Mistral and Tramontane Patterns in RCMs

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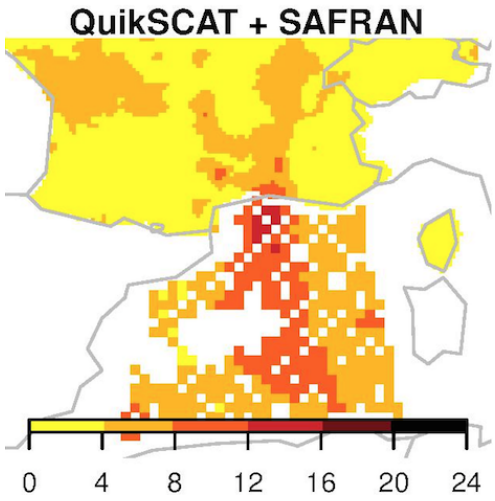
Aims

Evaluate Mistral and Tramontane in regional climate models
Gridded data sets for wind speed and wind direction:

- QuikSCAT: 0.25° scatterometer data
- SAFRAN: gridded daily mean wind speed



Mistral event: Mean wind speed (m/s) on March 24th, 2002.

Model runs of MedCORDEX framework in ERA-Interim:

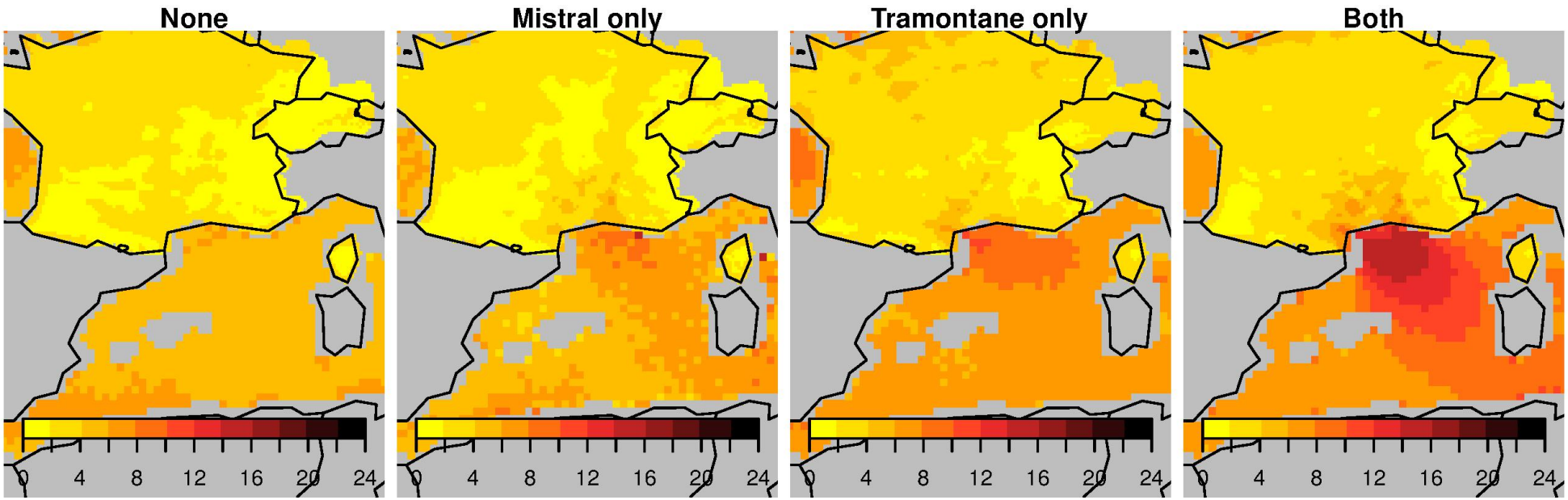
Model	Group	Version	Resolution
ALADIN	CNRM	v5.2	50 km 12 km
WRF	IPSL	311	50 km 20 km
PROMES	UCLM		0.44° 0.22°
COSMO-CLM	GUF	4-8-18	0.44° 0.088°
	CMCC	4-8-19	50 km

On Which days does Mistral/Tramontane occur?

Gust time series (Valerie Jacq) combined of 9 station (Mistral) and 4 stations (Tramontane).

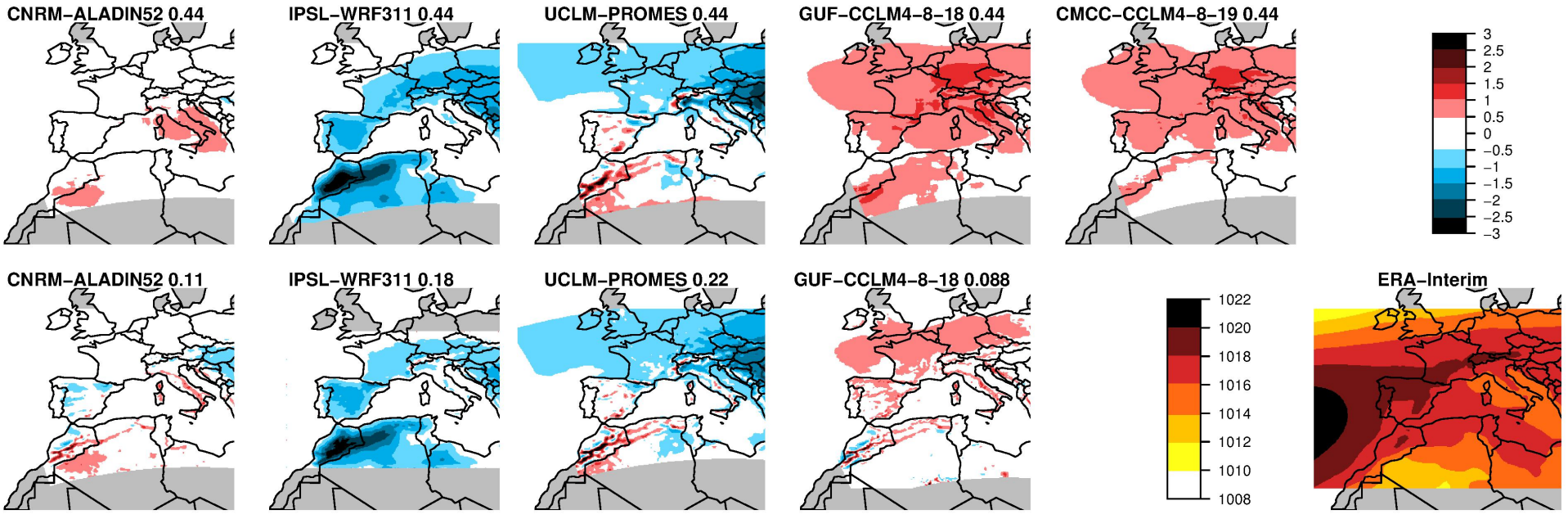
Numbers of days:

