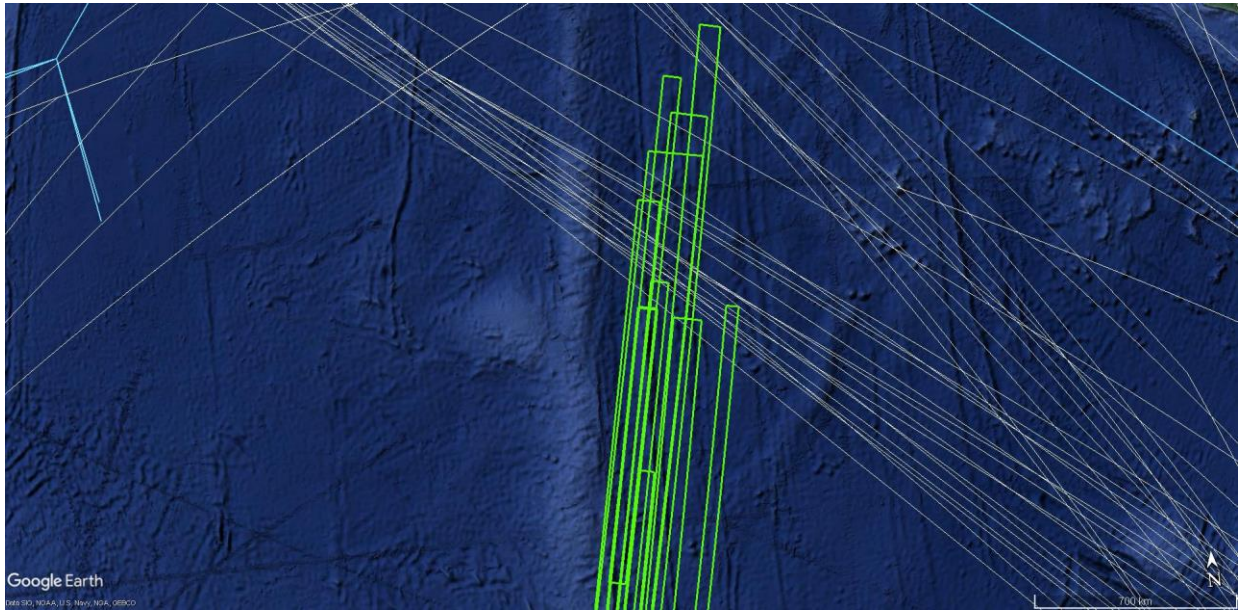
# Stages Reentries, far range (focus on Indian Ocean) - since September 2019

