Space Monitoring Data Center of SINP MSU

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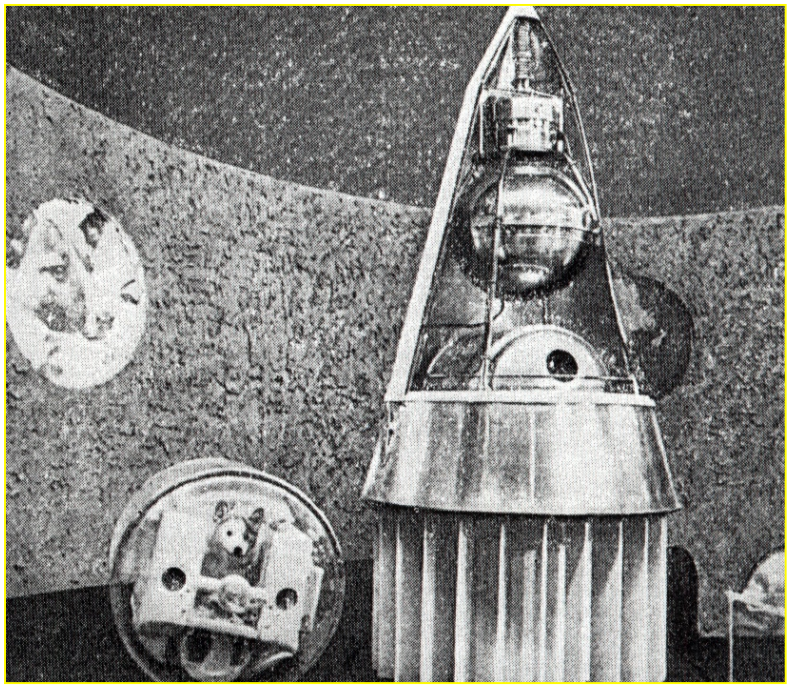
Moscow State University
(SINP MSU), Russia

CCMC Workshop,
Annapolis, 04/04/2014

Skobeltsyn Institute of Nuclear Physics
Moscow State University

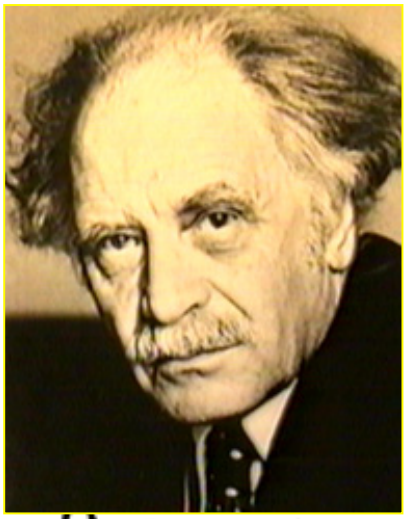
SPACE Physics

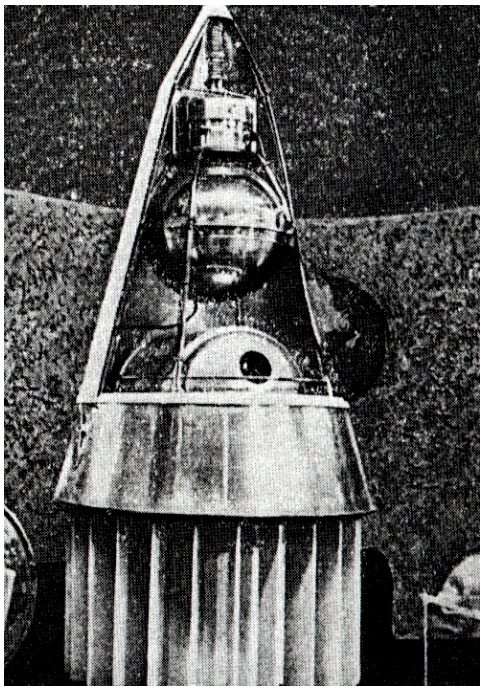
- Sun
- Heliosphere
- Earth's magnetosphere
- Magnetospheres of the planets in Solar system
- Cosmic rays
- Radiation belts
- TLE

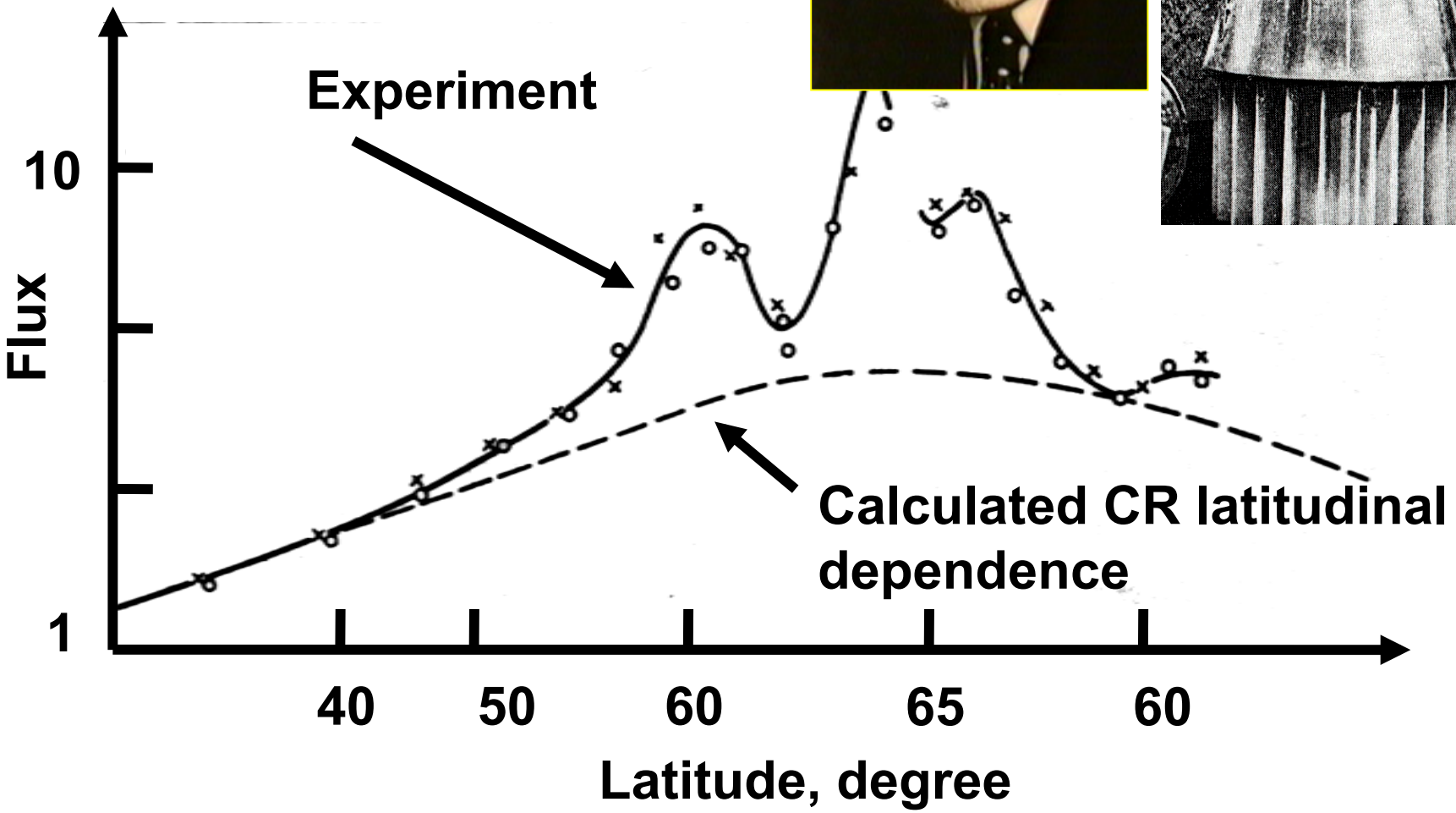


November, 1957

Academician Sergey Vernov







Space monitoring data center (SMDC)

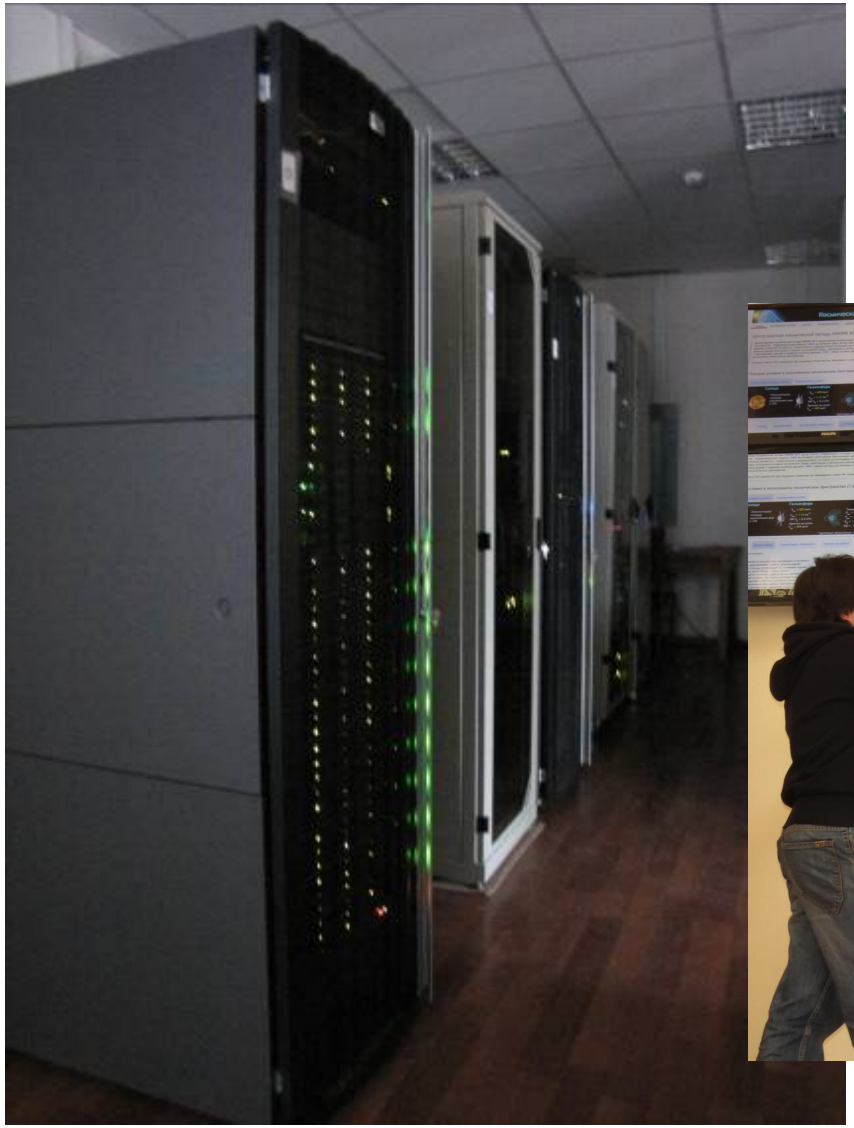
Main Objectives

- Mission support
- Data collection
- Radiation monitoring and reliable analysis of current space radiation conditions (data + models +visualization)

