

A satellite image of Earth showing a coastline and the ocean. The land is brown and rugged, with a dark blue shadow cast by the terrain. The ocean is a deep blue with white clouds scattered across it. The title text is overlaid on the top part of the image.

El régimen de viento costero en escenarios de cambio climático global

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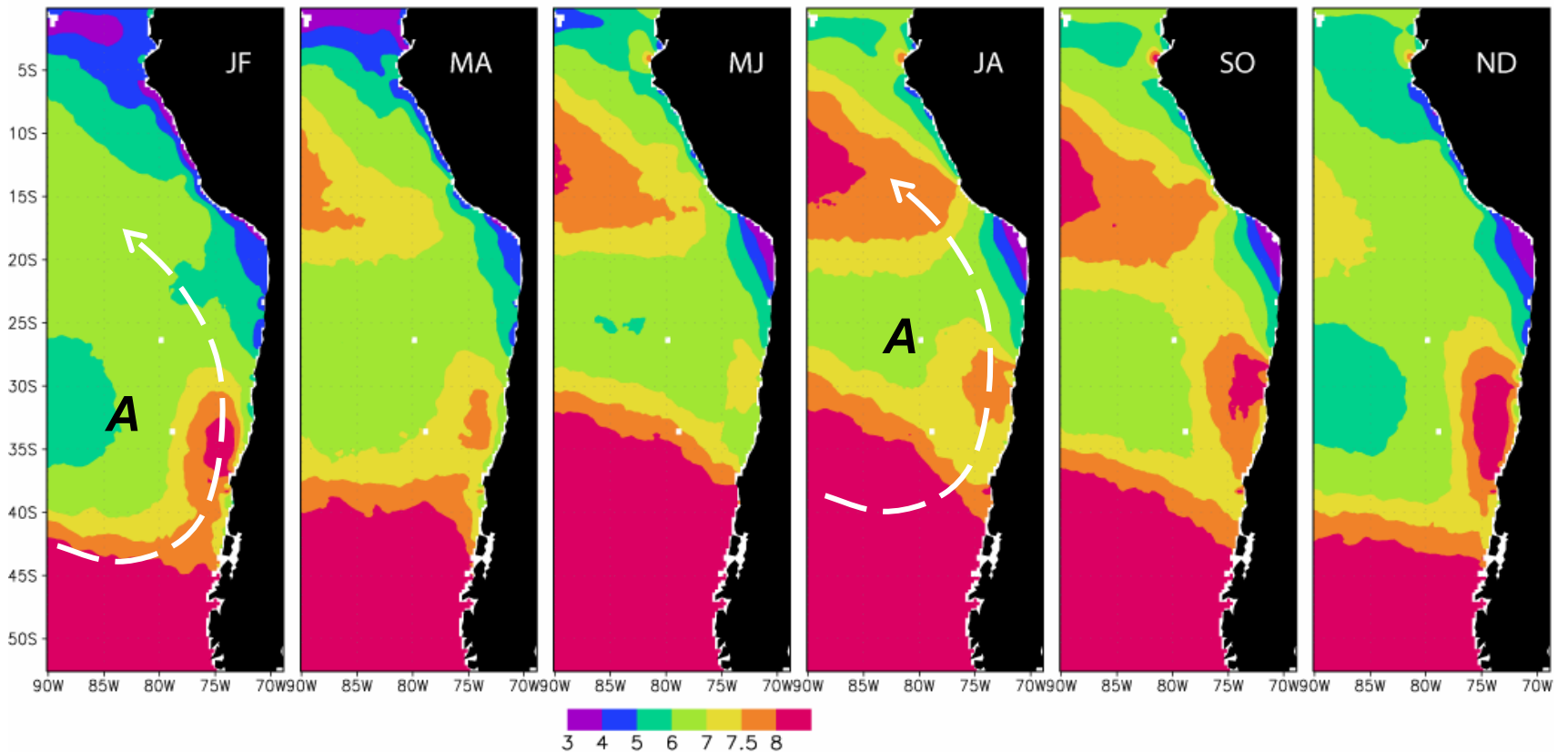
Seminario CONA-UNAB, 27 Agosto 2009

Programa

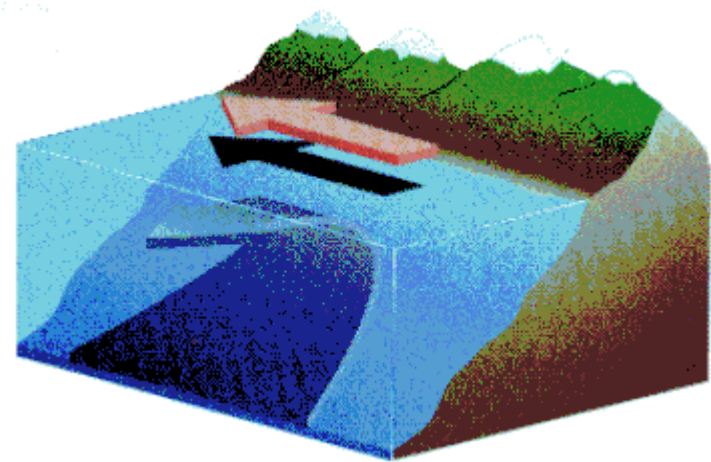
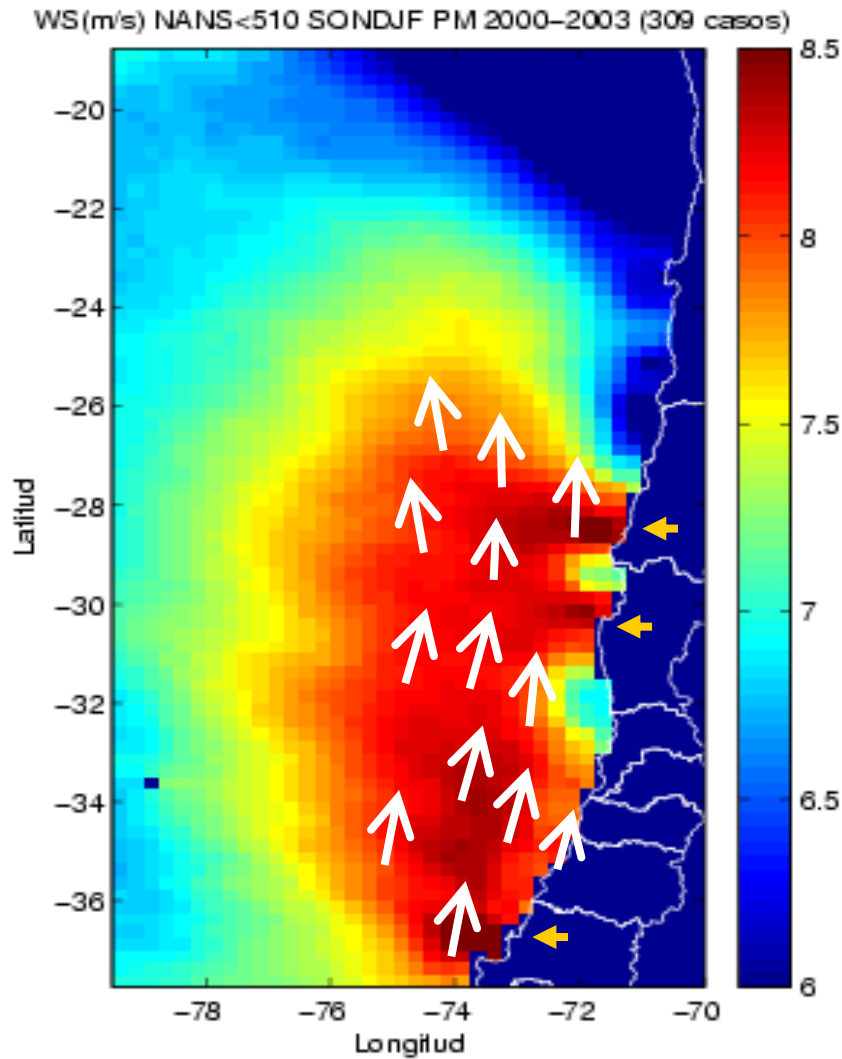
- El regimen de vientos a lo largo de la costa de Chile
- Clima futuro en base a modelos globales
- Clima futuro en base a PRECIS (modelo regional)
- Esta ocurriendo el cambio de clima costero?

