The International Project for Radio Meteor Observation 2001-2003

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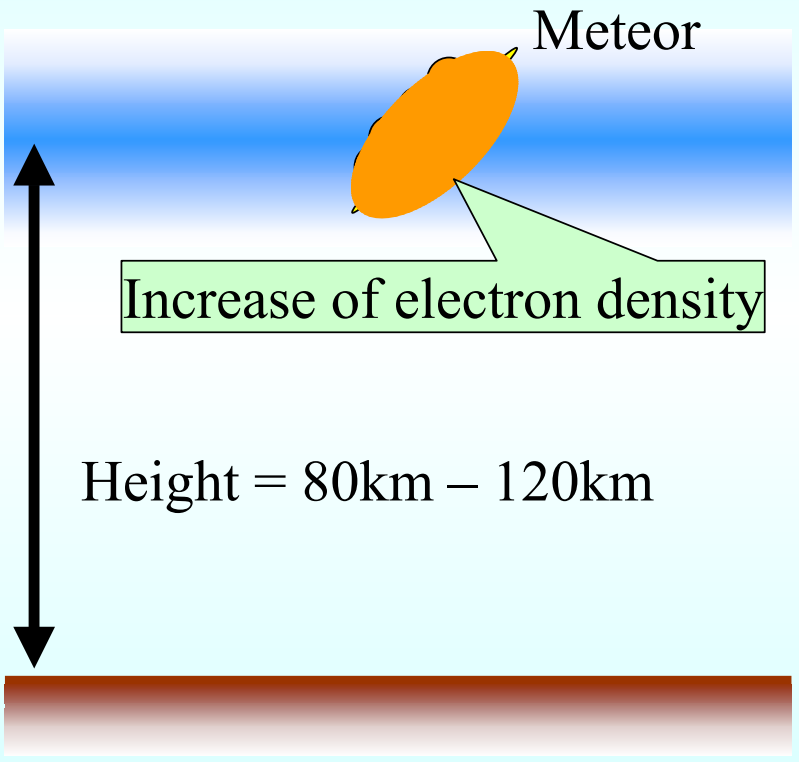
- Introduction -

1. Mechanism of Radio Meteor Observation



Meteor ionizes the atmosphere

↓

Increase of the electron density

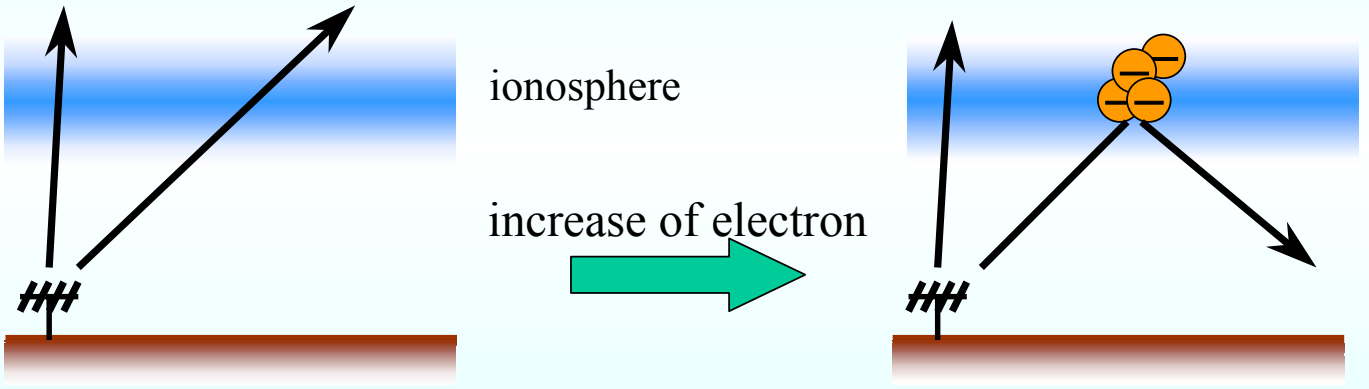
↓

Making of ionized trail

- Introduction -

1. Mechanism of Radio Meteor Observation

electron → scattering very high frequency(VHF)
(30MHz～300MHz)



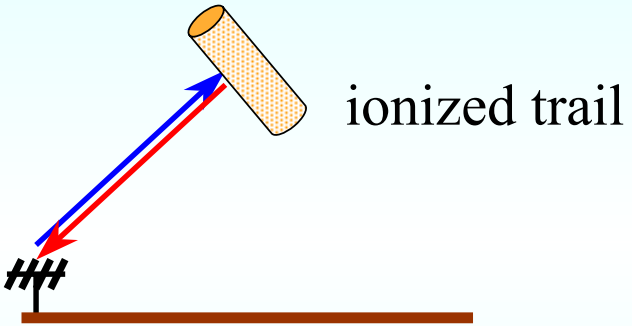
VHF wave is scattered due to the appearance of meteor !

Radio Meteor Observation !! (RMO)

- Introduction -

2. A kind of Radio Meteor Observation

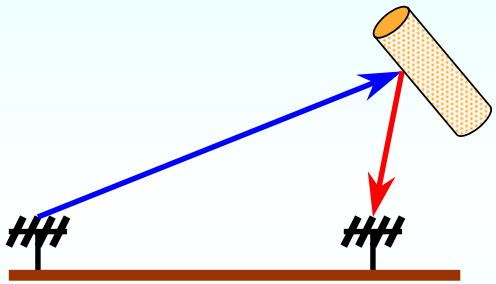
Back-Scattering



Ex. Radar Observation
(Transmitting Station is also Receiving Station)

Measurements of meteor and wind velocity, etc.

Forward-Scattering



incident angle = reflection angle
(A receiving station is different from the transmitting station.)

This is inexpensive and easy observation
Japanese observing stations are more than 150 !!

- Characteristics of RMO -

Radio Meteor Observation is possible to observe continuously

Bad weather, daytime and twilight → *No problem !!*

Continuous observation

Forward Scattering is easy to start

but

We cannot discuss or estimate meteor shower activity at only one observing station

This is because...

1. Radiant elevation
2. Reflection area of Radio Meteor Observation

therefore

We cannot observe meteor echoes when radiant rises around zenith…

- Motivation -

We would like to monitor meteor shower activity at all time

--- It is possible to observe at all time
even if it is bad weather or daytime.
--- By unifying worldwide data,
it becomes possible to observe without radiant problem.

Therefore

We have organized Worldwide Radio Network since 2001 !!

