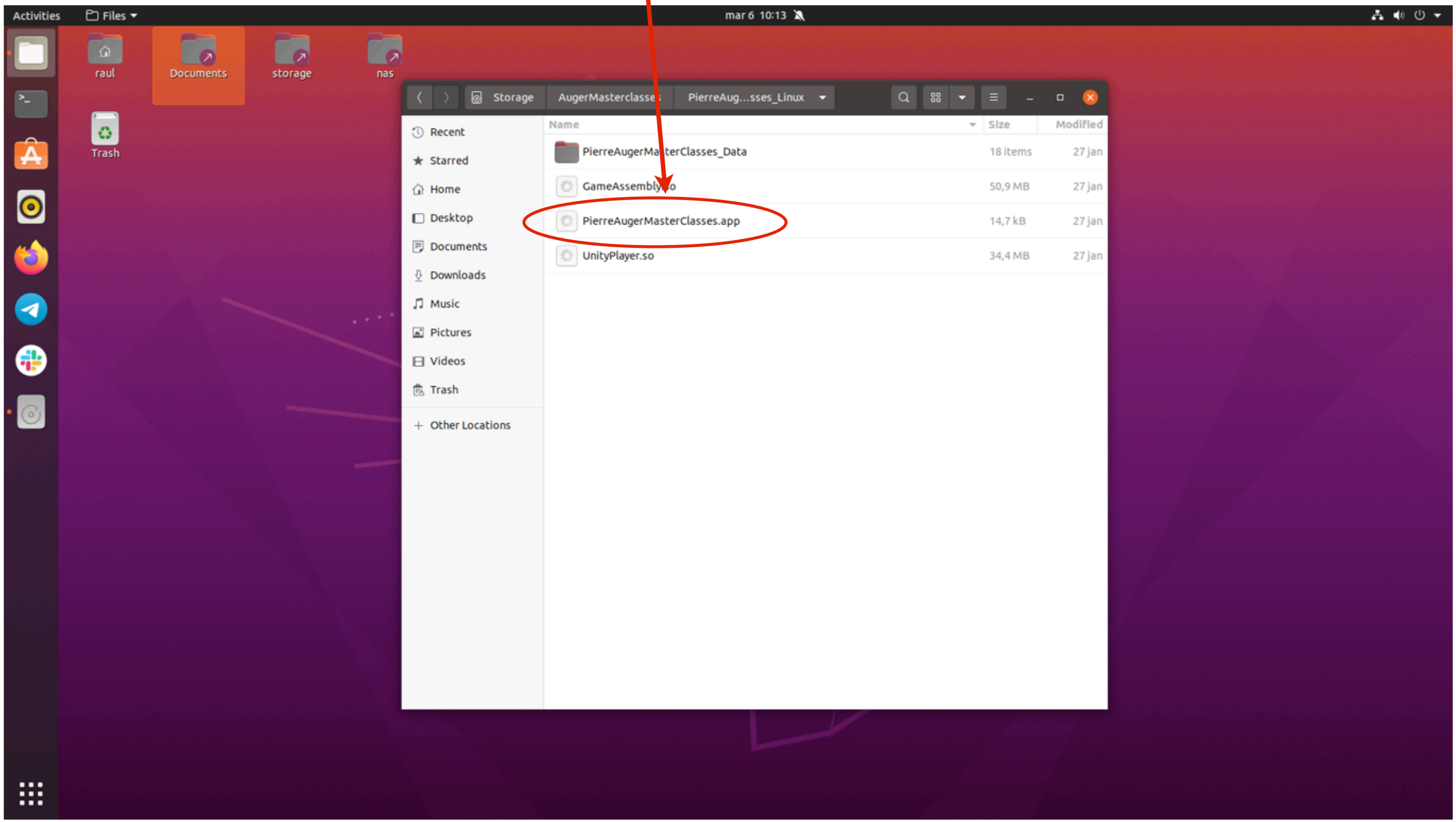
Masterclasses with the Pierre Auger Observatory

