History and modernity of the study of Space Weather in Russia

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At the international level, formulated a series of initiatives on Space Weather, which aims at the development of action plan countries participating in space activities to mitigate the impacts of the factors of Space Weather on space activities. These initiatives emanate from the Committee on the peaceful uses of outer space (UN COPUOS) the working group Technical Subcommittee on the Long-term sustainability of outer space activities", by the Scientific Committee on solar-terrestrial physics (SCOSTEP) in the framework of the "International initiative on Space Weather", regularly considered at meetings of the UN COPUOS from the scientific community in the framework of “Roadmap on Space Weather under the auspices of COSPAR and “International living with a star”, etc.

Also are exist documents as “Strategy of the United States and on Space Weather" and “Action Plan of the USA Space Weather".
The United Nations (UN)

The Committee on the peaceful uses of outer space (UN COPUOS)

Scientific and Technical Subcommittee

The working group "Long-term sustainable development of space activities"

The expert group (A, B, C, D)

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Expert group C “Space Weather”

Berlin, Germany
Recommendations for the mitigation of space weather for space activities

1. A consistent approach to monitoring and studying space weather:
   - modeling of space weather phenomena and their dynamics;
   - drawing up of forecasts;
   - research of influence of space weather on technical systems;
   - development and implementation of technical standards for design and the manufacture of satellites and other space and ground equipment.

2. Consolidate the results of all observations for the purpose of receiving a comprehensive picture of the status of space weather.

3. International cooperation and coordination of stakeholders of the parties around the world to lasting improvements in the area space weather:
   - to create a joint satellite observation system;
   - providing secure access to reports;
   - capacity development in the field of service and maintenance of global consistency of end-products users.
UN global observing system and monitoring

• 18 operating missions on (29 spacecrafts)
  Voyager-2, Geotail, Wind, SOHO, ACE, Cluster-4, TIMED, RHESSI, TWINS-2, Hinode, STEREO-2, THEMIS/ARTEMIS-5, AIM, CINDI, IBEX, SDO, Van Allen Probes-2, IRIS.

• 9 missions in preparation
Space Weather – solar and geomagnetic activity

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Aurora the only manifestation of Space Weather available to the naked tool man

2\textsuperscript{nd} International Conference and Exhibition on “Satellite & Space Missions”, July 21-23, 2016
Berlin, Germany
1600
William Gilbert explained the work of the compass the Earth's magnetic field as a whole

1806
Alexander von Humboldt noticed the trembling of the magnetic needle during the Aurora. Magnetic storm – change 1-10% of the Earth's field

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Sunspots occasionally seen since ancient times

1128
First known image of the spots. Medieval English chronicle

1612. Galileo. First spots scientific observation

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Sunspots and magnetic storms

1859. Richard Carrington. First observation of a solar flare for the first time clearly mapped sunspots, flare, auroras and magnetic storm.

1843. Samuel Schwabe. First discovered the 11-year cyclicity in solar spots.
Sunspots the result of the presence of a magnetic field and rotation

Spot – the area of high of the magnetic field. Magnetic field obscures the flow of energy from the depths of the Sun, this area is colder looks darker on a bright background

Plasma allows us to "see" magnetic field

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Magnetic storm.
This is a significant perturbation of the magnetosphere, caused by an abnormal increase in the solar wind and interplanetary magnetic field.

Storm - induced average magnetic cloud, has energy $10^{16}-10^{17}$ Joules ~ 10 megatons

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Current Factors:
- Solar short-wave radiation 8 min.
- Solar cosmic rays 1-12 hours
- Magnetic cloud (magnetic storm) 2-3 days
  - Magnetospheric radiation
  - Inhomogeneity of the magnetosphere and ionosphere
  - Variations of the geomagnetic field
The Earth is inside a huge electromagnetic installation:

electromagnetic interference on equipment: communication, power lines, exploration, pipelines, railways, automation

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Telecommunications.

ionosphere – the upper layer of the atmosphere (100-400 km), ionized by solar radiation - environment for propagation

Electromagnetic interference (EMI) after solar flares and magnetic storms:
- Local communication in the circumpolar regions;
- Space communications GPS/GLONASS

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On the ISS, the radiation dose is acceptable the protection housing and the Earth's magnetic field. During solar flares you cannot go into space.

Outside of the magnetosphere recruited for the year lethal dose: the restriction on flights to other planets.
Solar activity and climate

The sun is a stable star.
The flow of solar radiation – THE SOLAR CONSTANT ~ 1.5 kW per 1 sq. m.

The effect of the solar variability not more than 0.1% of the solar constant.

The 11-year period in the annual rings.

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Alexander Leonidovich Chizhevsky 1897 - 1964

Heliobiology

27-day periodicity mental disorders 1932

Probably has a small effect on the human body manifests itself individually more likely to have unhealthy people mechanism of the effect is unclear

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International initiative on space weather (SCOSTEP)  
Distribution of instruments across the globe

17 existing networks and chains of similar devices that measure different characteristics of solar activity, ionosphere, atmosphere, geomagnetic field and cosmic rays. 100 countries used by over 1000 instruments provided by 16 developed countries.  

**Part of Russia:** 3 magnetometers – Cape Schmidt, Magadan, Paratunka; 2 camera and optical IR range – Magadan, Paratunka; 1 solar radio spectrometer – Badary (Irkutsk).

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The forecast for the month-
return active region
(spots)

The forecast for the week the
stain is already visible on the left
of the disk.

Forecast for two or three days
the more and more dynamic the
spot, the greater the likelihood of outbreaks

Berlin, Germany
The forecast for the week the stain is already visible on the left of the disk.

Forecast for two or three days the more and more dynamic the spot, the greater the likelihood of outbreaks.

The forecast for 1-2 hours monitoring the solar wind before Earth.

Reliability >90%
With the star we were lucky...
With the star we were lucky...

THANK YOU FOR ATTENTION!