

Cambio Climático Global

Impactos en Chile

CIMA-UBA

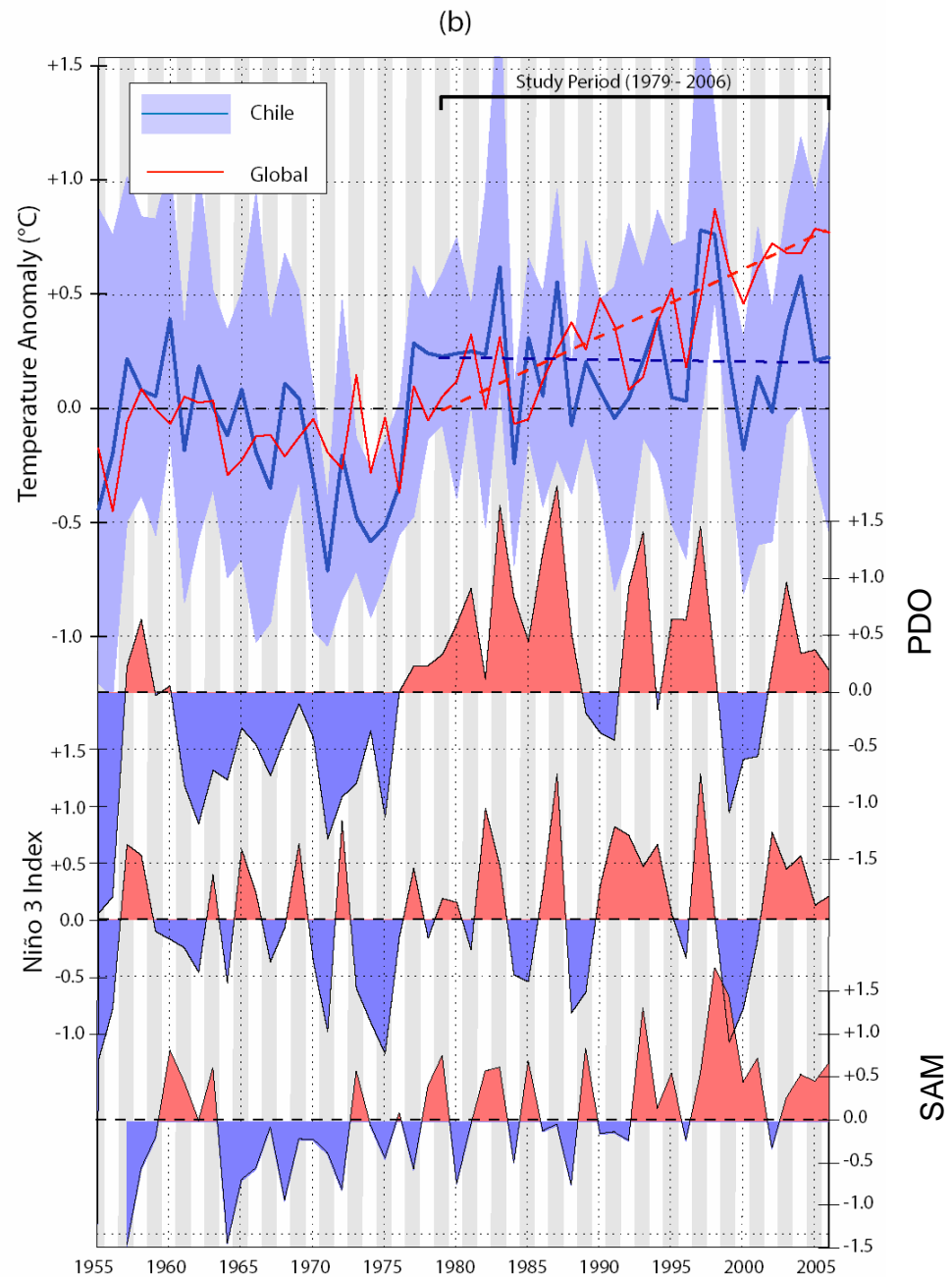
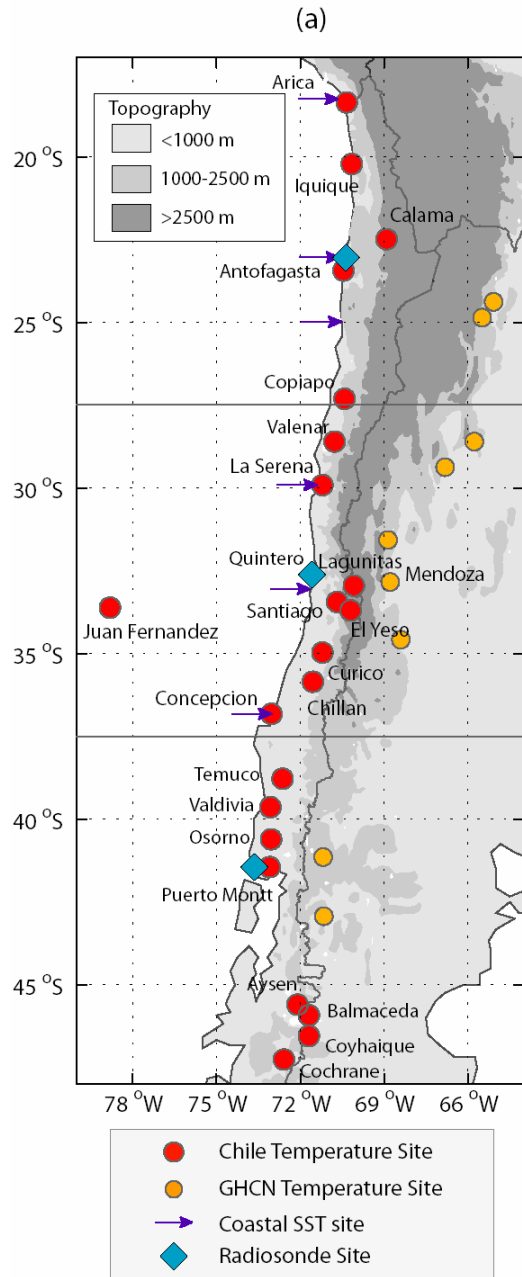
Marzo 2008

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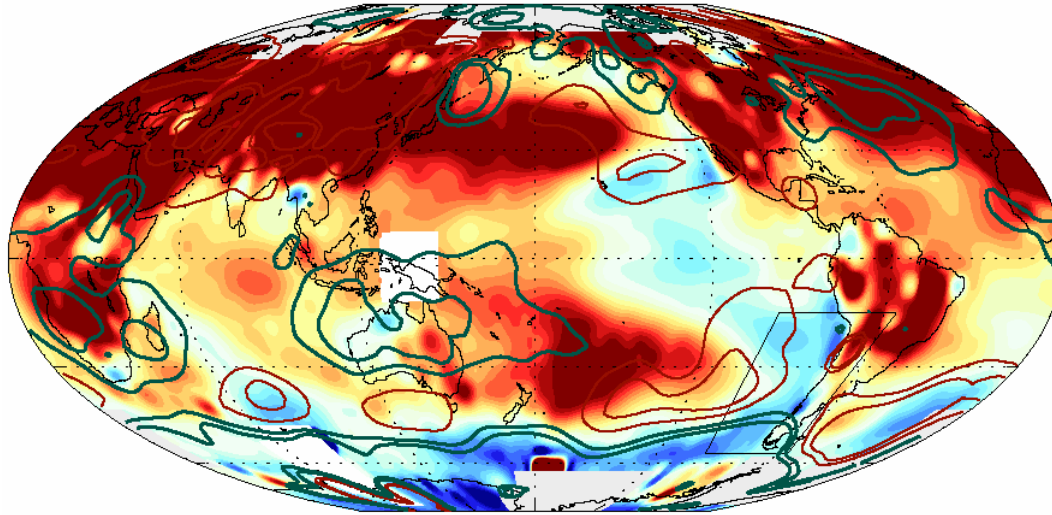
Temario

1. La Evidencia de cambio en Temperatura
2. Los mecanismos (natural vs antropogénico)
3. El futuro (PRECIS)

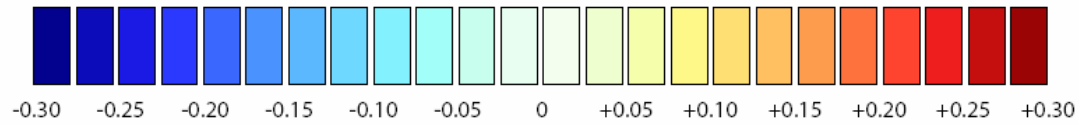
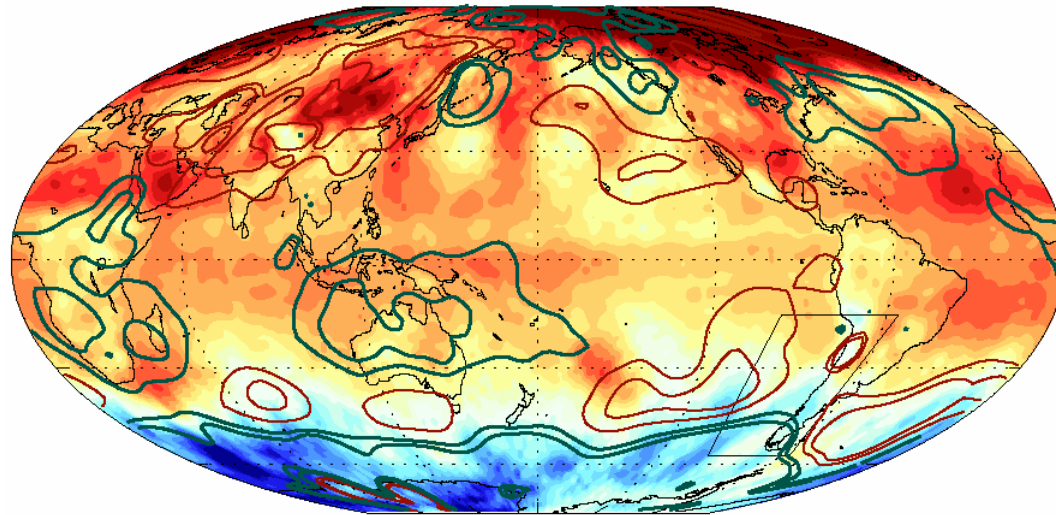
Geographical setting and global context



