Poster #16

P 16

Techniques of using data from OBS station

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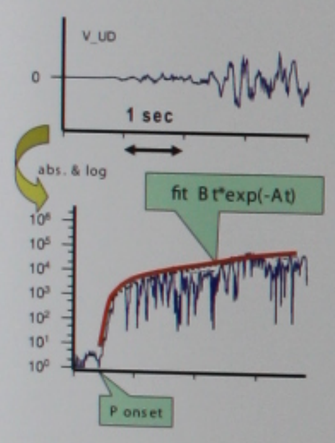
JMA EEW information are compiled from data of small numbers of stations, to estimate hypocenter quickly for immediate release to the public. In Japan, large earthquakes occur in the surrounding ocean area. Thus, using ocean bottom seismometers (OBSs) for EEW would be quite effective, and we should know thoroughly about the response of our estimating methods when using OBS data.

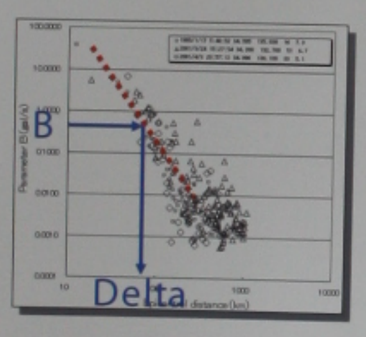
What is the B-Delta method ?

The B-Delta method is a step of estimating epicentral distance from a single seismic record in a short period, regardless of magnitude of earthqukaes.

Results of using the B-Delta method on 2005 off-Miyagi pref. earthquake. Filled triangles are our seismic stations, and each arrow describes estimation from each single station using the B-Delta method.

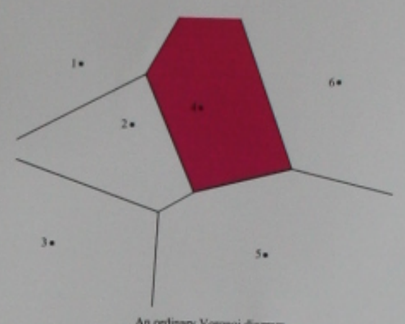


Calculate the absolute value of an accelerogram waveform and fit it to a function Bt*exp(-At) to determine unknown parameters A and B.



Estimate epicentral distance from the empirical relation using parameter B.

What is the Territory method ?

