

La actual Mega-Sequía en Chile Central: Llegó el futuro?



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La megasequía 2010-2015

- Moderada (20-40% déficit anual)
- Larga (5-6 años) e ininterrumpida
- Extensa (30-40°S)
- Cálida (+0.5 – 1°C)
- Alta demanda hídrica

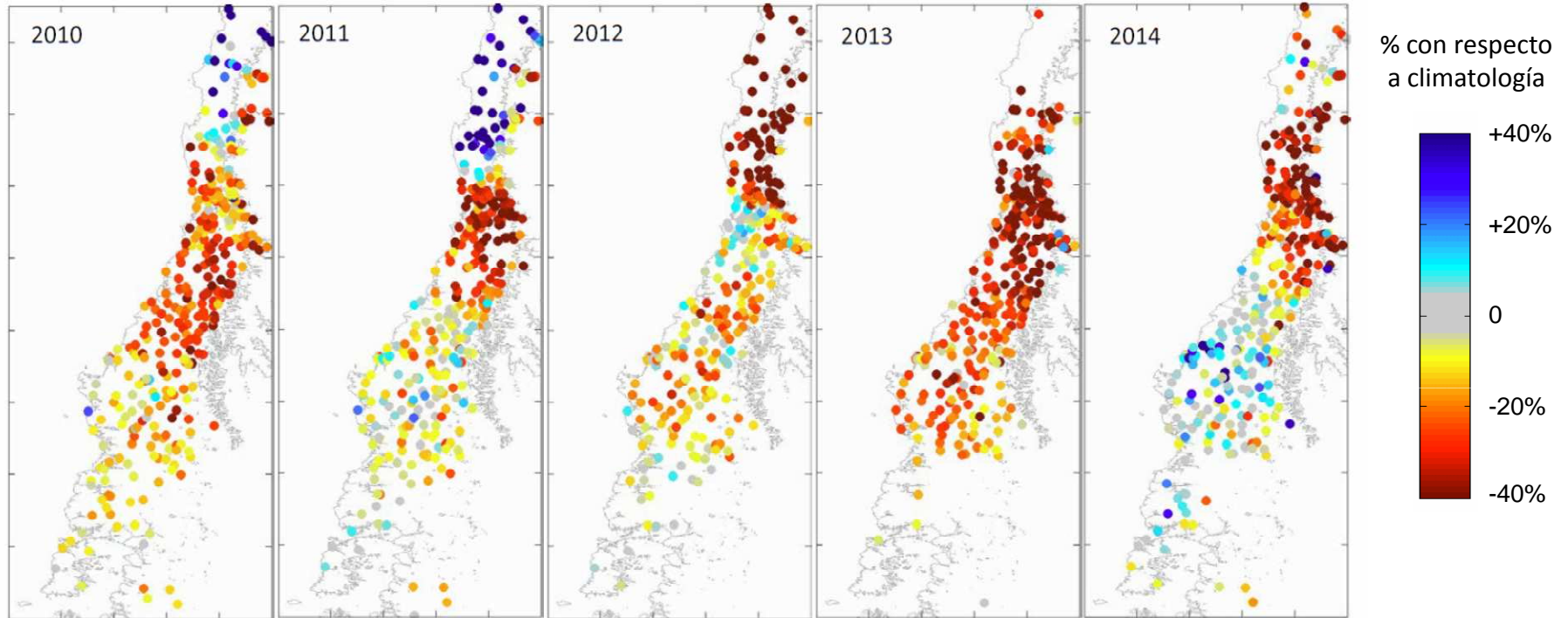
Recurrencia en el siglo XX

- 2-3 casos similares en centro-norte
- <1 caso en centro-sur
- También es inusual en reconstrucción Paleo

Impactos:

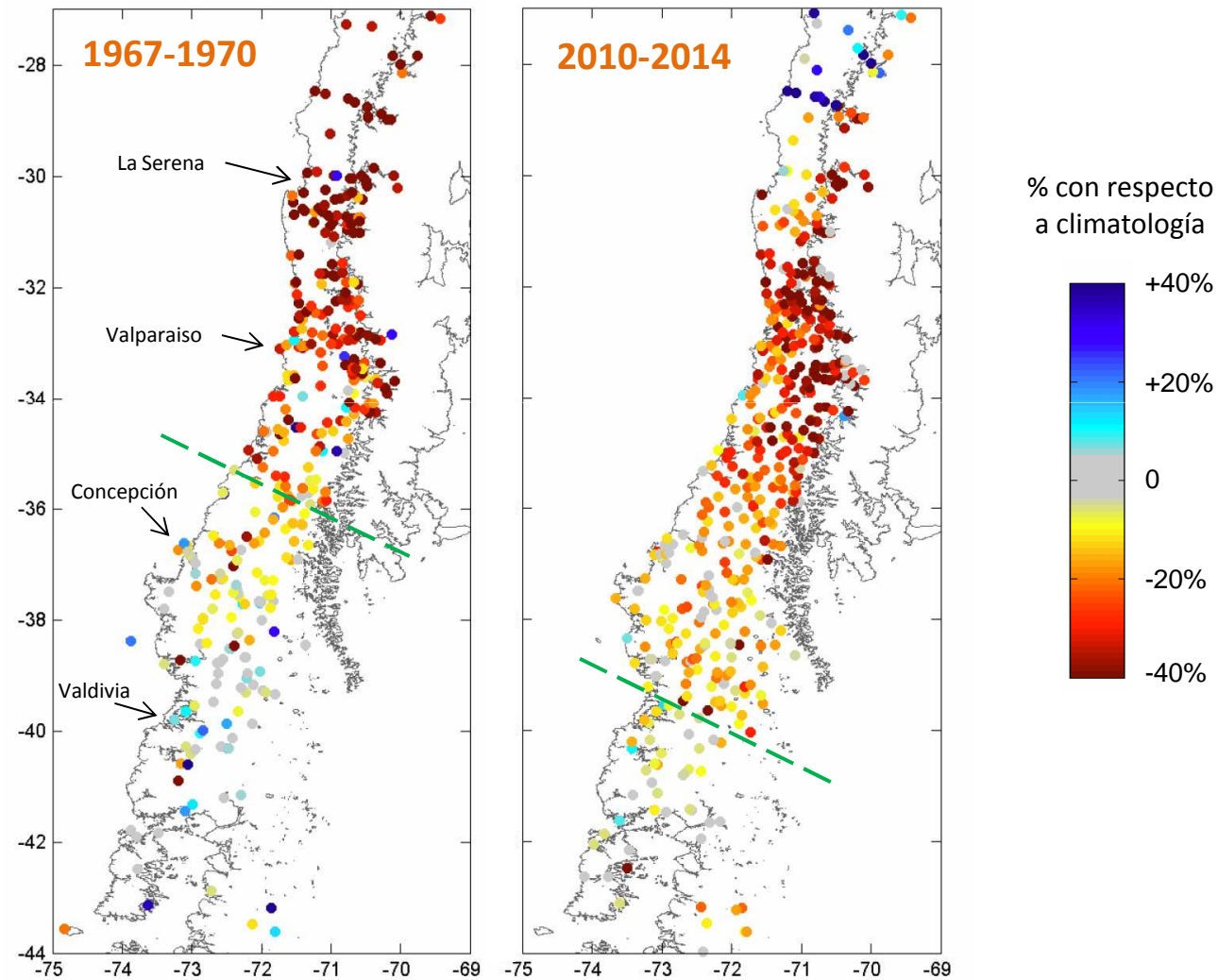
- Hidrología sfc y subterránea
- Vegetación natural
- Regimen de incendios
- Sociales y económicos

La Megasequía 2010-2015

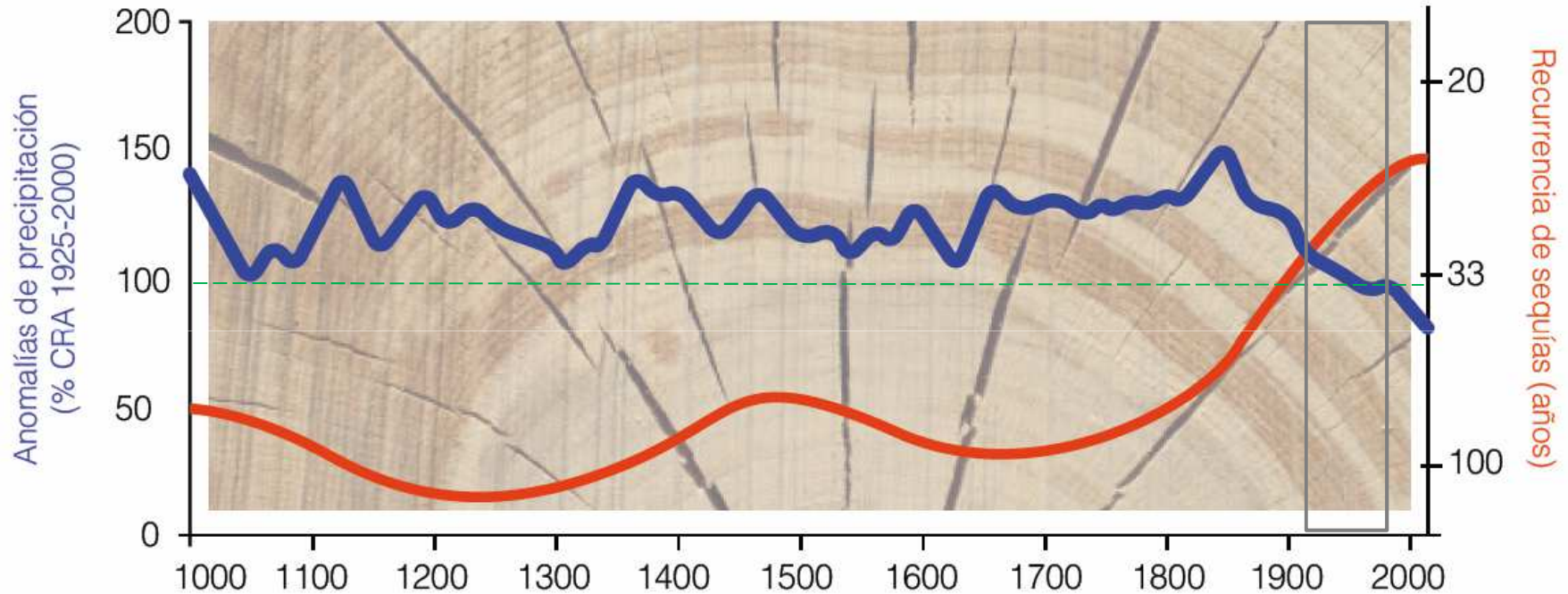


	Norte Chico	Centro	Centro-sur
Período de retorno del año más seco durante la MS (años)	7	15	>30
Recurrencia de eventos secos (>30%) de 4 o mas años	4-6	2-3	1?

