Radio Meteor Scattering with Software Defined Radio based on Open Hardware

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There is a description of a method for detection Meteors using SDR based on MLAB an Open Hardware project.

1. Introduction

The general principle of meteor observation by forward scattering of radio waves off their trails is easy to understand. It is illustrated in Figure 1. A lower VHF radio receiver (30-200 MHz) is located at a large distance (about 500-2000 km) from a transmitter at the same frequency. Direct radio contact is impossible due to the curvature of the Earth. When a meteor enters the atmosphere, its trail may reflect the radio waves from the transmitter to the receiver. At the receiver, where the signal of the transmitter is normally not received, the transmission can then be received for a moment, as long as the meteor trail is present. Such reflections can last from a tenth of a second to a few minutes. The received signal characteristics are related to physical parameters of the meteoric event.

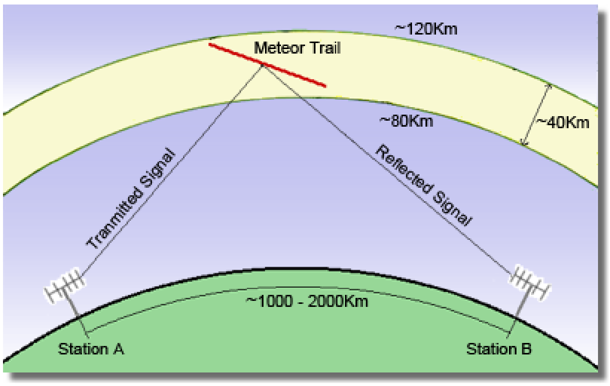


Figure 1 - General principle of meteor observation by forward scattering of radio waves off their trails.

2. GRAVES RADAR - Grand Réseau Adapté à la VEille Spatiale

We use the GRAVES radar for our meteor scattering experiments.

The GRAVES project (French acronym for large-scale network adapted to spatial monitoring) offers the only means for monitoring low orbits in Europe. Its operation was handed over the French Air Force at the time of in-service implementation in December 2005. This system was designed and built by France's Onera Aerospace Research Centre under the supervision of the General Armament Delegation (DGA). With responsibility assigned to the Command and Control System for Air Operations (SCCOA), the GRAVES system offers:

- non-stop operations, 24 hours a day, 7 days a week, without any human intervention;
- detection of objects in orbit at an altitude of between 400 and 1,000 km when flying over mainland French territory;
- orbit pattern descriptions of all detected objects.

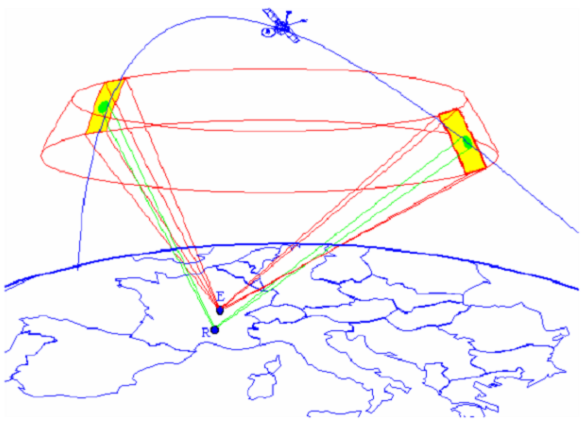


Figure 2 – GRAVES Project.

GRAVES is a bistatic RADAR system using Doppler and directional information to derive the orbits of the detected satellites. Its operating frequency is 143.050 MHz, with the transmitter being located on a decommissioned airfield near Broye-lès-Pesmes at 47.3480°N 5.5151°E and the receiver at a former missile site near Revest du Bion on the Plateau d'Albion at 44.0715°N 5.5346°E. Data processing and generation of satellite orbital elements is performed at the Balard Air Complex in Paris, 48.835°N 2.280°E.

