Evaluation framework of health impacts caused by massive earthquakes in Osaka

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When a high-intensity earthquake occurs, human damages occur at different timelines, as follows: i) deaths and wounds caused by the collapse of buildings or tsunami that comes immediately after the earthquake, ii) health damages caused by acute exposure to chemicals spilled from factories, or iii) deterioration of medical functions caused by the impact of lifeline damage. For this reason, we need to consider these human damages in the sequence of events to enact measures to minimize these damages. In this research, we aim to condense the human damages during the Nankai Trough Earthquake to the above three timelines and evaluate them quantitatively in a time-series of the duration of damage from the time immediately after the earthquake to the recovery period.
In this research, we consider health damages caused by acute exposure to chemicals spilled from one factory suffering tsunami damages. As such, the target area is Konohana-ku, where the factory used the largest number of Pollutant Release and Transfer Register (PRTR) method-designated volatile substances. Regarding the number of deaths caused by the collapse of buildings or tsunami, we used the Nankai Trough Earthquake data and methods for calculating damages published by the Cabinet Office. Moreover, we calculated the number of deaths caused by the tsunami using the tsunami evacuation buildings specified in the target area as an evacuation destination and determined whether evacuation to that building is possible.

We assumed that Toluene, the largest chemical at the target factory, spilled and that immediately after the factory was damaged by the tsunami, two weeks worth of the annual handling volume all flowed out at once. For exposure scenario, Toluene volatilized after the spillage was exposed from the atmosphere after people evacuated to the roof of the tsunami evacuation buildings. In addition, we analyzed the Toluene dynamics for using CAMEO-ALOHA and checked the transition of substances density. The Acute Exposure Guideline Level (AEGL) was used for evaluations for human health damages, which were assumed to be caused by the Toluene density as the tsunami evacuation buildings passed through the AEGL.
We calculated how much the above two human damages were buffered by treatment measures considering the impact of lifeline damages each day. Still, medical treatment completely recovers the human damages. In addition, these damage transitions were converted to Disability Adjusted Life-Years (DALY) for each day. DALY is one of the indicators of the time lost due to disability or premature death and is the sum of the years of life loss (YLL) and the years with disability (YLD). Each sum of DALY such as human damages caused by the collapse, tsunami, and health damages caused by substances were 1.30E+08, 04.12E+04, 5.16E+03 [day/day], respectively. The number of victims was the largest among human damages and the accident value was also the largest, and thus DALY about YLL is much larger than other damages. Human damages caused by substances lasted seven days after the earthquakes occurred despite the assumption that medical treatment enables people to recover completely. Thus, large damages negate the medical function if all of Toluene spilled. In this way, we could check the impacts for human damages, from the differences regarding the target area, degradation of medical function, earthquake, and the earthquake intensity using DALY.
Using the same index, we developed methods to evaluate three types of human damages that occur in different periods from the incidence of the earthquake to the recovery period. In addition, we found that the target area had sufficient medical function for the injured immediately after the earthquake and that

treating the severely ill persons from chemical substances lasted several days. As a future task, the damage to tourists visiting the target area could be considered.

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