Es hora de mirar mas allá de Niño3.4

El rol del Pacifico Suroccidental en el hidroclima de Chile

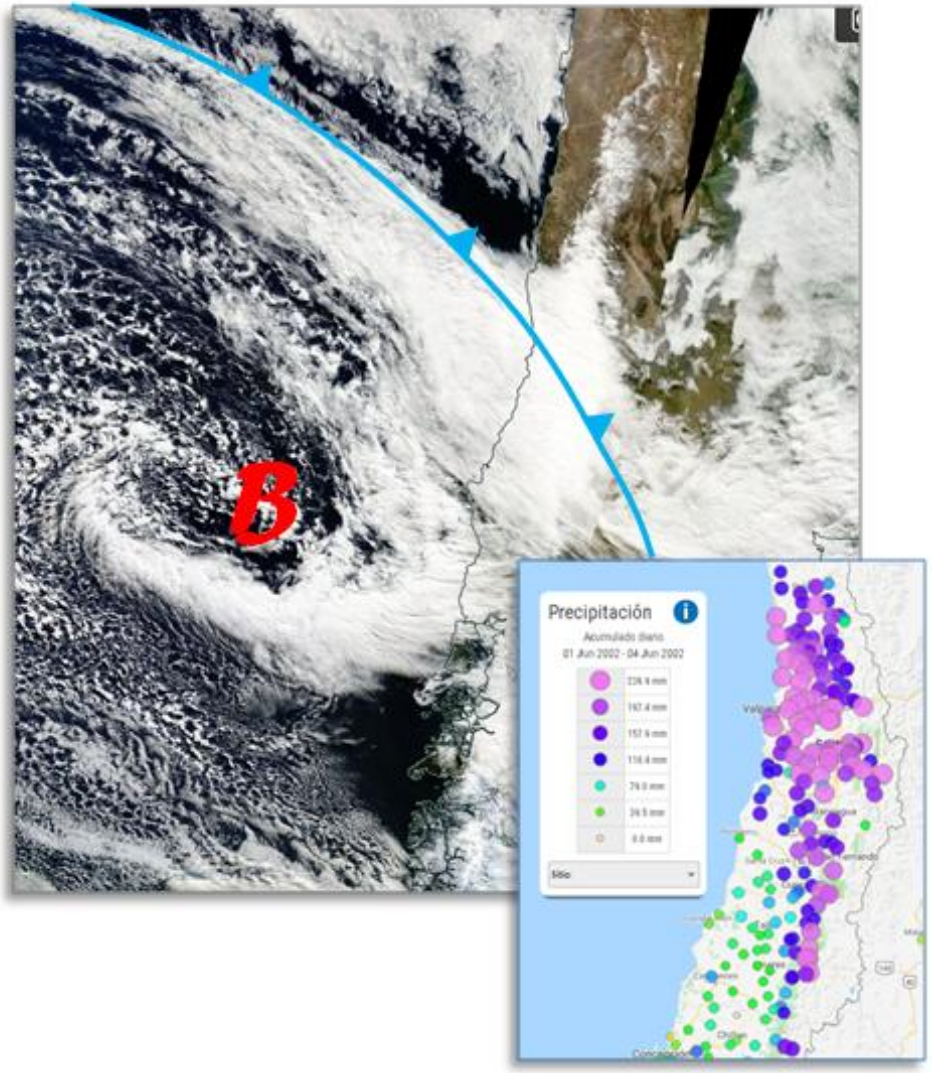
(*te pillamos po' compadre*)

René D. Garreaud
DGF-UChile + CR2

Agradecimientos: JP Boisier, R. Rondanelli, A. Montecinos, A. Sepulveda, D. Veloso

Synoptic control of central Chile precipitation

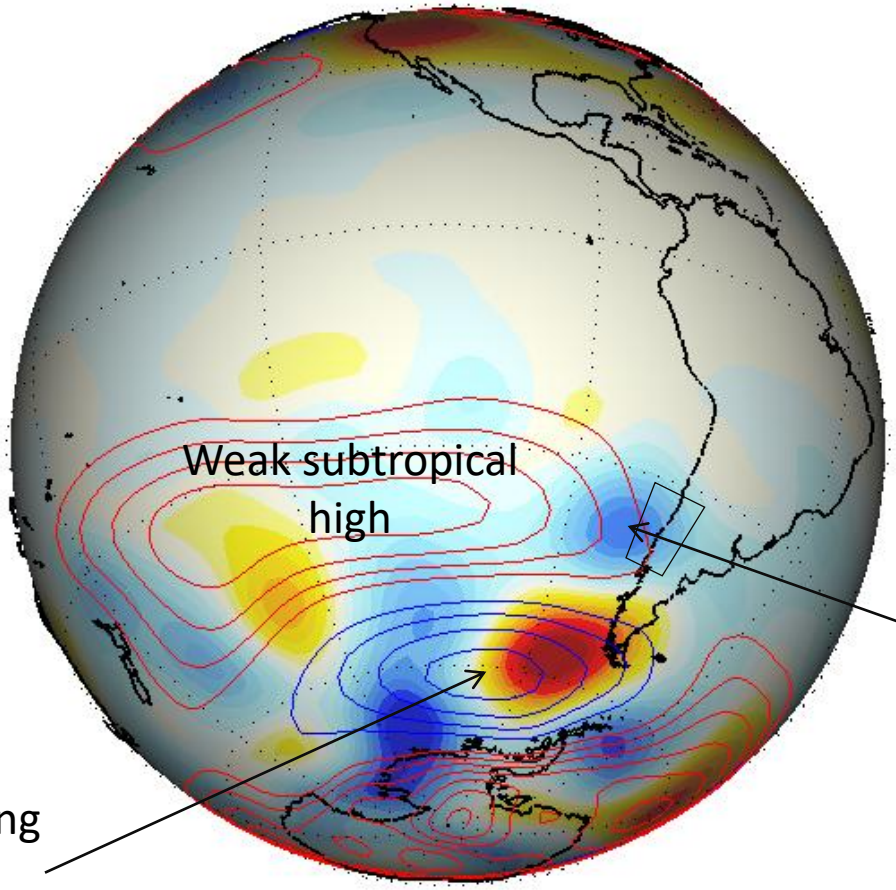
(It rains when a cold front reach us)



Synoptic control of central Chile precipitation

(It rains when a cold front reach us)

Composite Z500 anomalies for wet years in central Chile
Contours: mean, Colors: std