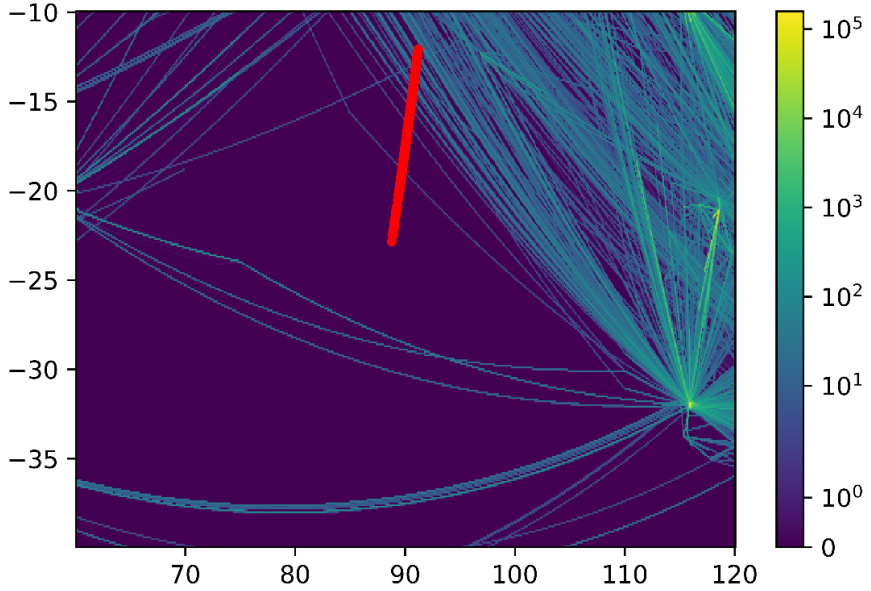


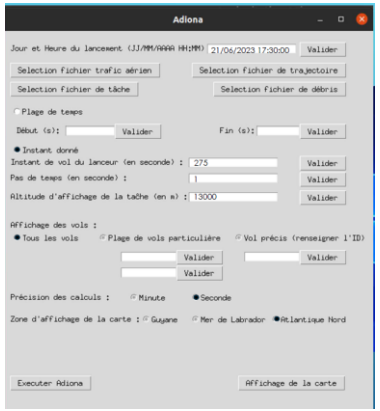



# Prospects: Preliminary Software Development of ADIONA

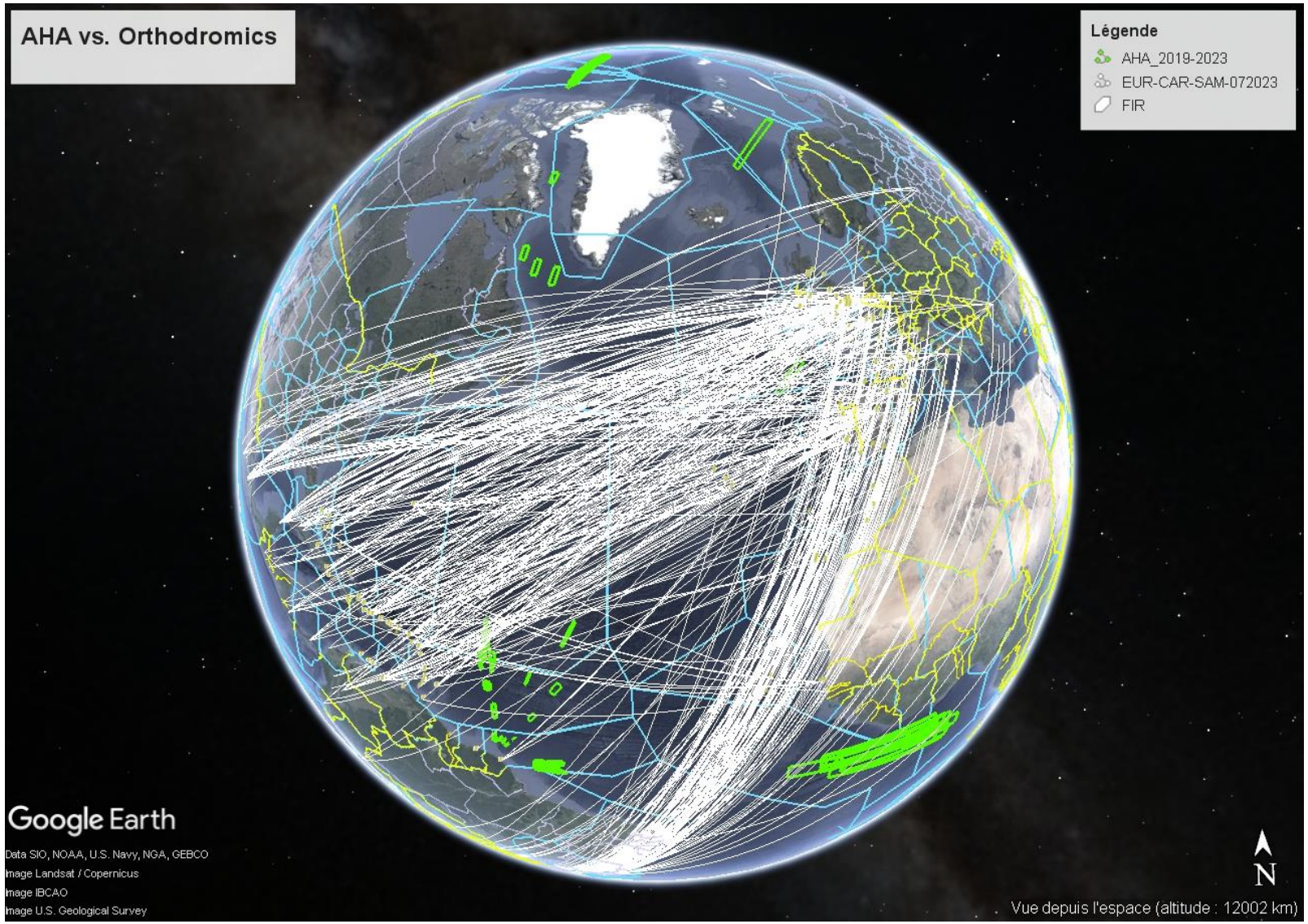
- High-Level Architecture, multipurpose, processing Air Traffic and Space Traffic (Trajectories) Data.
- Aims to study, assess and mitigate the impact of launch and reentry activities from CSG on world air traffic:
  - AT impact study of nominal splashdown zones
  - AT impact & risk study on splashdown zones resulting from deviated trajectories
  - Probabilistic risk method embedding
  - Mishap studies and resulting risks on AT
  - Operational solutions (time evaluation, rerouting options)
  - Ideal launch slots suggestions to Space Operators
  - Maximum acceptable deviation (i.e. how much can a rocket go off trajectory until its splashdown zones pose a threat to AT)