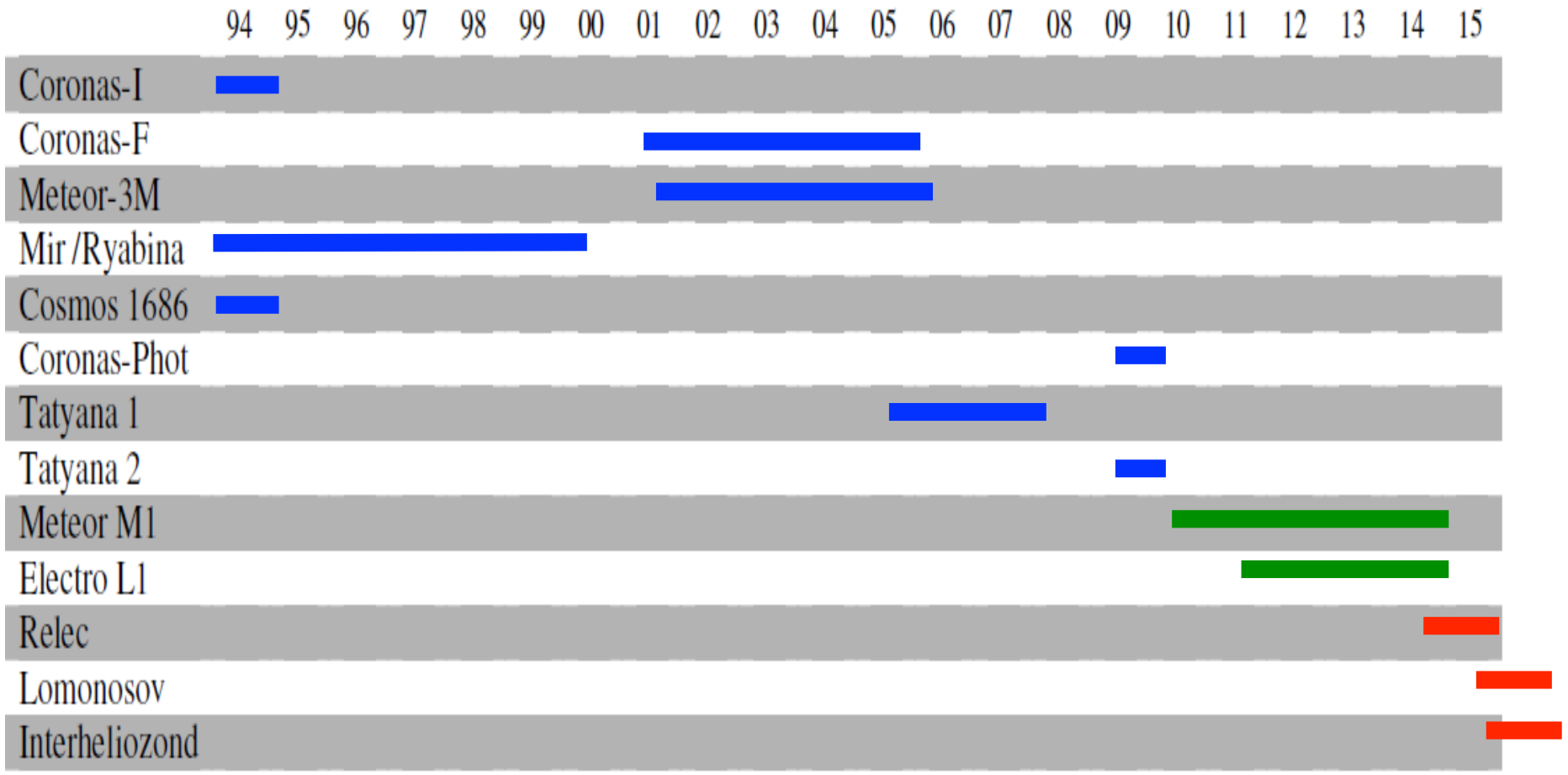
Structure

- Data center
  - RDB
  - Cluster
  - SAN Storage system
- SWX center
- Visualization center

