

Anomalous Excitation of Schumann Resonances before large earthquakes in Japan

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Observation of electromagnetic wave

“direct”

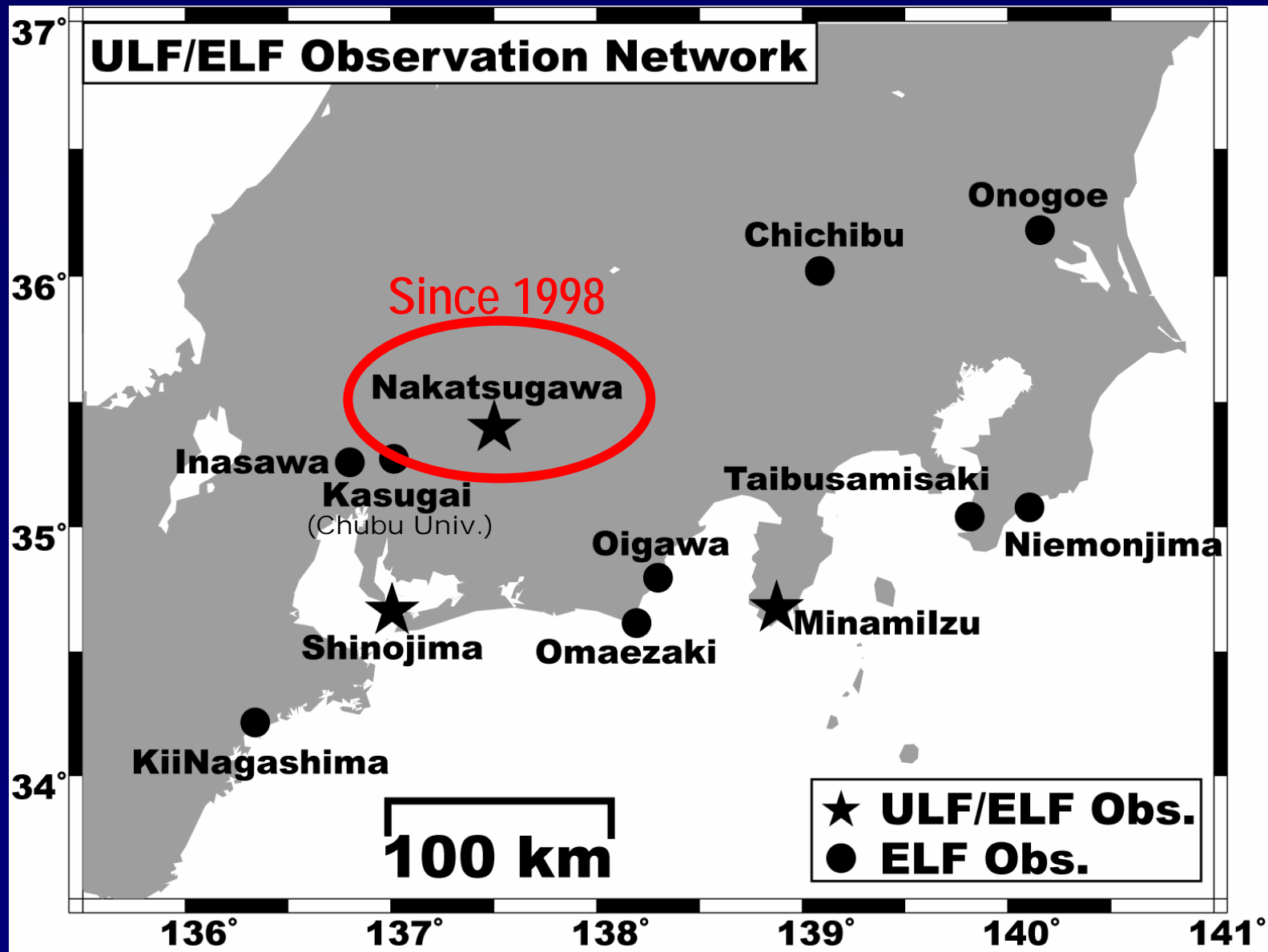
ULF range (~30Hz)

ELF range (223Hz and 17Hz)

“indirect”

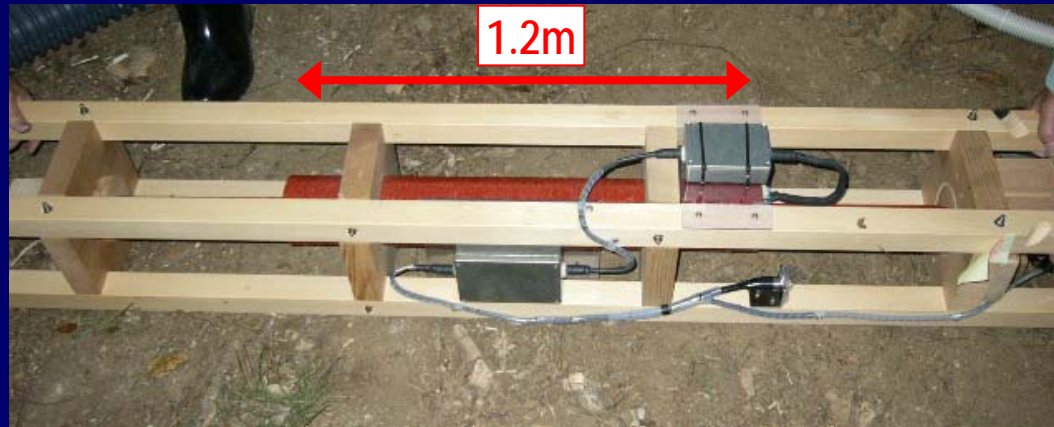
VLF range (Terminator-Time method)

