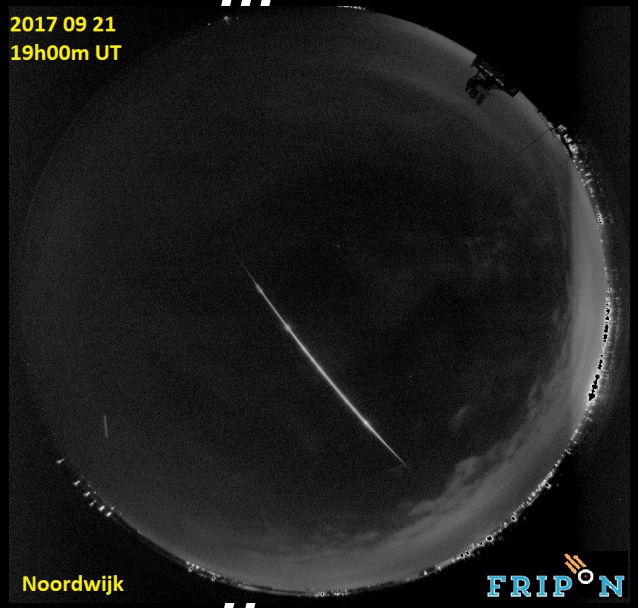
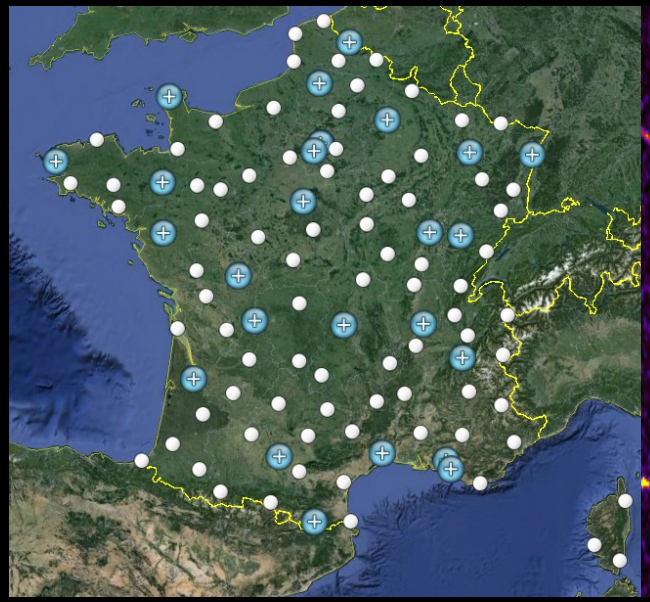
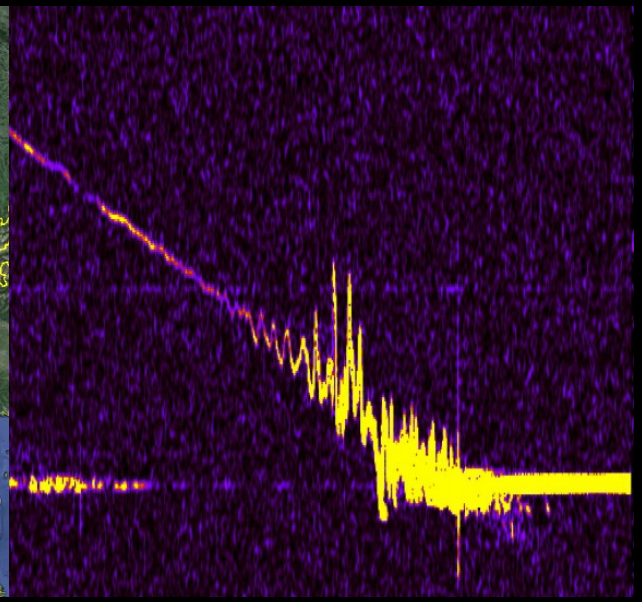
tatus of the radio
cal network

