Considering Directions for Response to Intensification of Storm Surge due to Global Warming

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1. Introduction

In September 2013, the IPCC approved the Fifth Assessment Report, Working Group I, Summary for Policymakers (hereinafter, referred to simply as AR5). AR5 states that the mean sea level will rise from 26cm to 82cm, and there is an "extremely high possibility" that the "occurrence and height of extremely high storm surges will increase" by the end of the 21st century. Sea level rise and increased storm surge deviation above high water level increase the risk of inundation by storm surges in coastal areas.

When Typhoon No. 30 crossed the middle part of the Philippines in November 2013, strong winds and storm surges caused enormous damage, resulting in the deaths of more than 6,000 people. According to the Japan Meteorological Agency, the maximum central pressure of the typhoon was 895 hPa, which was the same as Japan's Ise Bay Typhoon (1959), and the maximum wind speed was 65 m/s. Images of the storm surge and reports of maximum winds reaching 90 m/s (US. Army standard) shocked Japanese society.

In July 2014, Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) announced the Grand Design for National Spatial Policy 2050. According to this document, if current birthrates and other trends continue, in 2050, areas where the population decreases to less than half the current level will include more than 60% of current residential areas. Population change will cause changes in regional social and economic activity, and this in turn will also change regional assets. Therefore, it is important to consider population change when predicting the risk of damage by storm surge inundation.

In order to consider responses to the increased risk of storm surges due to global warming, it is necessary to analyze how far sea level rise and increases in storm surges due to global warming will progress, and how much damage Japan may receive as a result.

2. Sensitivity analysis of damage by storm surges

AR5 presents the future global mean sea level rise and temperature rise for four Representative Concentration Pathways (RCP) of greenhouse effect gases. Based on those RCP, we predicted the condition of inundation by storm surges in Japan, and also predicted the inundation area and monetary amount of inundation damage, considering population decrease and other factors.

The following knowledge can be obtained from the estimation results. These points offer suggestions on regions that require attention, the progress of responses over time, and how we should react to population decline.

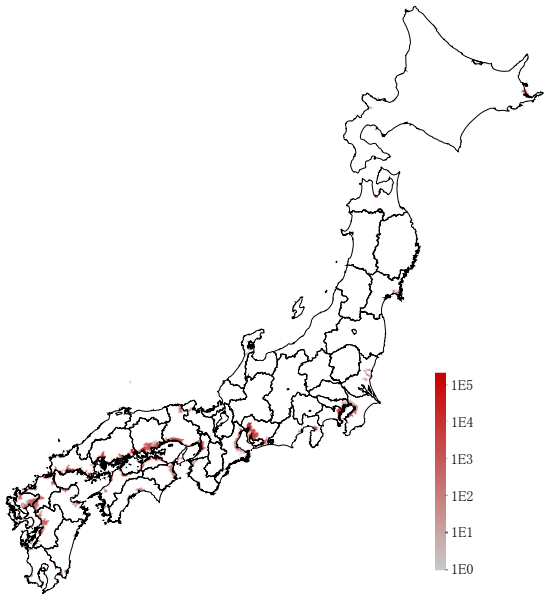
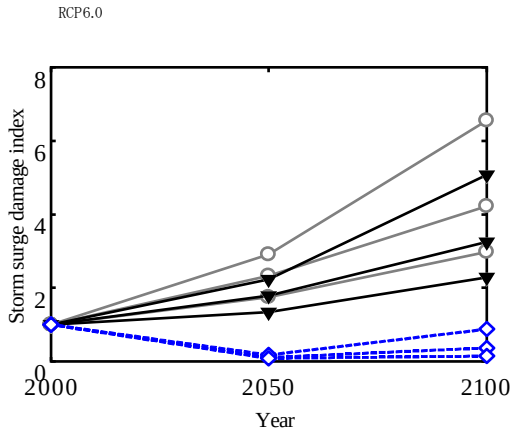


Fig. 1 Example of inundation damage index (monetary damage) in 2100



Note) ○: Base condition, ▼: Condition of population decrease, ◇: Condition of improvement of coastal facilities

Fig.-2 Example of changes in storm surge damage index (monetary damage) over 100 year period

① Inundation risk is relative large in Japan's three major bays (Tokyo, Osaka, Ise), the Seto Inland Sea, and the Ariake/Yatsushiro Sea areas.