Grandes sequías contemporáneas

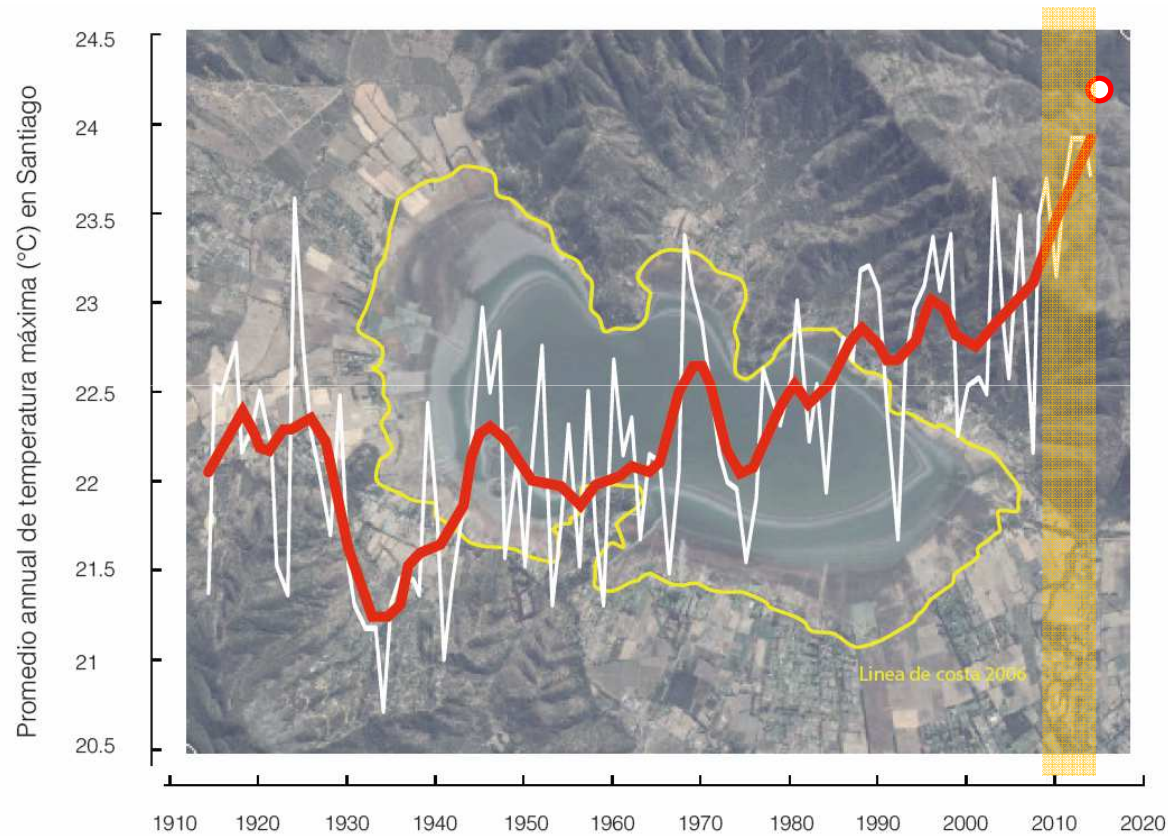


Una mirada al pasado



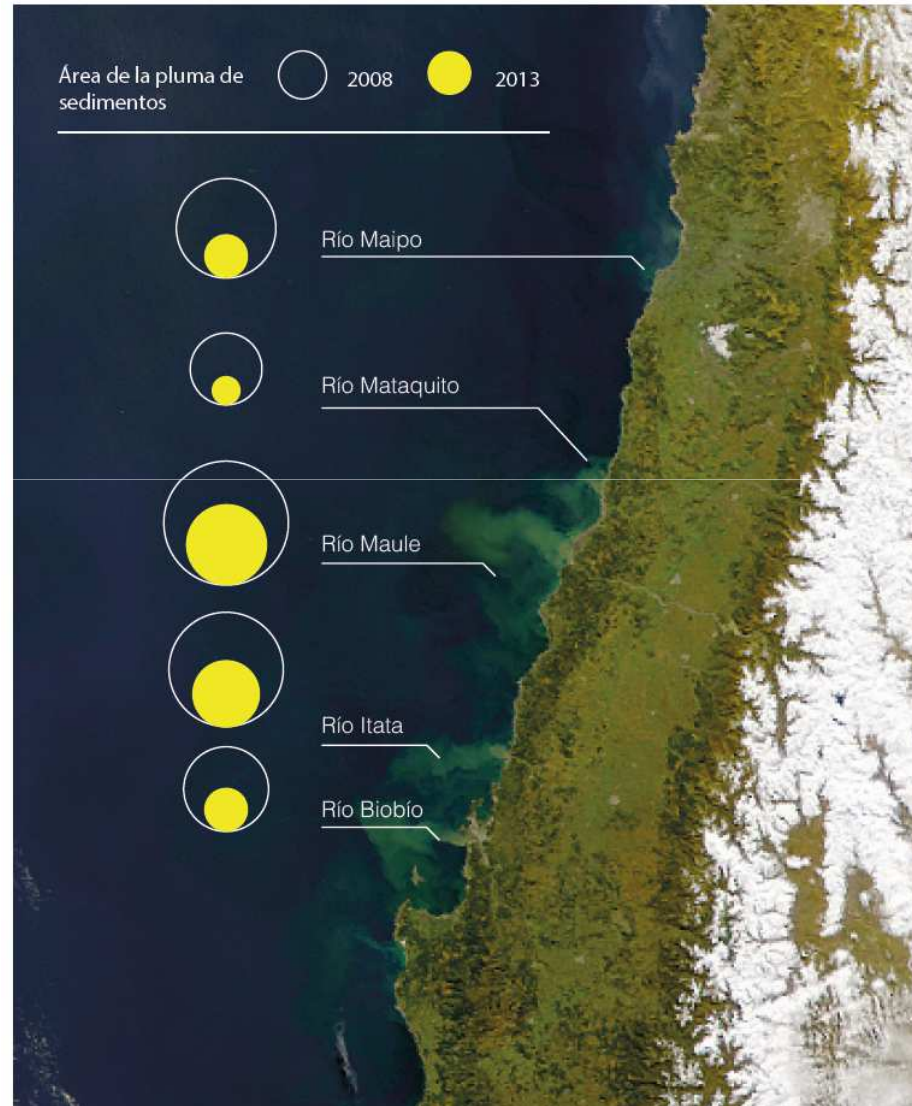
Reconstrucción dendroclimática (1000-2000 años d.C.)
de la precipitación en Chile central

Sequía y calor



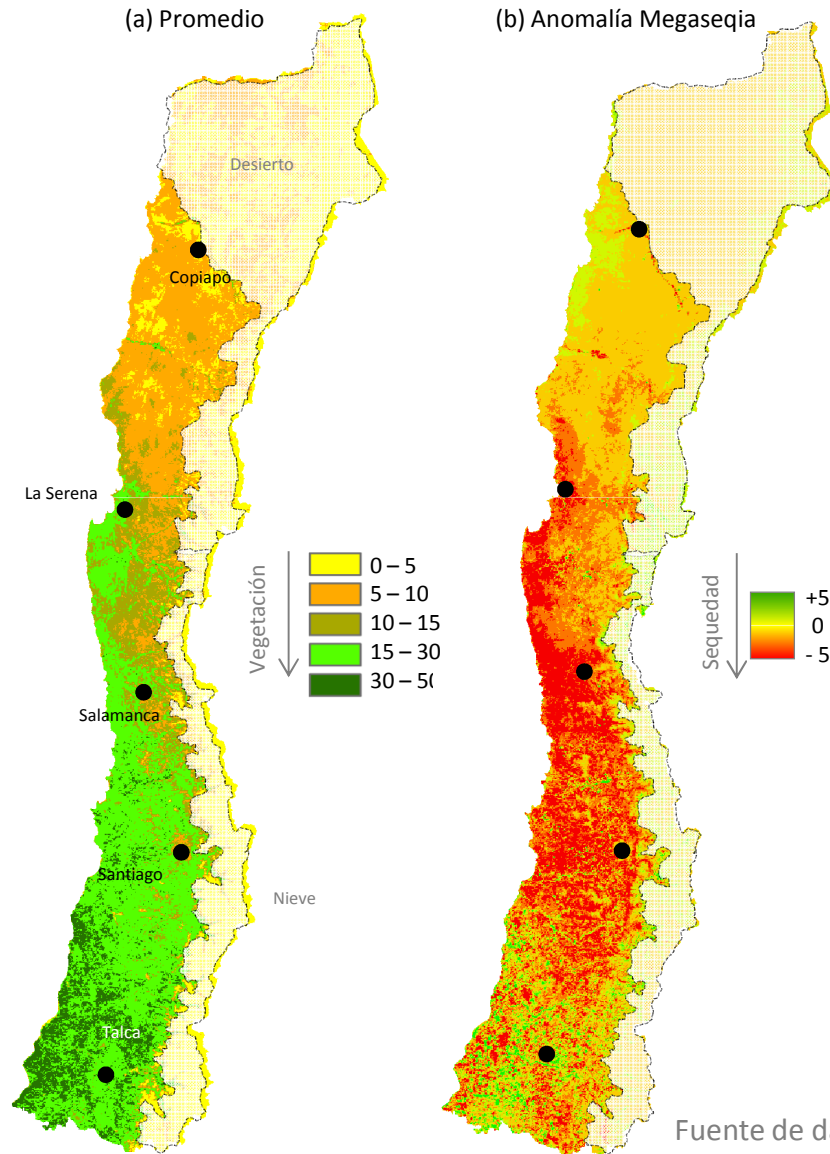
Promedio anual de la temperatura máxima en Santiago (DMC)

Impactos en Hidrología



Índice de Vegetación Mejorada (EVI)

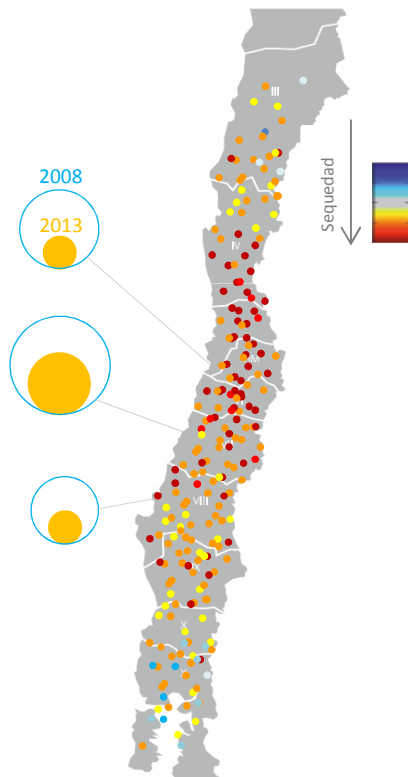
Julio-Agosto-Septiembre



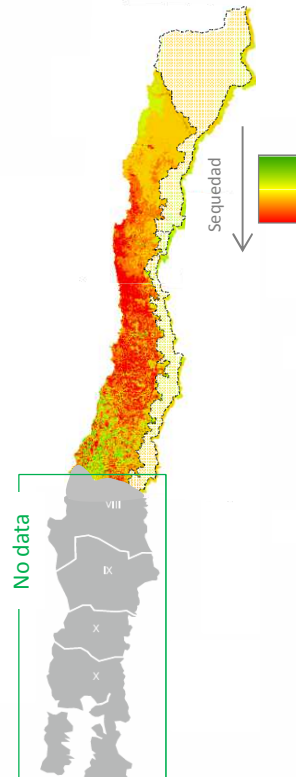
Fuente de datos: NASA (producto MODIS MOD13A3)
Mapas producidos por David Lopez, CEAZA