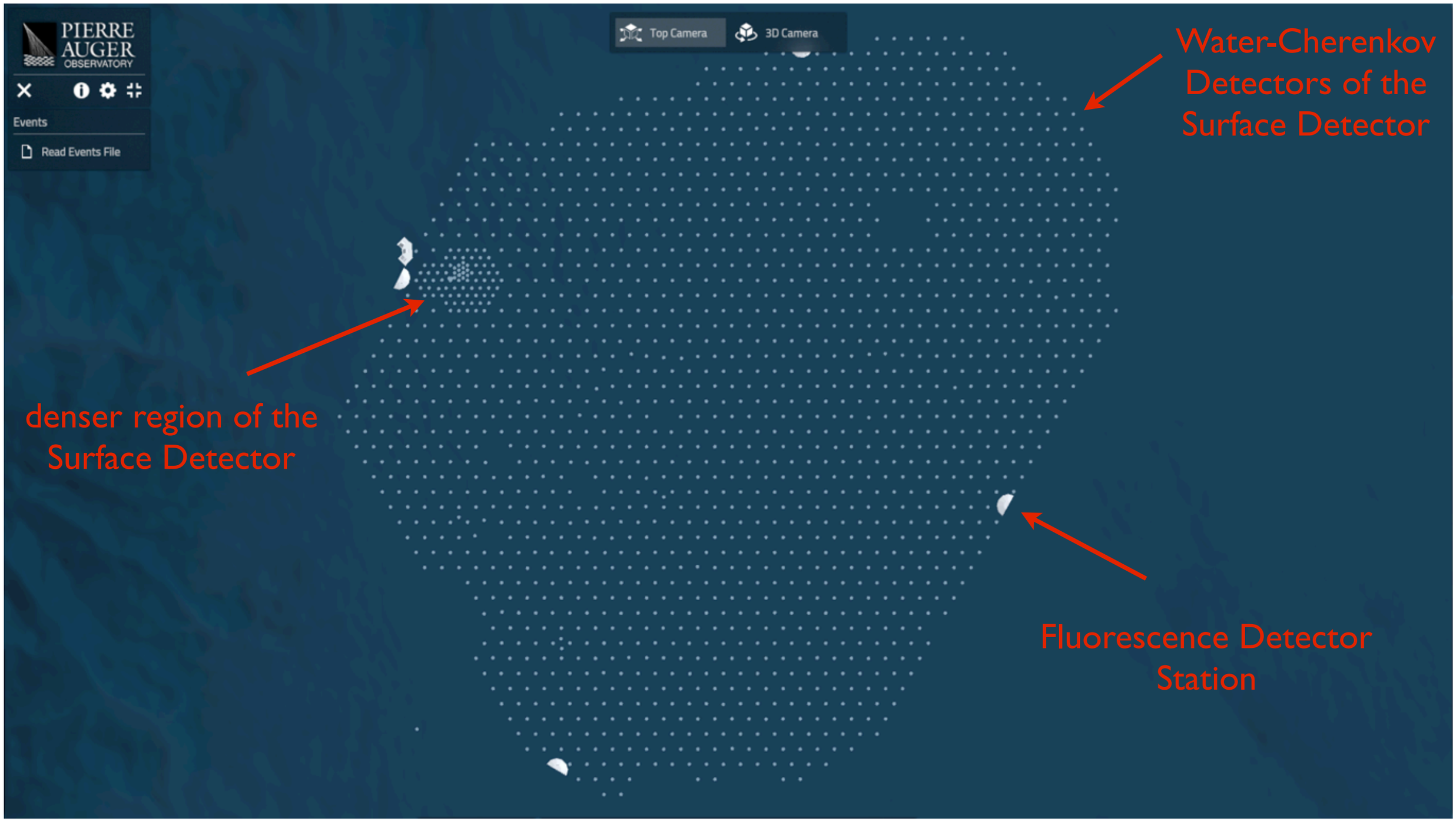
Tutorial of the Experimental Activity

- Download the software at https://augermasterclasses.lip.pt/downloads

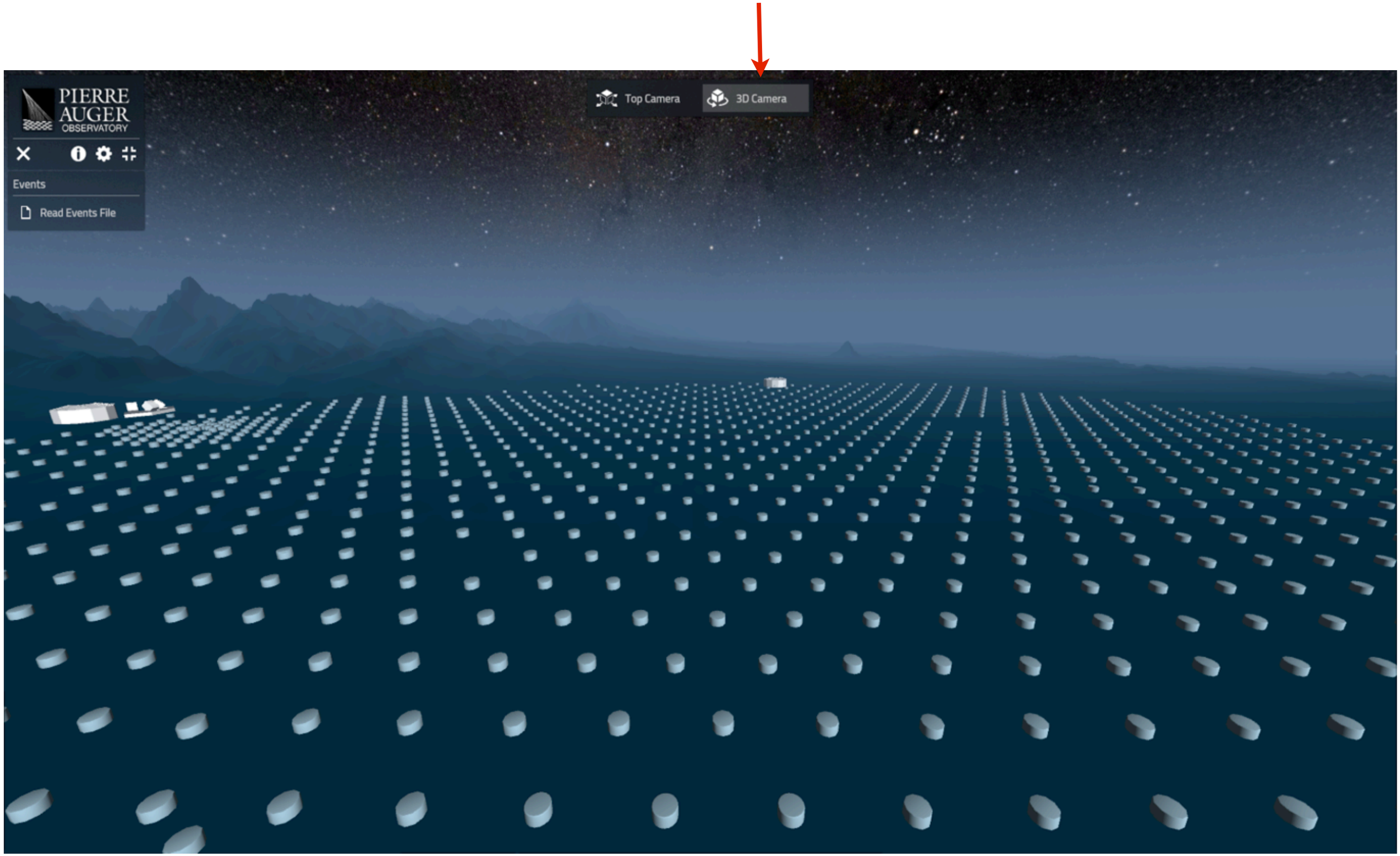
- Execute the data analysis interface application



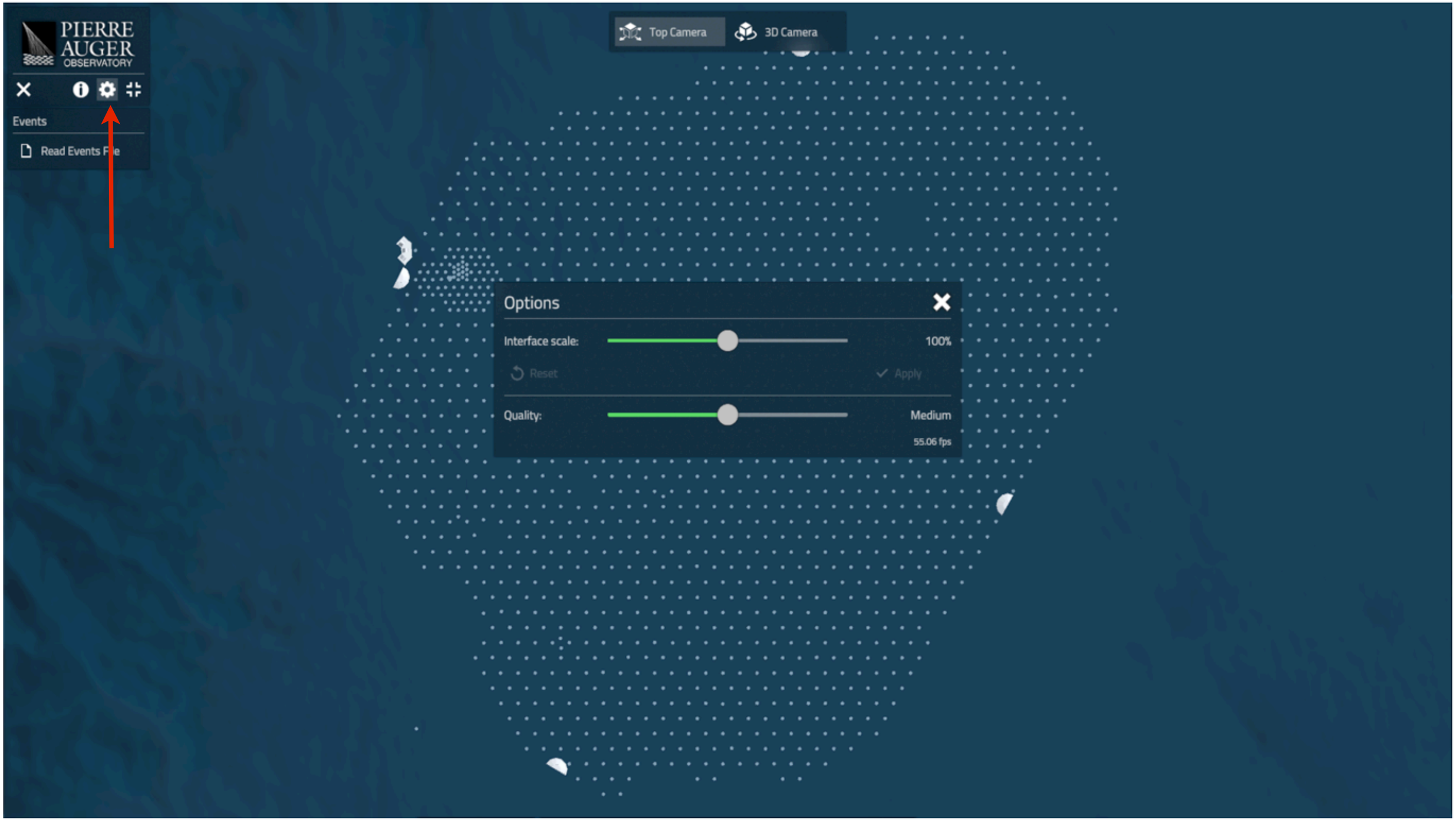
- Top view of the Pierre Auger Observatory