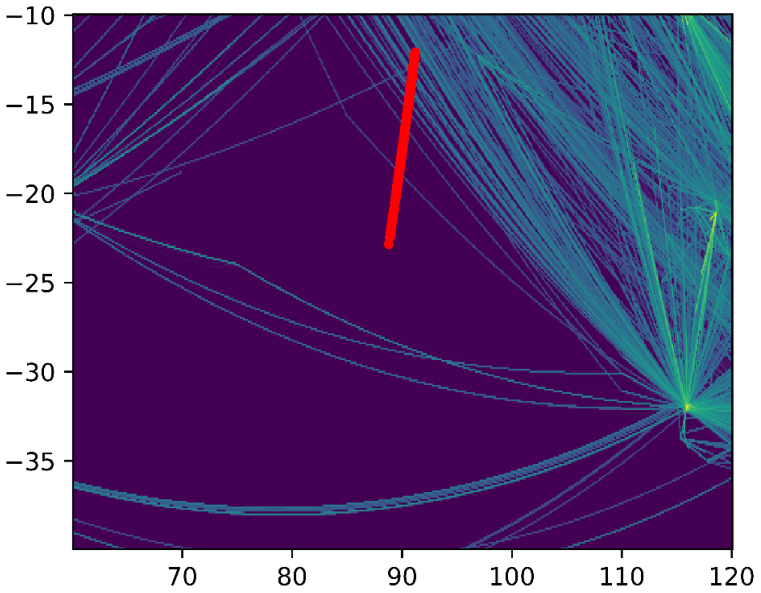



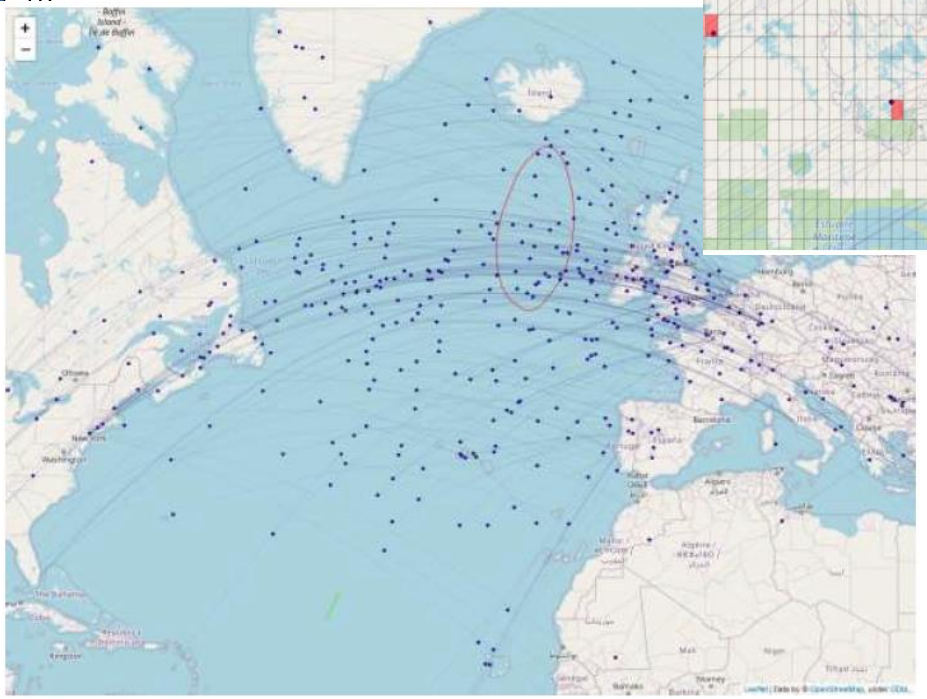



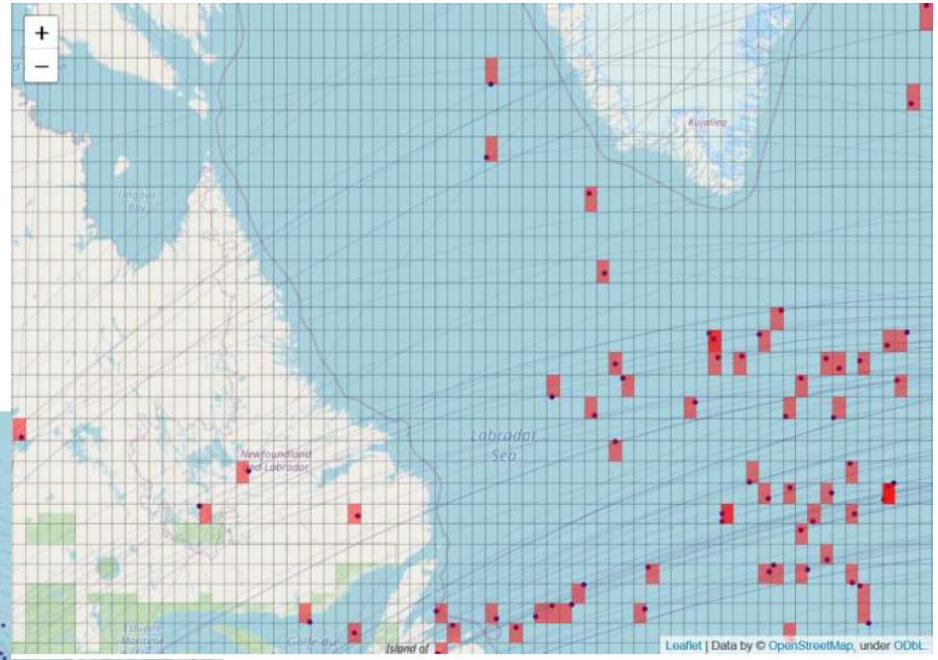
# ADIONA - Cataloguing and processing hundreds of thousands of data – Analyzing Impacts on AT