La Megasequía 2010-2015

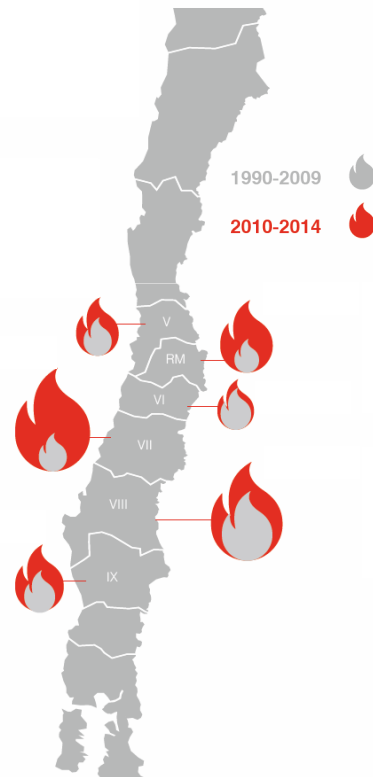
Transporte de sedimentos en invierno



Déficit Pluviométrico (2010-2014)

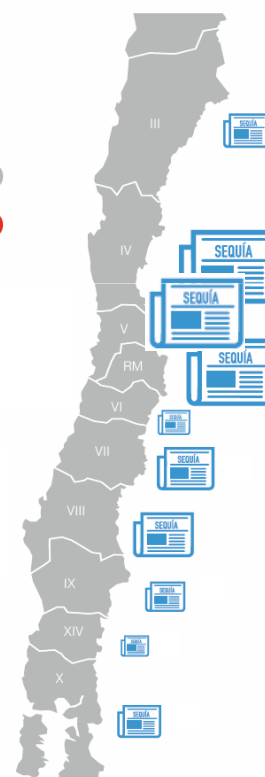


Deterioro vegetación Agosto 2010-2015



Incendios forestales de magnitud

Apariciones en prensa escrita (2014)

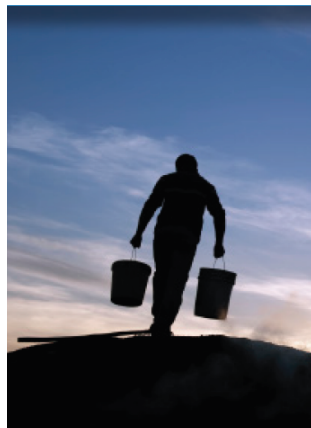
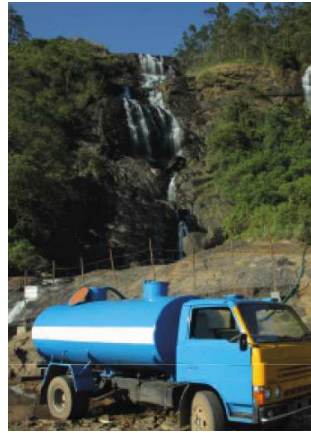


Gastos en Camiones Aljibes (Mill\$)



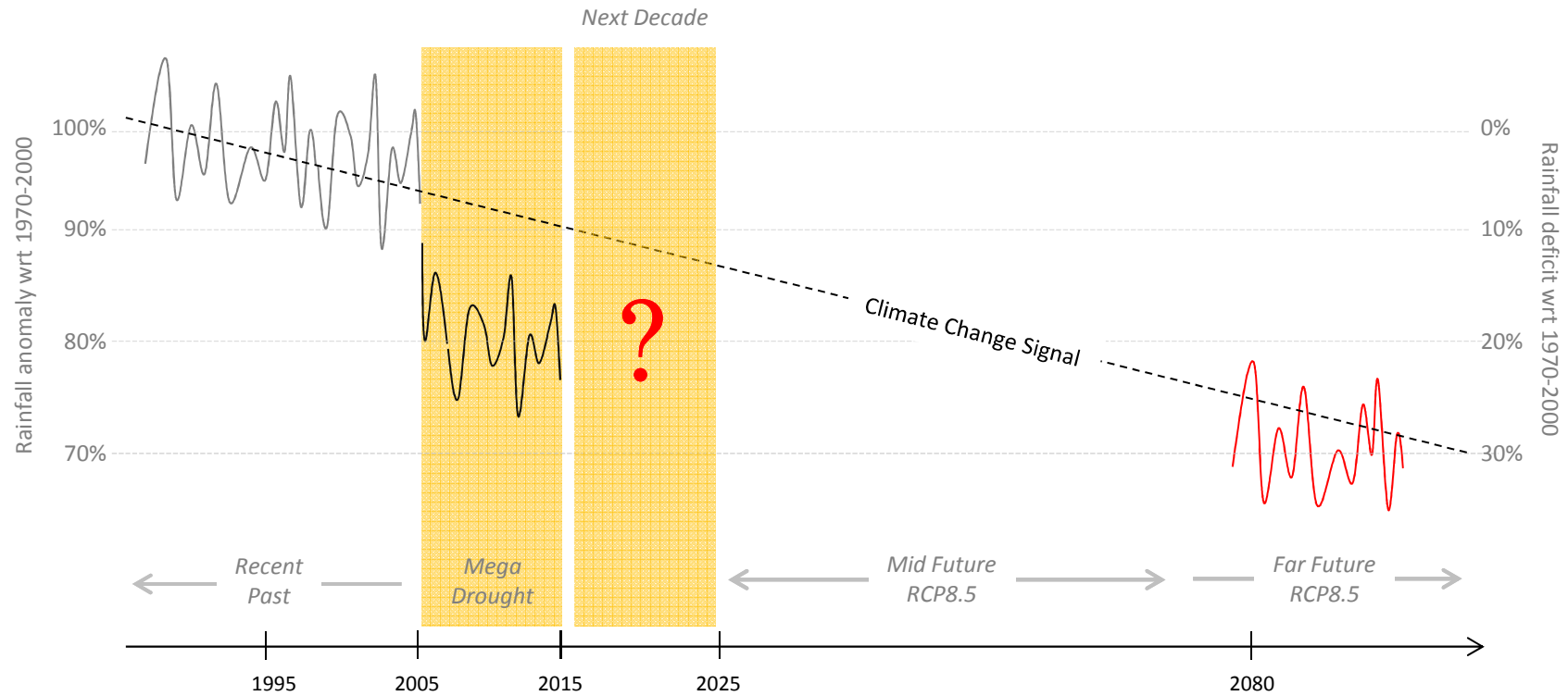
La Megasequía 2010-2015: Una lección para el futuro

