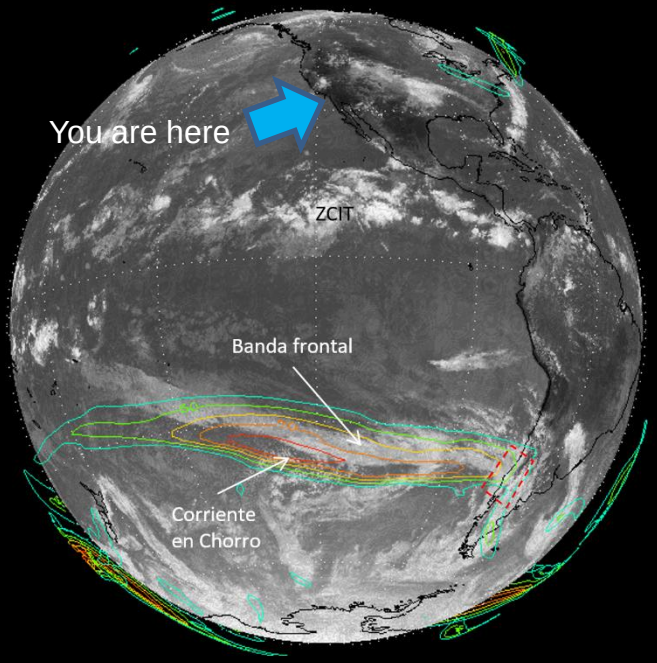
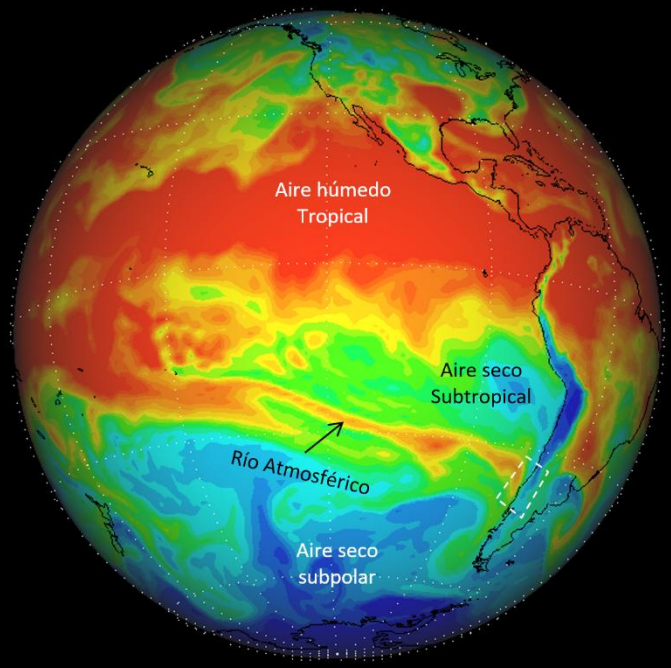
Atmospheric Rivers impacting the West Coast of South America

René D. Garreaud & Maximiliano Viale

Geophysics Department, Universidad de Chile

Center for Climate and Resilience Research (CR2)

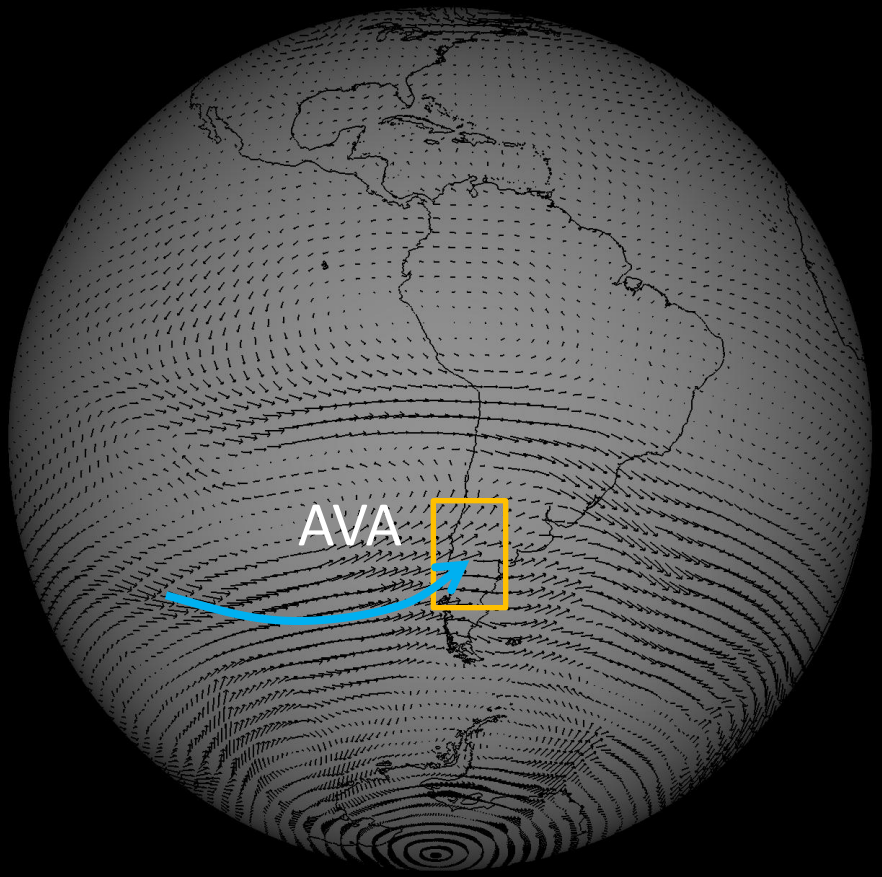




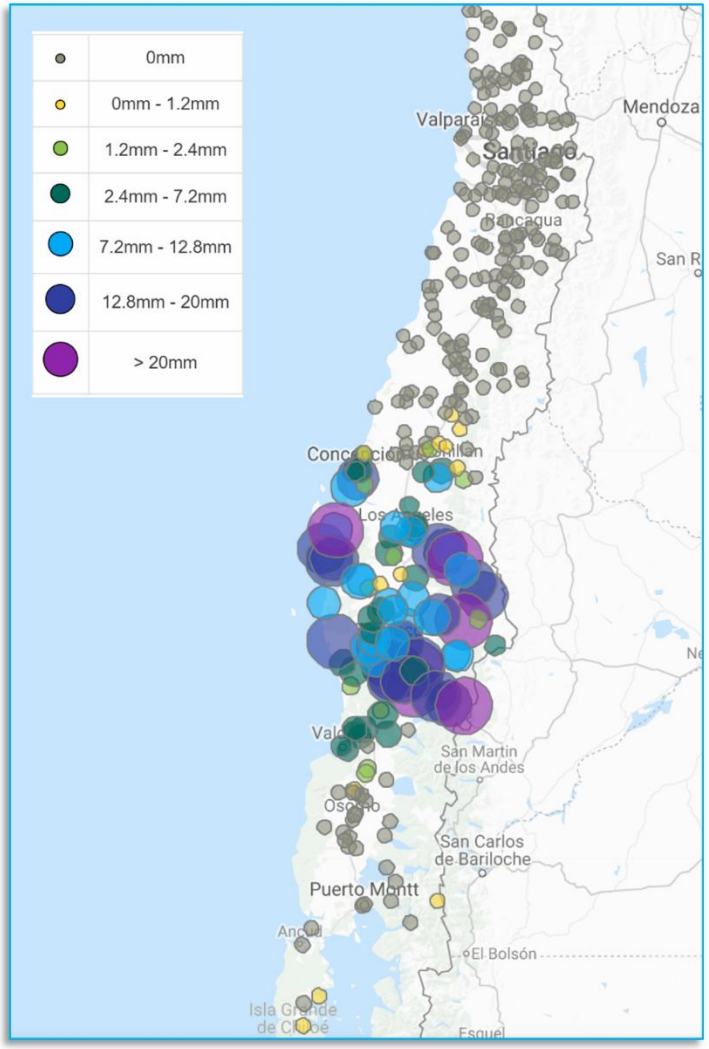
Collaborators: Raul Valenzuela, Deniz Boskurt Marty Ralph, Roberto Rondanelli

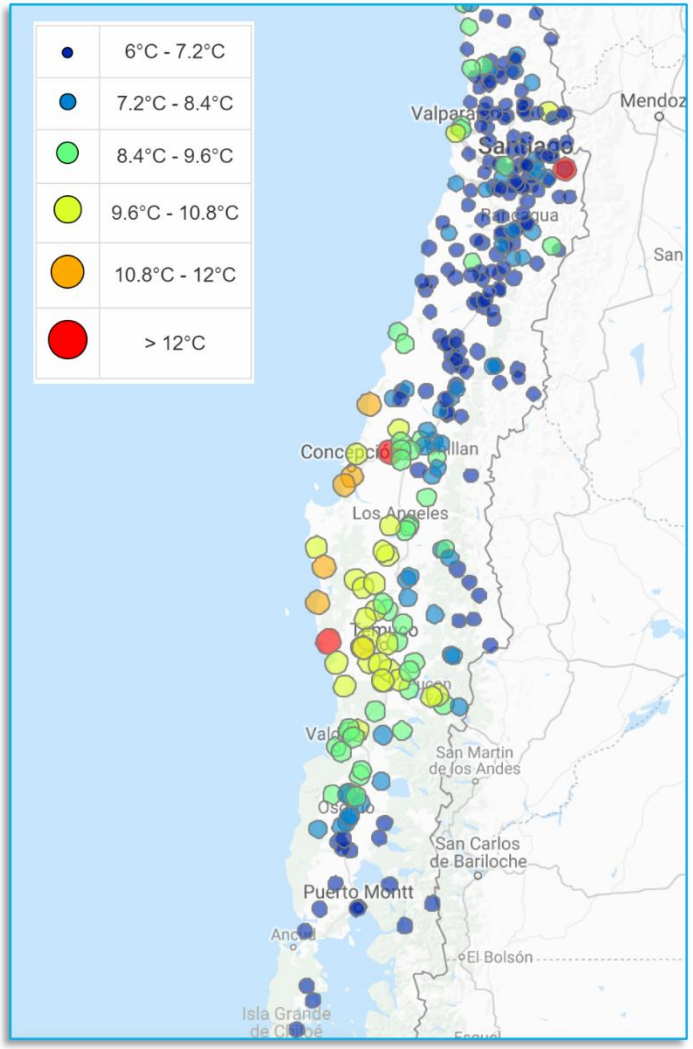
International AR Conference, La Jolla-CA, June 26, 2008

Monday night, winds at 300 hPa

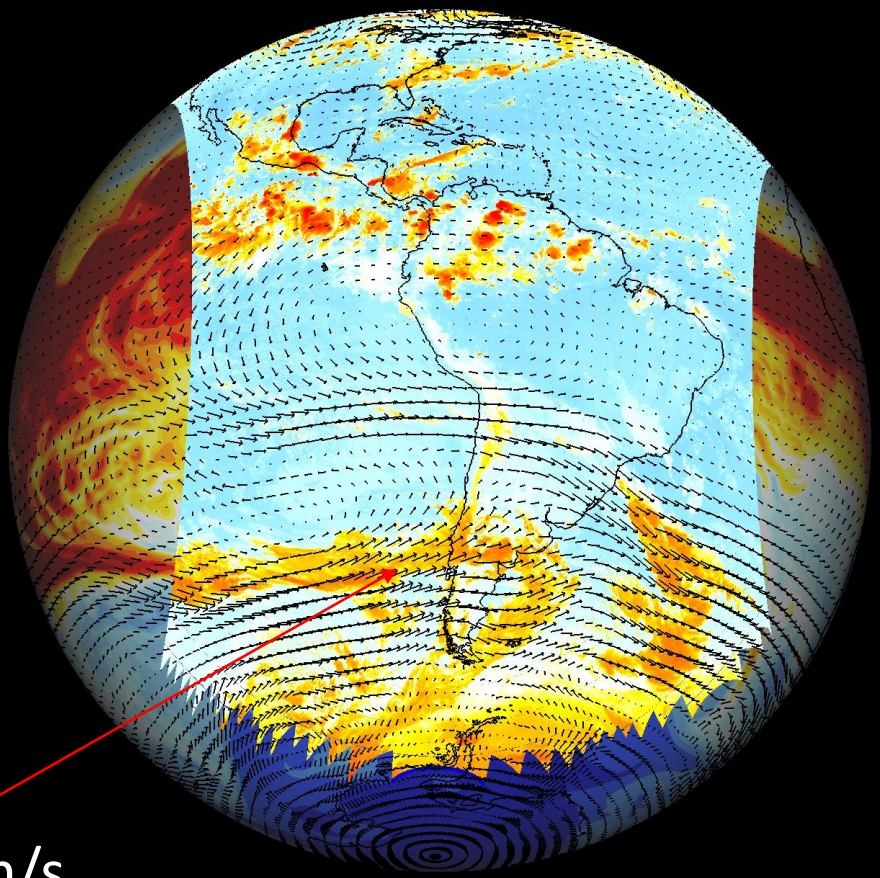


Monday night, 3-hr Precipitation
What did I drink?





