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Climatic and environmental impacts of an Oruanui-like supereruption in the Southern Hemisphere extratropics

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Explosive volcanic eruptions have disrupted the climate system dramatically in the past. Recent volcanological fieldwork suggests that at least four VEI 8 events took place in the past 100'000 years, depositing large amounts of volcanic volatiles onto polar ice sheets, each one with potentially significant impacts on human life on Earth. Previous studies on this research topic and time period tend to focus either on tropical eruptions or only consider changes in radiative forcing due to orbital parameters, solar variability, or changes in atmospheric CO₂. Here, we seek to evaluate the climatic and environmental impacts of the ~25.5 ka Oruanui eruption (Taupō caldera, 38°S, 175°E, New Zealand). We thereby refine our understanding of the volcanic forcing based on volcanological and ice core data to provide a basis for long-term climate simulations. We use existing emission details for an idealized Oruanui-like eruption scenario. We run an ensemble of CESM2/WACCM simulations with 1850 pre-industrial conditions and instantaneously emit 260 Tg SO₂, and the corresponding halogen load derived from petrological estimates into the stratosphere. We then analyze the climatic effects in the decades following the eruption compared with available paleo proxies. Our overarching goal is to provide comprehensive insights into the climatic and environmental repercussions of an Oruanui-like eruption, with a specific emphasis on the differences to tropical events of comparable magnitude. By comparing these two distinct types of eruptions, we aim to contribute to a refined understanding of volcanic impacts on Earth's climate and human life.