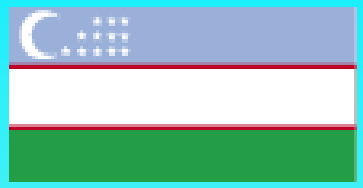
United Nations/Azerbaijan/European Space Agency/United States of America Workshop on the Applications of Global Navigation Satellite Systems

Hosted by and Co-organized with the
Ministry of Telecommunications and Information Technologies
Baku, Azerbaijan
11 – 15 May 2009

Use of GNSS technologies in Uzbekistan for studying of Geodynamical and Ionospheric processes

Ibragimov I.A., Fazilova D.Sh., Ahmedov A.J., Tyllaev Y. A.

The Astronomical Institute, Academy of Science, Republic of Uzbekistan



REPUBLIC OF UZBEKISTAN

General Information

- Location: Central Asia
- Geographic coordinates: 41 00 N, 64 00 E
  Area: 447,400 sq km
- Natural resources: natural gas, petroleum, coal, gold, uranium, silver, copper, lead and zinc, tungsten, molybdenu
- Population: 27,606,007 (July 2009 est.)
- Economy (major export earners): cotton and other agriculture production, color metals, gold, chemical fertilizers, natural gas and oil

Space activity in Uzbekistan, before:

- Elaboration of space constructions and apparats for research of Moon and planets, security systems of space apparats, investigations in the sphere of space materials.
- Development of ground infrastructure, providing of space-vehicles launching site by the systems of communication.
- Development of space devices, information security systems, special software products.
- Production of the equipment with composite materials for space and aviation.

Space activity in Uzbekistan, at present:

- Remote Sensing and Geograficl Information System
- Global Satellite Navigation Systems for the different branches of economics.
- Application of space telecommunication systems for environmental security, for monitoring of dangerous natural and anthropological phenomena and objects, for telemedicine and distance education
- Creation of the International Radioobservatory on the Suffa Plato (*Uzbekistan-Russia Agreement on 27.07.1995*)

RUSSIA-UZBEKISTAN SPACE PROGRAM (02.09.2008)

Part- I: Creation and use of objects of the space infrastructure in Uzbekistan

- **“SUFFA”** - creation, development and maintenance of the International Radio-observatory on plateau Suffa.
- **"Science"** - researches of a space with use of a scientific complex on plateau Suffa.
- **“Majdanak"** - maintenance, development and use of a network of quantum-optical stations for measurements and supervision over space vehicles.
- **"Astronomy"** - researches of a space with use of a scientific complex on mountain Majdanak.

RUSSIA-UZBEKISTAN SPACE PROGRAM
Part- II : Complex Projects of practical use RS@GIS, Satellite Navigation and other modern applied space technologies

- **"Accuracy"** - creation of system of precision navigation on territory of Republic Uzbekistan on the base of GPS/GLONASS .
- **"City"** - creation of the automated system of maintenance of town-planning with use of space technologies.
- **"Pioneer"** - creation of a mobile navigation-geodetic complex for geodetic and topographical works in territory of Republic Uzbekistan.
  "Transport" - creation of the automated system of satellite monitoring and management of transport of Republic Uzbekistan.
- **"Дehkanin"** - creation of the automated system of satellite monitoring and management of agricultural activity of Republic Uzbekistan.

Part- II (continuation)

- **"Basis"** - creation of a uniform electronic cartographical basis and geoinformation system of Republic Uzbekistan.
- **"Geology"** - creation of the automated system of satellite monitoring of natural resources and preventions from landslides processes in territory of Republic Uzbekistan.
- **"Space-UZ"** - system researches of questions of creation and development of a national space infrastructure in interests of the decision of social and economic, scientific problems and maintenance of national safety of Republic Uzbekistan.

GNSS for studying of Geodynamical and Ionospheric processes

Applied space technologies are important especially for continuous regional monitoring of the environment, for estimation of threats and forecasting of possible natural and technical disasters as Uzbekistan is located in a zone of active seismicity and high ecological risk.