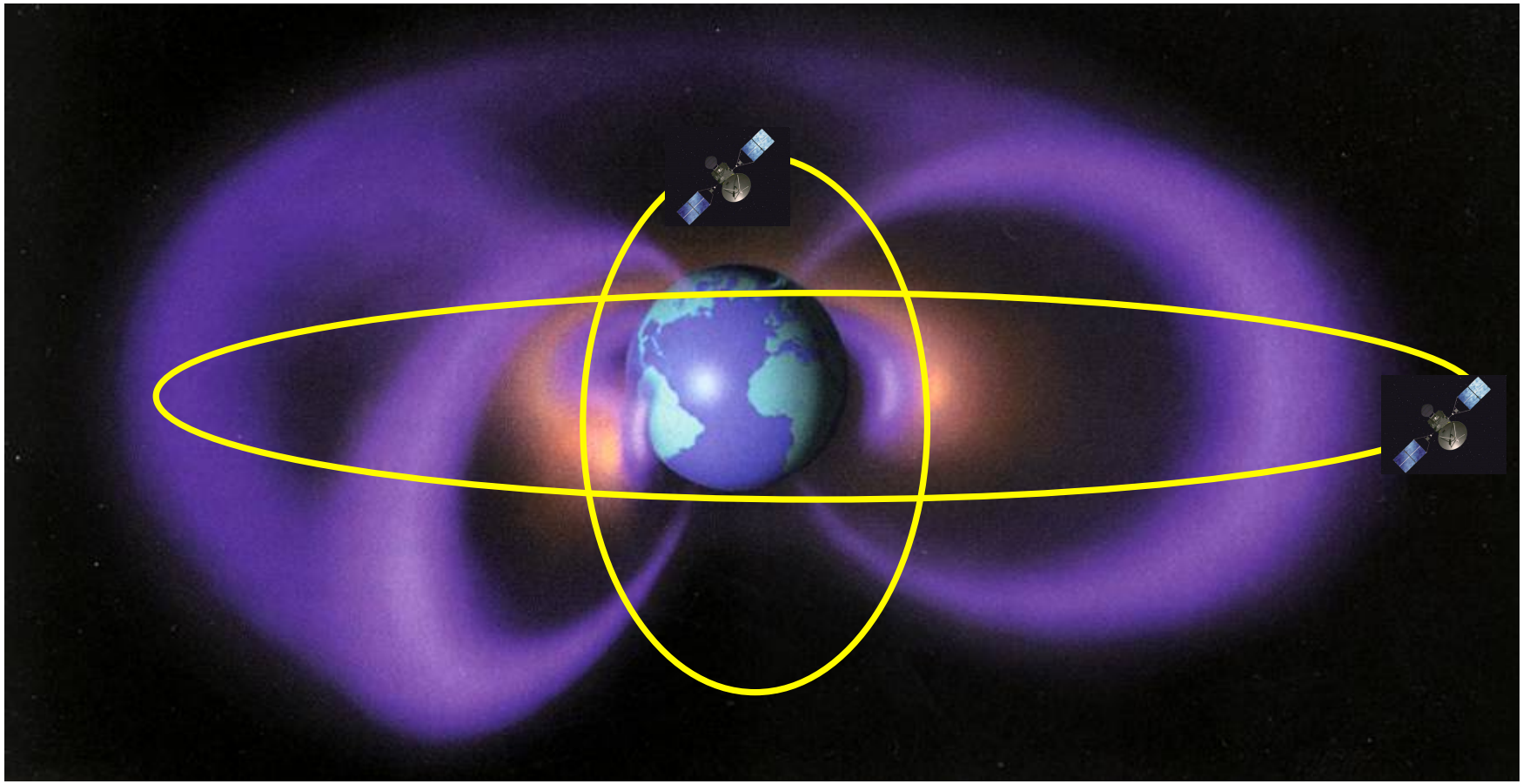
НИИЯФ МГУ



Satellites in DB



Satellites in operation

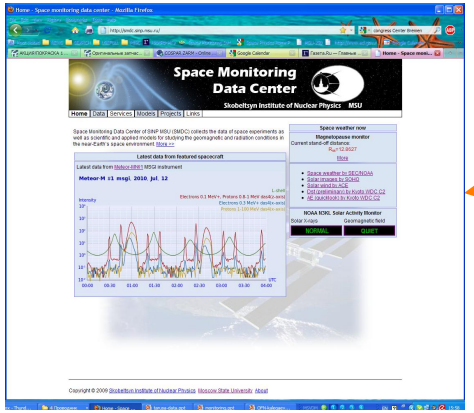


Real-time data processing

Telemetry and TLE

Processing

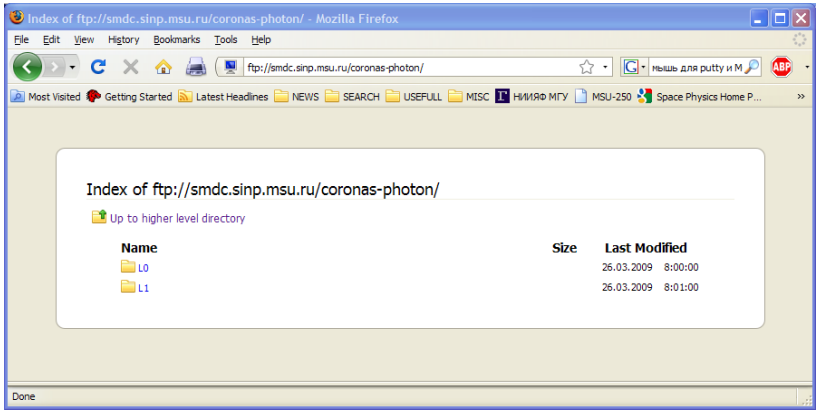
Coordinates, data_1, data_2, …, data_n



Web-site

FTP-server
ftp://smdc.sinp.msu.ru

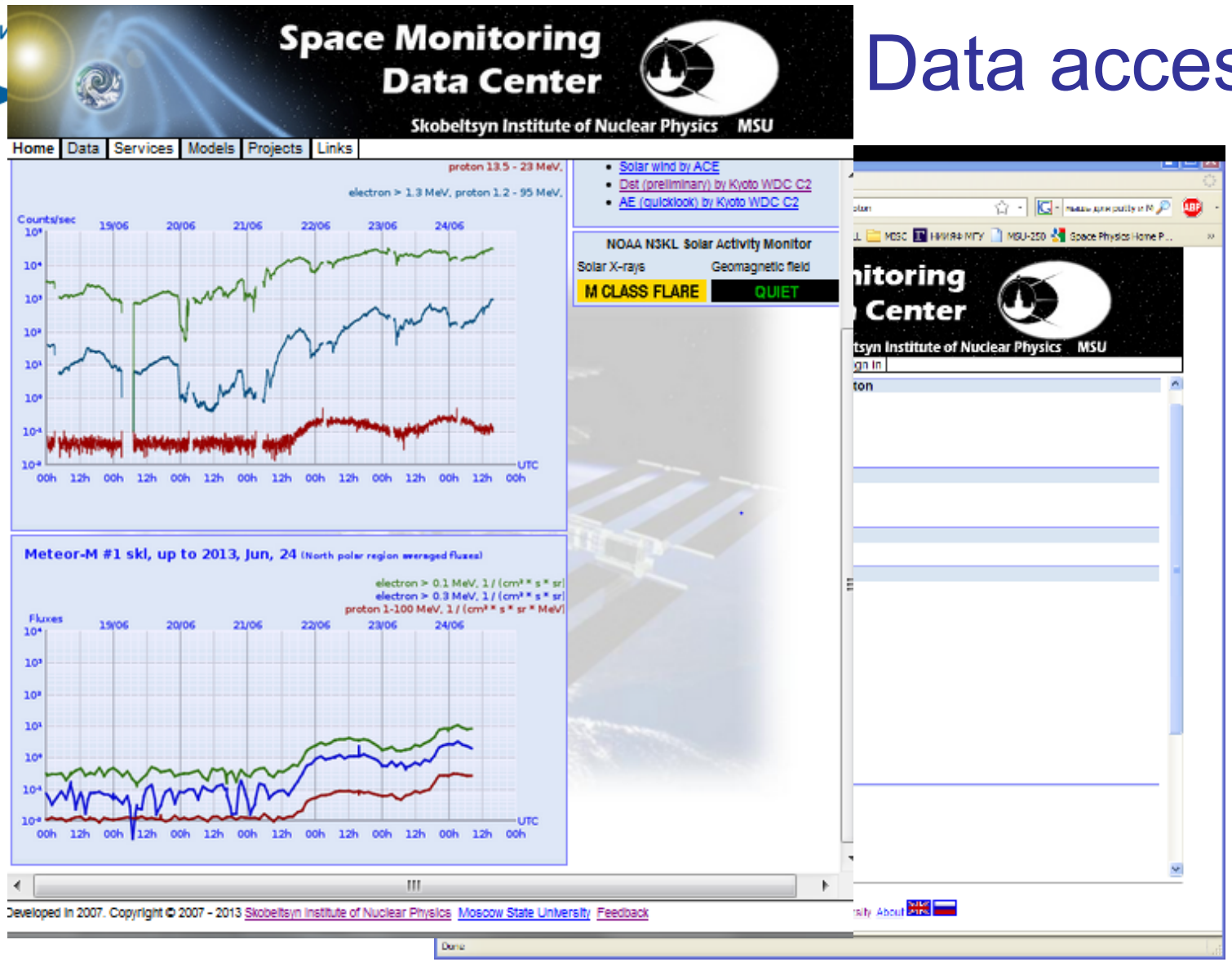
ORACLE RDB



Data access

Table

Figure

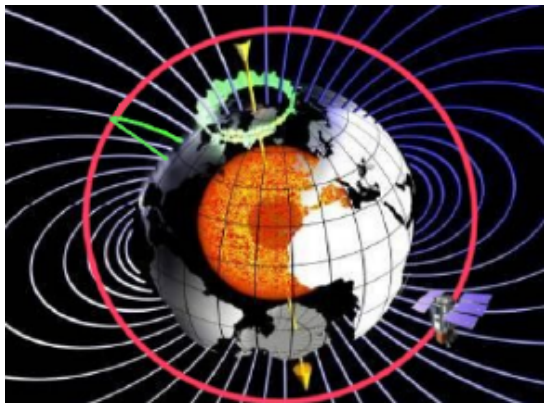


