

Royal Belgian Institute for Space Aeronomy (BIRA-IASB)

Institut royal d'Aéronomie Spatiale de Belgique (IASB)

Koninklijk Belgisch Instituut voor Ruimte-Aeronomie (BIRA)

Involving citizen scientists in radio meteor research

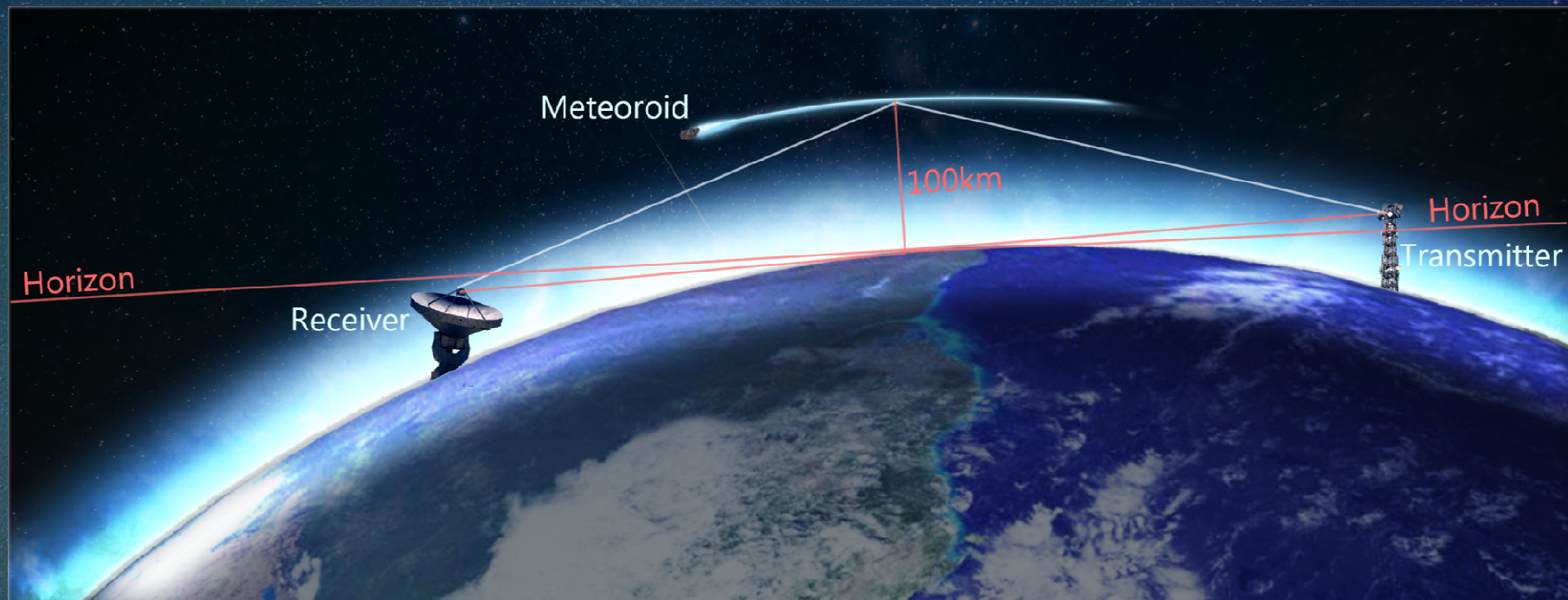
Stijn Calders

<https://www.radiometeorzoo.eu>



Radio meteors

A meteor doesn't emit radio waves itself, but the ionized trail behind the meteoroid reflects the radio waves.



Radio versus visual observations



Radio versus visual observations

- We can observe during the night, but also during the day
 - Daylight showers

Radio versus visual observations

- We can observe during the night, but also during the day
- We are less prone to weather conditions
 - Except sporadic E and thunderstorms

Radio versus visual observations

- We can observe during the night, but also during the day
- We are less prone to weather conditions
- We observe much smaller meteoroids
 - ca. 2000 meteors per day per station

Radio versus visual observations

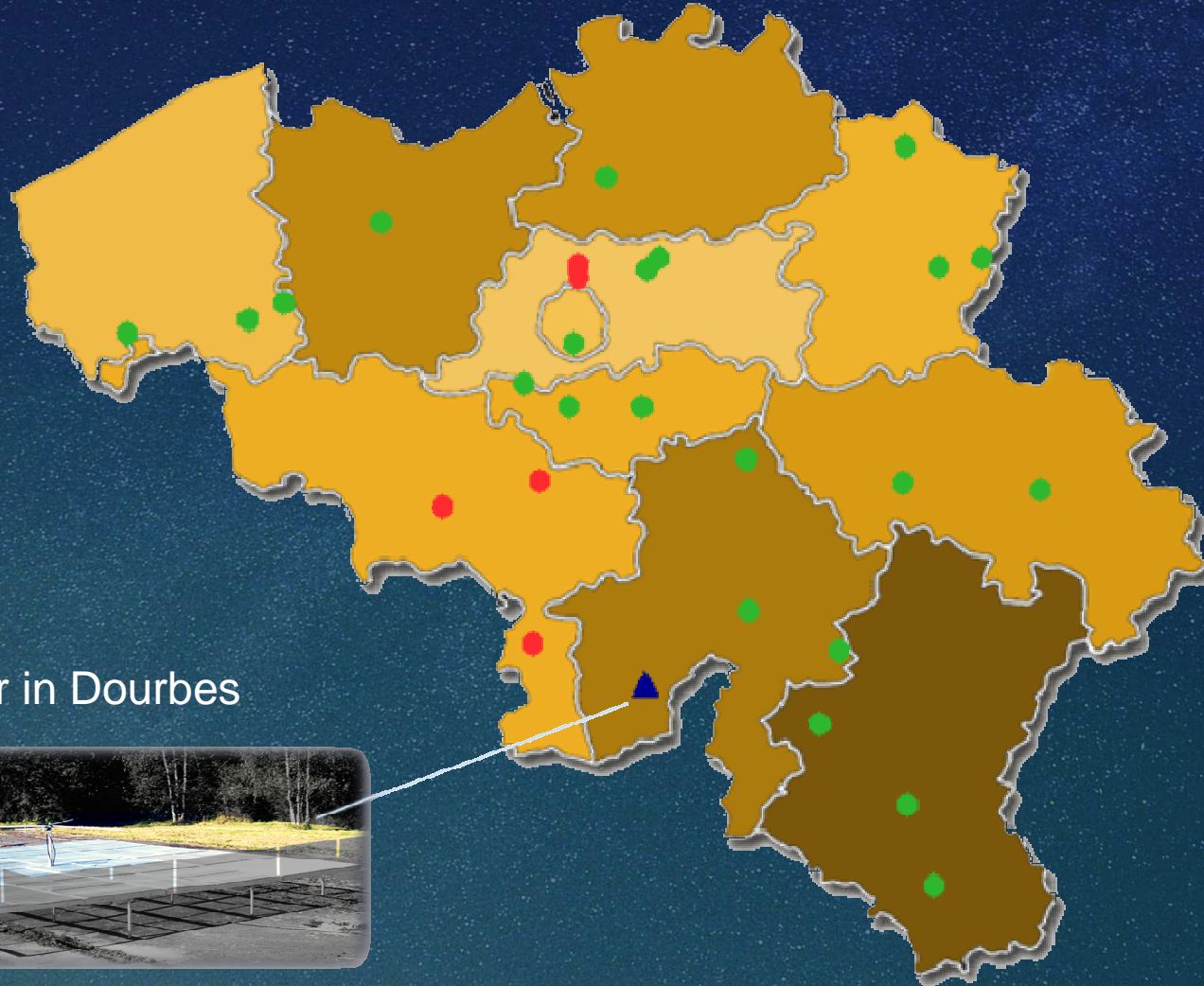
- We can observe during the night, but also during the day
- We are less prone to weather conditions
- We observe much smaller meteoroids
- If you are interested in the position/brightness/... of the meteor, camera networks are a much easier solution

Agenda

- The BRAMS network
- The physics behind radio meteors
- How could you help us?
- Results of the Radio Meteor Zoo

THE BRAMS NETWORK

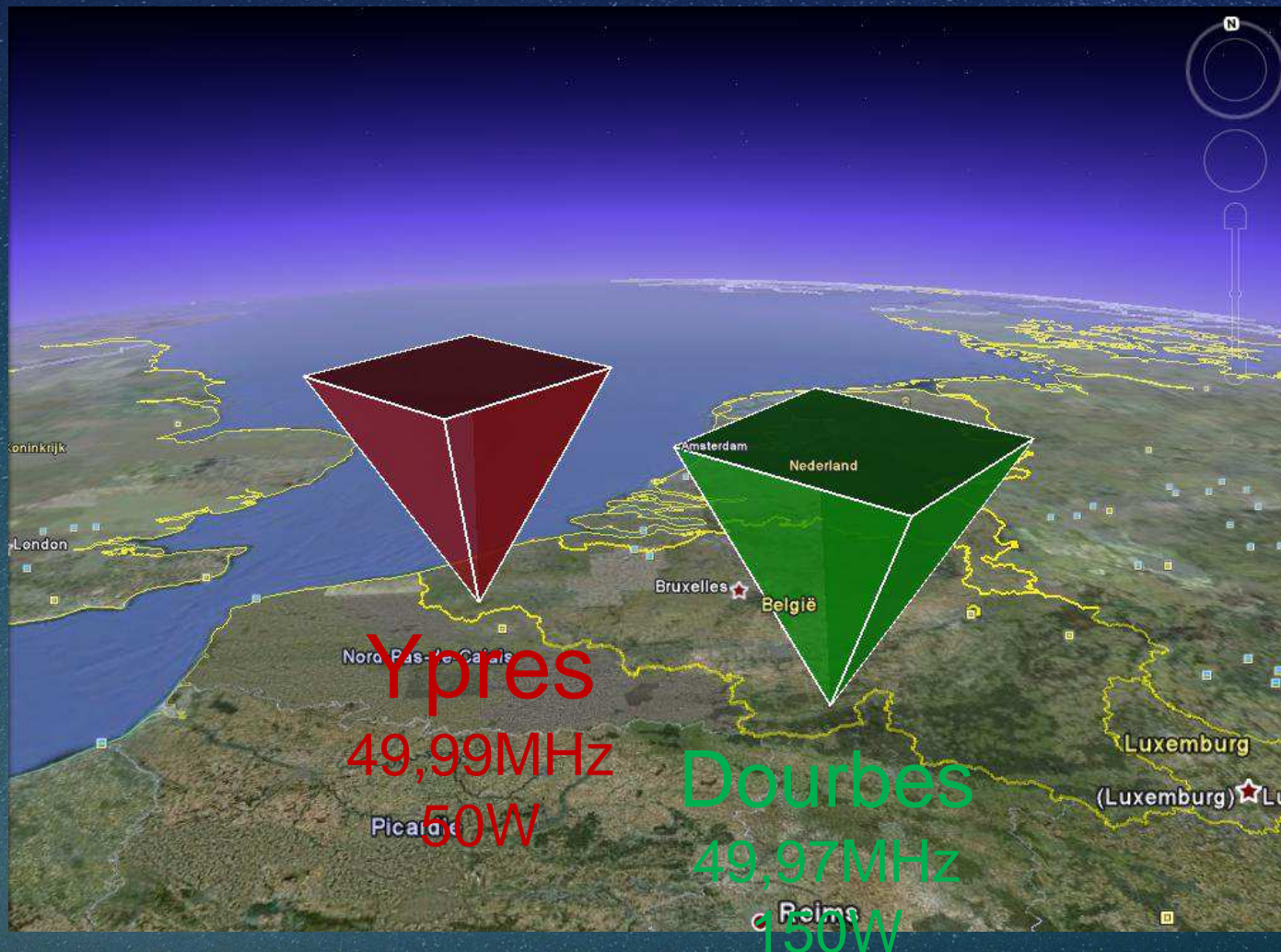
The BRAMS network



The emitter in Dourbes



Radio beacons in Ypres (VVS) & Dourbes (BRAMS)