Purpose of this project

1. To observe all activities of a meteor stream
without effect of radiant elevation

2. To catch outburst meteor streams
and research its characteristics

- Project Organization -

This project's keywords are…

1. Instantaneity (ex. FLASH and LIVE)

LIVE system --- installed by Mr. M. Kobayashi and H. Ogawa

⇨ observed image --- updated every 10minutes

FLASH system --- collected and calculated by H. Ogawa

⇨ calculated manually --- updated every 6 – 12 hours

2. Many observing stations

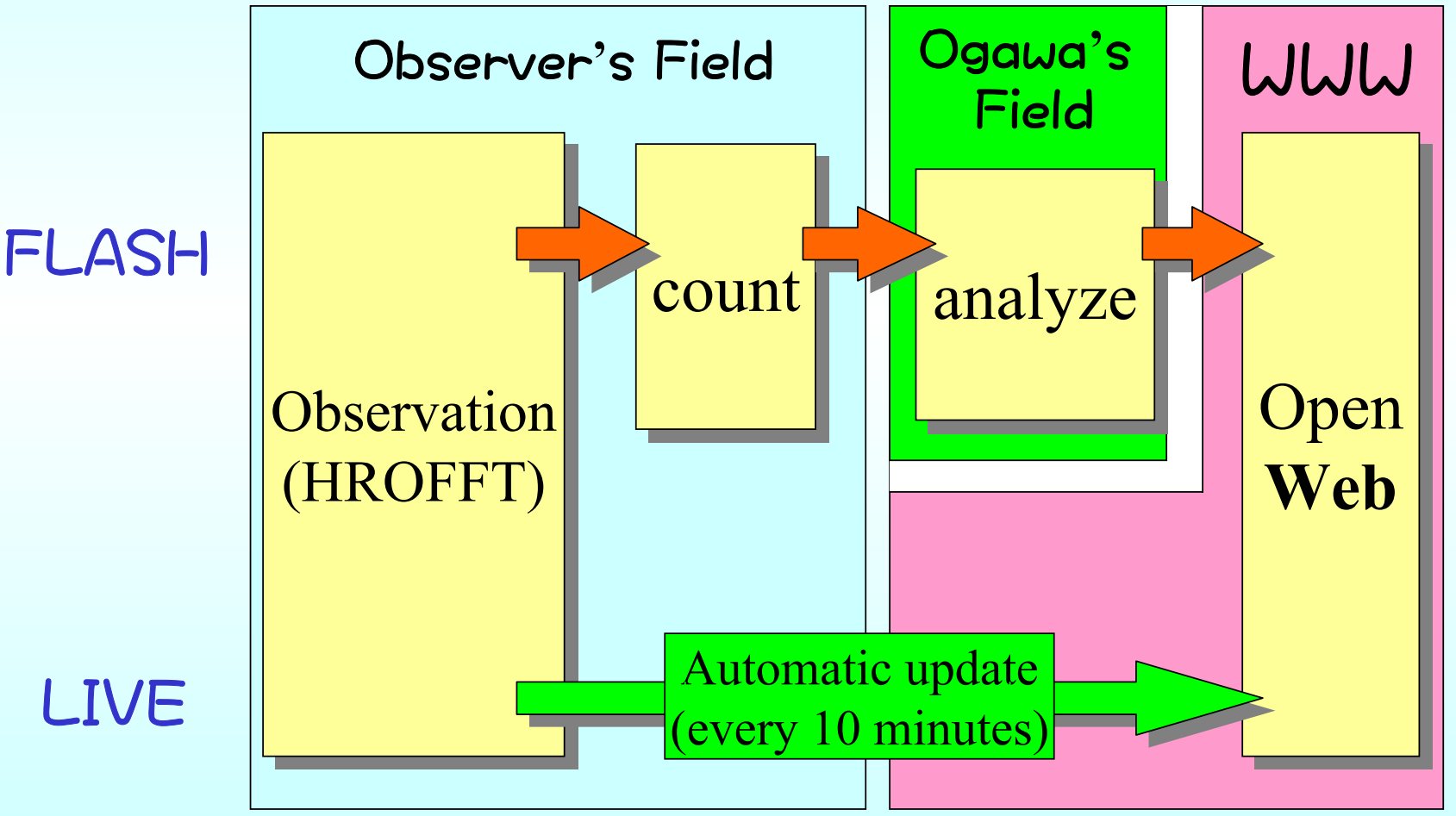
⇨ We must cover the whole world.

