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The Future Evolution of the Western Iberian Coastal Low-Level Wind Jet in a Warming Climate

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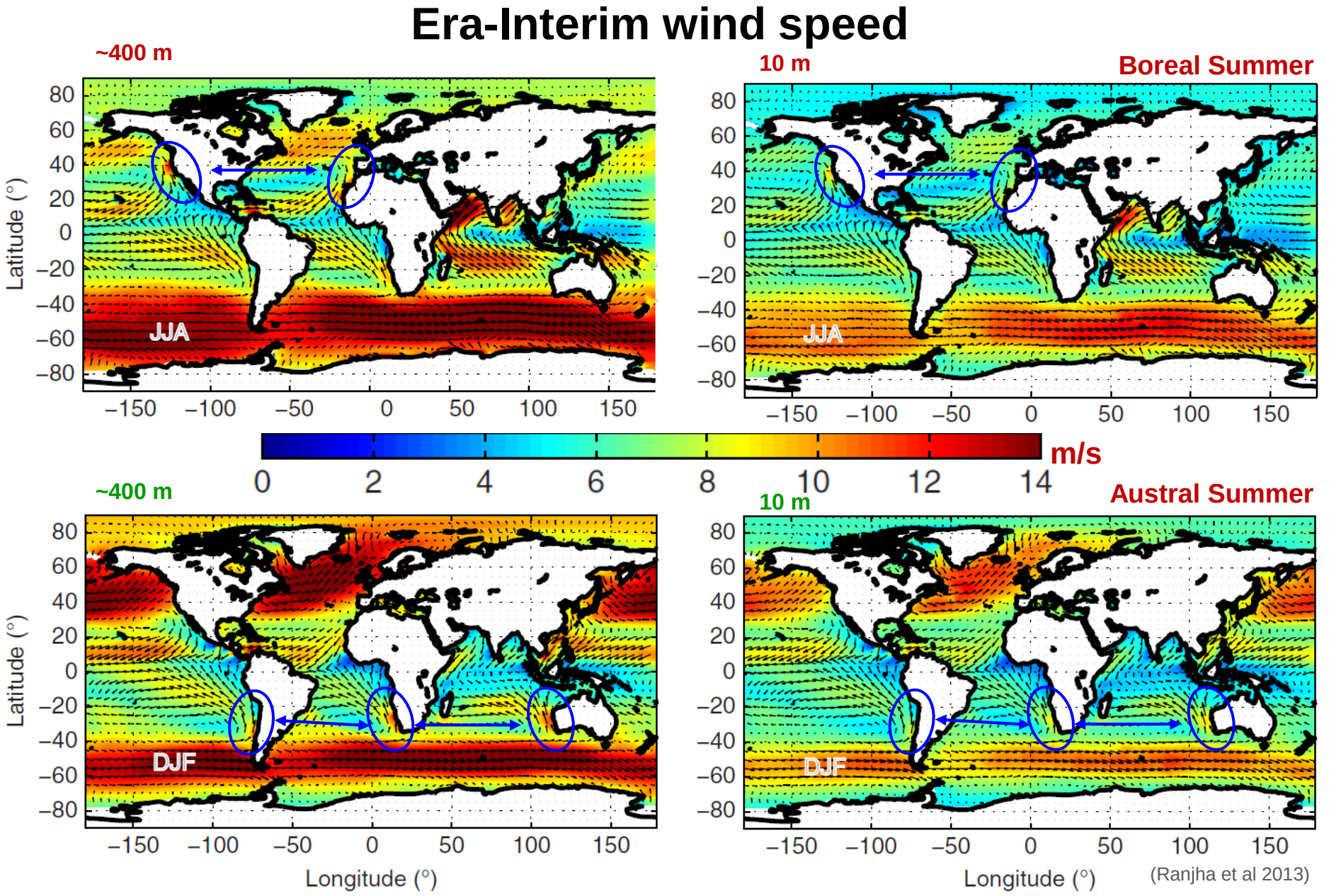
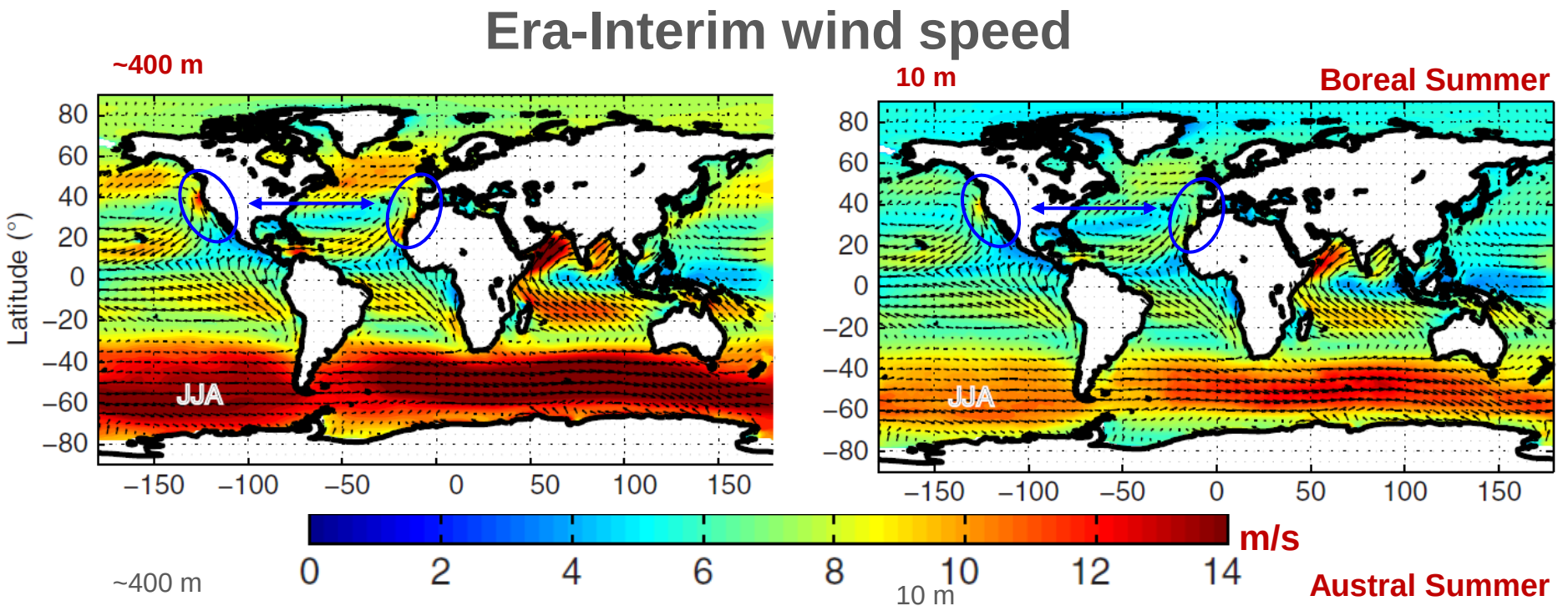
Looking at Global Wind

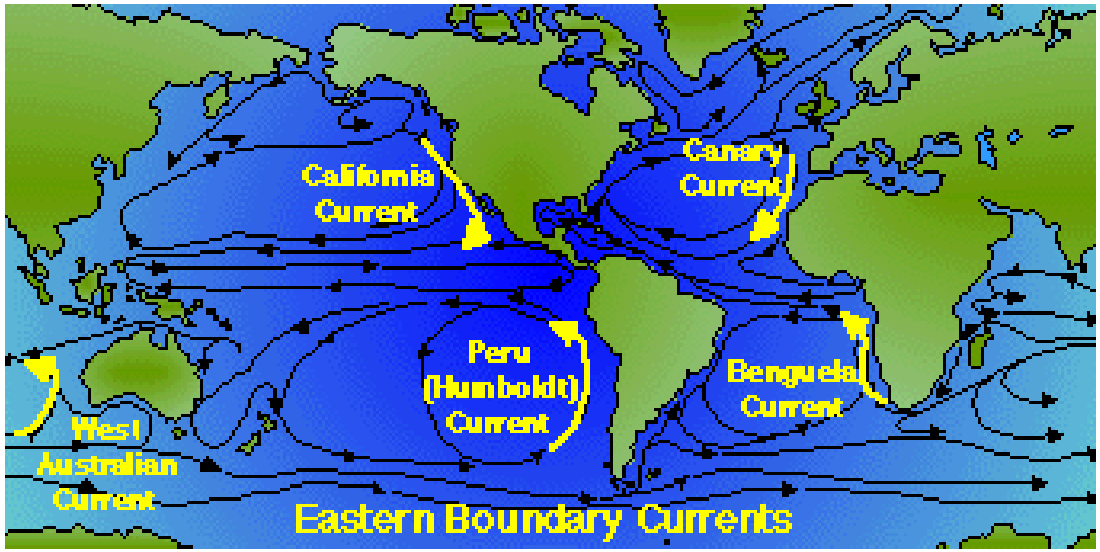


(Ranjha et al 2013)

