

# SATELLITE DATA ACCESS

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IRI 2023 Workshop

## International Reference Ionosphere

Improved Real-Time Ionospheric Predictions with Data  
from Spaceborne Sensors and GNSS

8 – 19 May 2023

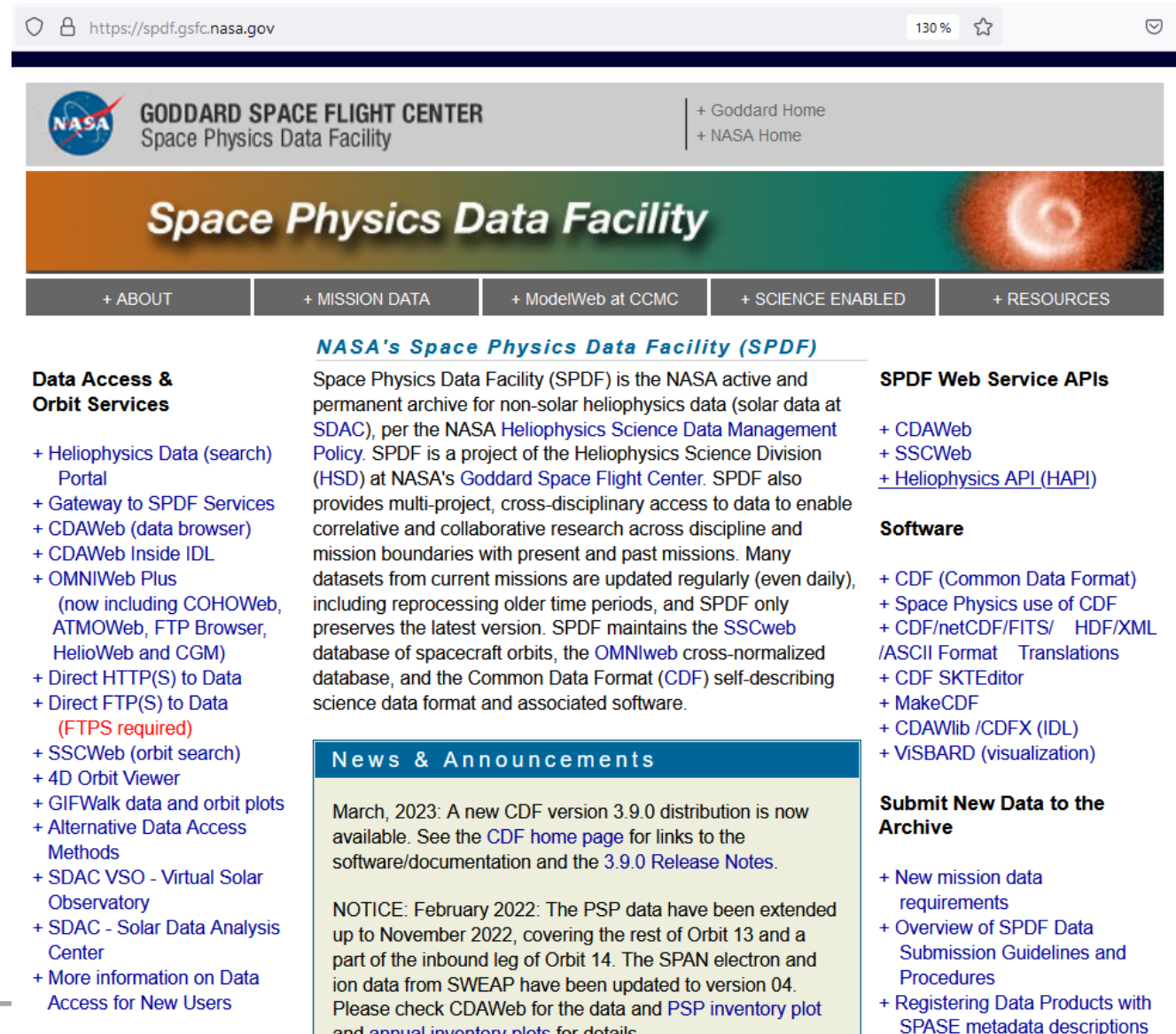




# Data availability

- I will focus on in-situ data (access to TEC data was already presented)
- Mission status
  - Past missions and partly continuing active missions
    - AE, DE, Hinotori, OGO, COSMIC, DMSP etc.
    - Data archives (publicly accessible e.g., NASA Space Physics Data Facility (SPDF), Madrigal, UCAR, NOAA)
  - New missions and continuing active missions
    - Swarm, ISS FPMU, DMSP, COSMIC 2 etc.
    - Data are directly provided by organizations responsible for the missions (ESA, NASA, UCAR, NOAA, universities etc.)
- Data Formats
  - ASCII (text, .txt), CDF (.cdf, developed by NASA), netCDF (.nc, developed at UCAR from CDF), HDF (.hdf, .hdf4, .hdf5 etc. developed at NCSA)
    - Libraries for IDL, Matab, Python

- Space Physics Data Facility (SPDF) is the NASA active and permanent archive for non-solar heliophysics data
  - <https://spdf.gsfc.nasa.gov/>
  - Generally the best service for data from past missions
  - Also some recent missions ISS (FPMU), ICON (also available from UC Berkeley) etc.
- CDAWeb
- SSCWeb (calculate satellite orbit)
- ftp and http data access



The screenshot shows the NASA Space Physics Data Facility (SPDF) website. The header includes the NASA logo and the text "GODDARD SPACE FLIGHT CENTER Space Physics Data Facility". Navigation links include "+ Goddard Home" and "+ NASA Home". The main banner features the text "Space Physics Data Facility" over a background image of a solar flare. Below the banner is a navigation bar with links: "+ ABOUT", "+ MISSION DATA", "+ ModelWeb at CCMC", "+ SCIENCE ENABLED", and "+ RESOURCES".