- Possibility to switch to 3D view

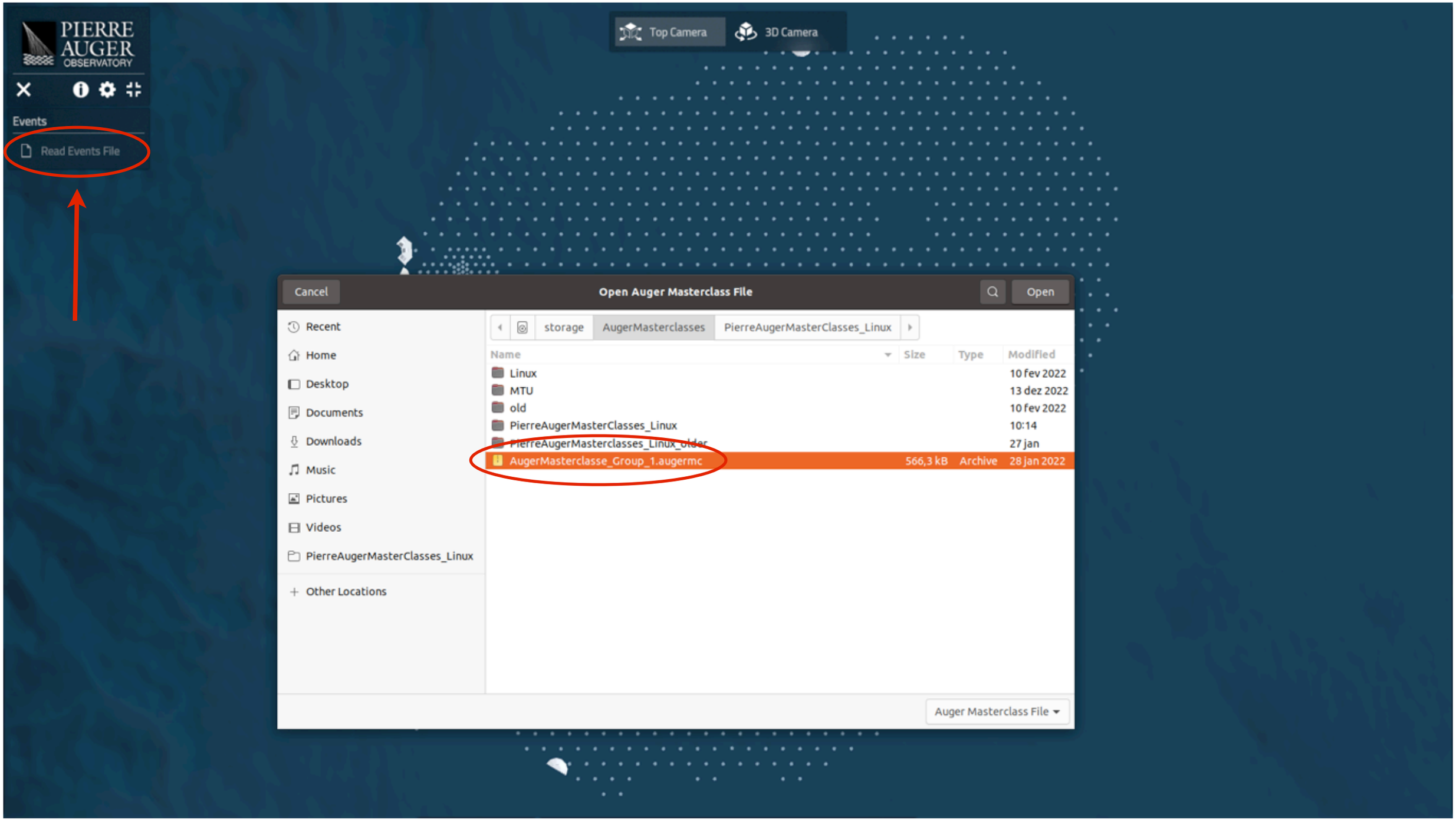


- Configuration options to adjust the interface scale and the quality



- The datasets are downloaded from https://augermasterclasses.lip.pt/downloads

- Then, open the file with the dataset of events



Left panel: list of 50 events to analyze

- For the selected event, the surface detector stations that have particles have color

Right panel:

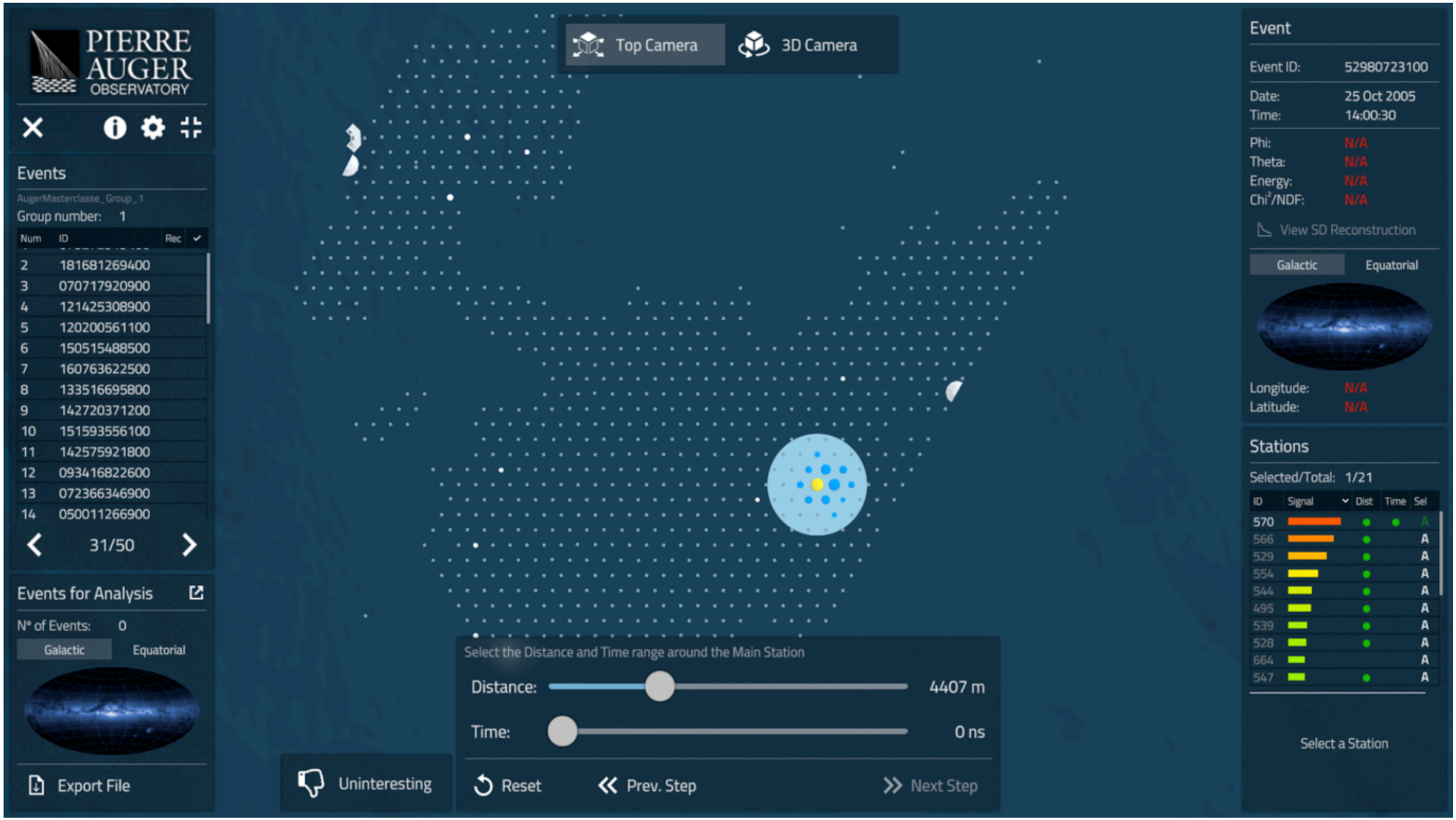
- event info
- reconstruction info
- stations of the event info

Step 1: select the stations of the event

- Start by clicking on the station with the highest signal

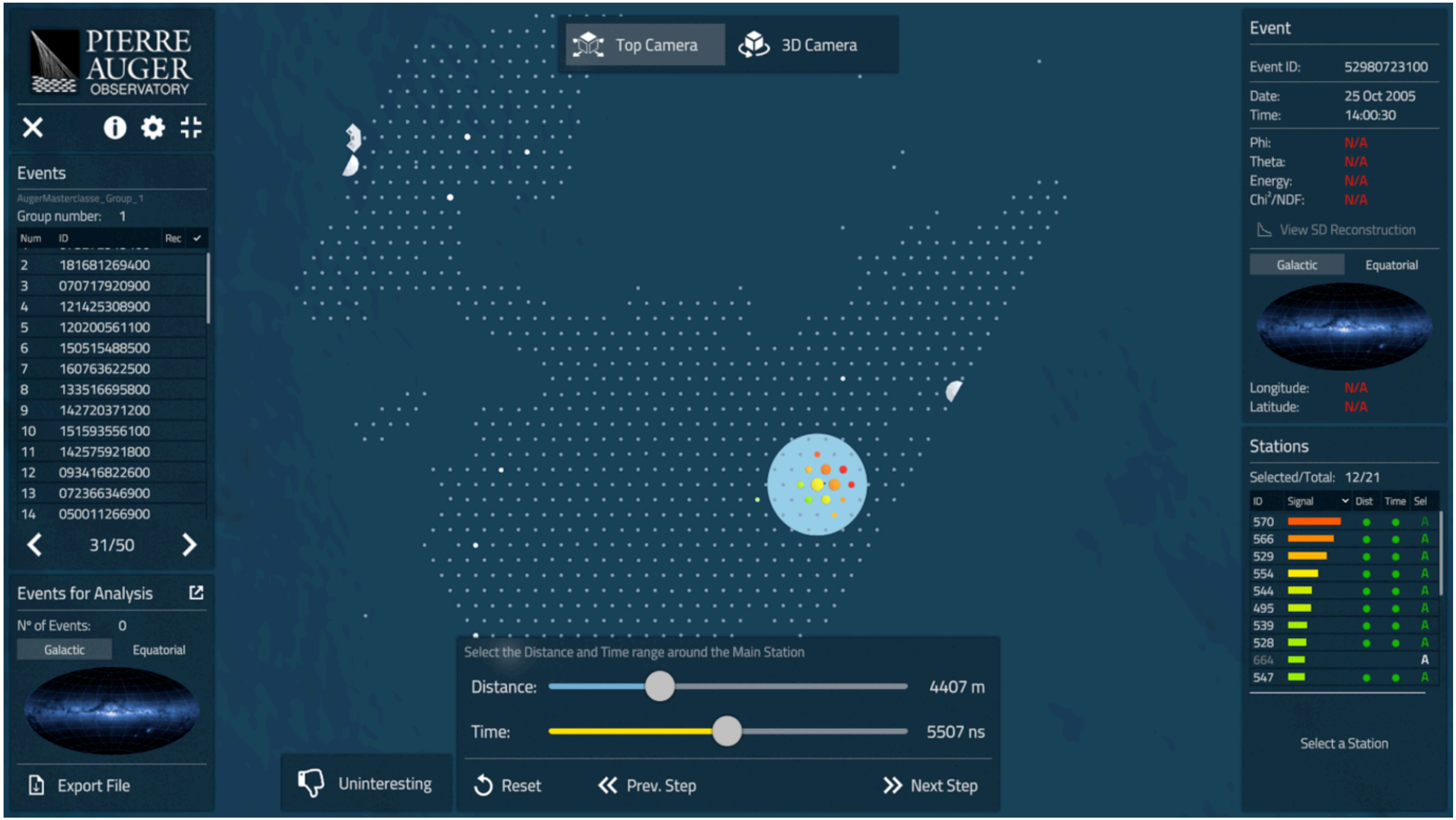
Step 1: select the stations of the event

•Select the shower region at ground by using the scroll that selects stations at increasing distances from the main station



Step 1: select the stations of the event

•Select also the stations by using the scroll of the arrival time of particles at ground, which allows to eliminate stations with signal at abnormal times