Monday night, PW+GOES-IR
Ok…it wasn't the wine, it was an AR



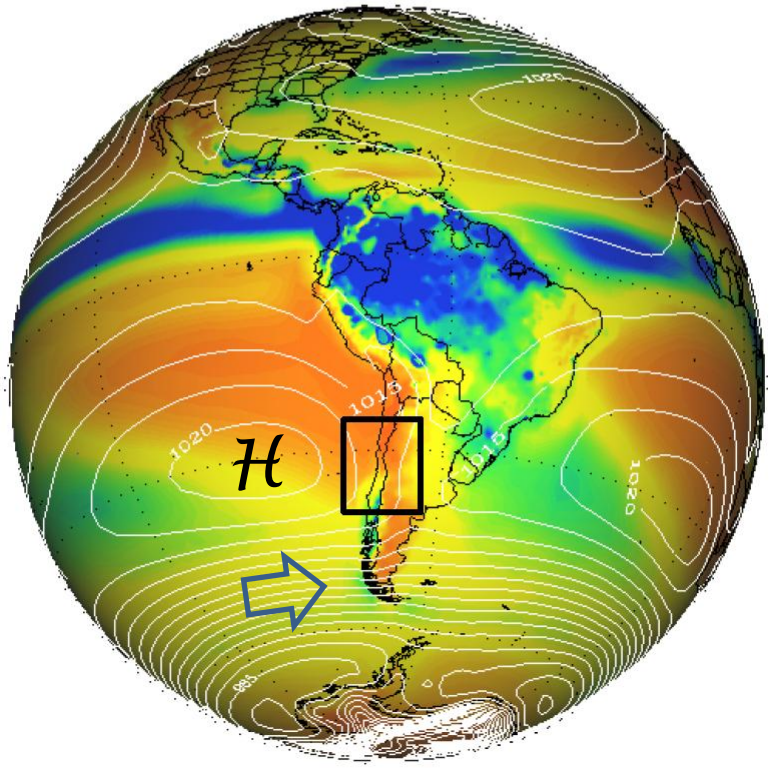
700 kg/m/s
Cat 2-3?

Atmospheric Rivers impacting the West Coast of South America

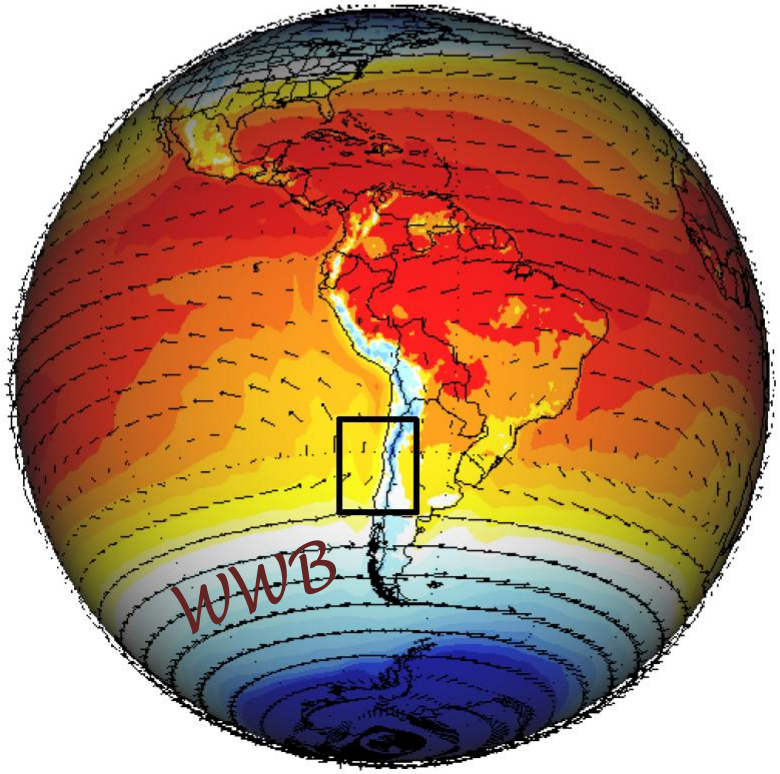
- Background (Falvey & Garreaud 2007)
- How did we study ARs without knowing ARs? (Garreaud 2013)
- ARs and extreme events (Valenzuela & Garreaud 2019)
- ARs climatology for the SE Pacific (Viale et al. 2018)
- Impact of local SST anomalies (Bozkurt et al. 2019)
- Come to join us….

Central Chile: subtropical (30-40°S) west coast of South America, bounded by the Andes cordillera (3-5 km). MAP from 100 to 1500 mm/year. Strongly impacted by ENSO

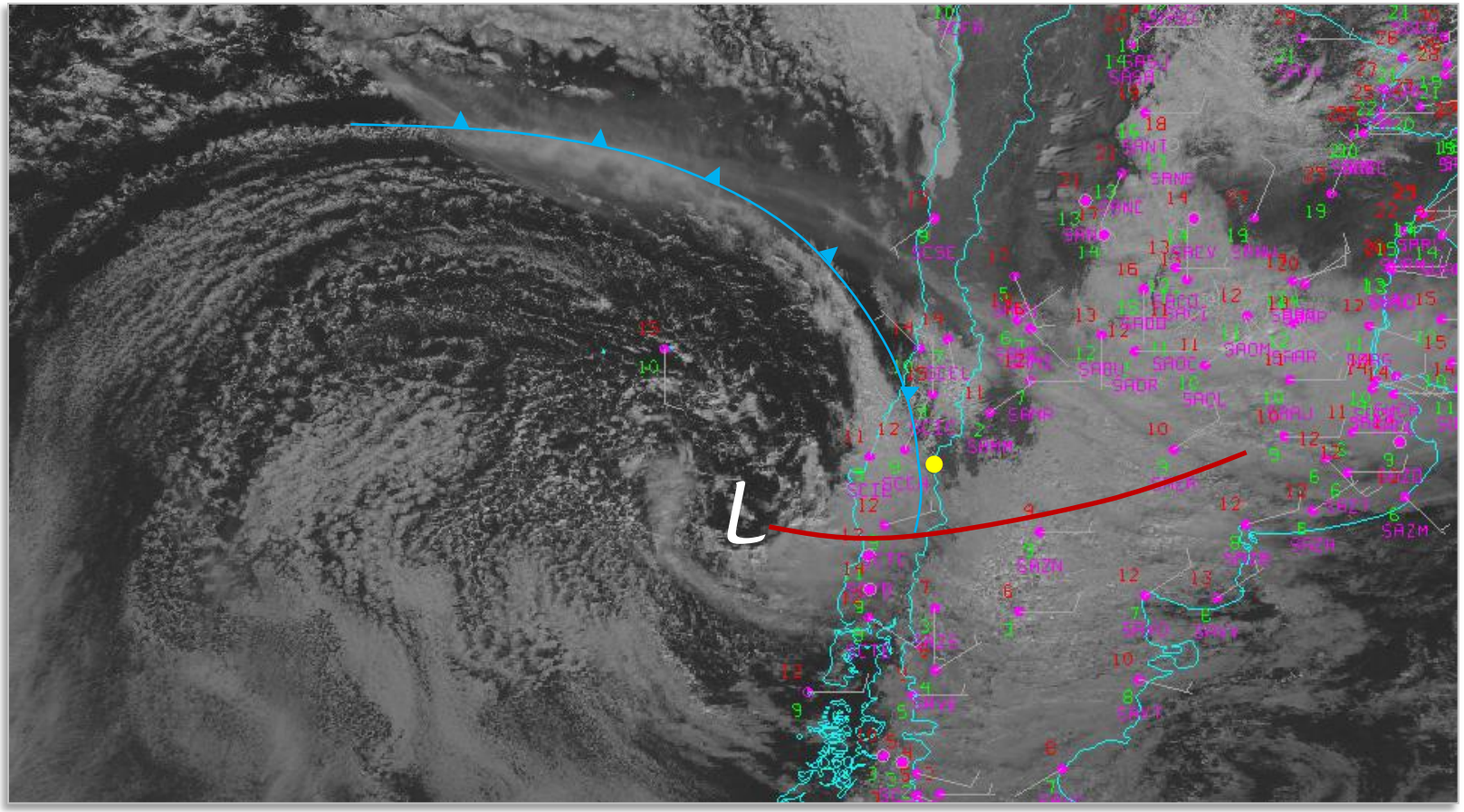
SLP & MAP



850 hPa winds & SAT



Typical winter (JJA) storm in central Chile: Cold front rooted in a midlatitude depression



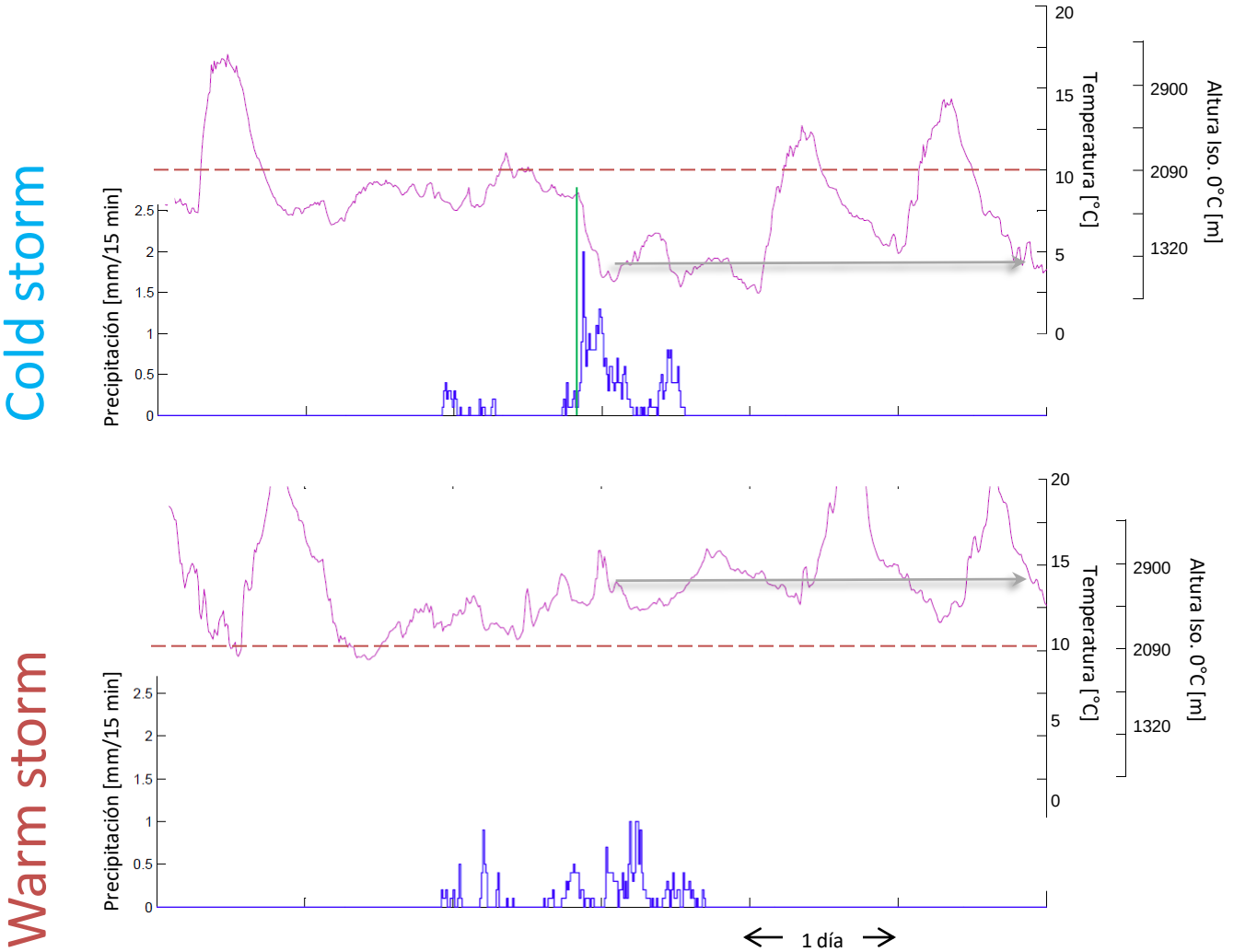
¿What synoptic scale variables are a good predictor for event-accumulated rainfall? U×q at 850 hPa

