

# Climate variability along the extratropical West coast of South America:

## Associated mechanisms

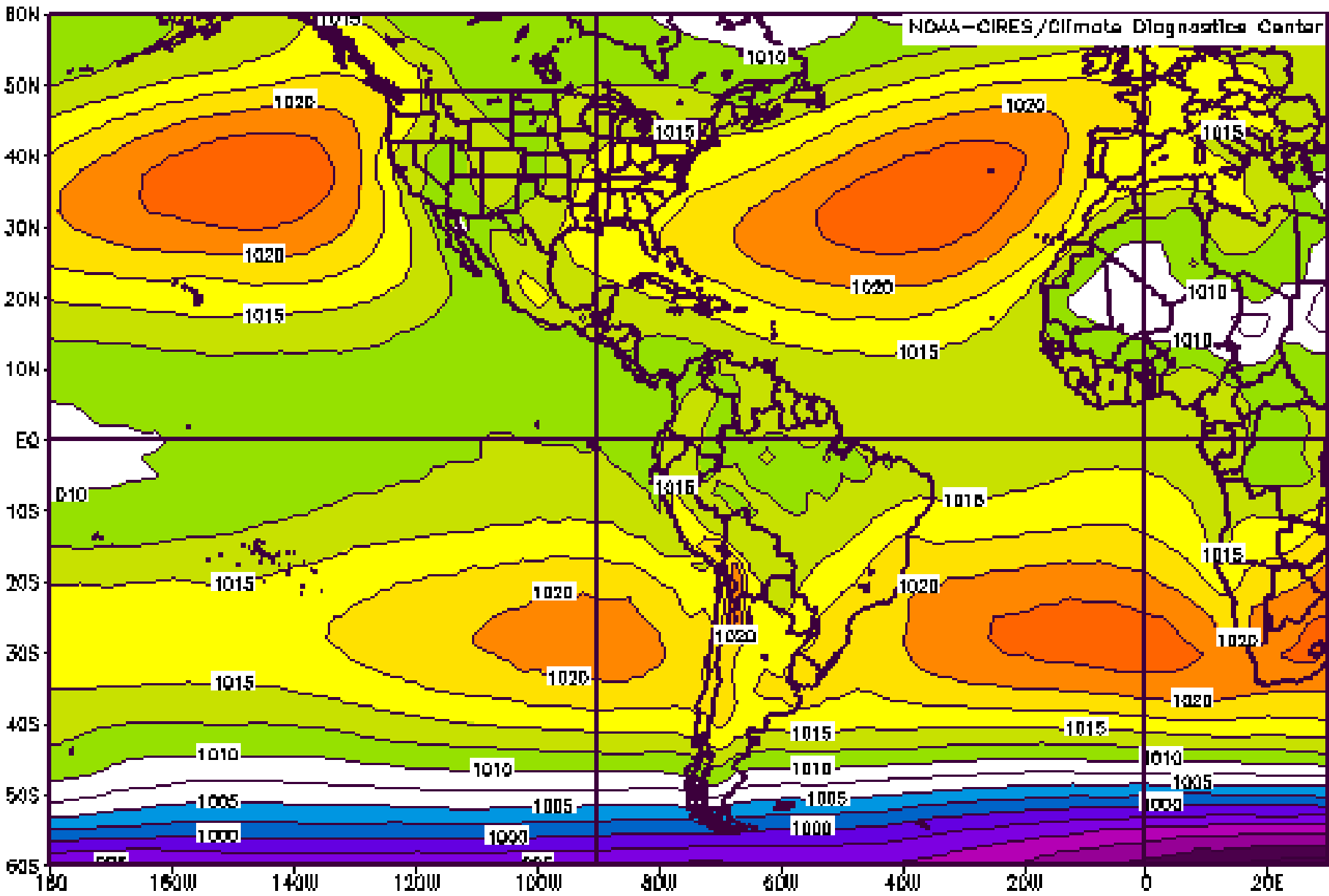
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Dpt. of Geophysics - Universidad de Chile

II SIMPOSIO INTERNACIONAL DE CLIMATOLOGIA  
Sao Paulo, Brasil, 2-3 November 2007



# SEA LEVEL PRESSURE

NOAA-CIRES/Climate Diagnostics Center



Sea Level Pressure (mb) Climatology, 1980-1998 NCEP/NCAR Reanalysis



# Main factors of climate system and its variability

ITCZ, seasonal convection regime, ENSO, Pacific Decadal Oscillation (PDO), Kelvin waves, coastal upwelling.

Subtropical anticyclone, stratiform cloudiness, subtropical jet stream, cut-off lows, Humboldt current and coastal upwelling, ENSO, PDO.

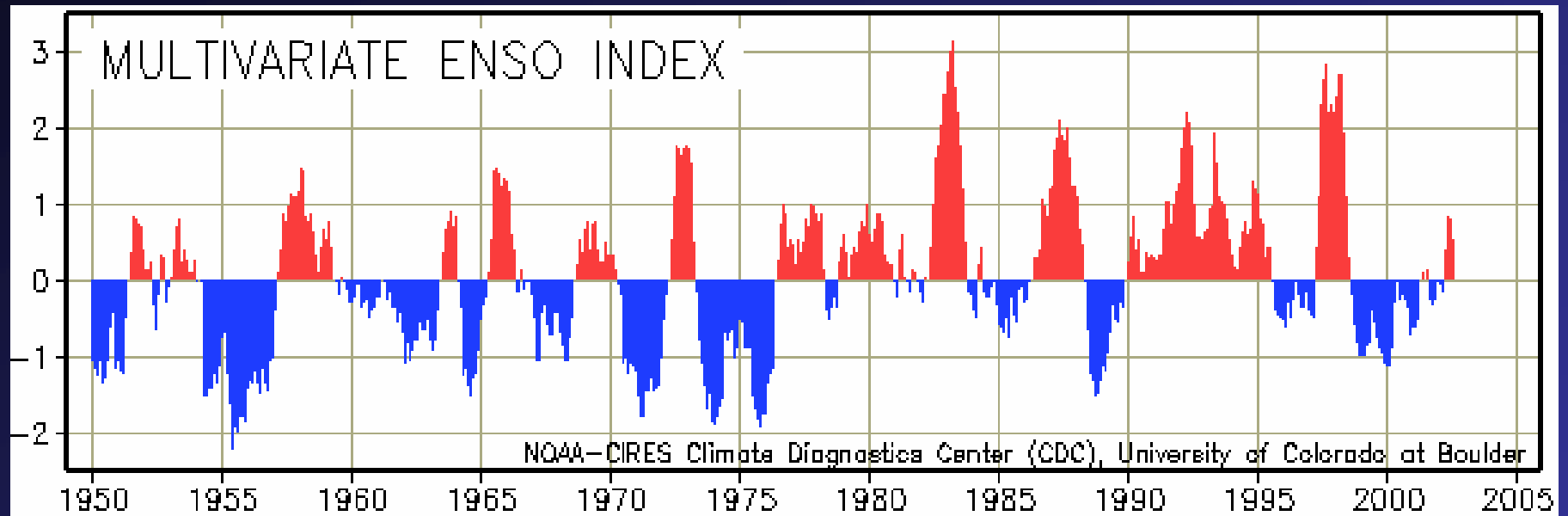
Westerly wind regime and associated migratory perturbations (highs and lows), blocking episodes, teleconnections with the tropics, Antarctic Oscillation.



## Large – scale factors of regional climate in Chile

- ▶ Southern Oscillation
- ▶ Pacific Decadal Oscillation
- ▶ Antarctic Oscillation

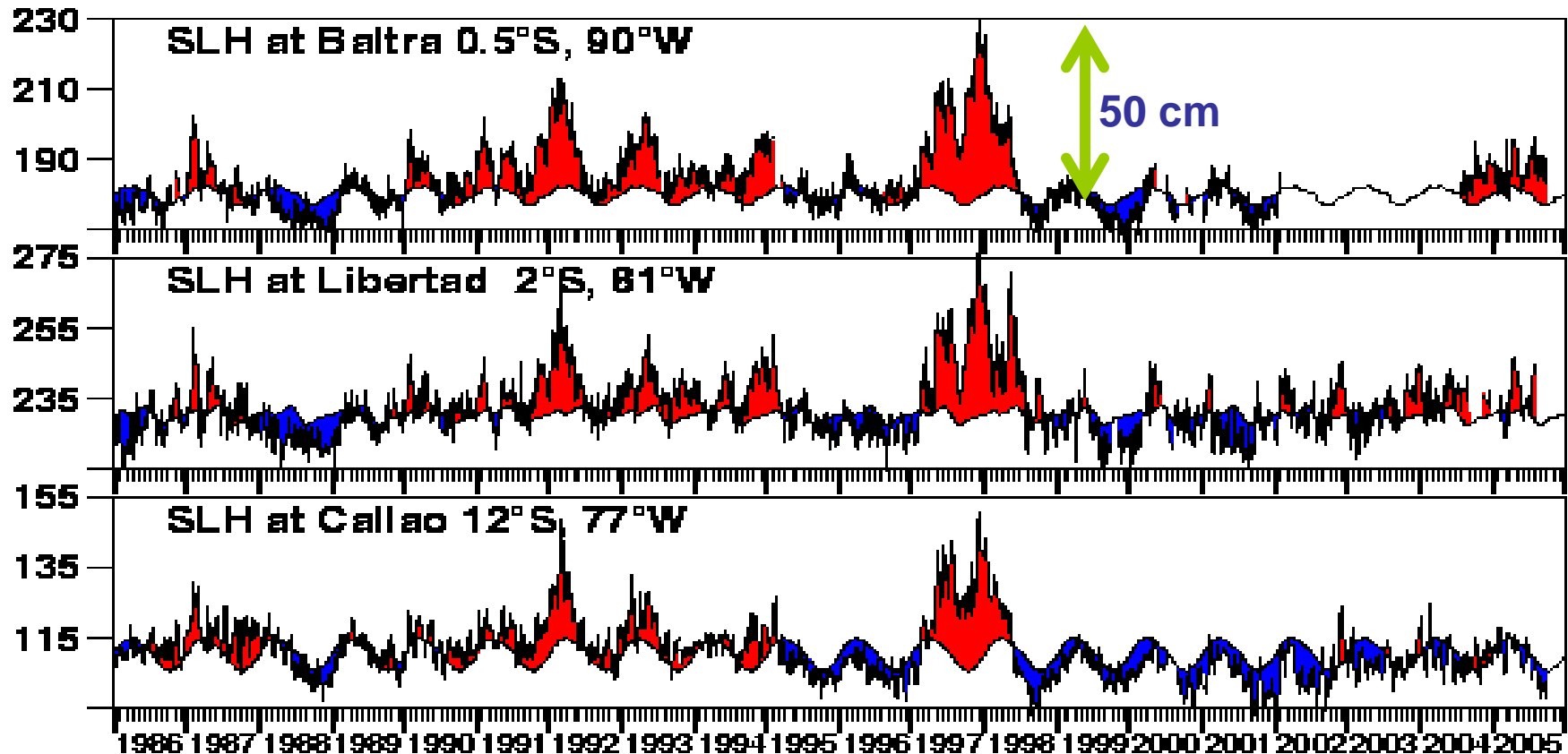
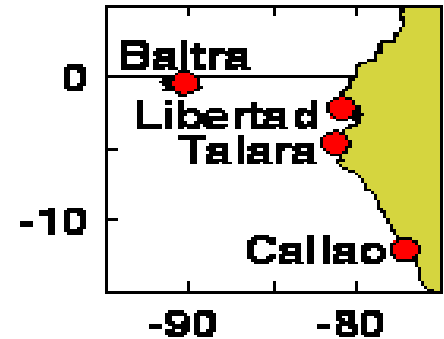
# EL Niño / Southern Oscillation