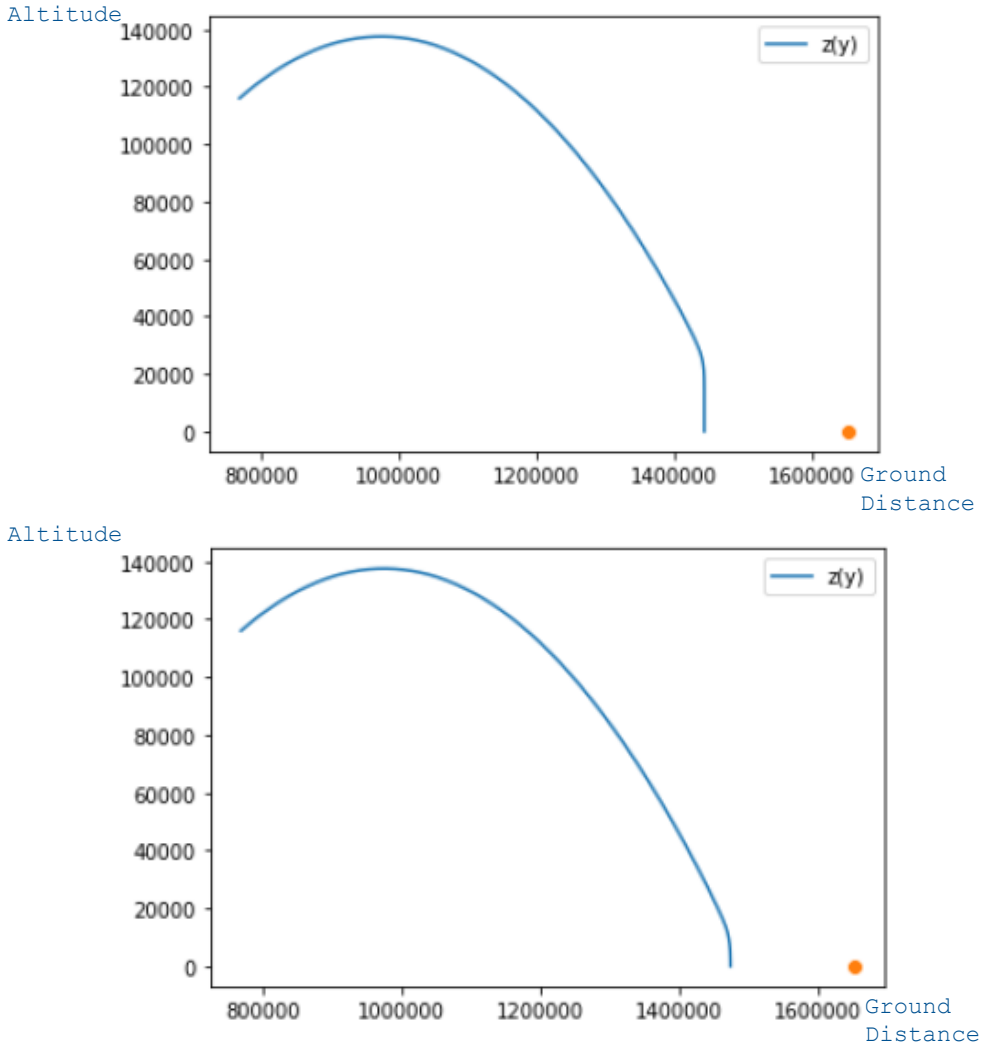
# ADIONA – Risk study and Probabilistic approach for deviated trajectories / mishaps