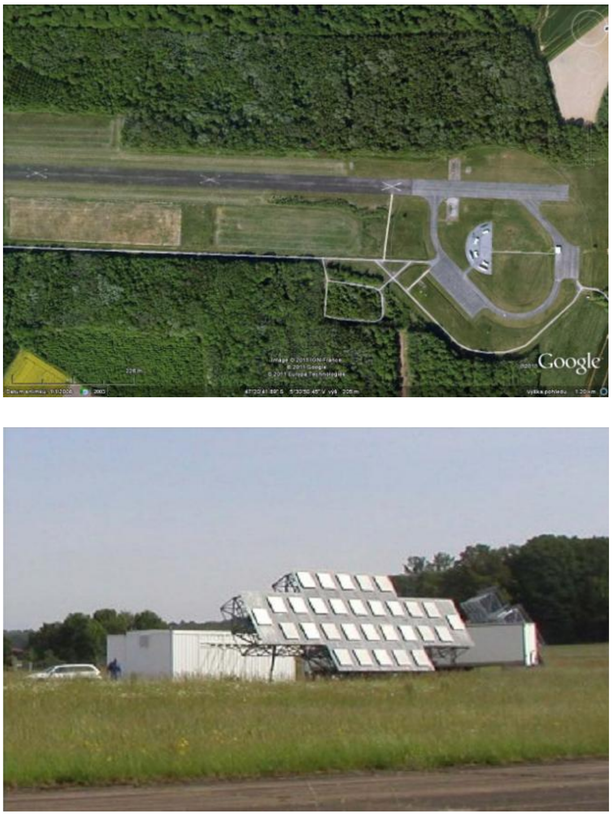


Figure 3 - GRAVES is a bistatic RADAR system.

3. Meteors Receiving

Figure 4 – Google map with the GRAVES system.

Figure 5 – GRAVES receiving antenna.

Figure 6 – Our receiving antenna at the Observatory Svákov.

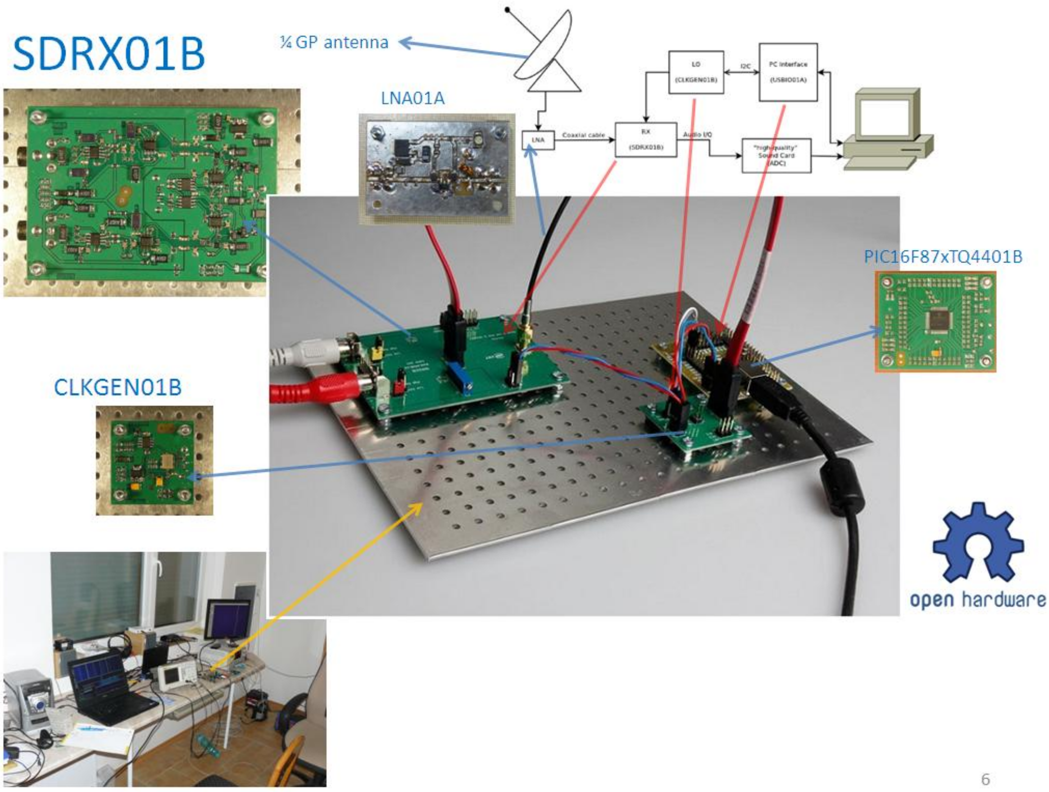


Figure 7 - Software Defined Radio SDRX01B is used for receiving a reflection meteor trails. SDRX01B is a device based on MLAB Open Hardware project. We provide all documentation for manufacturing and reviewing for free. Moreover, this hardware can be extended easily by other MLAB modules such as processors, A/D converters, amplifiers, …

