SINP MSU FEASIBILITIES FOR IMCP

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OUTLINE

International Meridian Circle Program (IMCP) tasks
where SINP MSU can contribute:

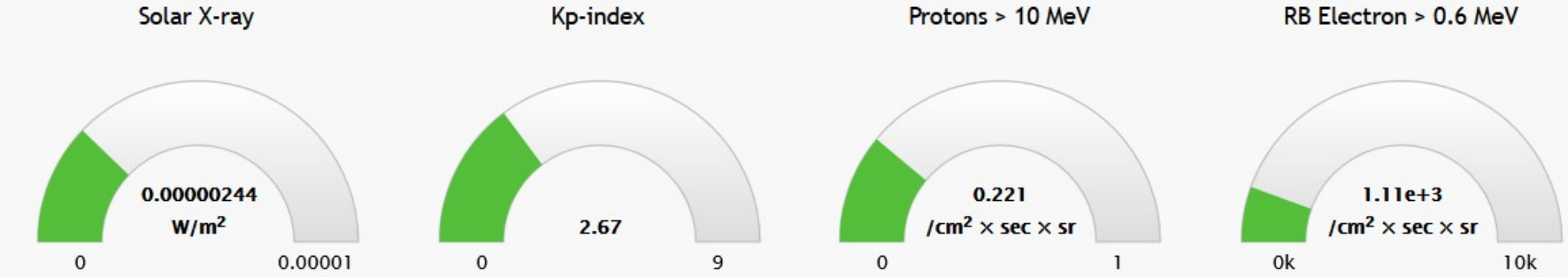
- Space Weather (SW)
- Global Electric Circuit (GE)
- Geomagnetic Field Variations (GM)

SWX https://swx.sinp.msu.ru/index.php

SINP MSU Space Weather Analysis Center

Space Weather Analysis Centre of SINP MSU provides information about the current state of near-Earth's space. Information Services (*SWX*) on the website the center provide access to current data describing the level of solar activity, geomagnetic and radiation state of the magnetosphere and the heliospher the real time. For data analysis, the models of the space environment, working in off-line as well as on-line mode have been implemented. Interactive services allow one to retrieve and analyze data in a given time moment. *SWX* is a flexible system for the analysis and forecasting of space weather in the near_Earth's space.

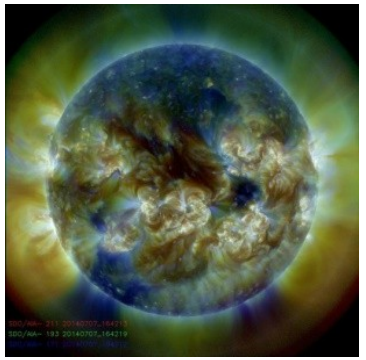
Current conditions in space (2024-08-27 17:16:58 UT)



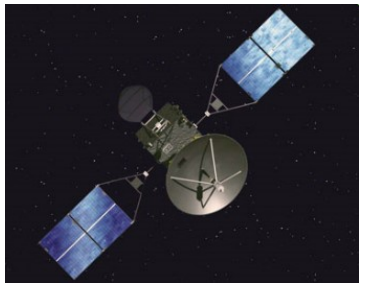
Space weather diagnostic

Data involved

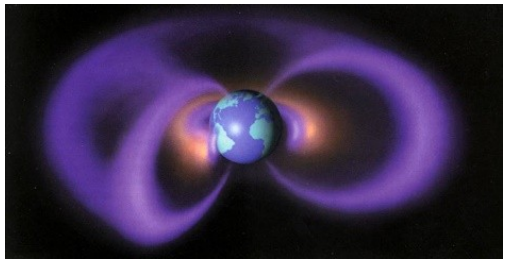
- Sun observations



- Solar wind parameters



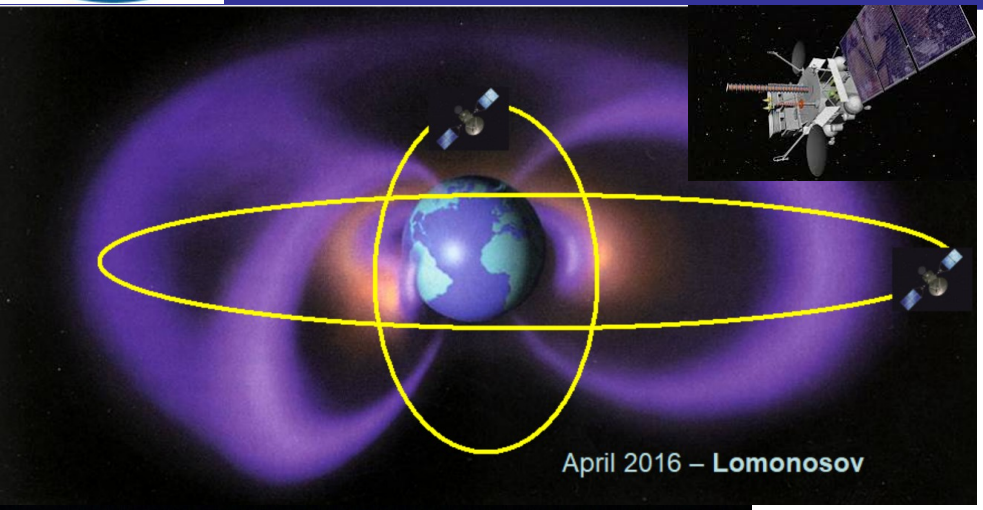
- Particle fluxes in the magnetosphere



Operational services: Data + Models

Radiation at GEO, HEO & LEO orbits

Space Weather



GEO: Electro L1 & L2

76°E

SKIF-6, SKL-E (SINP MSU)

