

Elevation-dependent changes in reference evapotranspiration due to climate change: The case of the Hengduan Mountains, China

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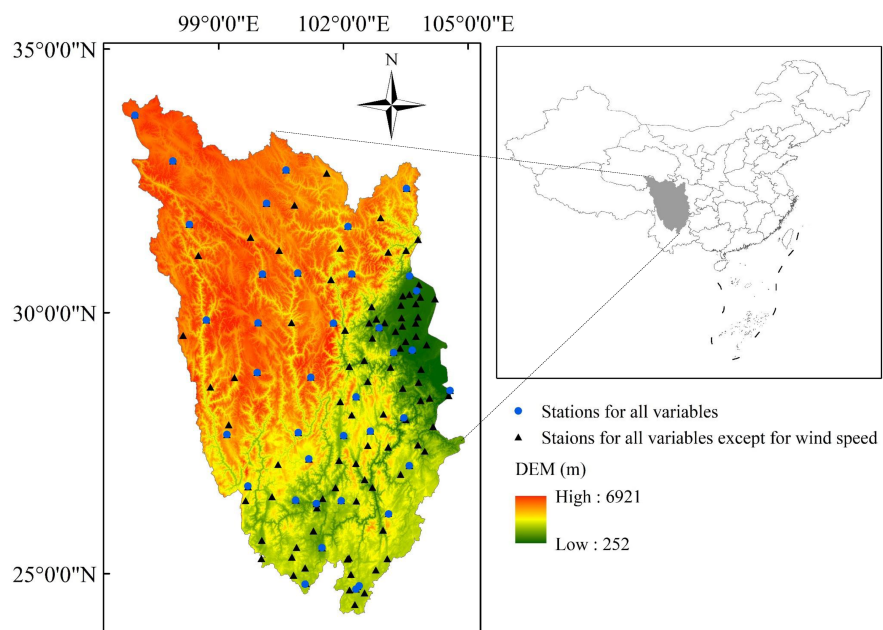
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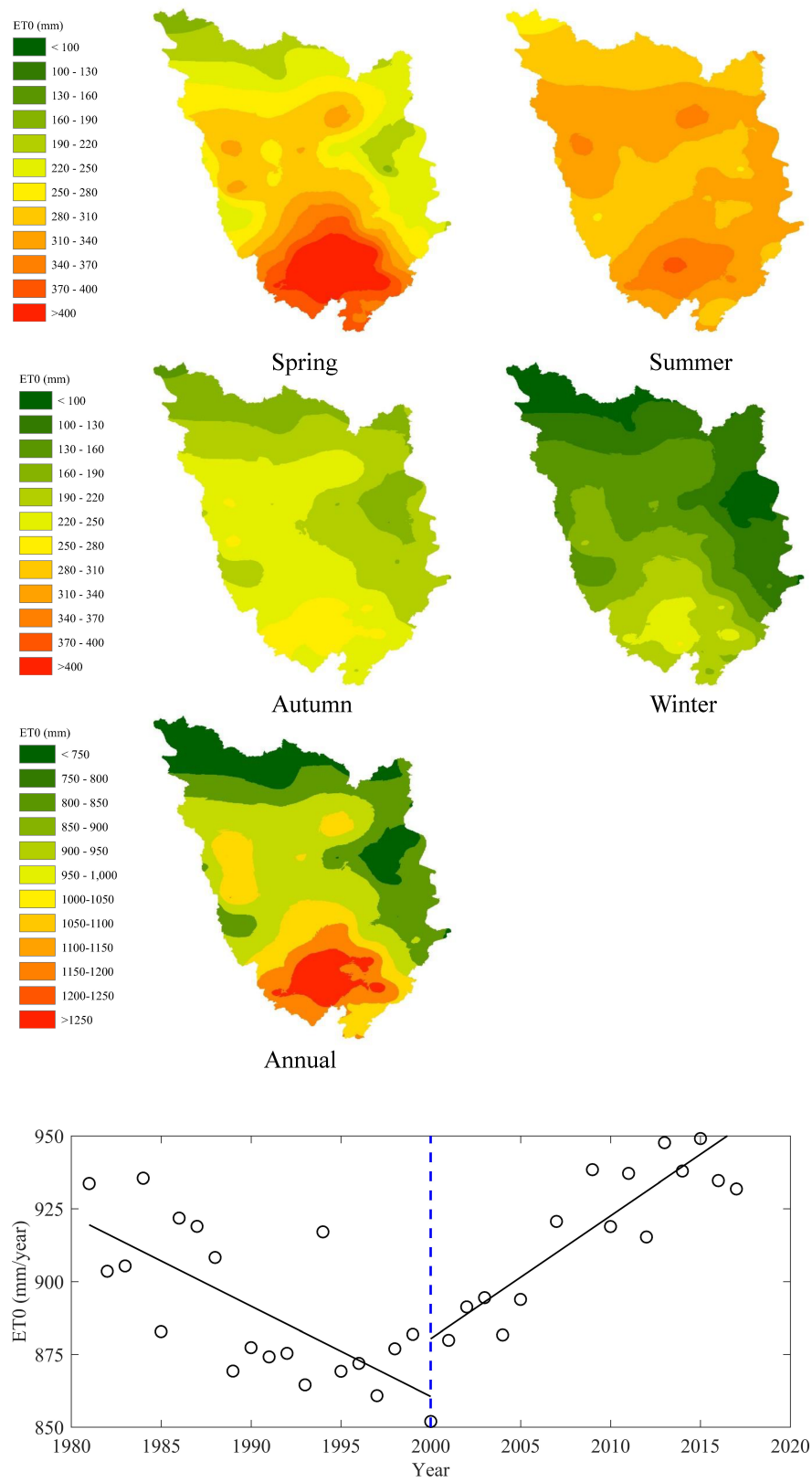
Abstract

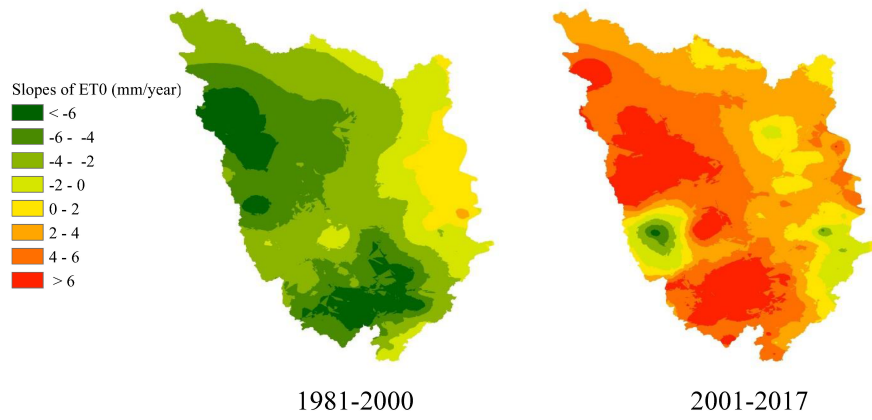
The Food and Agriculture Organizations' (FAO) Penman-Monteith reference evapotranspiration (ET₀) index is a key parameter in hydrological and meteorological studies. Temporal and spatial variations in ET₀ from 1981–2017 were investigated in the topographical rapid change zone in the Hengduan Mountains, China. The results showed a change point around the year 2000 in the area-averaged annual ET₀ series. ET₀ decreased and increased significantly by 3.103 mm/yrmm/year ($p < 0.05$) from 1981–2000 and by 3.591 mm/yrmm/year ($p < 0.05$) from 2001–2017, respectively. The contribution analysis shows that reduction in wind speed (Ws) was the primary driving force for the decrease in ET₀ during 1981–2000 in spring, autumn, and winter, and annually, while net solar radiation (Rn) was the dominant force in summer. Reduction in relative humidity (RH) was responsible for the increase in ET₀ in all seasons and for the annual scale in 2001–2017. The sensitivity analysis shows that ET₀ was most sensitive to Rn, followed by RH, and air temperature (Ta) was the least sensitive of the variables. The trends of ET₀ were also found to increase with elevation; we denote this as the elevation-dependence of ET₀ changes. The elevation-dependence was also noted for the trends of Ws, RH, and Rn, with higher elevations showing larger changes in these parameters. In addition, the sensitivities of Rn, RH, and Ta decreased with elevation, while that of Ws increased with elevation. A comprehensive investigation into the trends of these climatic variables and their sensitivities revealed complex trends of ET₀ along the elevation gradient, with typical increases with elevation over the annual scale despite the large differences in seasons. A more detailed exploration of the mechanisms causing this pattern is required.