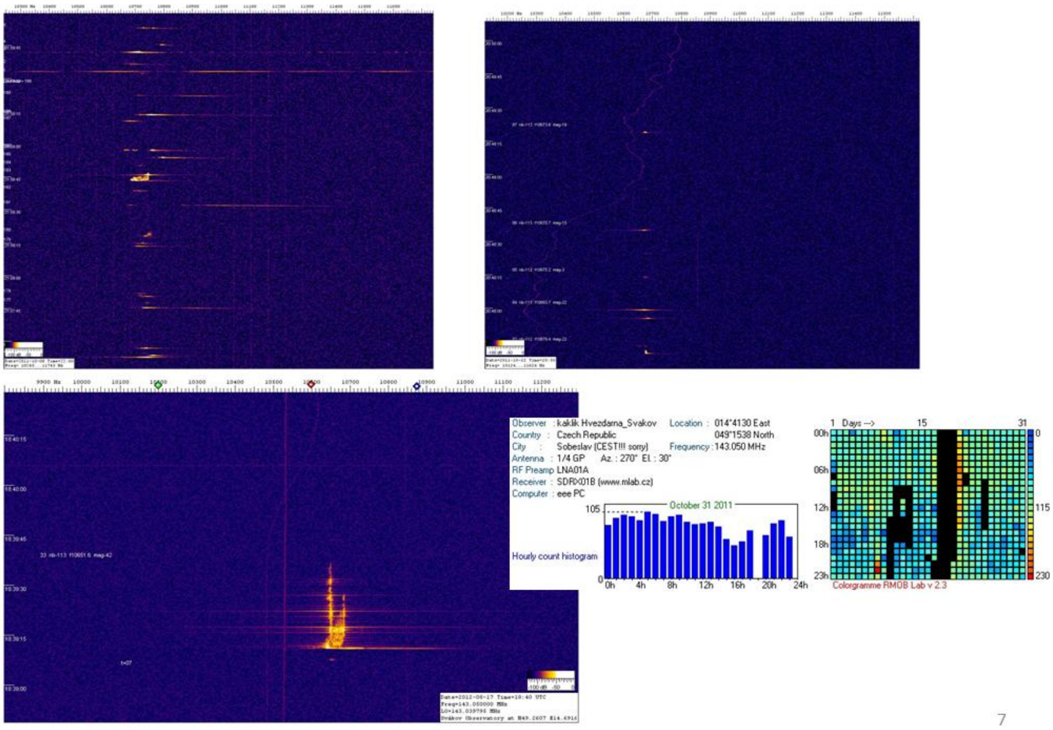


Figure 8 – Our data.

