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Merging field mapping and modeling to interpret the lithofacies variations from unsteady ash-rich pyroclastic density currents on uneven topography

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In order to obtain significant volcanological results from computer simulations of explosive eruptions, one either needs a systematic statistical approach to test a wide range of initial and boundary conditions, or needs using a well-constrained field case study. Here we followed the second approach, using data obtained from field mapping of the Grotta dei Palizzi 2 pyroclastic deposits (Vulcano Island, Italy) as input for numerical modeling. This case study deals with impulsive phreatomagmatic explosions that generated ash-rich pyroclastic density currents, interacting with the high topographic obstacle of the La Fossa Caldera rim. We demonstrate that by merging field data with 3D numerical simulation it is possible to highlight the details of the dynamical current-terrain interaction, and to interpret the lithofacies variations of the associated deposits as a function of topography-induced sedimentation rate. Results suggest that a value of the sedimentation rate lower than 5 kg/m2s at the bed load can still be sheared by the overlying current, producing tractional structures in the deposit. Instead, a sedimentation rate in excess of that threshold can preclude the formation of tractional structures, producing thick massive deposits. We think that the approach used in this study could be applied to other case studies to confirm or refine such threshold value of the sedimentation rate, which is to be considered as an upper value as for the limitations of the numerical model.