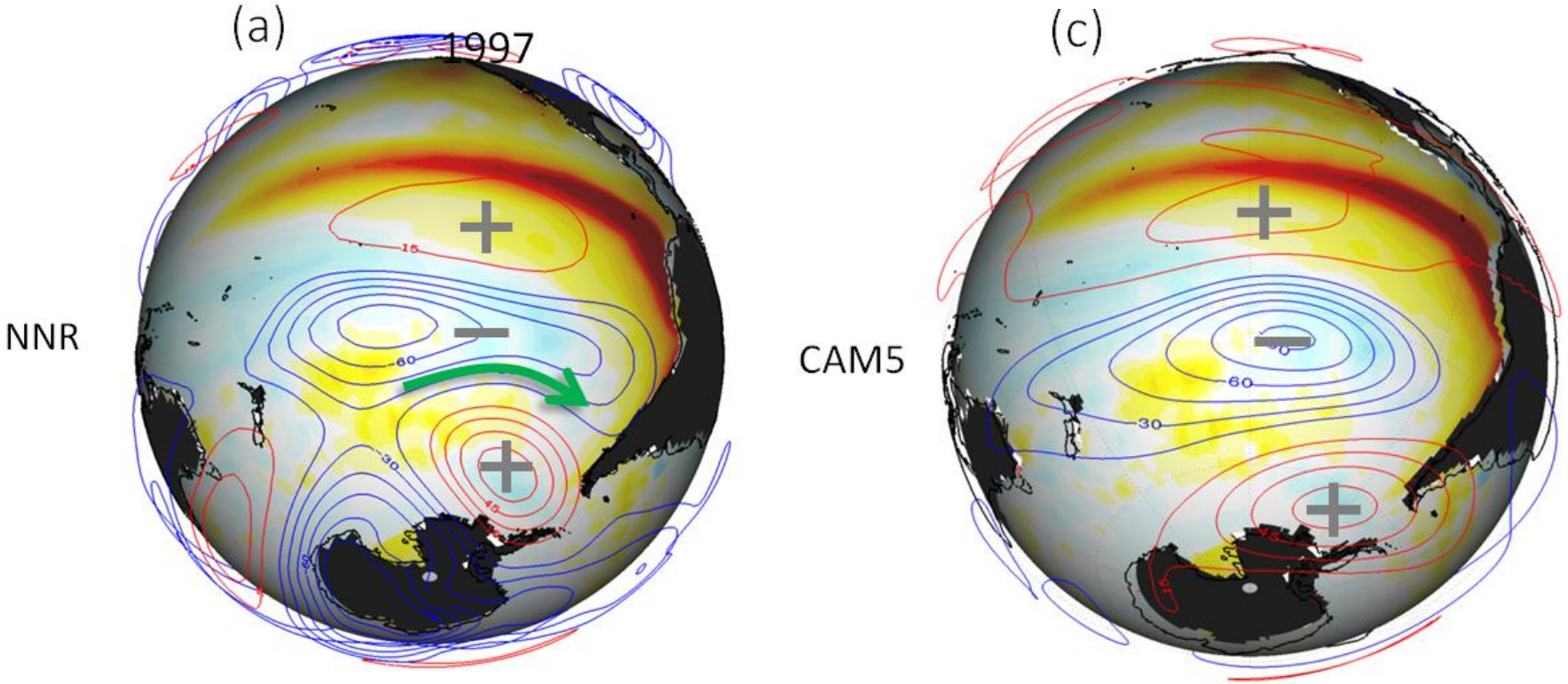


What planetary-scale mode can produce conditions favorable for central Chile winter rainfall?

El Niño, of course! Let's start with a good example: 1997

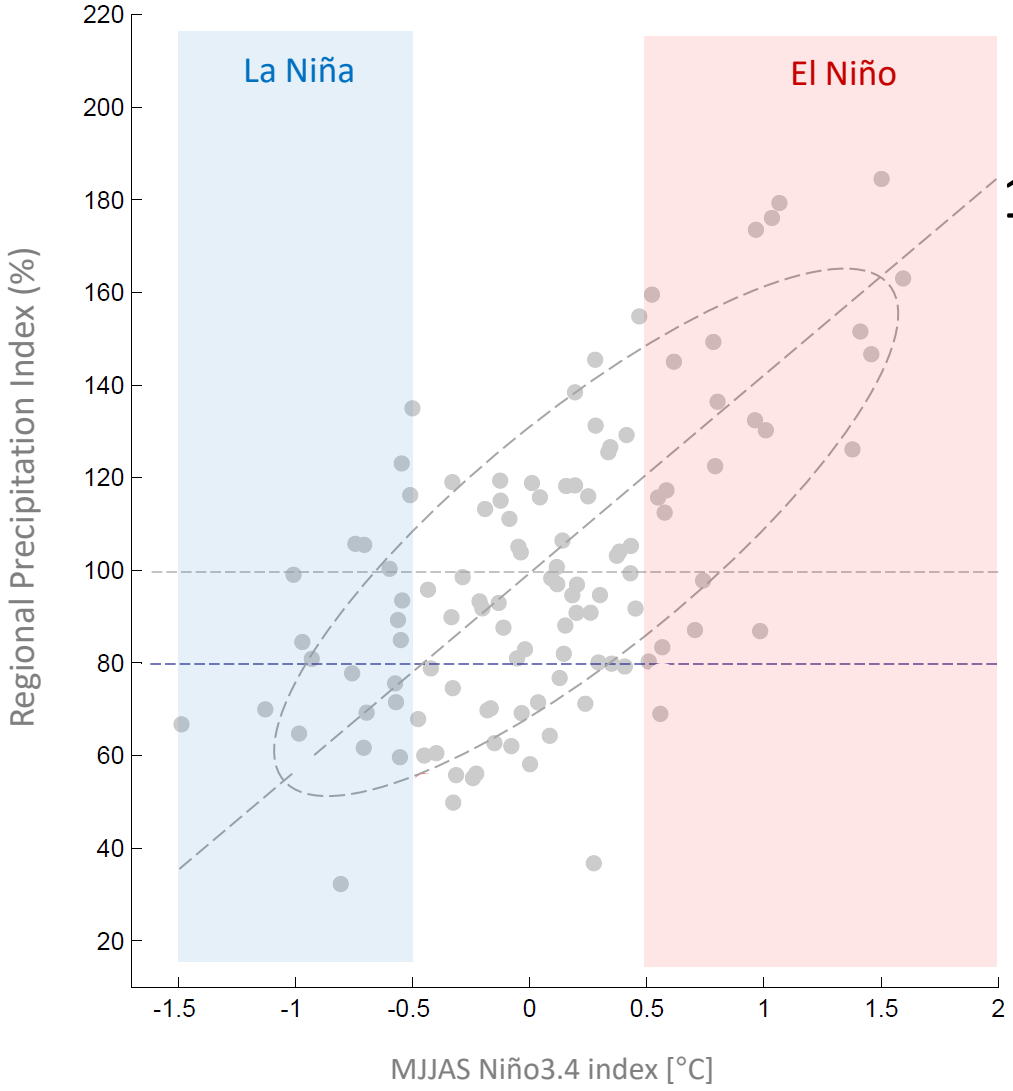
(>700 mm of rainfall, 2-3 larger than long-term-mean)