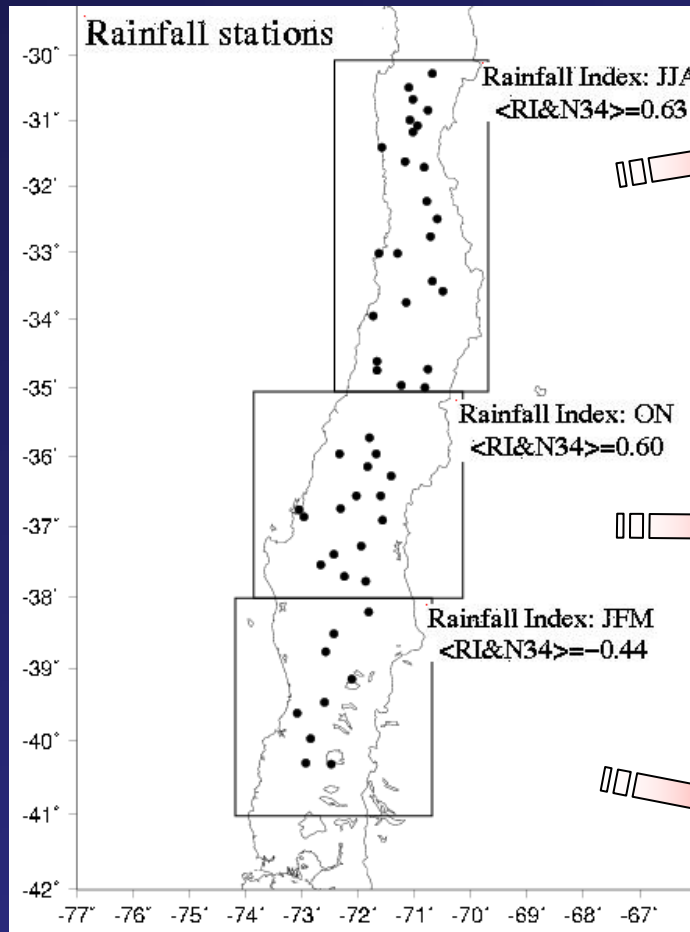
Predictability: some skill

# Five-day Averages of SLH at East Pacific Stations

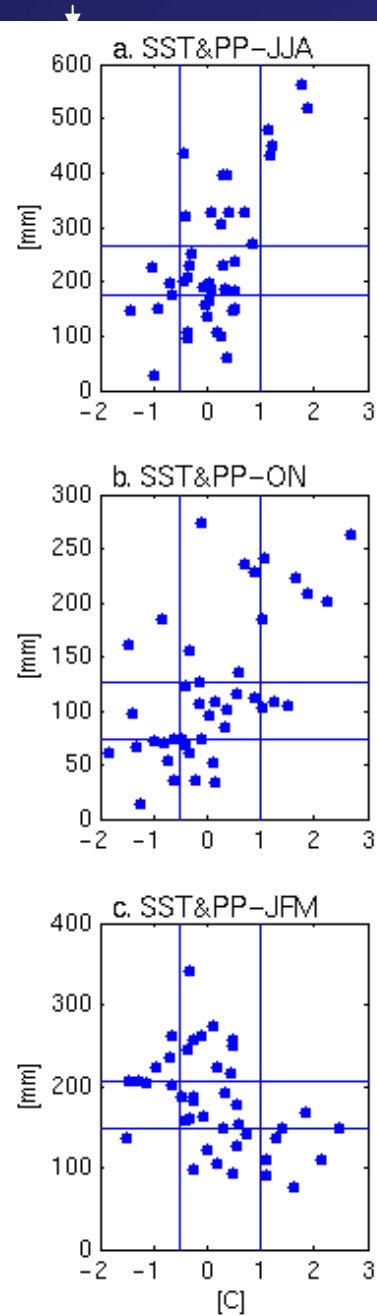
Ref: AOML – NOAA



# ENSO IMPACT ON RAINFALL IN CENTRAL CHILE



Rainfall



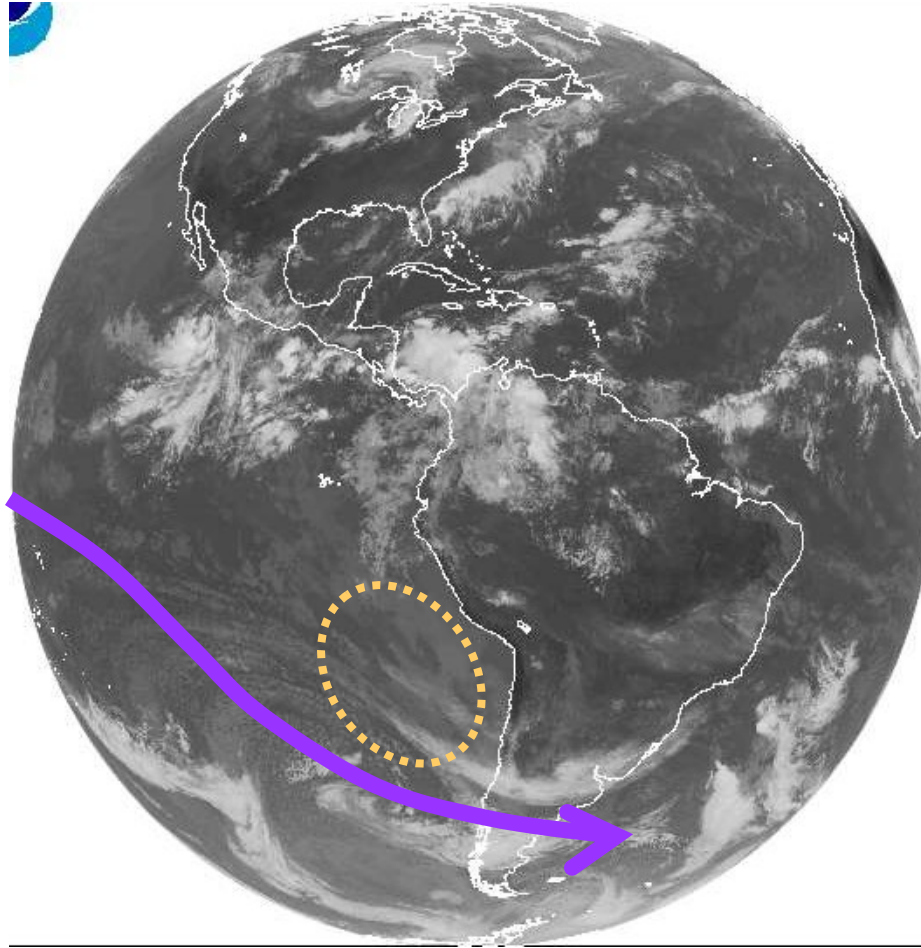
JJA

Niño 3.4 SSTa

ON

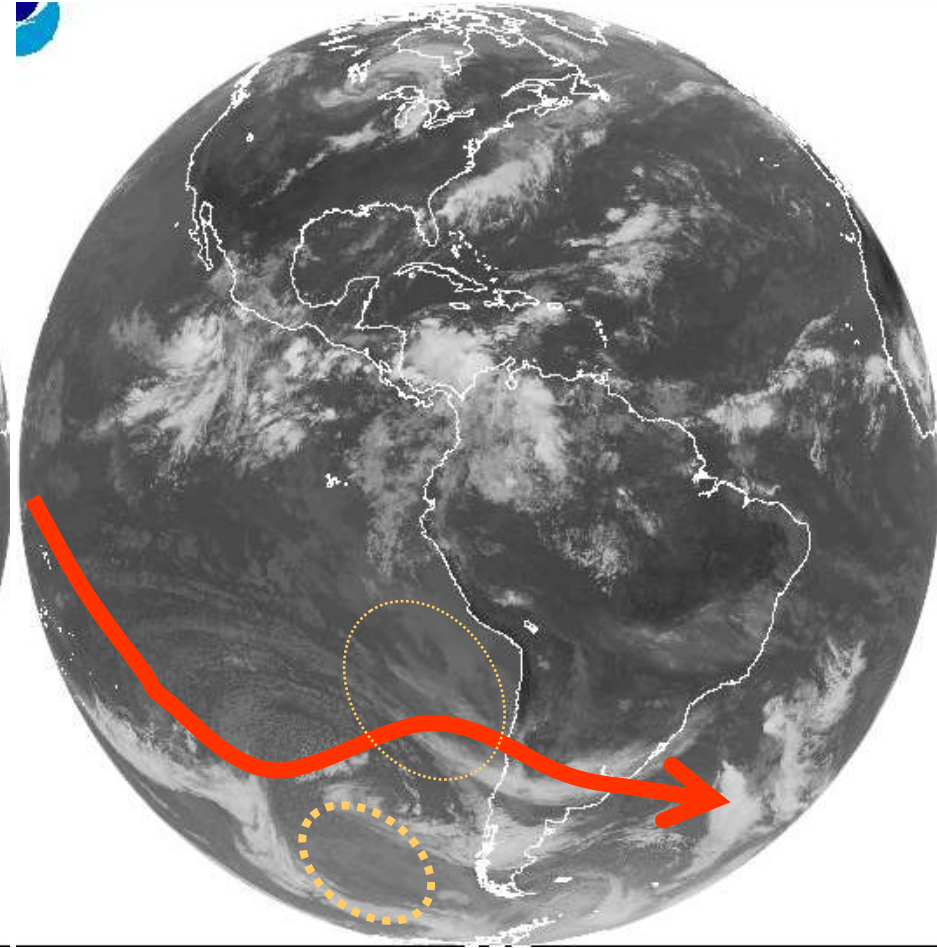
EFM

## Normal condition



Winter storm track

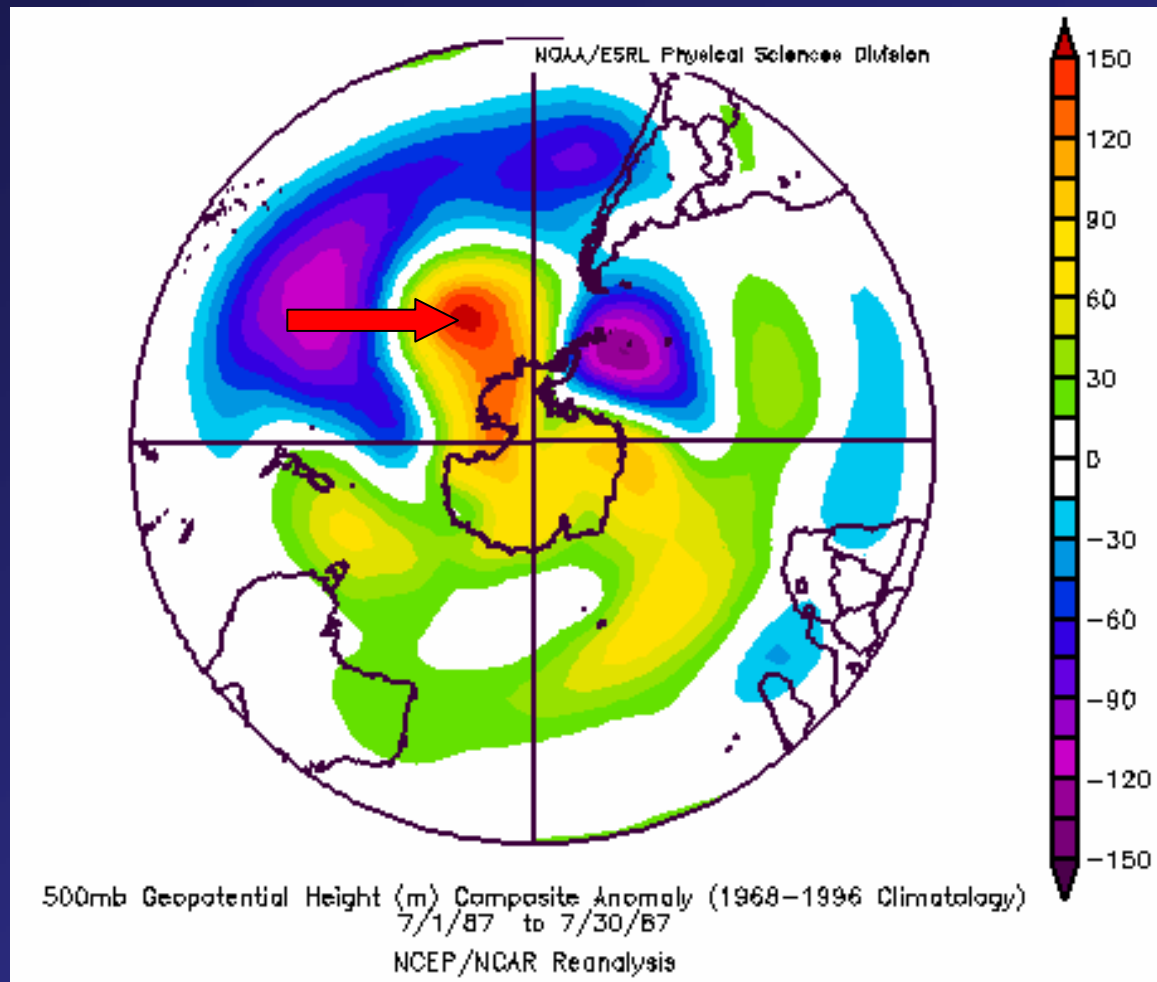
