

Numerical weather prediction in Portugal 2021

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

José Alves

Motivation



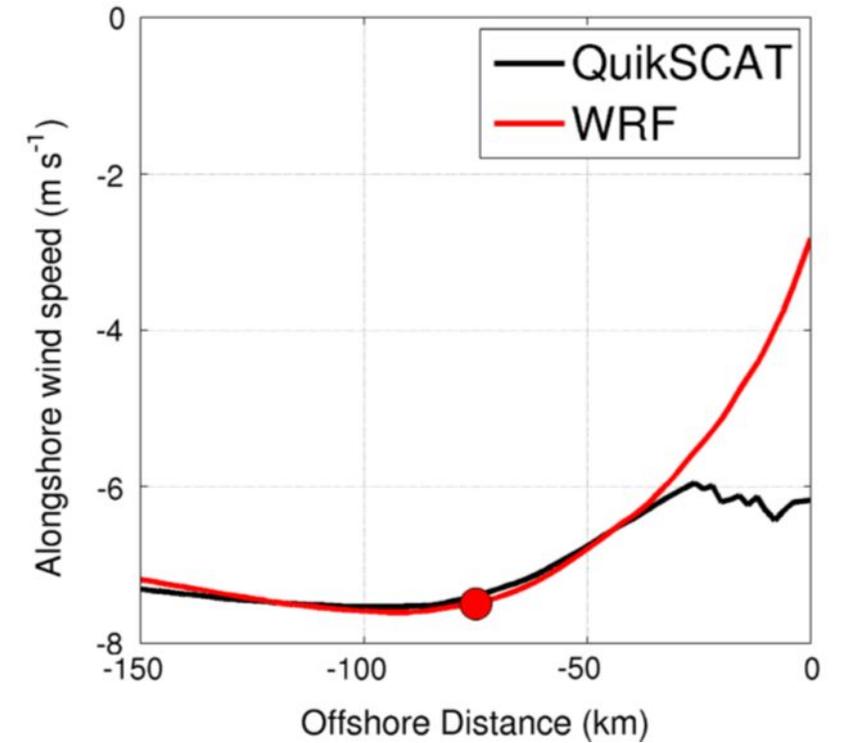
Evaluate coastal wind shape is relevant because ...

Weaker coastal wind (wind curl)  Ekman pumping

Northly wind right at the coast  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.

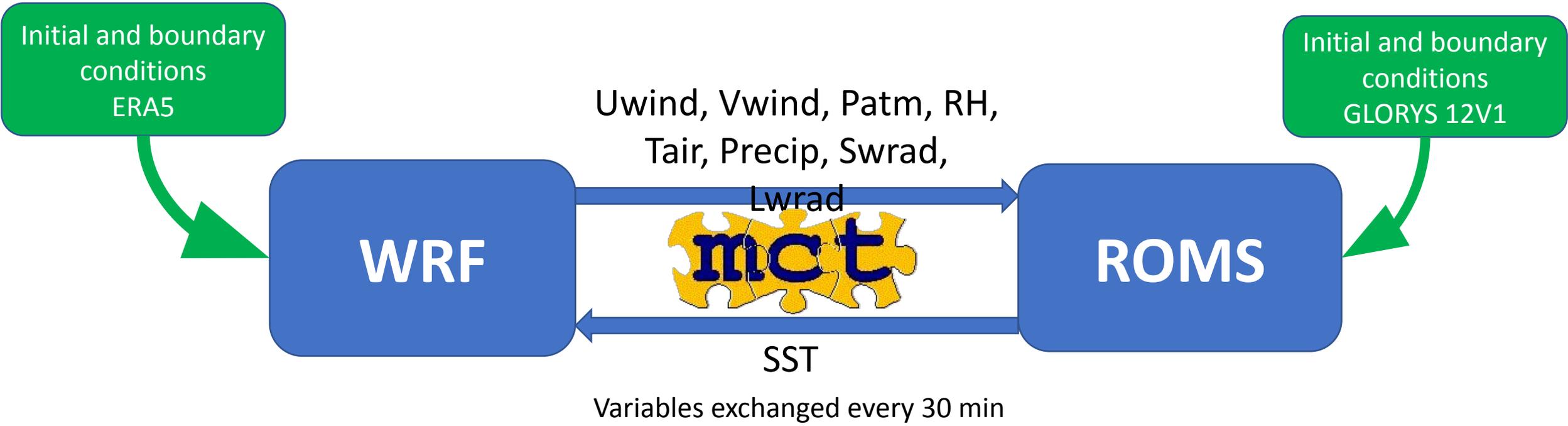
The role of coastal orography, coastline shape and SST.

