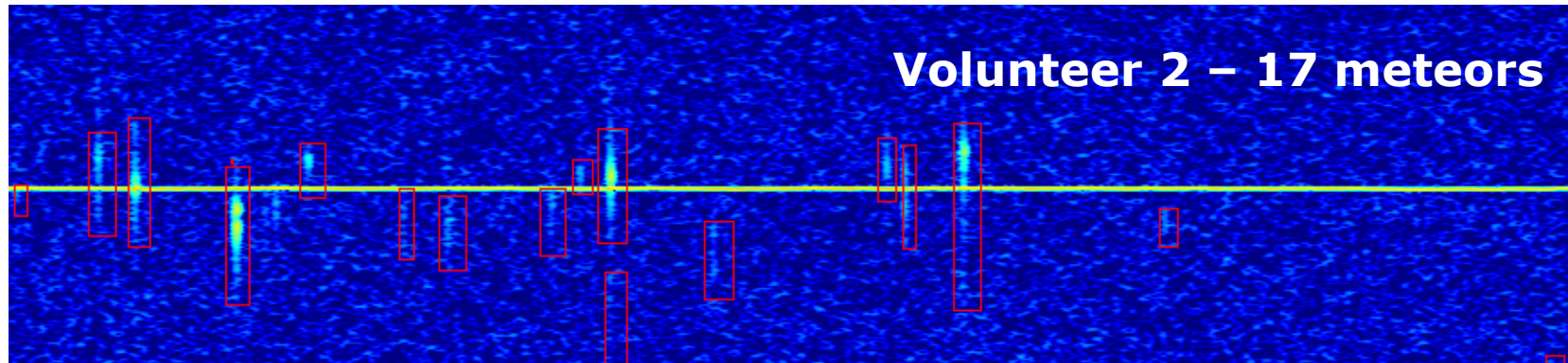
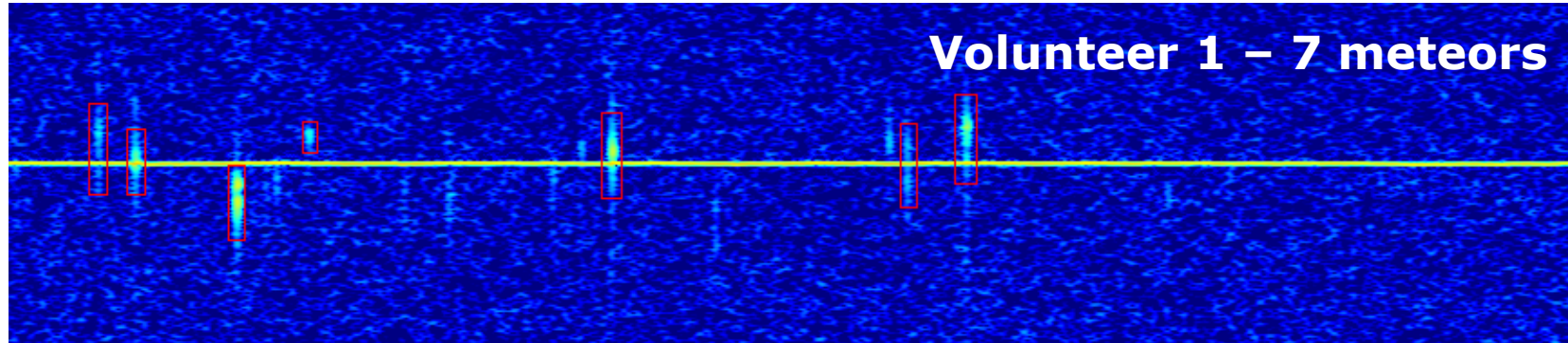