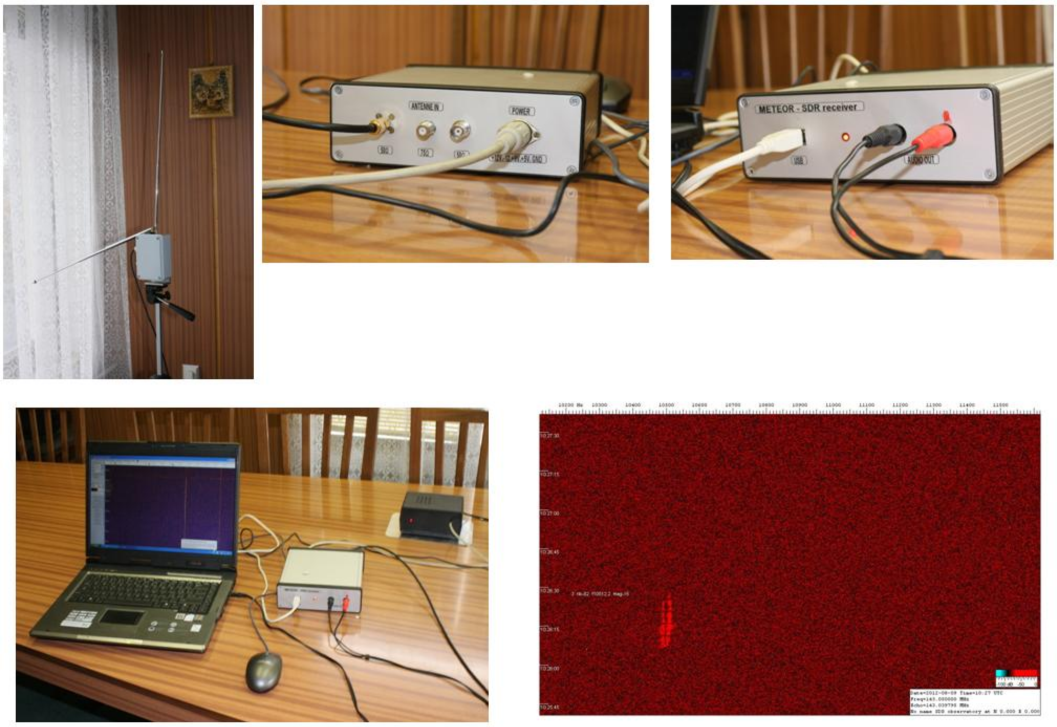
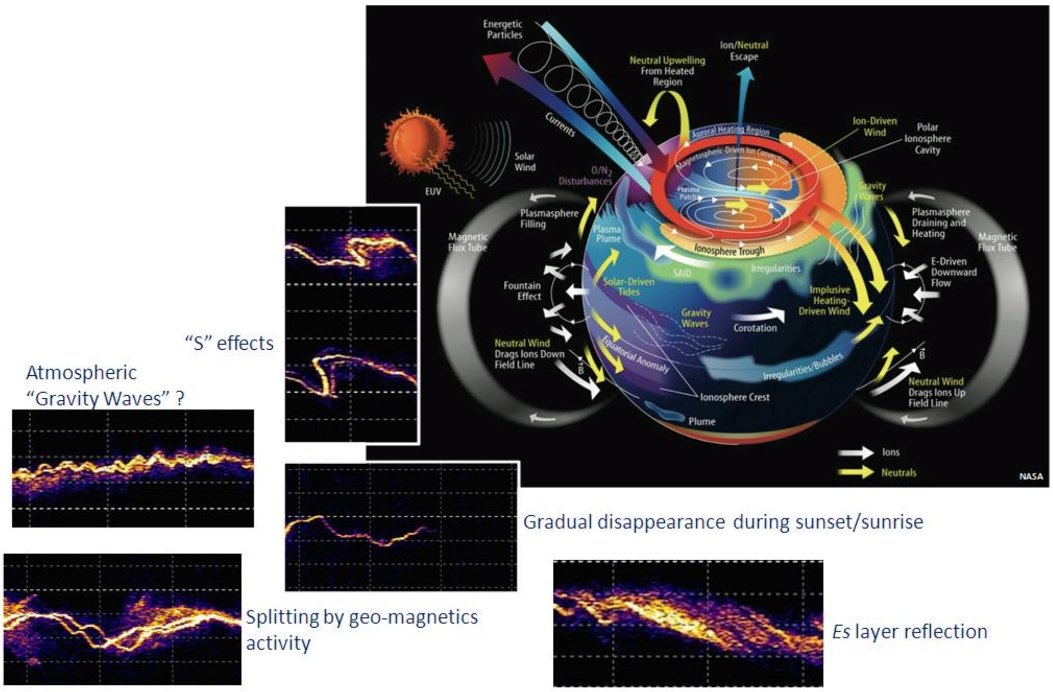


Figure 9 - Meteors Receiving in the Slovak Central Observatory.

4. Future Work



Sources: www.mlab.cz , www.ok1dub.cz/ok0eu , [ok0eu.fud.cz](ok0eu.fud.cz) , www.astrozor.cz/index.php?udalost=43 .
For your comments or proposals please contact the authors and Josef Szylar at info@robozor.cz. Thank you.

Figure 10 – Future plans.

Unfortunately the ionosphere is very complex. Elimination of the Sun influence is necessary for the data mining of the particular disturbances caused by GRBs or other distant high energy sources. Other data sources about the Sun activity have to be considered.
For instance VLF SID monitors or other data sources have to be combined with our data.

- A network of receiving stations is necessary to build for meteors trajectories measurement.
- We need more precise time synchronization of receiving stations. Now we can not measure parameters of meteors trajectories. In the future hopefully we can.
- We have to compare our data with visual observations. We are expecting something unexpected ;).

Sources: www.mlab.cz , www.astrozor.cz/index.php?udalost=5 .
For your comments or proposals please contact the authors. Thank you.