Orography

Coastline
shape

Coastal SST
cooling

Simulation's set-up



Tides

Computational domains

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

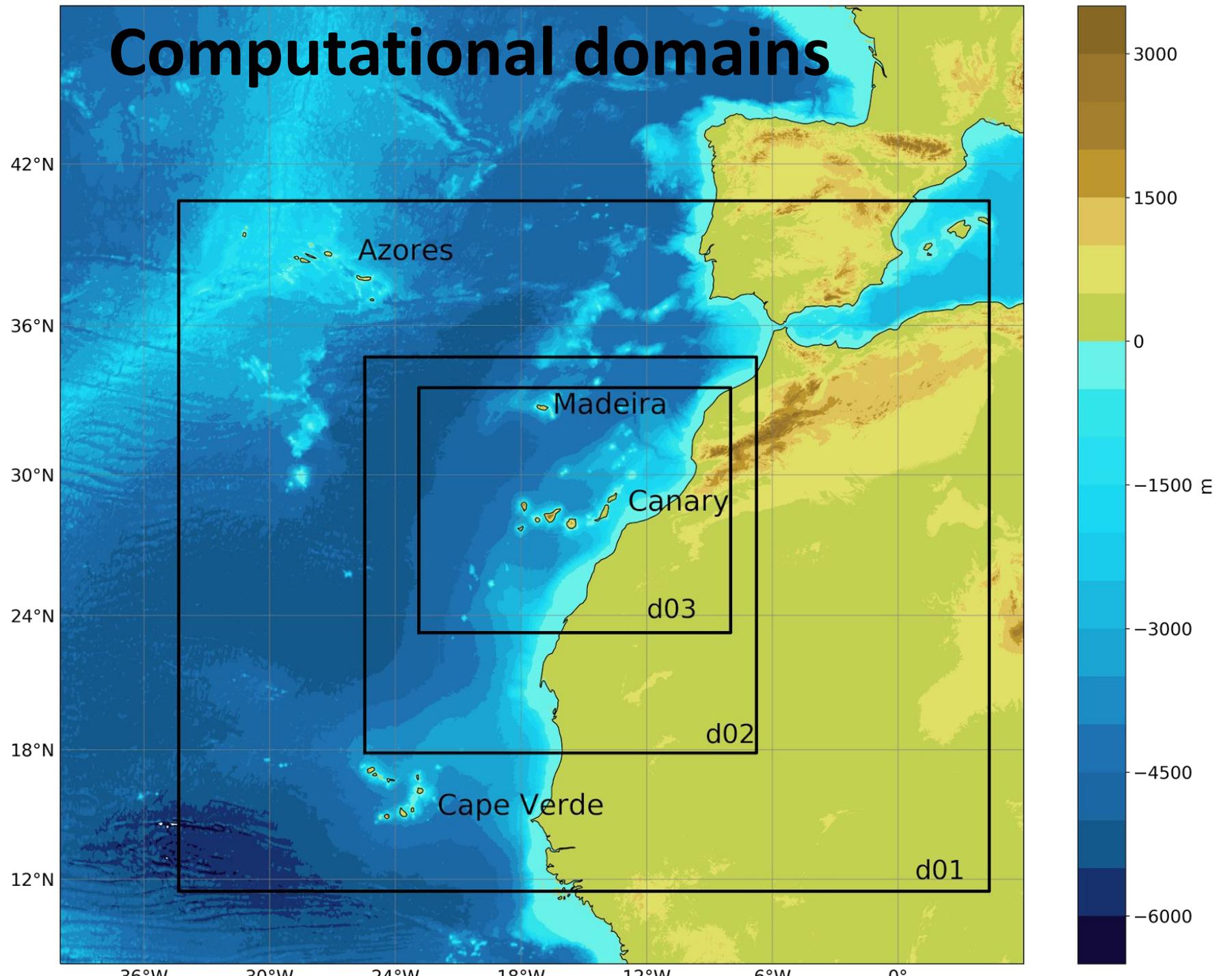
Mercator projection

Bathymetry

GEBCO 15 arc-second

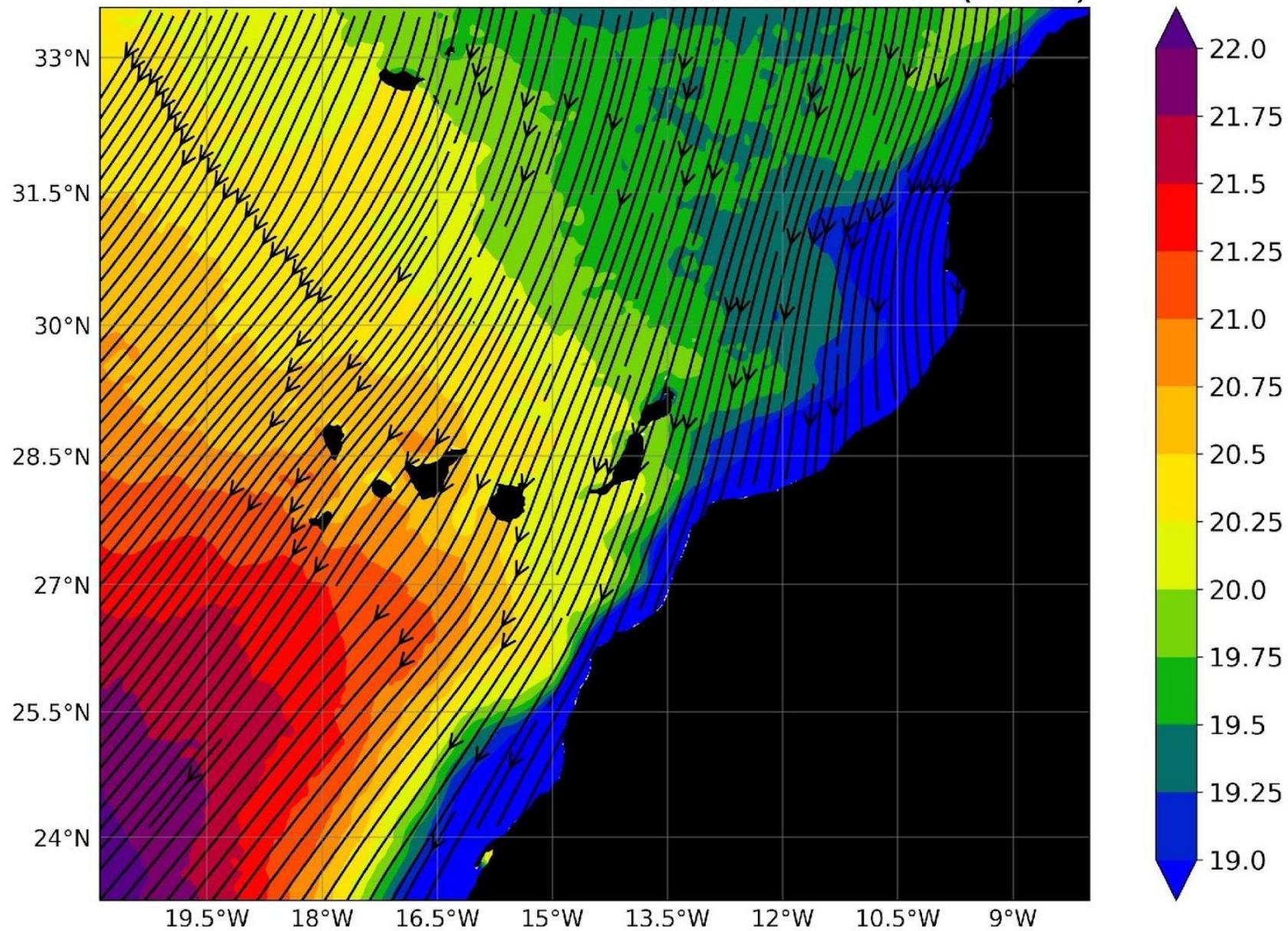
Topography

SRTM 3 arc-second



