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Influence of the startup period from initial conditions in modeling the dispersion of volcanic ash in Ecuador

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Information about the dispersion of volcanic in forecasting time is a priority in Ecuador. Ash emitted during explosive eruptions is dispersed by prevailing winds. Atmospheric Transport Models (ATMs) are pivotal for forecasting ash dispersion. One of the components of an ATM is the meteorological model, which describes the state and evolution of the atmosphere which disperses the volcanic ash. ATMs find an approximate numerical solution to the full atmospheric governing equations. Due to potential errors in the initial conditions, these models can provide poor results during the first hours of simulations. Also, due to the nonlinearity of atmospheric motions, the forecast skill of ATMs models extends to only some days from initial conditions, and after the performance decrease with time. It is necessary to define both a minimum startup period and the maximum number of extended days, to get useful performances in modeling. For this purpose, firstly we simulated the meteorology over Ecuador, using the Weather Research & Forecasting (WRF3.7.1) model with a spatial resolution of 4 km (domain 199 x 199 cells), and different startup periods. After, the meteorological outputs were ingested into the FALL3DV7.1.4 model to simulate ash dispersion from 4 eruptions (Tungurahua volcano: 16-Dec-2012, 14-Jul-2013, and 01-Feb-2014) (Cotopaxi volcano: 14-Aug-2015). We compared computed ash fallout quantities with records from ashmeters located on stations around these volcanoes. For all the eruptions, values of the correlation coefficient (R2) varied between 0.4 to 1.0, for startup periods of at least 30 hours, and extended times not larger than 82 hours from initial conditions. For other periods, R2 varied between 0.0 to 0.4. These results suggest that for the Ecuadorian case, it is advisable at least one day as startup period, and a maximum of three days as extended time from initial conditions, to get useful performances in forecasting the dispersion of volcanic ash.