## El Niño condition



Weak subtropical anticyclone and blocking in the SE Pacific favor a northward shift of the **storm track**

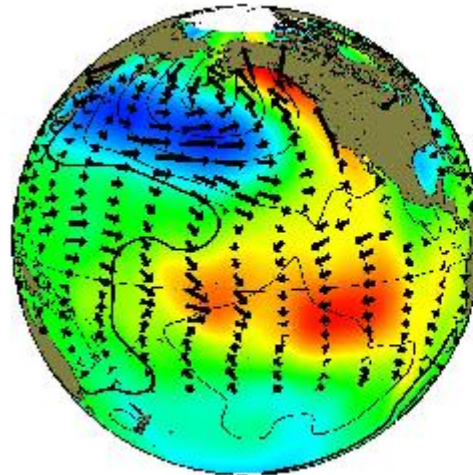
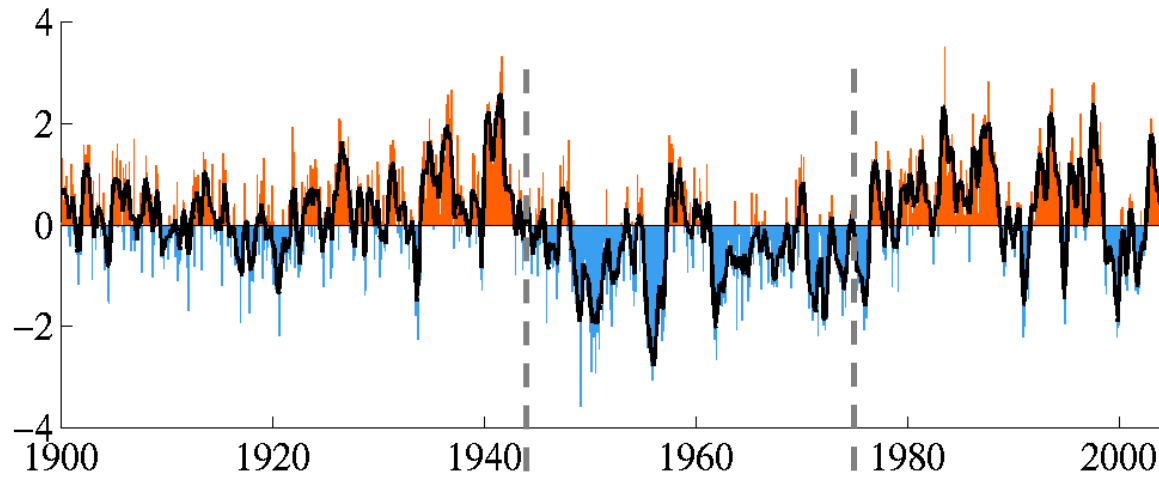


# 500 hPa height anomaly in July 1987, during an El Niño event

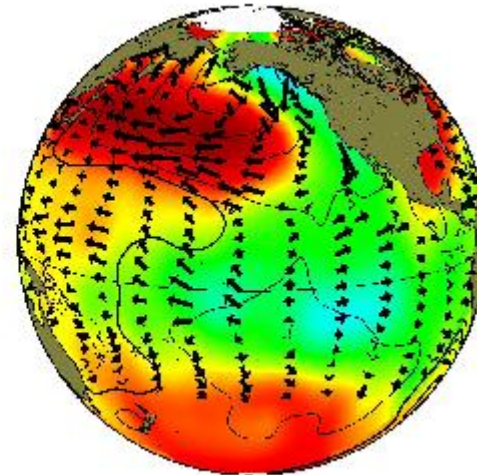
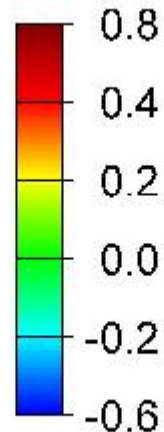


Blocking in the SE Pacific favored development of intense winter storm in central Chile (356 mm at Santiago)

