Numerical weather prediction in Portugal 2021

The role of orography and SST on shaping coastal surface wind, in the Canary upwelling ecosystem

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Motivation

Evaluate coastal wind shape is relevant because …

Weaker coastal wind (wind curl) $\rightarrow$ Ekman pumping

Northly wind right at the coast $\rightarrow$ Offshore Ekman transport
Motivation

Global reanalysis and satellite products do not realistically represent the wind drop-off.

(Renault et al., 2016)
Objectives

Assess coastal wind shape in the Canary upwelling ecosystem.

The role of coastal orography, coastline shape and SST.
Simulation's set-up

ROMS 2014-2018 → WRF-ROMS 2019

Initial and boundary conditions
- ERA5
- GLORYS 12V1

Uwind, Vwind, Patm, RH, Tair, Precip, Swrad, Lwrad

SST

Variables exchanged every 30 min

WRF

ROMS

Tides
Computational domains

- **d01** 27 km - WRF
- **d02** 9 km - WRF and ROMS
- **d03** 3 km - WRF and ROMS

Mercator projection

**Bathymetry**
- GEBCO 15 arc-second

**Topography**
- SRTM 3 arc-second
Observed satellite data

wind stress & SST (2019)
**Wind & SST accuracy**

**wind stress & SST (2019)**

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<th>wind speed</th>
<th>MAE</th>
<th>RMSE</th>
<th>R</th>
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<table>
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<th>MAE</th>
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Directional Constancy

\[ DC = \frac{\sqrt{u^2 + v^2}}{\sqrt{u^2 + v^2}} \]
WIND-SST coupling

**CW_gradSST vs Curl 2019**

- Coastal wind
  - + distance to coast
  - + Wind-SST coupling
  - - Coastal orography
Orographic effect

Wind drop-off length (dashed line)  \( \text{curl} = 5 \times 10^{-7} \, \text{s}^{-1} \)

Higher orography \( \rightarrow \) Narrower drop-off length \( \rightarrow \) Higher \% of wind drop-off (31N)

Lower orography \( \rightarrow \) Wider drop-off length \( \rightarrow \) Lower \% of wind drop-off (26.1N)
Coastline shape

Bearing compass
0°N, 90° W, 180° S, 270° E
Conclusions and next steps

Coastal orography, coastline shape and coastal SST cooling affect coastal wind shape.

Next steps

Biogeochemical model