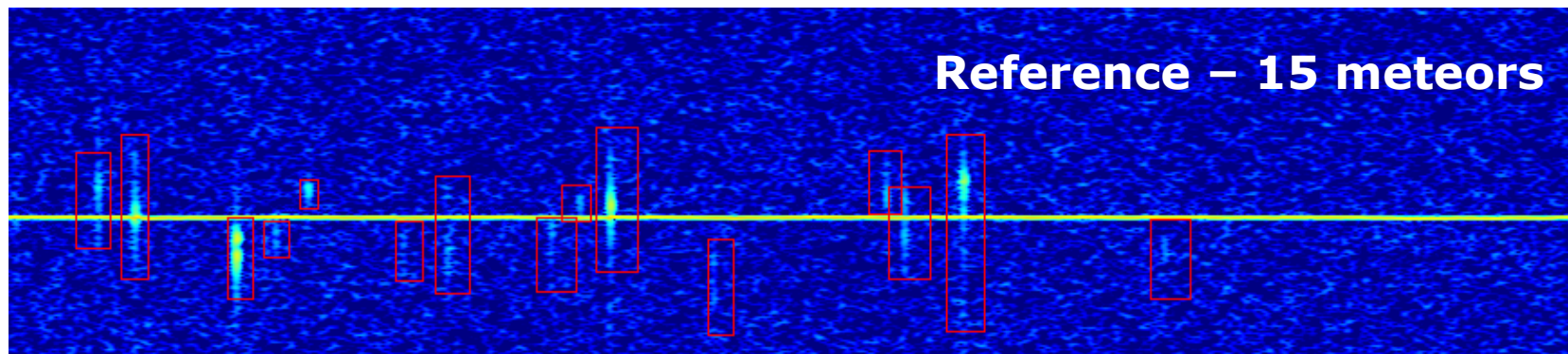
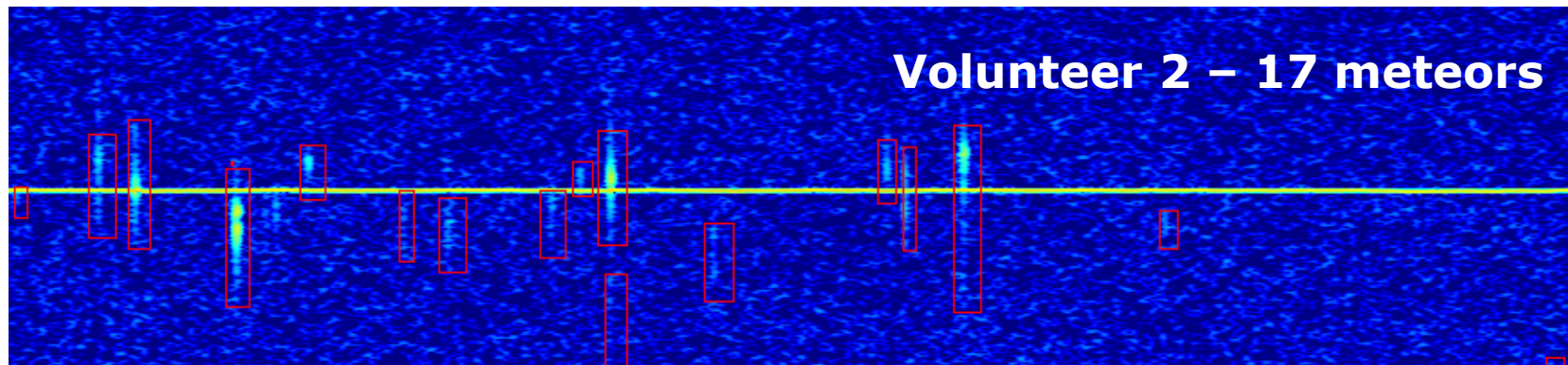
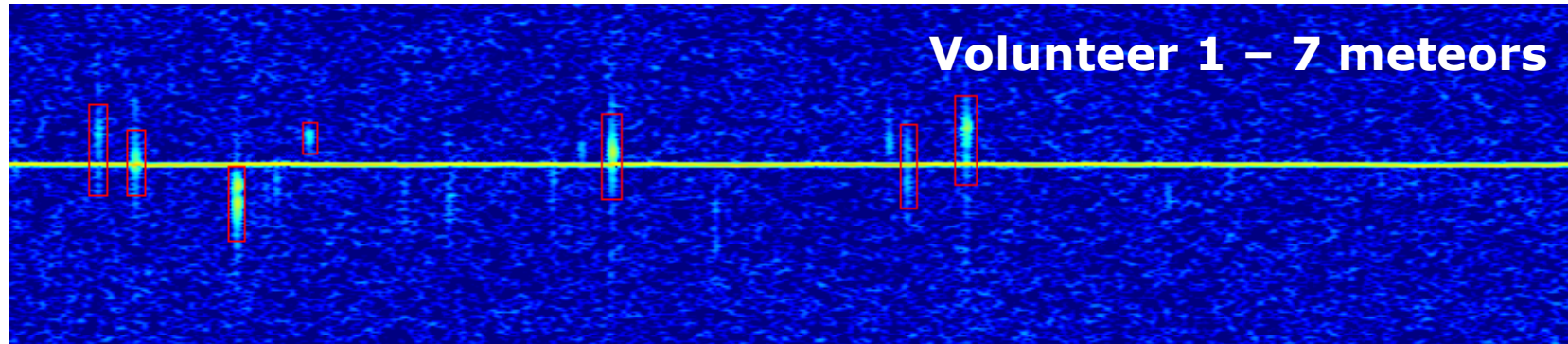
Radio Meteor Zoo

- In 2015, we did a call for volunteers to run a test on 12 spectrograms; 35 people responded
- Questions to answer:
 1. In a given spectrogram, how can we accurately derive the number and position of meteor echoes based on individual contributions?
 2. What is the minimum number of volunteers we need to inspect a given spectrogram such that we can statistically be confident in the results?

