

BRAMS  
annual  
meeting  
2019



## The Radio Meteor Zoo

Stijn Calders



Universiteit  
Antwerpen

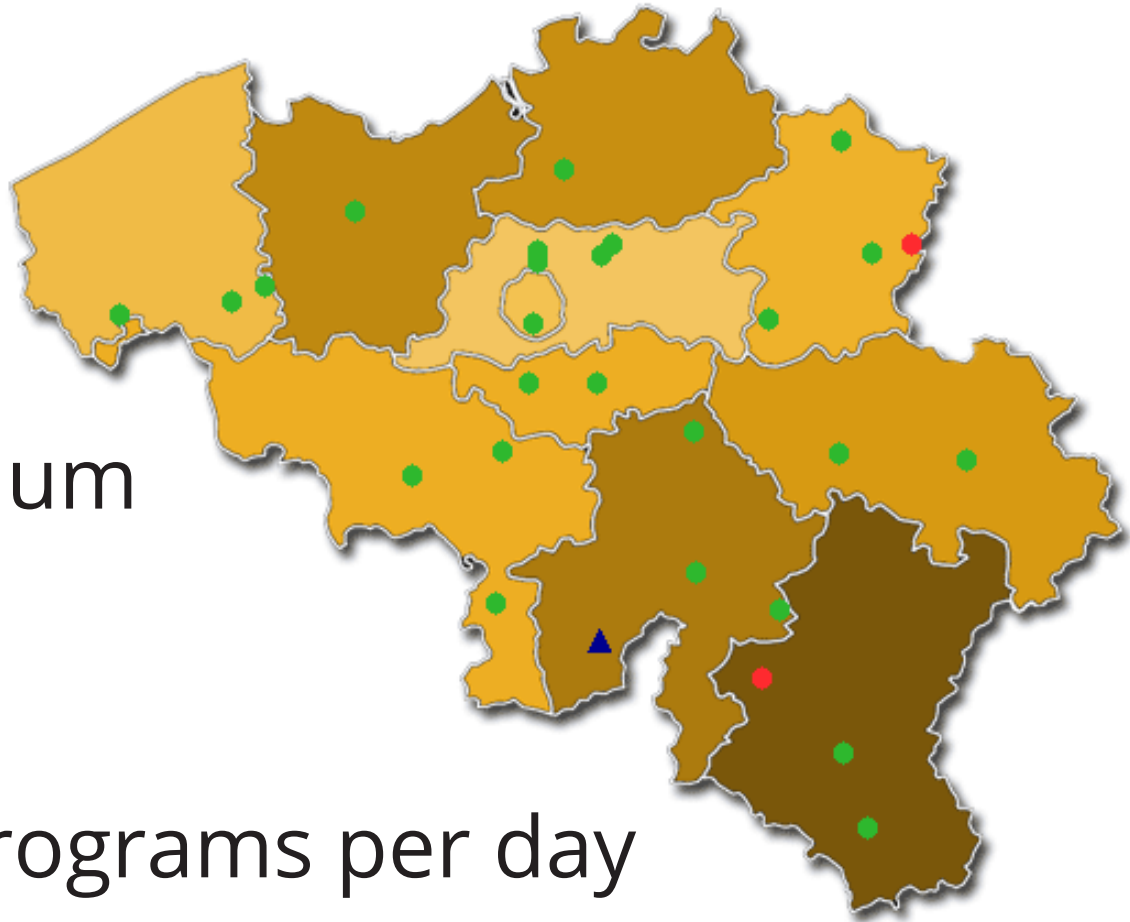


ROYAL BELGIAN INSTITUTE  
FOR SPACE AERONOMY



# BRAMS network

- ~25 stations all over Belgium



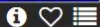
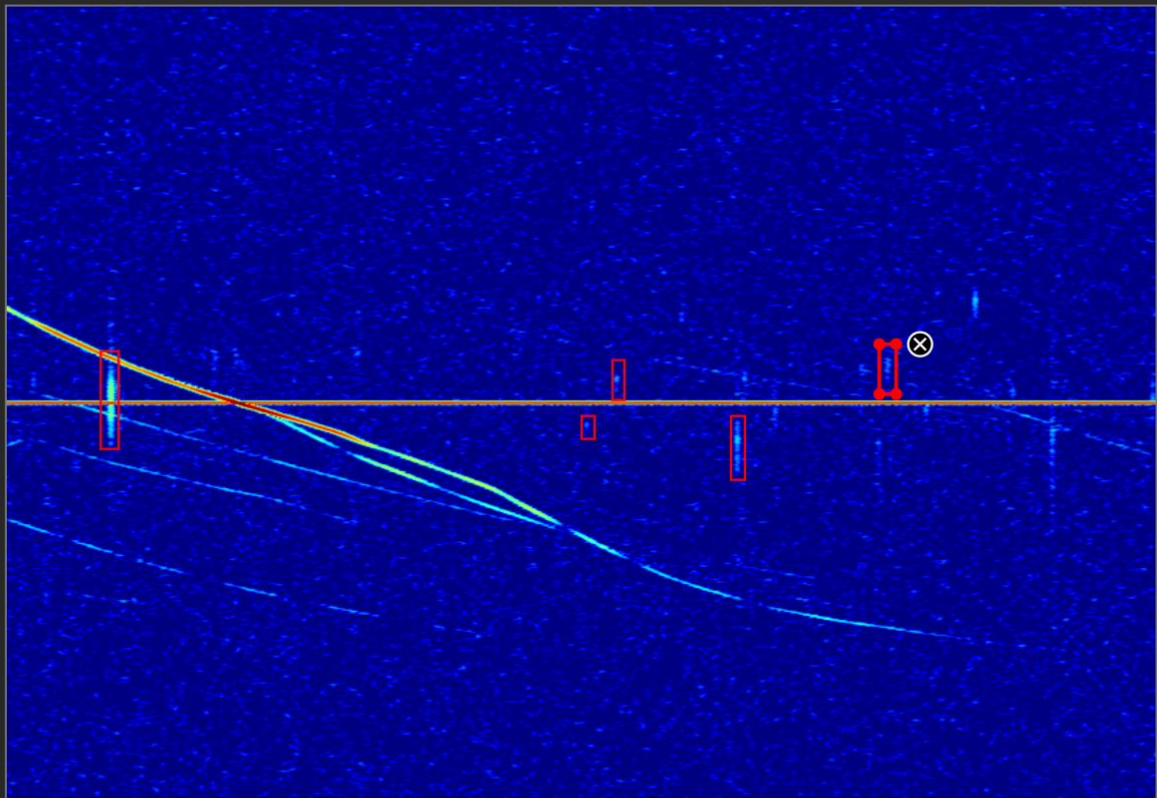
- ~8000 spectrograms per day





**WE  
NEED  
YOU**

<https://www.radiometeorzoo.org/>



SWITCH TO LIGHT THEME

## TASK

## TUTORIAL

Draw a rectangle around each potential meteor echo.

Rectangle tool

5 drawn

NEED SOME HELP WITH THIS TASK?

Done



Demo mode:

No classifications are being recorded. [Disable](#)

FIELD GUIDE



# Agenda

- ❖ New results from the RMZ
- ❖ Automatic detection using NNs





# **NEW RESULTS FROM THE RADIO METEOR ZOO**



# Showers analyzed in 2019

- Quadrantids
- Lyrids
- zeta Perseids (unfinished)
- Perseids
- Draconids (in progress)
- Geminids?



