



## Croatian Meteor Network

### Ongoing work 2017-2018

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Aleksandar Merlak, Patrik Kukić, Matej Butković, Renato Turčinov**

# Introduction

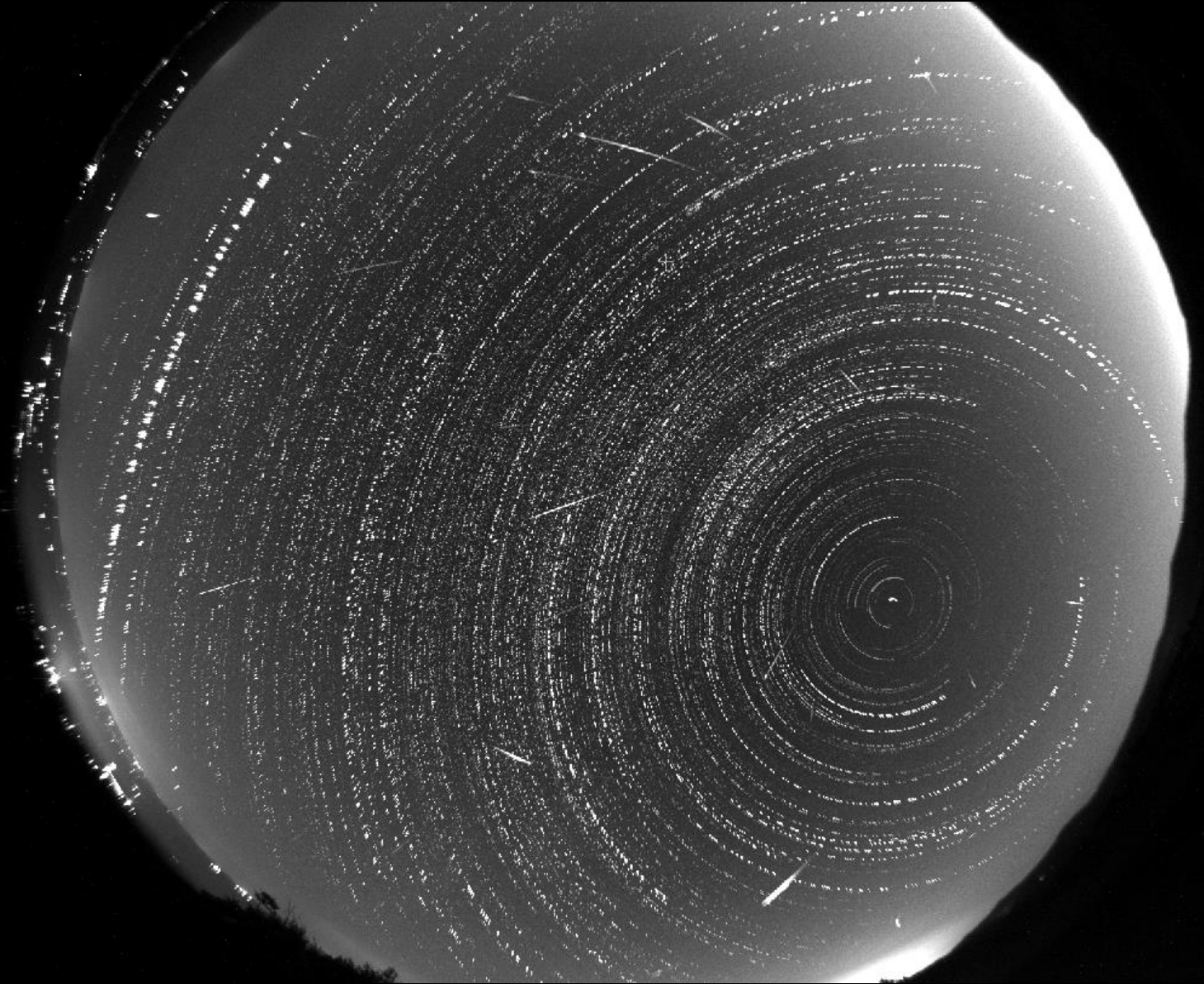
RMS - migration

Radiometer!

Infrasound?

Important stuff

Summary



# RaspberryPi Meteor Station: from the idea 2016 ...

- New detection approach
- End-to-end capture/detect/process solution
- Opportunity for network expansion and educational activities

## ... and operative 2018

- Cameras working in Canada, France, Brazil and Croatia
- Macedonia, South Korea, China and Poland announced
- Migrating CMN stations from ADAPT (SkyPatrol and CAMS) to RMS

# RaspberryPi Meteor Station: the CMN migration

- RMS working not only on Raspberry Pi
- PCI x878 chipset capture card tested on a Linux PC
- Should work on all other capture cards supported by Linux



- Complete IMX225/291 digital RMS solution camera+RPi available!
- See it live at poster session, presented by Denis Vida