www.cr2.cl/megasequia



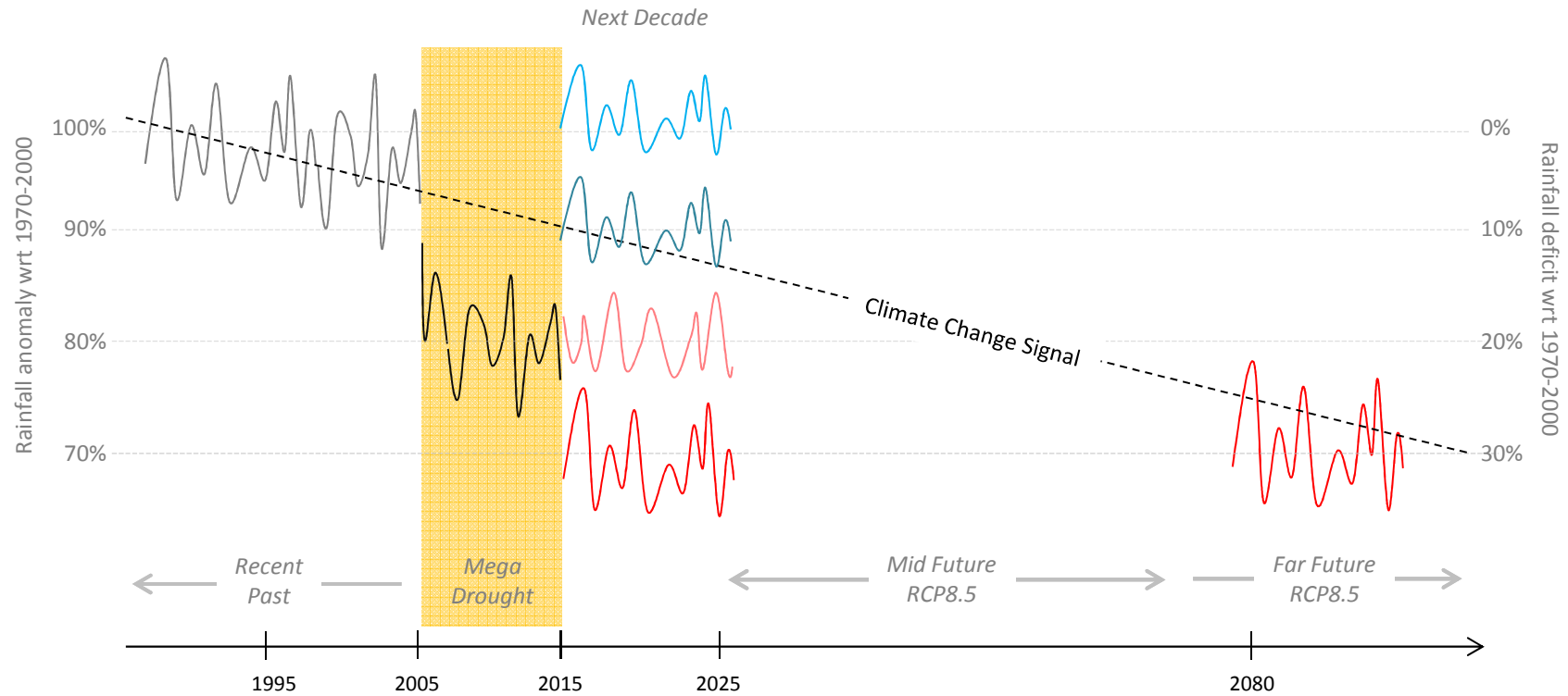
Precipitación en Chile Central

El desafío de la próxima década



Precipitación en Chile Central

El desafío de la próxima década



Large-scale context for central Chile droughts

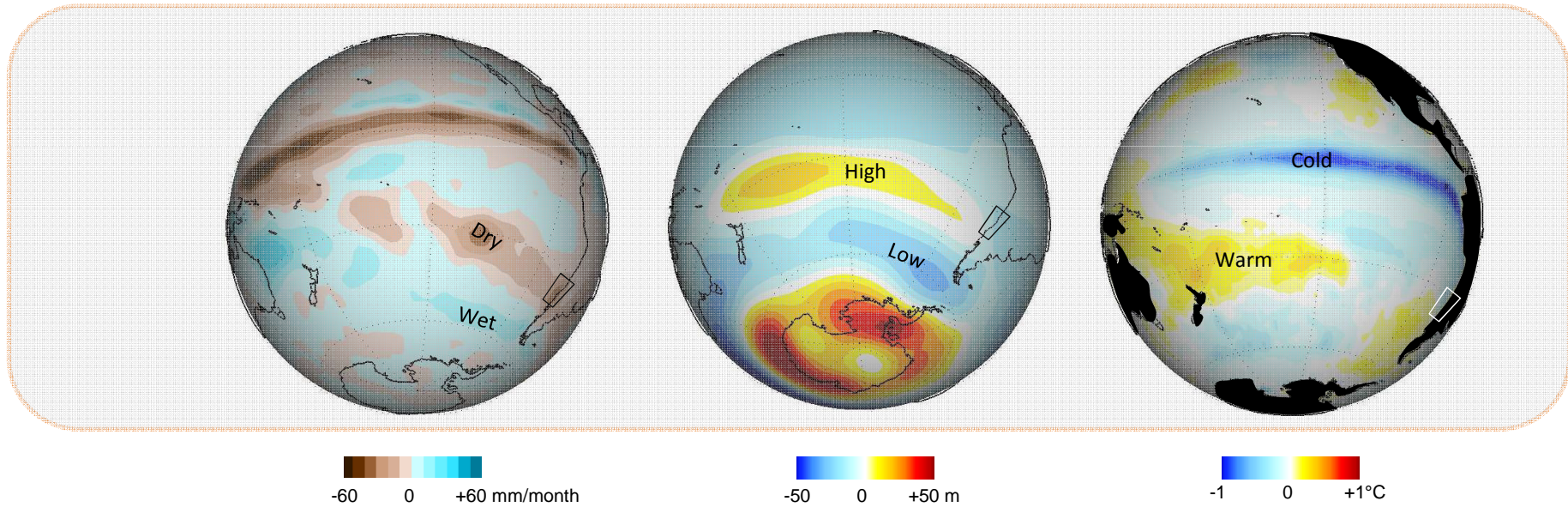
Drought Composite

1967,68,64,73,76,85,96,87,03,07

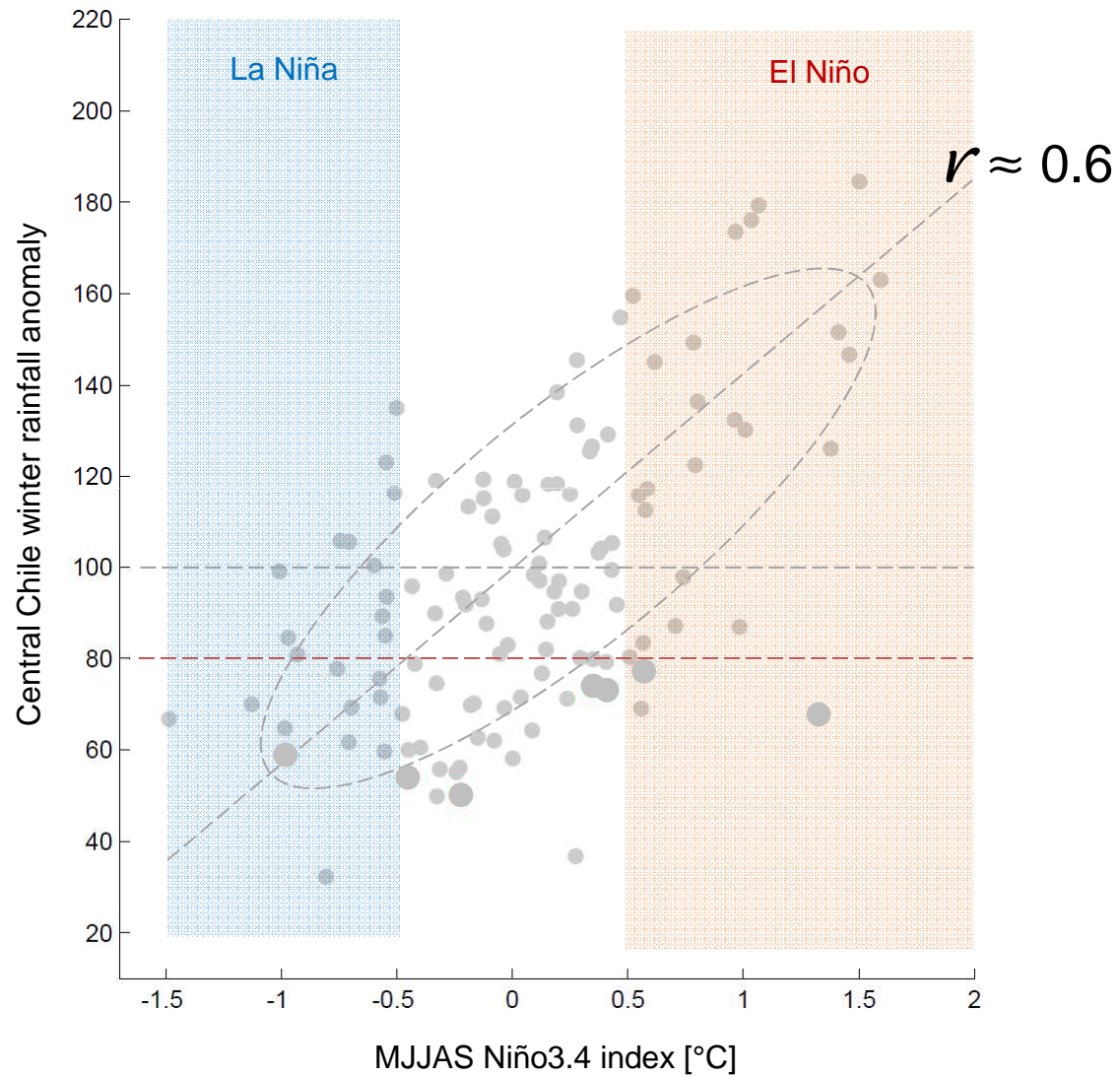
Rainfall (GPCP)

Z500 (NNR)

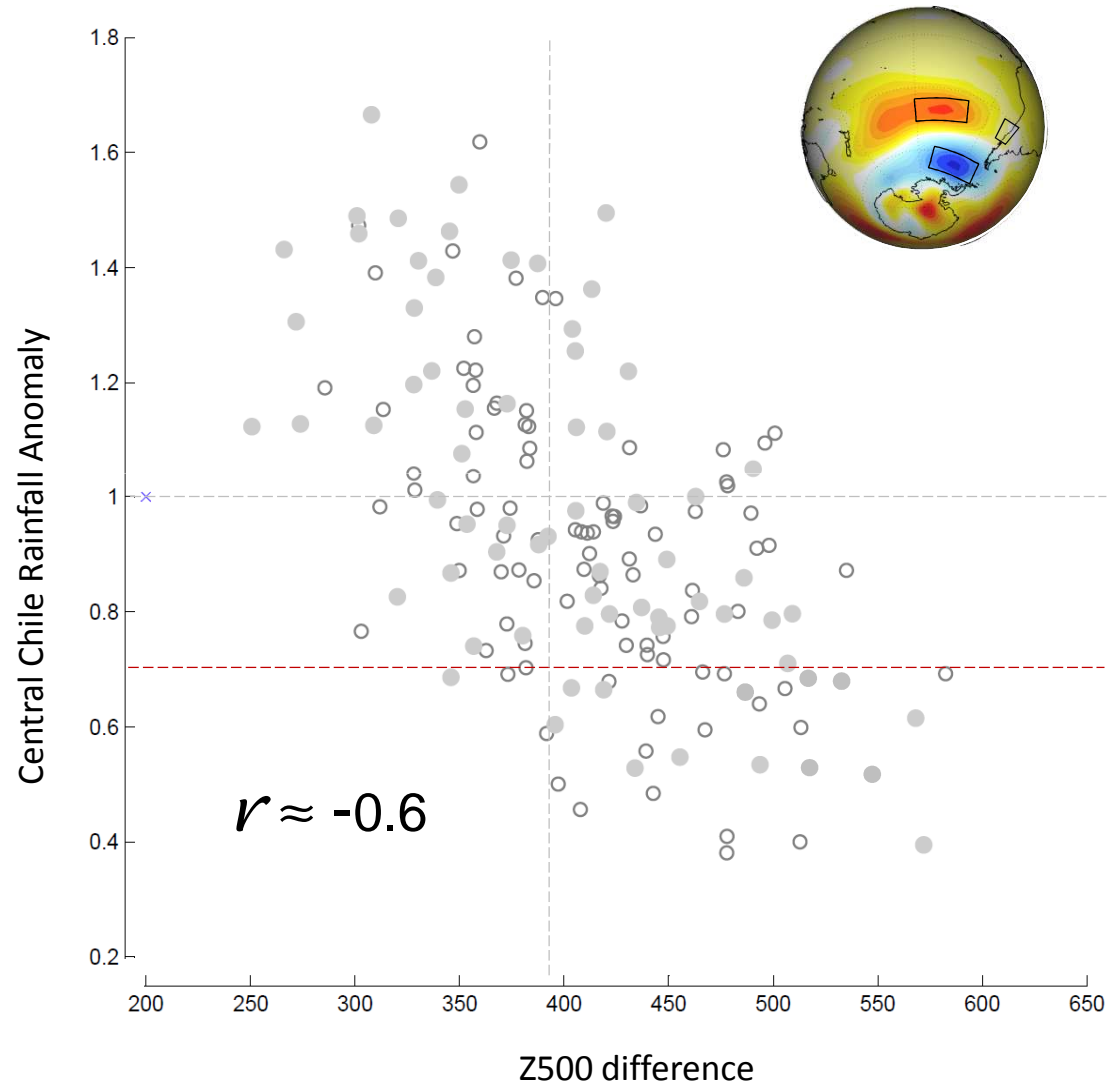
SST (NCEP-OI)



