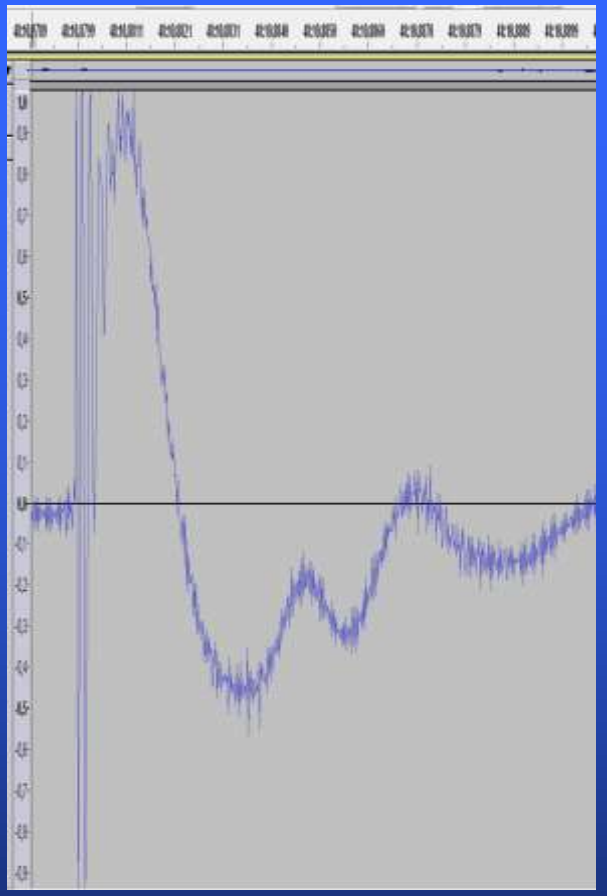
More on ELF, VLF and meteors



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Commission Radioastronomie

International Meteor Organization

Radio Commission

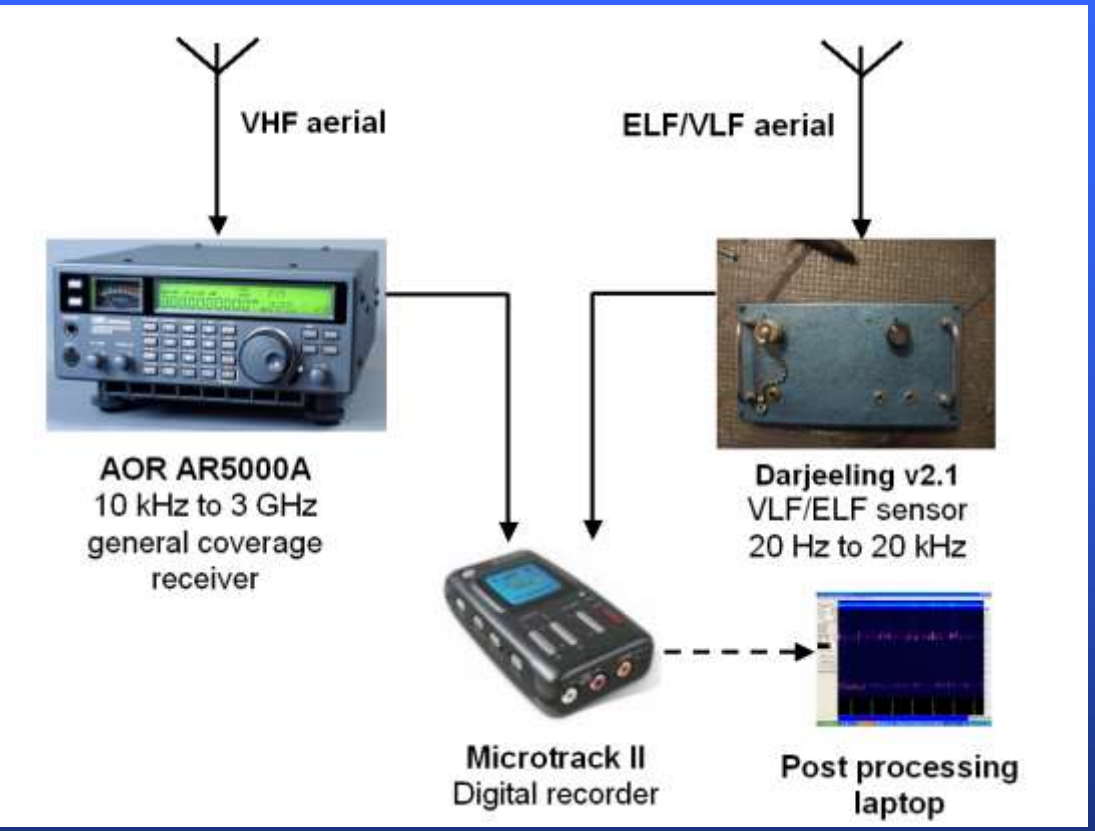
IMC, Sibiu , Romania, september 2011

A first presentation about electrophonic meteors was performed during IMC 2009 in Poreč

The present study aims to detect ELF/VLF radio waves potentially radiated by meteors entering the Earth atmosphere …

A collateral study using the same data is now under way to determine if meteors have any influence on the propagation of man-made ELF/VLF radio waves

Experimental set-up



Overview of the observation campaigns

Menez-Hom, Britanny

Leonids 2009 12 GB

Perseids 2010 18 GB

η-Aquariids 2009 12 GB

Observatoire de Haute Provence

Lyrids 2010 12 GB (video + radio)