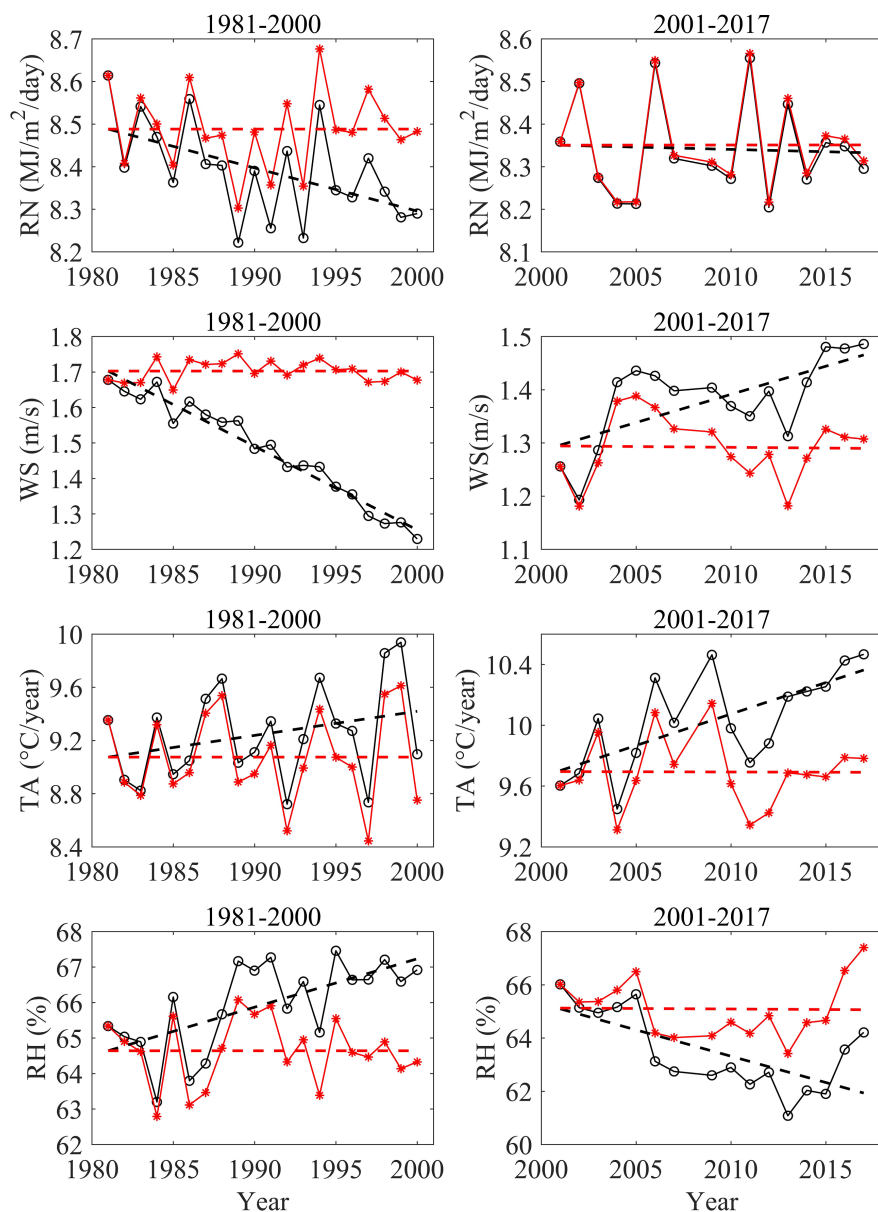
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