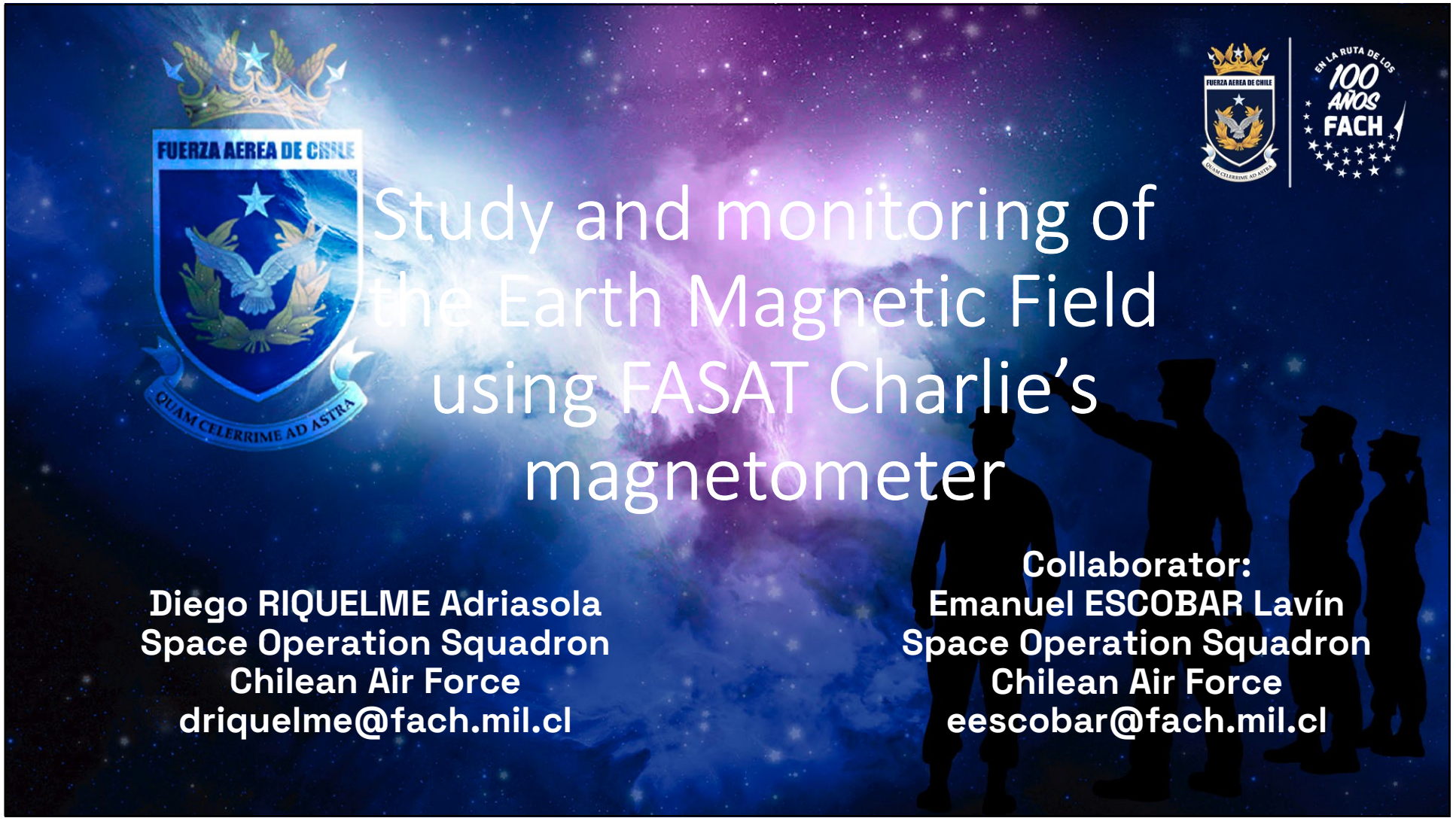

Study and monitoring of the Earth Magnetic Field using FASAT Charlie's magnetometer

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Schedule

- About FASAT Charlie
- Motivation
- Instruments
- Considerations
- Methodology
- Results & Analysis