Statistical analysis



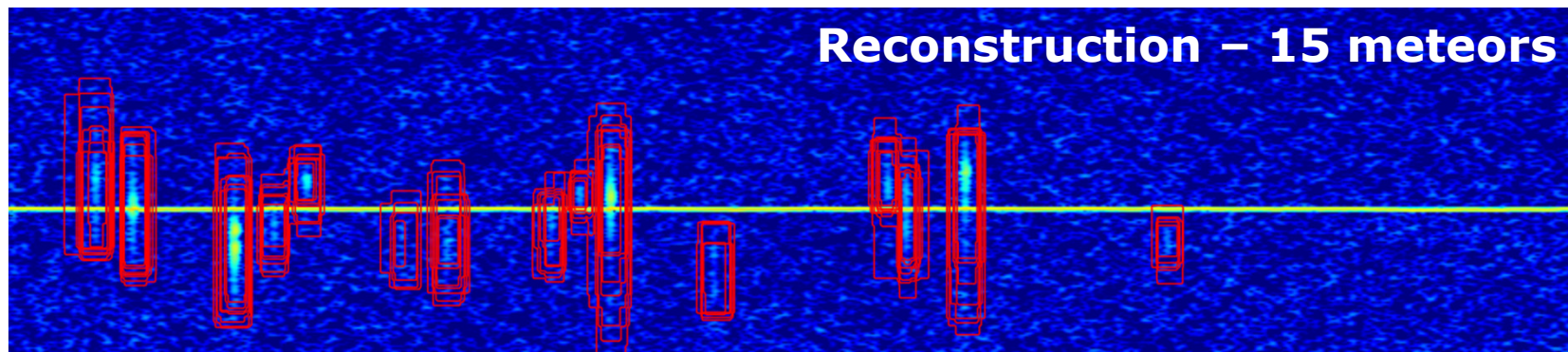
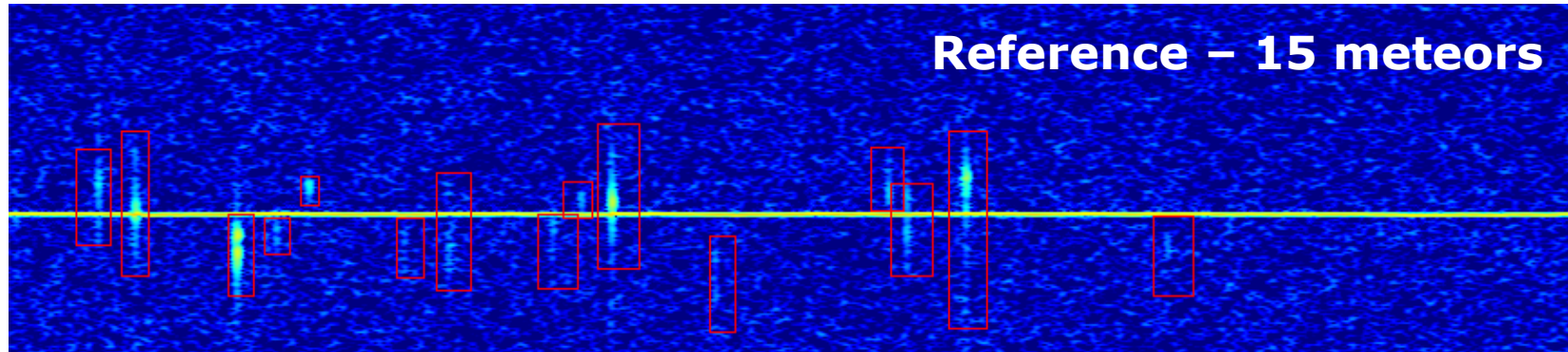
Statistical analysis



Statistical analysis

- Create a binary version of the spectrogram which has value 1 for pixels identified as a meteor pixel in the reference spectrogram, and pixel value 0 for all other pixels.
- Create a binary version of the spectrogram which has value 1 for pixels which were identified as a meteor pixel by at least i volunteers and pixel value 0 for all other pixels.
- Calculate the number $D(i)$ of pixels for which the two binary images have different pixel values
- Repeat for each value of i between 1 and 35 and find the one that minimizes $D(i)$