# Low Cost Radiometer

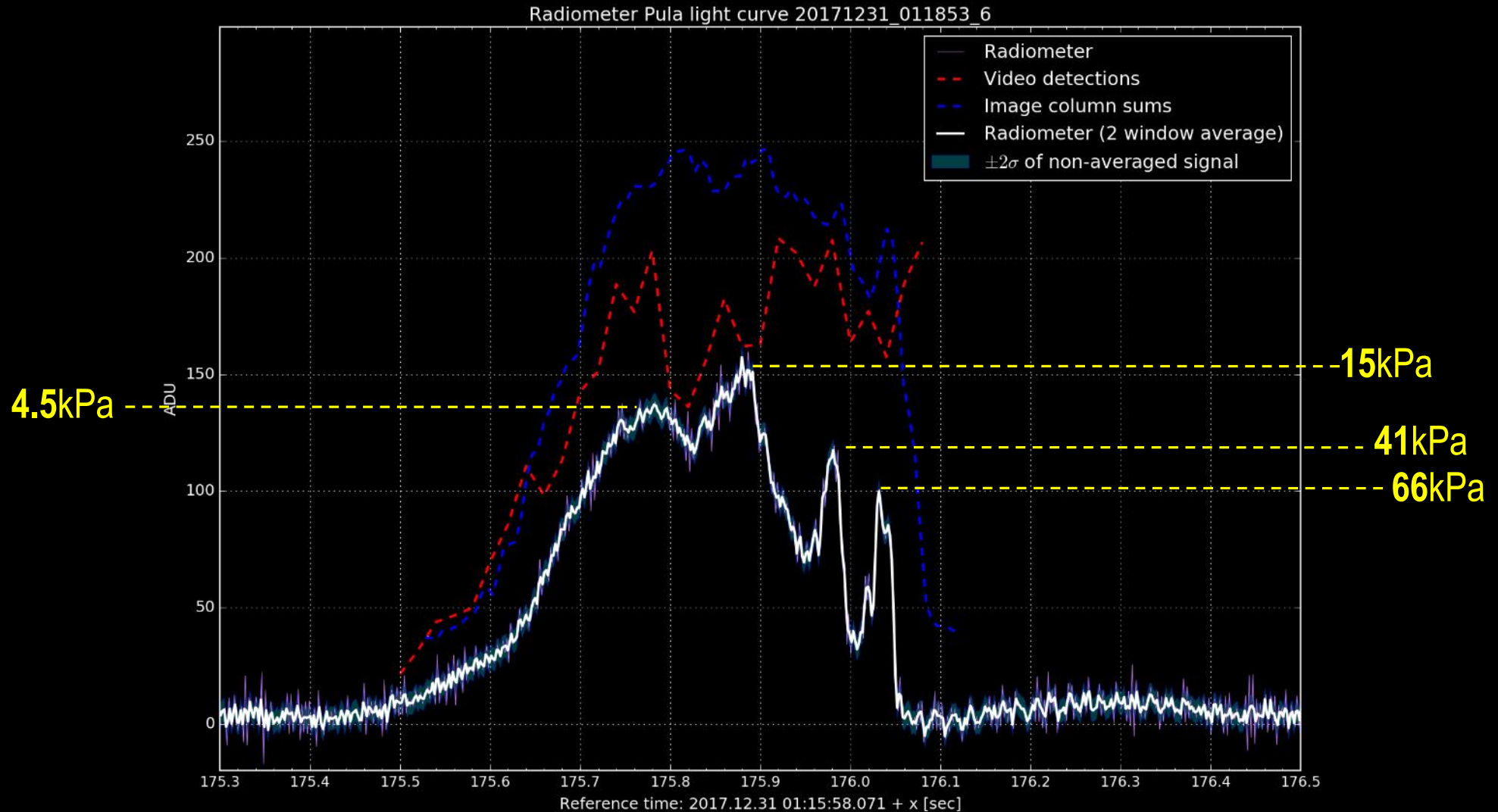
- First presented at IMC 2015, Mistelbach
- WGN paper on first results 2018



- Continuously monitoring from November 2017
- More than 40 of all-sky camera / radiometer fireballs paired up to date