② Coastal defense is shared by the four divisions of rivers, ports and harbors, fishing ports and farming villages (ratio of length of coastline requiring maintenance, 36 : 29 : 22 : 11). The areas with large damage are reclaimed land in the Ariake/Yatsushiro Sea, and in addition to this, ports and harbors.

③ The rate of increase in the damage index in the first half and second half of the period from 2000 to 2100 does not change greatly, except under the worst-case RCP. Thus, there is a possibility that a response can be made by gradual measures.

④ Under the population decrease scenario, the inundated population and amount of inundation damage decrease approximately in proportion to the rate of decrease in the national population as a whole.

Since the object of these estimates is the entire country and the future in half-century units, there is a possibility of roughness, skewing and high uncertainty in the preconditions, data, calculation methods, etc. Therefore, in studies aimed at actual implementation, it is necessary to ascertain the actual progress of climate change, to make estimates with higher reliability, for example, by narrowing the range and period of predictions, etc., and to carry out the study based on the results.

3. Viewpoints when considering response to intensification of storm surge by global warming

(1) Two types of targets

In order to promote efforts related to global warming, it is necessary to set a target for efforts as a whole. While that target must be ambitious so that we can have hope, it is not possible to set a target that can be implemented in all aspects, including the technological aspect, economic aspect, predictive aspect. Therefore, when making an actual effort, careful study of the multiple purposes of that action and limiting conditions, setting of a target that can realistically be implemented, and making efforts to achieve the target are necessary.

(2) Mobilization and use of policy/organization

In responding to the large problem of global warming under the difficult financial situation in Japan, there are limits by only bureaucratic efforts like those to date. In case implementation is difficult due to the heavy load if complete achievement is assumed as a precondition, there is a possibility that new measures can be deployed, which

enable improvement of the current condition by allowing incomplete achievement; it is necessary to promote this type of measures a larger extent than heretofore. Organizationally, if a pyramid-type organization is adopted under the current condition of diversifying needs, an enormous organization will be necessary. Therefore, while operation of a network-type organization is more difficult, consideration which enables an efficient organizational response by utilizing network-type organizations to a greater degree than in the past may also be necessary.

Fig.-3 Method of mobilizing policy/organization

(3) Renewed recognition of the worst case

When considering preparations for large-scale disasters, it is frequently said that we should consider and prepare for the worst case (WC). By definition, this means "the most dangerous condition that can be conceived." However, this is an extremely severe condition; response is difficult, and efficiency is very poor. Therefore, what should be discussed is a conditional WC for considering the direction of response and implementation targets. In discussions of the WC, a clear recognition of this fact is necessary.

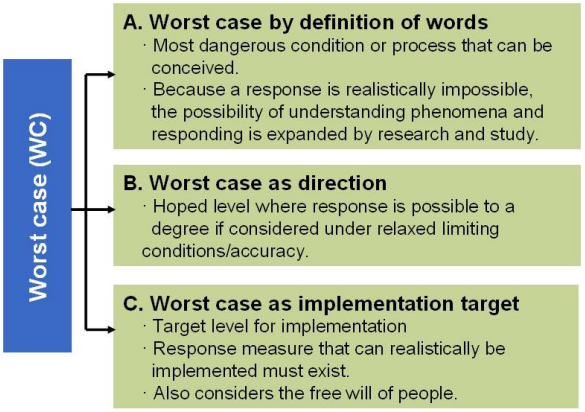


Fig.-4 Worst cases which should be considered

【Reference】

1) Lecture Meeting of NILIM 2014, Lecture materials
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