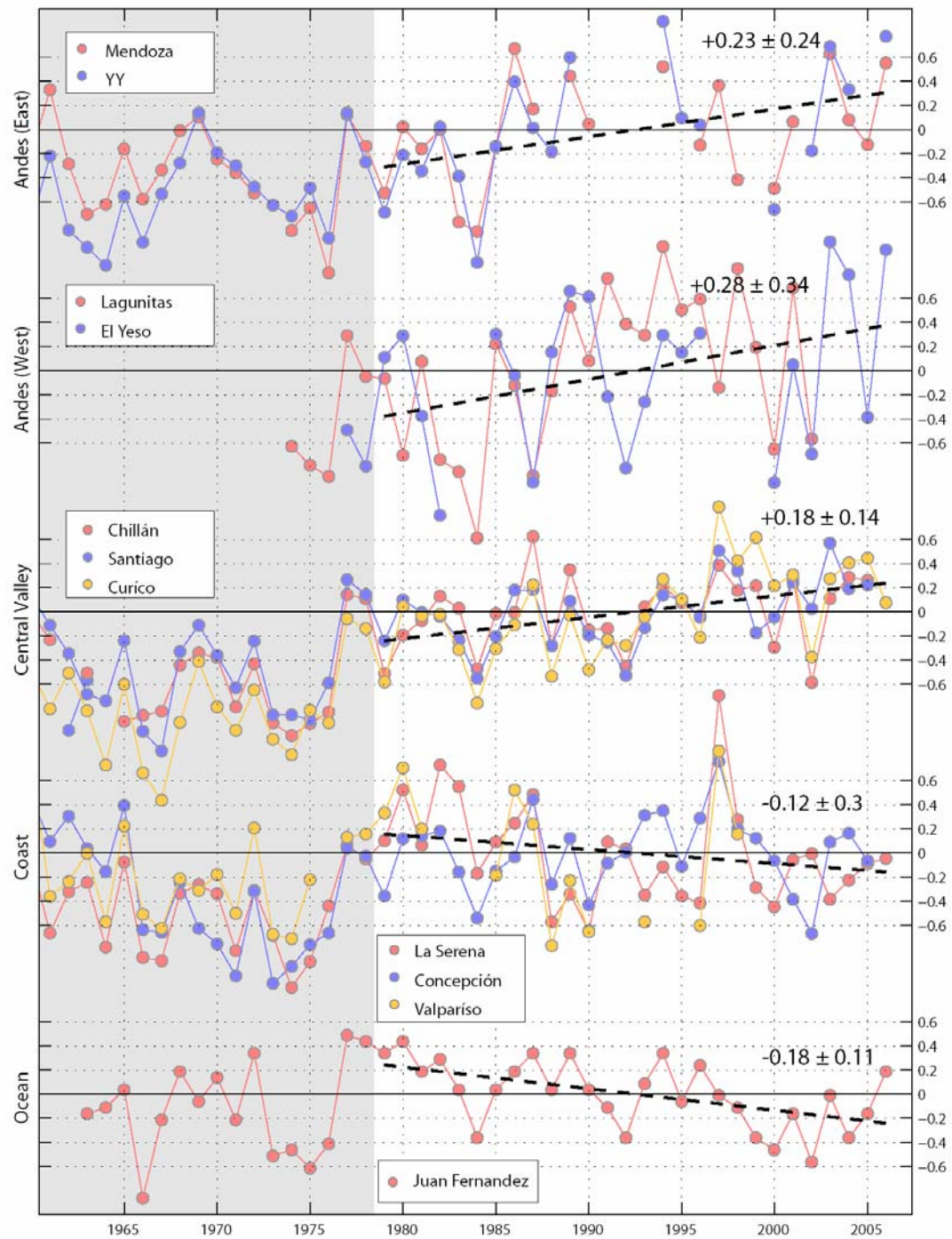
Surface Air Temperature and SST (NCDC)



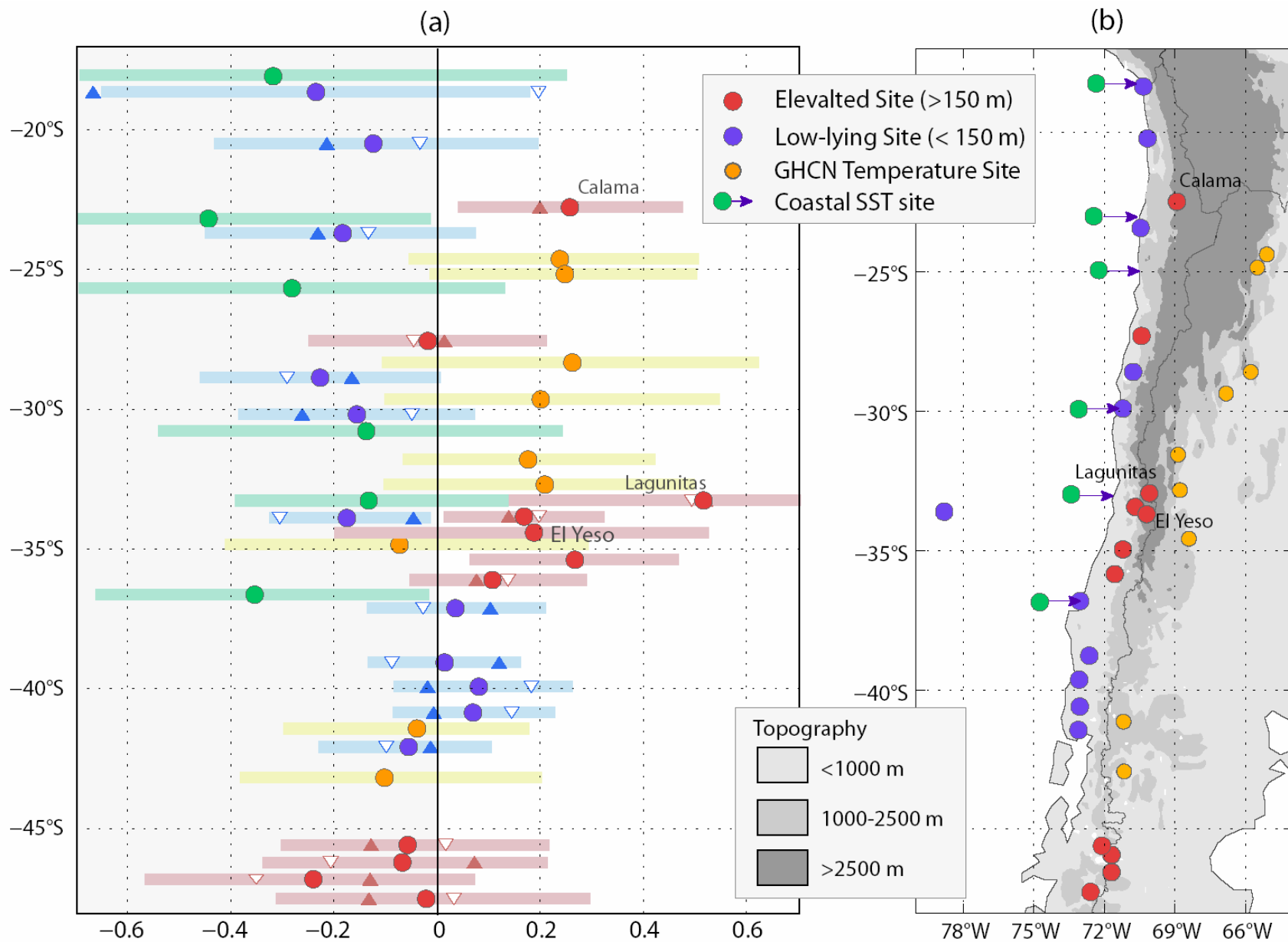
Mid-Troposphere Air Temperature (MSU)



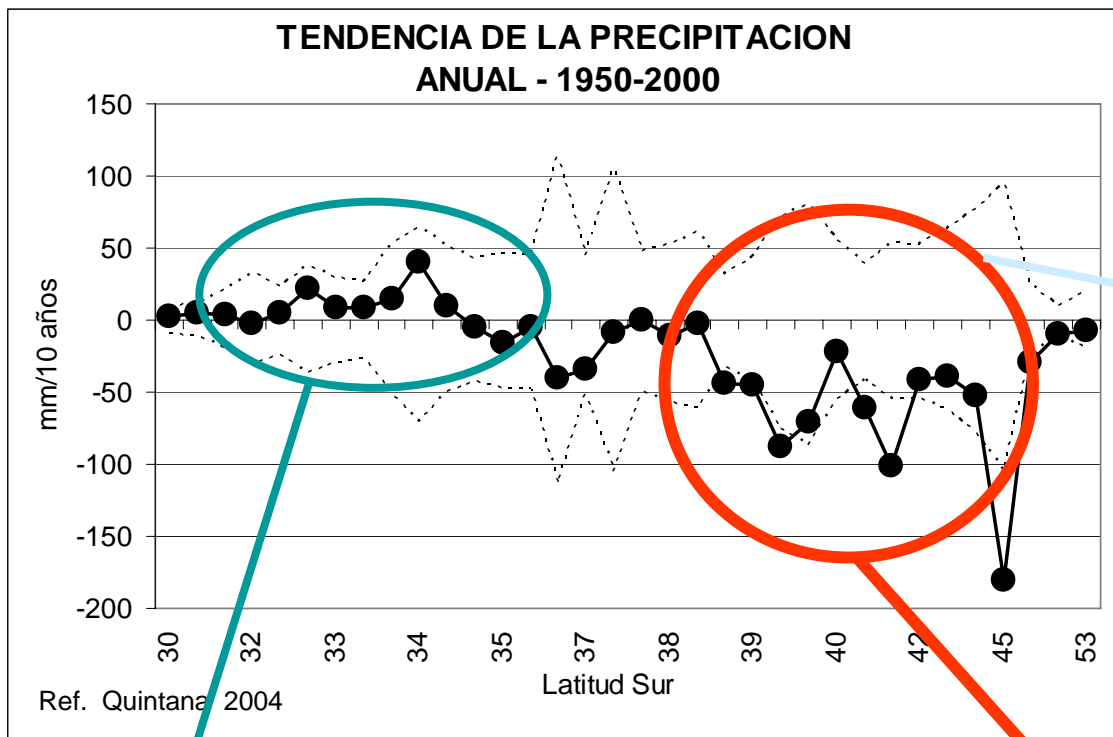
Temperature Tendency 1979-2006 ($^{\circ}$ / decade)



Ocean cooling – land warming along north-central Chile. Pattern reverses farther south