Simulation







FRIPON and

l'Observatoire de Paris | IMCCE | UPS | IM2 | Institut Pythéas

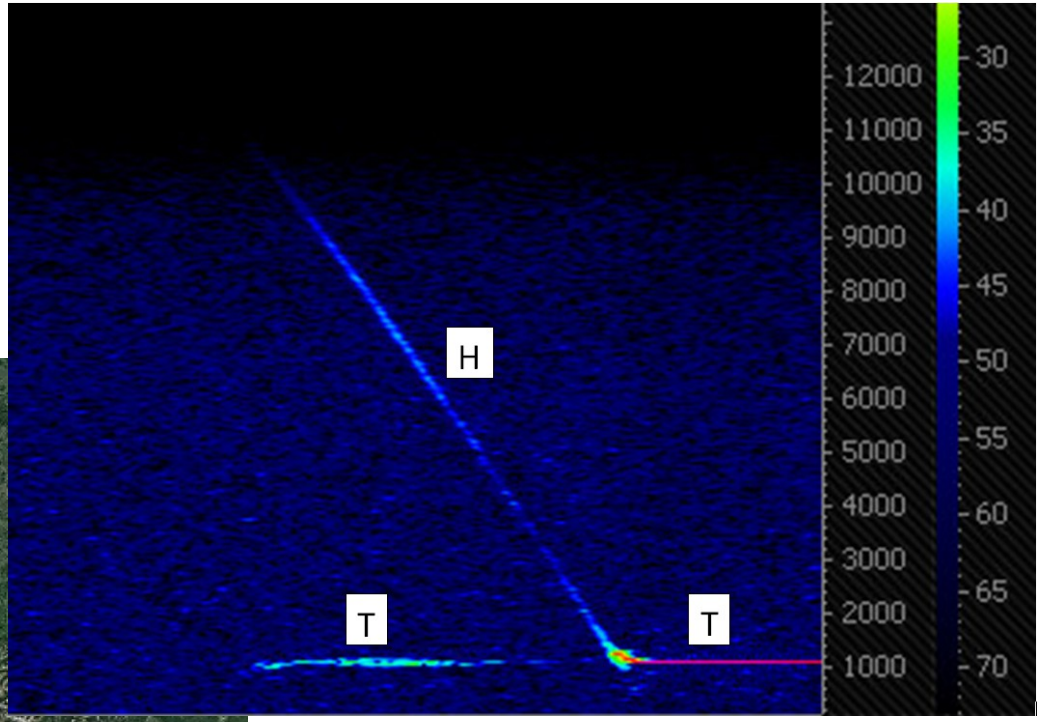
IMC 2017 PETNICA

2000 mutiple detections per year (mag < -1,5) => 2000 orbits per year

Simon JEANNE
IMCCE

FRIPON Radio

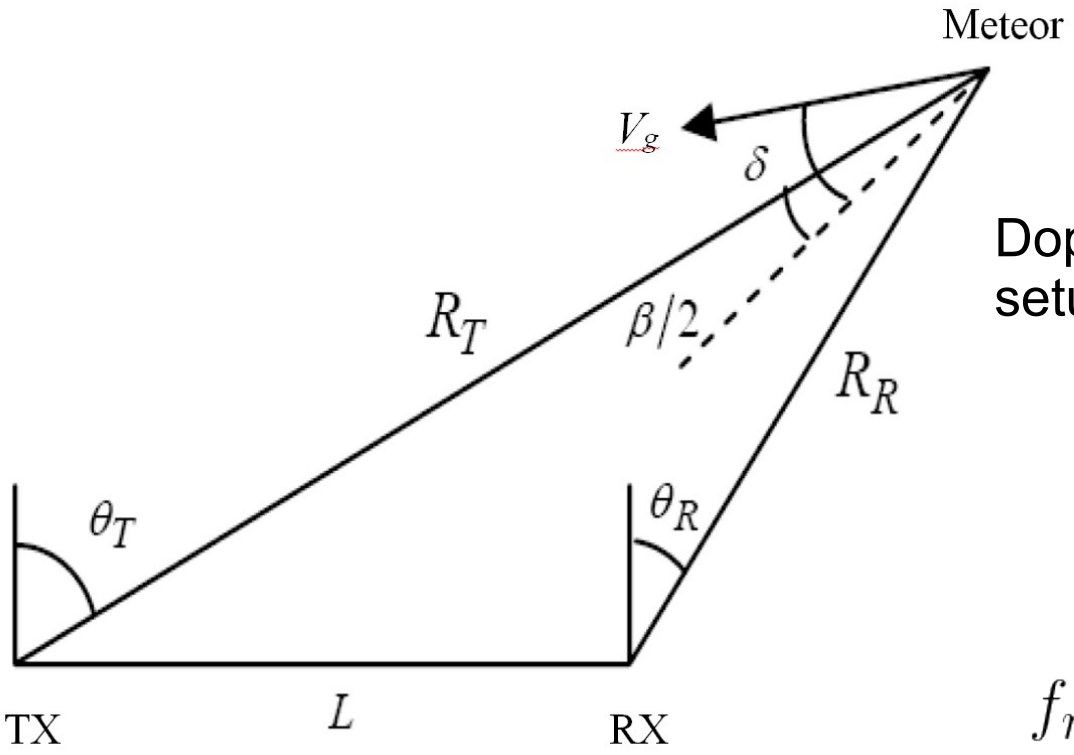
Fripon Radio is :
→25 receivers
→ 1 transmitter : GRAVES (143.05MHz)



- Reflexion on the trail (T) and on the meteor's head (H)

Doppler Shift

We can use the Doppler shift to compute the velocities of aerolites



Doppler shift for a bistatic radio setup :

$$f_{rec} = f_{em}\frac{1 - \frac{dR_T}{cdt}}{1 + \frac{dR_R}{cdt}}$$

$$f_{rec} = f_{em}\frac{1 + \frac{V_g}{c}cos(\delta - \frac{\beta}{2})}{1 - \frac{V_g}{c}cos(\delta + \frac{\beta}{2})}$$

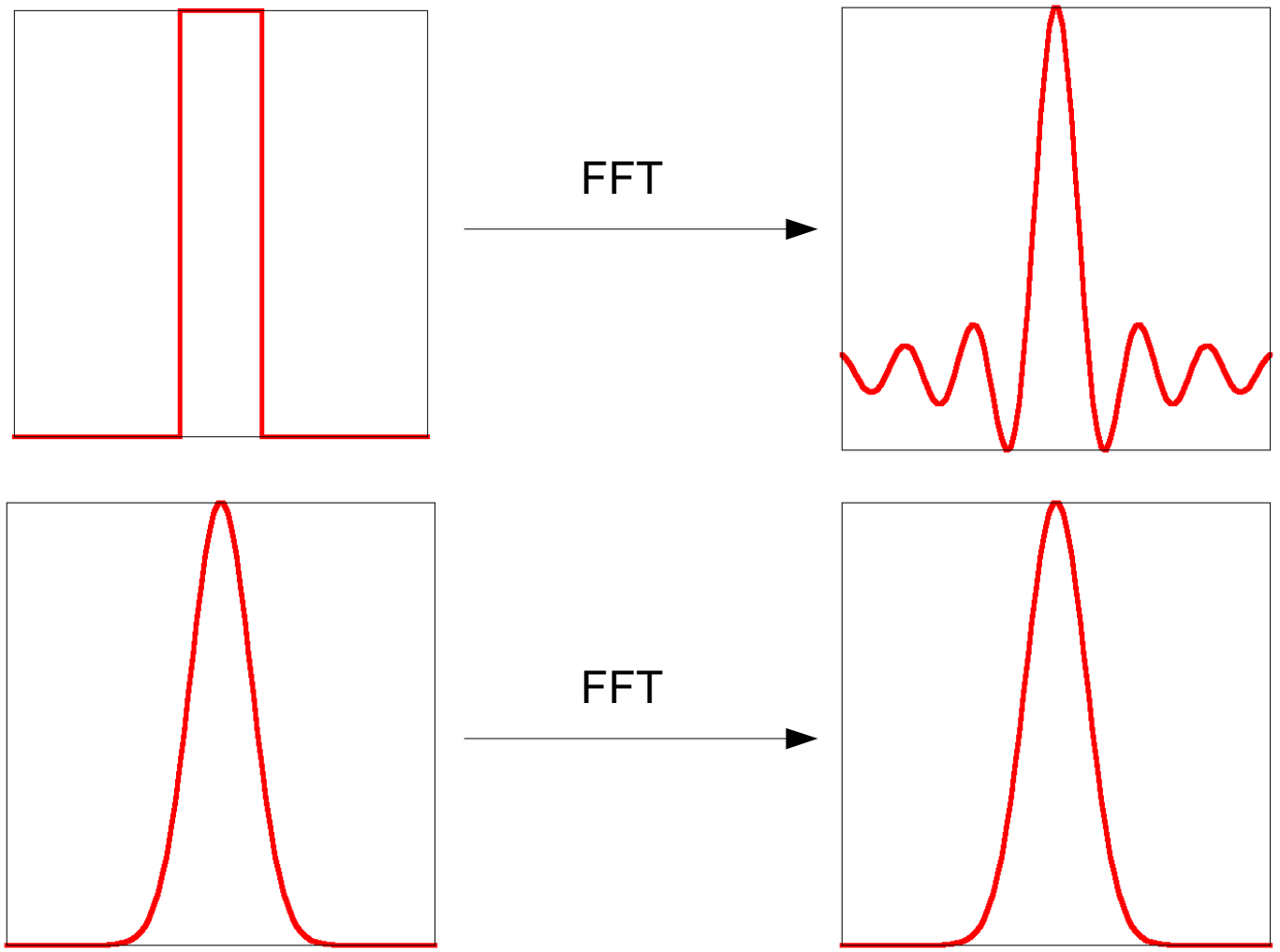
Spectrograms

- Record on 96KHz, centered at 143.065MHz
- Each colones of a spectrogram is a Fast Fourier Transform (FFT) of a small part of the total record.

