Impacts of Climate Change on Water Resources Processes in Chile. Projections for 2030-2060

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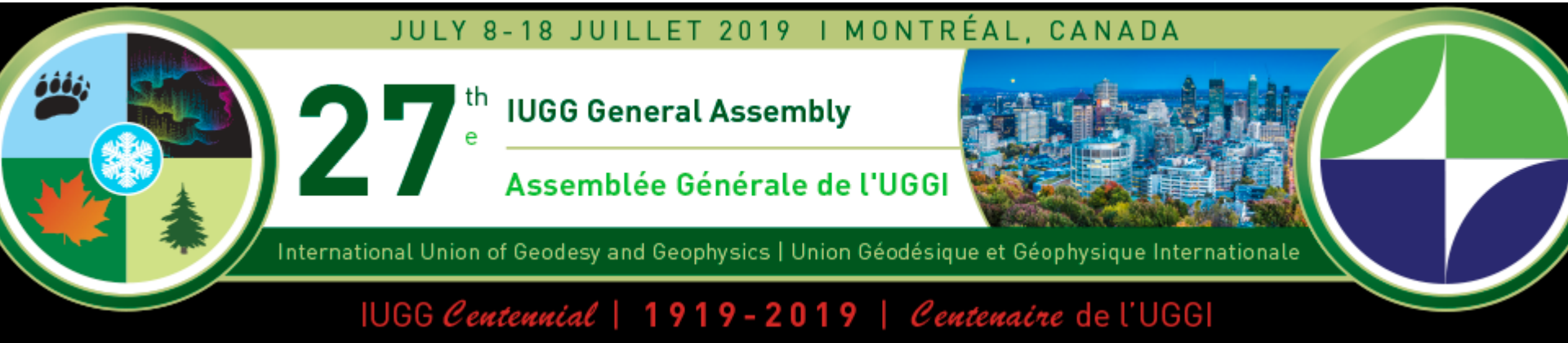
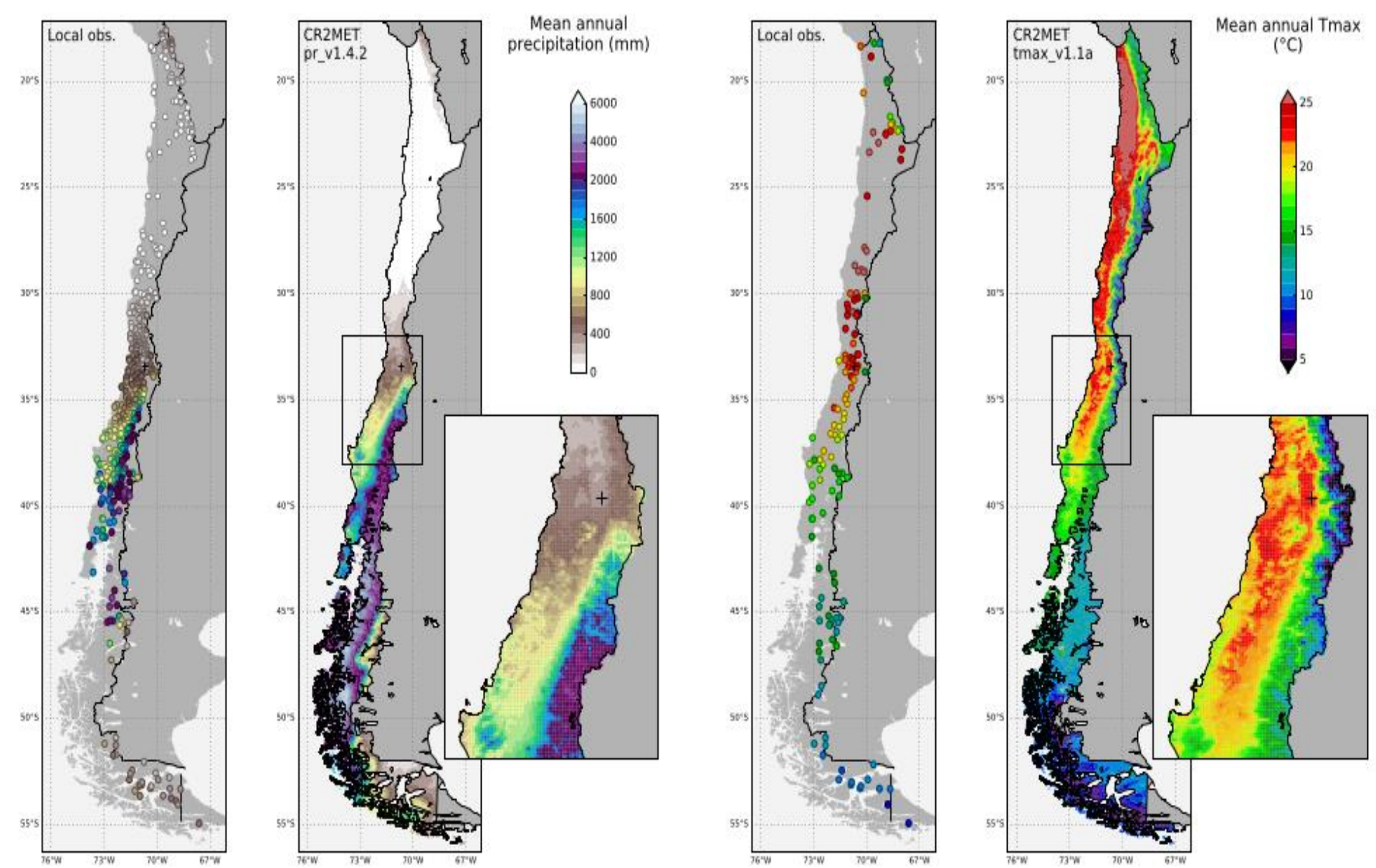