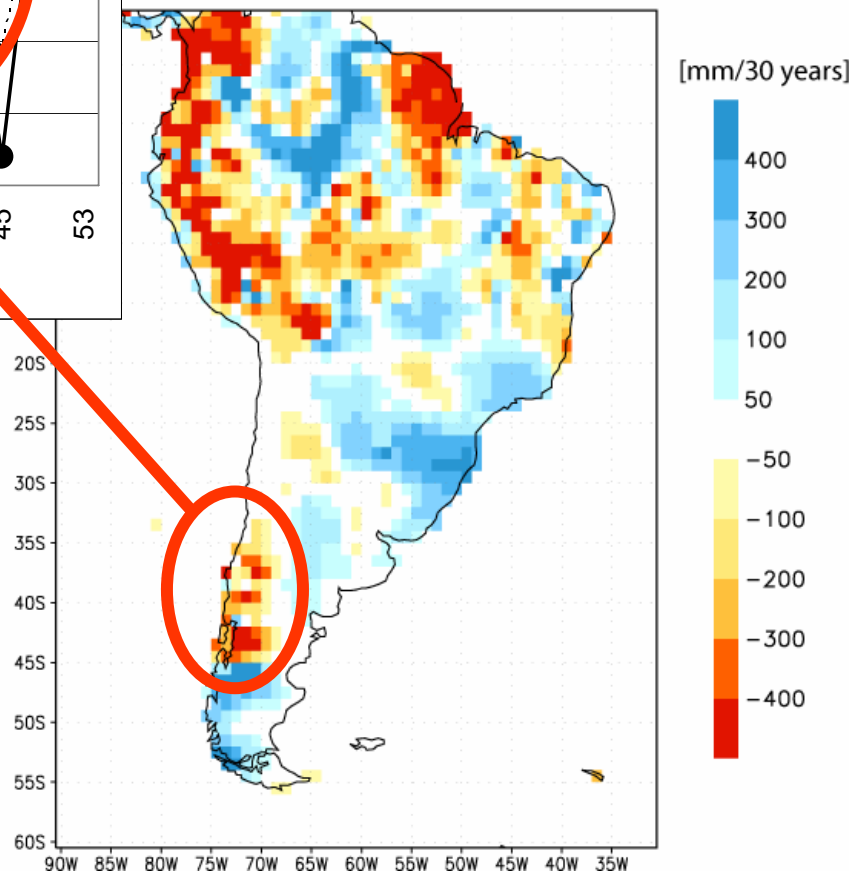


Precipitation Changes....warming, drying south

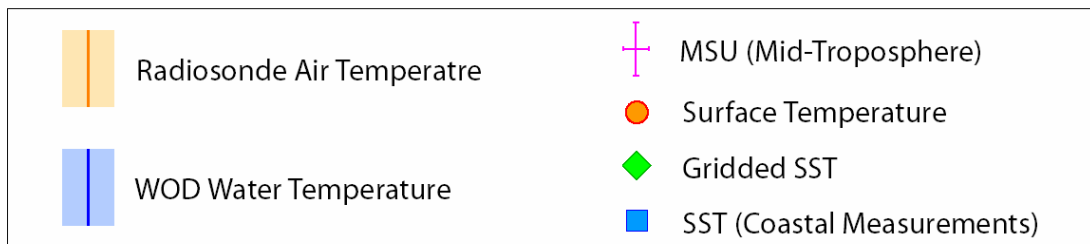
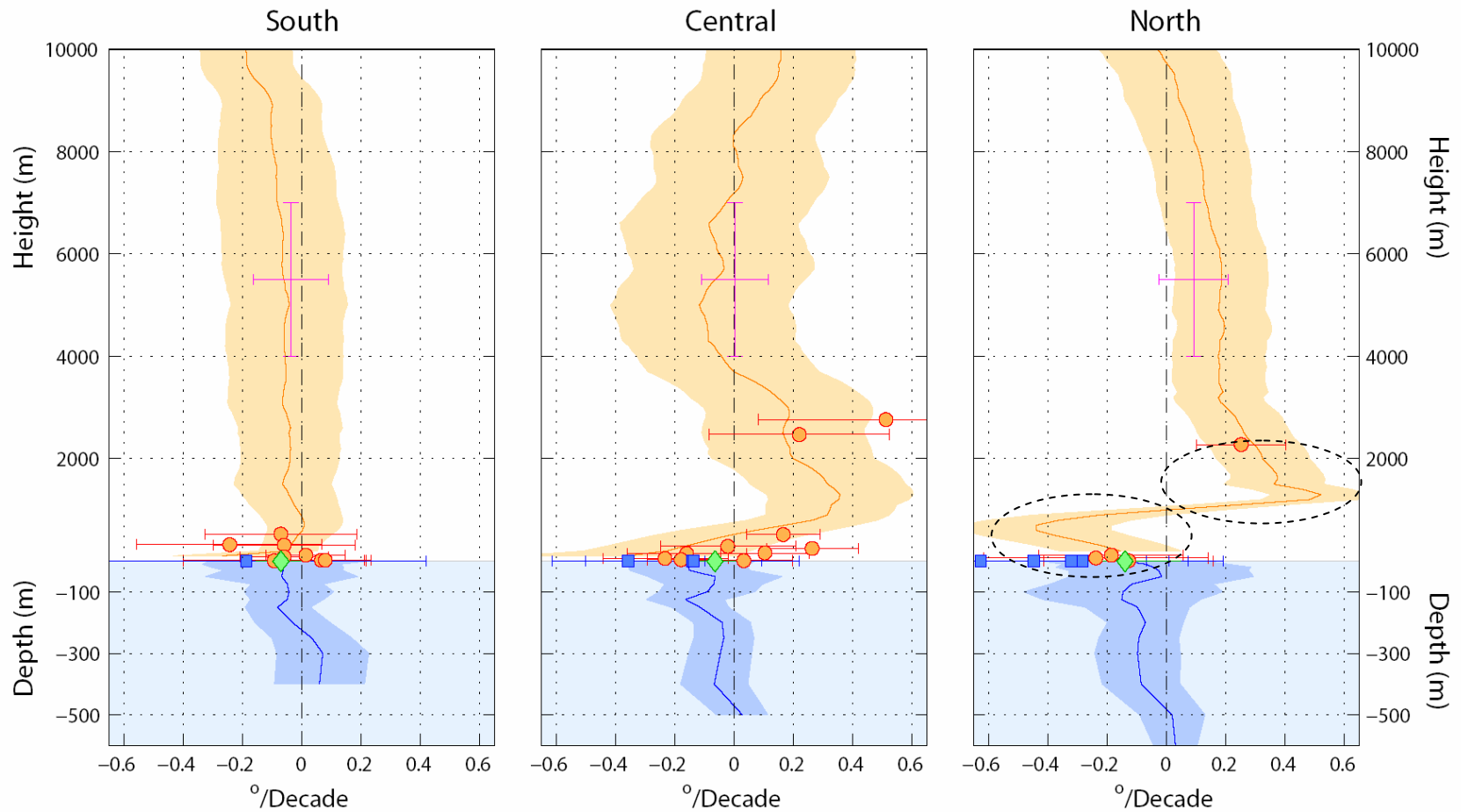


- Rainy climate
- MAP ~ 1000-3000 mm
- $\sigma(IA)/MAP \sim 0.1$
- Weak ENSO Impact
- Significant drying trend

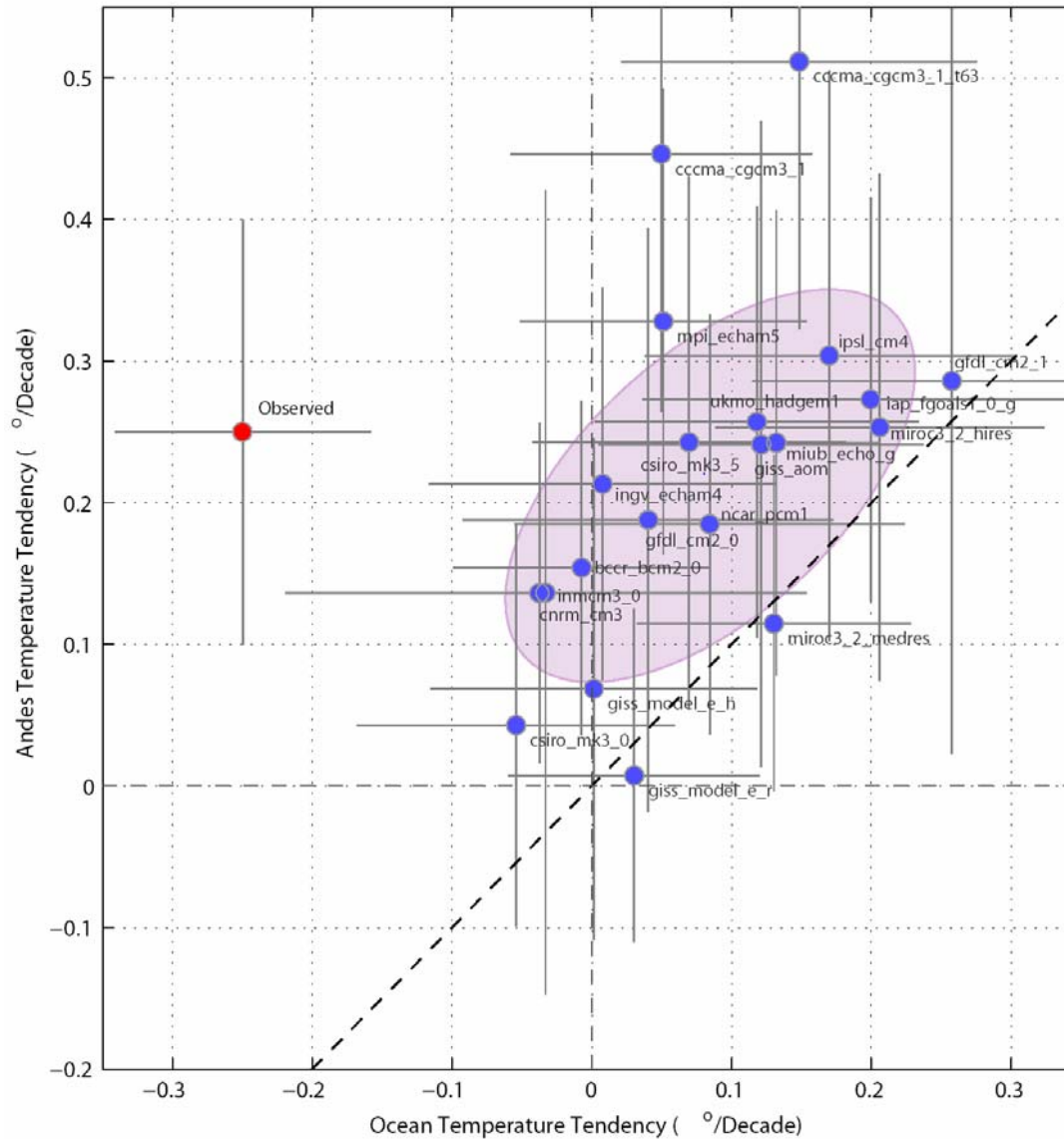
- Semiarid climate
- MAP ~ 30-500 mm
- $\sigma(IA)/MAP \sim 0.3 - 0.5$
- Strong ENSO Impact
- No significant trend



Cooling MBL / warming lower free troposphere → increased lower tropospheric stability ... Sc?

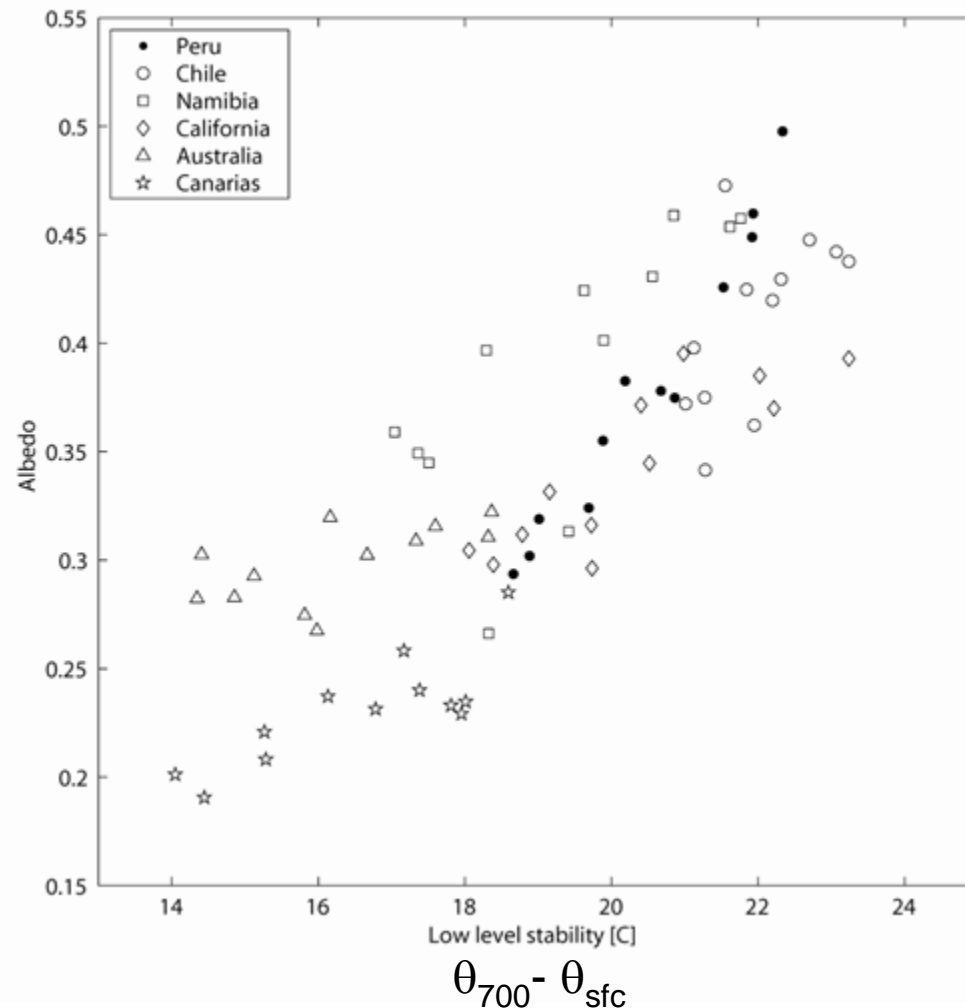


How are the models doing? Not good but no so bad..