3. building Mailing-List for participants

⇨ International and Japanese Mailing-List

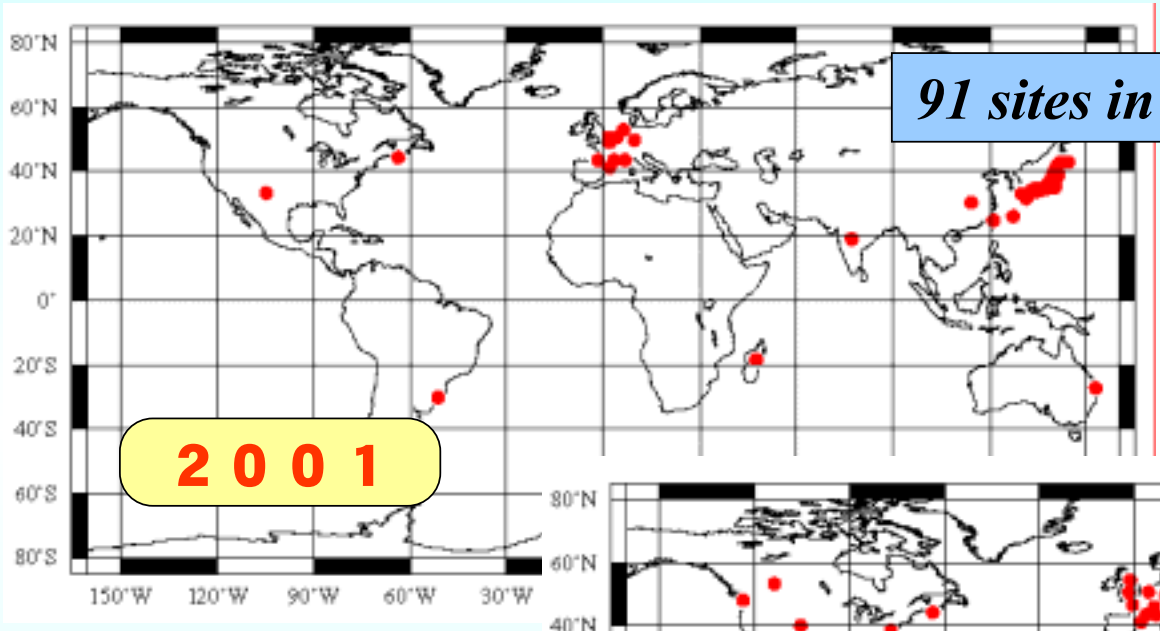
- Project Organization -

Flow Chart

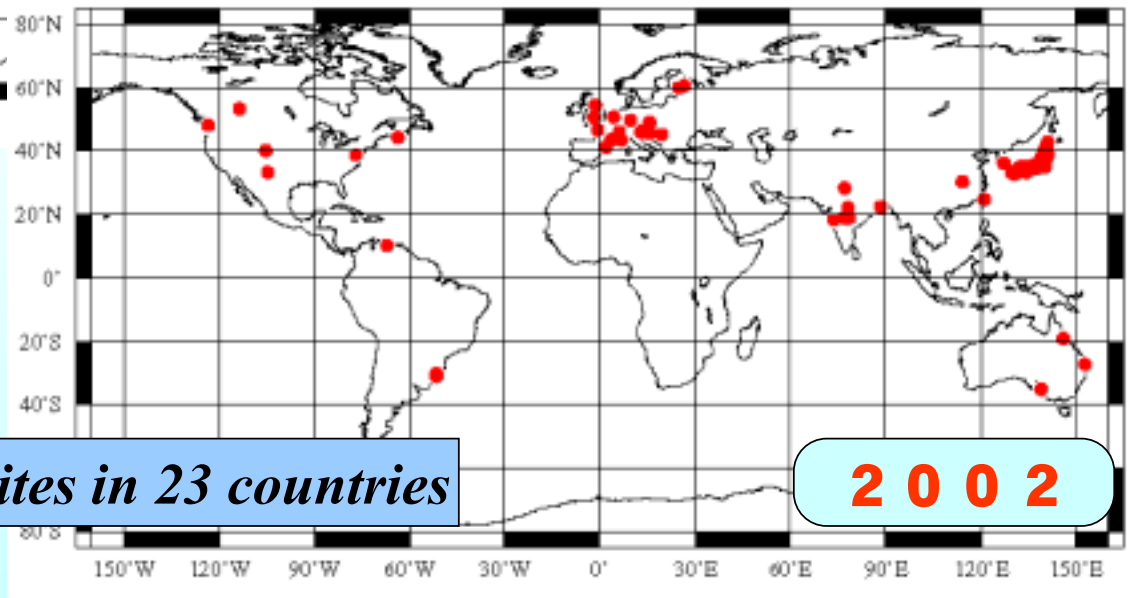


- Project Organization -

Participants Map



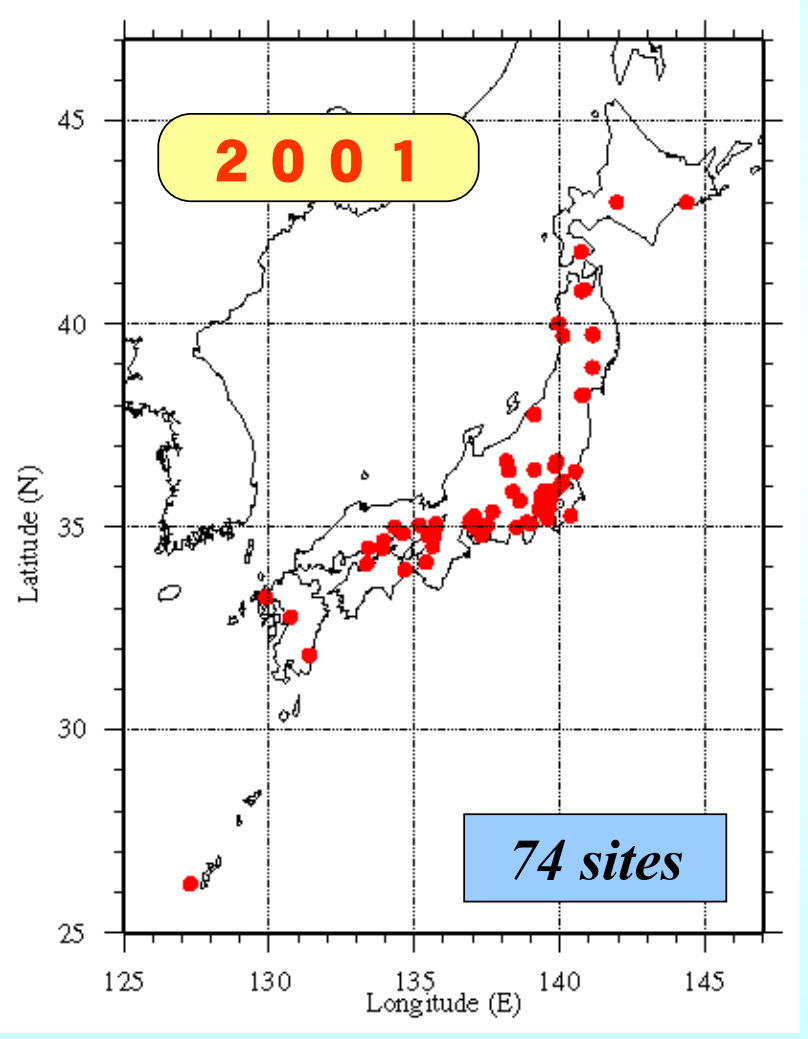
91 sites in 15 countries

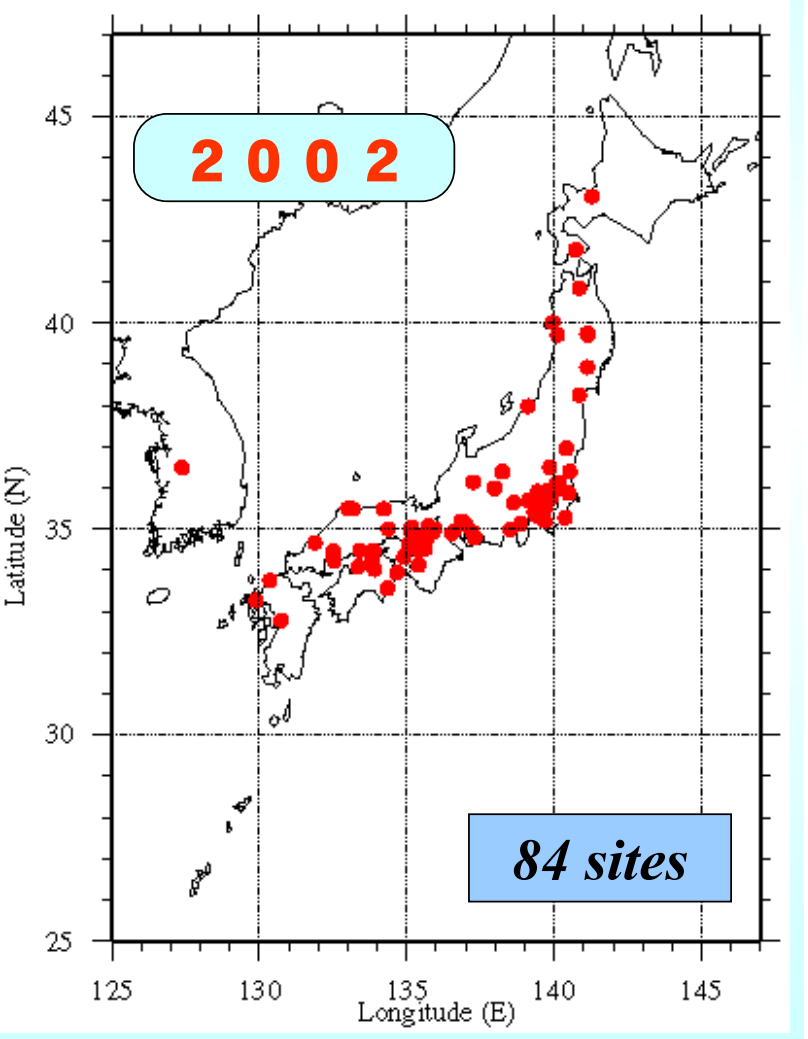


126 sites in 23 countries

- Project Organization -

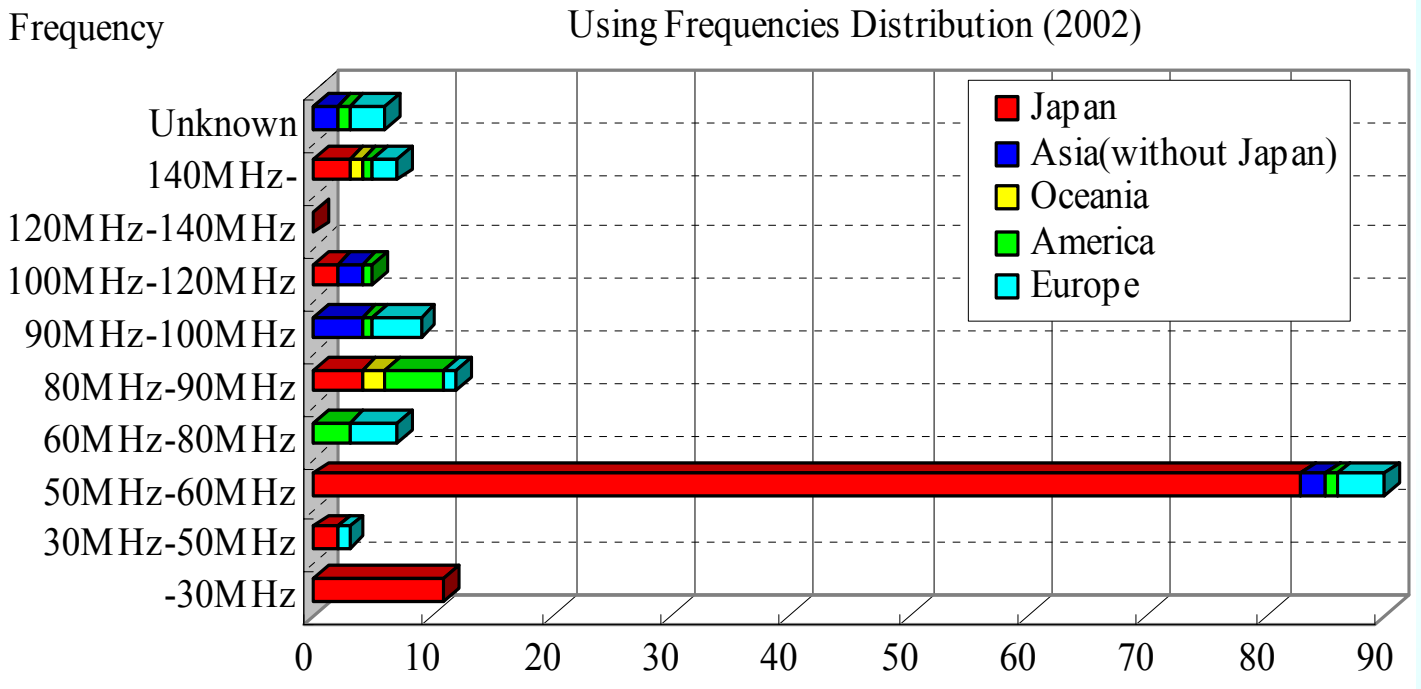
Participants Map





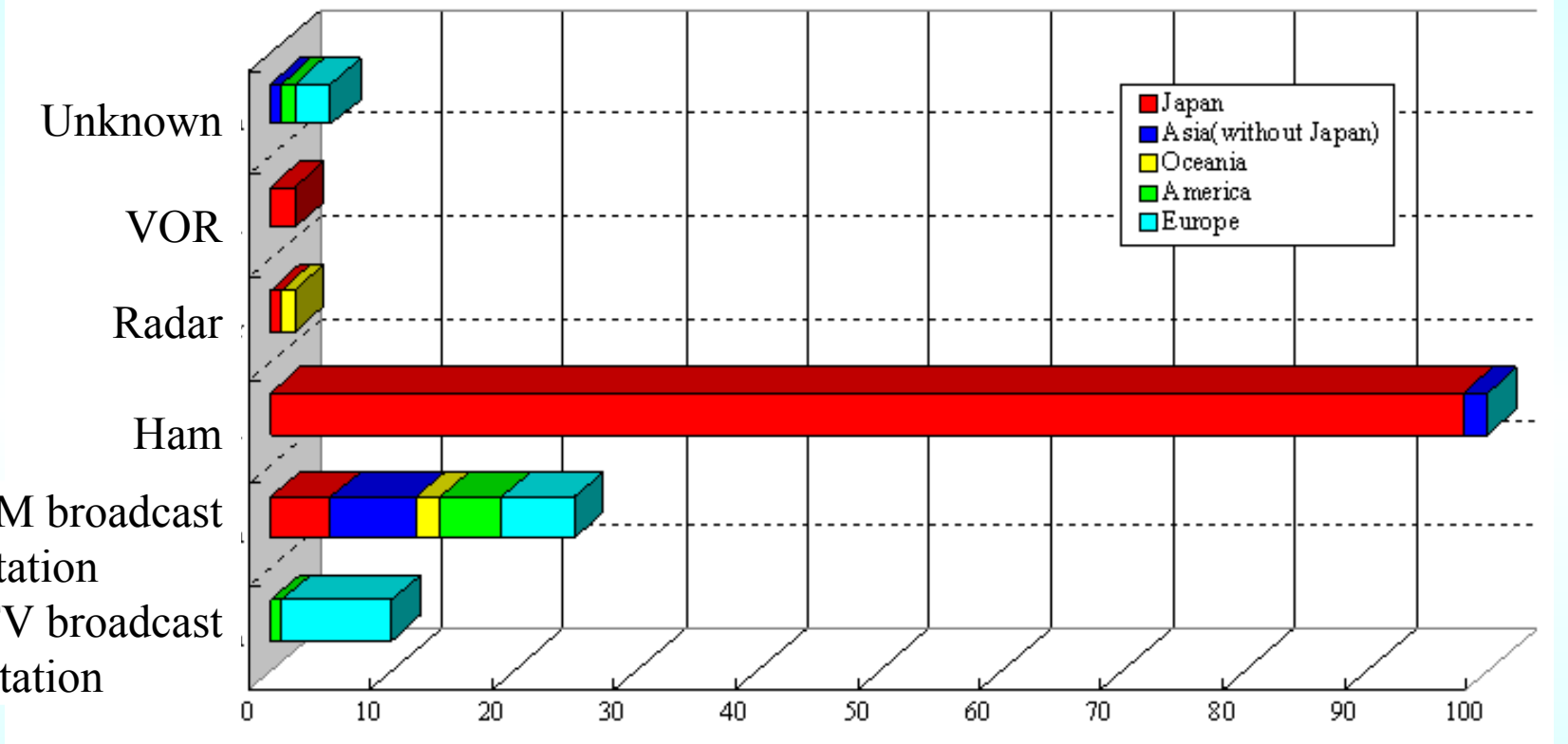
- Project Organization -

Using Frequency Distribution



- Project Organization -

Using Frequency Type



Japan ・・・Ham-band
Europe ・・・TV and FM Broadcast Station
America ・・・FM Broadcast Station

- Analyzing Plan -

In this time…. We analyze world observed data….

difference of receiver, location, frequency, etc.

but…

We adopt "Relative Value" named "**Activity Level**".

$$A(t) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{H(t)_i - \overline{H}(t)_i}{\overline{D}_i}\frac{1}{\sin(h)}\right)$$

H_i : the number of echoes at Observing Station, *i*