Xaintrie Noire

Perseids 2009 12GB

Perseids 2010 18 GB

Jura

Perseids 2011 18 GB

Geminids 2010

Pic du Midi
12 Gb

Photo +video + radio

The volume of simultaneous VHF and ELF/VLF data already collected is now about 100 Gb (7 campaigns including PER, LEO, ETA, LYR and GEM + several campaigns on sporadic meteors) …

… of which less than 10% have presently been processed

A joint radio, video and photo observation campaign organized by IMCCE was performed during GEM 2010 simultaneously at Pic du Midi observatory and at Guzet ski station

© François Colas, Pic du Midi

Preliminary comparisons performed between stereoscopic photos and radio VHF and ELF-VLF records show interesting correlations

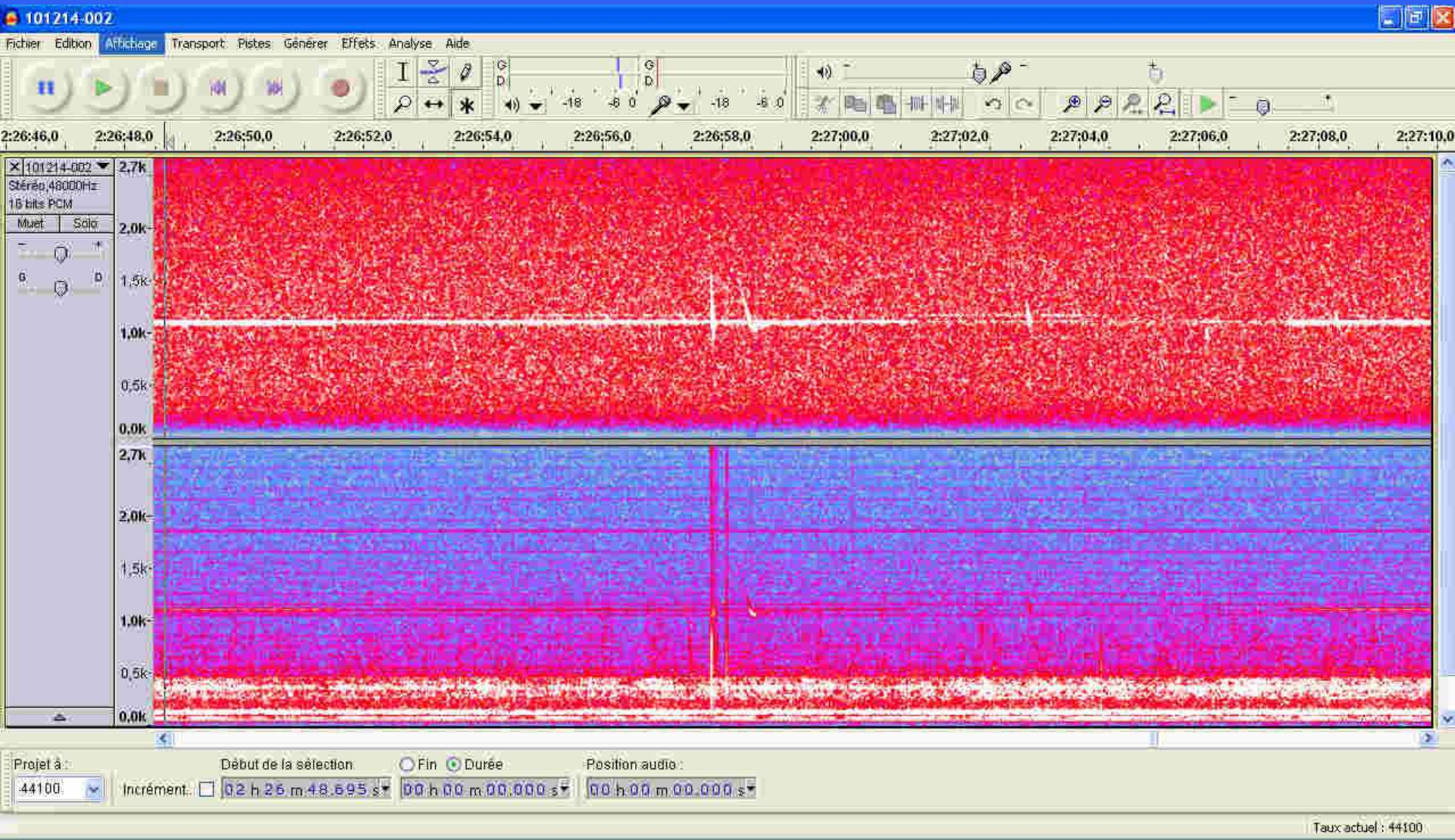
45 meteors seen simultaneously by the GUZET and by the Pic du Midi cameras have been examined until now, of which:

- 18 gave simultaneous VHF radio pings
- 6 gave simultaneous VHF pings and VLF events