Step 2: reconstruct the shower direction

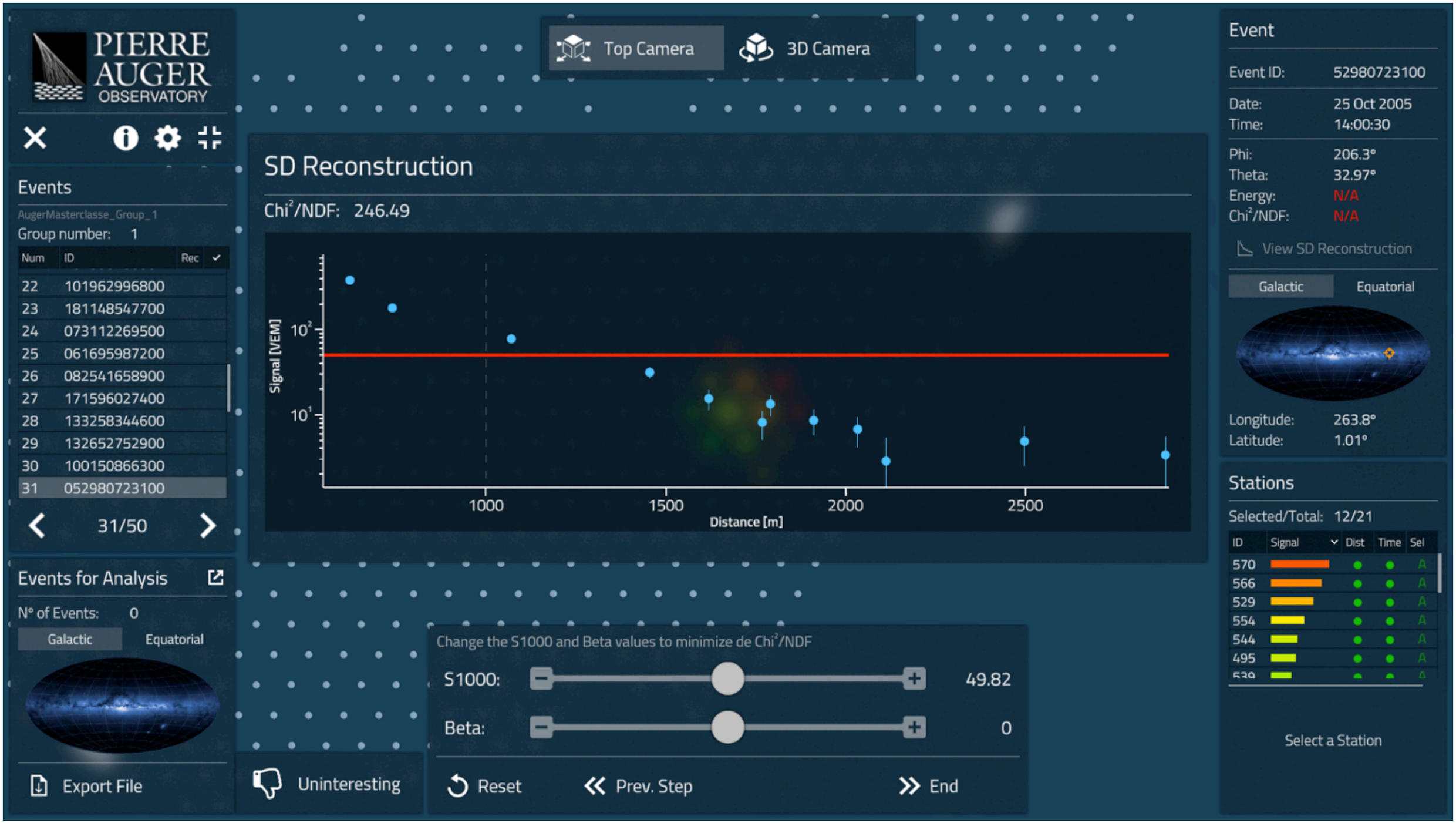
•Adjust the azimuth angle to follow the color pattern with the arrival time of particles at ground, which indicates from what side the shower arrives

Step 2: reconstruct the shower direction

•Select two stations at opposite sides of the event, so that the zenith angle of the shower is calculated by the program, which indicates the inclination of the shower with respect to the vertical

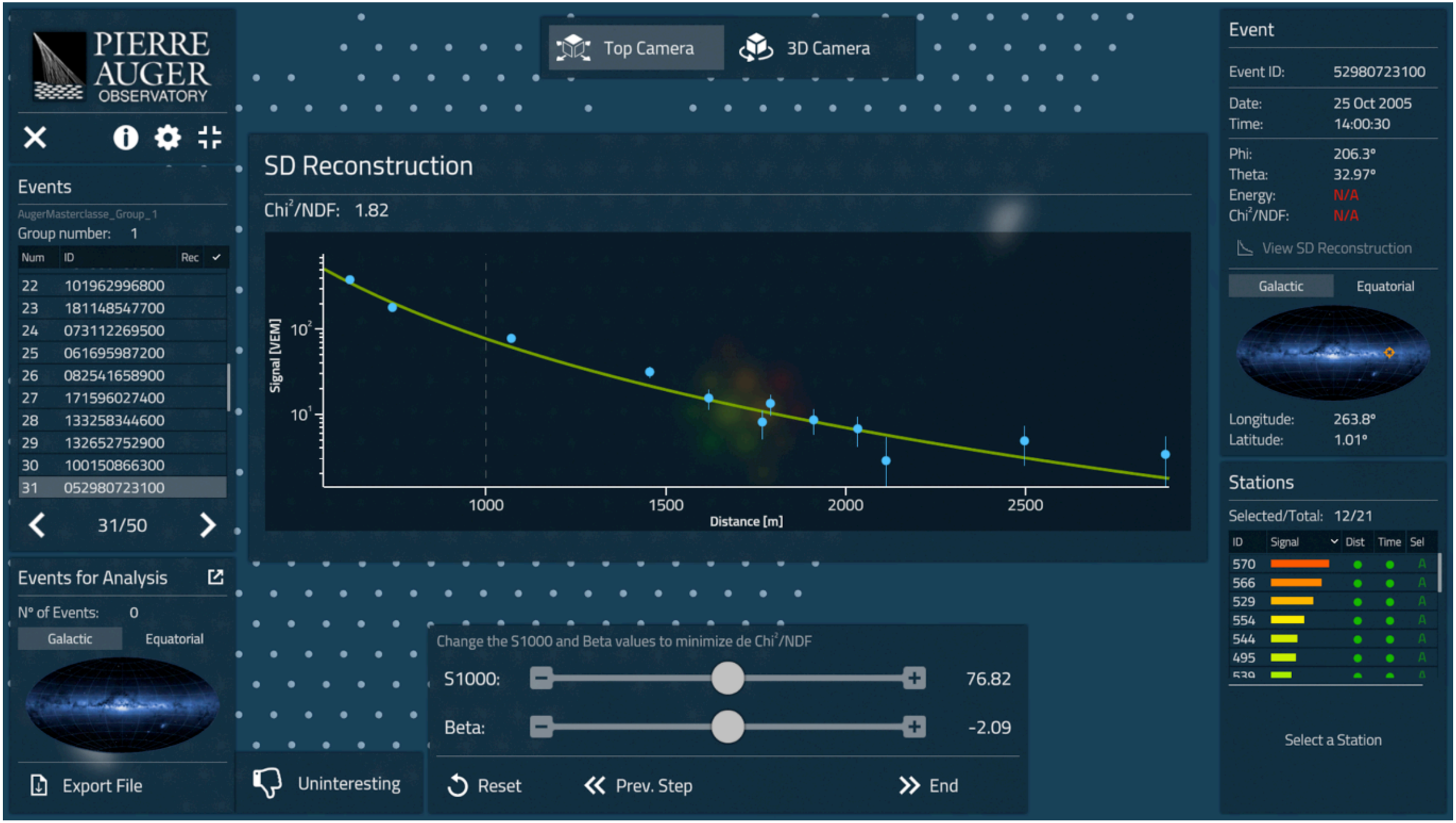
Step 3: reconstruct the shower energy

•Fit a lateral distribution function to the data points. Each point in the graphic corresponds to a selected station, its signal and the distance to the shower direction that was obtained in the previous step. Using the scrolls that determine the normalization and slope of the function, obtain a good fit to the data points - the line turns to orange and green when the quality of the fit improves, also measured by Chi^2/ndf