Falvey & Garreaud 2007

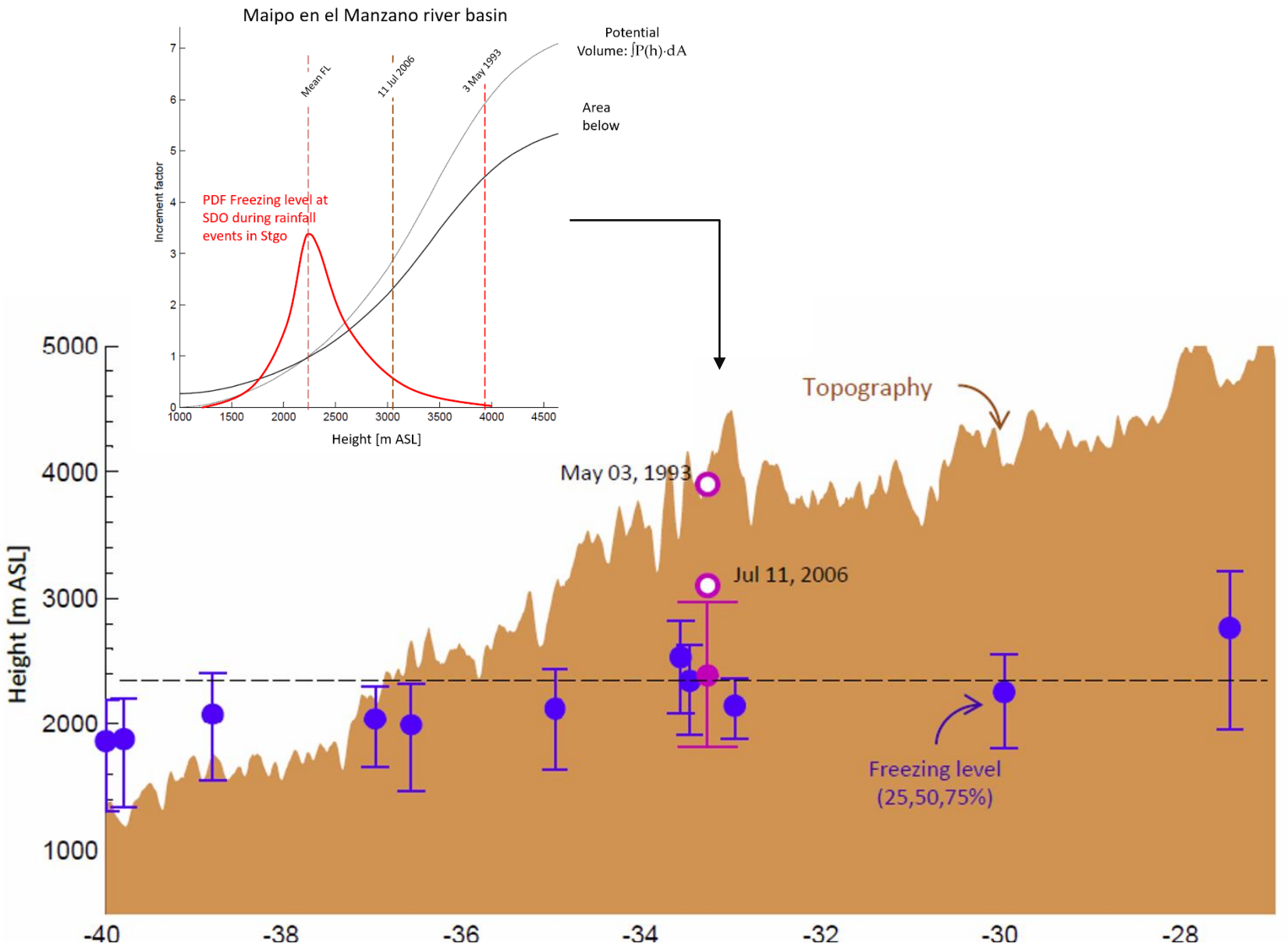
Precipitation events also differ in their temperature