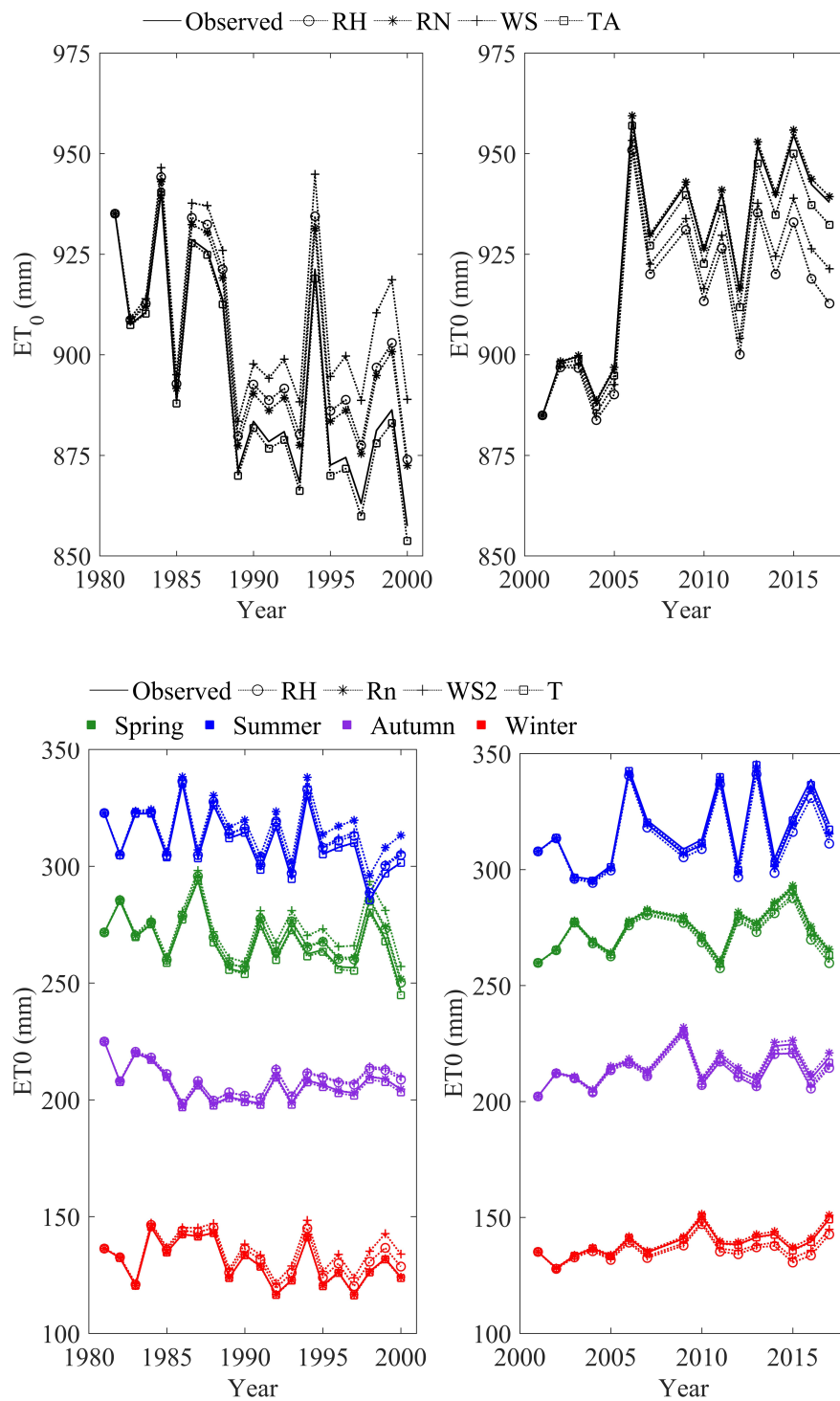
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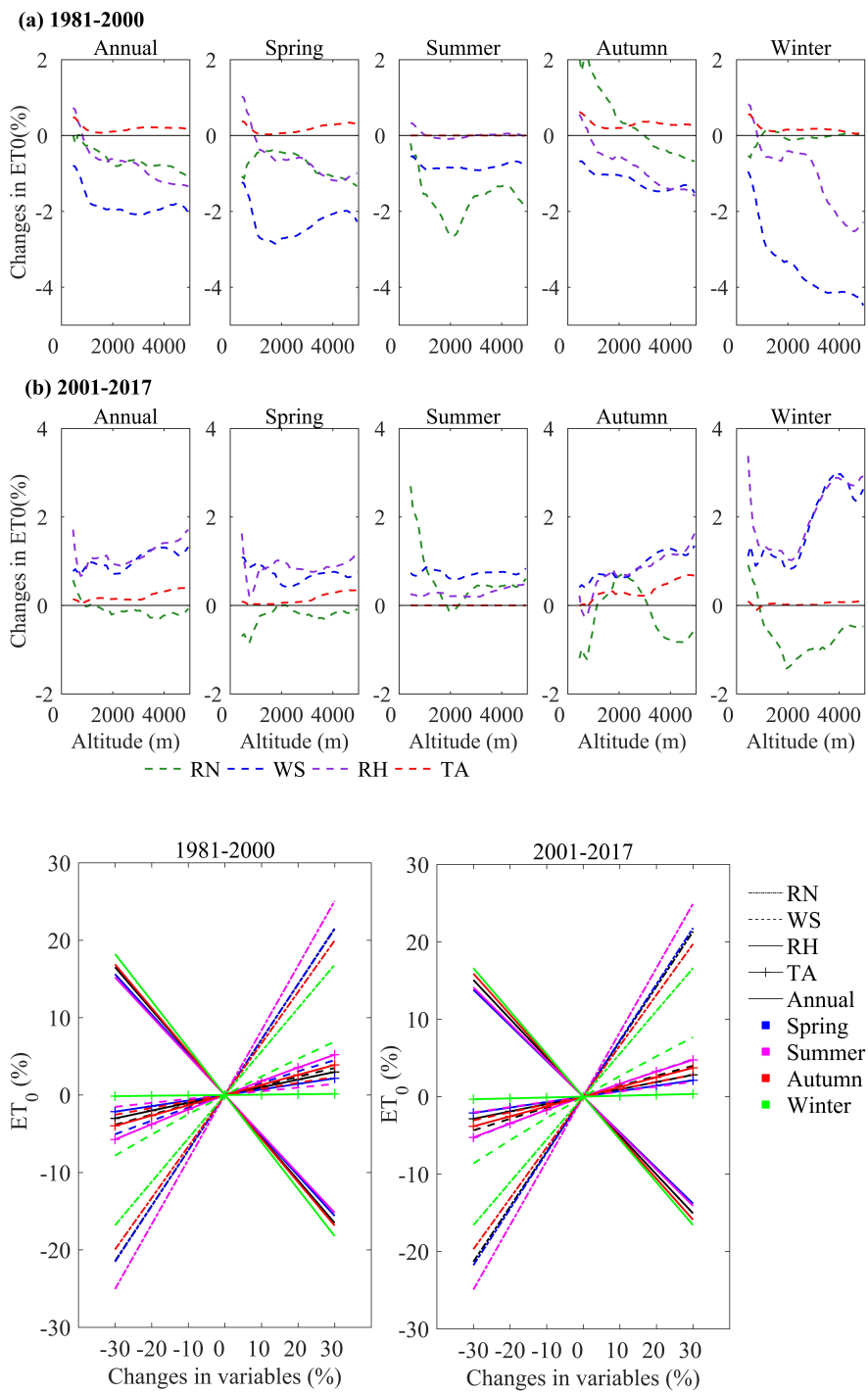




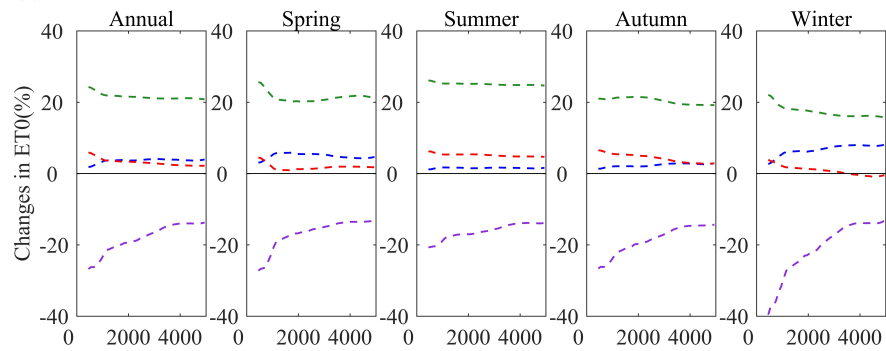








(a) 1981-2000



(b) 2001-2017