2000-2008	Mistral	no Mistral	
Tramontane	565	844	1409
no Tramontane	66	1813	1879
	631	2657	3288



Mean wind speed (m/s) from SAFRAN (2002-2008) and QuikSCAT (2000-2008).

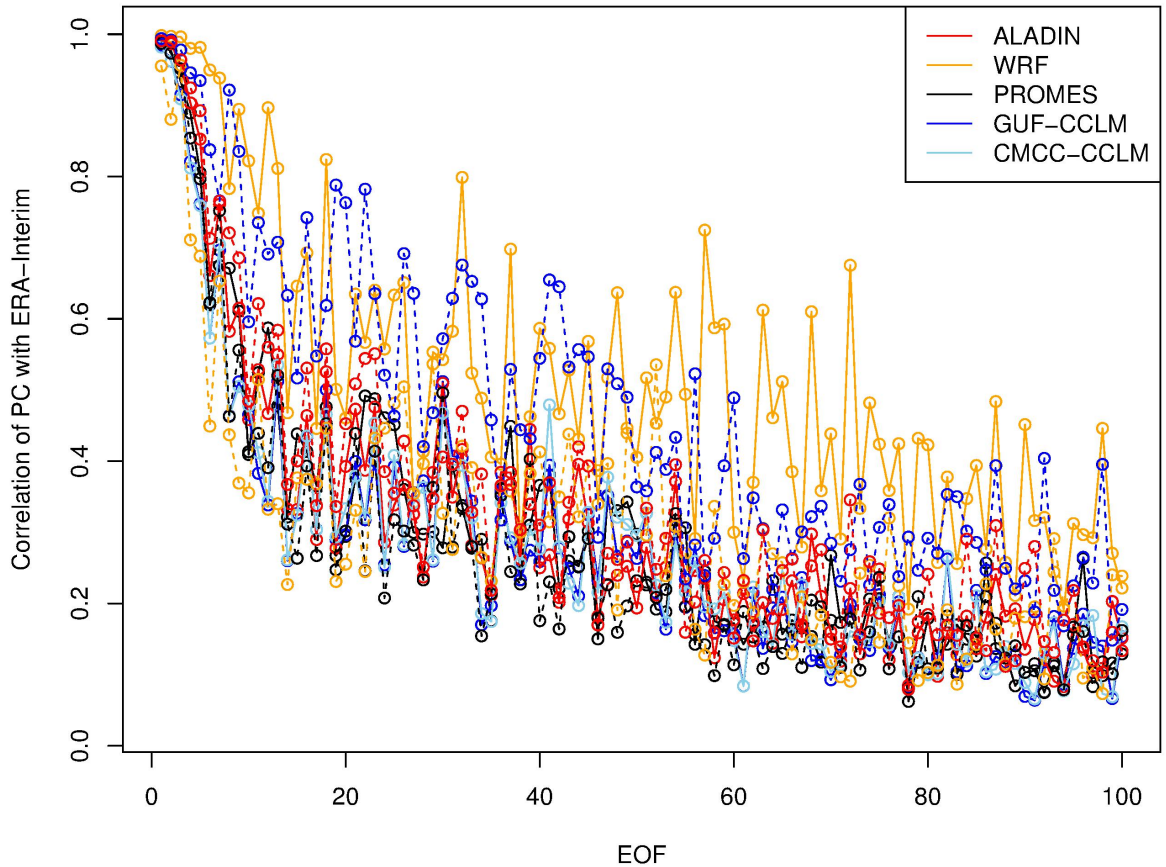
Pressure Bias



Sea level pressure bias (model - Era-Interim) and mean of Era-Interim 2000-2008 in hPa.