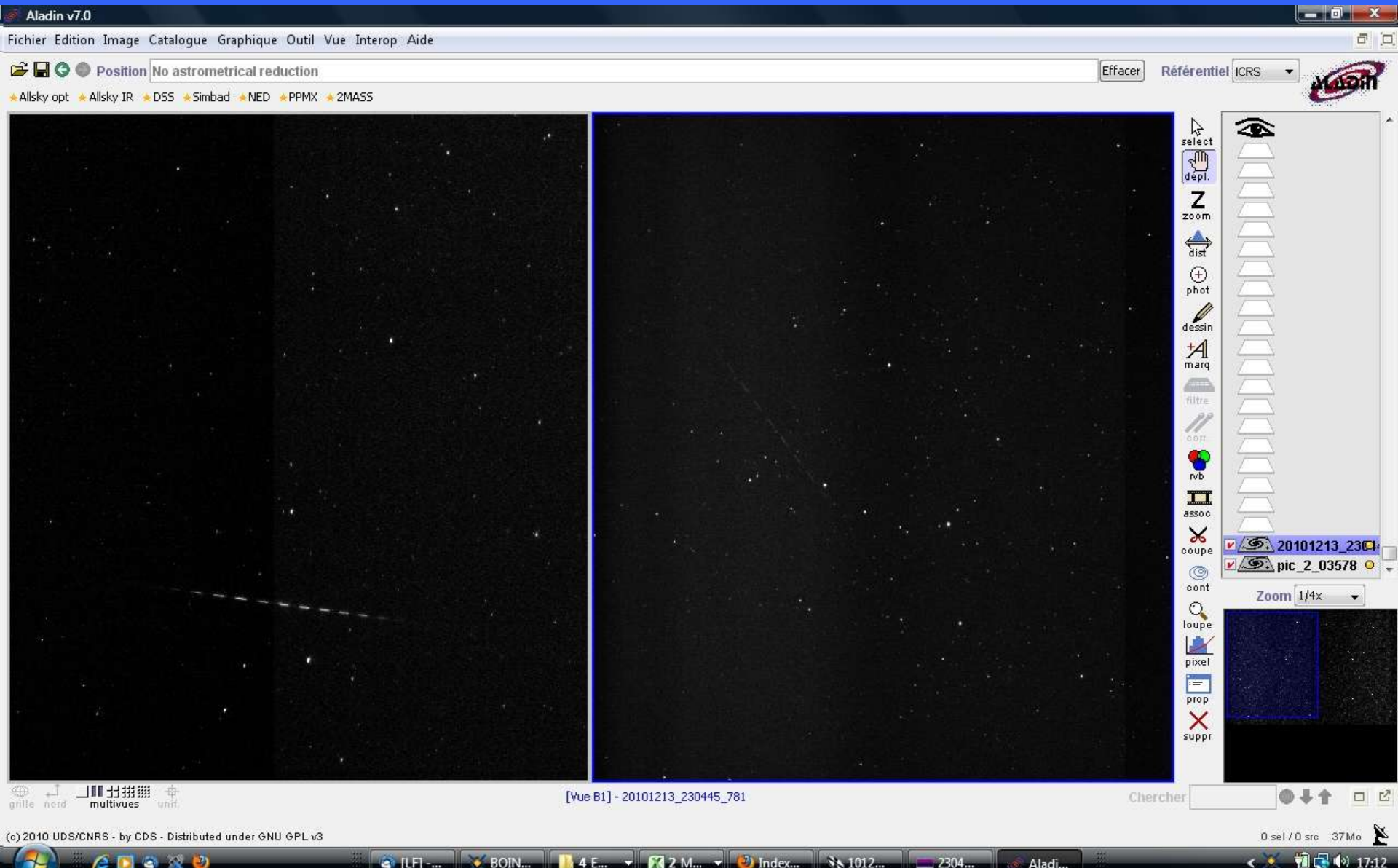
Hundred of meteors photos have still to be compared one by one to the VHF and ELF-VLF radio events …

Example of a same GEM meteor seen from Guzet station and from OMP @ 04:38:24 UTC on the 14th of december 2010

