

기후 분과 [P-172]

Uneven impacts of divergent El Niño and Indian Ocean Dipole on Equatorial Asian fires

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Equatorial Asian fires are strongly influenced by teleconnections associated with the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). Additionally, fire intensity in this region varies depending on the specific type of El Niño event, namely the Eastern Pacific (EP) El Niño and the Central Pacific (CP) El Niño. However, their distinct impacts and localized variations remain insufficiently understood. Using both reanalysis and future projection data, we investigated the distinct influences of the EP and CP El Niño, as well as the IOD, on potential fire danger. Our results indicate that both types of El Niño significantly enhance fire activity in southern Equatorial Asia, with a stronger impact associated with the EP El Niño, whereas the IOD primarily affects the southwestern and south-central regions. These fire patterns are closely linked to large-scale atmospheric circulation changes, particularly modifications in the Walker and Hadley circulations, which influence regional precipitation and atmospheric subsidence, thereby altering vapor pressure deficit and soil moisture availability. Furthermore, fire-prone conditions in Equatorial Asia are modulated by land-atmosphere coupling, with the EP El Niño and IOD intensifying surface drying and heat stress, while the CP El Niño exhibits a weaker influence. Moreover, we found that the relationships between these three climate variabilities and Equatorial Asian fires are projected to intensify, with the IOD's influence expanding geographically in the future. Our findings provide a foundation for improving fire prediction and enhancing our understanding of climate-driven fire variability in Equatorial Asia under both historical conditions and future climate scenarios.

Keywords: wildfire, EP El Niño, CP El Niño, Indian Ocean Dipole (IOD)