Observation Network



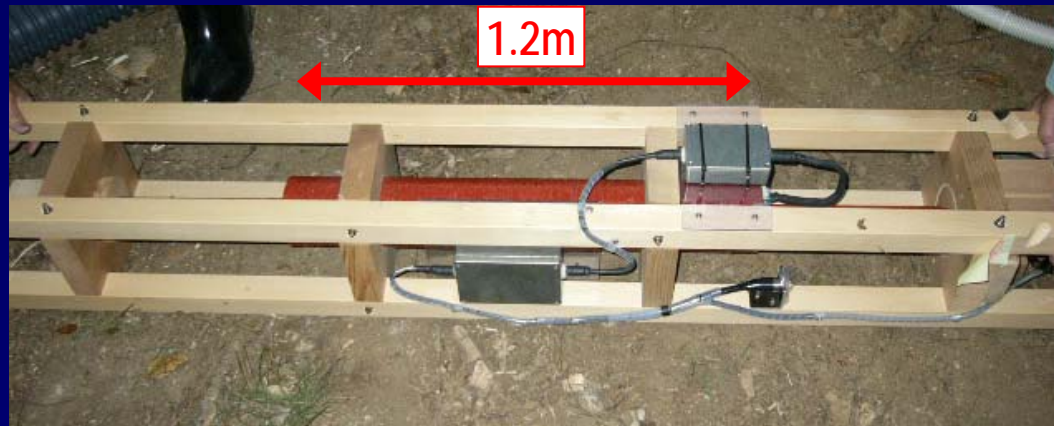
ULF Observation System

Induction Coil Antenna



ULF Observation System

Induction Coil Antenna

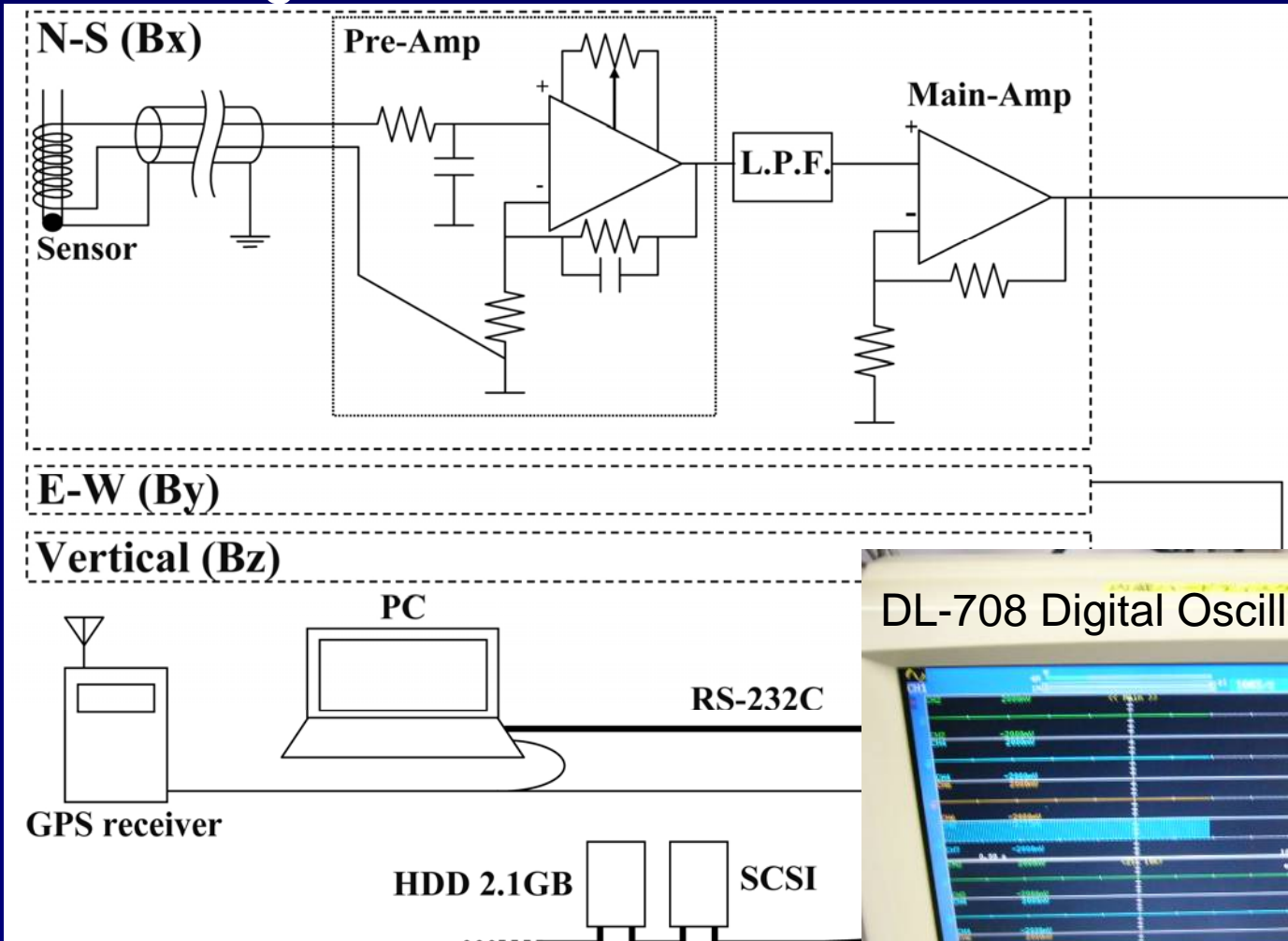


Observation of magnetic field (B_x , B_y , B_z)