SST and Z200 anomalies



Antes la vida era mas simple

ENSO / Central Chile winter precipitation

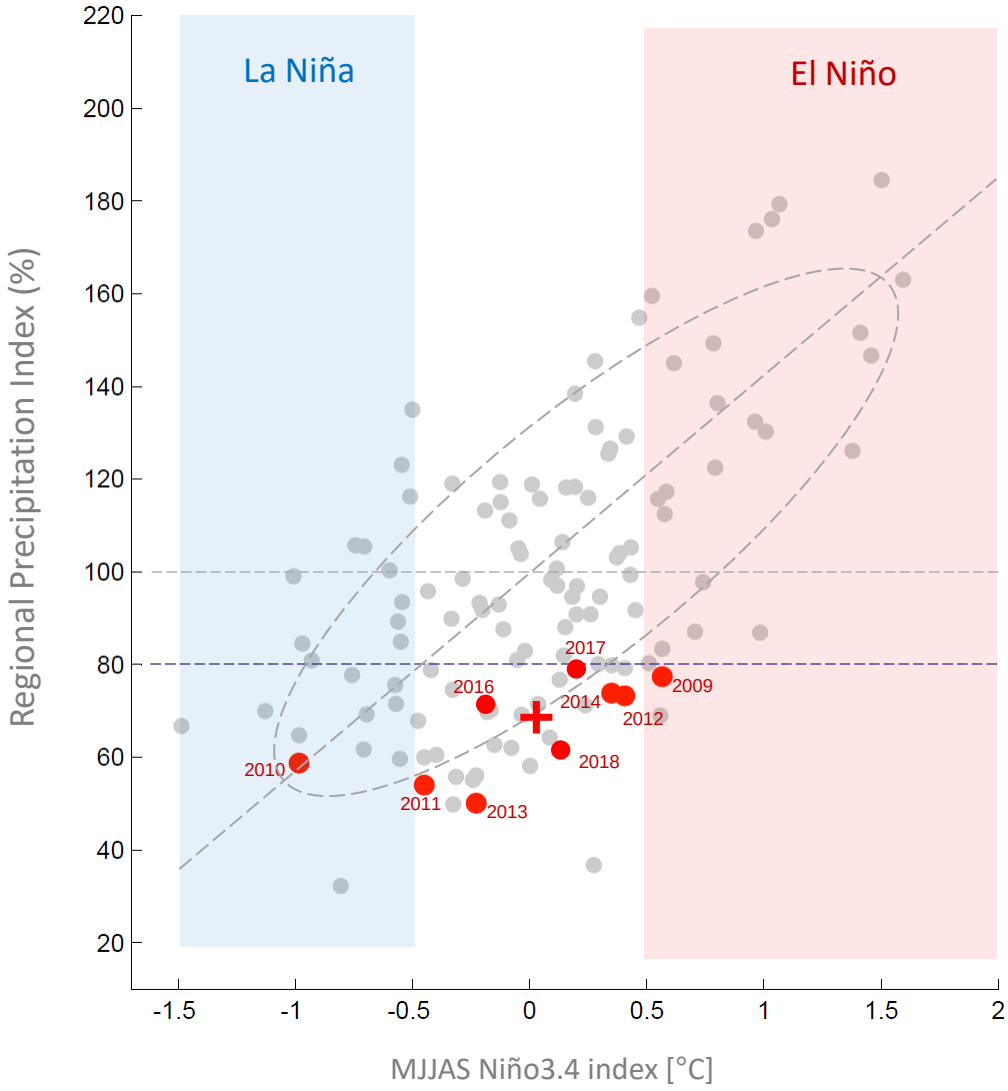


$r \sim +0.6$

1912-1999

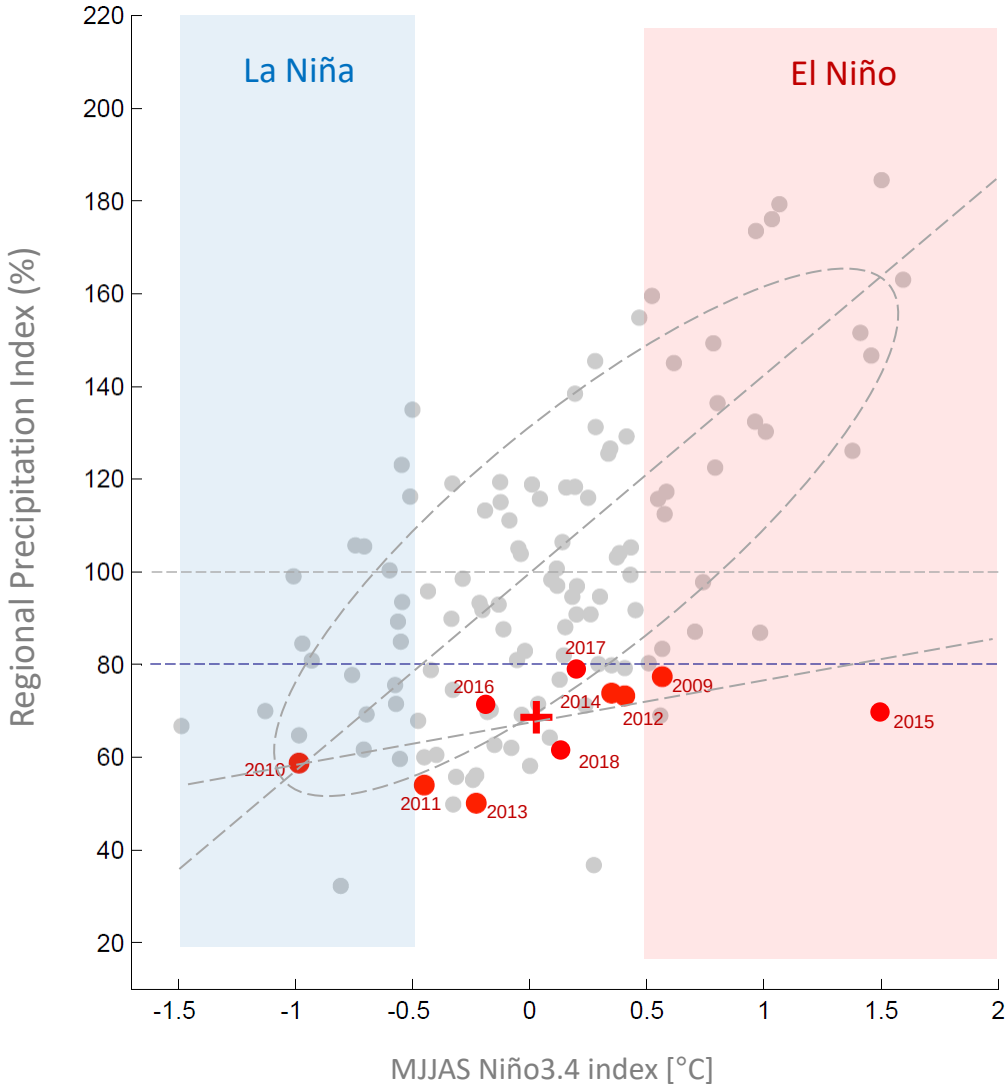
Antes la vida era mas simple

ENSO / Central Chile winter precipitation



Antes la vida era mas simple

ENSO / Central Chile winter precipitation

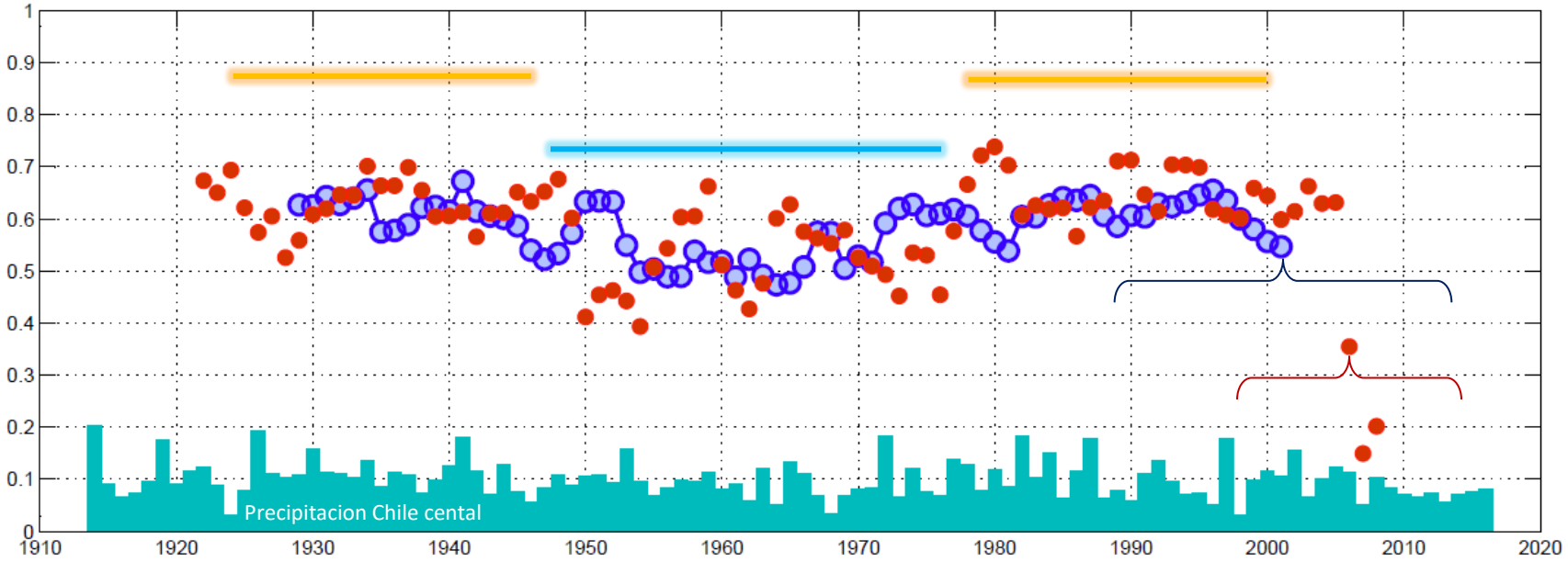


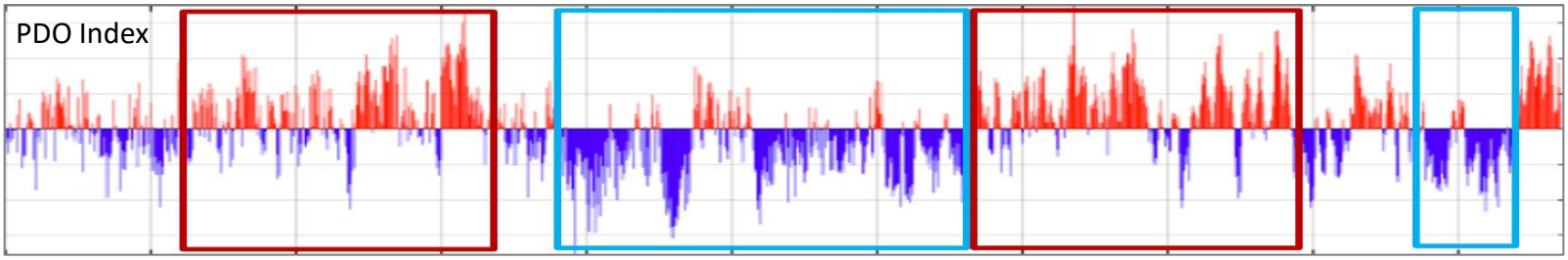
$r \sim +0.1$
2000-2018

r(PP-Chile Central, Nino3.4-MJJAS)

Ventanas de ±15 años centradas en año *j*

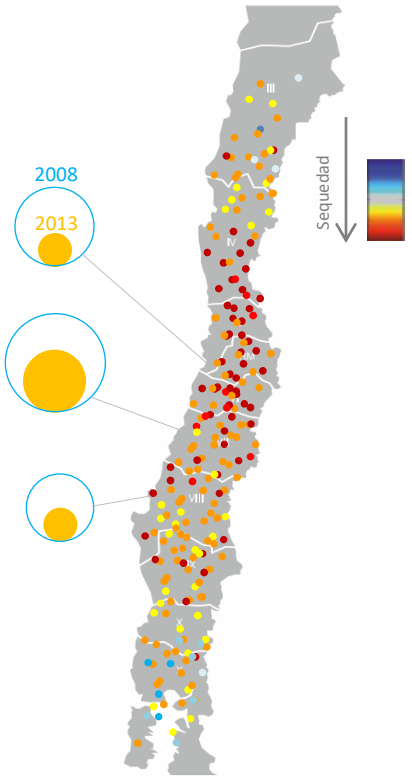
Ventanas de ±8 años centradas en año *j*





