Investigation on the periodicity and directivity of the 2018 Hokkaido Eastern Iburi Earthquake

平成 30 年北海道胆振東部地震の周期特性と方向性についての検討

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1. Introduction

On the 6th of September 2018, an earthquake measuring M6.7 struck Iburi Subprefecture in Southern Hokkaido, Japan at 03:08a.m. Japan Standard Time. JMA has officially named the event as "Hokkaido Eastern Iburi Earthquake of Heisei 30".

In this research, data of 100 out of 474 observation sites obtained from the National Research Institute for Earth Science and Disaster Resilience are used to study the periodicity and directivity of this earthquake, in hope that it can be used to predict damages sourcing from seismic motions in the future.

2. Analytic method

2.1 Earthquake response spectrum analysis

Acceleration response spectrum is used in this matter because it shows the force acting on structures, with damping ratio 5% as the main focus for this study. Predominant period is taken into account in order to study the periodicity.

2.2 Acceleration orbit

Acceleration orbit is the value obtained by taking the two directions of acceleration values obtained by strong seismographs in NS, EW and UD (North-South, East-West, Up-Down) direction as the axis, then by plotting and connecting the values.

2.3 36 direction component vector synthesis

Based on Fig 1 below, beginning with 0° from the North of NS direction, vector is synthesized by moving in 36 orientations by 5° clockwise. Then, average acceleration response graph is constructed.

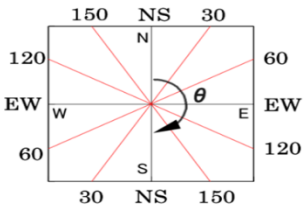

Fig 1 Vector synthesis

2.4 Average direction acceleration response value of seismic motion

Average acceleration of each direction component and the average of it are used to construct the graph of average acceleration response.

3. Analysis result

3.1 Acceleration response spectrum analysis

Fig 2 shows the acceleration response spectra for observation site HKD127 and is shown in

damping ratios of 0%, 1%, 2%, 5%, 10% (red, blue, purple, black, green). Its predominant periods are ranging from 0~1.0 second; hence this is a short-period earthquake.

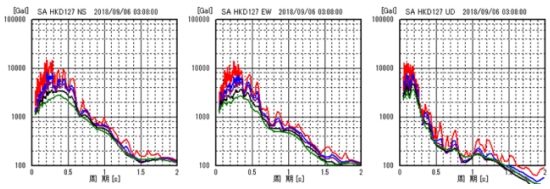

Figure 2 Acceleration response spectra HKD127 Oiwake (追分)

2.1 Acceleration orbits

Acceleration orbit HKD127 in Fig 3 is an example of a motion that is weak in directivity. This research has found that the acceleration orbits for the 2018 Hokkaido Eastern Iburi Earthquake are mostly motions weak in directivity.

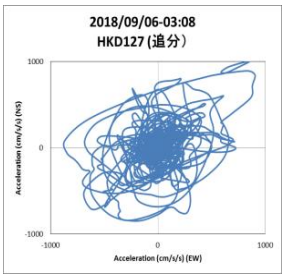

Fig 3 Acceleration orbit HKD127 (追分)

3.3 36 direction component vector synthesis

The “average direction acceleration response values of seismic motion” are of small and large average directions are plotted onto the map according to observation points.

3.4 Average direction acceleration response value of seismic motion

Based on Fig 4, the average direction 1 is facing the NE-SW direction, and the average direction 2 is facing the SE-NW direction.

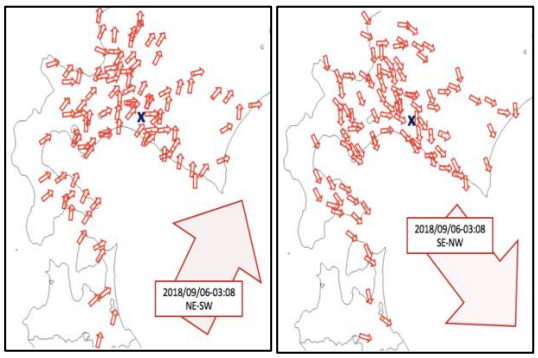

Fig 4 Average directions 1 and 2

4. Conclusion

Overall, the 2018 Hokkaido Eastern Iburi Earthquake is concluded to be a short-period earthquake, a motion with weak directivity, and has an average direction facing the NE-SW or specifically ENE-WSW, and SE-NW or ESE-WNW direction.

By incorporating these results onto the design and planning of structures, it is possible to make more accurate predictions of damages and also contribute in reducing structure damages against future earthquakes.

5. References

1) Strong-motion Seismograph Networks (K-NET, KiK-net) http://www.kyoshin.bosai.go.jp/kyoshin/
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3) 気象庁　報道発表(平成 30 年 9 月 20 日) https://www.jma.go.jp/jma/press/1809/20a/kaisetsu201809201500.pdf