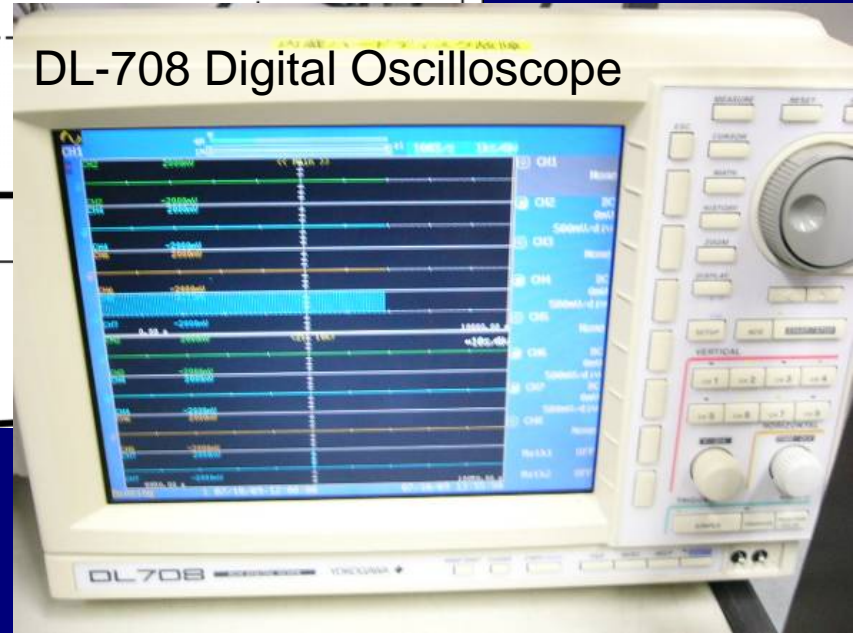


ULF Observation System

Block diagram

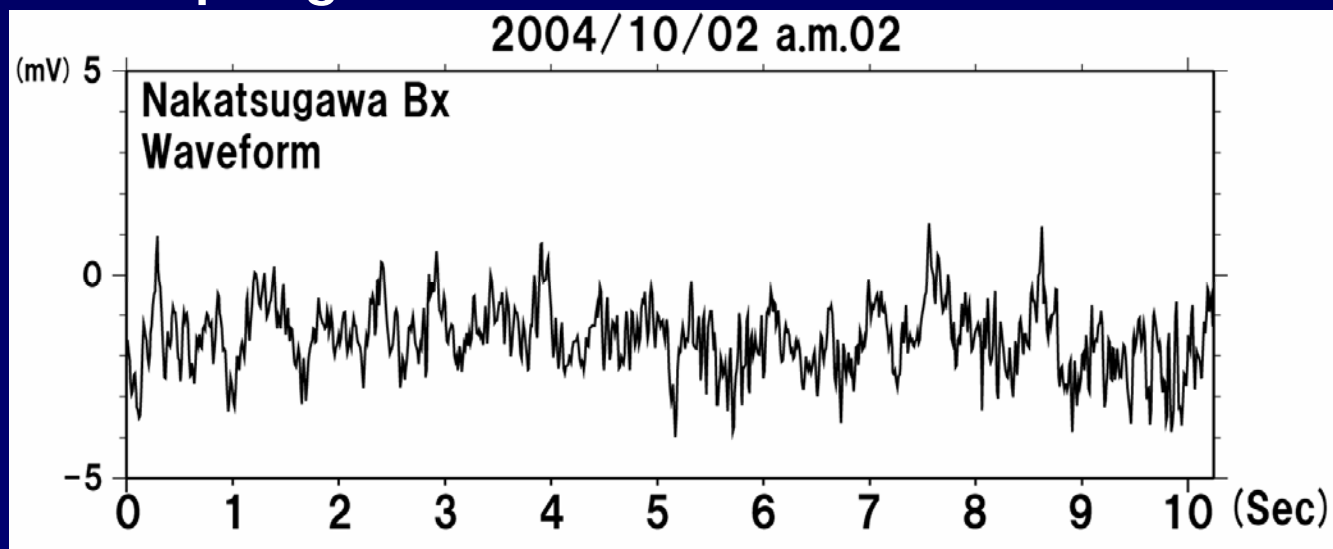


DL-708 Digital Oscilloscope

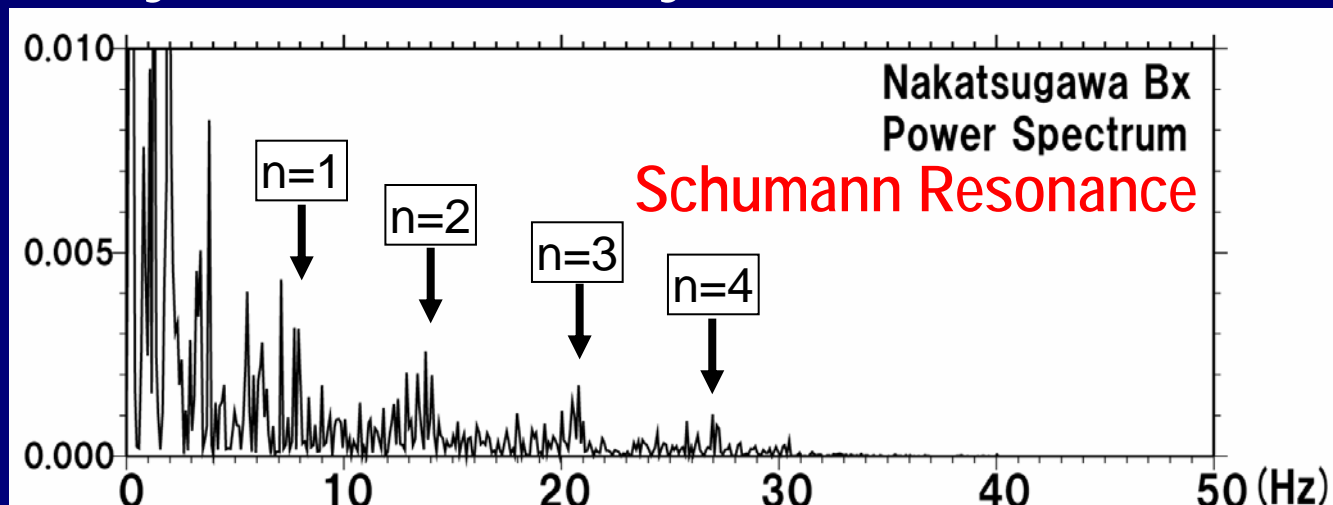


Observed data

100Hz sampling

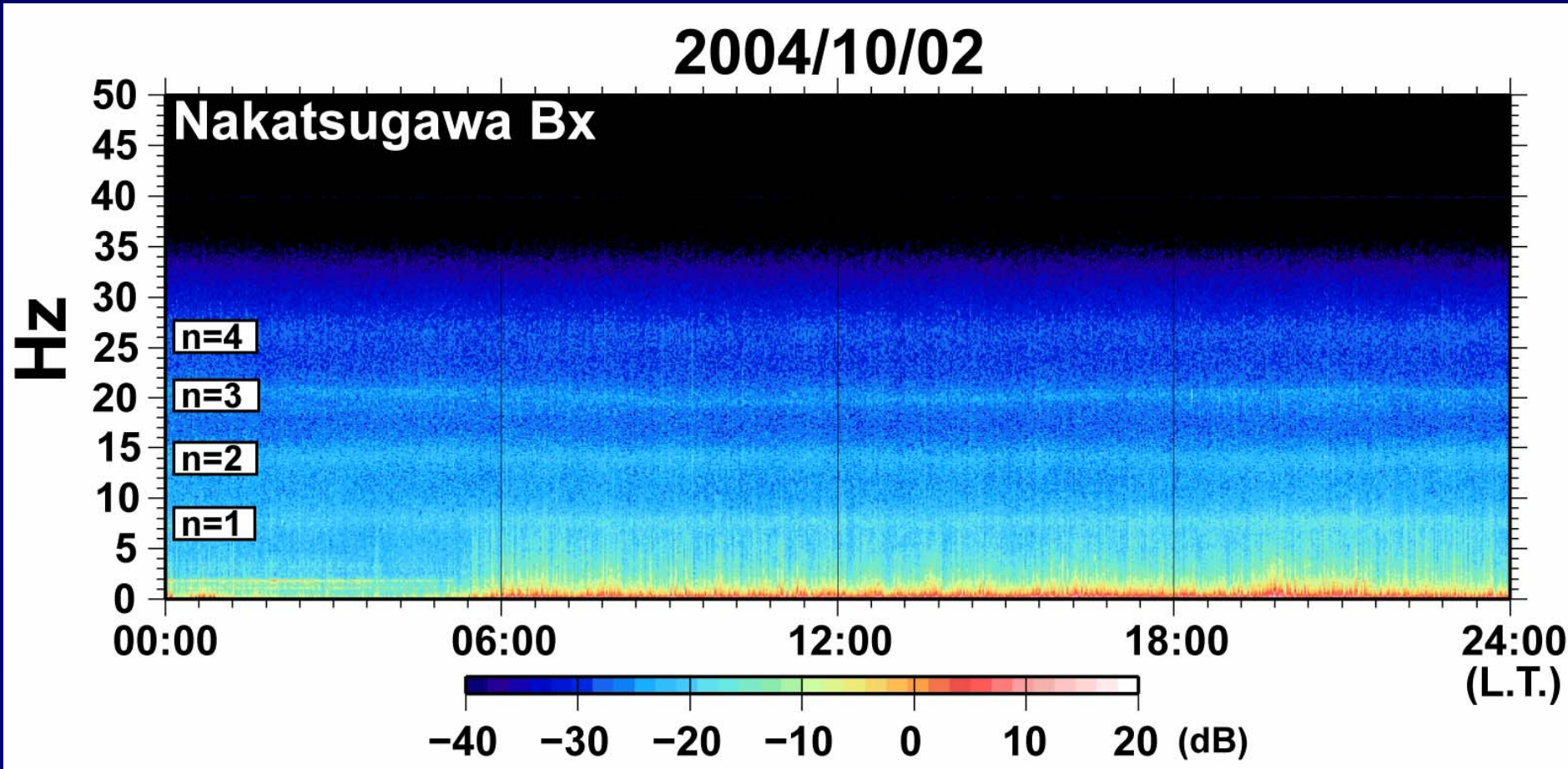


FFT analyze (N=1024; every 10.24 seconds)