SEP Protons 1 - 320 MeV

ERB Electrons 0,03 - 20 MeV

HEO: Arctica M1 & M2

40,000km 160/340E

MSGI-M, SKL-M (SINP MSU)

SEP & ERB Protons 2 - >160 MeV

Electrons: 0,15 - 10 MeV

Plasma 0.15 - 20 keV

LEO: Meteor-M1, M2, M2-4

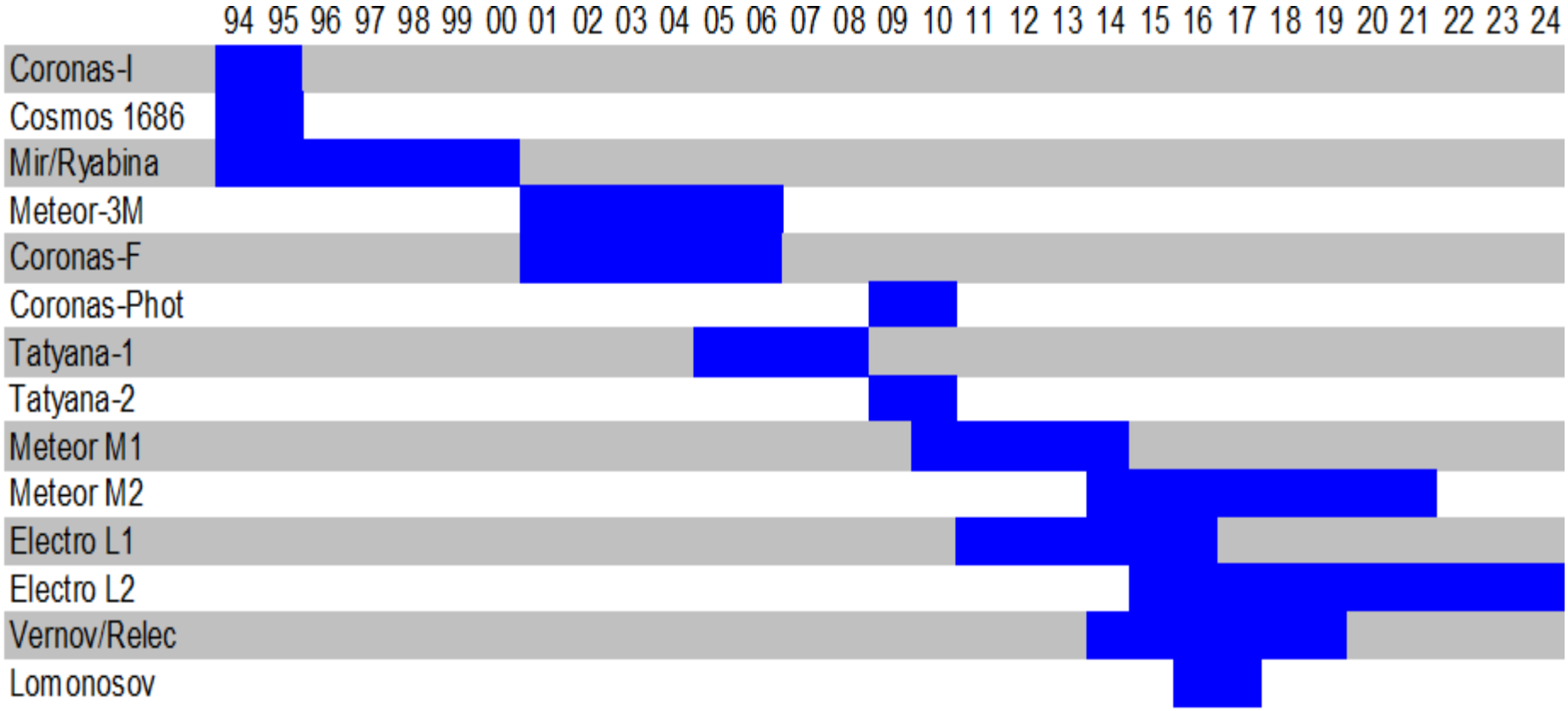
Sun-synchronous 3/15, 4/16, 9/21 MLT

MSGI-M, SKL-M (SINP MSU)

SEP & ERB Protons 1 - 160 MeV

Electrons: 0,03 - 13 MeV (auroral 0.03-16 keV)

Missions and Data availability

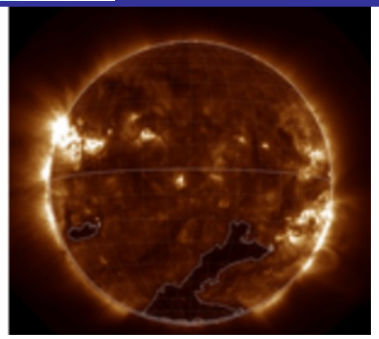


Currently operating sc are used but their data are still not public:

Electro L4
Arktika M1 & M2
Meteor M24

Forecasting models

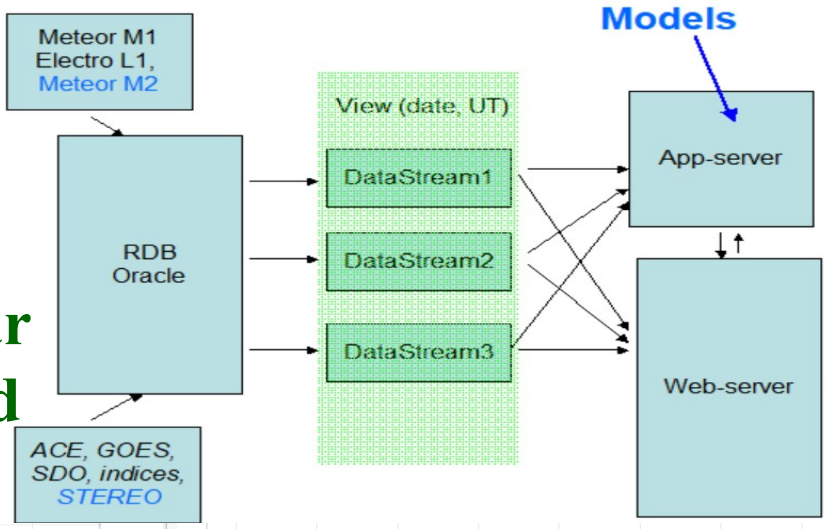
Space Weather

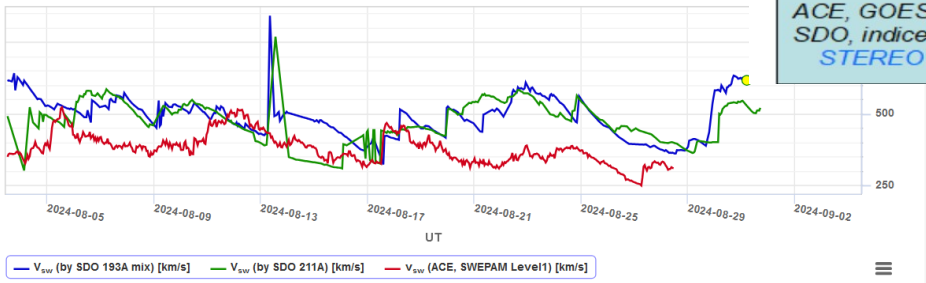


Coronal holes

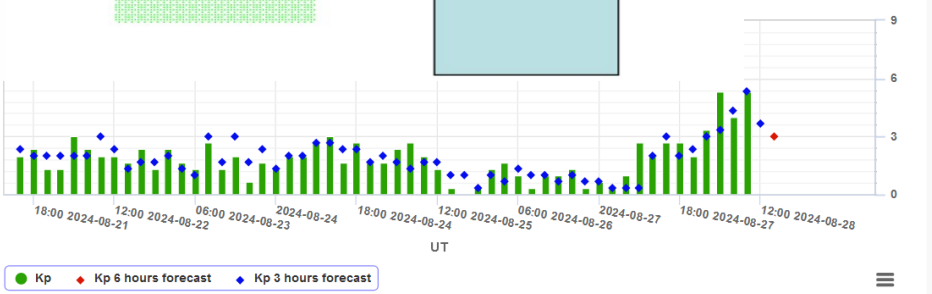
SW velocity (middle-term)