Implications for the freezing level height

Garreaud 2013

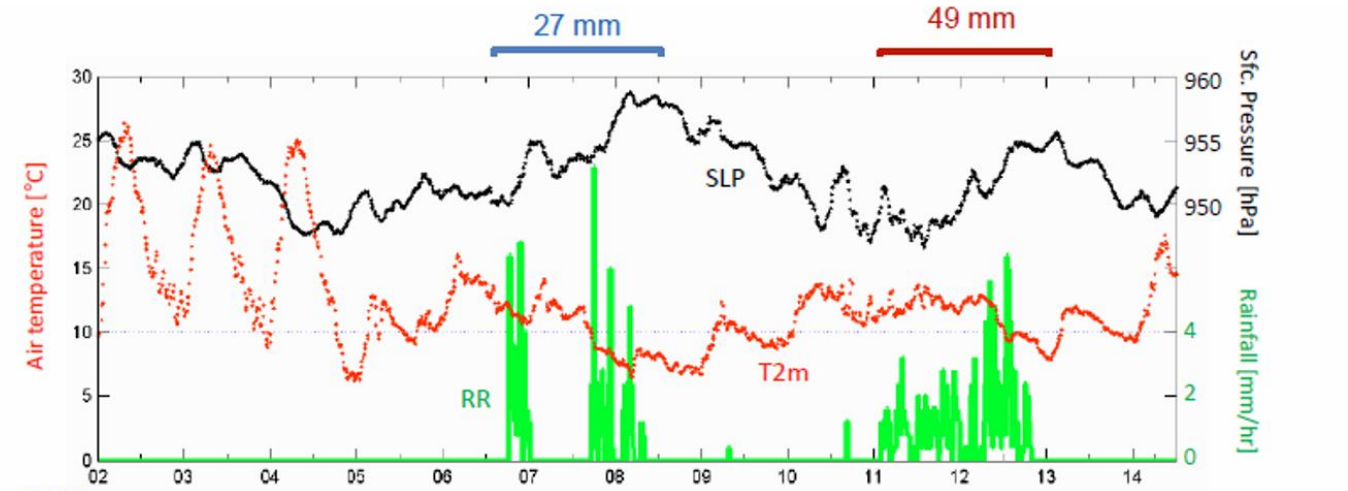


Hydrological Impacts

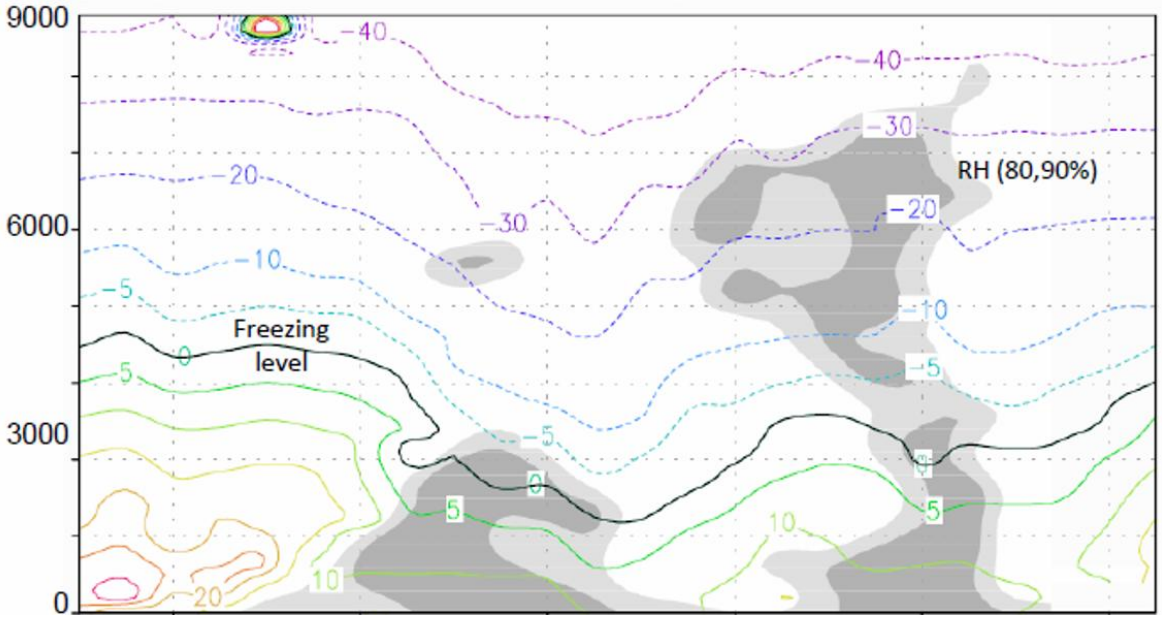


Case of study: July 2006

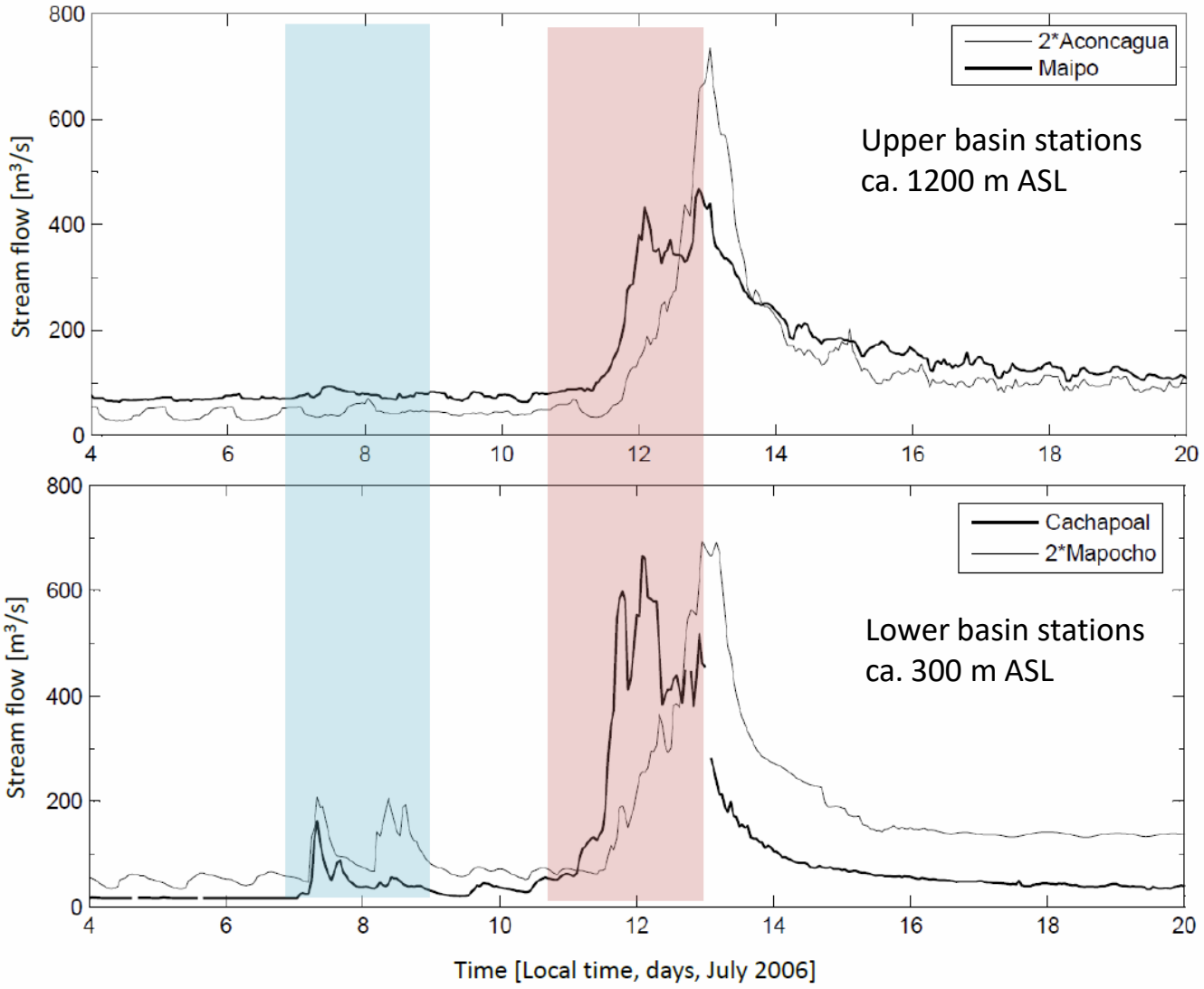
DGF station



Sto. Domingo radiosonde

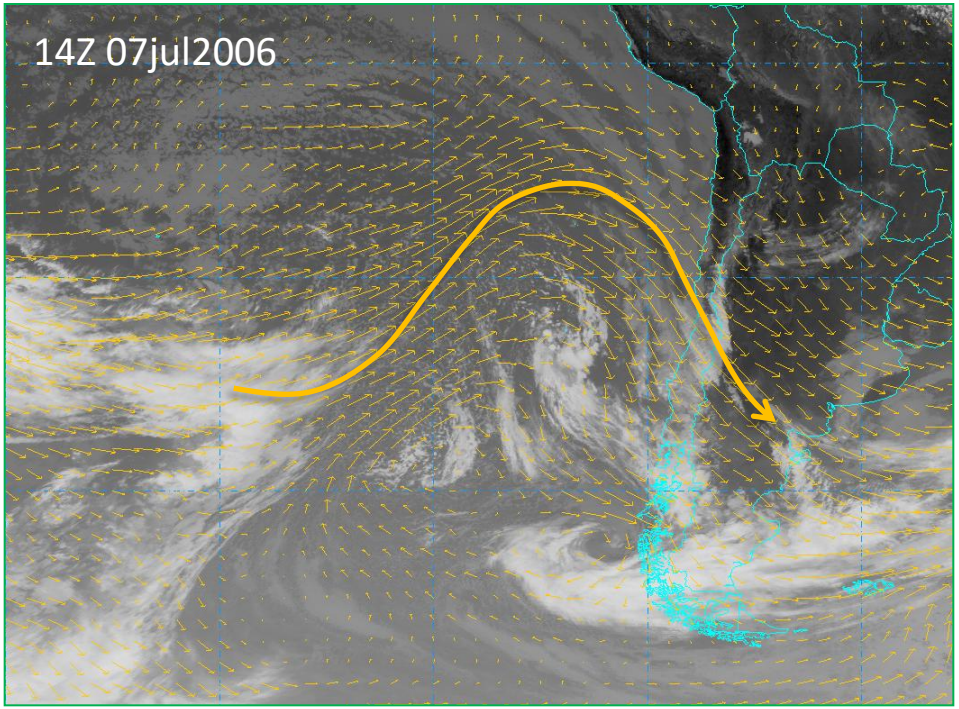


Case of study: July 2006



Case of study: July 2006

GOES12 IR2 + CFSR
500 hPa winds



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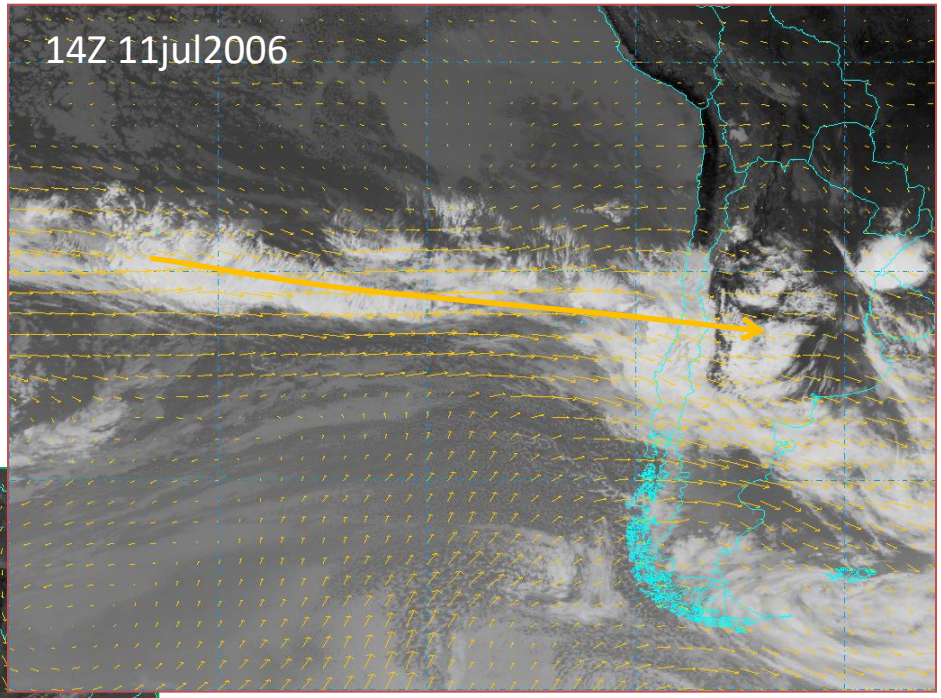
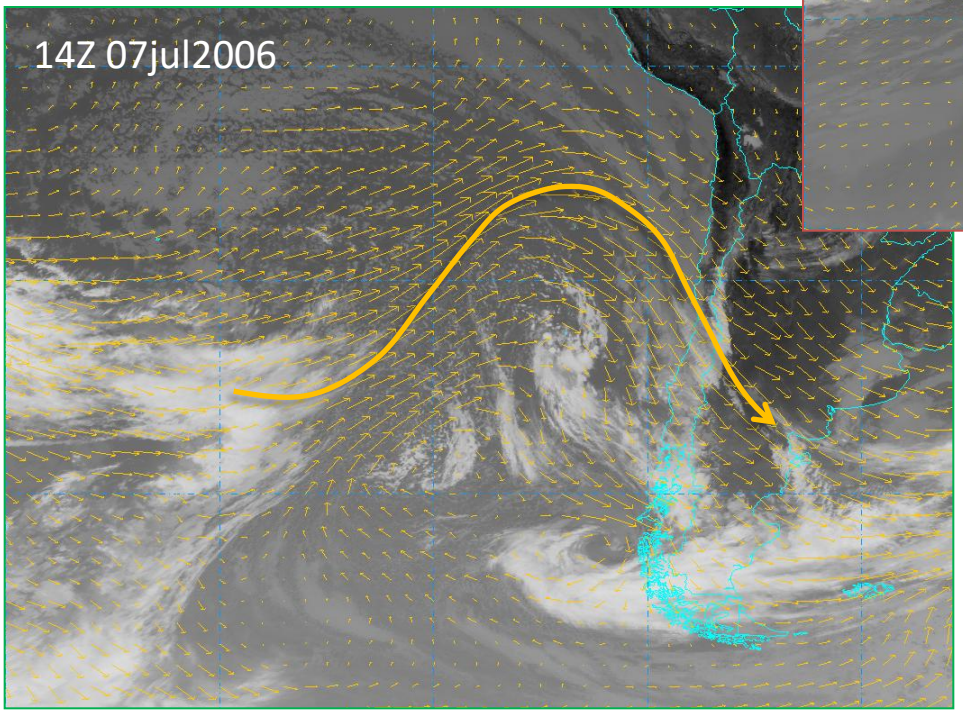
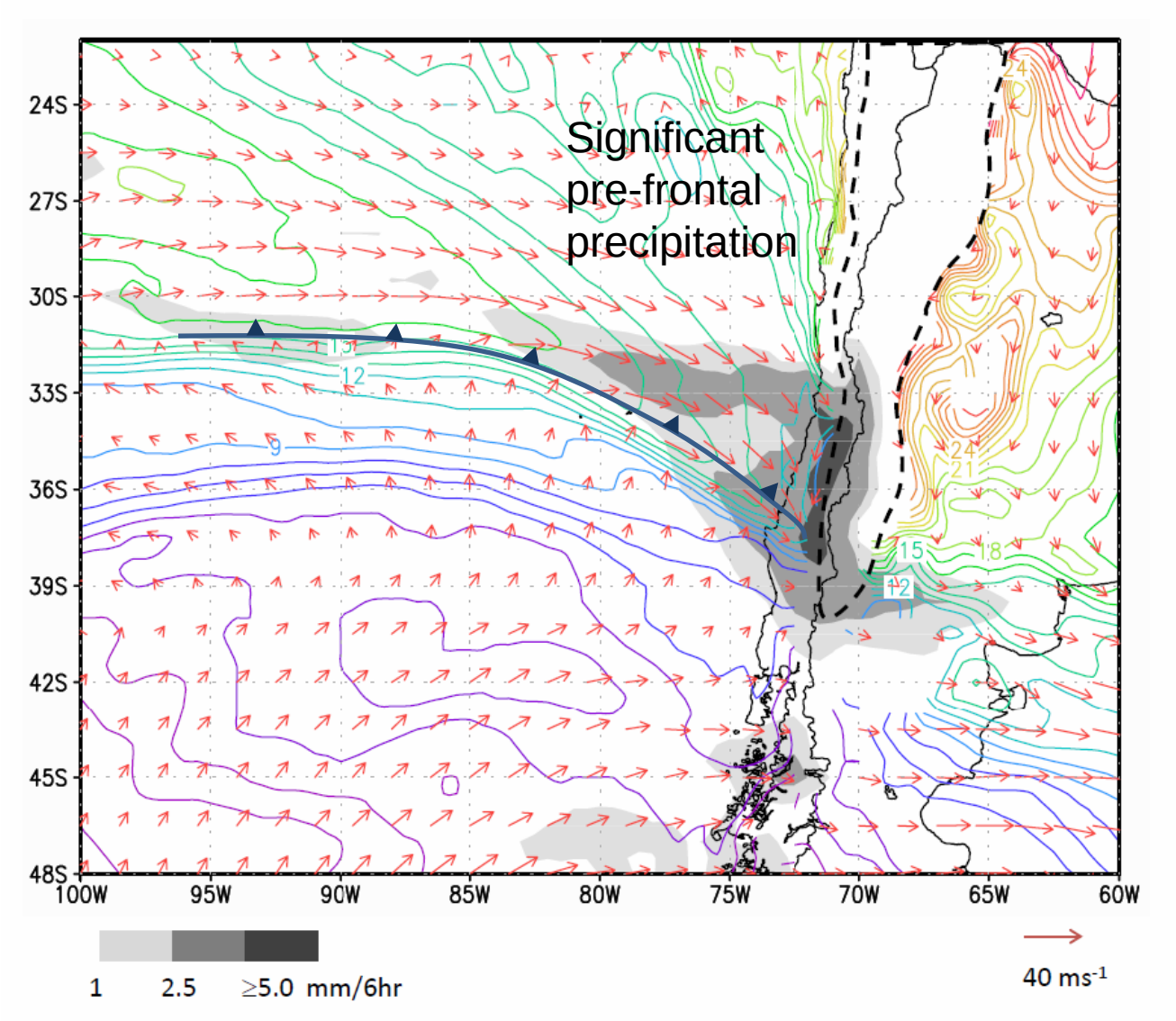