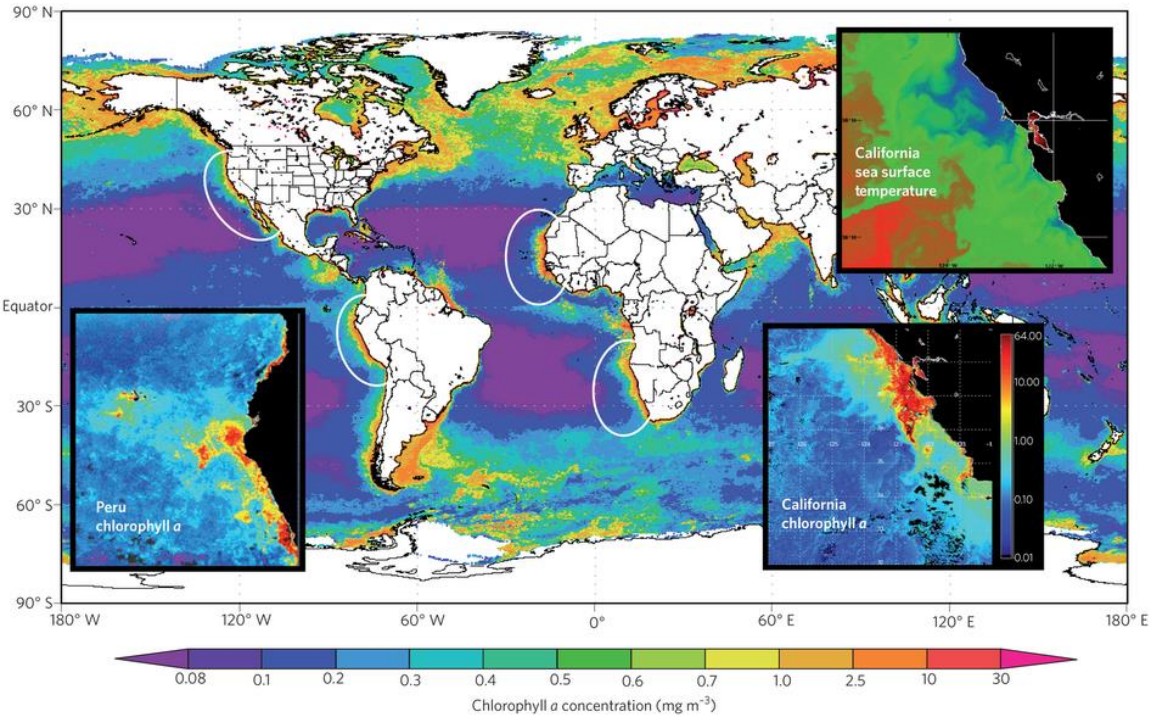
Looking at Global Wind



A coastal low-level jet (CLLJ) is a low-tropospheric mesoscale wind feature driven by the pressure gradient produced by a sharp contrast between high temperatures over land and lower temperatures over sea (Cross 2003)



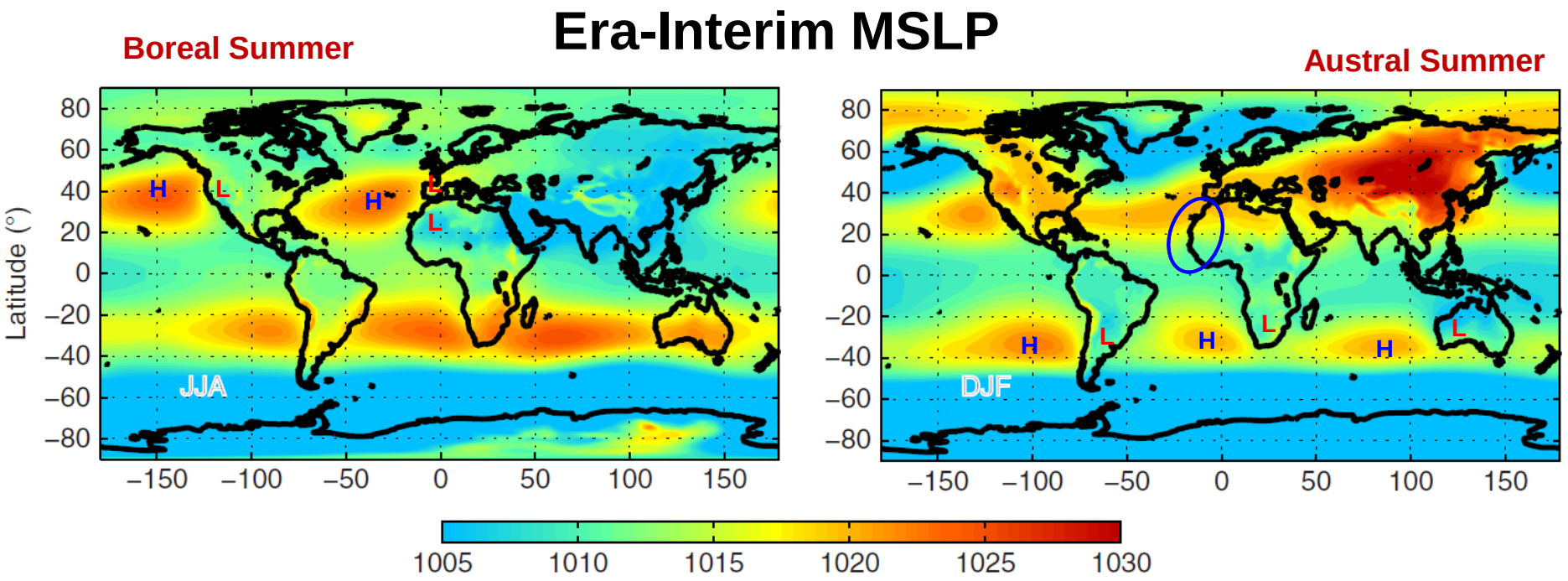
CLLJs occur in the eastern boundary current systems and play an important role in the regional climate



Coastal upwelling systems associated with eastern boundary currents are the most biologically productive ecosystems in the ocean

Capone and Hutchins (2013) Nature

Global pattern of MSLP



(Ranjha et al 2013)

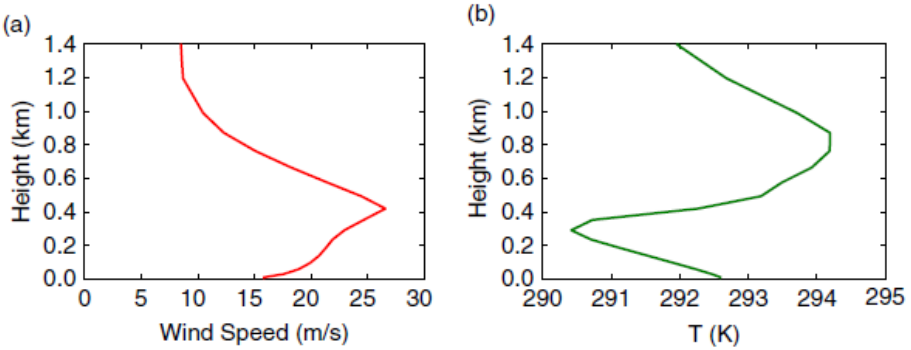
Main Ingredients

- Synoptic forcing: high pressure over the ocean and a thermal-low inland

  (coast parallel winds – geostrophic adjustment)
- Colder water at the coast (upwelling)
- Sharp thermal (pressure) gradient at the coast
- (Coastal topography)

Global CLLJ climatology

CLLJ= low level wind maxima + temp. Inversion



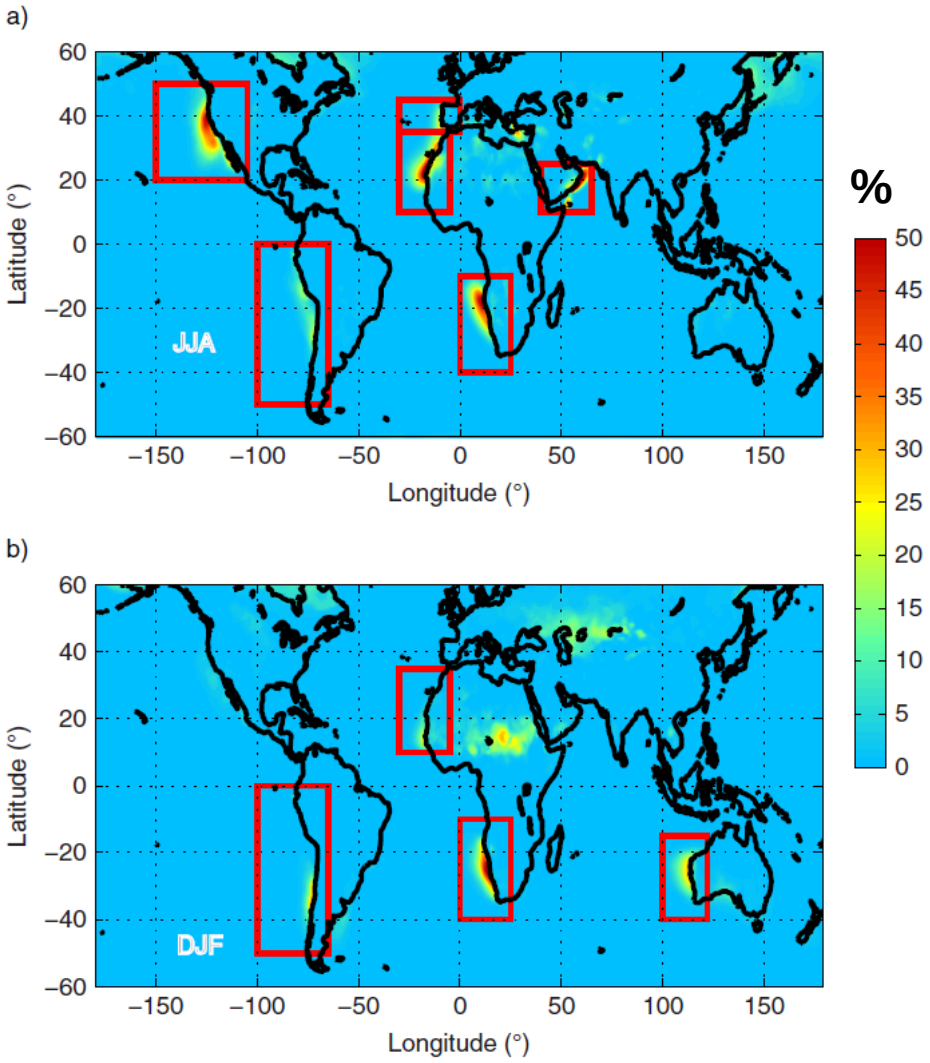
Detection criteria:

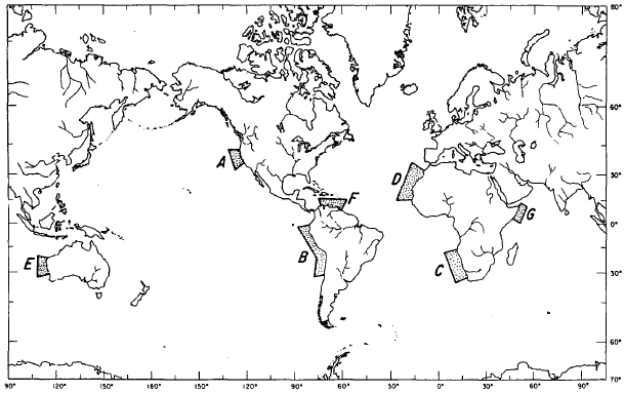
- The height of the jet maximum is within the lowest 1 km in the vertical;
- The wind speed at the jet maximum is at least 20% higher than the wind speed at the surface, and then decreases;
- The jet maximum occurs within the temperature inversion.

Ranjha et al. (2013)

biggest hurdle to use CMIP5 and CORDEX available data:
model levels data needed!!!!
high temporal sampling desired!!!

Global CLLJ climatology
ERA-Interim results





Winnant et al. 1988

6 areas of CLLJ “in agreement” with Winnant el al 1988:

North America (California)	NACJ
South America (Peru-Chile)	SACJ
Iberian Peninsula (Portugal-Spain)	IPCJ
North Africa (Morocco to Senegal)	NAFCJ
South Africa (Namibia to Angola)	SACJ
Australia	AUCJ
Arabian Peninsula (Oman)	APCJ

6-hourly

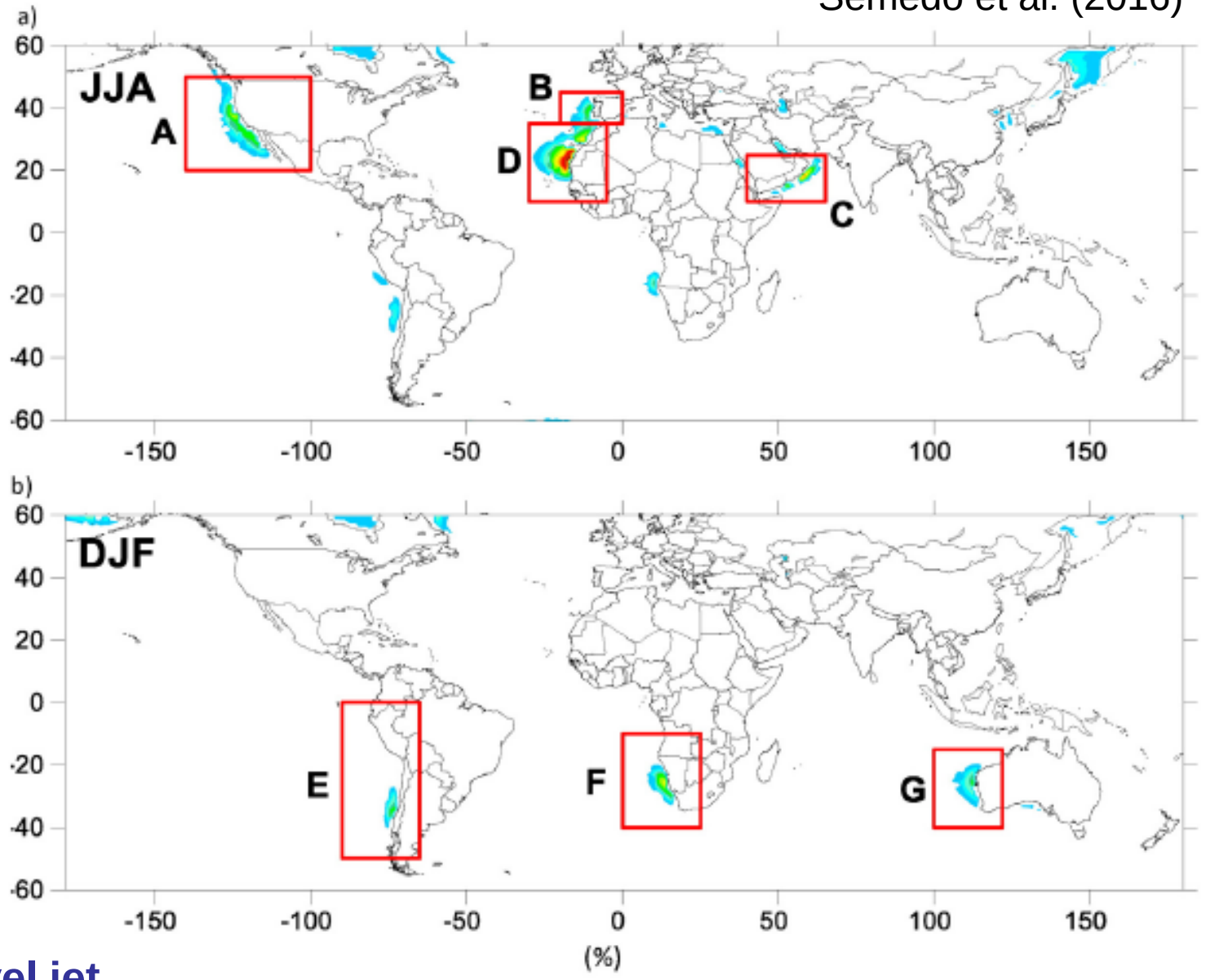
Ranjha et al. (2013)

EC-EARTH (2 members)

Semedo et al. (2016)

Present climate

1971-2000



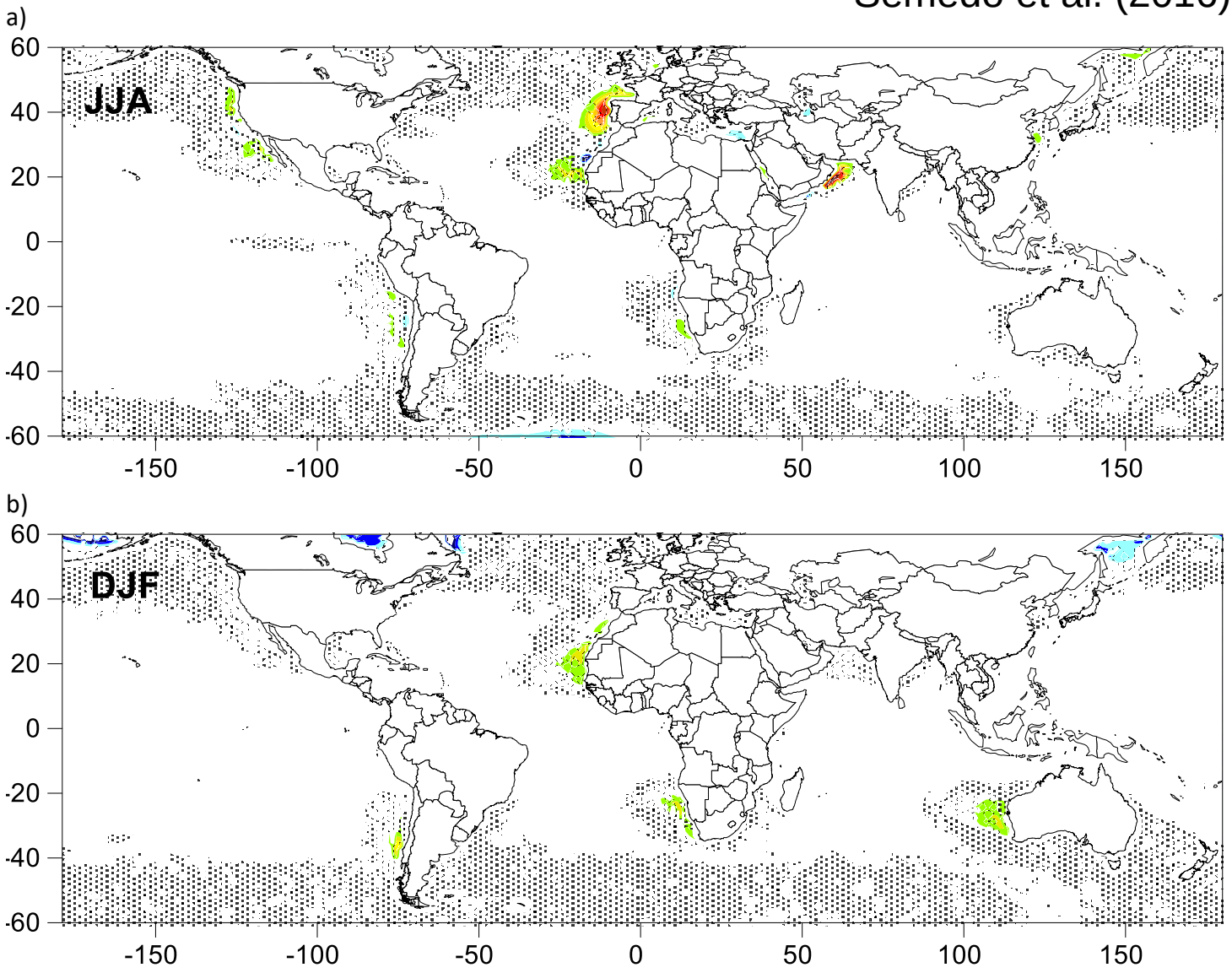
Coastal low-level jet frequency of occurrence