Solar wind





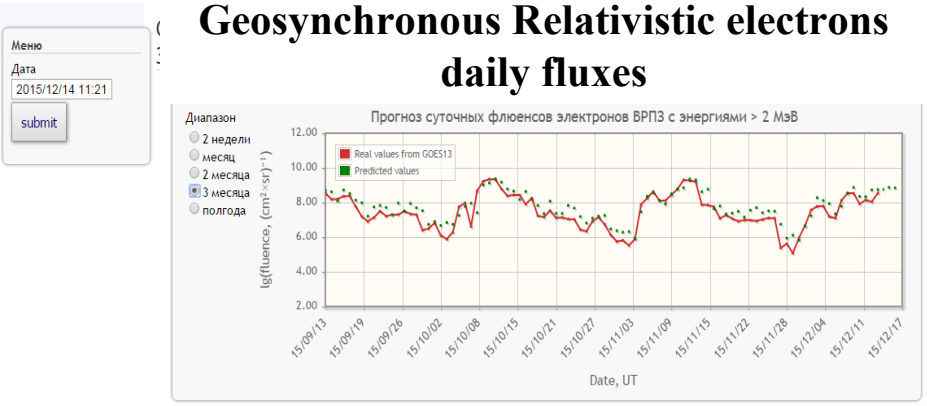
Kp

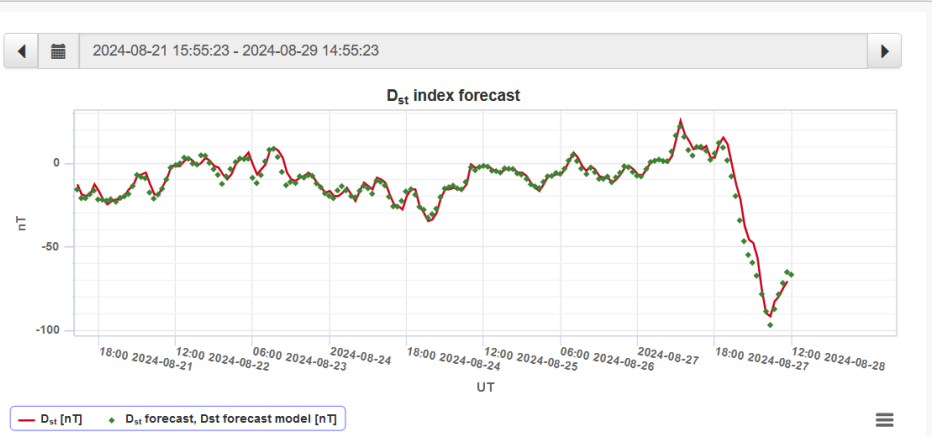


Dst

Dst forecast

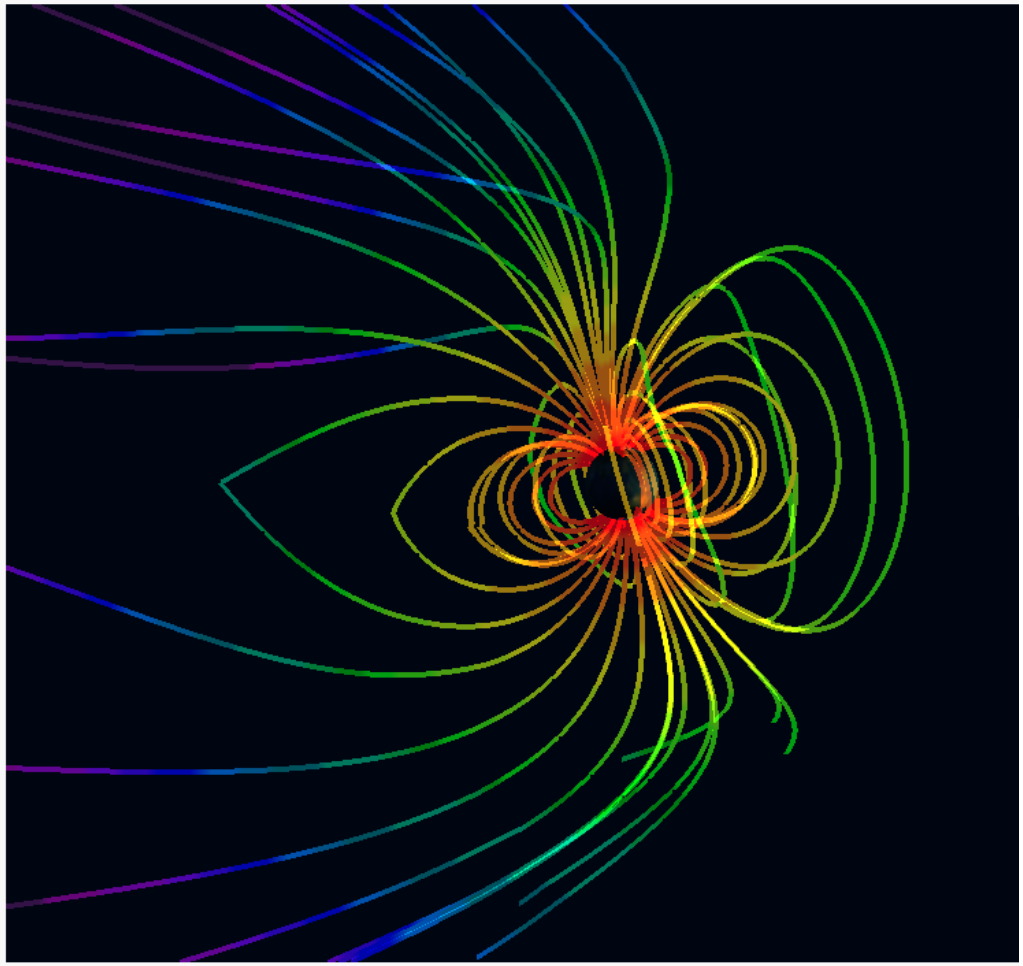
Geosynchronous Relativistic electrons daily fluxes