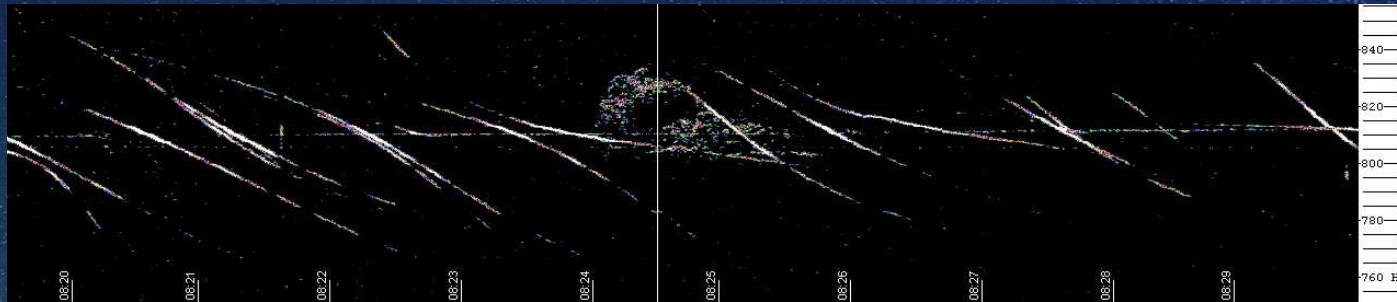


Radio beacon in Dourbes

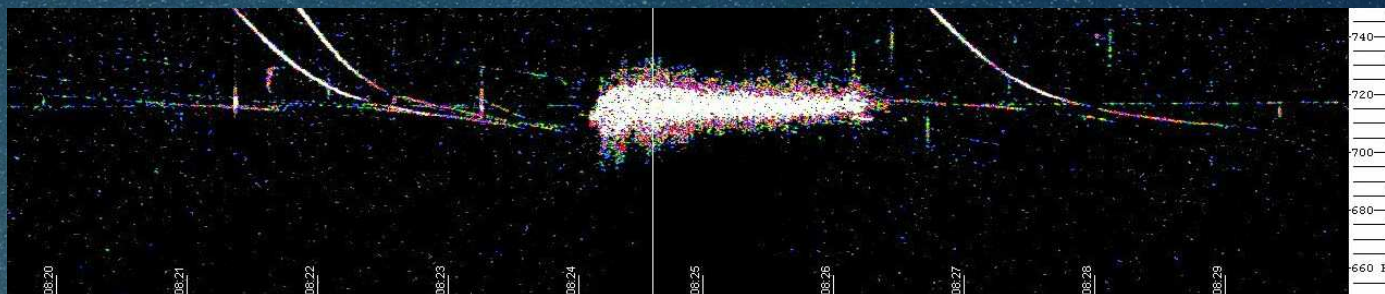


2010: Radio beacon in Dourbes

- Dourbes (49,970 MHz, 150W):



- Ypres (49,990 MHz, 50W):



(Felix Verbelen, 17 oktober 2010 @ 8u20 UT)