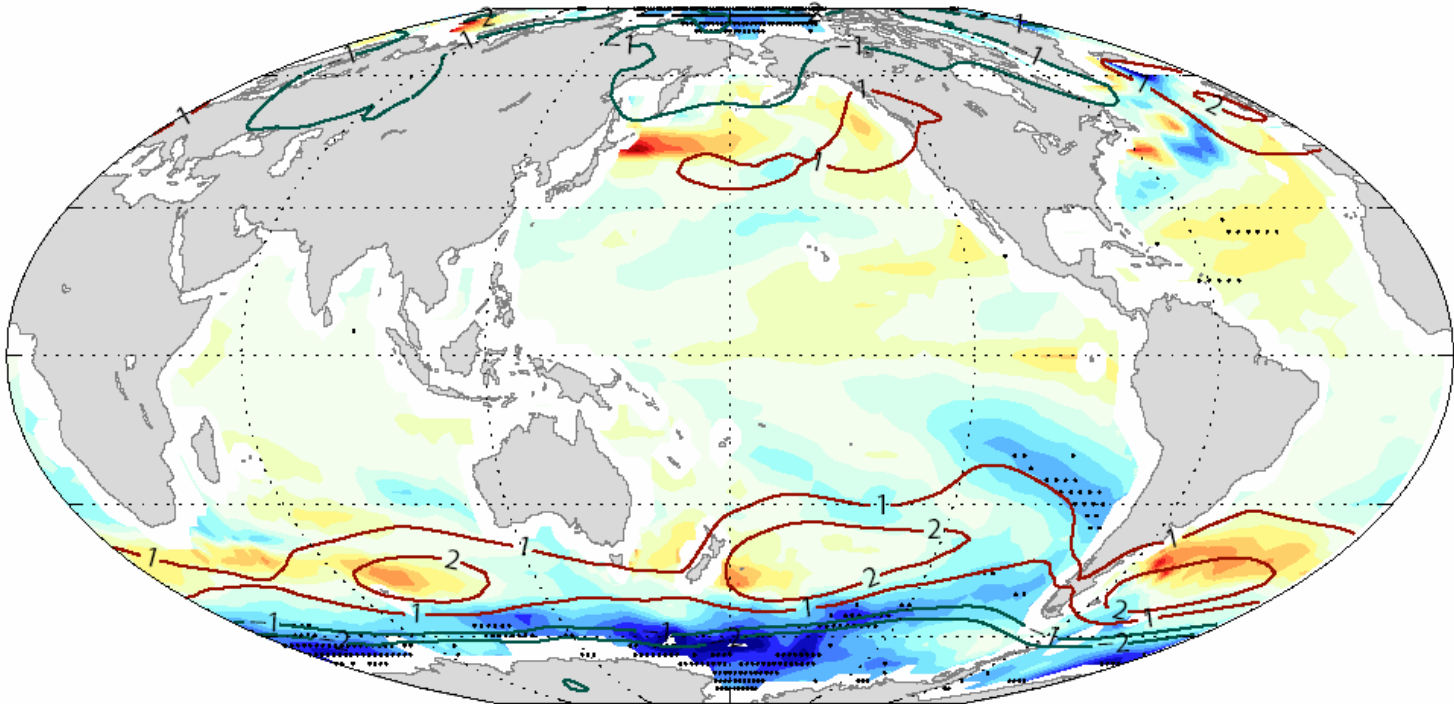
Increase in cloudiness?

Maybe...hard to test...requires a feedback

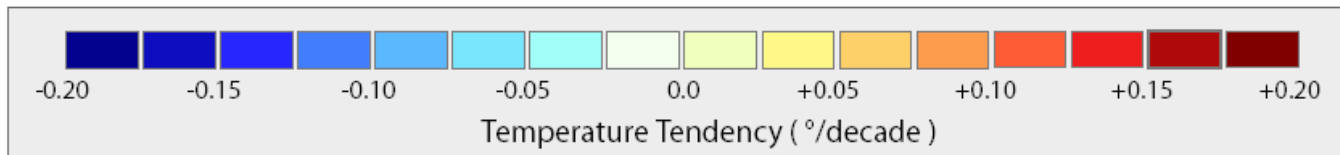


Annual cycle of SCu an inter-regional differences largely explained by low level stability: $\theta_{700} - \theta_{sfc}$ (Klein and Hartmann 1993)

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

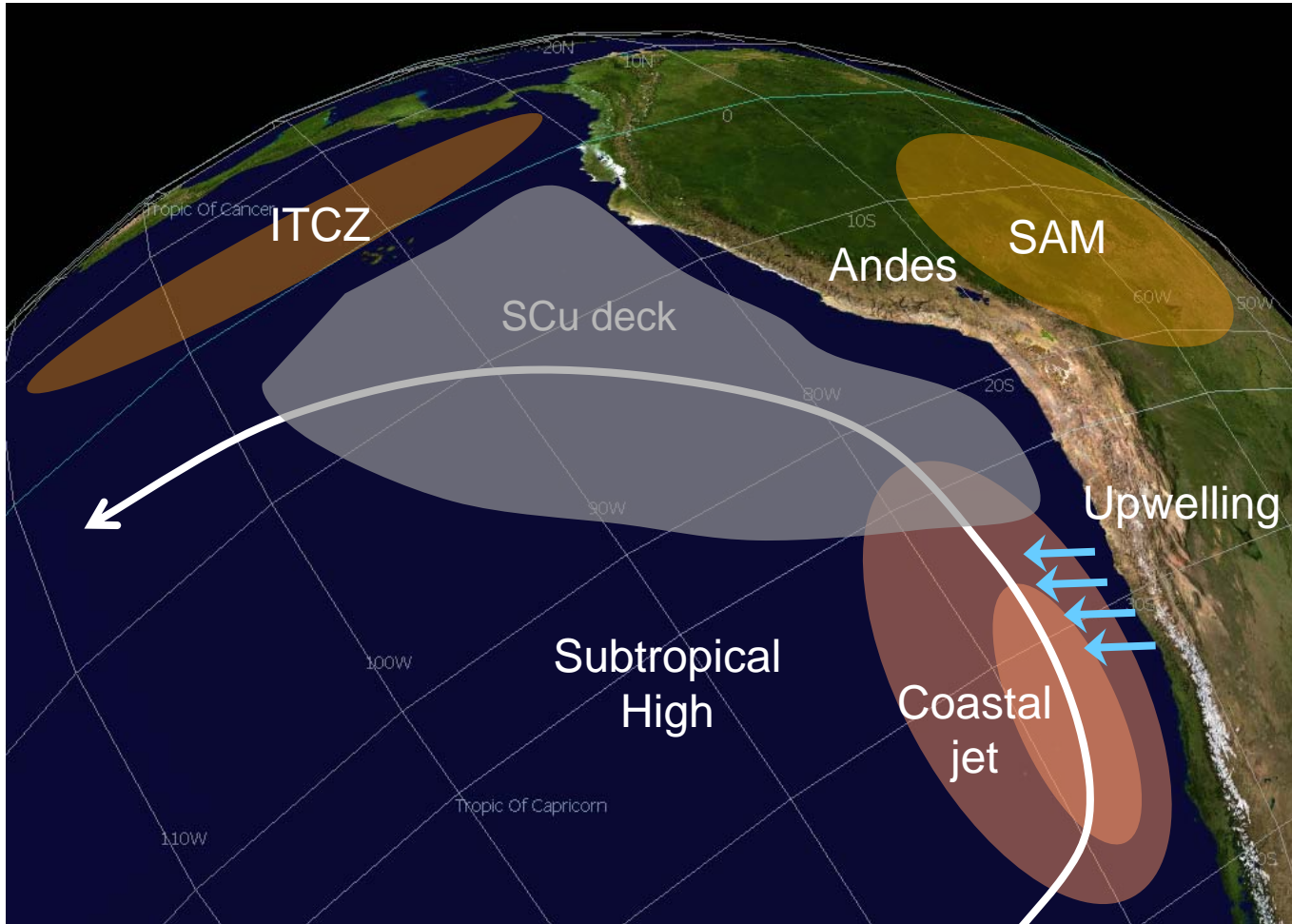


Global mean: +0.2°/dec

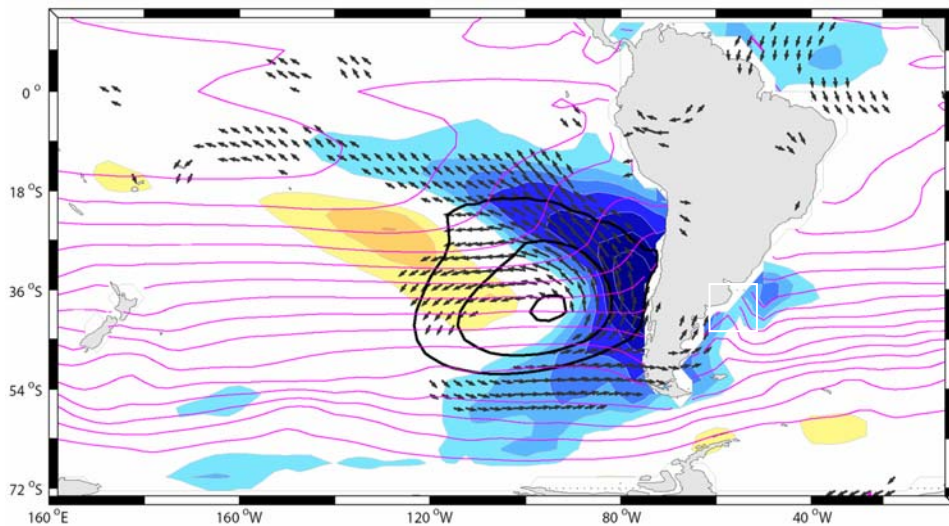


Possible explanations....

