



Space Weather Activities in Ukraine Summer 2013 Report

Aleksei Parnowski

Space Research Institute, Kyiv, Ukraine

Microsat/Ionosat-Micro

General description

Focus: Ionosphere-thermosphere interaction (waves)

Microsat is a small technology demonstrator platform (gross mass < 200 kg) aimed to flight-test new housekeeping systems and platform elements.

Orbit: dawn-dusk circular sun-synchronous LEO

Altitude: ~ 500 km

Launch date: 2014-2015

Launch location: Alcantara Space Center (Brasil)

Launcher: Cyclone-4 (**maiden flight**)

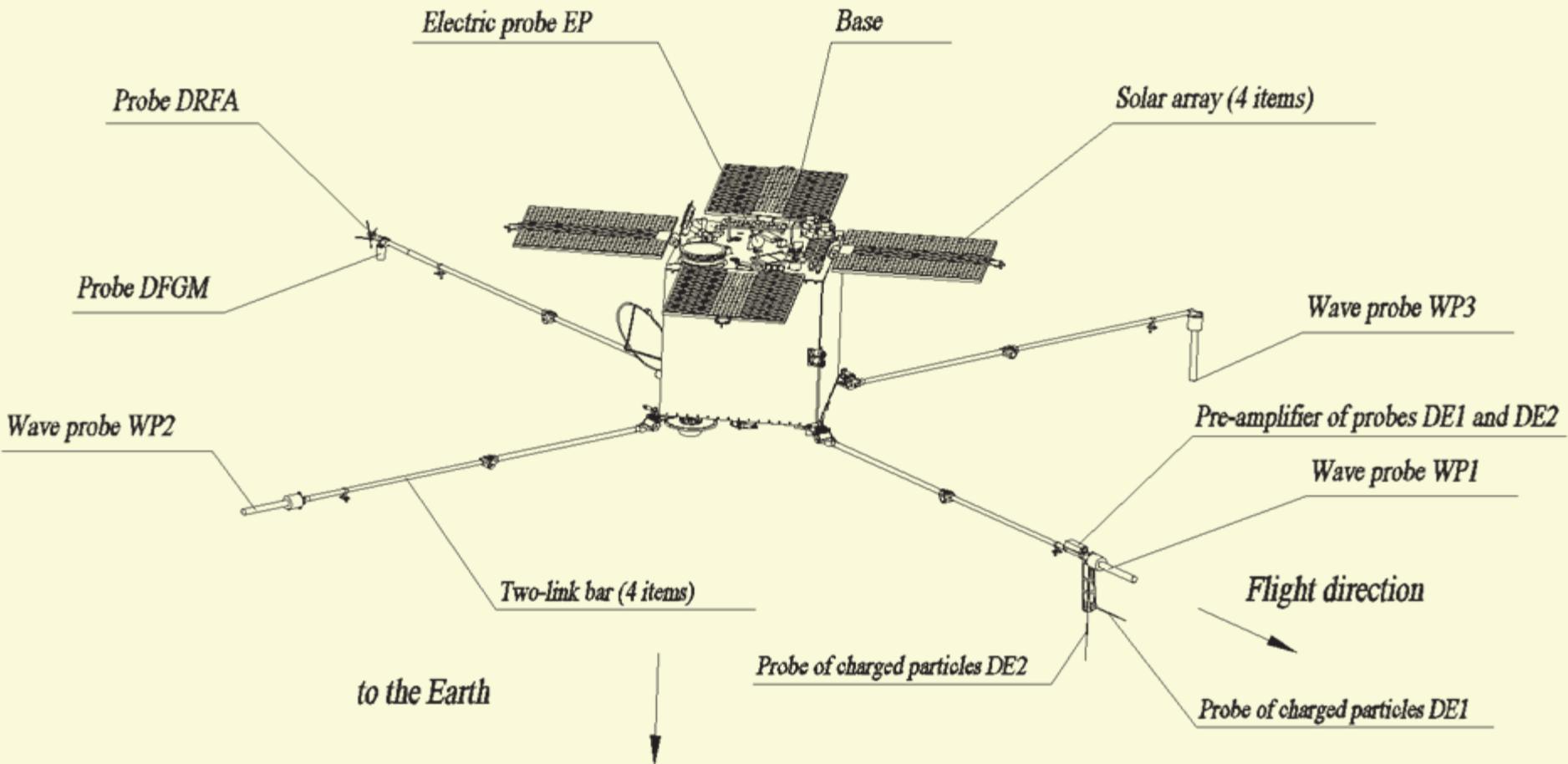
Microsat/Ionosat-Micro Objects of study

- Spatial and temporal structure of the inhomogeneities in the thermosphere and in the ionosphere and their global distribution
- Global structure and dynamics of DC currents, electric and magnetic fields
- Waves and turbulence at different spatial and temporal scales
- Synchronous experiments with ground-based instruments – both active and passive ones