**NASA's Space Physics Data Facility (SPDF)**

Space Physics Data Facility (SPDF) is the NASA active and permanent archive for non-solar heliophysics data (solar data at SDAC), per the [NASA Heliophysics Science Data Management Policy](#). SPDF is a project of the Heliophysics Science Division (HSD) at NASA's [Goddard Space Flight Center](#). SPDF also provides multi-project, cross-disciplinary access to data to enable correlative and collaborative research across discipline and mission boundaries with present and past missions. Many datasets from current missions are updated regularly (even daily), including reprocessing older time periods, and SPDF only preserves the latest version. SPDF maintains the [SSCweb](#) database of spacecraft orbits, the [OMNIweb](#) cross-normalized database, and the Common Data Format (CDF) self-describing science data format and associated software.

**Data Access & Orbit Services**

- + Heliophysics Data (search) Portal
- + Gateway to SPDF Services
- + CDAWeb (data browser)
- + CDAWeb Inside IDL
- + OMNIWeb Plus (now including COHOWeb, ATMOWeb, FTP Browser, Helioweb and CGM)
- + Direct HTTP(S) to Data
- + Direct FTP(S) to Data (FTPS required)
- + SSCWeb (orbit search)
- + 4D Orbit Viewer
- + GIFWalk data and orbit plots
- + Alternative Data Access Methods
- + SDAC VSO - Virtual Solar Observatory
- + SDAC - Solar Data Analysis Center
- + More information on Data Access for New Users

**SPDF Web Service APIs**

- + CDAWeb
- + SSCWeb
- + [Heliophysics API \(HAPI\)](#)

**Software**

- + CDF (Common Data Format)
- + Space Physics use of CDF
- + CDF/netCDF/FITS/ HDF/XML /ASCII Format Translations
- + CDF SKTEditor
- + MakeCDF
- + CDAWlib /CDFX (IDL)
- + ViSBARD (visualization)

**News & Announcements**

March, 2023: A new CDF version 3.9.0 distribution is now available. See the [CDF home page](#) for links to the software/documentation and the [3.9.0 Release Notes](#).

