

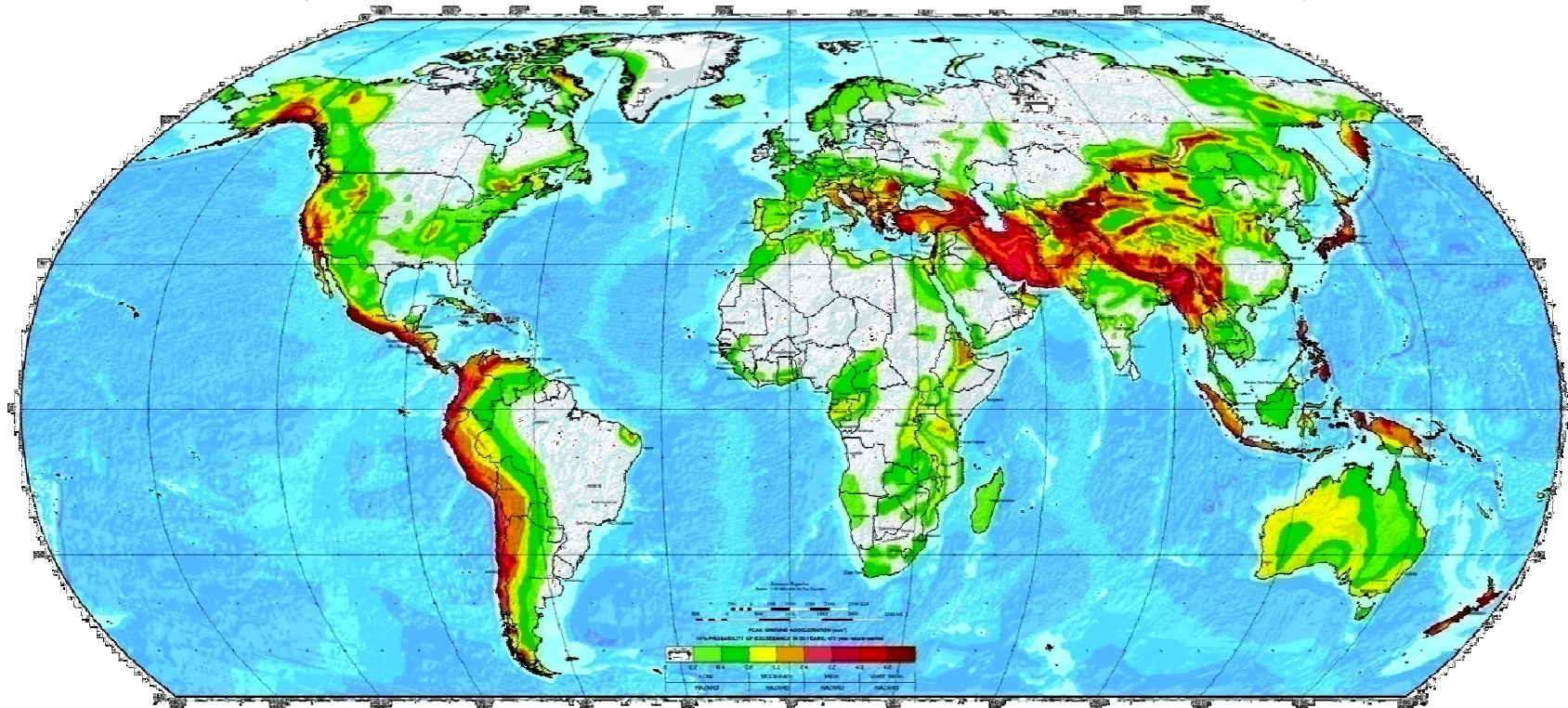
International Astronautical
Congress
IAC-2012



YUZHNOYE
design office

**GLOBAL SATELLITE SYSTEM FOR MONITORING
EARTH'S SEISMIC ACTIVITY**

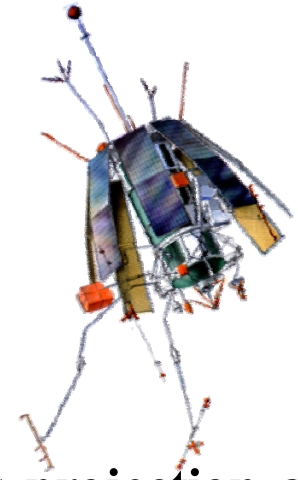
MAP OF SEISMIC ACTIVITY



- **1/3 of the Earth surface is earthquake-prone zone;**
- **For the recent 50 years more than 1 million human deaths all over the world were caused by earth-quakes.**