Large-scale context for central Chile droughts



Large-scale context for central Chile droughts

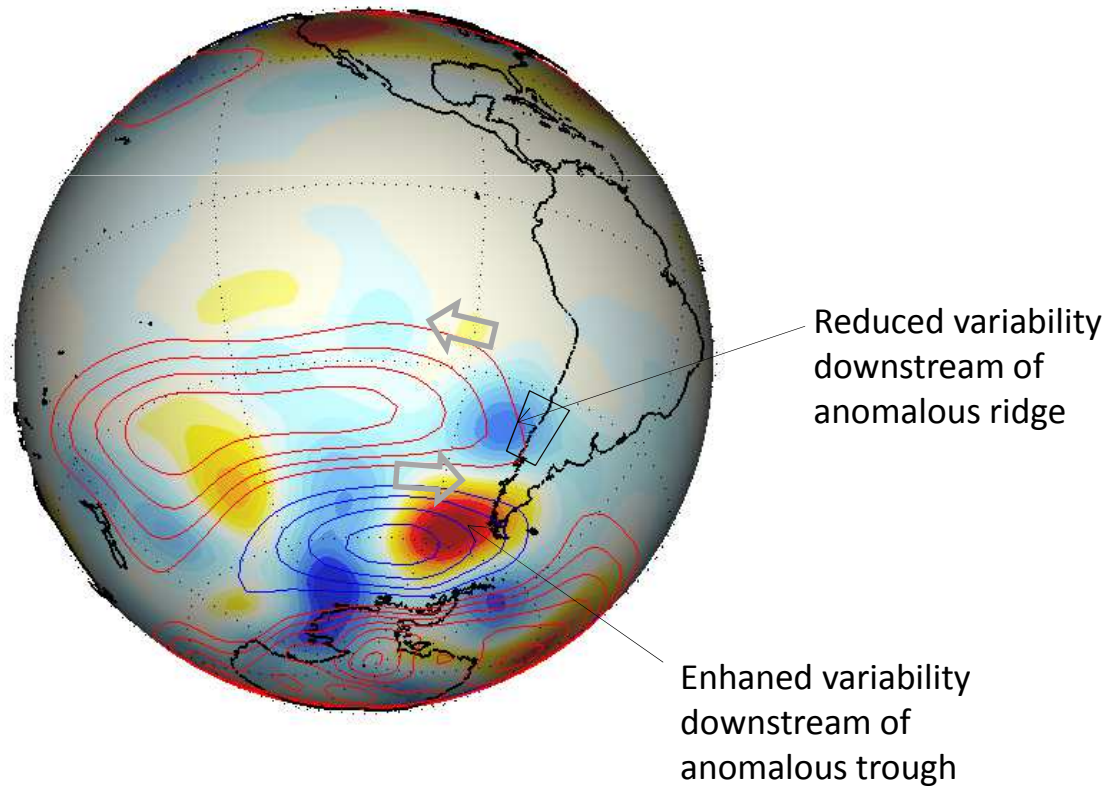


Large-scale context for central Chile droughts

Drought composite

Mean Z500 anomalies (contours)

Std Z500 anomalies (colors)



The 2010-2015 drought in Central Chile

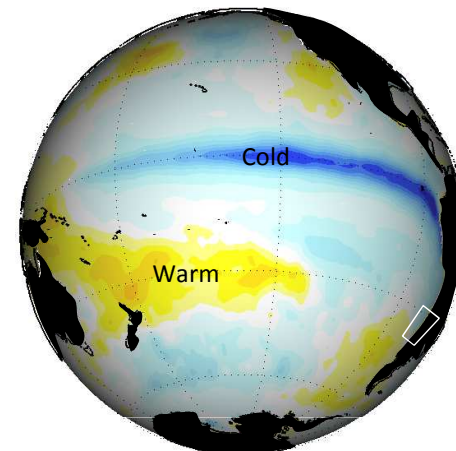
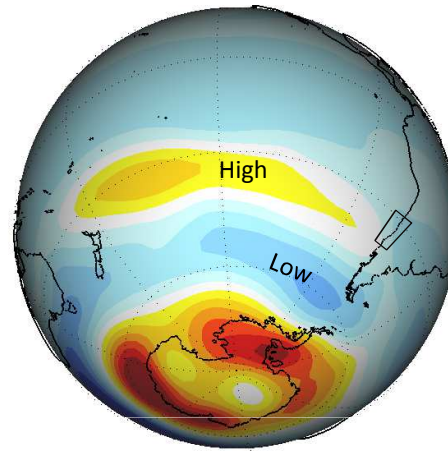
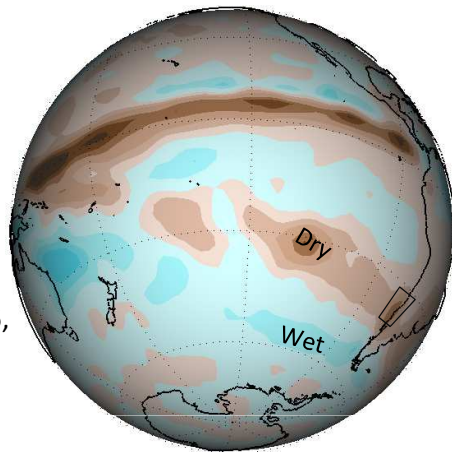
Rainfall

Z500

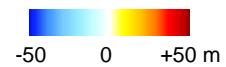
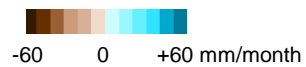
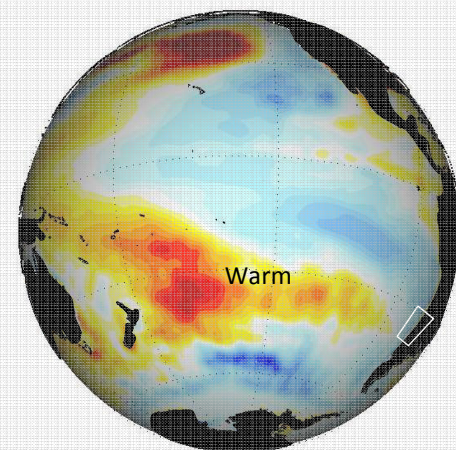
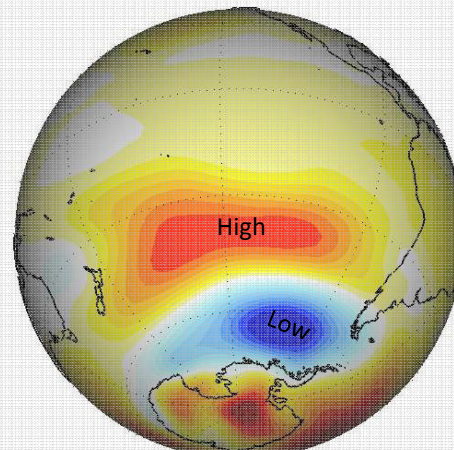
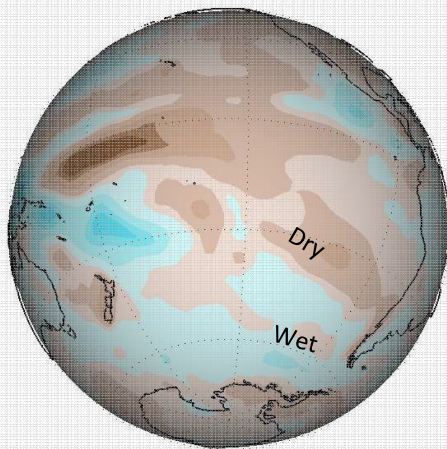
SST

Drought
Composite

1967,68,64,73,76,
85,96,87,03,07

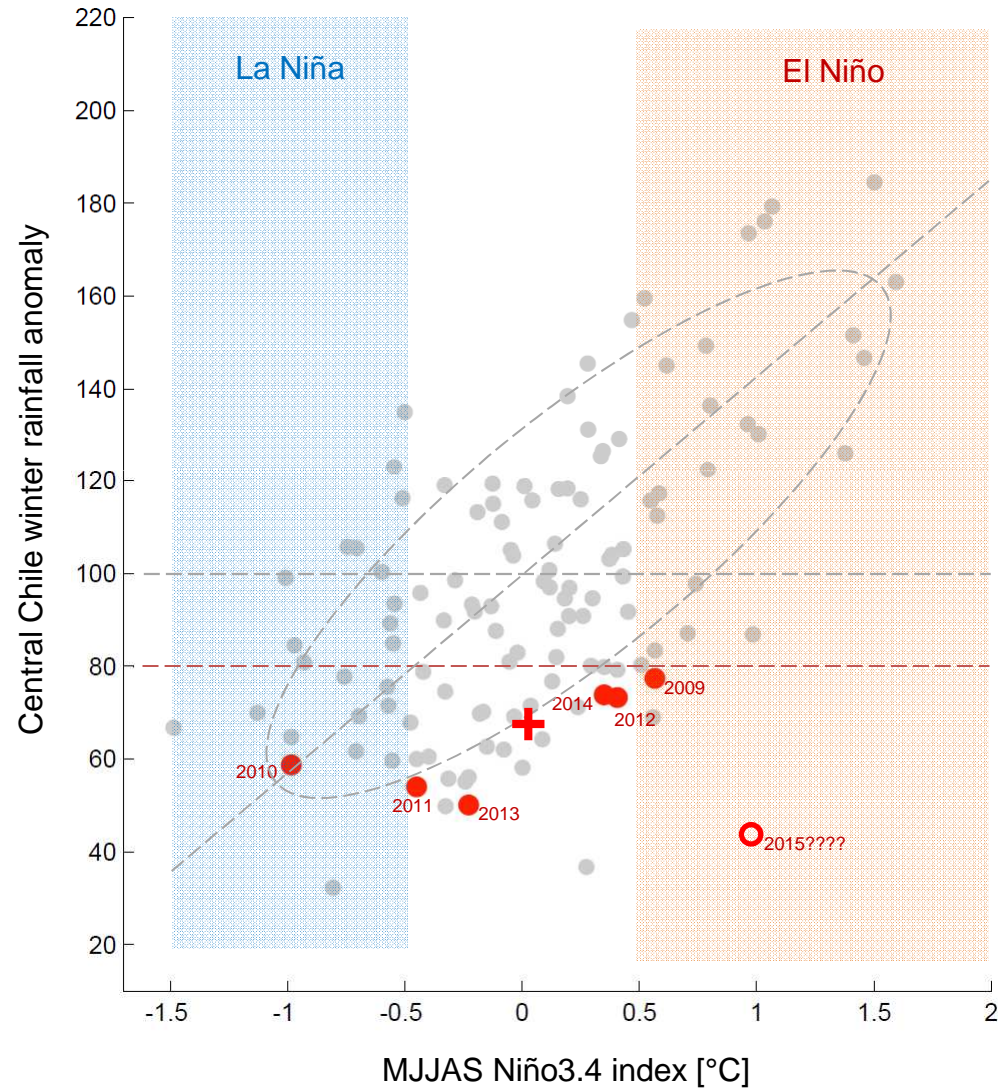
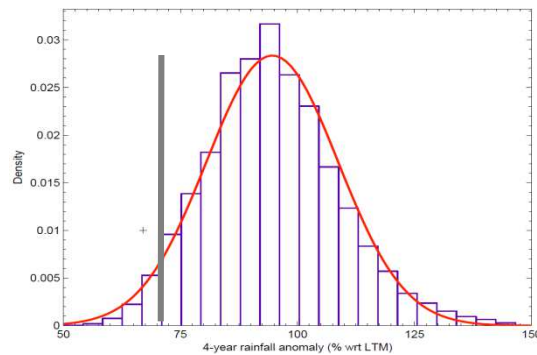