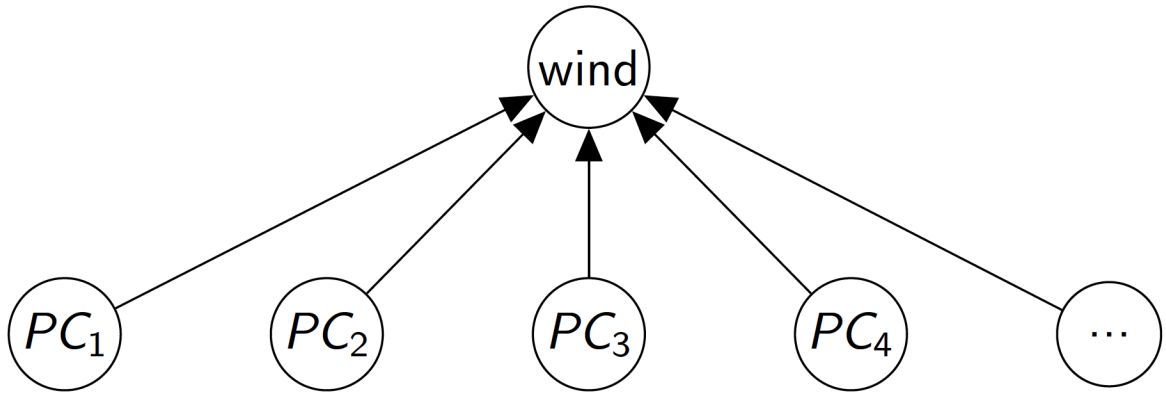
EOF Analysis

1. Empirical Orthogonal Functions (EOFs) and their Principal Components (PCs) of ERA-Interim
2. PCs for each model
3. Normalization of PCs



Correlation of model and ERA-Interim PCs. Dashed lines: higher resolution runs.

Bayesian Network



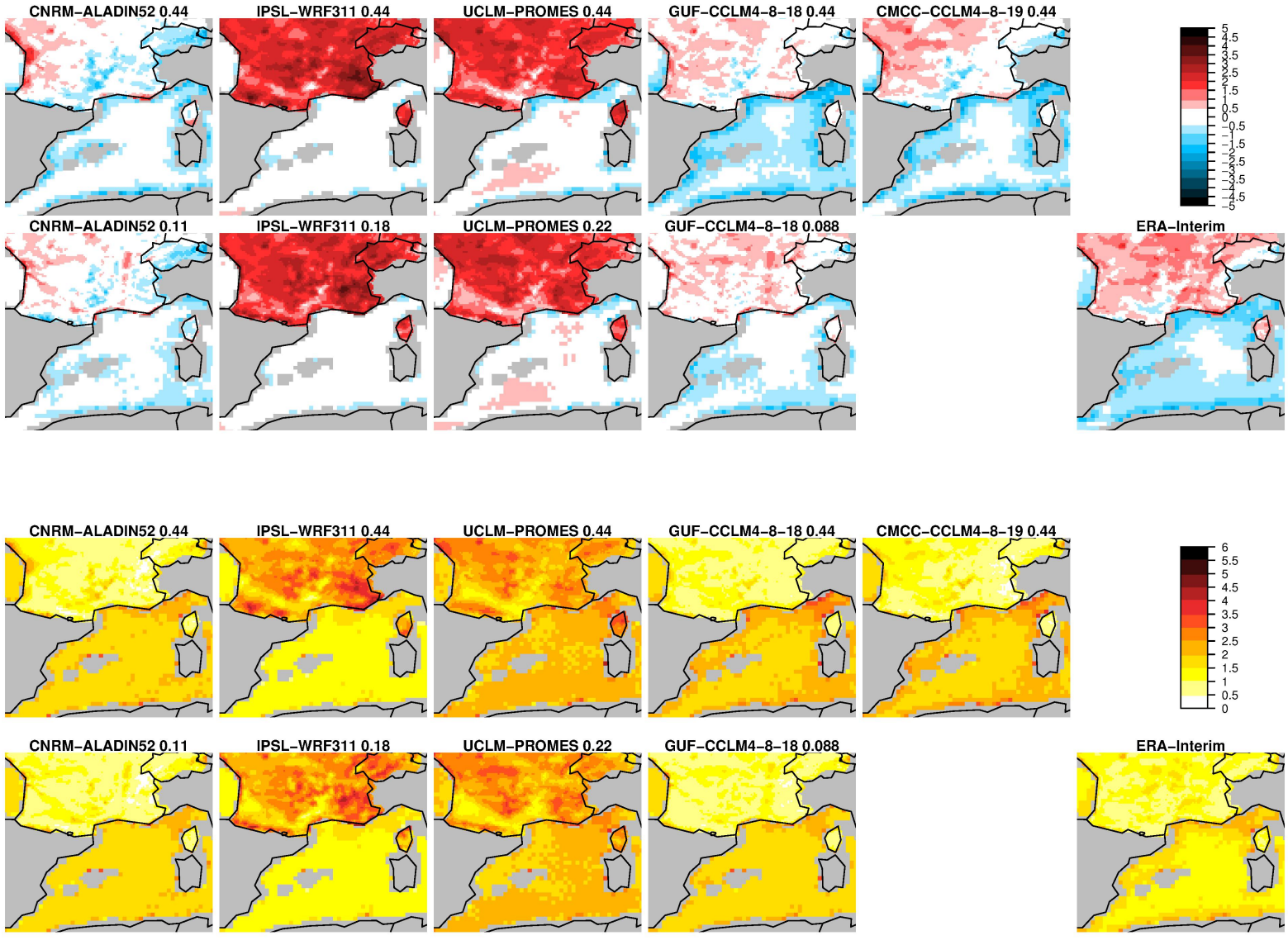
- trained with normalized ERA-Interim PCs using hill-climbing algorithm
- input: daily values of model PC_1 to PC_{100}
- output: continuos number related to likeliness of day being a Mistral or Tramontane day
- output is transformed to a TRUE/FALSE variable, so that the frequency of Mistral and Tramontane days is the same as observed

