Array Analysis of Lake Superior Microseisms

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A high-frequency analysis of records from the transportable seismic Superior Province Rifting EarthScope Experiment (SPREE) and the EarthScope Transportable Array (TA) is carried out in order to identify the generation of microseisms noise during large storms on Lake Superior. Beginning at 9:00 GMT on October 14, 2011, a series of intense storms passed over Lake Superior. Winds estimated at over 100 kph generated waves that reached 12 meters on the lake. At the same time, the TA and SPREE stations, which are deployed in Minnesota, Wisconsin, and Ontario, recorded elevated levels of microseism noise in the 0.1 – 0.3 Hz range. Spectral analysis of the records shows that the microseisms noise intensity increases and matches the lake waves heights recorded by the buoys. At the beginning of October 14, 2011, lower frequency energy between 0.11 and 0.16 Hz is generated. Those observations suggest that most of the microseisms are generated by the direct interaction between the water waves and the Lake Superior bed. A back-projection of the seismic energy recorded across the SPREE array indicates that the seismic noise mainly propagates as Rayleigh waves generated at the shorelines of Lake Superior.

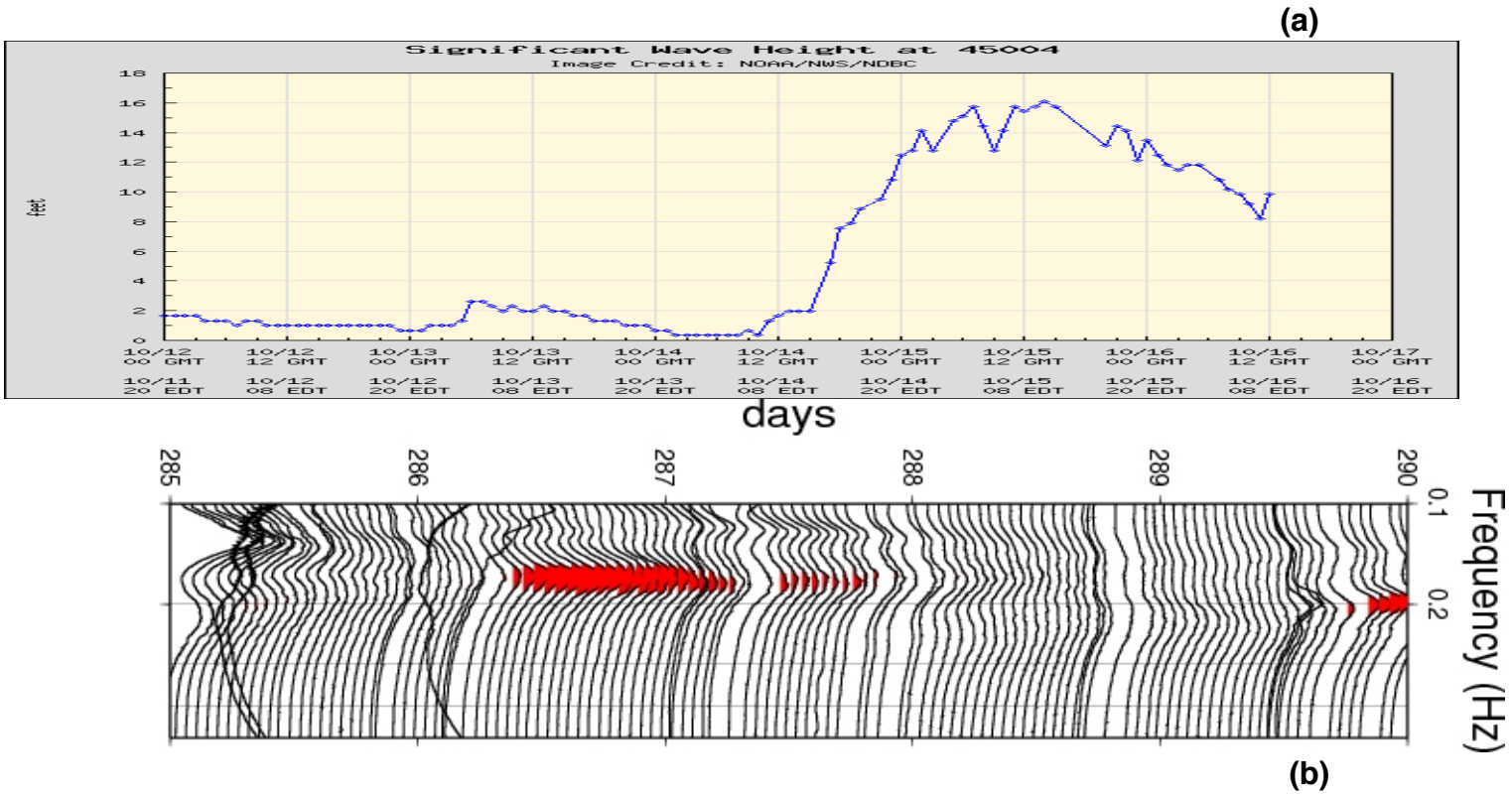

Figure 1. Comparison of hourly-stacked spectral amplitudes at TA and SPREE stations around Lake Superior with buoy 45004 wave heights during October 14 - 17, 2011. (a) Buoy 45004 wave heights. (b) The spectral amplitudes of the microseisms. Notice the increased intensity (red region) when the first storm approached the lake. The red region on the right marks the approach of another storm.