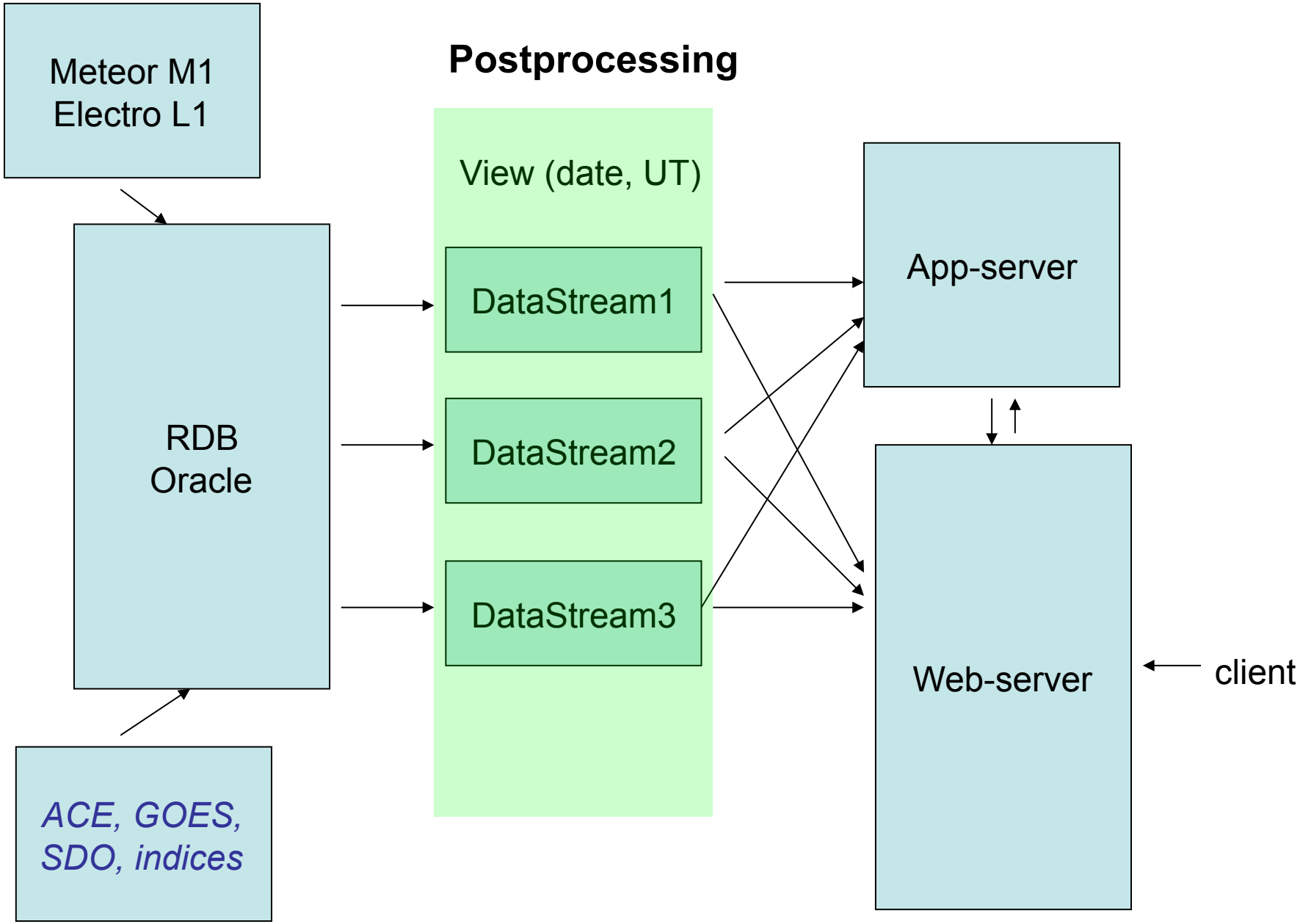
http://smdc.sinp.msu.ru

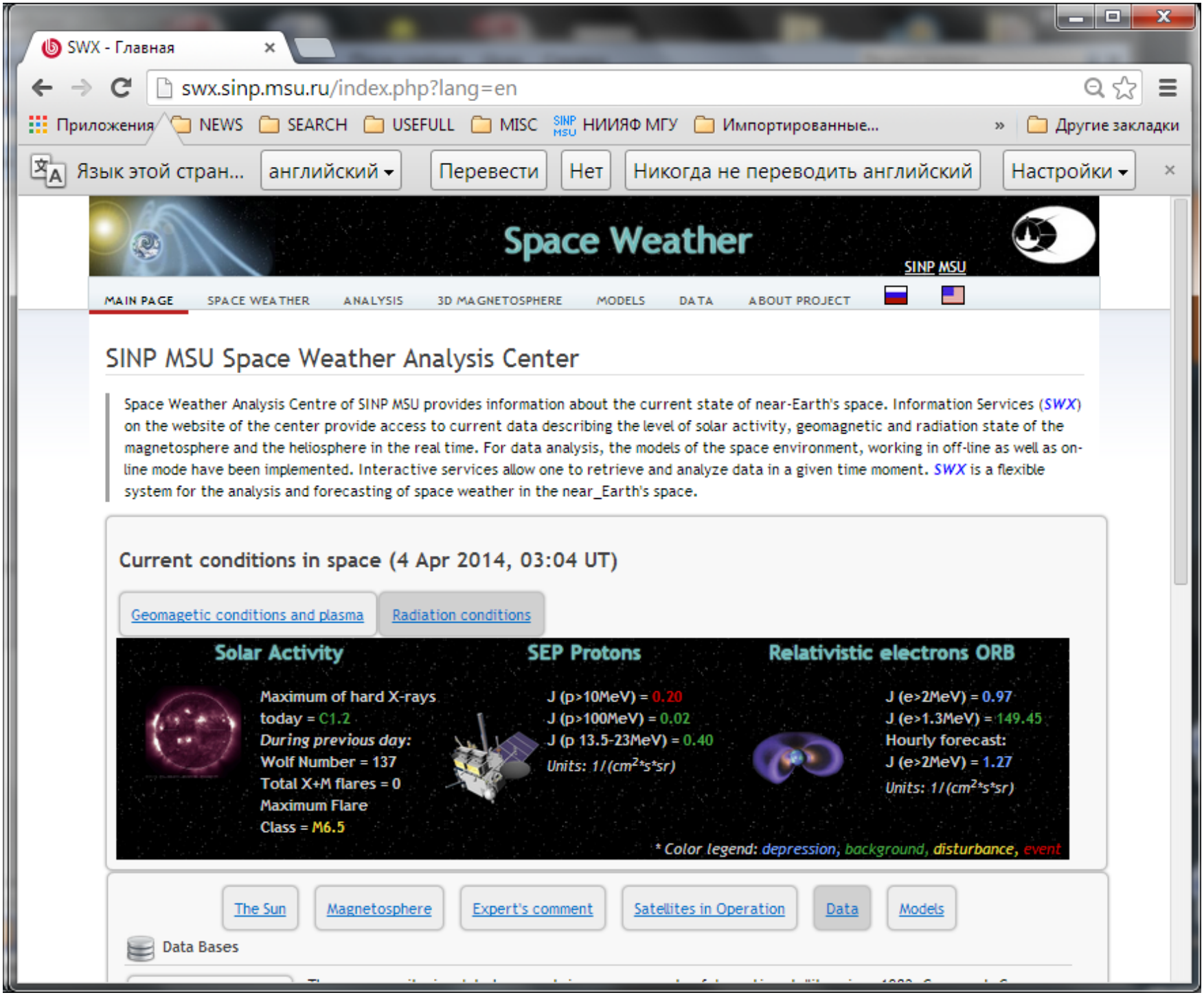
Radiation monitoring: main principles

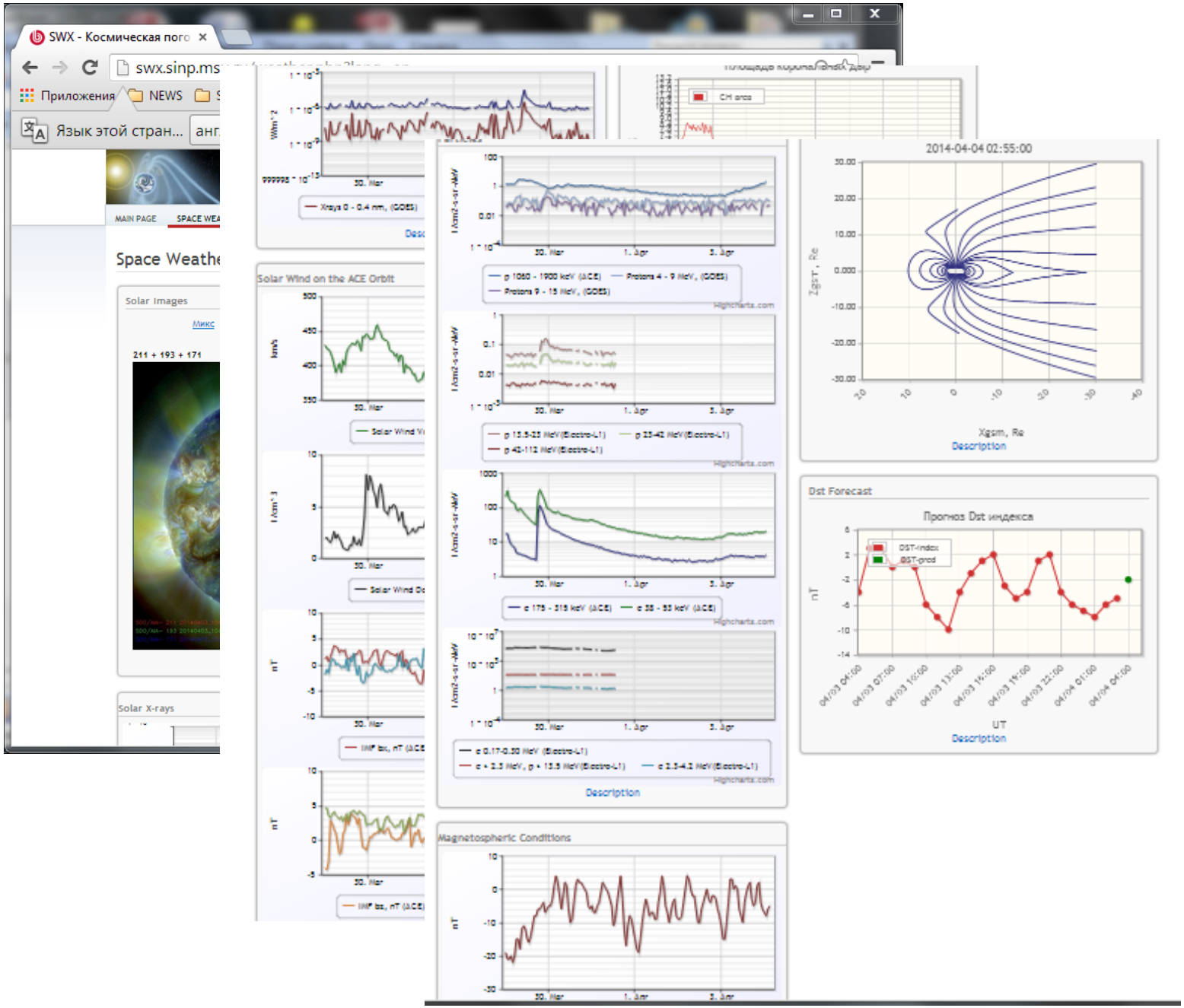
- Data:
  - Data from own sources, from worldwide
  - Data availability, real-time processing, *Free access*
  - Data postprocessing
  - Software: *standard (DB, graphics) and unique*
- Models
  - Interactive
  - Real-time, *DB connection*
- Visualization
  - Fast app (Ajax), DB connection, 3D