Statistical analysis

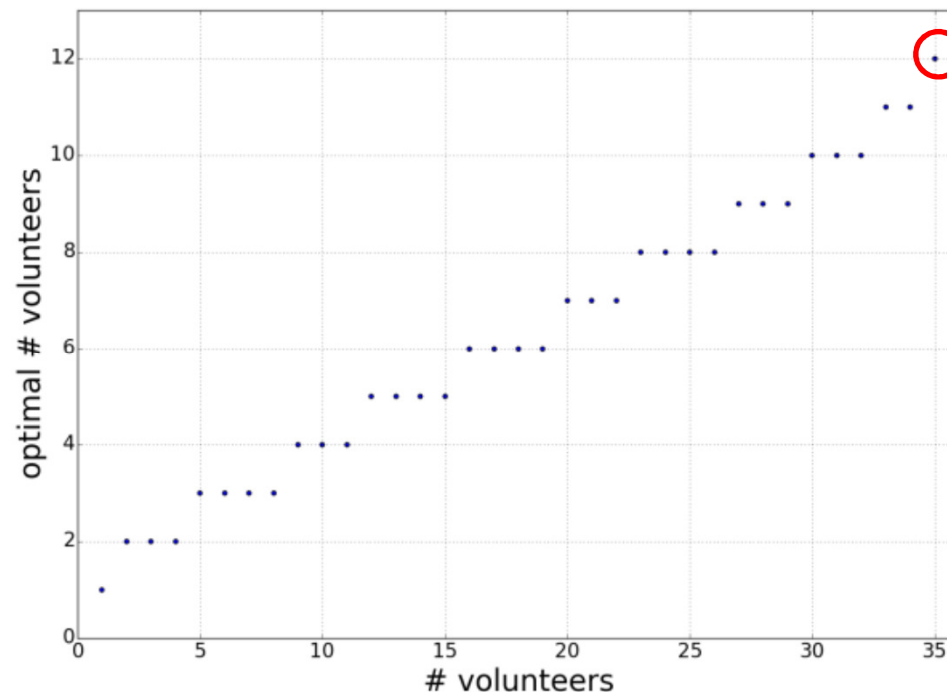


We got best results by assuming a spectrogram pixel belongs to a meteor if **at least 12 persons** have drawn a meteor box around that pixel.

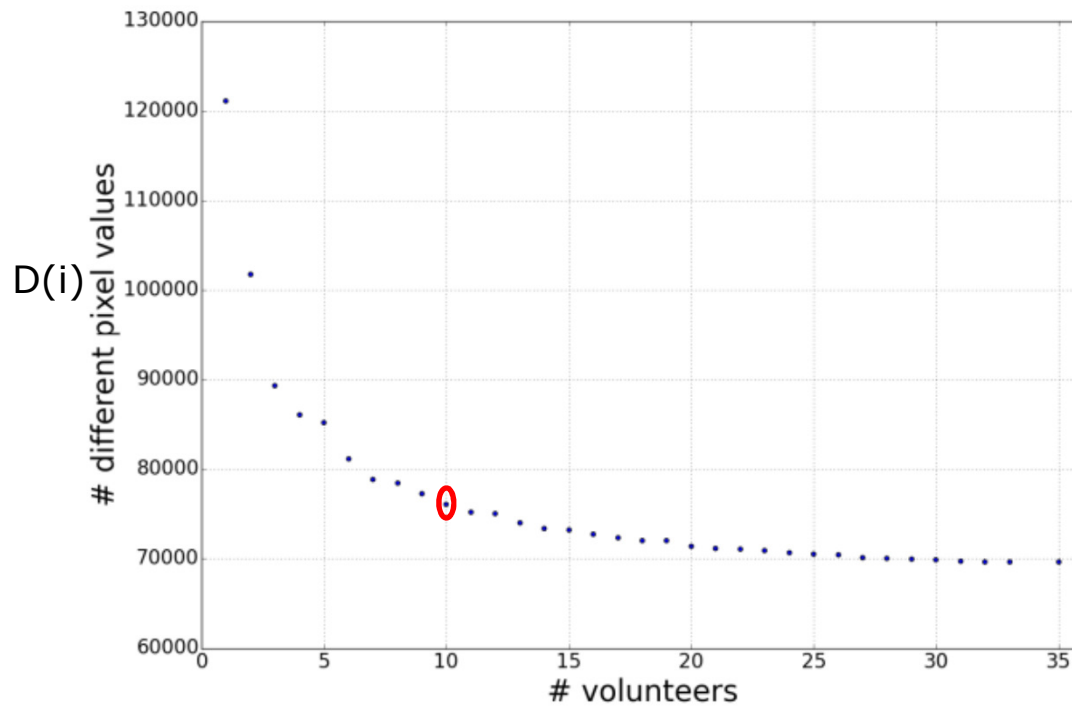
Statistical Analysis

BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY

- So for $n=35$ volunteers, $i=12$ is the optimal value to reconstruct the spectrogram
- For the RMZ, we need a lower value of n ($\gg 12$ spectrograms)
- Same simulations for each value of $n=1,2, \dots, 35$. For every n , we randomly select 1000 combinations of n volunteers among 35.



