DC4: High-resolution monitoring and forecasting of tropical cyclones

Task description

With the objective of better understanding and forecasting the evolving structure of the cyclone (radii, intensity, inflow circulation) and its interaction with the ocean during and after its passage (i.e. the TC wake signatures), the task will exploit various observations co-located with TC tracks in order to estimate ocean-atmosphere parameters such as surface winds, waves, sea surface height (SSH), sea surface temperature (SST), sea surface salinity (SSS), ocean colour and upper ocean SST and SSS, during the TC lifecycle. Three subtasks will be explored: filtering (*[t - inf, t[*), smoothing (*[t - inf, t+inf[*) or forecasting (*[t - inf, t-24h[*) the observations in order to estimate this set of variables at time *t*.

Training Data

A first version (scheduled September 2025) will rely on the existing MAXSS databases (ranging from 2010 to 2020, references MAXSS 1, 2, 3 and 4) as training data. These databases aggregate multivariate ocean and atmosphere data from various sources (satellite and in situ observations, forecasts and reanalyses from atmosphere and ocean models), with different sampling, resolutions and noise will be used as training input. In a second phase (scheduled September 2026), this dataset will be extended and updated in 2025-2026 making it possible to improve this DC by integrating the latest data.

Evaluation data and metrics

The evaluation will use a subset from the same datasets used for training. Representative TC events with relevant collocated data will be selected as evaluation data. Remaining data will be assigned to the training dataset. Evaluation metrics are of two types :

- Wind metrics : intensity spectral score, radius errors, wind profiles, … RMSE, wrt SAR, wind direction error wrt scatterometer and SAR,
- Ocean metrics: scaling laws, RMSE and spectral score for surface waves, surface currents, SSH, SST and SSS signatures in the TC wakes, Brunt-Vaisala parameter and mixed layer depth changes.

Baseline solutions

Baselines will be based on forecasts and reanalyses from wind and ocean models:

- Baselines for wind parameters: MAXSS 1 (see references section below), ERA5, ECMWF forecasts.
- Baselines for ocean parameters: SST, SSS, ocean colour merged L4, SSH merged AVISO, Interior ocean ARGO profiles and ISAS, Mercator-GLORYS re-analysis

References

MAXSS 1 : https://doi.org/10.12770/35002607-3546-412b-8c5d-9c182a16ffea
MAXSS 2 : https://doi.org/10.12770/447aa88f-0c0b-4607-afe2-9c77e95a14b8
MAXSS 3 : https://doi.org/10.12770/6c56bcde-050f-42eb-92b8-8e882e1f4db9
MAXSS 4 : https://doi.org/10.12770/cc0577e4-55d6-4aa9-a938-b4965be121ab