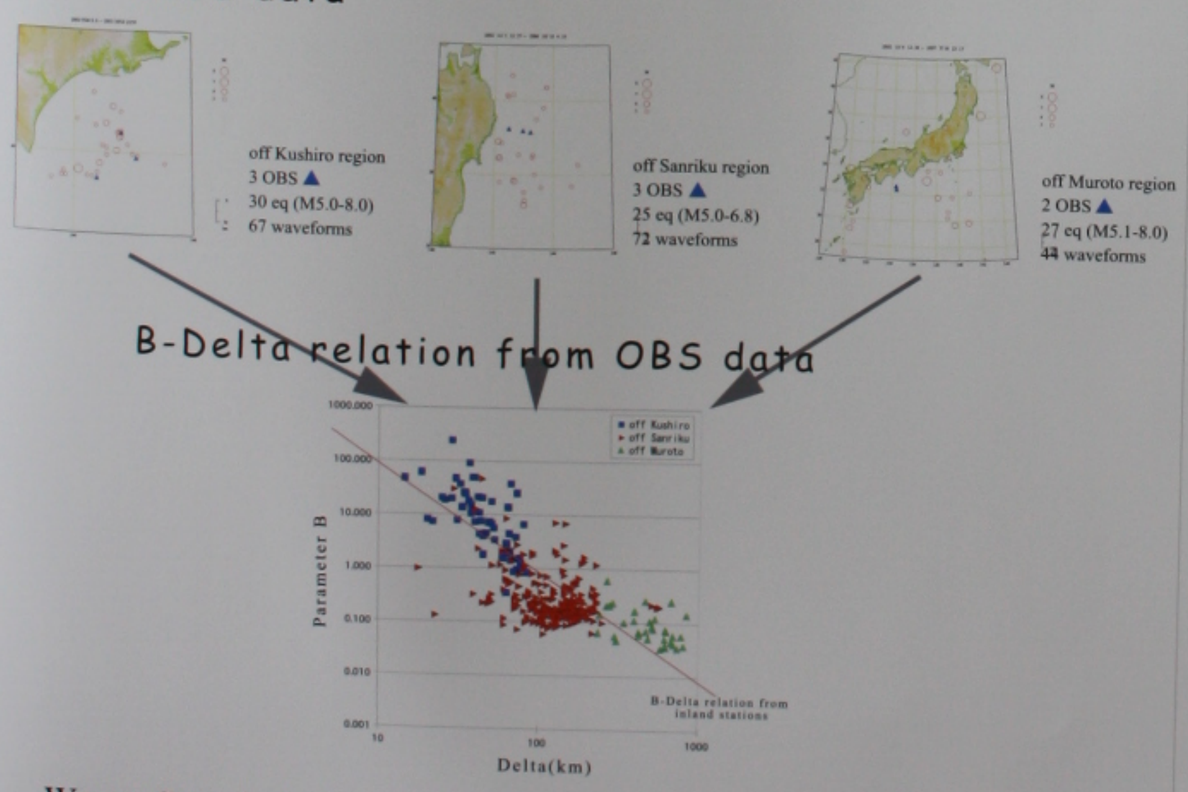


An ordinary Voronoi diagram

The left figure shows the concept of the Territory method. The earth surface is divided by seismic stations (shown in solid circle) using Voronoi tessellation. Assuming that station #4 is the first detected station, the red-covered area is the theoretical region that hypocenter should exist in. Obviously, the arrival order is the key concept of the Territory method. That means, data transmission delay of all stations are assumed to be the same. Since set up environment of OBS stations are significantly different from that of inland stations, OBS stations may have different transmission delay. In addition, traveltime correction of sedimentary layers may be considarable large. To solve this problem, we introduced the Additively Weighted Voronoi tessellation instead of the ordinary Voronoi tessellation.

Applying the B-Delta method to OBS data

Used data



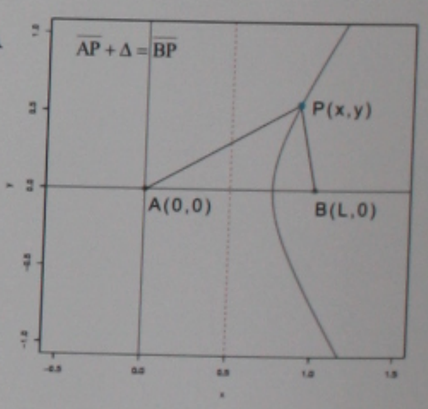
We confirmed whether the B-Delta relation is applicable to OBS data. As shown in above figure, OBS data from 3 regions are in accordance with the B-Delta relation made from inland data.

Introducing Additively Weighted Voronoi tessellation

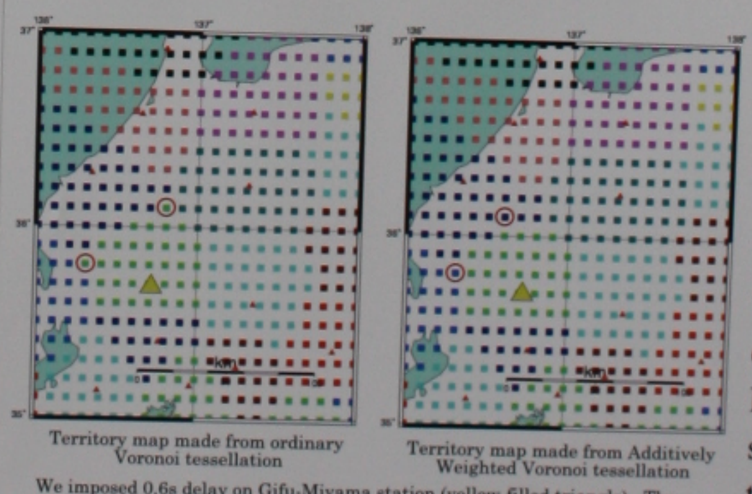
Assume that station B has δ(s) delay to station A (we use $\Delta = V_p \cdot \delta$ (km) hereafter), the territory border P should be expressed as $\overline{AP} + \Delta = \overline{BP}$. This equation resolvs to

$$f(x,y) = 2x - L - \Delta\sqrt{1 + \frac{4y^2}{L^2 - \Delta^2}} = 0$$

where L is the distance between station A and B. The sign of this function $f(x,y)$ denotes whether a point (x,y) is inner or outer of the territory.



Example



Territory map made from ordinary Voronoi tessellation

Territory map made from Additively Weighted Voronoi tessellation

We imposed 0.6s delay on Gifu-Miyama station (yellow-filled triangle) . The other stations (red-filled triangles) have no delay. 2 gridpoints of Gifu-Miyama's Territory (red-circled gridpoints) have moved to others.

This figure shows an instance of the difference of two (usual and improved) tessellations. Solid triangles are our seismic stations, and solid squares are Territories corresponding to each stations. Imposing 0.6s delay on a station makes 2 gridpoints of the Territory transfer to other.

Conclusion 1

The B-Delta method is applicable to the OBS data as well as to the inland station data. Its parameter for OBS is not much differ from inland one.

Conclusion 2

We are now able to handle different transmission delay of data from each station, by introducing Additively Weighted Voronoi tessellation.

Acknowledgments

We used strong-motion data of JAMSTEC OBS at off Kushiro and off Muroto, ERI OBS at off Sanriku. We thank them for providing valuable data.