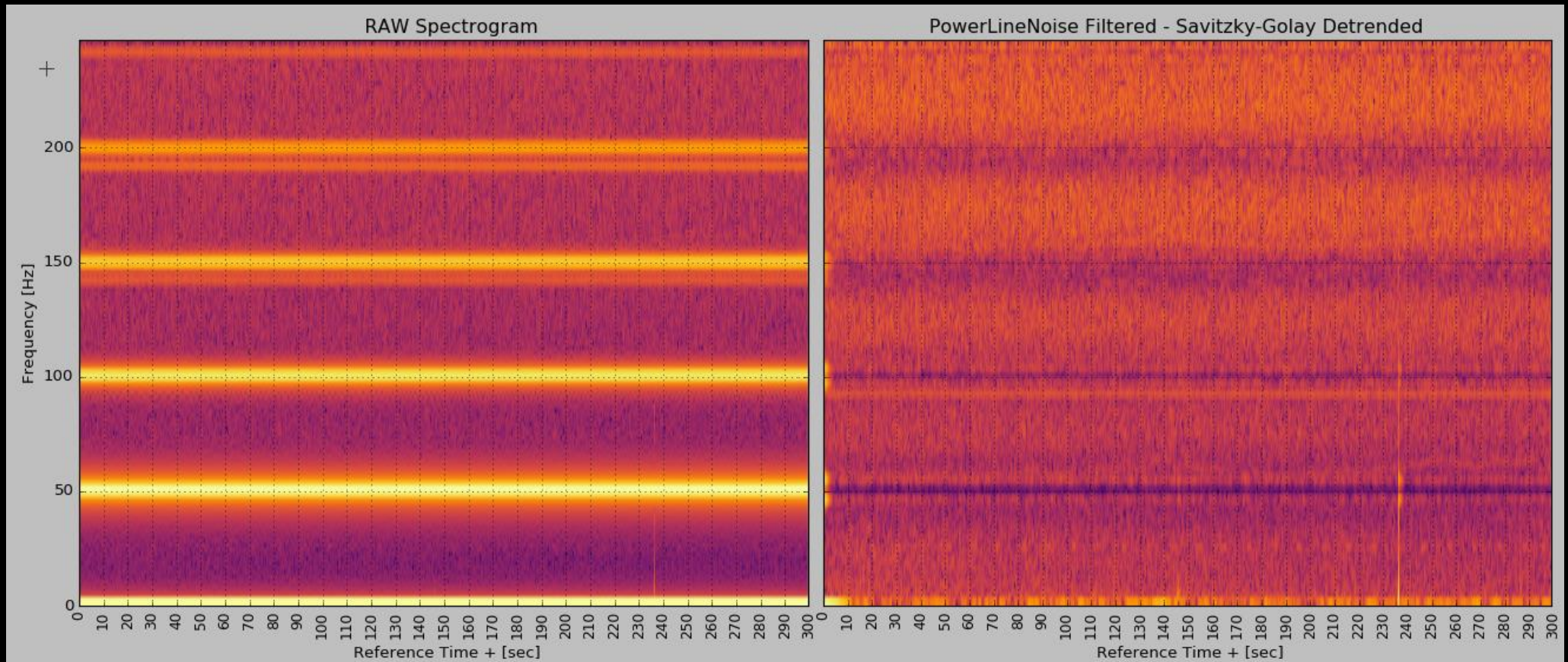
# Low Cost Radiometer

- A solution for dynamic pressure estimation, if trajectory is known



# Low Cost Radiometer

- It works, but how reliable and sensitive it is?



- Interference from 50 Hz harmonics light pollution and electronics noise coupling
- Clouds and other (un)natural sources changing illumination

# Low Cost Radiometer

- It works, but how reliable and sensitive it is?