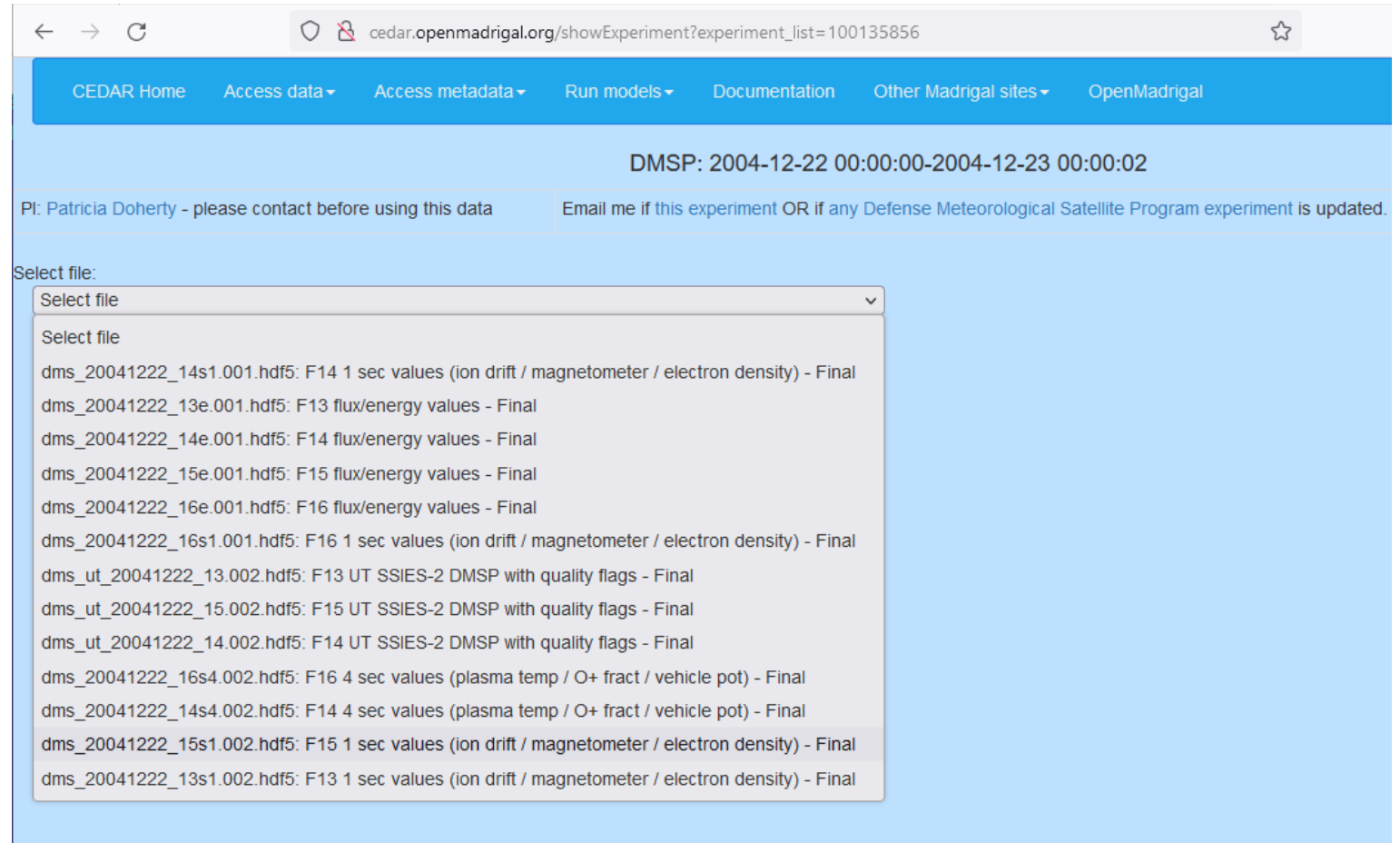
NOTICE: February 2022: The PSP data have been extended up to November 2022, covering the rest of Orbit 13 and a part of the inbound leg of Orbit 14. The SPAN electron and ion data from SWEAP have been updated to version 04. Please check CDAWeb for the data and PSP inventory plot and annual inventory plots for details.

**Submit New Data to the Archive**

- + New mission data requirements
- + Overview of SPDF Data Submission Guidelines and Procedures
- + Registering Data Products with SPASE metadata descriptions


# Madrigal

- Focused on ISR data
- Also available data from DMSP (SSIE instrument - Ne, Ti, Te, ion composition etc.)
  - Best version ('ut' in filenames) - processed directly by PIs i.e., The William B. Hanson Center for Space Sciences at The University of Texas at Dallas (data with quality flag) and provided them for dissemination via Madrigal – at least F11-F15 (more recently added)
- DMSP LP also <https://satdat.ngdc.noaa.gov>






# UCAR DAAC RO DATA



[Data Access Log In](#)