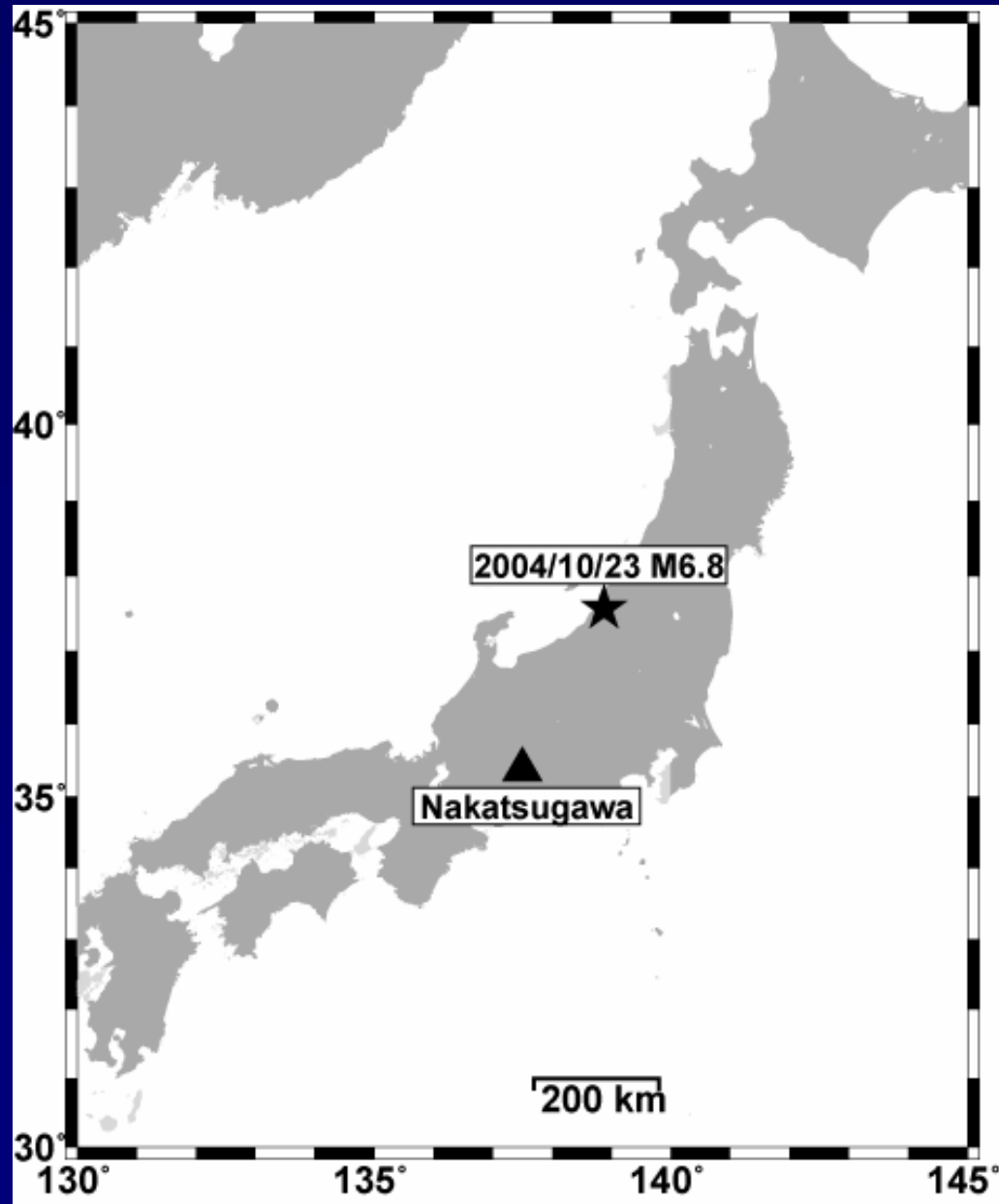
Observed data

Sonogram

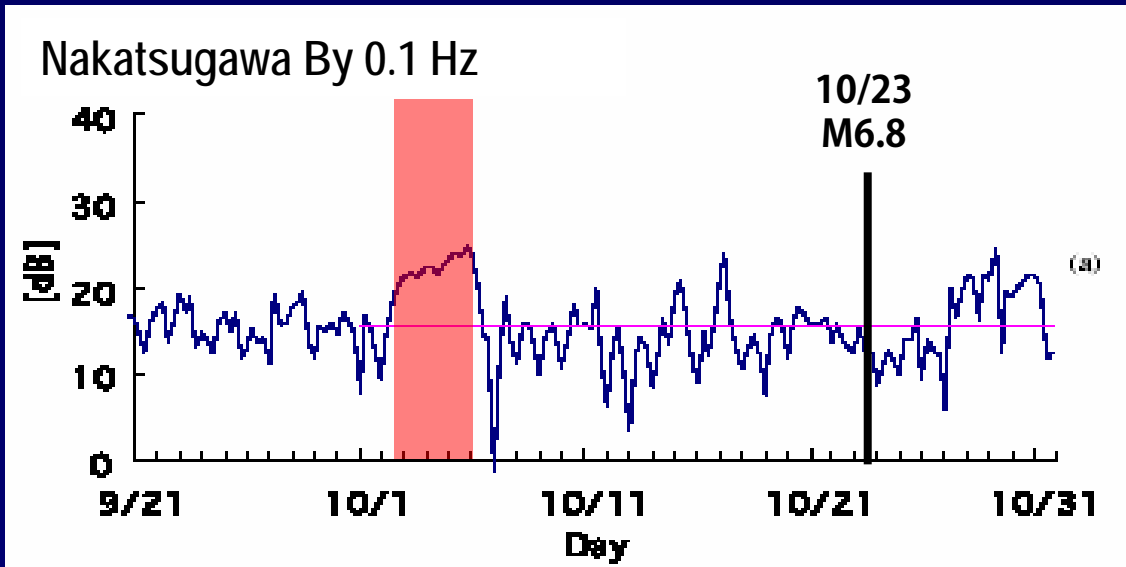


Schumann resonance is clearly observed.

2004 Mid-Niigata Earthquake



2004 Mid-Niigata Earthquake

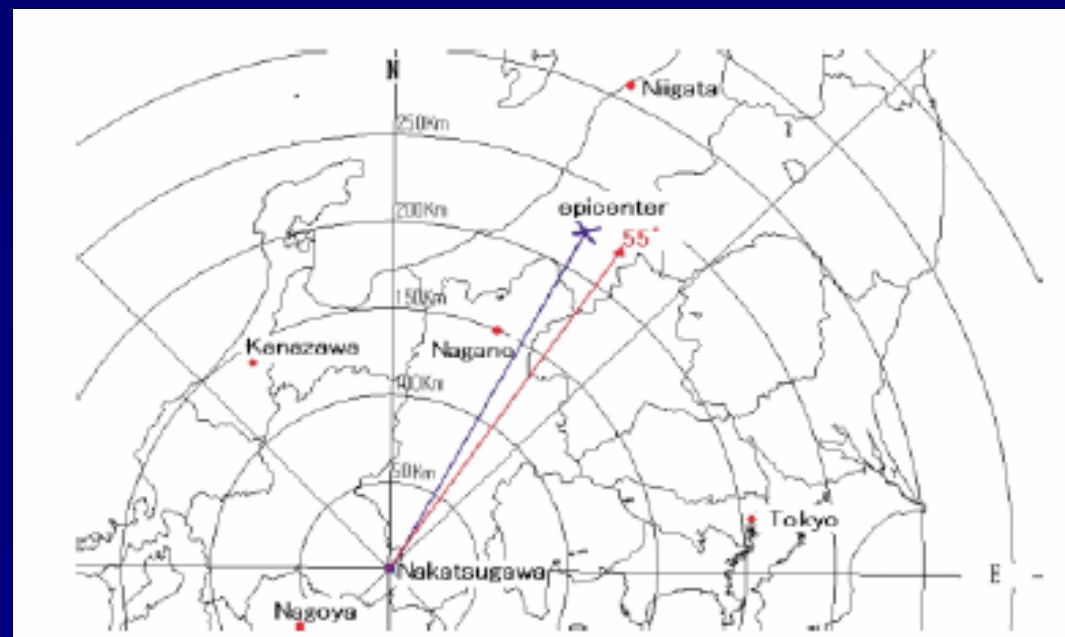


The intensity at 0.1Hz increased from 10/2 to 10/6.

By Goniometer method, we calculate the direction angle of this enhanced EM wave.

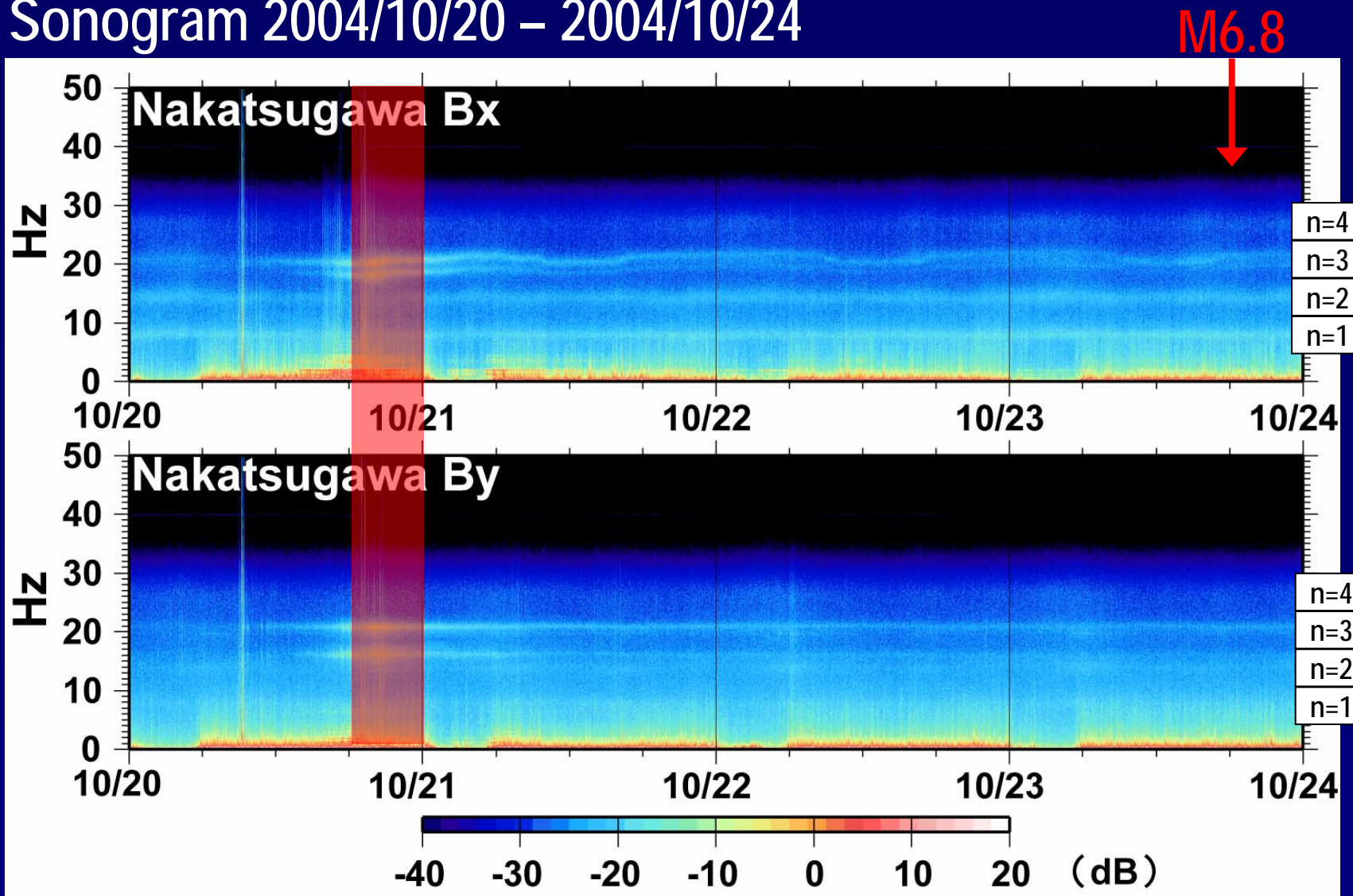
The direction angle pointed to the area near the epicenter.

