

SCIENCE CONOPS FOR APPLICATION OF SPORT MISSION DATA TO STUDY LARGE (~1000KM) IONOSPHERIC PLASMA DEPLETIONS

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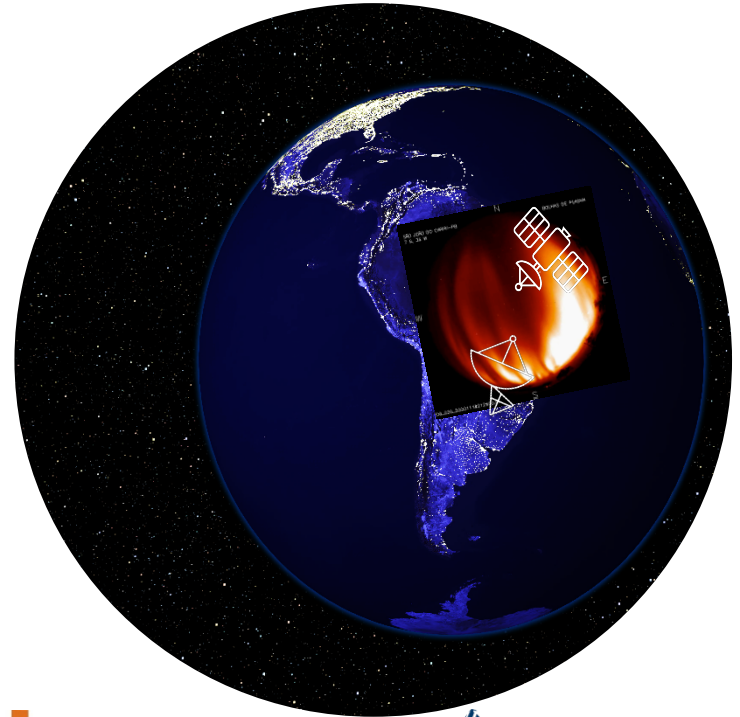
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EMBRACE
ESTUDO E MONITORAMENTO BRASILEIRO DO CLIMA ESPACIAL
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

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Day's last: R0 | G0 | S0
Day's max: R0 | G0 | S0
Latest event: R1 | G1 | S0

EMBRACE DETECTS IONOSPHERIC DISTURBANCE OVER THE SOUTH AMERICA DUE TO THE VOLCANIC ERUPTION IN THE TONGA ARCHIPELAGO

The underwater volcanic eruption that occurred in the Tonga archipelago (175.4° W, 20.6° S) on January 15, 2022, at 4:15...

X-Ray Flux
X-Ray Flux (GOES-16)
1 minute data - (06/30/2022)

Ksa Index
EMBRACE Magnetometers Network
Ksa index - (06/30/2022)

Kp Index Forecast
Kp index
Observation and Forecasting

Search

Daily Sun

Courtesy of NASA/SDO and the AIA, EVE, and HMI science teams. [More details.](#)

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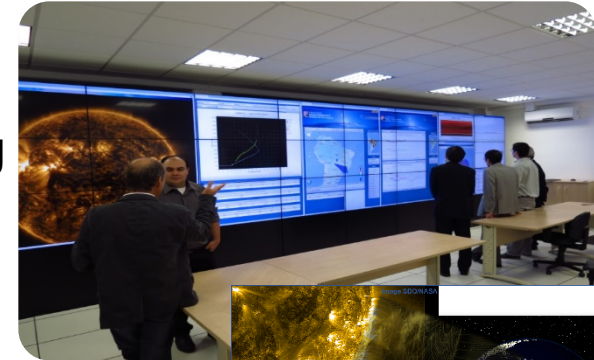
MOTIVATION: Enhance Space Weather Ops



Daily bulletins in [Portuguese and English]

