TUC-N Researches on Space Weather – SWE

Space weather (SWE) refers to the environmental conditions in Earth's magnetosphere, ionosphere and thermosphere. These conditions are mostly due to the solar activity. Of particular interest is the monitoring and analysis of solar flares induced events.

TUC-N Radiocommunications Group carried out researches on this topic closely colaborating with a valuable SME – BITNET CSS

I. Objectives

- Deployment of an experimental passive radio instrument able to monitor solar flares induced disturbances in low ionosphere layers
- Experimentation of some passive radio monitoring techniques for high ionosphere layers propagation anomalies monitoring
- Acquisition of original data sets regarding solar flares induced ionosphere radio propagation disturbances measured in Romania, especially during the solar maximum activity.

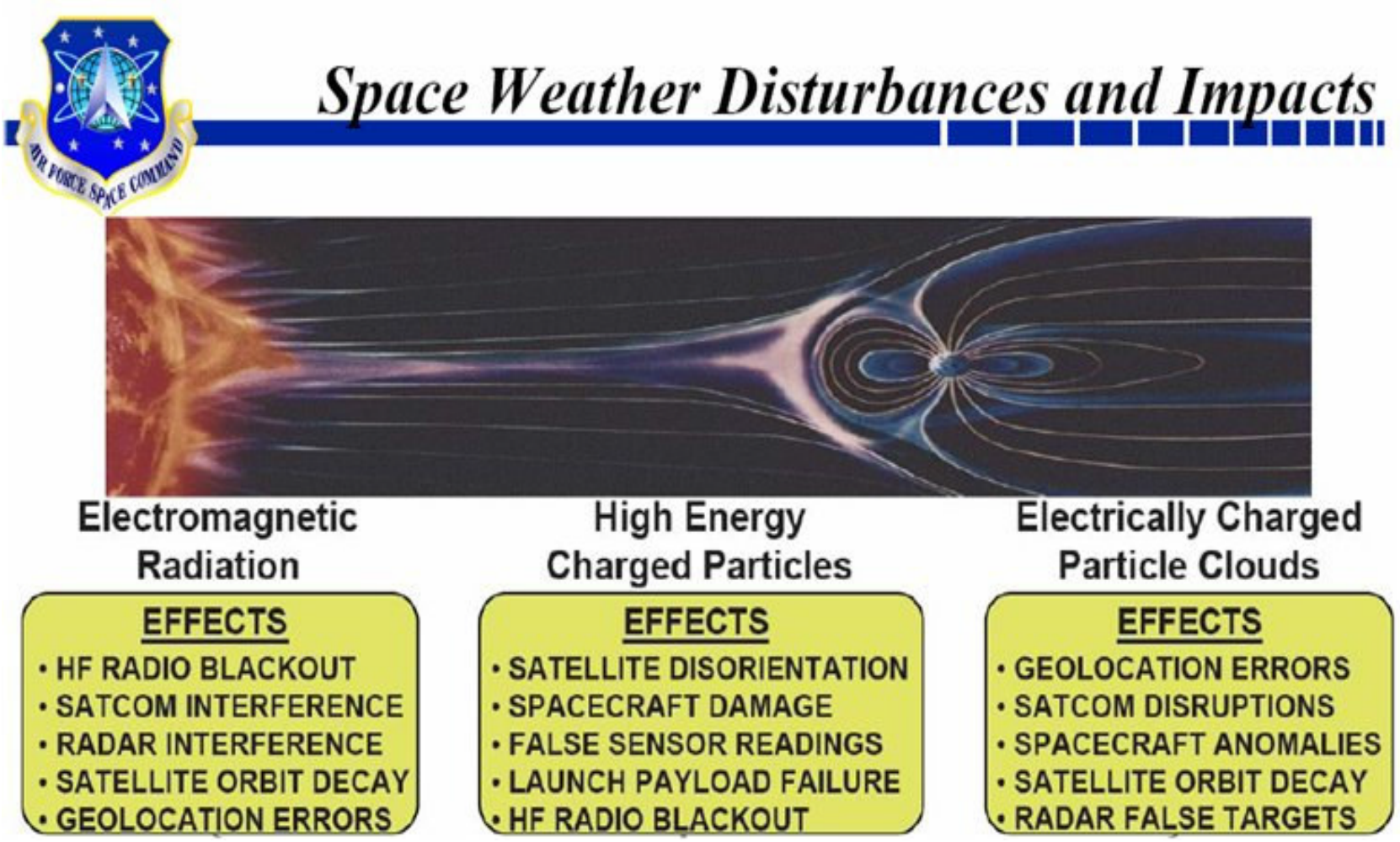

Fig. 1. Space weather impacts on technological infrastructure, according to US Air Force Space Command.

