

# Fenomena Historis Upwelling di Laut Flores = Historical Upwelling Phenomena in Flores Sea

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## Abstrak

Laut Flores memiliki dinamika oseanografi secara historis yang disebabkan oleh pergerakan massa air di dalamnya. Pergerakan massa air laut ini dikenal sebagai fenomena upwelling, dimana air bersuhu dingin dan kaya nutrisi dari kedalaman lautan bergerak menuju permukaan laut. Air laut yang bergerak ke permukaan ini membawa nutrisi, yang terukur melalui kadar klorofil-a yang dihasilkan oleh fitoplankton di permukaan laut. Upwelling disebabkan oleh transpor Ekman, yakni transpor arus laut yang terbentuk oleh angin yang bertiup di atas permukaan air laut. Dalam penelitian ini, digunakan data anomali suhu permukaan laut (SSTa) dari NOAA AVHRR Pathfinder Version 5.3 Collated Global, data vektor angin permukaan laut ( $u$  dan  $v$ ) dari ERA5 Copernicus, serta data konsentrasi klorofil ( $chl-a$ ) dari Ocean Color SMI dengan rentang tahun 1998 – 2023. Analisis spasial dilakukan dengan melihat variasi spasiotemporal klorofil-a, SSTa dan indeks upwelling. Analisis temporal dilakukan secara time series, dekomposisi dan rerata bulanan tiap variabel. Hasil penelitian menunjukkan fenomena upwelling di Laut Flores utamanya disebabkan oleh pergerakan angin arah barat laut pada musim angin muson timur (April-Oktober), ditandai dengan indeks upwelling positif. Pada periode tersebut, upwelling terjadi di Laut Flores bagian utara dekat Sulawesi Selatan. Upwelling kuat tercatat terjadi pada tahun 2004, 2014, 2015, 2019 dan 2020, dimana peristiwa ini dipengaruhi oleh El Niño.

.....The historical of Flores Sea was driven by oceanographic dynamics caused by the movement of water masses within it. This movement of seawater masses is known as the upwelling phenomenon, where cold-temperature, nutrient-rich water from the ocean depths moves towards the sea surface. This surface-moving seawater carries nutrients, which are measured through chlorophyll-a levels produced by phytoplankton at the ocean surface. *Upwelling* is caused by Ekman transport, which is the transport of water mass formed by wind blowing over the sea surface. This study use the data of sea surface temperature (SSTa) anomaly data from NOAA AVHRR Pathfinder Version 5.3 Collated Global, sea surface wind vector data ( $u$  and  $v$ ) from ERA5 Copernicus, and chlorophyll concentration data ( $chl-a$ ) from Ocean Color SMI with time range in 1998 – 2023. Spatial analysis was conducted by analyzing spatiotemporal variations in chlorophyll-a, SSTa and upwelling index. Temporal analysis was done by time series analysis, decomposition and monthly average of each variable. The results showed that the upwelling phenomenon in the Flores Sea is mainly caused by northwest wind movements during the east monsoon season (April – October), characterized by a positive upwelling index. During this period, upwelling occurs in the northern Flores Sea near South Sulawesi. Strong upwelling was recorded in 2004, 2014, 2015, 2019 and 2020, where this event was influenced by El Niño.