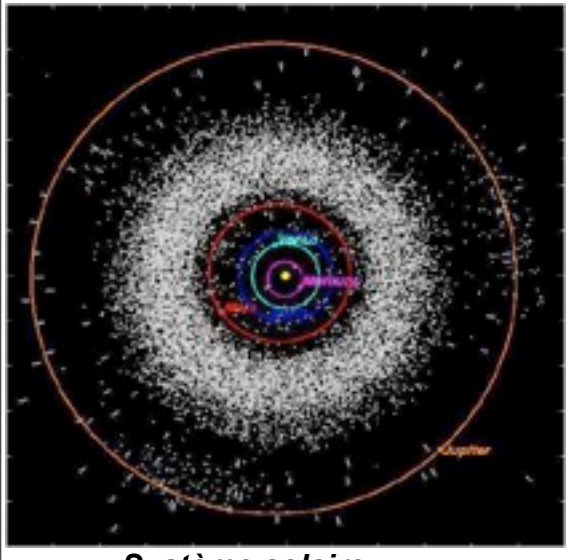
# FRIPON : 100 caméras dans l'hexagone pour surveiller le ciel

## *(Fireball Recovery and Interplanetary Observation Network)*



*Système solaire*

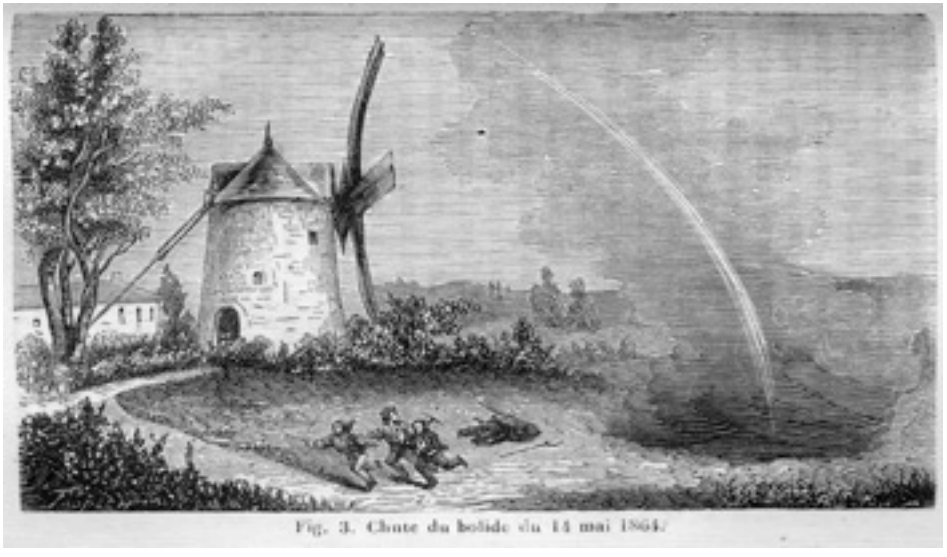


Fig. 3. Chute du bolide du 14 mai 1864.

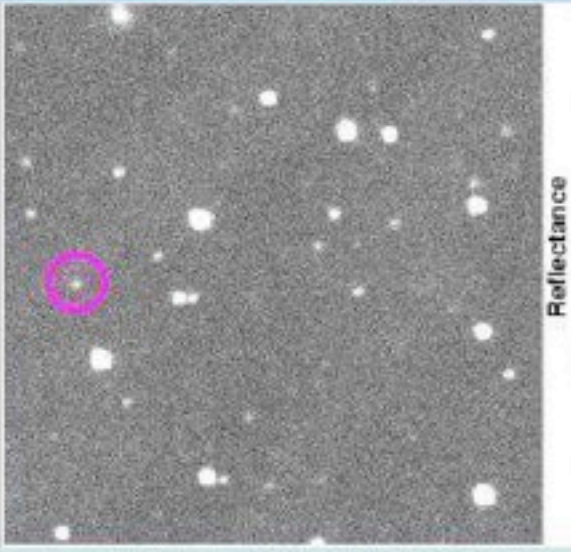
*Chute de la météorite d'Orgueil en 1864*