EC-EARTH (2 members)

Semedo et al. (2016)

Future climate RCP8.5

2071-2100 minus 1971-2000



CLLJ anomalies of the frequency of occurrence

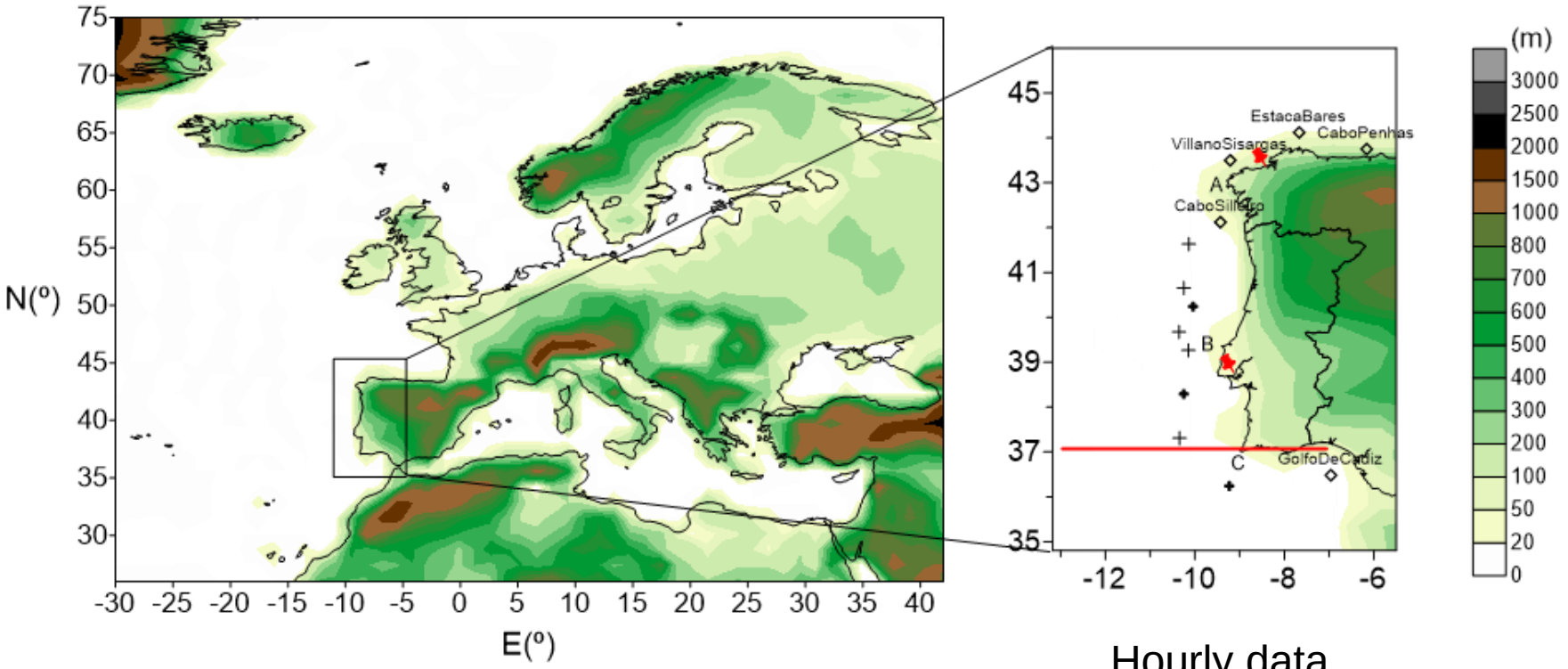
The Iberian Coastal Low-Level Wind Jet in present and future climate

Soares et al. (2014)
Cardoso et al. (2016)
Semedo et al. (2016)
Soares et al. (2016)

EURO-CORDEX (WRF at 50km)

Hindcast, present climate (1989-2008), forced by ERA-Interim

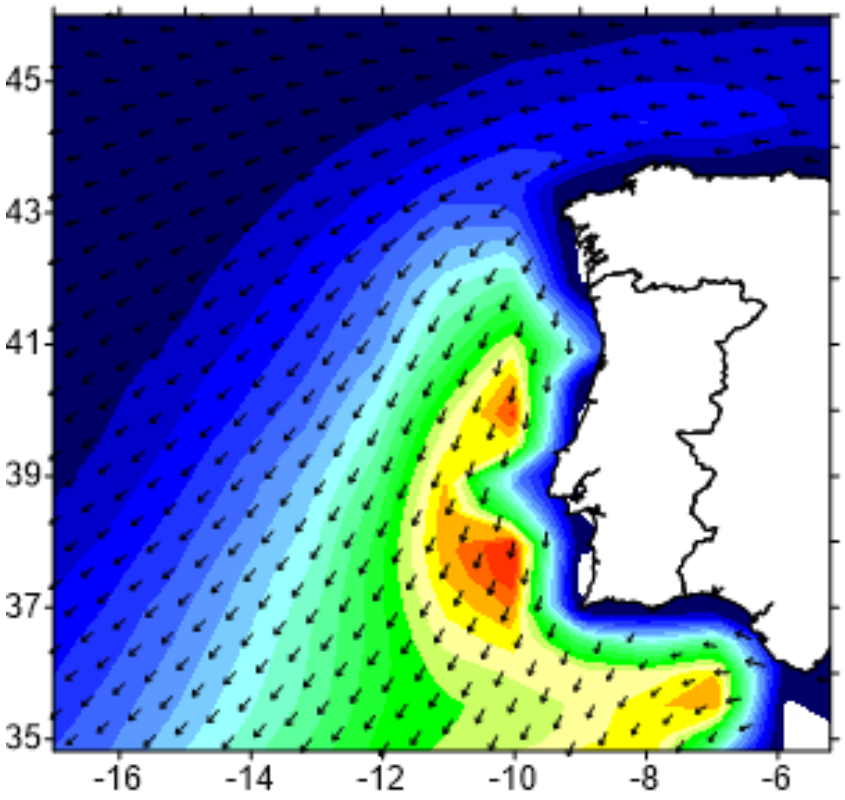
Climate projections: Historical (1971-2000) and RCP8.5 (2071-2100), both forced by EC-EARTH