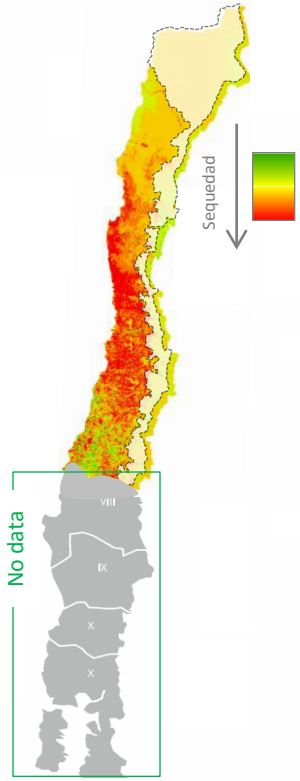
Impactos de la Msequia 2010-2015

Transporte de sedimentos en invierno

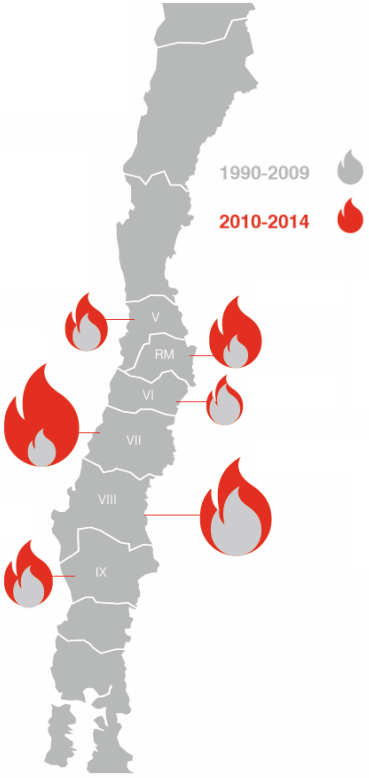


Déficit Pluviométrico (2010-2014)

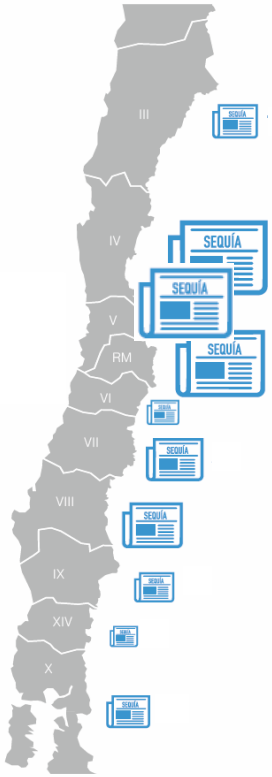
Deterioro vegetación Agosto 2010-2015



Incendios forestales de magnitud



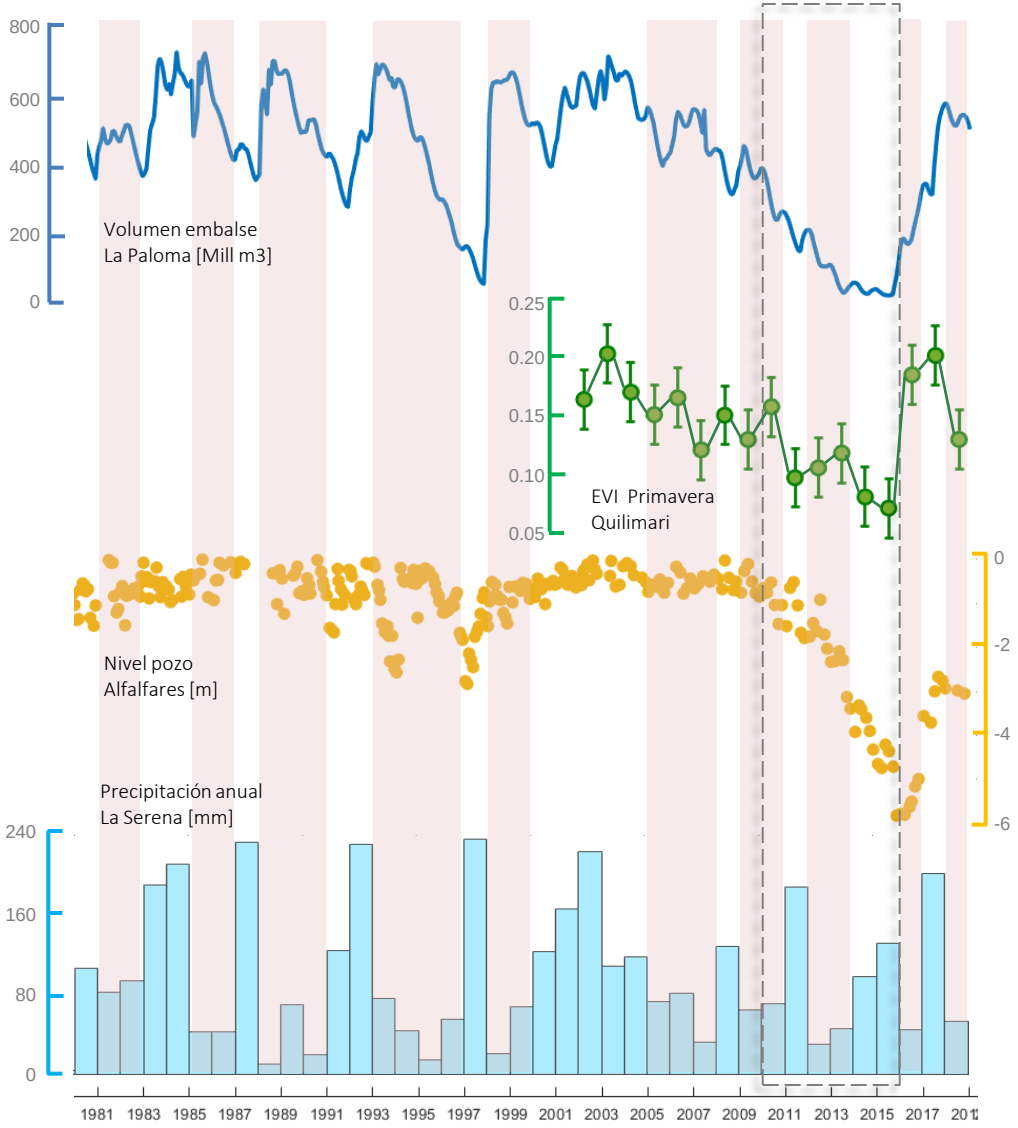
Apariciones en prensa escrita (2014)