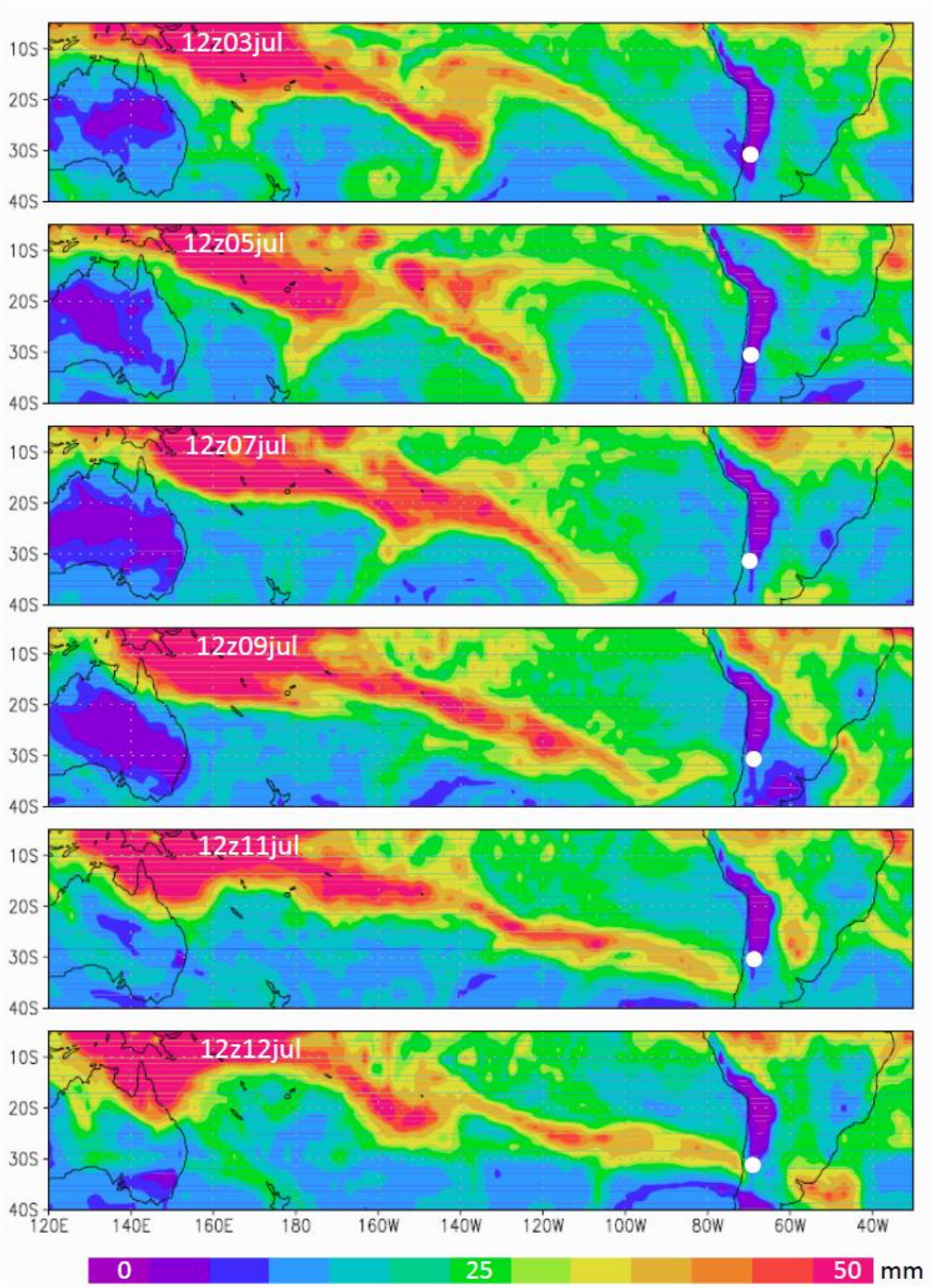


Case of study: July 2006

950 hPa winds, temperature and precipitation 18Z 11 Jul 2006

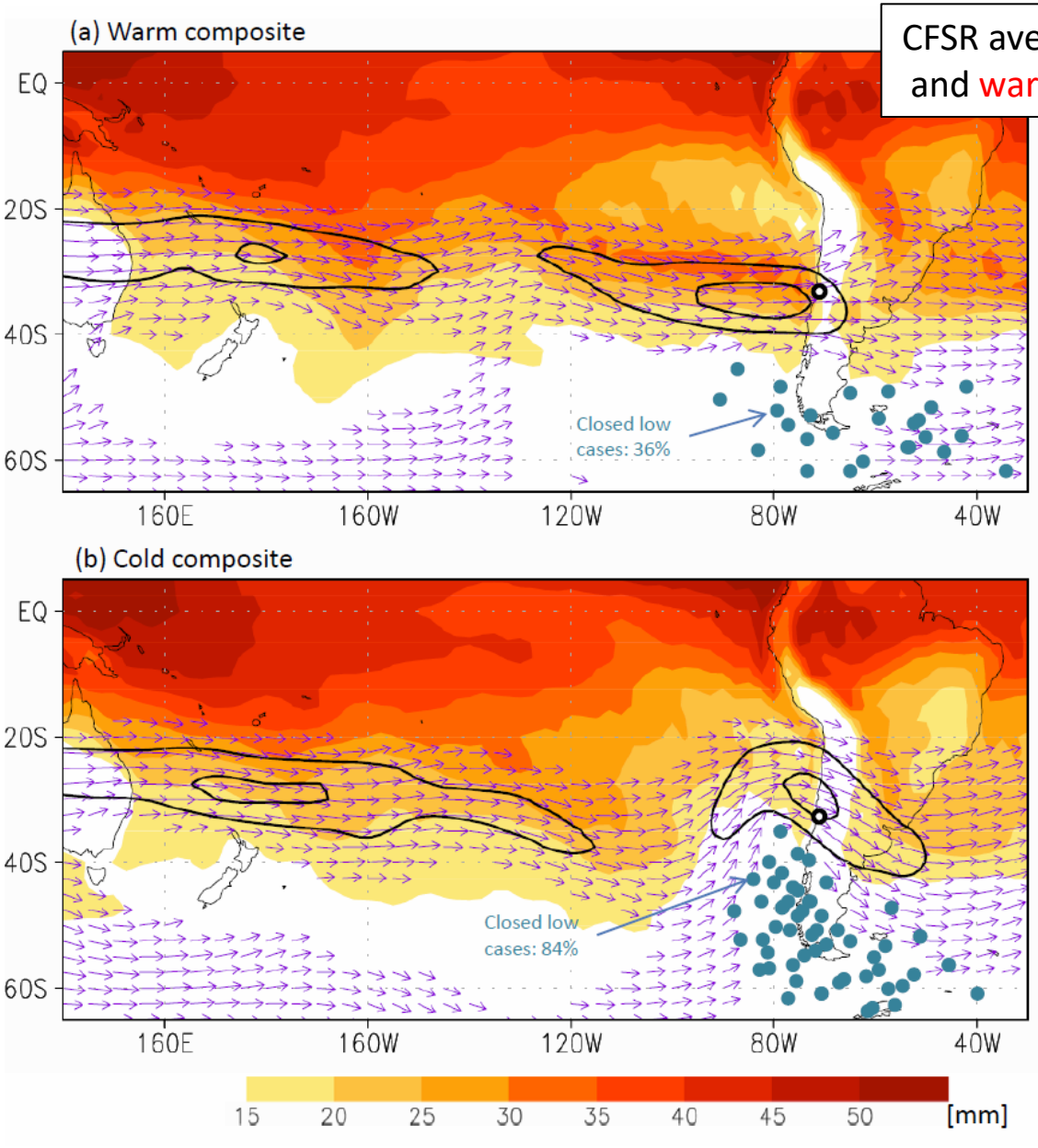


Case of study: July 2006



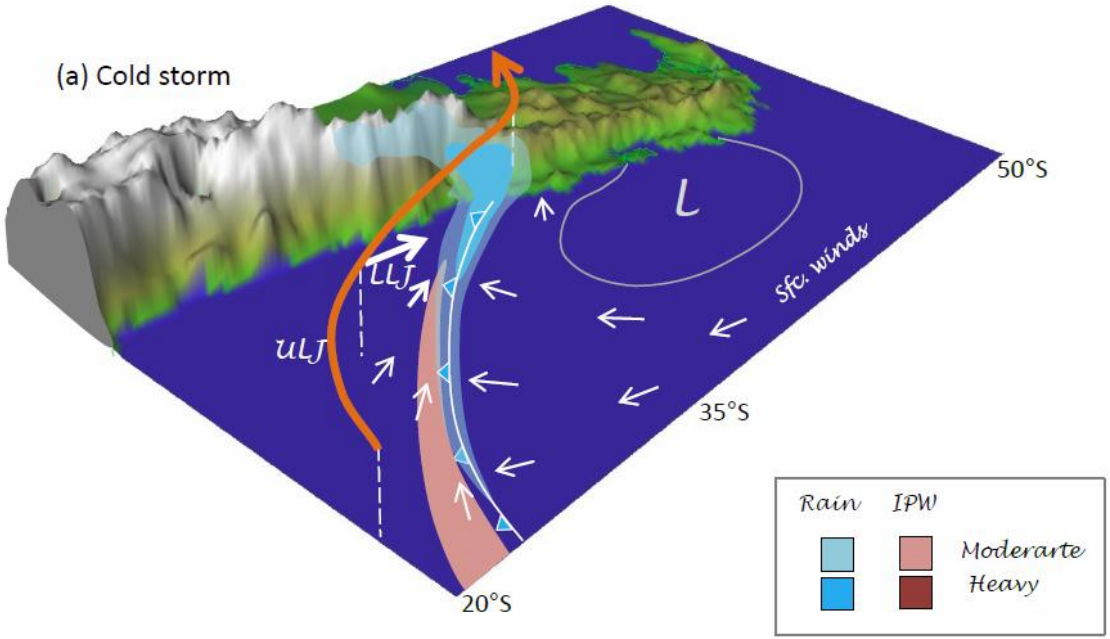
Large scale composite analysis: IPW & 200 hPa wind

CFSR averages for cold (44) and warm (22) rainstorms

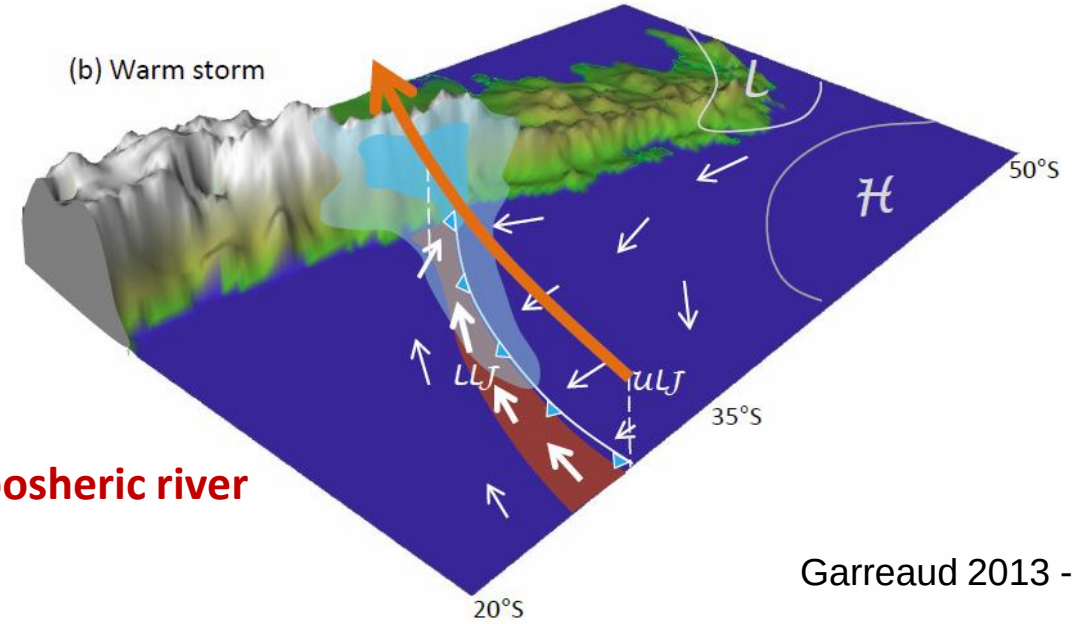


Conceptual Model

- Rainfall at and behind cold front
- H0 < 2500 m ASL
- Prefrontal rainfall up in the Andes
- Well defined baroclinic wave
- Deep cyclone off southern Chile
- NW flow aloft
- Strong topographic blocking
- Northerly low-level jet

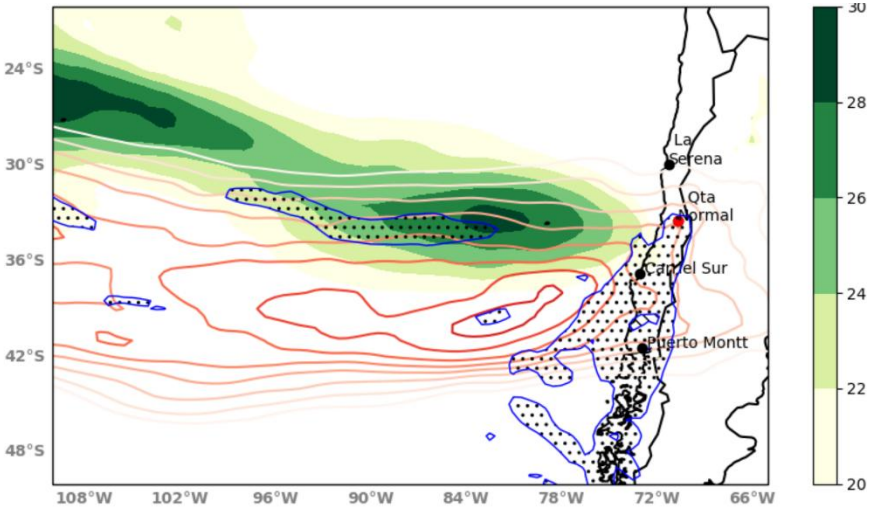


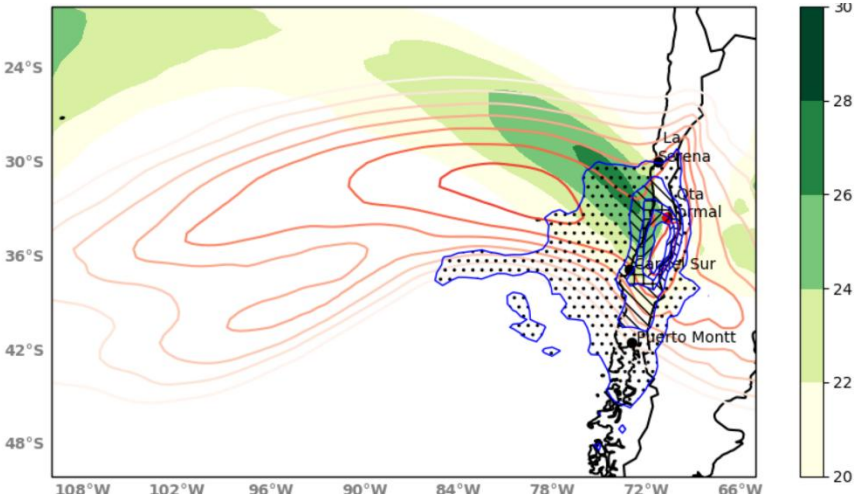
- Rainfall well ahead cold front
- H0 > 2500 m ASL
- Strong W flow aloft
- Conditionally unstable environment
- Reduced topographic blocking
- Wide, deep layer of ascent
- Weak trough farther south
- Blocking anticyclone farther west
- **TransPacific zonal jet and troposheric river**



Garreaud 2013 - JHM

Mean IWV for rainy days ≥ 35.0mm (n=22)
300hPa Isotacs (min:30m/s, interval:3 m/s)





Valenzuela & Garreaud
In preparation

Impacts of Atmospheric Rivers on Precipitation in Southern South America

Maximiliano Viale *

Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA), CCT – CONICET - Mendoza, Argentina, and Departamento de Geofísica, Universidad de Chile, Santiago, Chile.

Raúl Valenzuela and René D. Garreaud

Departamento de Geofísica and Centro del Clima y la Resiliencia, Universidad de Chile, Santiago, Chile.

F. Martin Ralph

Center for Western Weather and Water Extremes, Scripps Institution of Oceanography, University California, San Diego, California, USA.