Microsat/Ionosat-Micro Payload

Sensor	Measured value	Specifications	Designer
Wave probes (3 units)	Current density: 0.1 Hz ÷ 40 kHz, noise 10^{-12} A/cm ² Hz ^{1/2} Magnetic field: 0.1 Hz ÷ 40 kHz, noise 10^{-14} T/Hz ^{1/2} Electric potential: 0.1 Hz ÷ 40 kHz, noise 10^{-6} V/Hz ^{1/2}	Power: < 0.25 W Weight: 0.225 kg	L'viv Centre of Space Research Institute (LC ISR), Ukraine
Electric probe	Electric potential: DC ÷ 200 kHz Noise 10^{-6} V/Hz ^{1/2}	Power: < 0.15 W Weight: < 0.2 kg	LC ISR, Ukraine
Radiofrequency analyzer	High frequency variations, electric component Frequency range 0.1 ÷ 15 MHz	Power: < 5 W Weight: ≤ 4 kg (including antenna)	Space Research Centre (CBK), Poland
Sensor of neutral & charged particles DN-DE	Neutral particles density: 10^5 ÷ 10^{12} cm ⁻³ Charged particles density: 10^3 ÷ 10^{11} cm ⁻³ Electron temperature: 0.1 ÷ 1.5 keV	Power: ≤ 2 W Weight: ≤ 3 kg	Institute of Technical Mechanics (ITM), Ukraine
DC flux-gate magnetometer	Magnetic field: DC ÷ 1 Hz Resolution 0.01 nT	Power: < 0.3 W Weight: ≤ 0.3 kg	LC ISR, Ukraine
TEC meter	Frequency L1 = 1217 ÷ 1265 MHz, L2 = 1565 ÷ 1615 MHz, 20 channels	Power: 2.4 W Weight: ≤ 1.34 kg	IZMIRAN, Russia
Data processing unit	Information rate: 100 Mb/s (input), 64 Mb/s (output) Onboard memory: up to 28 GB	Power: < 4 W Weight: ≤ 1.5 kg	LC ISR, Ukraine

Microsat/Ionosat-Micro Spacecraft layout



International missions with Ukrainian instruments onboard

See <http://isr.lviv.ua> for full description of the instruments

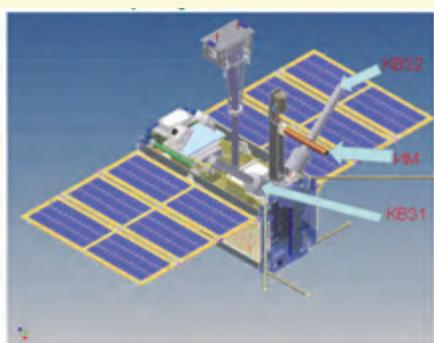
ISS/Obstanovka-1/PWC

*Delivered to the ISS on Feb 11
Installed on Apr 19*



2 wave probes
vector flux-gate magnetometer

Chibis-M/MWC



2 wave probes
search-coil magnetometer

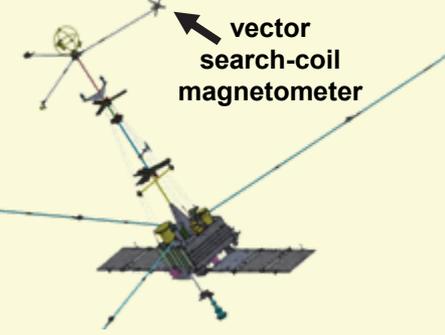
Currently in orbit

RELEC/LFA



2 wave probes
vector flux-gate magnetometer
search-coil magnetometer

Resonance



you are here ↓



2012

2013

2014

2015

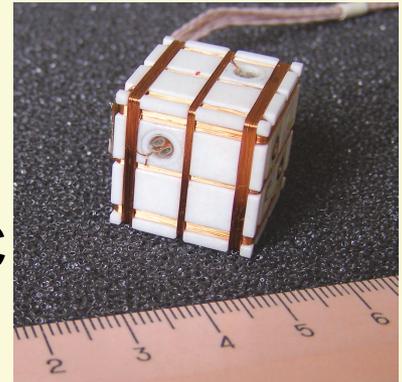
years

New onboard instruments

Tiny vector magnetometers for cubesats:

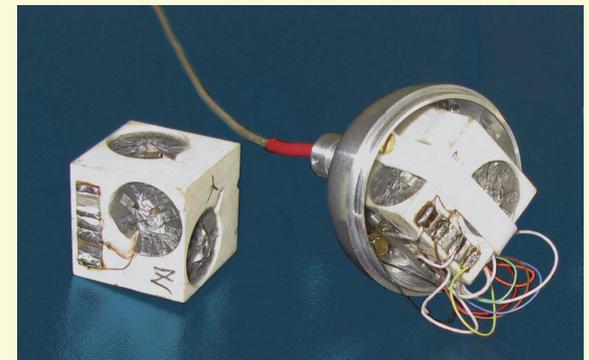
– Flux-gate

1. $20 \times 20 \times 20$ mm, 25 g, < 200 mW, $-50..+80^\circ\text{C}$
2. range ± 65 μT , noise < 15 $\text{pT}/\text{Hz}^{1/2}$ at 1 Hz
3. non-orthogonality $< 30'$, excitation freq. 8 - 16 kHz



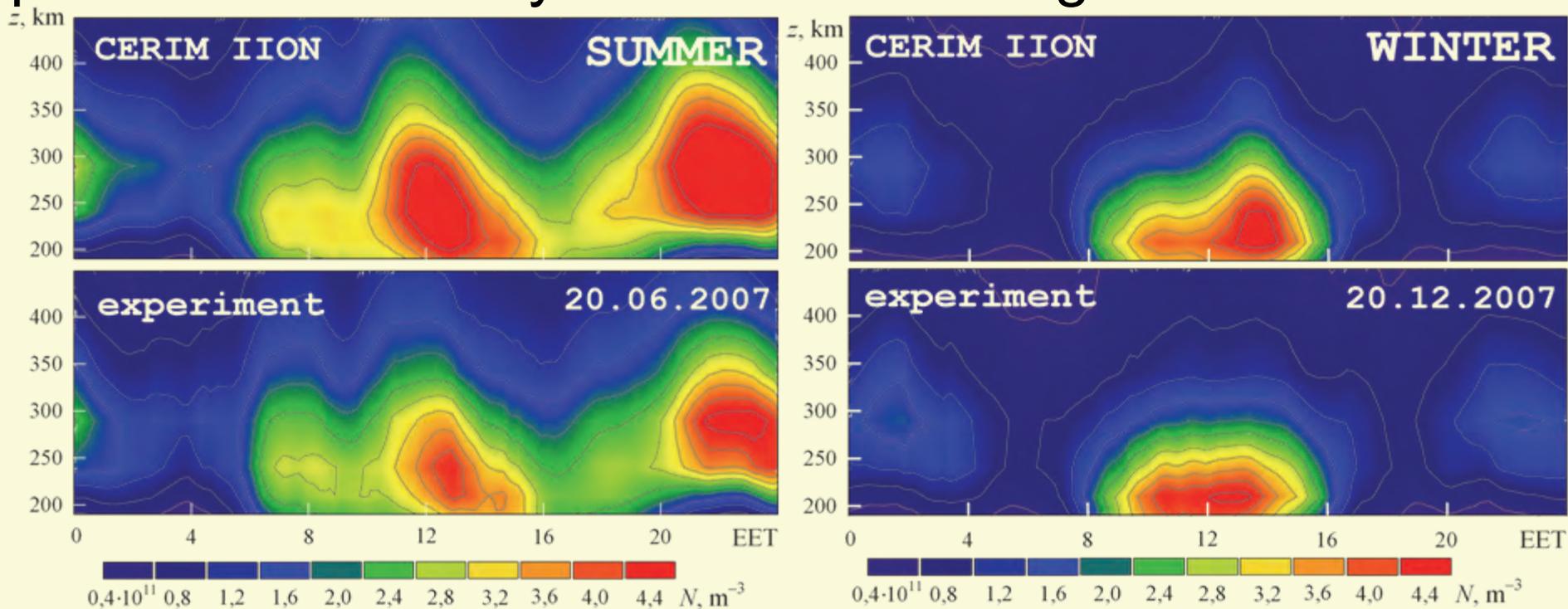
– Search-coil

- $19 \times 19 \times 19$ mm, 12 g, < 600 mW
- freq. range 40 - 10000 Hz, flat curve
- transformation factor 20 mV/nT
- noise, $\text{pT}/\text{Hz}^{1/2}$: 10 (100 Hz), 0.5 (1 kHz), 0.12 (10 kHz)



Central Europe Regional Ionospheric Model (CERIM)

CERIM outputs n_e , T_e , T_i , and the vertical component of plasma drift velocity in the altitude range 200-750 km.