Ohta et al. (2005)



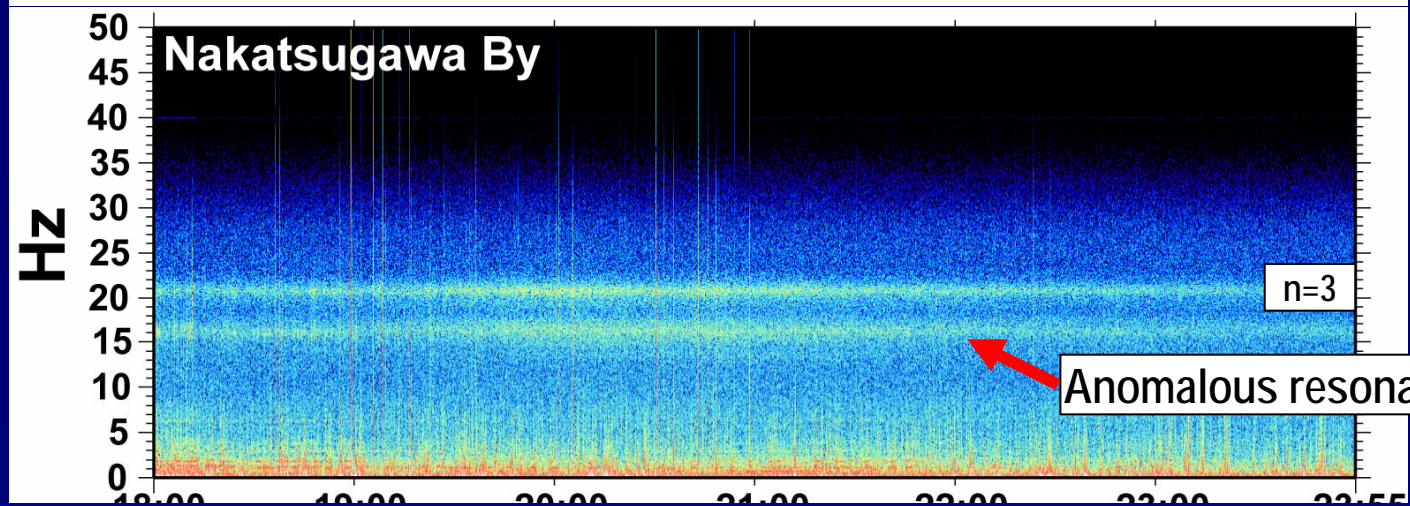
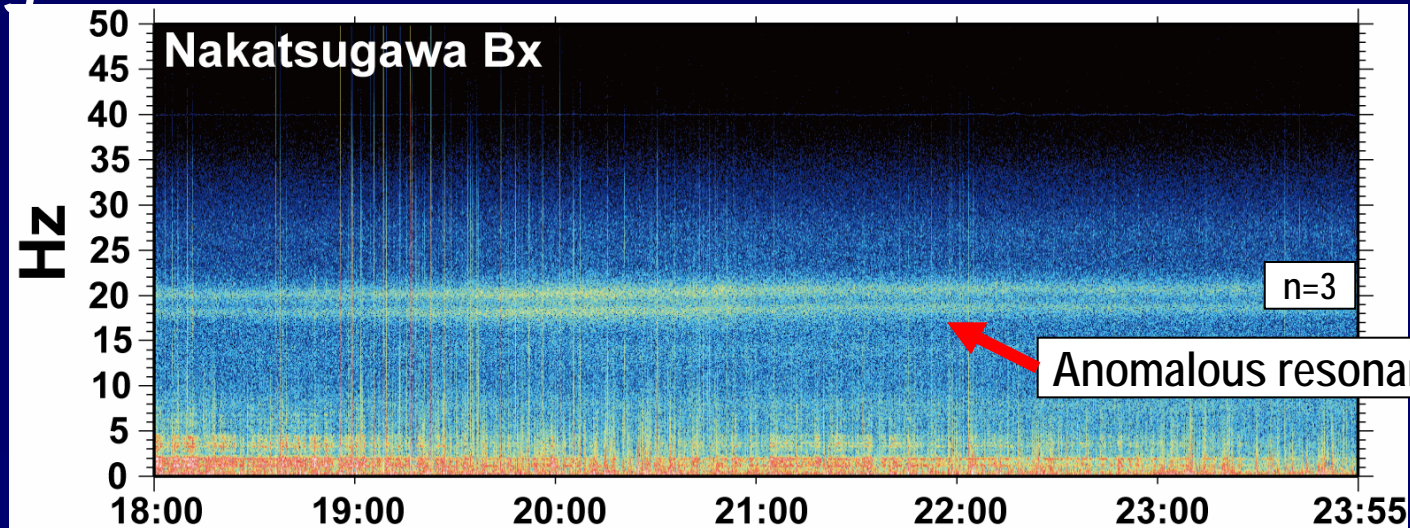
2004 Mid-Niigata Earthquake