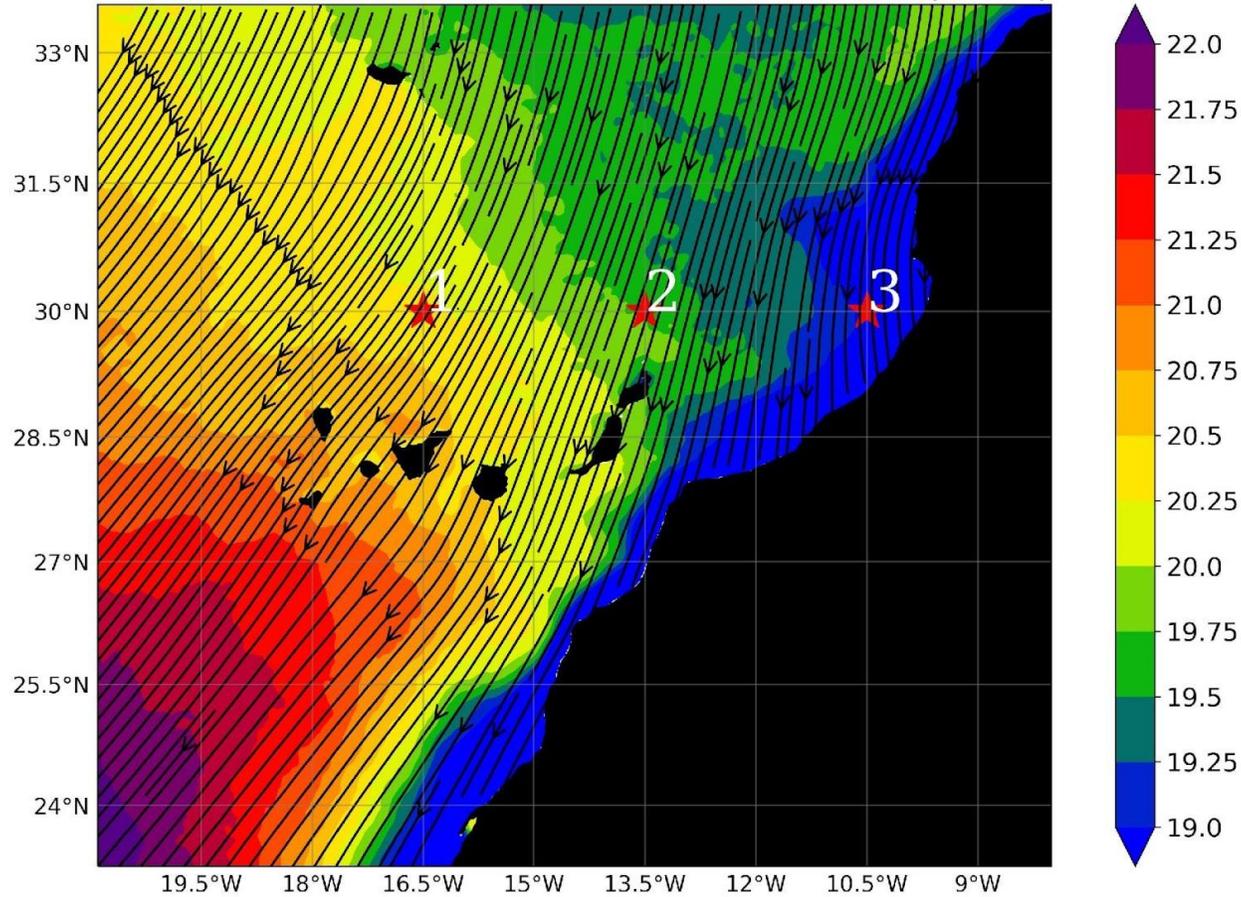
Observed satellite data

wind stress & SST (2019)



Wind & SST accuracy

wind stress & SST (2019)

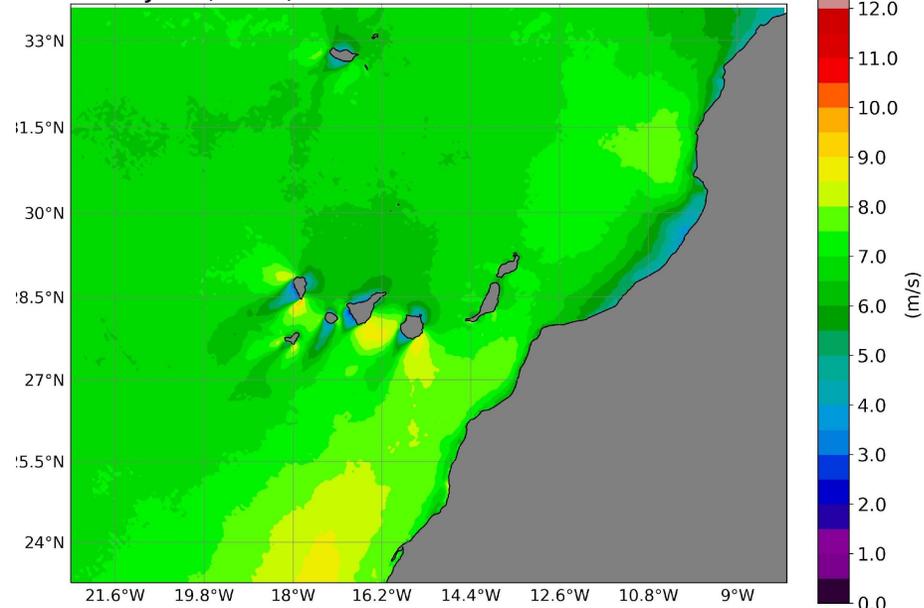


wind speed	MAE	RMSE	R
1	1.11	1.45	0.83
2	1.13	1.48	0.84
3	1.94	2.51	0.81

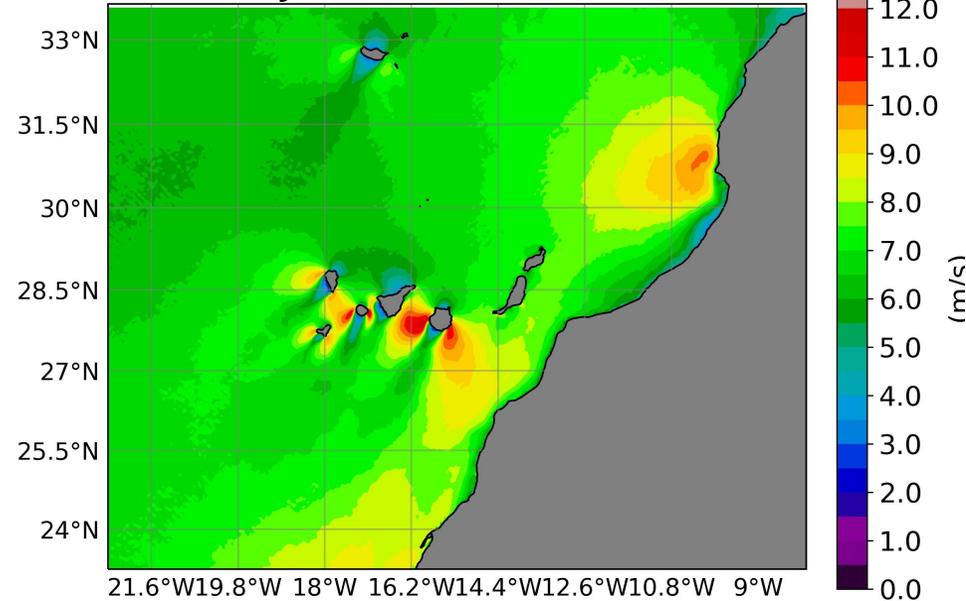
SST	MAE	RMSE	R
1	1.05	1.29	0.98
2	1.20	1.40	0.87
3	1.03	1.29	0.56