Next step: improvement of CERIM based upon the new ISR data processing algorithms

Problem-oriented Processing and Database Creation for Ionosphere Exploration (POPDAT)

Project goal:

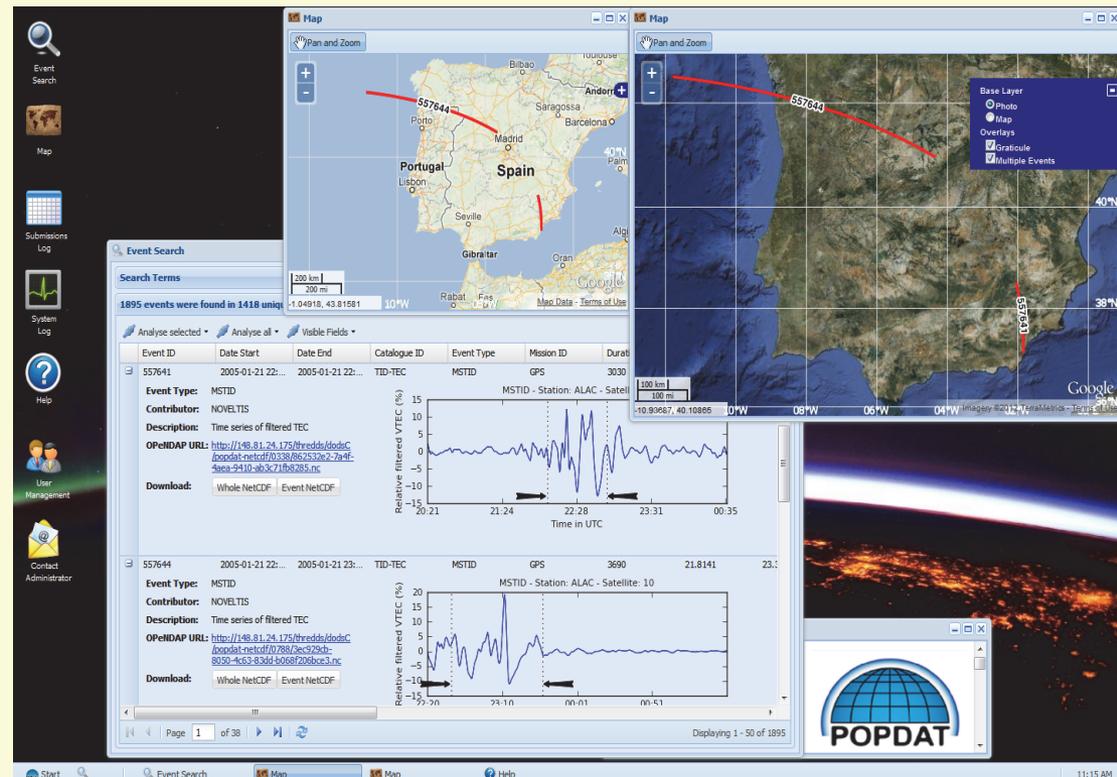
Cataloging of ionospheric waves extracted from archived data to improve their scientific value for modern researchers

Ukrainian contribution:

- Formulation of the project idea
- Contribution to waveform extraction from data (with focus on thermospheric gravity waves)

The service is operational and available at

<http://popdat.cbk.waw.pl/>



www.popdat.org



Acknowledgement

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 263240 (POPDAT).