Observacions I. Campo de Viento en Sfc

QuikScat surface wind speed climatology (2000–2005)

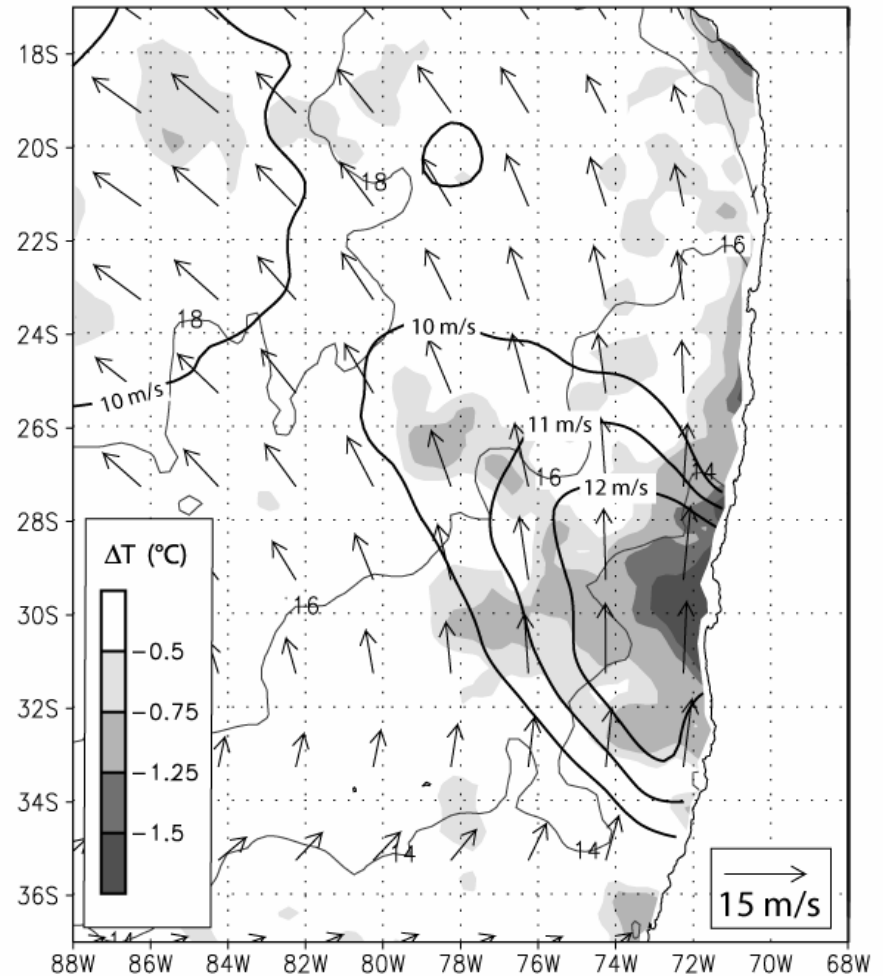
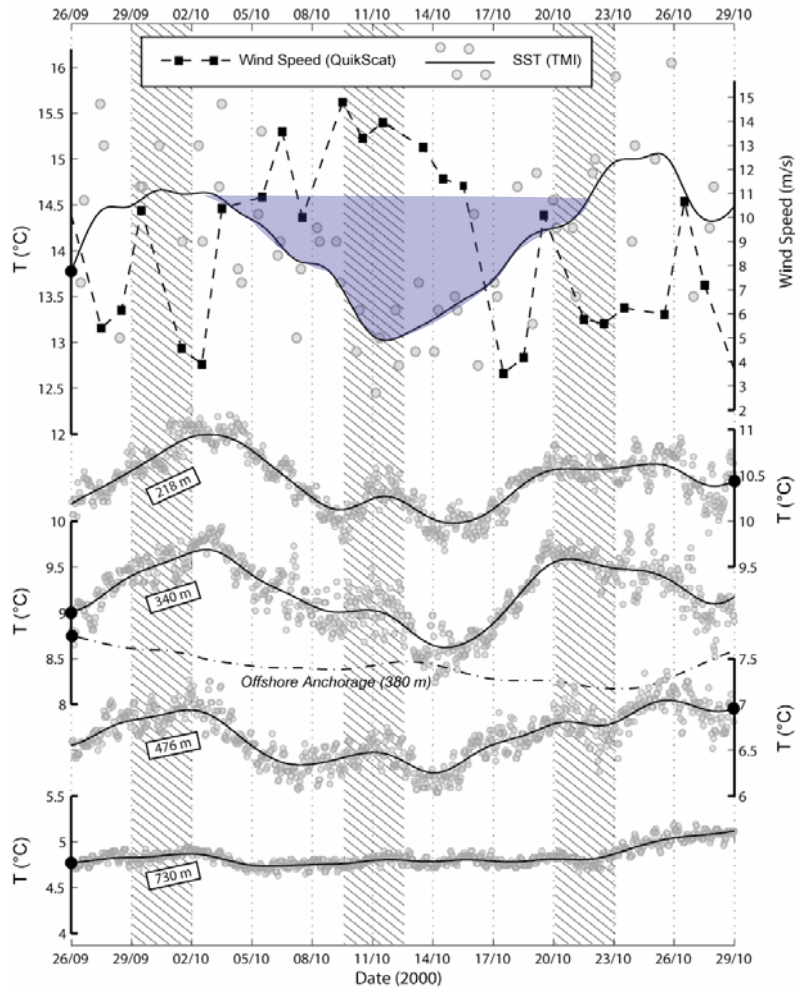


Observaciones II: Chorro Costero y Surgencia



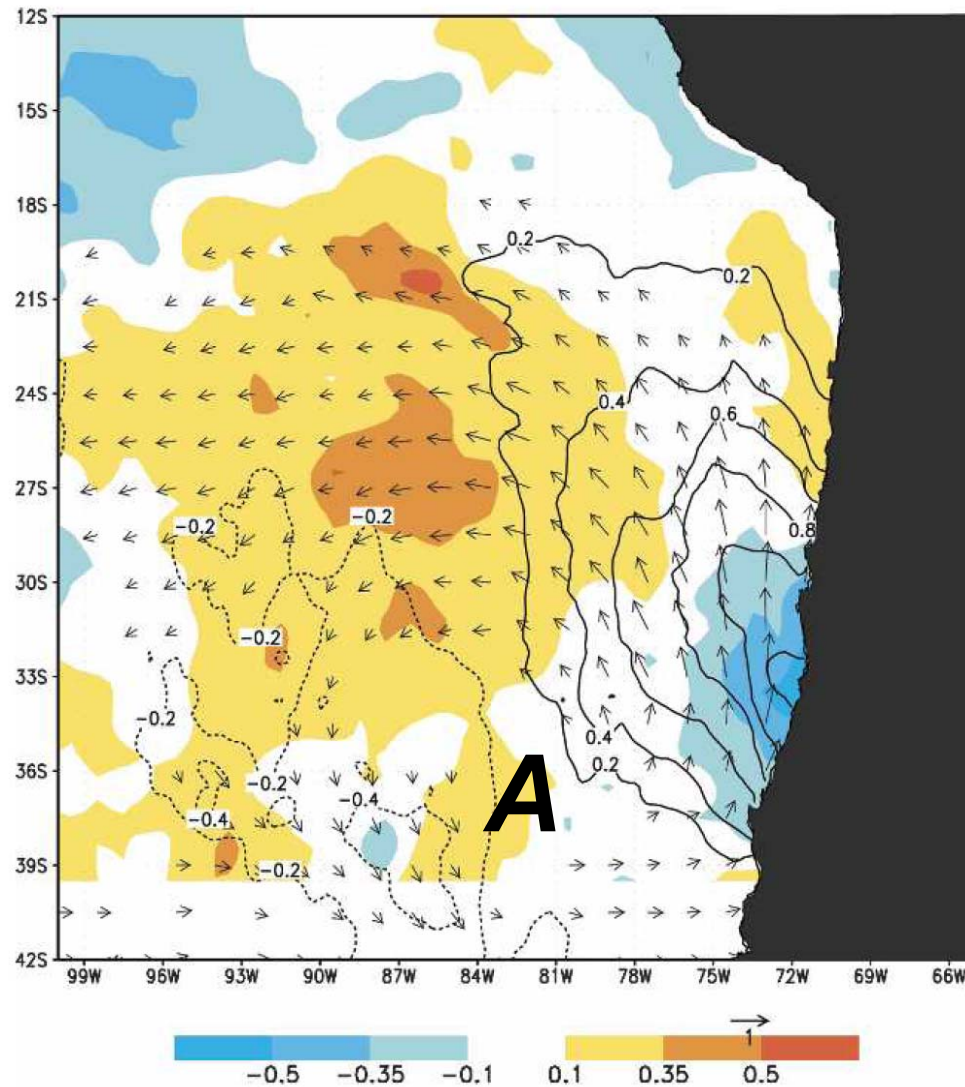
Observaciones III

Chorro Costero y Surgencia



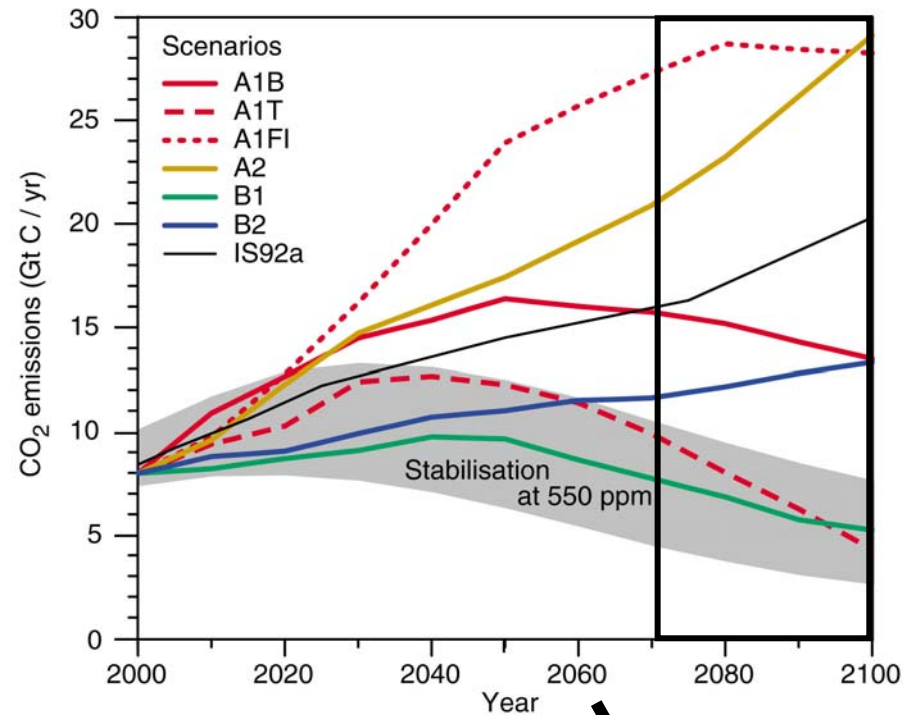
Observacions IV.

