

Estimation of S-wave velocity structure  
of deep sedimentary layers  
using geophysical data and earthquake  
ground motion records.

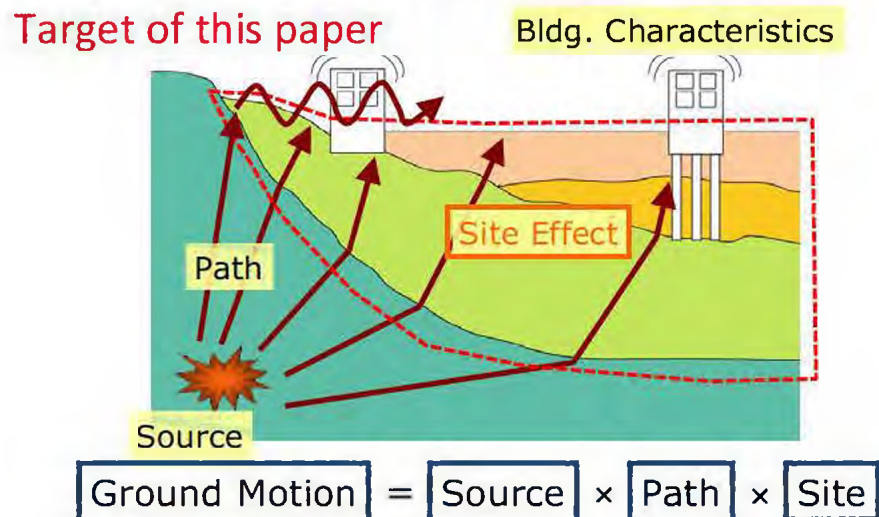
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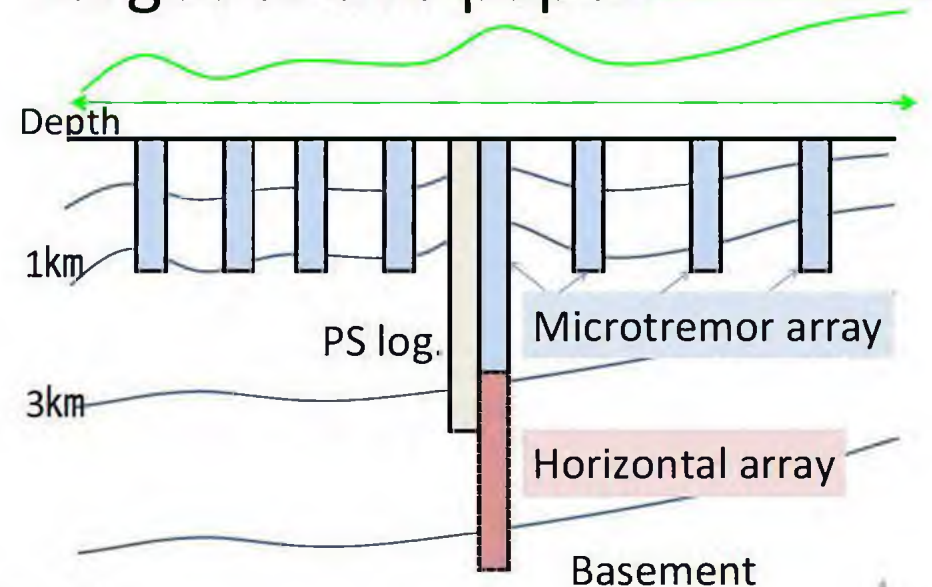
## Outline

- Background
- Target of this paper
- Microtremor Survey
- Horizontal array of strong motion observation points
- Gravity Survey
- Conclusions