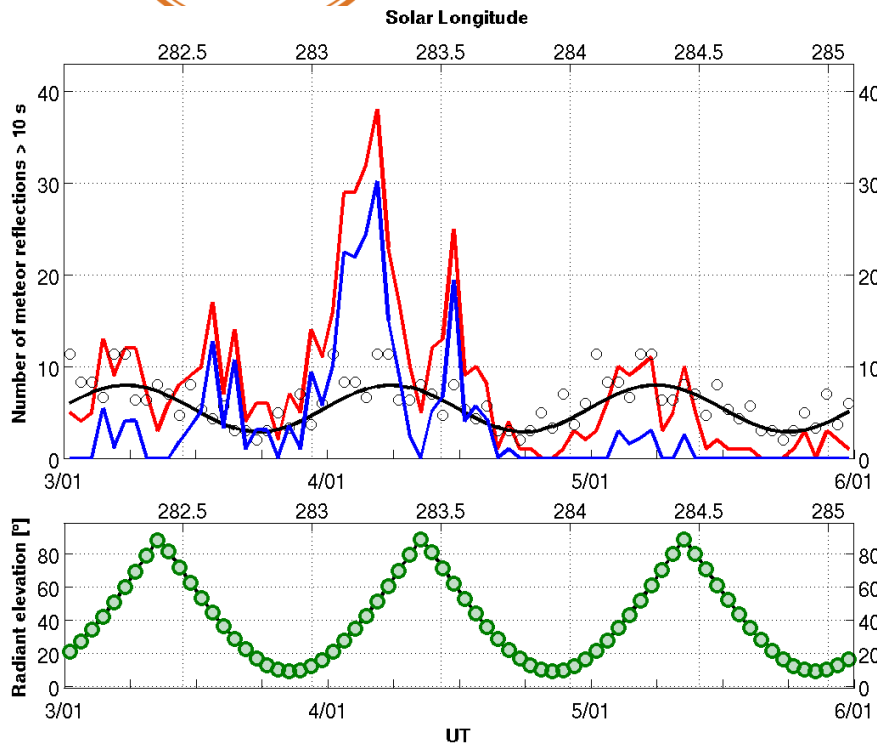
# Showers analyzed in 2019

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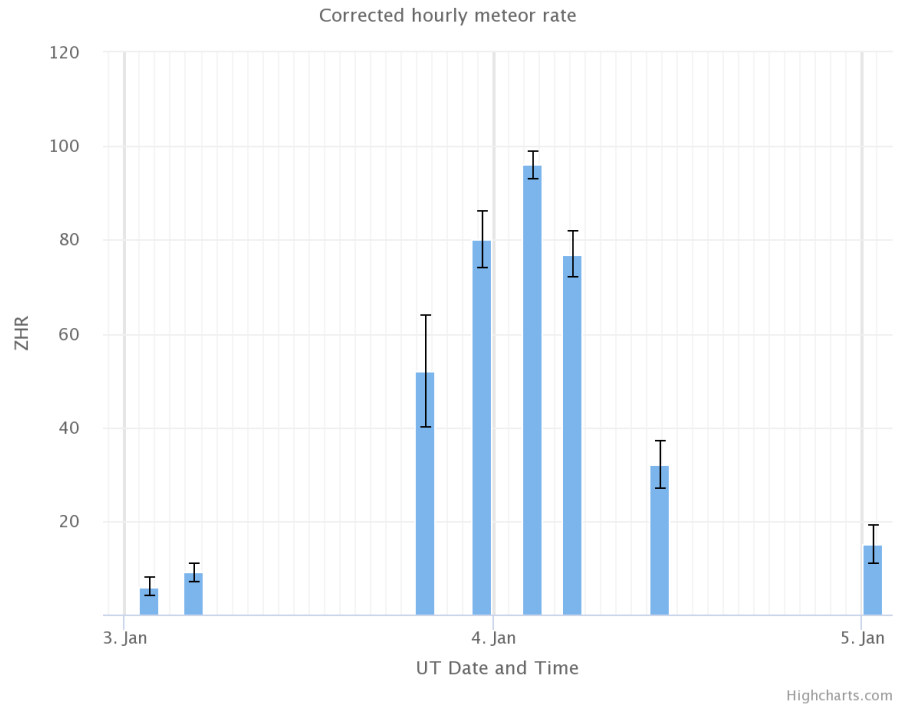