II. The expected end results:

- An experimental portable low-cost research grade ionosphere disturbances radio monitoring instrument which can be made available to other interested research groups.
- Original data sets regarding Solar flares and observed radio interferences in Romania during the solar maximum activity.

III. Preliminary results:

- Some two years ago, TUC-N and BITNET started the studies to develop, by collaboration, an ionosphere VLF radio propagation monitor.
- The idea was to setup a cheap instrument for students at the Technical University of Cluj-Napoca.
- The project was supported using internal resources of BITNET and TUC-N in terms of electronic components, radio equipment and software.
- Another reason was to test some of the basic ideas on which a future high-performance SID radio monitoring instruments could be developed.
- The first results obtained in this research were recently published:
  - P. Dolea, O. Cristea, V. Dascal, T. Palade, ”4th of January 2011 solar eclipse induced disturbances in VLF radio waves propagation”, IEEE Proceedings for

International Conference on Telecommunications in Modern Satellite, Cable and Broadcasting Services, TELSIKS 2011.

- P. Dolea, V. Dascal, T. Palade, O. Cristea, “Low-Cost Prototype Equipment for VLF Radio Wave Monitoring”, Acta Technica Napocensis - Electronics and Telecommunications, Volume 53, No. 1/2012, ISSN 1221-6542.

- The next figures illustrates some of the achievements during 2011.

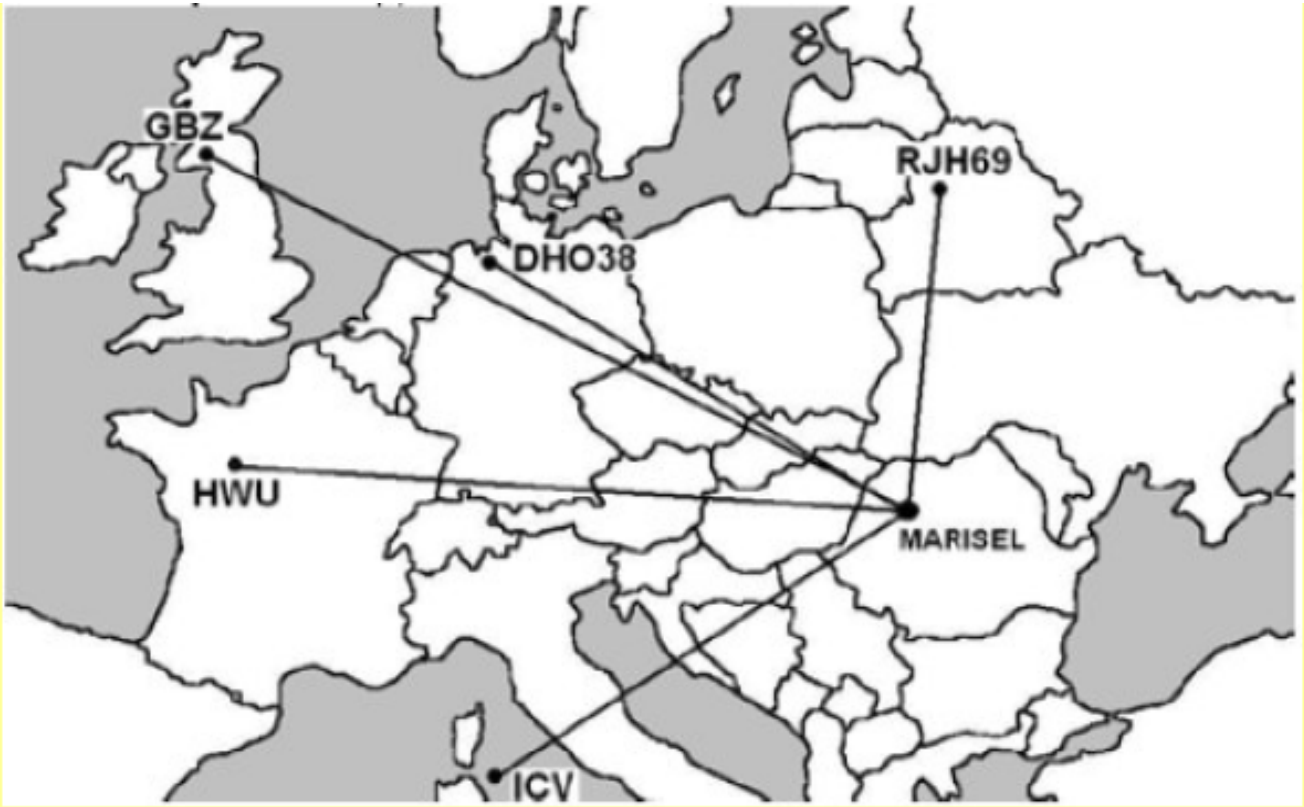

Fig.2. Geographical location of the monitored VLF stations and of the receiver.

