Plain Language Summary: The El Niño–Southern Oscillation (ENSO) climate pattern significantly impacts rainfall and warm cloud processes in Thailand. During the El Niño phase, rainfall from 1991 to 2022 is lower compared to La Niña phases. The Contoured Frequency by Optical Depth Diagrams (CFODDs) method, which analyzes meteorological satellite data from 2006 to 2014, reveals variations in internal warm cloud structures based on seasonal and ENSO phases, influenced by factors like aerosols, humidity, and temperature, which are shaped by geographical characteristics.
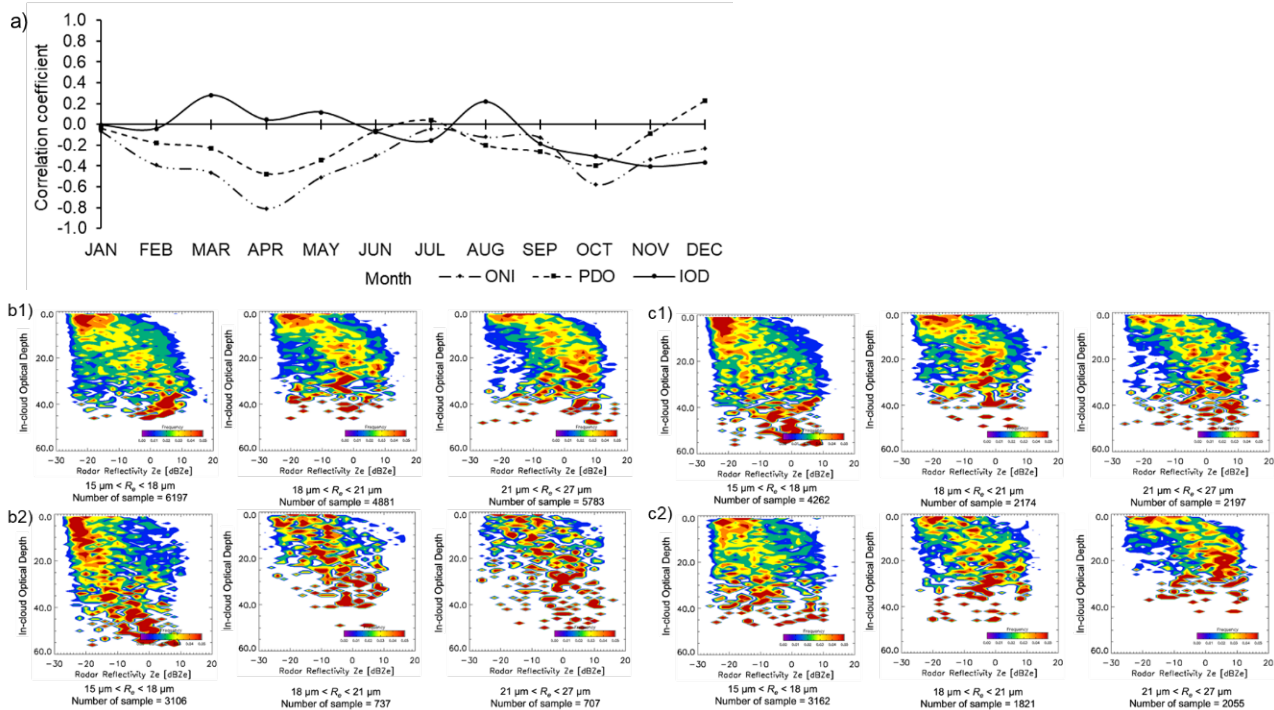

Figure 1: Correlation coefficients between ocean indices (ONI, PDO, IOD) and Thailand rainfall from 1991–2022 (a), and Contoured Frequency by Optical Depth Diagrams (CFODDs) classified by Cloud droplet radius (R_e) with threshold values between 15 and 27 μm for Thailand from 2006 –2014 during the wet season (b1), dry season (b2), La Niña phase (c1), and El Niño phase (c2).

- There is a correlation between rainfall and ENSO monitoring indices, including the Oceanic Niño Index (ONI), Pacific Decadal Oscillation (PDO), and Indian Ocean Dipole (IOD). The analysis reveals a negative correlation with ONI and PDO, particularly in April and October, and a weak correlation with IOD.
- Warm cloud droplet sizes over the Thailand region range from 4 to 36 μm, with cloud droplet mode observed from 4 to 15 μm, drizzle mode from 15 to 21 μm, and rain mode dominating above 21 μm.
- Warm clouds in the dry season have smaller droplet sizes and are thinner compared to those in the wet season.
- During the El Niño phase, warm clouds are generally thinner and face greater challenges in rain formation compared to the La Niña phase, when cloud droplet sizes increase.