# Pacific Decadal Oscillation



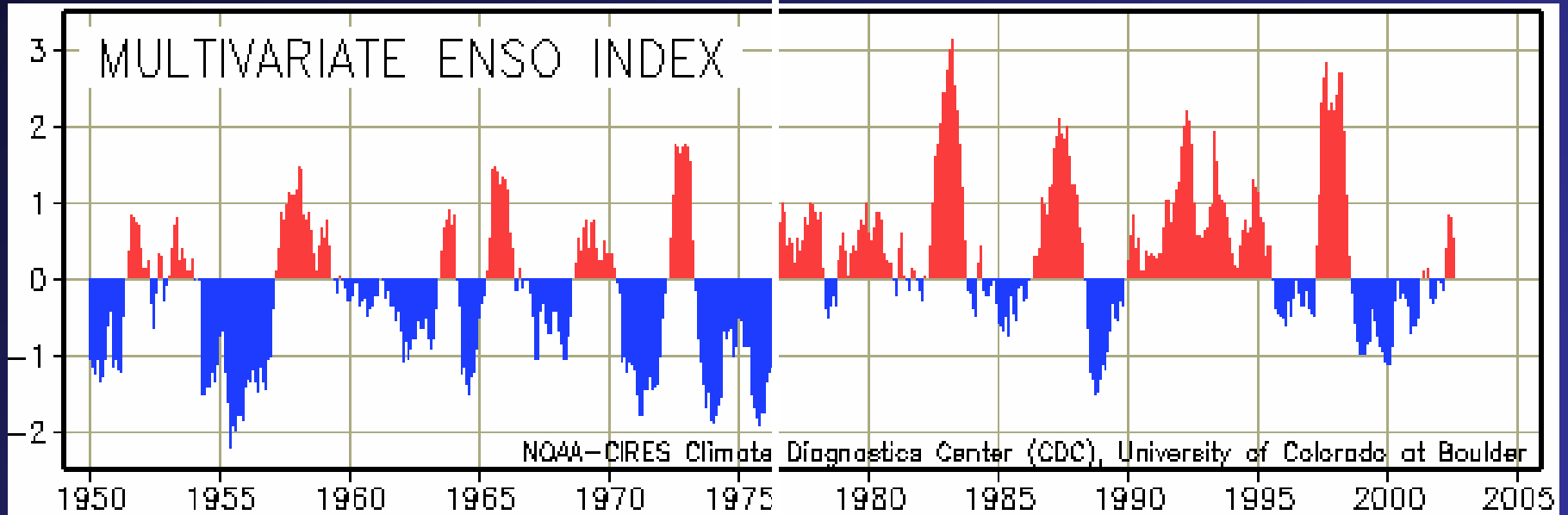
Warm phase



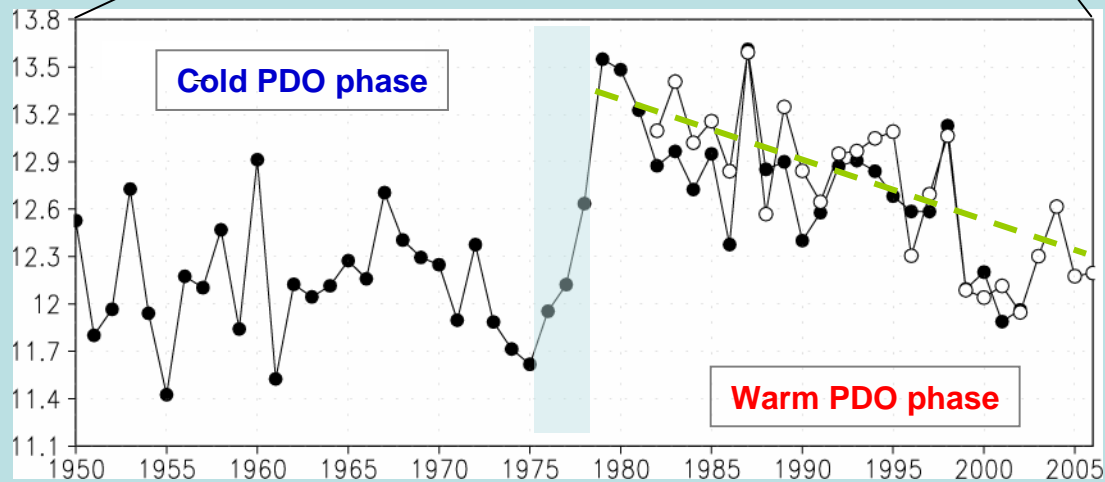
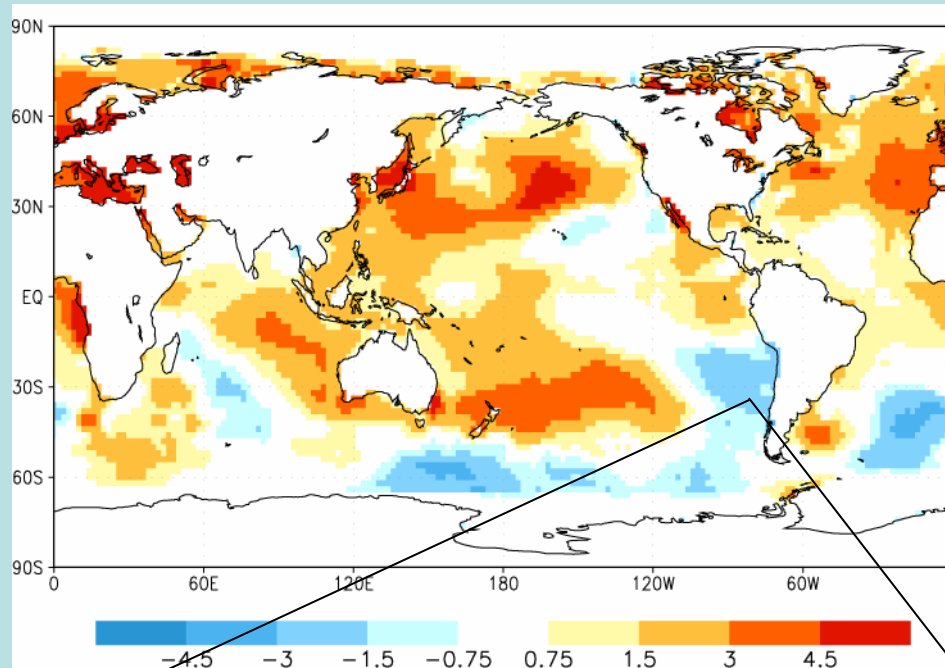
Cold phase