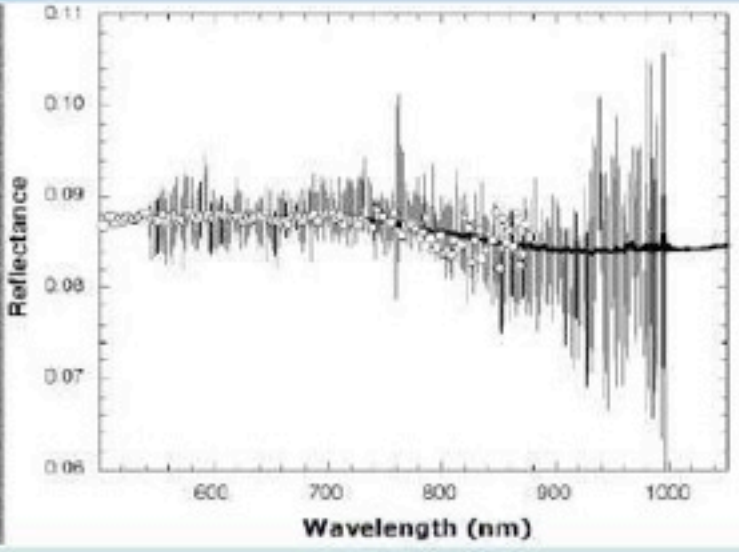

**J. VAUBAILLON**
**F. COLAS**

***IMCCE***

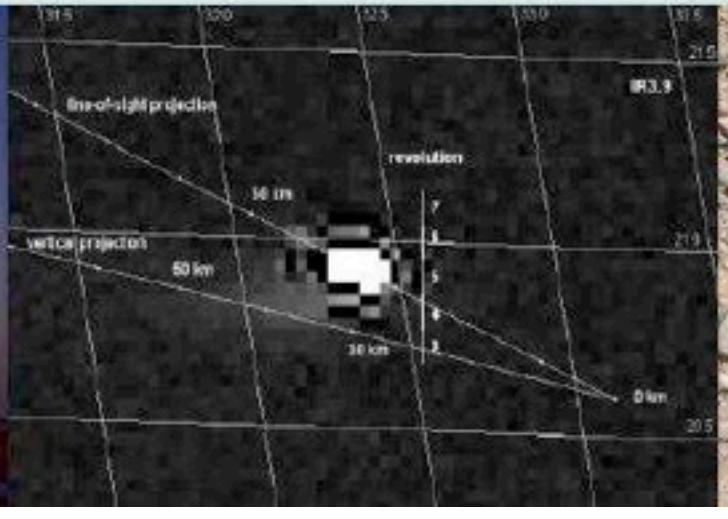

***Conférence CAIPAN, CNES, 8-9 juillet 2014***

# 2008 TC3

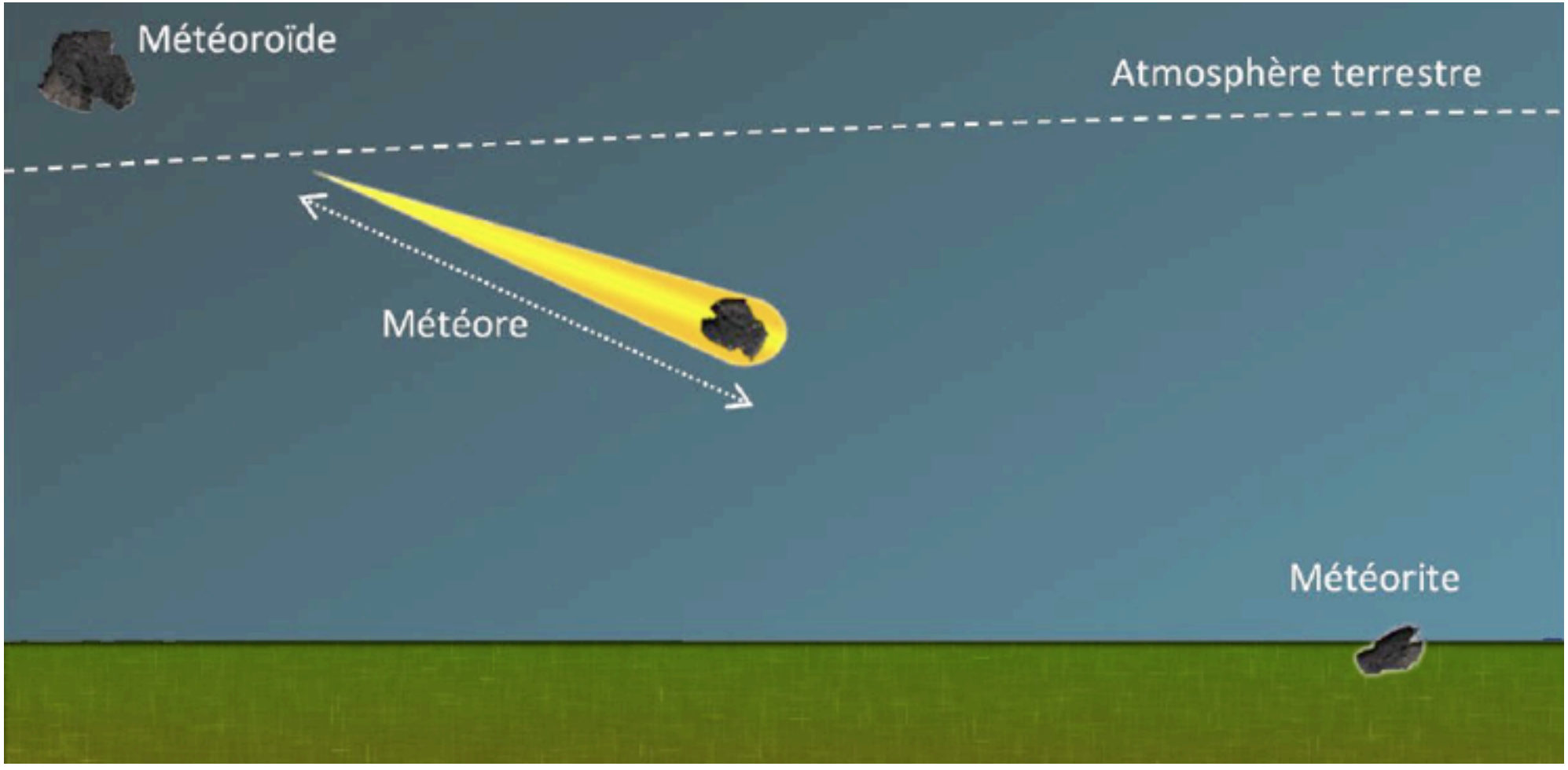