## Background

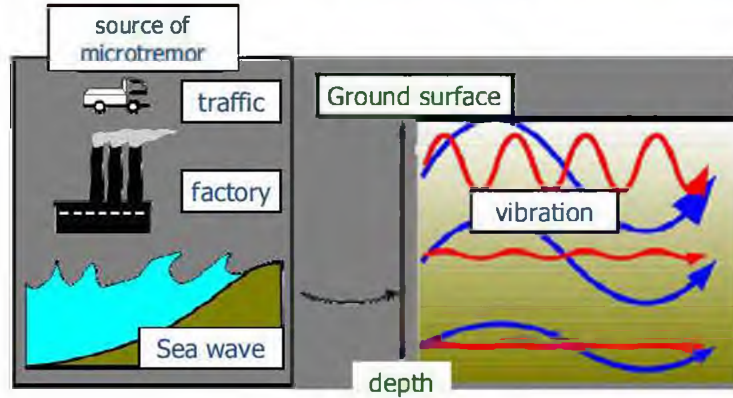


## Target of this paper

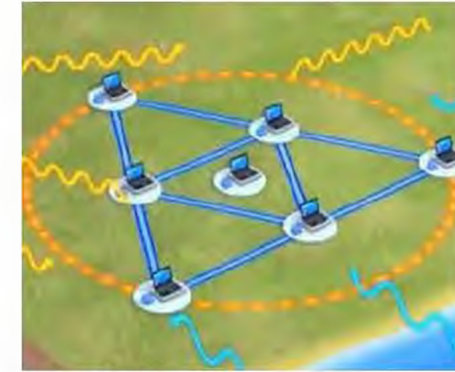


# Microtremor Survey

- Low Cost
- Surface Waves  
(e.g., Tokimatsu et al.(1992); Bonnefoy-Claudet et al.(2008))
- Survey depth is influenced by the power of microtremor.

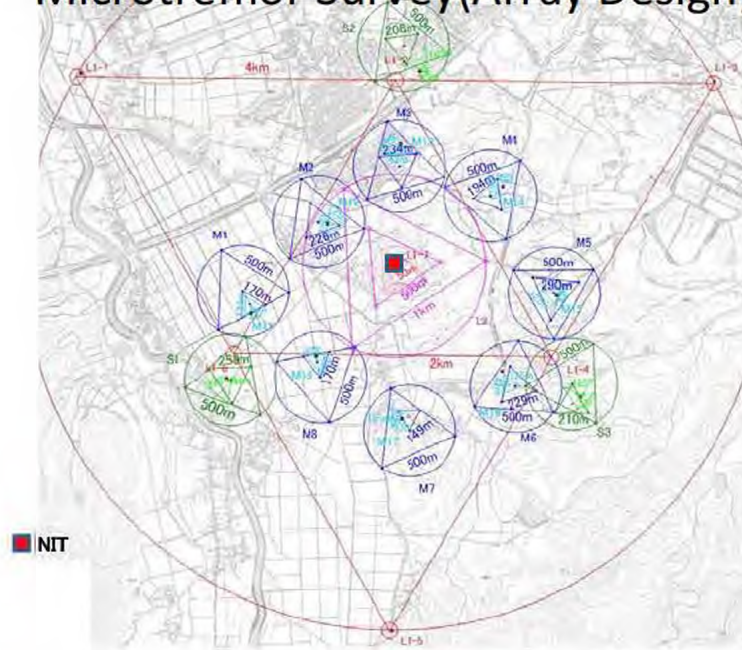


# Horizontal array of strong motion observation points

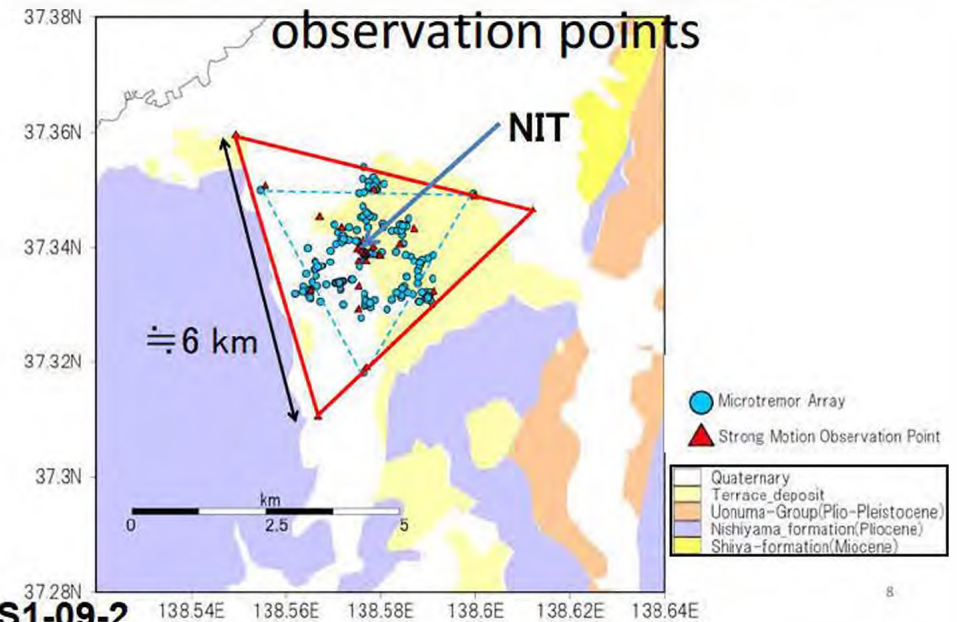


The long period earthquake records more than 5sec.