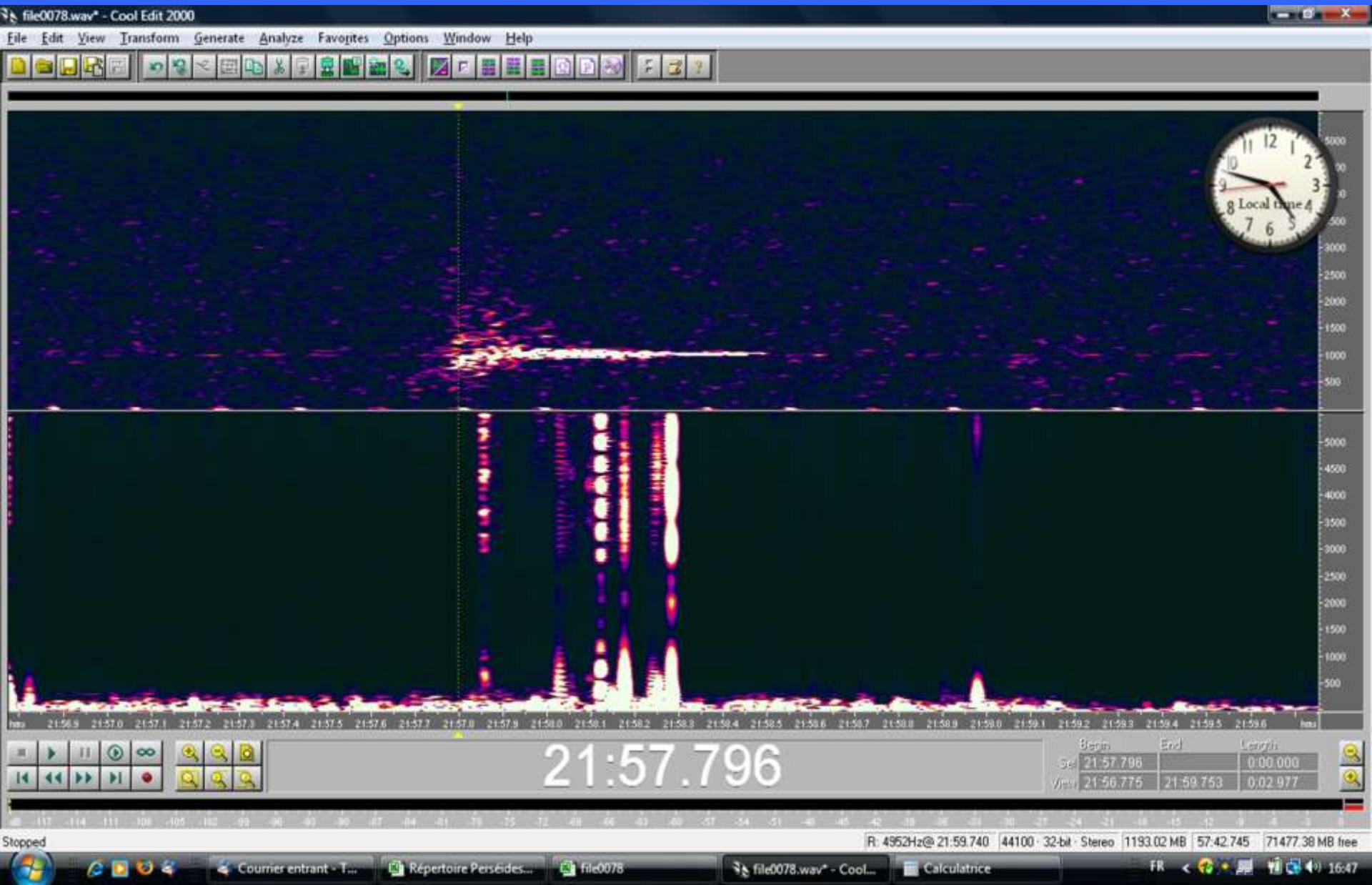
… and simultaneously detected in VHF forward scatter AND on VLF



Another example of a same GEM meteor at 23:04:45 UTC on the 13th of december 2010



… and simultaneously detected in VHF forward scatter AND on VLF



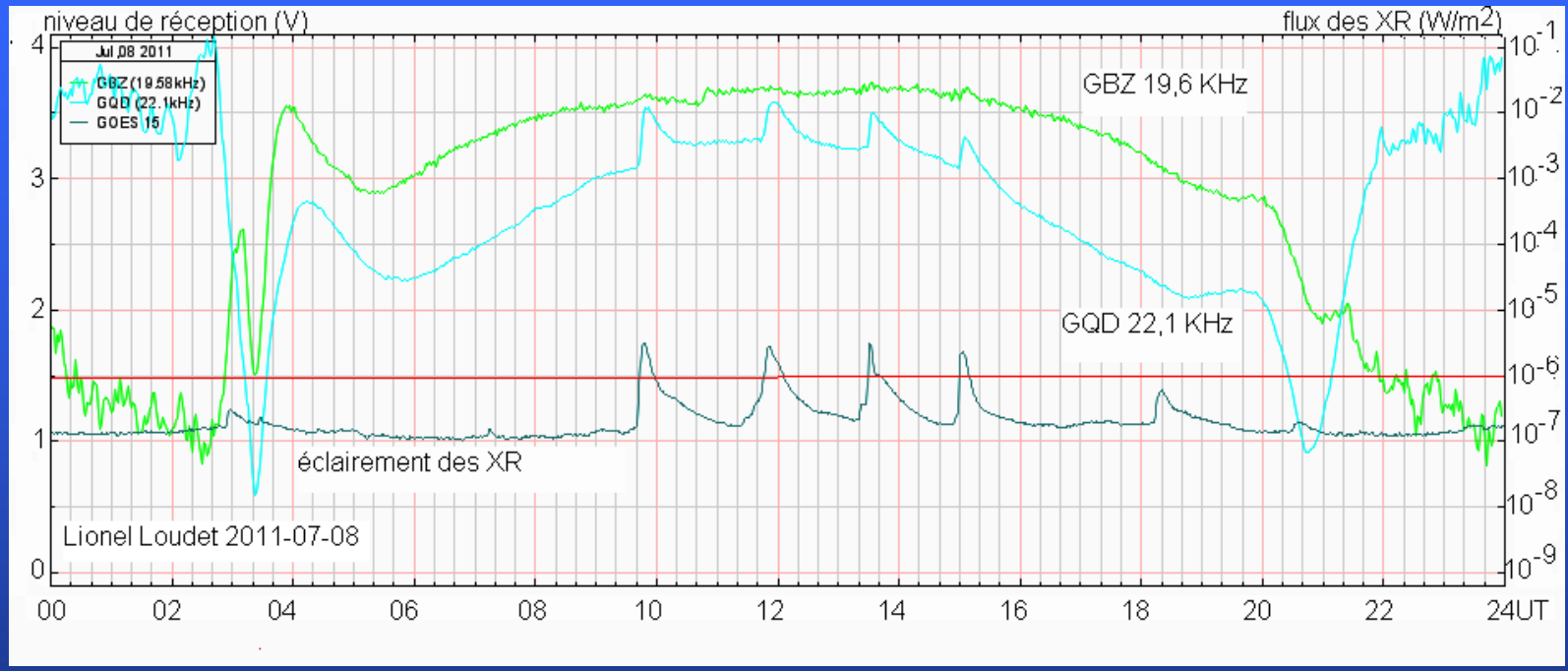
The ELF-VLF radio records contain natural events, but also several man-made VLF transmissions (military communications with submarines).