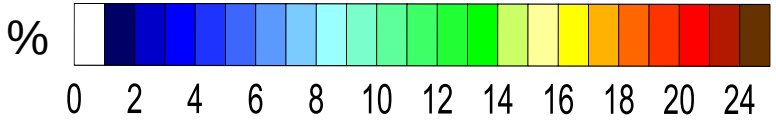


Hourly data

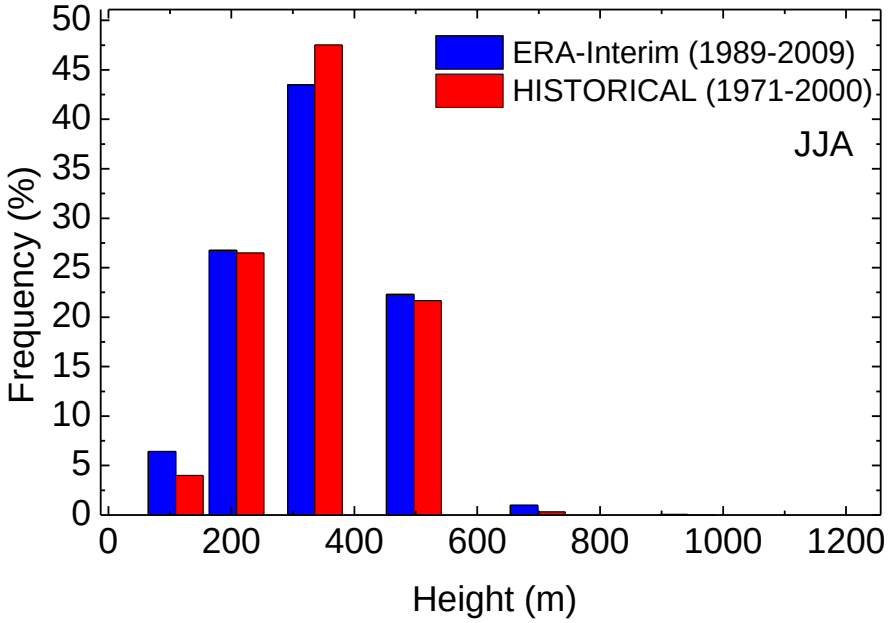
EURO-CORDEX (WRF at 50km) CLLJ results

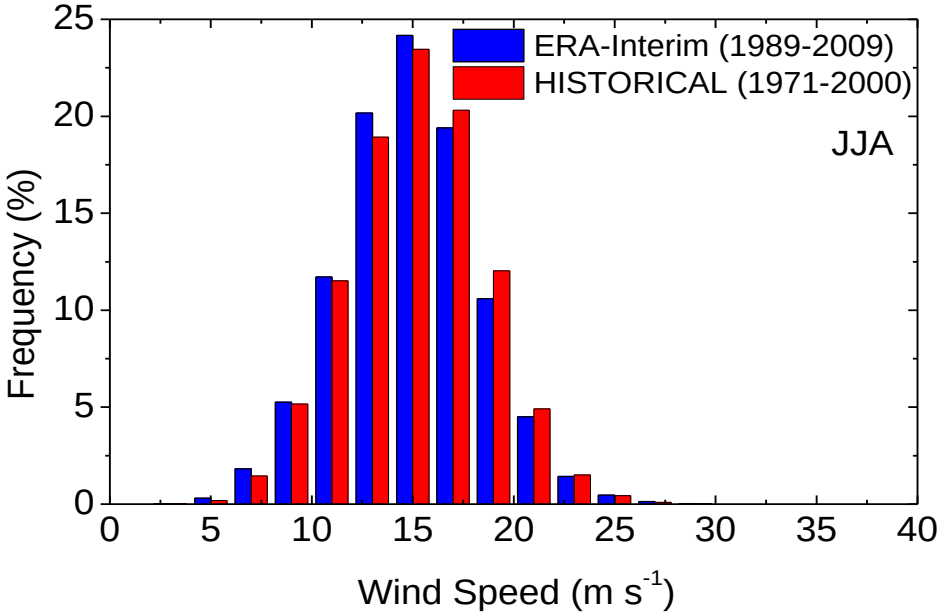
Present climate JJA





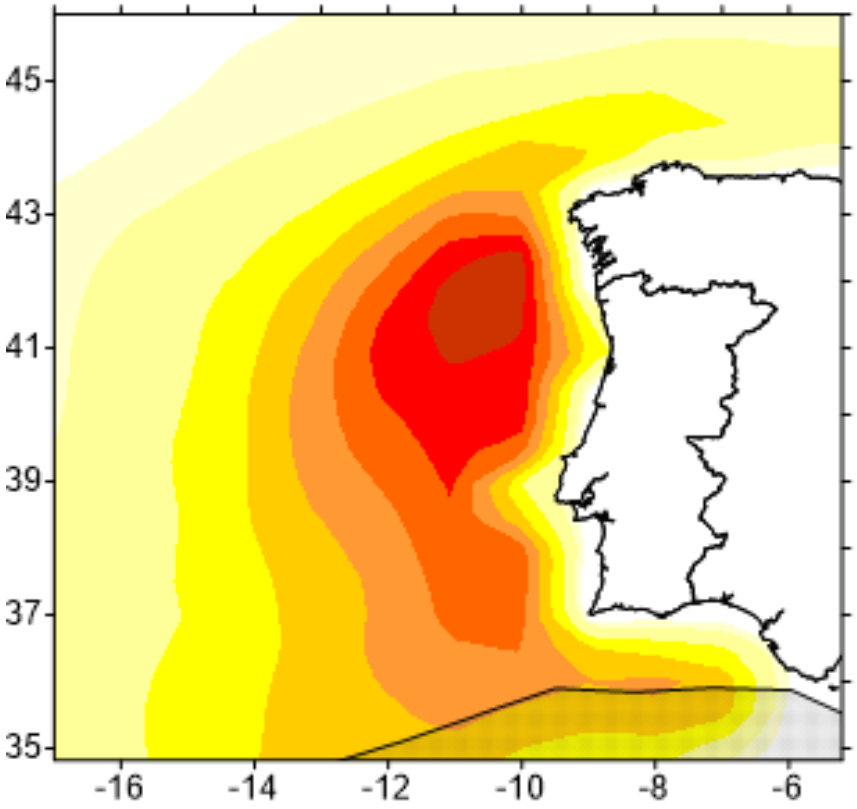
Coastal low-level jet frequency of occurrence