Surface Wind Speed

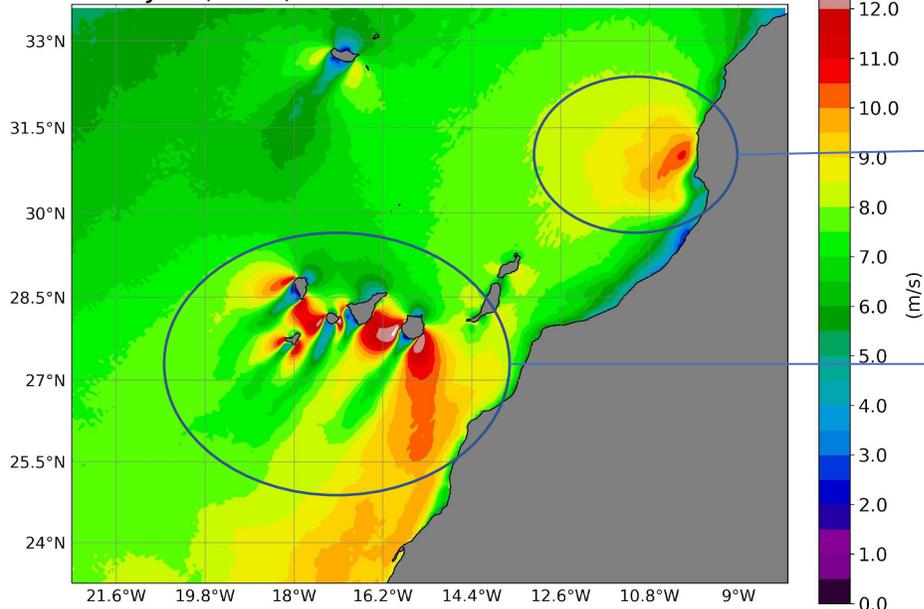
WDS JFM (2019)



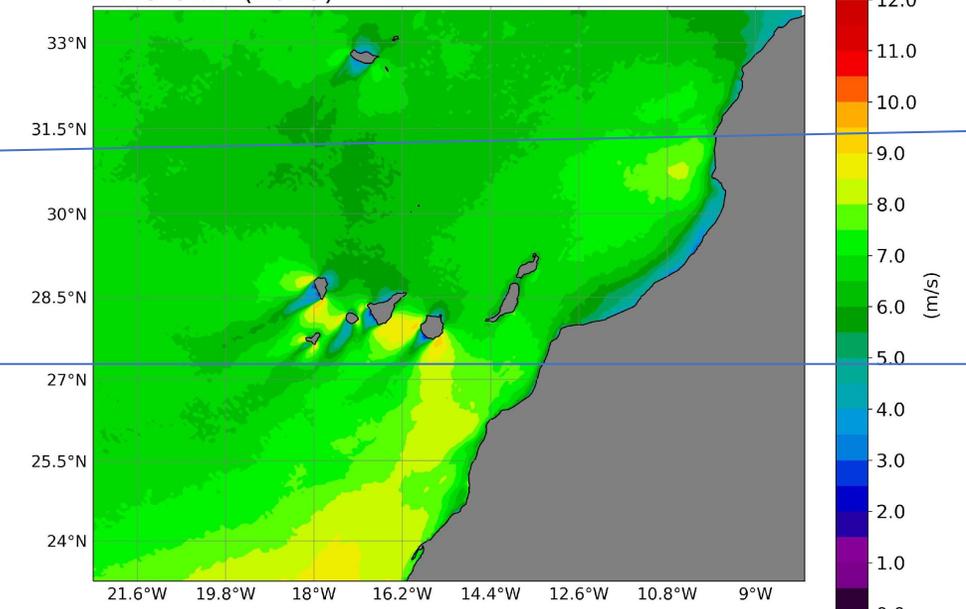
WDS AMJ (2019)



WDS JAS (2019)



