CLIMATE CHANGE IN CHILE: ESTIMATIONS OF TEMPERATURE AND PRECIPITATIONS ON A LOCAL SCALE FOR THE FUTURE USING STATISTICAL DOWNSCALING

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1. Background

General Circulation Models allow to analyze alternative pathways of possible changes in the climate system under different emissions scenarios (Cabré,2011). However, their **spatial resolution** is **too coarse** to produce useful and usable climate information for the impacts, adaptation and vulnerability communities (Amador y Alfaro, 2009). This is especially relevant for regions with **complex orography and coast lines**, such as Chile.

Statistical downscaling is used for the first time in Chile to produce climate change projections of daily maximum and minimum temperature as well as precipitation in over 400 locations.

Our results show that **minimum and maximum** temperature are projected to **increase** in the **entire Chilean territory** in all seasons. The largest increase of maximum temperature is found in boreal spring which amounts **4-7°C under RCP8.5** for the end of the 21st century (2081-2100). Minimum temperature is projected to increase of **1-3°C under RCP8.5** in all seasons. Precipitation changes present higher spatial variability.

2. Material and Methods

A. Obtaining data and data treatment:

Predictand (DGA, DMC, CR2, CEAZA, INIA)

Observed daily minimum and maximum temperature and precipitation data for the period of study 1980 – 2015.

3 filters were applied (≥15 years, outliers, >50% NA).

Reanalysis (NCEP/NCAR)

Daily air surface temperature (Tas), air temperature at 500, 700 and 850 hPa (T500, T700, T850), specific humidity at 300, 700 and 850 hPa (Q300, Q700, Q850), geopotential height at 250, 500 and 850 hPa(Z250, Z500, Z850), U-wind and V-wind at 250 hPa. Same period (1980 – 2015).

GCM *(CMIP5,* MPI-ESM-LR r1i1p1; RCP2.6, RCP4.5 and RCP8.5)

Three periods of study were used 2016 – 2035, 2046 – 2065, 2081 – 2100 and the historical scenario 1986 – 2005.

Monthly mean biases were corrected with the reanalysis data.

B. Statistical Downscaling

- Analog method (Zorita and von Storch, 1999) under the perfect prognosis approach.
- Cross-validation with 6-folds (only with reanalysis data).
- Evaluation: Bias, temporal correlation, Kolmogorov-Smirnof test
- Climate projections: Climate change signal (CCS) calculated with respect to 1986 – 2005 period.

C. Potential predictor sets:

Temperature		Precipitation	
Predictor	**Potential predictor (hPa)**	**Predictor**	**Potential predictor (hPa)**
P1	Tas	P10	Tas, Z500, Z850
P2	T850	**P11****	**Tas, Q700, Z500, Z850**
P3	T700	P12	T850, Q700, Z500, Z850
P4	T500	P13	Tas, Q700, Z500, Z850, U250, V250
P5	Tas, T700, T850	P14	Q300, Q700, Z250, Z500, Z850
P6	Tas, T700, T850, Q700	P15	Q300, Q700, Z250, Z500, Z850, U250, V250
P7	Tas, T700, T850, Q700, Q850	P16	Tas, Q300, Q700, Z250, Z500, Z850, U250, V250
P8**	**Tas, T700, T850, Z500**	P17	Q700, Z850
P9	Tas, T700, T850, Q850, Z500	P18	Q700, Z850, U250