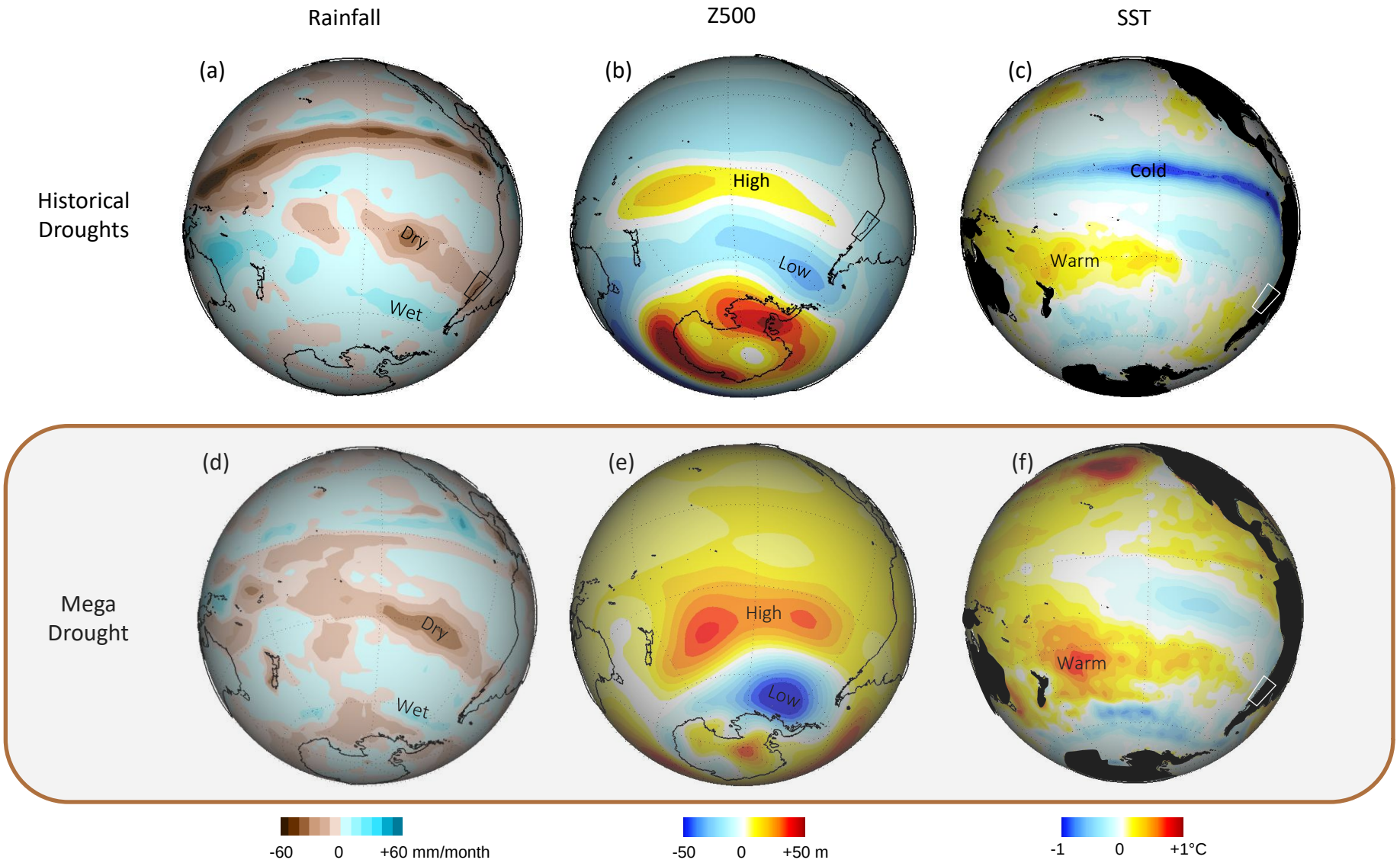
Gastos en Camiones Aljibes (Mill$)

Hidroclima de la zona árida

(actualizado Dic. 2018)

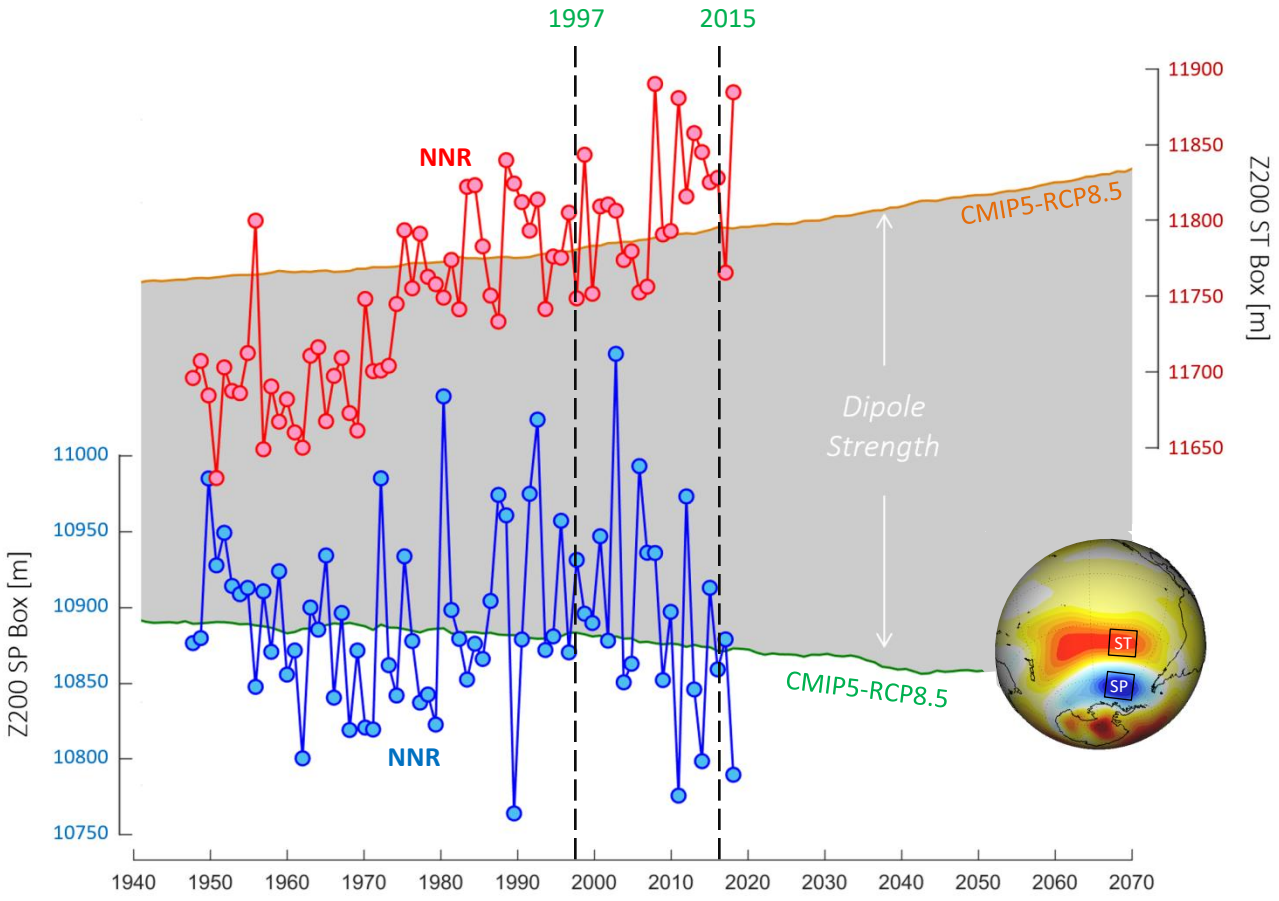


The 2010-2018 drought in Central Chile



Variabilidad y Tendencia

Recall that rainy winters require positive (negative) pressure anomalies over the Amundsen Bellinhausen Sea (subtropical SE Pacific)…



Attribution of the 2010-2018 mega drought

AMIP-X simulations: Atmospheric Global Circulation Model (AGCM) forced by

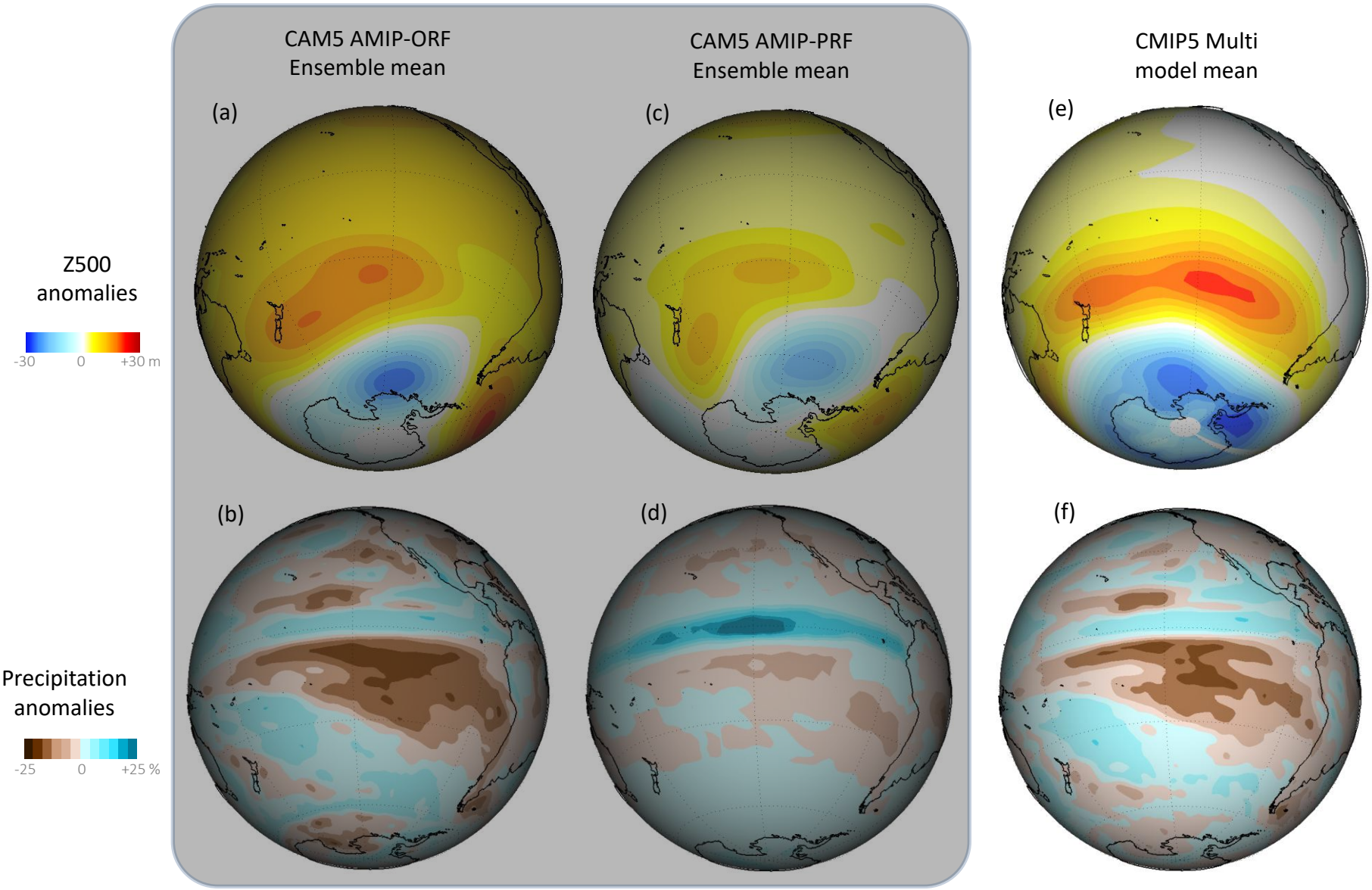
- Observed SST & Sea Ice Distribution
- Observed Radiative Forcing (CO2, aerosols, O3,…)
- Special AMIP simulations with natural-historical RF (1900')