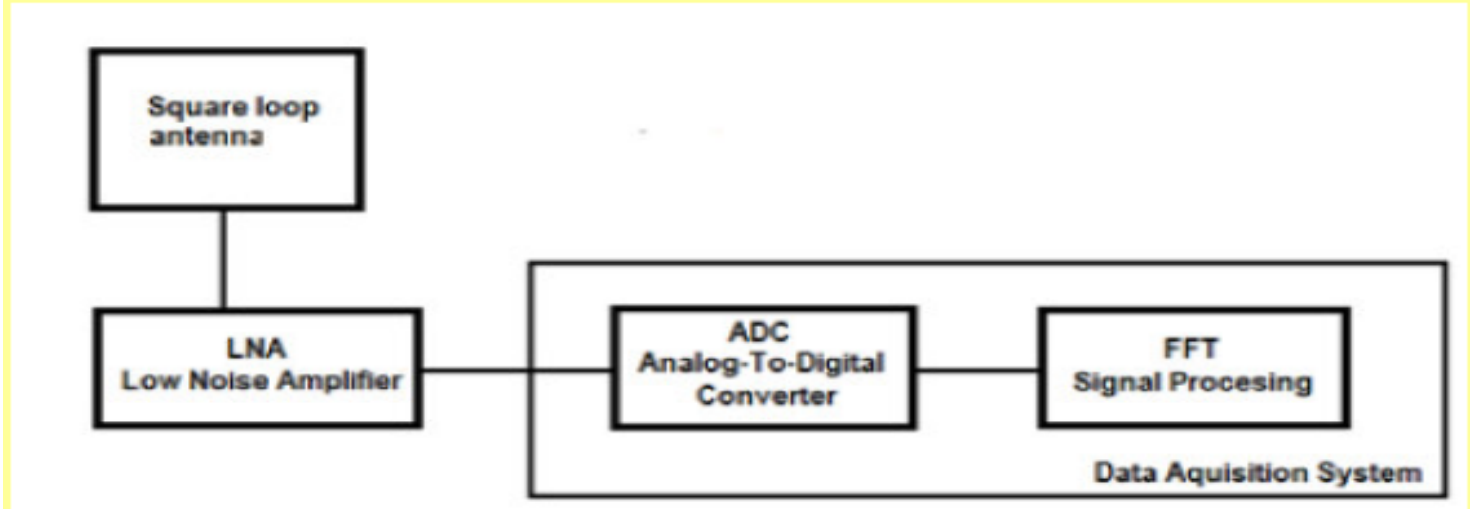

Fig.3. Block diagram o a VLF radio propagation monitor. Sampling is made with 24 bit resolution, at 96 KHz.

