ABSTRACT

Analysis of Tropical Cyclone Activity in the South China Sea, its Impacts in the Philippines and ENSO Influence

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The Philippines is among the world's most tropical cyclone (TC)-exposed countries in the world, with an average of 19–20 TCs entering the Philippine Area of Responsibility (PAR) annually and about 8 making landfall (Cinco et al., 2016). While most of these TCs originate in the Western North Pacific (WNP), many are linked to the South China Sea (SCS), either forming within the basin (SCS-originating) or developing elsewhere and entering it (SCS-entering). Despite their frequency and impacts, SCS-related TCs remain relatively understudied. This study examined the climatology, impacts in the Philippines, and El Niño–Southern Oscillation (ENSO) influence on SCS-originating and SCS-entering TCs from 1979 to 2025. Using International Best Track Archive for Climate Stewardship (IBTrACS) data, TCs are classified and analyzed in terms of genesis location, track characteristics, frequency, and intensity while impact data from the National Disaster Risk Reduction and Management Council (NDRRMC) quantify the impacts in terms of casualties, affected populations, and economic losses. Statistical analyses and environmental diagnostics are conducted to assess ENSO modulation through changes in large-scale atmospheric circulation and sea surface temperature (SST). Results indicate that SCS-entering TCs exhibit significantly greater mean track length (3,746 km vs. 1,716 km), lifetime duration (8.1 days vs. 4.98 days), and maximum intensity (66 kt vs. 39.6 kt) compared to SCS-originating TCs. SCS-entering TCs also account for a disproportionately larger share of impacts. In contrast, SCS-originating TCs, while weaker and shorter-lived, still produce substantial localized impacts, with an average of 34 casualties and ₱2 billion landfalling even. ENSO phase analysis shows that SCS-originating TC frequency increases from 2.33 (El Niño) to 2.80 TCs yr^{-1} (La Niña), whereas SCS-entering TCs peak during El Niño (5.75 TCs yr^{-1}) with a decrease during La Niña (4.94 TCs yr^{-1}). However, correlation analyses reveal weak relationships between ONI

and TC frequency and ACE. Environmental diagnostics show that ENSO modulates SST, vertical wind shear, humidity, and low-level vorticity, which collectively influence the Genesis Potential Index (GPI). Over the SCS, GPI decreases during El Niño and increases during La Niña, which promote more favorable conditions for cyclogenesis.

Keywords: *South China Sea, tropical cyclones, ENSO, climatology, Philippines, socio-economic impacts*