2010-2014
Average

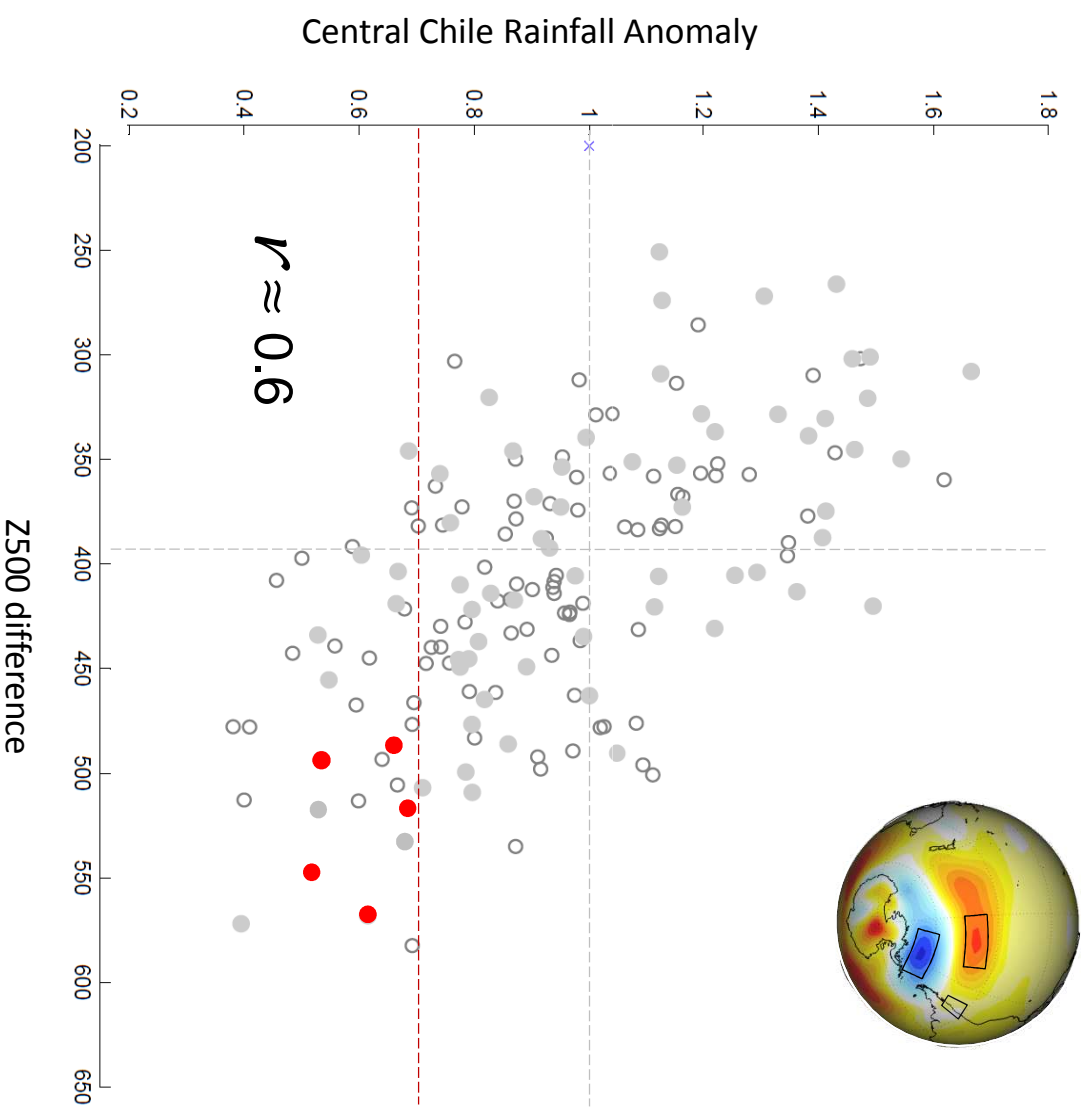


The 2010-2015 drought in Central Chile

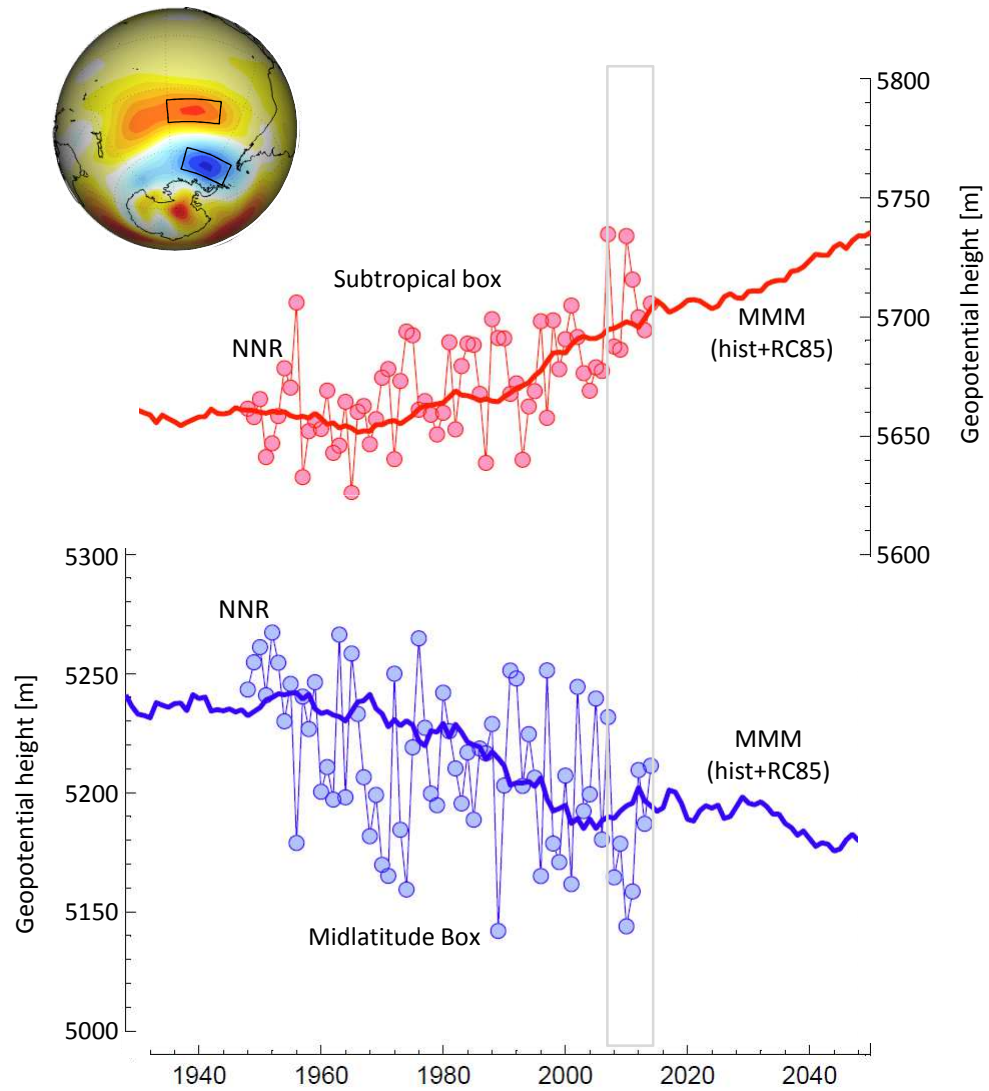
Monte Carlo Experiment:
5000 samples of 4 randomly
chosen ENSO-neutral years



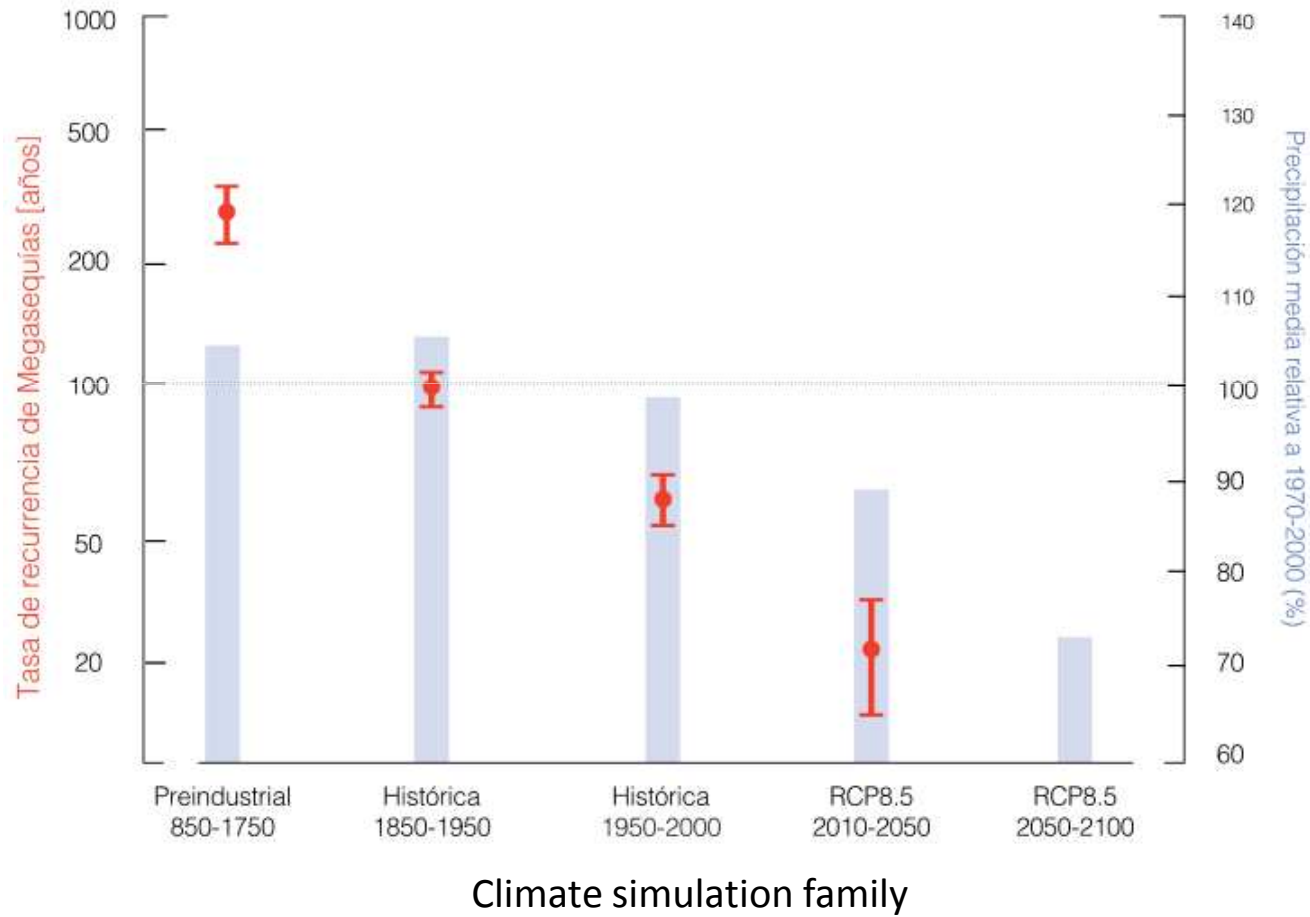
The 2010-2015 drought in Central Chile



The 2010-2015 drought in Central Chile



Evidence for anthropogenic forcing



Attribution of the 2010-2015 mega drought

AMIP simulations: Global Circulation Model (GCM) forced by

- Observed SST
- Observed Sea Ice Distribution
- Observed or past Radiative Forcing (CO₂, aerosols, O₃,...)