Nikon DSLR image, courtesy by Hrvoje Damjanović

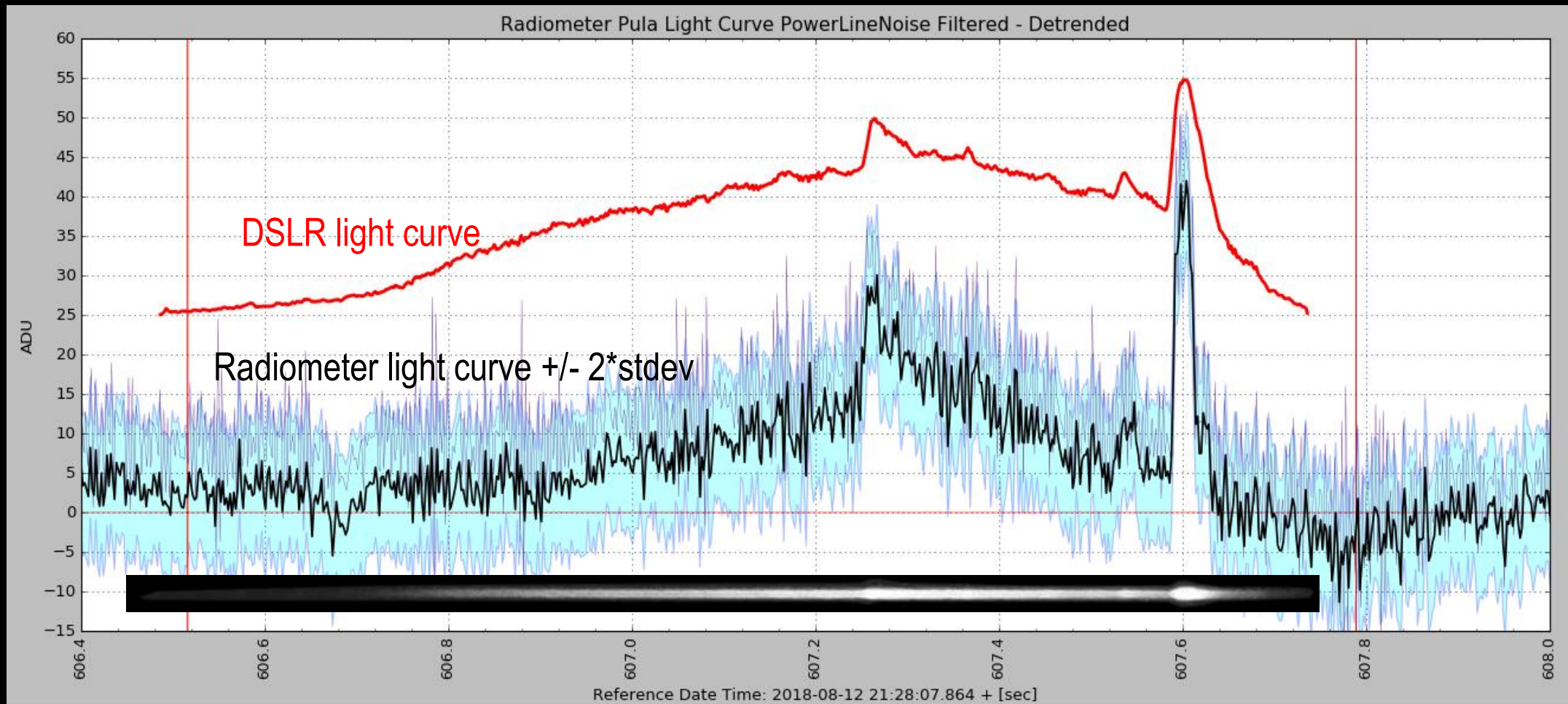
ASI 174,  
Fujinon 2.7mm F1.8

20180812\_213815UT



# Low Cost Radiometer

- It works, but how reliable and sensitive it is?



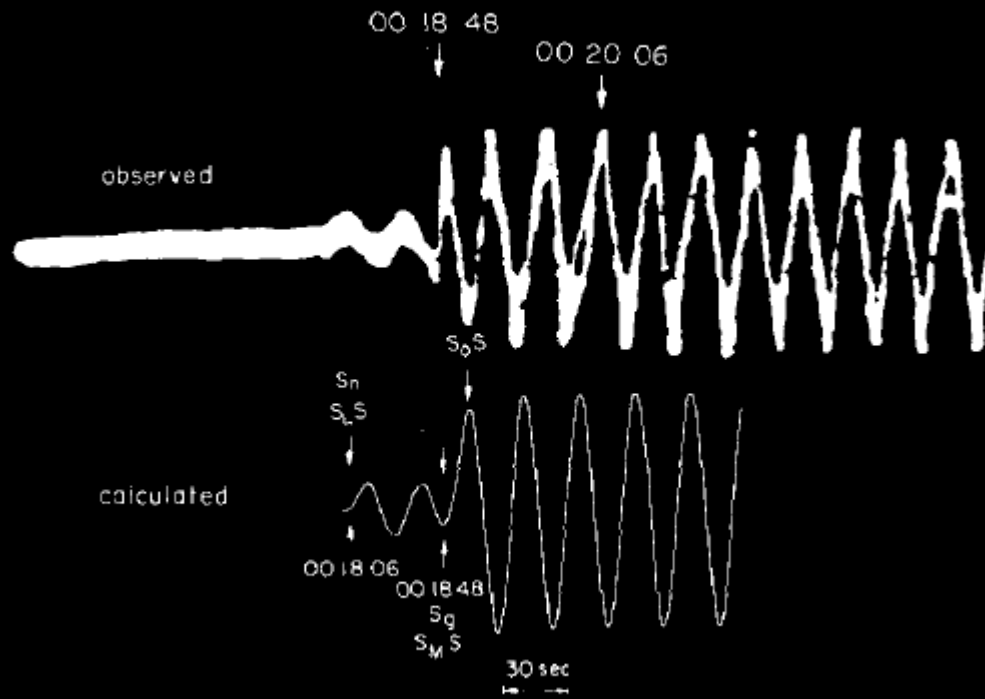
- Opportunities for further hardware and software improvements

# Low Cost Infrasond Sensor

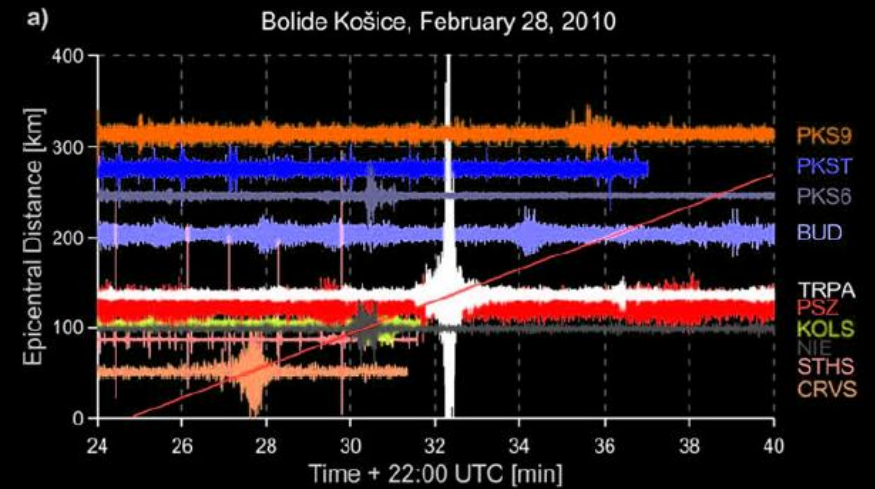
- Infrasound: not necessarily a night event
- Ballistic wave coverage: trajectory estimation from multi-site arrival time

*P. Kalenda et al.*

Observed vs. calculated SH seismogram of the Siberian explosion of June 30, 1908, at Irkutsk.