Step 3: reconstruct the shower energy

•Example of a good fit - the energy is calculated by the program using the value of the function at 1000 m, indicated by the dashed line



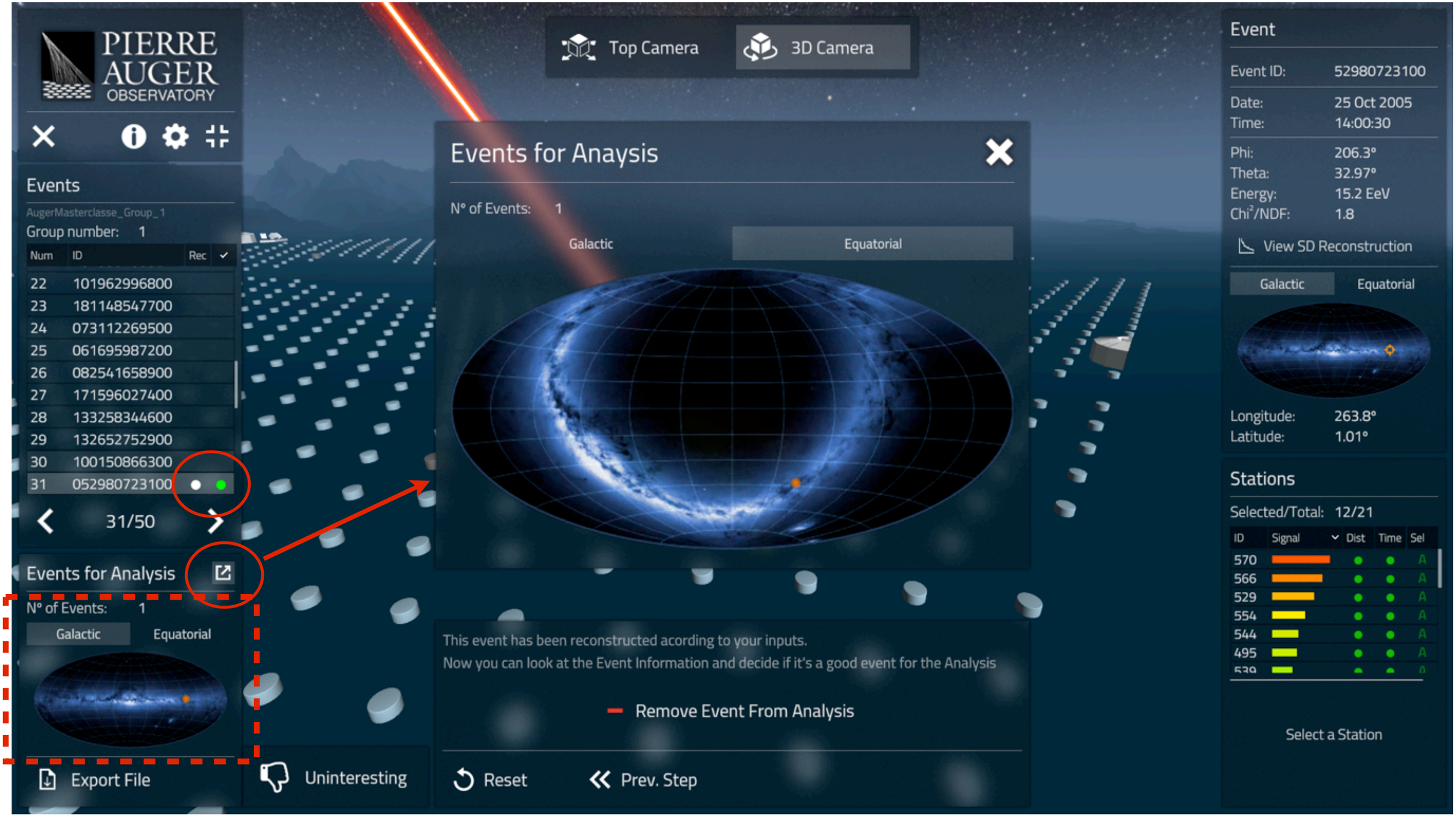
Step 4: application of selection criteria

- After the previous step, there is an animation of the reconstructed event
- If the event fills the selection criteria, accept it for the analysis

Reconstruction info is complete, including the arrival direction in the sky map

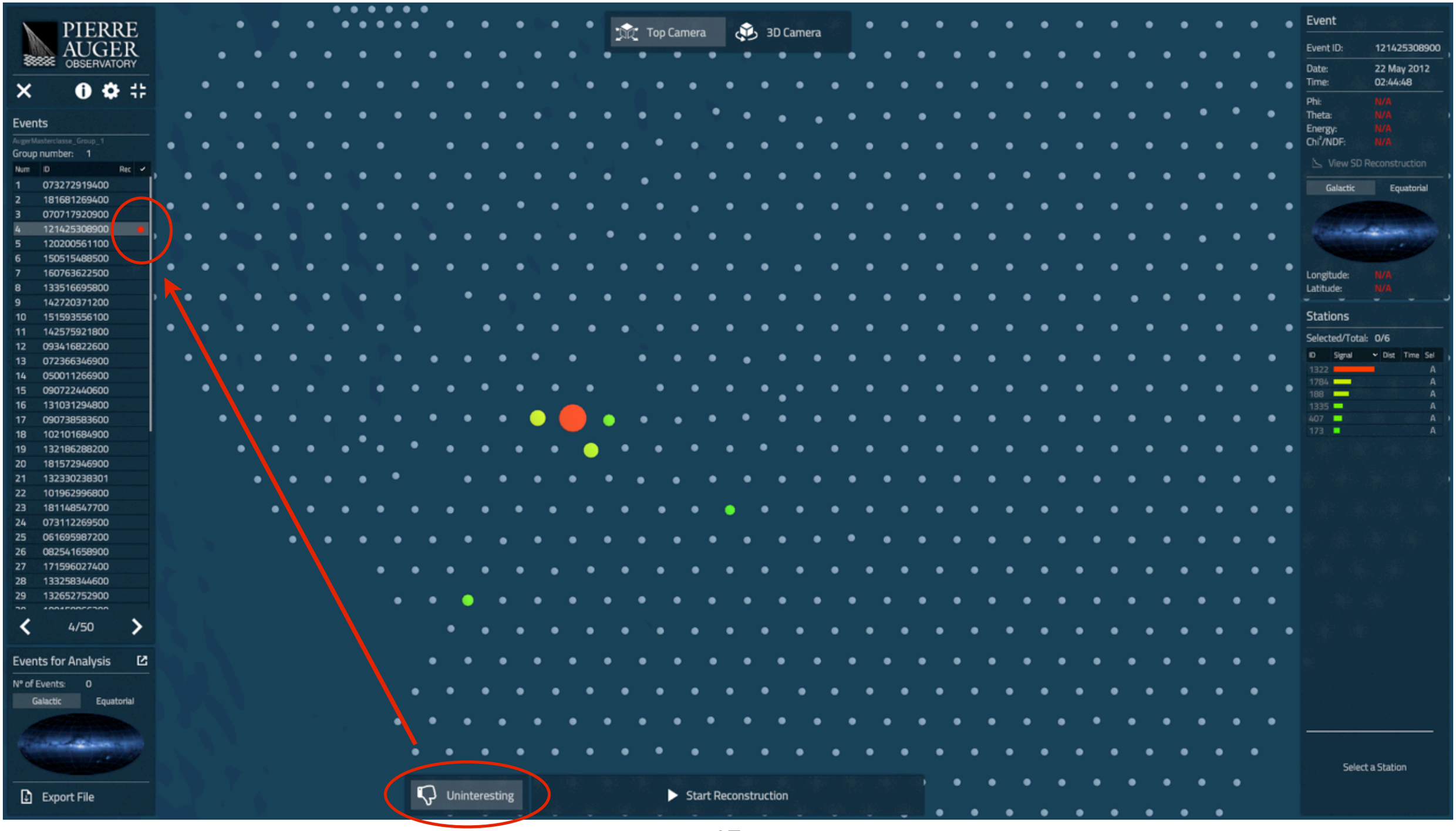
Step 4: application of selection criteria