Fluctuations of the recorded amplitudes and phases of these VLF transmissions are linked to the densities and to the altitudes of the D and E ionospheric layers

So an answer to the question « *Do meteors produce enough free electrons to modify the VLF ionosphere / Earth wave guide ??* » is presently under study, using correlation technique between the VHF meteors echoes and any related VLF SID (Sudden Ionospheric Disturbances).

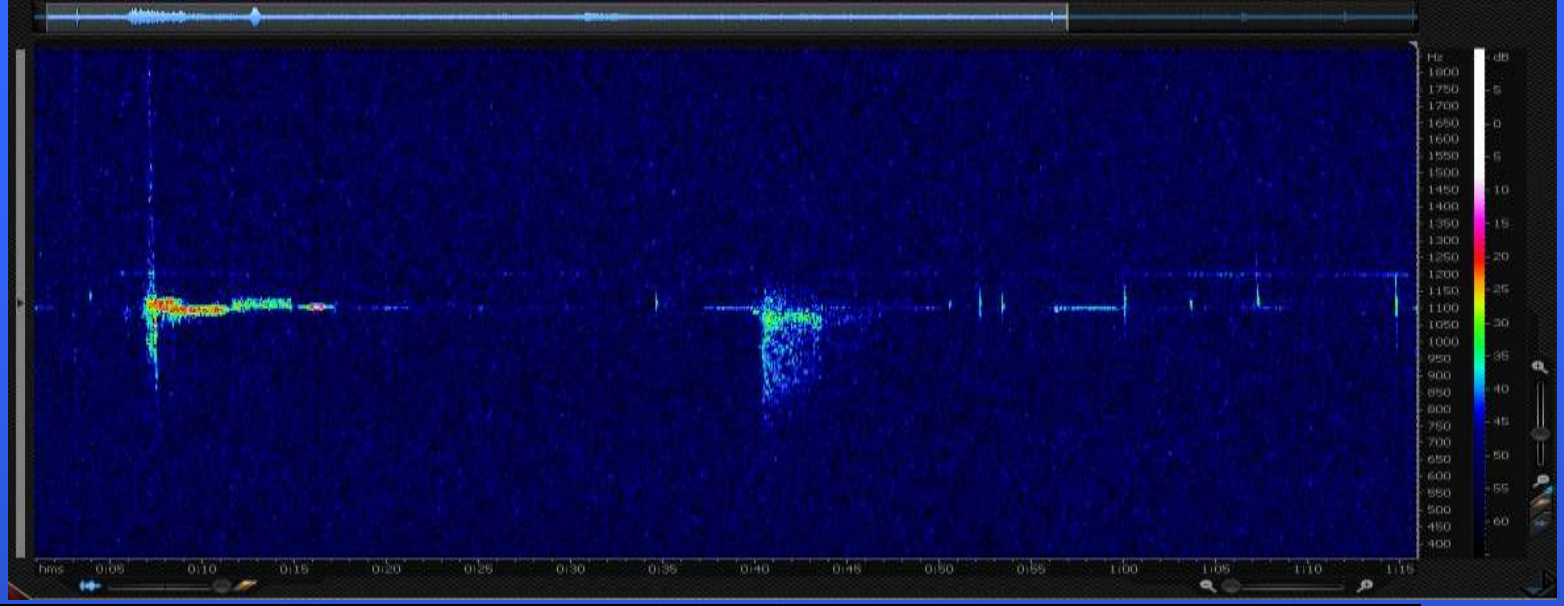
Well known SIDs are produced by Sun flares radiating sudden UV bursts. Other SIDs called TRIMPIs come from high energy electrons interacting with magnetospheric whistlers