- 10-30 "runs" of several decades long with slightly different initial conditions
- Ensemble mean reveals the "natural" SST forced response
- Ensemble spread reveals impact of internal variability (weather)
- Ensemble mean with NH-RF excludes *direct* anthropogenic impact

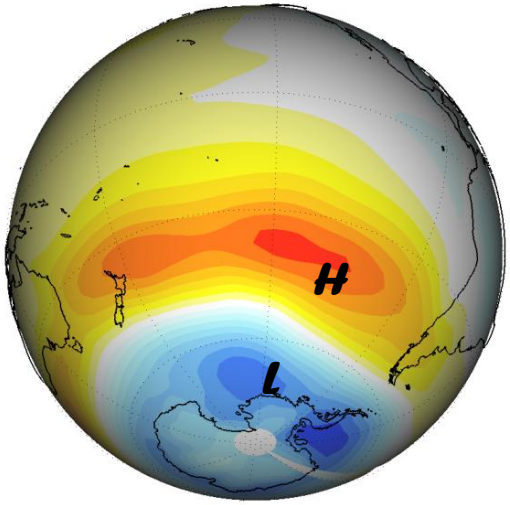
CMIP-X simulations: AO oupled Global Circulation Model (AOGCM) forced by

- Observed or projected RF (CO2, aerosols, O3,…)
- Multi-model, multi-run mean reveals the RF forced response