Visitor Center

- A portal for space weather monitoring
- Data and Products
- Free data access



<http://www2.inpe.br/climaespacial/portal/en/>



AEROSPACE

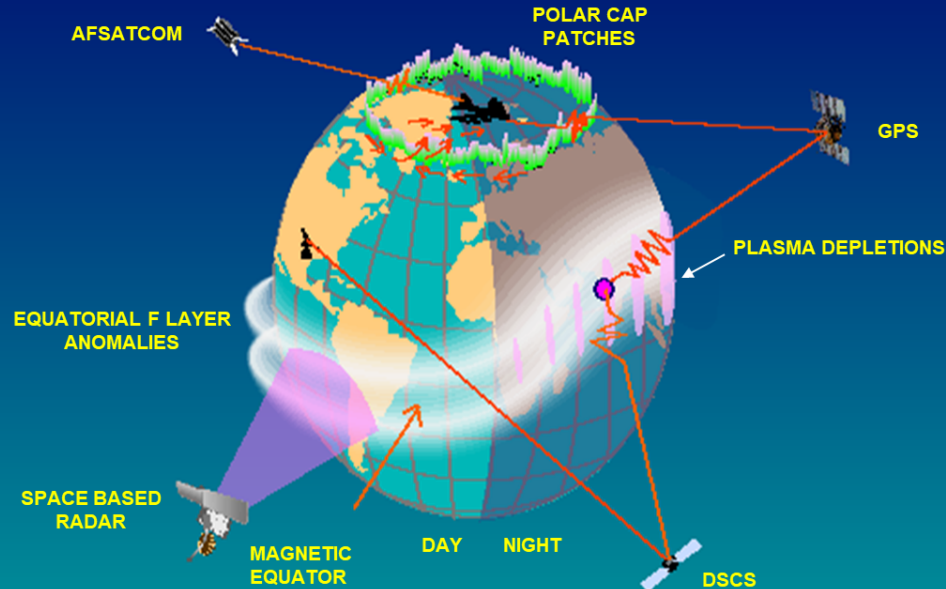


UAH
The University of Alabama in Huntsville



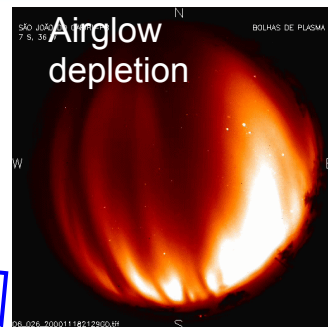
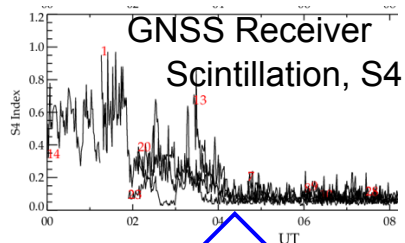
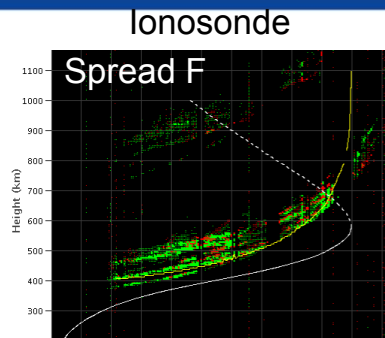
MOTIVATION: Enhance Ability to Predict Comm/ Nav Outages

GLOBAL COMM/NAV OUTAGE REGIONS

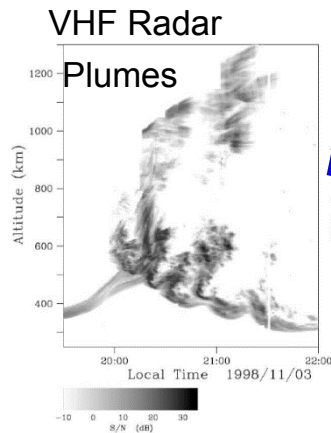


- **Space Weather** storms create turbulent plasmas in our upper atmosphere
- Plasma turbulence can lead to radio wave scrambling (AKA "**Scintillation**")
- GPS and other GNSS signals can experience **outages**, sometimes for hours

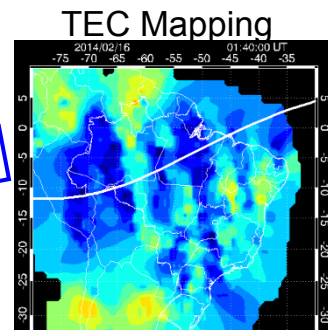
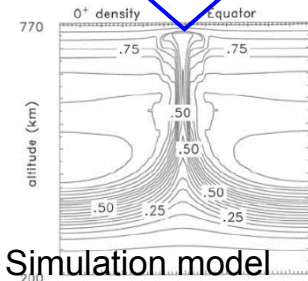
The Culprit: Equatorial Plasma Bubbles



