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| **Climatic-induced mangrove dieback in the Gulf of Carpentaria, Australia** |
| Mangrove ecosystems are being lost largely due to human activities and the increasing effects of climate change. Recent research has proposed that changes in mangrove distribution and events of mangrove dieback will become more frequent and intense.  However, a lack of detailed, long-term monitoring using Earth observation data has limited our understanding of the specific impacts of climatic events like El Niño-Southern Oscillation (ENSO) on mangrove structure and condition. Changes in mangrove vegetation dynamics was assessed on a large scale for each year between 1987 and 2023, focussing initially on the Leichhardt River region, and later expanded to include other regions of the Gulf of Carpentaria (GoC), an area minimally influenced by human intervention. We used a combination of remote sensing data from Landsat 5, 7, and 8 retrieved from Digital Earth Australia (DEA), with ancillary sources such as LiDAR and aerial photography to differentiate mangrove zones and areas of mangrove dieback. These zones represent distinct mangrove ecosystems and included a *Rhizophora*-dominated zone, open and closed *Avicennia*-dominated zones, and open and closed mixed zones. We accessed changes in mangrove conditions, including greenness, vegetation moisture content and canopy structure, for each zone using NDVI, NDWI and Fractional Vegetation Cover (FVC), respectively. We used climate data indicators reporting changes in temperature, precipitation, and sea level, such as Southern Oscillation Index (SOI), Dipole Mode Index (DMI), and Lunar Nodal Cycle (LNC) to identify climate anomalies affecting mangroves. Overall, the mangrove zones classification (kappa = 0.84) showed closed vegetation zones expanding in area over the years, while open areas tend to be more stable in the region. The co-occurrence of different climatic and tidal perturbations, including ENSO, Indian Ocan Dipole (IOD) and LNC, in the 1990’s and 2015/2016 contributed to higher mangrove dieback extent and pronounced declining conditions for all the zones, with major effects at higher elevations in the tidal frame. Early signs of mangrove dieback were observed prior to the 2015/2016 ENSO event as declining conditions in NDVI and NDWI. By integrating estimates of mangrove zones extent over time with climate analyses and assessments of condition, this study offers novel insights into the temporal and spatial dynamics of mangrove ecosystems. This research elucidates the mangrove response mechanisms to environmental change and offer an approach to monitoring and managing these areas in the face of climate uncertainty. |