A. BEN-MENAHEM

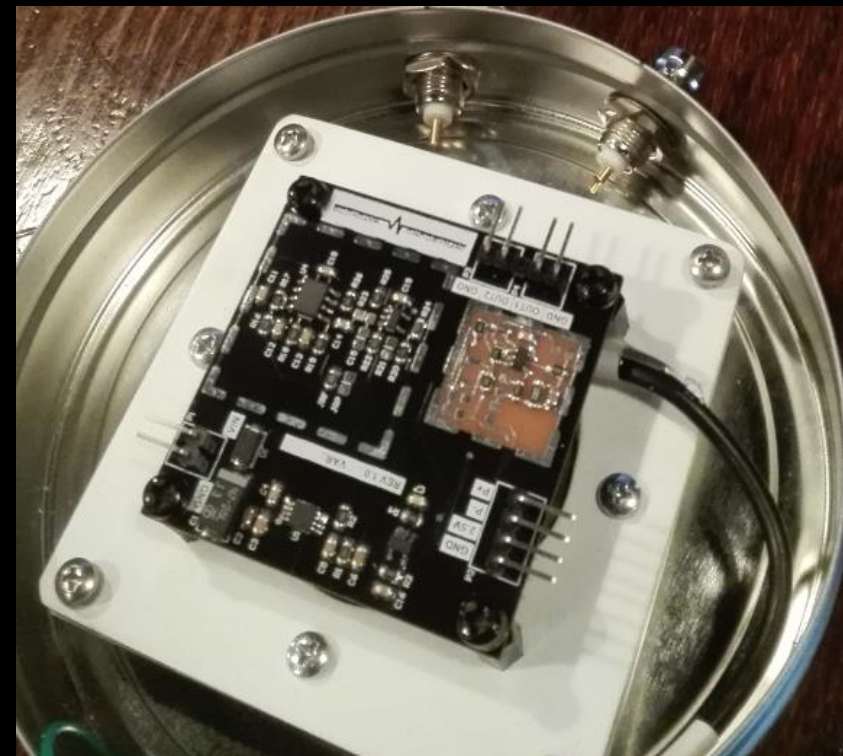


# Low Cost Infrasond Sensor

- To have a complete fireball network: cheap & plug'n'play!
- Sensor based on piezo microphone, 35mm diameter chosen
- Two designs under testing



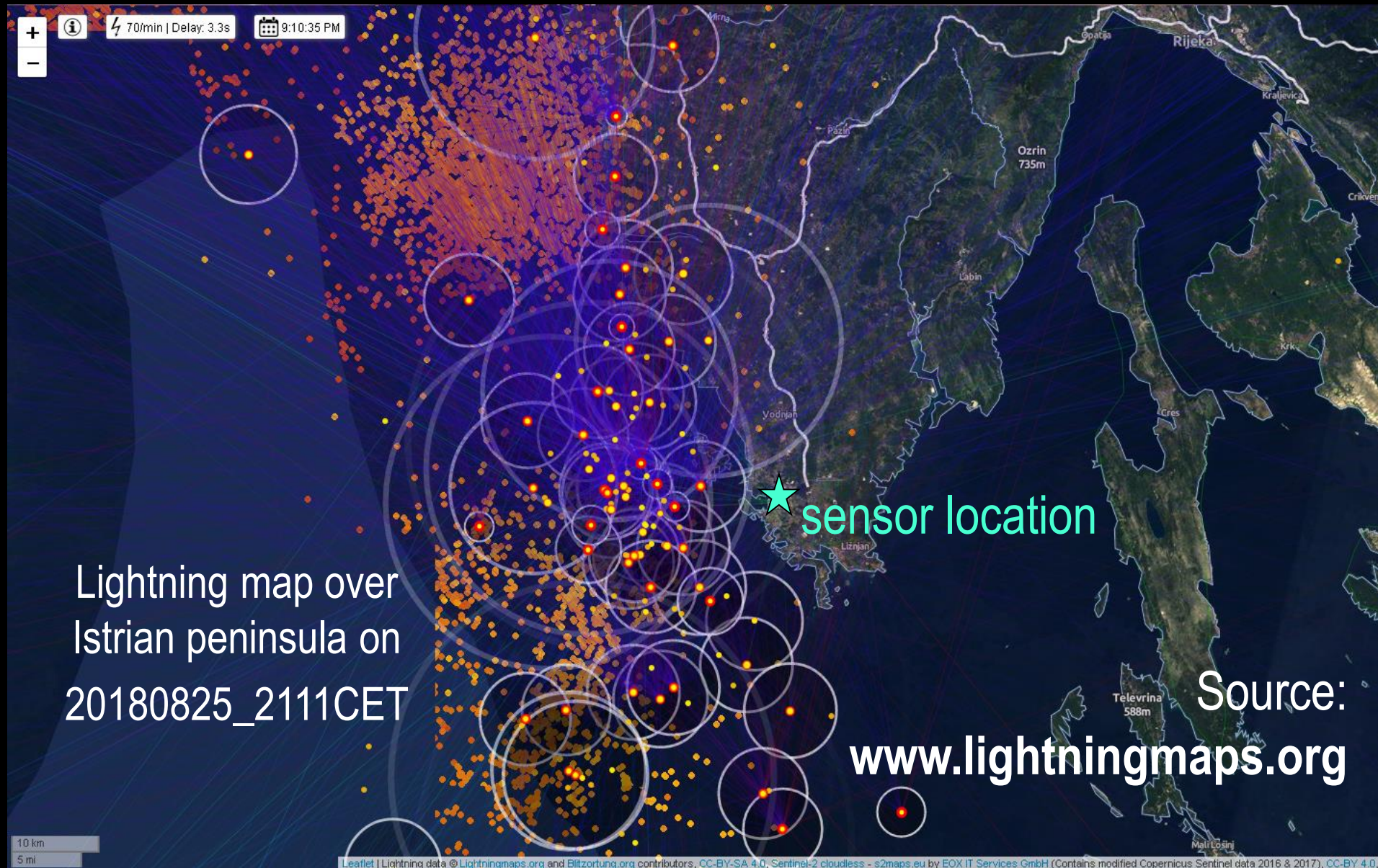
**v00**: web based electronics  
(you do not want to see the PCB)