6300 airglow imager



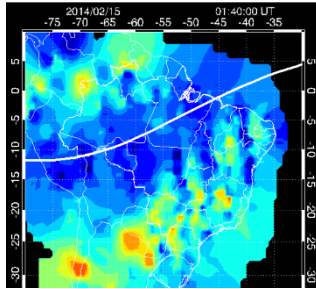
Equatorial Plasma Bubbles



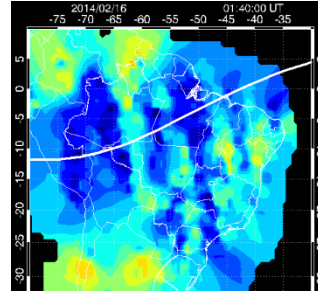
Source: Workshop for EPB Campaign, 25-26 September 2019
Hisao Takahashi

Background: Periodic Plasma Bubble structures

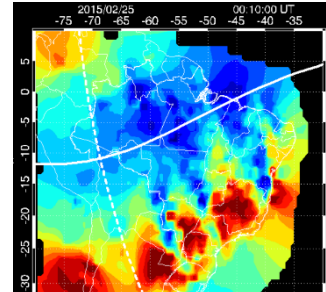
2014 Feb. 15,
01:40 UT



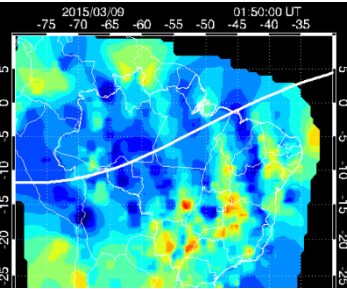
2014 Feb. 16,
01:40 UT



2015 Feb. 25,
00:10 UT



2015 March 9,
01:50 UT



Bubble scales: 1 - 1000 km

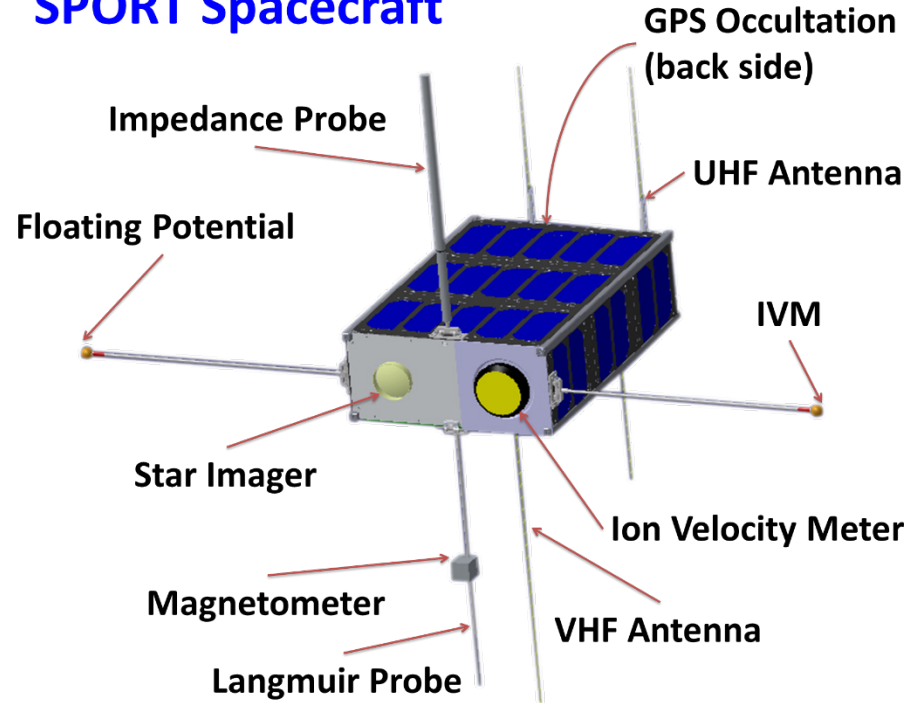
Periodic structures occur most frequently in February and March.

