

A comprehensive database of historical and projected future climate for Latin America

(Unpublished manuscript, please contact the author for more information)

Dante Castellanos-Acuna^{1*}, *Andreas Hamann*¹ and *Tongli Wang*²

¹) Dept. of Renewable Resources, University of Alberta, 751 General Services Building
Edmonton, AB, Canada, T6G 2H1

²) Department of Forest and Conservation Sciences, University of British Columbia,
Vancouver, BC, V6T1Z4, Canada.

* Corresponding author: dcastell@ualberta.ca

Abstract

Analysis of climate change impacts and planning of adaptation strategies requires accurate historical climate databases and projections of future climate conditions. Although such gridded data is generally widely available, the data formats, projection of grids, temporal coverage, spatial resolution and spatial extent are highly variable. As a consequence, customized datasets suitable for research or management applications are only accessible to expert GIS users, and preparing the data can be complex and time consuming. The objective of this chapter is to contribute a collection of selected databases for Latin America that can be accessed through an easy-to-use software solution that applies lapse-rate based down-scaling of temperature variables to higher resolutions, and overlays anomaly layers for historical monthly data and future projections. Climate estimates resulting from interpolation and down-scaling were validated against weather station records. For the 1961-1990 average climate normal, we find a mean absolute error (MAE) of 0.6°C for annual temperature, and an 8% error for annual precipitation, compared to observed values. For estimates of individual years from 1901-2010, we find an average MAE of 0.7 for temperature, and an average 11% error for precipitation. The database also includes future projections for the 2020s, 2050s and 2080s based on 15 AOGCMs from the CMIP5 project. To guide the selection of future projections, regional rankings of different scenarios with respect to the magnitude of their temperature and precipitation projections are provided. We provide estimates for 80 monthly, seasonal, annual, and bioclimatic variables for 5 climate normals, 11 decades, 113 years, and 3 future time periods for a total of 18,000 data layers, which can be interactively queried for point locations or read out as grids for a user-defined spatial extent, resolution and time period.

(Selected Figures and Tables provided below, for more information, contact the author)

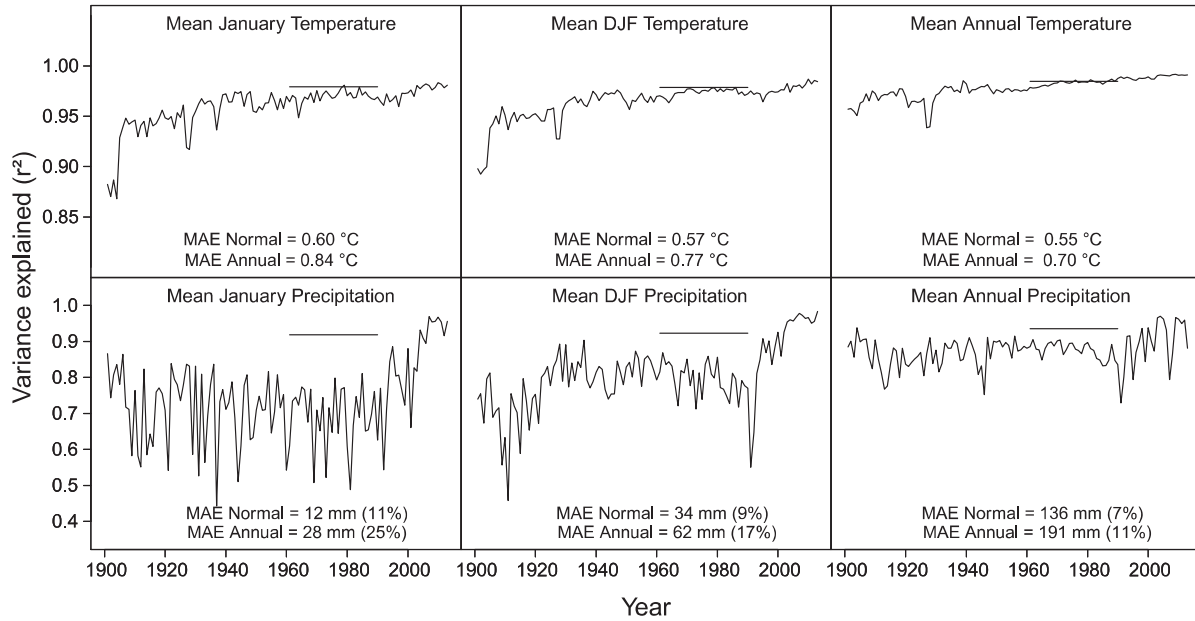


Figure 2. Statistical precision of climate estimates expressed as variance explained (r^2) by ClimateSA estimates against weather station data, and expressed as mean absolute error (MAE) of climate estimates for the 1961-1990 normal period (non-zonal bar) and the average annual error from 1901 – 2013.