$\overline{H}_i$: the background number of echoes at site *i*,

$\overline{D}_i$: average number of echoes during a day at site *i*

h : Radiant Elevation, t : time, N : the number of observing stations

- Analyzing Plan (factor) -

1. The factor of radiant elevation (h)

20deg < h < 80deg data is only used.
1/sin (h) is corrected

2. Elimination of observational error data

- 1.5 σ (H) < results < +1.5 σ (H) is only used (91% of total).

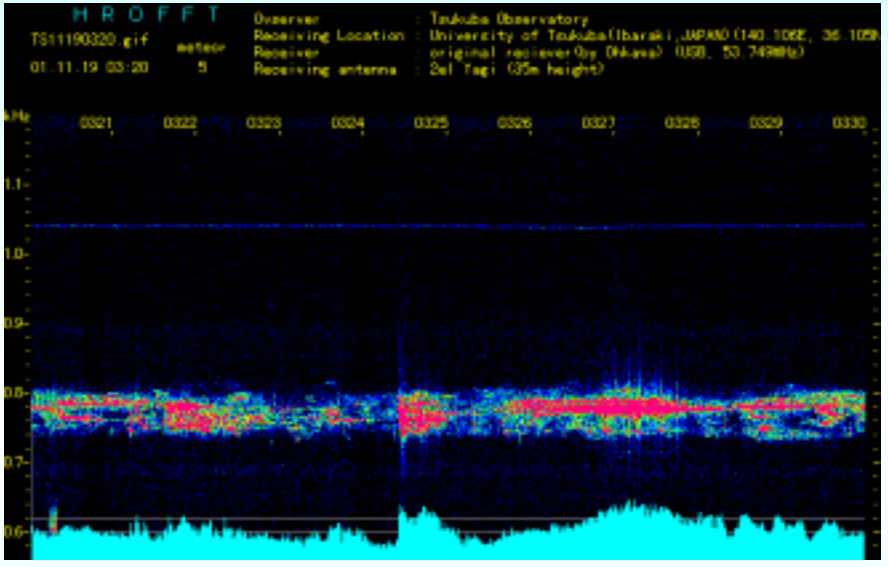
And I am thinking about the factor of using frequency.

→ This is because we have to consider "Height Ceiling"
This effect is "reflection time of echoes in low frequency is longer than high."

- Analyzing Plan (2) -

In Leonids, it became impossible to count the number of echo.

other analyzing method



The activity level was estimated from "reflection time" of echo

reflection time (sec.) of echo more than 10dB, 20dB, 30dB and 40dB

- Observation -

2001

Leonids

2002

Quadrantids, Perseids, Leonids
Geminids, Ursids

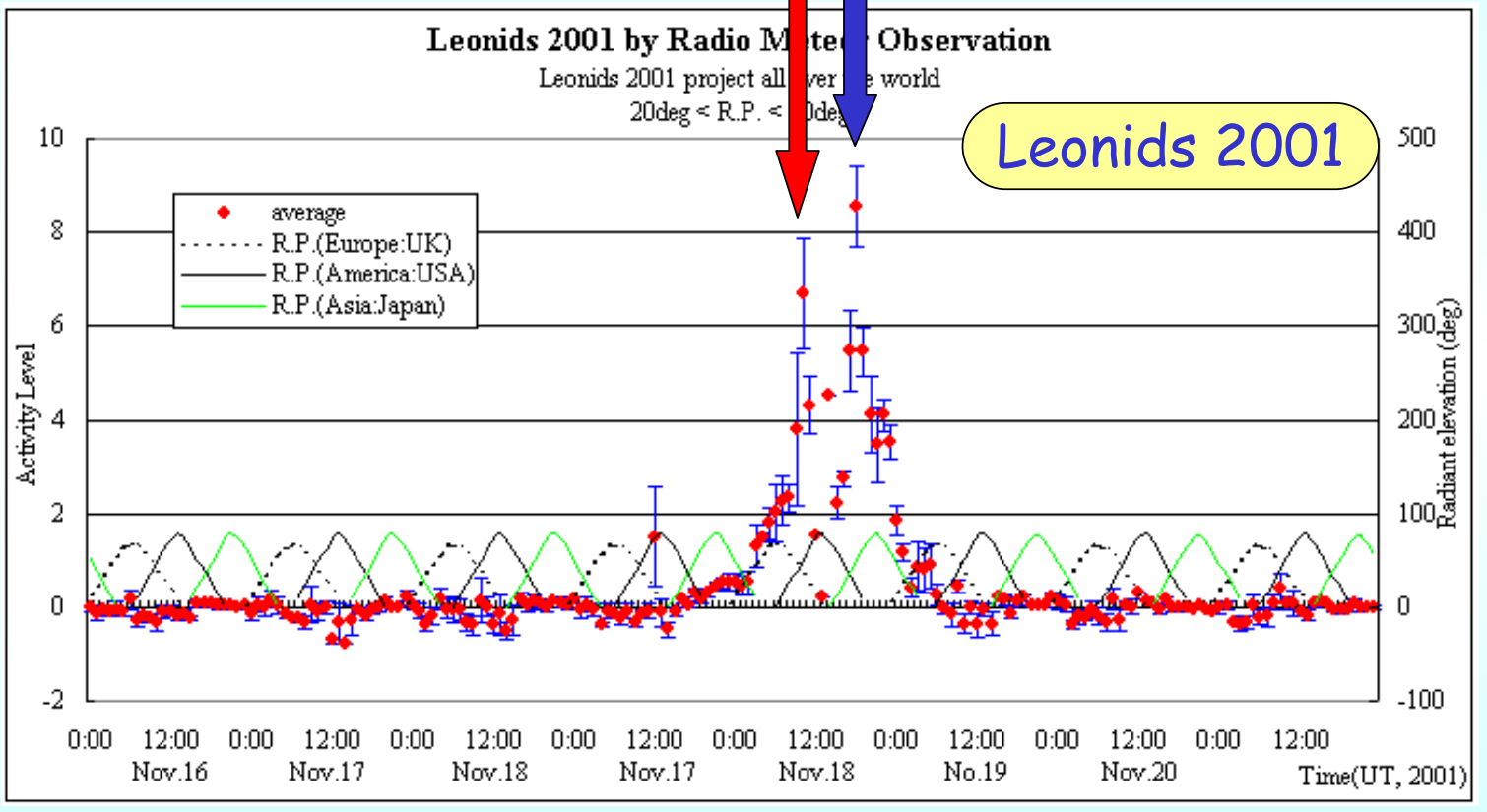
2003

Quadrantids, Lyrids, eta-Aquarids, Perseids,
(Leonids), (Geminids)