# Microtremor Survey(Array Design)

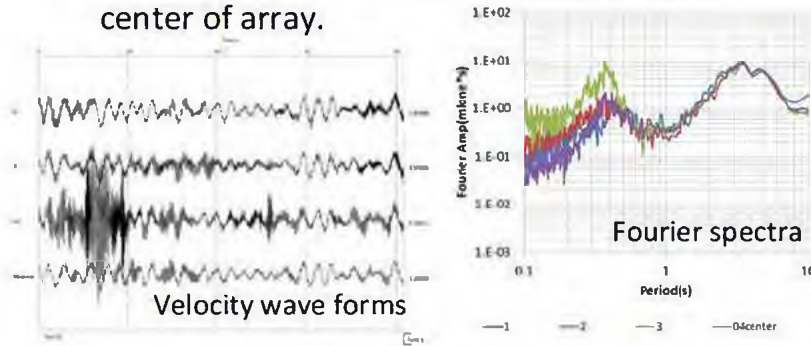


# Horizontal array of strong motion observation points



### Microtremor Exploration(Array Design)

- The array consists of 7 vertical seismometers with the length of triangle from 4km to 125m
- We carried out the 11 array which the length of triangle is 1km.
- Three component of Microtremor at the center of array.



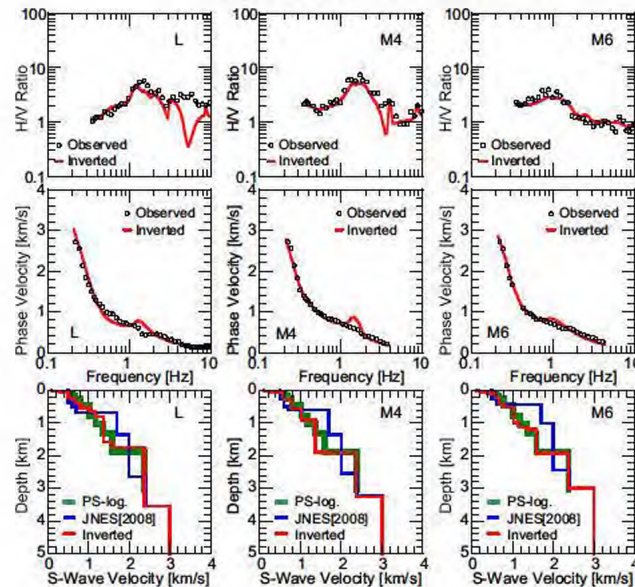
### Definition of Misfit for Joint Inversion

- More than 2 observation data are used (e.g., Dispersion curve (phase vel.) **H/V Spectrum**)

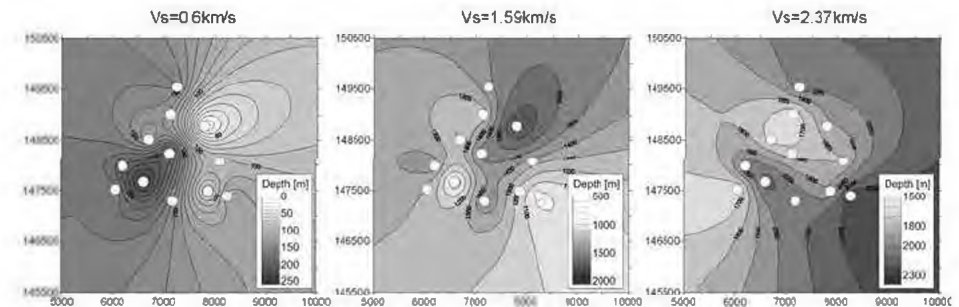
$$misfit = \frac{w_v}{N_v} \sum_{i=1}^{N_v} \left( \frac{c_{obs i} - c_{cal i}}{c_{obs i}} \right)^2 + \frac{w_{(H/V)}}{N_{(H/V)}} \sum_{i=1}^{N_{(H/V)}} \left( \frac{(H/V)_{obs i} - (H/V)_{cal i}}{(H/V)_{obs i}} \right)^2$$

$w$  : Weighting factor  
 $N$  : Number of data  
 $c_{obs}$  : Phase velocity (obs.)  
 $c_{cal}$  : Phase velocity (cal.)  
 $(H/V)_{obs}$  : H/V ratio (obs.)  
 $(H/V)_{cal}$  : H/V ratio (cal.)