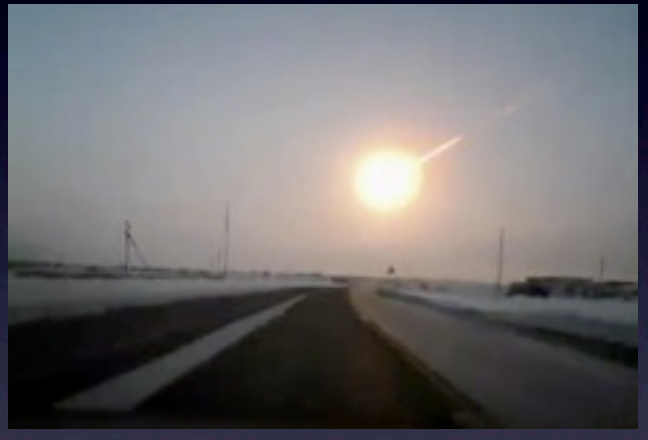

# Almahata Sitta



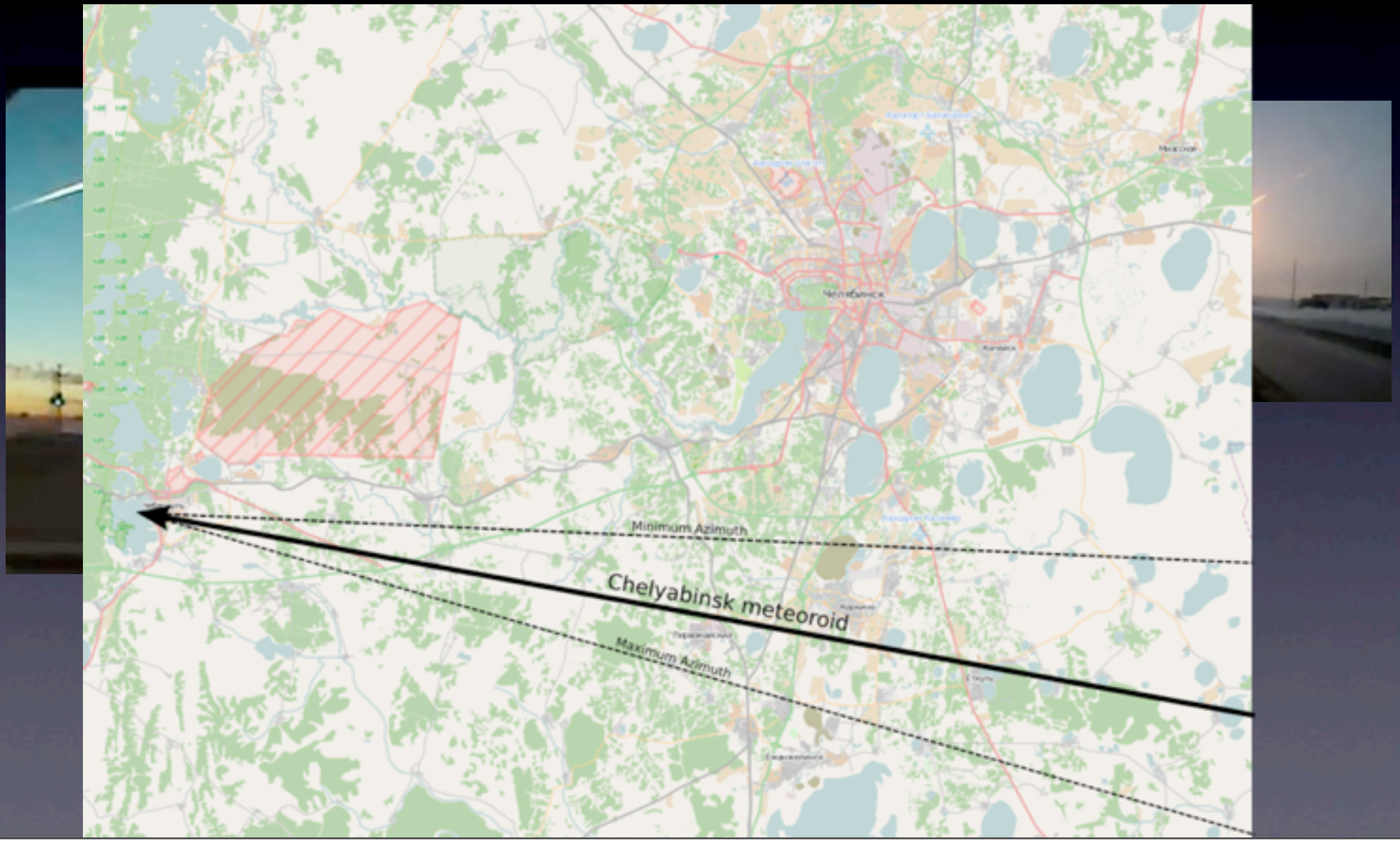

# What is a meteor?



# Chelyabinsk 15/02/13



# Chelyabinsk 15/02/13



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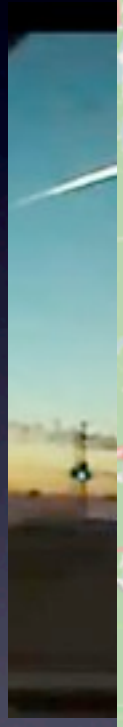

