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Hydroclimate variability in northern Vietnam as reconstructed from tree rings of *Fokienia hodginsii*

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A 535-year ring-width chronology developed from 22 trees of rare and long-lived conifer, *Fokienia hodginsii*, from northern Vietnam was employed to study hydroclimate variability. Empirical climate modeling revealed that the annual growth of *Fokienia* was primarily governed by moisture availability in the pre-monsoon season (March-May). This relationship was manifested as a positive correlation with precipitation and a simultaneous negative correlation with temperature (more evaporative). The hydroclimate in the monsoon season was therefore reconstructed by calibrating with the Palmer Drought Severity Index (PDSI). The reconstruction passed calibration-verification tests commonly used in dendroclimatology, and revealed two prominent periods of drought in the mid-18th and late-19th centuries, respectively. The former lasted nearly 30 years and was concurrent with a similar drought over northwestern Thailand inferred from tree rings of teak, suggesting a mega-drought extending across Indochina in the 18th century. Both of the reconstructed droughts are consistent with the periods of warm sea surface temperature (SST) anomalies in the tropical Pacific. Spatial correlation analyses with global SST indicates that ENSO-like anomalies play a role in modulating droughts over the region, with El Nino (warm) phases resulting in reduced rainfall. However, significant correlation was also seen with SST over the north Pacific and the Indian Ocean, suggesting that ENSO is only one factor, and likely not the main contributor to multi-decadal scale drought. Spectral analyses revealed significant peaks between 53.9 to 78.8 years, and within the range of ENSO-variability at 2.0 to 3.2 years.

Keywords: Dendroclimatology, Indochina, Palmer Drought Severity Index, ENSO