- Results in 2001 & 02 Leonids -

First peak : 10h(UT) 18th

Second peak : 18h(UT) 18th



- Results in 2001 & 02 Leonids -

The Structure of Second peak (Reflection Time analysis)

Main peak (expected)

Time : 18:20-30 (UT)

FWHM:

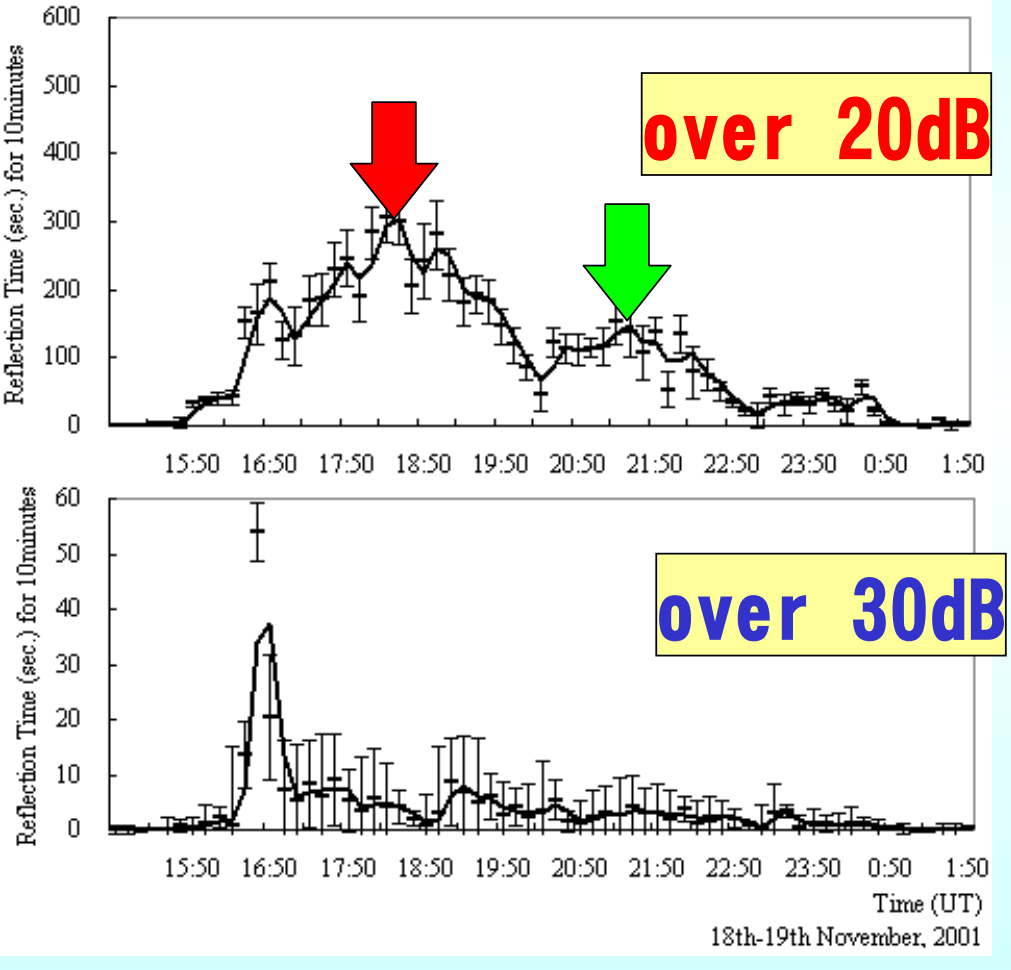
- 90min / +100min

Sub peak (Unexpected)

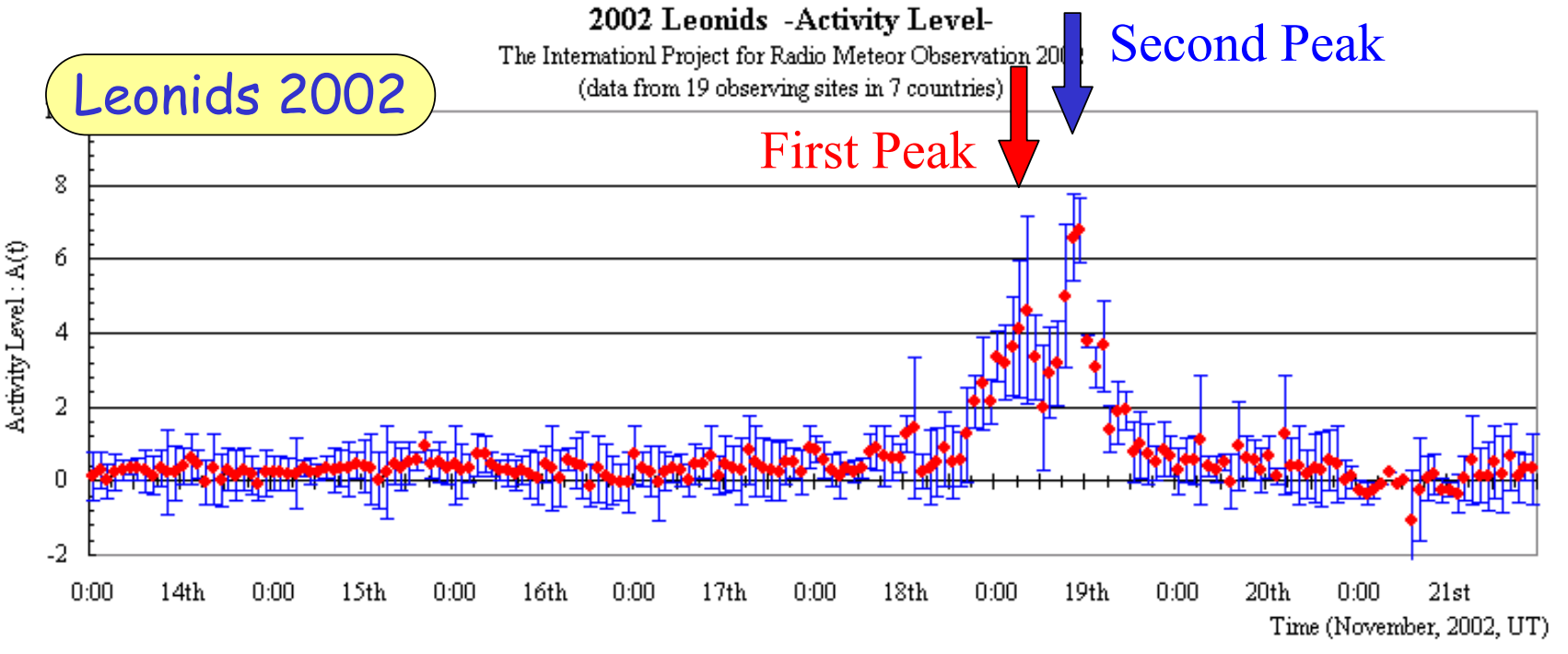
Time : 21:20-30 (UT)

FWHM:

- 45min / +40min



- Results in 2001 & 02 Leonids -

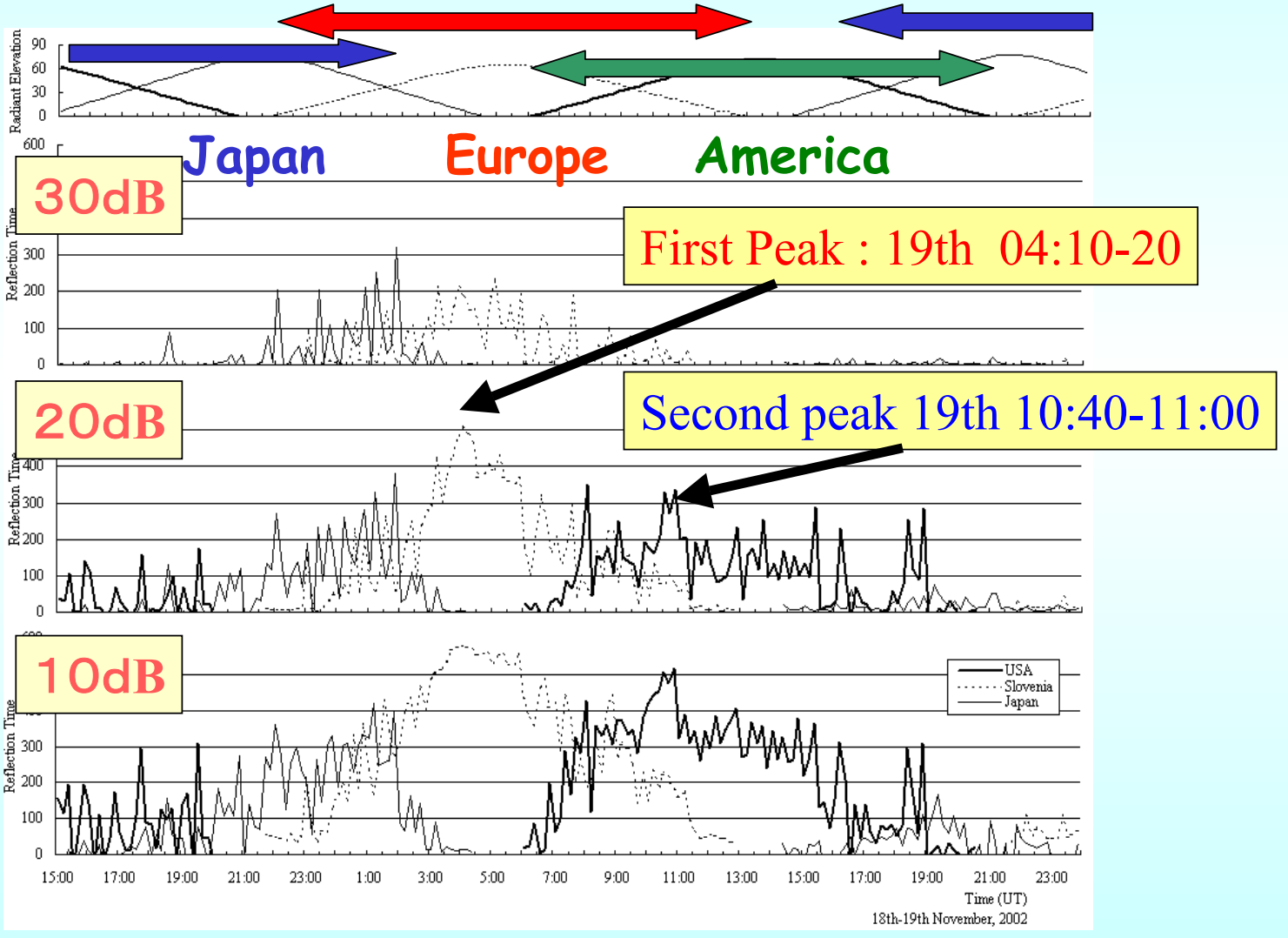


First Peak (Europe)・・・ 4h 19th (UT)　A(t)=4.0　FWHM：±120min

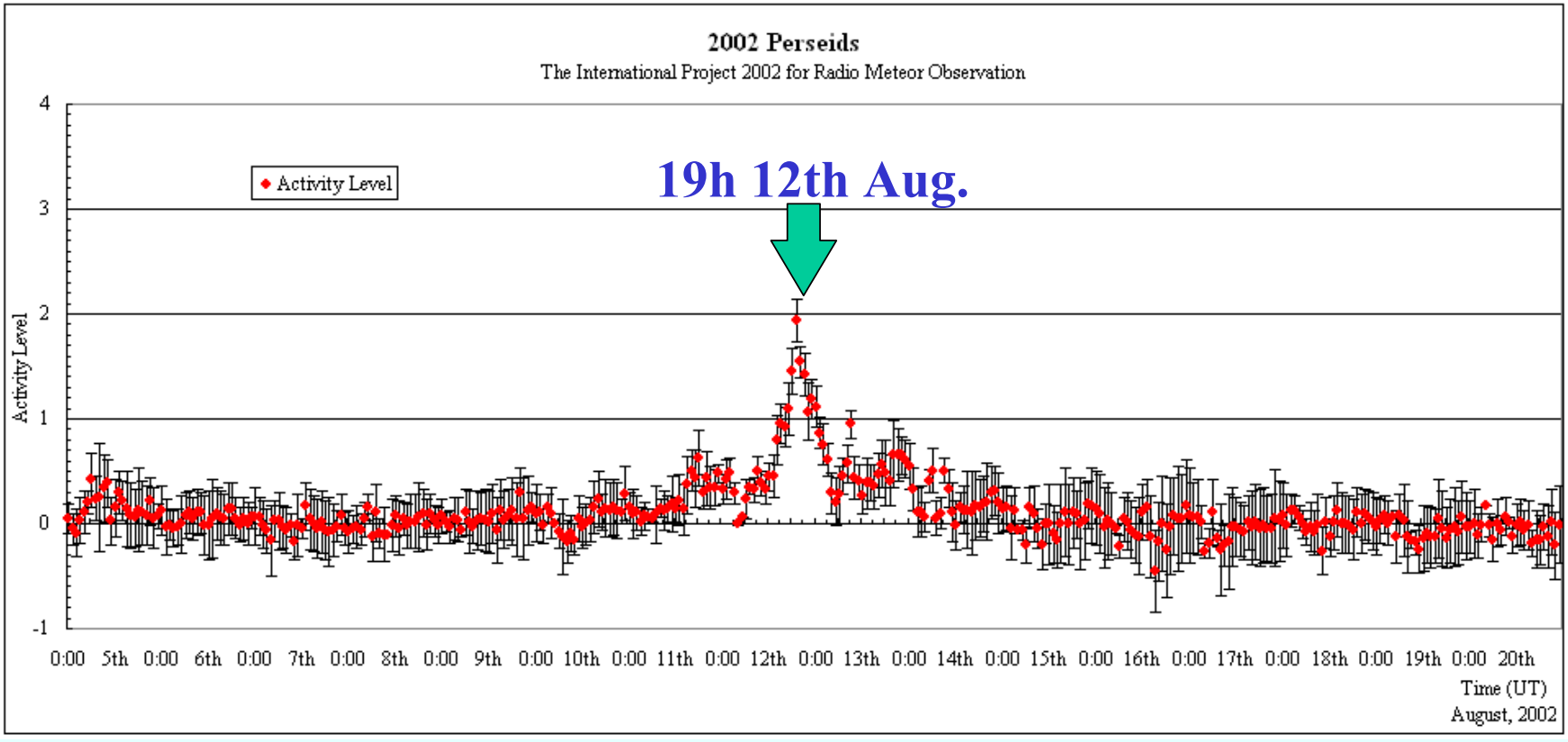
Second Peak (America)・・・10h 19th (UT)　A(t)=6.2　FWHM：±60min

- Results in 2001 & 02 Leonids -

Leonids 2002 (Reflection Time Analysis)

