

EGU26-9868, updated on 11 May 2026

<https://doi.org/10.5194/egusphere-egu26-9868>

EGU General Assembly 2026

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Exploring the role of SO₂ emission altitude in the 1912 eruption of Katmai/Novarupta

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The 1912 eruption of Katmai/Novarupta injected an estimated 7 Tg SO₂ into the atmosphere leading to Northern Hemisphere cooling. The eruption has been an important case study for deriving the relationship between ice-sheet sulfate deposition and stratospheric SO₂ emission, the so-called 'transfer function', which has been subsequently used to estimate the SO₂ emissions for other historical extratropical eruptions. However, new ice core data and sulfate isotope analyses demonstrate that a portion of the SO₂ was injected below the stratospheric ozone layer, suggesting a lower injection altitude for the plume bottom than previously assumed, with implications for the transfer function. Here, using the UK Earth System Model and an interactive aerosol scheme, we investigate the role of injection altitude and magnitude and revisit the transfer function and climate response considering both tropospheric and stratospheric SO₂ emissions.