Probabilistic Tsunami Hazard Assessment for next Nankai Earthquake sequence

*Kenji Hirata[1], Hiroyuki Fujiwara[1], Hiromitsu Nakamura[1], Tsuneo Ohsumi[1], Nobuyuki Morikawa[1], Shinichi Kawai[1], Takahiro Maeda[1], DOHI YUJI1[1], Hisanori Matsuyama[2], Nobuhiko Toyama[2], Tadashi Kito[2], Kenshi Ohshima[2], Xuelei Zhang[2], Yasuhiro Murata[3], Ryu Saito[3], Tomoyuki Shibuki[3], Shin'ichi Akiyama[4], Mariko Korenaga[4], Yuta Abe[4], Teppei Ono[4]

1. National Research Institue for Earth Science and Diaster resilience, 2. OYO corporation, 3. KKC, 4. CTC

Earthquake Research Committee (ERC)/HERP, Japanese government assessed next Nankai earthquake could be M8 to M9 class(ERC, 2013) andits occurrence probability(P30) that next event will occur within next 30 years(from Jan. 1, 2020) is 70% to 80%(ERC,2020a) in long-term evaluation reports. They expected that next Nankai event sequence could occur as one of a variety of occurrence patterns with a variety of earthquake source regions(ESRs), and considered that such varieties could be represented by a variety of combinations of 18 segments on subducting plate geometry(ERC, 2013). Based on the long-term evaluation reports, ERC(2020b) announced a probabilistic tsunami hazard assessment(PTHA) for the next Nankai event sequence in January 2020, although they excluded possible maximum-sized ruptures over M9, etc. from their PTHA. In this study, we make another PTHA for the next Nankai event sequence by adding tsunamis from possible maximum-sized ruptures over M9, etc. to the PTHA of ERC(2020b).

We first review methodology of ERC(2020b); (1) they constructed 79 earthquake source regions(ESR) that are expressed by a variety of combo of 18 segments and 2,720 characterized earthquake fault models(CEFMs) which yields 176 combo of ESRs and 348,345 combo of CEFMs for next event sequence based on Tsunami Recipe (ERC, 2017). (2) They divided 176 combo of ESRs(hence 348,345 combo of CEFMs) into Groups I and II; Group I consists of combo of the ESRs(CEFMs) whose largest ESR(CEFM) spans three or less segments along the trough, representing cases where Tonankai and Nankai regions are ruptured individually(e.g.,1944 and 1946 sequence). Group II consists of combo of the ESRs(CEFMs) whose largest ESR(CEFM) spans four or more segments along the trough, representing cases where both the Tonankai and Nankai regions are simultaneously ruptured (e.g.,1707 Hoei). (3) From occurrence pattern history, they assigned weight ratios (ratios of relative occurrence probability) 2/3 vs 1/3 to Group I vs Group II.

The present study follows the methodology of ERC(2020b) principally, but newly adds (i) CEFMs in Group III that consists of maximum-sized ruptures over M9 and (ii) CEFMs with a super large slip(4 times amount of average slip) that ERC(2020b) excluded to the original CEFMs in Groups I and II, in which (ii) is allowed to exist when earthquake ruptures reach the trough axis as the 2011 Tohoku rupture reached the trench axis. Consequently, we construct 83 ESRs and 3,480CEFMs which yields 180 combo of ESRs and 916,669 combo of CEFMs for next event sequence (Kito et al., this meeting).For initial water surface distribution caused by CEFM each(Okada,1992;Tanioka&Satake,1996), we compute tsunami by solving nonlinear long wave equations, using finite difference method, including runup calculation, over a nesting grid system with a minimum grid size of 50 meters to obtain 3,480coastal tsunami height distribution patterns(Saito et al., this meeting). We assign an weight ratio 1/21 vs 20/21 to Group III vs Groups I &II by accepting an idea regarding the weight ratio in “National Seismic Hazard Maps for Japan in 2014“(ERC,2014). Other frameworks to estimate hazard curves will be explained in Abe et al. (this meeting).

PTHA in the present study shows that distribution of exceedance probability(P30) that coastal tsunami height becomes over 3 meters in next 30 years shows similarities to those of ERC(2020b). But P30s in this study become ˜1% and ˜2% on average (˜3% and ˜4% at maximum) larger than those of ERC(2020b) in several coasts facing the Pacific between Kyushu and Boso Peninsula, and in Izu-Bonin islands, respectively(Abe et al., this meeting). However, the scientific evidence to the weight ratio to Group III vs Groups I &II is not so strong. A case study shows epistemic uncertainty to the weight ratio affects PTHA largely not to ignore, which implies further researches to the weight ratio regarding Group III, that is maximum-sized ruptures over M9, are needed.

Keywords: Tsunami, PTHA, exceedance probability, Nankai Trough, Nankai earthquake