OBSERVATIONS OF AMBIENT NOISE INDUCED BY HURRICANE KATRINA IN THE SOUTHERN USA

Spingos Ioannis* (1), Kaviris George (2), Kassaras Ioannis (1)
(1)National And Kapodistrian University Of Athens, (2)Section Of Geophysics-Geothermics, Department Of Geology And Geoenvironment, Panepistimiopolis 15784
* ispingos@geol.uoa.gr

The study of ambient noise is increasingly becoming a significant topic of research in the fields of seismology and applied geophysics. Ocean waves generate noise that can be recorded by seismographs in large distances from the source. Based on the location and type of its nature, ambient noise can be classified as primary (0.05 – 0.1 Hz) and secondary (0.1 – 0.5 Hz). By processing the Rayleigh-dominated content of short period secondary microseism, i.e. above 0.2 Hz, indicators regarding the location (e.g. wave polarization) and proximity (e.g. displacement amplitude) of local noise sources can be extracted. Violent local weather phenomena, such as tropical storms, are known to generate observable ground excitations and, thus, can be exploited for correlating seismological and meteorological observations. Nevertheless, the nature of ambient noise is complex and there is a wide range of factors that affect it, such as coastal morphology, variations in wind characteristics (speed and direction) and circulation of currents.

In the present study, we examine a tropical storm in the southern United States of America (USA). Hurricane Katrina was formed in the Gulf of Mexico on August 23rd 2005 and dissipated 8 days later, after making landfall in the continental USA and causing extensive damage. The passing of Katrina through the Gulf of Mexico enabled the recording of high amplitude ambient noise at stations in the southern USA. Waveform data were obtained from the international Federation of Digital Seismograph Networks (FDSN), recorded by broadband stations of the Global Seismograph Network (IU). The processing scheme that was applied is the following. Initially, daily waveforms were cut in hourly windows and the trend and mean were removed. After decimating the recordings to a sampling frequency of 2 Hz, the response of the instrument was removed. The dominant frequency of the signal was manually determined from the Power Spectral Density (PSD) computed for the vertical component of the processed signals. Along with the PSDs, waveforms were visually inspected and recordings contaminated by earthquake signals or instrument malfunctions were removed from the dataset. For the remaining data, we obtained the polarization direction of the signal by performing a grid search (Tanimoto et al., 2006) in the range N0°E – N359°E employing horizontal waveforms. Using the spectral amplitudes of the horizontal components around the defined dominant frequency, a polarization factor (I) was calculated. The azimuth value that minimizes I is the preferred polarization direction value.

Despite possible scatter in the results due to remaining contamination from other noise sources, the above procedure yielded a correlation of the polarization direction with the location of the storm in the respective time window. The possibility of combining ground motion amplitude data and PSD curves with the proximity of the cyclone to the station is explored. This approach is considered as a first step in investigating the topic of storm tracking with the use of land seismological stations from permanent networks, for cost-effective application in areas without Ocean Bottom Seismographs.

Acknowledgements: We would like to thank the staff of the Incorporated Research Institutions for Seismology (IRIS) and the United States Geological Survey (USGS) for rendering seismological data available to the scientific community, as well as the personnel of FDSN for providing open access to the waveforms and station
metadata. We would also like to thank the National Oceanic and Atmospheric Administration (NOAA) for providing hurricane data.

References