# Quadrantids 2019



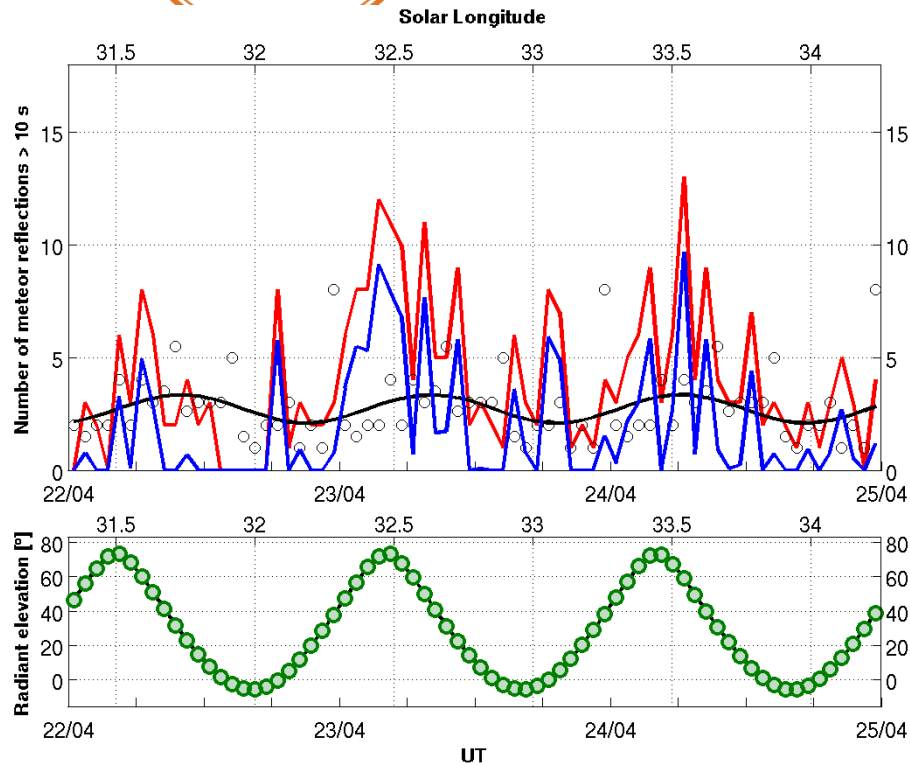
## Quadrantids 2019 ZHR Graph



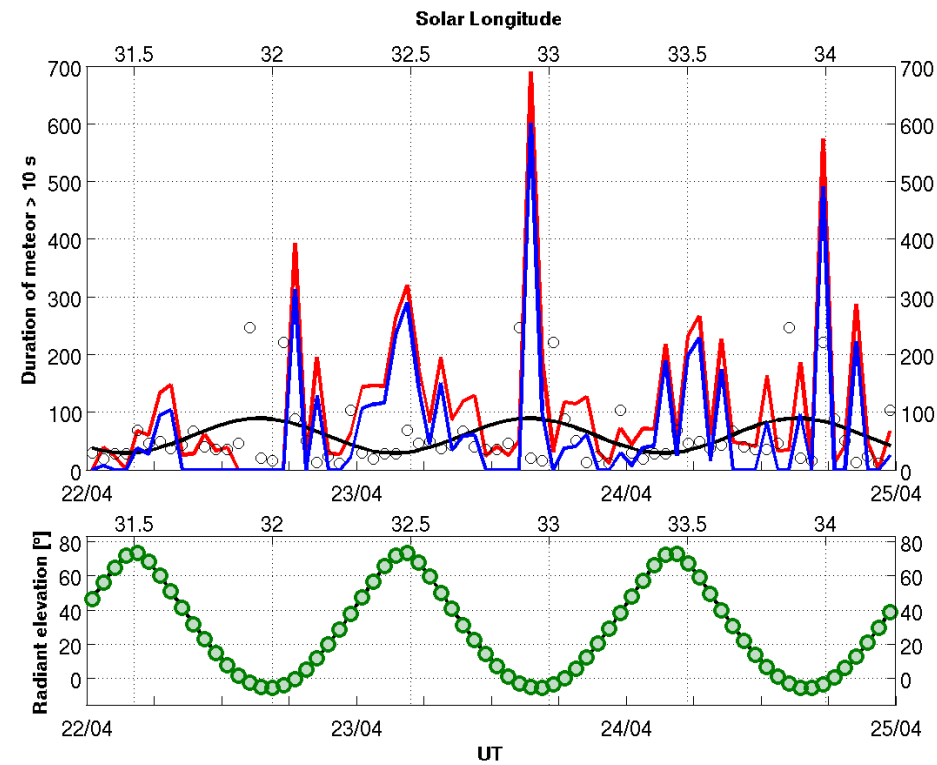
Number of meteor  
reflections > 10 s



# Lyrids 2019



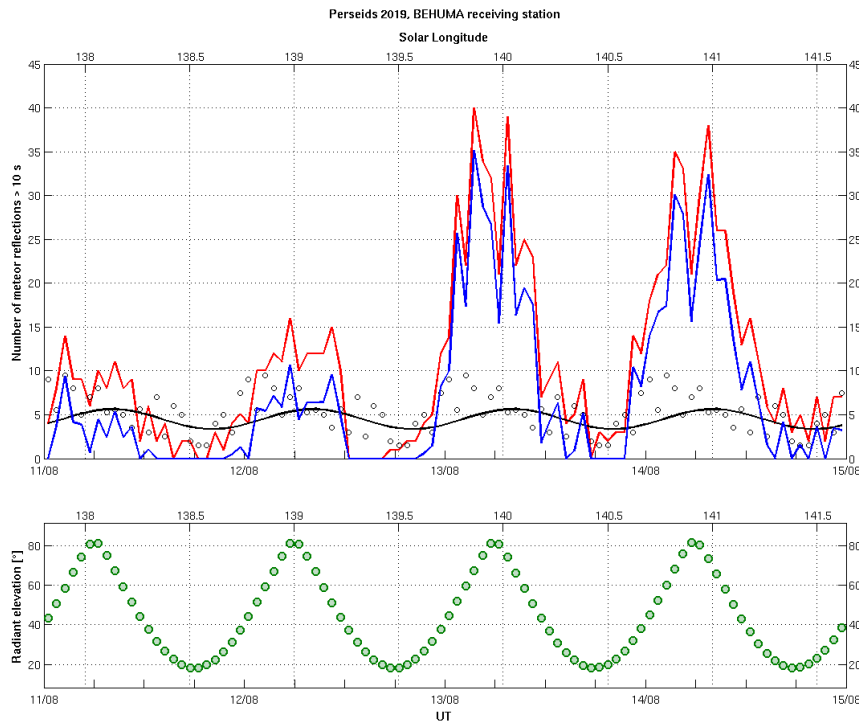
Number of meteor  
reflections > 10 s



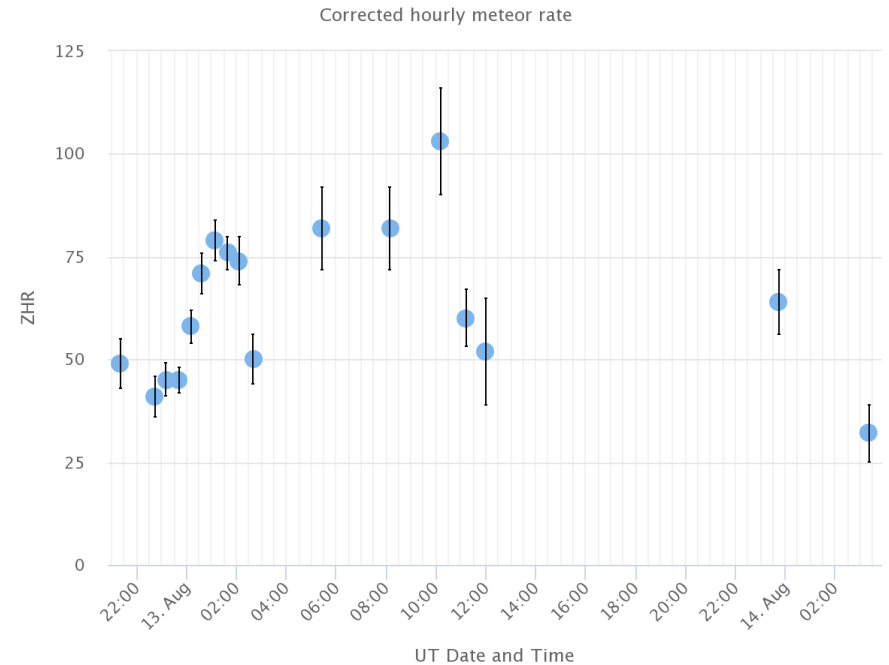
Total duration of meteor  
reflections > 10 s



# Perseids 2019



## Perseids 2019 ZHR Graph – Peak



Highcharts.com

Number of meteor  
reflections > 10 s



# Agenda

- ❖ New results from the RMZ
- ❖ Automatic detection using NNs





# WHAT IS A NEURAL NETWORK?





AlphaGo



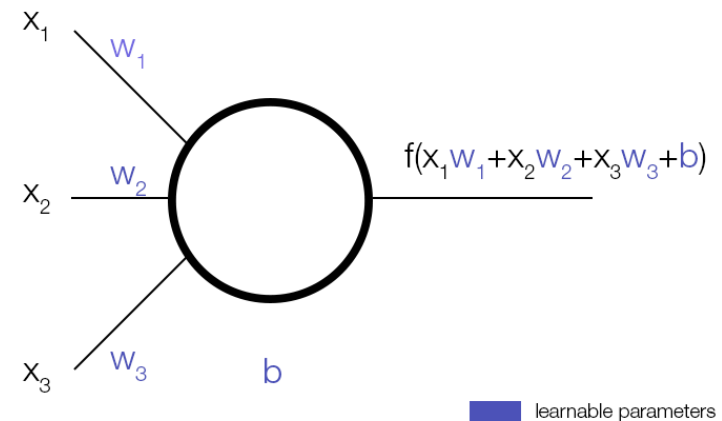
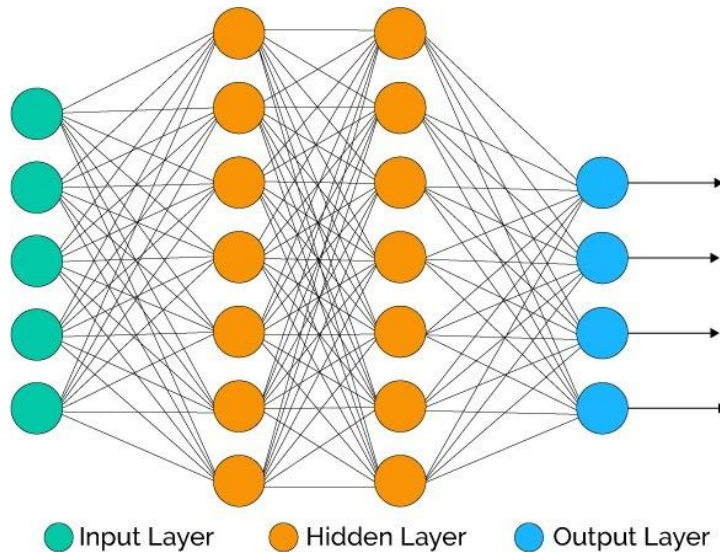
Lee Sedol





