

Idealized Mistral Simulations with CCLM

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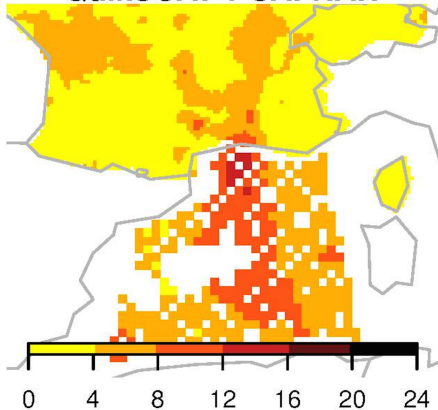
Goethe University Frankfurt

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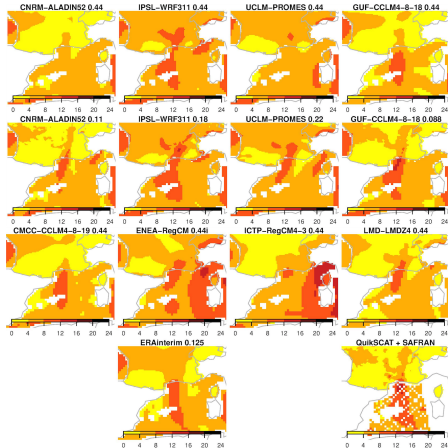
Mistral in RCMs

QuikSCAT + SAFRAN



10m wind speed on March 24th 2002 (m/s).

- Tendency to be simulated too far in the West
- Too low wind speeds



Bias (mean over 9 years)

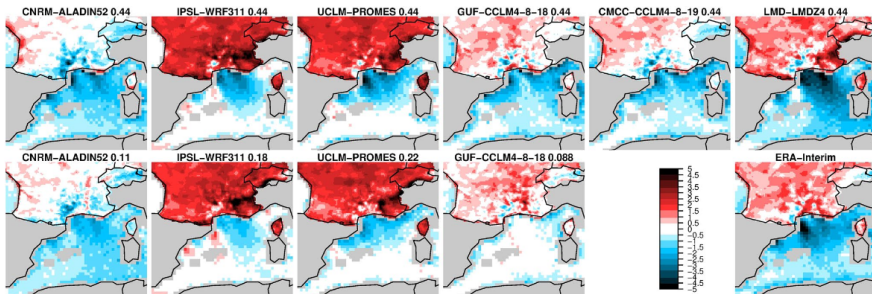


Fig. 10 Wind speed bias (m/s) for M/T days

- Stronger bias at borders of flow
- clockwise rotated wind

Clim Dyn
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Mistral and Tramontane wind speed and wind direction patterns in regional climate simulations

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Influence of Charnock $z_0 = \frac{\alpha}{g} u_*^2$

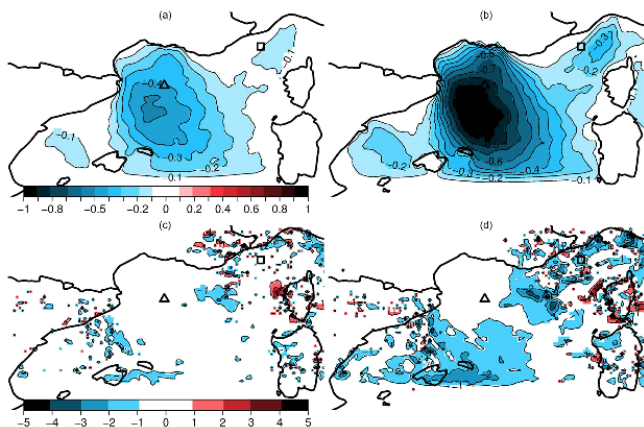


Figure 4. 10 m wind speed bias [m s^{-1}] (a, b) and 10 m wind direction bias [$^\circ$] (c, d) for $\alpha = 0.025$ (a, c) and $\alpha = 0.05$ (b, d) with respect to reference ($\alpha = 0.0123$). Locations of Lion (triangle) and Azur (square) buoys.