Ensemble AMIP simulations

- 10-30 “runs” of several decades long with slightly different initial conditions
- Ensemble mean reveals the SST forced response
- Ensemble spread reveals impact of internal variability (weather)

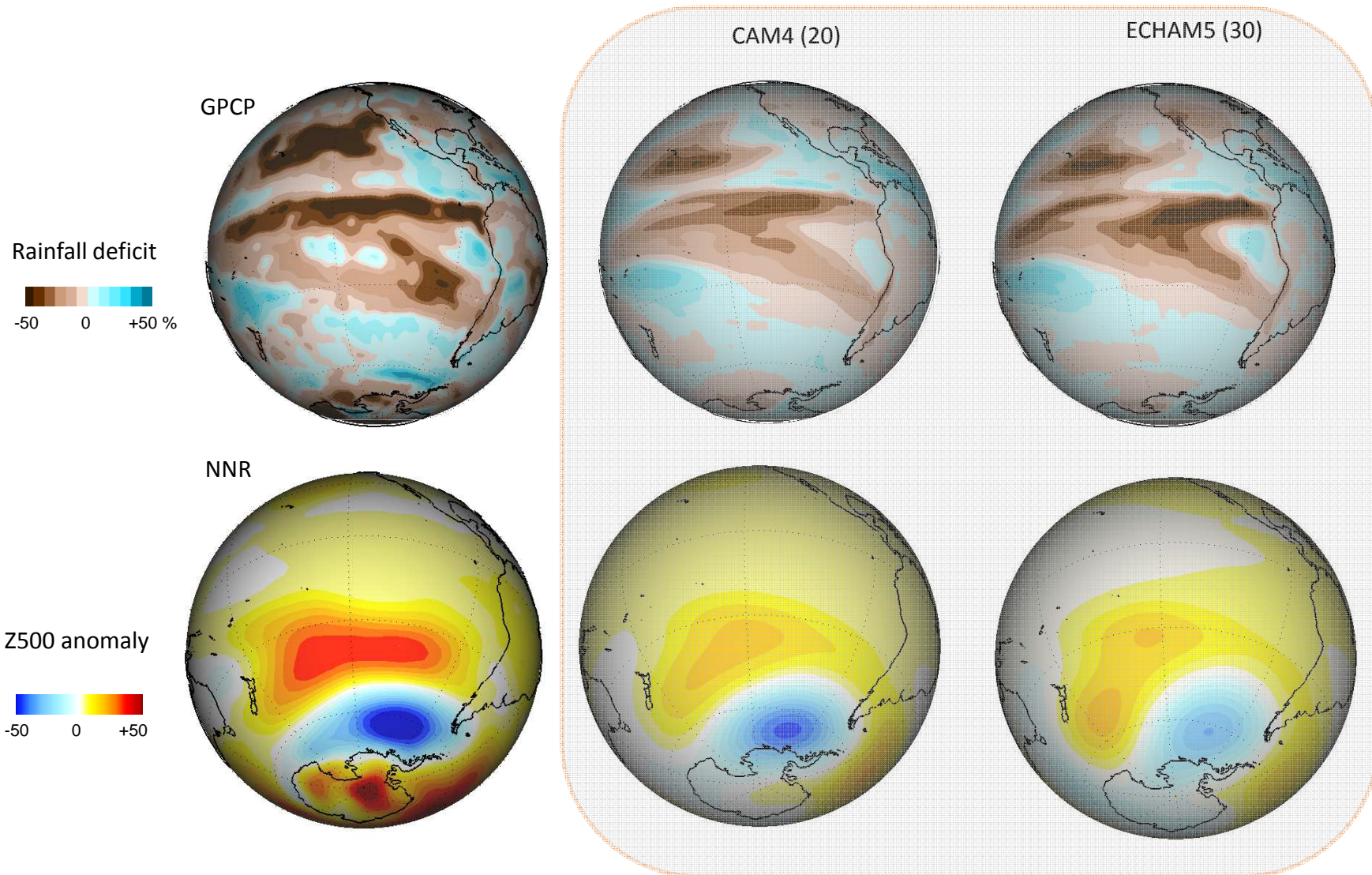
SST forcing includes natural variability (e.g., ENSO) but also anthropogenic impact

Ensemble mean with past radiative forcing excludes direct anthropogenic impact

May-September, 2010-2014

Observations

AMIP (Obs .SST, Obs. Rad.Forc.)

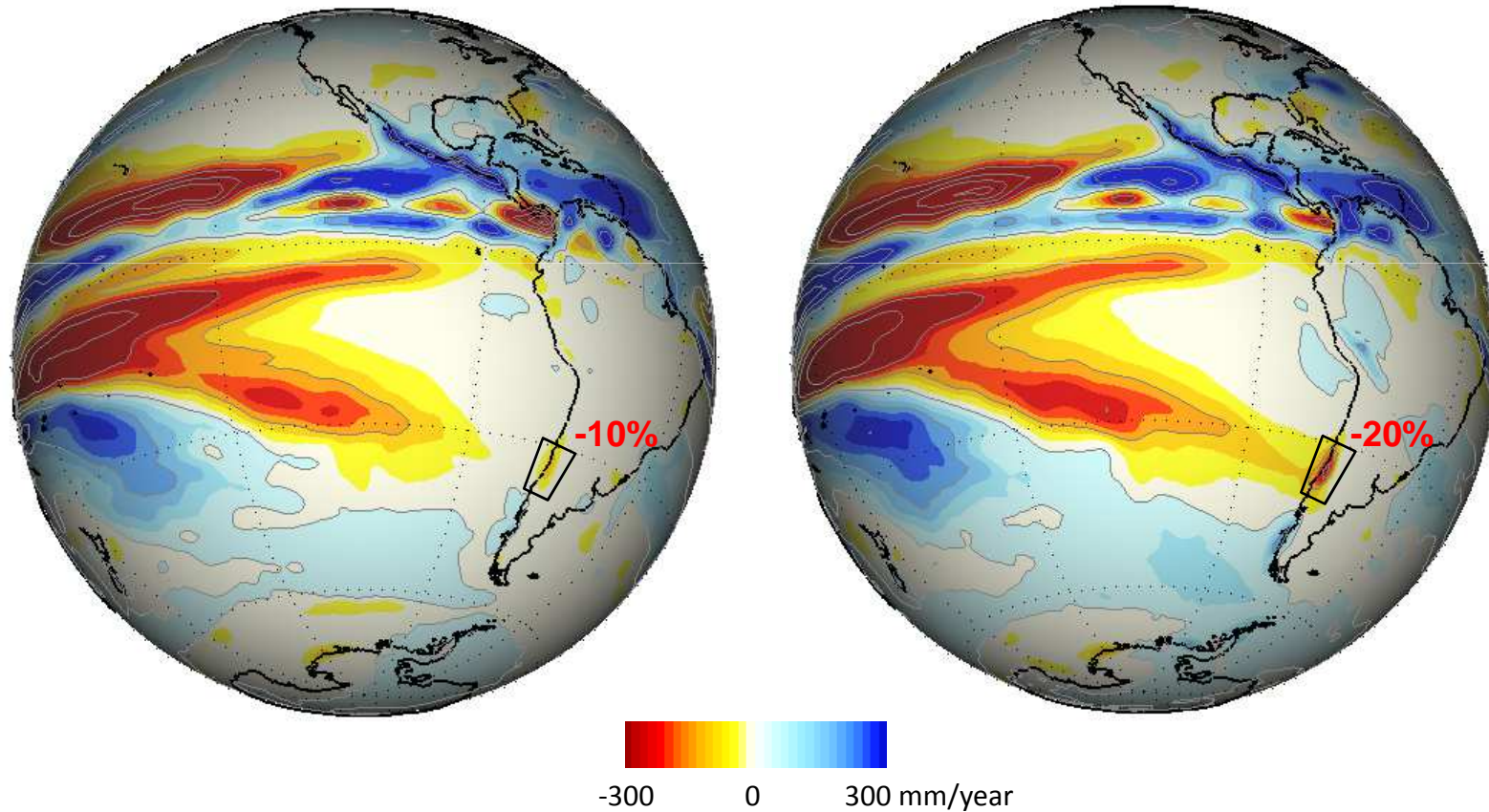


SST variability + Obs. Rad. Forcing during 2010-2014 accounts about half of the observed Z and P anomalies. Remaining anomaly can due to “bad luck”