Agenda

- Basic Hypothesis
- Meteorological Forcings
- Hydrological Model. Calibration
- Water Balance for Base Line Period
- GCM Selection
- Projected Variations for period 2030-2060 using RCP8.5

Hyphotesis
Balance results presented here build upon four key elements:

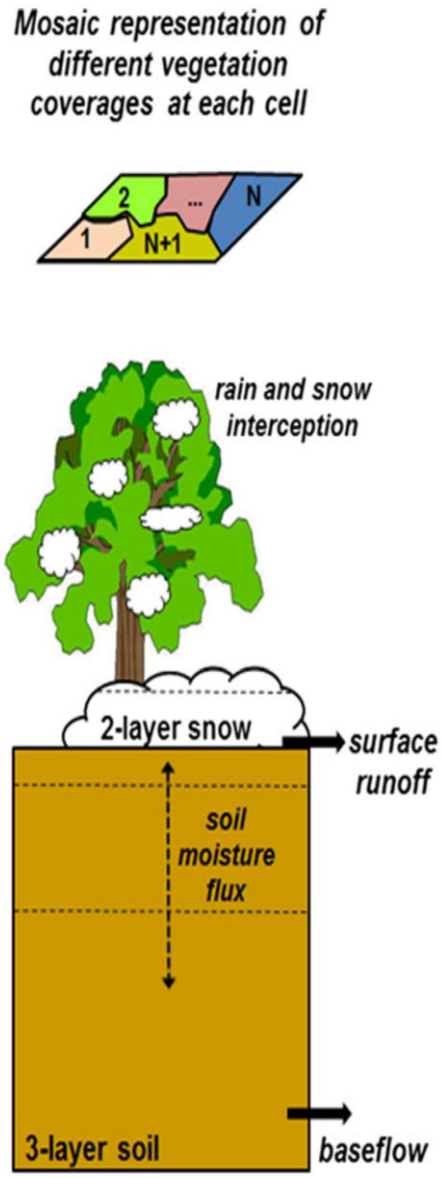
- A gridded meteorological dataset based on in-situ observations and reanalysis data.
- The calibration and validation of the Variable Infiltration Capacity (VIC) macro-scale hydrological model (Wood et al. 1992; Liang et al. 1994) in naturalized catchments across continental Chile.
- The selection of four GCM that replicates ENSO and SAM correlation with annual precipitation.
- No temporal variation of Land use.



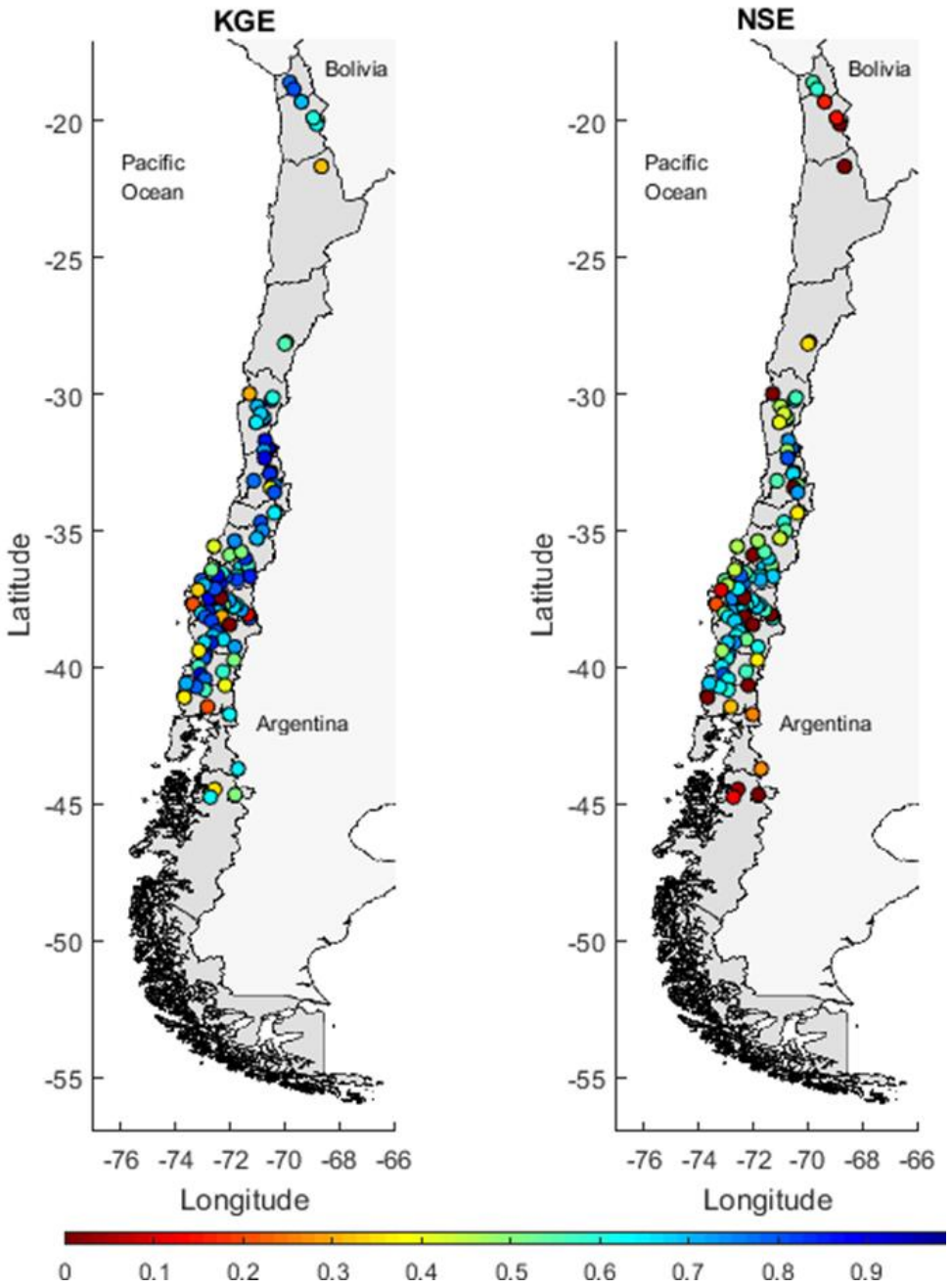
Climatological values (1979-2016) for (left) precipitation and (right) maximum daily temperature. Maps where points can be seen are the climatological mean values of observed values in measuring stations. Maps with continuous color map covering the whole study area show the CR2MET estimated values for the same period.