BUT this is for the Brazilian longitude sector. What about the others?

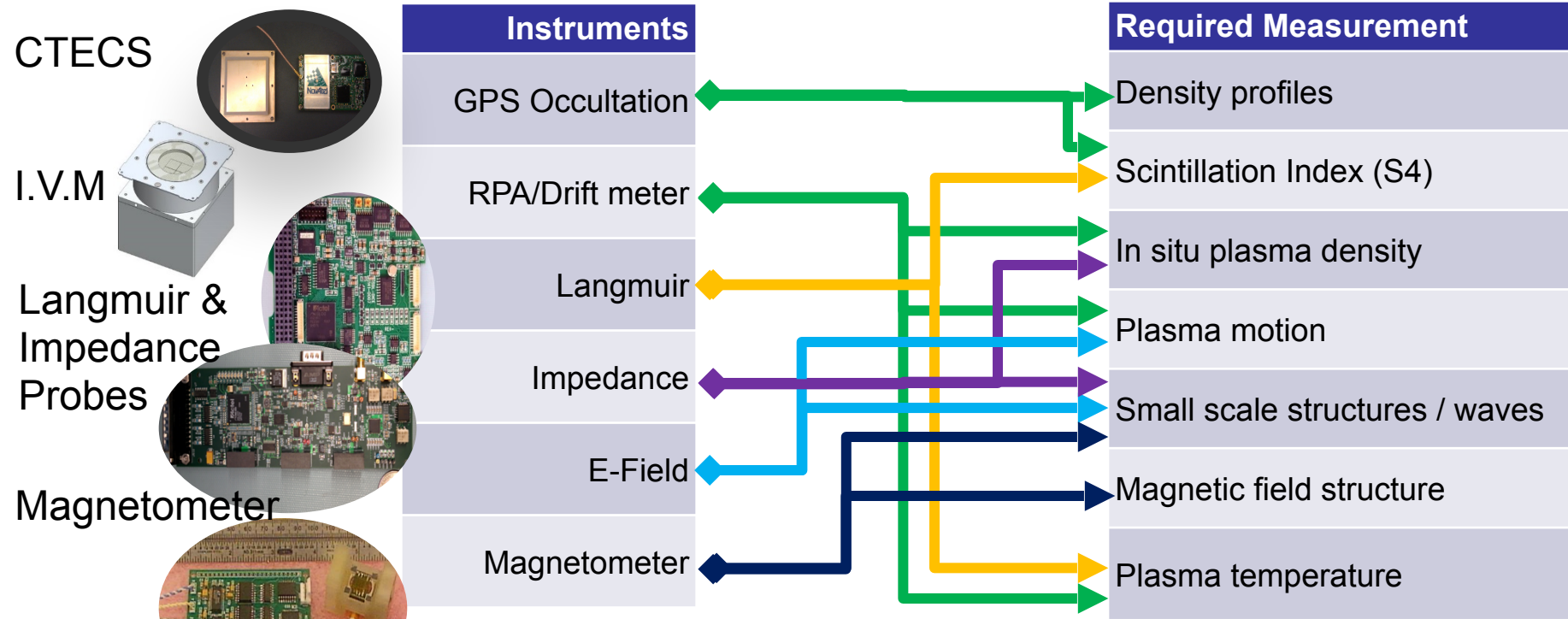
Science Goals

1. What is the state of the ionosphere that gives rise to the growth of plasma bubbles that extend into and above the F-peak at different longitudes?
2. How are plasma irregularities at satellite altitudes related to the radio scintillations observed passing through these regions?