Time Series from Bayesian Network

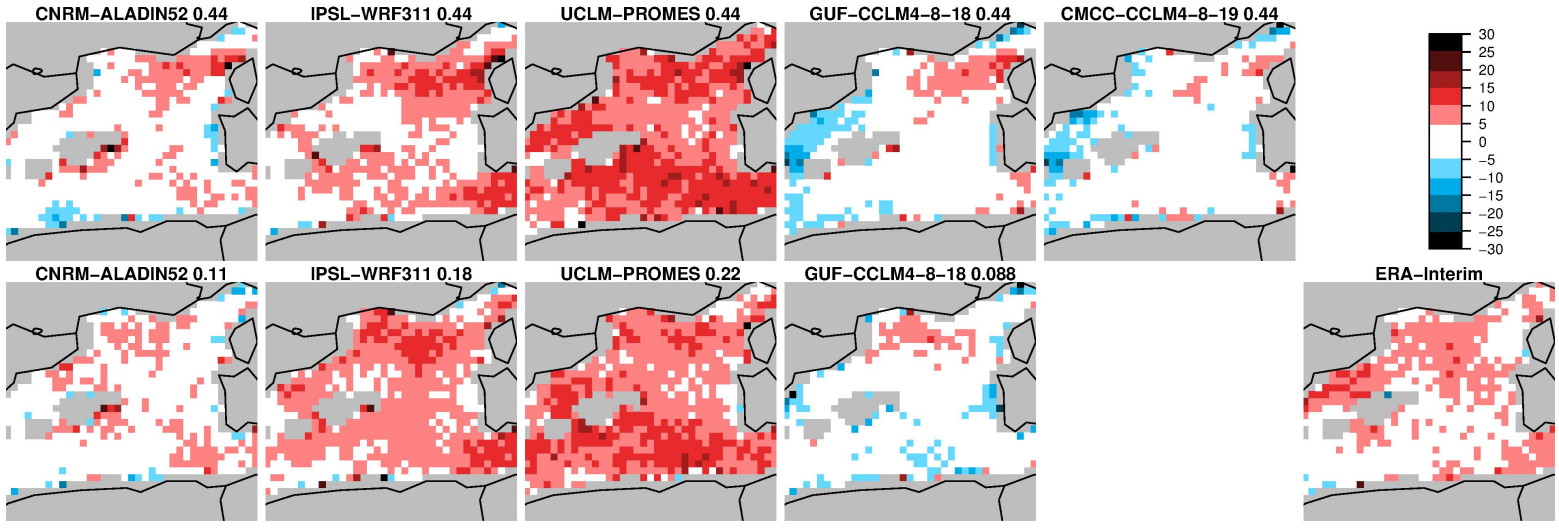
Number of days with wind systems correctly predicted by bayesian network.

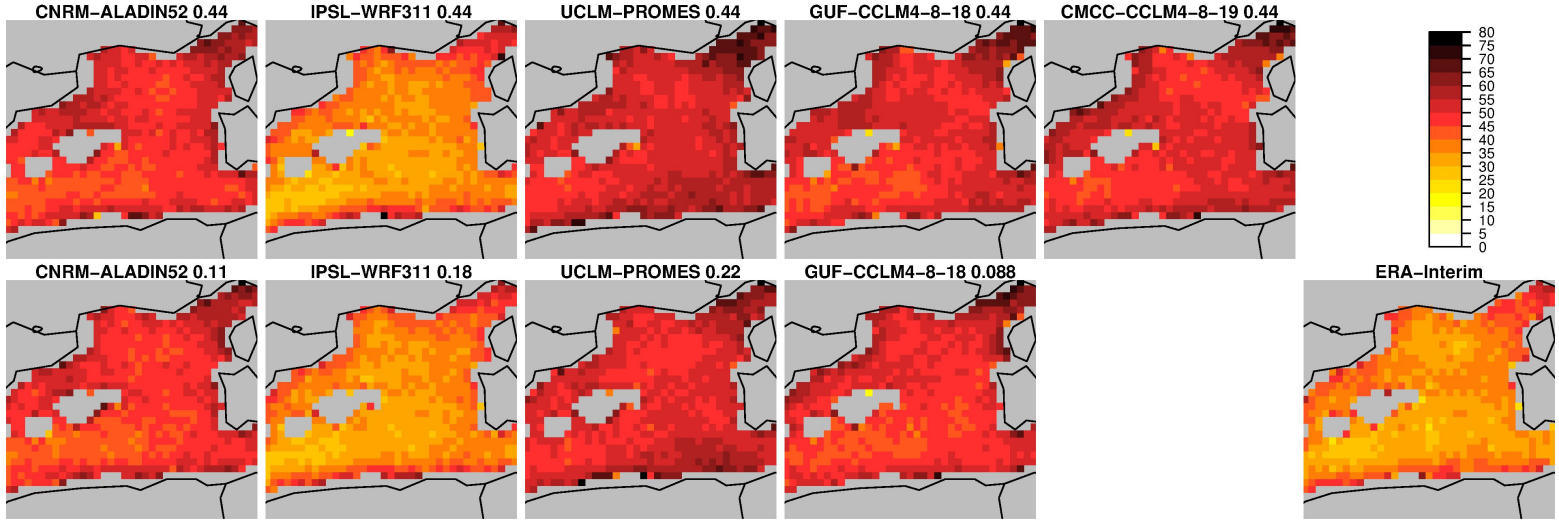
Model	group	resolution	None	Mistral	Tramontane	both	% correct
ALADIN	CNRM	50 km	1601	3	486	432	76.7
		12 km	1589	10	504	429	77.0
WRF	IPSL	50 km	1611	10	540	439	77.7
		20 km	1626	5	514	451	79.0
PROMES	UCLM	0.44°	1585	8	483	410	75.6
		0.22°	1561	10	469	409	74.5
CCLM	GUF	0.44°	1601	10	510	420	77.3
		0.088°	1546	13	507	403	75.1
	CMCC	50 km	1580	11	493	414	76.0
ERA-Interim			1654	12	580	449	82.0
original time series			1813	66	844	565	

