“AURORA” PROJECT

Ultra-Resolution Ocean Analysis for Advanced Tracking

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Date

October 5, 2025

Place:

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(Análisis de Ultra Resolución Oceánica para el Rastreo Avanzado)

Abstract

We implement a lightweight PACE L1/L2 mapping model to map grayscale background from L1 reflectances, and overlay L2 chlorophyll-a heatmap on geographic coordinates. L1 and L2 files are paired by a shared timestamp token in their filenames. Chlorophyll is visualized on a logarithmic scale with controlled dynamic range, and a companion true-color L1 image is produced using the exact geographic limits of the chlorophyll map to enable side-by-side interpretation. The outputs are portable PNGs suitable for rapid inspection, figure generation, and downstream ML labeling.

Implementation

Data discovery & pairing

- Scan L1/ and L2/ folders, write file inventories to a common route txt file
- Extract a core key from filenames that tracks file timestamp to map L1 to L2 pairs reliably.

Preprocessing

- **L1 (grayscale background):** read *rhot* bands near 665/547/443 nm, percentile-stretch per band, convert to luminance (Y) and optional gamma. Produces a clean, contrast-balanced 2D backdrop.
- **L2 (chlorophyll):** read *geophysical_data/chlor_a* and *l2_flags*. Build a **reliability mask** that excludes LAND, CLDICE, PRODFAIL, and SEAICE bits; keep only finite, positive *chlor_a.*

Georeferencing & plotting

- Pull latitude/longitude from either L1 or L2 geolocation data. Rendered with pcolormesh so the plot is in true geographic space.
- Apply logarithmic scale to chlorophyll value with a default fixed range for consistent cross-scene comparison
- Save two outputs per pair into an output folder:
    1. L1 grayscale + L2 *chlor_a* overlay (with colorbar).
    2. True-color L1 using the identical map limits as the chlorophyll plot.

Reproducibility controls

- Tunables are explicit (VMIN/VMAX, alpha, grayscale percentiles).
- QA bit list is centralized; changing flags immediately updates masking.
- All filenames and counts are echoed to console for traceability.

Results

Per scene (L1/L2 pair):

- **Clean georeferenced overlay** where chlorophyll-rich filaments, fronts, and coastal plumes are visible on top of a neutral grayscale ocean background.
- **Physically plausible log scale**: low-chlorophyll open ocean rendered darker/cooler, eutrophic or coastal regions brighter/warmer, with a labeled colorbar in mg m^{-3}.
- **No land/cloud contamination** on the overlay (masked by l2_flags); land boundaries visible only in the L1 grayscale.
- **One-to-one framing**: the true-color PNG matches the exact geographic bounds of the chlorophyll map, enabling pixel-level visual comparison or swipe comparisons in a dashboard.

Quantitative/visual checks:

- **Mask sanity:** near-shore pixels with obvious land should be absent from chl overlay; cloud decks should appear as gaps, not false high-chl patches.
- **Dynamic range consistency:** scenes with very clear water still show structure.
- **Aspect & axes:** longitude on x, latitude on y, aspect='equal' so degrees are not distorted; colorbar labeled to display the Chlorophyll-a volume data.
- **Throughput:** the script reports N number of L1/L2 pairs then emits two saved alert notifications

Deliverables:

- PACE_DATA_L1.txt, PACE_DATA_L2.txt — flat inventories for iteracion
- <timestamp_data_prefix>.L1_2.png — publishable overlay figure.
- <timestamp_data_prefix>.L1_truecolor_RGB.png — companion true-color frame (same extent).

Operational expectations:

- **Robust to missing lat/lon**: any scene lacking valid lat/lon or shape match is skipped with a clear console warning.
- **Region-to-region comparability**: with fixed VMIN/VMAX, plots across dates/areas are directly comparable; for exploratory zoom-ins, percentile mode highlights local variability.
- **Ready for ML labeling:** masked, georeferenced PNGs reduce label noise (no land/cloud artifacts), helpful for training hotspot classifiers.

Common failures & remedies:

- Skipped pair errors → confirm chlor_a presence and lat/lon group availability; ensure file timestamps align across L1/L2.

References:

1. NASA Ocean Biology Processing Group. (2024). PACE OCI Level-1B Science Data (Version 3) [Data set]. NASA Earthdata. https://search.earthdata.nasa.gov/search/granules?portal=obdaac&p=C3392966952-OB_CLOUD&pg[0][v]=f&tl=1734627260.284!4!!&lat=77.730520000000001&long=53.2960893854748 86&zoom=1.4838157772642564

2. NASA Ocean Biology Processing Group. (2024). PACE OCI Level-1B Science Data (Version 3) [Data set]. NASA Earthdata. https://search.earthdata.nasa.gov/search/granules?portal=obdaac&p=C3620139643-OB_CLOUD&pg[0][v]=f&g=G3784043337-OB_CLOUD&tl=1734627297.254!4!!&lat=-11.444955&long=-72.55236495111731&zoom=5.155347436119818