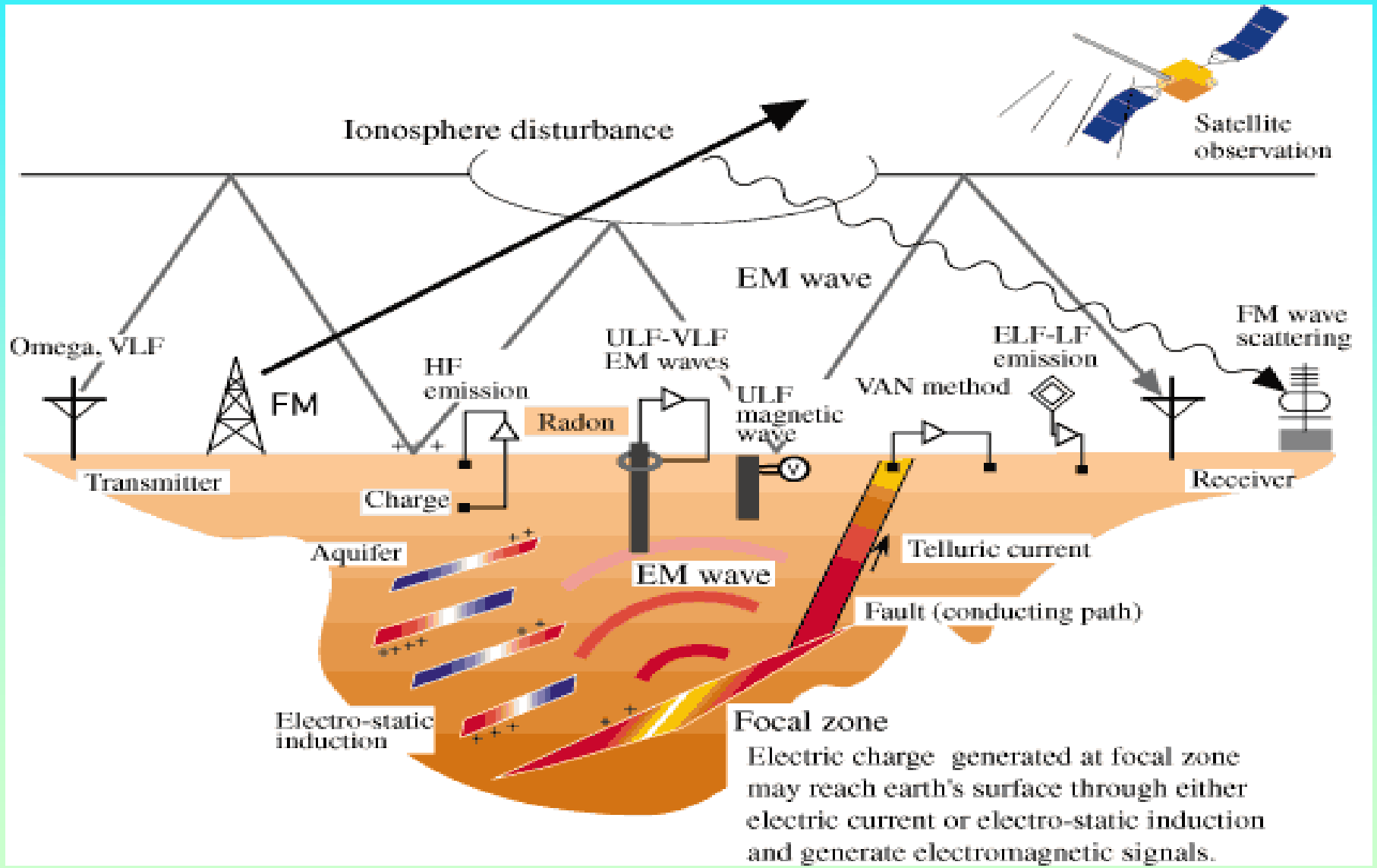
GPS-stations of IGS network

Fifteen years ago the Astronomical institute has installed the reception stations of GNSS (GPS and DORIS) (in Tashkent and Kitab, Uzbekistan) for precise geodetic measurements.
These stations are included in the International Geodynamic Network IGS.

Tasks:

- to create and maintain the exact terrestrial coordinate system;
- to define the Earth’s rotation parameters, study of geodynamic processes, deformations of an Earth's crust and movement lithosphere plates;
- exact definition of parameters of GPS satellites orbits, specification of global and regional geodetic networks;
- cartography and seismology.