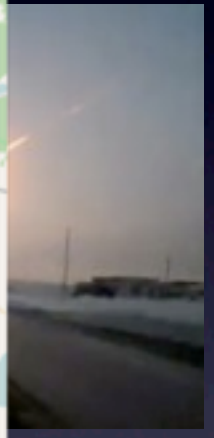

# Meteor - Bolide

- Size
- 0.1 mm - 10 m
- Speed :
- 11 - 71 km/s
- altitude :
- 80 - 110 km

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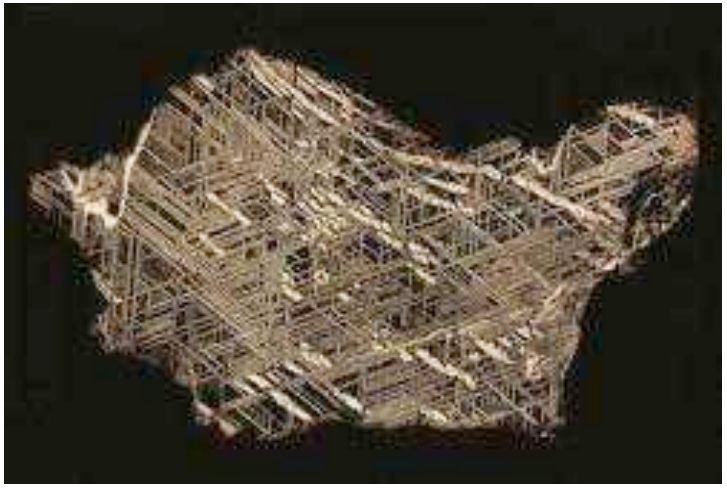
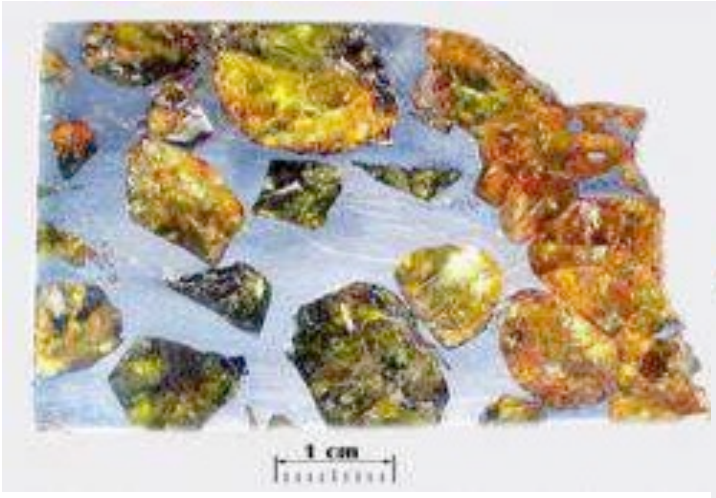
# Connexion asteroid / meteorite