Forzante sinóptico del chorro costero

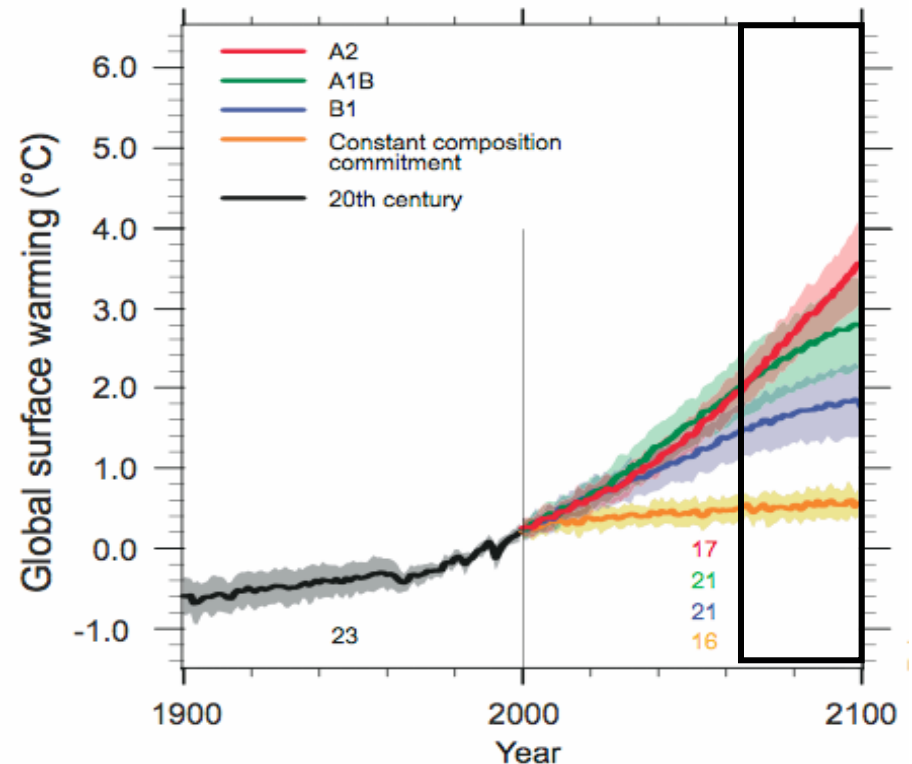


Future Climate Scenarios

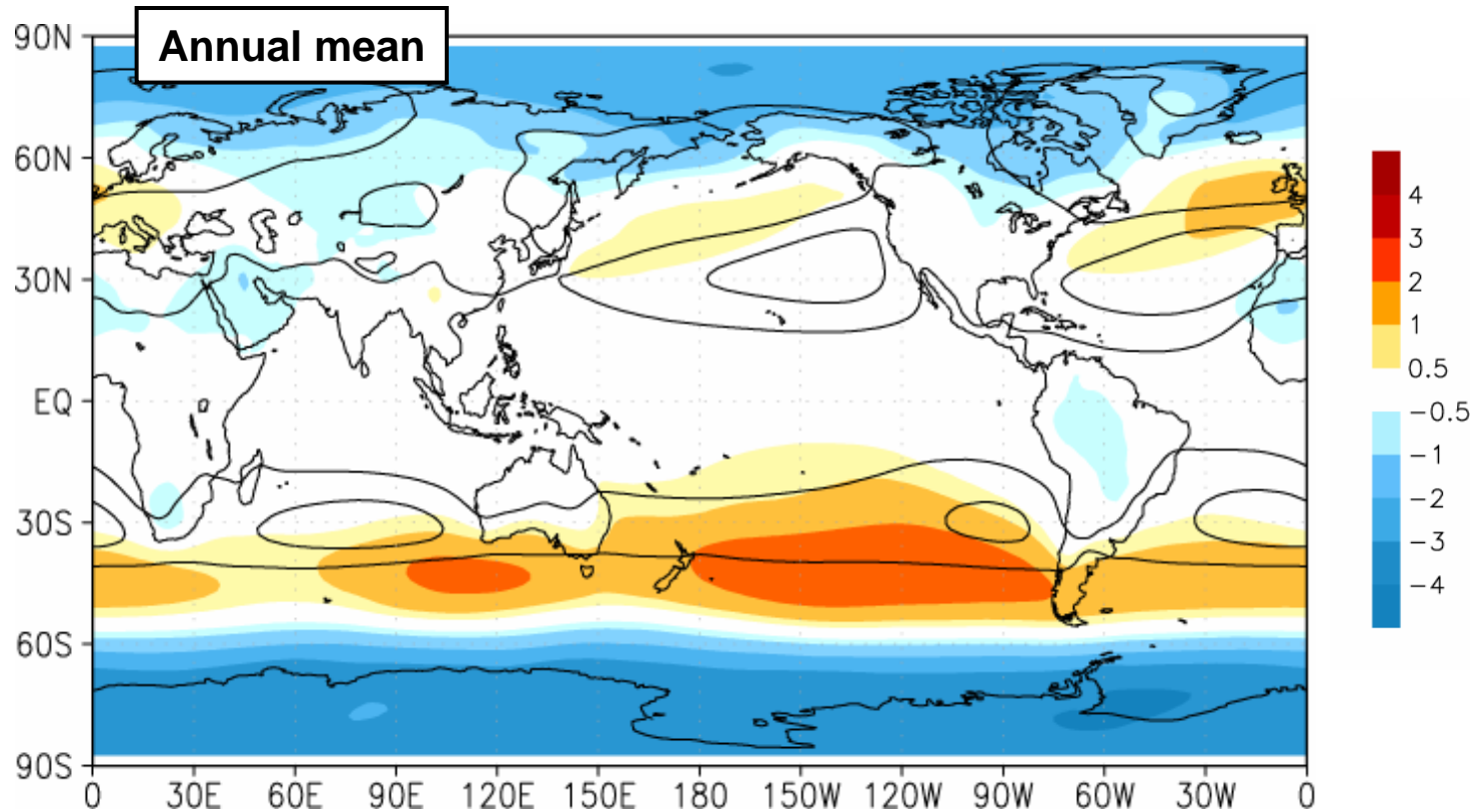
GHG (CO₂,...) emissions projections + GCMs



20+ GCMs
CMIP3/IPCC AR4

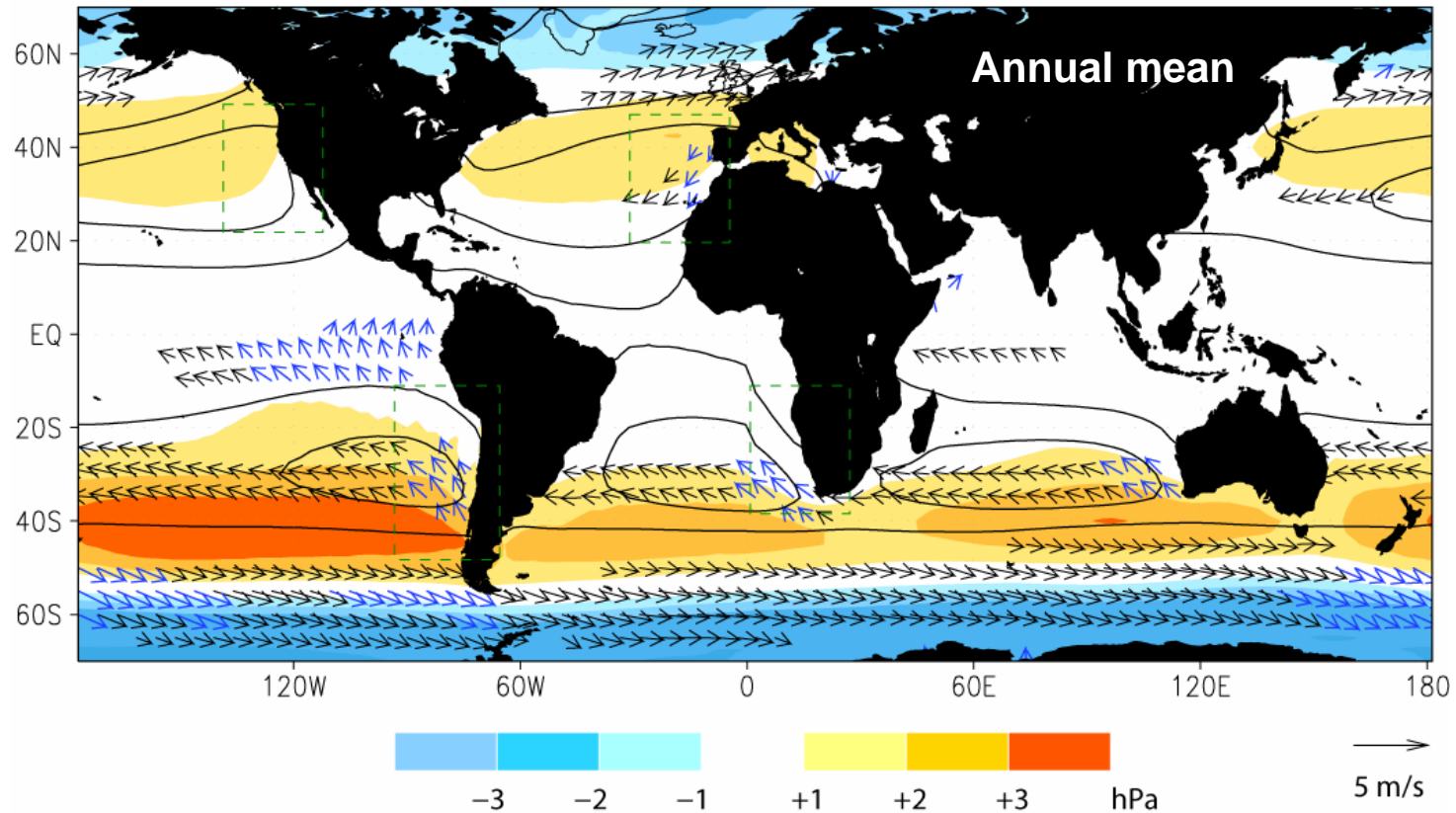


Multimodel average SLP difference between A2 (2070-2100) and BL (1970-2000)