**v01**: own design  
(PCBs made in...)

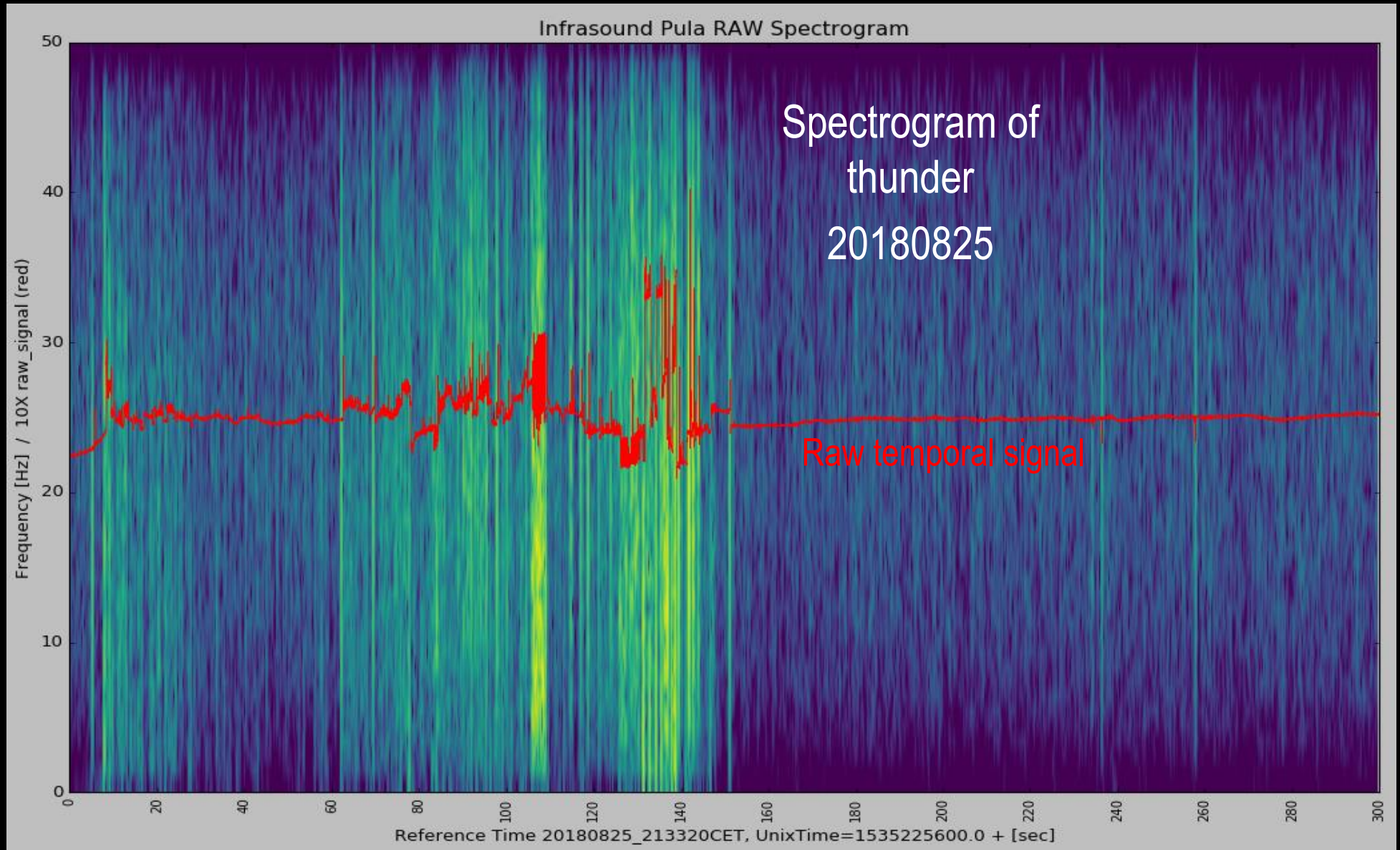
# Low Cost Infrasond Sensor

- Initial tests: where to find an infrasond source?