Minimization of time/frequency uncertainties :

- Principle of uncertainty : $\Delta t \Delta f \geq \frac{1}{4\pi}$
- Frequency variation in a head echo : $\Delta f \geq \Delta t \left| \frac{\delta f}{\delta t} \right|$
- For events with a variation of 10kHz/s, the optimum standard deviation is 2.8ms

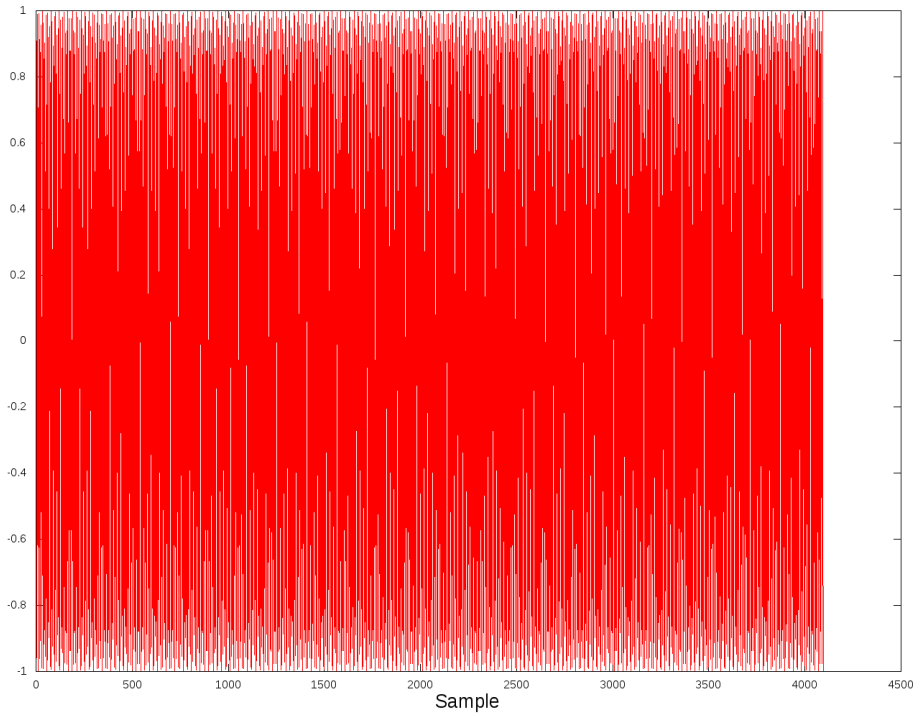
Spectrograms

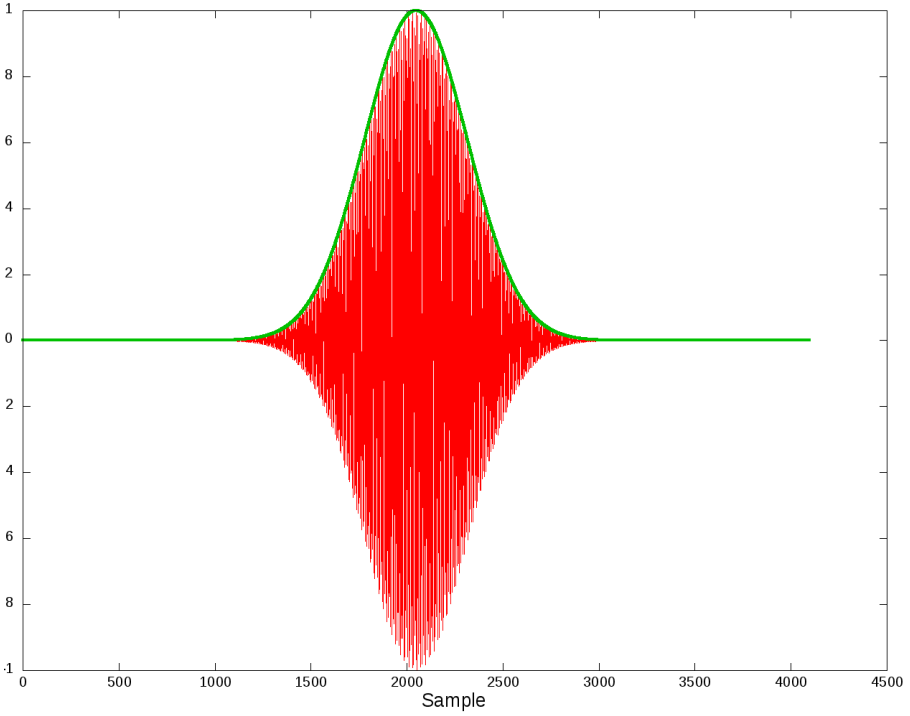


Spectrograms

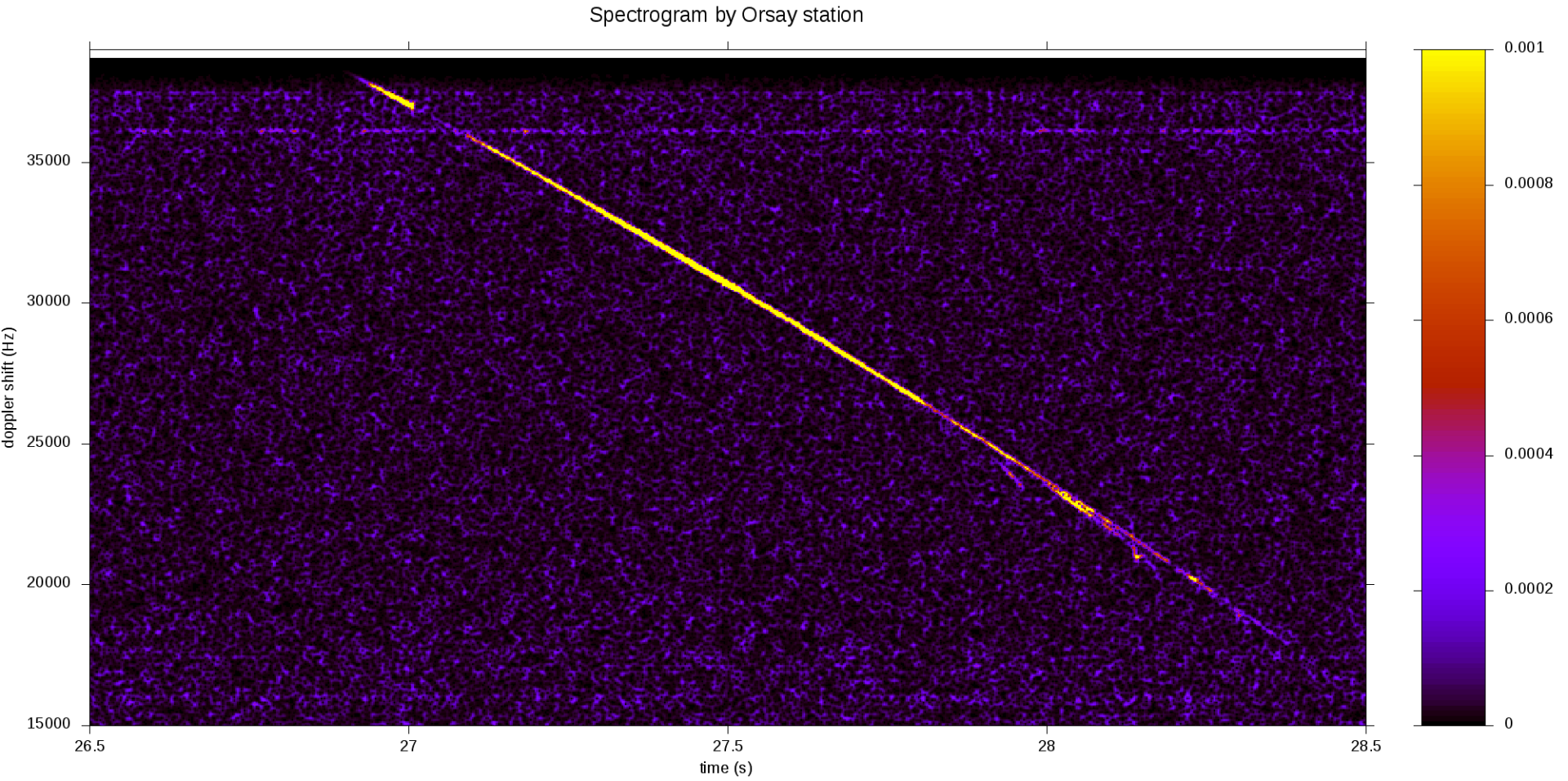
Optimal form of the window : The gaussian window

- This window minimize the principle of uncertainty
- Moreover, the Fourier transform of a function gaussian is a function gaussian.





Spectrograms



Deceleration and ablation model

3 Equations :

$$M\frac{\mathrm{d}V}{\mathrm{d}t} = -\frac{\rho_{atm}V^2}{2}\cdot c_d S$$

$$\frac{\mathrm{d}M}{\mathrm{d}t} = -\frac{\rho_{atm}V^3}{2}\cdot\frac{c_h S}{H}$$

