Transient Effects in Atmosphere and Ionosphere Associated with January 2020 Caribbean Earthquakes

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Several significant earthquakes occurred in the Caribbean in January 2020. The first earthquake with M = 6.4 occurred on January 7 off the coast of Puerto Rico. An earthquake of M7.7 occurred in the Caribbean Sea on January 28, 2020, around 19:10 UT on the island of Jamaica. After 3 hours (21:55), another M 6.1 earthquake (NEIC / USGS) occurred in the Caribbean. We analyze retrospectively four different physical parameters of atmosphere/ionosphere during the time of mentioned earthquake events namely: (i) the lower atmosphere chemical potential (ACP), (ii) outgoing earth radiation (OLR) at the TOA, (ii) GPS/TEC and (iv) the very-low-frequency (VLF/LF) signals at the receiving. We found that in the beginning January 2020, a rapid augment of satellite observed earth radiation in the atmosphere, an anomaly appeared over Puerto Rico on January 6 (1 day before the M6.4), and the maxim anomaly appeared eastward from on January 20 (eight days before the M7.7). The increases in ACP on January 20-23 were measured near the epicentral area of M7.7 and coincided with the anomaly of OLR. For the VLF analysis, we used the amplitude data of the NAU signal (signal frequency 40.75 kHz), which was received at Chapman University in Orange, California. The length of the signal propagation path from the transmitter to the receiver was about 5300 km. A significant decrease in signal amplitude, exceeding the level of two standard deviations, is observed before the January 7 earthquake (M = 6.4) off the coast of Puerto Rico. A more significant anomaly in the VLF signal is observed before the M7.7 of the January 28 earthquake.

The pre-earthquake nature of the signals in atmosphere and ionosphere were revealed by simultaneous analysis of satellite, GPS/TEC, and VLF/LF observations and suggest that they follow a general temporal-spatial evolution pattern, which has been seen in other large earthquakes worldwide.

Keywords: earthquake, Caribian, precursors, OLR, VLF