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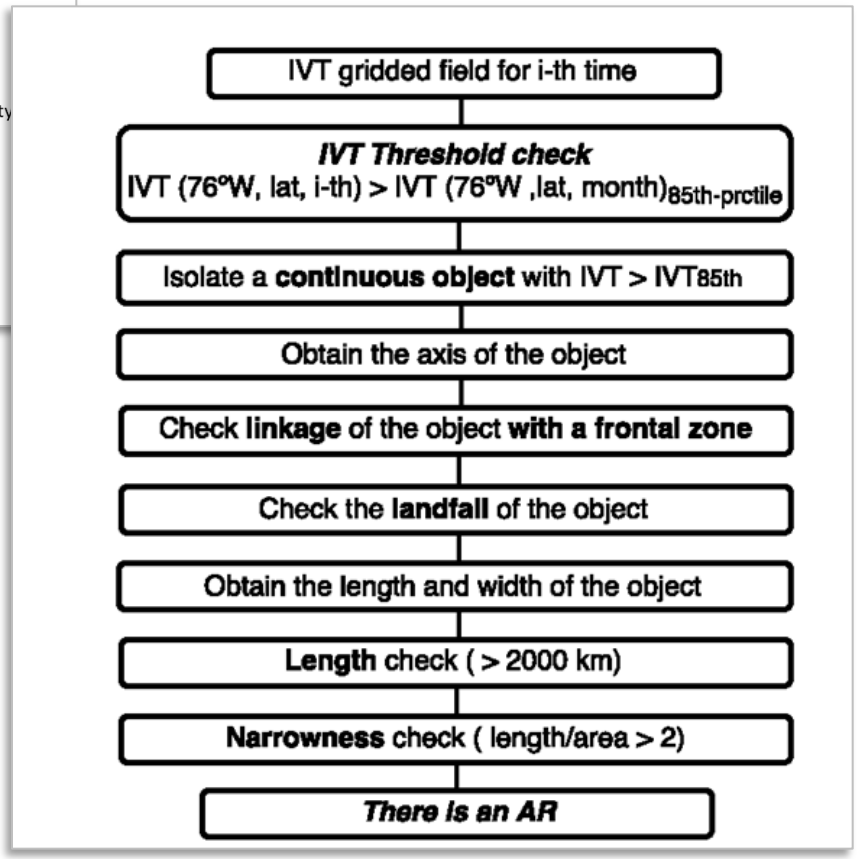
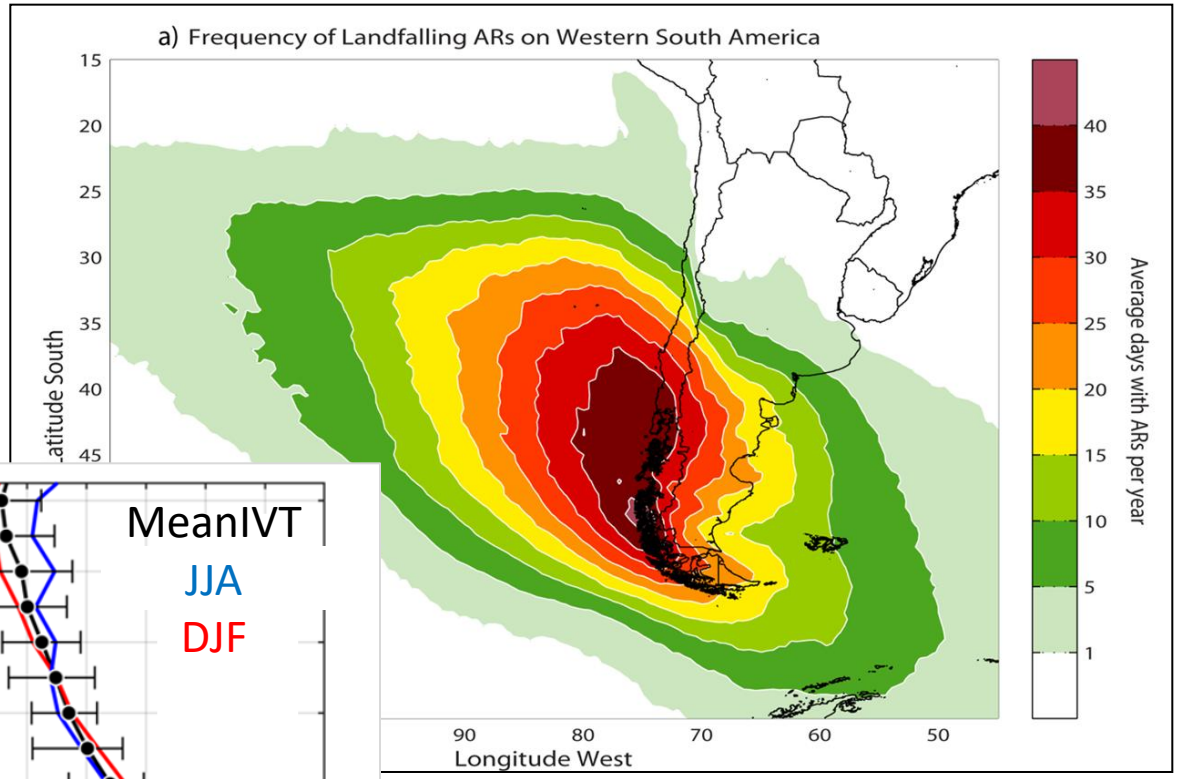
January 2018

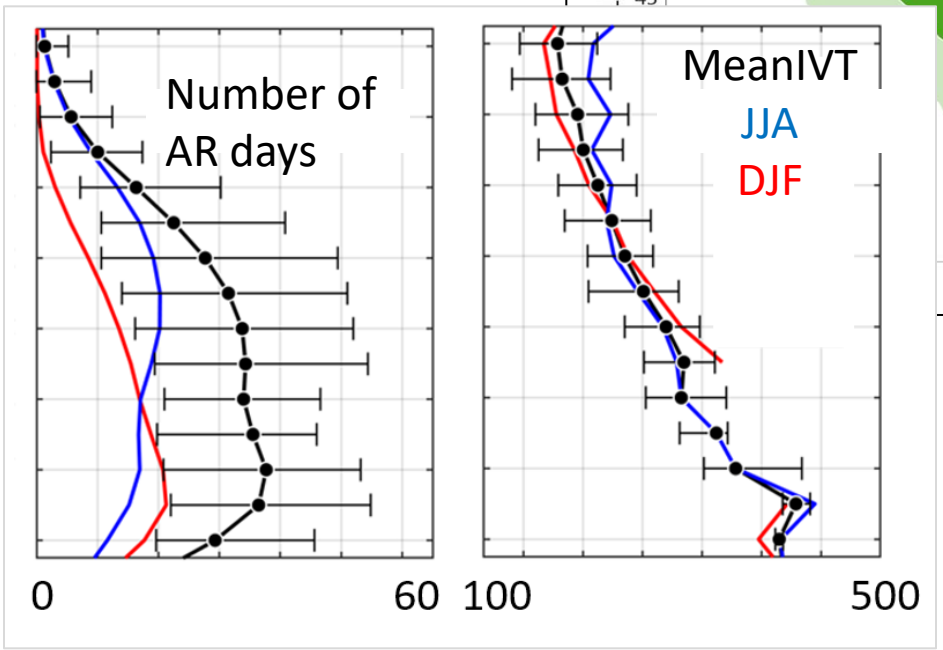
Modified Guan and Waliser (2015) approach
Uses CFSR 2001-2016
IVT as a key variable



15 year landfalling AR climatology

Viale et al. 2018

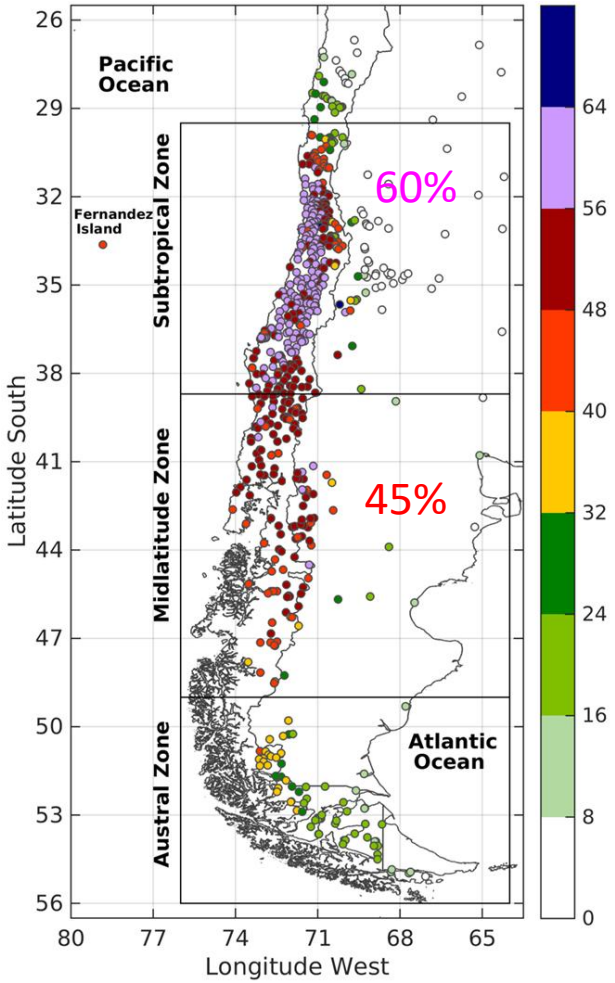




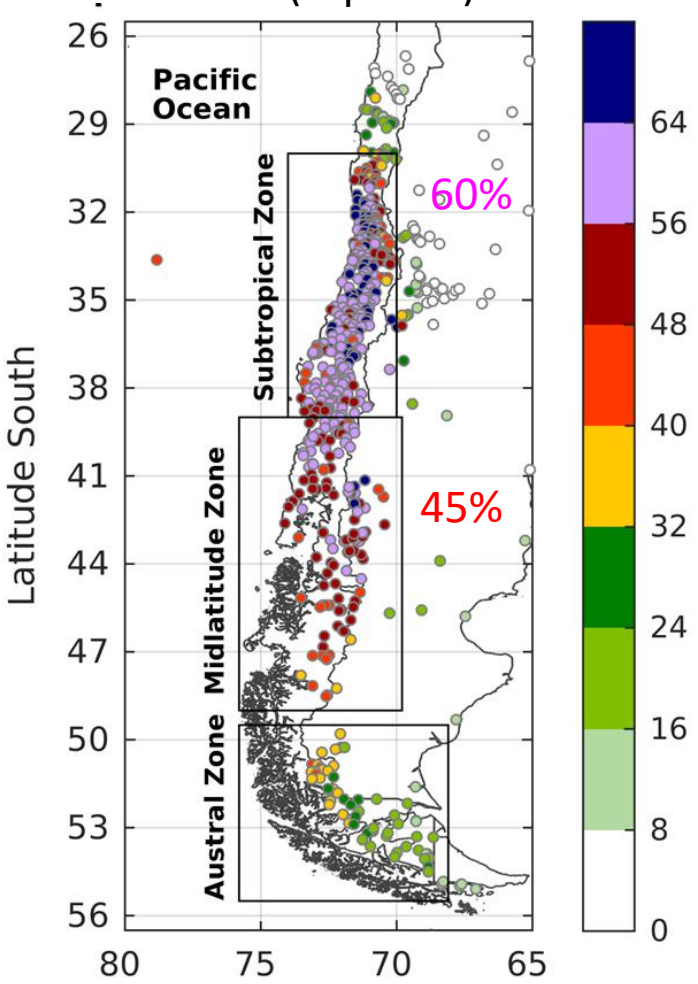
15 year landfalling AR climatology

Why is the impact of AR i so uniform along the coast?

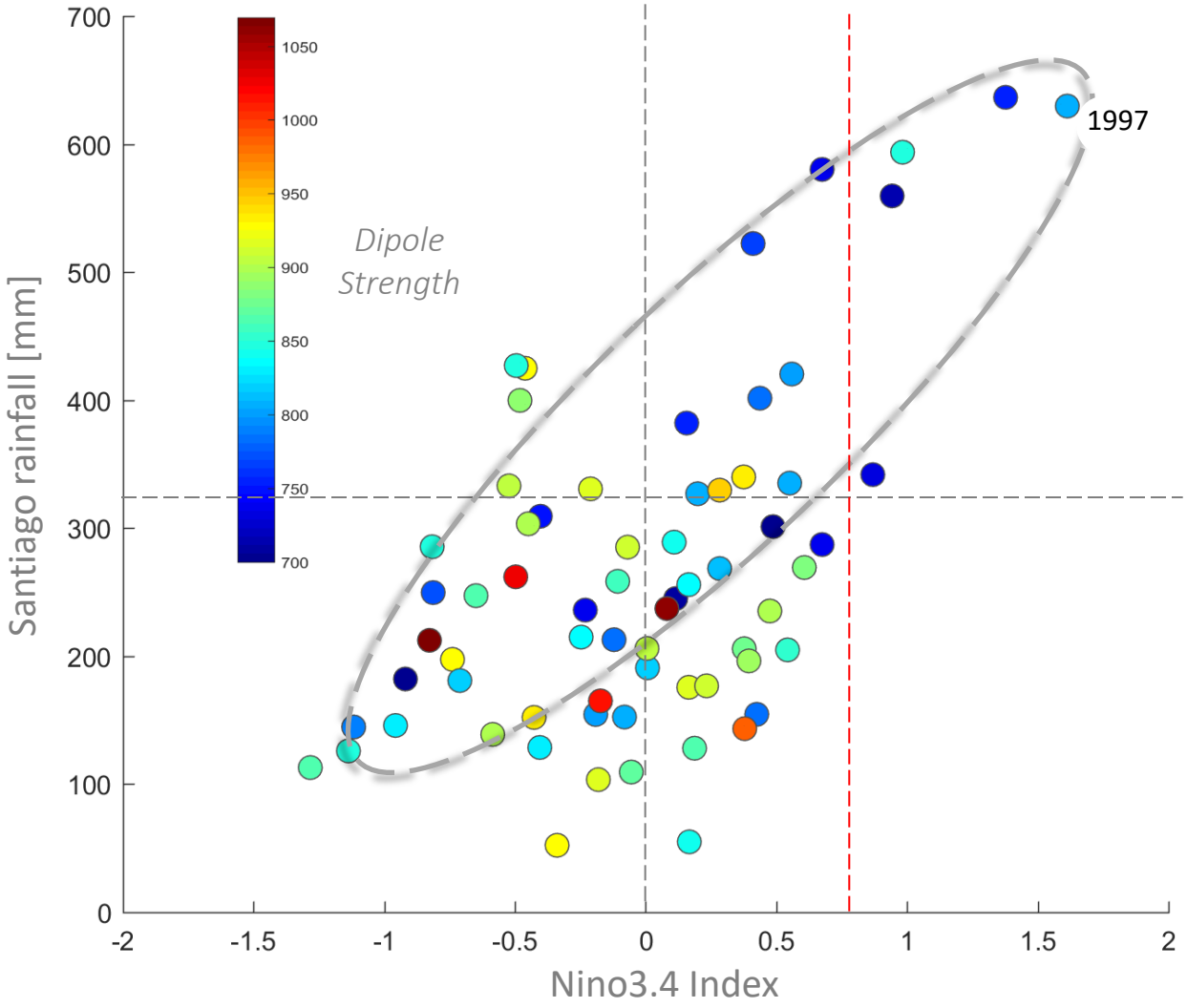
AR contribution to annual rainfall



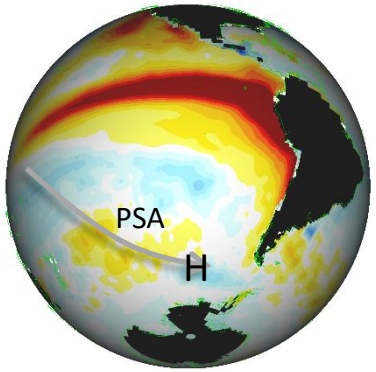
Fraction of AR-related EPEs (top 25%)