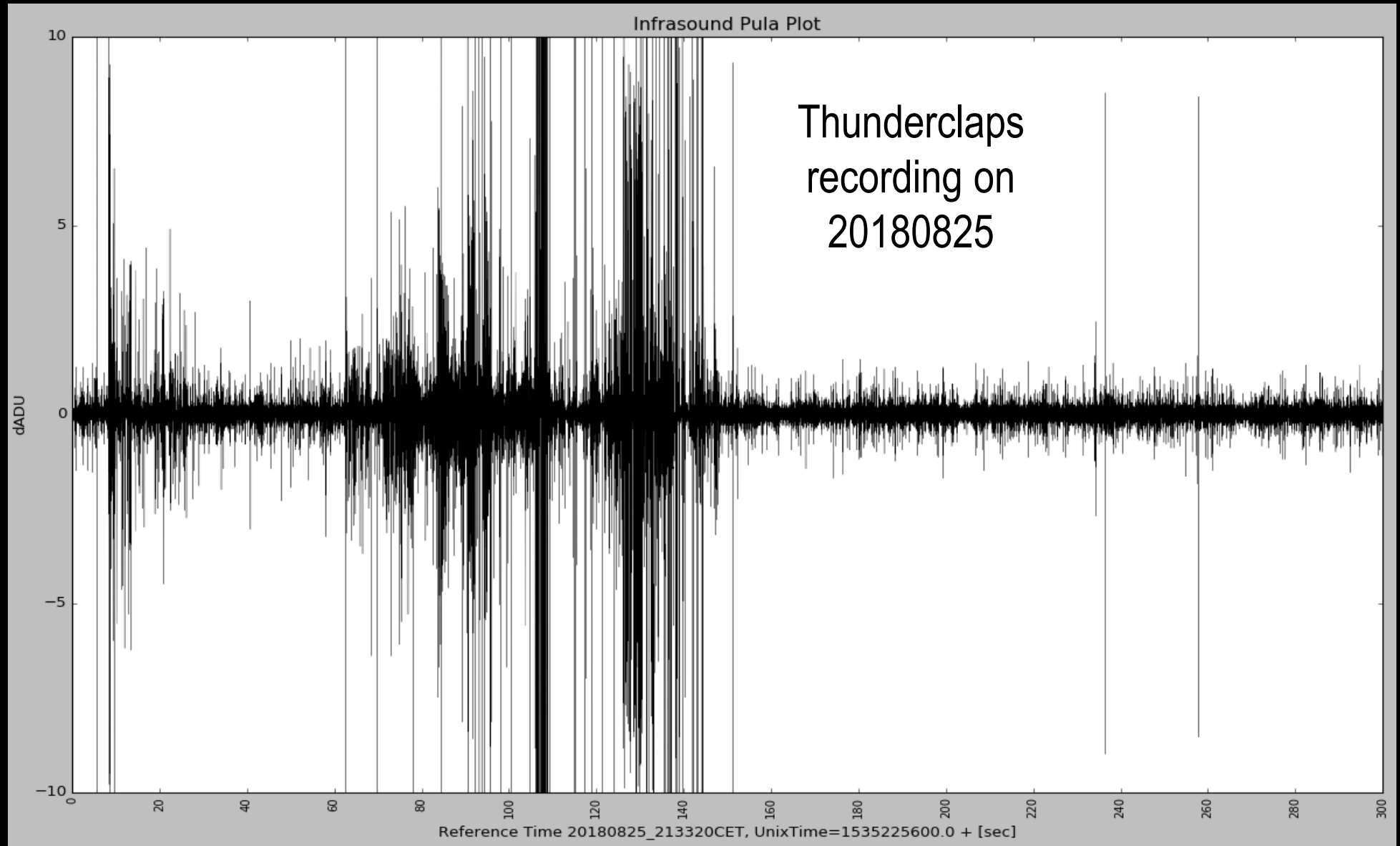
# Low Cost Infrasond Sensor

- Initial results: encouraging!



# Low Cost Infrasond Sensor

- Initial results: encouraging!