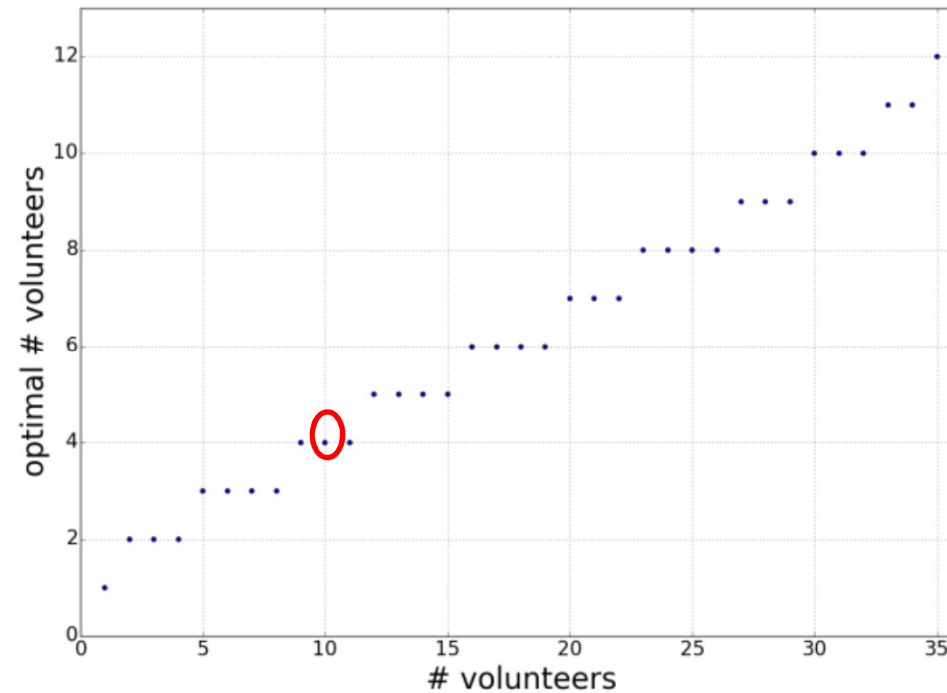
Statistical Analysis



Size of a spectrogram in the 200 Hz range = 595 x 864 pixels.
Total for 12 spectrograms > 6 × 10⁶ pixels