Neither Mistral nor Tramontane: Wind Speed Bias and RMSE (m/s)

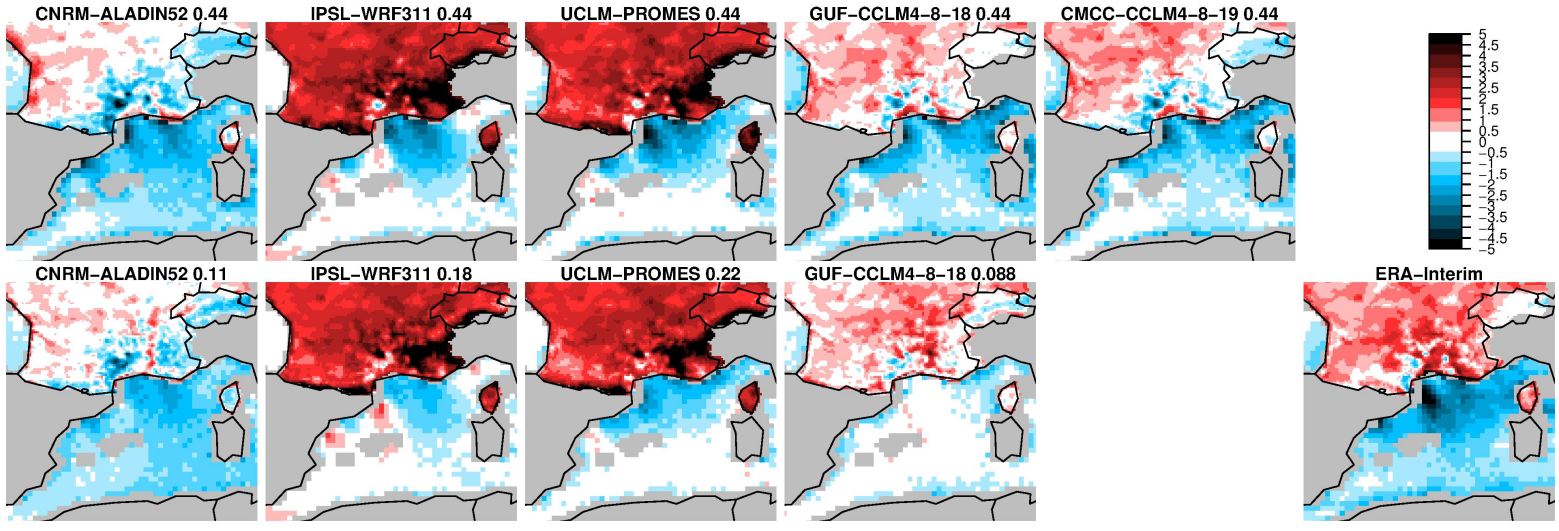


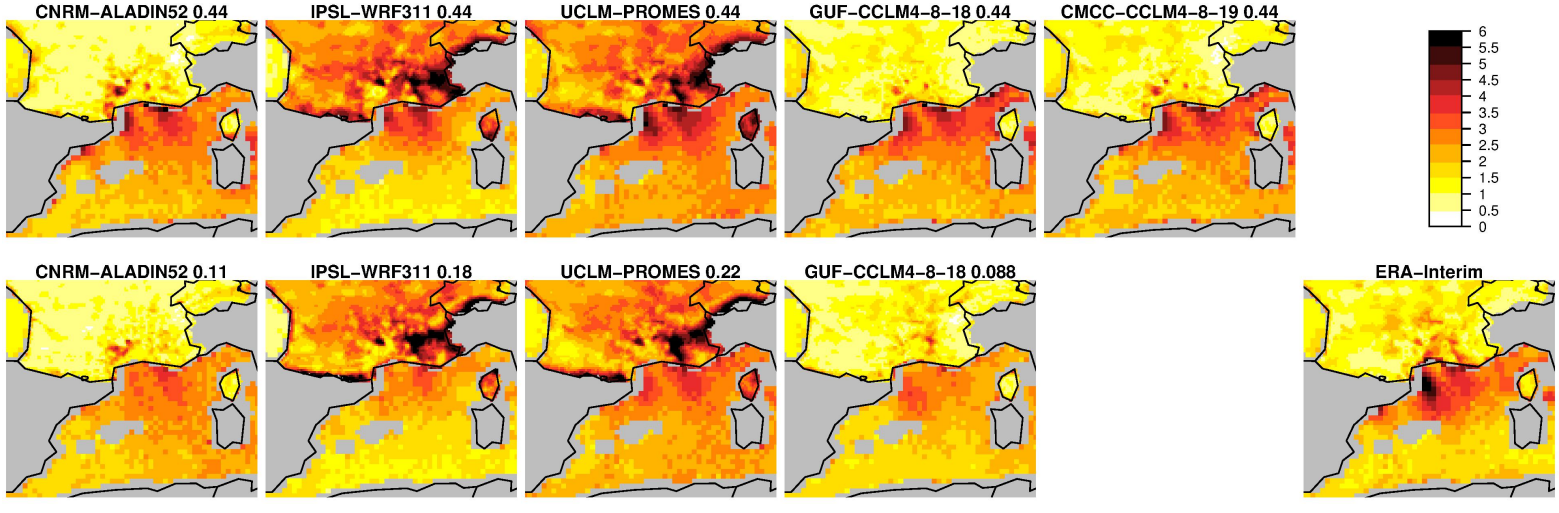
Neither Mistral nor Tramontane: Wind Direction Bias and RMSE (°)