May-September, 2010-2018



SLP Anomalies (hPa)
Antropoghenic



1/4

2010-2018 Central Chile MD

May-September, 2010-2018

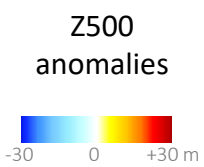
“Natural” (ocean) signal

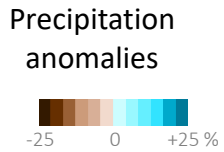
Climate change

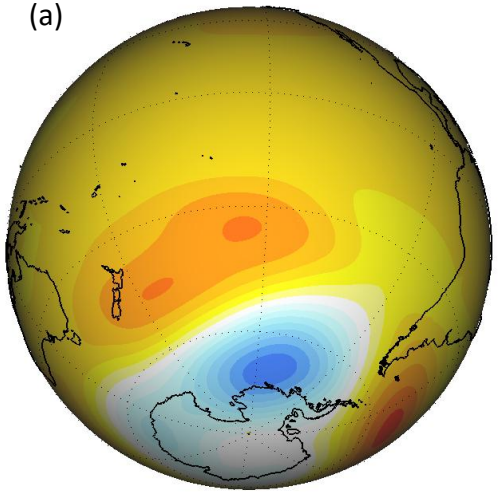
CAM5 AMIP-ORF
Ensemble mean

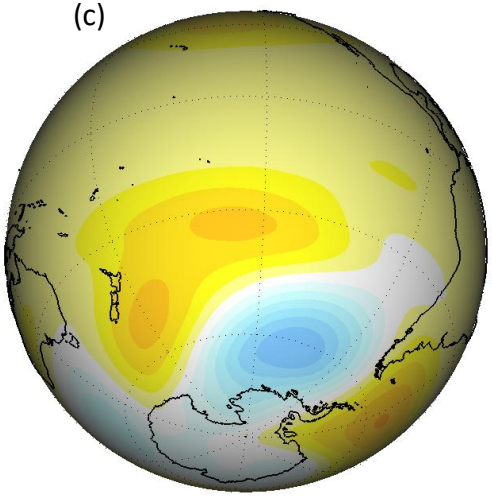
CAM5 AMIP-PRF
Ensemble mean

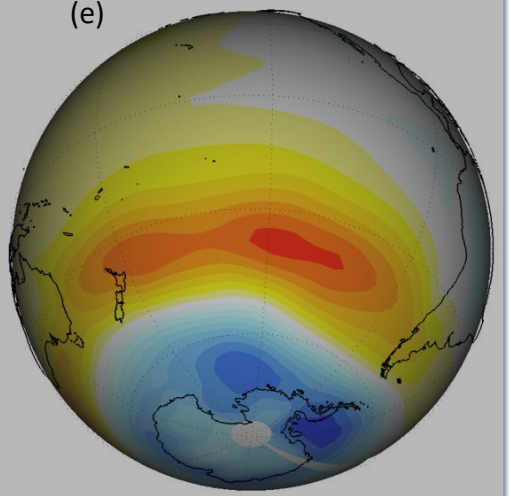
CMIP5 Multi
model mean

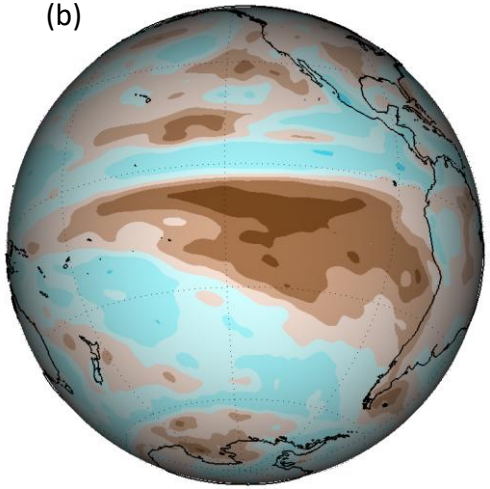


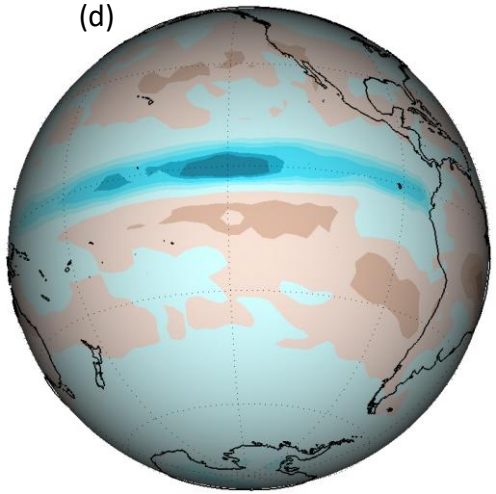


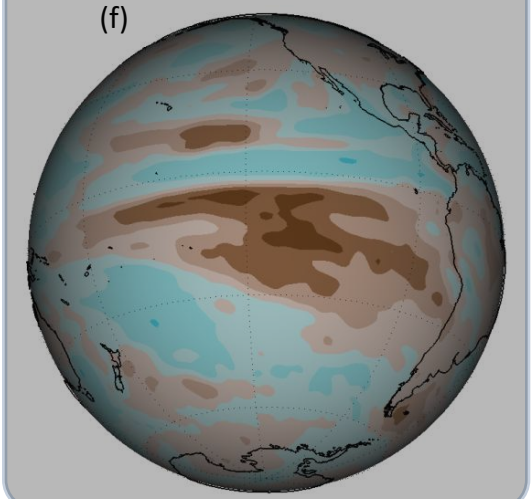






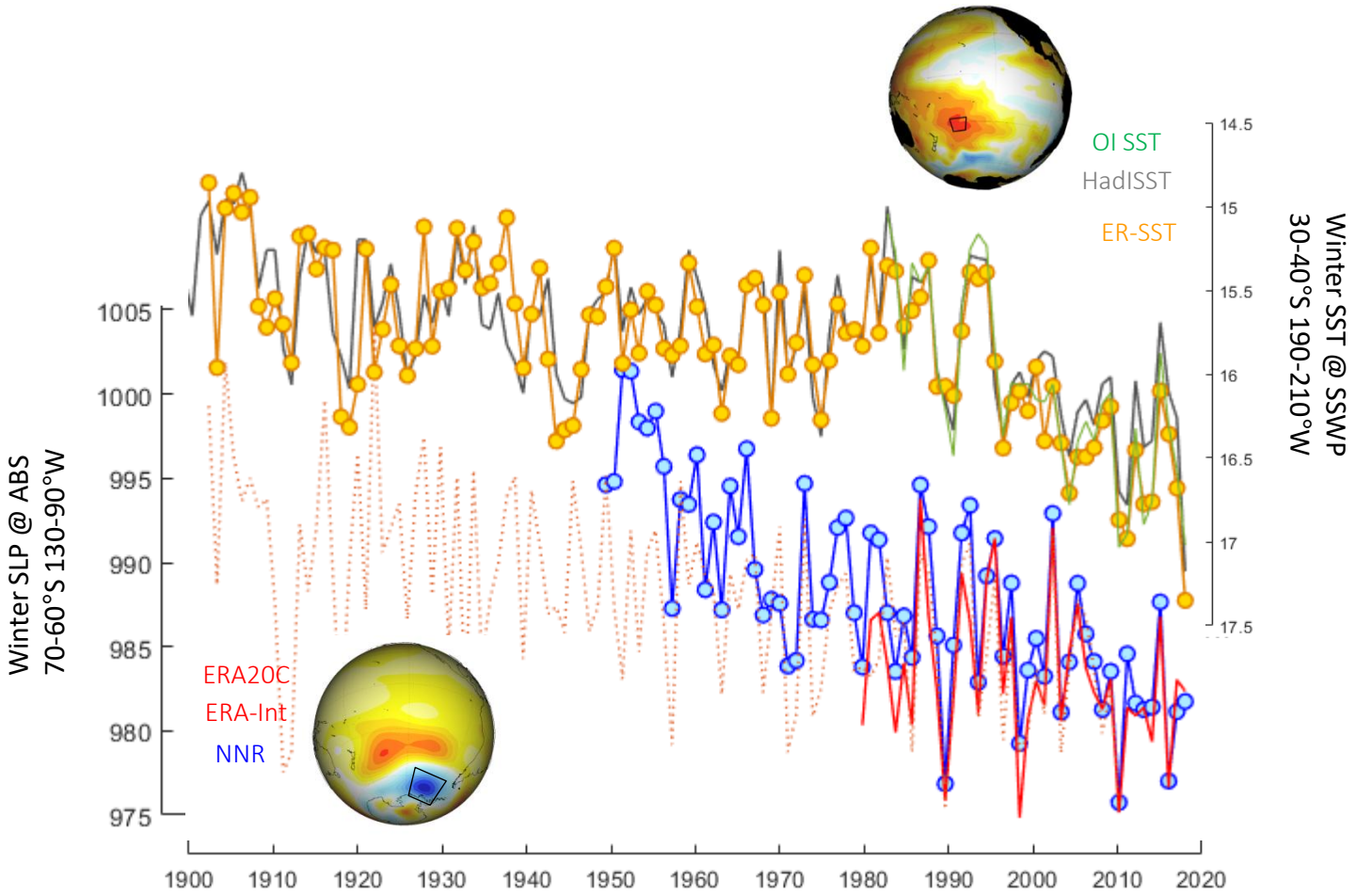


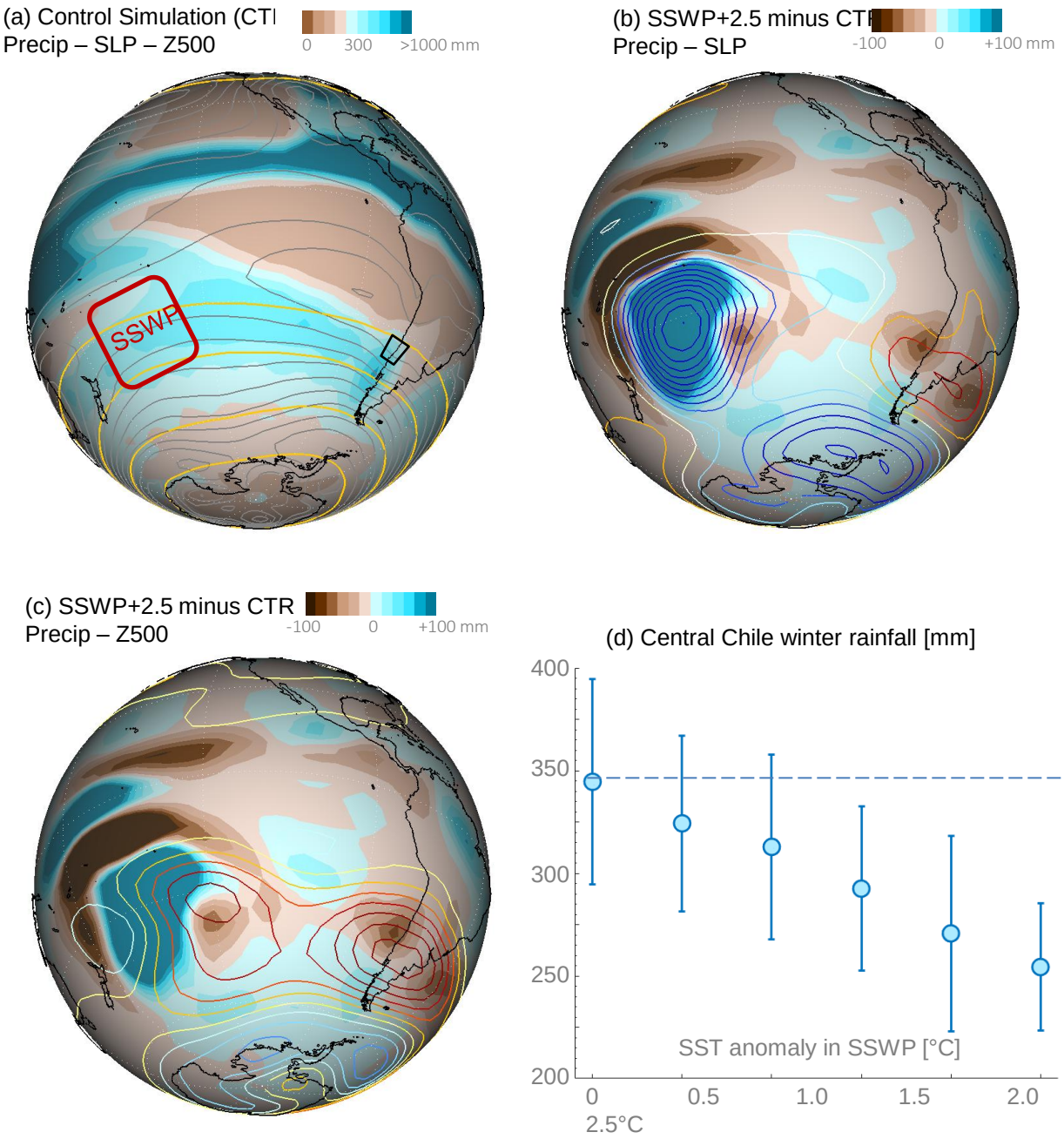




Are long term trends (Climate Change) interfering with ENSO teleconnections in western SA?