Sonogram 2004/10/20 – 2004/10/24



2004 Mid-Niigata Earthquake

Sonogram 2004/10/20 18:00 - 24:00

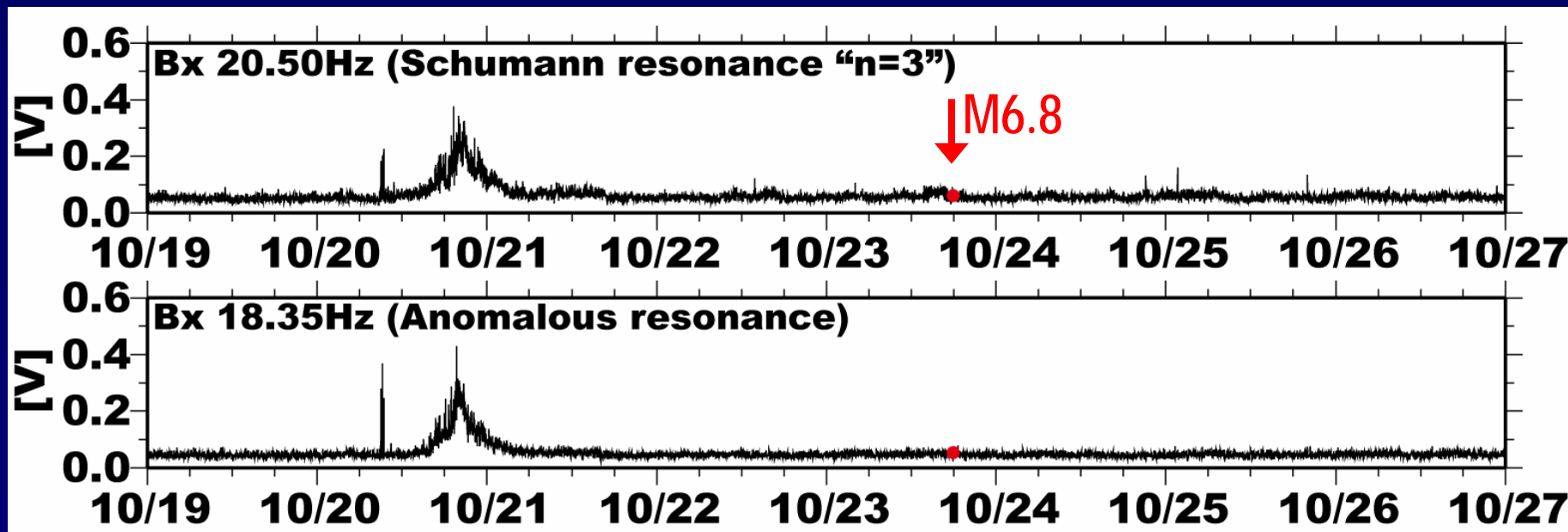


The intensity of Schumann resonance ($n=3$) increased.

Another resonance (18Hz and 16Hz) appeared.

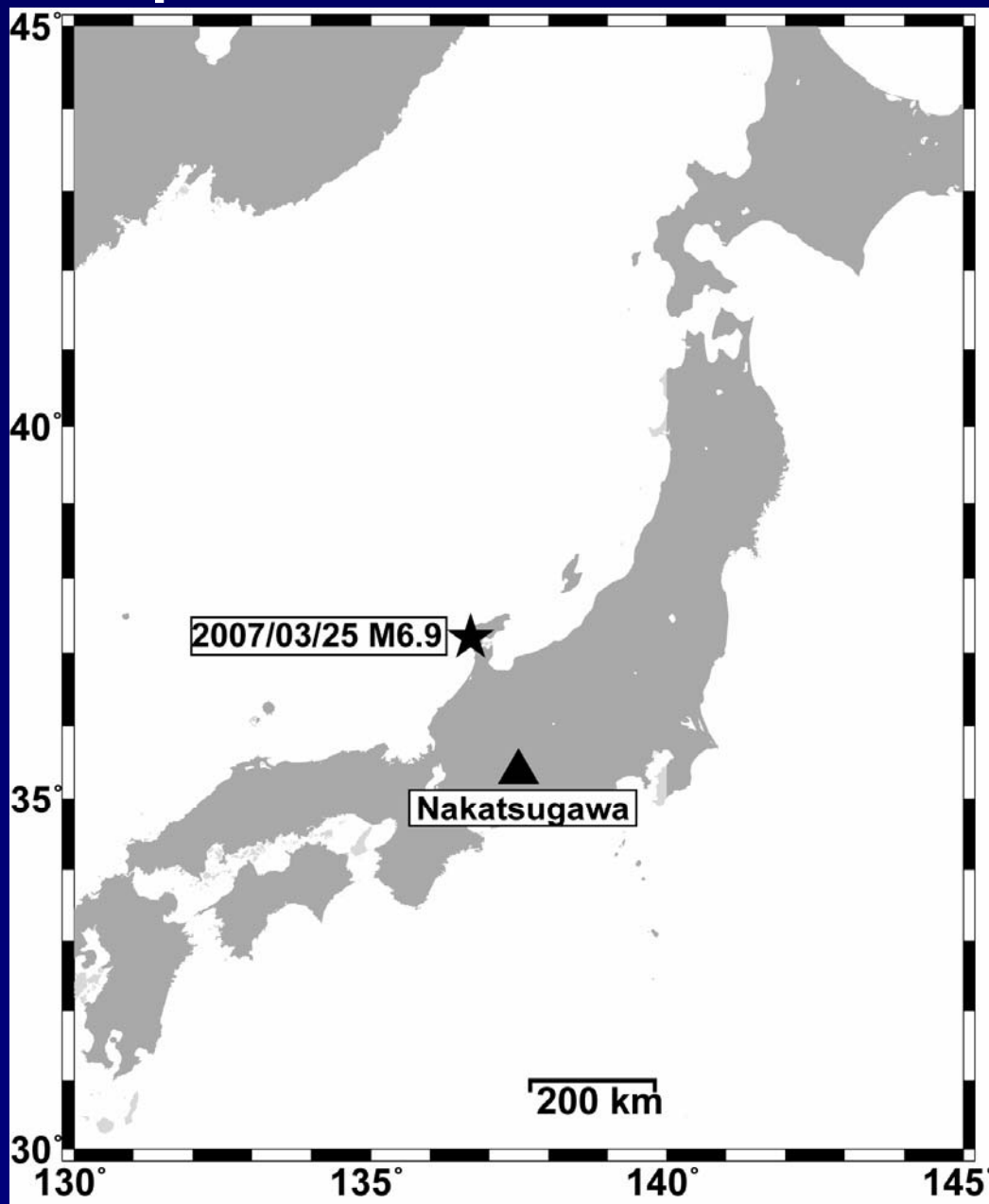
2004 Mid-Niigata Earthquake

Temporal change of the intensity from 10/19 to 10/27 (1 week)



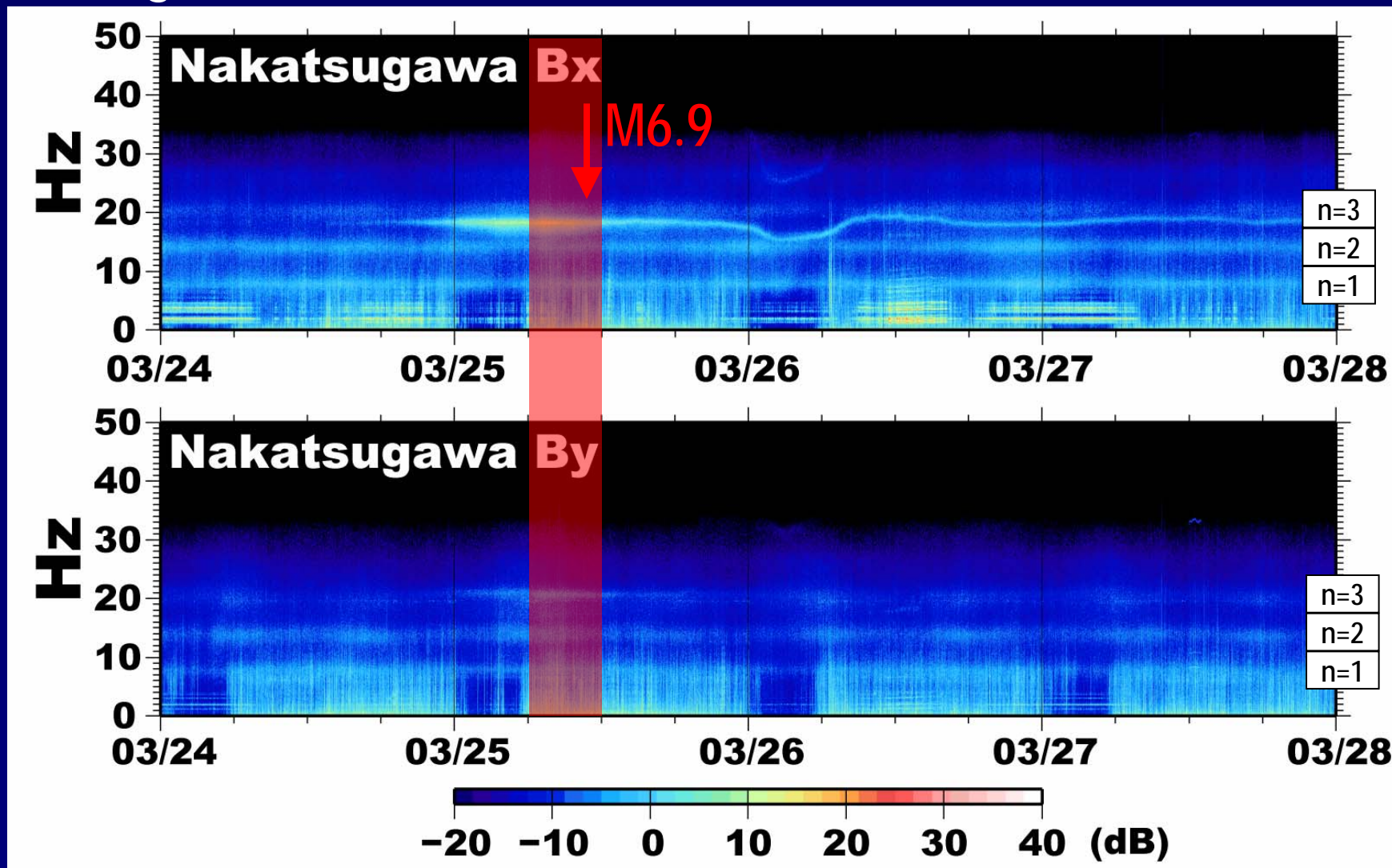
The intensities of the Schumann resonance ($n=3$) and the anomalous resonance are synchronized.