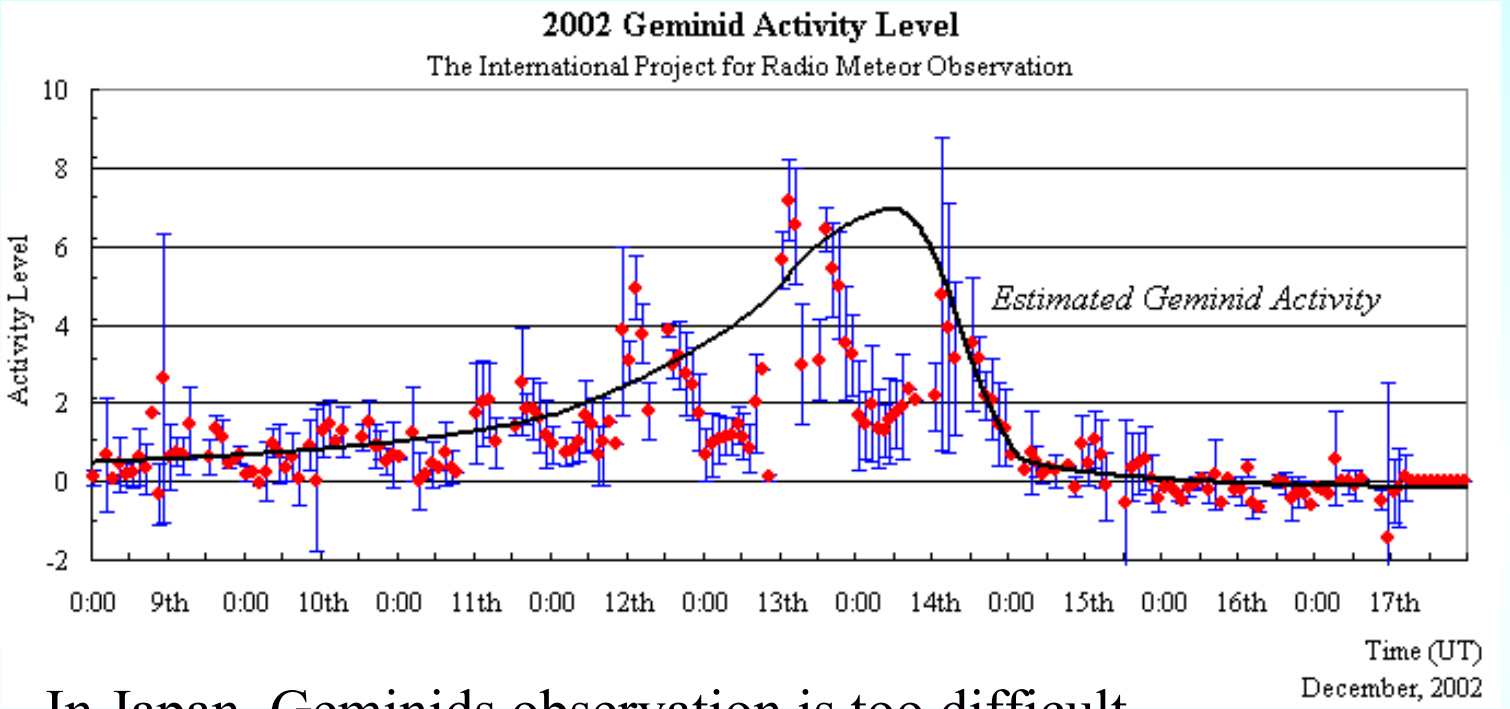


- 2002 Perseids -



Since it is too difficult to define the background level because of some other meteor streams, Perseid project is difficult …

- 2002 Geminids and Ursids -

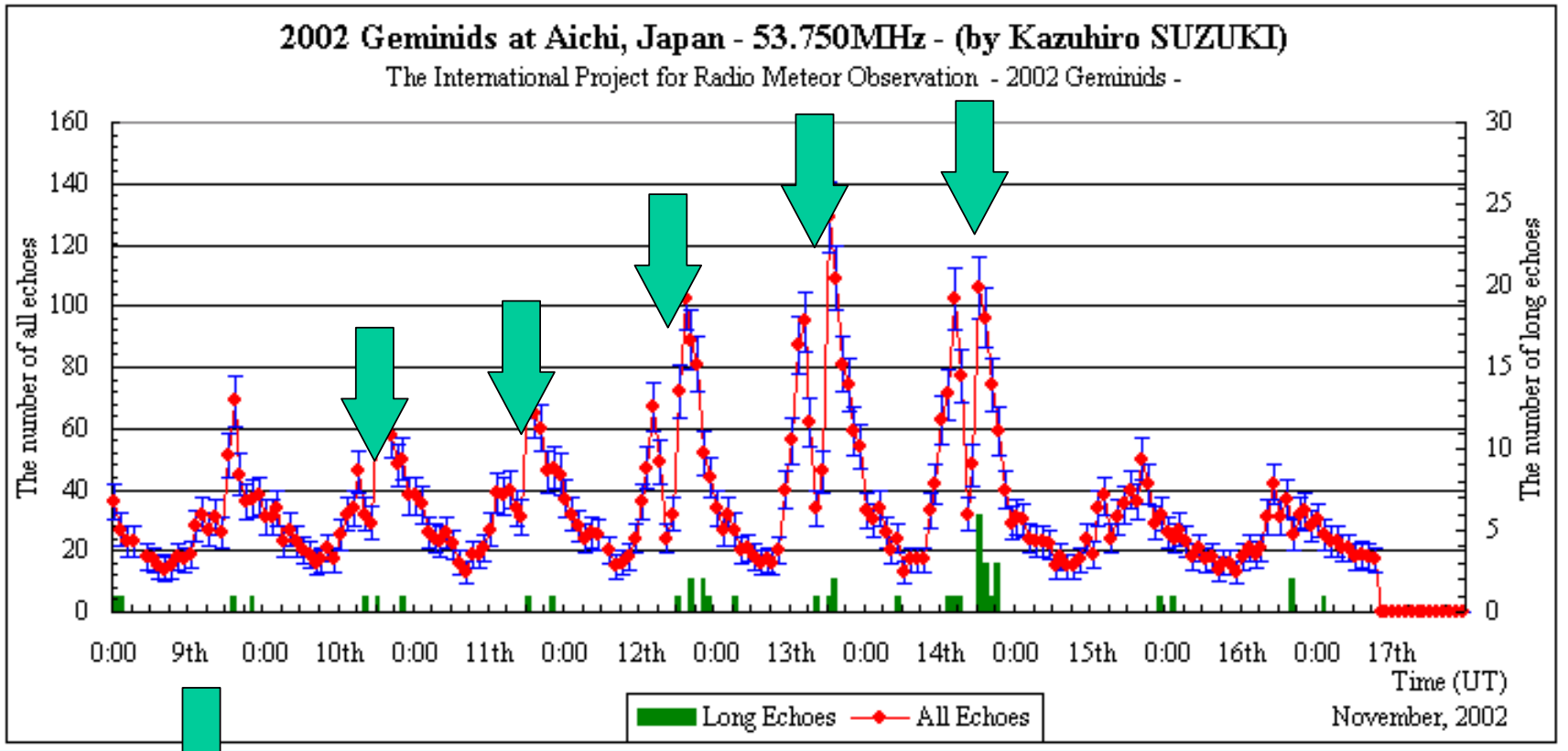


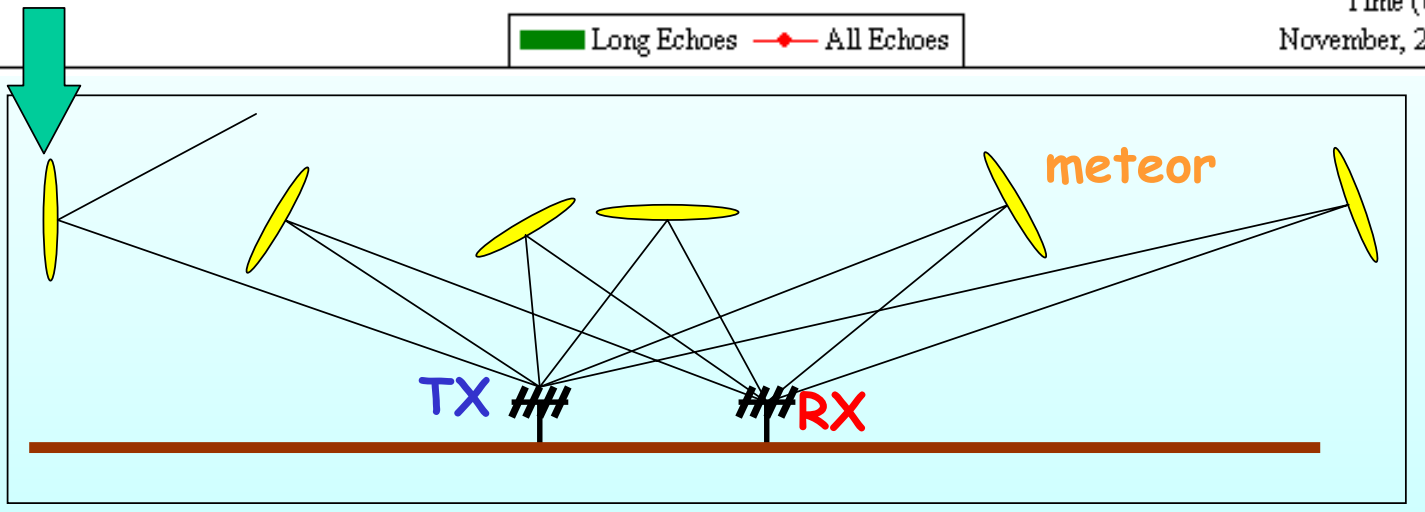
In Japan, Geminids observation is too difficult…