# What is a neural network?

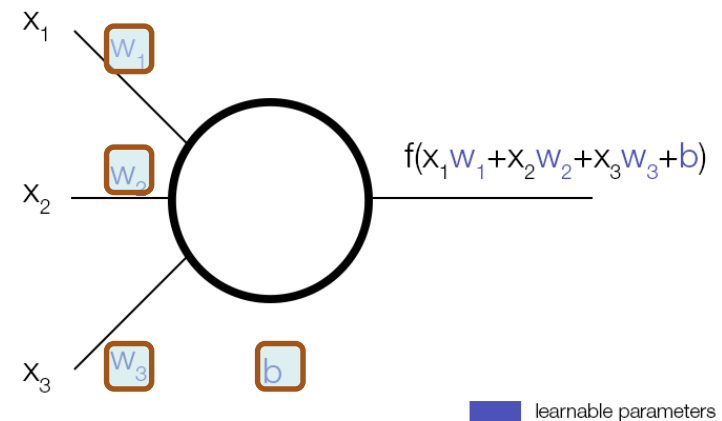
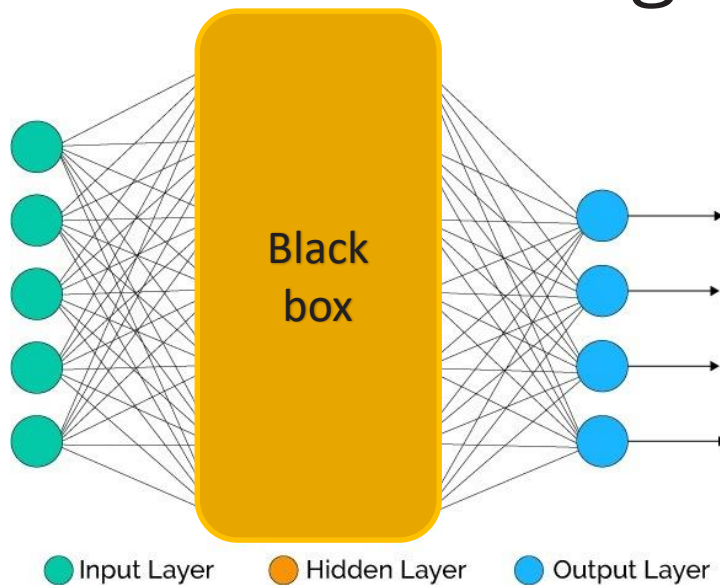
- A convolutional neural network (CNN) is a type of supervised learning often used for image recognition.





# What is a neural network?

- A convolutional neural network (CNN) is a type of supervised learning often used for image recognition.







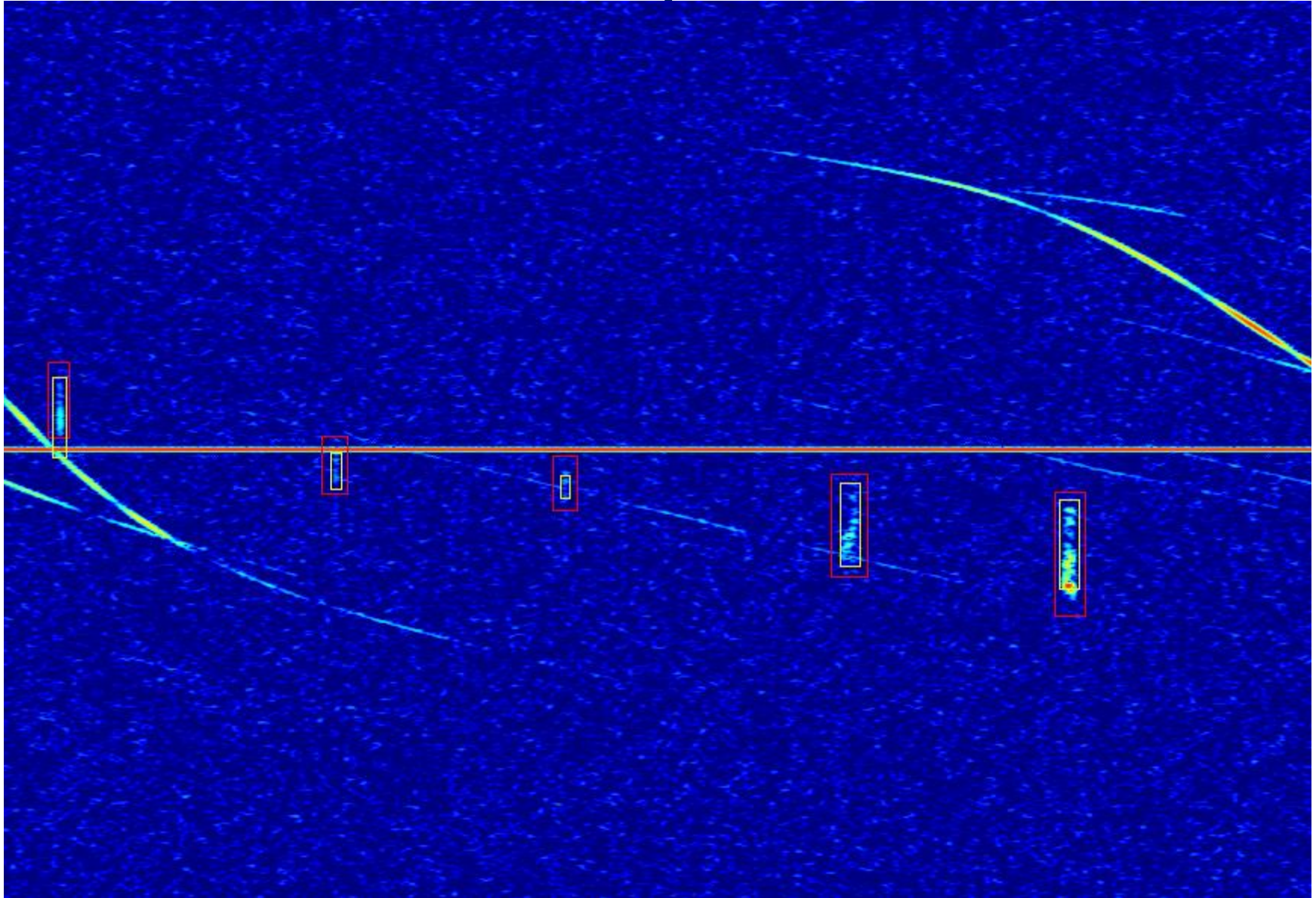
# What is a neural network?

- A convolutional neural network (CNN) is a type of supervised learning often used for image recognition.
- The aggregated classifications from the RMZ volunteers are used to train the CNN.