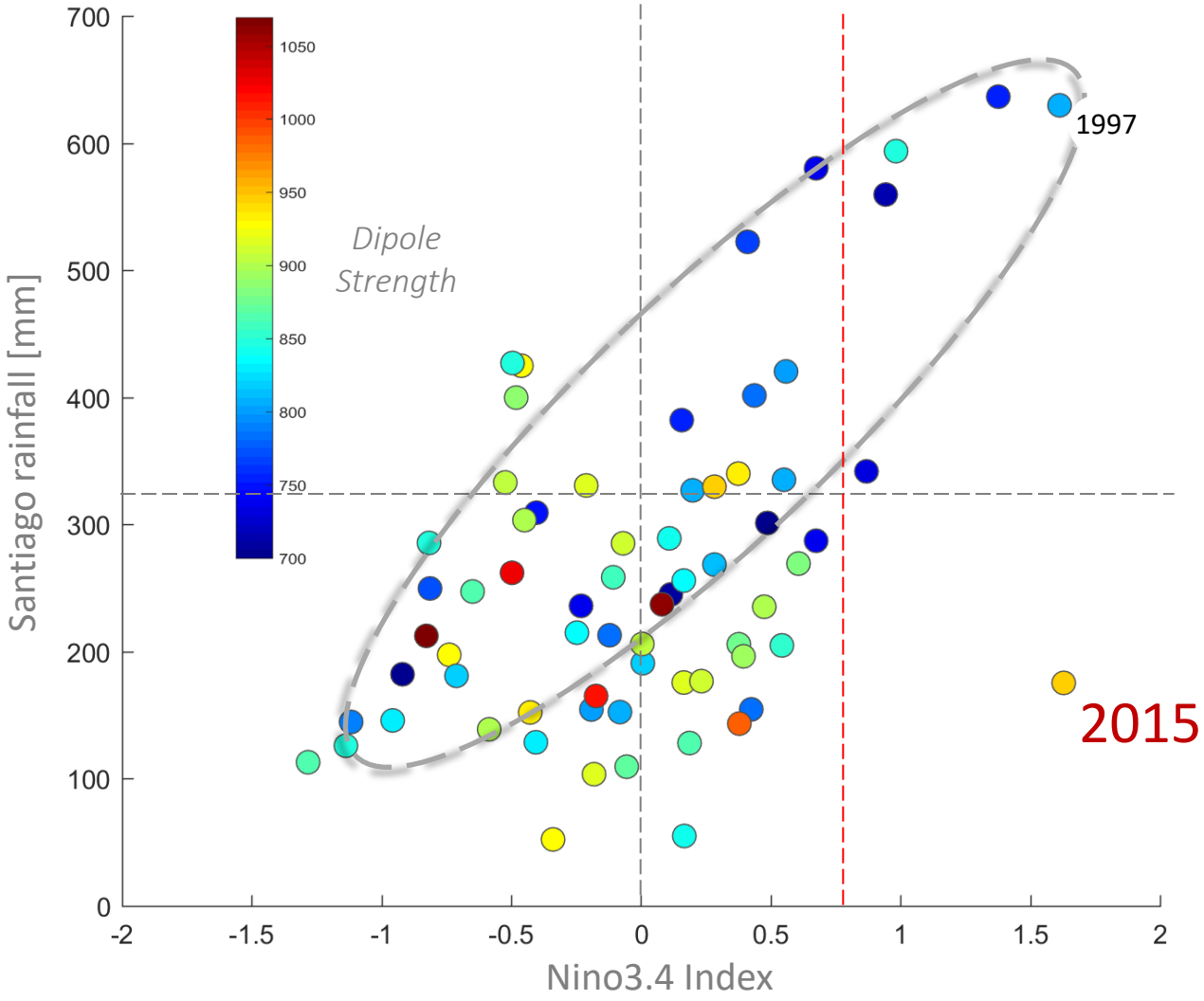
ENSO – Precipitation in Central Chile



SST Anomaly 1997



ENSO – Precipitation in Central Chile



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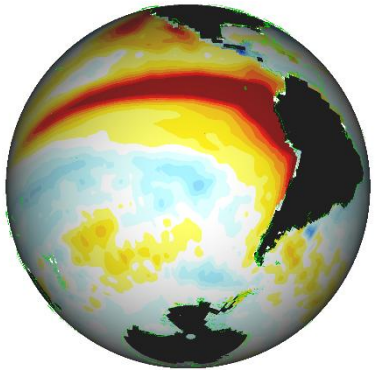

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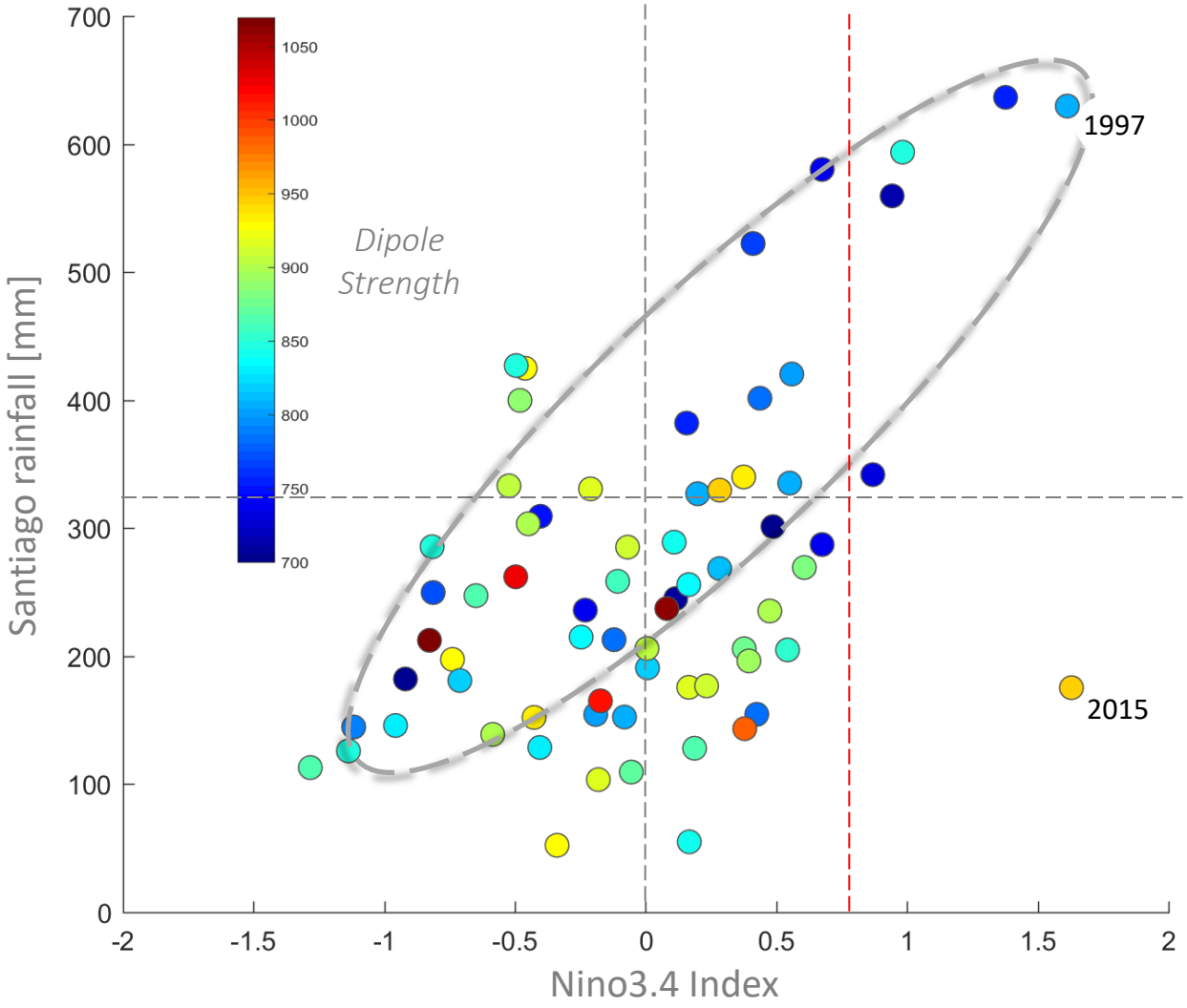
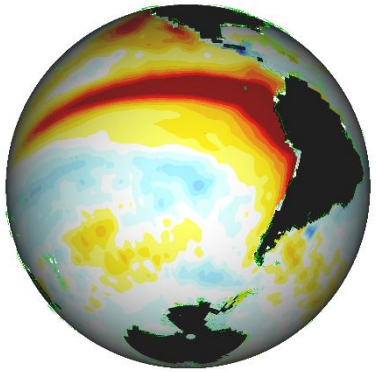
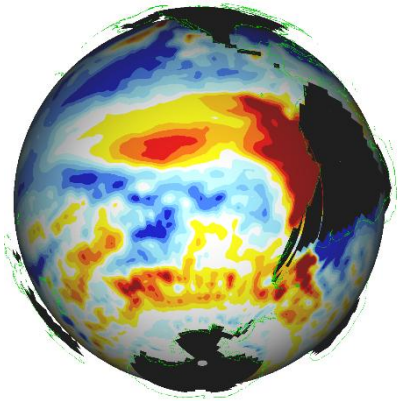
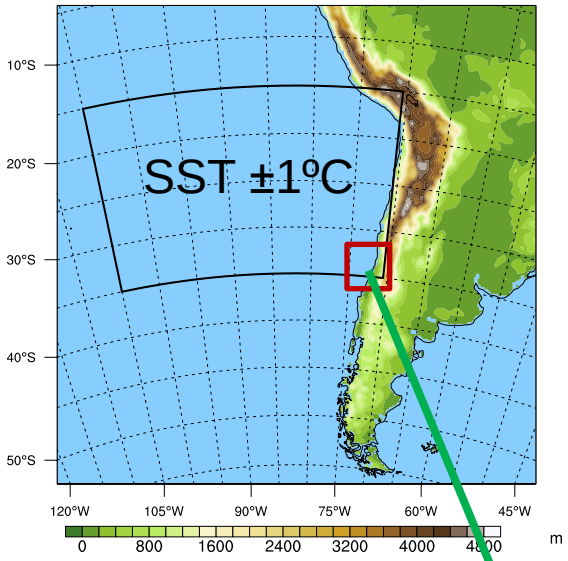


SST Anomaly 1997



SST 1997 - 2015



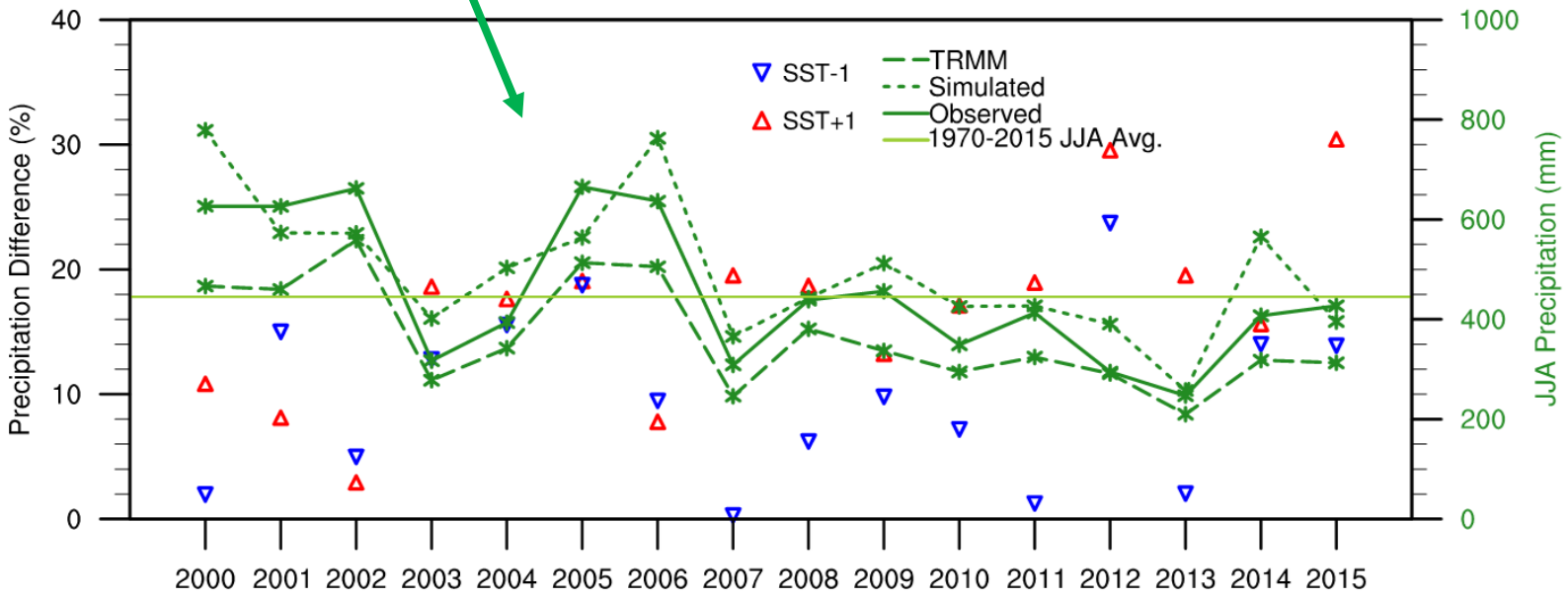


Coastal SST linked to open-ocean conditions. To isolate the signal we did a 10 year long simulation with RegCM (10 km res). Three experiments:

Control: Observed SST

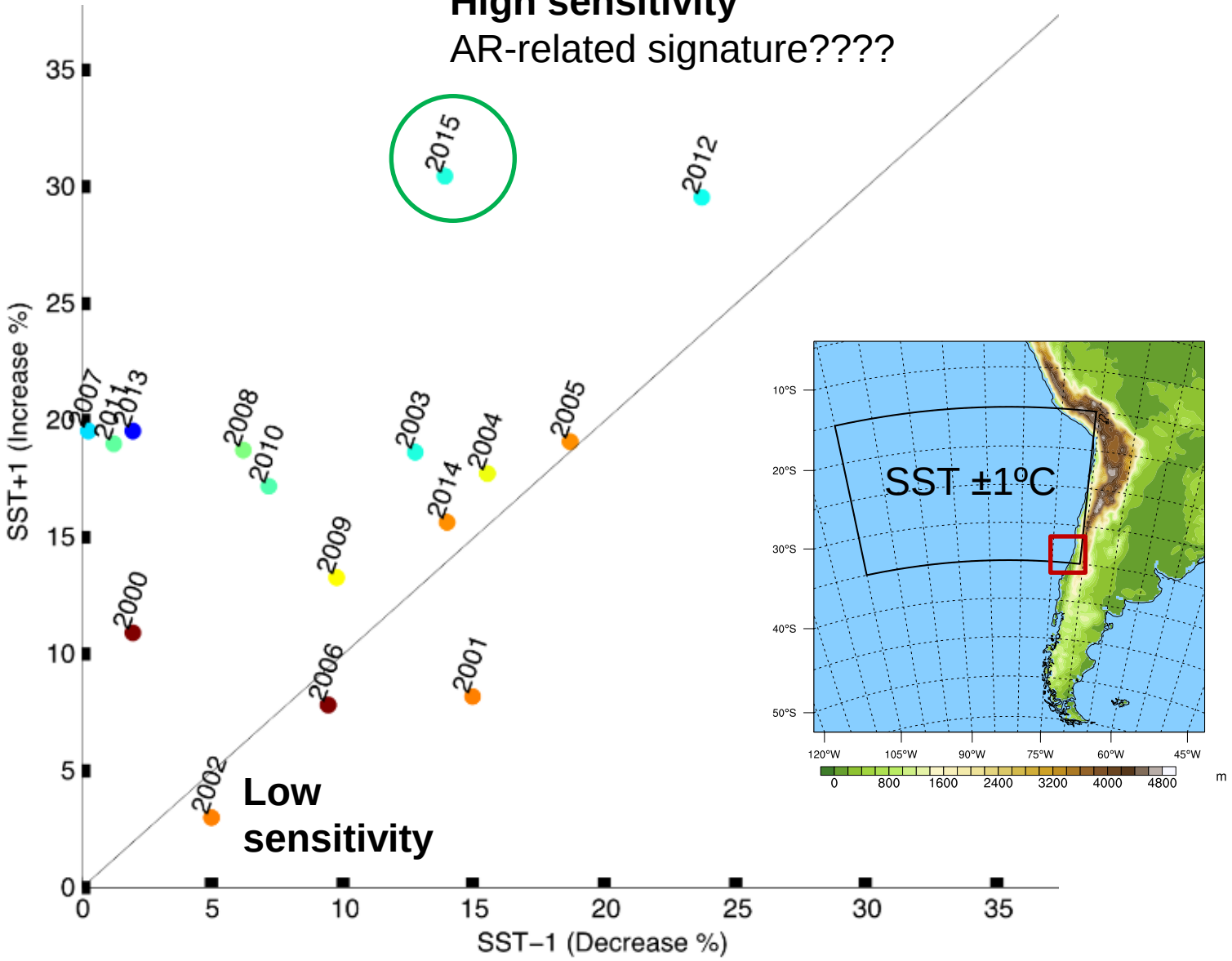
Warm SEP: +1ºC in coastal box

Cold SEP: -1ºC in coastal box



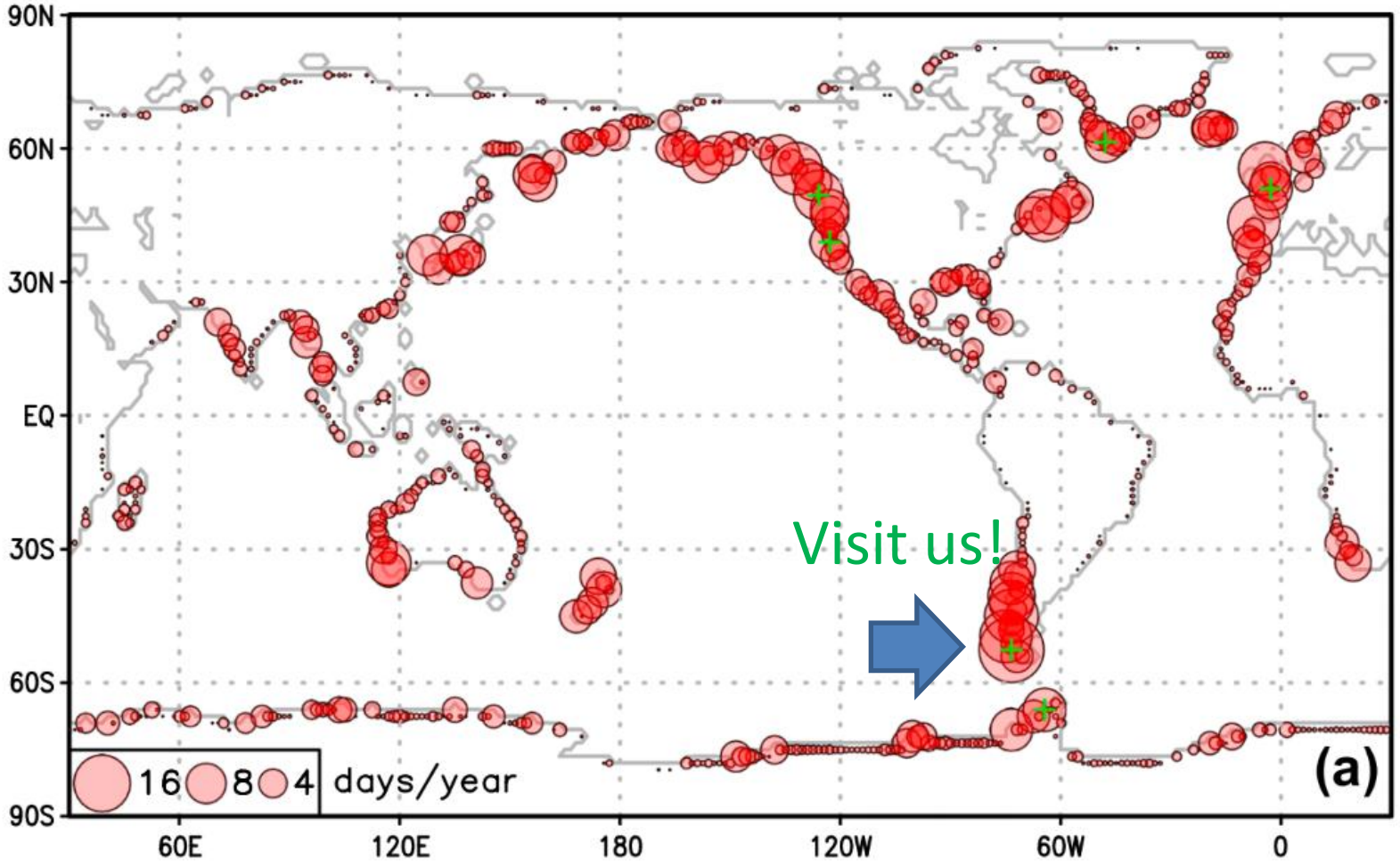
Deniz Bozkurt et al….201X

High sensitivity
AR-related signature????



Deniz Bozkurt et al….201X

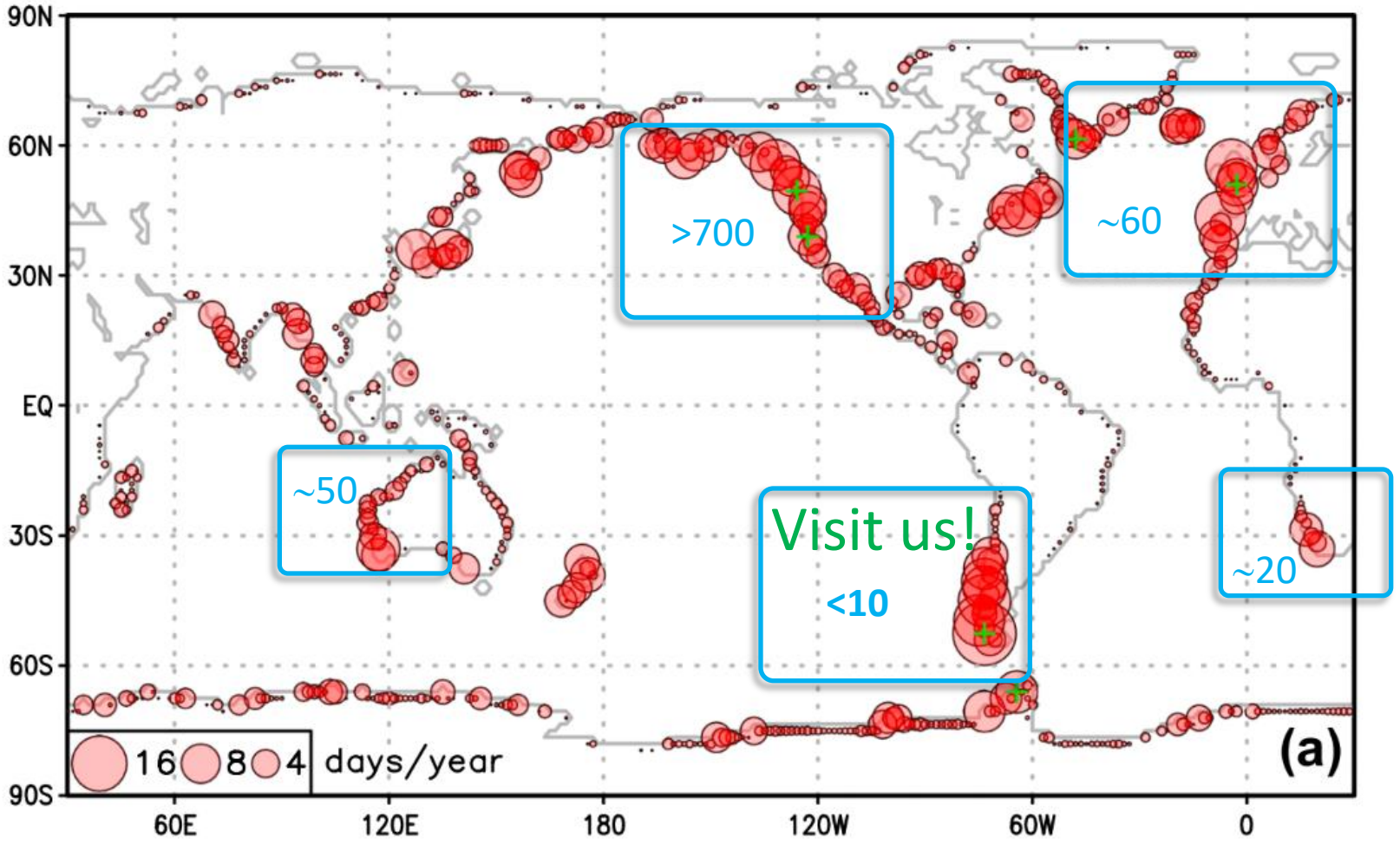
Landfalling AR – Global Survey



Modified Guan and Waliser (2015)

Landfalling AR – Global Survey

Number of AR paper per region*



Modified Guan and Waliser (2015)