[Home Page](#)
[Data Center](#)
[Research Tools](#)
[Post Process Results](#)
[Climate Processing](#)



[Link to Image Credits](#)  
**CDAAC: COSMIC Data Analysis and Archive Center**

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[COSMIC-1 Data Access](#)  
[COSMIC-2: Data Access](#)  
[Other RO Missions: Data Access](#)

**Special Announcements:**

**COSMIC-1, COSMIC-2 Data and Other RO Mission:**

COSMIC-1, COSMIC-2 and Other RO Missions data are now available at <https://data.cosmic.ucar.edu/gnss-ro/>. To learn which products are available, please go to [COSMIC-1 data](#), [COSMIC-2 data](#) and [Other RO Missions](#) information pages. Please note, there is no need for a login to access these data.

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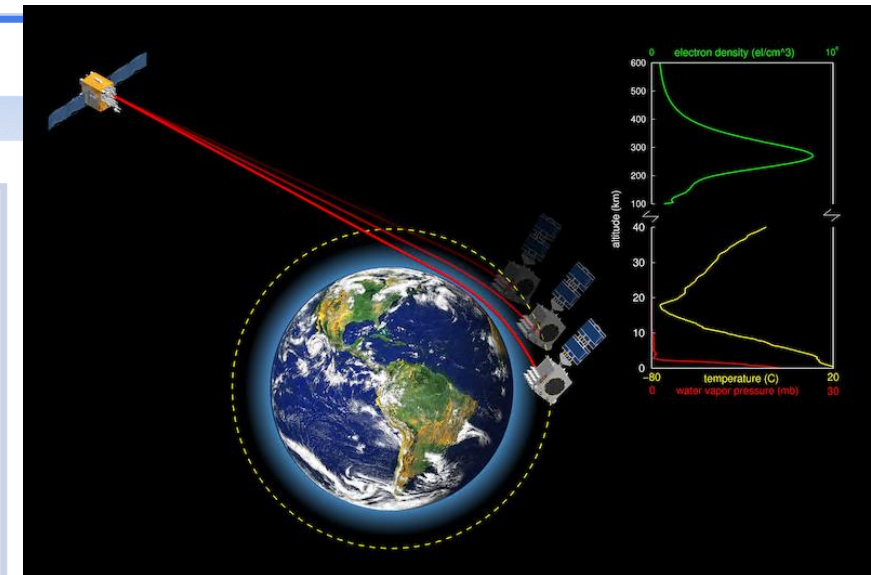
**SatDAAC Available for Licensing**

SatDAAC (Satellite Data Analysis and Archive Center) is a sophisticated software package that automatically processes and analyzes data from terrestrial and space-based instruments for near real-time and post-processing science applications. [Click here for more information](#)

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**CDAAC Data Users Forum**

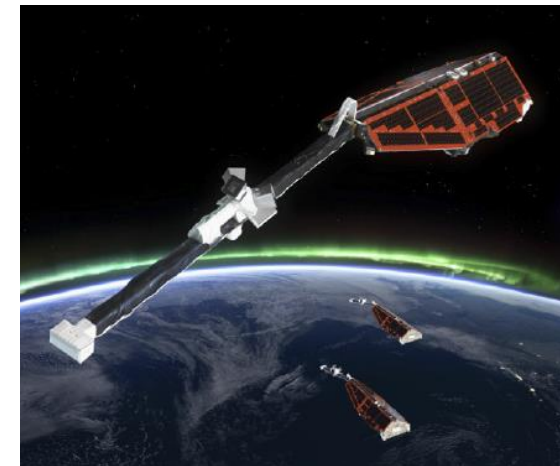
We are transitioning CDAAC data user support from email to a web based forum. [Click here to signup!](#) After signing up, you will be invited to the CDAAC Data Users Forum where you can post your question and interact with other data users.



