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Reconstructing the volume and tephra dispersal for each phase of the Campanian Ignimbrite super-eruption

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The Campanian Ignimbrite (CI) super-eruption, the largest eruption in Europe in the last 200,000 years, would have caused a volcanic winter within the coldest and driest Heinrich event and severely impacted Late Middle Paleolithic groups in Southern and Eastern Europe. These devastating events cannot always be explained by the classical Plinian eruption column approach. Instead, collapsing fountains may develop above the vent after an initial Plinian phase, and shed pyroclastic flows, which spread laterally along the ground.
We use a novel computational approach to reconstruct the volume and tephra dispersal of the CI super-eruption given modern meteorological patterns. Our methodology uses an intense series of inversion analyses to estimate the long-term ashfall distribution for each phase of the eruption. This is the first time where the Plinian and co-ignimbrite phases are reconstructed independently. An ensemble of 3D time-dependent meteorological fields across the region, and a range of volcanological input parameters were used in several hundreds of simulations of the tephra dispersal model FALL3D. To account for the density-driven transport of ash in the umbrella region of the CI volcanic cloud, we coupled the tephra dispersal model FALL3D with an analytical model that describes cloud spreading as gravity current.
Results reveal that $\sim$211 cubic km of fallout material were produced during the eruption, with the Plinian tephra constituting $\sim$25% of the deposit. The model also indicates that the column height for each phase of the eruption was 44 km for the Plinian and 37 km for the co-ignimbrite phase. The eruption averaged a column height of 38 km and lasted $\sim$1 day.