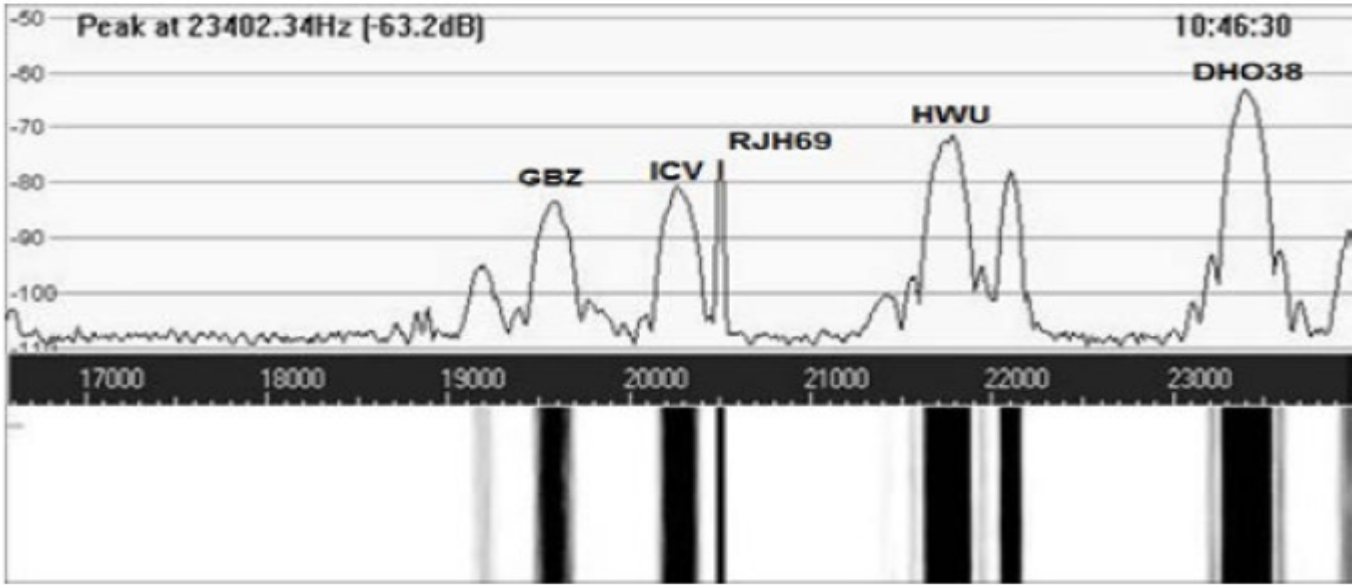

Fig.4. Received VLF signals with the radio propagation monitor and using a small loop antenna. All signals are received by ionosphere reflections.

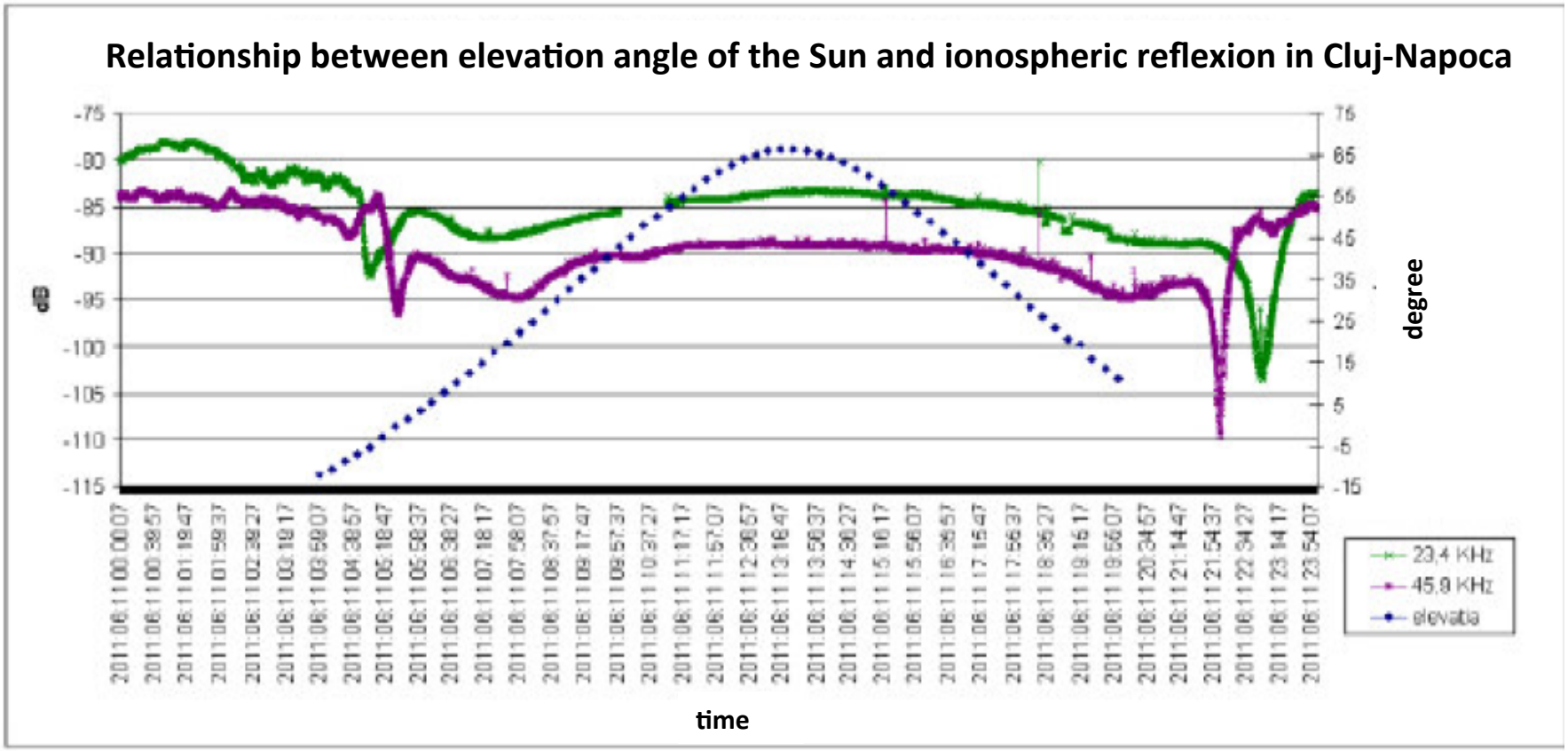

Fig.5. Relationship between the VLF ionosphere reflected signals power and the Sun elevation at the receiver site, as measured with the radio propagation monitor and using a small indoor loop antenna. Diurnal variations in both monitored frequencies are easily recognized.