Strengthening of the poleward flank of subtropical anticyclones and poleward shift of the midlatitude storm track is very consistent among GCMs

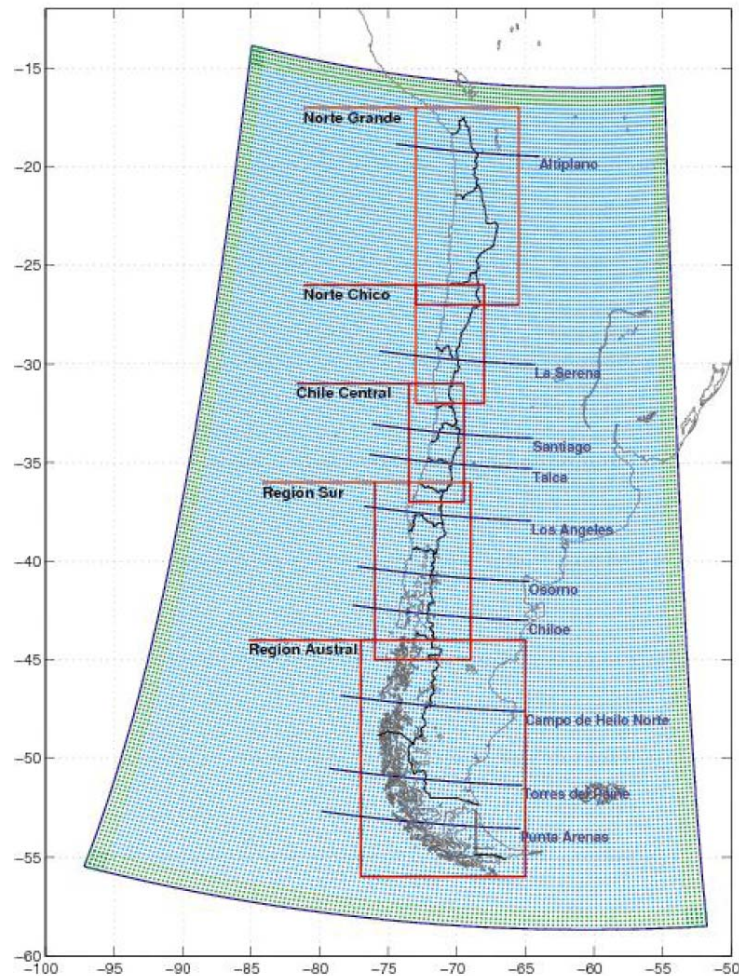
Multimodel average SLP and sfc wind difference between A2 (2070-2100) and BL (1970-2000)



Over open ocean Δv in geostrophic balance with ΔSLP .
Near the coast Δv more controlled by along-coast ΔSLP

PRECIS Results

PRECIS (Providing REGIONAL Climates for Impact Studies)
(Hadley Centre UK MetOffice RCM)



Single domain

- Horiz. grid spacing. 25 km
- 19 vertical levels
- Lateral BC: HadAM every 6h
- Sfc. BC: HadISST1 + Linear trend

Simulations

- 1961-1990 Baseline
- 2071-2100 SRES A2 y B2
- 30 years @ 3 min → 4 months per simulation in fast PC

Why?

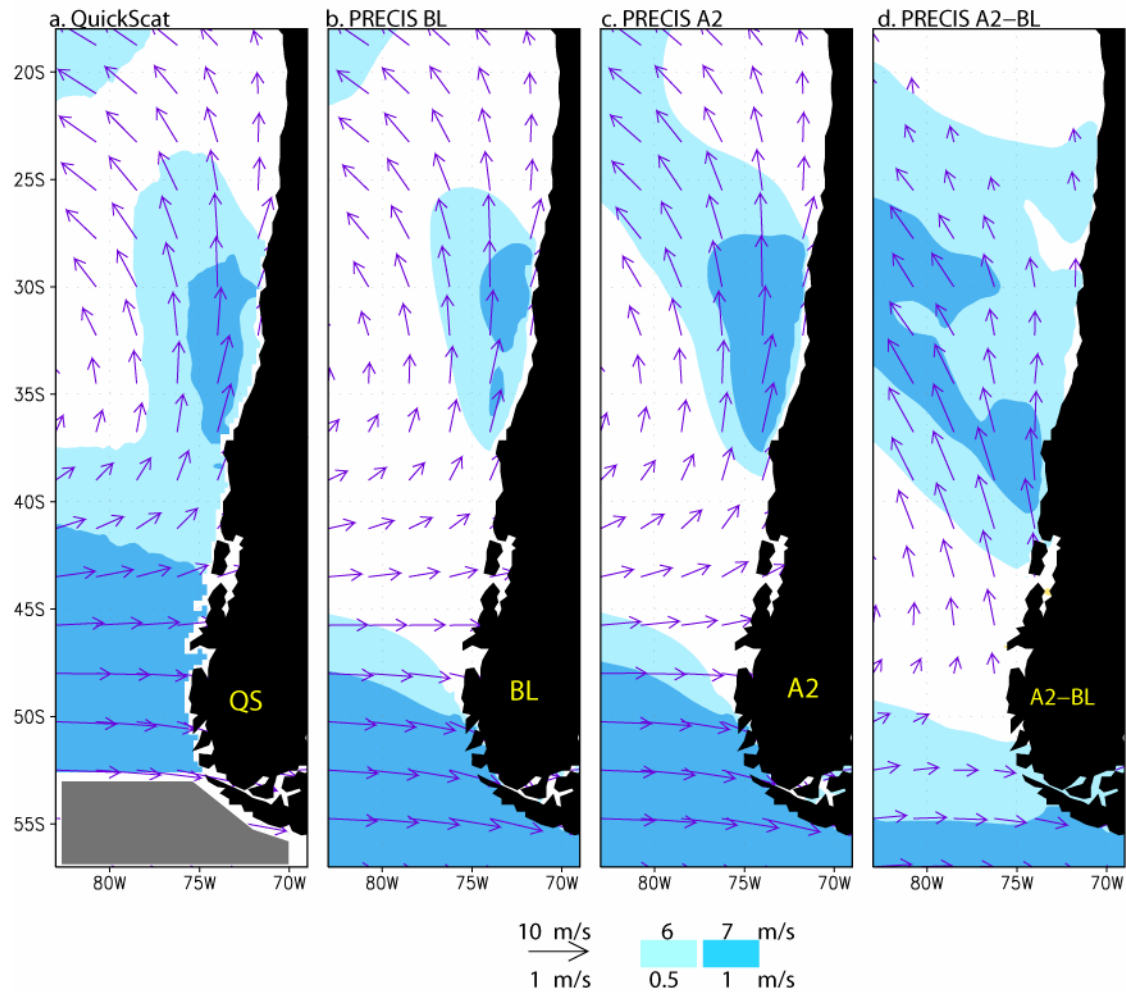
- CONAMA (Chile) needed results in 9 months

Where?