Monitoring Earthquake's precursors

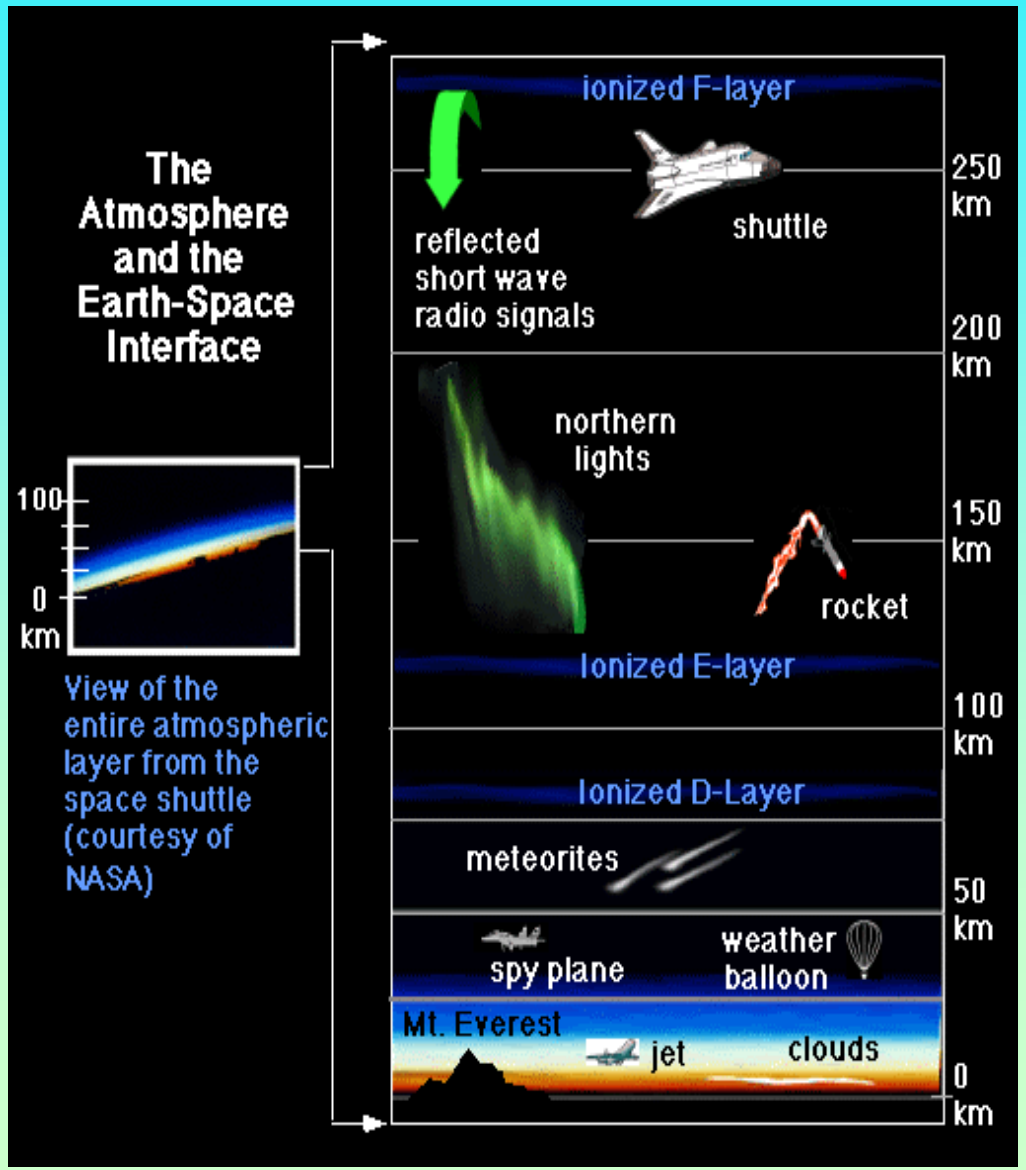


IONOSPERE

F-layer – (130– 1000 км)
$n \sim 10^5 – 10^6$ cm^{-3}

E-layer– (90 - 120 км)
$n \sim 10^5$ cm^{-3}

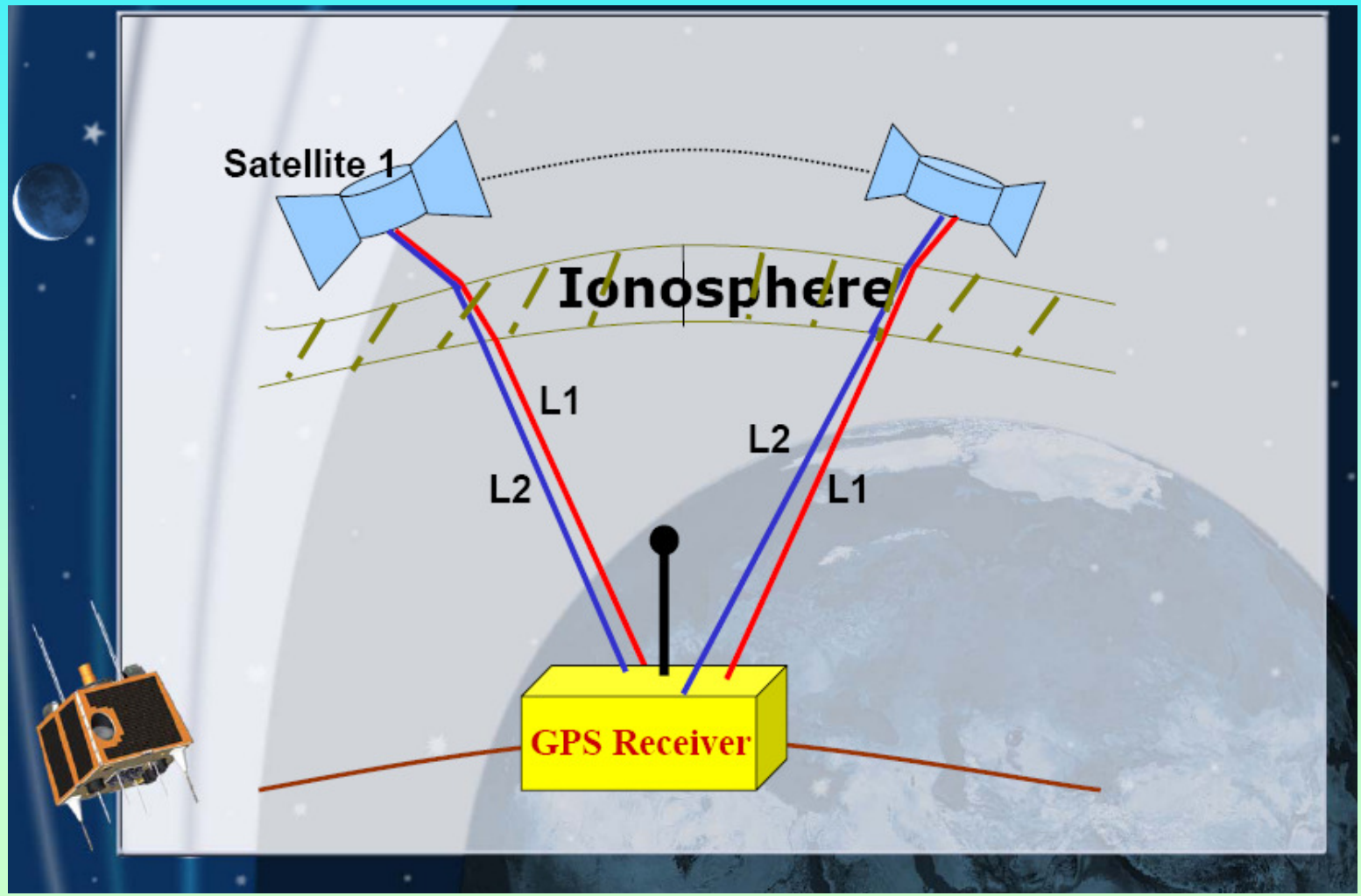
D-layer –(60 - 90 km)
$n \sim 10^2 - 10^3$ cm^{-3}



Main characteristics of the ionospheric earthquake's precursors

- Variations of the electron density in all of ionosphere layers;
- changes in parameters of ionosperic waveguide;
- arousing of the electromagnetic signals of weak-intensity in the range 0,1Hz – 50KHz;
- arousing of the plasma turbulences (dimensions 10E3–10E7m) in the Earth's ionosphere which penetrate on a distances (0,5-2)*10E7m from point of origin etc.

GPS-signals time delay method



GPS/DORIS monitoring of ionosphere

- Correlation analysis and processing of the signals that receive with GPS/DORIS stations in Tashkent and Kitab to study variation of electron density in the F-D-ionosphere layers;
- The idea is in use of time delay of signals in two difference frequencies L1=1575.42 MHz and L2=1227.6 MHz due to dispersion that depends from the electron density and total electron content along the path signals;
- Special software has been developed for preliminary processing of data in real time;
- Continuous monitoring is processing to search of electromagnetic precursors that are induced by increasing of seismic activity before earthquakes.