The BRAMS network



Harelbeke



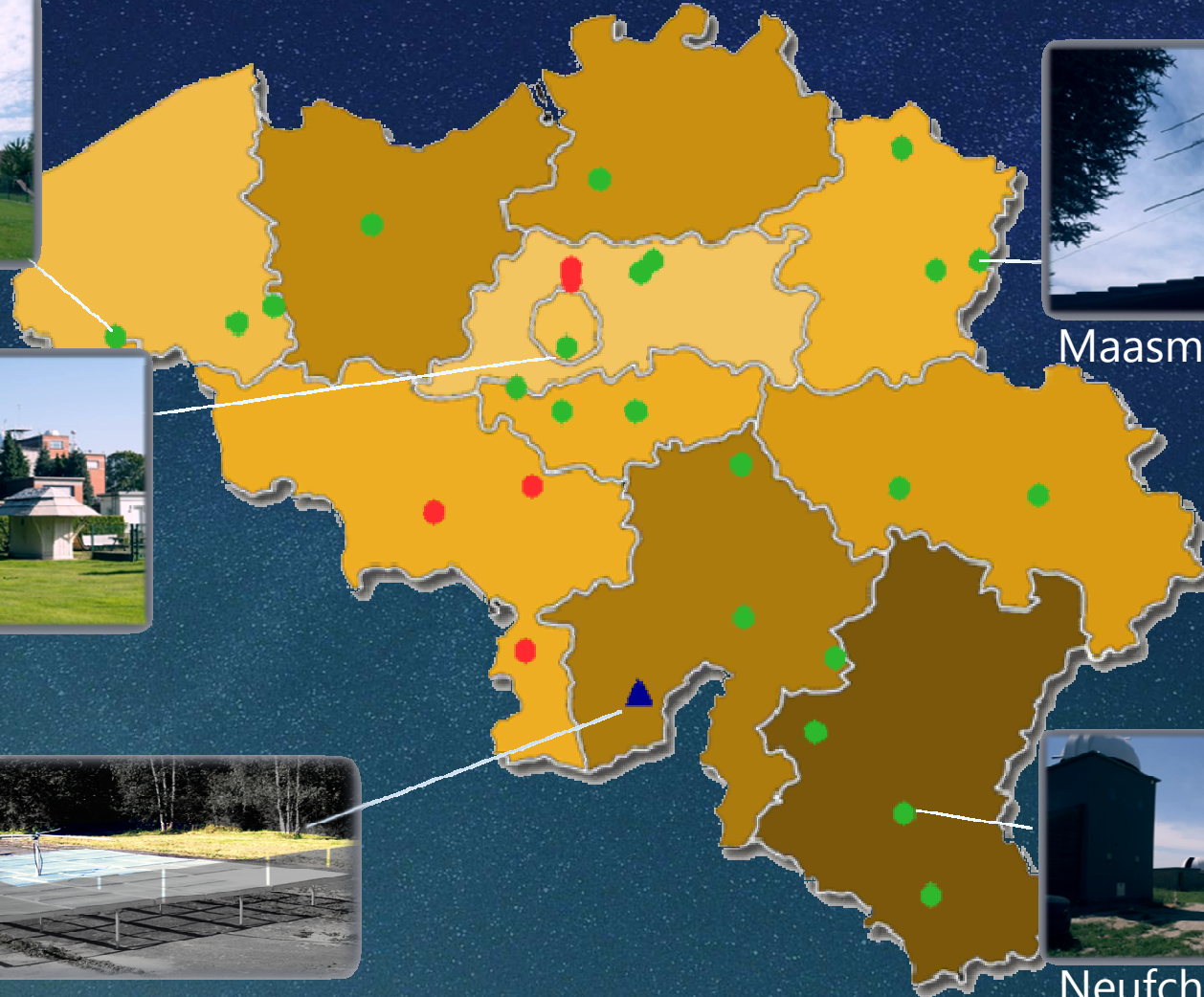
Uccle



Maasmechelen



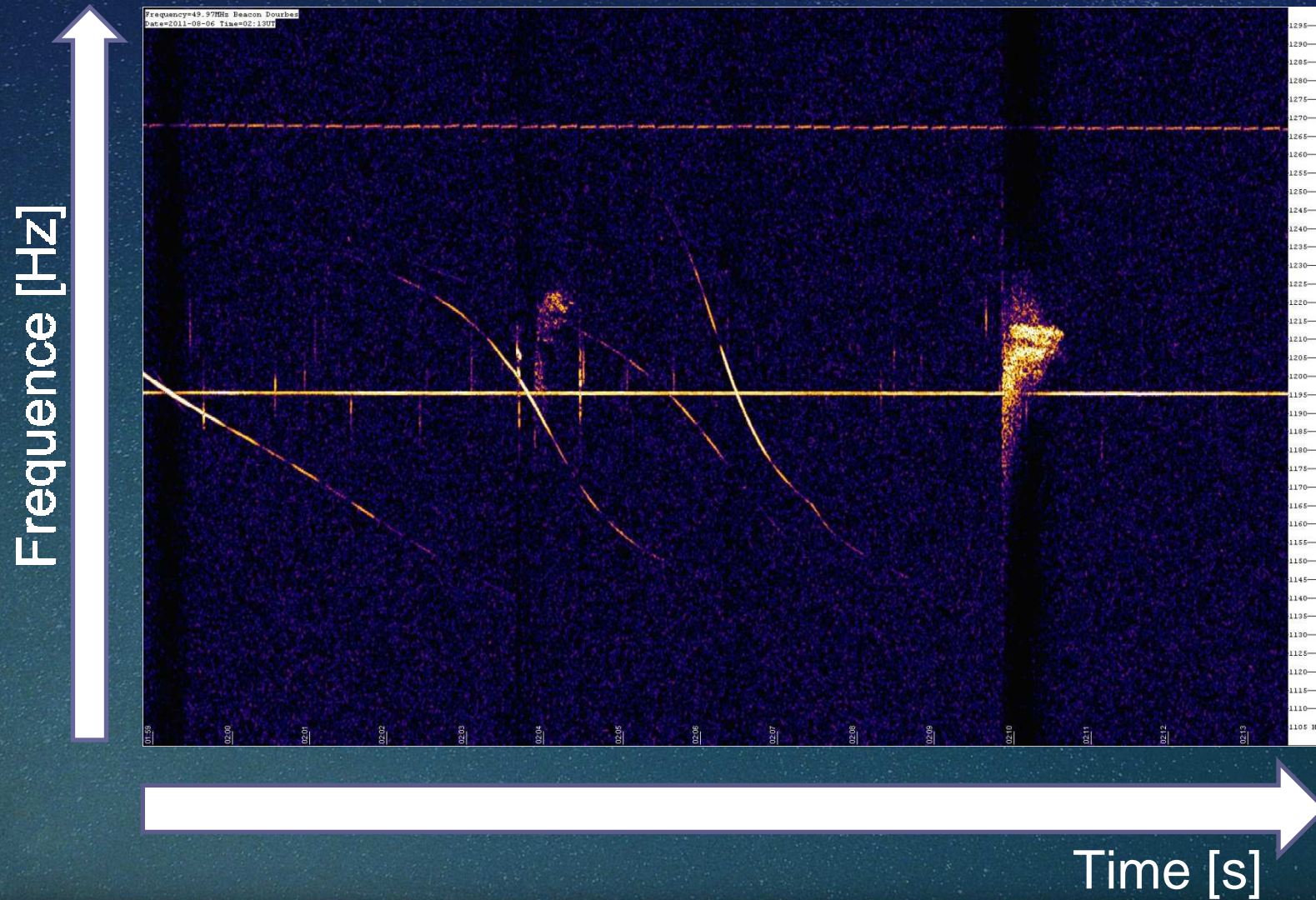
Neufchâteau



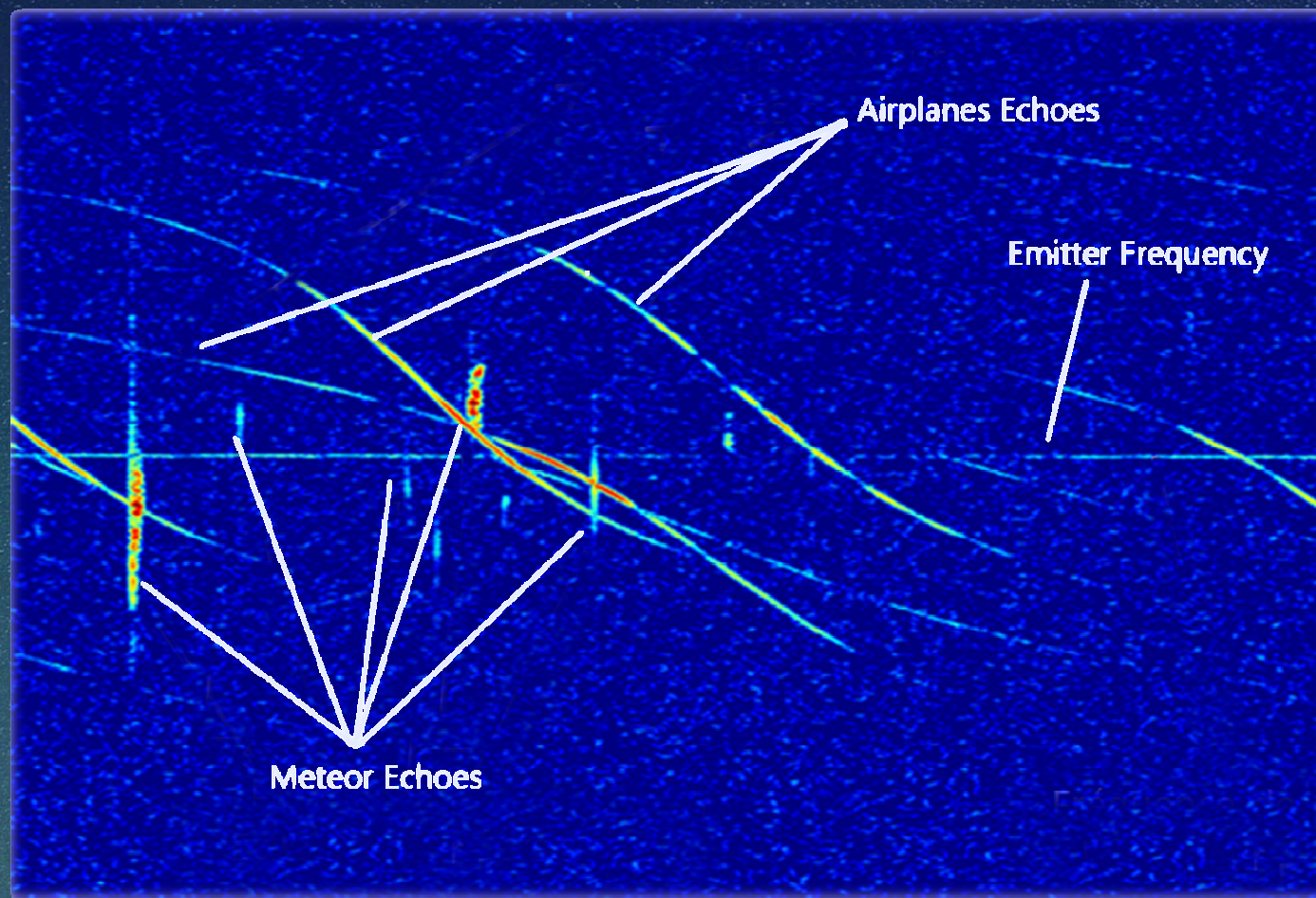
Receiving station

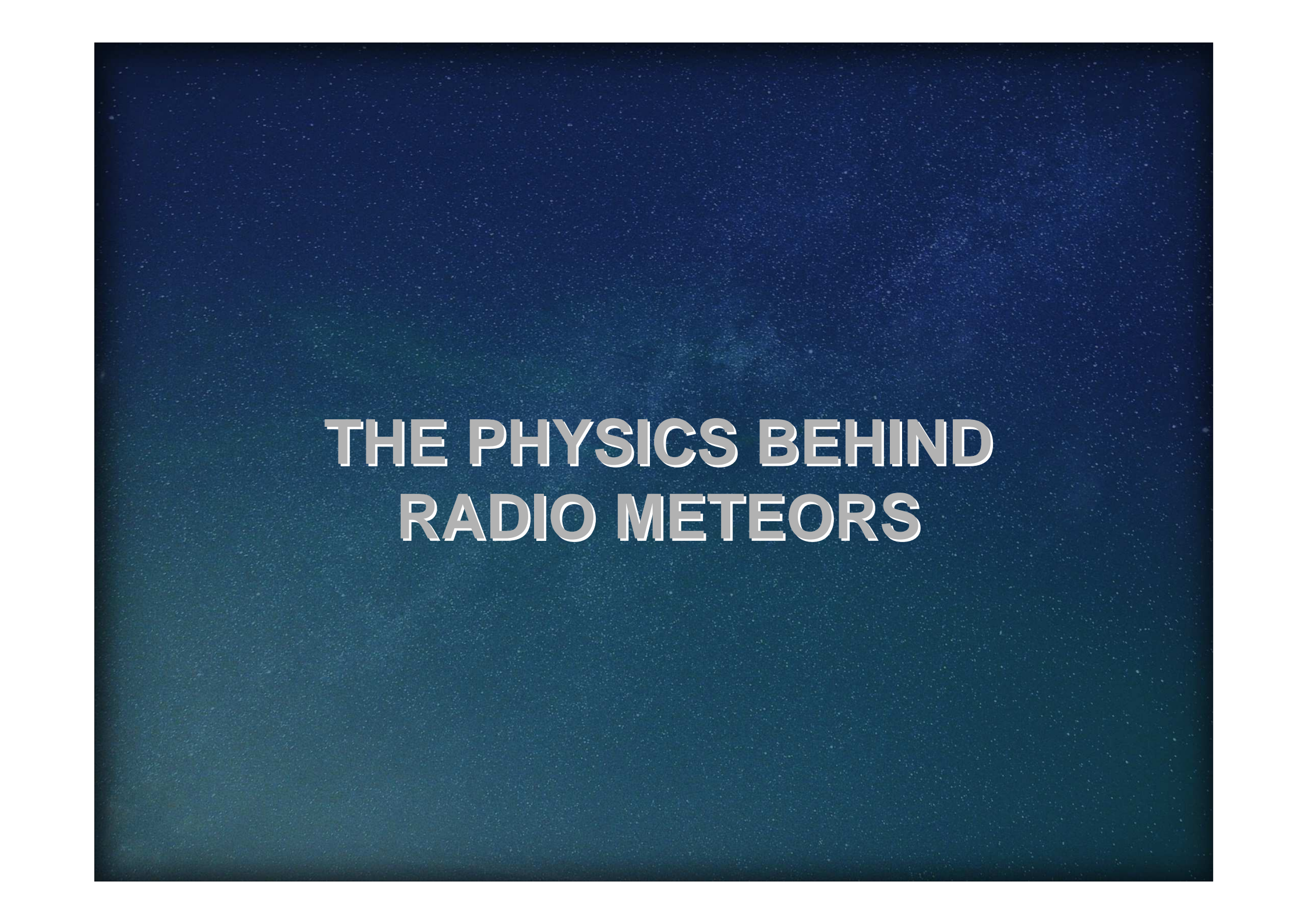


Spectrogram



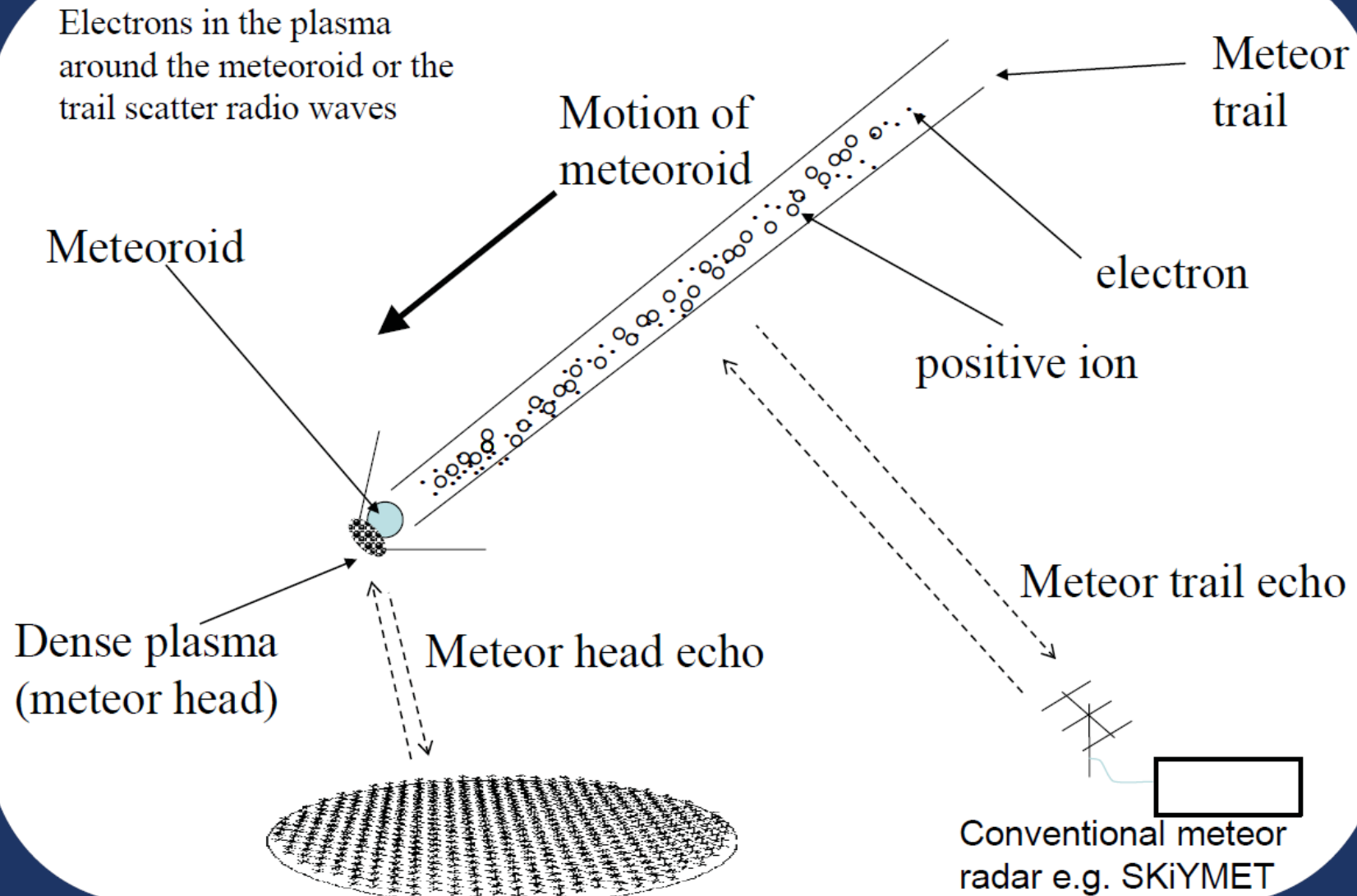
Spectrogram

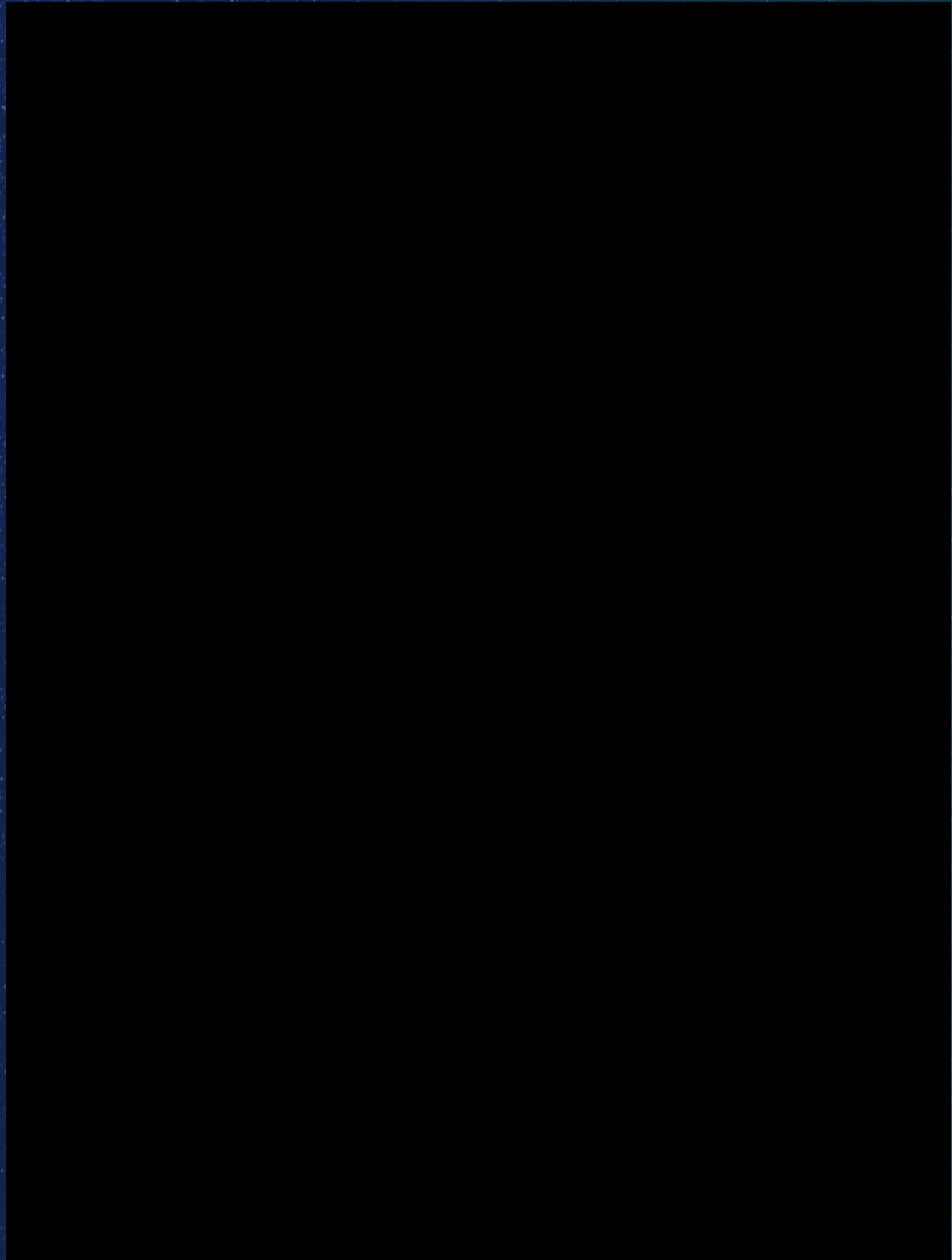




THE PHYSICS BEHIND RADIO METEORS

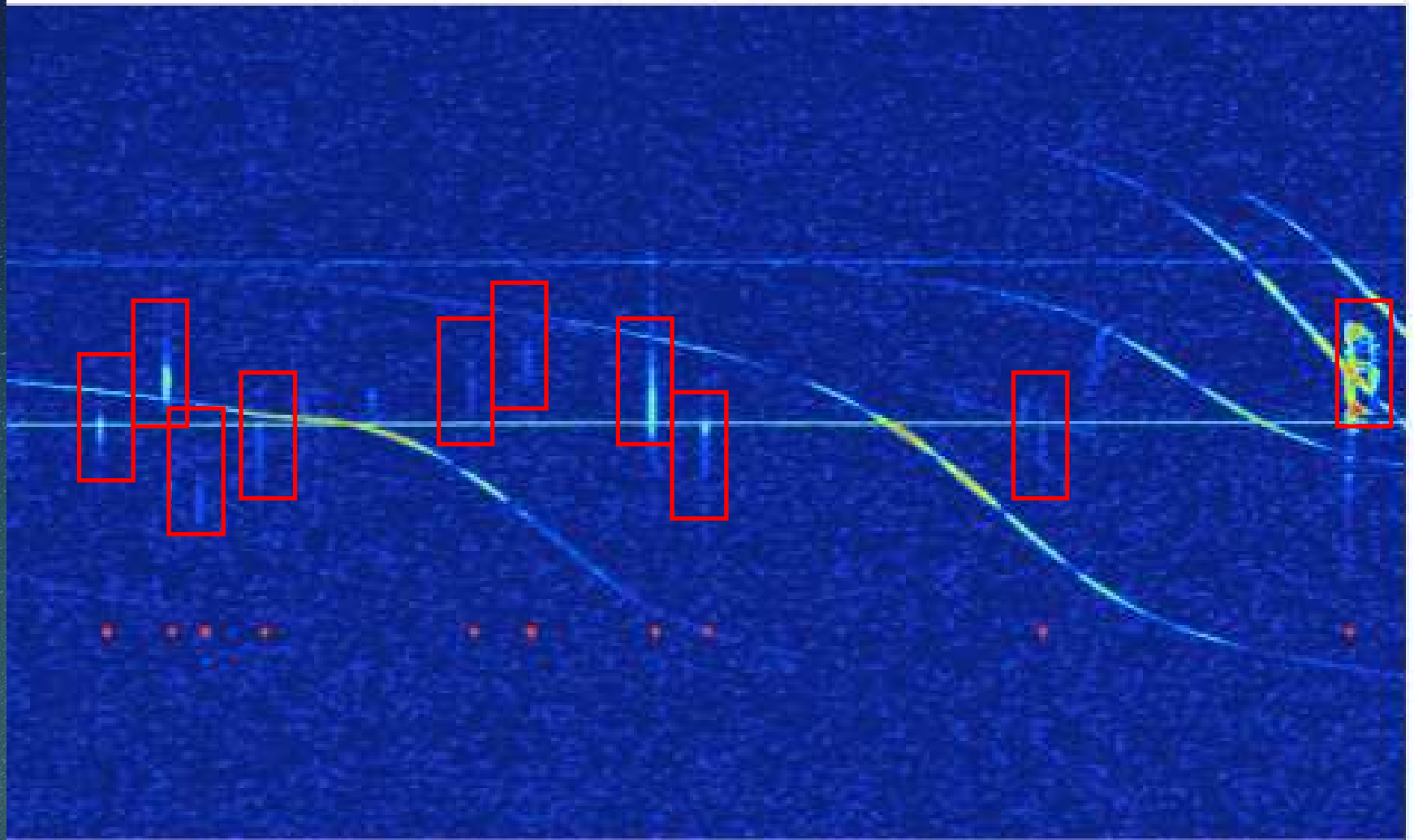
What do we observe?



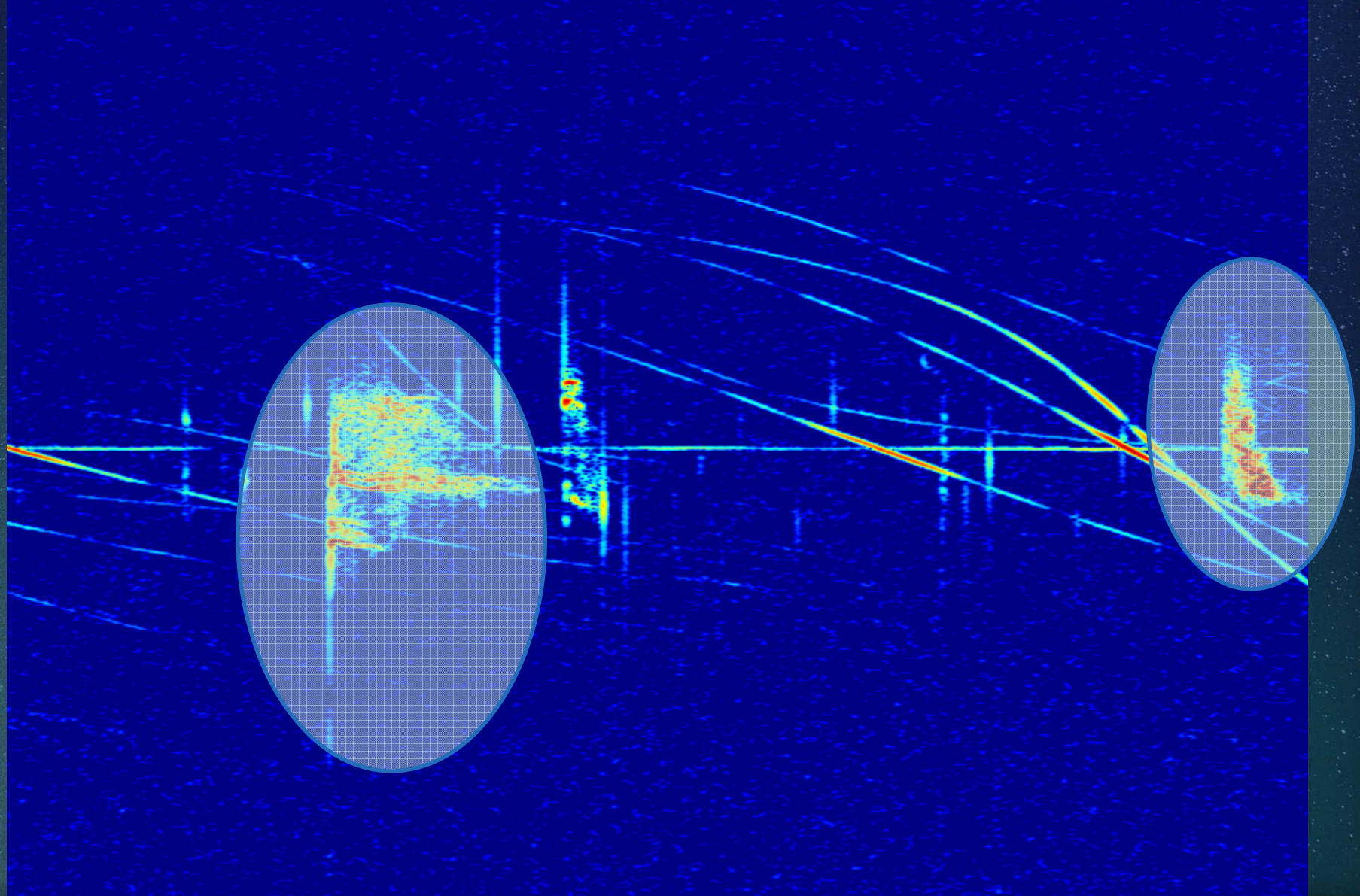


Automatic detection

RAD_BEDOUR_20111007_0420_BEUCCL_SYS001:16384-14746



But sometimes it fails...



**WE
NEED
YOU**



The Radio Meteor Zoo

www.radiometeorzoo.eu

The screenshot displays the 'CLASSIFY' section of the Radio Meteor Zoo website. The interface features a navigation bar at the top with links for 'RADIO METEOR ZOO', 'ABOUT', 'CLASSIFY' (the active tab), 'TALK', 'PROJECT WEBSITE', and 'FEEDBACK'. The main content area is divided into two panels. The left panel shows a spectrogram with a blue background and a horizontal line of yellow and white dots representing meteor echoes. A red rectangle is drawn around one of these echoes, indicating a potential meteor echo. The right panel contains instructions: 'Draw a rectangle around each potential meteor echo.' Below this, there is a 'rectangle tool' button with a red rectangle icon and a '1 drawn' counter. A 'Need some help with this task?' button is also present. At the bottom of the right panel, there are two buttons: 'Done & Talk' and 'Done'. A 'Show the project tutorial' button is located below the 'Done & Talk' button. A small notification at the bottom right of the interface says 'You should sign in'.

RADIO METEOR ZOO ABOUT **CLASSIFY** TALK PROJECT WEBSITE FEEDBACK

Draw a rectangle around each potential meteor echo.