SPORT Spacecraft

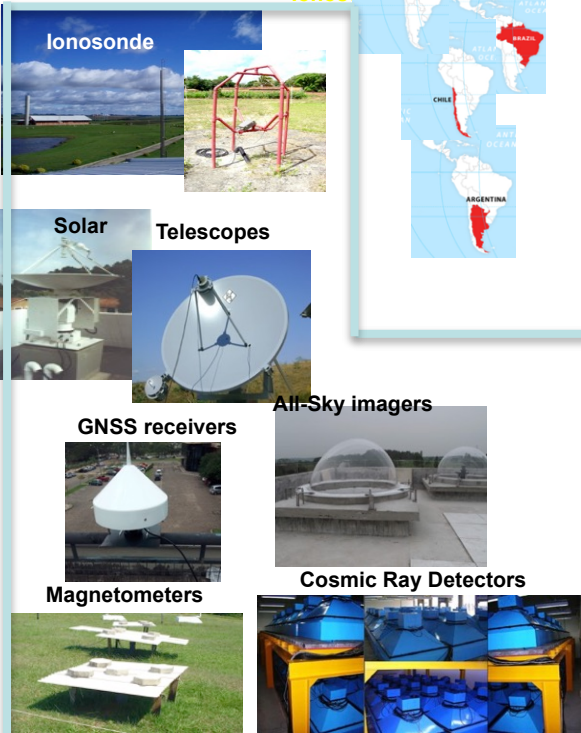


SPORT Instrument Measurement Mapping

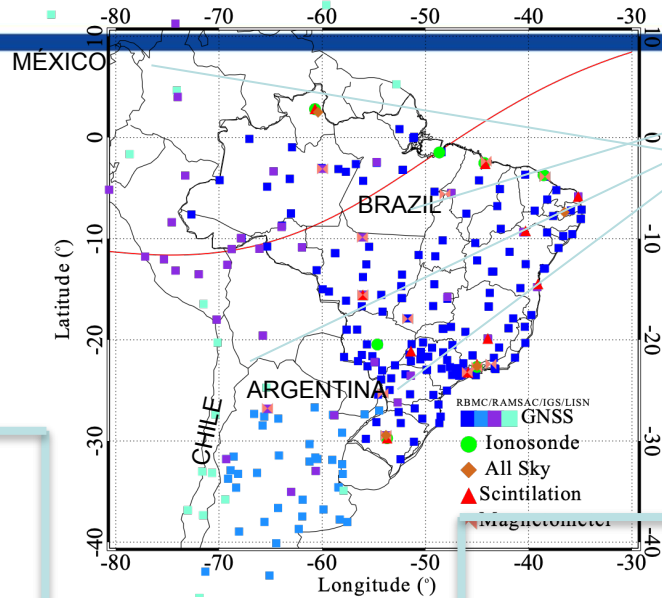


Instrument network and Services in Latin America

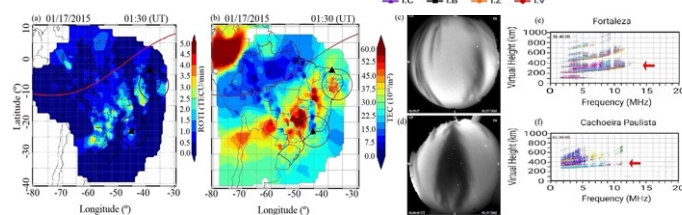
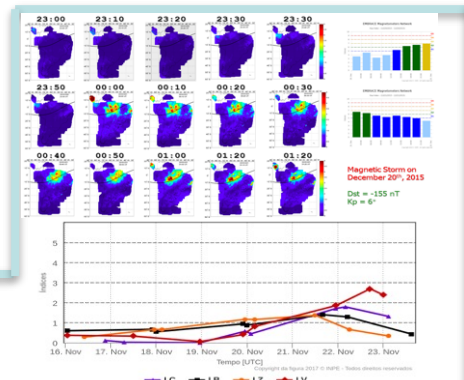
Instruments



- Ionosonde**
- Solar Telescopes**
- GNSS receivers**
- Magnetometers**
- Cosmic Ray Detectors**
- All-Sky imagers**