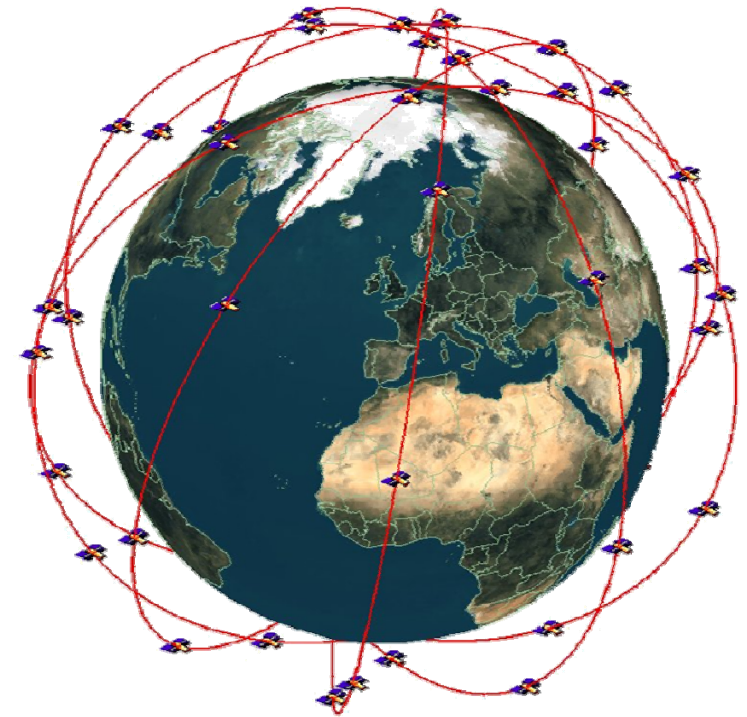
PREREQUISITES

- **Implementation of joint USSR-France Project ARCAD allowed to discover effects in ionosphere and space plasma connected with seismic activity using observations data from «Oreol-1» (1971), «Oreol -2» (1973) and «Oreol -3» (1981) satellites.**
- **Today sufficiently big number of evidences of disaster precursors projection at the ionosphere altitudes have been generated, for example at the early stages of origin of earthquakes and volcanoes eruptions.**
- **Analysis of principal possibility of seismic activity prediction and development of the forecasting methodologies using different approaches has been carried out by many scientists from different countries.**
- **Detection and forecasting of dangerous and disastrous Earth phenomena by means of space monitoring of ionosphere gain more practical importance.**
- **Creation of thoroughly designed global satellite system for monitoring and forecasting seismic activity could be a significant step towards provision of humankind safety.**



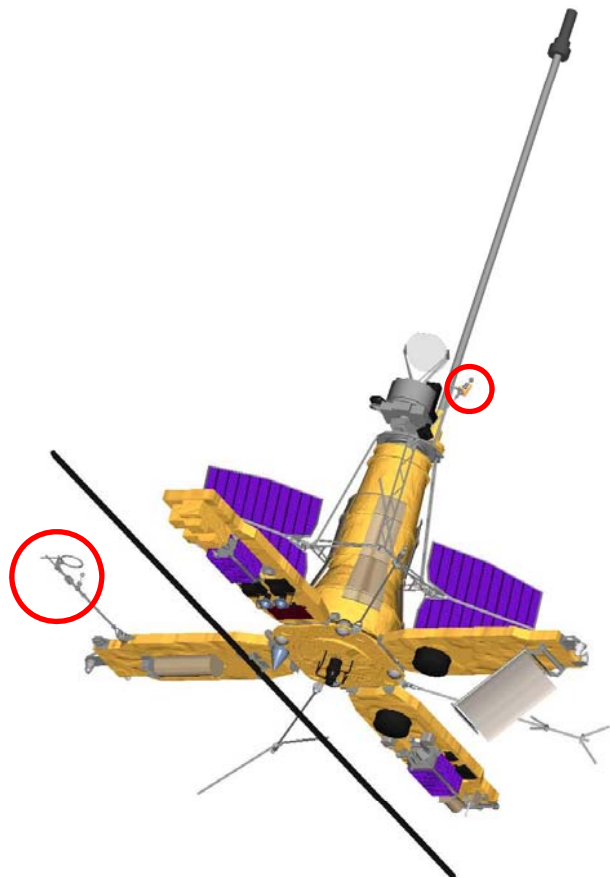
ADVANTAGES OF SPACE OBSERVATION APPLICATION