rectangle tool 1 drawn

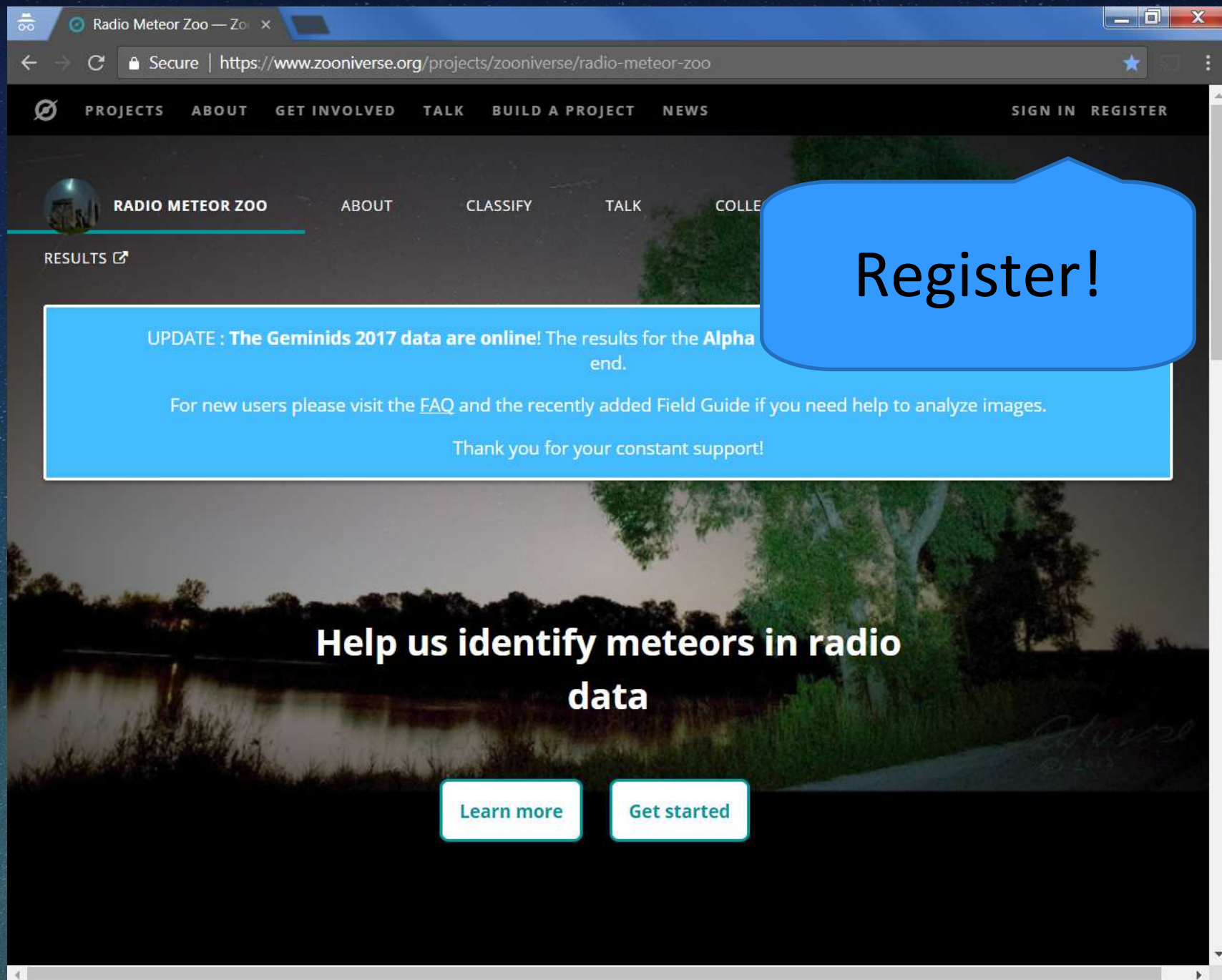
Need some help with this task?

Done & Talk Done

Show the project tutorial

You should sign in

[illegible]



Register!

UPDATE : The **Geminids 2017 data** are online! The results for the **Alpha** end.

For new users please visit the [FAQ](#) and the recently added Field Guide if you need help to analyze images.

Thank you for your constant support!

Help us identify meteors in radio
data

[Learn more](#)

[Get started](#)

Radio Meteor Zoo » Clas x

Secure | https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo/classify

PROJECTS ABOUT GET INVOLVED TALK BUILD A PROJECT NEWS SIGN IN REGISTER

RADIO METEOR ZOO ABOUT **CLASSIFY** TALK COLLECT PROJECT WEBSITE

RESULTS

UPDATE : The **Geminids 2017 data are online!** The
For new users please visit the [FAQ](#) and the rec
Thank you fo

Examples of (non-)meteors

FIELD GUIDE

Draw a rectangle around each potential meteor echo.

rectangle tool 0 drawn

Need some help with this task?

Done & Talk Done

Show the project tutorial

You should sign in!

ZOOONIVERSE

Projects
Collections
Build a Project

About Us
Education
Get Involved

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Project Websites

f t G+

Radio Meteor Zoo » Talk

Secure | <https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo/talk>

PROJECTS ABOUT GET INVOLVED TALK BUILD A PROJECT NEWS SIGN IN REGISTER

RADIO METEOR ZOO ABOUT CLASSIFY **TALK** COLLECT PROJECT WEBSITE

RESULTS

UPDATE : The Geminids 2017 data are online
For new users please visit the [FAQ](#) and the [tutorial](#) to analyze images.
Thank you

coming this week-end.


FIELD GUIDE

Radio Meteor Zoo Talk

Search or enter a #tag

Notes


General comment threads about individual subjects. We speak English, Dutch, French or Spanish.

