EXPLANATION OF THE NATURE OF COHERENT LOW-FREQUENCY SIGNAL SOURCES RECORDED BY MONITORING STATION NETWORK OF THE NNC RK

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I. DETECTION OF MICROBAROMS AT 131KZ

Since March 2008, a fully automatic seismic detector has been run on incoming data from the Eventnet-1 3.5Hz infrasonic array at Alyibekov in Kazakhstan. The search algorithm is based on the Progressiv Multi-Channel Correlation Technique (PMCC) [1; 2]. PMCC detects signals that are coherent across several sensors of the array and that are delayed by time-delays corresponding to the mean acoustic travel speed wavefronting across the array. Coherent wavefronts can be either specular, transient signal or continuous signals of longer duration. PMCC detects and classifies both types of signals effectively. PMCC generates a bulletin of infrasonic signals detected at the array, with the characteristics of each detection described as a single line by parameters for time, location, distance, frequency, and amplitude. Figure 1 shows the automatic distribution of the signals detected by the station from January 1 to January 8, 2008.

PMCC Detections – Upper Plots and Levelled Energy of Oceanic Waves – bottom plots for Kazakhstan Arrays, Data for One Year of Observations

II. GENERATION OF MICROSEISMS AND MICROBAROMS

Microbaroms were first observed by Bessai and Gutenberg [2] who noted the similarity between the infrasonic signals on an acoustic chart and microbarom-type oscillations. Oscillations typically observed on infrasound waveforms (‘sharp peaks’) are almost the same as those recorded in the atmospheric region. Even though the mechanism of their generation is not clear, they are most likely to be produced by waves emerging from a point source. This conclusion is based on the fact that the waves have a period of about 100 s and are observed at distances of hundreds of kilometers.

PMCC Detections – Left Plots and Levelled Energy of Oceanic Waves – Right Plots for European Arrays, Data for the January 2008

REFERENCES


CONCLUSION

For three Kazakh seismic arrays: Akbulak (ABKAR), Borovoye (BVAR), Karatayu (KKAR), and for the 131KZ –Allybekov infrasonic array, there is a quite good correspondence between the observed backazimuths of low frequency acoustic and infrasonic signals and the directions towards areas of severe storms in the world oceans. Continuous measurement of the direction of arrival of microseisms at six European seismic arrays supports the hypothesis that the microseisms and microbaroms recorded in Kazakhstan are generated in the same source regions in the North Atlantic Ocean as those observed in Europe. Microseisms and microbaroms generated in the North Pacific do not appear to be observed on the stations in Central Asia. The background infrasonic noise at 131KZ comes from two very different directions. The microbaroms arriving from the north-west are dominated by very low frequencies (never exceeding 1 Hz). Continuous noise from the south (“185 degrees backazimuth”) is generated by gas flares in the Zhanazol oil fields and is dominated by far higher frequencies (between 1.5 and 4.0 Hz). The low-frequency background seismic and infrasonic noise recorded at the arrays in the north of Kazakhstan indicate almost exclusively generation zones in the North Atlantic. The KKAR array and the Makanchi array (KKAR) - both in the south of Kazakhstan - also recorded persistent noise (at somewhat higher frequencies) from different directions: to the south of the KKAR and to the east of KKAR. These signals are not consistent with the regions of oceanic microseismic generation and are likely to result from activity in the Tien Shan glaciers [9].

PMCC Detections – Levelled Energy of Oceanic Waves – bottom plots for Kazakhstan Arrays, Data for One Year of Observations

Figure 1. Automatic distribution of infrasonic detections (for 131KZ Alyibekov) for January 2008.

Figure 2. Frequency characteristics of infrasonic detections at 131KZ as a function of backazimuth.

Example of the map of ocean wave height for January 6, 2008

There are two waves when observations do not match with expectation. The wave in the direction of waves signals at the array of Akbulak in the North Pacific is not the same as the wave in the direction of the wave in the Atlantic Ocean. The wave in the direction of the wave in the Atlantic Ocean is not the same as the wave in the direction of the wave in the North Pacific.

Figure 3. Frequency characteristics of infrasonic detections at 131KZ as a function of backazimuth.

Figure 4. Example of the map of ocean wave height for January 6, 2008

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