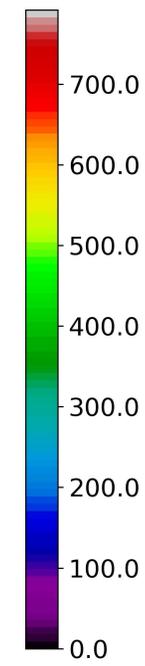
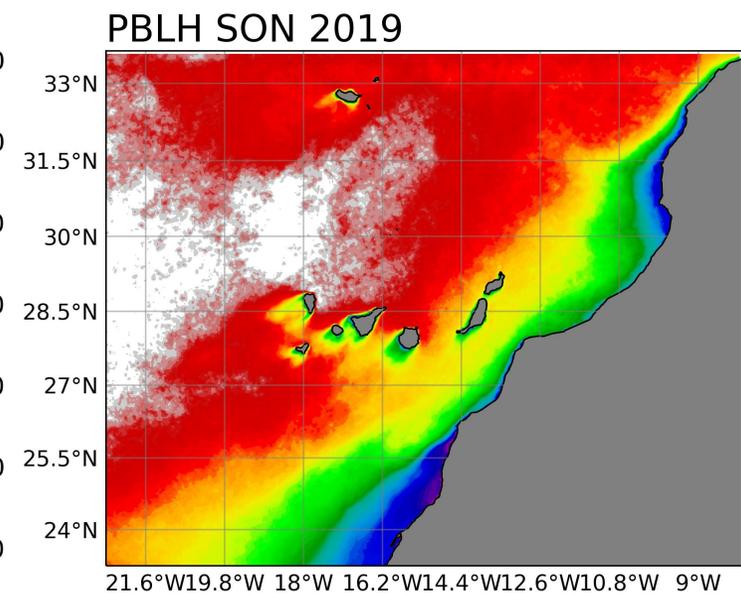
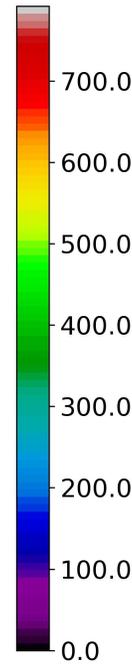
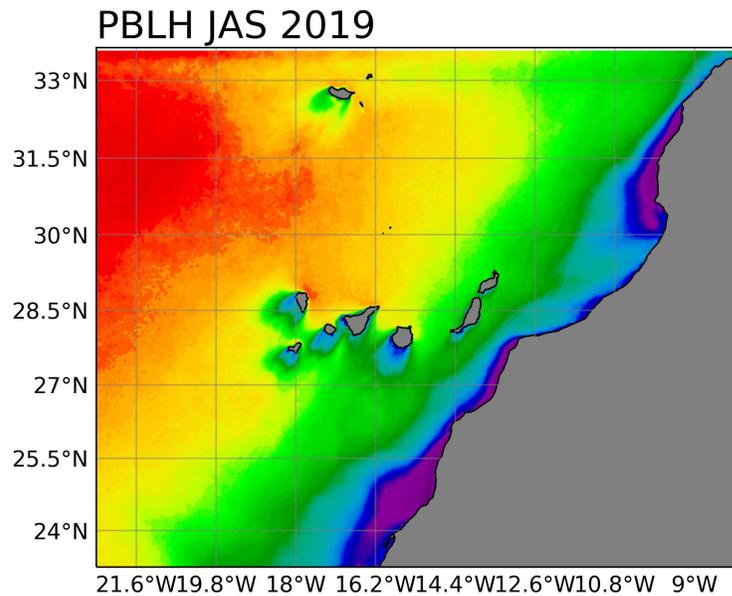
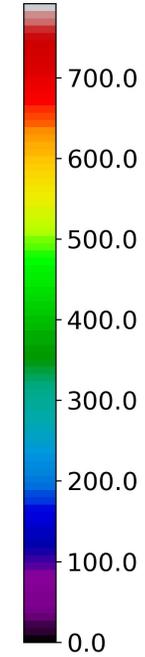
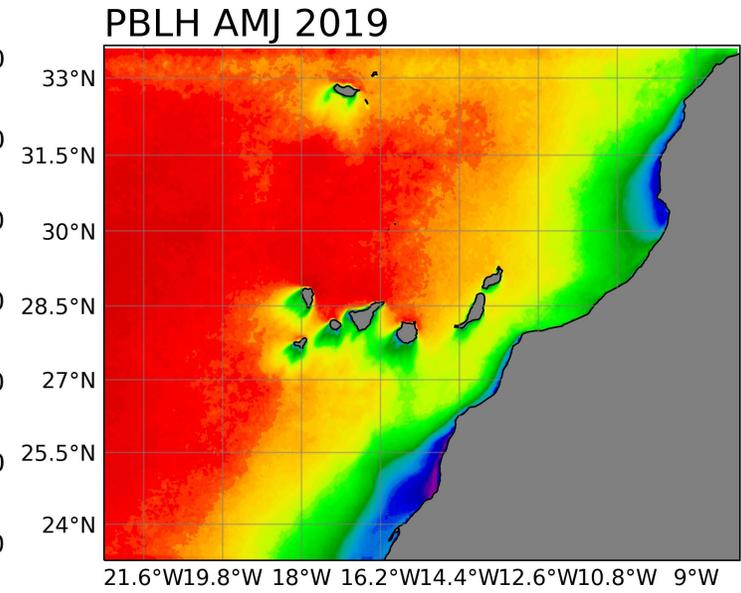
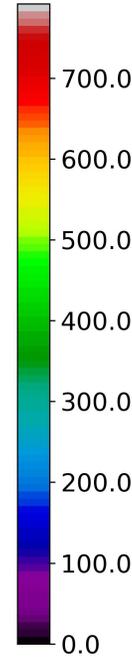
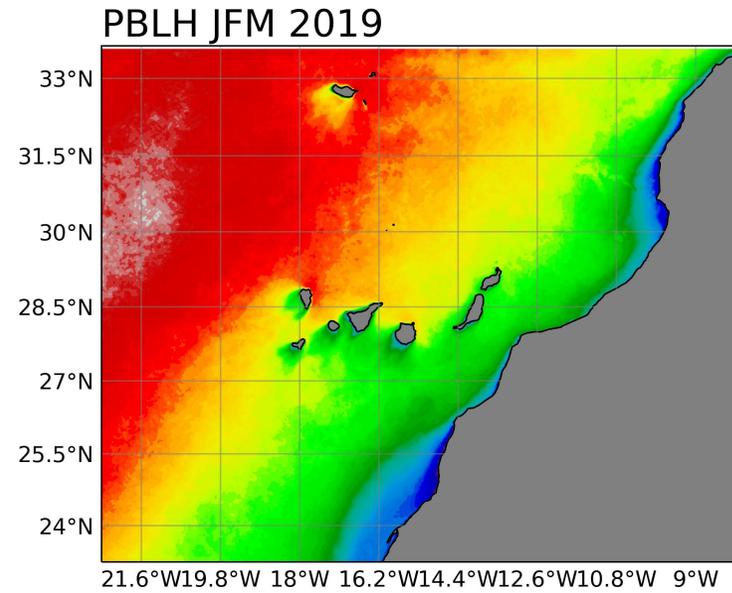
WDS OND (2019)



