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Estimation of ash concentration from particle distribution of Lagrangian dispersion model

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Recent interests on volcanic ash dispersion arose right after the disastrous disruption in aviation due to the eruption of Mt. Eyjafjallajökull, Iceland. Including PUFF-UAF, there are tens of numerical models to predict the ash dispersion using meteorological forecasting data to mitigate the potential damage or loss from the ash airborne and on the ground. According to the mathematical scheme to compute the ash dispersion, either Lagrangian or Eulerian model is employed, among which the former is widely utilized due to its swiftness in producing the prediction. In spite of its practical usefulness, Lagrangian model suffers from the incomplete information on the spatial distribution of ash concentration because the model in nature assumes puffs or parcels of particles representing pre-assigned amount of ash with given distribution of particle sizes. This results in spatial discontinuity in the ash concentration with unrealistic distribution in some cases. In order to overcome these shortcomings, Gaussian distribution of concentration is applied to each puff which is calculated from a Lagrangian model, PUFF-UAF. Since each puff represents a certain amount of volcanic ashes emitted from the vent, the mass represented by the puff is then modeled with Gaussian puff model which reflects dispersion from the calculated puff location with elapsed time after it is discharged from the eruption. By doing this, the dispersed effect gradually developed across the spatial range is well expressed and the ash concentrations at given locations are computed by adding all the effects from the puffs in the domain. From the comparisons of present results with others, we can observe both advantages and disadvantages of the methods for the calculation of ash concentration which lead to the efficiency of computation method. This research was supported by a grant [MPSS-NH-2015-81] through the Disaster and Safety Management Institute funded by Ministry of Public Safety and Security of Korea government.