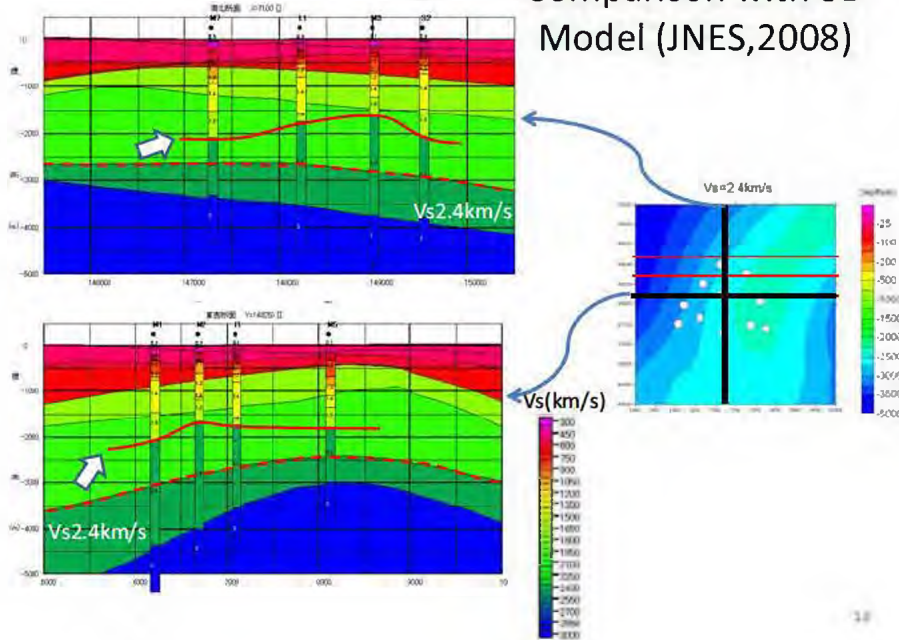
### Joint Inversion Result



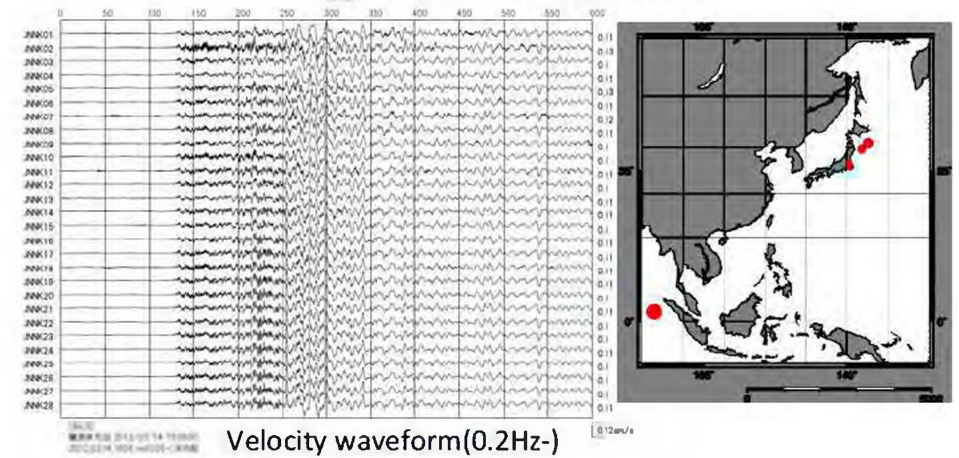
### Depth of Each Layers



Comparison with 3D Model (JNES,2008)

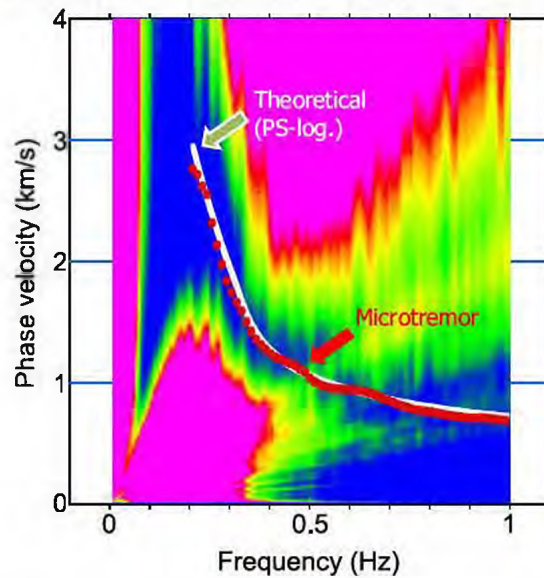


The strong motion records observed by the Horizontal array data.

