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Reassessing the climatic impacts of the AD 1257 Samalas eruption in Europe and in the Northern Hemisphere using historical archives and tree-rings

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The 1257 volcanic signal identified in ice core from Antarctica, Greenland and Bolivia and recently attributed to the Samalas volcano in Indonesia, is by far the largest signal recorded during the past the past millennium. Amounts of sulphate deposited in ice sheets are respectively 10 and 2 times greater than those deposited after the 1991 Pinatubo and the 1815 Tambora eruptions. Stratigraphic and sedimentological analyses of deposits carried out in Indonesia further confirm the exceptional magnitude of this eruption that expelled a minimum of 40 km3 of dense magma at an estimated altitude of 43 km3. Scarcity of annually resolved proxy records extending back to the 13th century has so far hampered to robustly document the climatic perturbations induced by the 1257 Samalas eruption, in terms of severity, spatial extent and duration. Here, drawing on newly exhumed historical archives, ice cores and recently developed tree-ring chronologies we quantify the mean Northern Hemisphere cooling induced by the eruption and we also map the spatial extent of the climatic perturbations triggered by the Samalas eruption for the Northern Hemisphere. Our results suggest that the largest eruption of the past millennium did not trigger a widespread "year without a summer" all over the Northern Hemisphere. While Europe, Japan and part of Siberia were struggling with unseasonable temperatures, other regions such as Alaska were not significantly affected by the climatic anomalies induced by the Samalas eruption.