http://swx.sinp.msu.ru

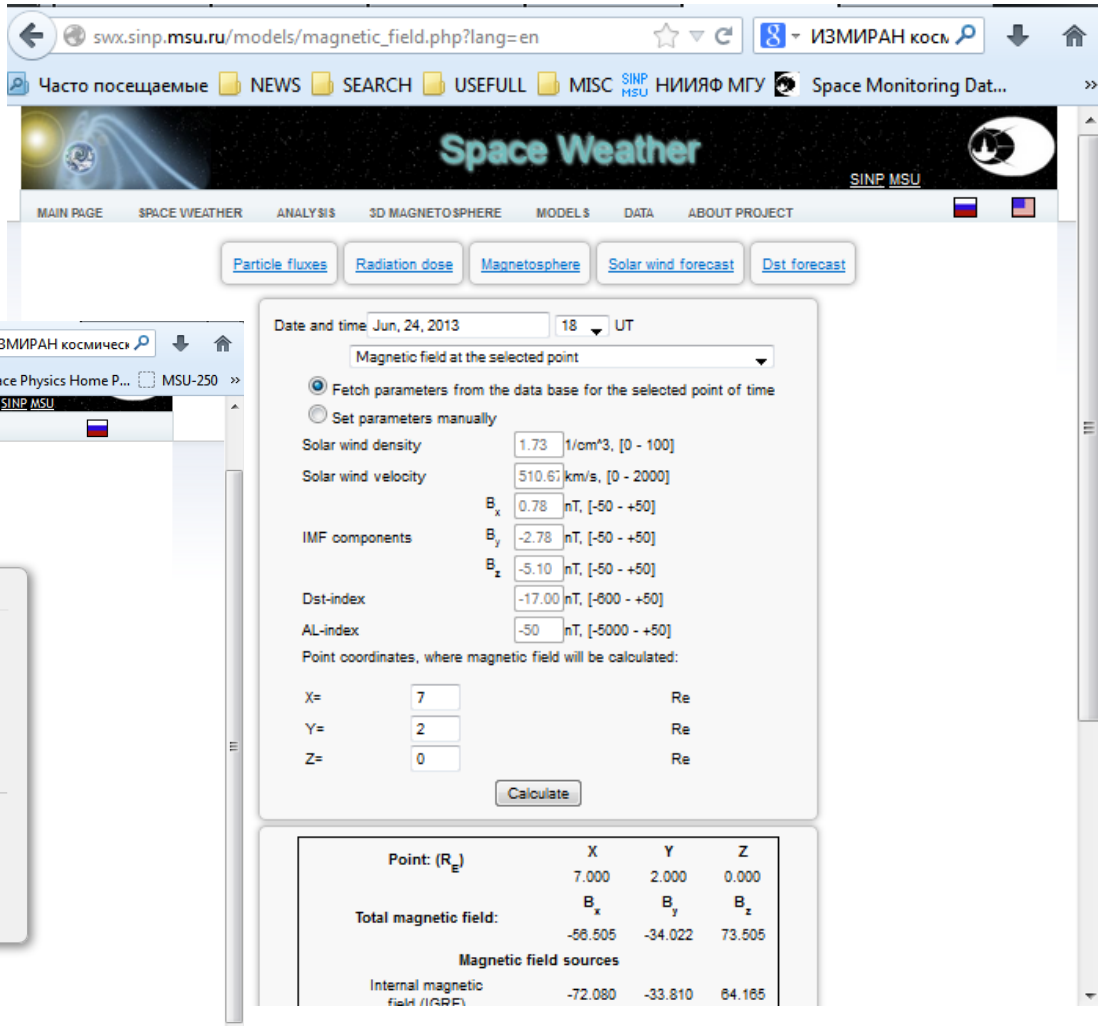


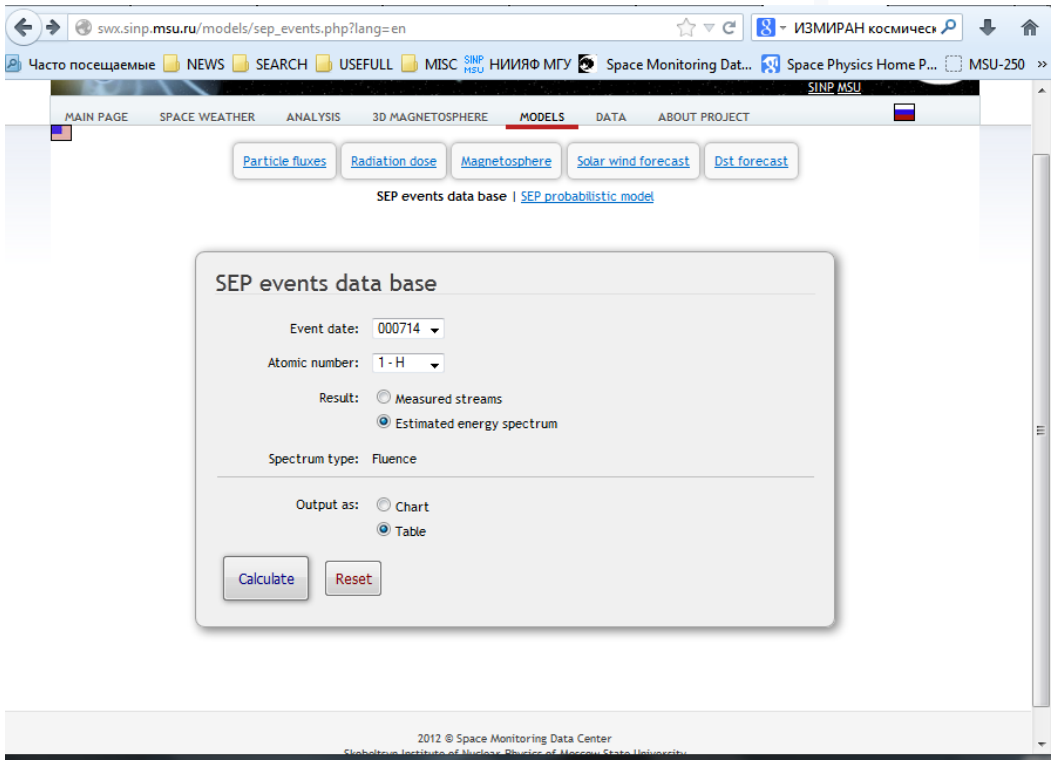

Meteor M1
Electro L1
Postprocessing
View (date, UT)
App-server
RDB
Oracle
DataStream1
DataStream2
DataStream3
Web-server
client
ACE, GOES,
SDO, indices


SWX - Главная
swx.sinp.msu.ru/index.php?lang=en
Приложения
NEWS
SEARCH
USEFULL
MISC
НИИЯФ МГУ
Импортированные...
Другие закладки
Язык этой стран...
английский
Перевести
Нет
Никогда не переводить английский
Настройки
Space Weather
SINP MSU
MAIN PAGE
SPACE WEATHER
ANALYSIS
3D MAGNETOSPHERE
MODELS
DATA
ABOUT PROJECT
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 of the center provide access to current data describing the level of solar activity, geomagnetic and radiation state of the magnetosphere and the heliosphere in 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 (4 Apr 2014, 03:04 UT)
Geomagetic conditions and plasma
Radiation conditions
Solar Activity
Maximum of hard X-rays
today = C1.2
During previous day:
Wolf Number = 137
Total X+M flares = 0
Maximum Flare
Class = M6.5
SEP Protons
J (p>10MeV) = 0.20
J (p>100MeV) = 0.02
J (p 13.5-23MeV) = 0.40
Units: 1/(cm²*s*sr)
Relativistic electrons ORB
J (e>2MeV) = 0.97
J (e>1.3MeV) = 149.45
Hourly forecast:
J (e>2MeV) = 1.27
Units: 1/(cm²*s*sr)
* Color legend: depression, background, disturbance, event
The Sun
Magnetosphere
Expert's comment
Satellites in Operation
Data
Models
Data Bases


SWX - Космическая пого
swx.sinp.ms
Приложения
NEWS
Язык этой стран...
MAIN PAGE
SPACE WEA
Space Weathe
Solar Images
Микс
211 + 193 + 171
Solar X-rays
Solar Wind on the ACE Orbit
Xrays 0 - 0.4 nm, (GOES)
Description
2014-04-04 02:55:00
Xgsm, Re
Description
Dst Forecast
Прогноз Dst индекса
DST-index
DST-prod
nT
UT
Description
Magnetospheric Conditions
nT

Interactive models





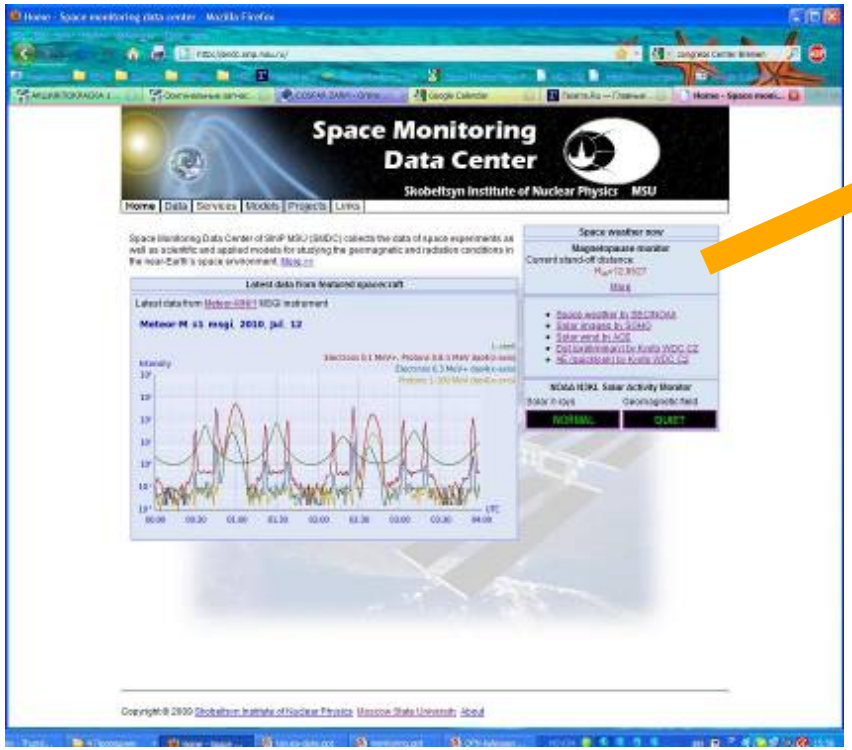
Operational models

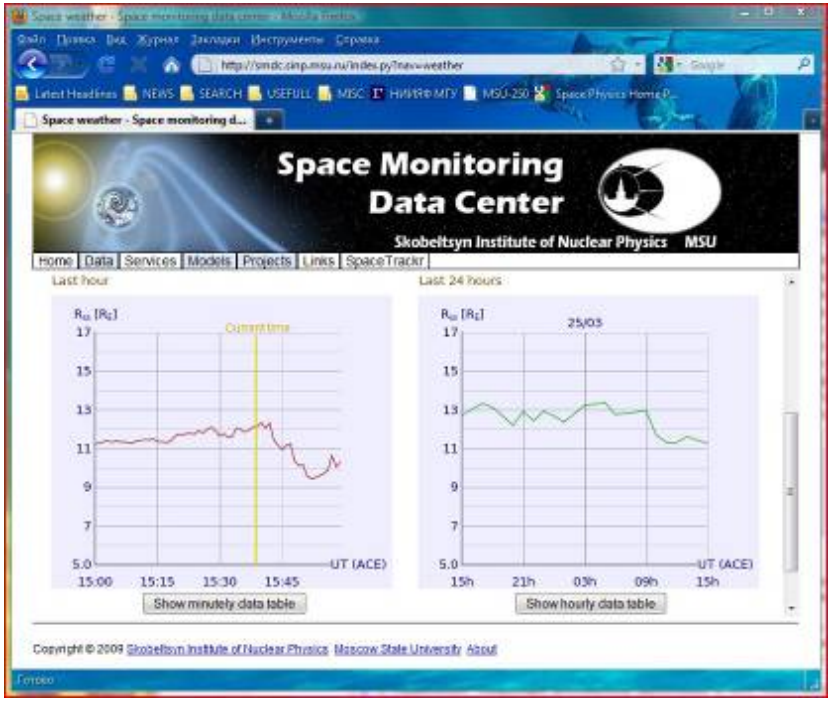
- ACE data propagation and stand-off distance
- Particle spectra at LEO
- Coronal Holes total area RT estimation and SW velocity forecasting at L1
- Dst forecasting
- Magnetospheric magnetic field
- Radiation models – under development