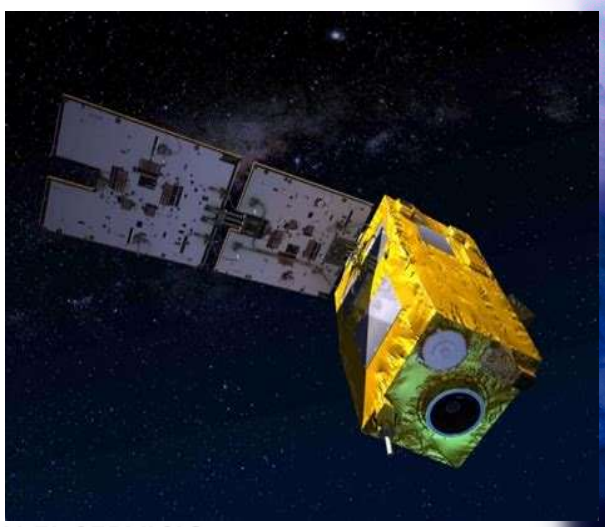
About FASAT Charlie

Operation since 2011:

- Observation satellite
- Designed for 05 operational years of life
- However, 11 years of operation has been achieved

Satellite imagery use:

- Military
- Civilean



Motivation

- Peaceful use of a defense satellite for scientific purposes
- Perform satellite data analysis of sensors and actuators
- Study applied on Space Weather:
  - Understanding international model (The US/UK World Magnetic Model)
  - South Atlantic Anomaly and its consequences for satellite operations
  - Space awareness and diffusion

Instruments: Magnetometer

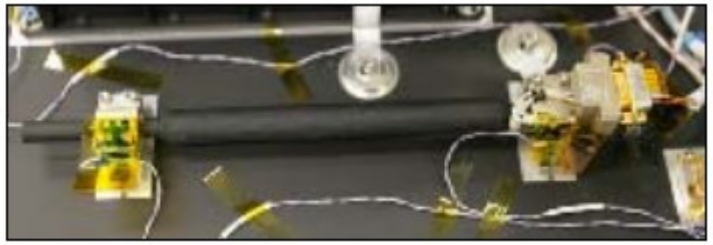
- Used to sense the Earth's magnetic field
- There is 01 magnetometer on board
- Data is used by the satellite to guide itself

Measured axes	**3 axes**
Measurement range	**+/- 6.10-5 T**
Measurement noise	**2.10-9 T**
Bias	**+/- 5.10 -7 T**
Mass	**0.18 Kg**
Power consumption	**0.8 W**

Instruments: Magnetotorqueur

- Used to guide the satellite
- There are 03 magnetotorqueurs on the satellite
- Using electric current and the Earth's magnetic field, a torque is generated in the sector where it is mounted

Magnetic momentum	**> 10 Am^2**
Residual momentum	**0.08 Am^2 max**
Time constant	**45 ms**
Mass	**0.220 Kg**
Power consumption	**1.1 W @ 10 Am^2**

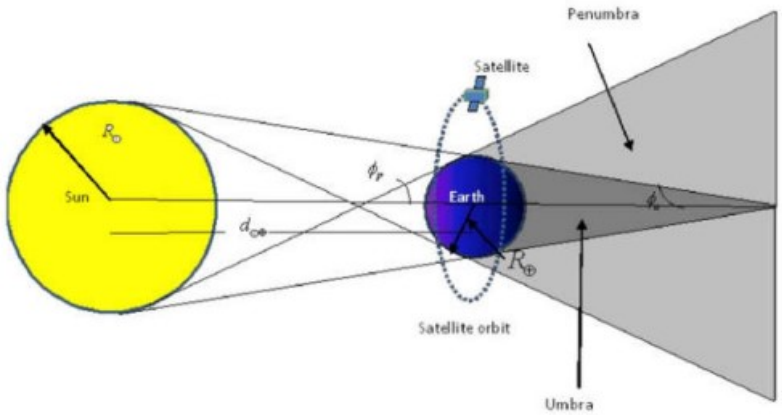


Considerations

- Magnetometer measurements are polluted by the field induced by the Magnetotorqueurs when they are activated:
  - Drop data when both are active at the same time
- Magnetometer is OFF during operation:
  - Coordination with Mission Manager to turn ON