For $n=10$, $D(i)$ is only 9% larger than for $n=35$

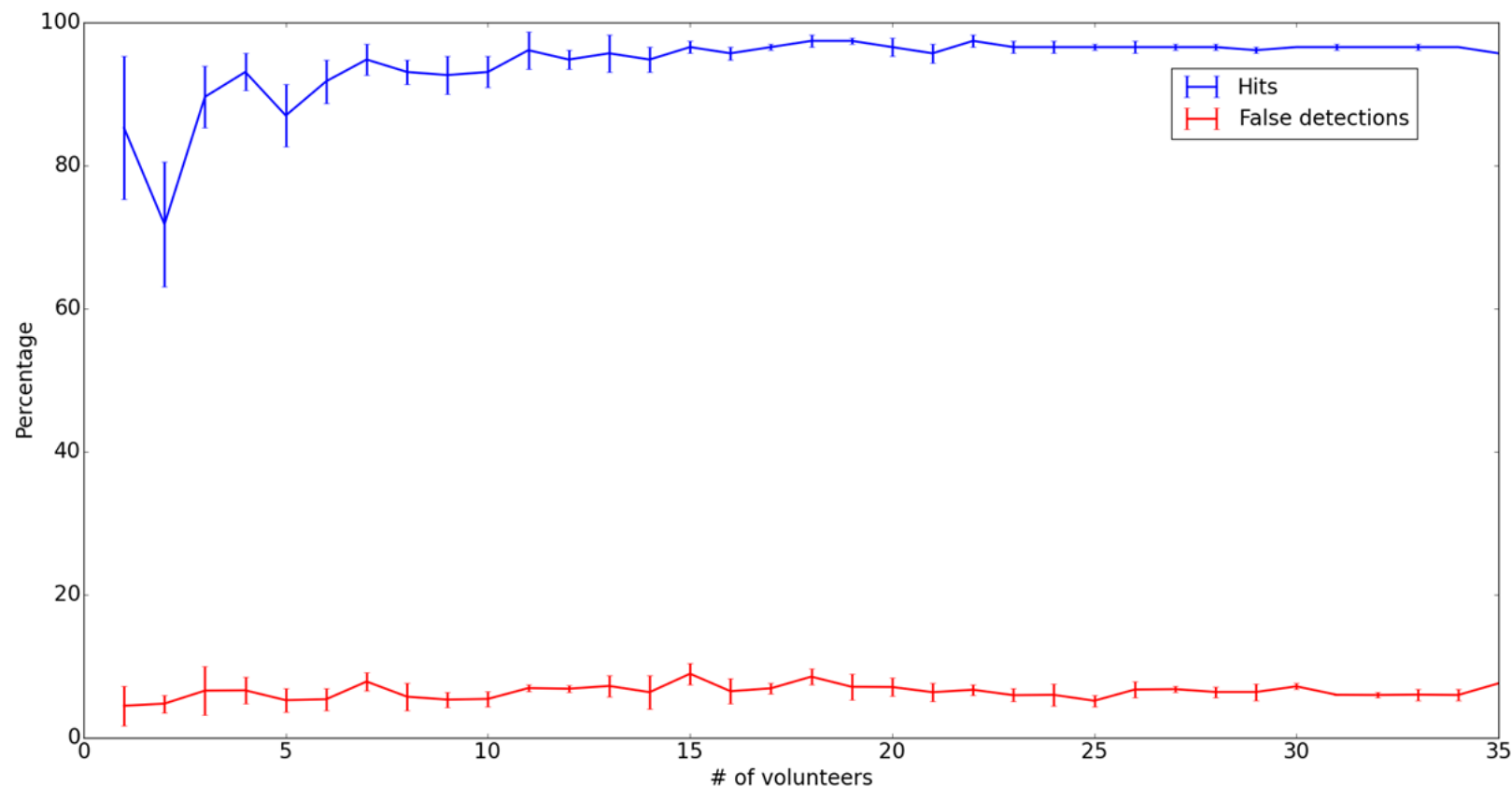
Statistical Analysis



For $n=10$, the optimal value of i for reconstruction is equal to 4

Detection and false detection rates

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Conclusion: with **10 volunteers** we get 95% hits and 6% false detections

12 August 2016: official launch



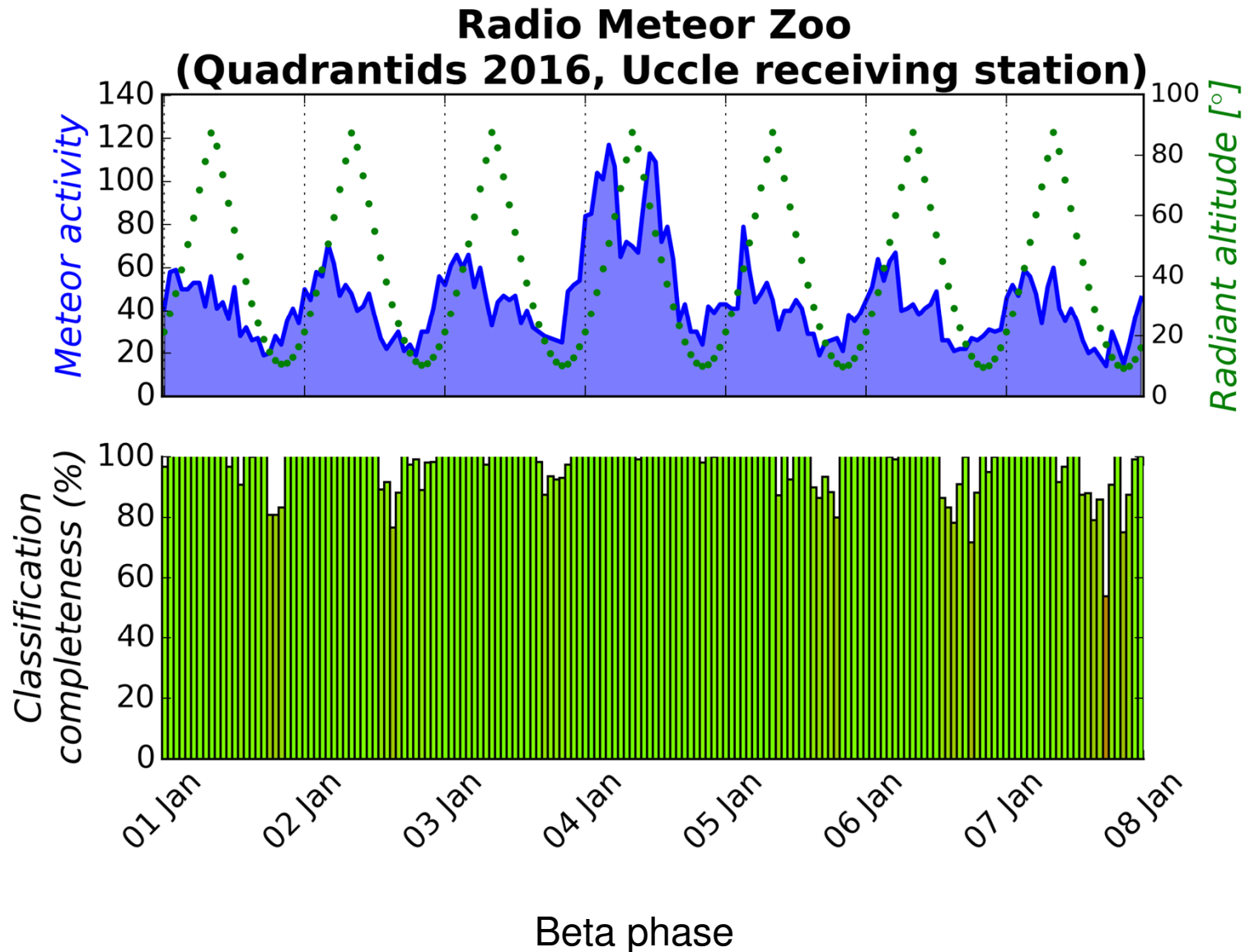
BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERONOMIE SPATIALE DE BELGIQUE BELGIAN INSTITUTE OF SPACE AERONOMY BELGISCH INSTITUUT VOOR RUIMTE-AERONOMIE INSTITUT D'AERON