- **Wide spectrum of earthquake precursor observation due to combination of space and ground measurements;**
- **Global nature of study;**
- **Establishment of integrated database of the observed geophysical parameters;**
- **Provision of scientific breakthrough in the field of physical phenomena study related to seismic activity and etc.**



“VARIANT” AND “POTENTIAL” PROJECTS

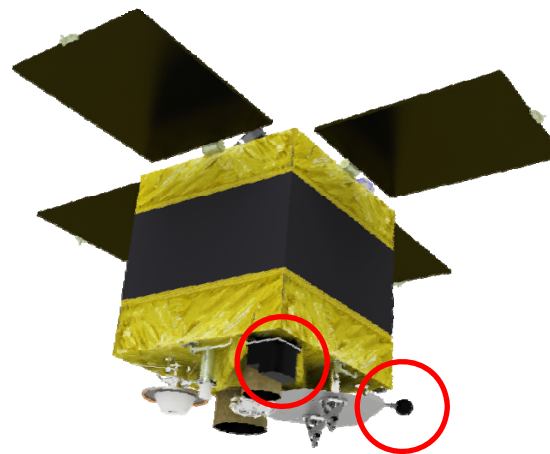
Today Ukraine continues to perform space researches of ionosphere



Sich-1M

Launched in December 24, 2004

Retired in April 15, 2006



Sich-2

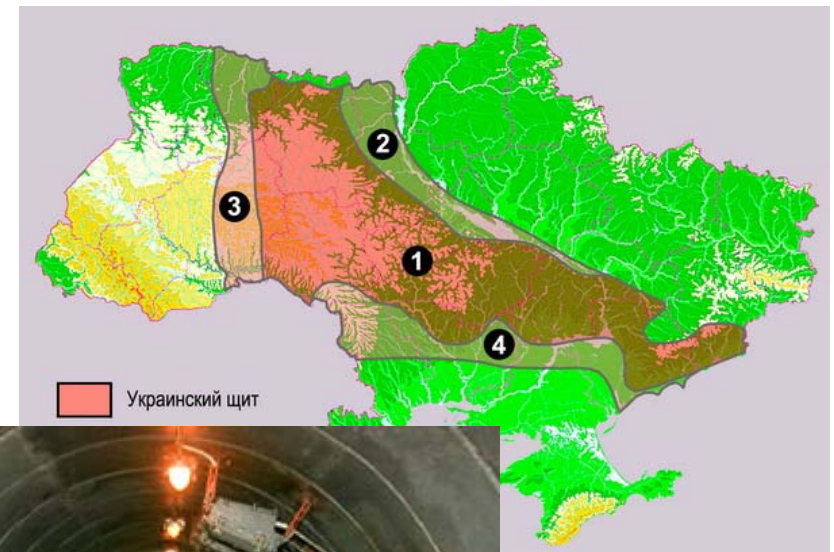
Launched in August 17, 2011

UKRAINIAN GROUND SUPPORT FACILITIES OF SEISMIC-IONOSPHERE EXPERIMENTS

Radiotelescope URT-2

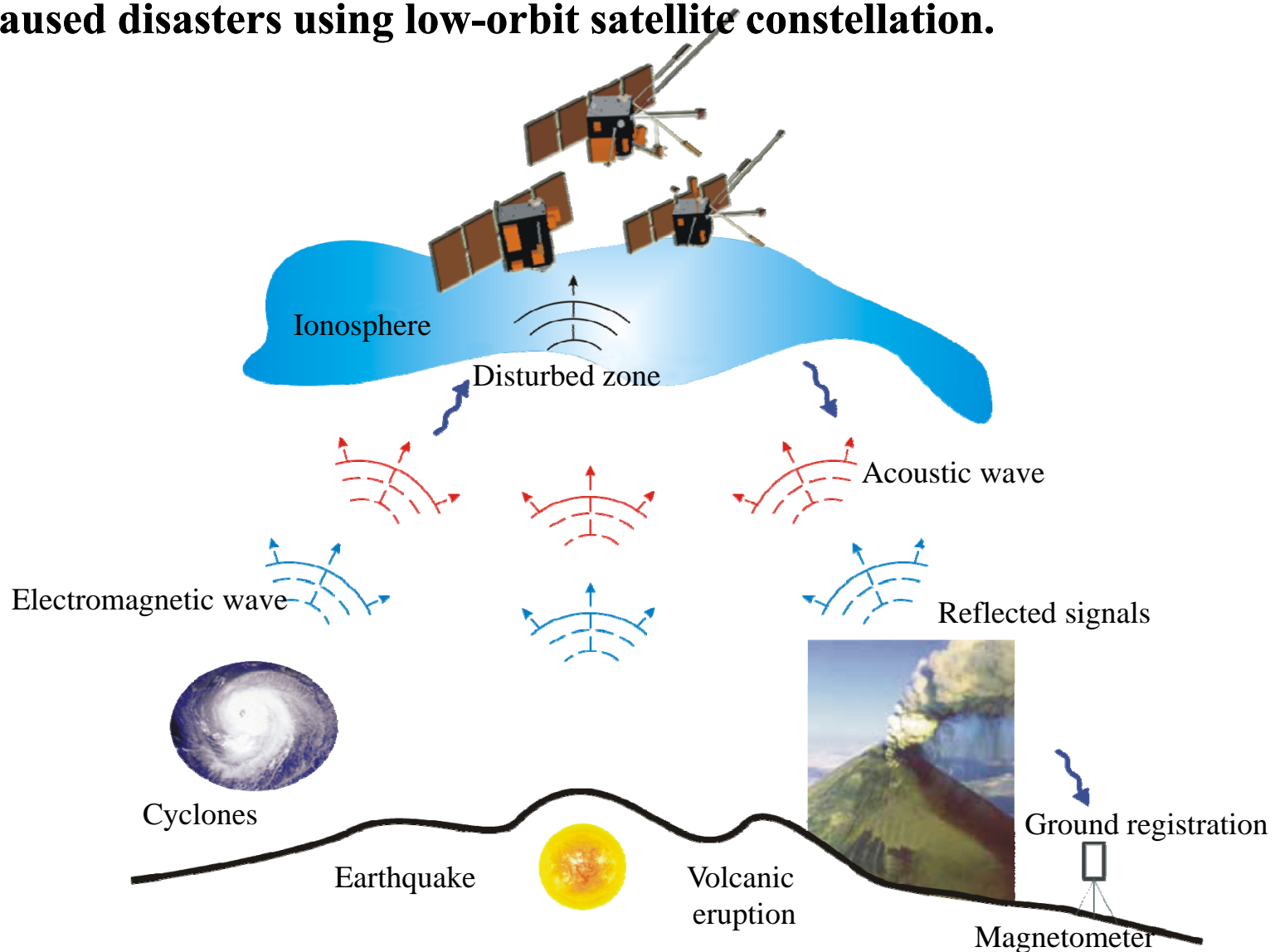


Main data center of special monitoring