Considerations

- Criterion for day-side and night-side:
  - Use of solar panel data
  - For simplicity, if solar panel has data it is considered day-side



Considerations

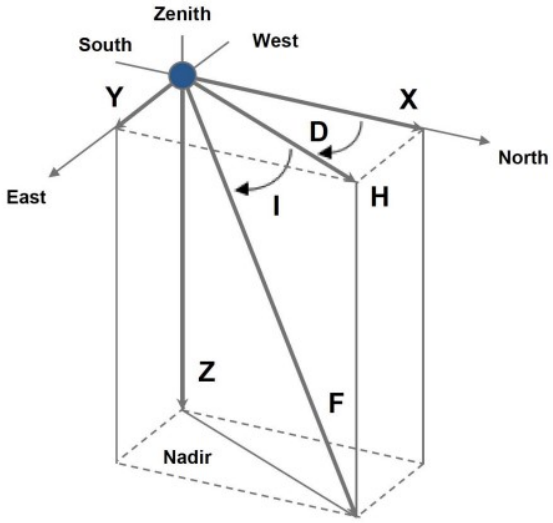
- Data date range

From	To
2022-03-01	2022-03-31
2022-05-19	2022-05-31
2022-06-28	2022-07-01
2022-07-14	2022-08-09

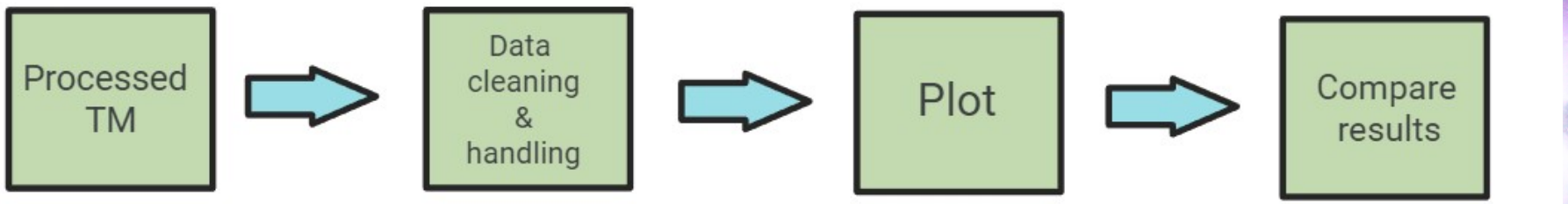
- Total: ~70 days

Considerations

- World Magnetic Model:
  - Components analysis: X, Y, Z, H & F
  - Measures during night side



Methodology



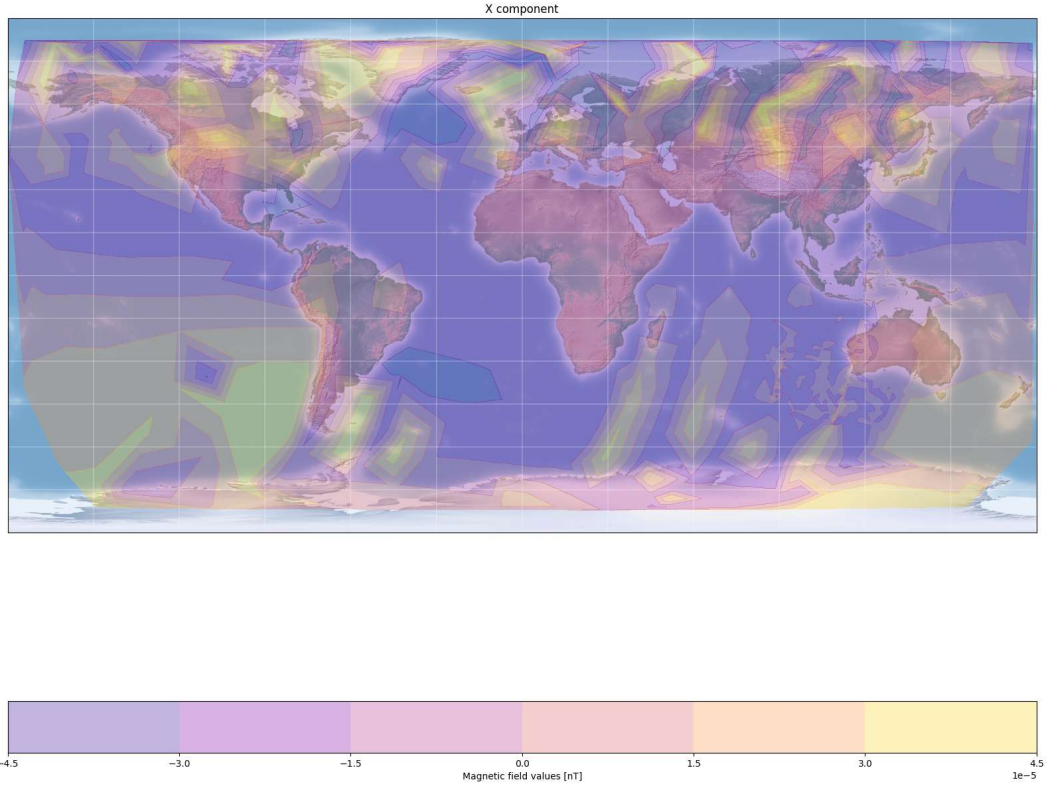
- MAG
- MTB
- Solar Panel
- Colatitude
- Latitude
- Quaternions