 [rosemarybillington](#) Subject 16771796 *12 hours ago*

273 Participants
1988 Discussions
3133 Comments

Science

A place to talk about the science behind the Radio Meteor Zoo and related research

 [Hervé Lamy](#) **RESEARCHER** **RESEARCHER** **TEAM** Next campaign:

31 Participants
43 Discussions
180 Comments

Recent Comments

Popular Tags:

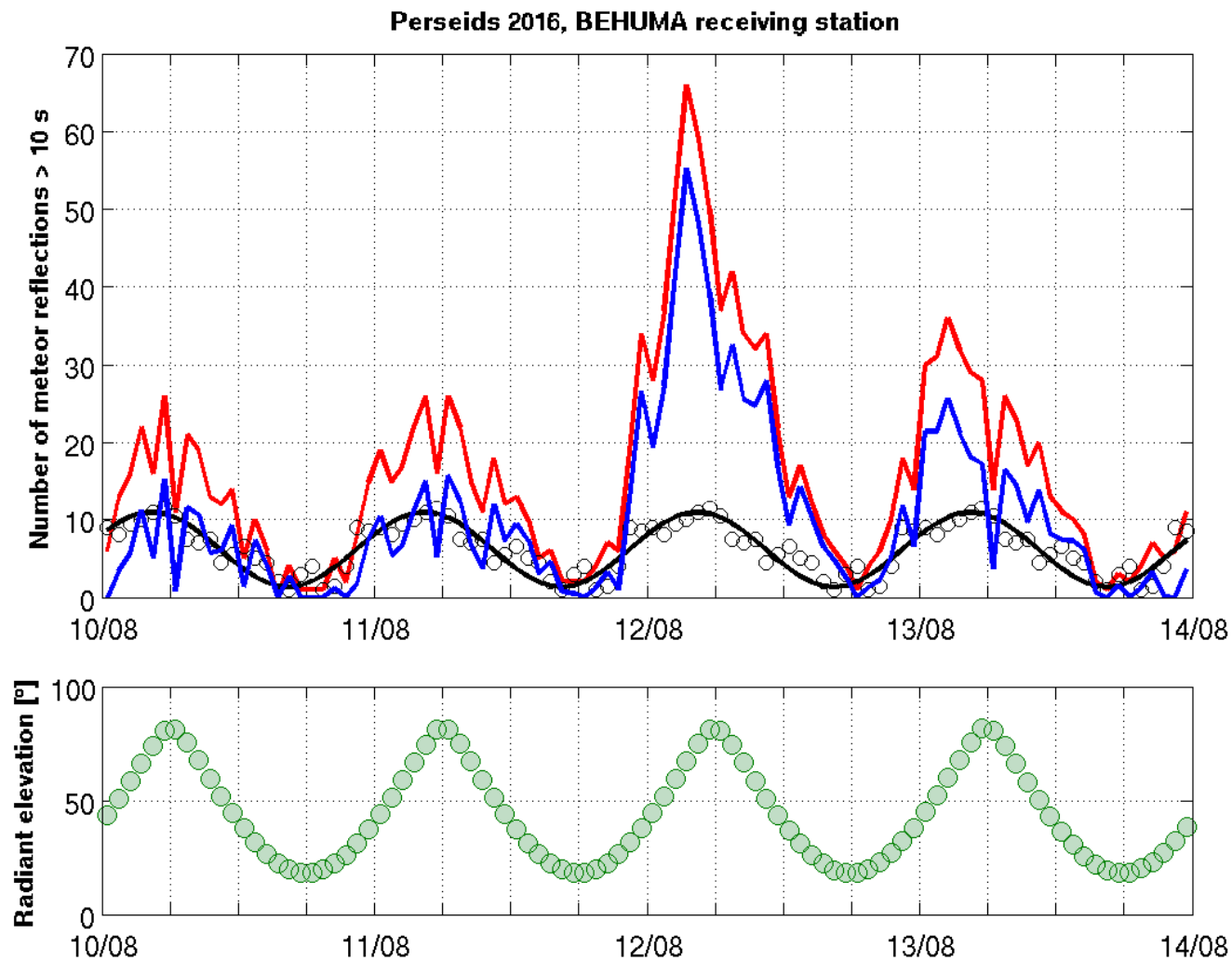
[overdense](#)
[epsilon](#)
[complex](#)
[c-echo](#)
[multiple](#)
[m-echo](#)
[interesting](#)
[echo](#)
[intense](#)
[overlap](#)

Ask your questions in our forum

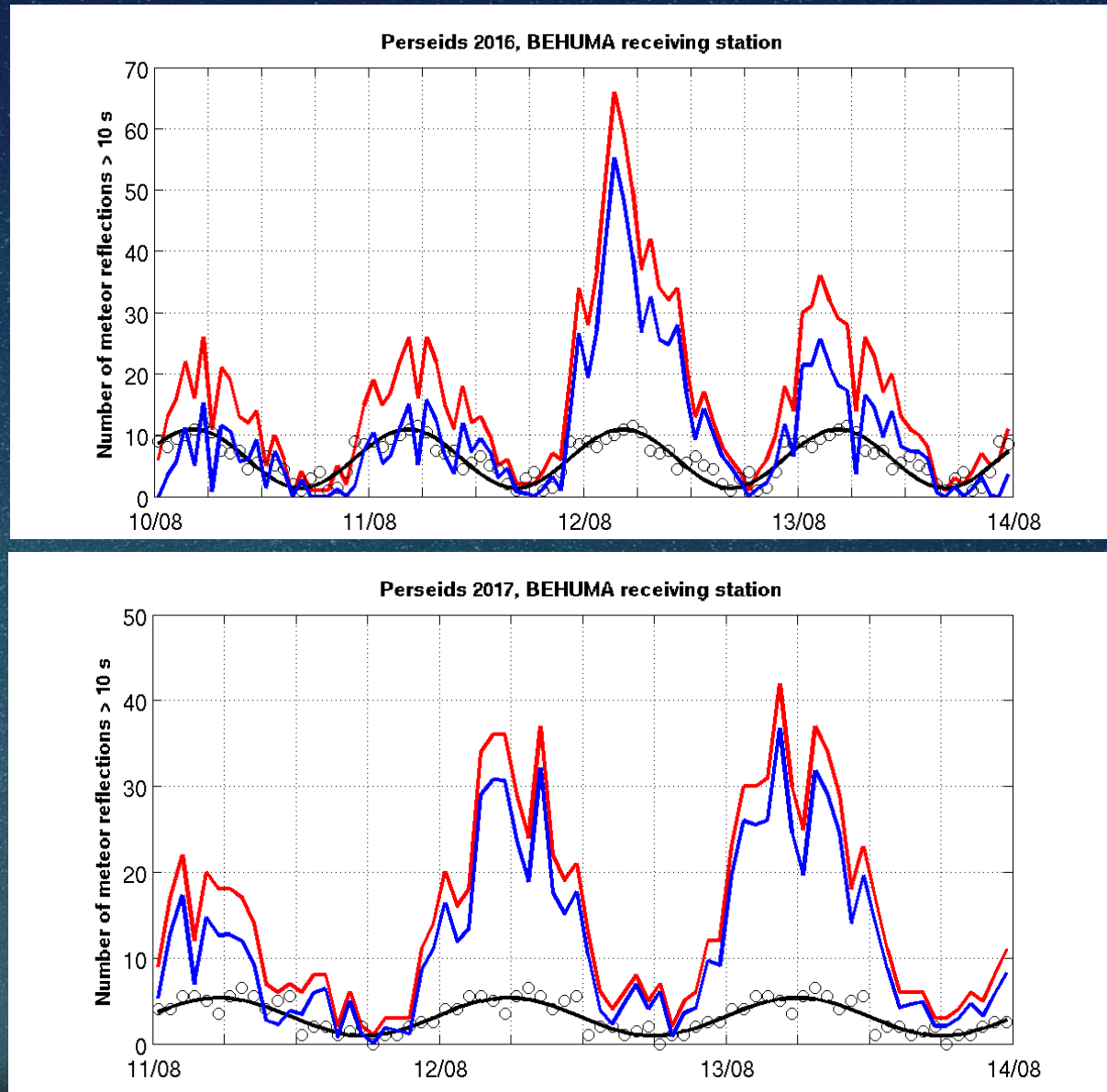
The screenshot shows a web browser with two tabs open, both titled 'Radio Meteor Zoo » About'. The address bar shows the URL <https://www.zooniverse.org/projects/zooniverse/radio-meteor-zoo/about/results>. The website has a dark theme with a navigation bar at the top containing links: PROJECTS, ABOUT, GET INVOLVED, TALK, BUILD A PROJECT, NEWS, SIGN IN, and REGISTER. Below this, a secondary navigation bar for the 'RADIO METEOR ZOO' project includes links: RADIO METEOR ZOO, ABOUT (highlighted with a red underline), CLASSIFY, TALK, COLLECT, and PROJECT WEBSITE. A 'RESULTS' link with an external icon is also present. A large blue callout box on the left contains the text 'Results of previous campaigns'. A light blue banner at the top of the main content area reads: '2017 data are online! The results for the Alpha Monocerotids are coming this week-end. Visit the FAQ and the recently added Field Guide if you need help to analyze images. Thank you for your constant support!'. Below this banner, there are three tabs: 'The Team', 'Results' (highlighted with a red border), and 'FAQ'. The main heading is 'Activity plot of the Perseids 2017'. The text below the heading explains the methodology for computing the activity of the Perseids 2017 for the BRAMS station in Humain (called BEHUMA) from 11 to 13 August, i.e. plot a graph showing the number of detected meteors per hour. These numbers are the sum of two populations of meteors, namely those from the meteor shower itself and those due to the sporadic meteors. The latter activity is called the background hereafter. The most accurate way to separate these two populations is by looking at individual trajectories and consider only the meteors coming from the radiant direction (+/- a few degrees) as belonging to the meteor shower. In that way the contamination by the background is very weak. We work on this but retrieving trajectories from BRAMS data is not yet possible. Instead, we have to estimate the activity of the background in a different way. For that we select a few days before the meteor shower where only meteors from the background are observed and we compute an average activity curve for these days that we can subtract from the general activity curve.