<http://www.dgf.uchile.cl/PRECIS>

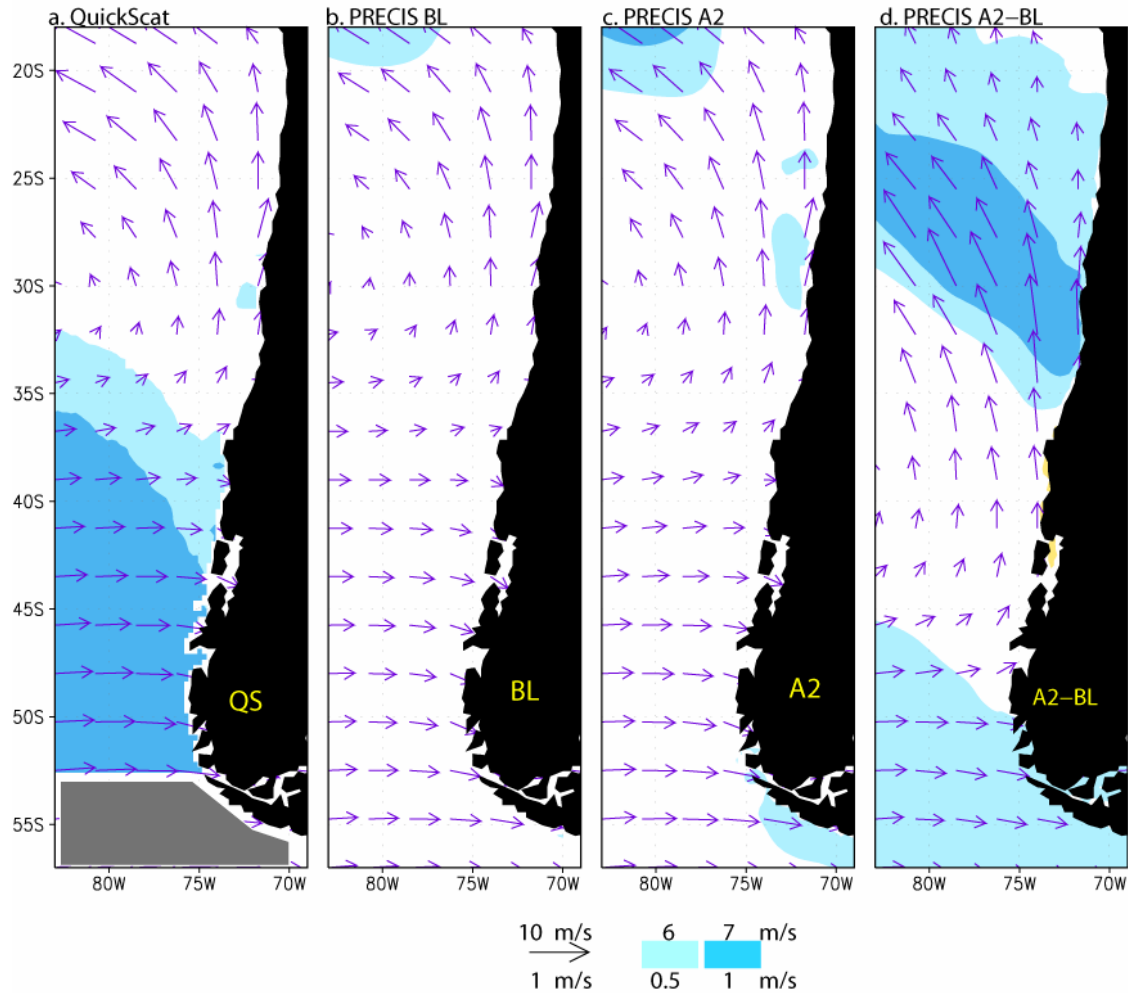
PRECIS Results

Surface Wind – SONDJ



PRECIS Results

Surface Wind – AMJJA



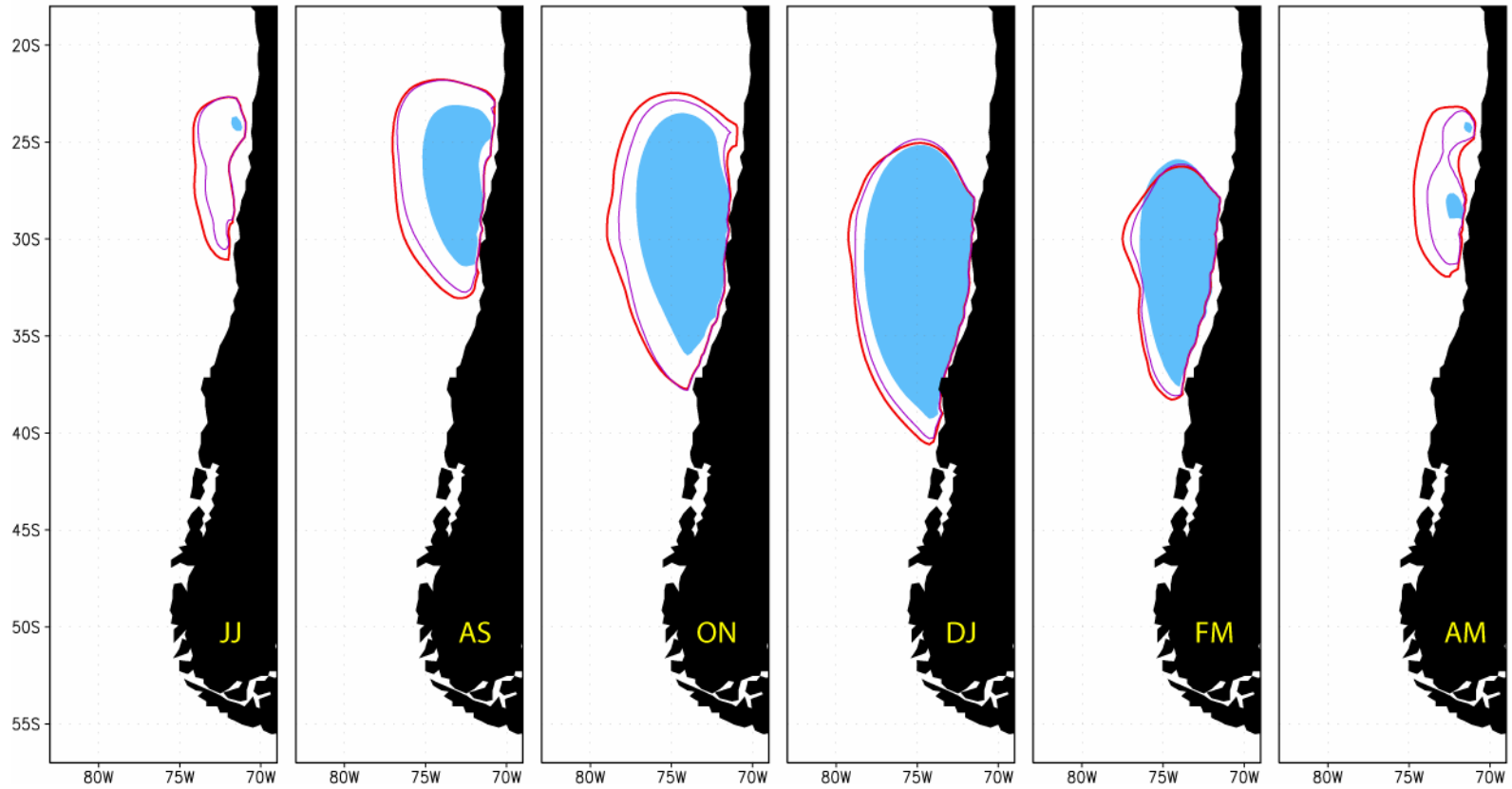
PRECIS Results

10-m Meridional wind – Outlines of $v > 6$ m/s

Baseline (1960–1990)

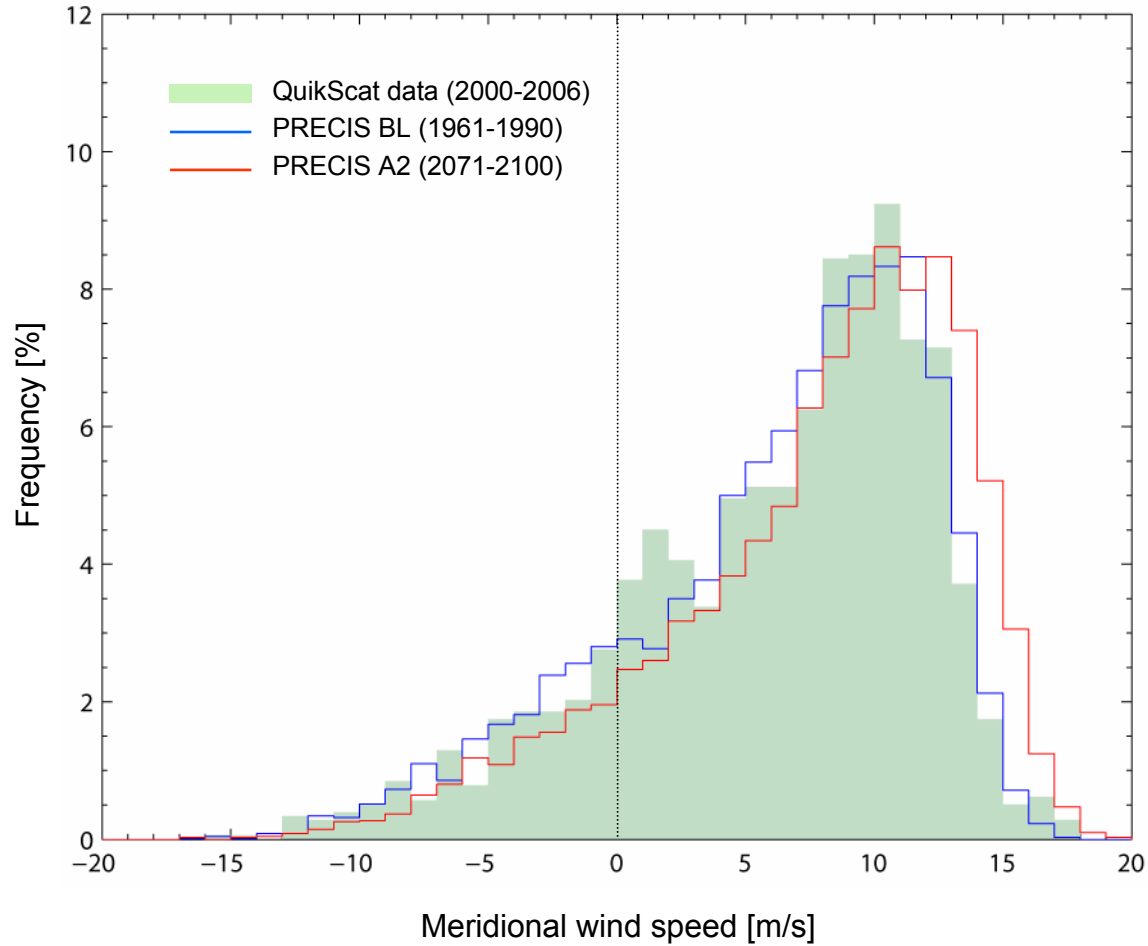
B2 (2070–2100)

A2 (2070–2100)