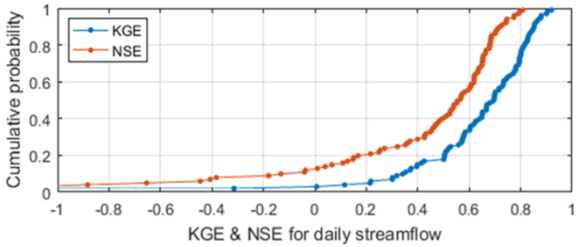
Hydrological model

- **Variable Infiltration Capacity (VIC)**
  - Physical motivation.
  - Semi-distributed, vegetation heterogeneity.
- **Meteorological Forcings**
- **Data (parameters)**
  - Soil type and land cover.
  - Leaf Area Index(LAI).
- **Simulations**
  - Spatial resolution 0,05º x 0,05º, Δt = 3 hr.
  - *spin-up* (i.e., inicialization of state variables): hydrologic years 1979/80-1984/85.



VIC model structure



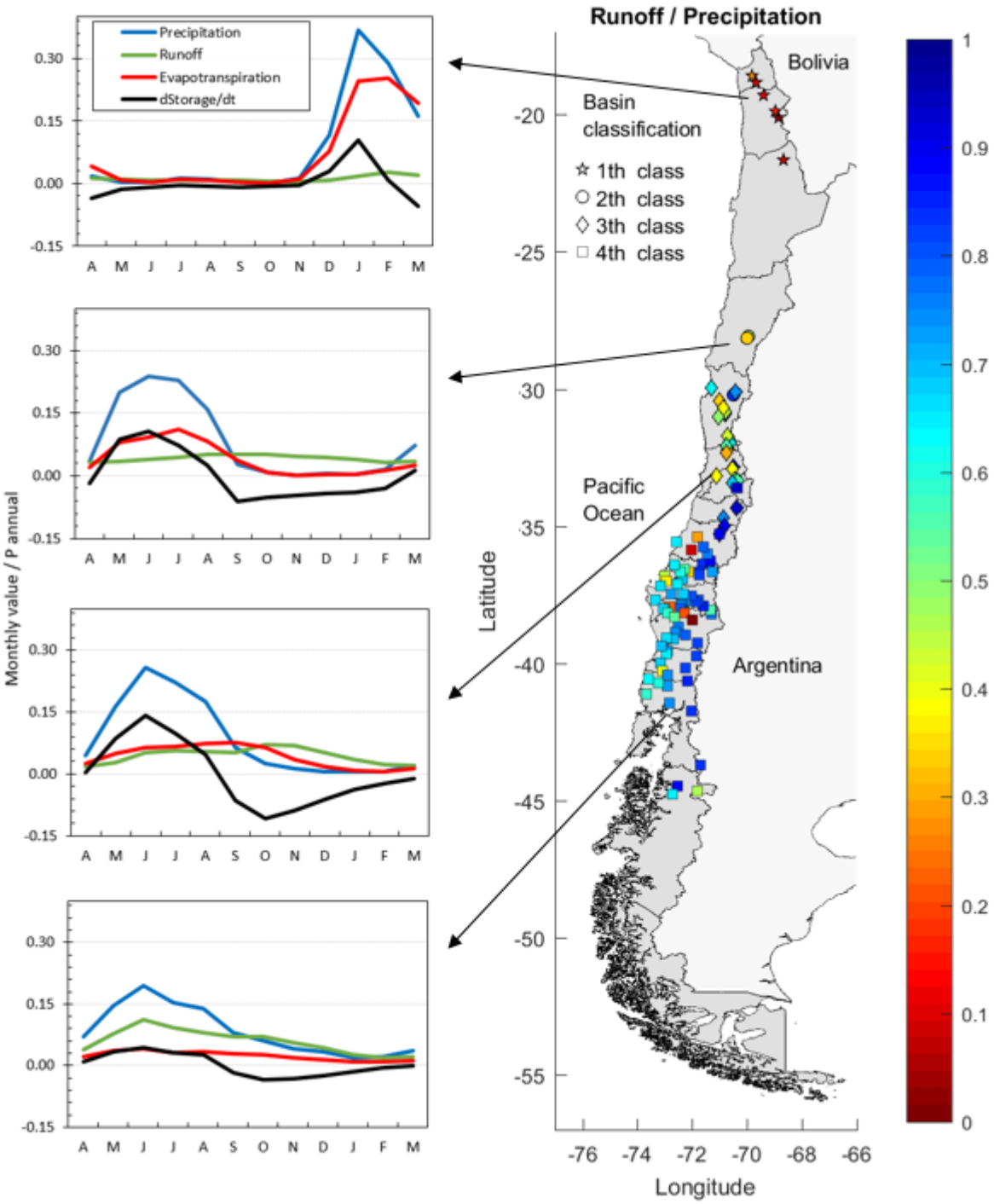


Cumulative probability distributions for daily calibration.

Performance of daily streamflow simulations. Basins in natural regime.

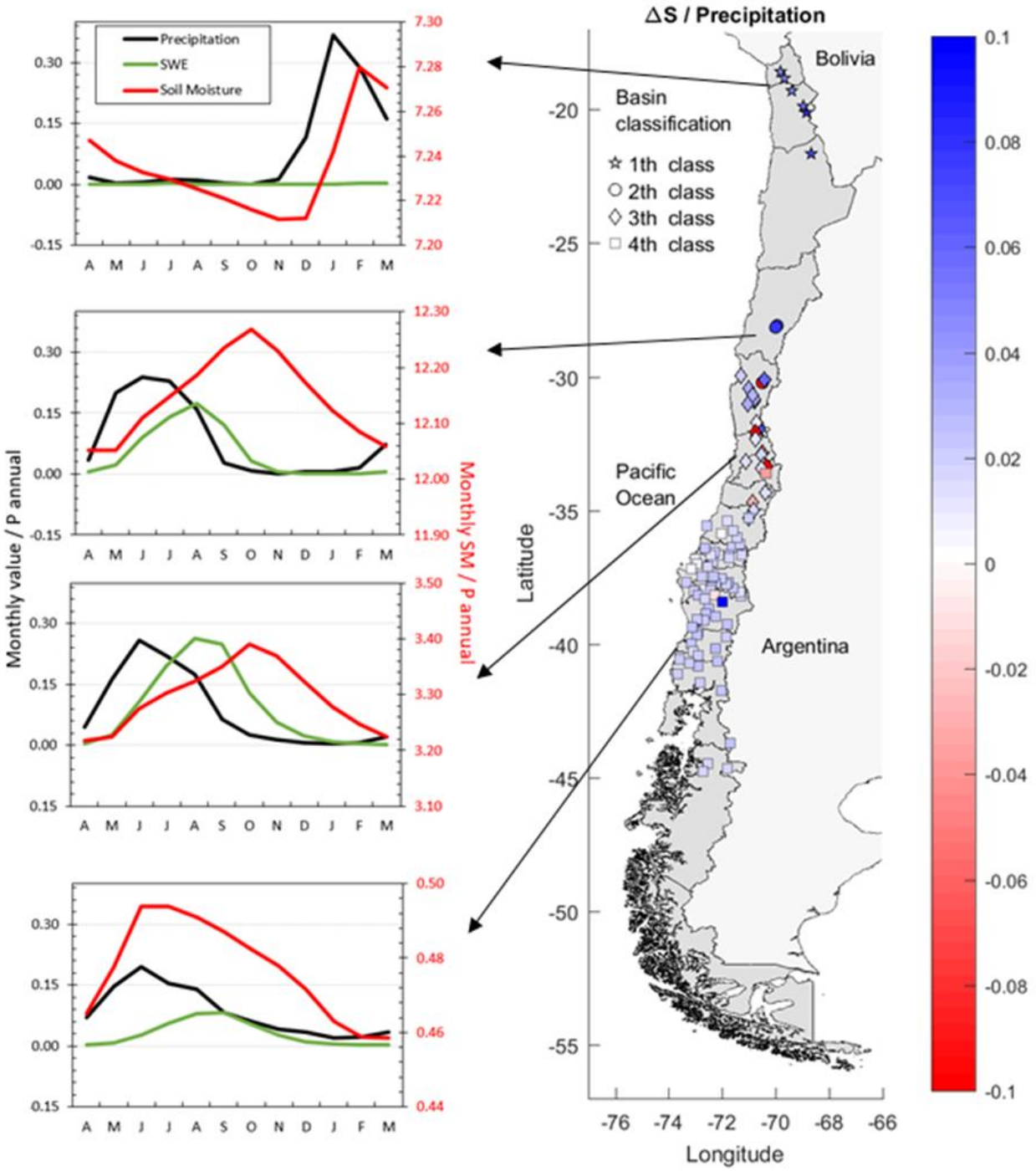
(Left) Monthly **water balance components** (normalized by annual precipitation) for the basin types obtained from climatic classification (precipitation seasonality , aridity index and fraction of snow events).

(Right) **Runoff coefficient** for calibrated basins (1985-2015).