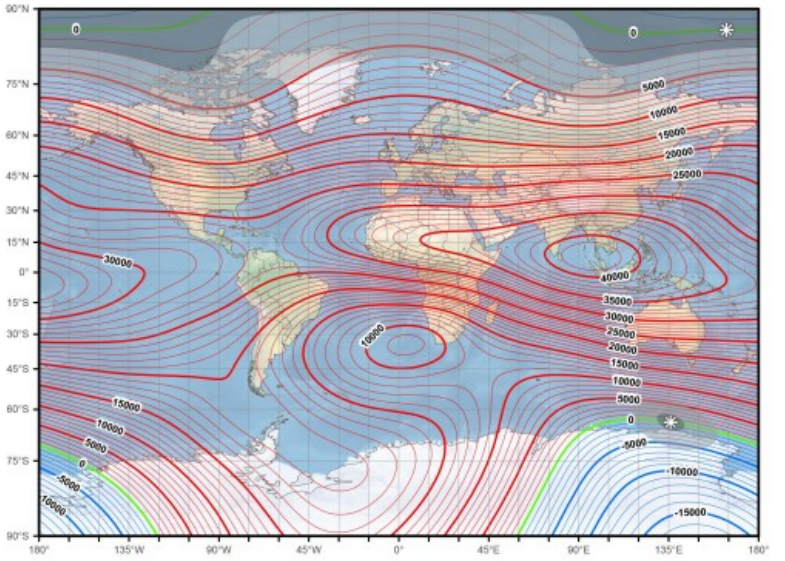
- Data match on exact date & time
- Remove matches between MAG & MTB
- Transform Colatitude and Latitude from spherical to cylindrical coordinates
- MAG remains values rotated by Quaternions
- Solar panel for day/night side