AWESOME

A tmospheric

W eather

E lectromagnetic

S ystem for

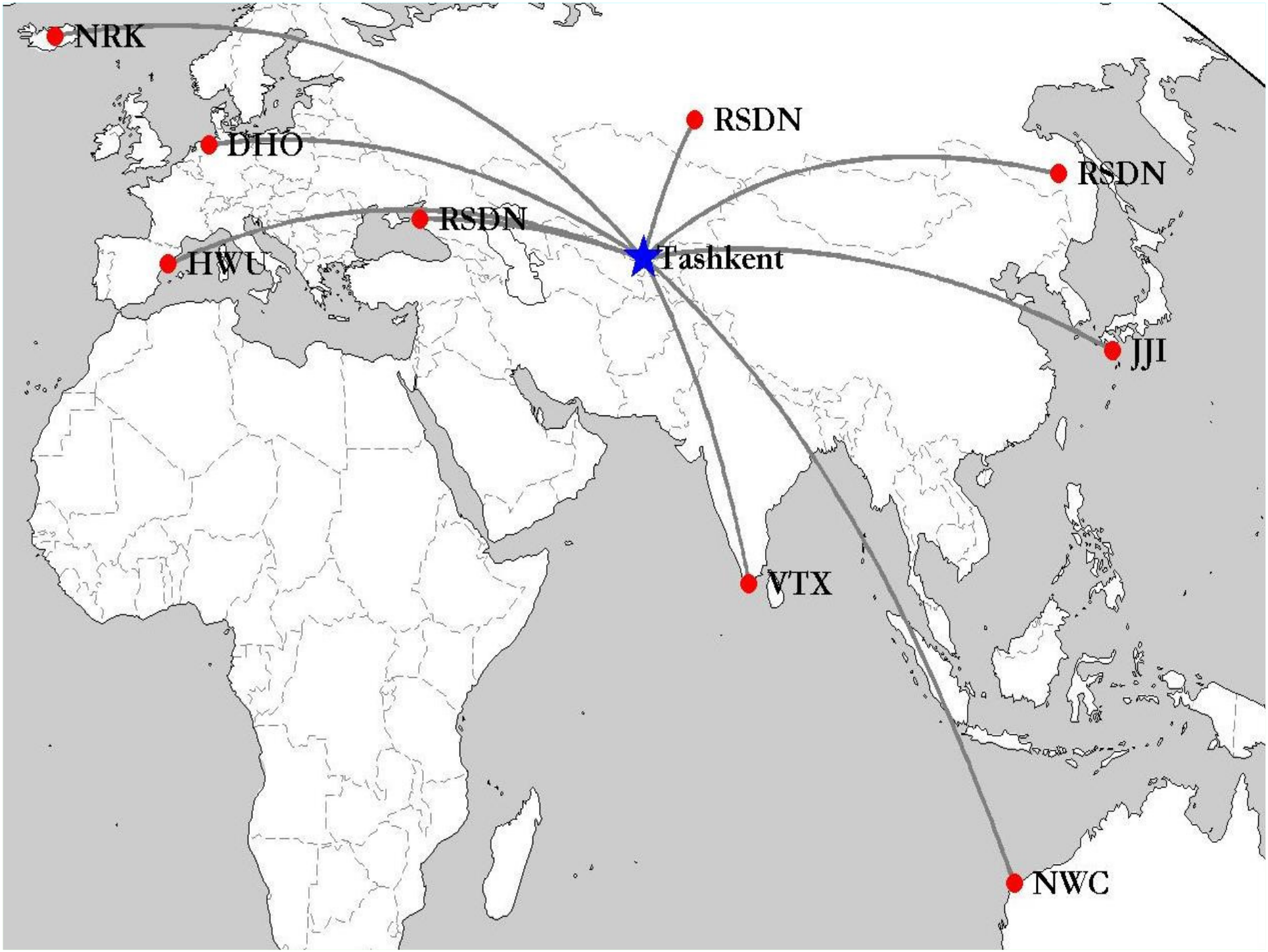
O bservation

M odeling and

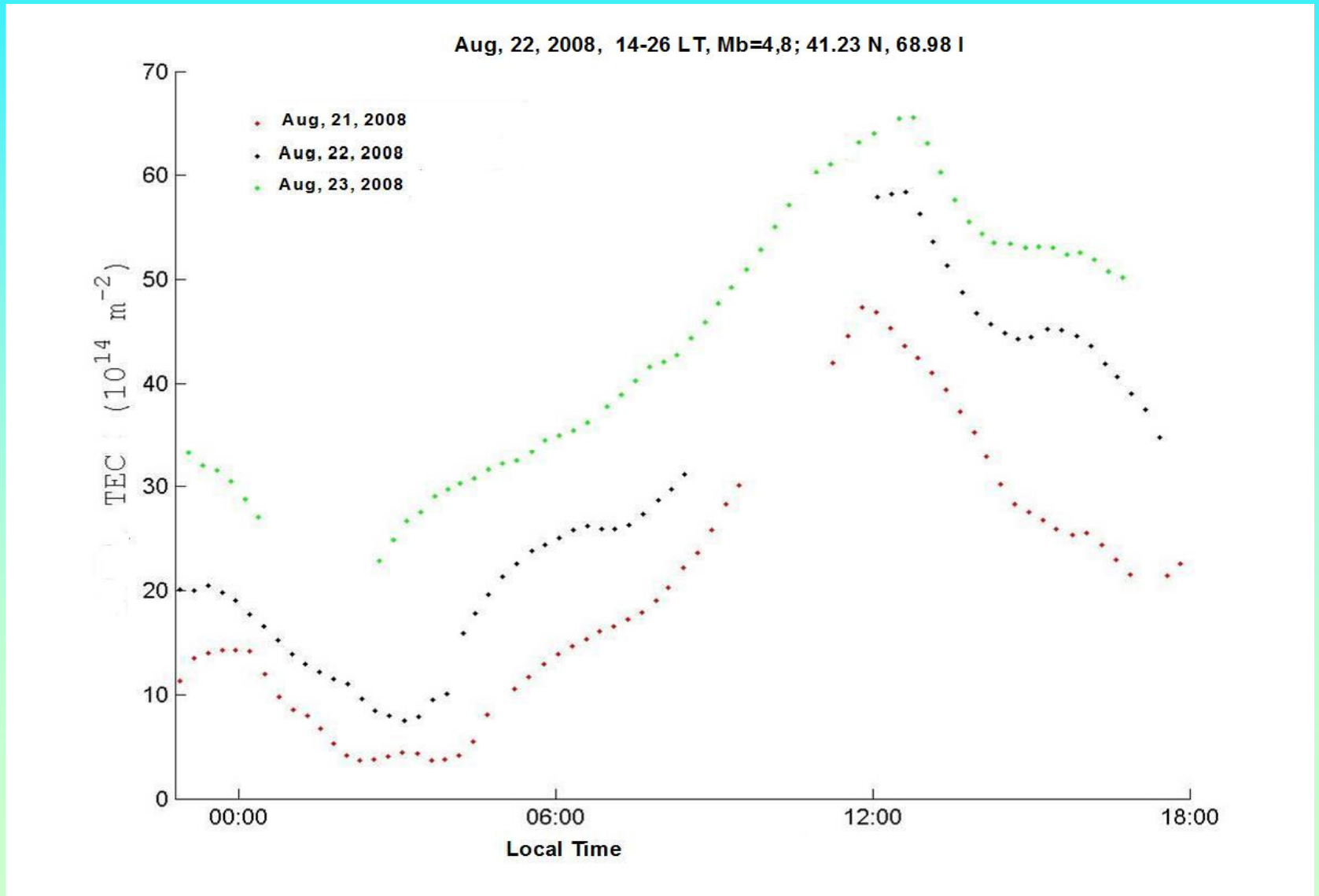
E ducation

Tashkent VLF receiver (May, 2008)

- The receiver consists of GPS antenna, VLF antenna, the block of the preliminary amplifier, the block of the linear receiver.
- The receiver is capable to register frequencies of EM-emission in a range of 100Hz - 45KHz, that includes both natural and technical signals and any signal exceeding atmospheric noise.
- Research of acting signals allows to make the qualitative physical analysis of the electromagnetic phenomena in bottom D - a layer of an ionosphere and in prospect will allows to define ionospheric precursors of the seismic phenomena.


NRK
DHO
RSDN
RSDN
RSDN
HWU
Tashkent
JJI
VTX
NWC

Tashkent Earthquake 22.08.2008



Advantages of GPS/DORIS & AWESOME methods

- Use of global navigation GPS-signals and existing equipments;
- simultaneous reception and processing of signals from GPS satellites and Earth stations;
- common time scale of WLF–receiver and GPS stations in Kitab and Tashkent;
- Use of Uzbekistan seismic stations network data;
- It is possible to discover electromagnetic precursors that are induced by increasing of seismic activity before earthquakes and evaluate possible intensity and location.

Thank you