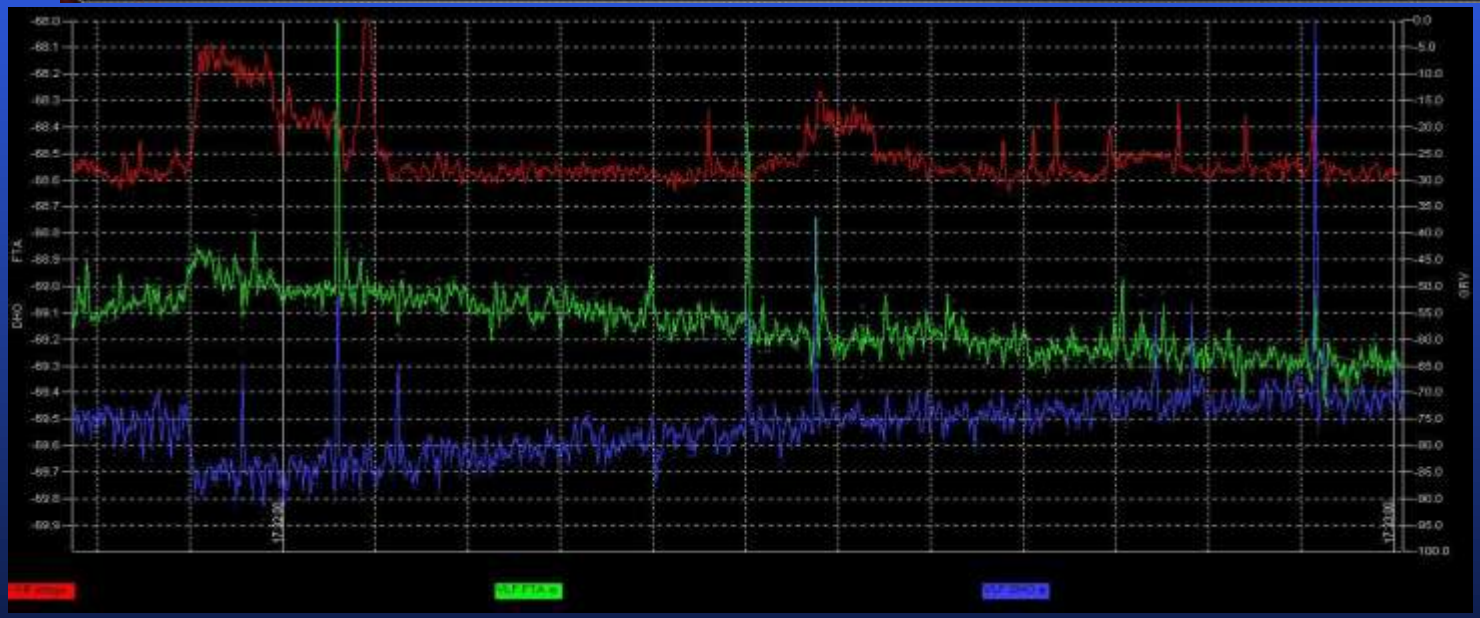
But what about meteor SIDs ?



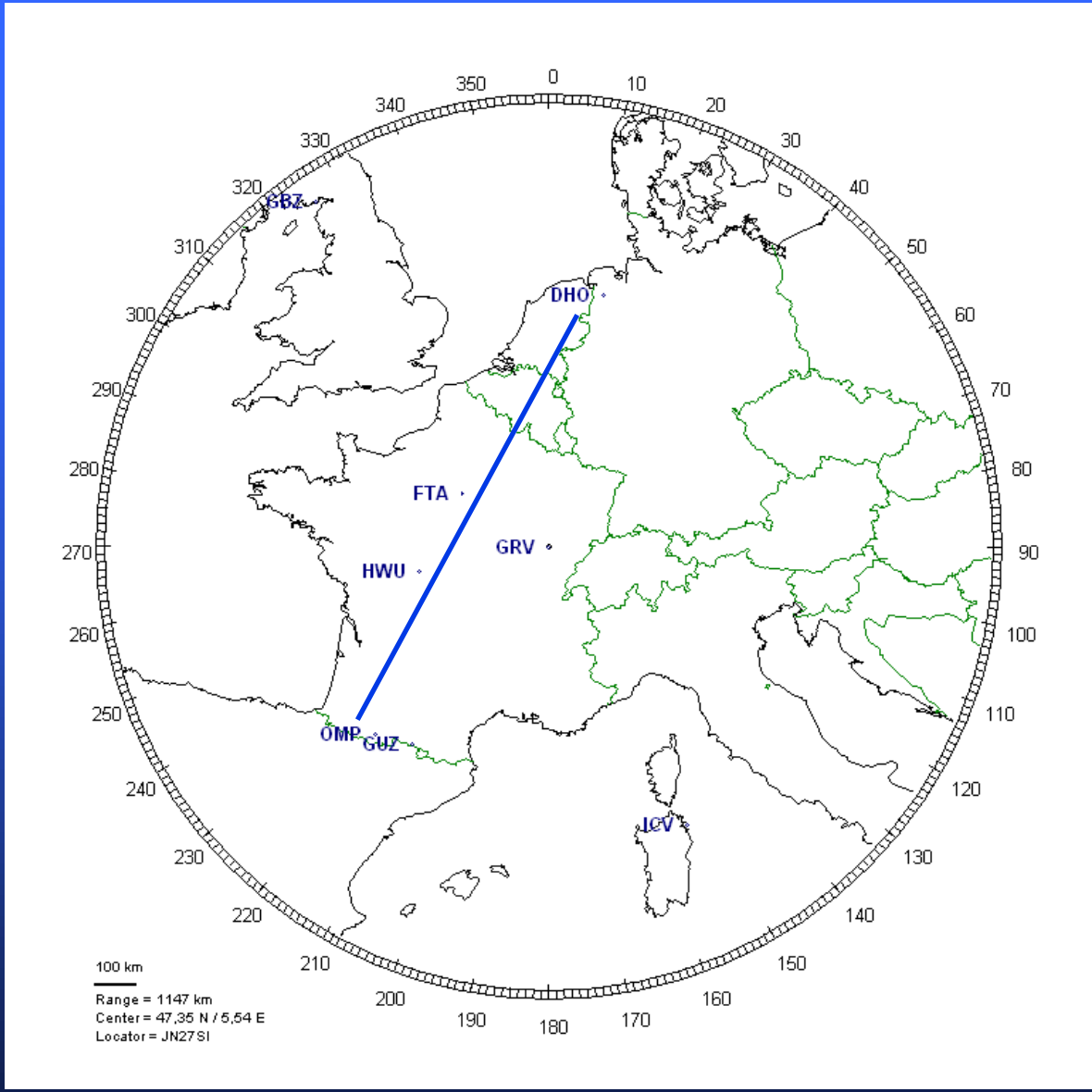
Examples of successive Sun SIDs

(Observer: Lionel Loudet, Toulouse)