Magnetopause stand-off distance

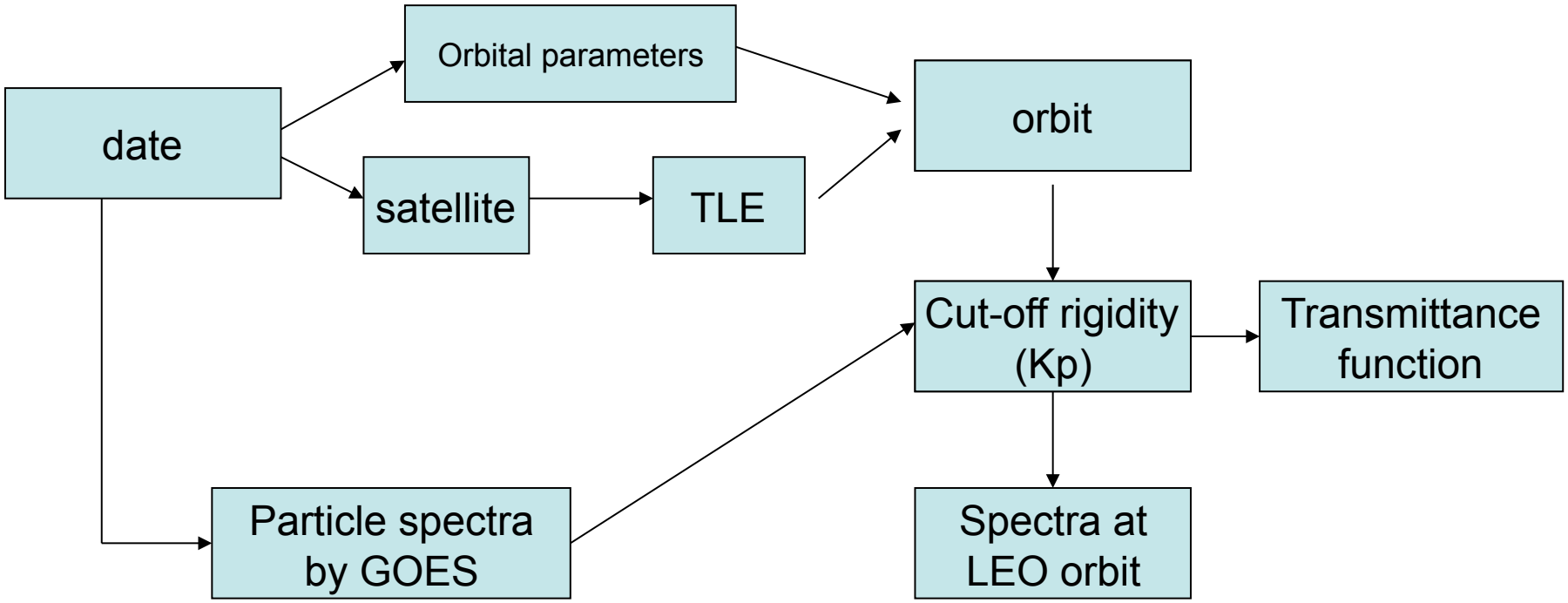
R_{ss} = 8.6*(1 + 0.407*exp(- (|Bz| - Bz)^2/(200*p$^{0.15}$))*p$^{-0.19}$) – by S.N. Kuznetsov,1997

$$R_1 = \{10.22 + 1.29\tanh[0.184(B_z + 8.14)]\}(nv^2)^{-\frac{1}{6.6}}$$ – by Shue, 1998



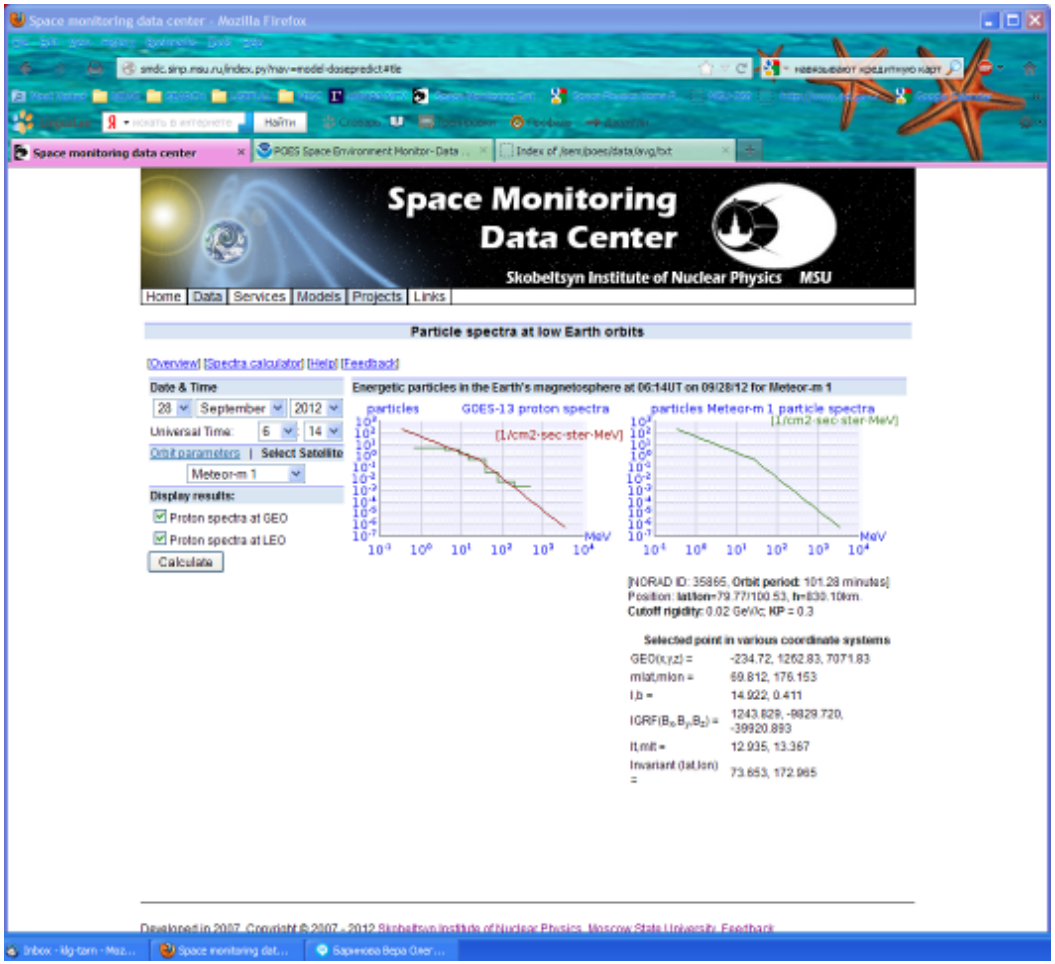


Particle spectra at LEO orbits

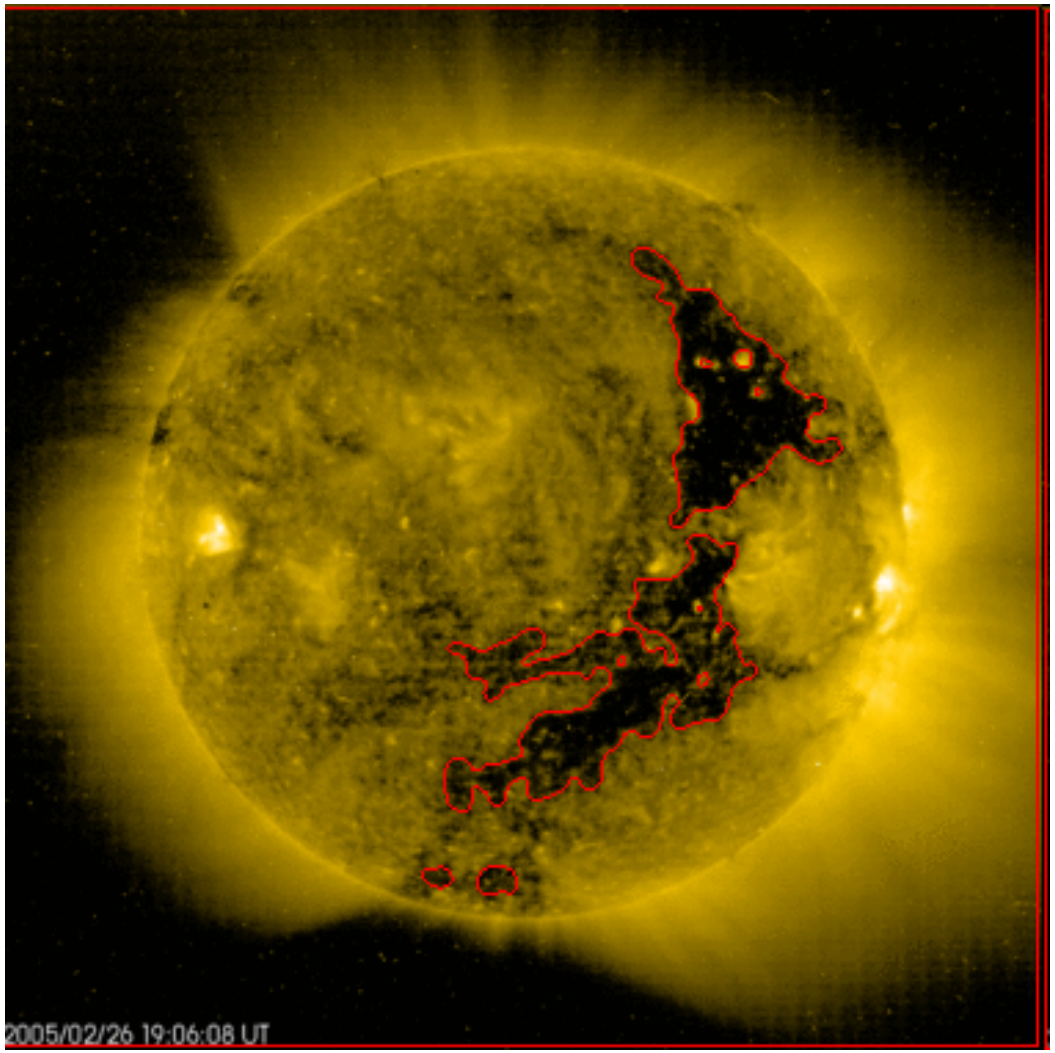


Input from NORAD, NOAA/GOES, Potsdam (Kp)