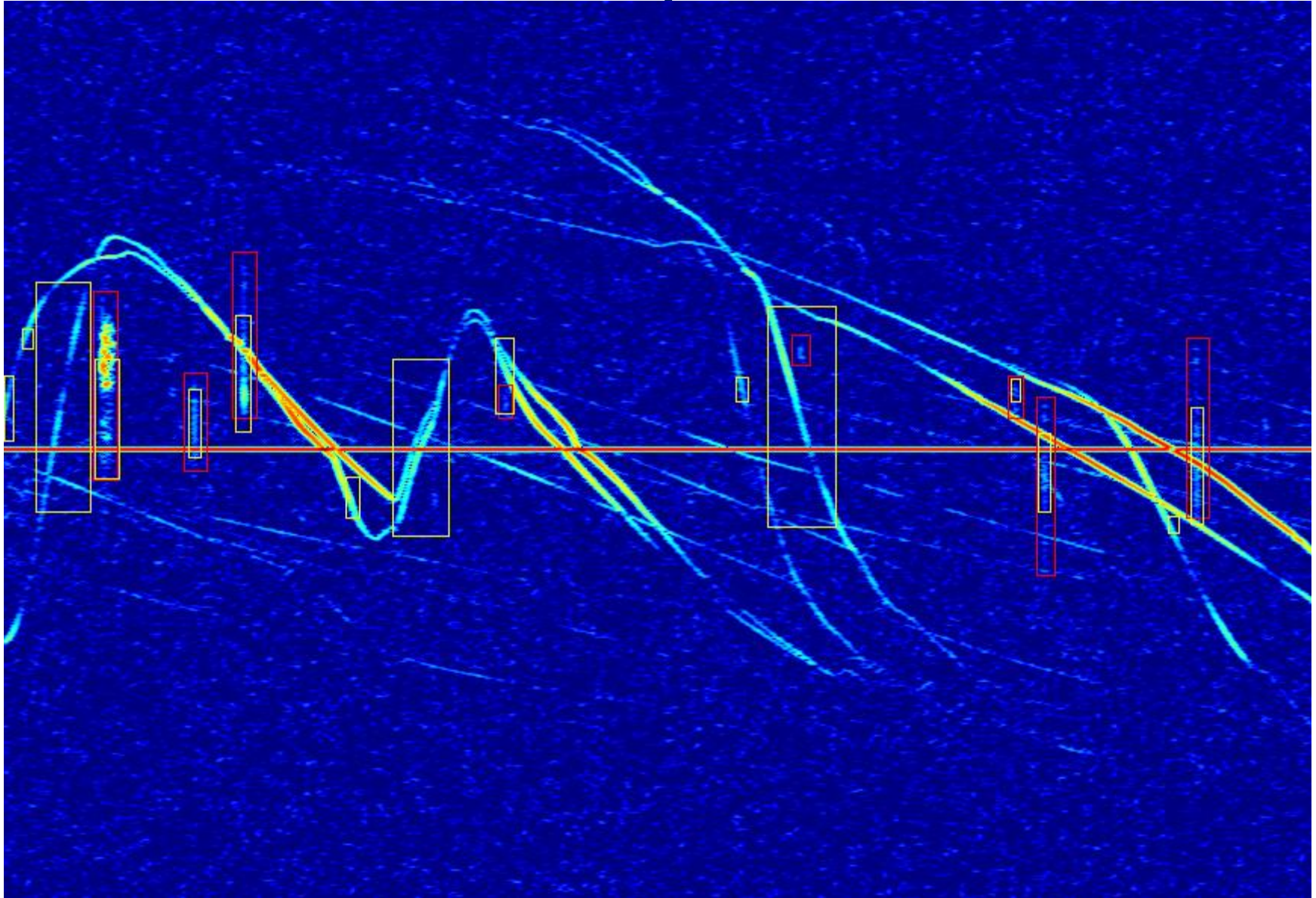
# MEASURING PERFORMANCE

# How well does it perform?



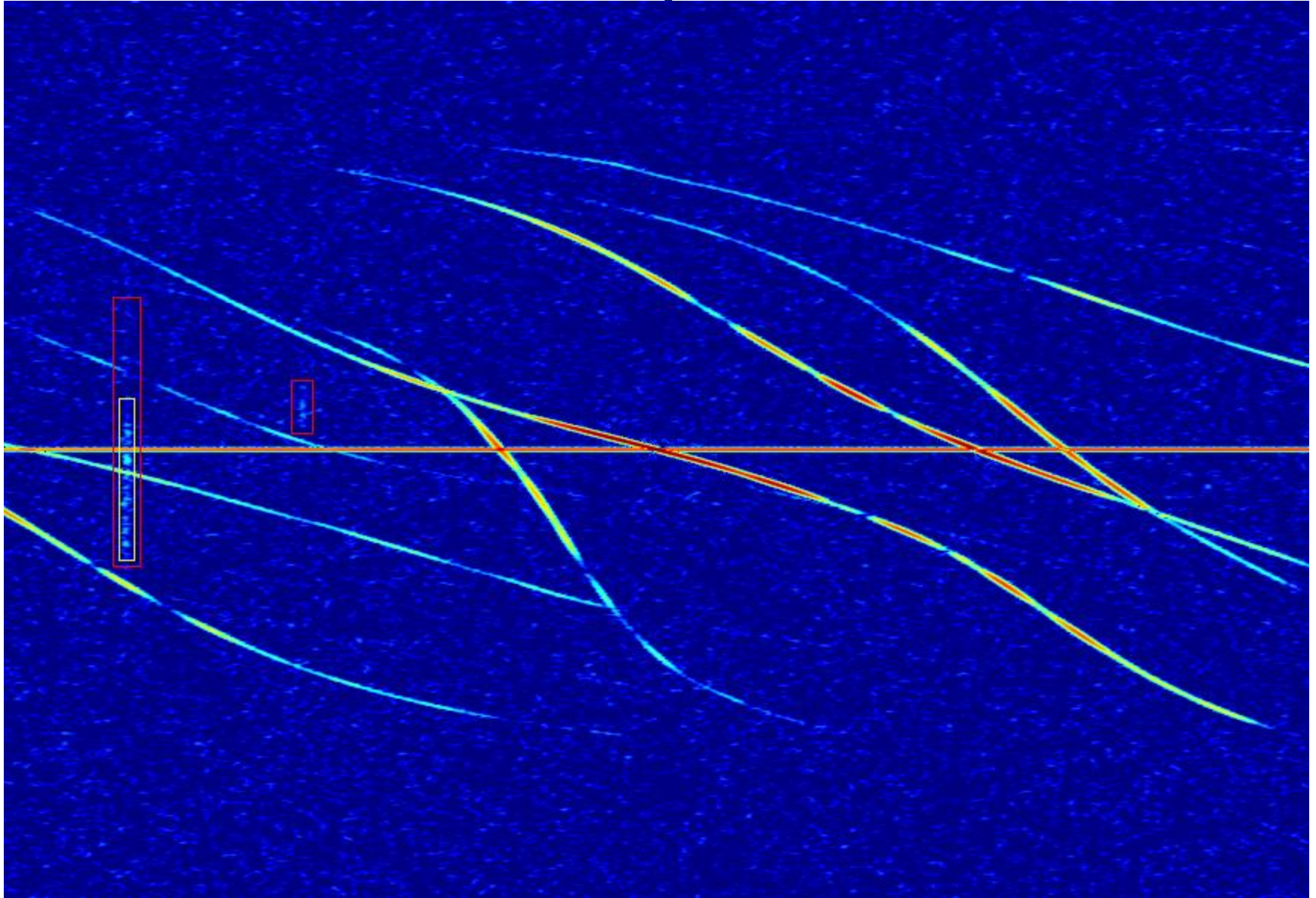


# How well does it perform?





# How well does it perform?





## How do we quantify it?

- 3 distinct data sets: training, test & validation
- We have used expert validation (on an unseen data set of Orionids & Geminids 2018)