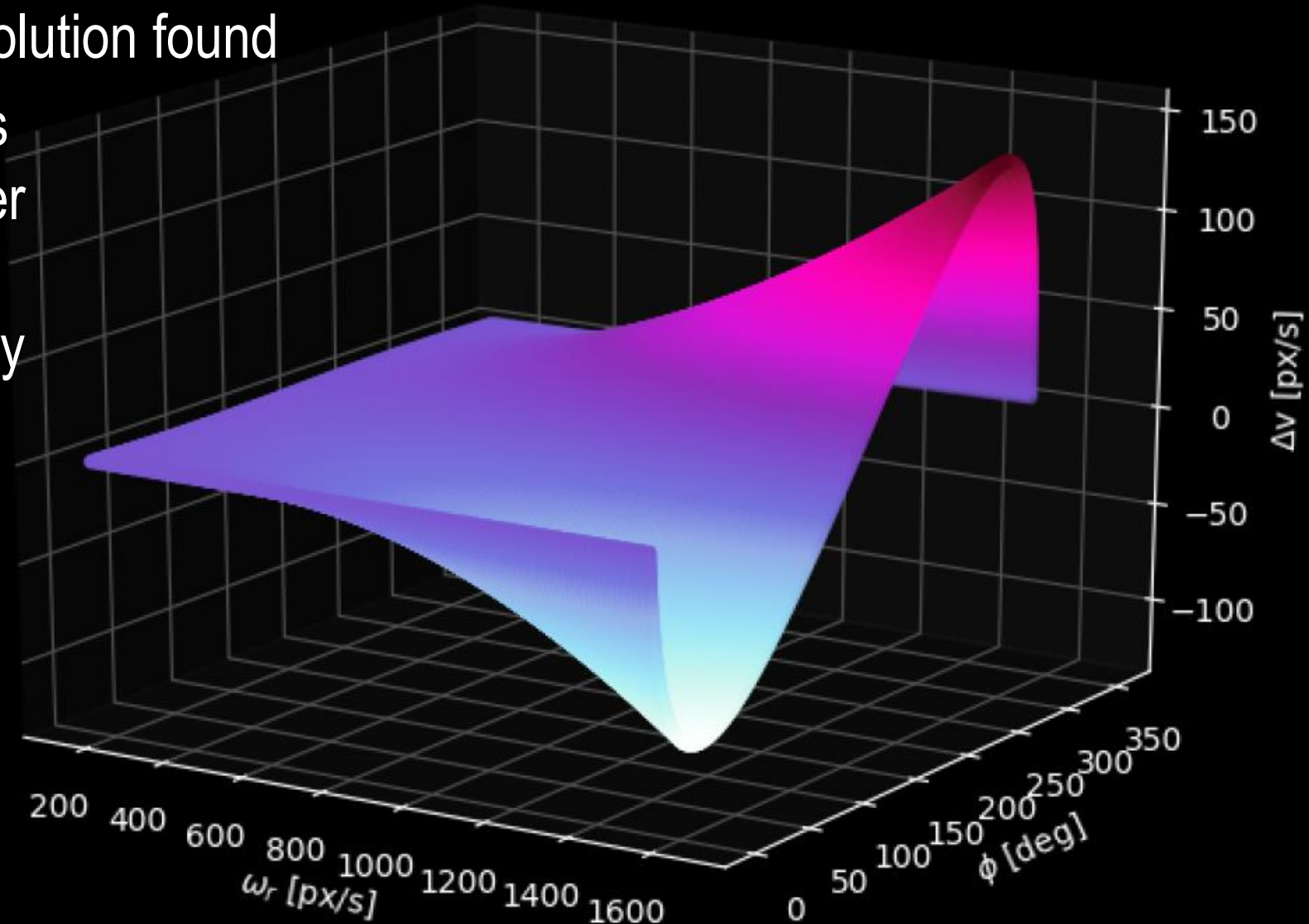
# Important stuff: a meteorite dropper fireball

- Very well observed ([http://fireball.imo.net/members/imo\\_view/event/2018/1336](http://fireball.imo.net/members/imo_view/event/2018/1336))
- Multiple search expeditions
- No findings...
- Rocks on the strewn field are all black!!!



# Important stuff: rolling shutter correction

- Meteor centroid position shifted
- Mathematical solution found
- CMOS cameras with rolling shutter may be used for meteor astronomy



Kukić et al



# Important stuff: meteor photometry

- Back down to the roots - photography
- Photometric mass from magnitude?
- Find the way to recalibrate data

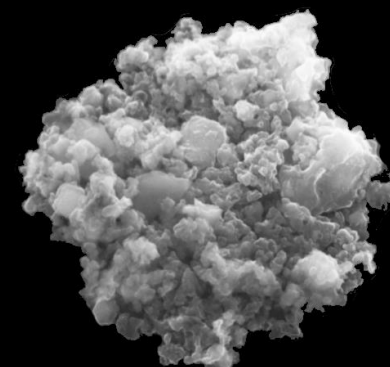
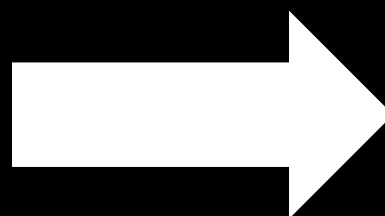
Panchromatic:  $-2^m5$

Human eye:  $-2^m1$

CMOS (full):  $-3^m6$

CMOS (VIS):  $-2^m8$

EOS 10D:  $-2^m7$



OR

???



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# Summary

- Migration to RMS: goal to be reached soon
- Radiometer operative: going to the next level
- Infrasound observations: investigating
- Rolling shutter correction allow the use of low cost CMOS board cameras
- Meteor photometry: making progress





## Acknowledgements

All the CMN members for their devoted work and persistence

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Astronomical Society "Istra" Pula, Croatia

**Thank you for your attention!**  
**Questions?**