



## **Modulation of the Northern Edge of the tropical belt by climate and volcanic activity since 1203**

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Movements in the position of the northern edge of the tropical belt have strong hydroclimatic implications in many Northern Hemisphere (NH) regions. The tropical belt has shown a widening trend since the late 1970s, which is primarily attributed to anthropogenic forcings. Yet, the influence of natural climate variability is also acknowledged and the relative importance of prospective drivers is incompletely understood. Tree-ring data from five NH mid-latitude regions were used to reconstruct interannual spring NH tropical belt boundary movements over the past 800 years (1203-2003 CE). The target of our reconstruction is the latitudinal extent of the Hadley circulation (HCE), a commonly used metric that is robust in its representation of the position of the tropical belt boundary. Our results showed that southern-most (northern-most) tropical belt, or HCE positions, occurred during positive (negative) El Niño Southern Oscillation and Pacific North American phases and that the tropical belt contracted significantly following strong volcanic eruptions. The longest period of persistent tropical belt expansion occurred in the late 16th century and can be linked to synchronous societal crises in North America, Turkey, and China that were exacerbated by severe regional droughts during out of the past 500 years. These results thus warn for potential socio-economic consequences of future tropical expansions, which could be modulated by natural modes of climate variability and by potential natural or artificial stratospheric aerosol injections.