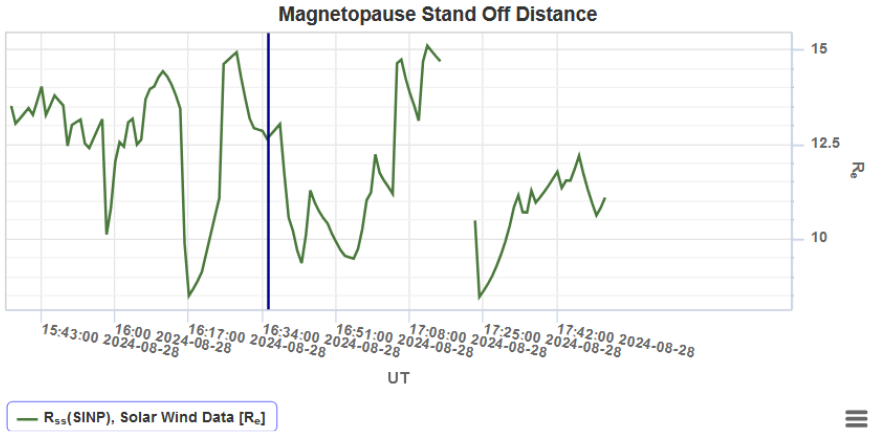


3D-magnetosphere

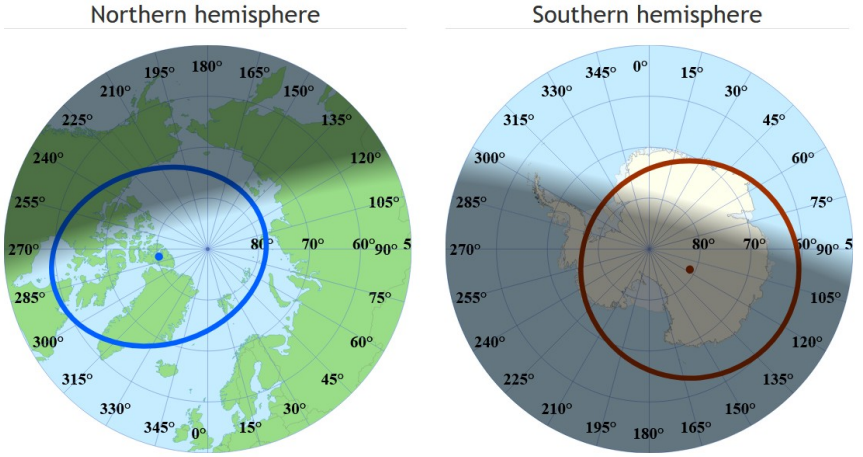
http://swx.sinp.msu.ru/3d.php?lang=en



Magnetopause standoff distance



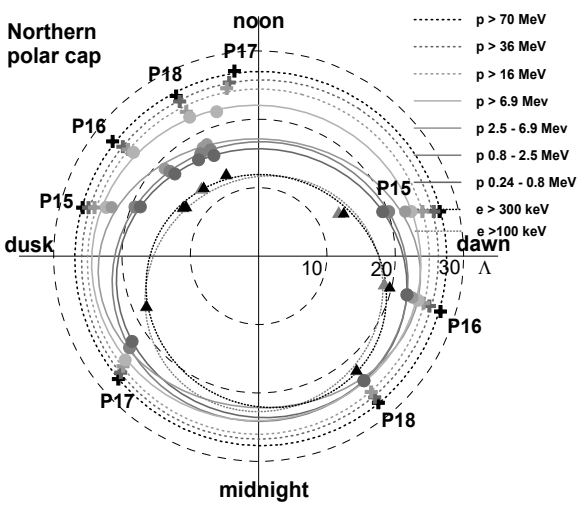
ORB high-latitude boundary

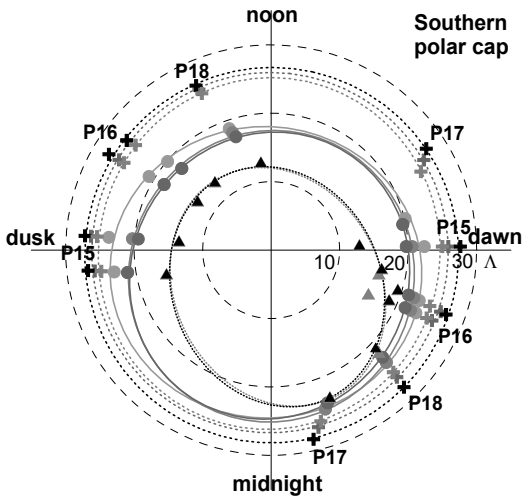


Elliptical model of SEP cutoff boundary

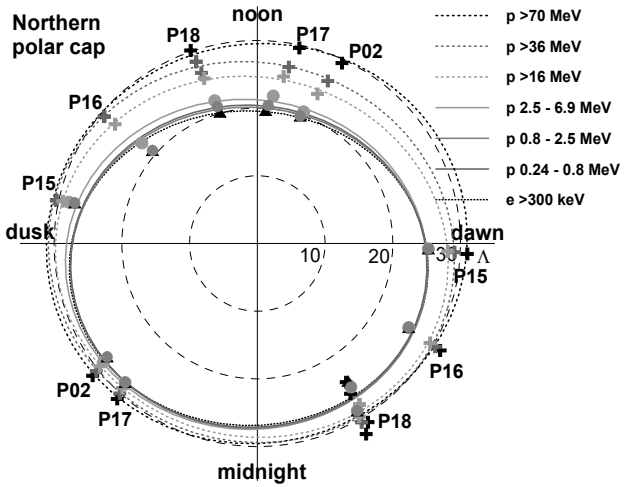
Invariant co-latitudes of SEP cutoff

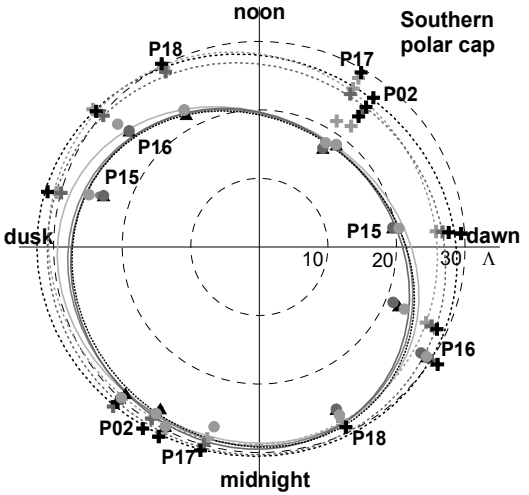
Quiet time





Magnetic storm





Approximation of the SCR cutoff boundaries under quiet conditions and during the magnetic storm at 17:00 UT on December 14, 2006 in the northern (left) and southern (right) hemispheres. The cutoff latitudes determined for HEP, LEP, and electrons are indicated by crosses, circles, and triangles, respectively. The flybys of various spacecraft are indicated by their respective abbreviations.