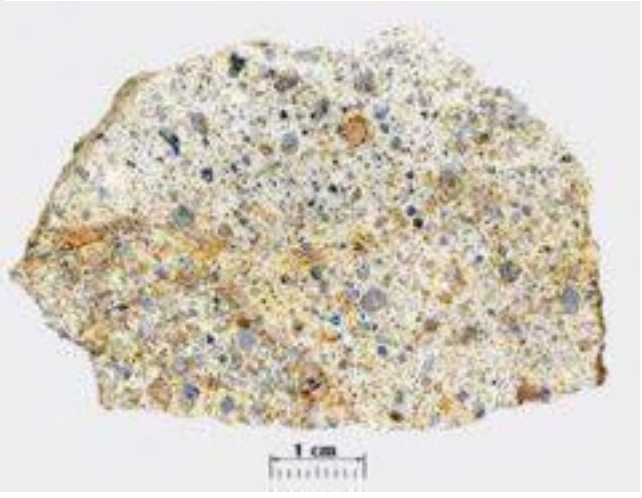
## Geology



Iron meteorite

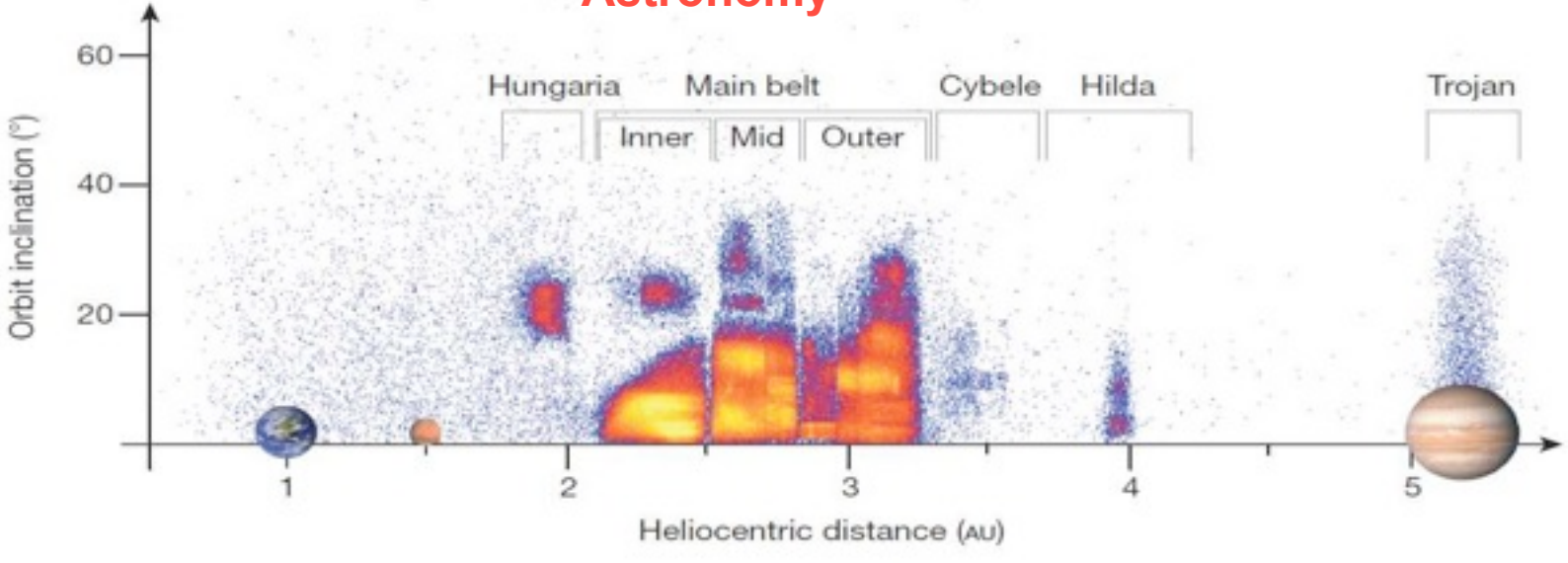



Pallasite




Achondrite

## Astronomy



| Name | Date of fall (UT) | Meteorite type | Recovered mass (kg) | $V_\infty$ (km s$^{-1}$) | $a$ | $e$ | $i$ | $\omega$ | $\Omega$ |
|---|---|---|---|---|---|---|---|---|---|
| Přibram | 1959/04/07 | H5 | 5.8 | 20.89 | 2.4 | 0.67 | 10.5 | 241.8 | 17.8 |
| Lost City | 1970/01/04 | H5 | 17 | 14.2 | 1.66 | 0.42 | 12.0 | 161.1 | 283.8 |
| Innisfree | 1977/02/06 | L5 | 4.58 | 14.54 | 1.87 | 0.47 | 12.2 | 177.9 | 317.5 |
| Peekskill | 1992/10/09 | H6 | 12.4 | 14.72 | 1.49 | 0.41 | 4.9 | 307.6 | 17.0 |
| Tagish Lake | 2000/01/18 | C2 | ~10 | 15.8 | 1.98 | 0.55 | 2.0 | 224.4 | 297.9 |
| Morávka | 2000/05/06 | H5 | 0.633 | 22.5 | 1.85 | 0.47 | 32.2 | 203.5 | 46.3 |
| Neuschwanstein | 2002/04/06 | EL6 | 6.19 | 20.95 | 2.4 | 0.67 | 11.4 | 241.2 | 16.8 |
| Park Forest | 2003/03/27 | L5 | 18 | 19.5 | 2.53 | 0.68 | 3.2 | 237.5 | 6.1 |
| Villalbeto de la Peña | 2004/01/04 | L6 | 3.5 | 16.9 | 2.3 | 0.63 | 0.0 | 132.3 | 283.7 |
| Bunburra Rockhole | 2007/07/20 | Euc | 0.324 | 13.4 | 0.85 | 0.25 | 9.1 | 209.9 | 297.6 |
| Almahata Sitta (2008 $TC_3$) | 2008/10/07 | Ure-Anom | 3.95 | 12.42 | 1.31 | 0.31 | 2.5 | 234.5 | 194.1 |
| Buzzard Coulee | 2008/11/21 | H4 | >50 | 18.0 | 1.23 | 0.22 | 25.5 | 212.0 | 238.9 |
| Jesenice | 2009/04/09 | L6 | 3.6 | 13.8 | 1.75 | 0.43 | 9.6 | 190.5 | 19.2 |

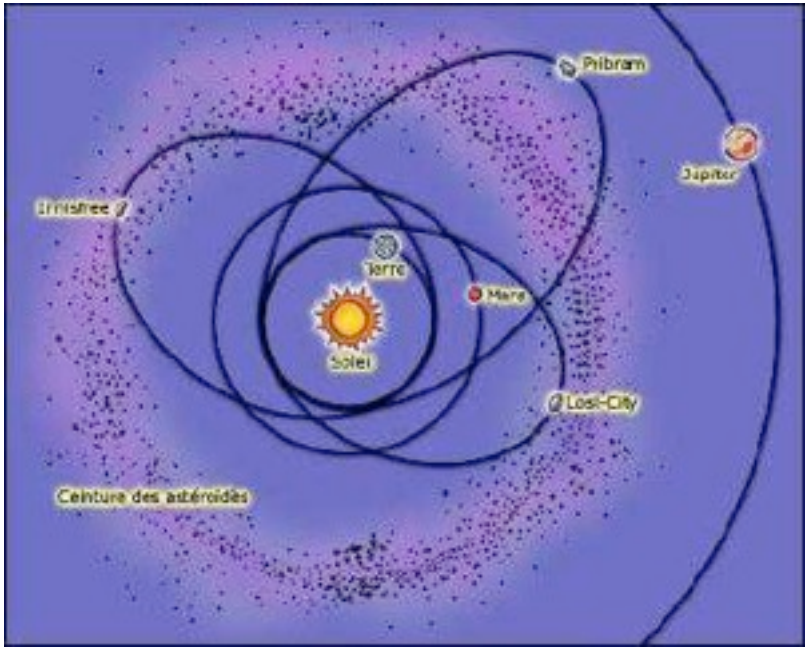



Table 4. Heliocentric orbit for the Grimsby meteorite.