RESULTS

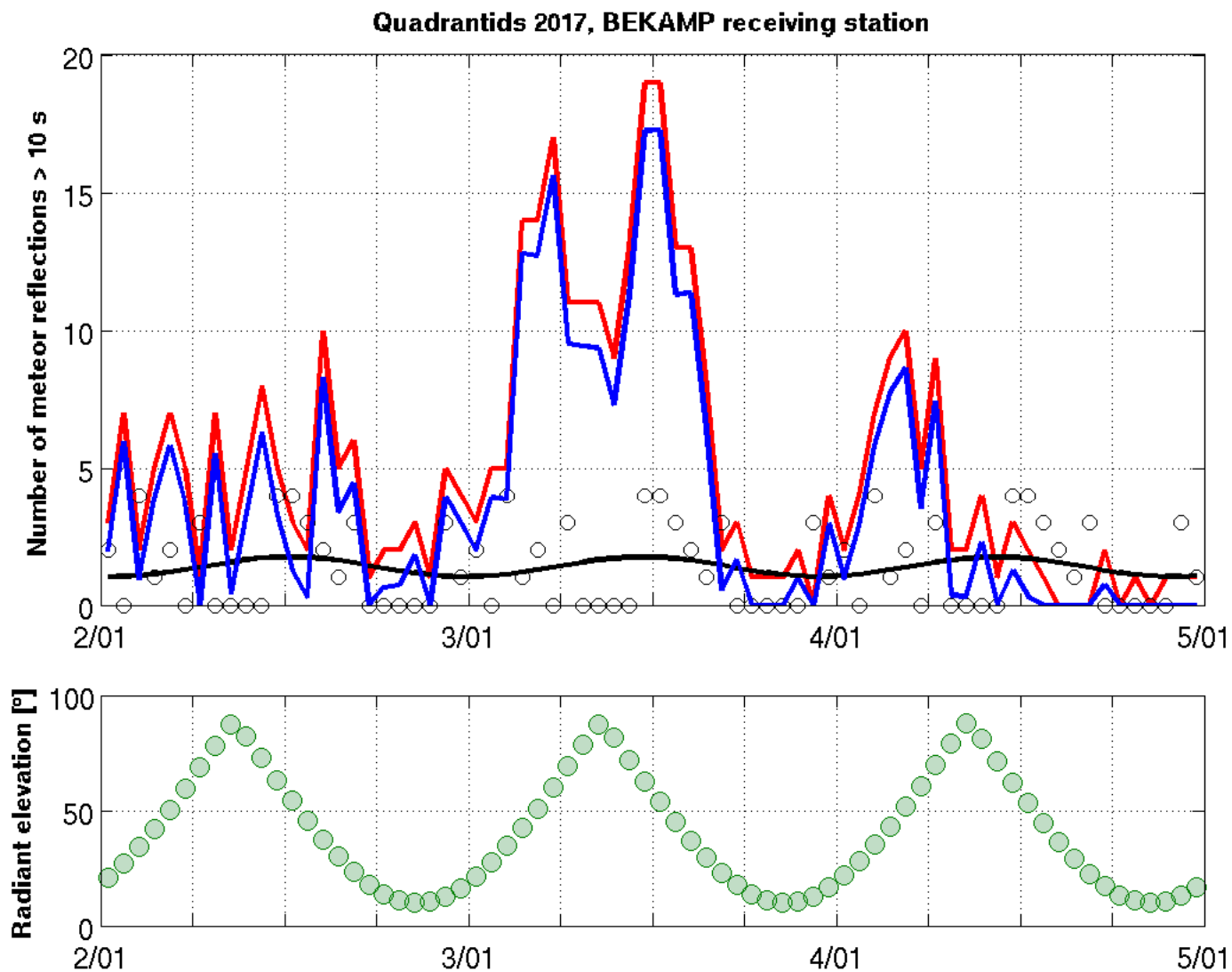
Start of the RMZ project



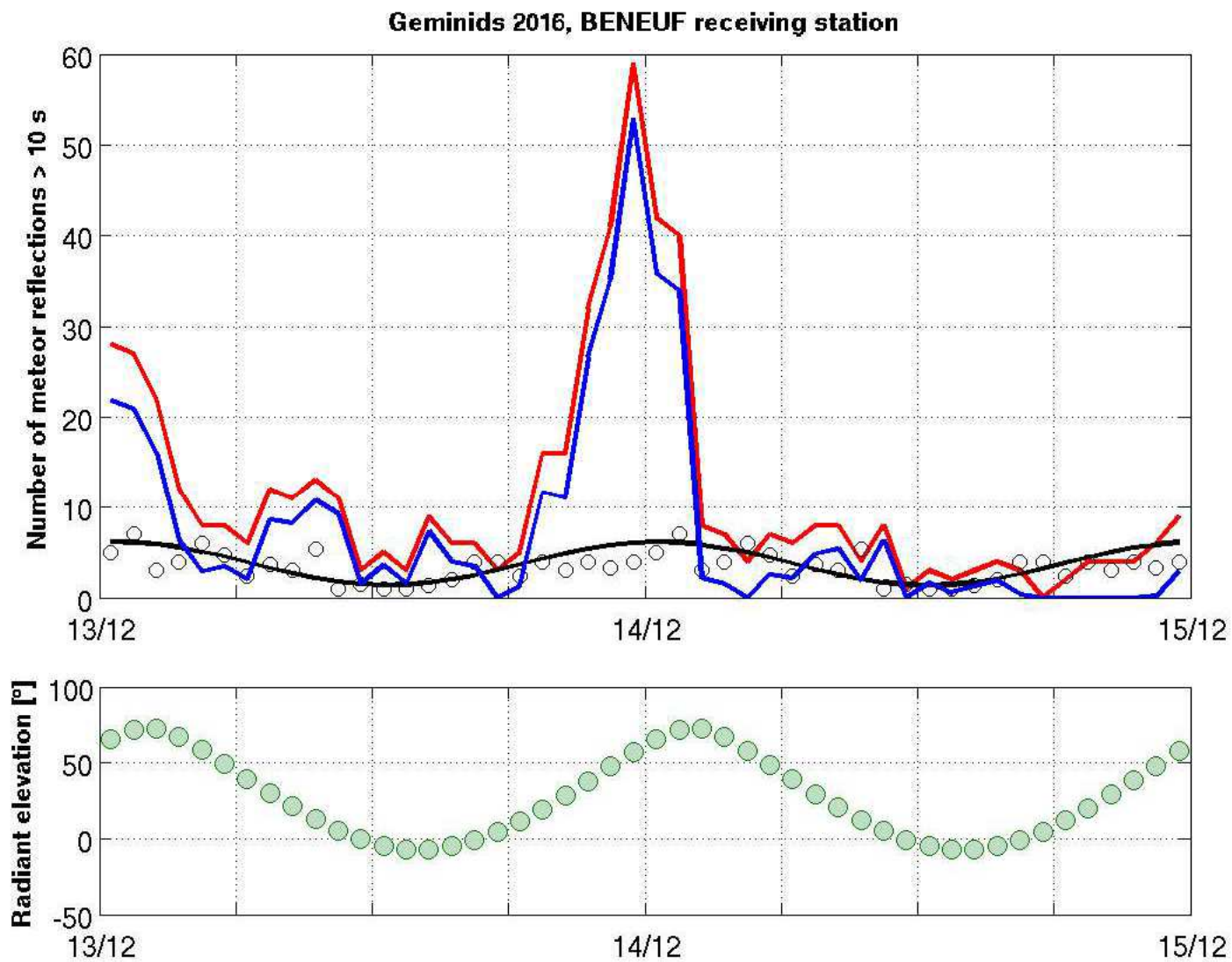
Perseids in 2017 were less active



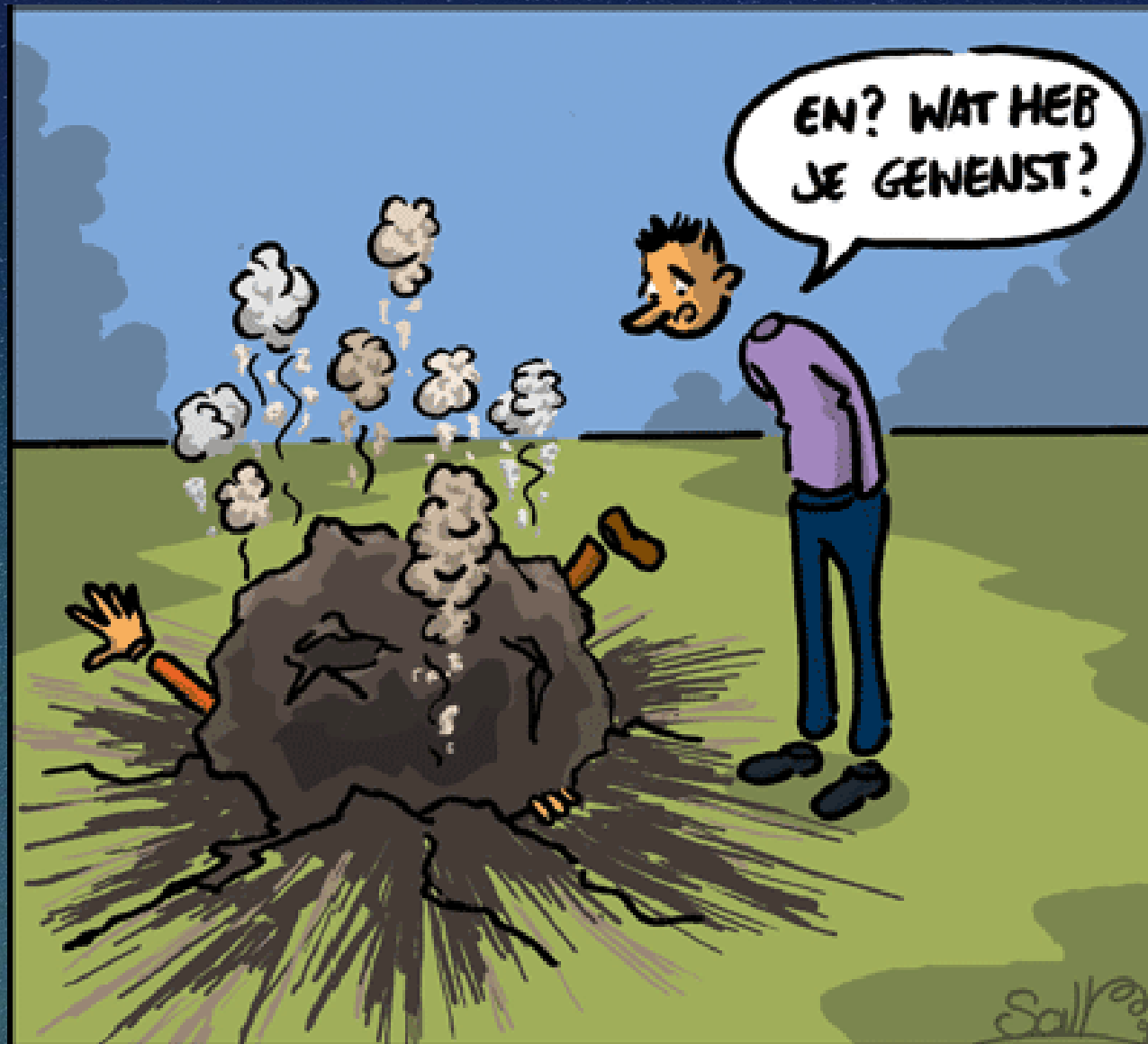
Quadrantids 2017

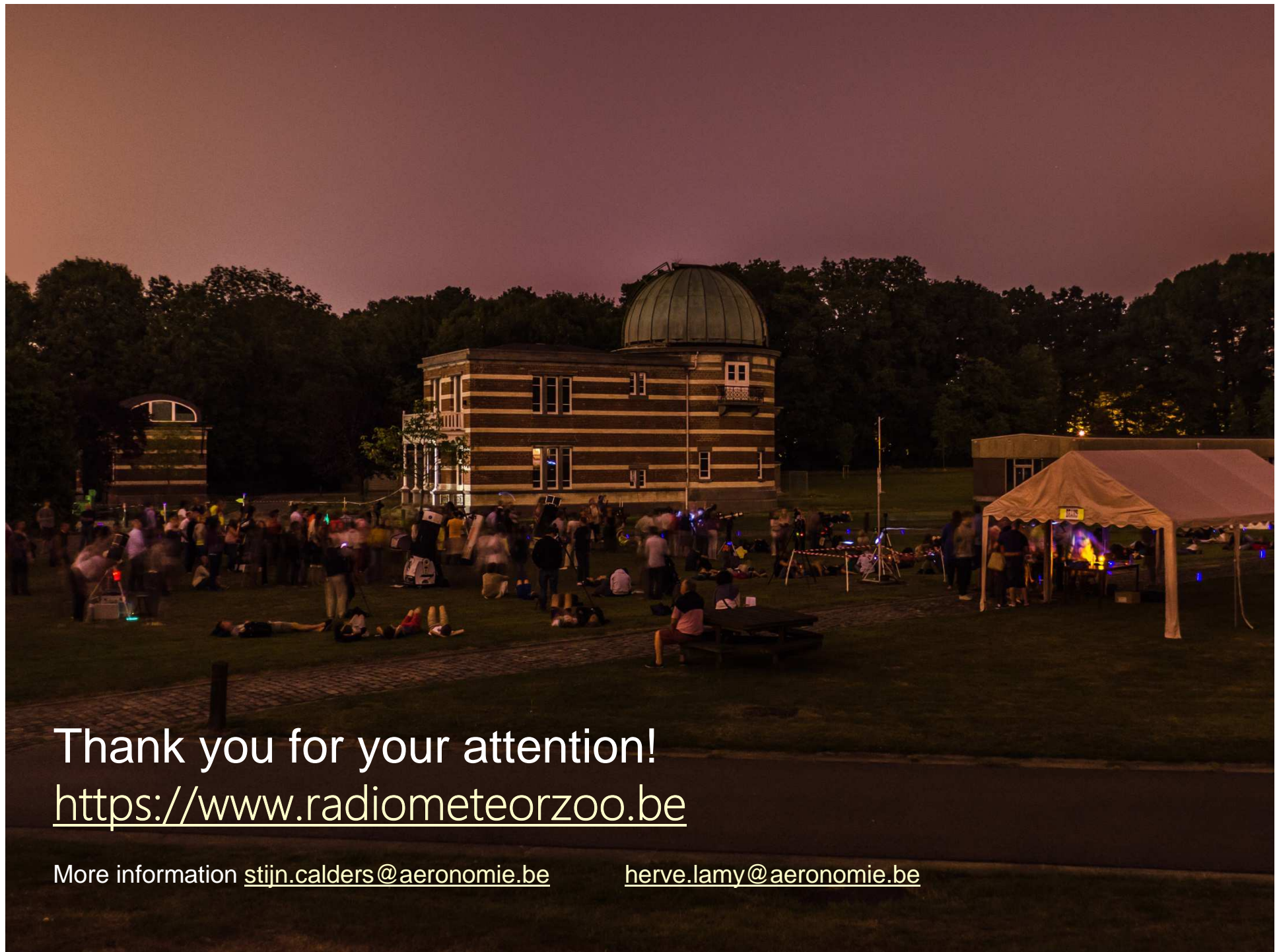


Geminids 2016



Questions?