$$\frac{S}{S_e} = \left(\frac{M}{M_e}\right)^{\mu}$$

4 Parameters :

$$V_e$$

$$A = \frac{c_d.S_e}{M_e}$$

$$B = \frac{c_h.S_e}{H.M_e}$$

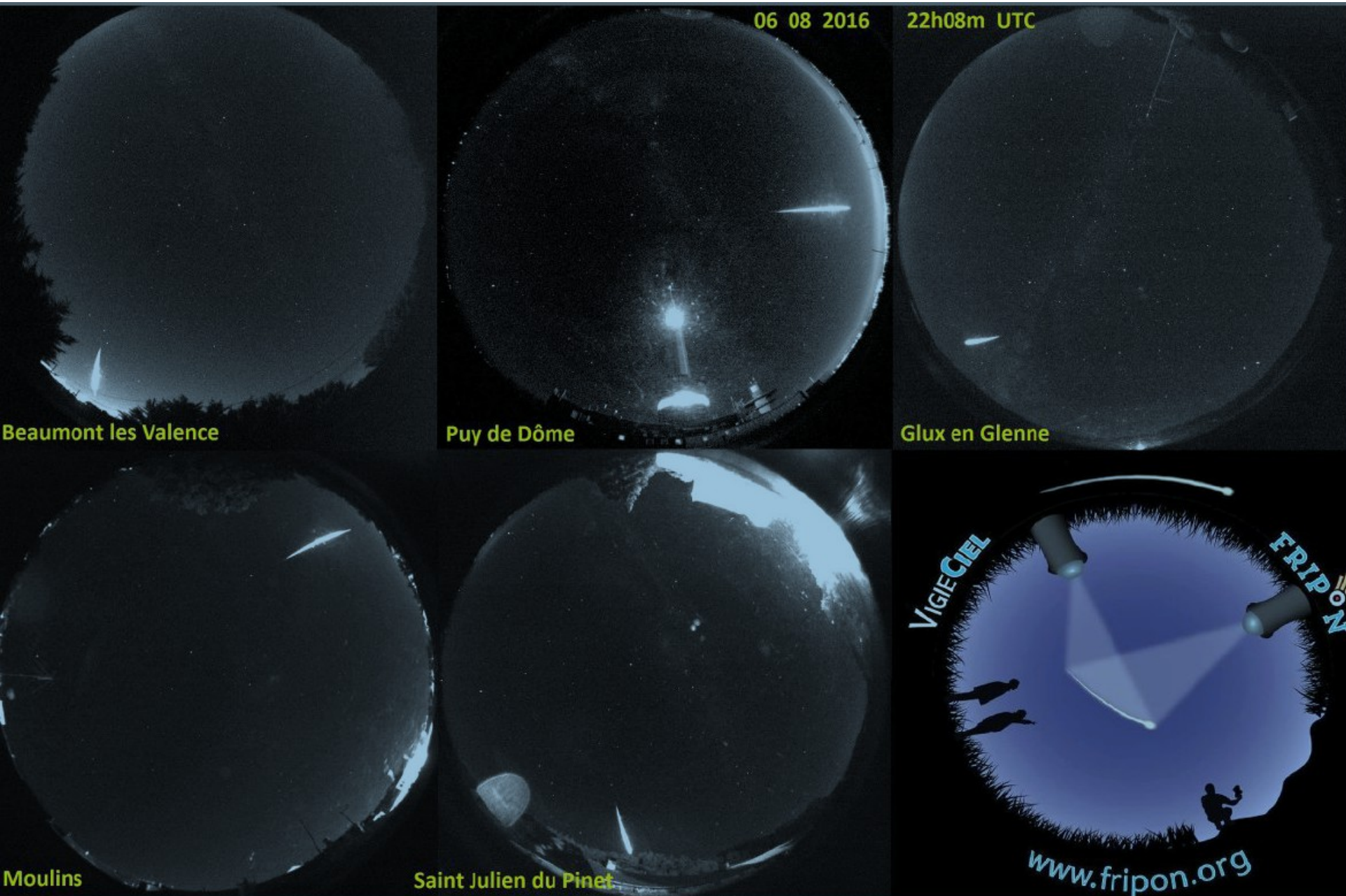
$$\mu$$

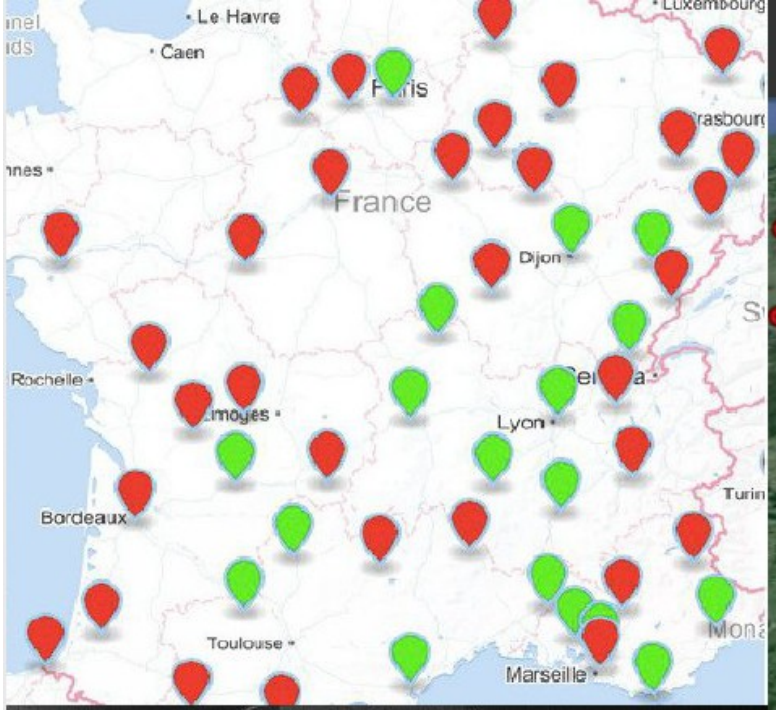
We fit this model on camera observations AND radio observations
DV/V < 0.5 % !

Future

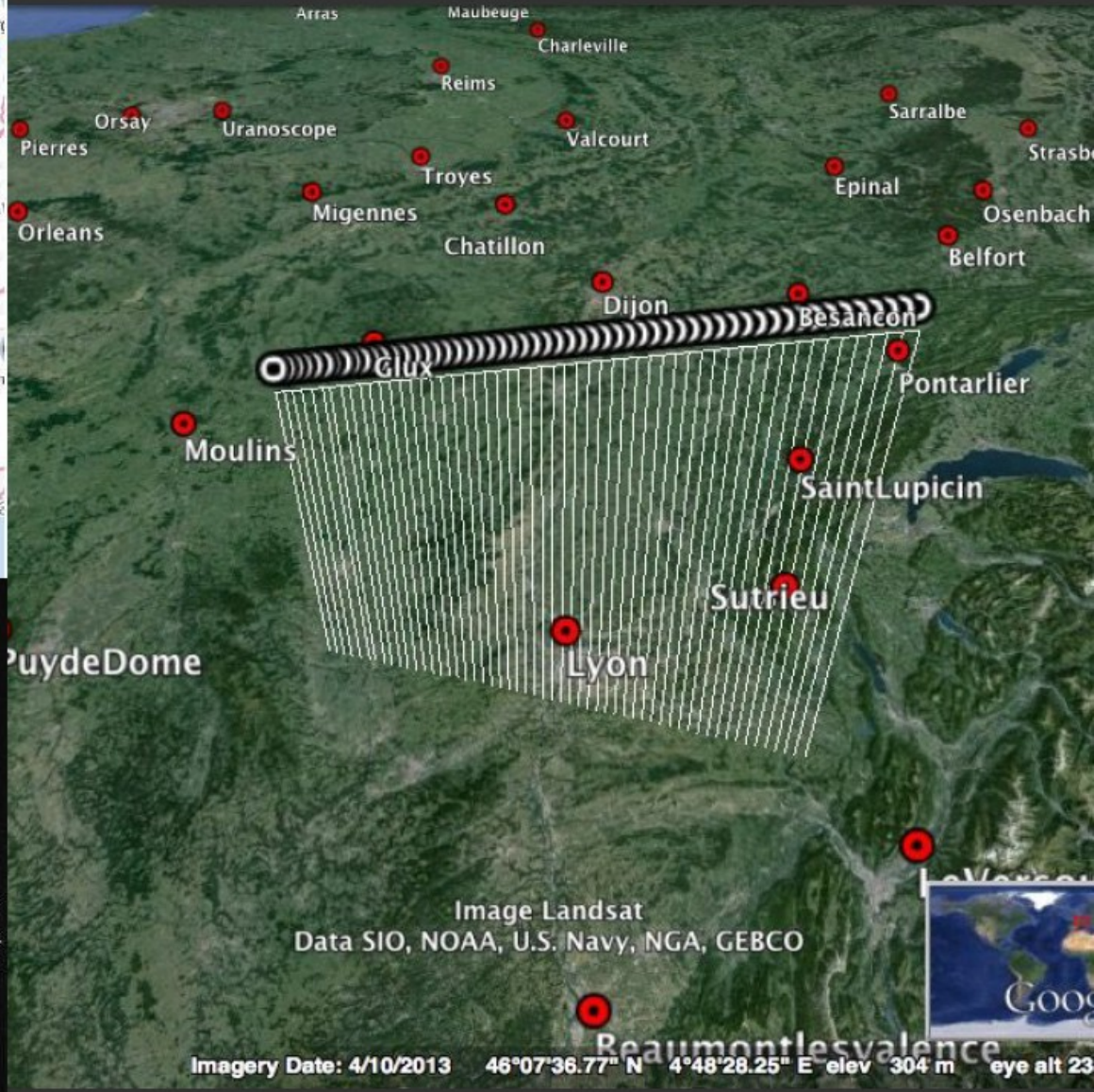
- Orbits
- A better comprehension of the atmosphere/bolide interaction
- Information about mass and composition of bolides
- Collect of meteorites
- Seize the means of production
- Take of the world

First possible falls *(3 since 2016)*




Le Havre
Caen
Paris
France
Dijon
Rochelle
Limoges
Lyon
Bordeaux
Toulouse
Marseille