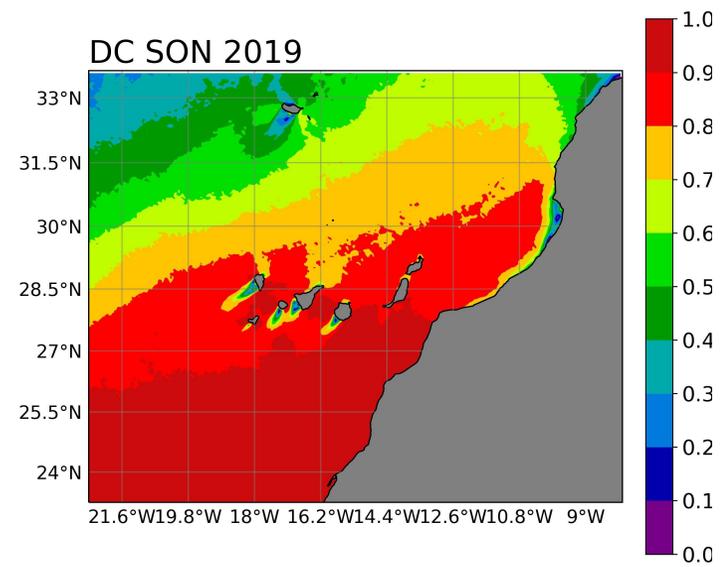
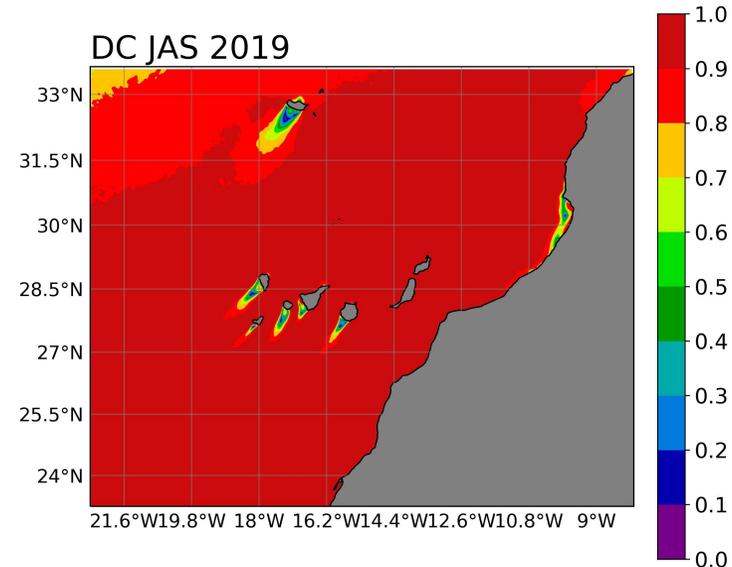
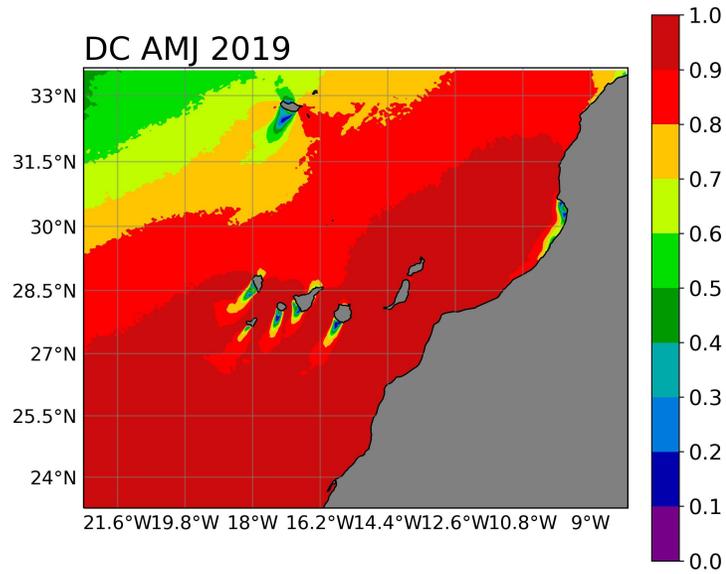
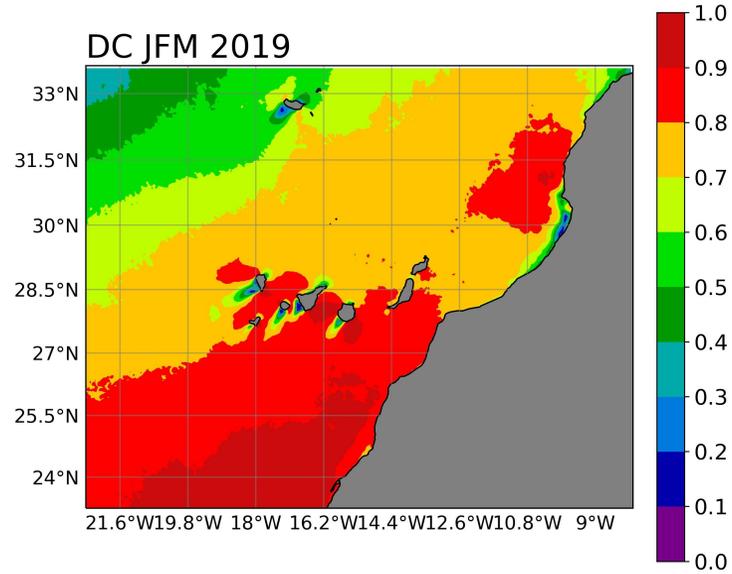
Cape Ghir lee ward jet

Tip-jets

Planetary Boundary Layer Height

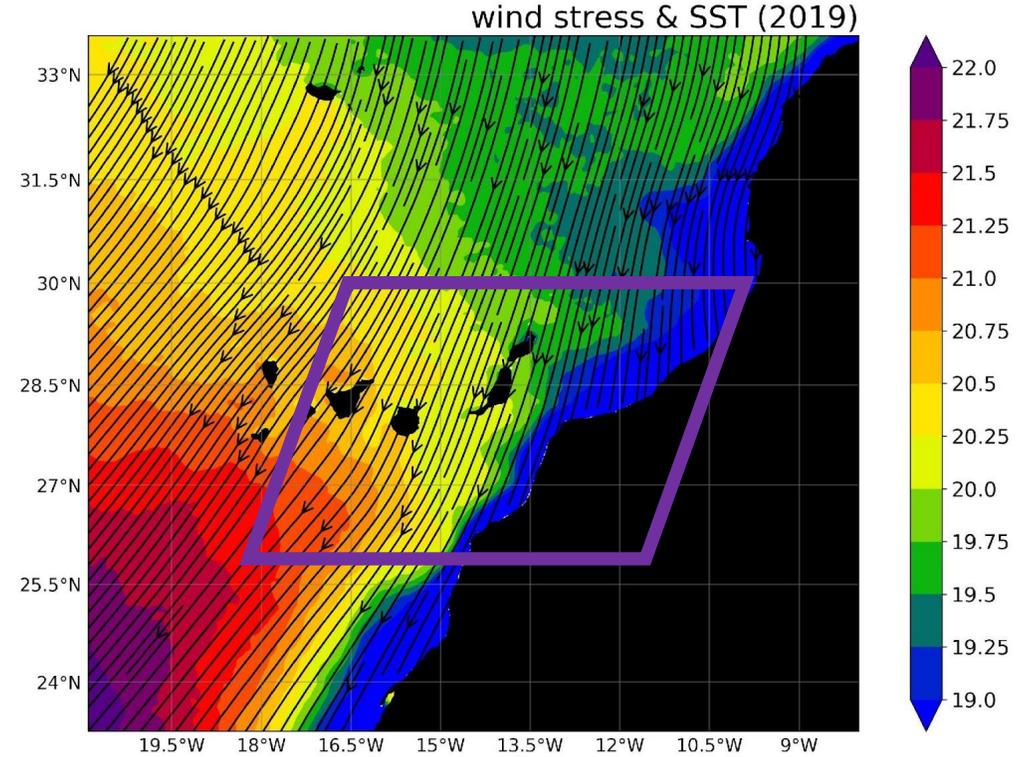
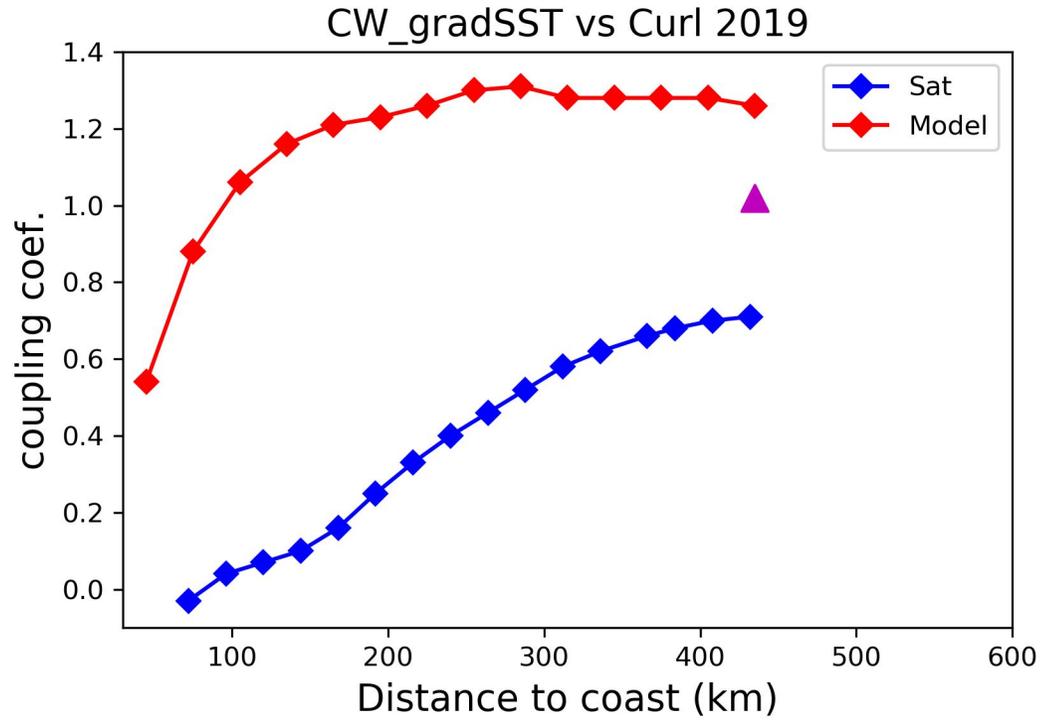