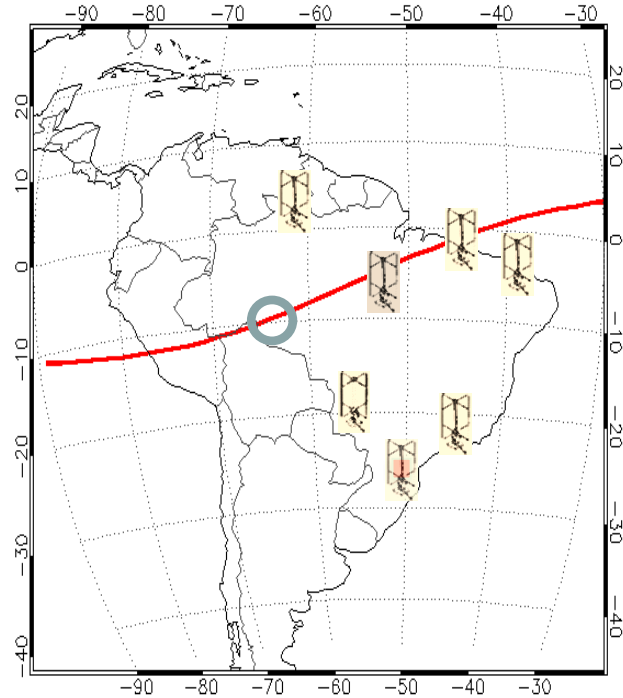
International Cooperation Products



Ground-Based Digital Ionosondes → Plasma Density

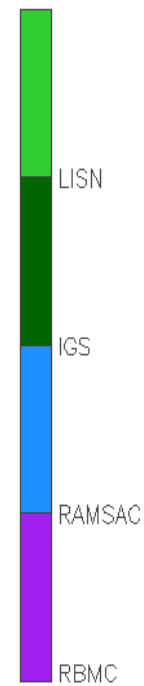
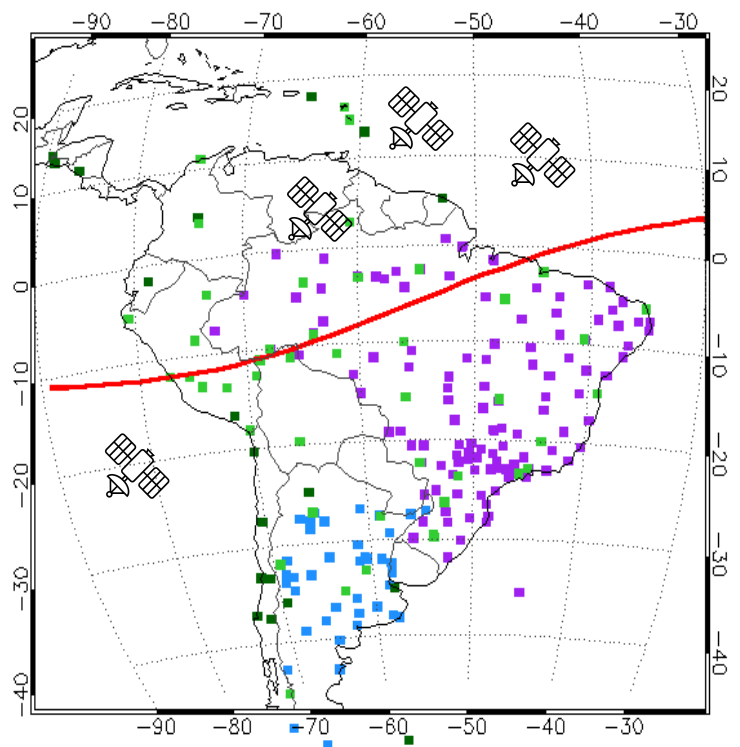


- **Digisonde** network that monitors ionosphere of **E** and **F** layers in **seven** locations over Brazil

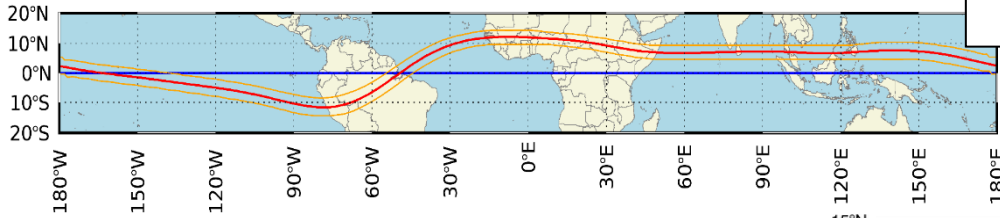


Ground-Based GNSS Receivers → TEC

A network of over 200 **GNSS** monitors (sixteen of them measuring **S4 index**).