| | |
|---|---|
| $\alpha_r$ | 248.93 ± 0.22° |
| $\delta_r$ | 55.87 ± 0.11° |
| $V_\infty$ | 20.91 ± 0.19 km s$^{-1}$ |
| $V_g$ | 17.89 ± 0.22 km s$^{-1}$ |
| $\alpha_g$ | 242.61 ± 0.26° |
| $\delta_g$ | 54.97 ± 0.12° |
| $a$ | 2.04 ± 0.05 AU |
| $e$ | 0.518 ± 0.011 |
| $i$ | 28.07 ± 0.28° |
| $\omega$ | 159.865 ± 0.43° |
| $\Omega$ | 182.9561° |
| $q$ | 0.9817 ± 0.0004 AU |
| $Q$ | 3.09 ± 0.10 AU |

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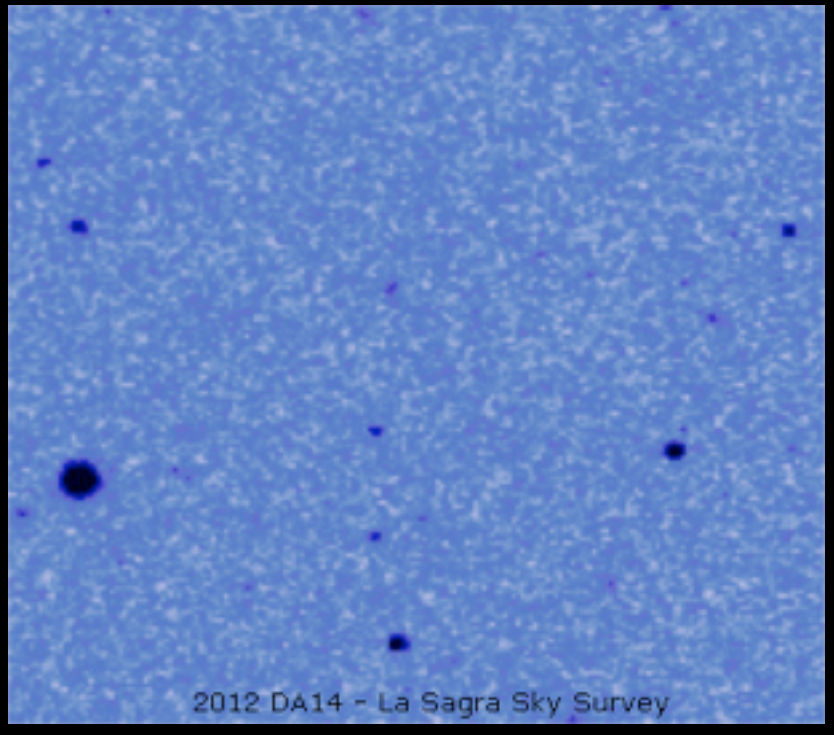
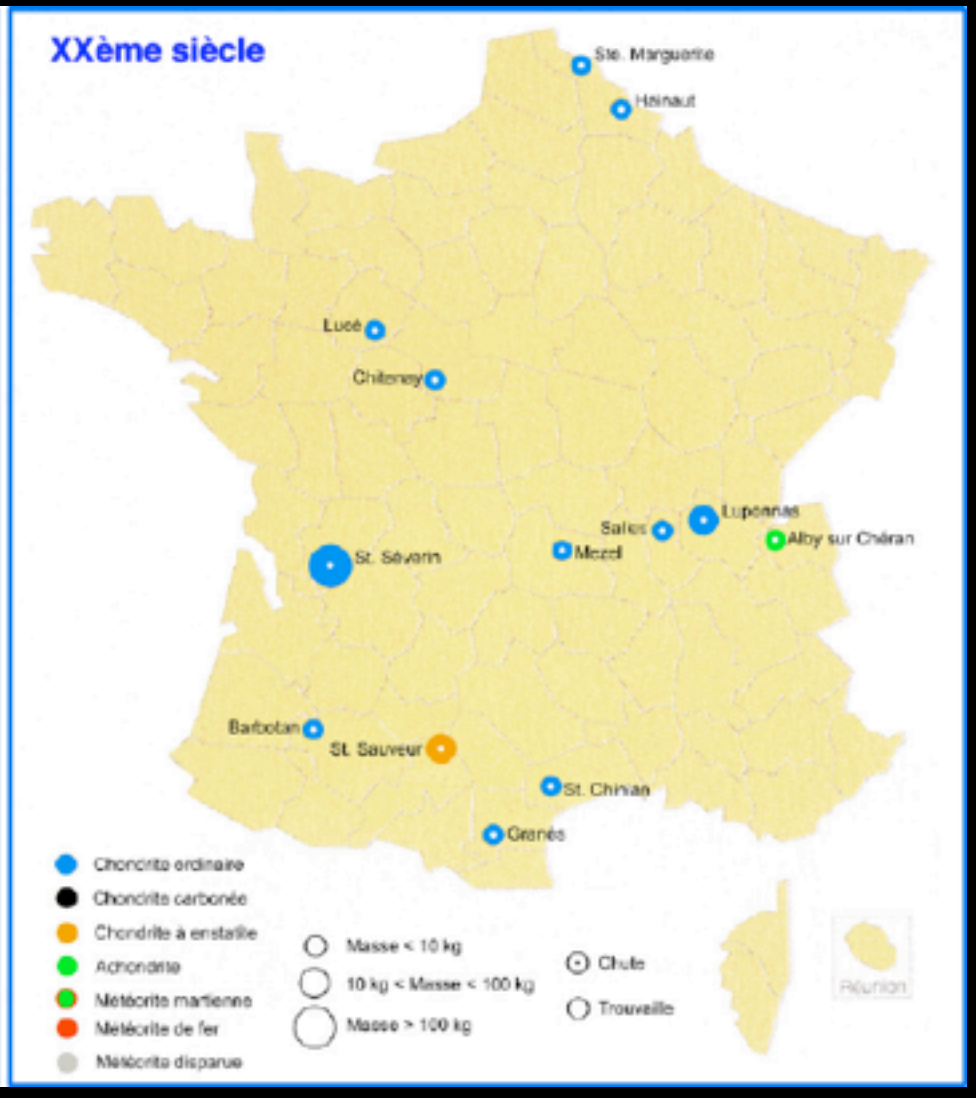
# Two aspects of the same problem !