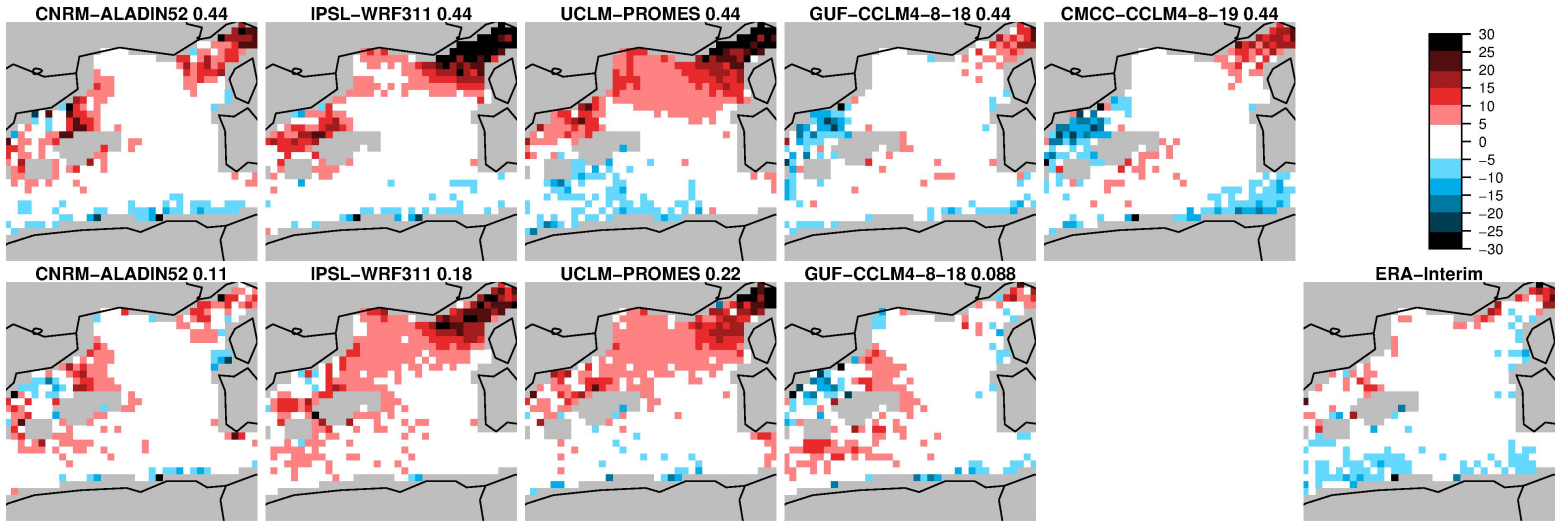


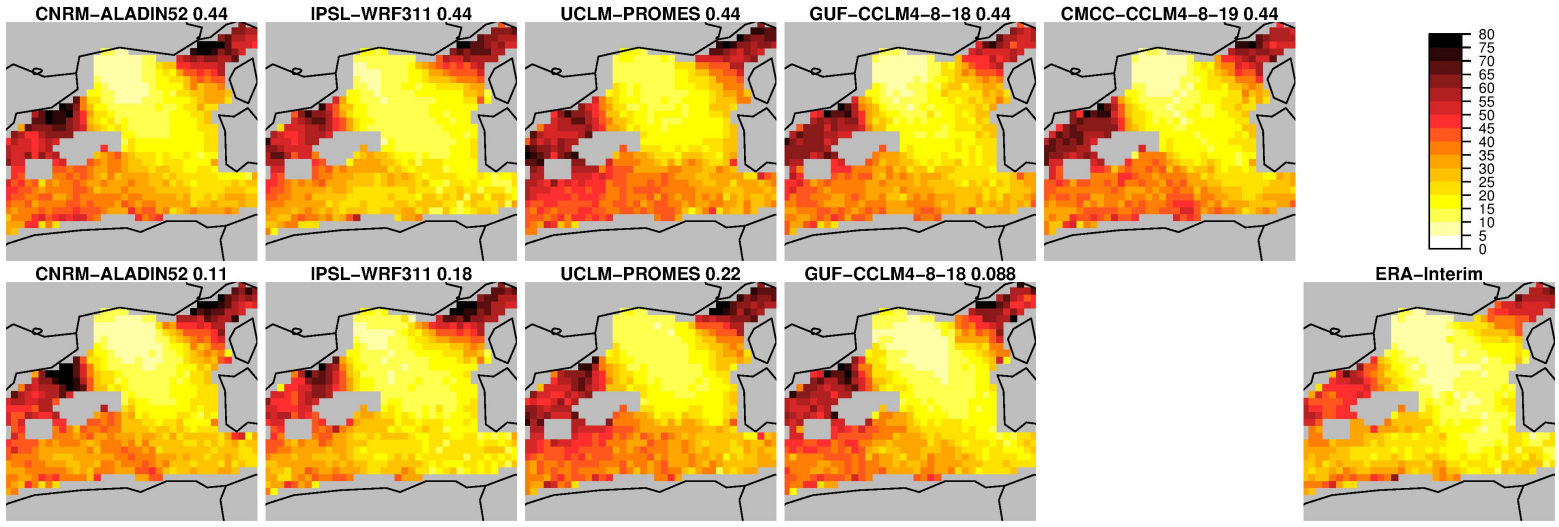
Mistral and Tramontane:
Wind Speed Bias and RMSE (m/s)





Mistral and Tramontane: Wind Direction Bias and RMSE (°)