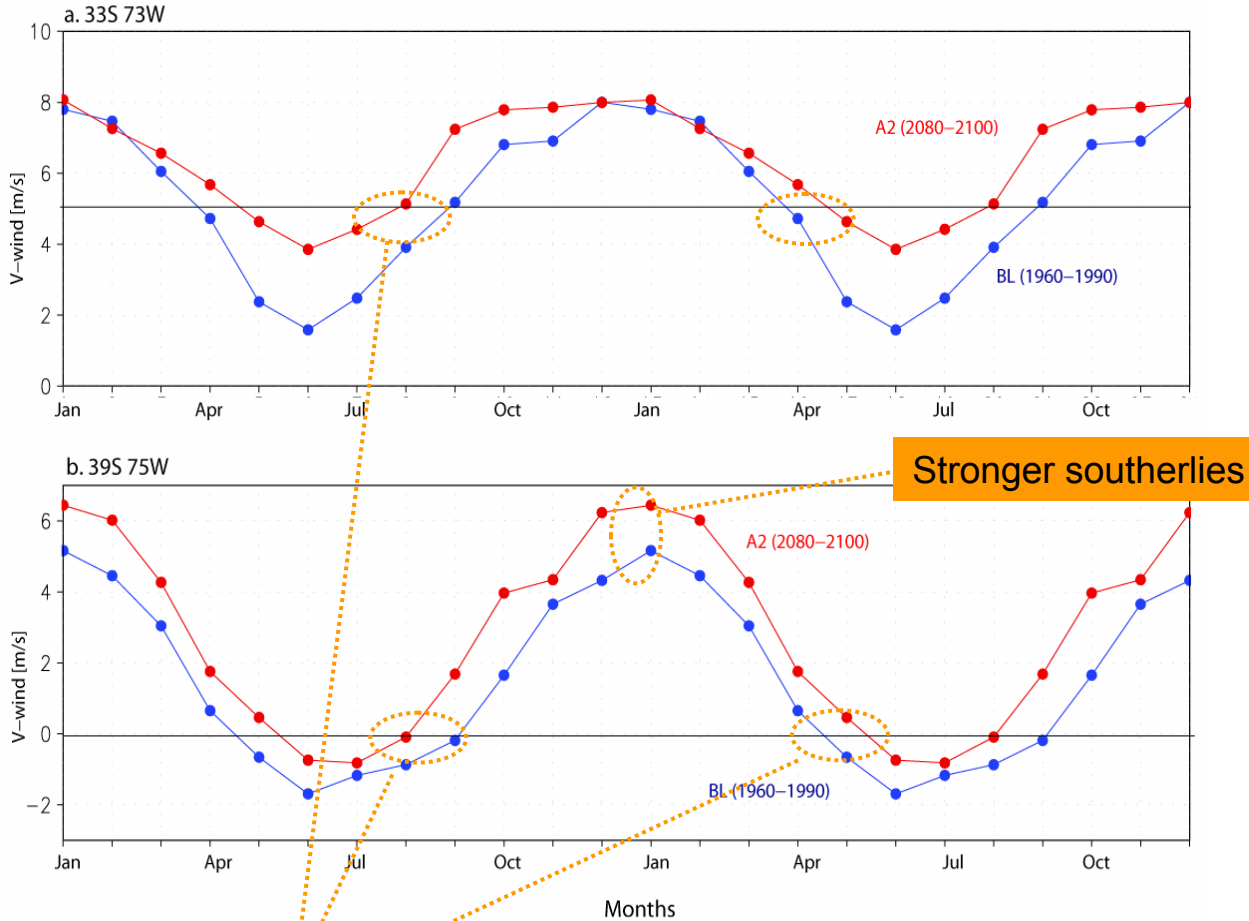


PRECIS Results

Frequency of surface meridional wind speed at 33°S 74°W



PRECIS Results

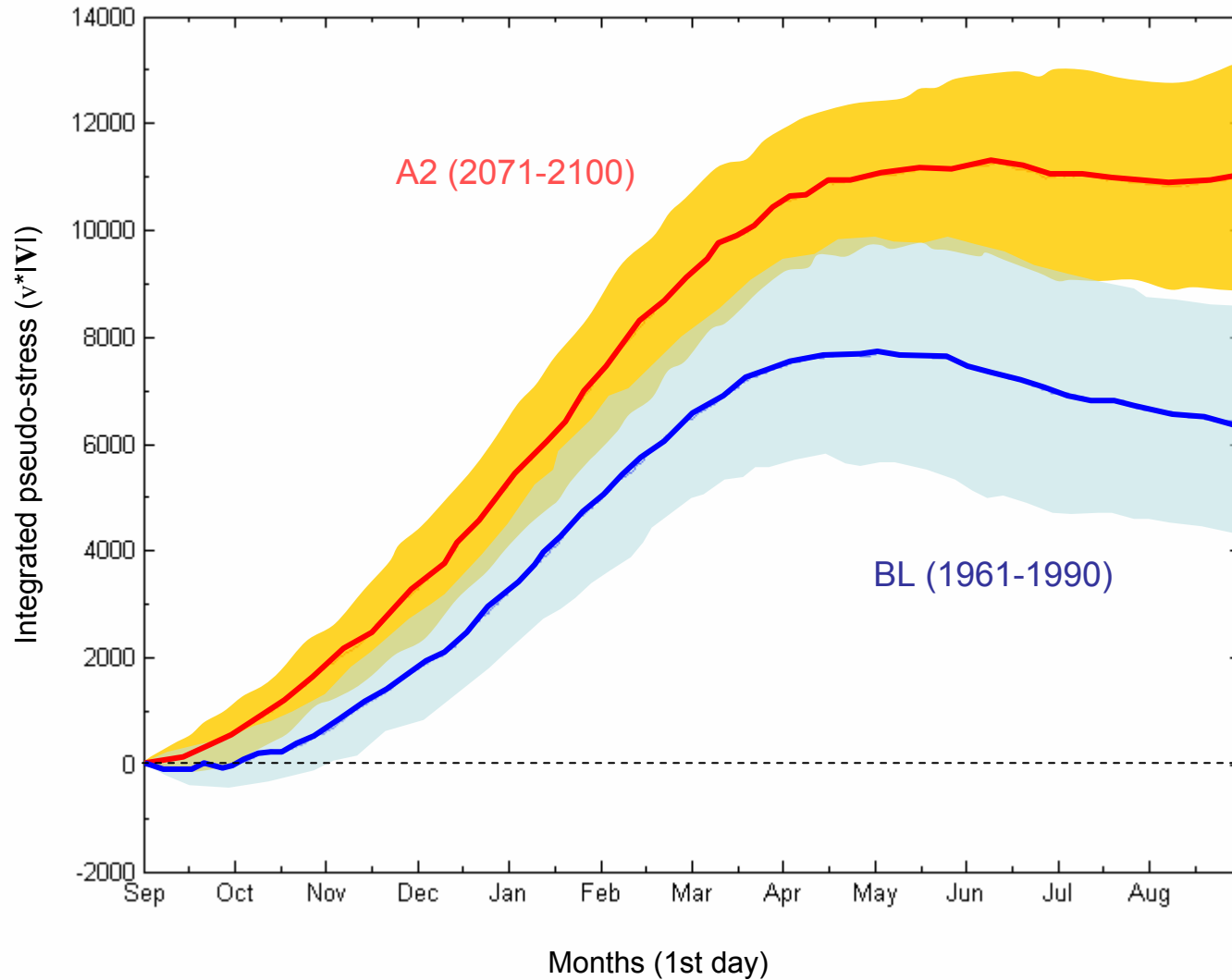


Stronger southerlies

2 month extended upwelling season (earlier onset, later demise)