A screenshot of a Zooniverse project interface. The background is a dark image of a tree and a body of water. The interface includes a top navigation bar with 'Projects', 'About', 'Talk', 'Notifications', 'Collect', and 'BUILD A PROJECT'. A user profile for 'Stijn Calders' is visible in the top right. Below the navigation, the project name 'RADIO METEOR ZOO' is shown, along with tabs for 'ABOUT', 'CLASSIFY' (which is active), 'TALK', and 'PROJECT WEBSITE'. The main area displays a large rectangular field of blue dots representing meteor echoes. Several curved lines in cyan and yellow are drawn across the dots, indicating potential meteor paths. On the right side, there is a control panel with the instruction 'Draw a rectangle around each potential meteor echo.' Below this, there is a 'rectangle tool' button with a '0 drawn' counter. A 'Need some help with this task?' button is also present. At the bottom of the control panel, there are 'Done & Talk' and 'Done' buttons, and a 'Show the project tutorial' button. At the very bottom of the screenshot, there is a small disclaimer: 'This project has been built using the Zooniverse Project Builder but is not yet an official Zooniverse project. Queries and issues relating to this project directed at the Zooniverse Team may not receive any response.'

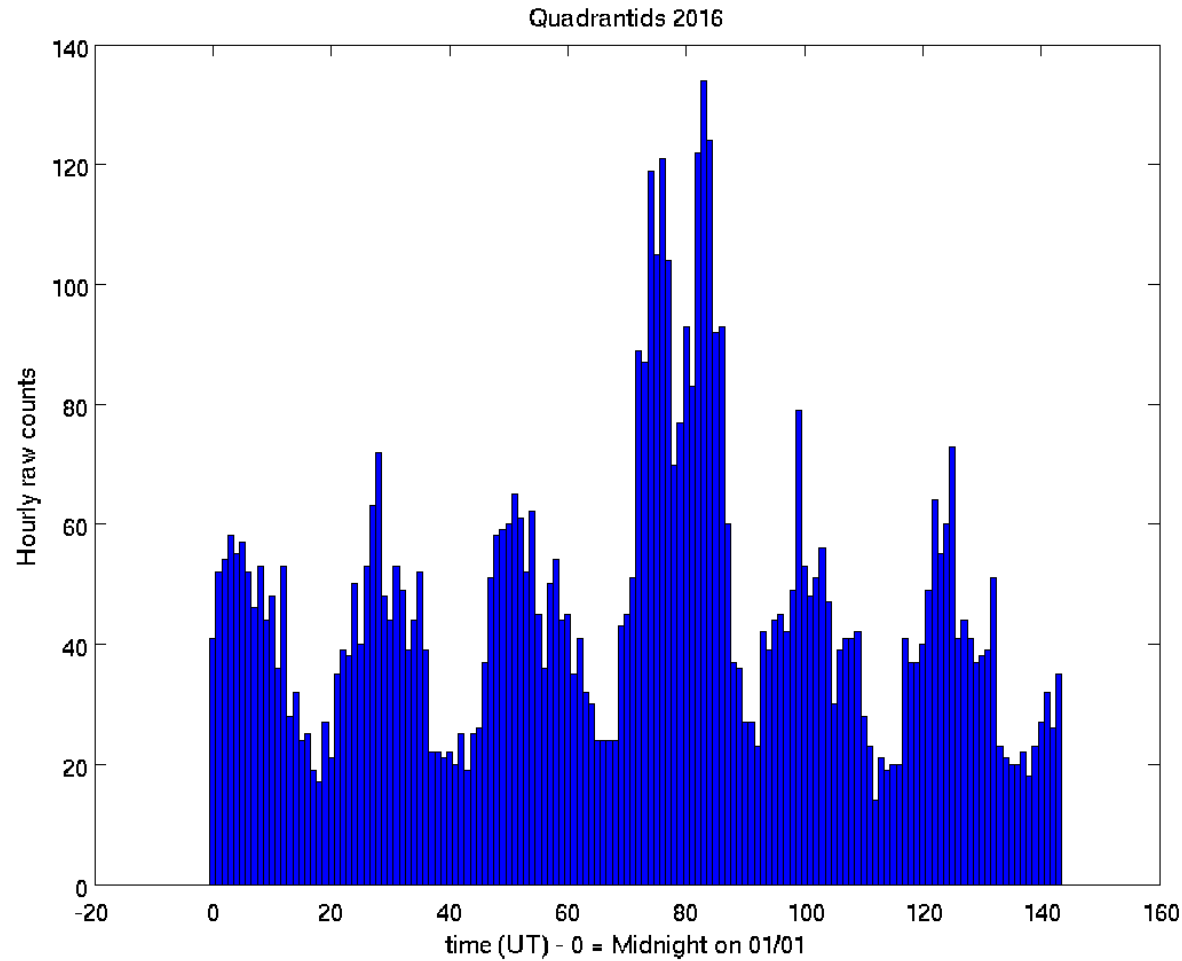
Some numbers

- 2276 volunteers
- 106.383 classifications
- 19.739 images
- Processed stations:
 - Humain
 - Ottignies
 - Overpelt
 - Uccle