2007 Noto Earthquake



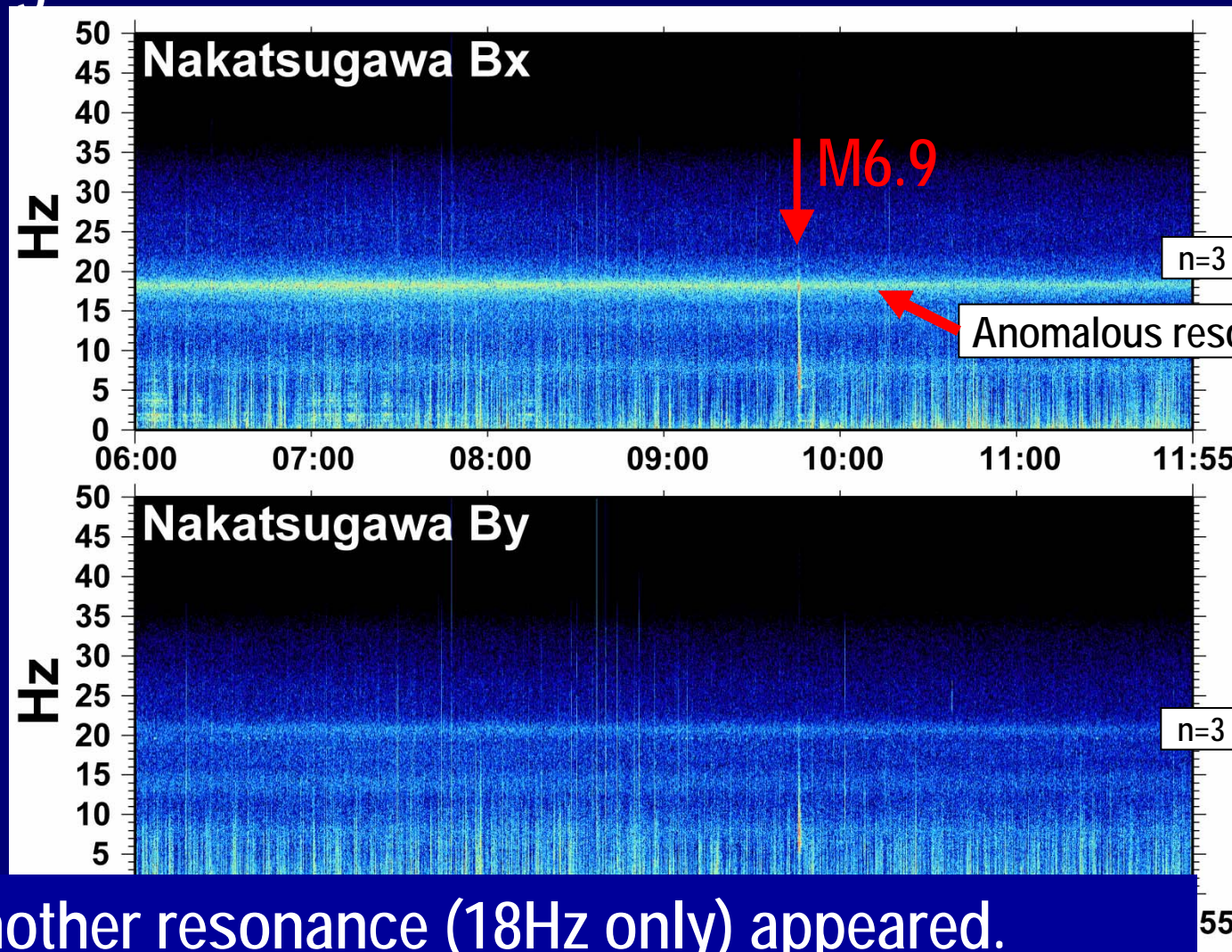
2007 Noto Earthquake

Sonogram 2007/03/24 – 2007/03/28



2007 Noto Earthquake

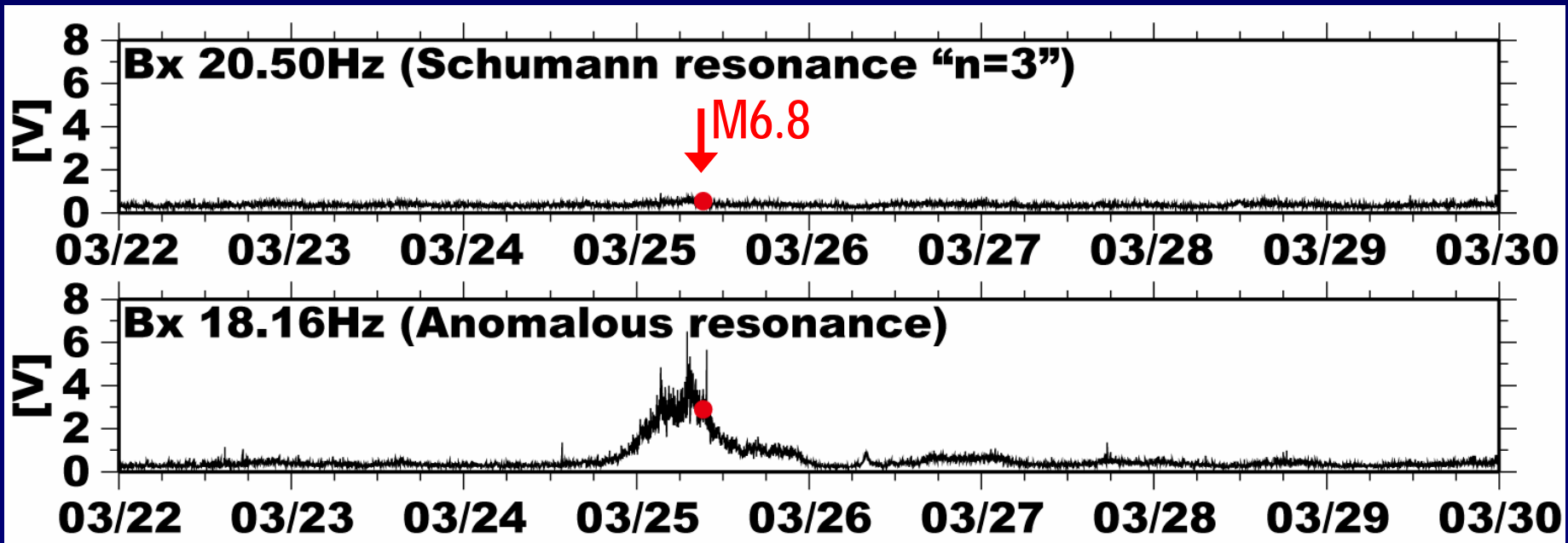
Sonogram 2007/03/25 06:00 - 12:00



Another resonance (18Hz only) appeared.
 The intensity of Schumann resonance (n=3) didn't increase so much.