Project “UV atmosphere” (Mini-EUSO)

Global Electric

Dimensions	370×370×620 mm
FOV	36°× 36° = 0.42 sr
Entrance pupil diameter	25 cm
Focal distance	25–27 cm
Pixel size	3 mm
Number of pixels	2304
Spatial resolution at ground level	6 км
Area of observations	260 km × 260 km = $6.8 \cdot 10^4$ km^2
Temporal resolution	**2.5 us, 320 us, 40 ms**

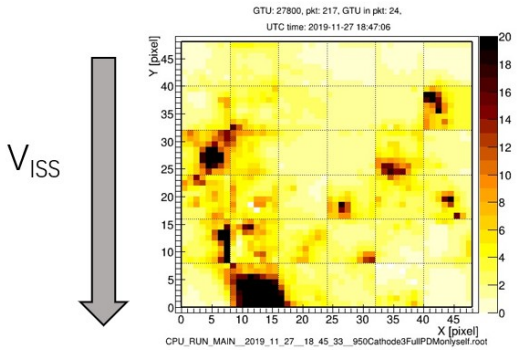
u.ru/uf-atmosfera-1.html

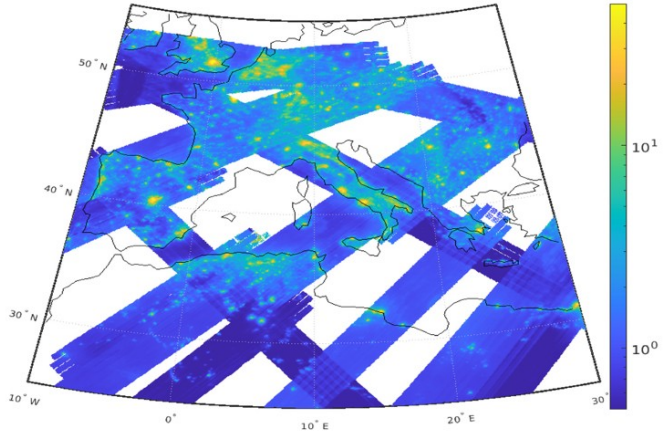
Lunched on 22.08.2019, delivered to the ISS on 27.08.2019.

To date, 110 experimental sessions have been conducted, the equipment operates well.

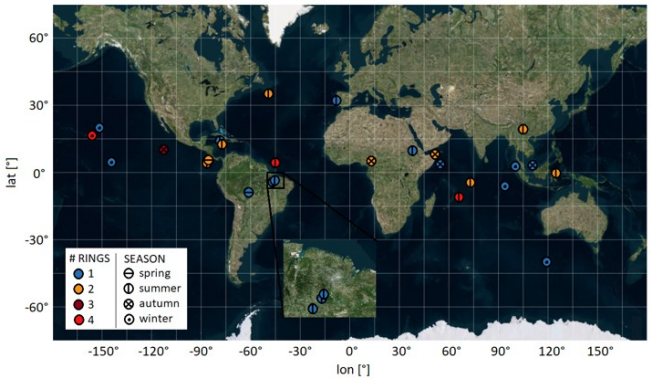
Multi-level trigger system with different time resolution allows to measure variable atmospheric phenomena.

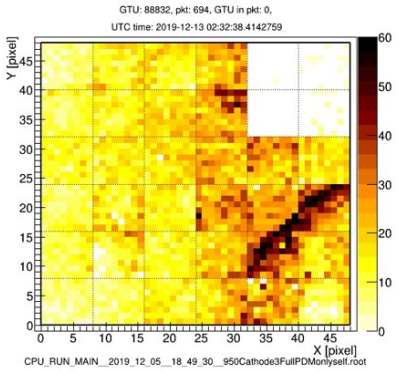
Monitoring of the UV emission and Transient luminous events





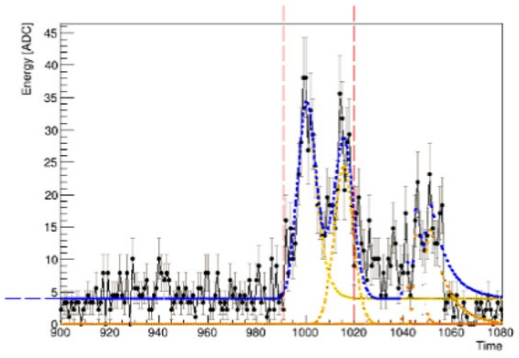
ELVES map and one example of fine spatio-temporal structure





ELVE light curve

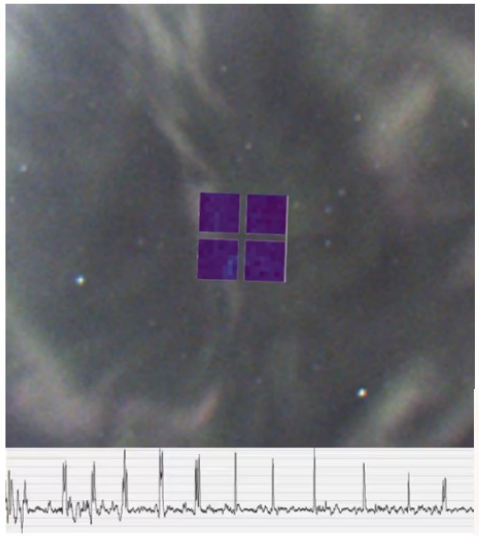
Unique measurements of the fine spatiotemporal structure of ELVES, allowing probing intra-cloud processes.