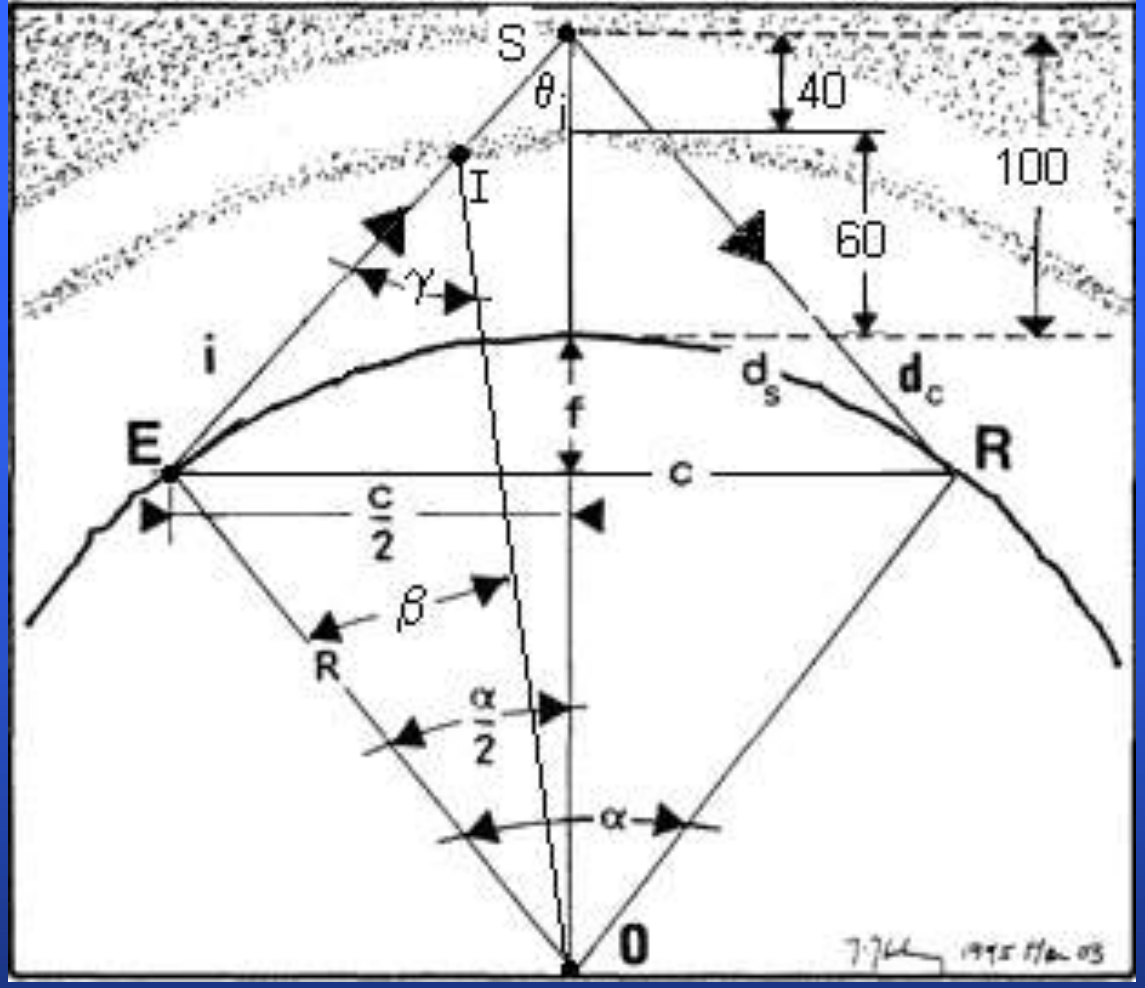




Example of a meteor triggered SID observed during the GEM 2010 campaign



1D VLF circuit geometry



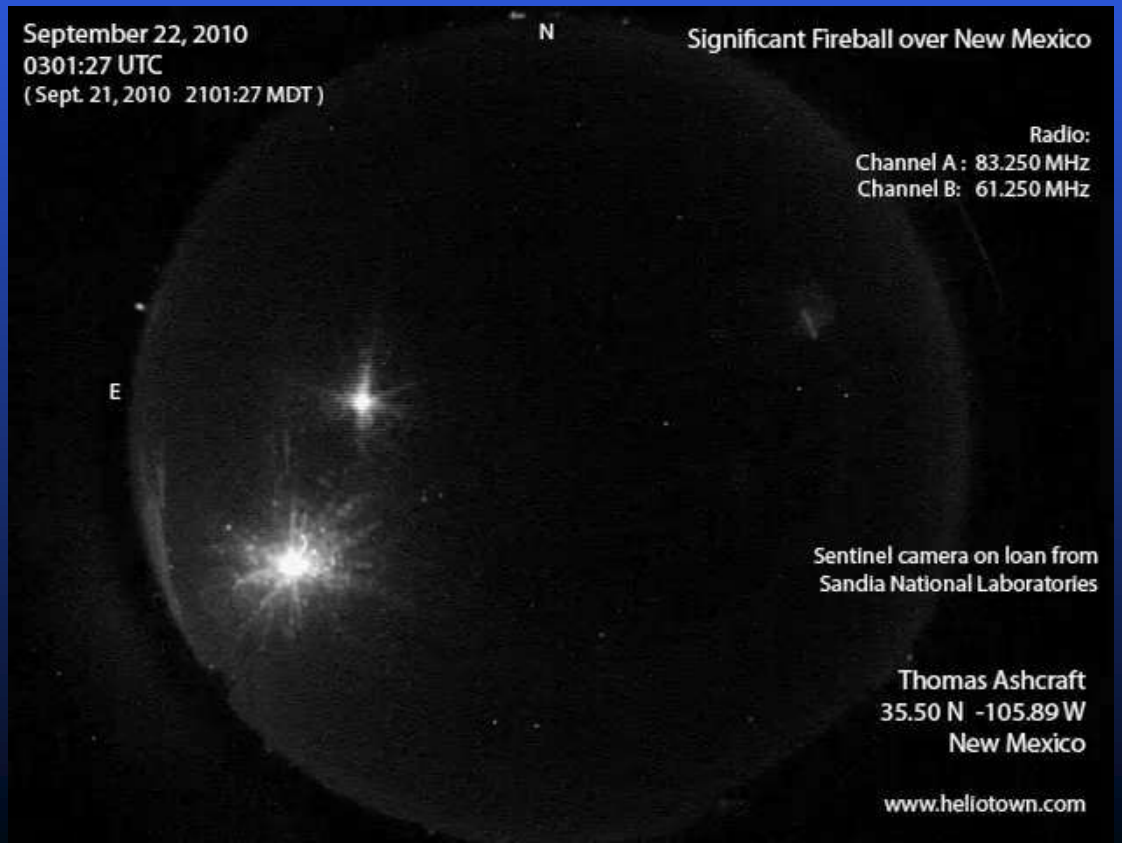
© Jean-Jacques Delcourt

1D VLF circuit geometry showing that a VHF interference can be constructive or destructive

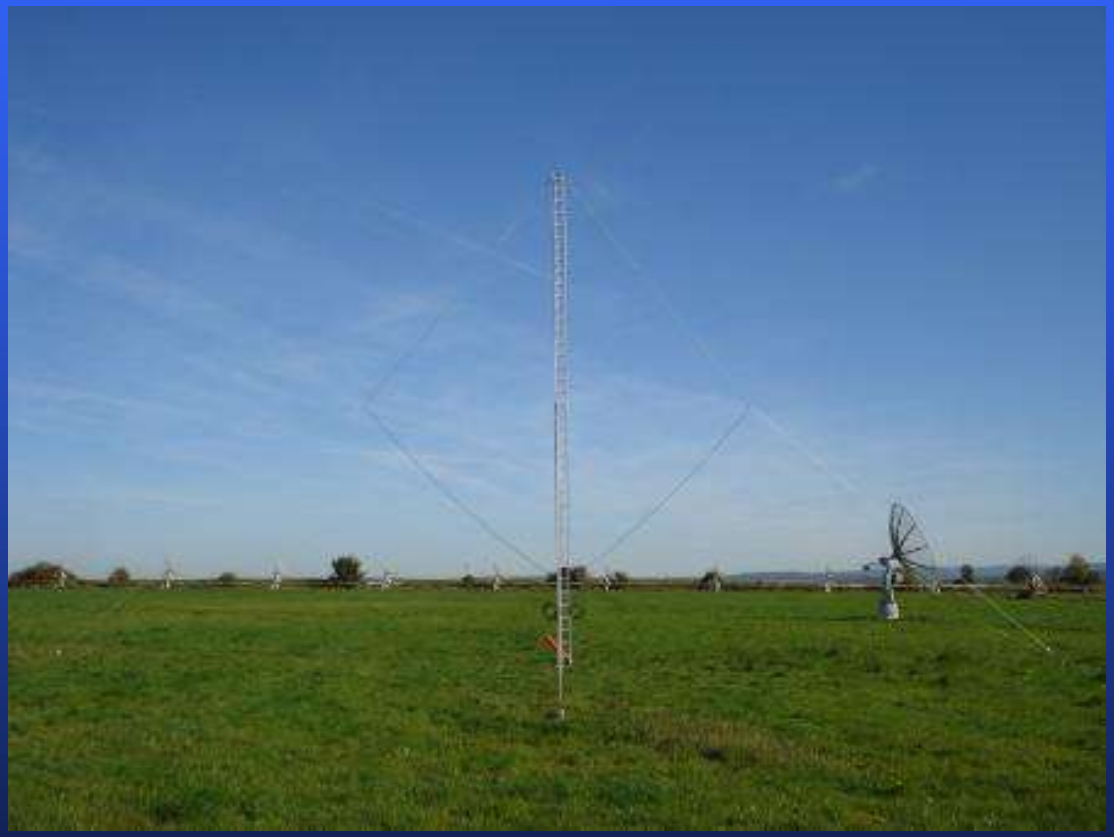
Meteors versus D and E ionosphere layers:

some encouraging perspectives

- Some french amateurs like Christian Paillart (new IMO member) are building VLF receivers
- Thomas Ashcraft from New Mexico (who recently joined IMO) is searching for correlations between meteors video observations, VHF forward scatter pings and VLF events



- BIRA is planning to look for conjunctions of VLF emissions and VHF meteor echoes, using their BRAMS interferometer site



- 50 m^2 magnetic field VLF sensor deployed at Humain, Belgium

- Armagh observatory is developping a ELF-VLF observation system (Research Technician position financed by Europlanet funds)

First trials of the ELF-VLF aerial at Armagh observatory

That’s all, folks

Any questions ?