- COSMIC1 and COSMIC2 + other mission
  - COSMIC1 vertical profiles ionProf repro 2021 latest version (2006-2019)
  - COMIC 2 also includes the IVM instrument (Ni, Ti, ions composition)
    - Provisional ionProf 2019-now
    - IVM rapid day 84 2022-now

# Swarm mission

- Project of ESA
- Primary purpose – monitoring of the geomagnetic field
- Launch date - 22 November 2013 (more than 10 years of data!)
- Constellation of three identical satellites
  - Satellite A (Alpha) + C (Charlie)
    - Altitude: ~480km, inclination: 87.4°
    - side-by-side flying ( $\Delta\text{lon}$ : 1.4°,  $\Delta\text{LT}$ : 6min)
    - 160km distance at equator
    - Orbital delay: 6s
  - Satellite B (Bravo)
    - Altitude: ~520km, inclination: 88°
- All satellites 270 days to cover all LT



# Langmuir probes - Swarm EFI

- Developed by IRF Uppsala
- 2 probes:
- Probe 1 in high gain, probe 2 in low
- Probe 1 – nitrated titanium (TiN)
- Probe 2 gold-plated titanium (Au)
- Data from probes telemetred to ground
- Principle: 128Hz applied to the I-V characteristics
- Measure the resulting current
- “ripple” technique, harmonic
- 1% classical sweep

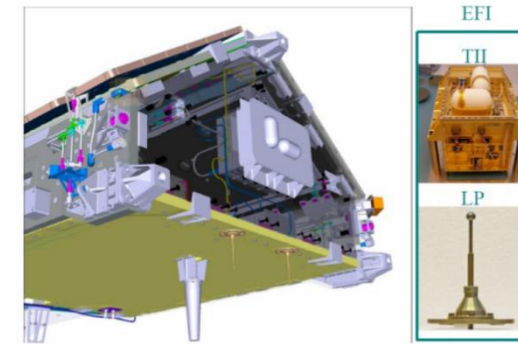
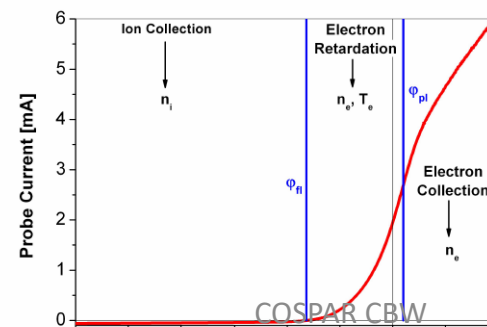
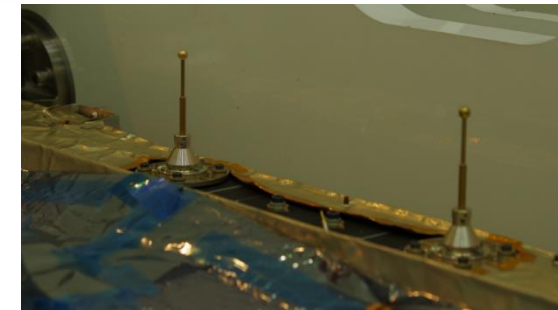
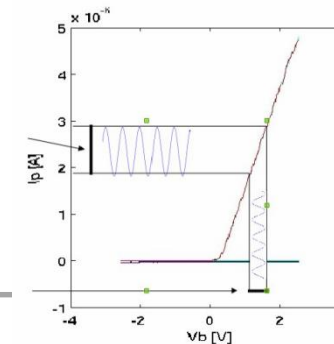


Figure 2.4: Panoramic view of the Electric Field Instrument, EFI. Langmuir probes are mounted perpendicularly to the ram side. Credits: Astrium.