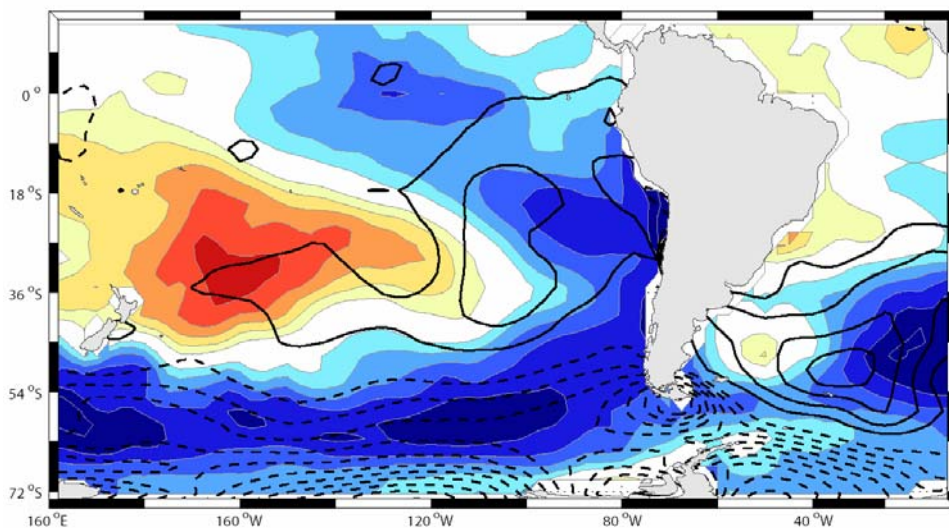
Key atmospheric features over the coastal SEP



SAT, SST Cold advection



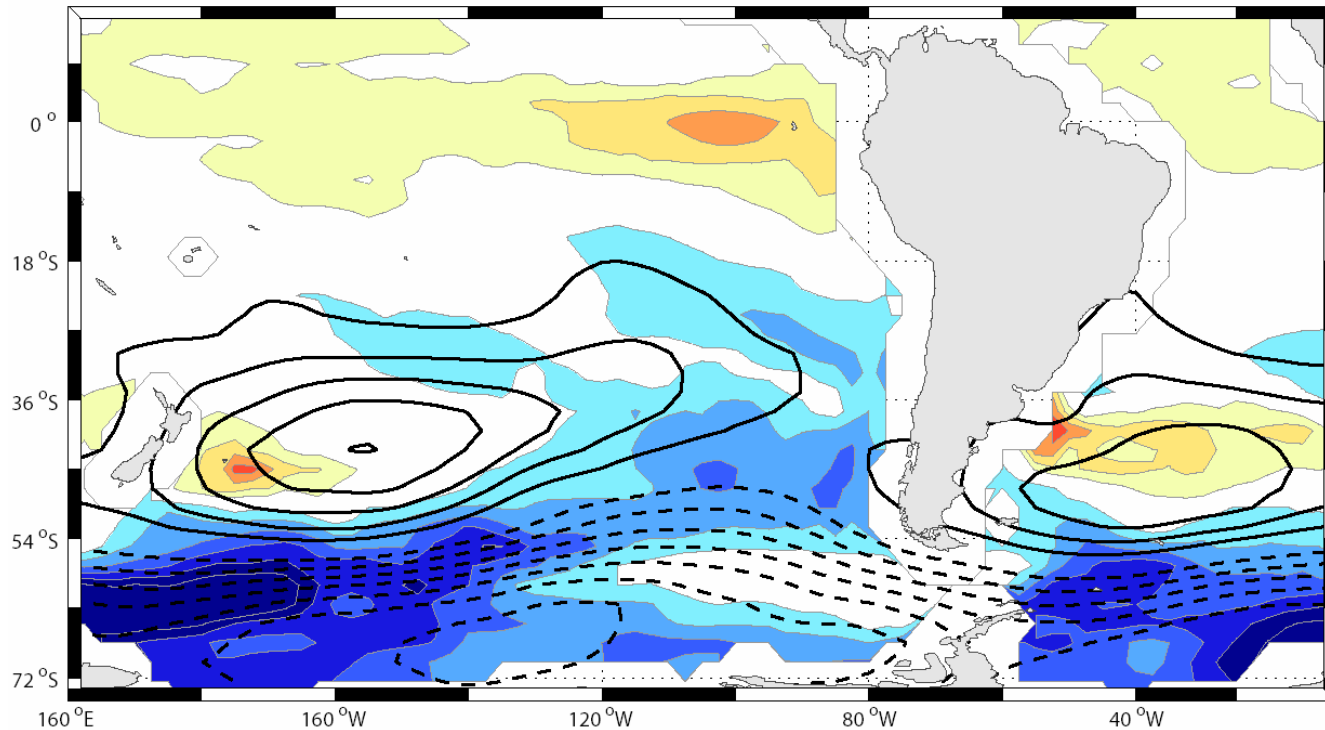
1-Point correlation map SST off central Chile, SST, SLP, sfc. winds. Interannual variability only.



Observed ERSST and SLP changes, 1979-2005. SLP from NCEP/NCAR reanalysis, supported by insitu observations.

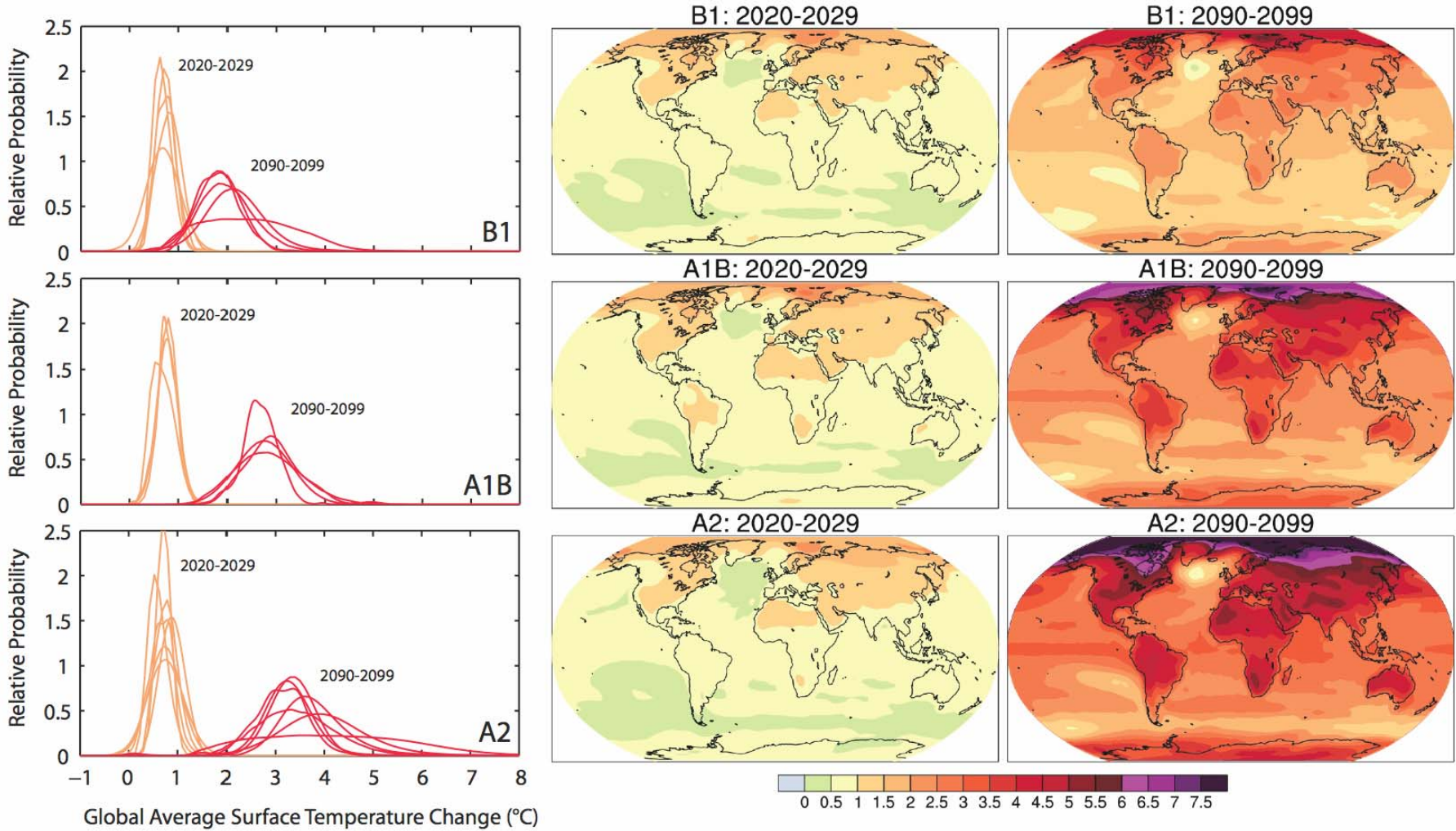
At interannual time scales, cooling off central Chile associated with spin-up of SEP anticyclone (increased cold advection, upwelling and heat fluxes). The same mechanism appears to operate in last decades to produce trends.

Multimodel mean SST* and SLP tendency, 1970-2000



The same mechanism appears to operate in the models during the last decades to produce trends. Thus, observed change is at least partially due to increased GHG (the only common ingredient in GCMs)

AOGCM Projections of Surface Temperatures

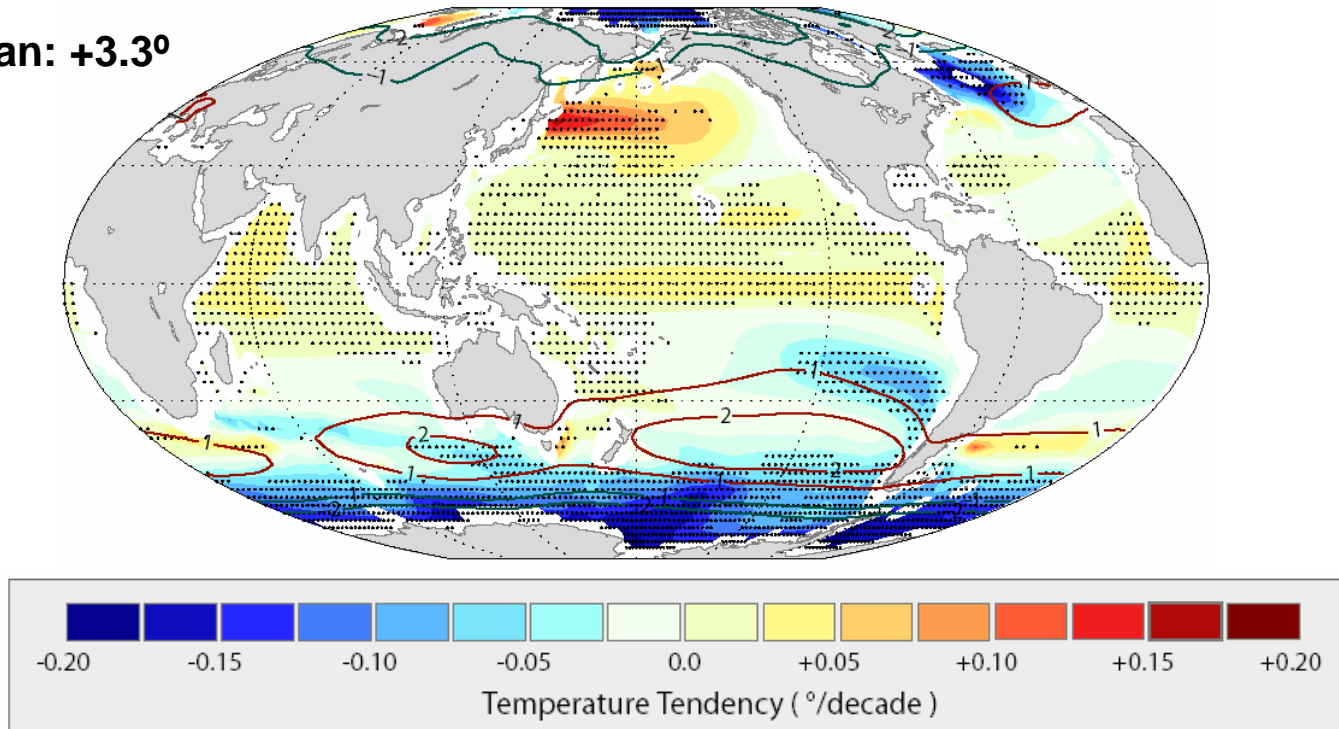


© IPCC 2007: WG1-AR4

Multimodel mean Regional warming A2-BL (future-present)

