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Regional numerical modelling of volcanic ash atmospheric dispersion and deposition after the eruptions of Mt. Pinatubo and Kasatochi

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The violent nature of volcanic eruptions involving steam can fragment magma and solid rocks surrounding the volcano into particles as small as the size of aerosols. The very fine ash particles may be carried for hundreds of miles before settling onto land or into the ocean. Fierstein and Nathenson (1992) describe several ways to determine the deposited volcanic ash fall volume and mass. These, however, only work if ash is deposited on land. They are unsuitable when volcanic ash is mainly deposited into the ocean as it was the case after the eruptions of Kasatochi in 2008 or Pinatubo in 1991. Another possibility to estimate the deposited ash volume is to use three-dimensional atmospheric models which include transport and removal processes of volcanic ash to estimate the atmospheric distribution and fall-out of volcanic ash. Here we use the three-dimensional Eulerian atmosphere-chemistry/aerosol model REMOTE (Langmann et al., 2008) to simulate the distribution of volcanic ash and its deposition after the eruptions of Mt. Pinatubo and Kasatochi. The aerosol dynamic and thermodynamic module M7, described in detail in Vignati et al. (2004), provides the framework for the volcanic ash size determination using log-normal size distributions. Our model simulations suggest that sedimentation was the most efficient removal process for volcanic ash mass after the eruption of Kasatochi with 70% of the total mass removed out of the atmosphere at ground level, followed by wet deposition (23%) and dry deposition (7%). The situation was different after the eruption of Pinatubo as a typhoon passed by and wet deposition of volcanic ash was even more important than in the case of Kasatochi. Here a series of sensitivity studies will be presented focussing on the contribution of the three ash removal processes out of the atmosphere: dry deposition, wet deposition and sedimentation.

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