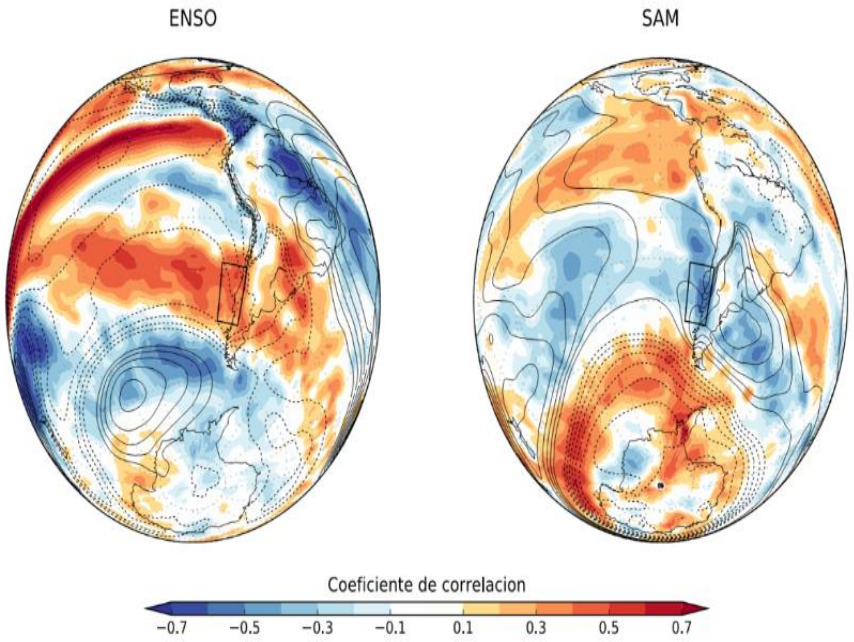
(Left) Mean monthly **soil moisture and SWE** (normalized by mean annual precipitation) for the basin types obtained from climatic classification (precipitation seasonality , aridity index and fraction of snow events).

(Right) Annual variations in total **basin storage** (1985-2015).

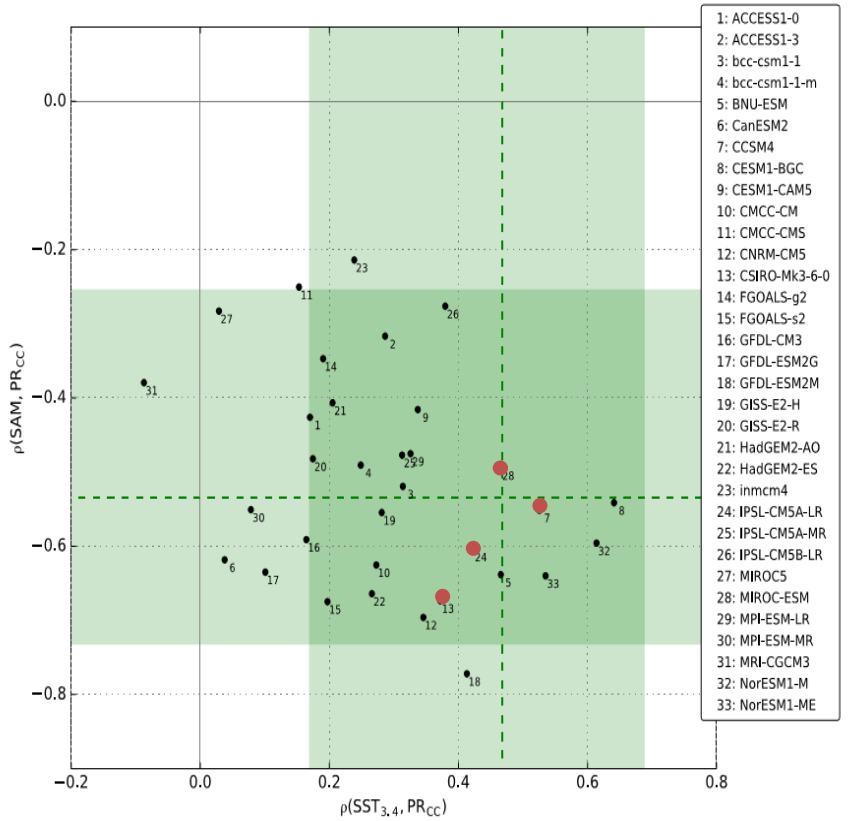


GCM Selection

- Representation of SAM and ENSO
- Climatic Sensitivity
- Precipitation and temperature Regional delta analysis