•Selected events get a green dot and their arrival directions may be zoomed in



Analyze the remaining events of the dataset

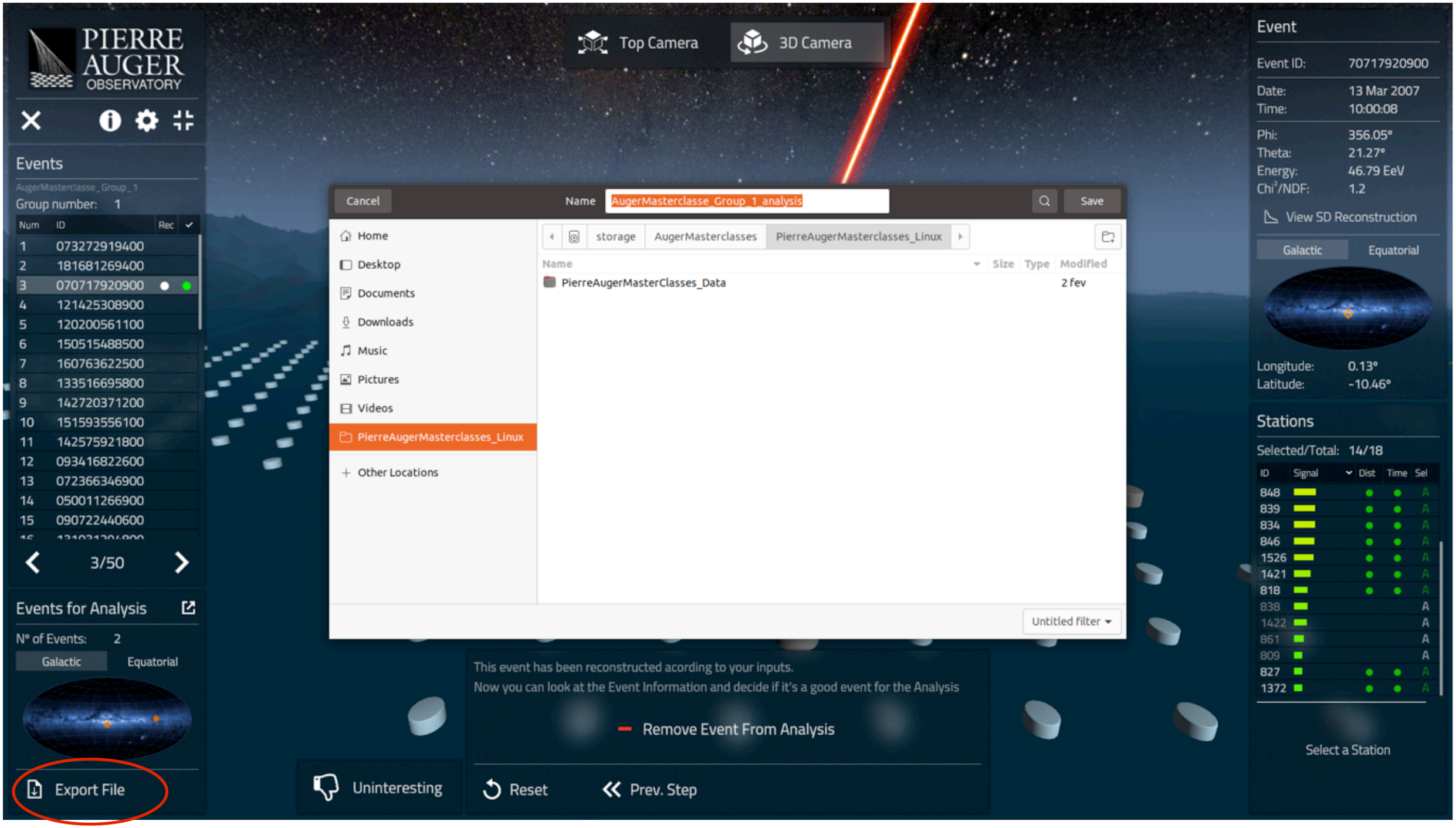
•Some events may be rejected immediately, given that one may conclude that they will not comply with the final selection criteria



After analyzing the events:

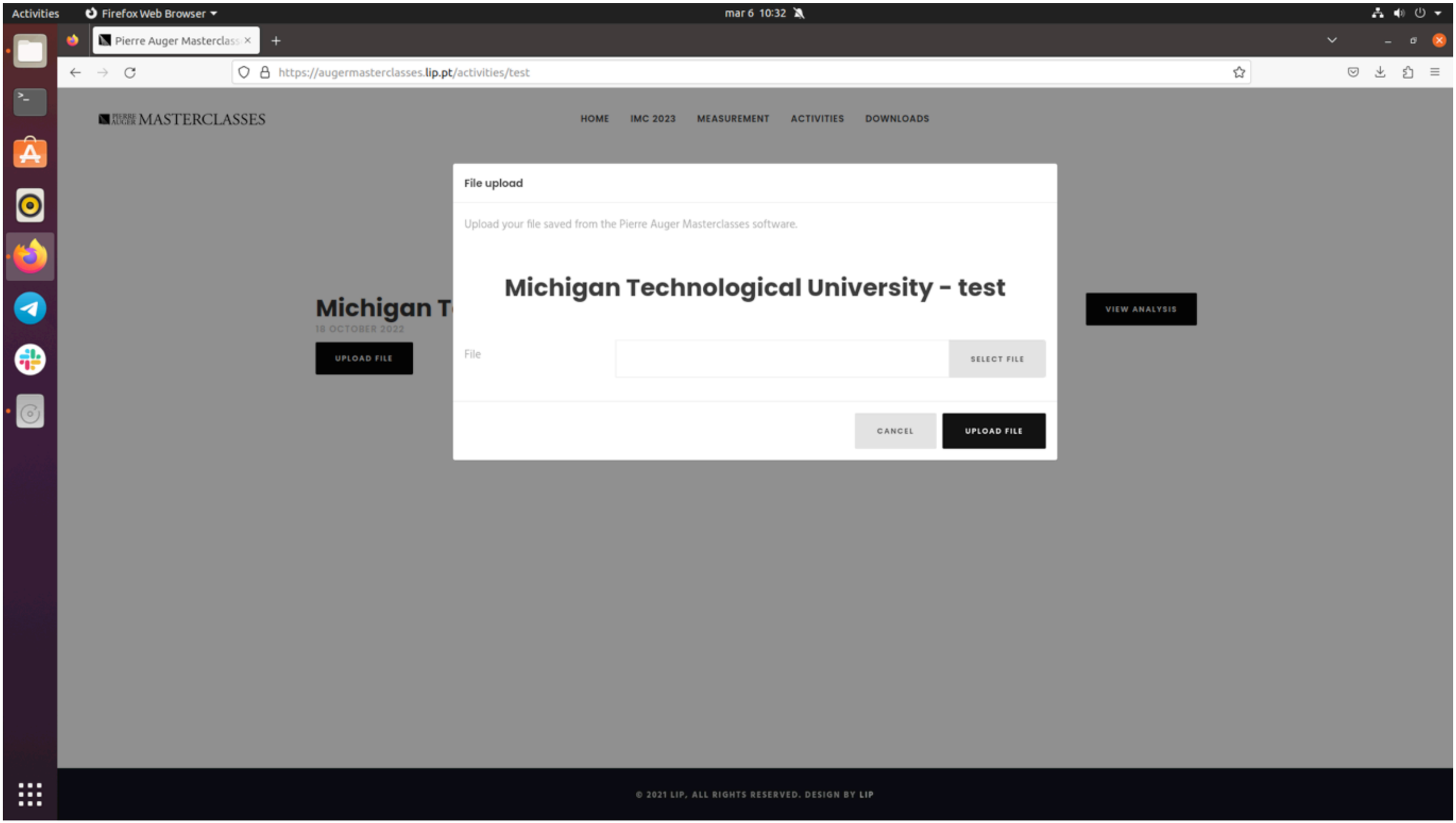
- Export the file with the results, saving it to the computer, the format of the output file is ".augermcexport"

- **Important:** please do not open or try to edit the output file!



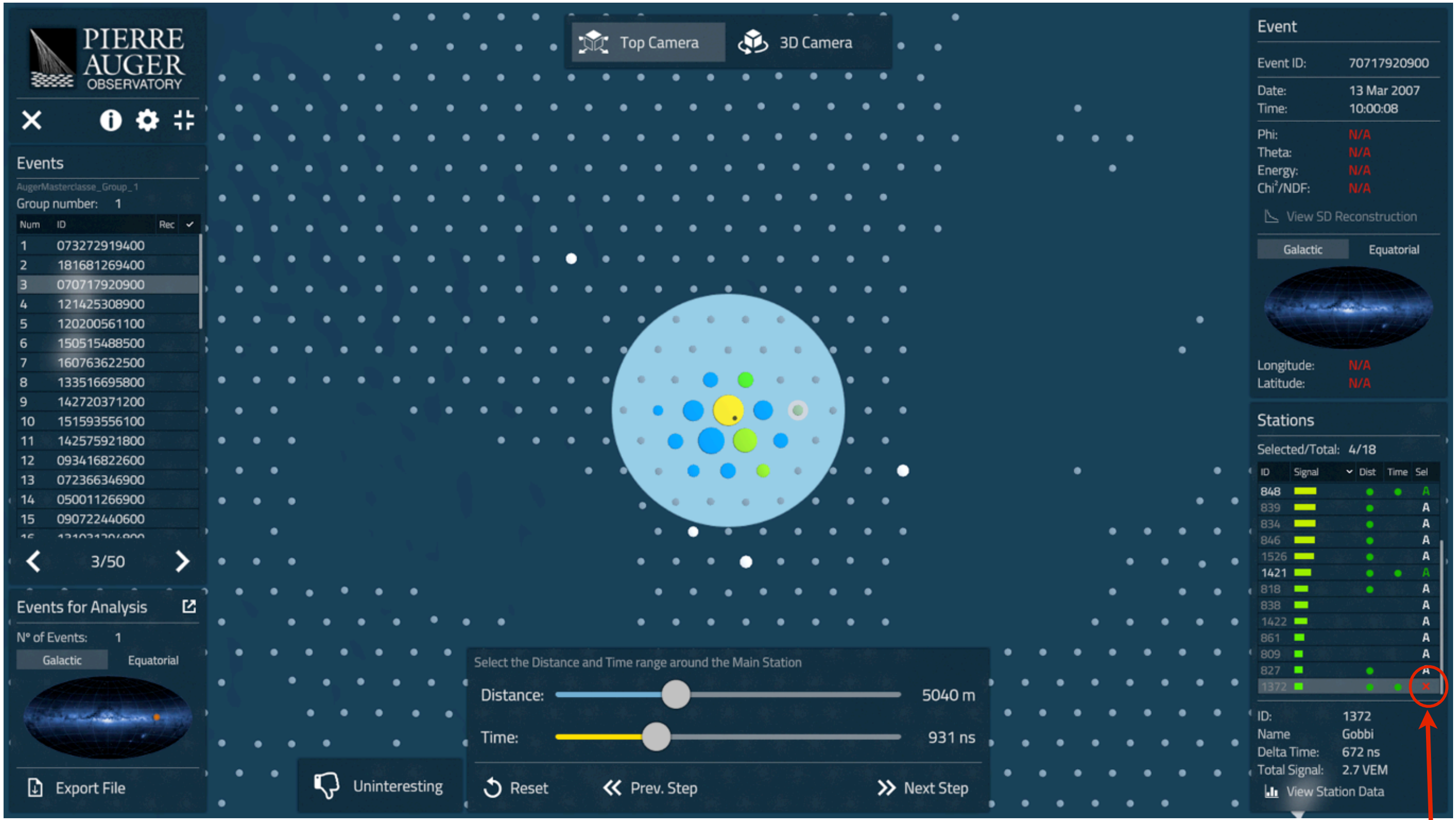
After analyzing the events:

- Upload the output file to the webpage https://augermasterclasses.lip.pt/activities



Additional features

•For more refined analyses, there is the possibility to reject or select individual stations from the right panel bar, by clicking below the "*Sel*" column



Additional features

•Other features may be explored, such as clicking on an individual station and looking at the station data, i.e. the PMT traces