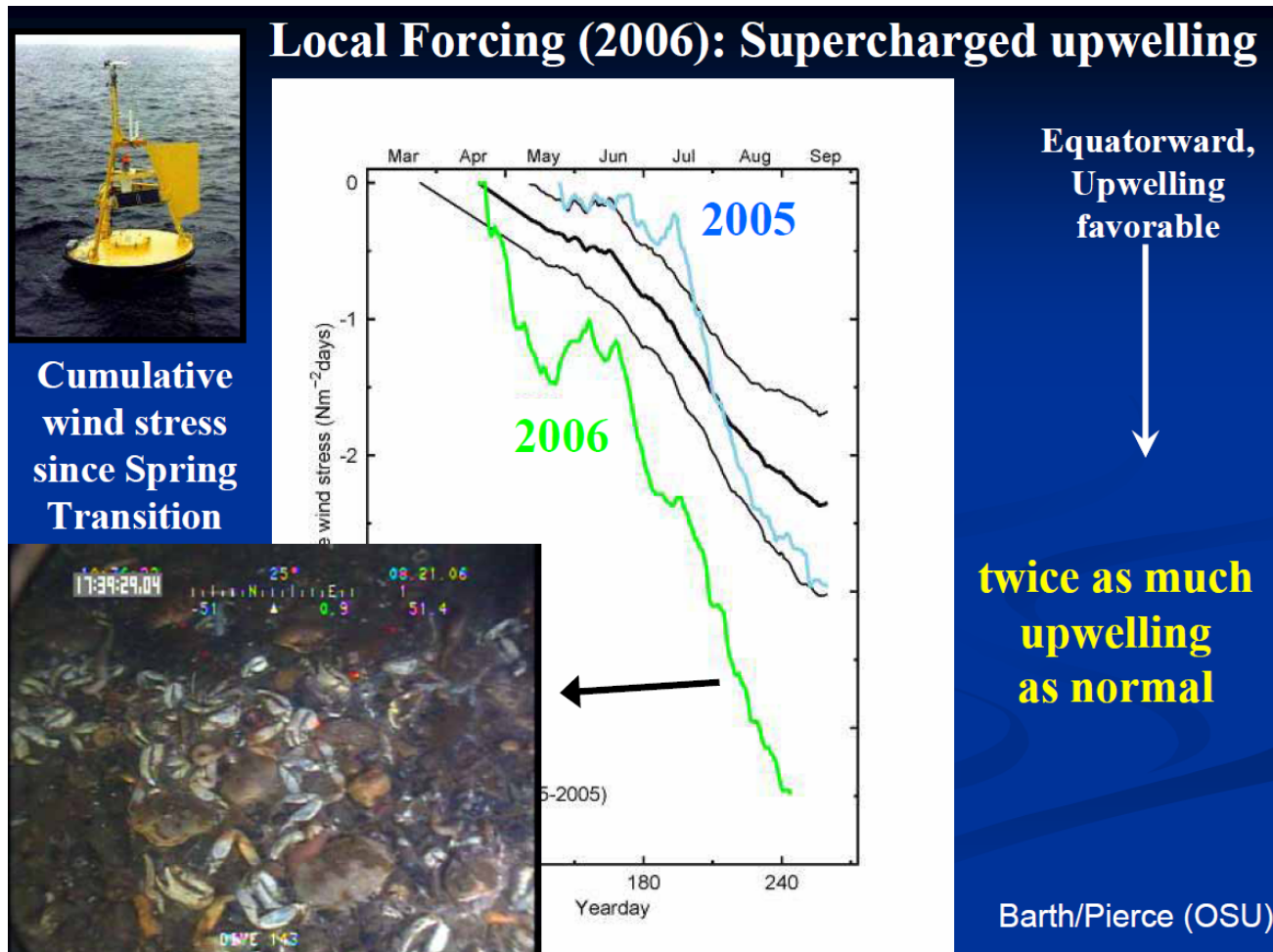
PRECIS Results

PRECIS simulations – 39°S 75°W



PRECIS Results

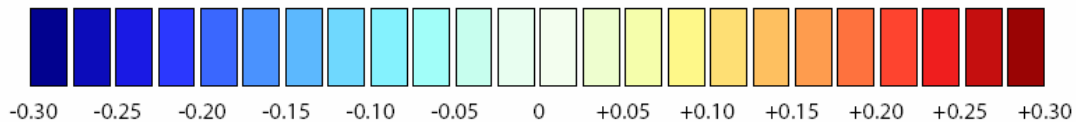
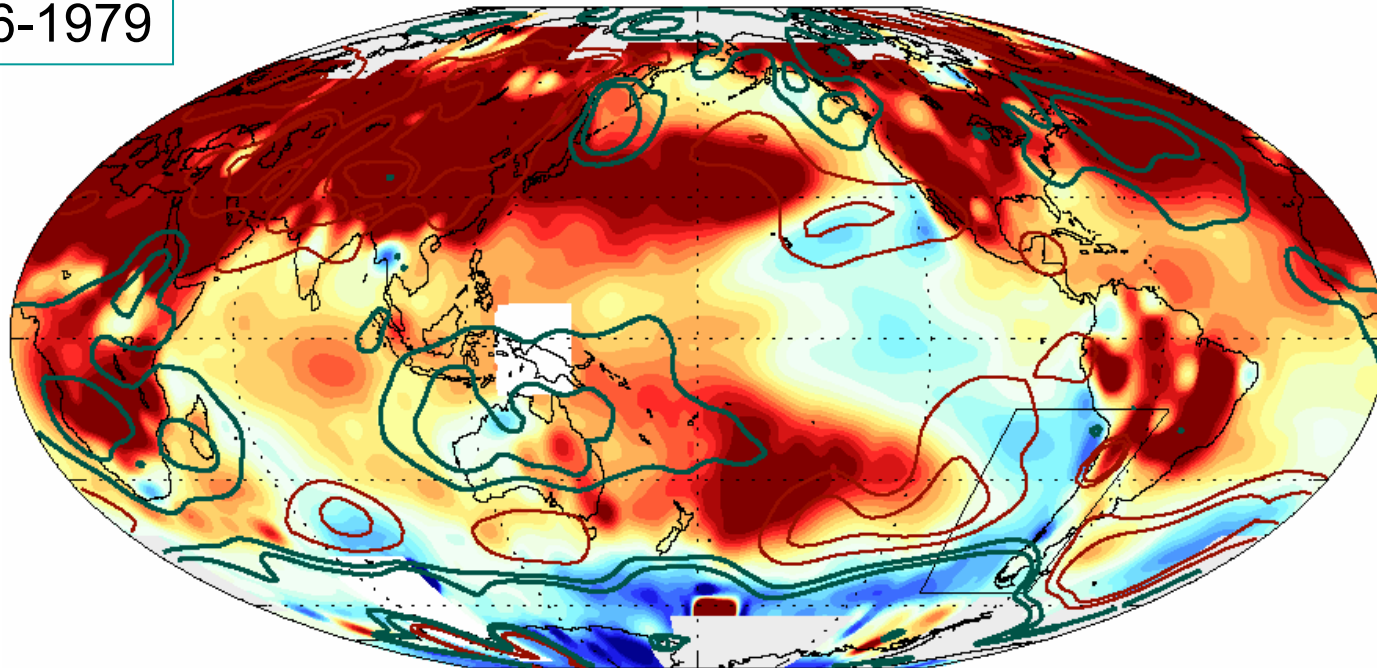
Entonces...mas surgencia en el futuro...que bueno!
Parece que no tanto ☹



Is the regional cooling of the Humboldt EBUS already taking place?

2006-1979

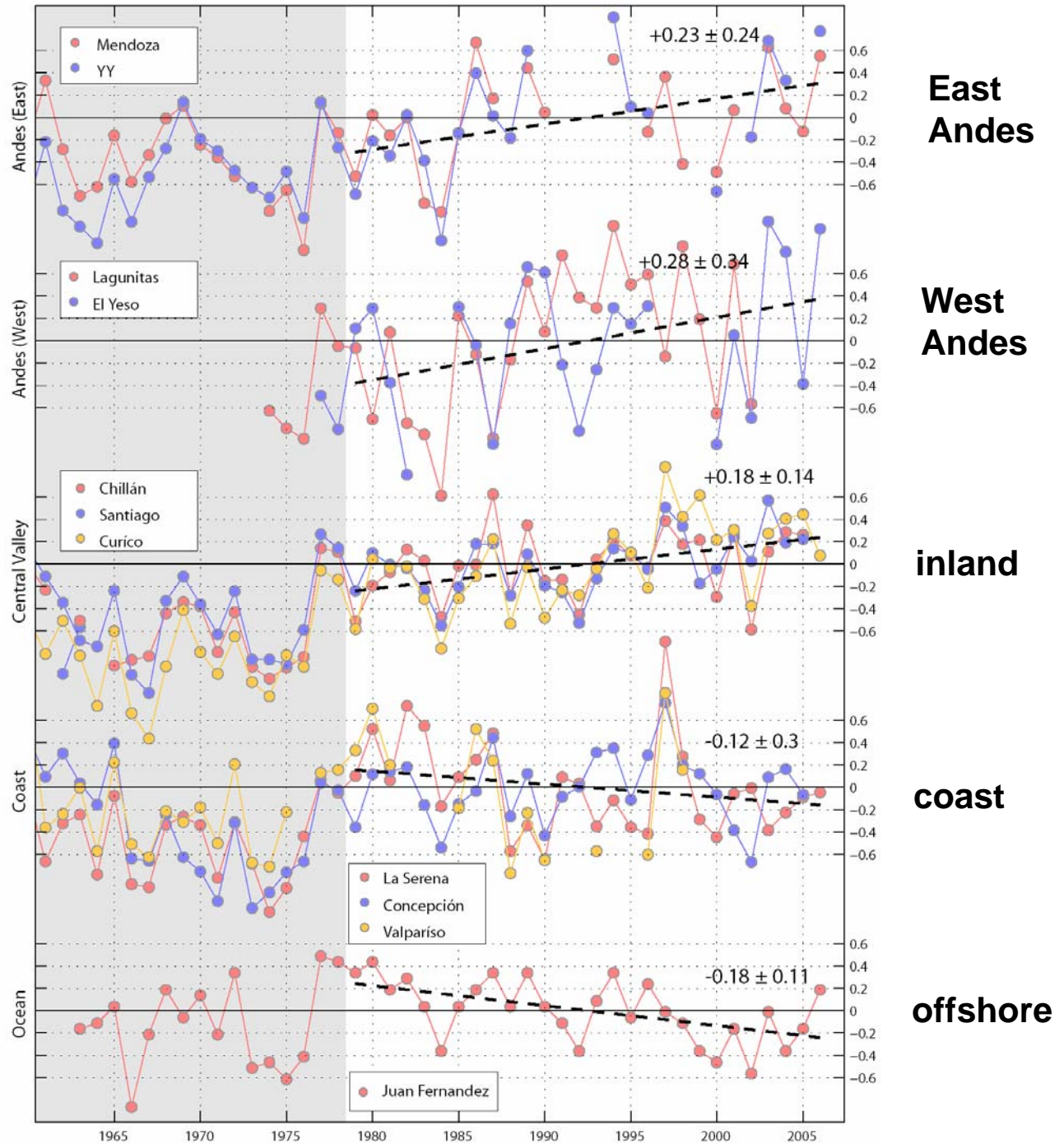
Surface Air Temperature and SST (NCDC)



Temperature Tendency 1979-2006 ($^{\circ}$ / decade)

