Estimating topography before the volcanic sector collapses using tsunami survey data with numerical simulations

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Large sector collapses and landslides have the potential to cause significant disasters. Estimating topography and conditions such as volume before the collapse are thus important for analyzing behaviors of moving collapsed materials and hazard risks. This study considers three historical volcanic sector collapses in Japan that caused tsunamis: the collapses of Komagatake Mountain in 1640, Oshima-Oshima Island in 1741, and Unzen-Mayuyama Mountain in 1792. Numerical simulations of the tsunamis generated by each event were first carried out based on some assumed collapse-scenarios. Presenting concrete conditions relating to the topography before the events based on those results and tsunami survey data is the primary objective of this study.

The Oshima-Oshima Tsunami, which is the subject of many previous studies, was first simulated to evaluate how tsunami heights changed during the simulation as the topographic conditions changed. It was found that tsunami height was especially sensitive to the collapsed volume and frictional acceleration acting on the collapsed material; however, observed tsunami heights could be reproduced with high accuracy using proper conditions of frictional acceleration for the scenarios even they were not exact. A minimum requirement for the collapsed volume of the observed tsunami height was introduced and quantitatively evaluated using the results of numerical tsunami simulations. The requirements for the collapses of Komagatake Mountain and Unzen-Mayuyama Mountain, for which there is not much quantitative data or many previous studies, were estimated to be approximately 1.2 and 0.3 km^3, respectively.

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