Because…

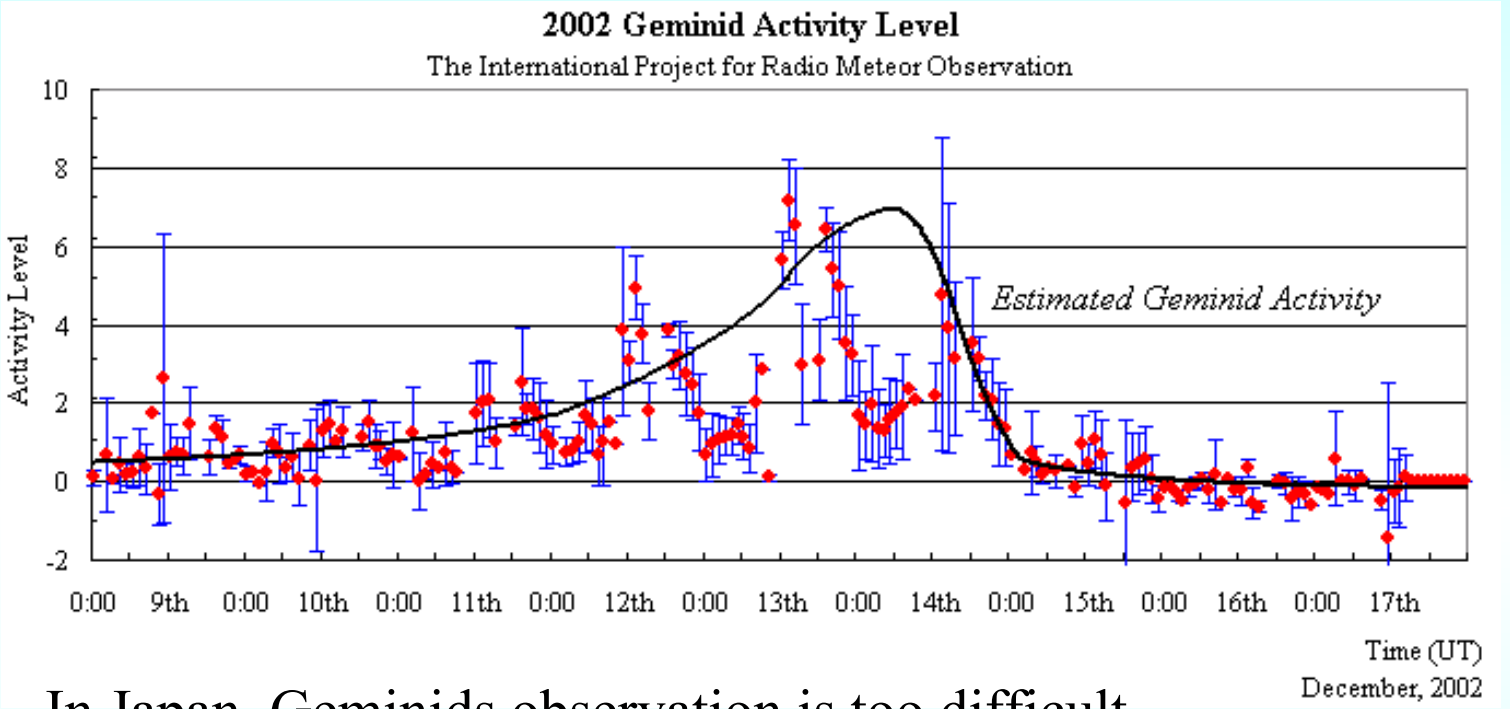
➡ Geminid radiant rises around zenith…

Therefore, Radio Observation cannot detect meteor echoes


2002 Geminids at Aichi, Japan - 53.750MHz - (by Kazuhiro SUZUKI)
The International Project for Radio Meteor Observation - 2002 Geminids -
The number of all echoes
The number of long echoes
160
140
120
100
80
60
40
20
0
30
25
20
15
10
5
0
0:00 9th 0:00 10th 0:00 11th 0:00 12th 0:00 13th 0:00 14th 0:00 15th 0:00 16th 0:00 17th
Time (UT)
November, 2002
Long Echoes
All Echoes


meteor
TX
RX

- 2002 Geminids -



In Japan, Geminids observation is too difficult…

Because…

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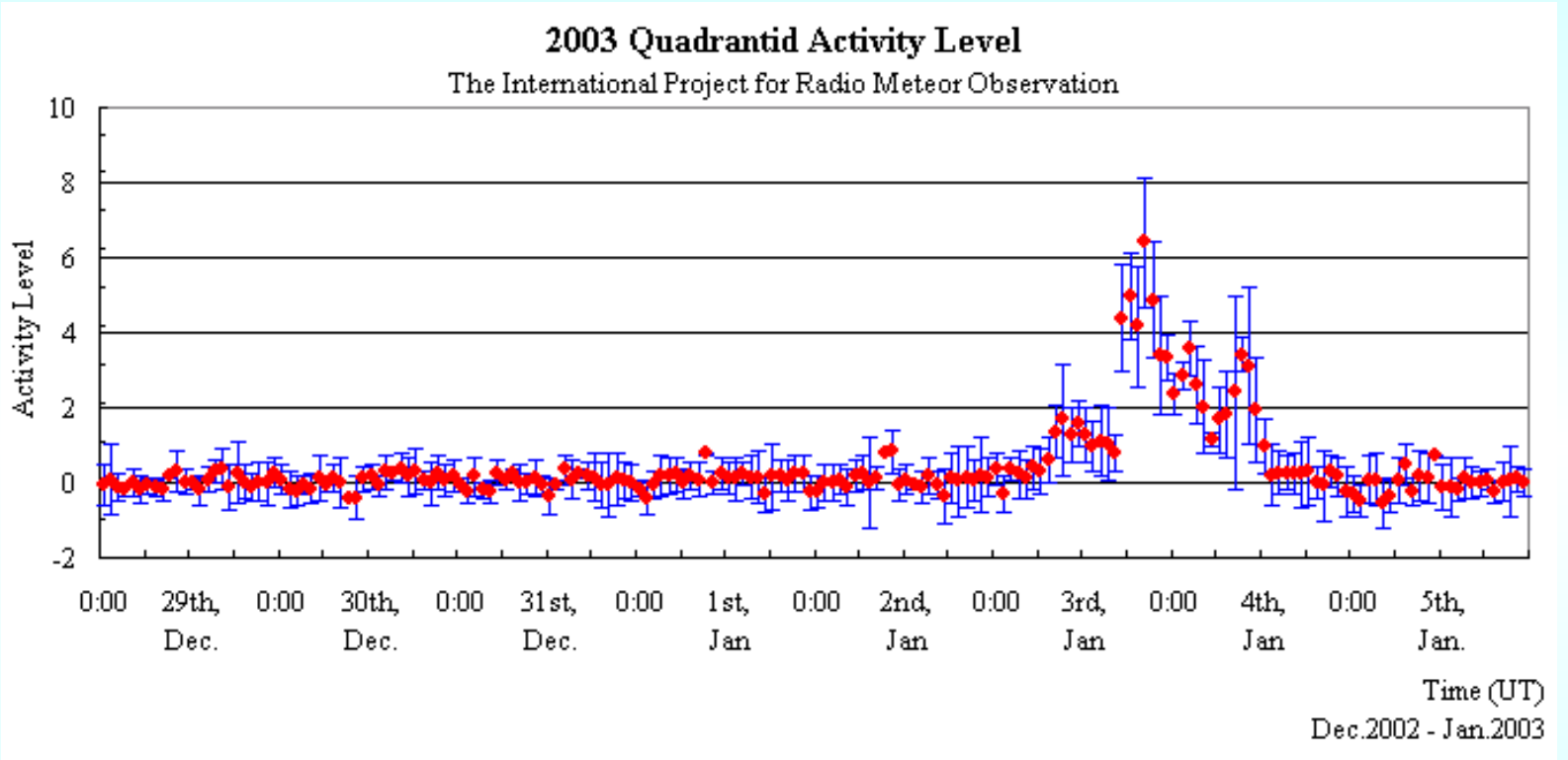
- 2003 Quadrantids -



- Conclusion -

1. This project is very useful to monitor whole activity

"Activity Level" shows meteor activity

➡ Some problems are solved by using relative value

This network is possible to monitor whole meteor activity

2. LIVE and FLASH is very useful for monitoring

It is very important to monitoring meteor activity at all times.

This network is possible to monitor and open on the web.

3. Local area networks are very important

Observing conditions depend on each country (or area)

➡ In Japan, the original network "AMRO" is organized

➡ This network is useful for Japanese observers

- Problems and Future work -

1. There are a few observing stations in Southern Hemisphere

This project is too difficult to catch if outburst occurs in Southern Hemisphere

2. We have to consider reflection area

Radio Meteor Observation mechanism is too complex.
Forward scattering observation cannot know “Where did meteors appear ?”.
Therefore we have to obtain this information to discuss the meteor flux, etc.

3. The amount of observed data is too large !!

We would like to open these observed data on the web.
But we do not have enough web space.

- Proceeding of this project -

I have already edited the proceeding of this project in JAPANESE !!

but !! Don't worry !

I am editing and making ENGLISH version now !!!

If you want to see proceeding in Japanese version,
please tell me !!

- Next Project ? -

In the future, I do not decide
whether we continue this project or not.

But, in Japan, many observers have already researched
many research program
(such as reflection area, long echo, multi frequency,
decision of meteor echo position, etc.)

Therefore, we will continue this project (probably…)

And I would like to do interesting research program
"worldwide scale" !!

So, if you have a idea, please contact me !!
*(mailto : **ogawa@nms.gr.jp**)*

PS. Please talk questions and opinions slowly (if possible, easy English)