Recall that rainy winters require positive (negative) pressure anomalies over the Amundsen Bellinhausen Sea (subtropical SE Pacific)…

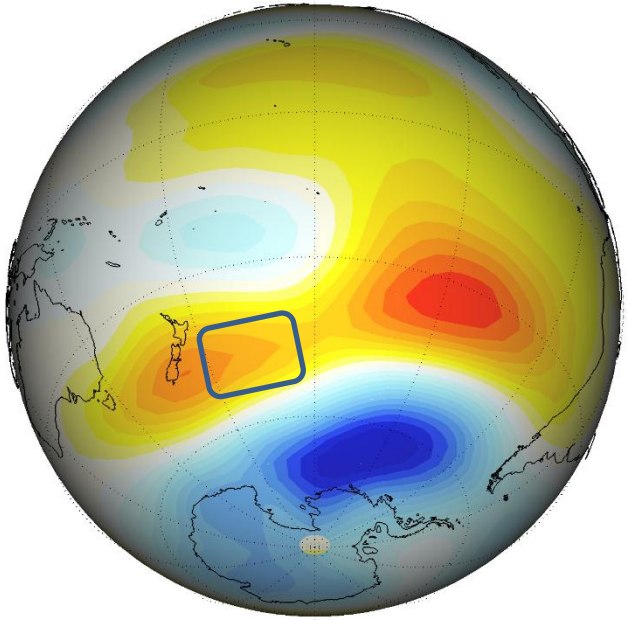



(a) Control Simulation (CTl
Precip – SLP – Z500
0
300
>1000 mm
SSWP
(b) SSWP+2.5 minus CTl
Precip – SLP
-100
0
+100 mm
(c) SSWP+2.5 minus CTR
Precip – Z500
-100
0
+100 mm
(d) Central Chile winter rainfall [mm]
400
350
300
250
200
SST anomaly in SSWP [°C]
0
0.5
1.0
1.5
2.0
2.5°C

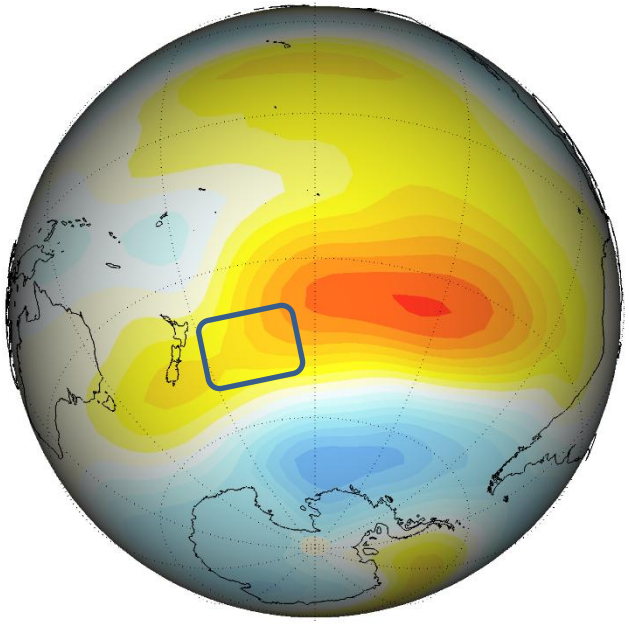
Is the southwest subtropical Pacific causing the pressure drop over the ABS?

SLP Trend 1980 – 2015 calculated with SPEEDY

Control (Full SST)

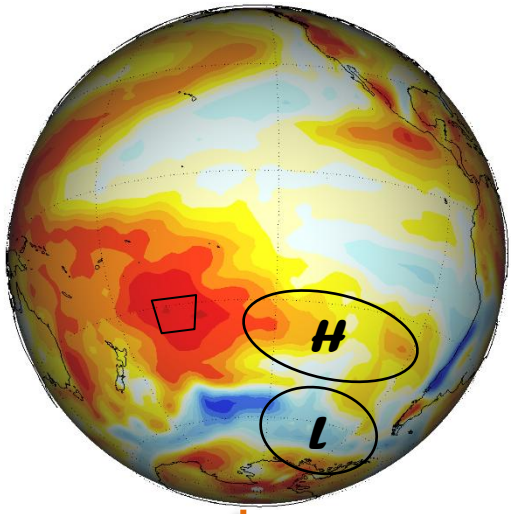


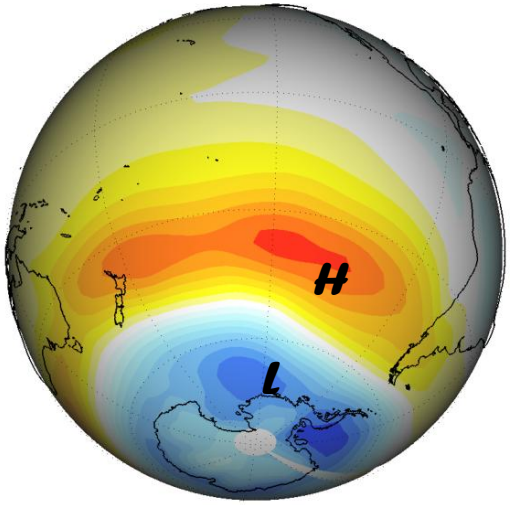
No SSWP SST



Observed SAT Anomalies (°C)
Natural (+ Trend?)

SLP Anomalies (hPa)
Antropoghenic





2/3

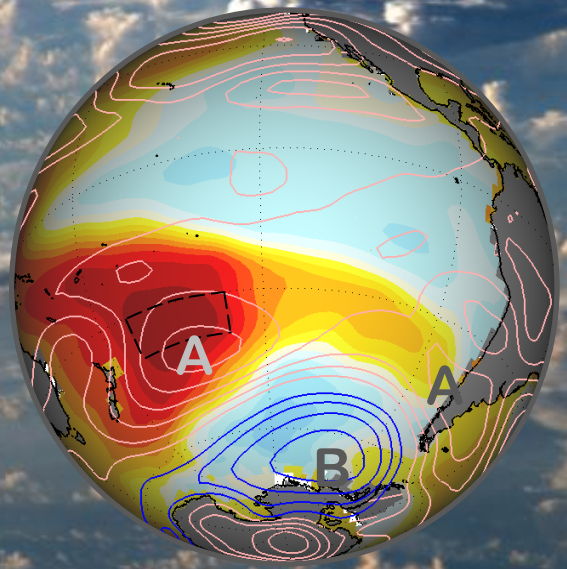
1/4

2010-2018 Central Chile MD

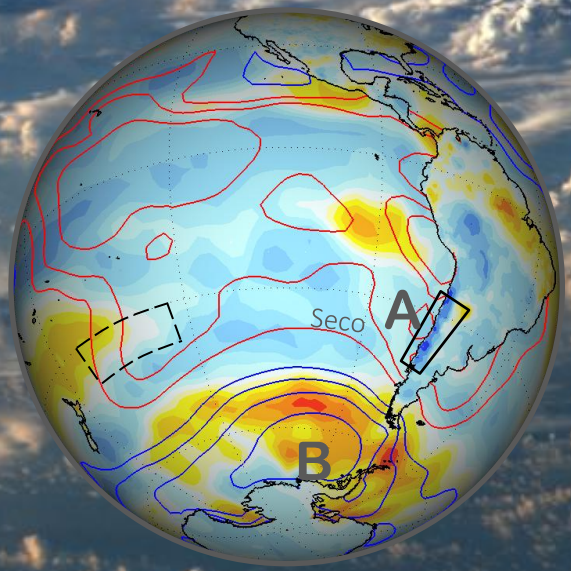
Es hora de mirar mas allá de Niño3.4

El hidroclima de Chile central también es controlado, parcialmente, desde el sector subtropical del Pacifico occidental (SSWP).

Un calentamiento en esa zona genera una teleconexión con una baja sobre el mar de Bellinhausen y una alta sobre Chile central…la receta de nuestras sequias

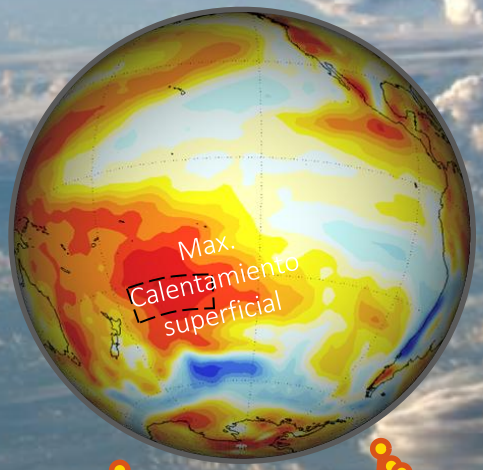


(a) Correlación de la TSM-SSWP con TSM (colores) y Z500 (contornos)



(b) Correlación de la TSM-SSWP con Precipitación (colores) y PNM (contornos)

El SSWP y la Mega Sequía



Tendencia de la TSM (invierno austral) entre 1980 y 2018

TSM en el Pacifico Subtropical sur occidental (Fuente: ERSST-v4)

El SSWP ha experimentado un marcado calentamiento en los últimos 30 años, alcanzando valores record desde el año 2000.

Lo anterior podría estar contribuyendo a las condiciones secas que han prevalecido en Chile central, independiente de la señal de ENOS

Average SST Anomalies
28 APR 2019 – 25 MAY 2019