2007 Noto Earthquake

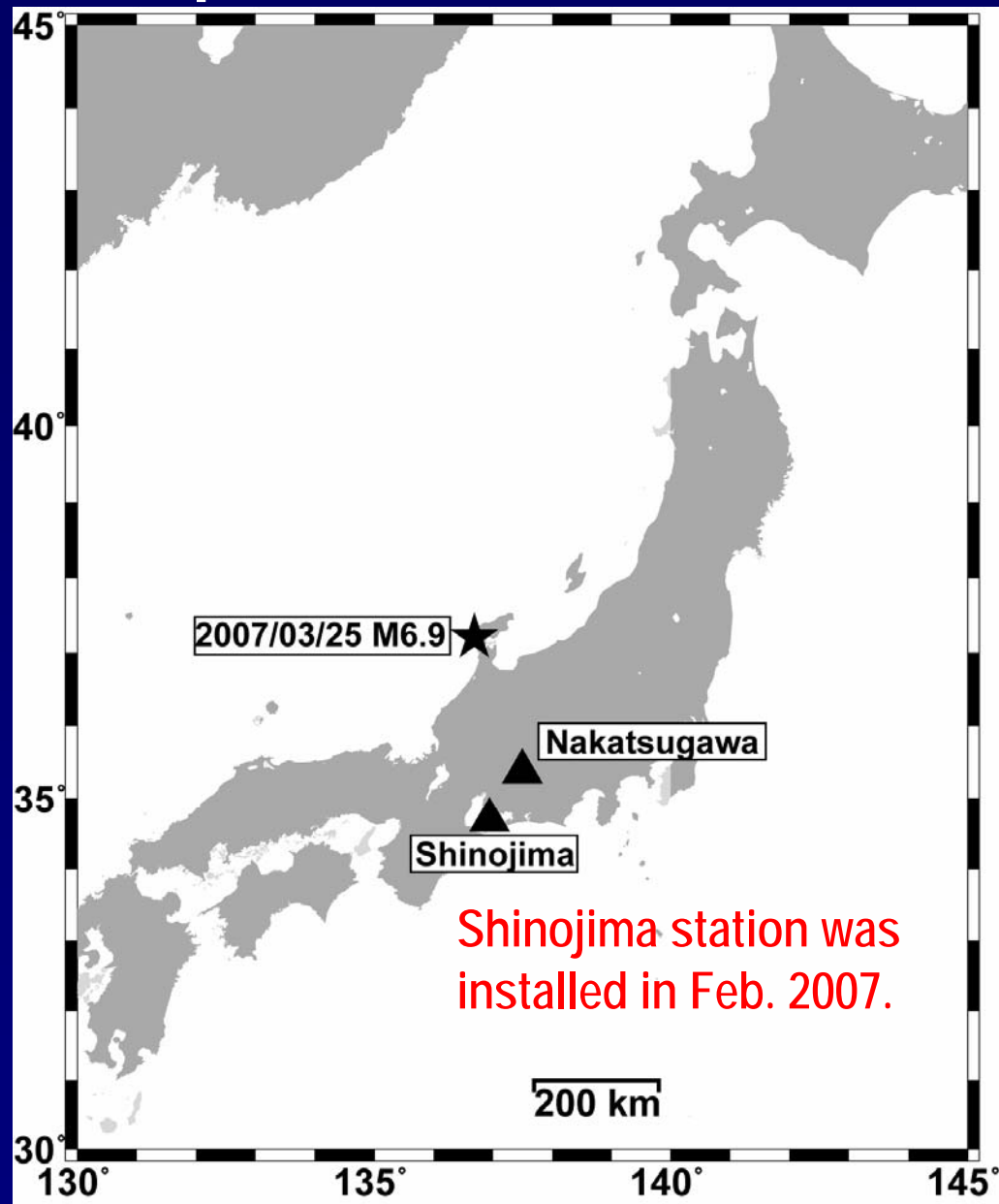
Temporal change of the intensity from 03/22 to 03/29 (1 week)



The intensity of the Schumann resonance ($n=3$) didn't increase.

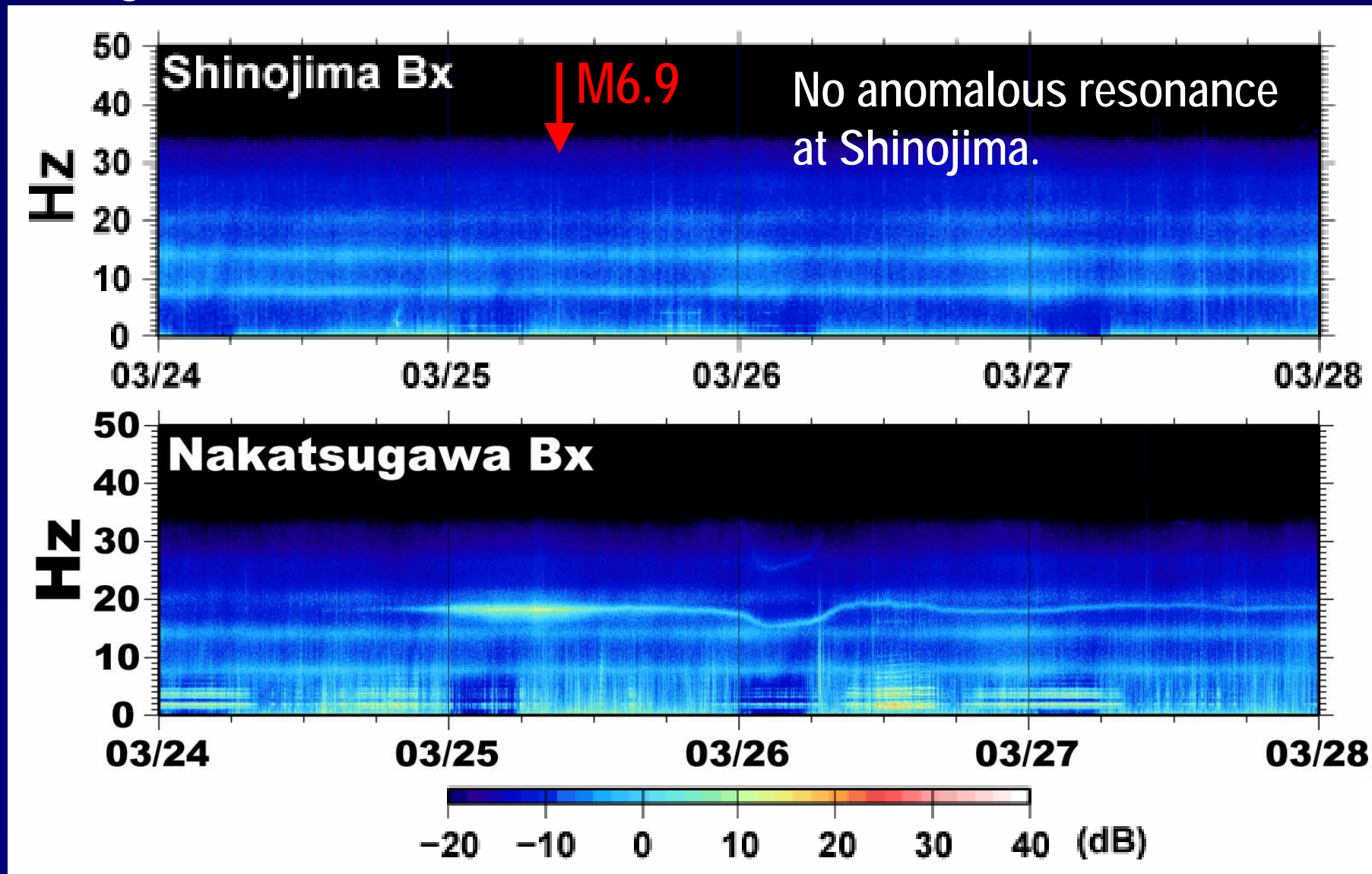
The intensity of the anomalous resonance increased just before the earthquake.

2007 Noto Earthquake



2007 Noto Earthquake

Sonogram 2007/03/24 – 2007/03/28



Conclusion

We observed anomalous Schumann resonance and another anomalous resonance before 2004 Mid-Niigata earthquake and 2007 Noto earthquake.

The generation mechanism of these anomalous resonances was obscure. (local problem ?)

We installed 3rd ULF station last year.

We expect to acquire new information by our new observation network.