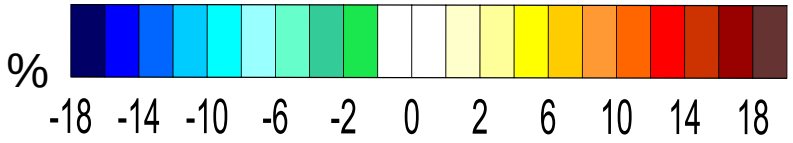




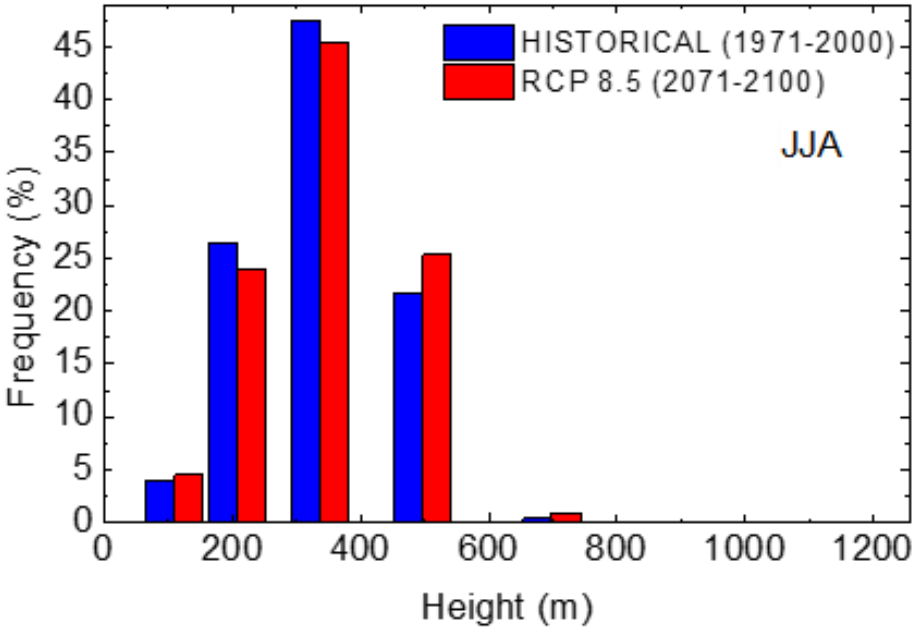
EURO-CORDEX (WRF at 50km) CLLJ results

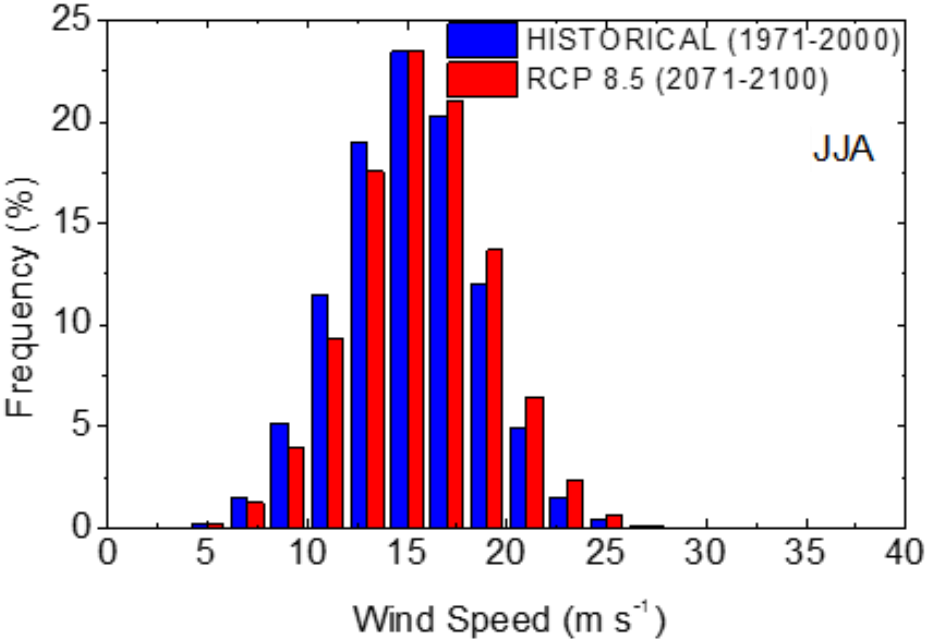
Future climate JJA





Anomalies of CLLJ frequency of occurrence

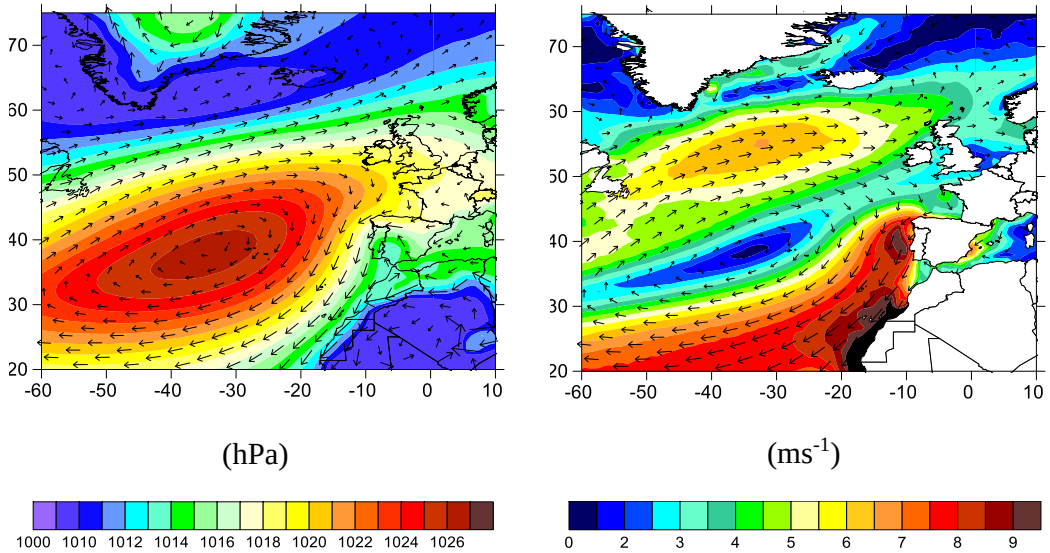




(a) Mean sea level pressure

(b) Geostrophic Wind

Future

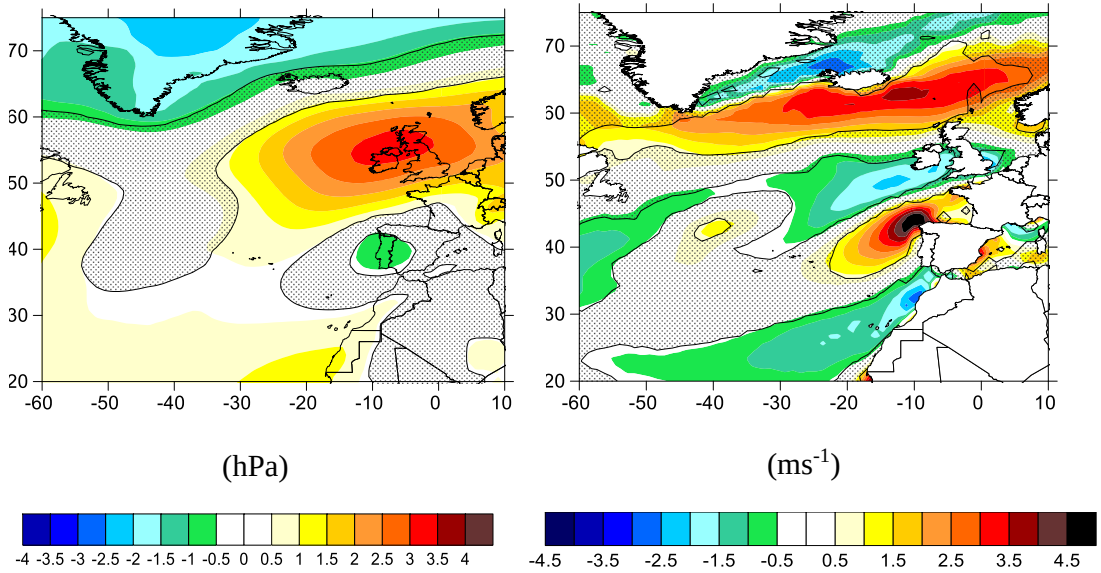


JJA (2071-2100)
MSLP
Wind speed at ~400m

(c) MSLP - anomalies

(d) Wind speed - anomalies

Anomaly (Future – Historical)



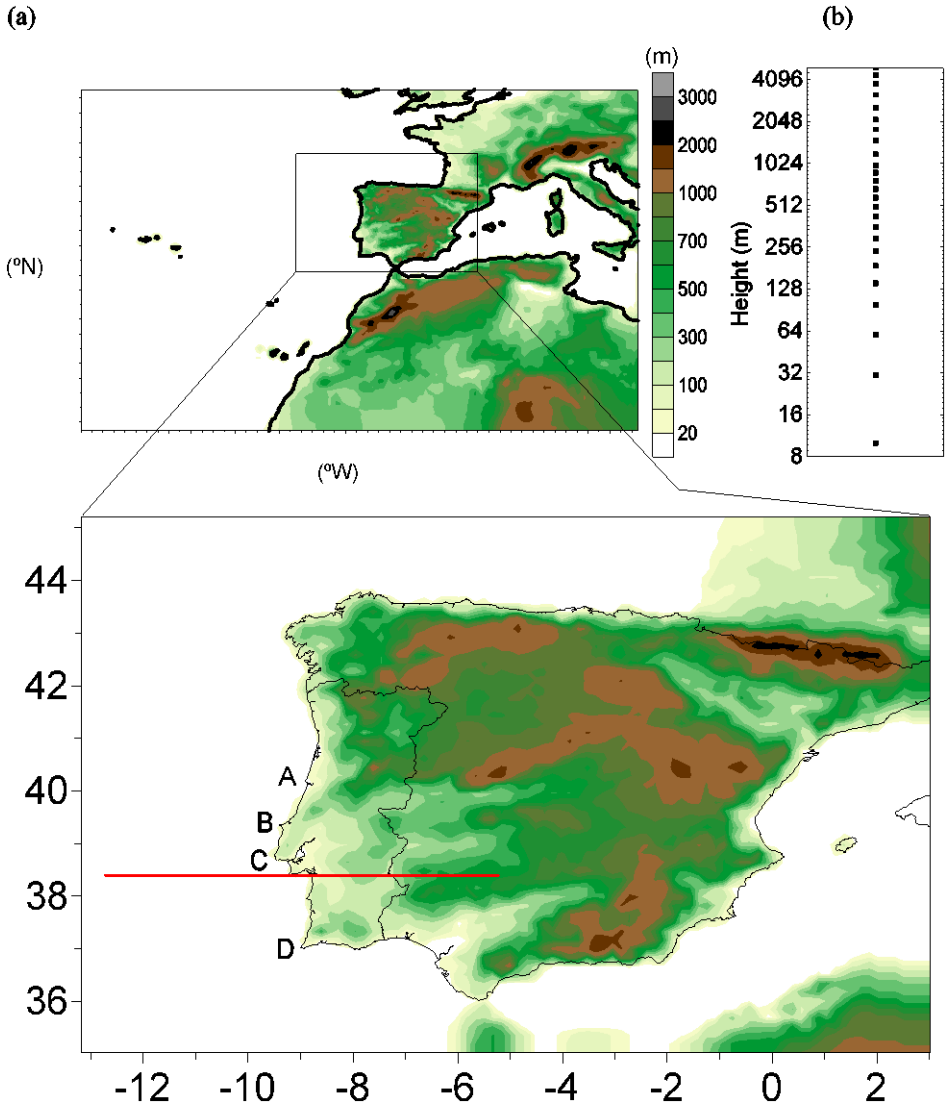
JJA anomalies against historic
MSLP
Wind speed at ~400m

Shaded grey areas are non statistically significant

Higher Resolution RCM (WRF at 27 and 9 km)

