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Assessing conditional effects of vent location, event scale and time forecasts on pyroclastic density currents hazard maps at Campi Flegrei caldera (Italy)

Andrea Bevilacqua[1,2], Augusto Neri2, Marina Bisson[2], Tomaso Esposti Ongaro [2], Franco Flandoli [3], Roberto Isaia[2], Mauro Rosi [3,] Stefano Vitale [4].

[1]University at Buffalo, USA.

[2]Istituto Nazionale di Geofisica e Vulcanologia, Italy.

[3]Università di Pisa, Italy.

[4]Università di Napoli Federico II, Italy.

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The development of long-term hazard maps for pyroclastic density currents (PDC) at Campi Flegrei (CF) caldera is a challenging problem. The probability distributions for the spatial location of the next event producing a PDC, the size of the flow, and the temporal estimate for such an event in the future must be convolved to achieve the necessary assessments. This task is additionally complicated by the remarkable epistemic uncertainty on the eruptive record, affecting the time of past events, the location of vents as well as the PDCs areal extent estimates. As a consequence, with the aim of quantifying some of the main sources of uncertainty, we provided mean and percentile maps of PDC hazard levels. The hazard maps were produced combining a vent-opening probability map, statistical estimates concerning the eruptive scales and a Cox-type temporal model including self-excitement effects, based on the eruptive record of the last 15 ka. The results were obtained by using a Monte Carlo approach and adopting a simplified inundation model based on the "box model" integral approximation and tested with 2D transient numerical simulations of flow dynamics. Remarkable differences can be observed between the past activity in the eastern and western sectors of the caldera: the dependence between PDC scales and the caldera sector was implemented in the hazard maps. Conditional maps concerning PDC originating inside limited zones of the caldera, or PDC with a limited range of scales were also produced with the aim of providing hazard assessments for particular scenarios. Finally, the effect of assuming different time windows for the hazard estimates was explored, including also the possibility of the occurrence of multiple events in the same time window. The analysis

allowed us to identify areas with elevated probabilities of flow invasion as a function of the time window considered.