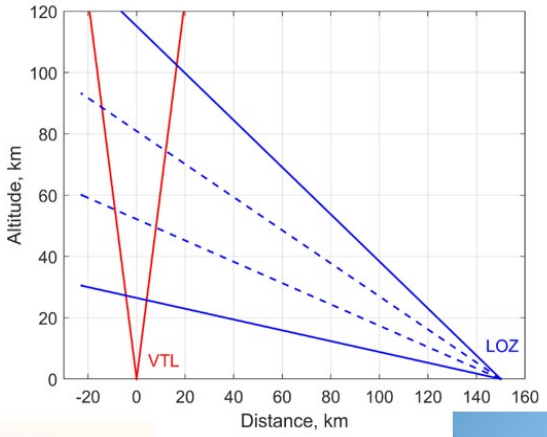


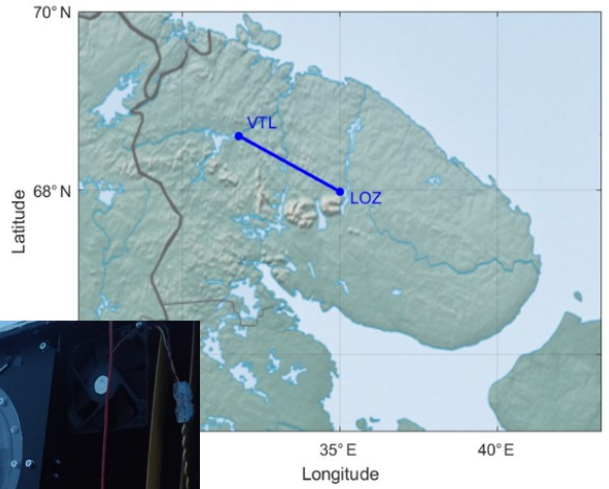
TLEs from ground-based instrument at high-latitude station in Apatity

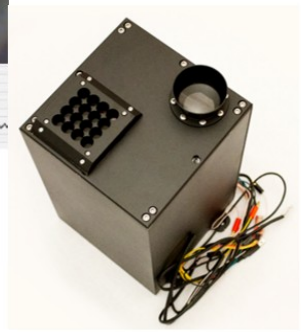
PAIPS (Pulsating Aurora Imaging Photometers System)

