

Investigation of the impacts of volcanic eruption on flight passengers and cargo: A case study of Sakurajima volcano

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In recent years, transportation modes for passengers are becoming more diversified due to new developments of transportation systems. For example, a new trunk rail line between Hakata Station and Kagoshimachuo Station was constructed in 2011. As a result, entire Kyushu Shinkansen was completed, which leads to 4 hours or less for the trip between Shin-Osaka station and Kagoshimachuo station. In addition, the low-cost carriers are launched into service in recent years, attracting the passengers who require both time and cost reductions. Passengers can choose transportation of several modes for going to the destination depending on the situation.

If airports are closed by natural disasters or accidents, passengers and cargo flows have to be redirected or stopped otherwise. As a result, the change may induce significant economic losses. In fact, there were the cases that large amount of economic damages were caused by closures of airports due to volcano eruptions. Eyjafjallajokull volcano in Iceland corresponds to such a case. This eruption caused confusions of society in a large area, since many airports in Europe were forced to be closed by visible and invisible ash in the air. According to the International Air Transport Association, the airline's loss was estimated as \$ 200 million per day.

In order to properly assess the risk of such an event, this study proposes a method to analyze changes in the flow of passengers and cargo in the situation when the airport was disrupted due to a volcanic activity. Eruptions of Sakurajima volcano in Kagoshima Prefecture is selected as a case study. One of the features of the focuses in this study is that the restrictions of flights change from day to day depending on the conditions such as wind and volcanic activities. Therefore, it is necessary to dynamically represent the flight restricted area and to analyze the change in the modes of transportation. In addition, this study uses the method for selecting the Kth best path to reduce the computation time of implementing the dynamic model. The usefulness of the model is demonstrated through the case study.