- Latitude & Colatitude projection

- Compare results with US/UK World Magnetic Model for 2020-2025

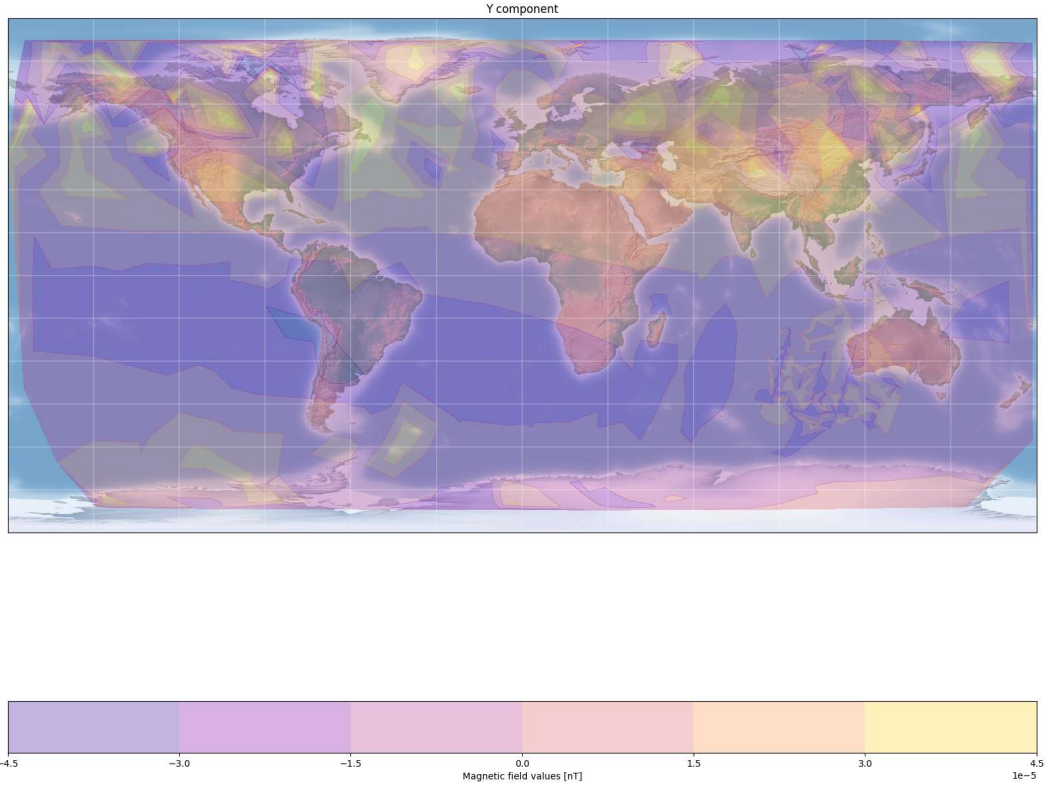
Results & Analysis: X component

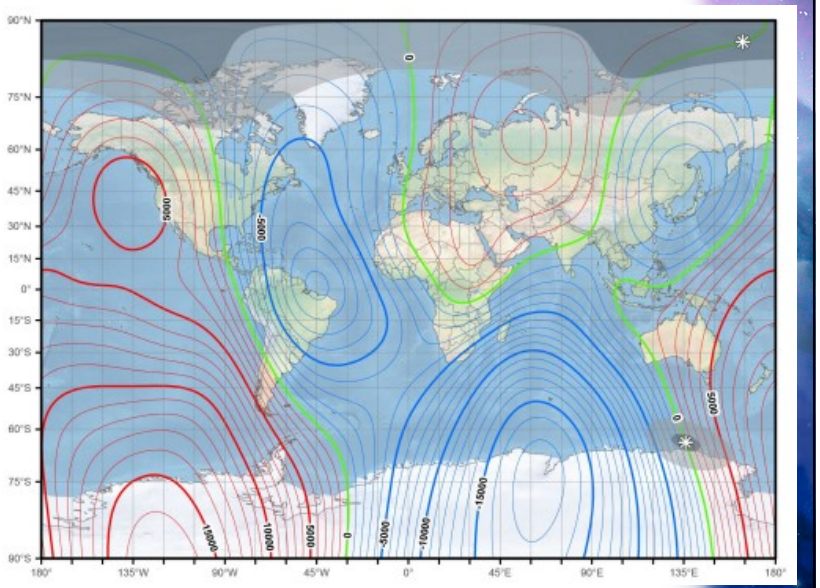




X component plot
Left: FASAT Charlie
Right: World Magnetic Model

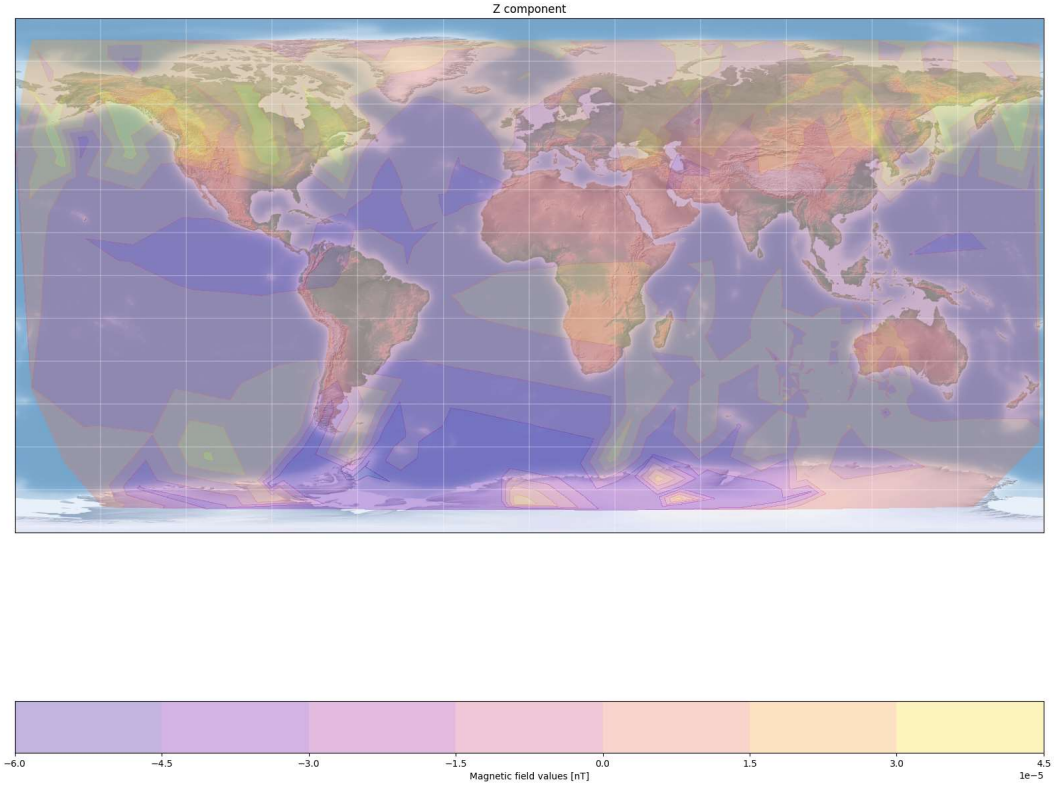
Results & Analysis: Y component

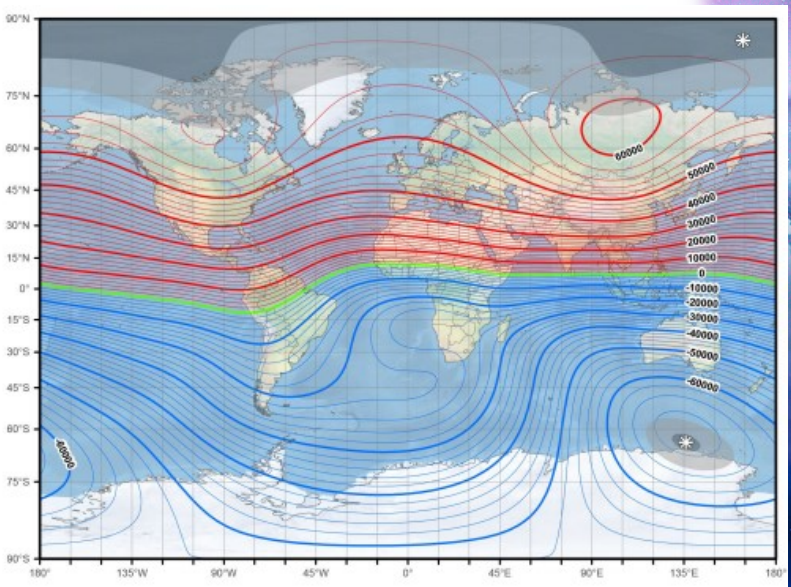