## How do we quantify it?

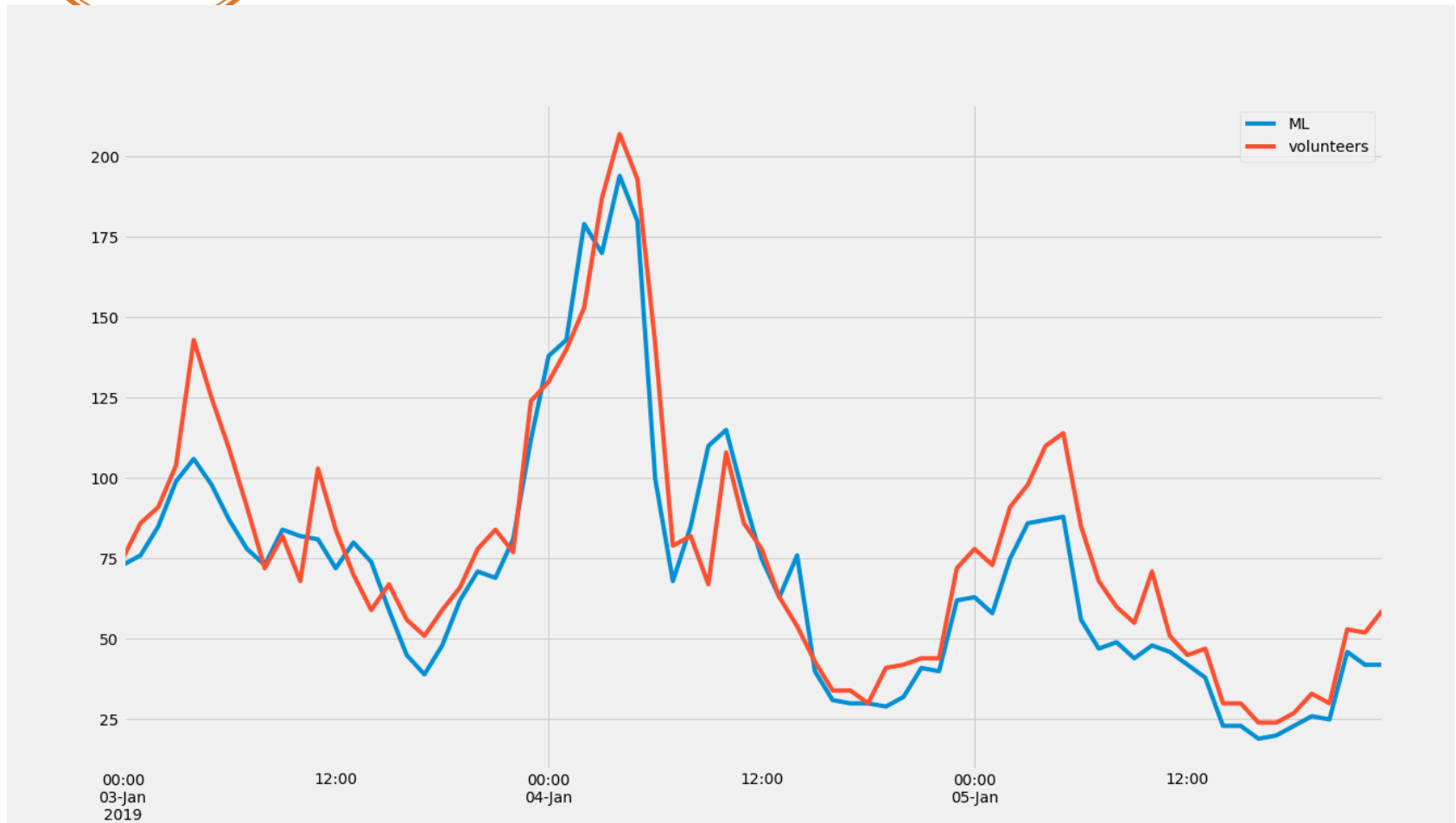
$$Precision = \frac{TP}{TP + FP} = 0,85$$