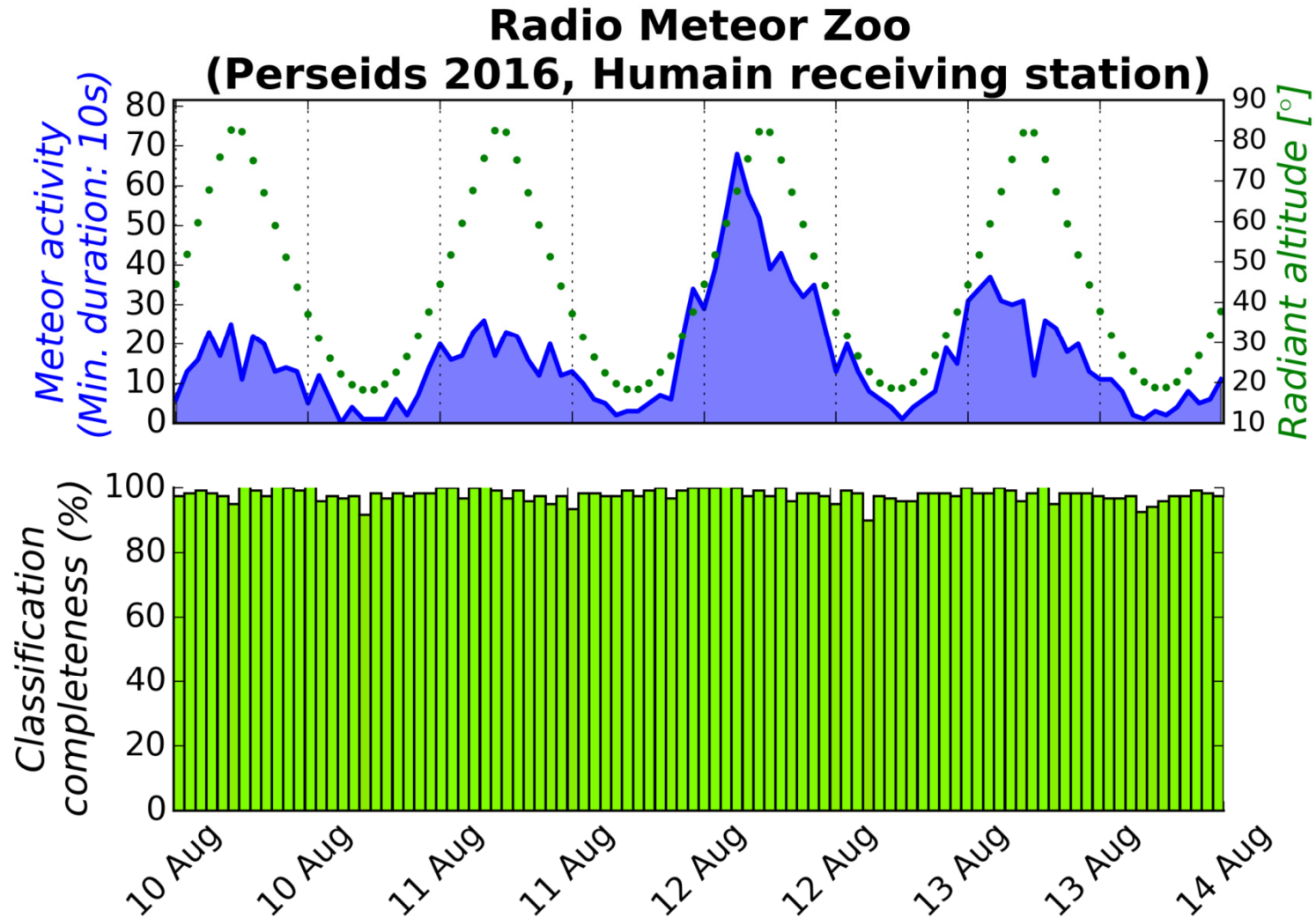
Results: Quadrantids 2016



Results: Quadrantids 2016



Results: Perseids 2016




Perspectives

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- More data to analyze
- Aggregate method for rectangles okay during quiet periods. Underestimate number of meteor echoes when they overlap (case with many overdense echoes close to the activity peak)
- Give weights to users
- Next call during the Geminids



Thank you for your attention!

<http://www.radiometeorzoo.be>

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