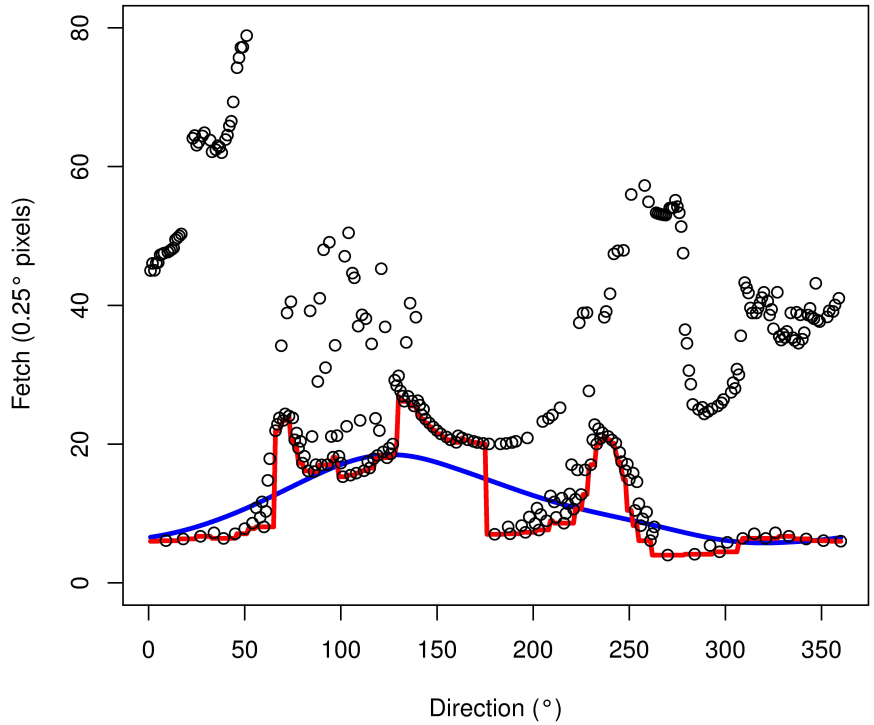




Fetch

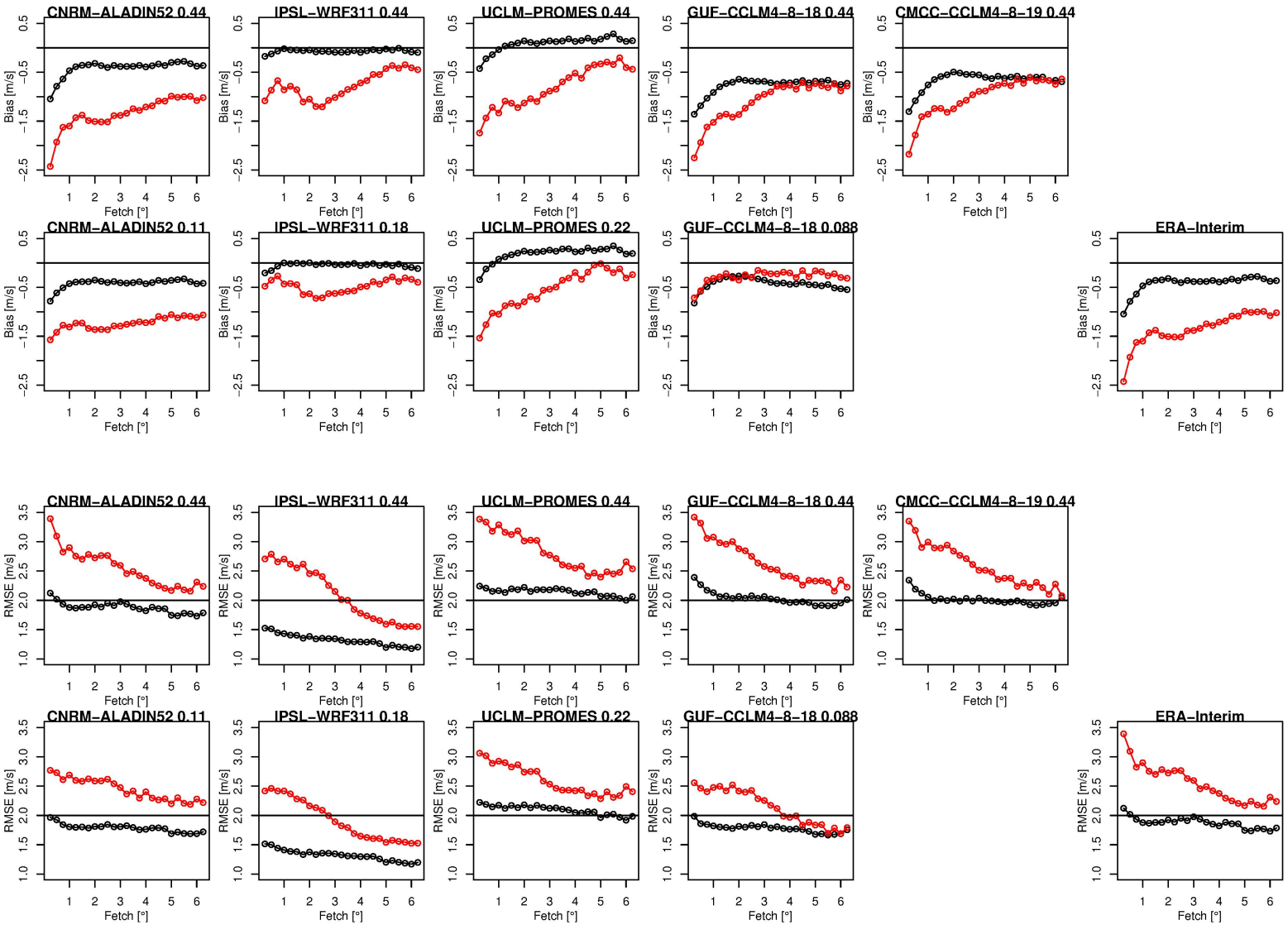
Distance the wind travelled over water calculated in two steps:

1. **Nearest coastal grid cell** in each direction (red).
2. **Averaging** due to uncertainties in wind direction: Fetch in $\phi \pm 90°$ interval weighted with a $\cos^2$ function (blue).