Particle spectra at LEO orbits



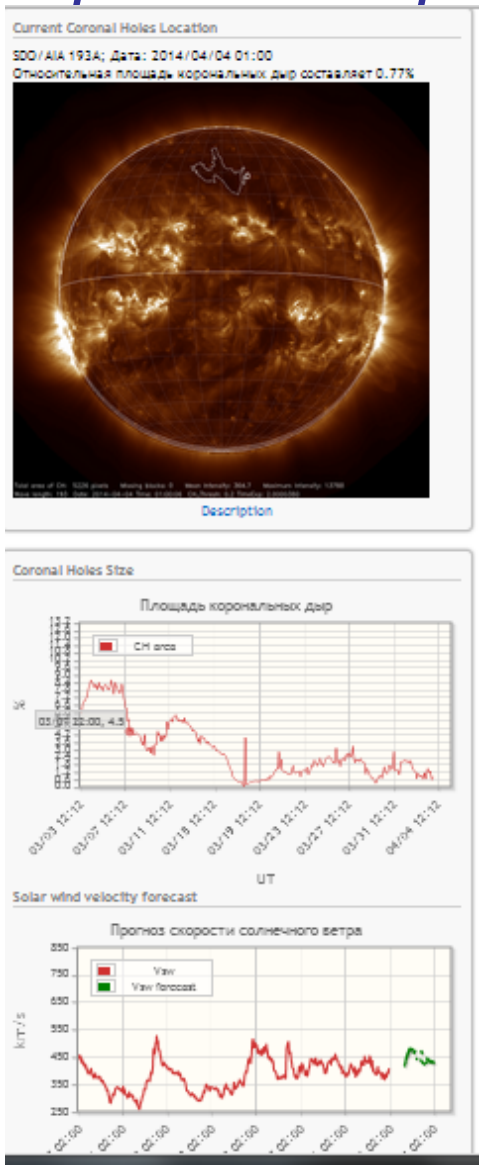
Determination of coronal holes area

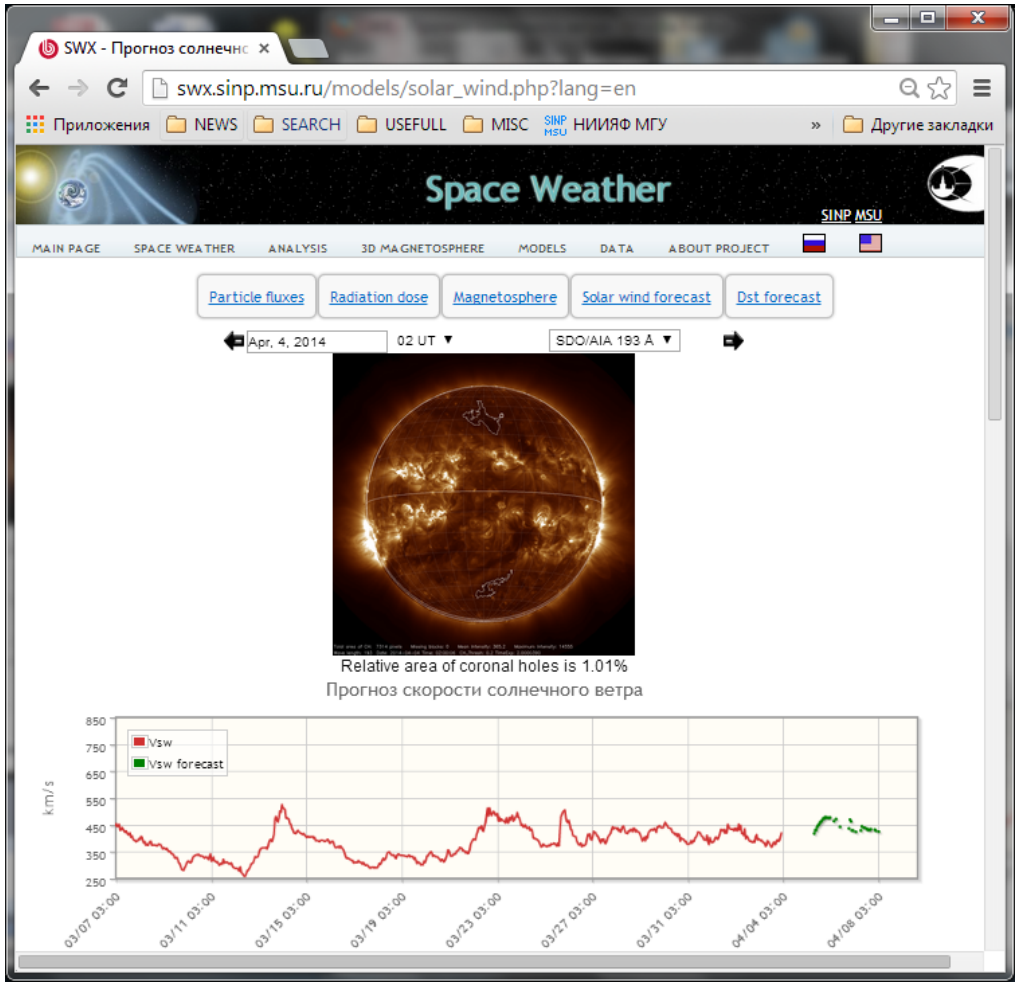


Index	Area	Intensity
1	0.0020	33.7032
2	0.0522	25.8788
3	0.0036	32.9647
4	0.0413	16.5017

Solar Wind Velocity Forecast

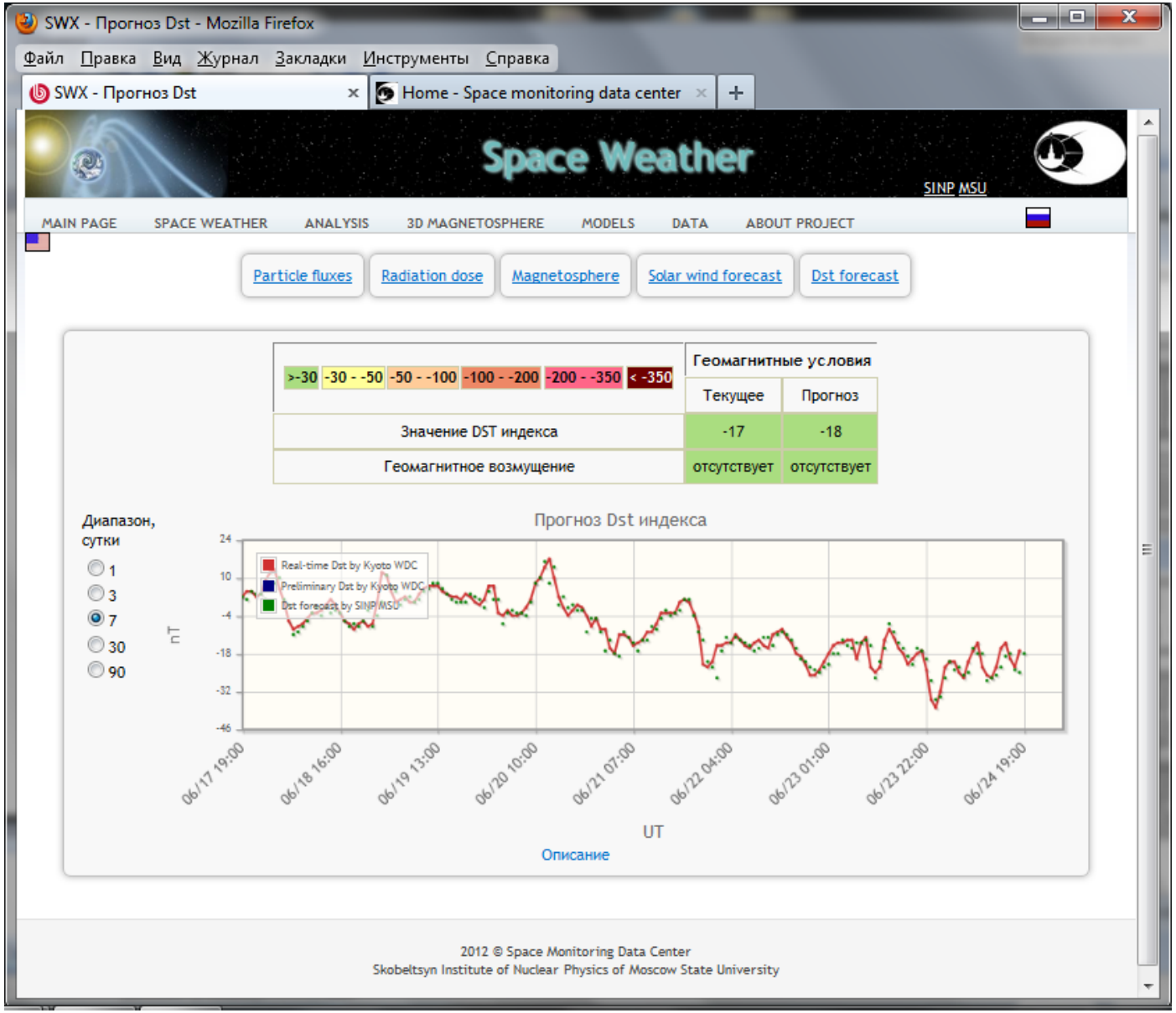
http://swx.sinp.msu.ru/models/solar_wind.php?lang=en