$$Recall = \frac{TP}{TP + FN} = 0,67$$

$$F1\ score = 2 * \frac{Precision * Recall}{Precision + Recall} = 0,75$$

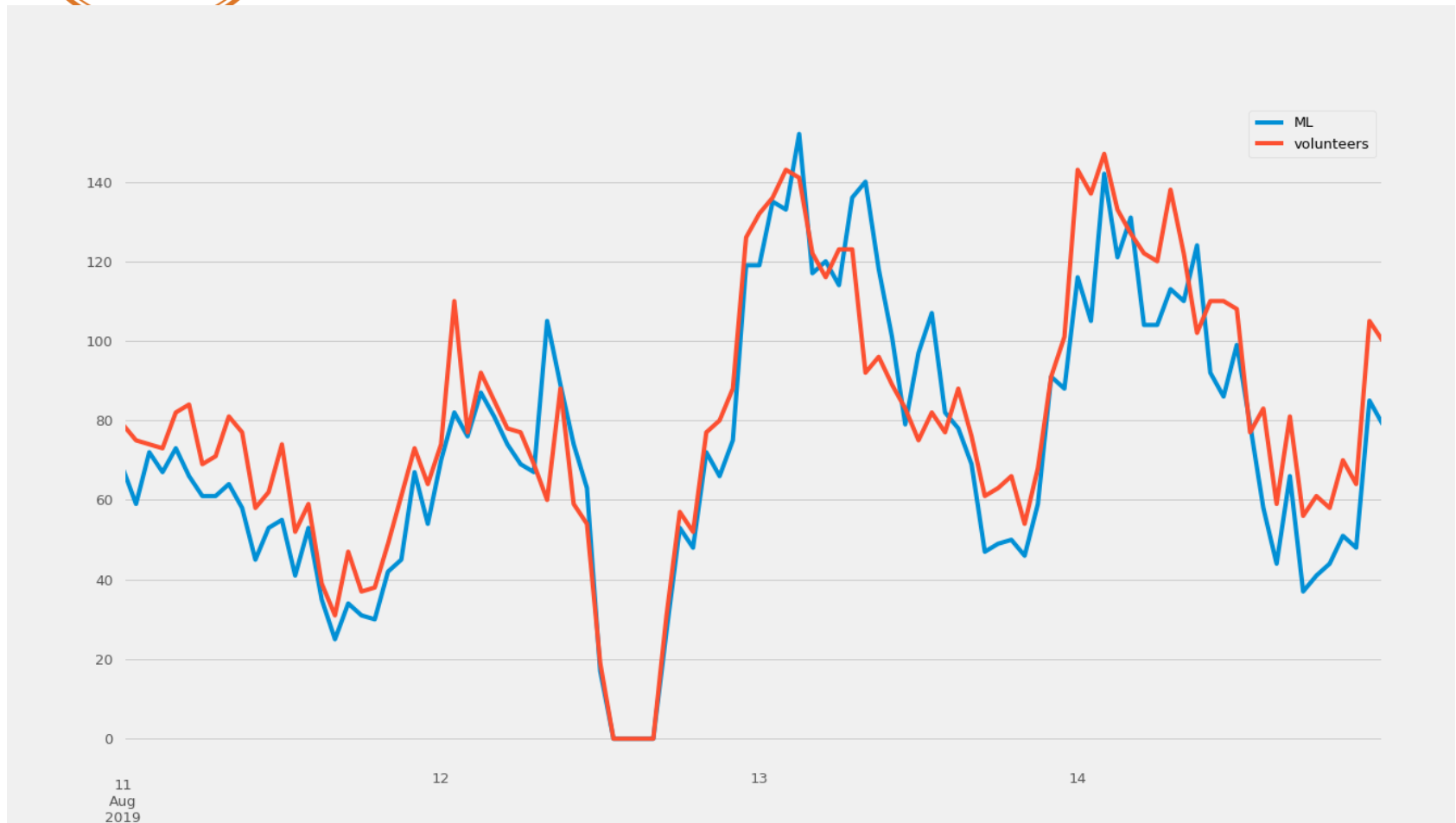


# Quadrantids 2019





# Perseids 2019







# IMPLEMENTATION INTO RMZ



# Implementation into RMZ

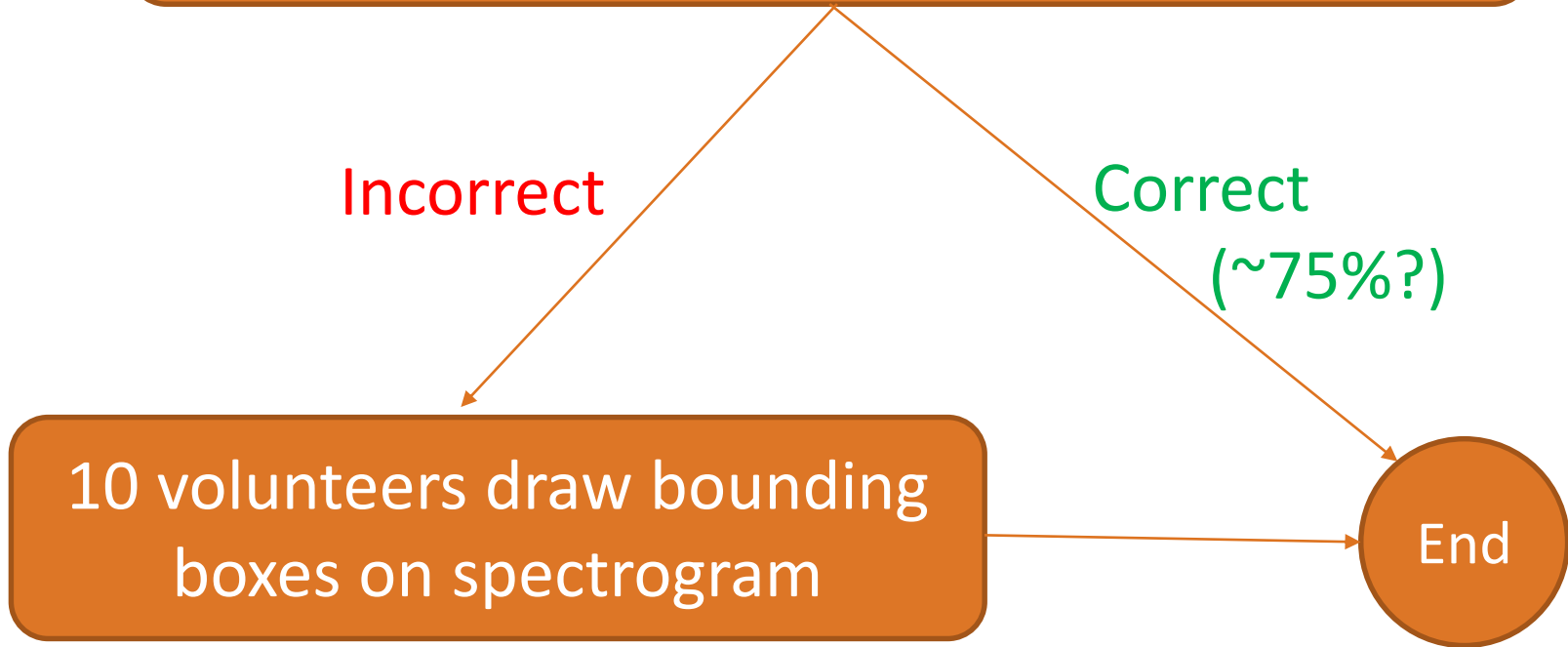
X volunteers verify spectrogram with bounding boxes (from ML algorithm)

Incorrect

Correct  
(~75%?)

10 volunteers draw bounding boxes on spectrogram

End





*still*

**WE  
NEED  
YOU**

<https://www.radiometeorzoo.org/>





THANK YOU!  
MORE INFO?

[www.aeronomie.be](http://www.aeronomie.be)

[Stijn.Calders@aeronomie.be](mailto:Stijn.Calders@aeronomie.be)