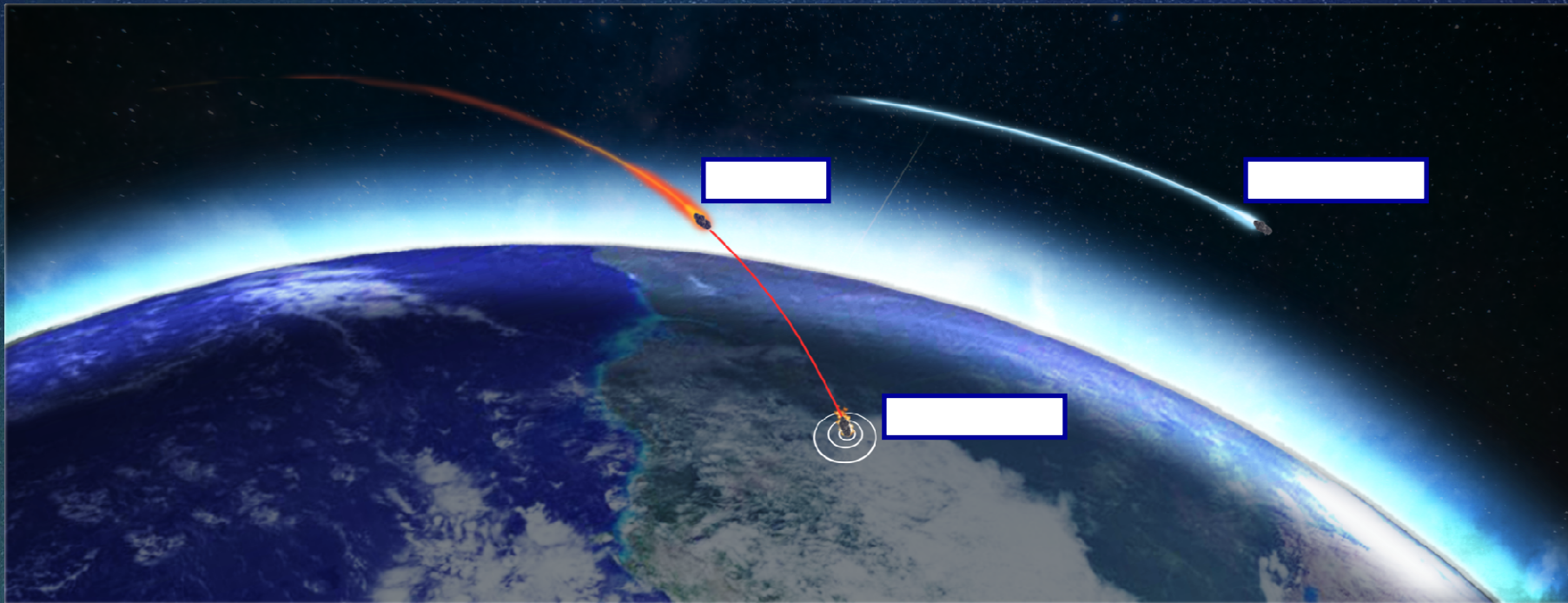
Thank you for your attention!
<https://www.radiometeorzoo.be>

More information stijn.calders@aeronomie.be

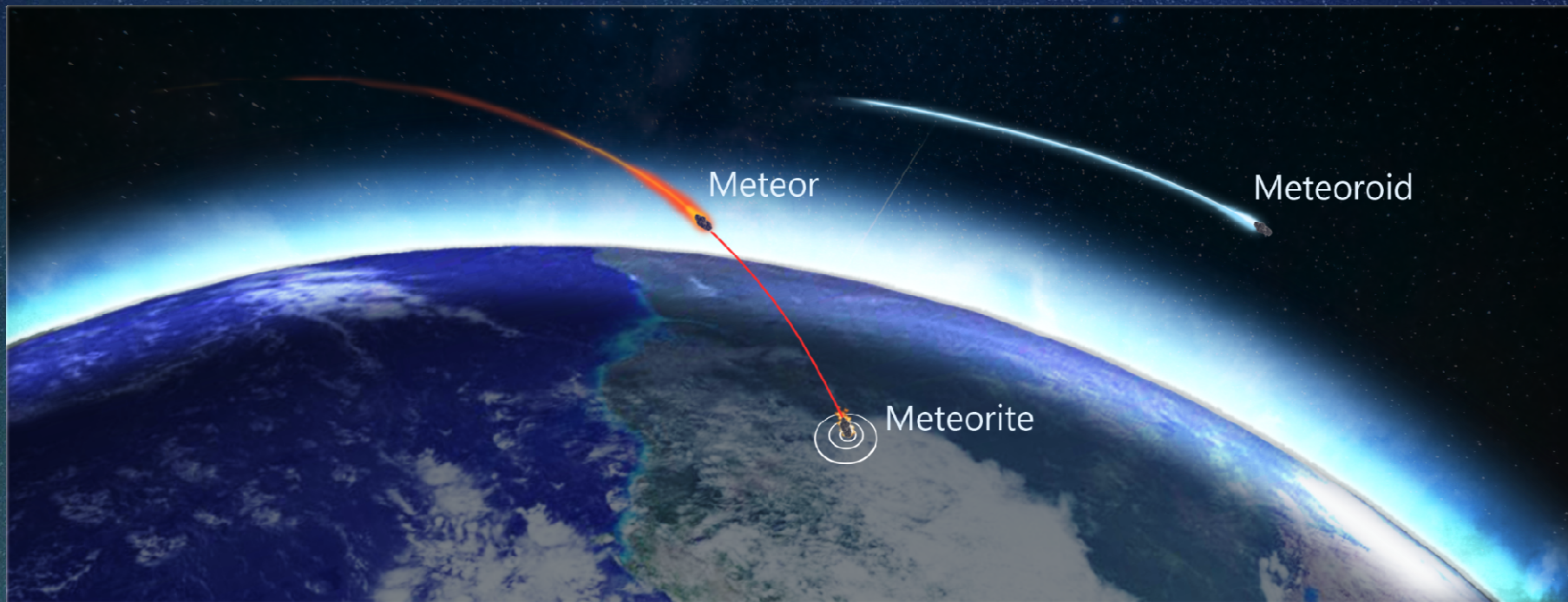
herve.lamy@aeronomie.be

BACKUP SLIDES

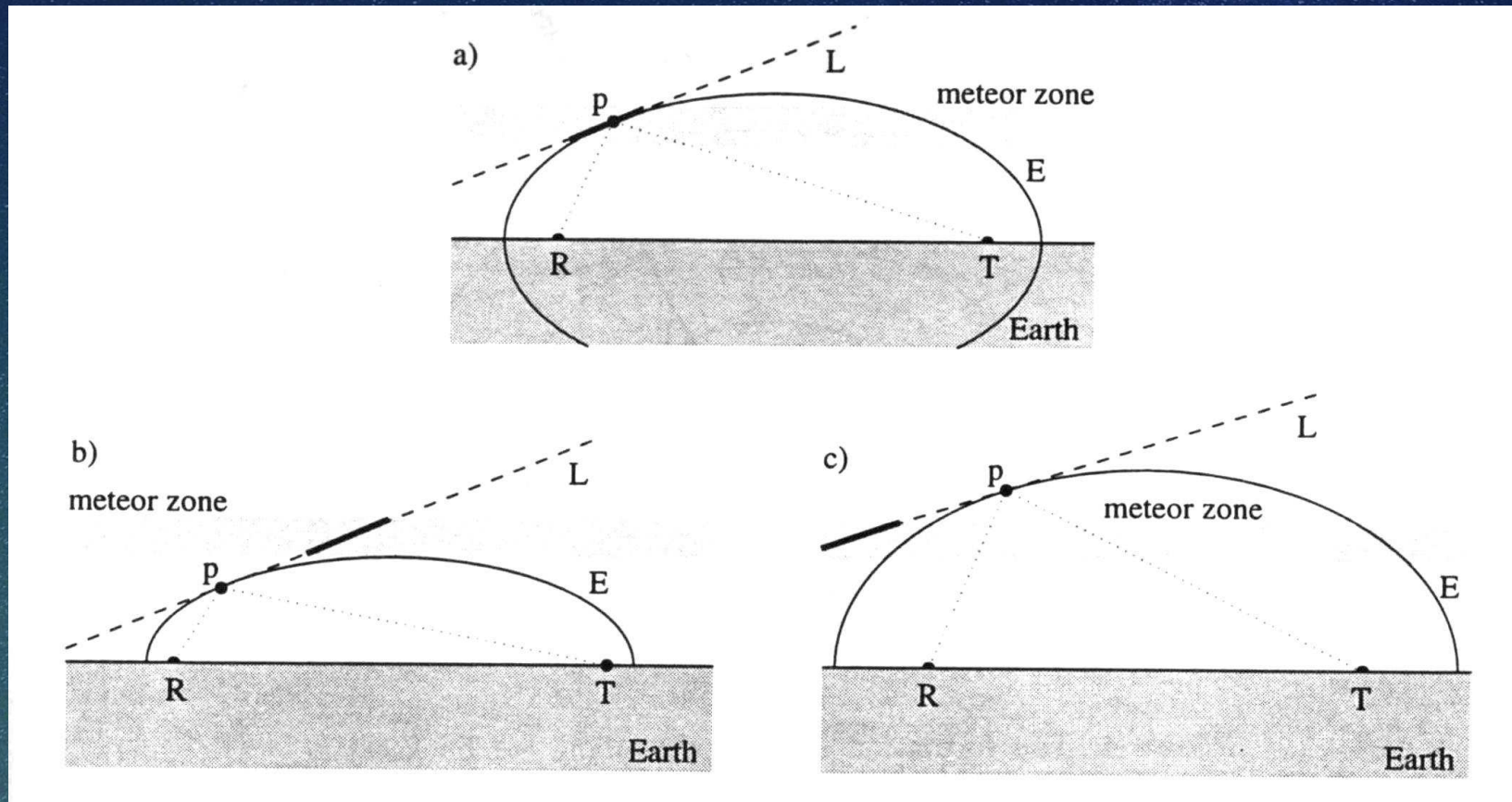
Terminology



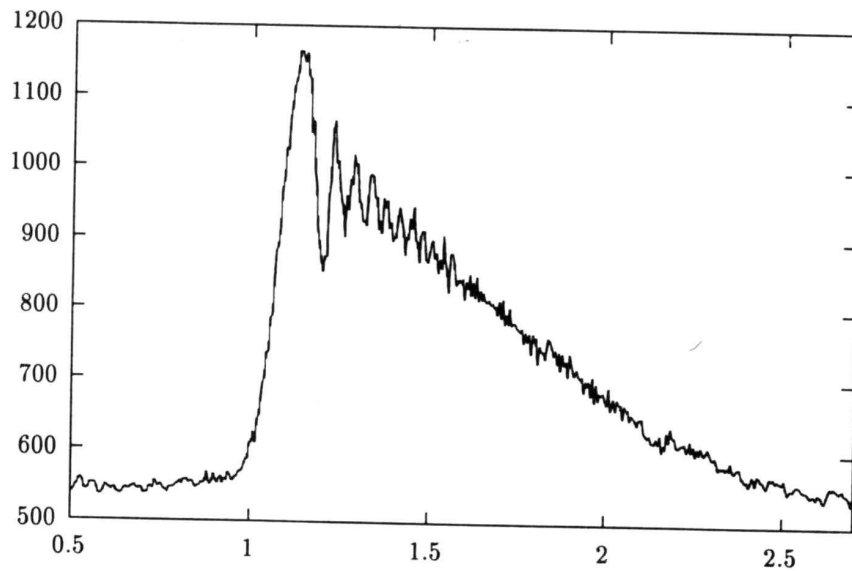
Terminology



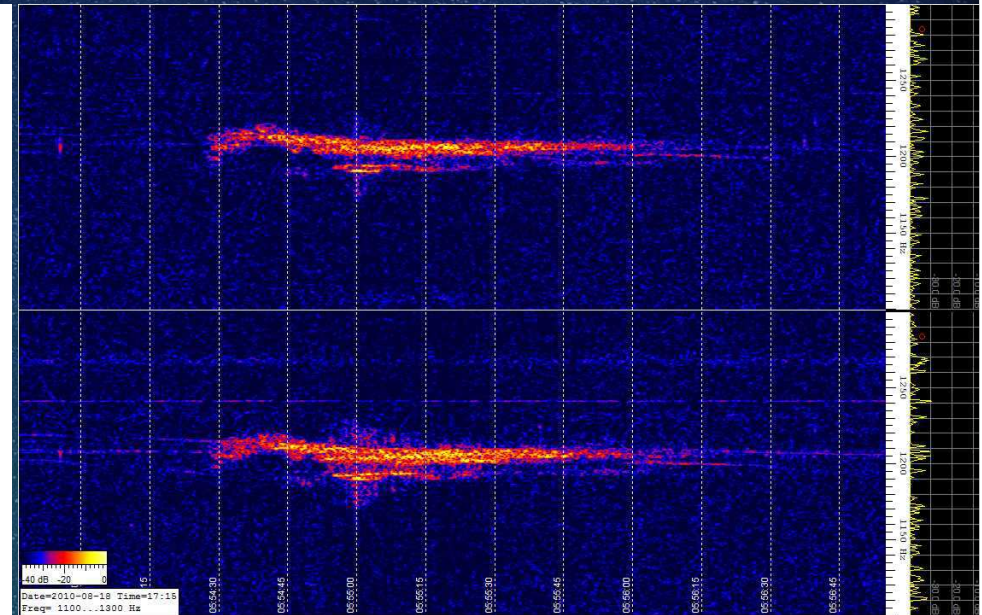
Geometrical conditions



How do we observe?