3. Results

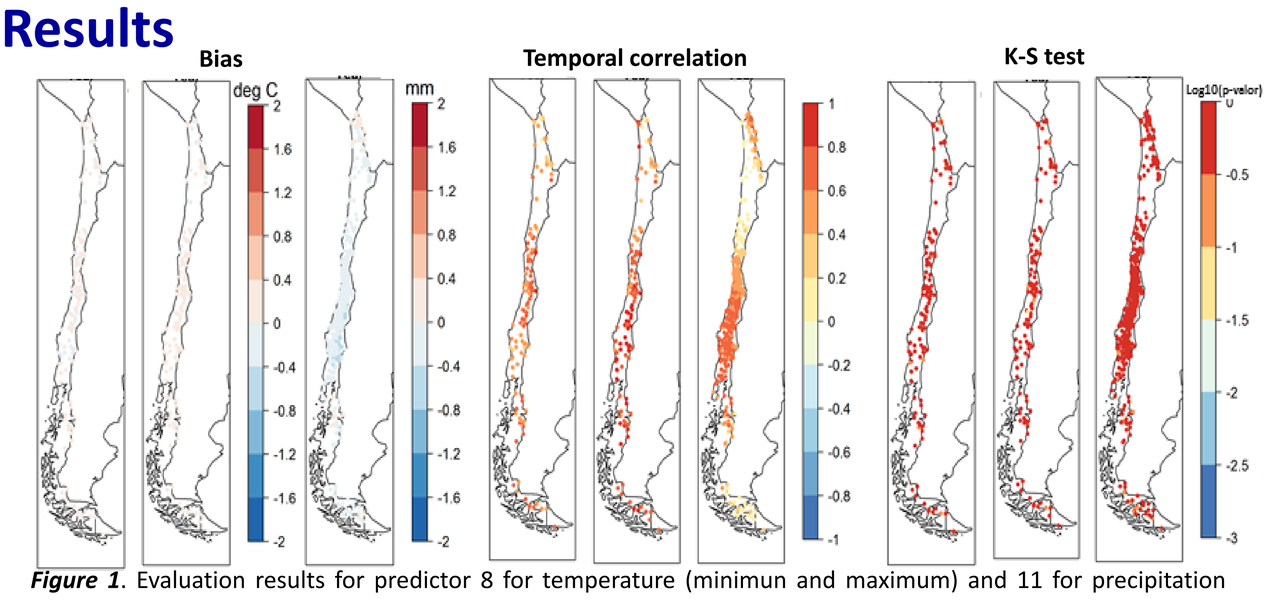

Figure 1. Evaluation results for predictor 8 for temperature (minimun and maximum) and 11 for precipitation (annual mean bias, temporal correlation and K-S test).

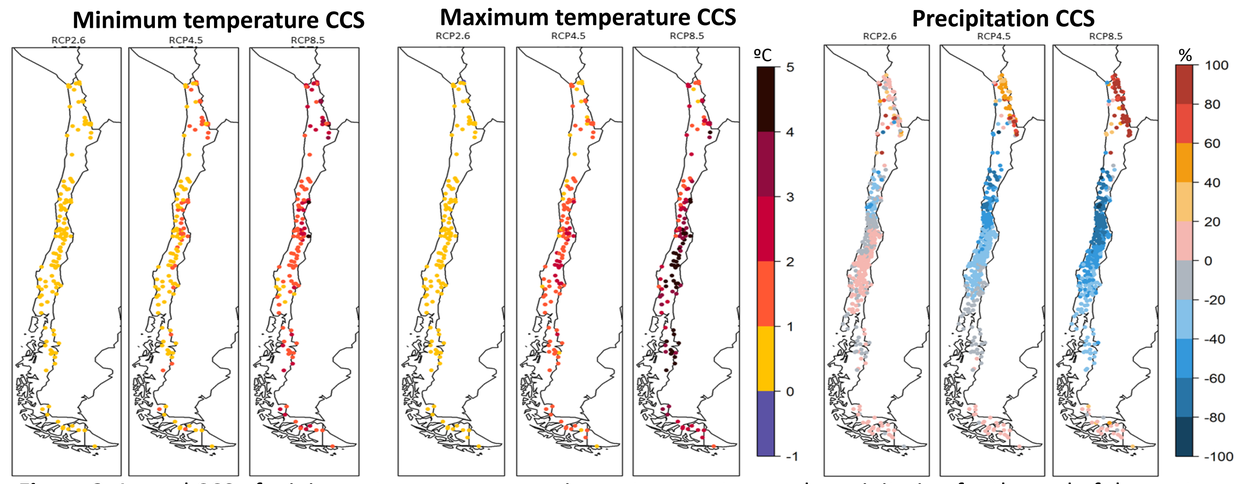

Figure 2. Annual CCS of minimum temperature, maximum temperature and precipitation for the end of the century (2081-2100) for RCP2.5, RCP4.5 and RCP8.5 scenario.

- The **best** predictor set is **P8** (Tas, T700, T850, Z500) for temperature and **P11** (Tas, Q700, Z500, Z850) for precipitation considering their results in the evaluation analysis using mean bias, temporal correlation and K-S test. (Figure 1).
- The **projected increase** is **smaller** for minimum than for maximum temperature in all RCP scenarios (Figure 2).
- The results shows an increment for all scenarios and the national territory, of up to 2°C (4°C) for minimum (maximum) temperature for RCP8.5 by the end of the century.
- Under RCP8.5 scenario for precipitation, the projected tendency is to increase 20% in the austral zone and decrease between 40 - 100% in the central and southern zone. For the northern zone, towards the Andes, the results shows an increment between 60 - 100% by the end of the century.

4. Conclusions

- The **best predictor** sets are predictor **8** for temperature and predictor **11** for precipitation.
- Tas and Z500 belong to both predictor sets. They are commonly used in SDM.
- At the end of the century, minimum and maximum temperature might **increase up to 2°C and over 4°C**, respectively, under RCP8.5 scenario.
- For precipitation, a **decrease between 40-100%** in Central Chile is projected for RCP8.5 for 2081-2100. In the northern Andean Cordillera, precipitation might increase substantially for the same period and scenario.

5. References

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