Y component plot
Left: FASAT Charlie
Right: World Magnetic Model

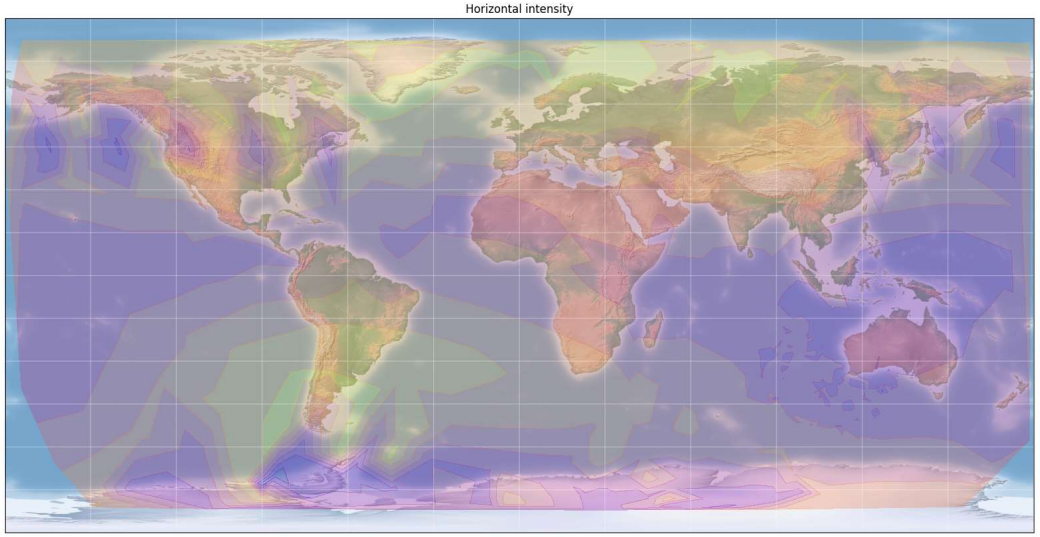
Results & Analysis: Z component

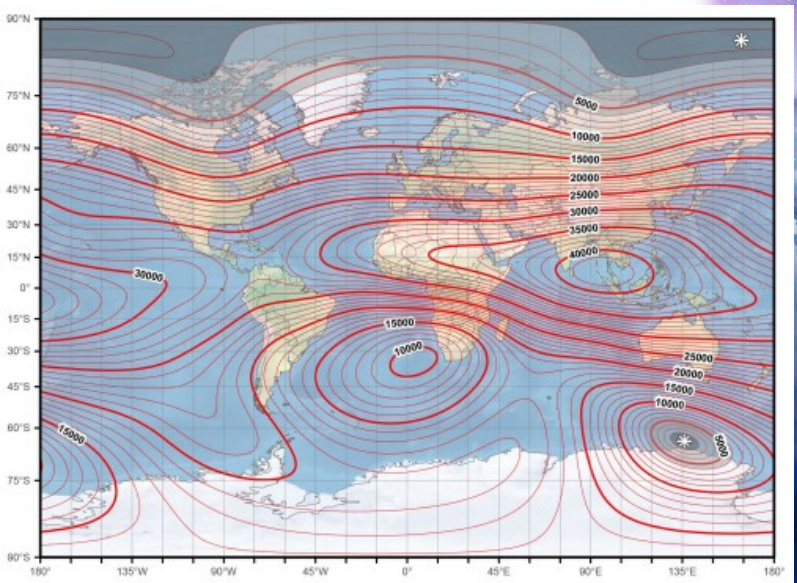




Z component plot
Left: FASAT Charlie
Right: World Magnetic Model

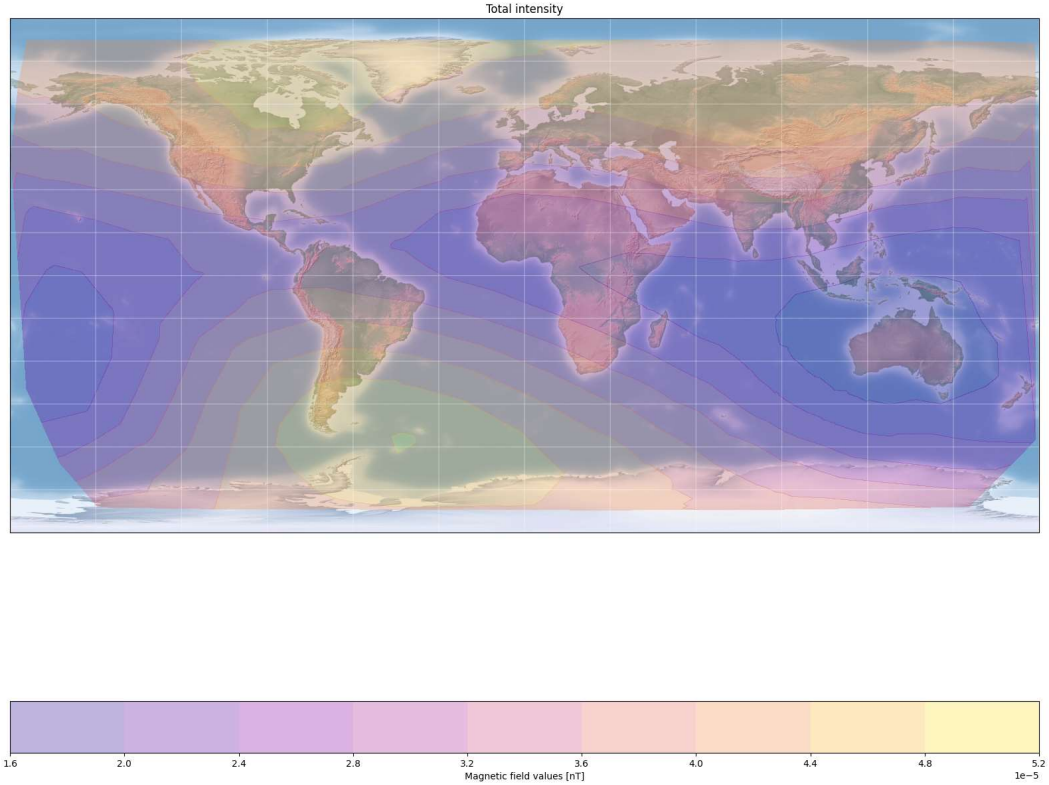
Results & Analysis: Horizontal intensity

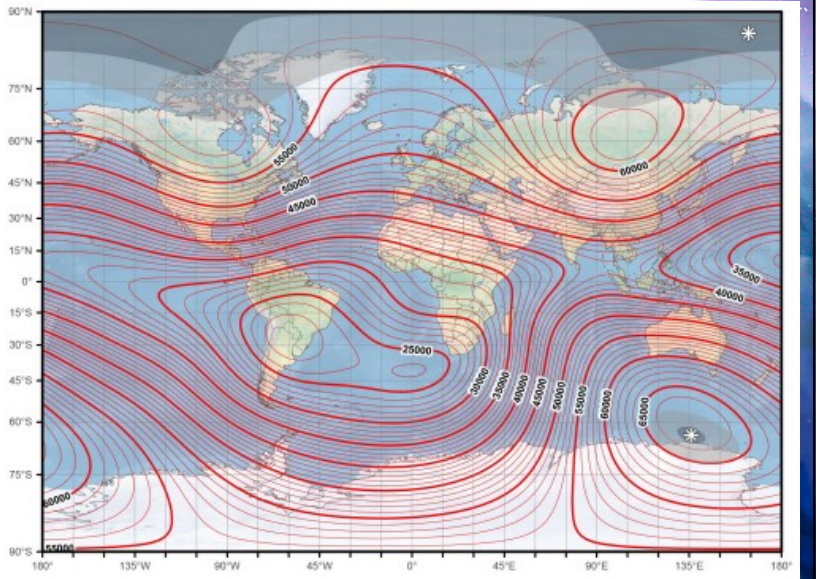




Horizontal intensity
Left: FASAT Charlie
Right: World Magnetic Model

Results & Analysis: Total intensity





Total intensity
Left: FASAT Charlie
Right: World Magnetic Model

Results & Analysis

- Better understanding about geomagnetism and its effect on space weather
- Improvement on satellite operations, create procedures concerning to space weather monitoring
- Ability to use a defense satellite for scientific purposes
- Differences between model and results:
  - Data quantity
  - Data quality

Results & Analysis

- Useful case of study for students interested on STEM
- Possible use of the data for update the current model or to feed new studies in the field

Thanks for your attention

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