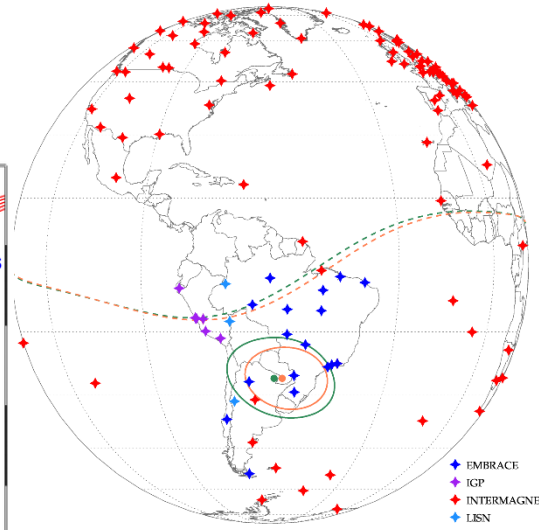
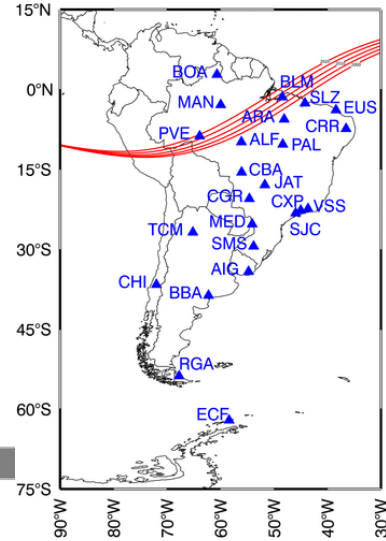


Ground-based Magnetometers



Geographic equator
Magnetic equator

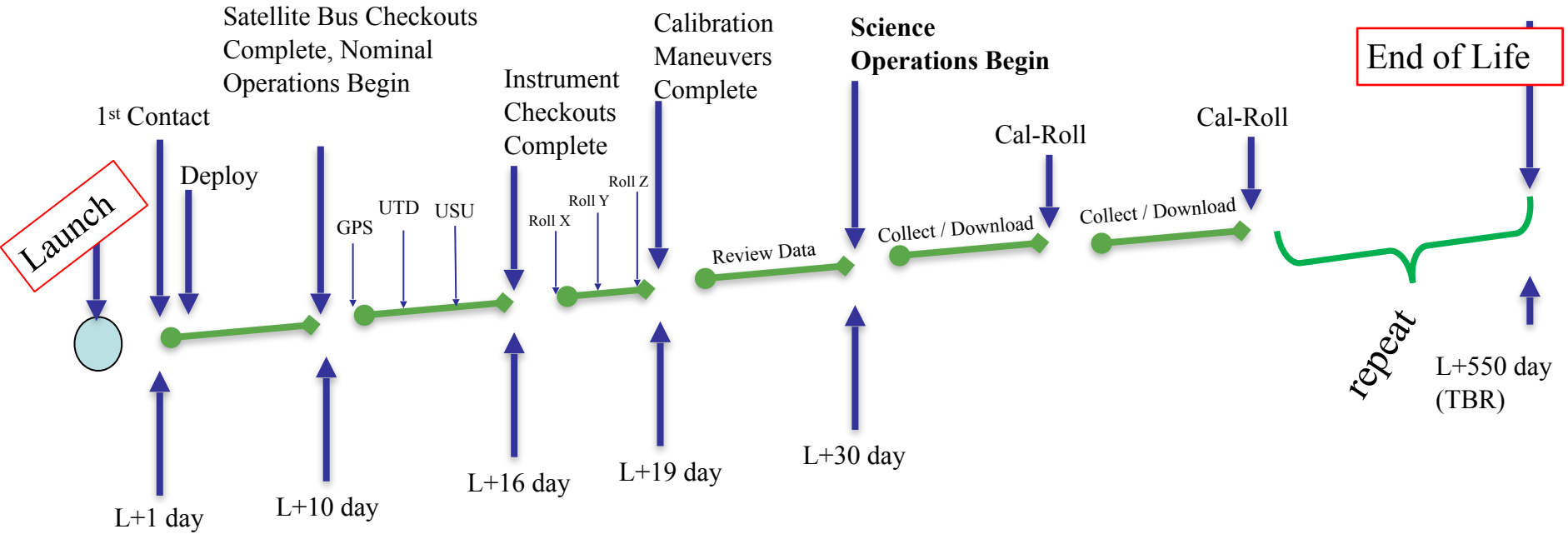
- 19 magnetometers installed by EMBRACE magnet (three outside the Country)
- 5-year plan for 30