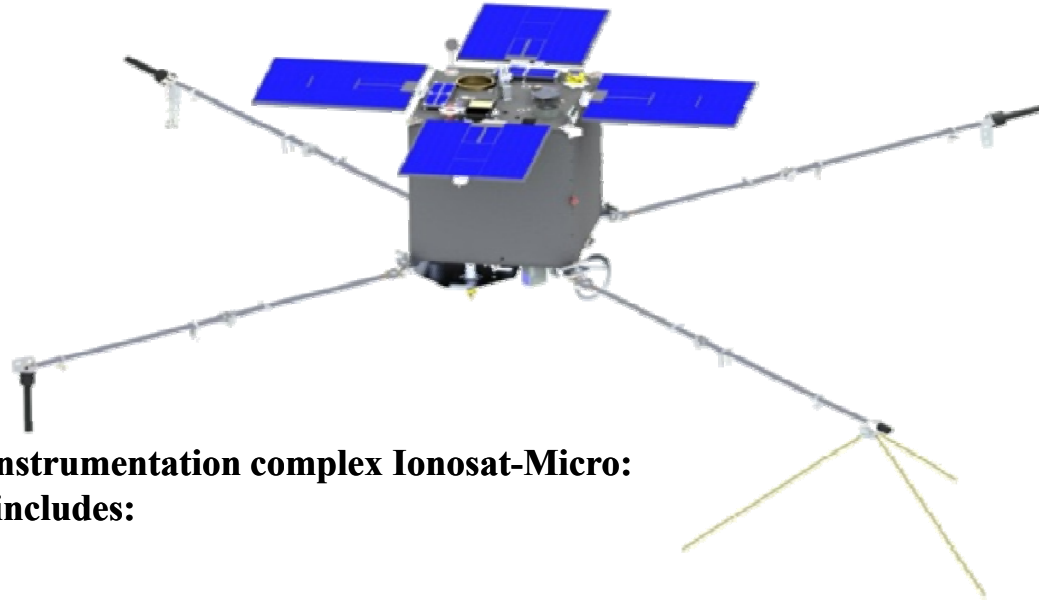


YUZHNOYE CONCEPT OF SPACE SYSTEM

Conducting scientific experiments related to forecasting and diagnostics of natural and man-caused disasters using low-orbit satellite constellation.



SPACECRAFT «MICROSAT»



Composition of scientific instrumentation complex Ionosat-Micro:

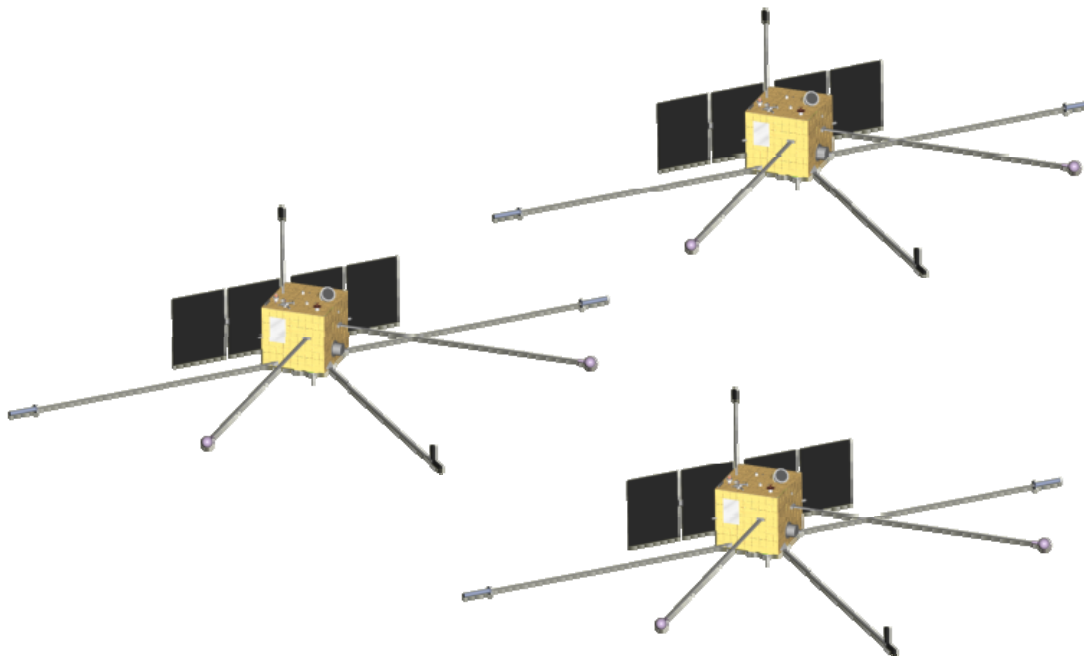
- magnetic-wave complex includes:
 - wave probes,
 - electric probe,
 - fluxgate magnetometer of constant field,
 - electronic unit;
- sensors complex of kinetic parameters of ionosphere plasma particles includes:
 - neutral particles sensor,
 - charged particles sensors,
 - electronic unit;
- electric field spectrograph;
- GPS-GLONASS measurement unit of complete electronic content;
- scientific data gathering system (SDGS).

Main characteristics of the satellite:

- | | |
|------------------------|--------------|
| - orbit altitude | ~668 km |
| - inclination | ~98.1degrees |
| - orientation accuracy | <5 degrees |
| - mass | ~200 kg |
| - launch-vehicle | Cyclon-4 |
| - lifetime | 3 years |

SPACECRAFT CLUSTER FOR MULTIPOSITION MEASURING

Three satellites with identical composition of scientific equipment on near-circular near-polar orbit which form triangular configuration with possibility to change distance between each other from several tenth to several thousands kilometers. It is proposed to define optimal parameters of clusters configuration during implementation of the Project taking into consideration requirements to implementation of synchronous multiposition measurements of ionosphere parameters.