Advanced Forecast For Ensuring Communications Through Space (AFFECTS)

Project goal:

Development of the first European space weather warning and forecasting system

Ukrainian contribution:

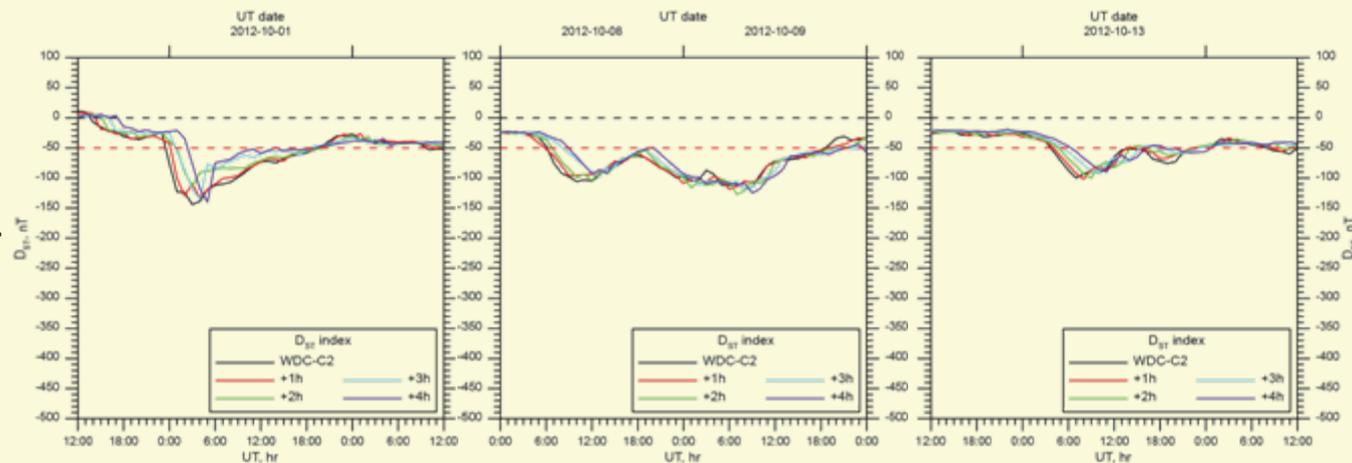
Real-time geomagnetic forecast service

- The product is currently at the pre-operational deployment stage.
- Operational status will be achieved by the end of 2013.
- Temporary link:

<http://swaciwebdevelop.dlr.de/geomagnetic-indices/dst-index/>

Performance stats of near-real time D_{ST} forecast, 2012-09-28T04:00:00Z to 2012-10-27T06:00:00Z

Lead time, h	1		2		3		4	
Model type	Forecast Persistence		Forecast Persistence		Forecast Persistence		Forecast Persistence	
MSE, nT	3.9	5.1	6.6	8.8	7.4	12	11	14
PE, %	97.6	96.0	93.3	88.2	91.7	79.7	82.6	70.8
r, %	93.1	98.0	89.8	94.1	86.0	89.9	84.4	85.5
Skill score, %	41.1		43.4		59.2		40.3	



www.affects-fp7.eu



Acknowledgement

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 263506 (AFFECTS).



Upcoming SWx meetings in Ukraine

- COSPAR symposium “Cosmic Magnetic Fields: Legacy of A.B. Severny”, 2-6 September 2012, Crimean Astrophysical Observatory, Nauchny, <http://solar.crao.crimea.ua>
- 13th Ukrainian Conference on Space Research, 2-6 September 2013, National Space Centre, Yevpatoria, <http://space-conf.ikd.kiev.ua>
- 2nd UK-Ukraine meeting on solar physics and space science, 16-20 September 2013, Kyiv, http://swat.group.shef.ac.uk/Conferences/Ukraine_UK_2013/

Thank you! Questions?



Space Research Institute <http://www.ikd.kiev.ua/>

- L'viv Center <http://www.isr.lviv.ua/>



Main Astronomical Observatory <http://mao.kiev.ua/>



Taras Shevchenko National University of Kyiv <http://univ.kiev.ua/>

- Astronomical Observatory <http://www.observ.univ.kiev.ua/>
- Chairs of Astronomy and Space Physics <http://space.univ.kiev.ua/>



Radioastronomical Institute <http://ri.kharkov.ua/>



V.N. Karazin Kharkiv National University <http://univer.kharkov.ua/>

- Space Research Sector <http://src.univer.kharkov.ua/>
- School of Radiophysics <http://www-radiophys.univer.kharkov.ua/>



Institute of the Ionosphere <http://www.iion.org.ua/>



Crimean Astrophysical Observatory <http://www.crao.crimea.ua/>

- Solar Physics Laboratory <http://solar.crao.crimea.ua/>



Institute of Technical Mechanics <http://www.itm.dp.ua/>