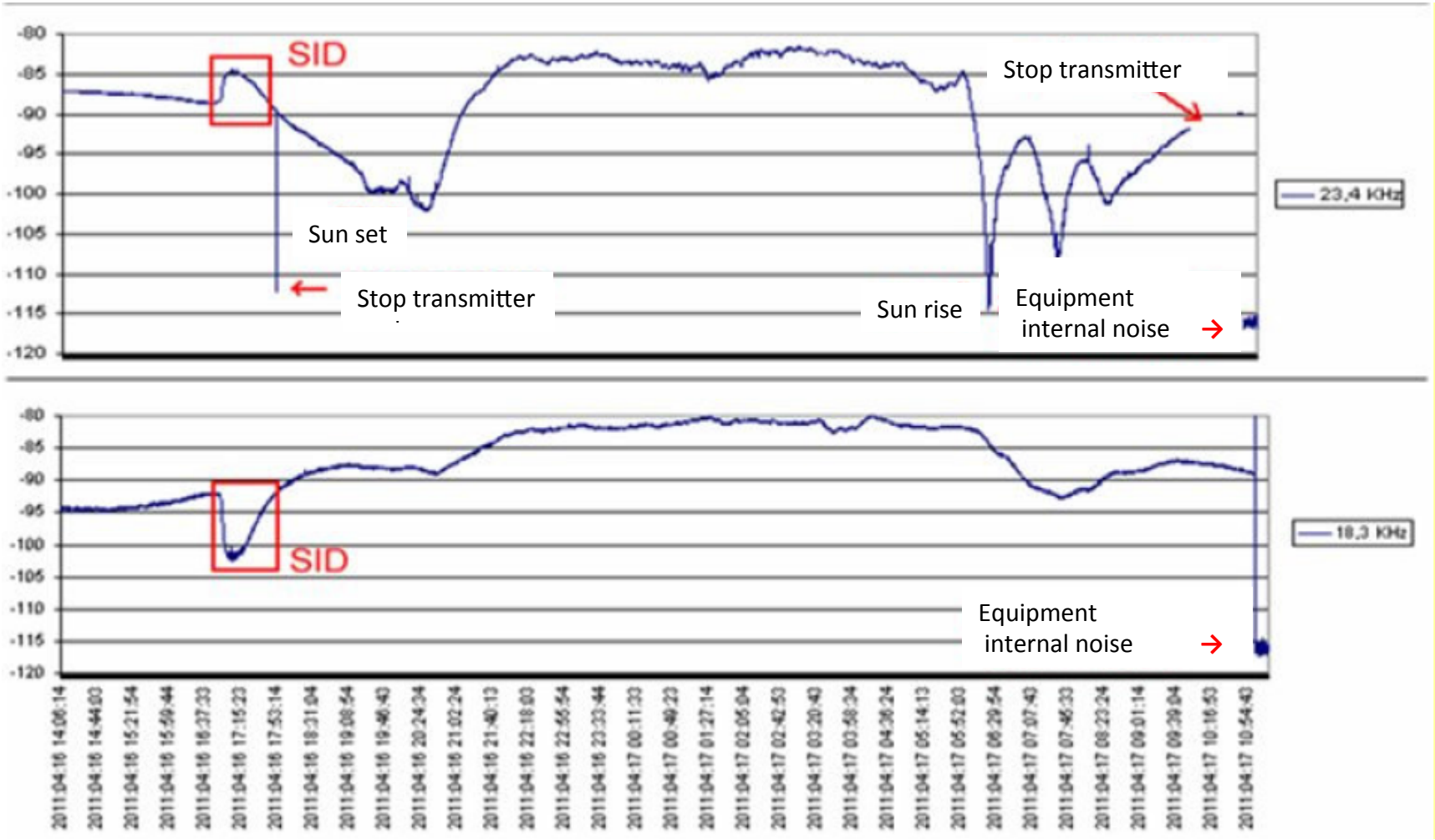

Fig.10. SID induced by an X-ray solar flare of class C5.5 on April 16, 2011. Measured in Cluj with the radio propagation monitor, at two VLF frequencies. Propagation data were compared with X-ray flux data from GOES satellites.