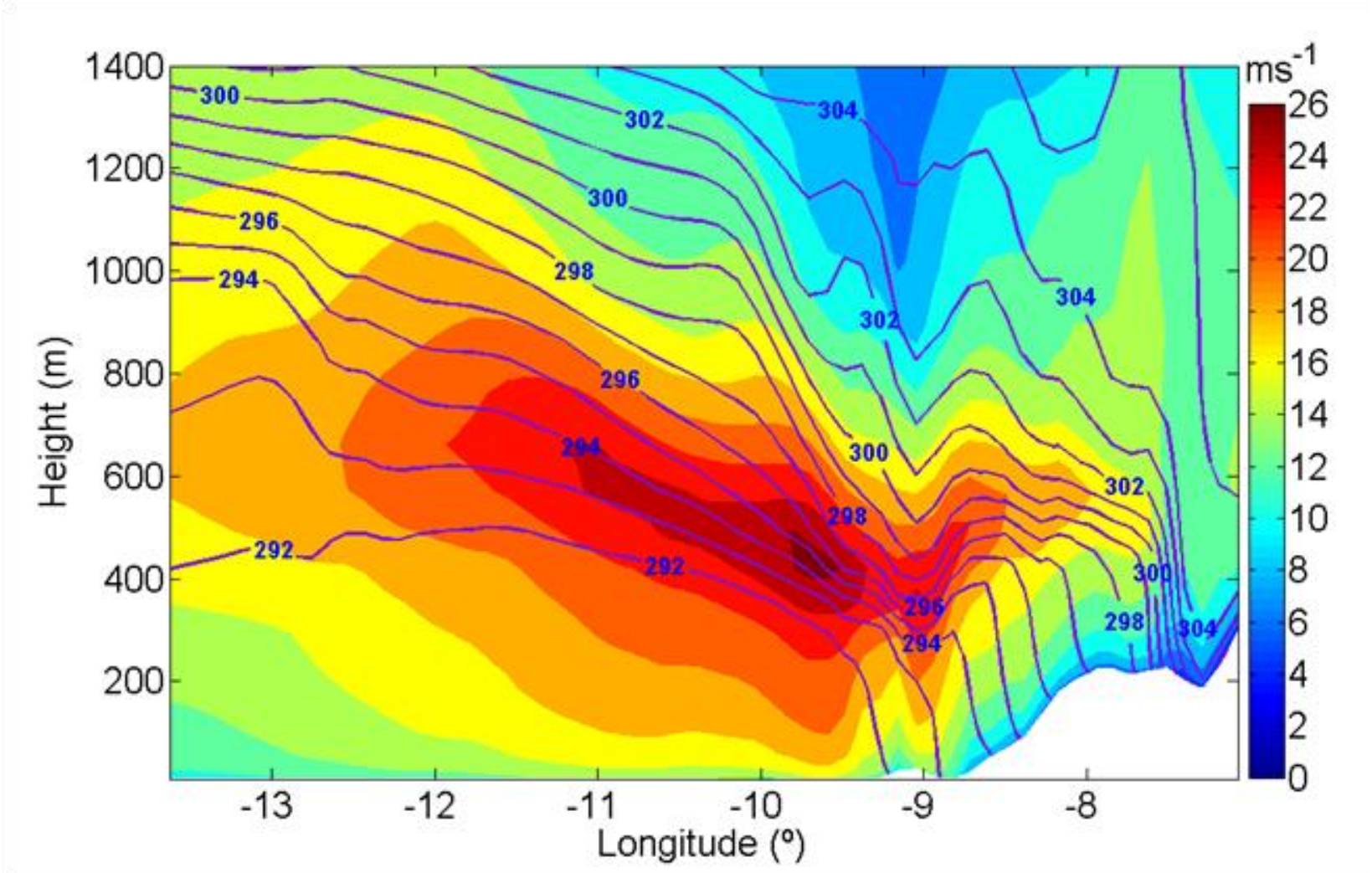
Present climate (1989-2008)
forced by ERA-Interim

Climate projections
Historical (1971-2000)
RCP8.5 (2071-2100)
forced by
EC-EARTH



Hourly data

Soares et al. (2014)



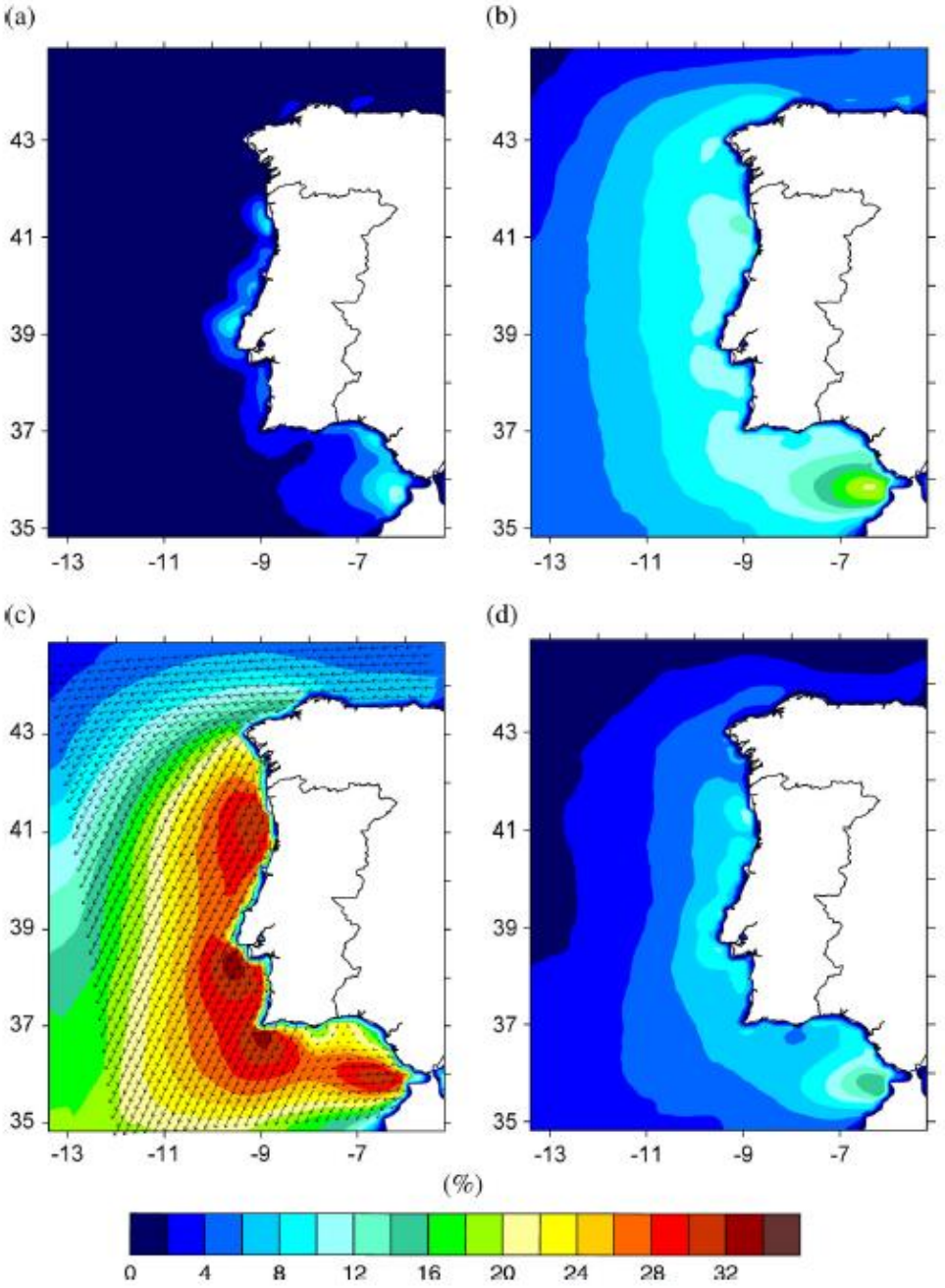
Vertical cross section of wind speed (ms^{-1}) and potential temperature (19 August 2007 at 2100LT)

Soares et al. (2014)

Iberian Peninsula CLLJ

Frequency of occurrence (%) (WRF 9 km)

Hindcast



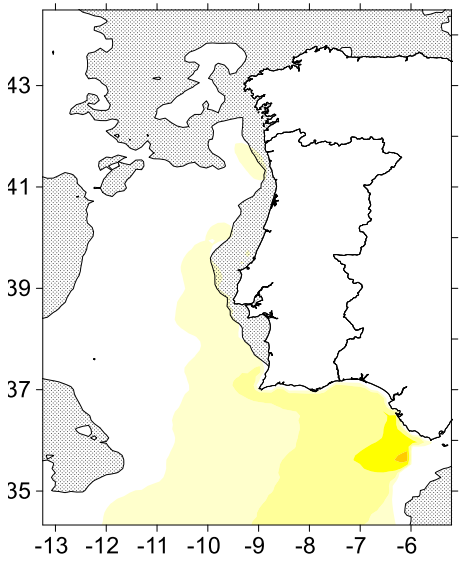
One in three days having IPCJ in JJA

Soares et al. (2014)