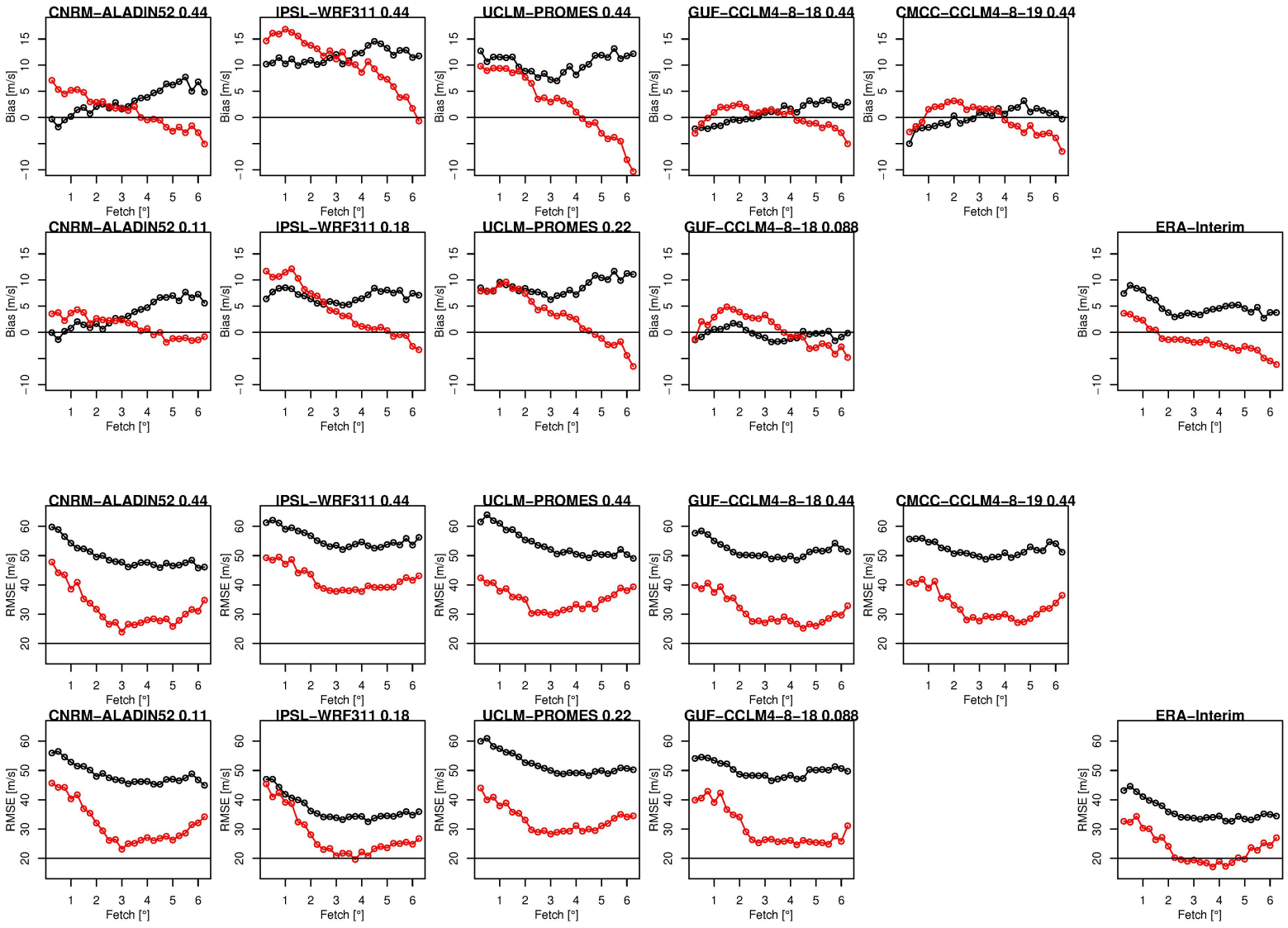
Fetch at one grid point in the Gulf of Lions (at location of Lion buoy).

Fetch dependence: Wind Speed Bias and RMSE (m/s)



Black: days with neither Mistral nor Tramontane, red: days with both.

Fetch dependence: Wind Direction Bias and RMSE (°)



Black: days with neither Mistral nor Tramontane, red: days with both.

Summary and Outlook

- large scale pressure patterns represented well
- errors are higher at sides of main flow than at the center
- wind direction bias smaller on days with Mistral and Tramontane
- wind speed underestimated on days with Mistral and Tramontane
- bias and rmse are fetch dependent

Next steps:

- improve day selection by Bayesian Network
- influence of Charnock formula
- survey land effects

Charnock Formula

Parameterizations

Model	$z_0 =$
ALADIN	$\frac{0.015}{g} \cdot u_*^2 + z_{oc} F_m(Ri)$
WRF	$\frac{0.0185}{g} \cdot u_*^2 + 1.59 \cdot 10^{-5}$
PROMES	$\frac{0.032}{g} \cdot u_*^2$
CCLM	$\frac{0.0123}{g} \cdot \max(u_*^2, w_*^2)$

Circles: 0.44° resolution, stars: higher resolution runs.
Red: Mistral/Tramontane days, black: days with neither Mistral nor Tramontane