Cold PDO phase

Warm PDO phase

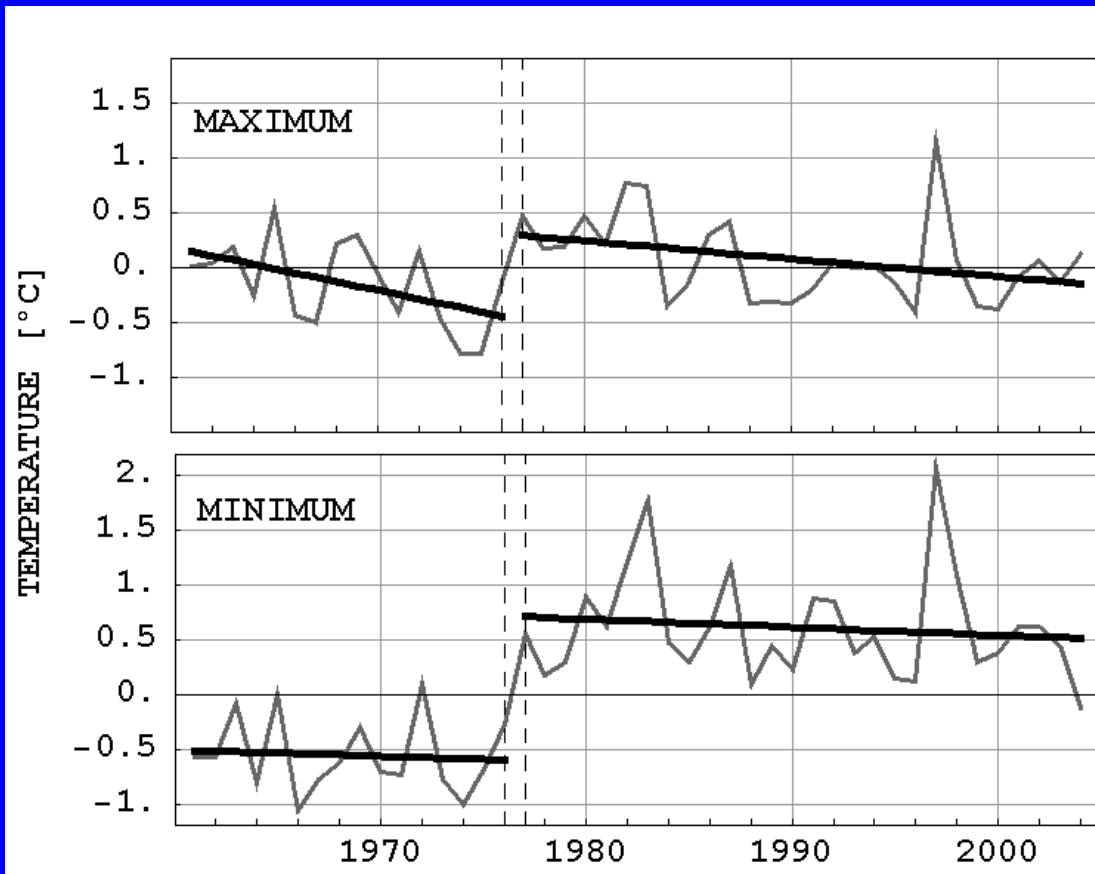


# Trend in SST ( $^{\circ}\text{C}/28$ years) during the period 1978-2004

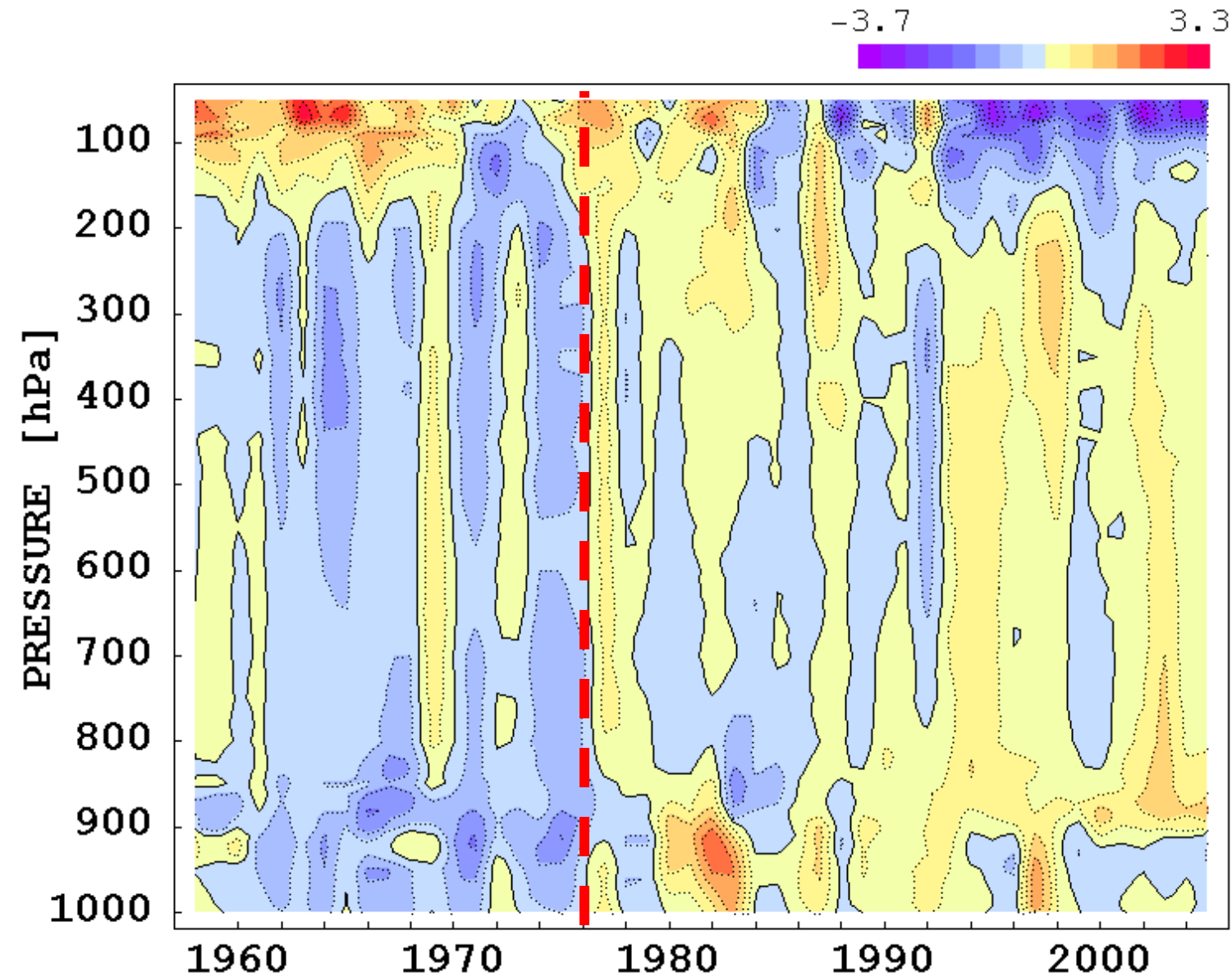


Source:  
Garreaud & Falvey

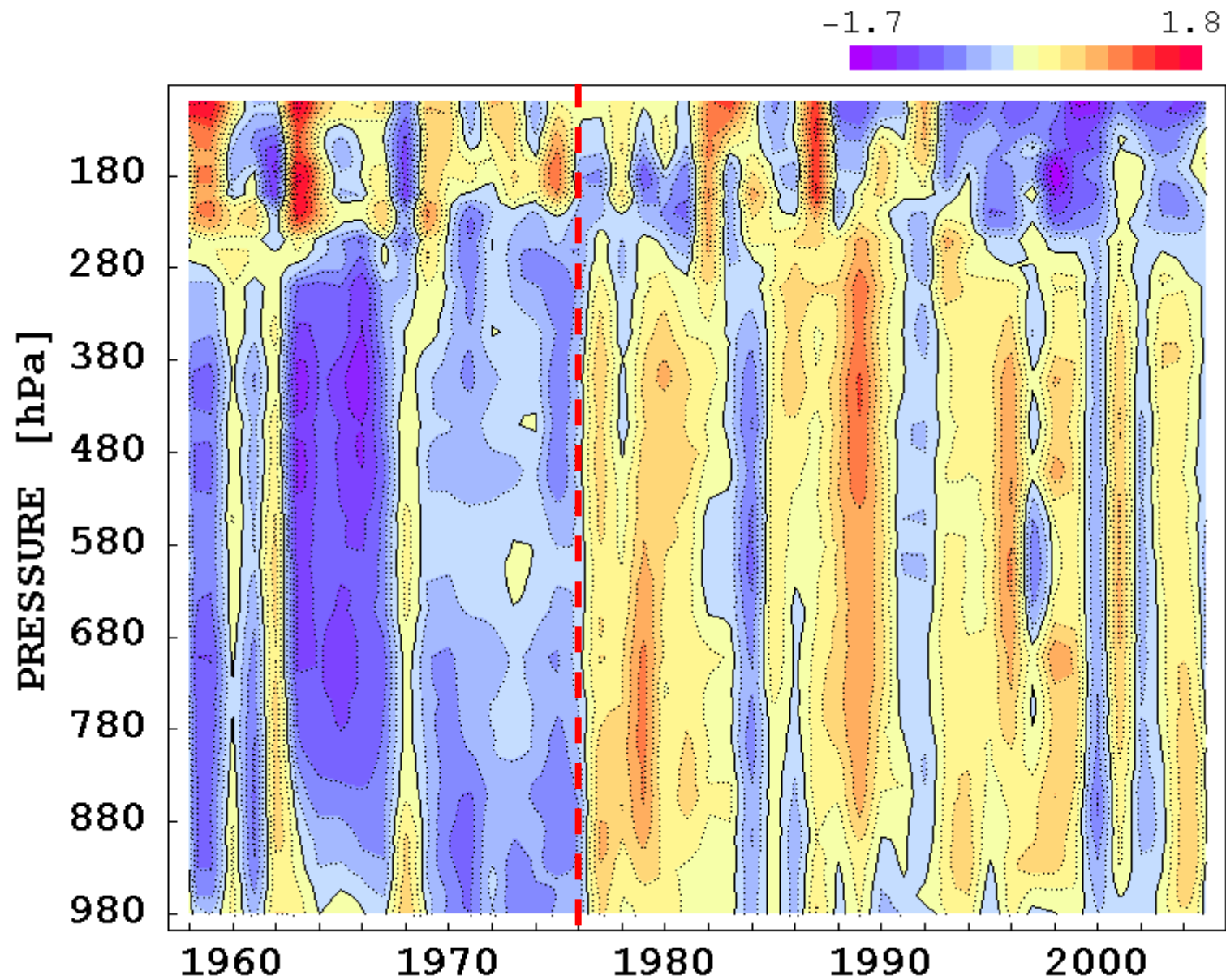
# Annual anomalies of daily maximum and minimum temperature at Antofagasta, Copiapó, Vallenar y La Serena (23°S – 30°S)



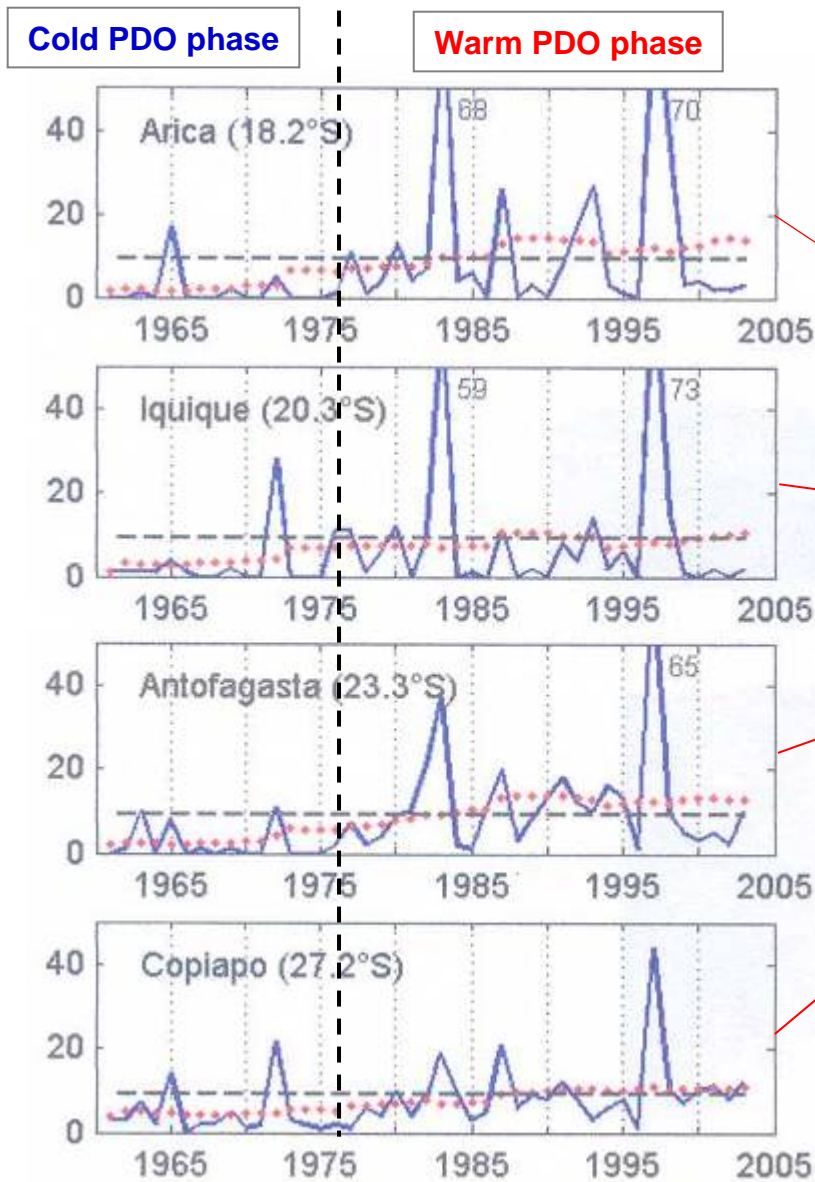
# Annual temperature anomalies at Antofagasta (23.6° S) from 1958 to 2004