2012 DA14 from La Sagra Obs. (Spain) *15th feb 2013*

Cheliabinsk (Russia) *15th Feb 2013 …*

# Frequency of falls in France


XIX$^{th}$ c.: 46 meteorites
XX$^{th}$ c.: 13 meteorites

# Systematic detection of bolides



Fisheye cameras – 360° FOV

DB of all detections

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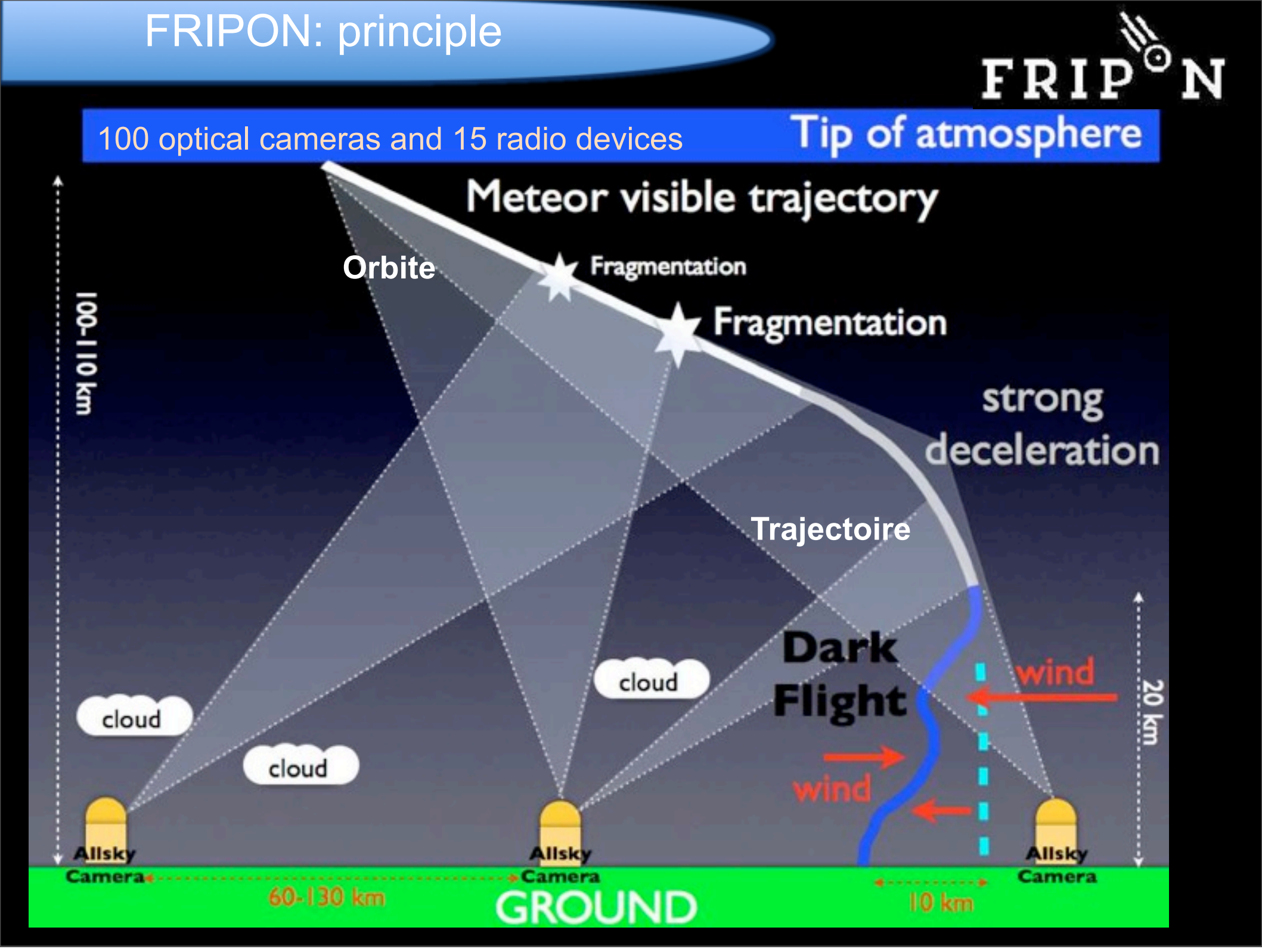
# FRIPON: principle