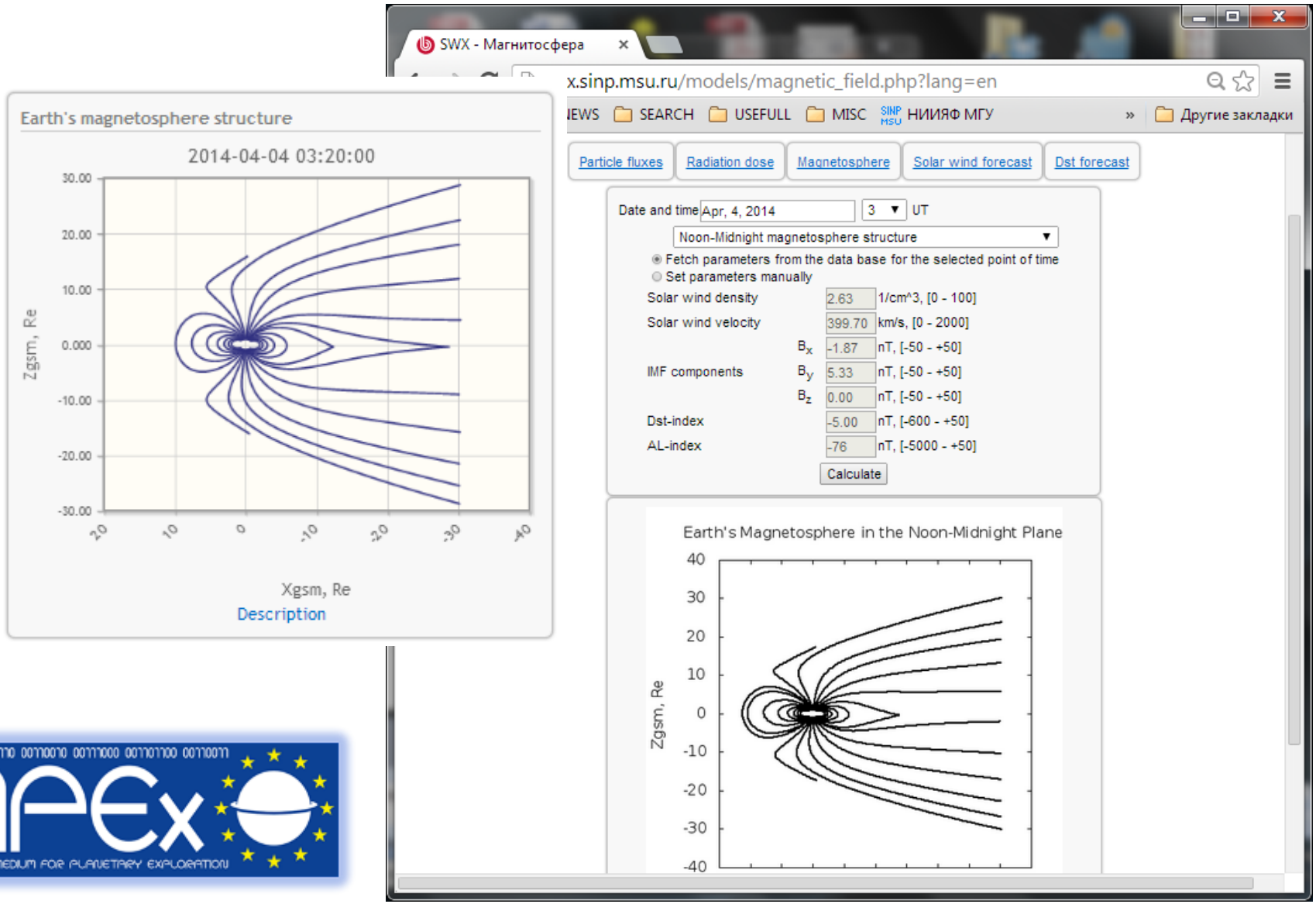
Dst Forecast

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



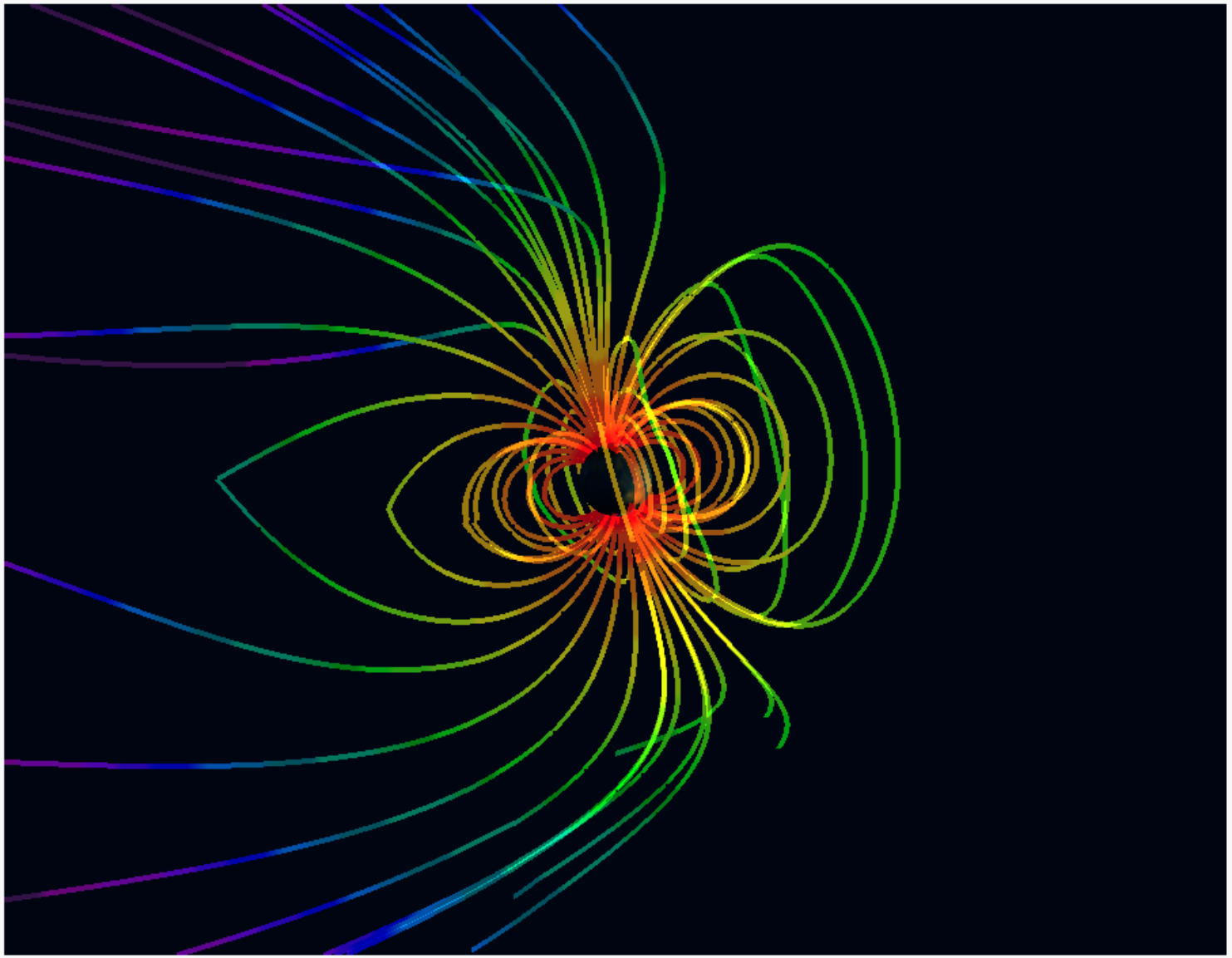
Paraboloid model A2000

http://swx.sinp.msu.ru/models/magnetic_field.php?lang=en



3D-magnetosphere

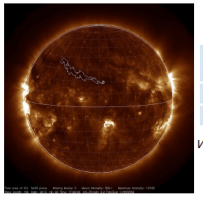
http://swx.sinp.msu.ru/3d.php?lang=en



Состояние околоземного космического пространства
02 October 2013, 12:00 UT

1 Солнечная активность

Текущее изображение Солнца (УФ, λ = 193 Å)



	01 October, 12h	Максимум за 24 часа	Текущее
Относительная геоэффективная площадь корональных дыр	0.5%	1.2%	0.5%
Максимальный класс рентгеновского излучения	B3.3	B6.1	B3.4
Число Вольфа	59	59	59

Источники данных: SDO (NASA), GOES (NOAA), ЦОКМ (НИИЯФ МГУ)

2 Геомагнитная обстановка на орбите Земли

Dst-индекс за неделю, нТл

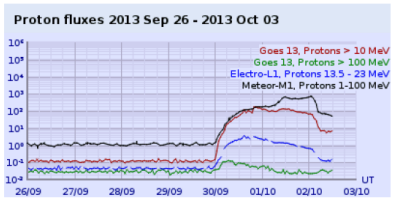
	01 October, 12h	Экстремум за 24 часа	Текущее
Давление солнечного ветра:	1.0 нПа	41.6 нПа	6.1 нПа
KP-индекс	2+	7+	3-
Dst-индекс	11.0 нТл	-75.0 нТл	-63.0 нТл

Источники данных: ACE (NASA), GFZ (Potsdam), WDC-2 (Kyoto), ЦОКМ (НИИЯФ МГУ)

3 Радиационная обстановка

3.1 Солнечные космические лучи

Потоки за неделю, $(см^2*с*ср)^{-1}$

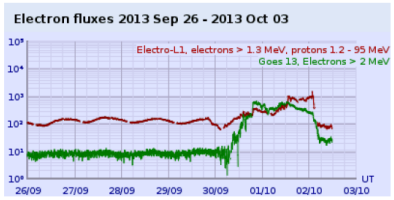


Потоки протонов	01 October, 12h	Среднее за 24 часа	Текущее
E 1-100МэВ	643.55	273.10	50.08
E>10МэВ	127.86	37.82	6.99
E 13.5-23МэВ	1.31	0.39	0.15
E>100МэВ	0.02	0.02	0.03

Источники данных: GOES (NOAA), ЦОКМ (НИИЯФ МГУ)

3.2 Релятивистские электроны внешнего радиационного пояса

Потоки за неделю, $(см^2*с*ср)^{-1}$



Потоки электронов	01 October, 12h	Среднее за 24 часа	Текущее
E>1.3МэВ	455.6	387.3	68.0
E>2МэВ	475.0	140.4	26.2

Источники данных: GOES (NOAA), ЦОКМ (НИИЯФ МГУ)

Обозначения: — понижение (только для электронов); — норма; — повышение; — событие.

Центр Оперативного Космического Мониторинга
НИИ Ядерной Физики МГУ

http://smdc.sinp.msu.ru
smdc@sinp.msu.ru

Conclusions

- **Space monitoring data center of MSU gives access to satellite data via Web-site *http://smdc.sinp.msu.ru***
- **SMDC provides real-time analysis of physical conditions in the near-Earth space based on data and models via Web-site *http://swx.sinp.msu.ru***
- **SMDC has the same aims and the same users as CCMC**
- **NASA CCMC and MSU Space monitoring data center began first contacts in 2011 and intend to work in close collaboration**