Higher $\alpha \rightarrow$ lower wind speed,
counter-clockwise rotation



Idealized Simulations

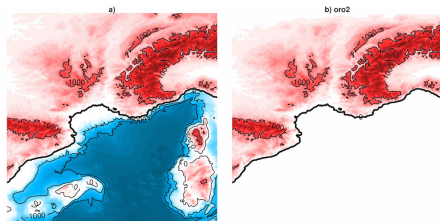
Simulating idealized cases with the COSMO-model (draft version)

Ulrich Blahak

January 13, 2015

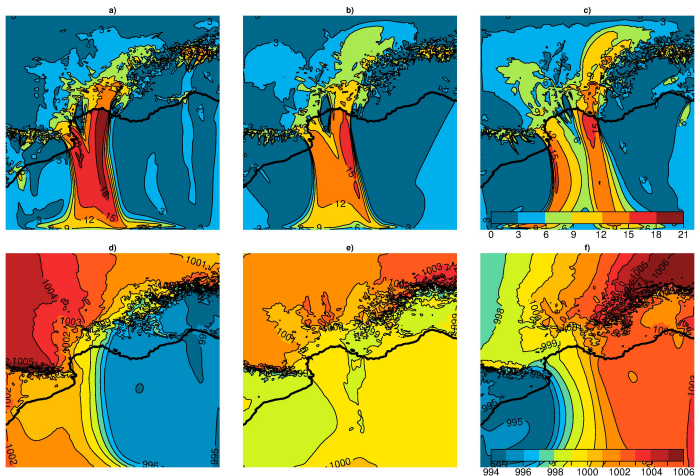
- constant inflow boundary conditions: $v = -5\text{m/s}$ (wind from north)
- open boundaries at east and west
- Coriolis force in f-plane approximation ($f = 2 \sin 45^\circ$)

- 601×601 grid points, $10 \times 10^\circ$ domain
- $Z_0 = 0.01$ m, no SSO
- 14 days simulation, use day 12-14 for evaluation



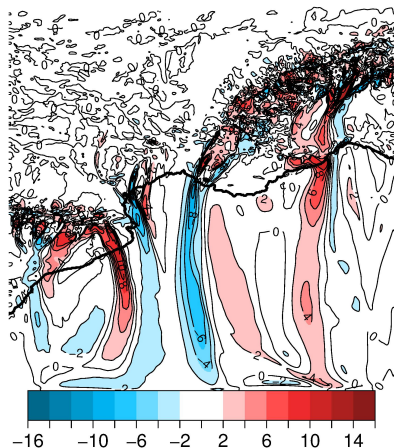
- a) original Orography
b) only continent

Influence of Coriolis Force



Mean wind speed (m/s) and mean sea level pressure (hPa) for simulations with Coriolis force (left), without Coriolis force (middle) and with negative Coriolis force (right).

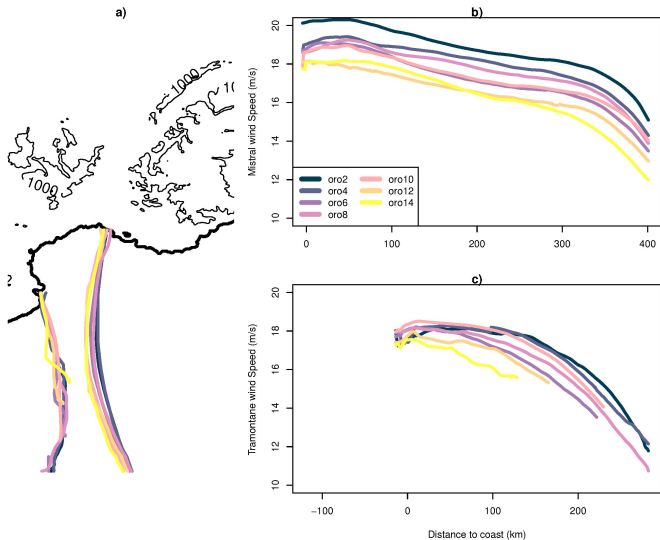
Smoothing the Orography



Change in wind speed (m/s) when orography is smoothed from $n = 2$ to $n = 14$.