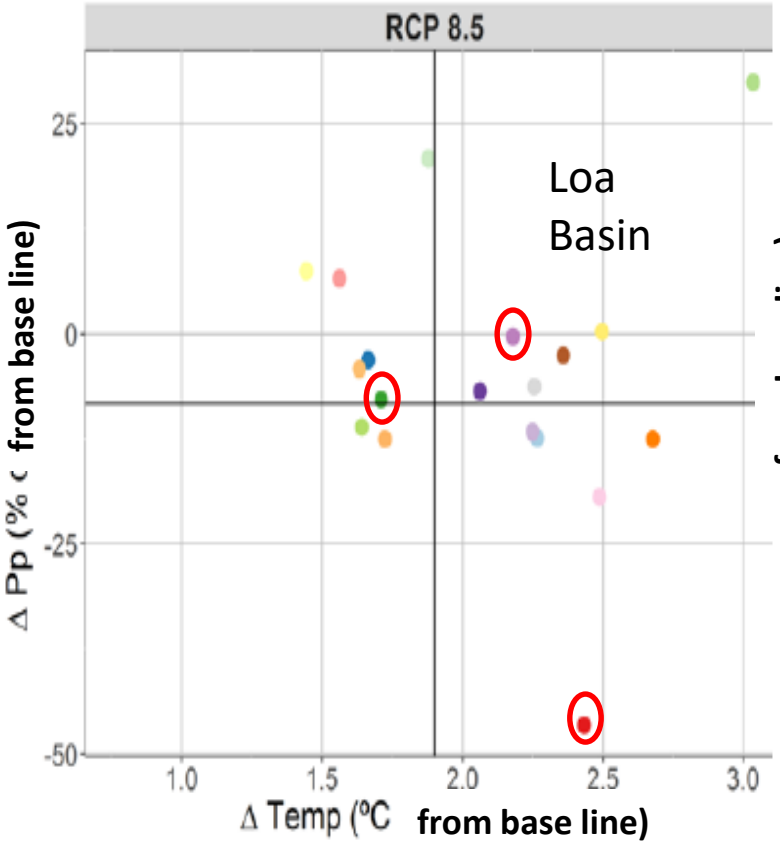
Climatic Variability

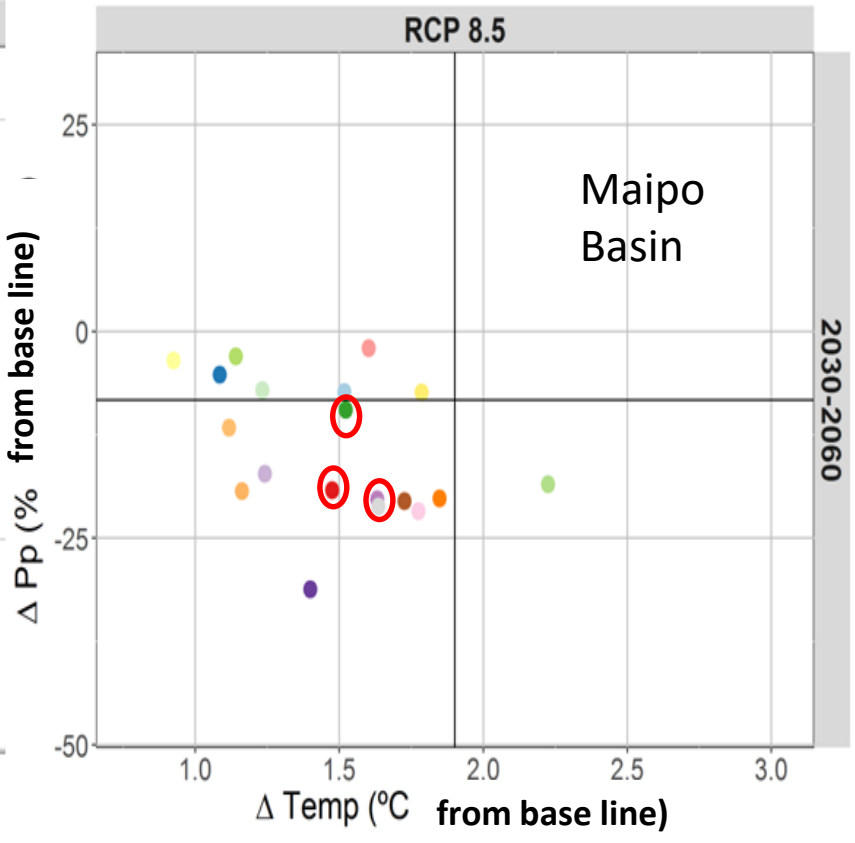


ENSO (SST3.4) and Southern Annular Mode (SAM) correlation with annual precipitation (1979-2015). Data from GPCP (Pr); ERA-Interim (SLP); ERSST (SST).