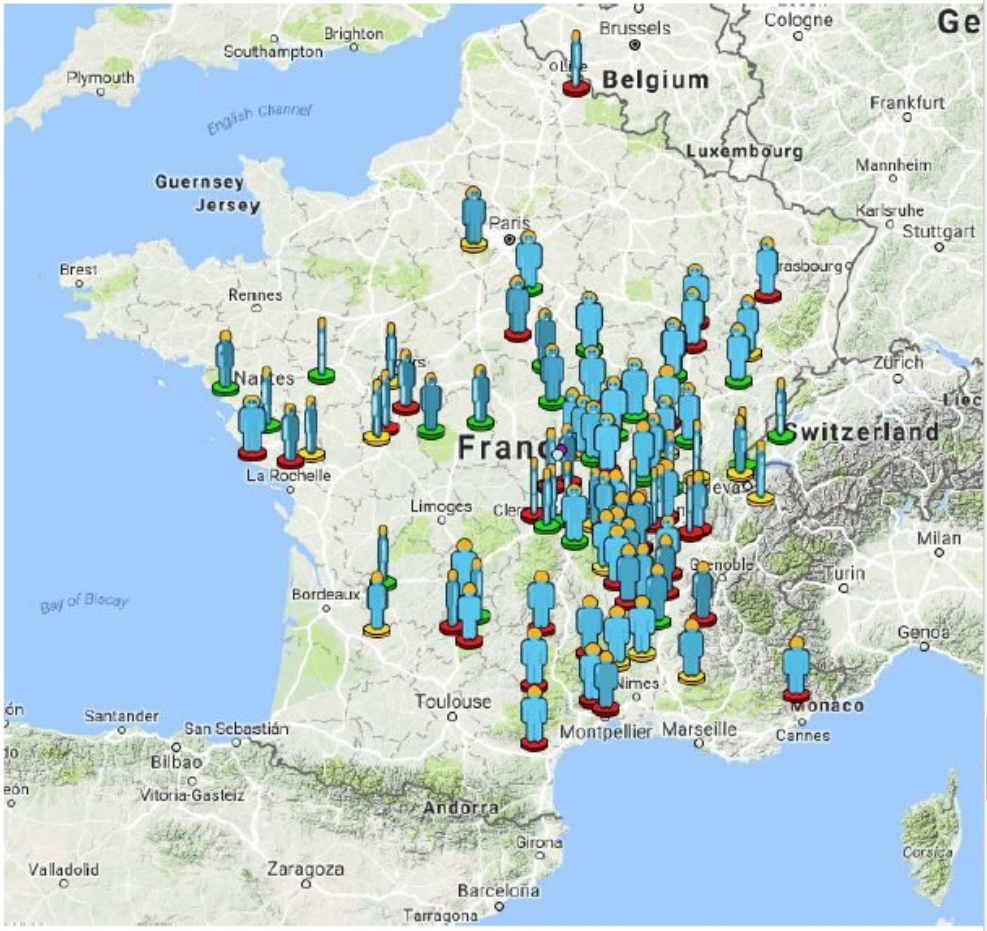

Lyon


Arras
Maubeuge
Charleville
Reims
Orsay
Uranoscope
Pierres
Valcourt
Sarralbe
Troyes
Epinal
Migennes
Orleans
Chatillon
Belfort
Dijon
Besancon
Pontarlier
Moulins
SaintLupicin
Sutrieu
PuydeDome
Lyon
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Imagery Date: 4/10/2013 46°07'36.77" N 4°48'28.25" E elev 304 m

Fireball

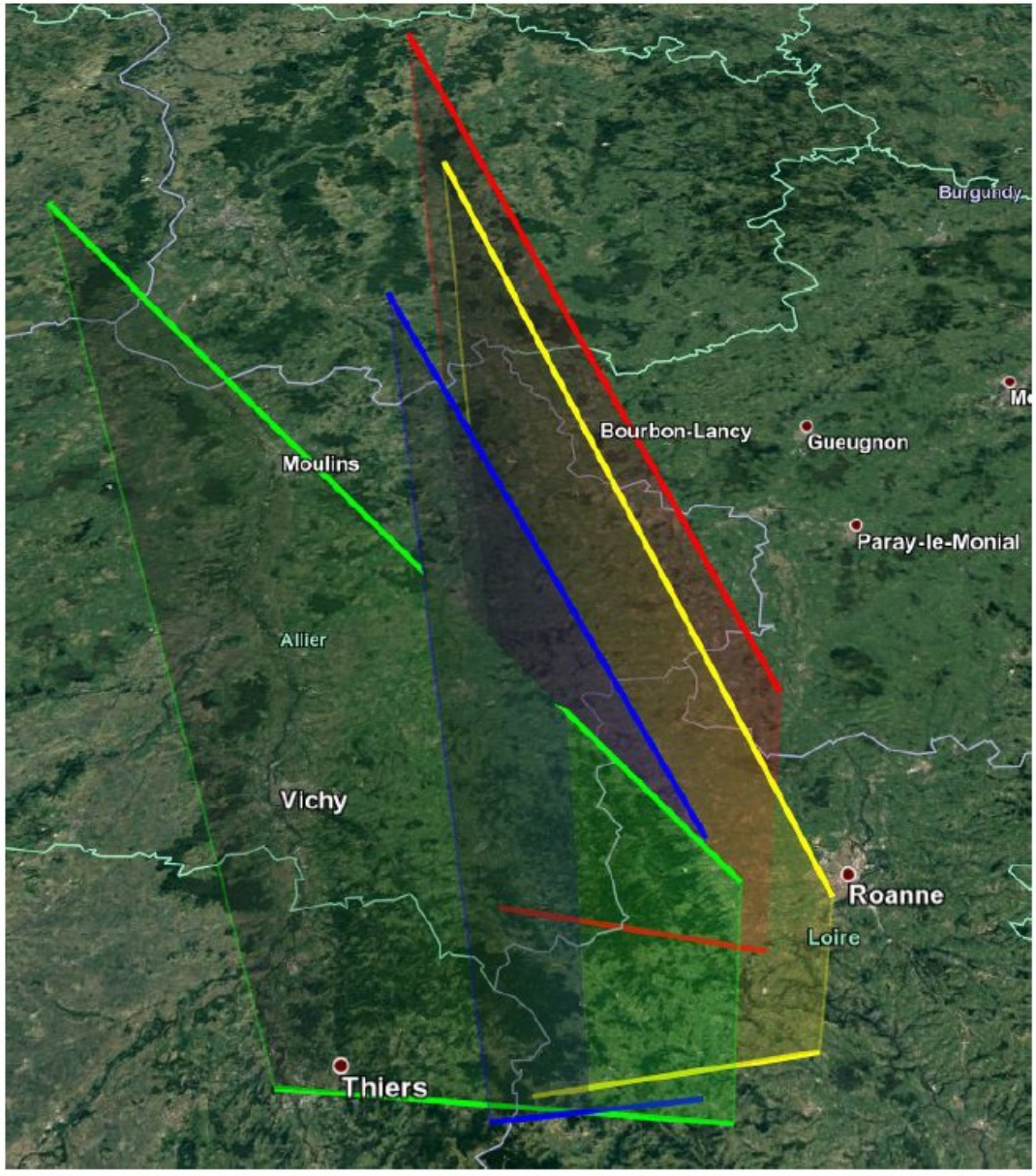
2016 08 06 22h08m UTC

Gaël Le Bas, Céron



IMO/AMS observations

Trajectory computation



From all the observations reported to the AMS/IMO

From the observations reported within 4 hours after the event

From REFORME & BOAM (video data)

From FRIPON DATA

Egal et al (2017)