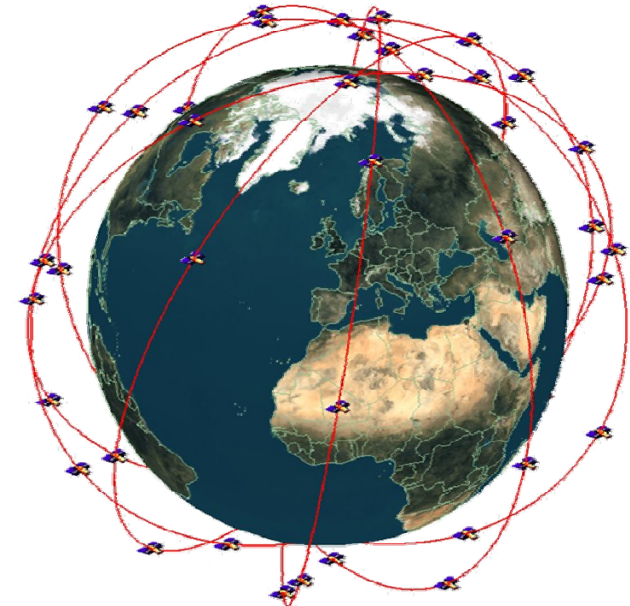
Main characteristics of the satellite:

- | | |
|------------------------|--------------|
| - orbit altitude | ~500 km |
| - inclination | ~90 degrees |
| - orientation accuracy | <0.2 degrees |
| - mass | ~300 kg |
| - lifetime | 3 years |

CONSTELLATION OF CLUSTERS

It is assumed that space segment of the system will represent a constellation capable of sequential increase of clusters number up to 6..8 (18..24 satellites).

The optimum structure of the constellation (number of orbit planes and relative allocation of clusters in planes) is proposed to be determined during implementation of the Project on the basis of requirements to frequency of ionosphere parameters measurements in the same specified areas of space.



Satellite payload (complex of scientific equipment for ionosphere monitoring) is formed by international cooperation of developers on the basis of existing equipment complexes and the ones under development. Satellites are created on the basis of space-proven subsystems and solutions which allows to reduce costs for the space system development and to create unified space platform for space segment.

KEY ASPECTS (TASKS OF THE PROJECT)

- 1. Search and detection of seismic activity precursors, including ionosphere disturbances;**
- 2. Investigation of physical interaction mechanisms in the system “lithosphere – atmosphere – ionosphere – magnetosphere”;**
- 3. Development of approaches of seismic activities satellite monitoring for Earth quakes forecasts;**
- 4. Development of composition of the satellites instrumentation system;**
- 5. Selection of satellite orbits, configuration of cluster, structure of satellite constellation and ground system segment.**

PROPOSED SOLUTIONS

- **Ukraine (Yuzhnoye SDO) proposes to initiate research-scientific Project devoted to the specified subject within the frames of International Academy of Astronautics which will allow to consolidate efforts of international experts in space and other related areas of science with the purpose of finding solution to a number of key aspects of the Project, based on data, obtained under existing scientific missions of different countries;**
- **The main contribution into solution of the first, the second and the third groups of tasks shall be made by joint group of experts in the field of tectonic, atmospheric, ionospheric processes, meteorological phenomena, solar-terrestrial relations, etc.;**
- **Main contribution into solution of the forth and the fifth groups of tasks shall be made by space industry experts.**

EXPECTED RESULTS OF THE PROJECT

- **Determination of reliable precursors of seismic activity and substantiation of the physical mechanisms of their emergence;**
- **Development of reliable methods of earthquake forecasting using space monitoring data;**
- **Determination of expediency of the full-scale deployment of scientific-research and design activities for creation of the global satellite system for seismic activity monitoring, scope of works and possible duration of works execution;**
- **Proposals on optimal composition of satellite instrumentation for seismic activity monitoring;**
- **Proposals on optimal parameters of the satellite orbit, cluster configuration, structure of the satellite constellation and ground segment of the system;**
- **Costs estimates for full-scale implementation of the Project;**
- **Proposals on international scientific-industrial cooperation necessary for implementation of the Project.**

THANK YOU FOR ATTENTION!