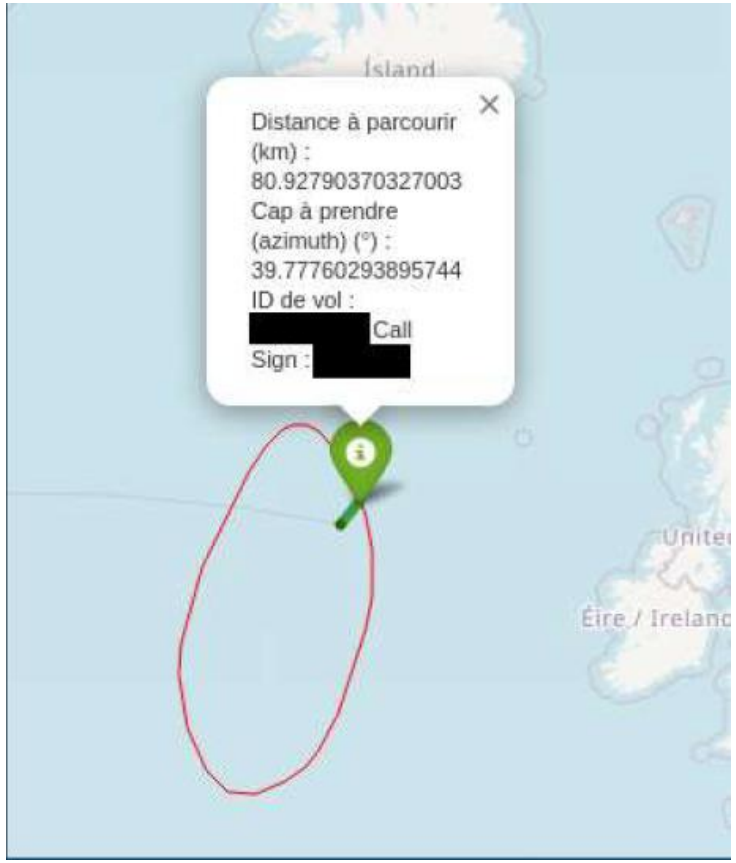


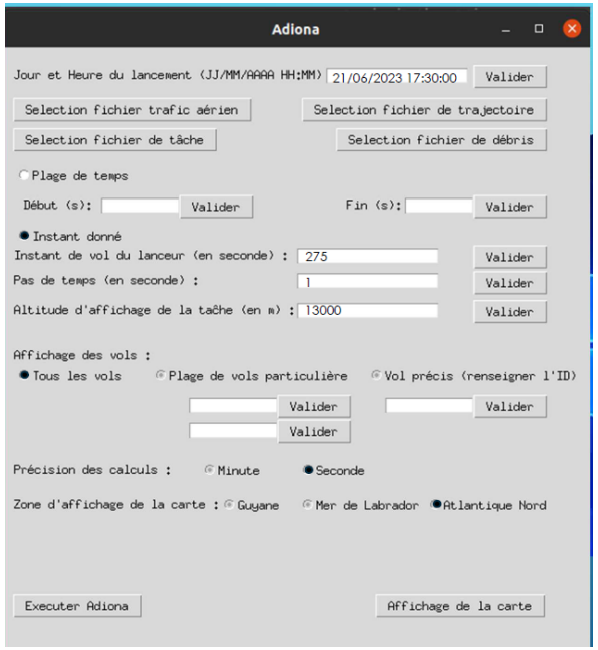





# ADIONA – Basic Ballistic Models – Drafting Operational Solutions



# Enhancements supported by CNES

- Tight cooperation with Cayenne Control (protocol, learning visits,…)
- Regular CADENA meetings & Briefings
  - Regional coordination with local authorities, FAA, FAA ATO Space Ops,
    Airlines, stakeholders for wider awareness
  - Sharing good practices

- Encouraging MOUs with ANSPs for enhanced cooperation
- Open communication with Launch Operators
- Tactical Hotline capacity with ACCs
- Technical investigation for seamless inclusion of AT into Space Ops
- Earlier broadcast of novel operations and ongoing projects to ANSPs:
  - Reentry capsules
  - New launchers
  - Reusability
  - Demonstrators
- Open discussions with international partners for better tracking and observation of stages' splashdowns and debris footprints


Source: cadenaois.org

# THANKS FOR YOUR ATTENTION

# ANY QUESTIONS ?

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