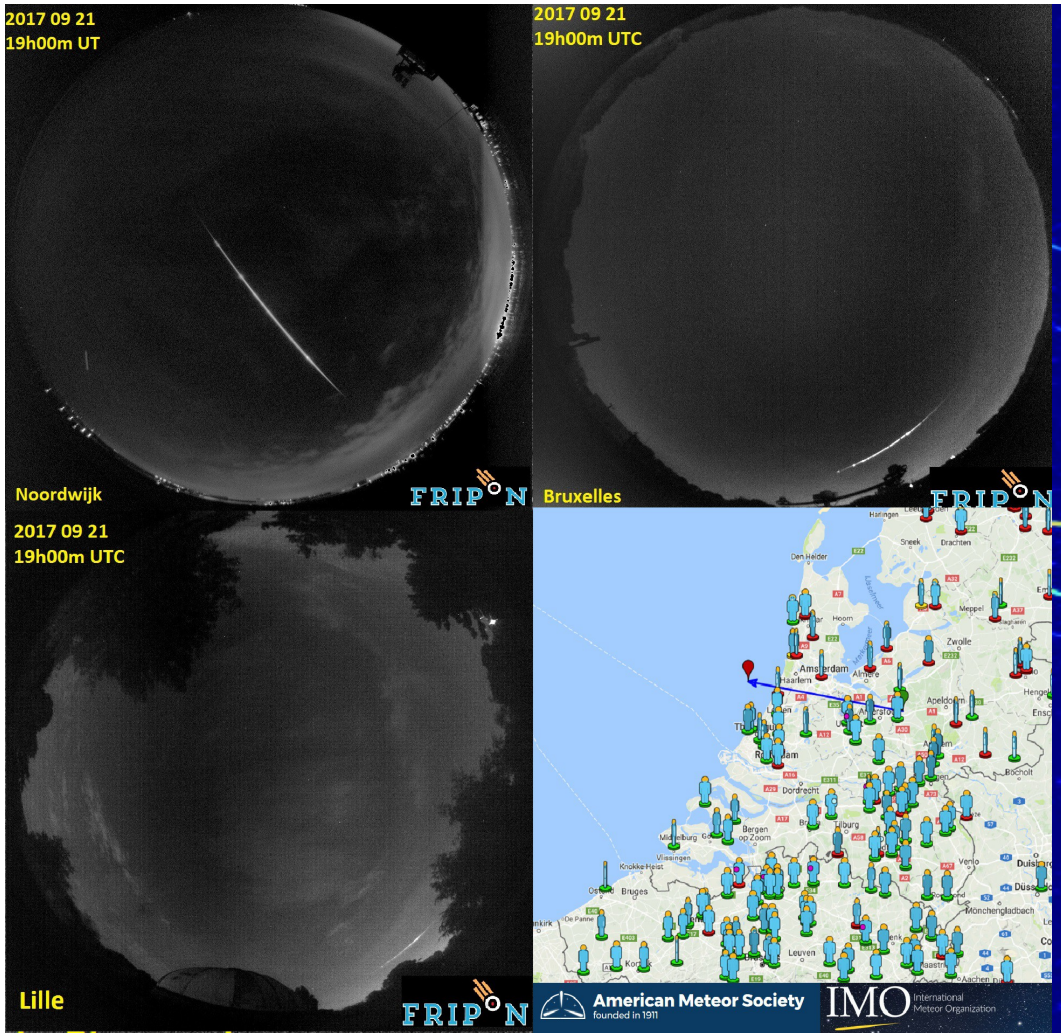
Main change from one year ago...

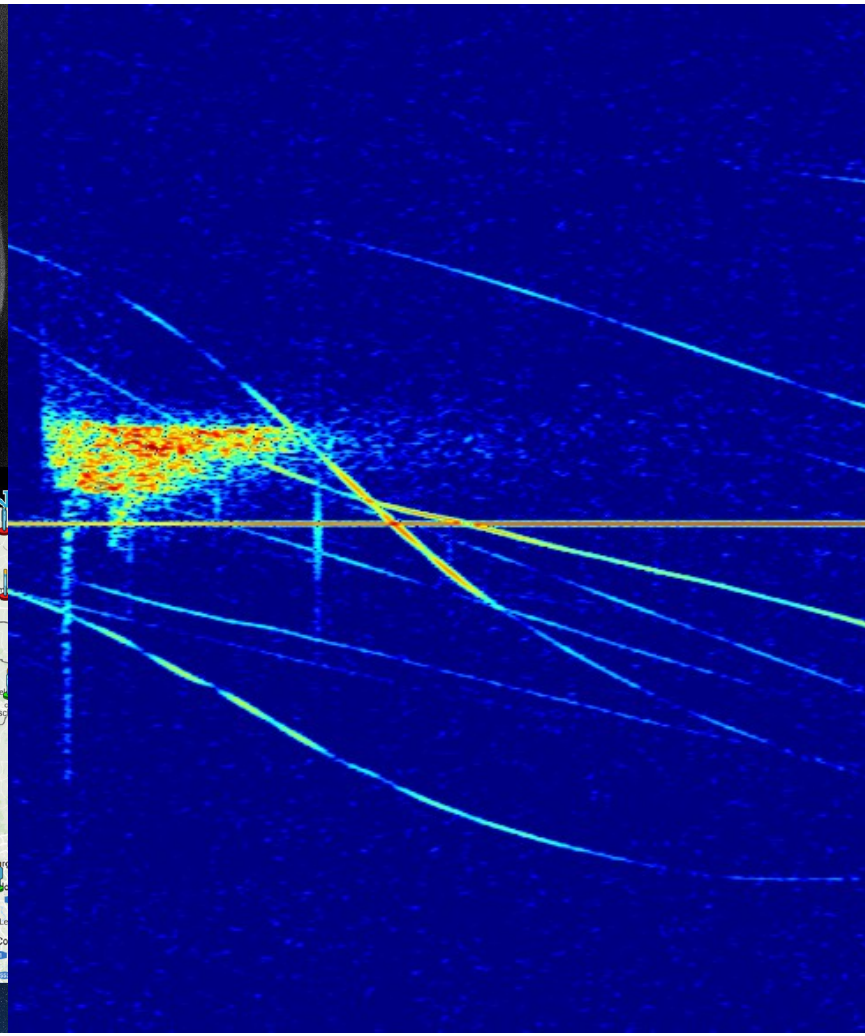
2016, game with hidden meteorites...