GCM Selection

Scenario RCP8.5

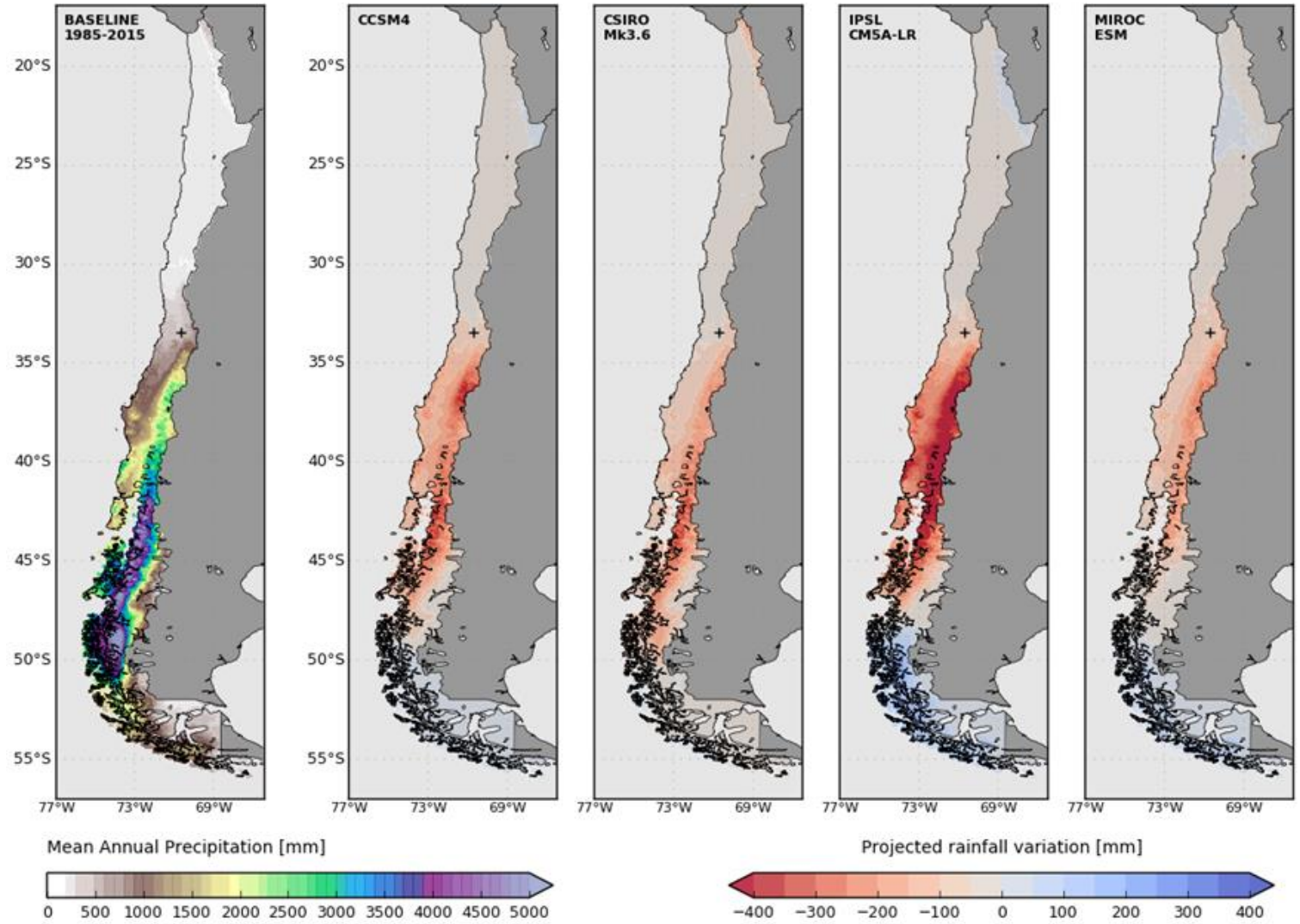




CSIRO: Extreme Low sensitivity
IPSL: Extreme High sensitivity

CCSM4: Moderate Low sensitivity
MIROC: Moderate High sensitivity

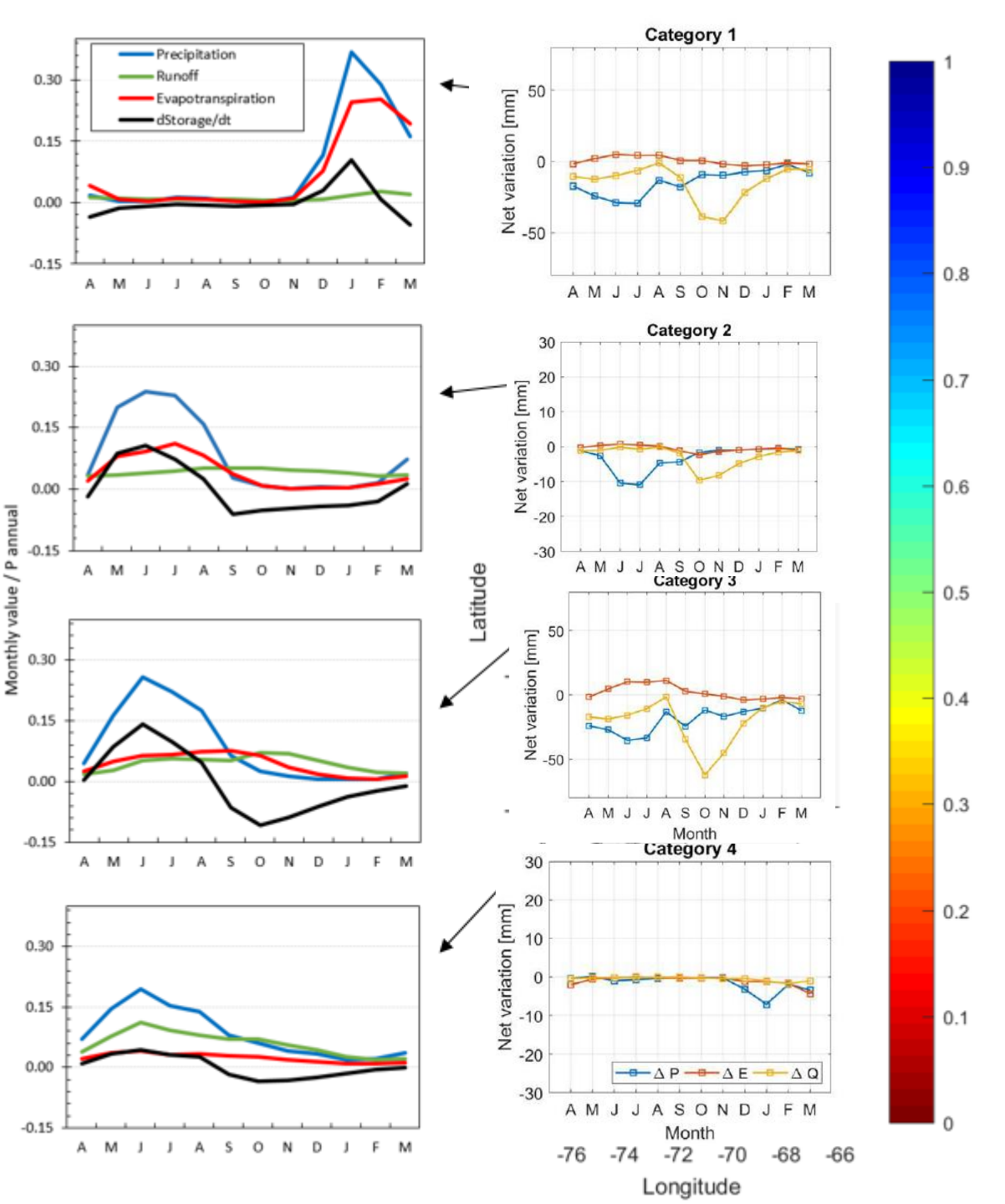
alta extrema: IPSL



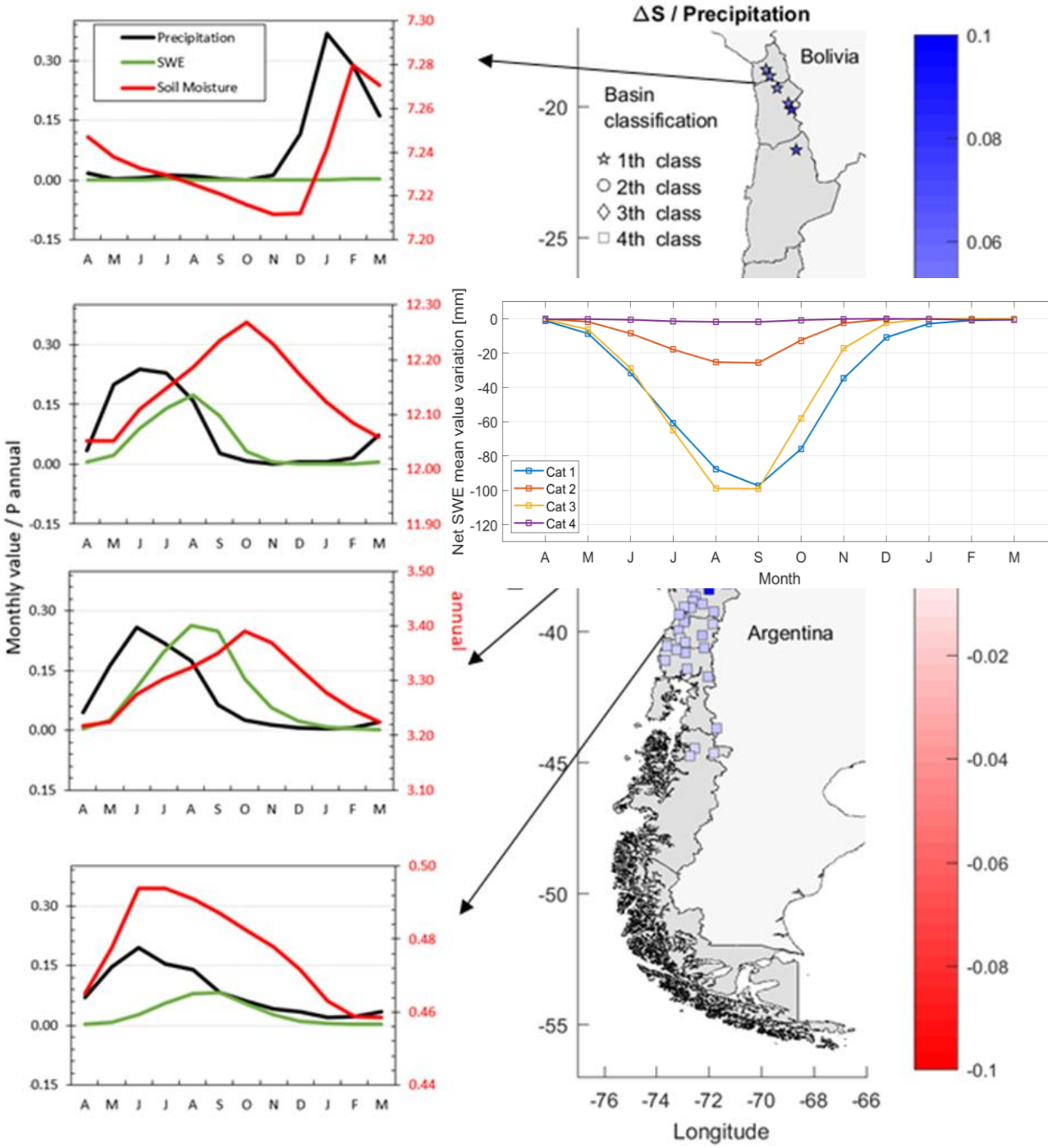
Mean Annual Precipitation. Left panel: climatology period 1985-2015. Other panels: Projected variation for RCP8.5 with different GCMs. Period 2030-2060.

(Left) Monthly water balance components (normalized by annual precipitation) for the basin types obtained from climatic classification (precipitation seasonality , aridity index and fraction of snow events).

(Right) **Net variation** under climate change RCP8.5, 2030-2060



(Left Green Line) Mean monthly SWE (normalized by mean annual precipitation) for the basin types obtained from climatic classification. (Right) **Net SWE mean value variation** under climate change RCP8.5, 2030-2060



Conclusions

- Recent climatic trends are consistent with future projections in Chile in terms of precipitation reduction in the Central area, and increase in temperature across the country.
- These climatic changes affect hydrologic conditions, decreasing runoff during spring and summer, as a result of an accelerated seasonal cycle associated with the increase in temperature
- In general, changes in water balance for the southern part of Chile are low.

Acknowledgement

Powered@NLHPC: This research was partially supported by the supercomputing infrastructure of the NLHPC (ECM-02)