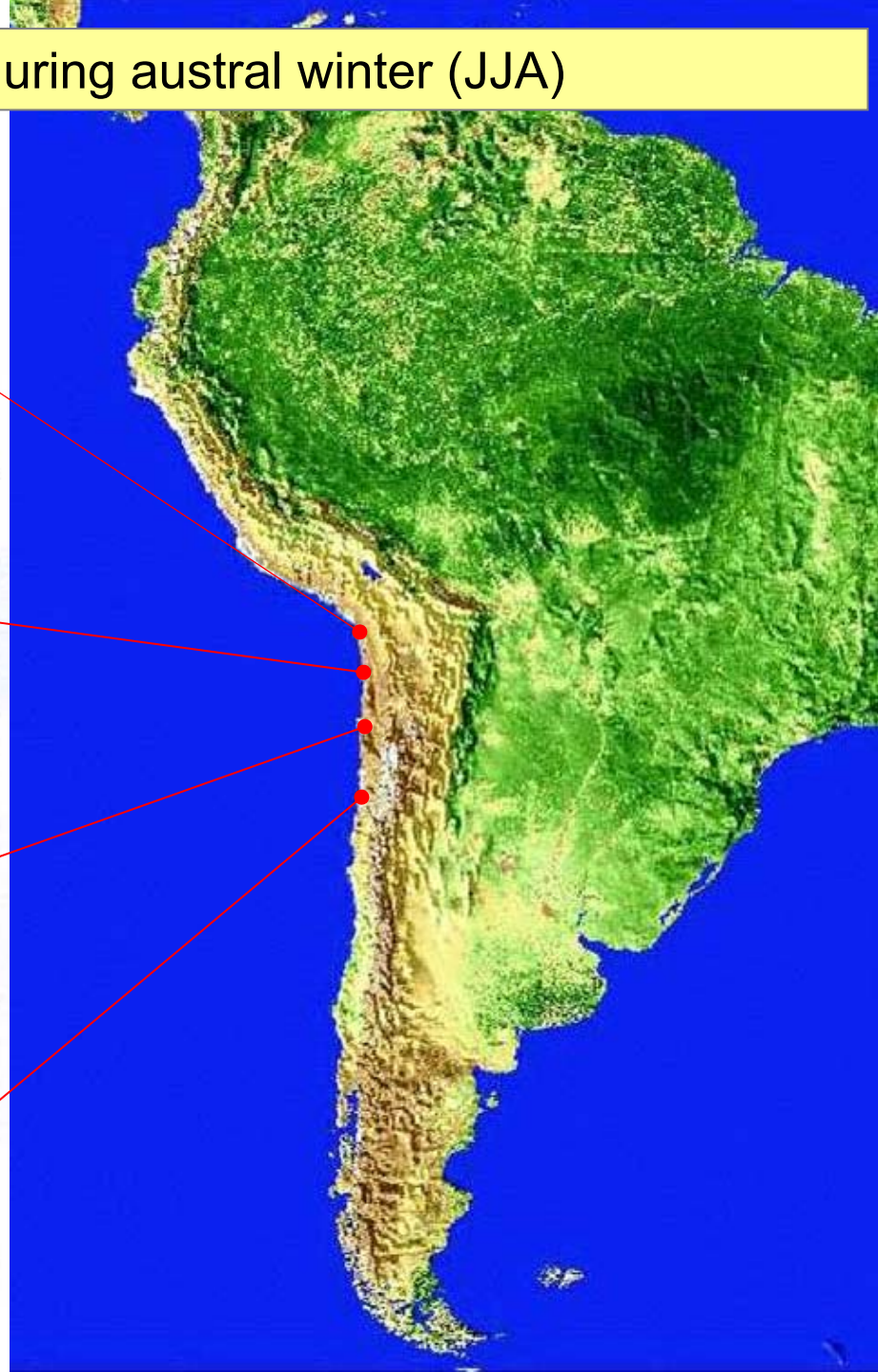
# Annual temperature anomalies at Puerto Montt (42° S) from 1958 to 2004



# Frequency of warm nights during austral winter (JJA)

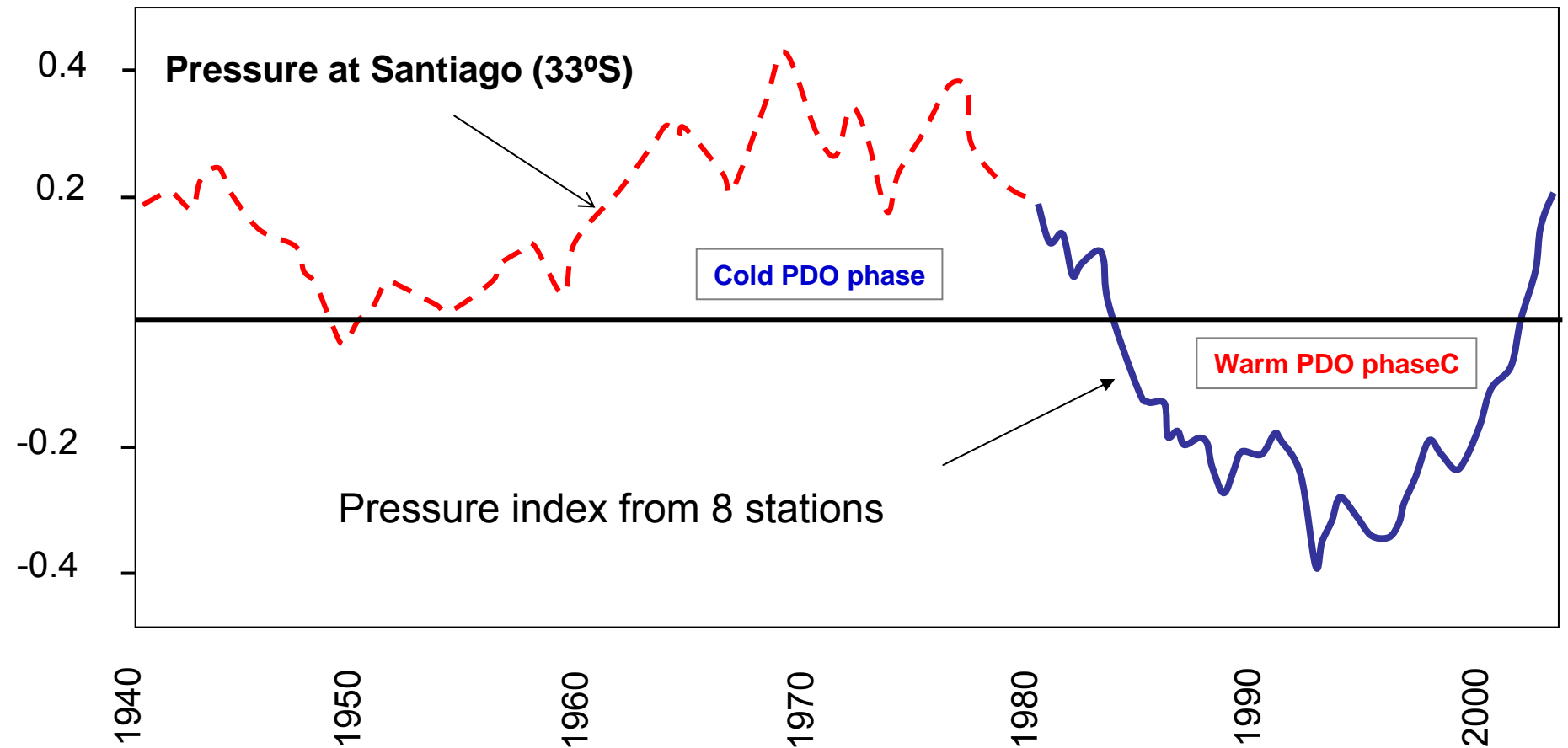
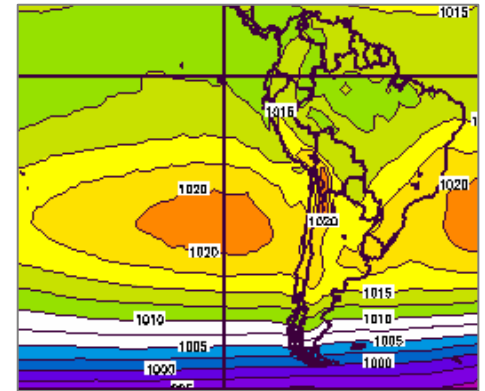