2017, real research of a possible fall

Extension of the Network over Europe

First detection over Northern Europe 2017 septembre 21 19h00m UTC



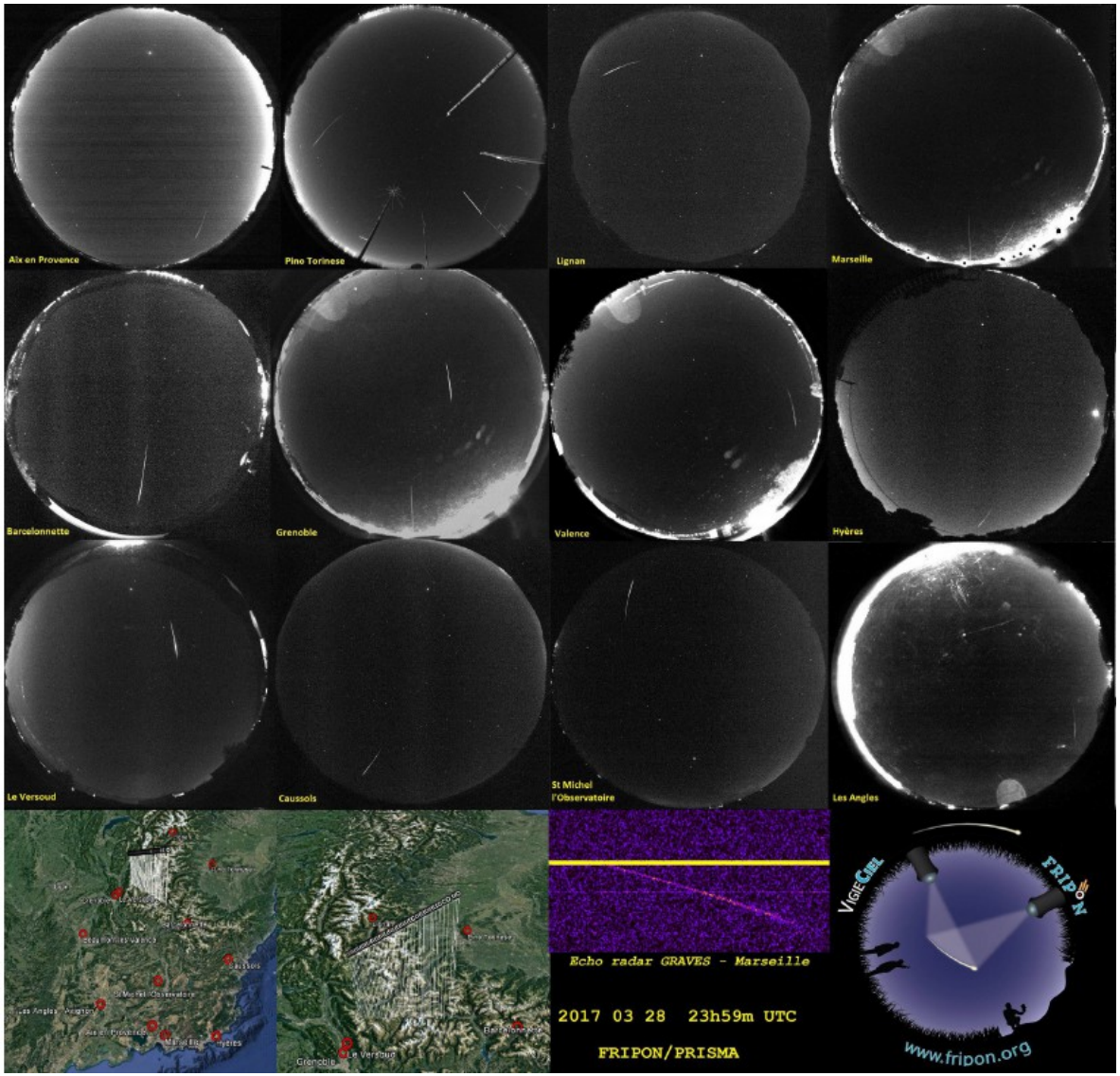


Fripon cameras (5 in total)

Brams echo

Extension of the Network over Europe

First Franco – Italian detection march 2017 28

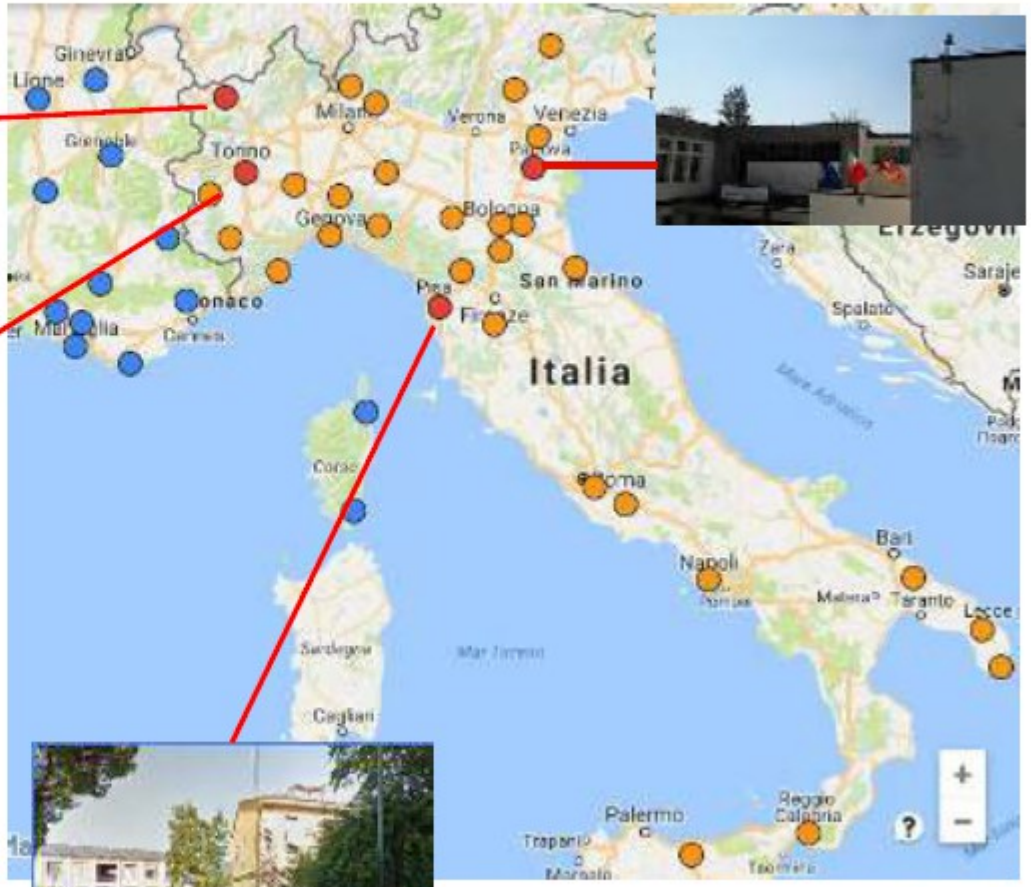


PRISMA one year ago (Reunion FRIPON Marseille, June 2016)

PRISMA station

FRIPON stations

PRISMA today (Reunion FRIPON Paris, May 2017)



PRISMA stations

**** Connected***

**** Under deployement***

FRIPON stations