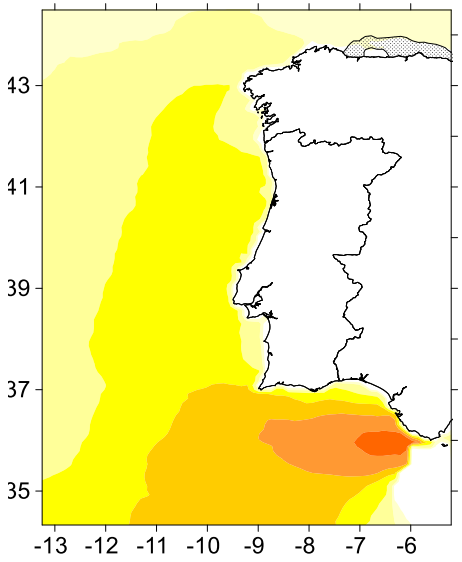
Future climate forced by EC-EARTH

Anomalies Future minus Historical

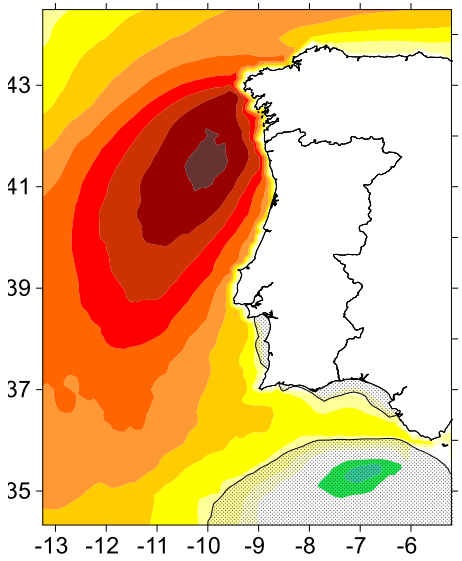
(e) DJF



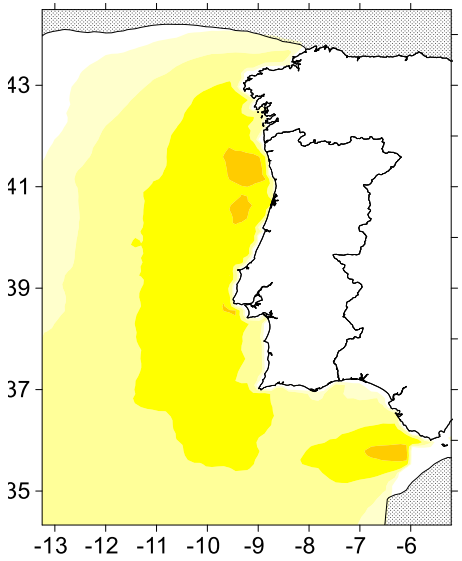
(f) MAM

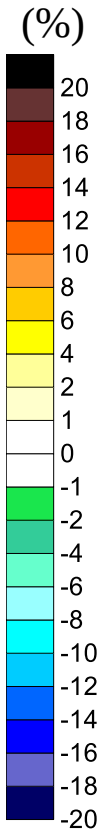


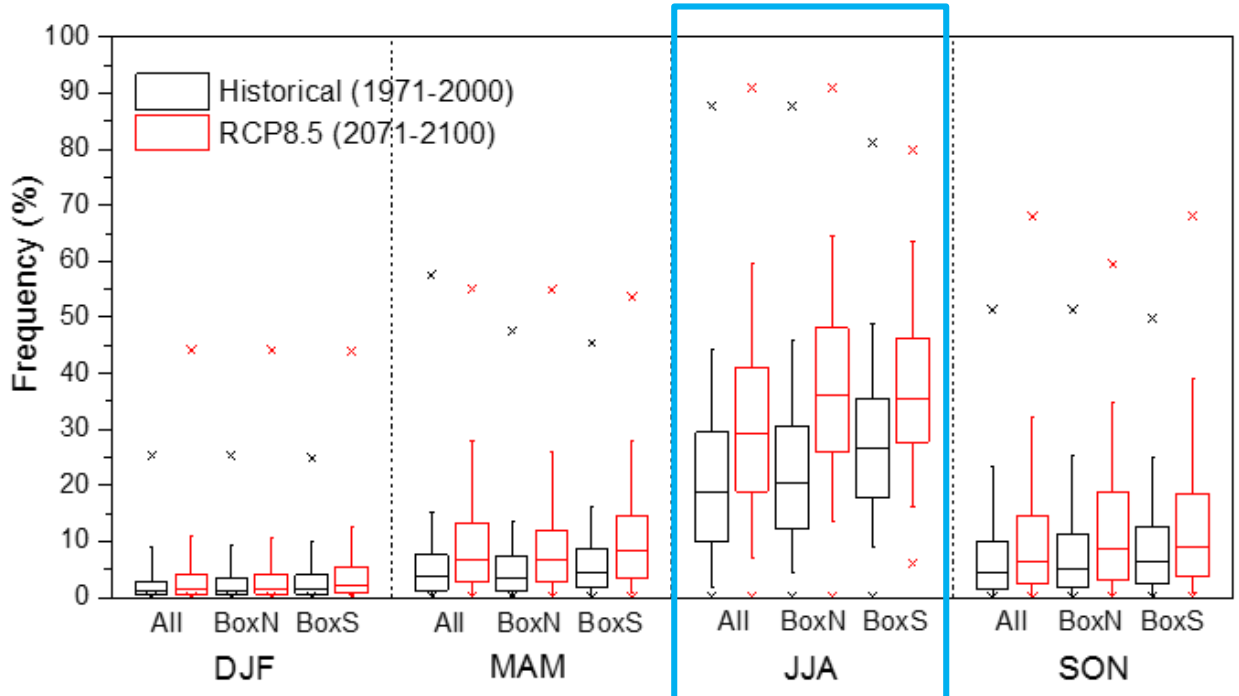
(g) JJA

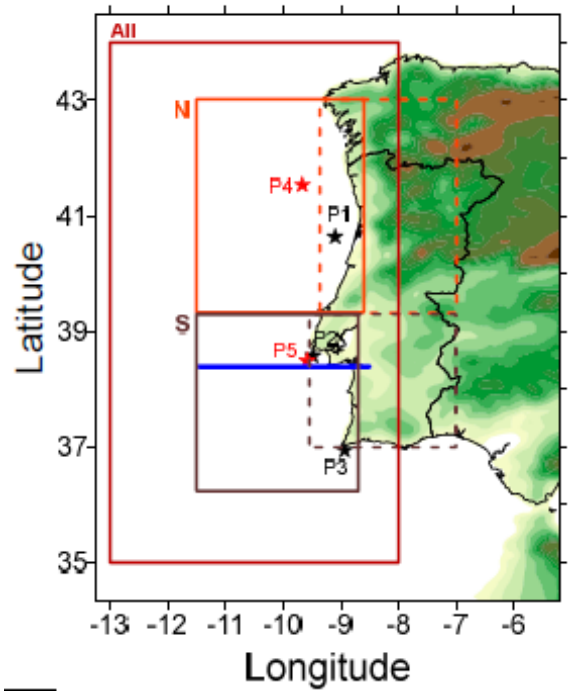


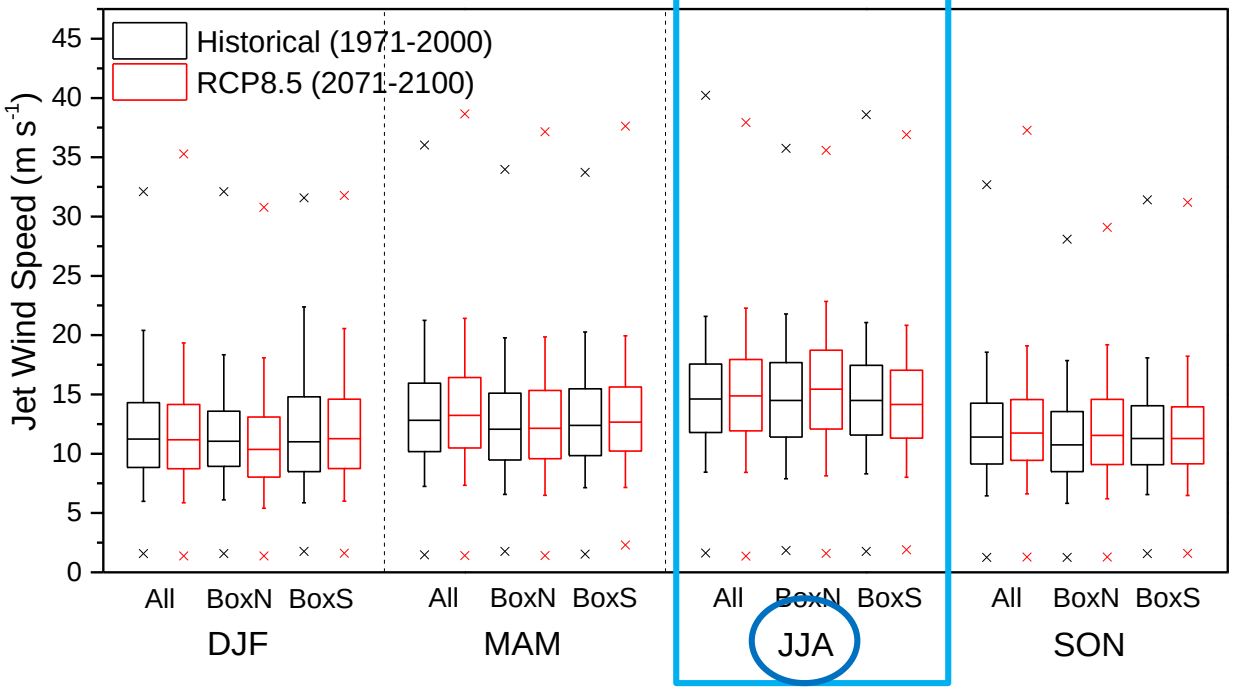
(h) SON











Changes in frequency of occurrence and wind speed

Summary

- An increase of the CLLJ occurrence along the Iberian is expected for future climate
- This augment seems to apply to other NH CLLJs
- High resolution matters
- Multi-model ensembles with model levels information are crucial for extending this study to other regions and to assess the associated uncertainty

Thank you!