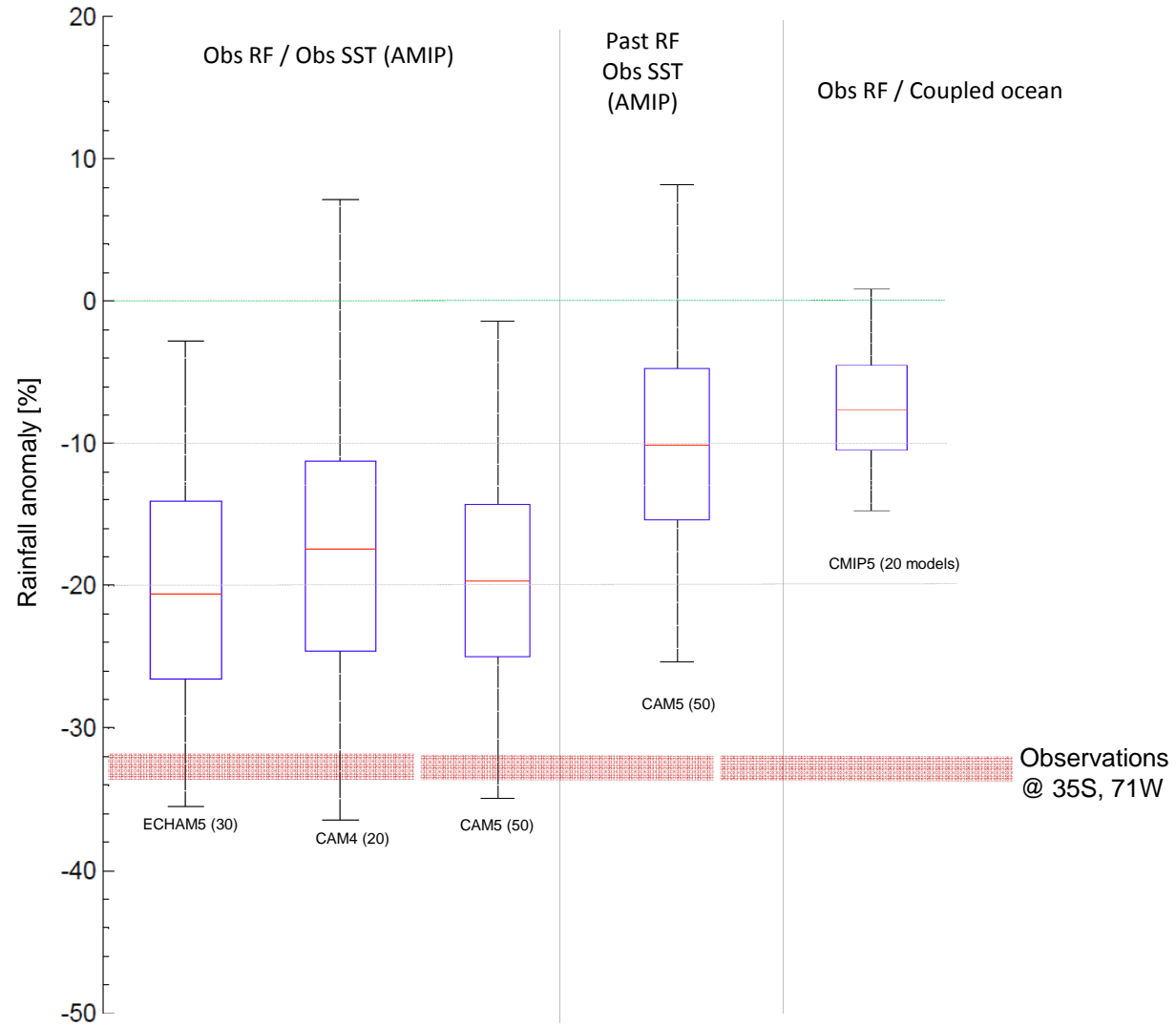
Winter (MJJAS) rainfall anomaly 2010-2014 LBNL CAM 5.1 AMIP simulations (50 runs)

(a) Nat-Hist forcing / Obs SST

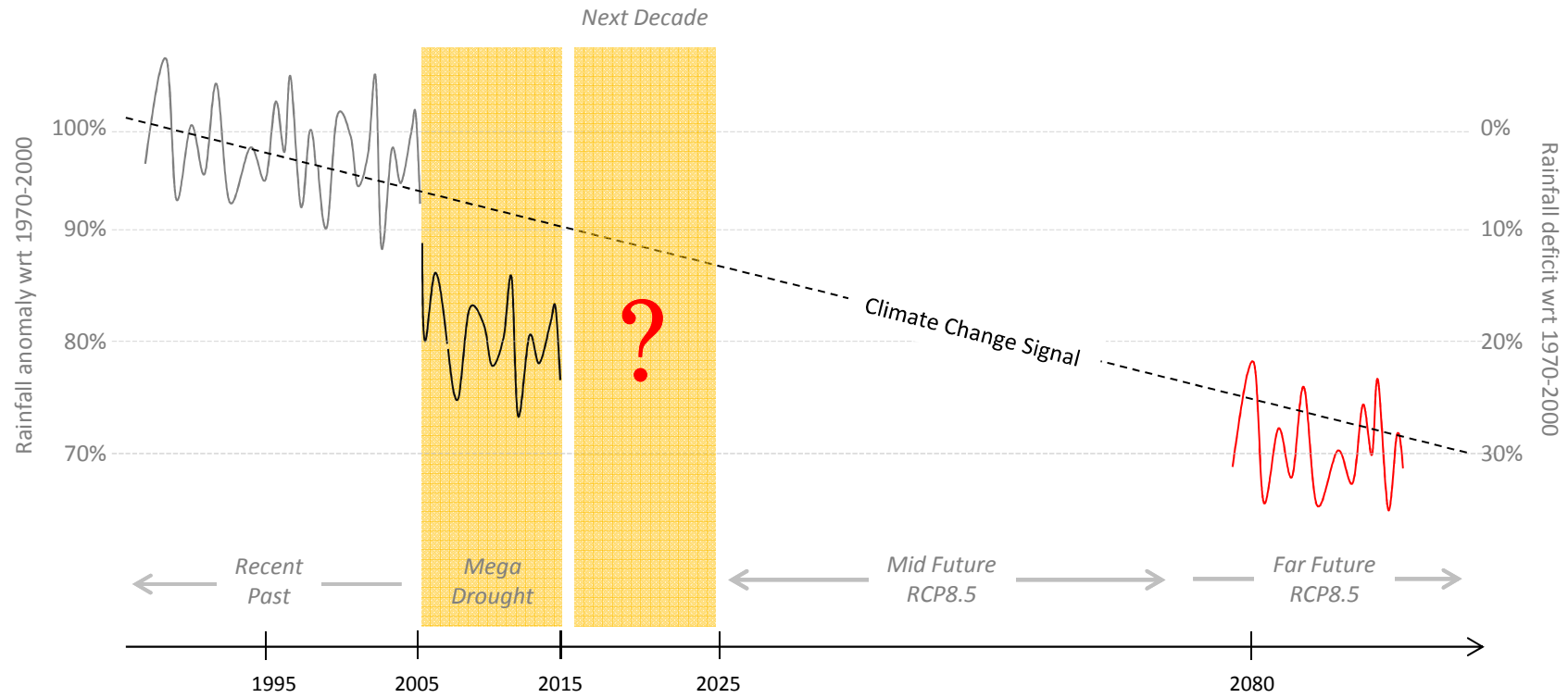
(b) Obs. Rad. Forcing / Obs. SST



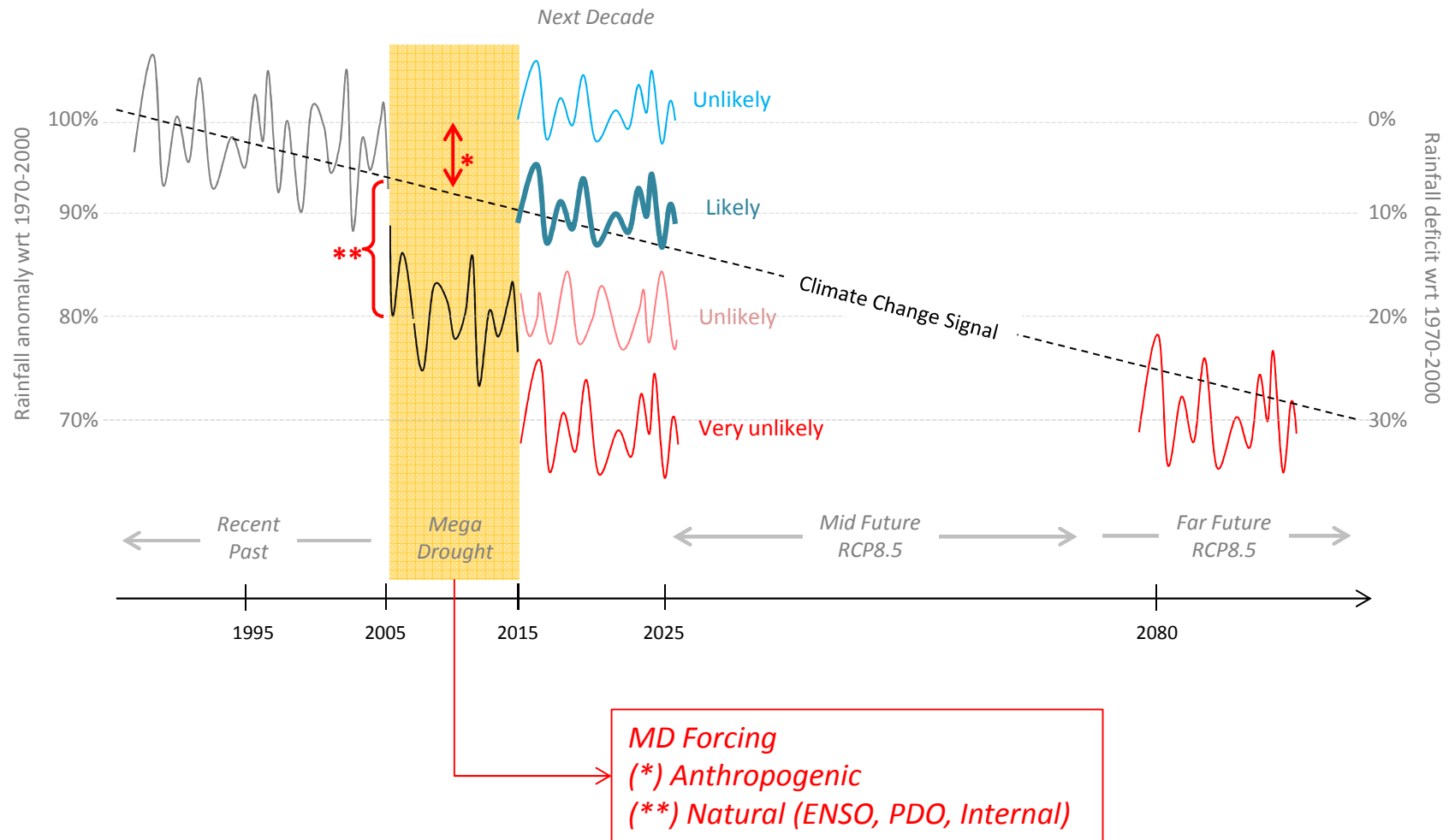
2010-2014 Winter rainfall anomaly in Central Chile



The Next Decade Challenge



The Next Decade Challenge



Conclusions

- Current multi-year drought (MD) in central Chile is a very infrequent event in the historical record (100 years) and paleo-record (1000 years). It occurs during the warmest decade on record and much increased water demands.
- The uninterrupted sequence of 5 (6) dry years occurred during mostly ENSO-neutral conditions, a very unlikely situation.
- **Roughly speaking, half of the current MD rainfall deficit can be attributed to concurrent SST state (cold-phase of PDO).**
- Thus, anthropogenic climate change, mediated by circulation anomalies, is already influencing central Chile hydro-climate.
- **So, we are not fully into the “future”, but this is how it will be...warm and dry.**

The 2010-2015 drought in Central Chile