Directional Constancy

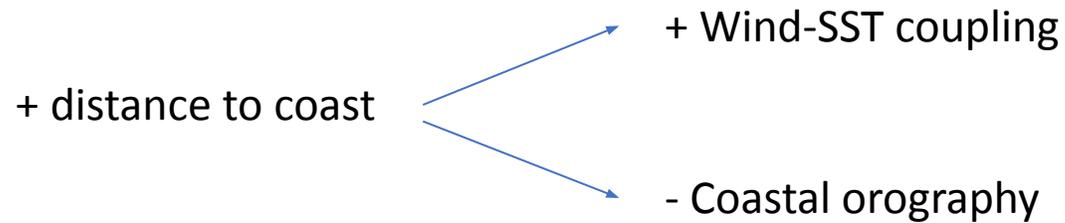


$$DC = \frac{\sqrt{\bar{u}^2 + \bar{v}^2}}{\sqrt{u^2 + v^2}}$$

WIND-SST coupling

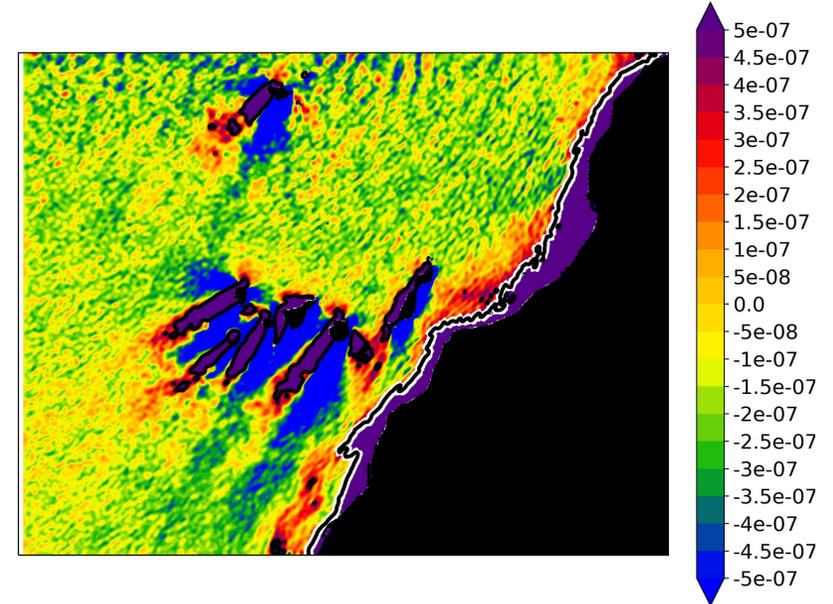
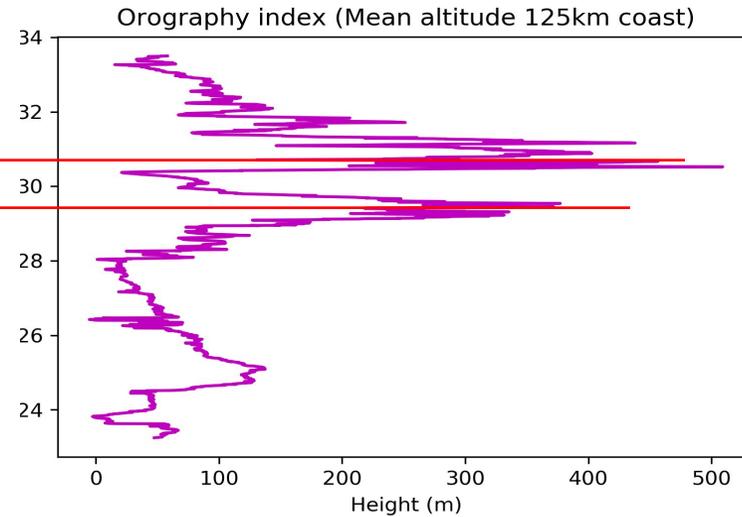
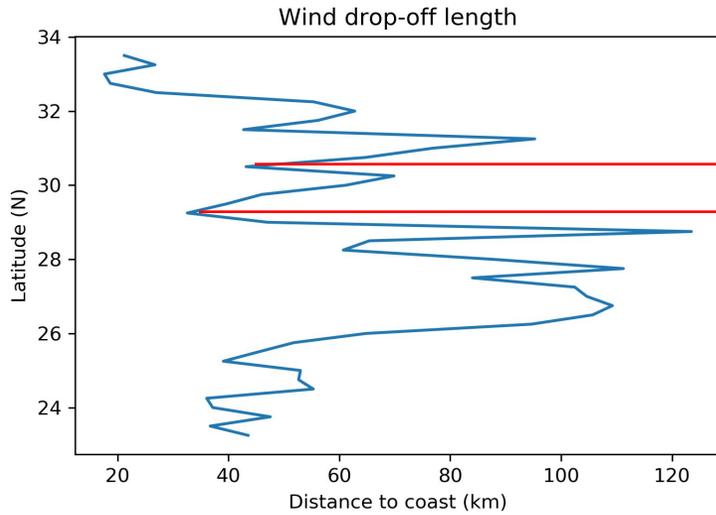