# The FRIPON network


IMCCE / Observatoire de Paris
→*Détermination des trajectoires/Expertise technique*

*LMCM / MNHN*
→*Search for meteorites / Science participative*

*GEOPS / OSUPS:*
→*DB, social network*

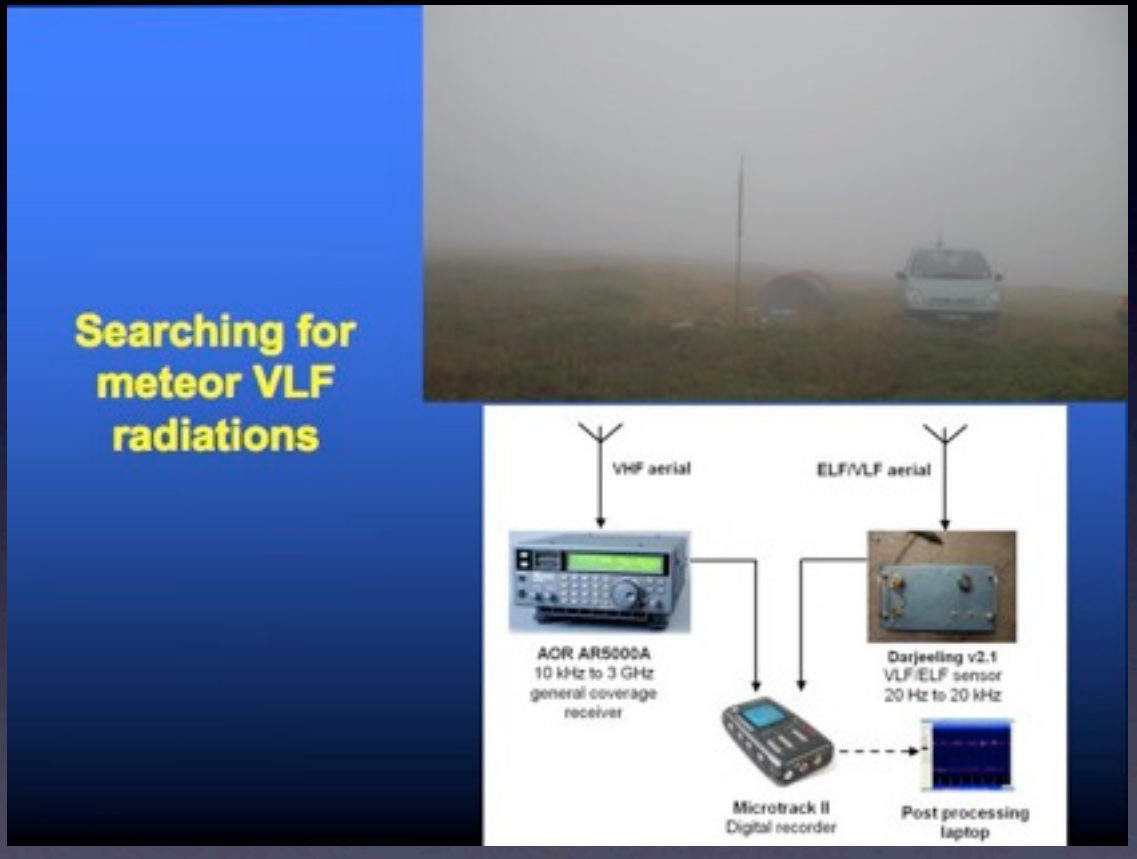
*CEREGE - LAM / OSU Pytheas*
→ *Meteorite features*

100 camera stations:

24 county stations
→ Laboratoires Astro / Univ.

75 local stations
→Amateur obs, planetarium etc.

# Radio Observations




J.L. Rault (IMO, SAF)

Obs de Lille (LORMS) - IMCCE, assoc Jonkhere, J.L. Rault (IMO, SAF)

# Autres objets visibles

# Autres objets visibles

# Autres obiets visibles

# Data

## Observations

→*Orbit, strewn field (camera triangulation)*
→*Bolide features (size, velocity, light curve, fragmentation)*
→ *Composition (spectroscopy)*

## Meteorite hunt and keep

→*Search of the meteorite in the strewn field*
→*Be on site as quick as possible (24-48hrs)*
→*Expected: 2-3 meteorites per year*

# FRIPON today

## Hardware

→*camera: still choosing / testing*
→*Radio device: 1st antennas installed on May 21st*

## Software

→*Detection + coordination pipeline*
→*Astrometry pipeline*
→*Trajectory & orbit determination*
→*Dark Flight*

## Network

→*Science network*
→*Social network*

# Conclusion

## Largest and Densest Network

→ *100 cameras in France*
→ *24/7 Survey of the whole French territory (metropolitan)*

## Near future work

→ *First cameras in late 2014*
→ *Observations starting in 2015*
→ *Radio device in late 2015*
→ *Spectro cameras in late 2015*
→ *ANRU  program: VIGIE CIEL*

# Acknowledgements


## CAIPAN organizers

→ *X. Passot - CNES*
→*Michaël Vaillant - CNES*
→ *A. Palis - Carte Blanche*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