

## Real-time earthquake monitoring for Tsunami Warning System in Petropavlovsk-Kamchatsky (Russian Far East) during 2011-2015

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Tsunami Warning System (TWS) in Kamchatka was established in Petropavlovsk-Kamchatsky, Russia in 1956–1959 years as a direct result of the great earthquake and tsunami that occurred on November 05, 1952 ( $M = 8.5$ ). In 2006–2010 TWS in the Russian Far East was deeply modernized as the response of Federal officials to the tragedy of December 26, 2004. The task of Kamchatka Branch of Geophysical Survey was to develop and implement the seismological component (Chebrov et al., 2009, 2012).

Here we shortly describe the concept of TWS and real-time earthquake monitoring system in Kamchatka and report on its present status. To date the system of seismological observations (SSO) developed by the Kamchatka Branch of GS RAS includes:

- (1) three regional processing centers (PCs in Petropavlovsk-Kamchatsky, Yuzhno-Sakhalinsk and Vladivostok) equipped with satellite communication system. All of them have complete access to the data of all seismic stations of SSO TWS, analyze seismic data and determine earthquake parameters in real time in 24/7. Processing centers obtained two types of estimations: interactive (preferred, human-controlled) and automatic (as an auxiliary alarm signal which turns on when 7 onsets are detected);
- (2) seismic network, consisting of 55 strong motion instruments, 31 among them are in seismic groups around 6 principal stations, and 18 auxiliary digital stations. All stations are equipped with both accelerometers and broadband velocimeters ( $T_c = 120$  sec). Principal stations are located near the towns on the coast. Also data of Global Seismographic Network and a few regional GS stations are incorporated in the data processing;
- (3) real time data acquisition system.

In 2014 a new service was implemented, such as mapping of instrument intensity for the (1) Petropavlovsk-Kamchatsky city and (2) Kamchatka region. These two documents are formed automatically in real time using strong ground motion data and supposed to be sent within 15–20 minutes since the event's origin time in cases of  $I \geq 1$  in the city and  $I \geq 3$  in the region.

PC "Petropavlovsk-Kamchatsky" is mainly responsible for the offshore zone within the circle area with the radius of 1000 km around PET station. The "tsunami" alert should be released when within the area an undersea earthquake with  $M_s \geq 7.0$  occur. In 2011-2015 there were 41 regional events with  $K_s \geq 13.5$  and/or  $M_s \geq 6.0$  (critical for TWS). SSO TWS is capable to release the first alert about the fact of a strong earthquake ("possible tsunami" alert) not later than 4 minutes after its origin time. For the near-fields (with radius of 200 km from PET), estimates of earthquake parameters are supposed to be sent within 7 minutes from the time of registration at the first station. In fact in 2011–2015, the average response time to an earthquake within this area is 4 minutes 25 seconds after its origin time. The discrepancy of epicentral assessments, comparing to NEIC solutions, equals 40 km in average.