Modeling ash dispersal of the 23 February 2013 Etna lava fountain

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Most plumes generated by explosive eruptions from Mt. Etna, Italy, are affected by winds towards East driving volcanic ash over the sea. It implies that erupted tephra can be collected only at proximal area around the volcano, i.e. within 20-25 km. It follows that the quantification of fine ash component and the Total Grain Size Distribution (TGSD) are very difficult and highly uncertain. Among the five lava fountain episodes occurred on the New South-East Crater of Mt. Etna, from the 17 to 23 February 2013, the 23 February paroxysmal phase lasted 1 hour and produced magma jets higher than 500 m and an eruptive plume that reached $\sim$9 km above sea level. Winds oriented toward North-East advected the plume and produced an extended tephra fallout deposit from the slope of Etna up to Puglia region ($\sim$ 400 km from the volcano), allowing lapilli and ash to be sampled at different locations. Here, we first estimate the TGSD and the fine ash content associated to 12 samples collected after the paroxysmal episode over the entire tephra blanket. The TGSD is compared with the one related to the 12-13 January 2011 lava fountain showing a similar distribution with a mode around phi = -3. Satellite data describing the evolution of PM10 from the vent up to Calabria region were used to quantify the tail of the distribution and the fraction of the very fine ash. In order to reproduce both the field and spaceborne (MSG-SEVIRI) observations we simulated the tephra dispersal using the computational model Fall3D after modifying the TGSD by adding the fine ash component empirically. A set of simulations allowed us to assess key volcanological parameters such as the column height, the mass distribution within the plume and the effective TGSD. Best fit results indicate a Mass Eruption Rate around 1.0d+6 kg/s, a Total Erupted Mass of about 3.8d+9 kg and a PM10 fraction of $\sim$0.73% respect to the total mass. Results lead the 23 February 2013 lava fountain episode as one of the most intense in the recent history of Etna.