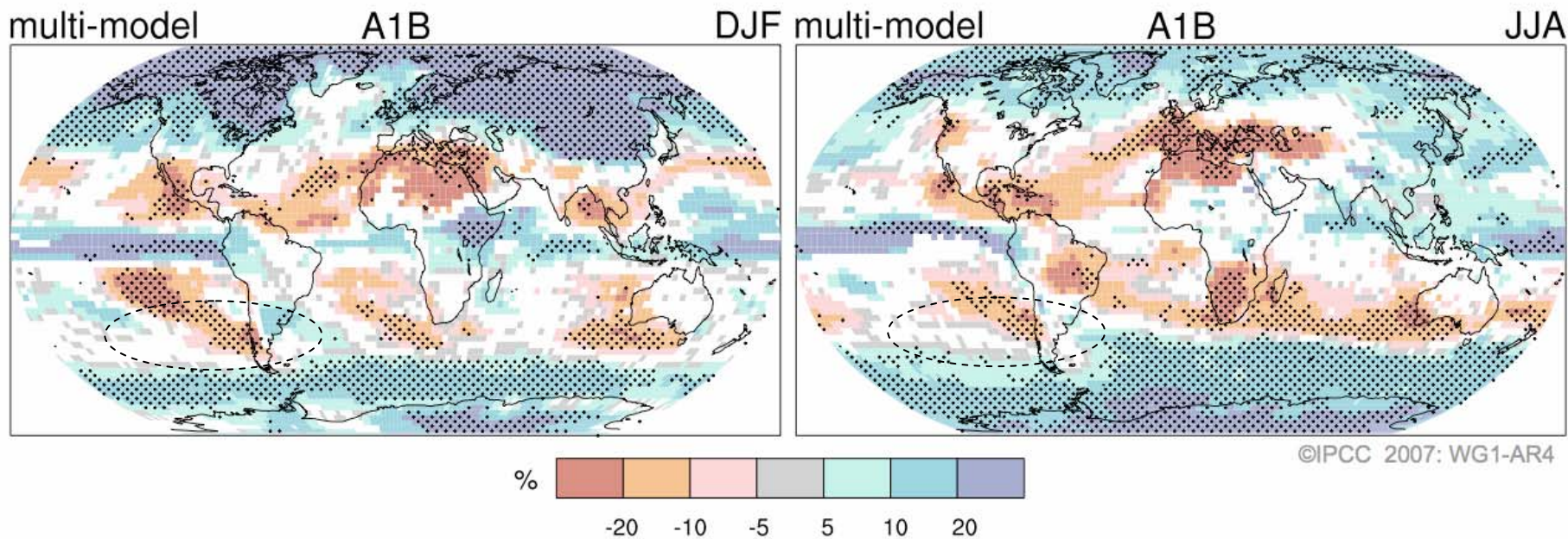
Also shown dSLP

Global mean: +3.3°



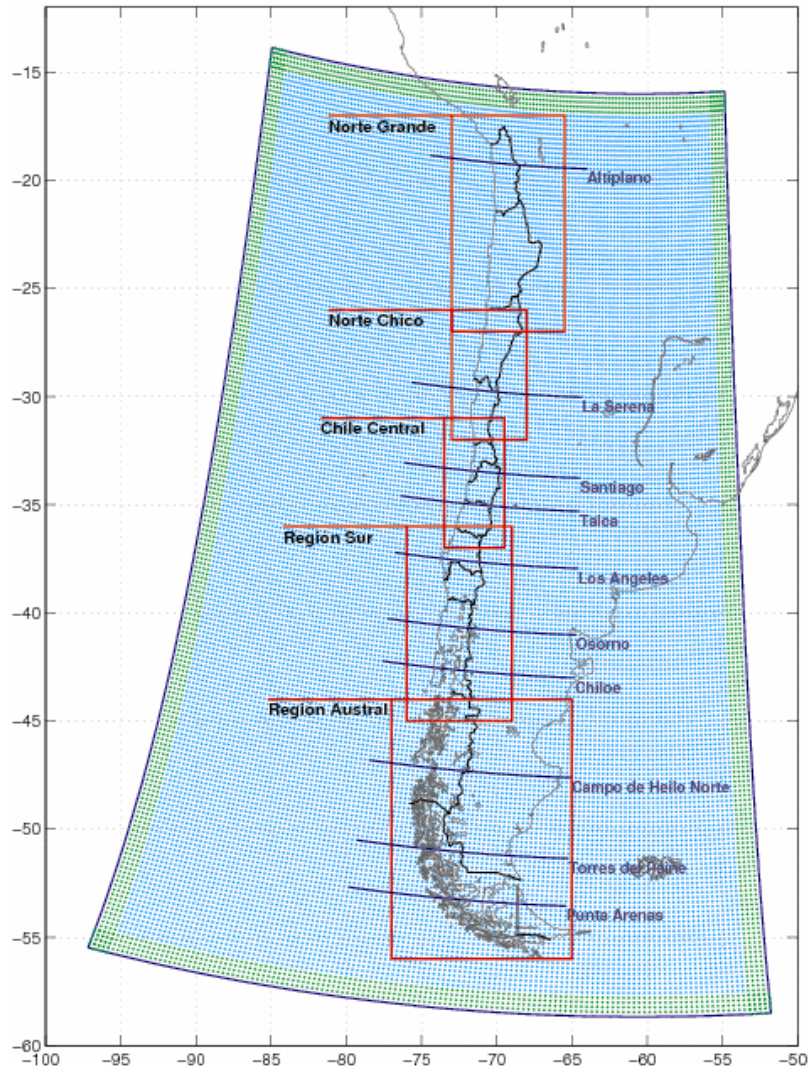
The future shows a consistent poleward expansion of the subtropical highs and poleward shift of the storm track. Thus, the same mechanism acting in recent decades appears to operate in the future and cause a regional cooling within a global warming context.

Projected Patterns of Precipitation Changes



Proyecto CONAMA – DGF/UCH

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



Model:

- PRECIS – UK

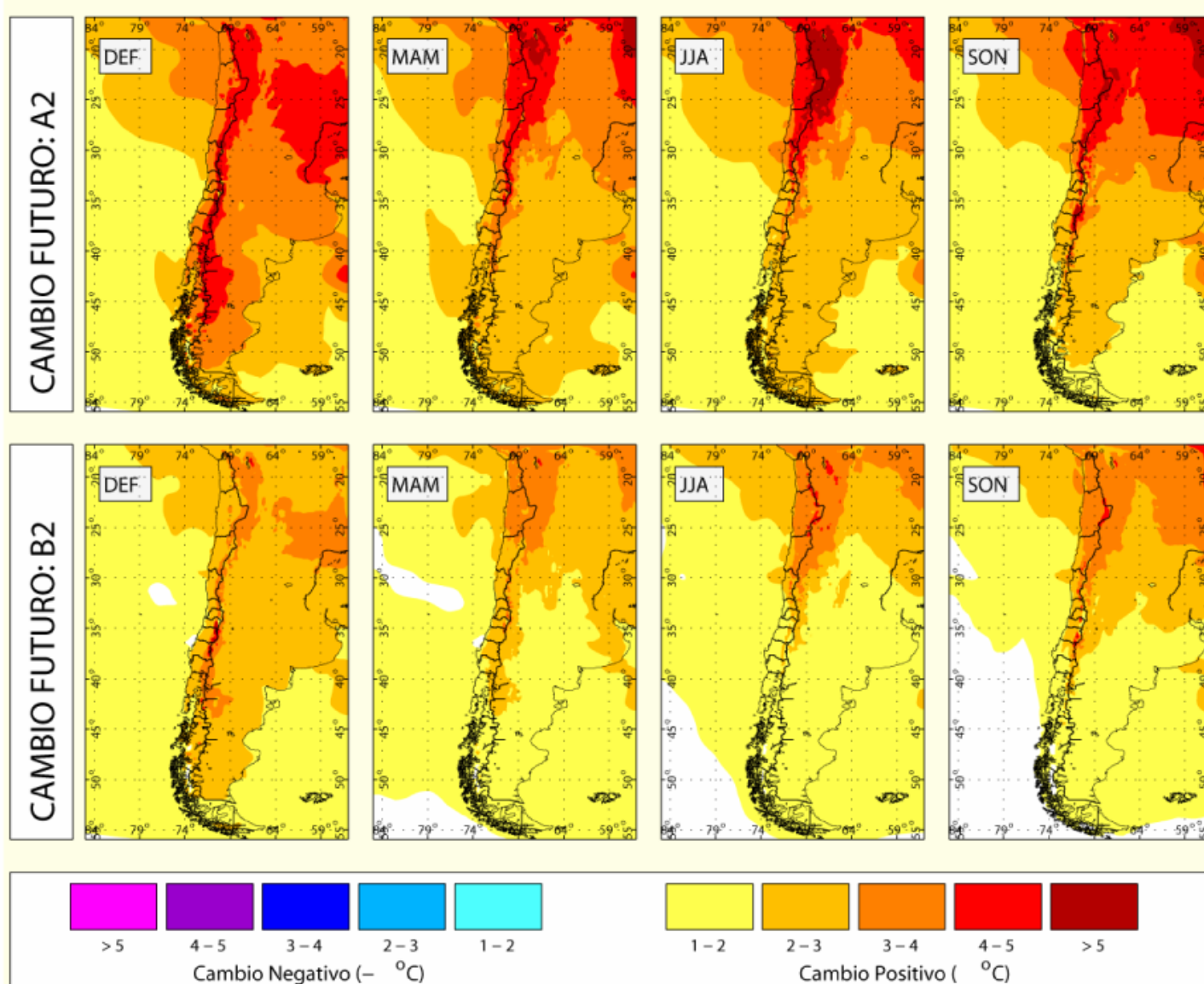
Single domain

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

Simulations

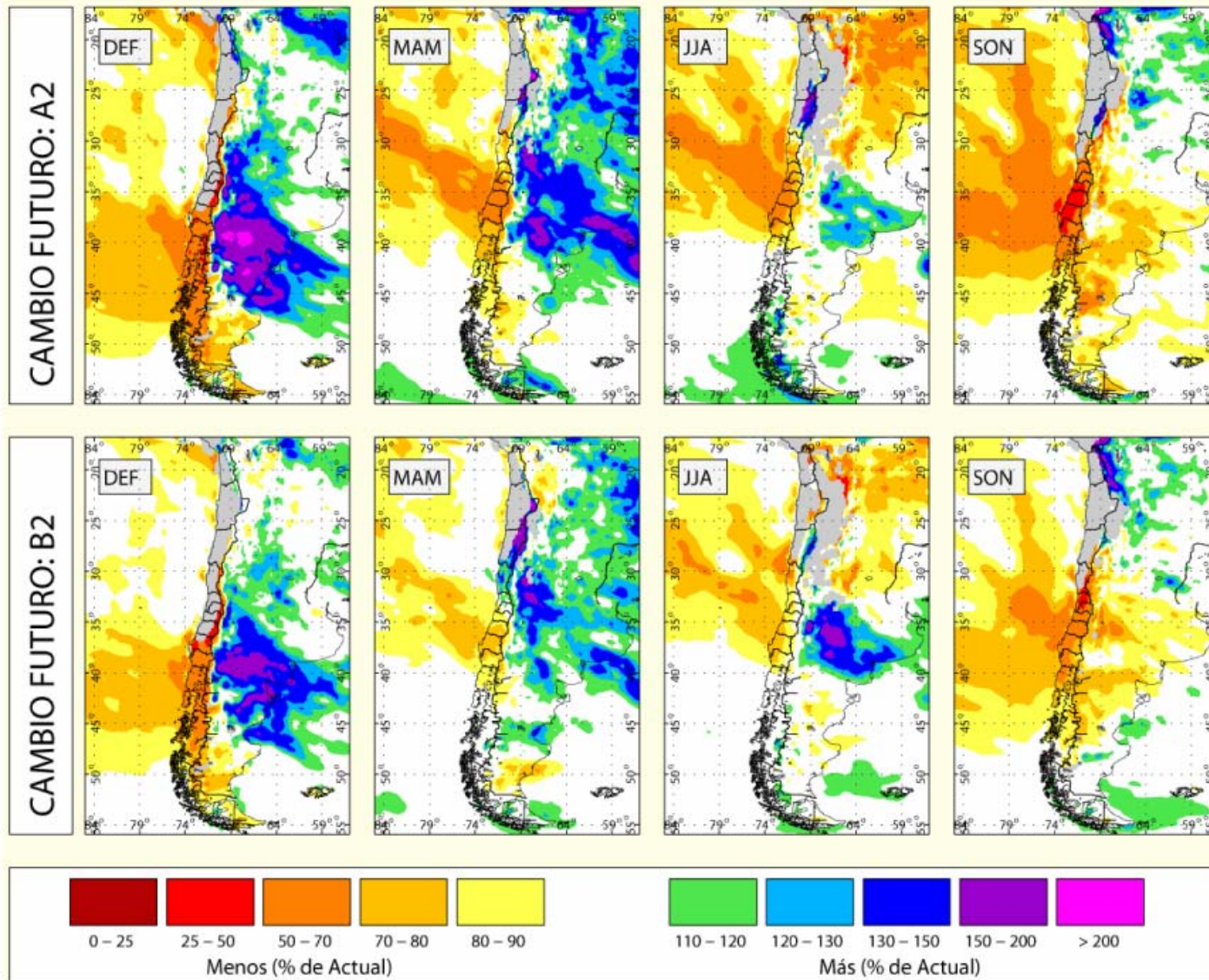
- **1961-1990 Baseline**
- **2071-2100 SRES A2 y B2**
- 30 years @ 3 min → 4 months per simulation in fast PC