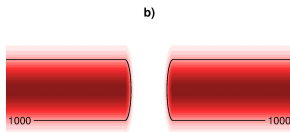
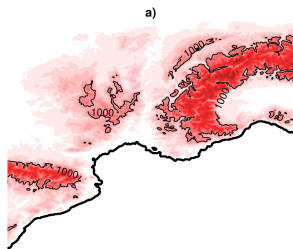
- Smoothed by linear interpolation to a coarser grid spacing and back
- n -times coarser grid spacing simulations named *oron*
- Other simulations show similar patterns with less strong differences

Smoothing the Orography

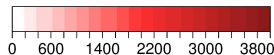


a) 20point smoothed location of wind speed maximum for smoothed orographies. b) and c) Wind speed at these locations.

Idealized Orography



a) realistic orography
b) idealized orography (m)

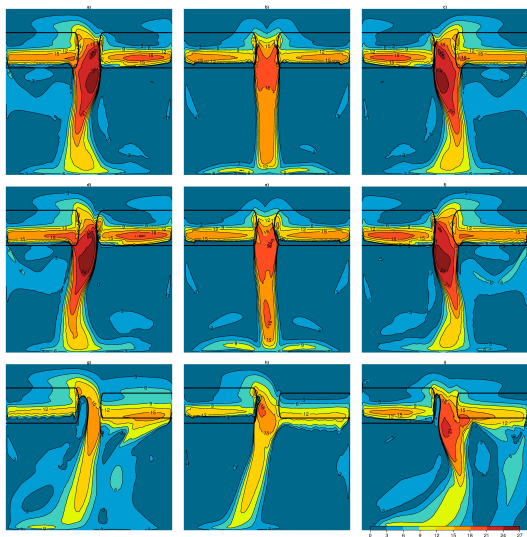


Vary

- Land surface
- Gaussian shaped hills

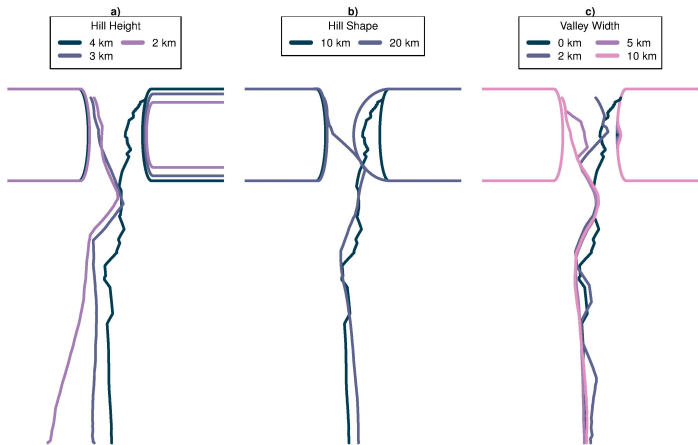
- Hill height
- Hill standard deviation
- Valley width

Idealized Orography



Wind speed for hills with equal shape (upper row), a rounder right hill (middle), and a smaller right hill (lower row) with (left), without (middle) and negative Coriolis force (right).

Idealized Orography



50point smoothed location of wind speed maximum, 1000 m isolines.

Conclusions

- Orography, Charnock parameterization and Coriolis force influence Mistral wind pattern
- Smoothing of orography \Rightarrow
 - flow moves to the West
 - lower wind speeds
- α influences wind speed and direction over Mediterranean Sea
- Hill height, shape and valleys in the mountains influence area of main flow in idealized simulations