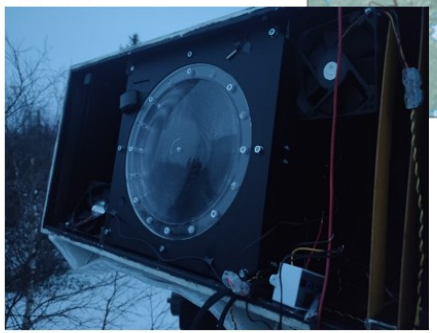
https://uhecr.sinp.msu.ru/paips.html





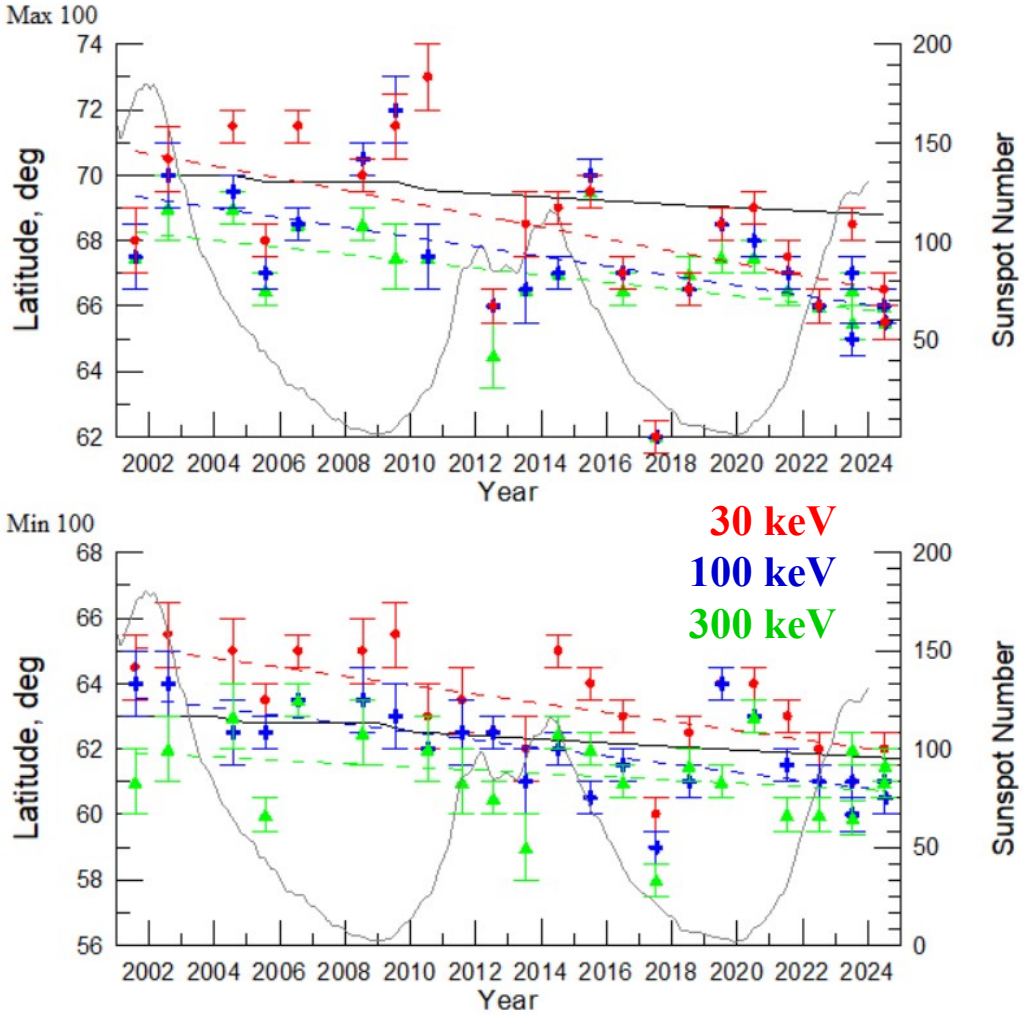


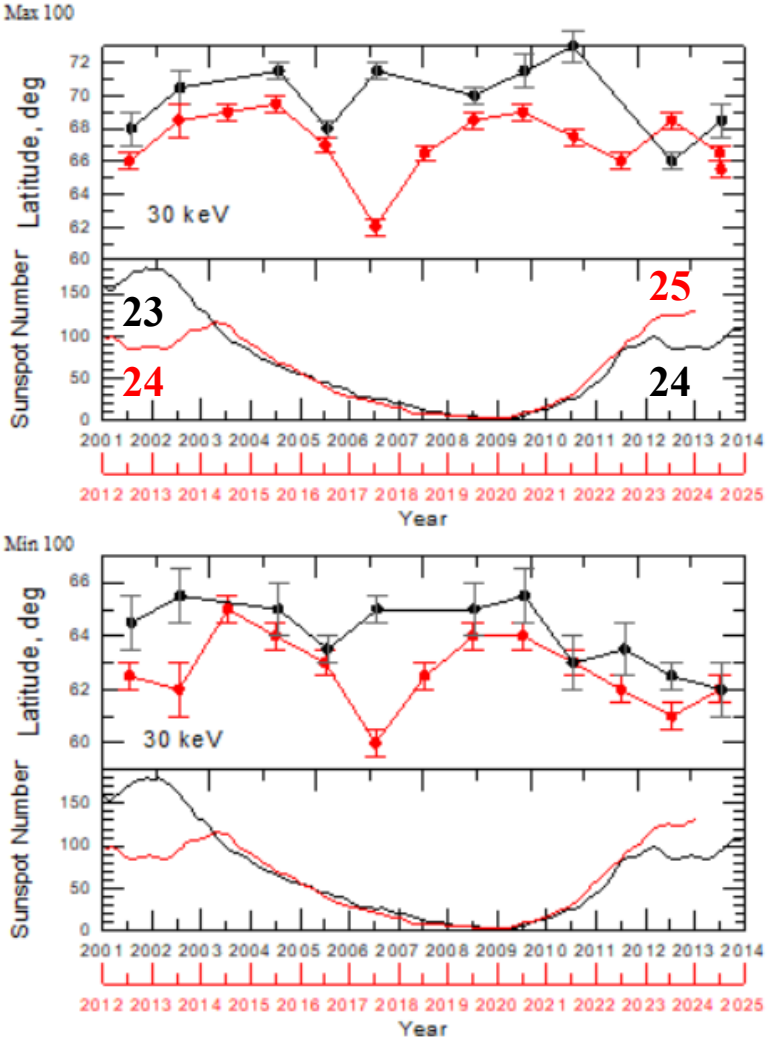




Two highly sensitive photometers at a distance of 150 km at the Verkhnetulomsky and Lovozero observatories, which allow stereometric measurements of atmospheric pulsations and UV-microbursts with high time resolution, complementing the information from all-sky cameras about the fine spatiotemporal structure of the emission and spectrum of precipitating particles.

Decadal dynamic of the outer ERB location at 100°E





Geographic latitude of the maximum (top) and inner edge (bottom) of the outer ERB projection at height of ~850 km and around 100°E during magnetic quiet days. Dashed curves show a latitudinal shift predicted by IGRF model of corresponding epochs.

Conclusions

SINP MSU can contribute to the following tasks of the IMCP:

Space weather

•Monitoring of the energetic particles from ERB and SEP
(p 1- 320 MeV & e 30 keV – 20 MeV)
•Forecasting of the solar wind velocity, geomagnetic indices Kp & Dst, and relativistic electrons at GEO
•Modeling of the manetosphere, magnetopause, outer ERB, SEP penetration and their radiation effects

Global Electric Circuit

•Transient Luminous Events – spaceborne and ground based observations in UV

Geomagnetic field variations

•Tracing of the ERB projections to the low latitudes