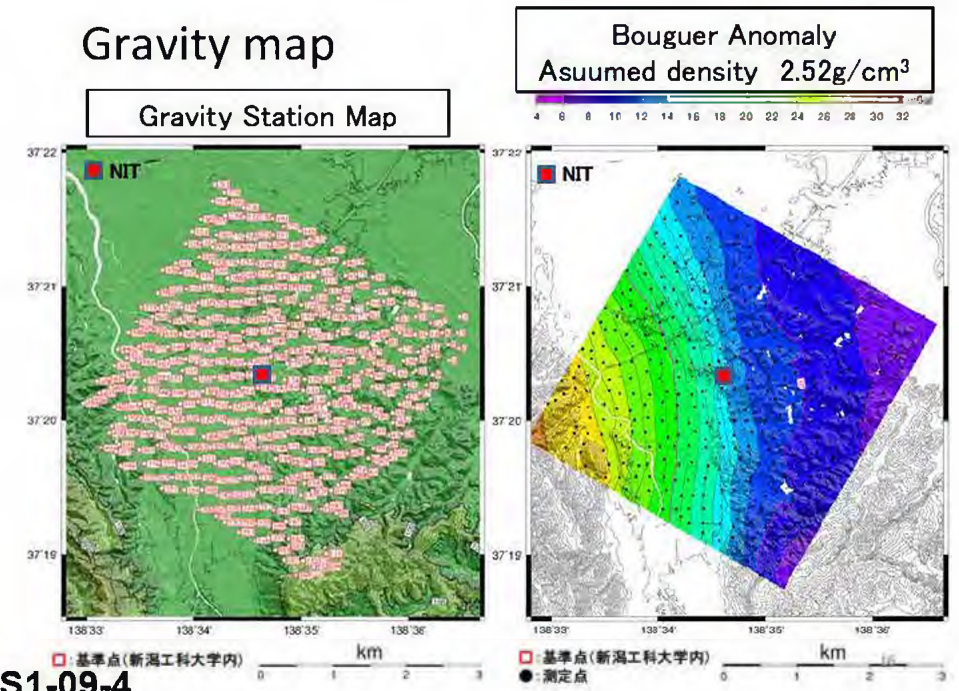


2012/3/14 FAR SE OFF HOKKAIDO  
Mj 6.9 Dep64km

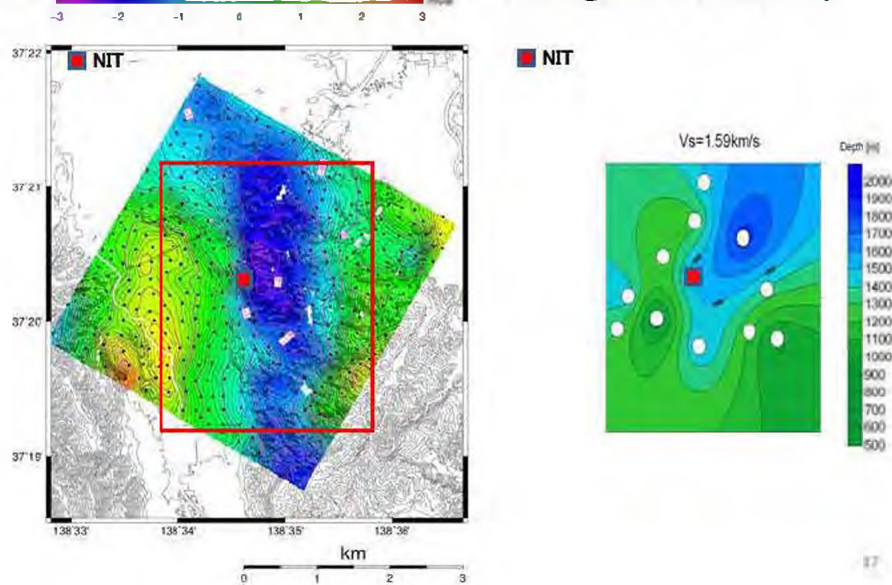
The image of surface wave dispersion curve using earthquake ground motion records.



Gravity map



## Residual Bouguer Comparison with Residual Anomaly( $\lambda \sim 0.38\text{km}$ ) Bouguer Anomaly



## Conclusions

- We conduct microtremor exploration at 12 sites in and around NIT.
- By the use of joint inversion, S-wave velocity profiles can be obtained.
- Phase velocity estimated from horizontal array of strong motion observation agree with that from microtremor survey.
- Estimation result is harmonious with other literature such as PS-logging data and gravity map.
- We will improve the 3D model using microtremor survey and horizontal array survey results.