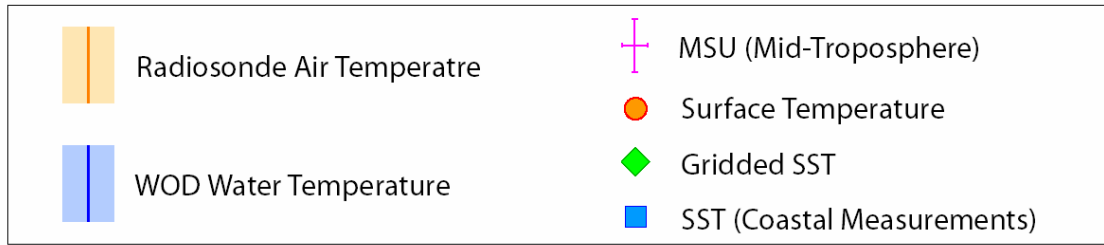
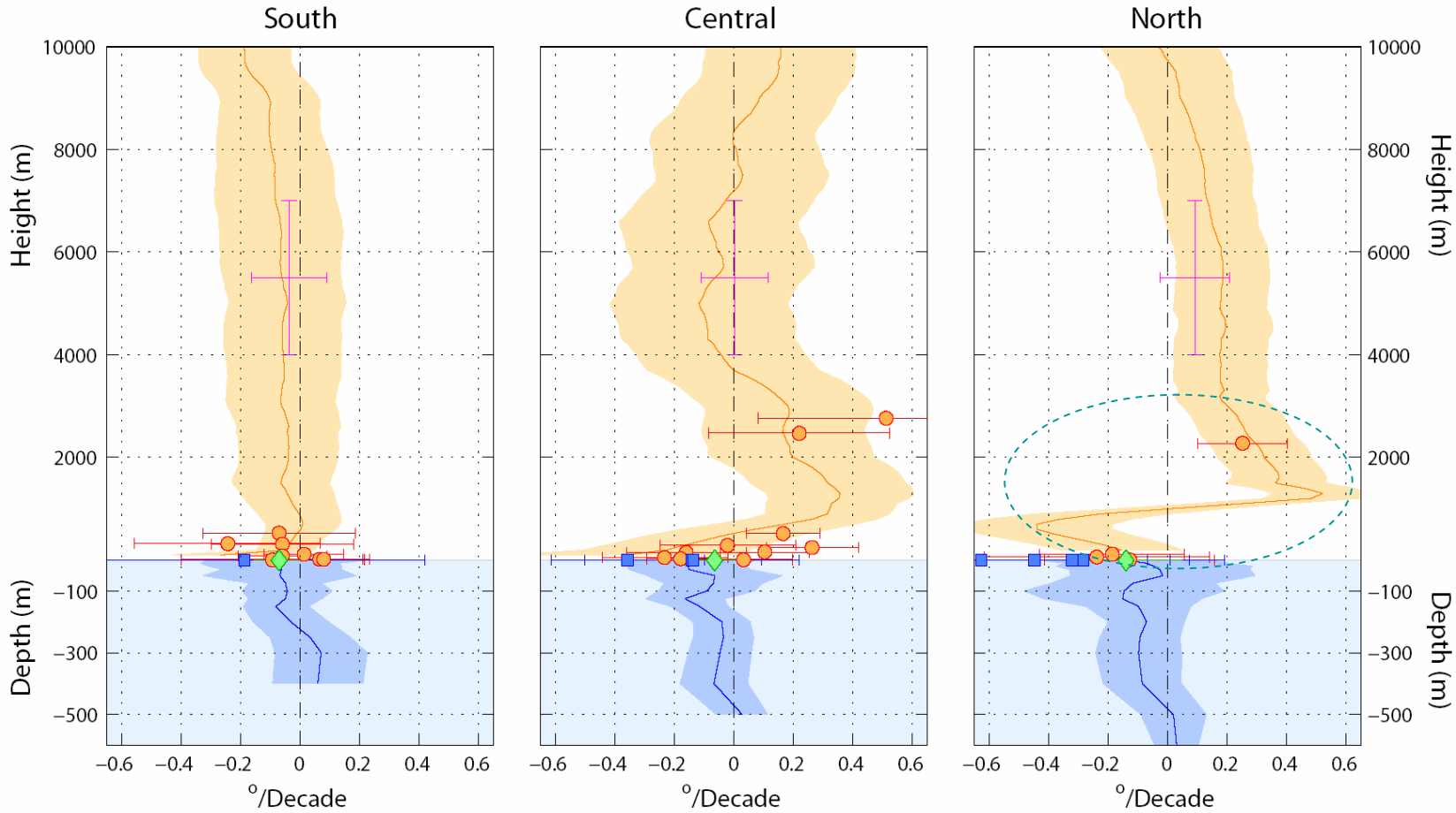
Over the Pacific SST trend looks very similar to the PDV patter

Is the regional cooling of the Humboldt EBUS already taking place?



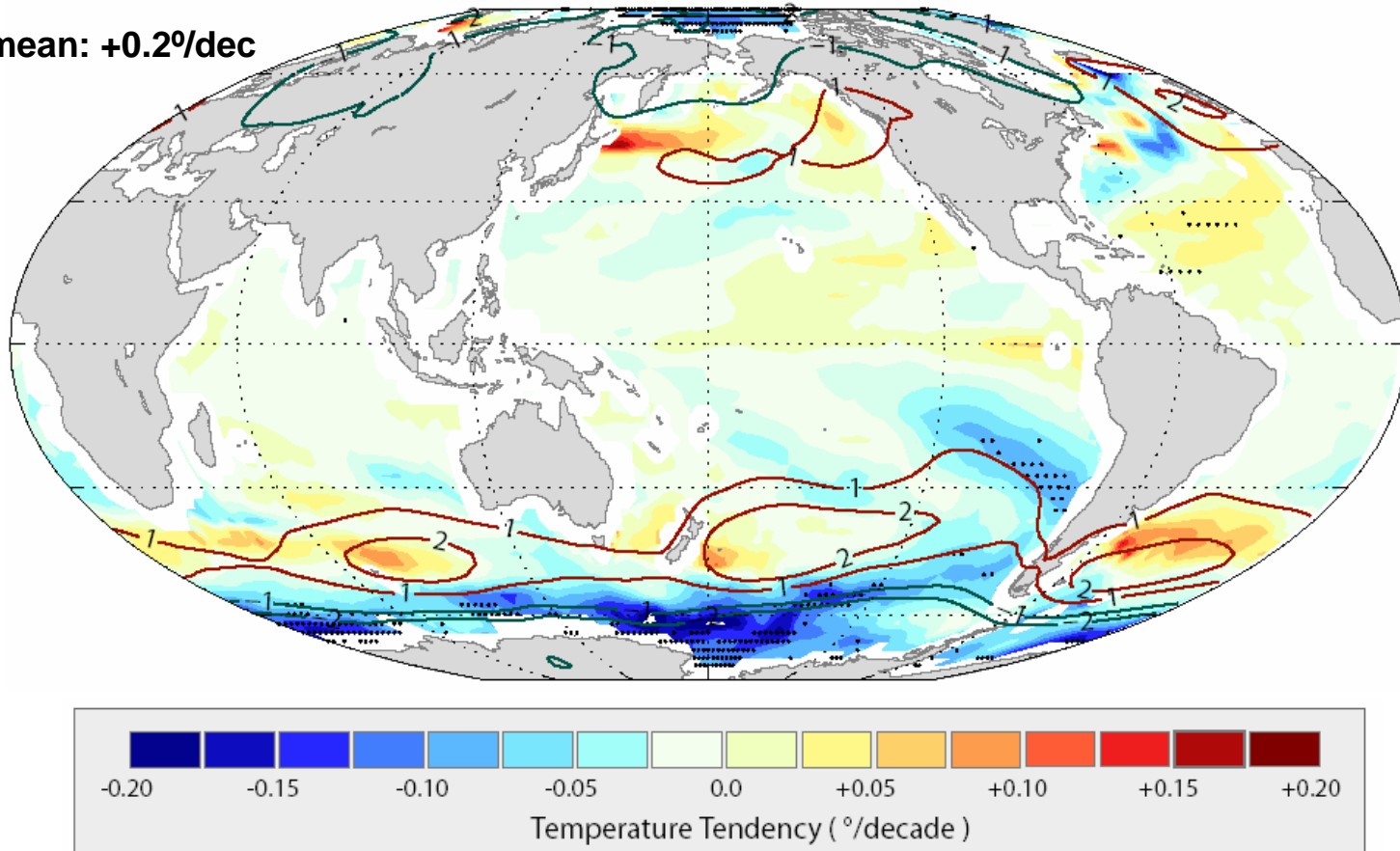
Is the regional cooling of the Humboldt EBUS already taking place?

Temperature trends 1979-2006



Is the regional cooling of the Humboldt EBUS already taking place?

Global mean: $+0.2^\circ/\text{dec}$



Multimodel mean Regional warming 1970-2000 (SST anomaly).
Also shown in contours SLP trend

Conclusiones

- Variaciones diarias, estacionales e internuales de los bientos del sur producto de cambios en el gradiente meridional (a lo largo de la costa) del gradiente de presión.

- GCMs predicen en forma consistente una expansión de la celda de Hadley resultando en un incremento de presión a lo largo de la costa.
- El incremento de la PNM favorece aumento de vientos del sur.

- El modelo PRECIS aporta detalles. Extensión de la estación de surgencia e incremento de los vientos del sur en zona centro-sur.
- Vientos del sur mas estables y eventos mas intensos en zona central.
- Respuesta oceanografica & biologica incierta...modelación acoplada

- Enfriamiento costero en las últimas tres décadas ($0.25^{\circ}\text{C}/\text{decada}$) contrasta con calentamiento continental. Posiblemente debido a factores naturales pero también a efecto de cambio climático debido a incremento de surgencia

References

Falvey, M. and R. Garreaud, 2009: Regional cooling in a warming world: Recent temperature trends in the SE Pacific and along the west coast of subtropical South America (1979-2006). *J. Geophys. Res.*, **114**, D04102, doi:10.1029/2008JD010519.

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Munoz, R. and R. Garreaud, 2005: Dynamics of the low-level jet off the subtropical west coast of South America. *Mon. Wea. Rev.*, **133**, 3661-3677