sony.chen@inpe.br

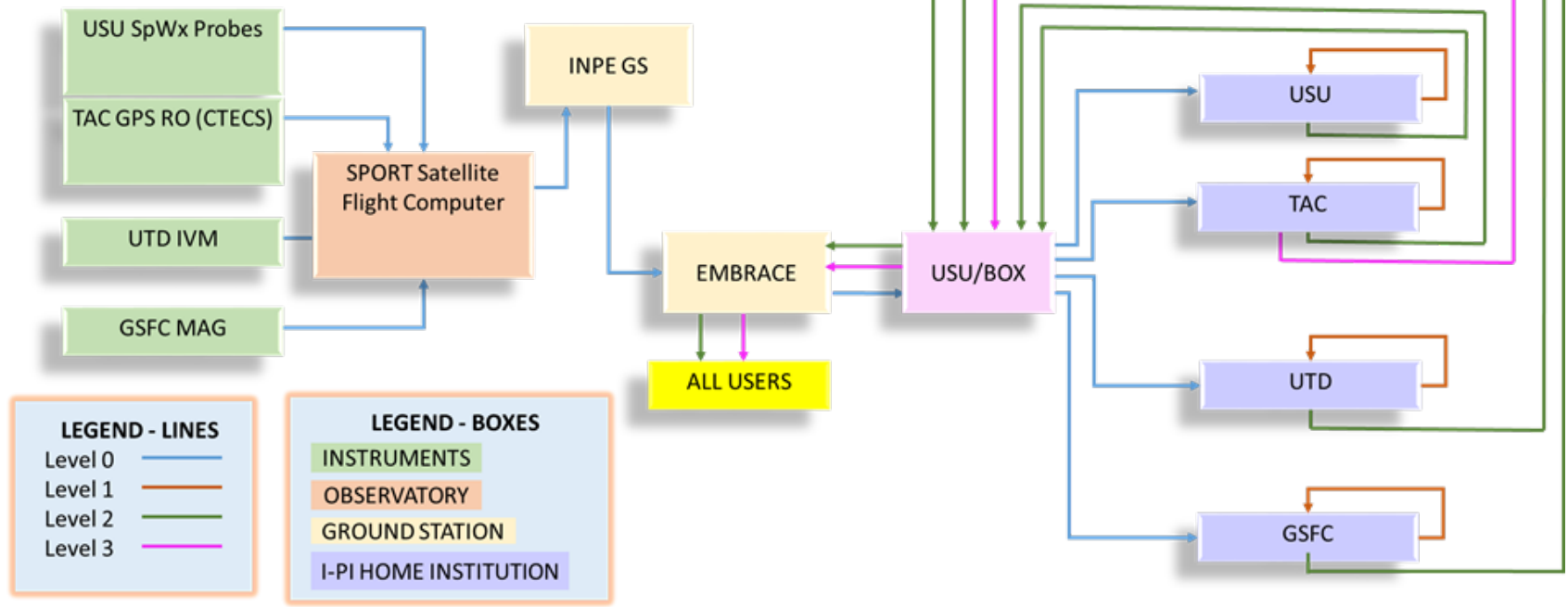
9 de novembro de 2021

SPORT Mission Timeline Concept



SPORT Mission Data Flow







On-Orbit Data Flow from Instruments to Users



Data Sharing

<https://embracedata.inpe.br/>

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<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Descri</u>
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 JAT/	2022-02-24 12:56	-	
 MAN/	2022-04-26 13:39	-	
 MED/	2022-02-24 12:56	-	
 PAL/	2022-02-24 12:56	-	
 PVE/	2022-02-24 12:56	-	
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THANK YOU



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