Constraining the temperature history of the past millennium using early instrumental observations

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Abstract.

The current assessment that twentieth-century global temperature change is unusual in the context of the last thousand years relies on estimates of temperature changes from natural proxies (tree-rings, ice-cores etc.) and climate model simulations. Confidence in such estimates is limited by difficulties in calibrating the proxies and systematic differences between proxy reconstructions and model simulations. As the difference between the estimates extends into the relatively recent period of the early nineteenth century it is possible to compare them with a reliable instrumental estimate of the temperature change over that period, provided that enough early thermometer observations, covering a wide enough expanse of the world, can be collected.
One organisation which systematically made observations and collected the results was the English East-India Company (EEIC), and their archives have been preserved in the British Library. Inspection of those archives revealed 900 log-books of EEIC ships containing daily instrumental measurements of temperature and pressure, and subjective estimates of wind speed and direction, from voyages across the Atlantic and Indian Oceans between 1789 and 1834. Those records have been extracted and digitised, providing 273,000 new weather records offering an unprecedentedly detailed view of the weather and climate of the late eighteenth and early nineteenth centuries.
The new thermometer observations demonstrate that the large-scale temperature response to the Tambora eruption and the 1809 eruption was modest (perhaps 0.5℃). This provides an out-of-sample validation for the proxy reconstructions - supporting their use for longer-term climate reconstructions. However, some of the climate model simulations in the CMIP5 ensemble show much larger volcanic effects than this - such simulations are unlikely to be accurate in this respect.