Ref.: Villarroel & Aceituno, 2005

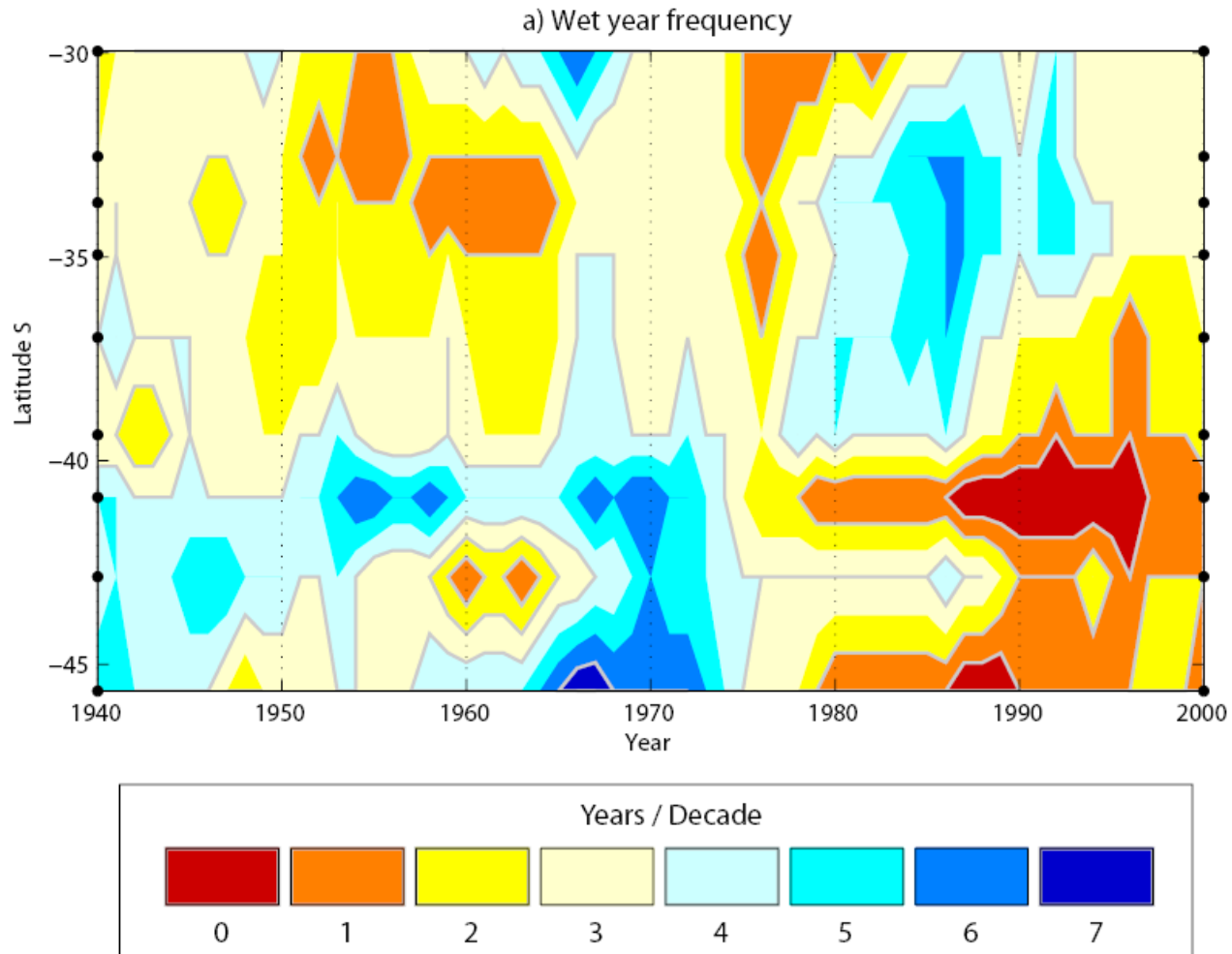




# Changes in the intensity of the SE-Pacific subtropical anticyclone (10-years moving average)



# FREQUENCY OF WET YEARS IN CHILE (30°S – 45°S) FOR 10-YEAR SLIDING INTERVALS DURING 1940 - 2000

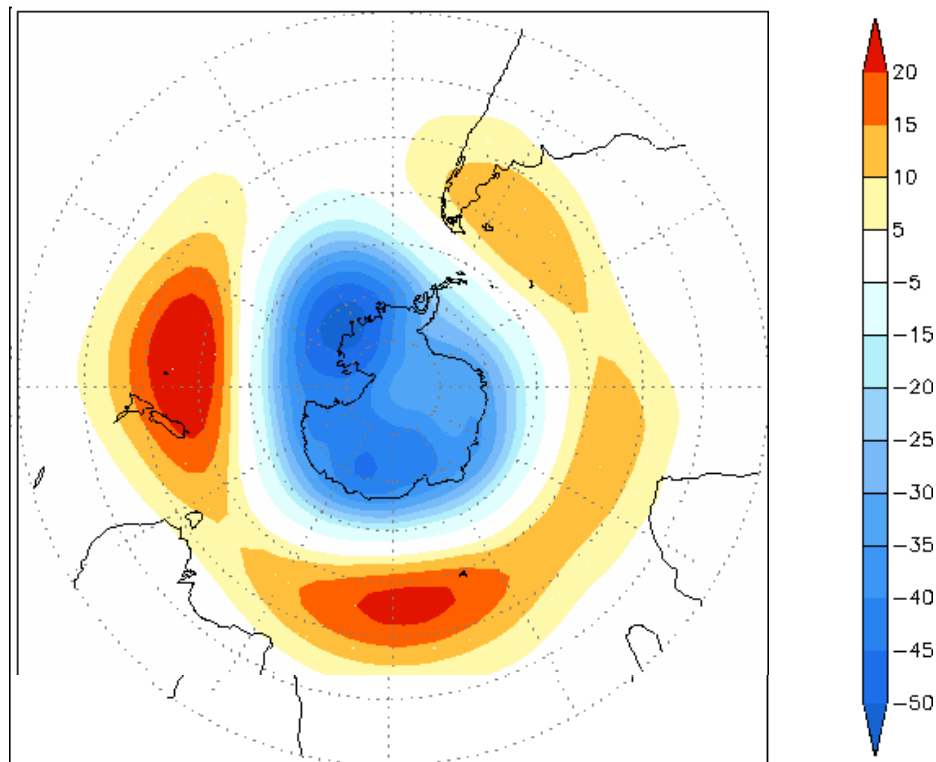


Source: Quintana & Aceituno, 2007

# Antarctic Oscillation (AAO)

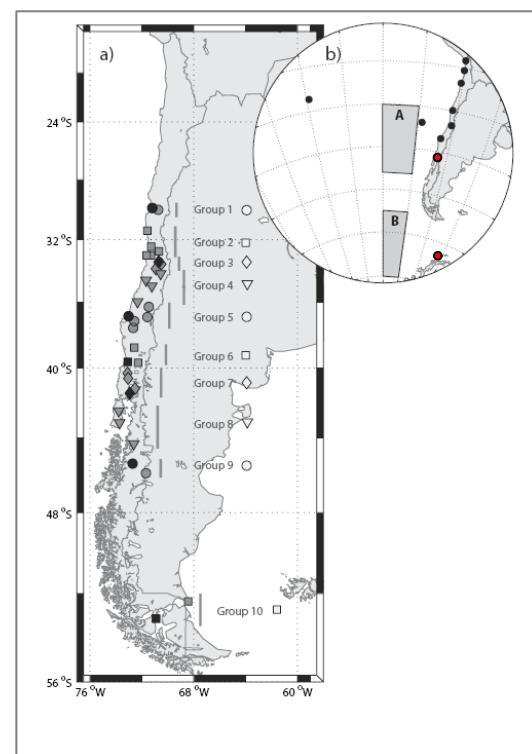
Loading pattern of the AAO defined as the leading mode of EOF analysis of monthly mean 700 hPa height during 1979-2000 period.

Leading EOF (27%) shown as regression map of 700mb height (m)



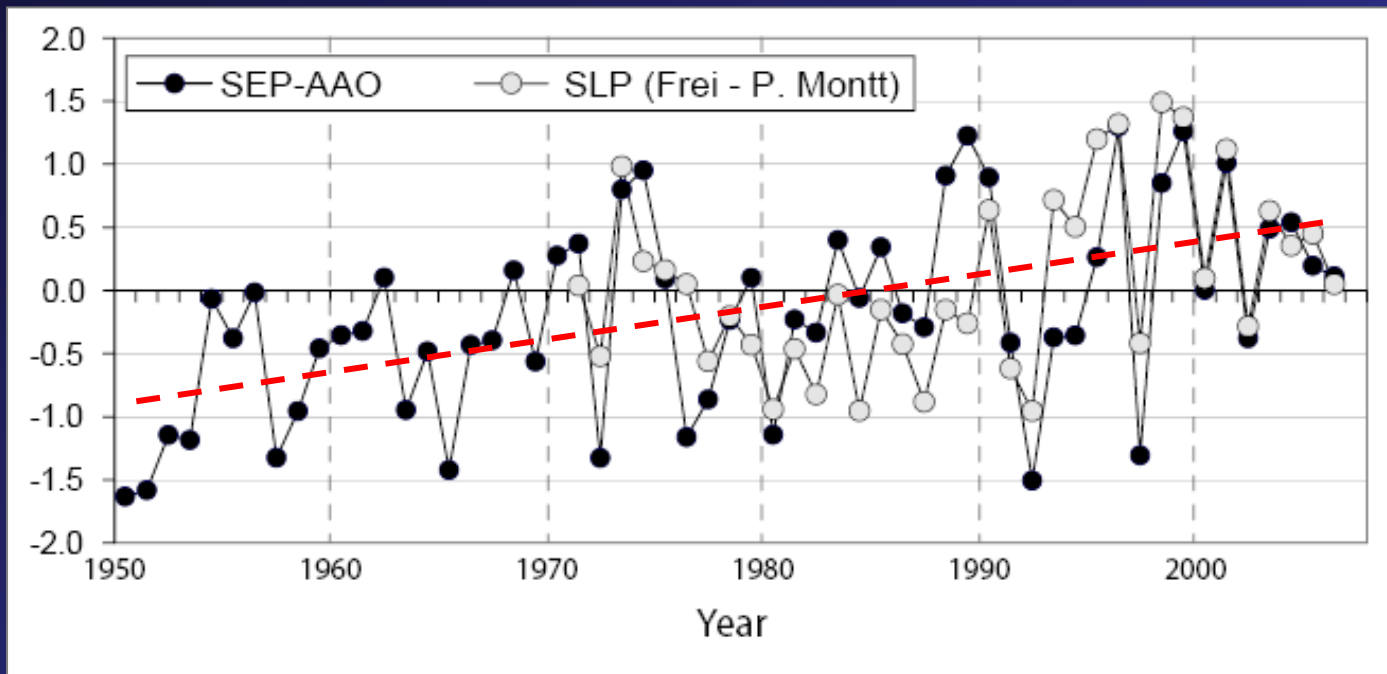
Source: CPC/NOAA

Zonal circulation index calculated as the SLP difference between region A and B (SEP – AAO)