PRECIS-DGF $T_{\text{futuro}} - T_{\text{presente}}$



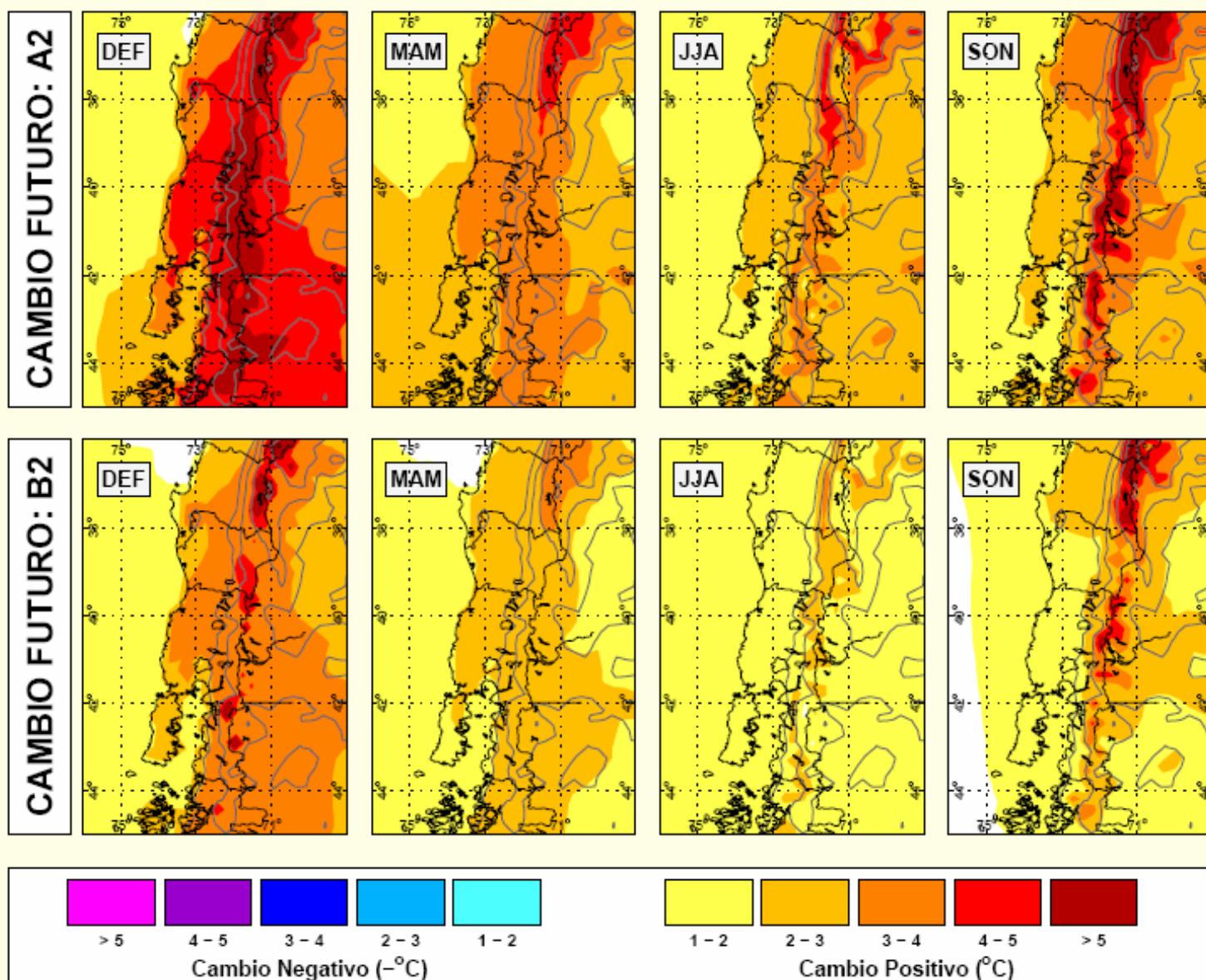
Futuro: 2071-2100 / Presente: 2071-2100

PRECIS-DGF $R_{\text{futuro}} / R_{\text{presente}}$



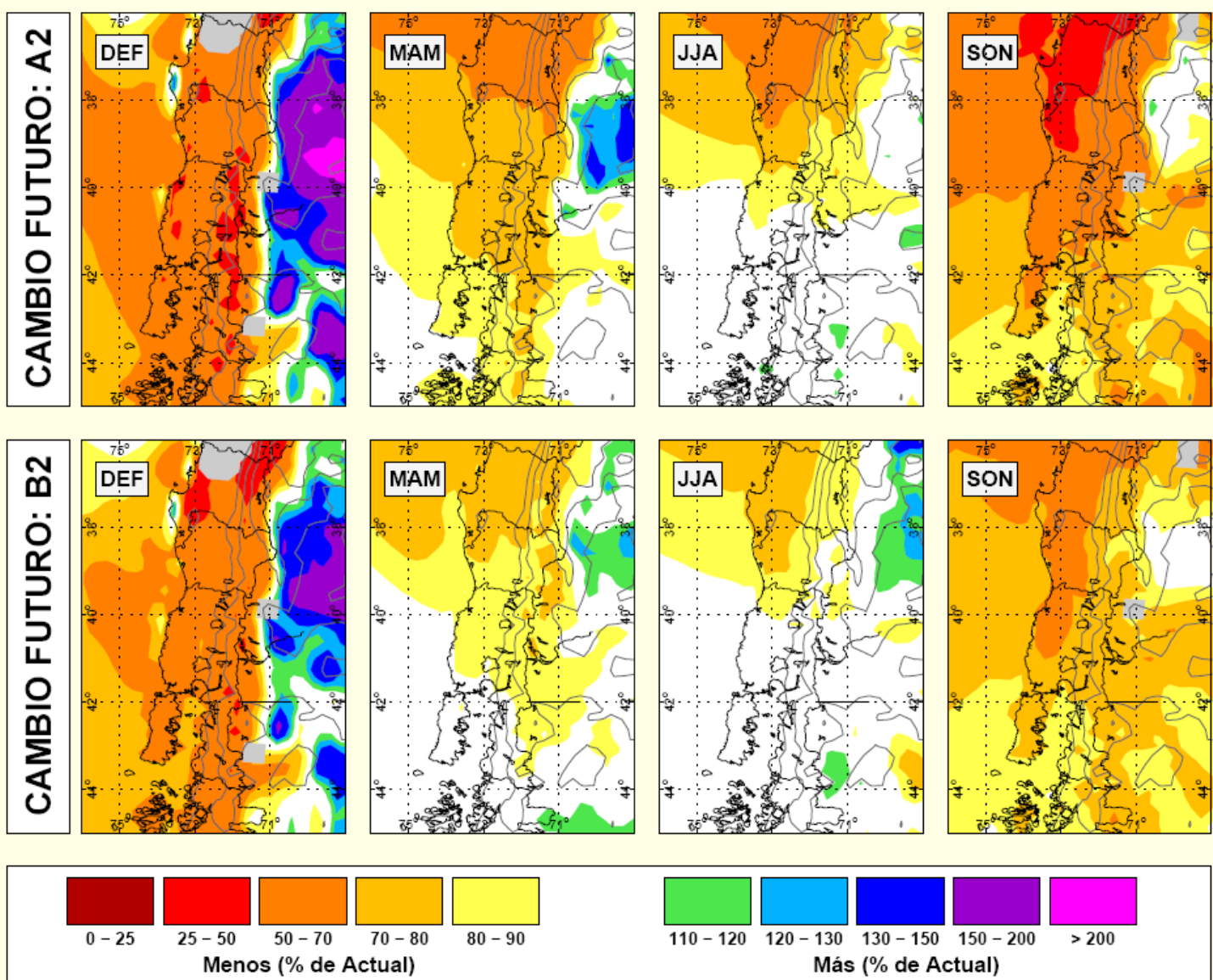
Futuro: 2071-2100 / Presente: 2071-2100

PRECIS-DGF $TX_{\text{futuro}} - TX_{\text{presente}}$



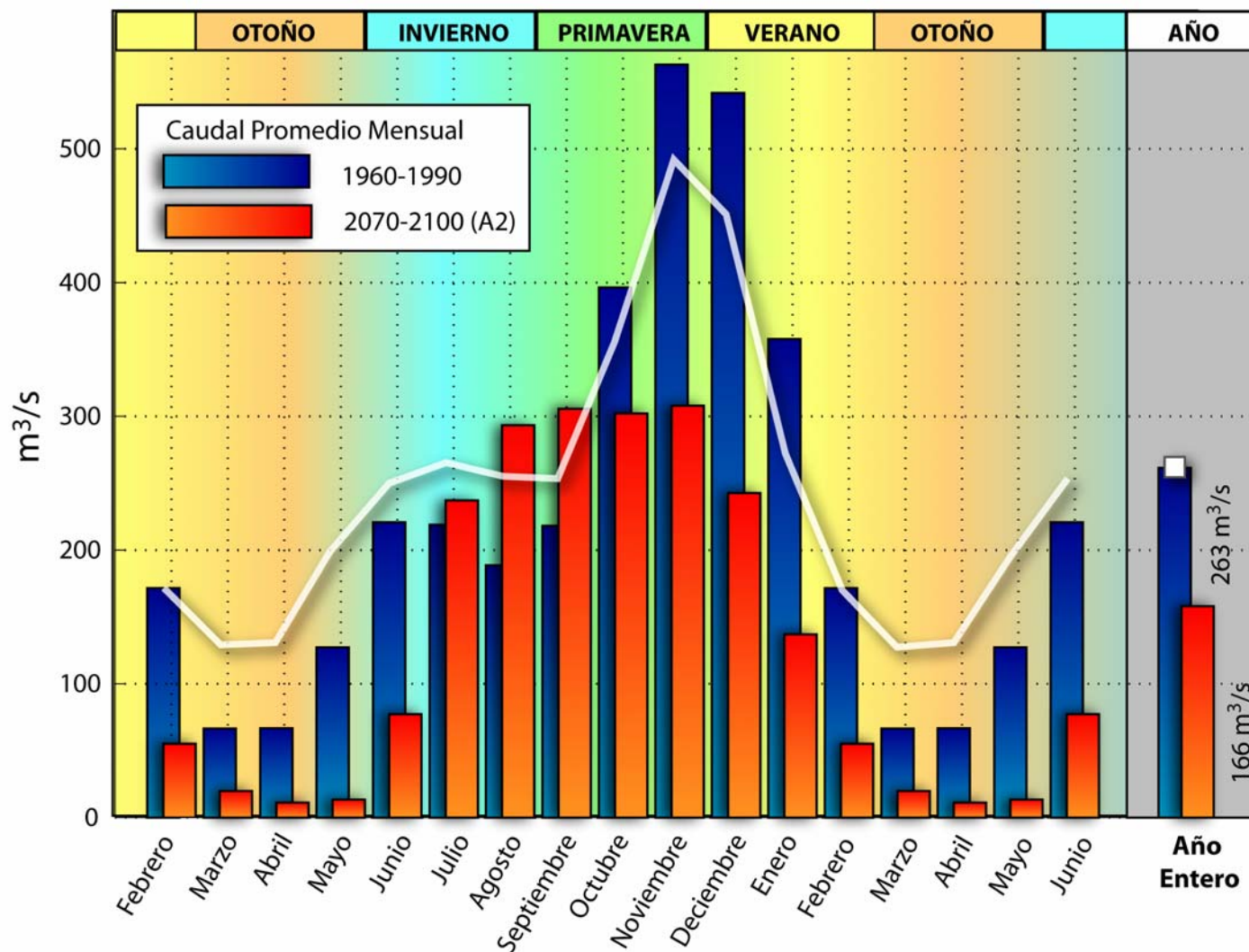
Futuro: 2071-2100 / Presente: 1961-1990

PRECIS-DGF $R_{\text{futuro}} / R_{\text{presente}}$



Futuro: 2071-2100 / Presente: 1961-1990

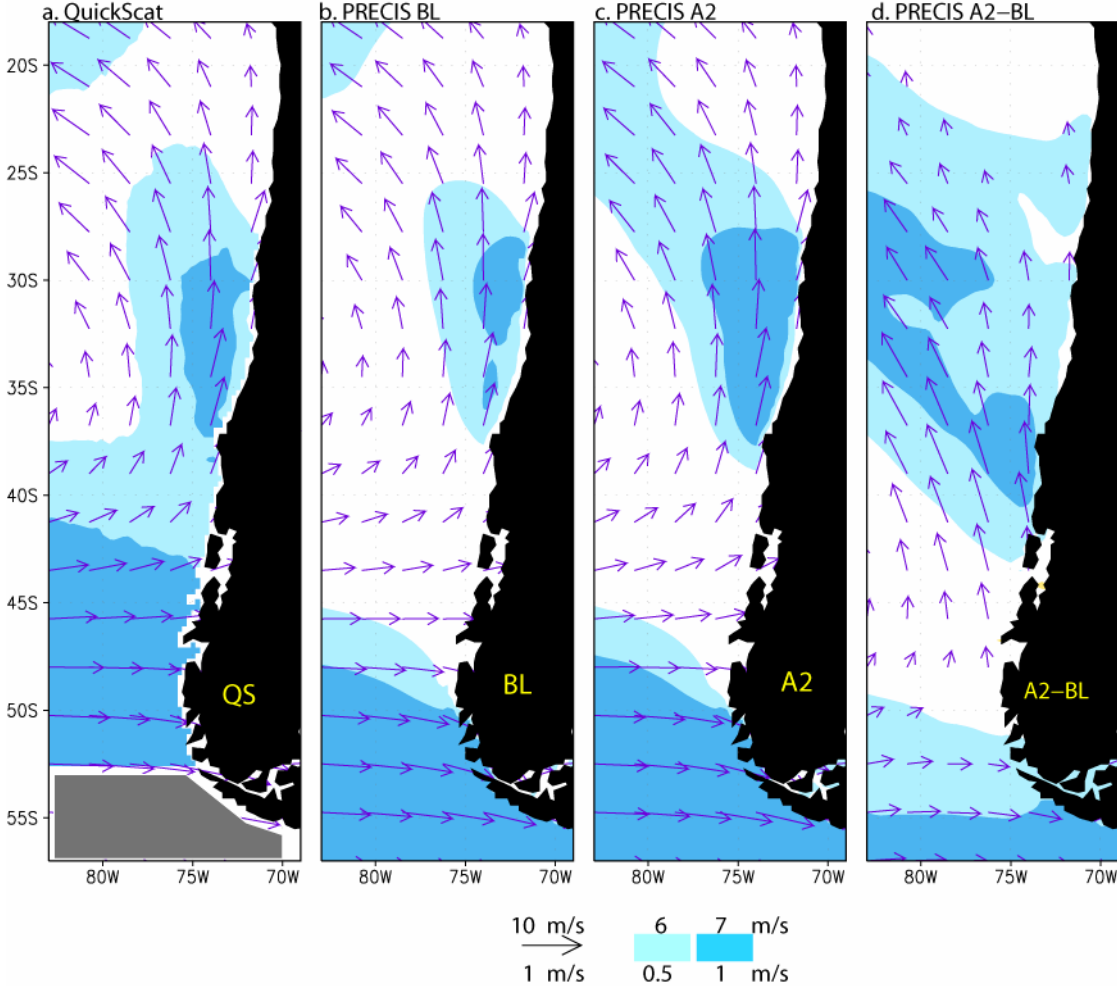
CAUDAL SIMULADO DEL RIO MAULE* - PRESENTE y FUTURO (A2)



* Rio Maule en Armerillo - Pre-Cordillera

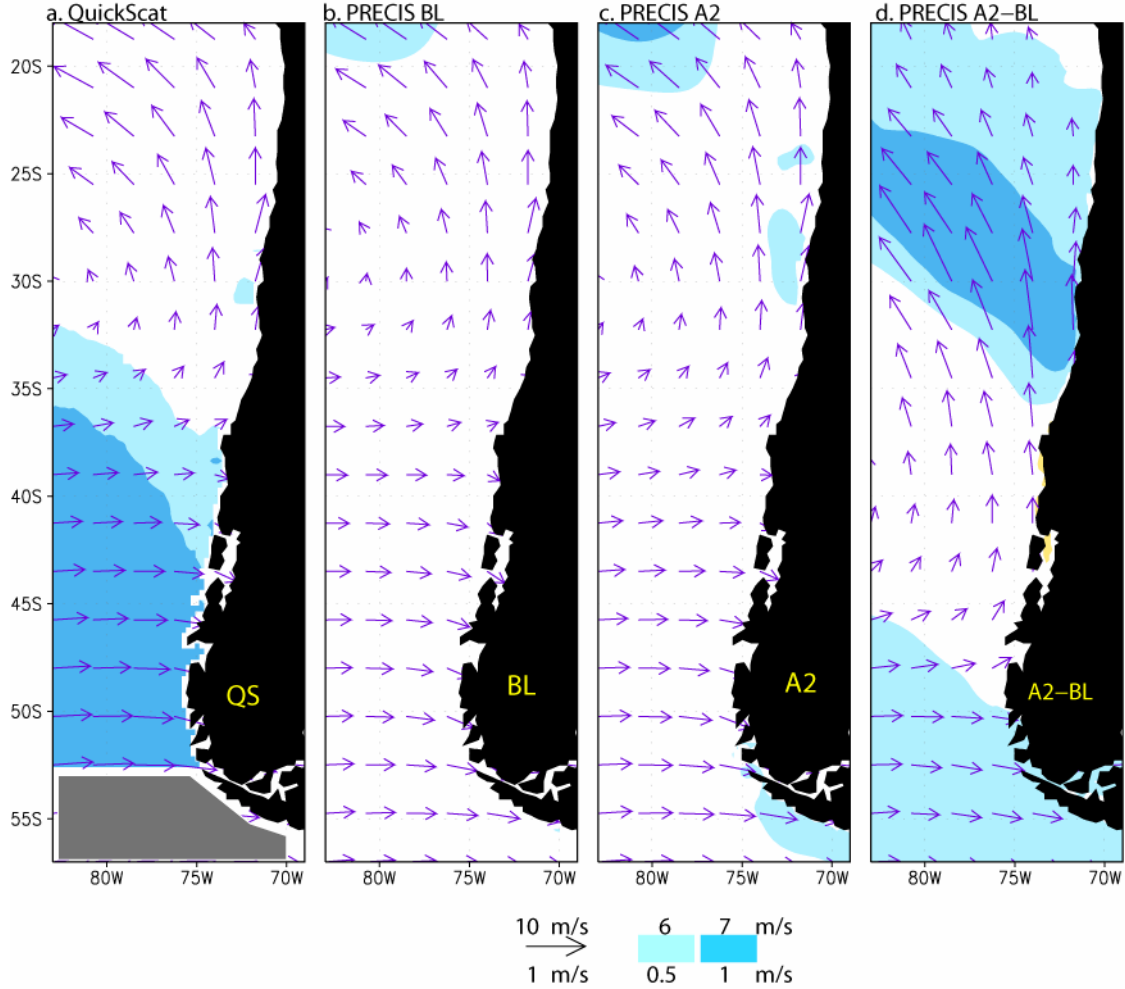
PRECIS Results

Surface Wind – SONDJ



PRECIS Results

Surface Wind – AMJJA



Conclusiones

Existen manifestaciones del cambio climático asociado a los GI en las últimas décadas a lo largo del país.

Cambios proyectados son en algunos casos similares en magnitud y signo a los observados en las últimas décadas.

Zona centro sur afectada por disminución de precipitación (especialmente en primavera, $\sim 1/2-3/4$ actual) y aumento de temperatura (especialmente T_x , $\sim + 2-4^\circ\text{C}$)

PRECIS-DGF es una buena base de datos para análisis sectoriales, pero solo un comienzo....