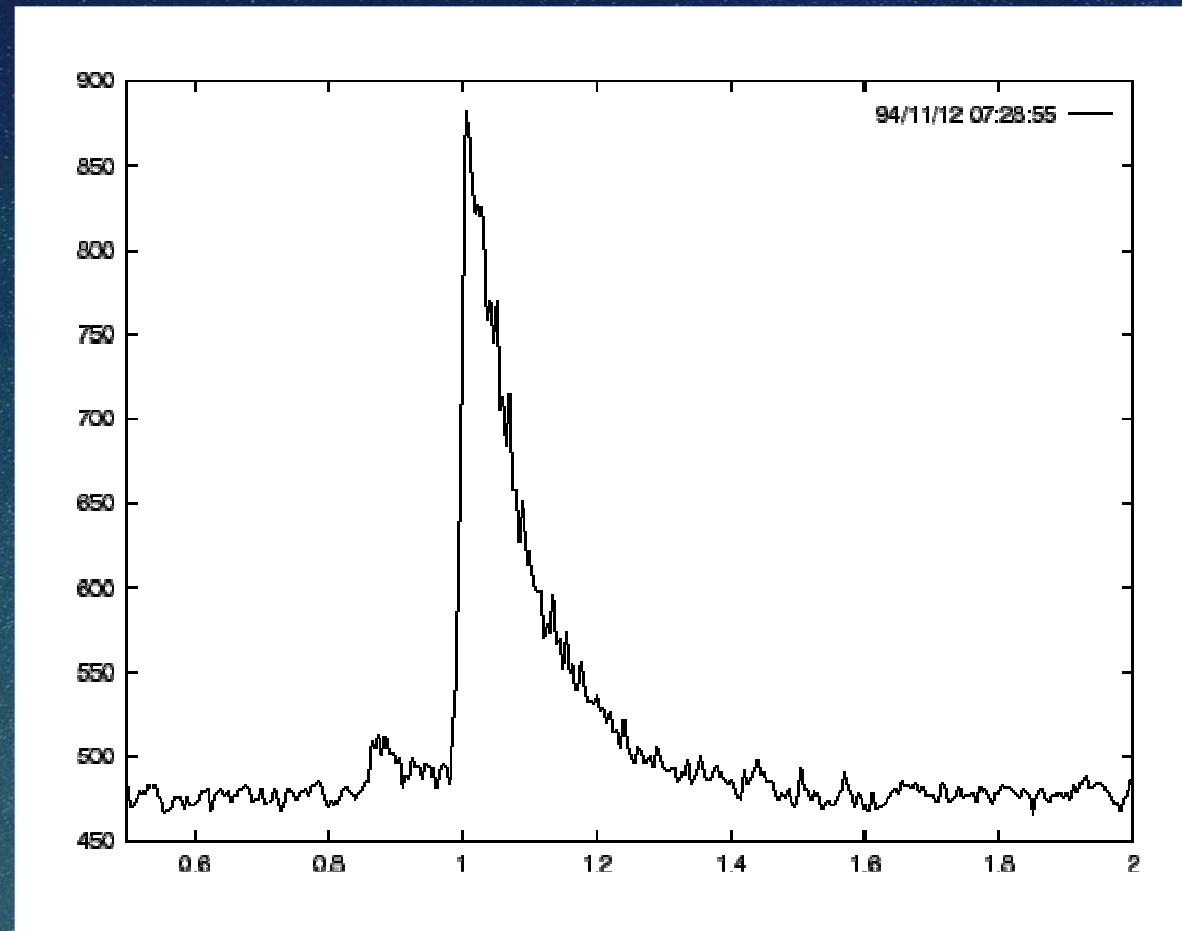
Power profile:
reflected power as a
function of time



Spectrogram:
spectrum as a
function of time

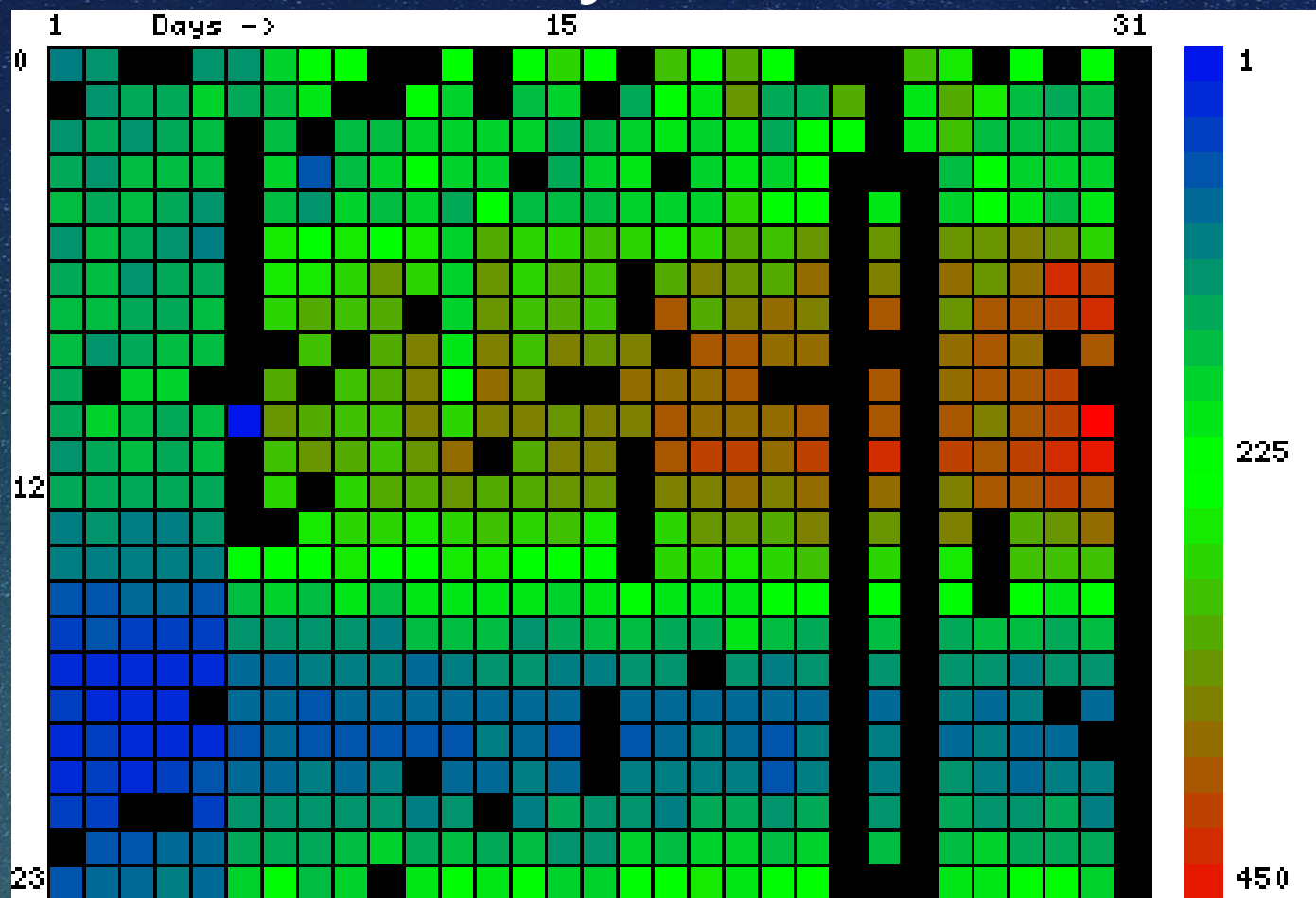
Reflected power

Reflected power [-]



Time [s]

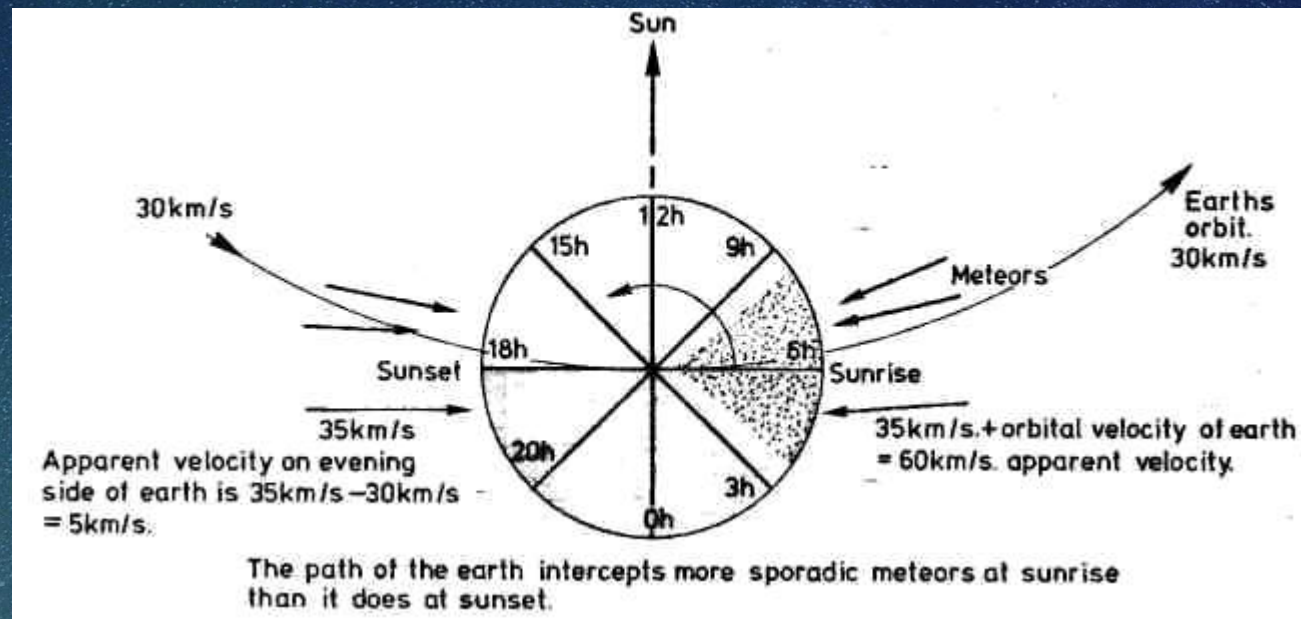
Monthly overview



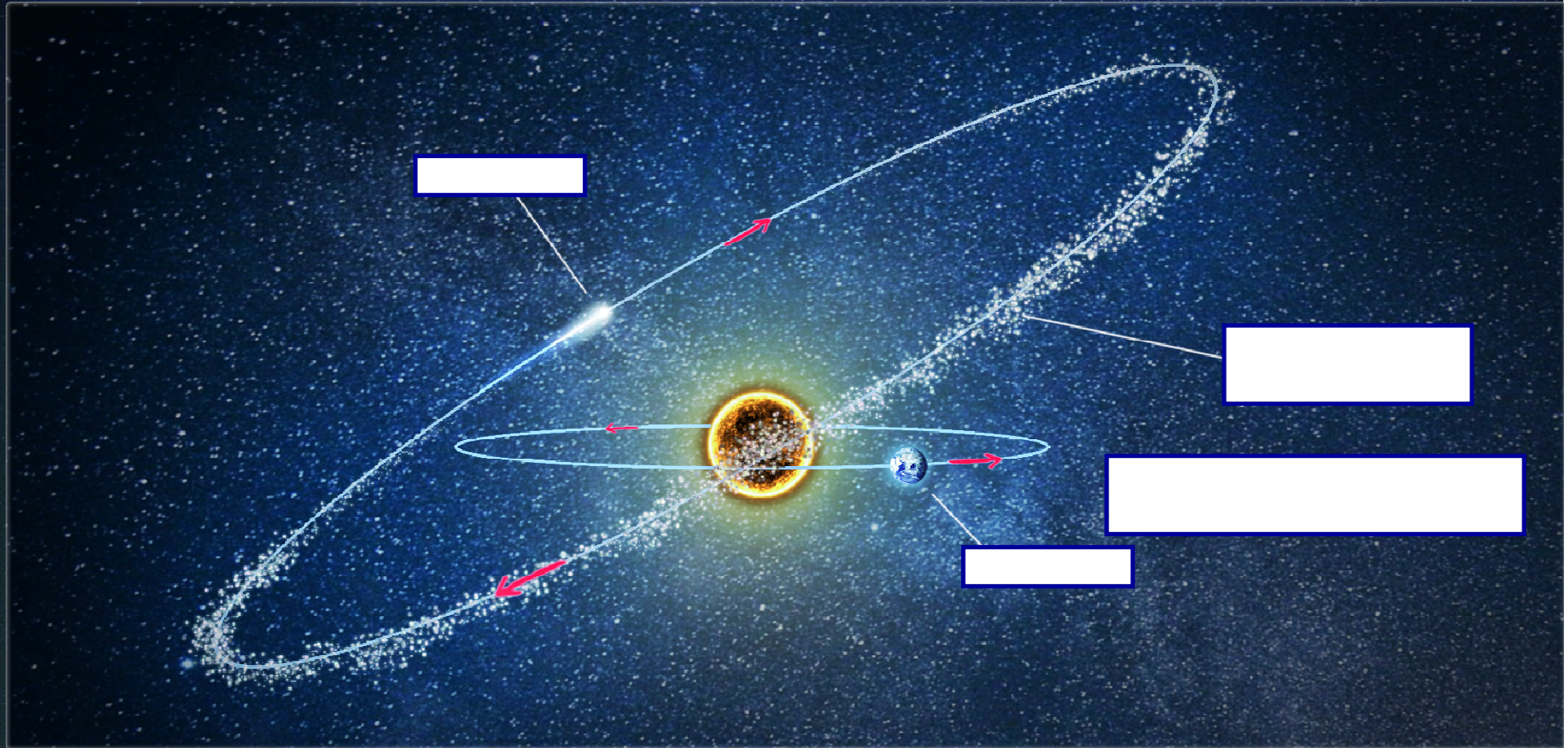
The diurnal variation of sporadic meteors
& a daylight shower

Patrick Vanouplines, May 2008

Diurnal variation



Comets & meteors



Comets & meteors