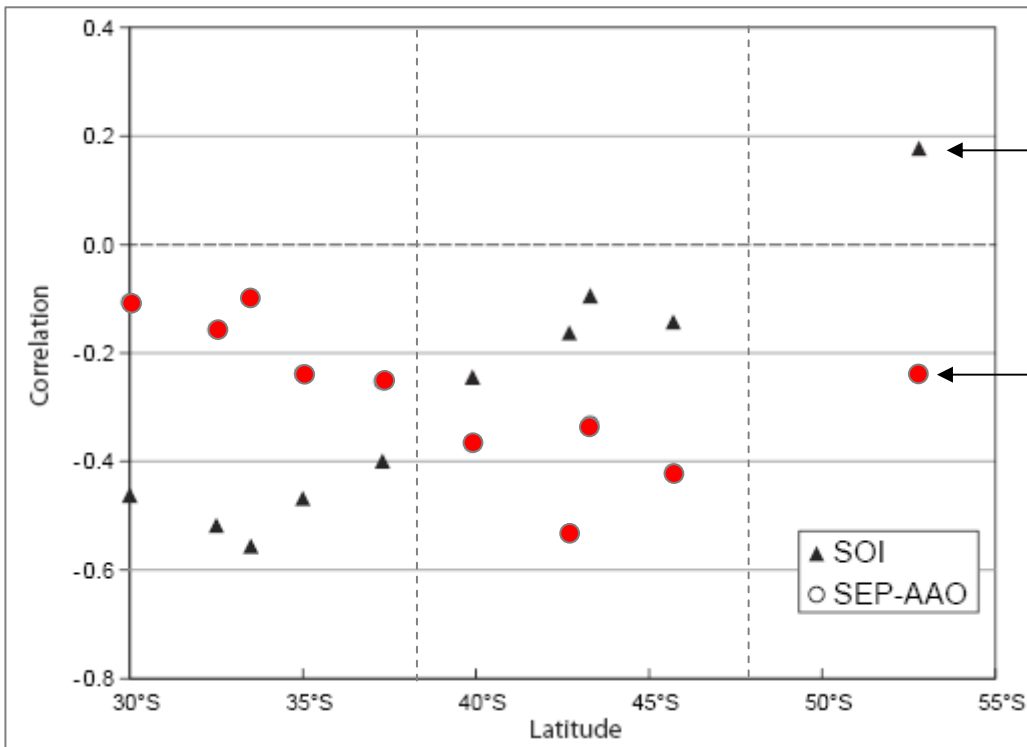


Source: Quintana & Aceituno, 2007

## SE Pacific Antarctic Oscillation

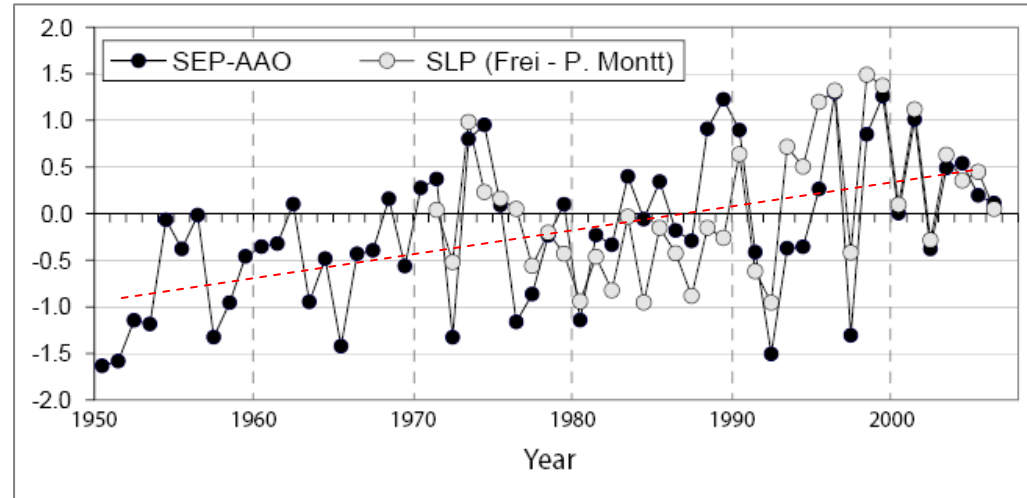


# AAO has a significant impact on rainfall in southern Chile



Correlation between SEP – AAO and annual rainfall

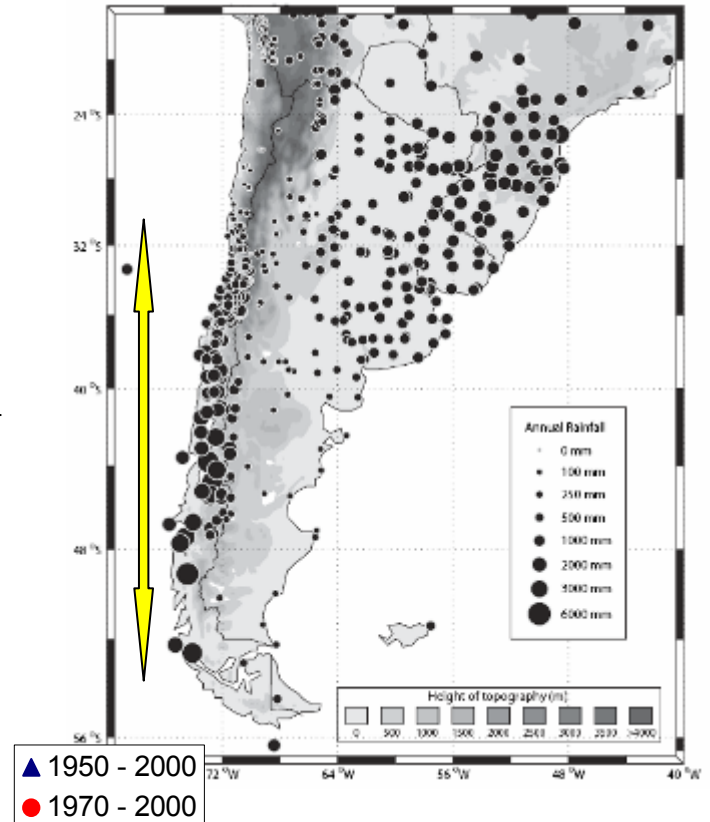
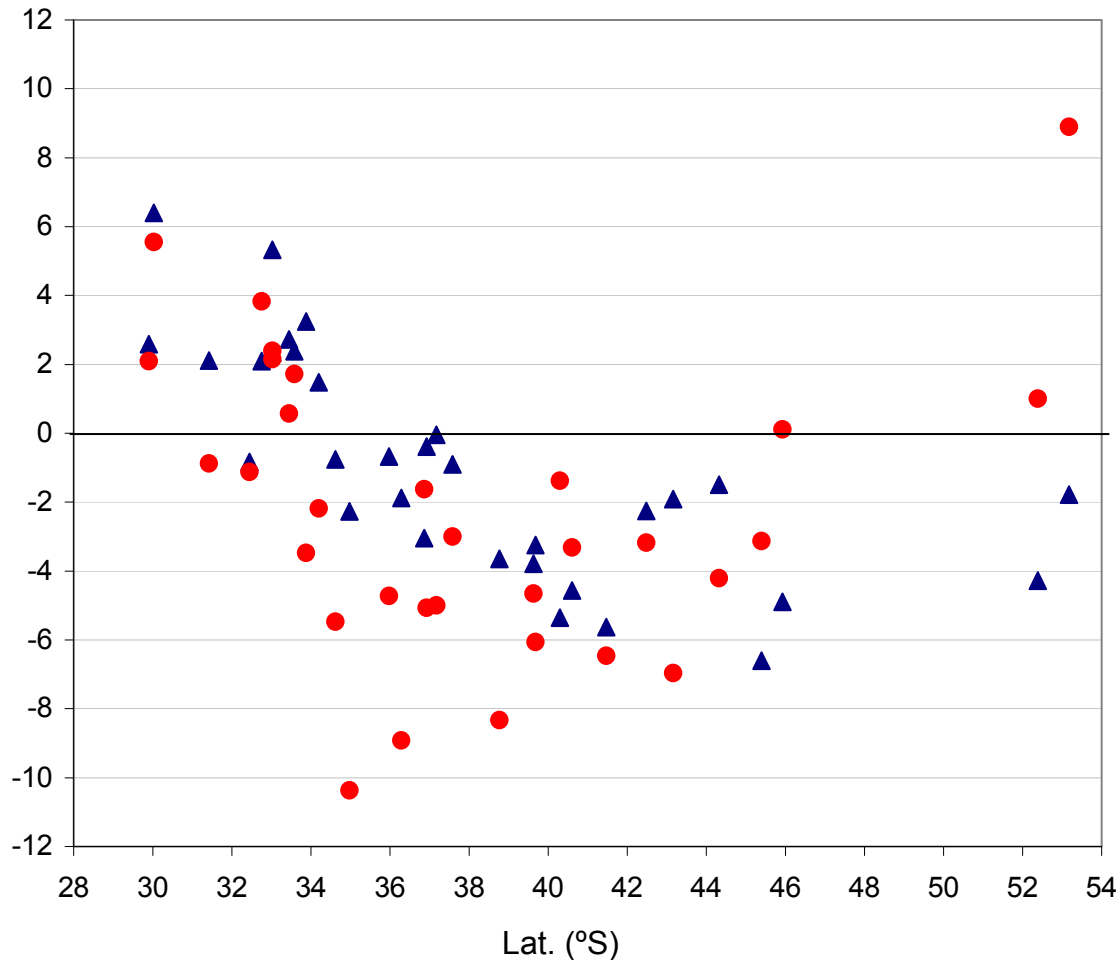
Correlation between SEP – AAO and annual rainfall



Source: Quintana & Aceituno, 2007

Trend in annual rainfall in Chile (%/decade) for the periods 1950 – 2000 (dots) and 1970 – 2000 (triangles)

%/decade

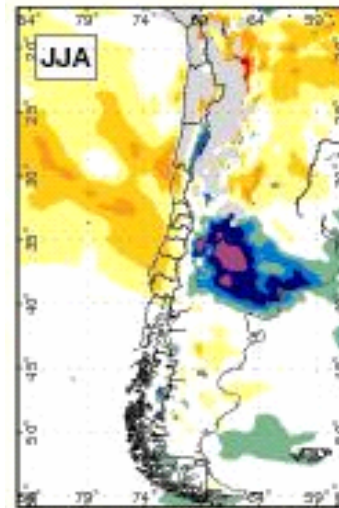
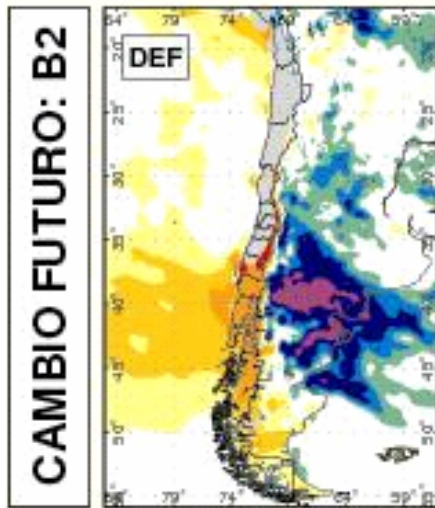
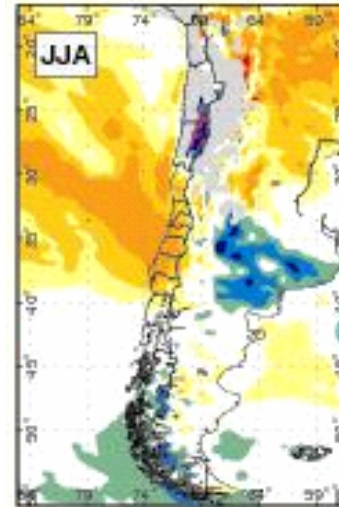
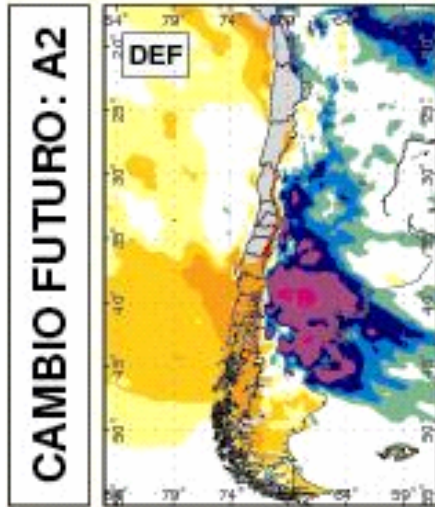


Source: Quintana & Aceituno, 2007

# Changes in rainfall projected for 2070-2100 with model PRECIS and HadCM3

summer

winter



Source:  
CONAMA report  
Feb. 2007