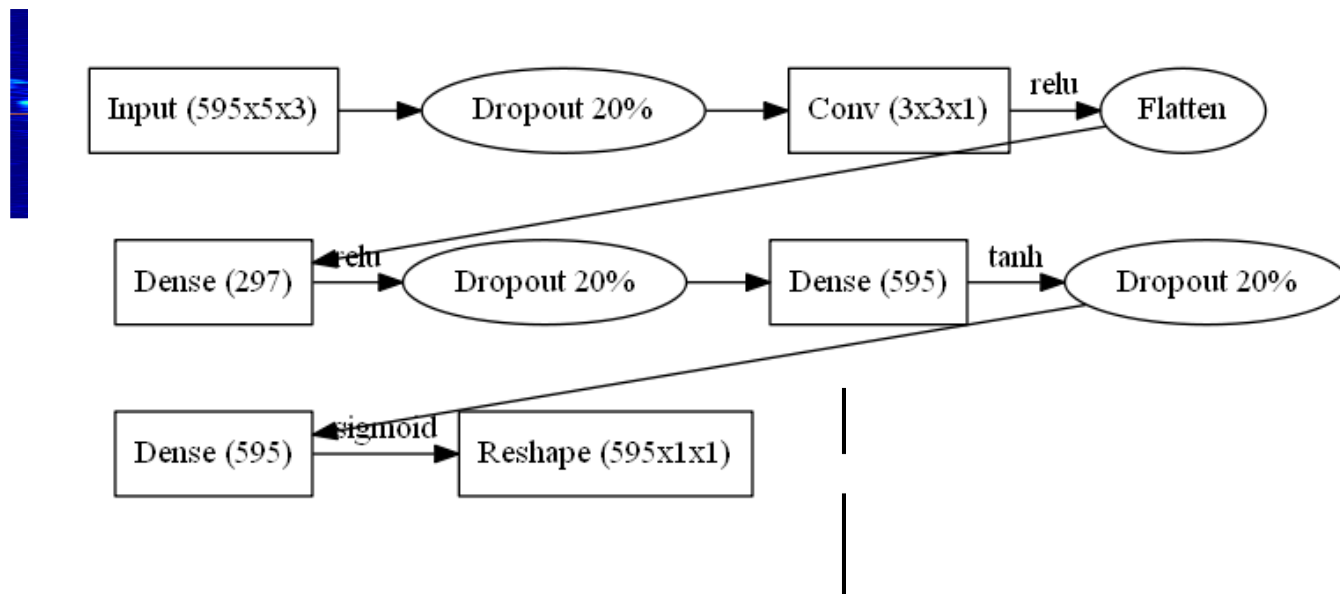




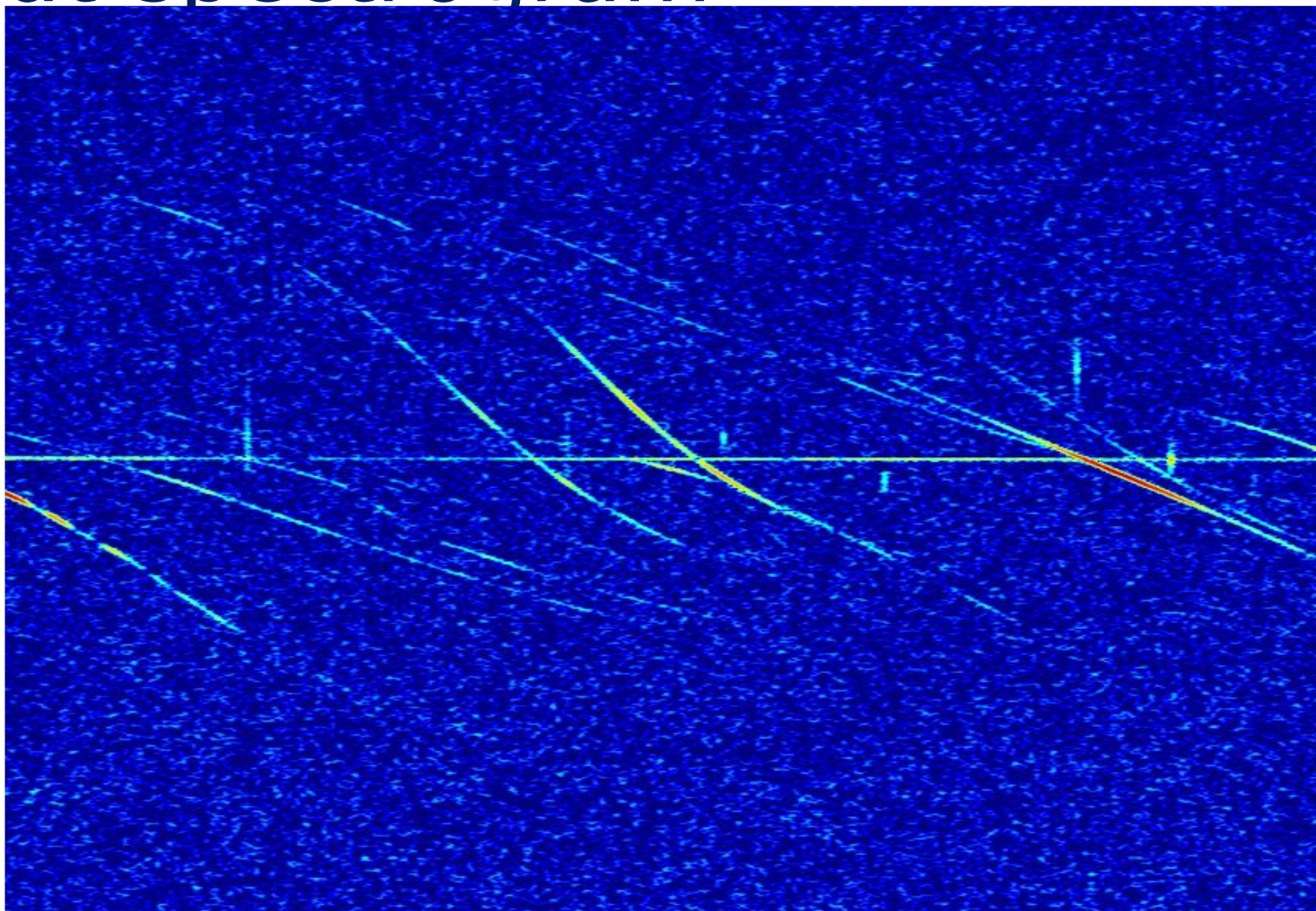
# BACKUP SLIDES



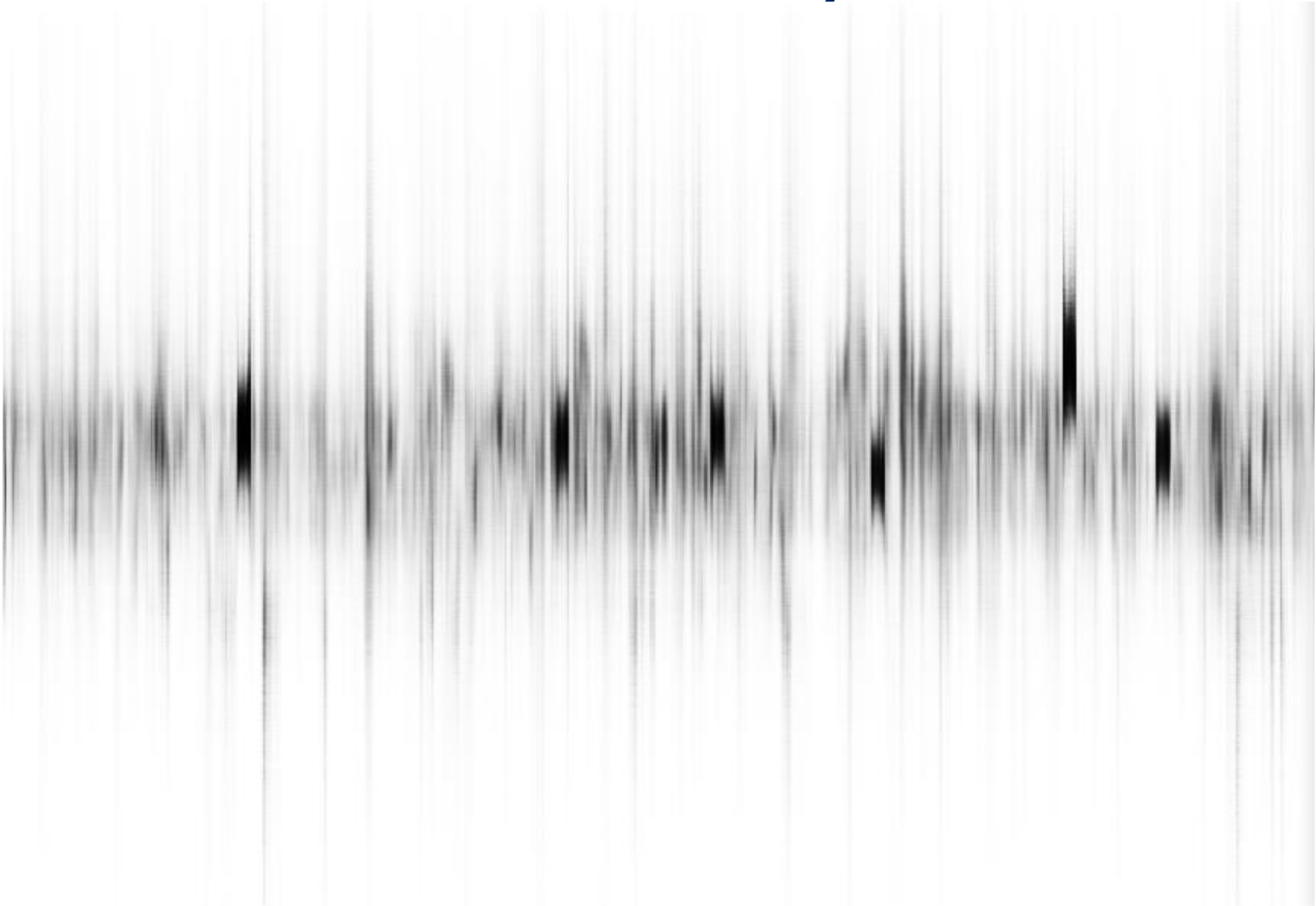
# The CNN developed by Stan Draulans



# Input spectrogram



# Pixel confidence array





After median blur



# After thresholding



# Precision-recall curve