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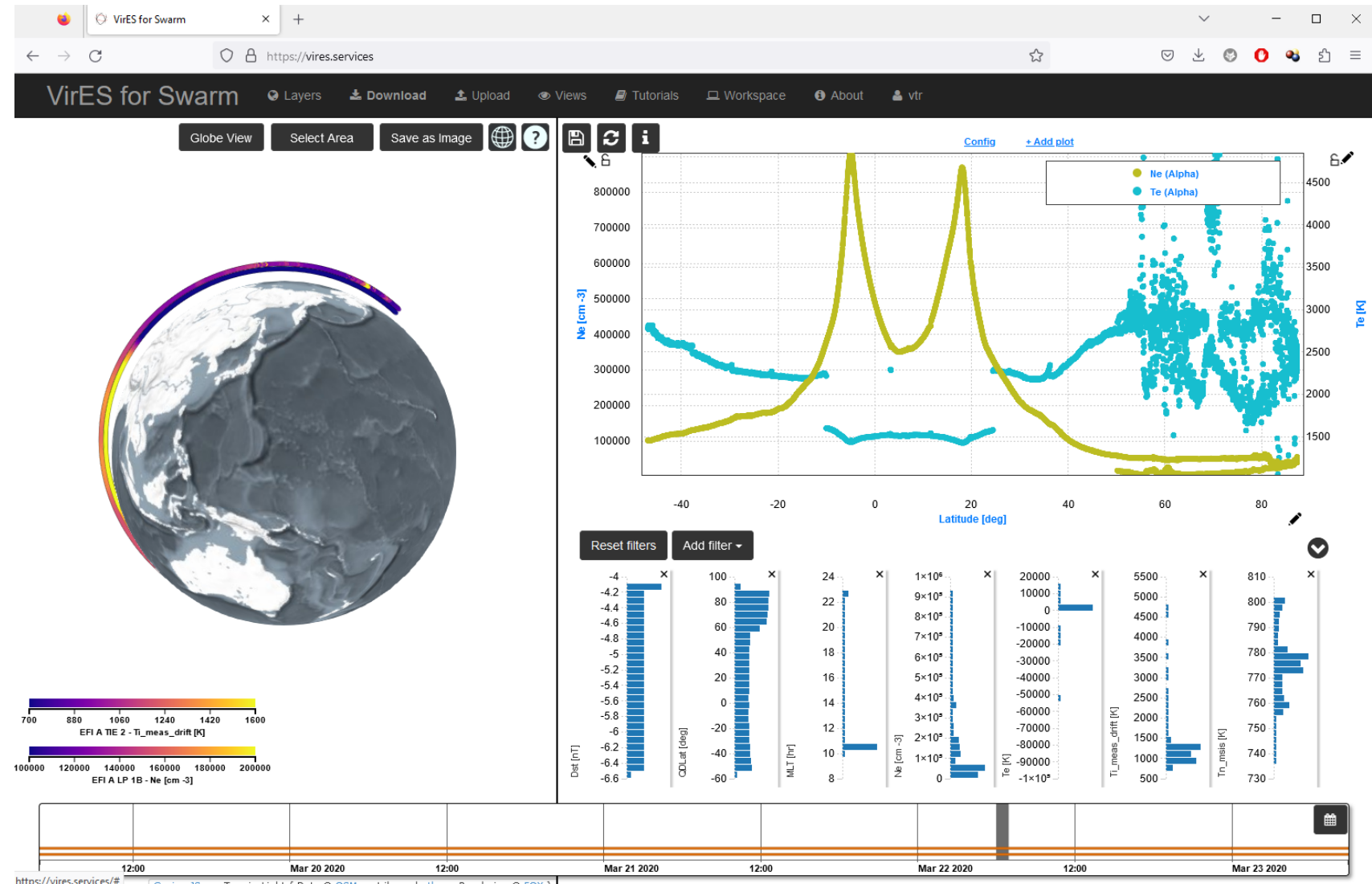
# Langmuir probes – access to data

- Various products released
  - **0.5s Ne, Te – Level 1b, 060x latest version (previous version are not accessible!), Operational data set “OPER” (cdf) – (harmonic mode, high gain probe, Ne derived from ion current i.e., in fact Ni)**
  - 16Hz Ne - Faceplate plasma density (limited intervals)
  - 0.5s Extended data set (both hi and low gain separately) only for ‘experts’
  - 128s Ne, Te sweep mode - only for ‘experts’
  - Rapid version of data
  - Various Level2 products (derived products from measurements - thermospheric density, effective mass, ion temperature)
- [https://swarm-diss.eo.esa.int/#swarm%2FLevel1b%2FEntire\\_mission\\_data%2FEFlx\\_LP](https://swarm-diss.eo.esa.int/#swarm%2FLevel1b%2FEntire_mission_data%2FEFlx_LP)



# VirES for Swarm

- The virtual research service - [VirES for Swarm](https://vires.services) - adds discovery and visual analytics capabilities to the European Space Agency's online data access services established for the Swarm satellite mission constellation.
- <https://earth.esa.int/eogateway/tools/vires-for-swarm>
- <https://vires.services>
- Easy access to Swarm data, graphical interface, no-processing CDFs by users needed



# Conclusions

- An overview of how to access the most important satellite data for ionospheric studies, especially in-situ measurements of plasma parameters was presented.
- Different services have been developed to access satellite data and therefore there is no simple and single approach to access satellite data.