Coastal wind



Orographic effect

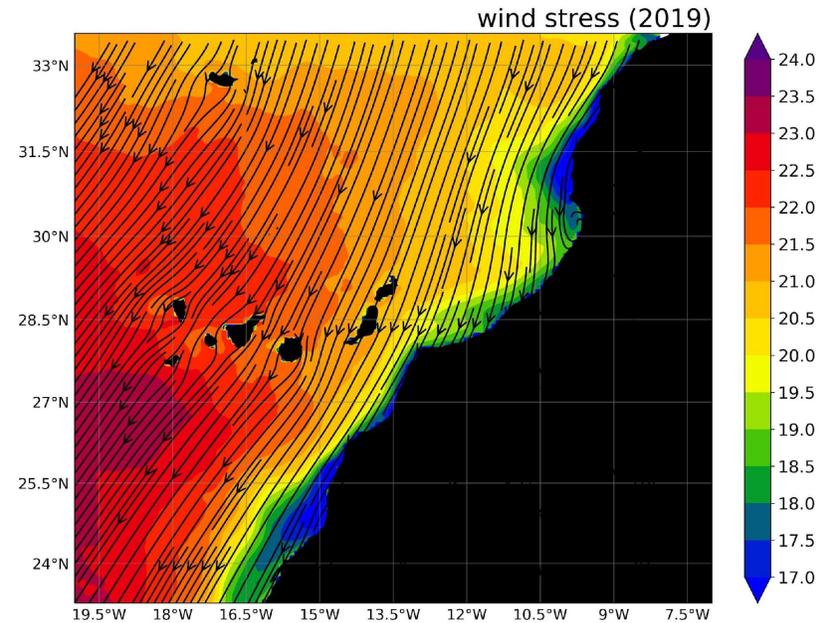
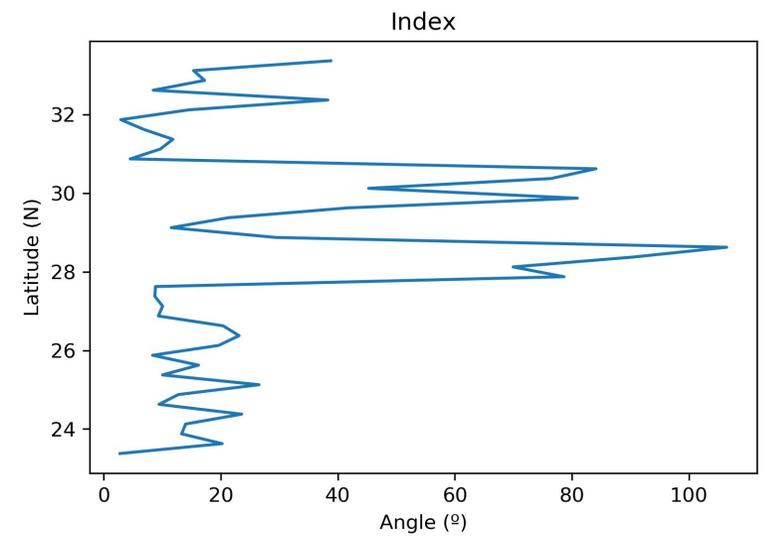
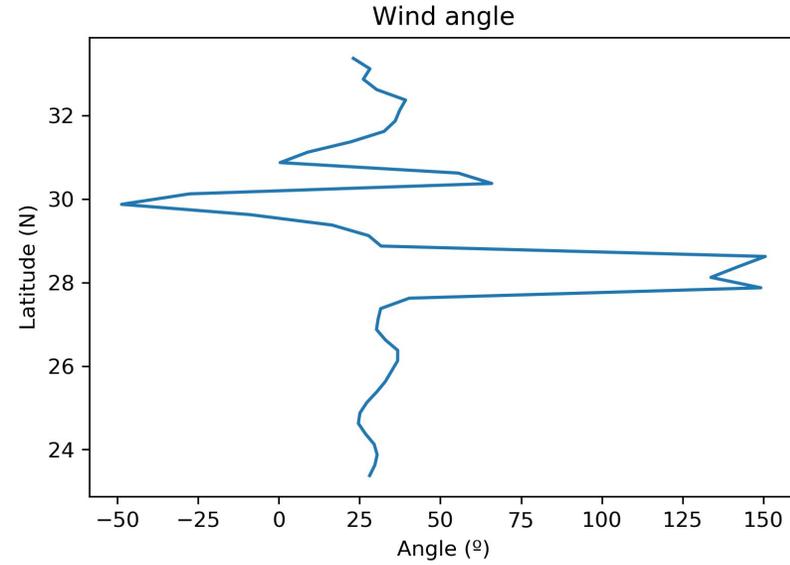
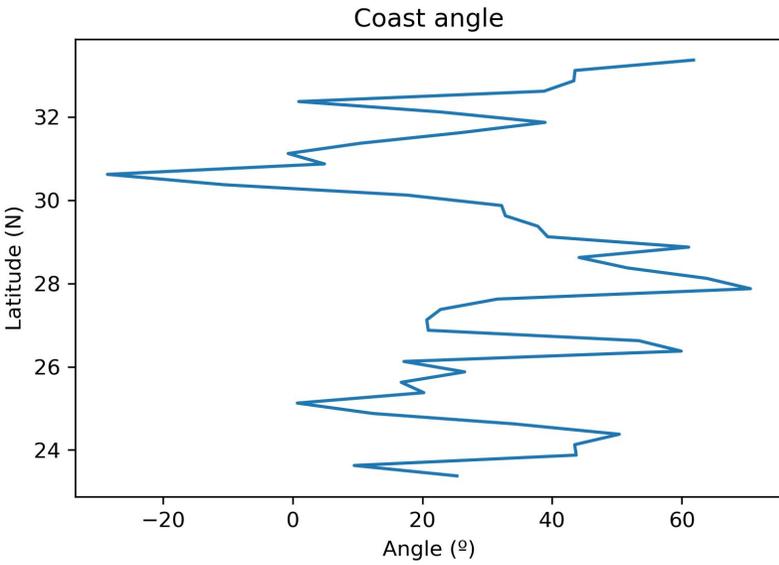
Wind drop-off length (dashed line) $\text{curl} = 5 * 10^{-7} \text{ s}^{-1}$



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

Lower orography \longrightarrow Wider drop-off length \longrightarrow 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

Thanks!