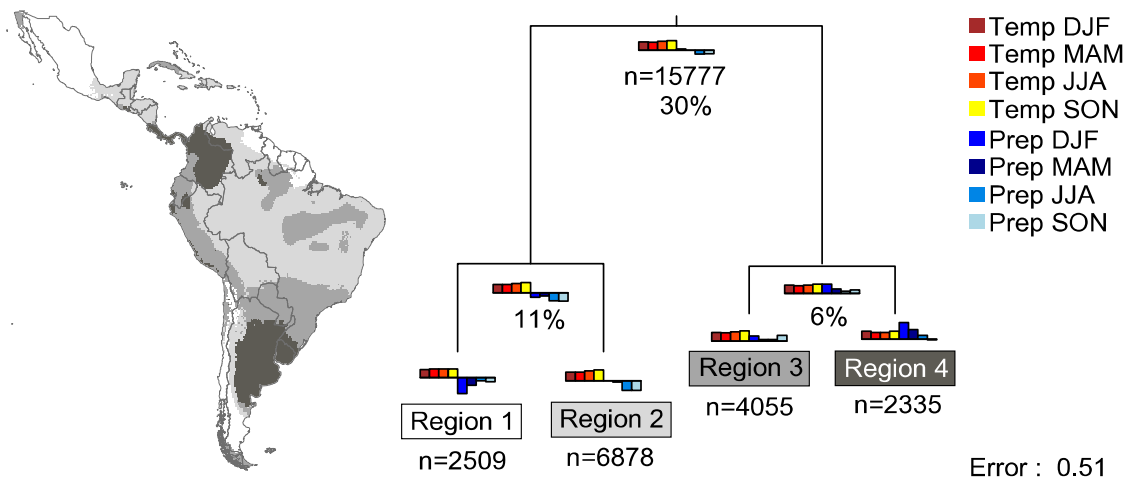
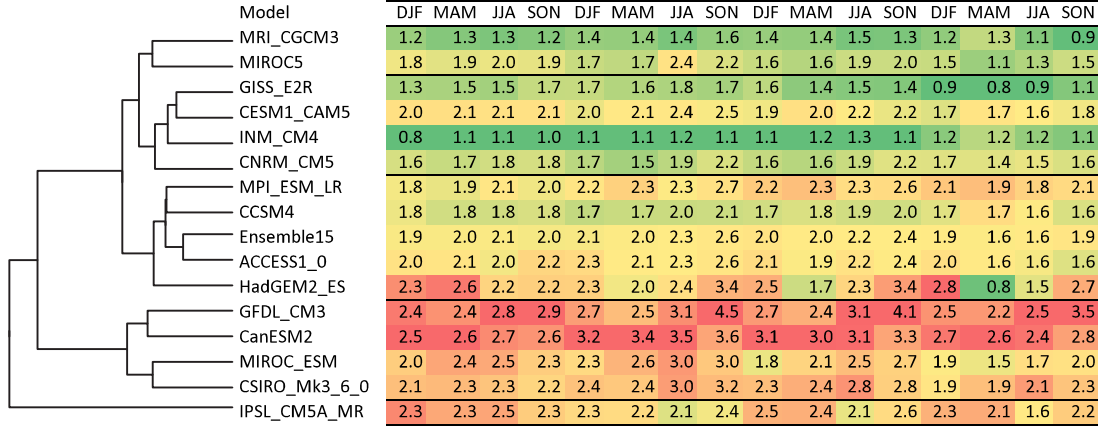


Figure 3. Clustering of grid cells of Latin America that show similar projected climate changes. Temperature and precipitation anomalies for each season of the year were obtained with an ensemble of 15 AOGCMs of the CMIP5 multi-model project, for the 2050s climate normal period, relative to the 1961-1990 climate normal.

a) Δ Temperature (C)



b) Δ Precipitation (%)

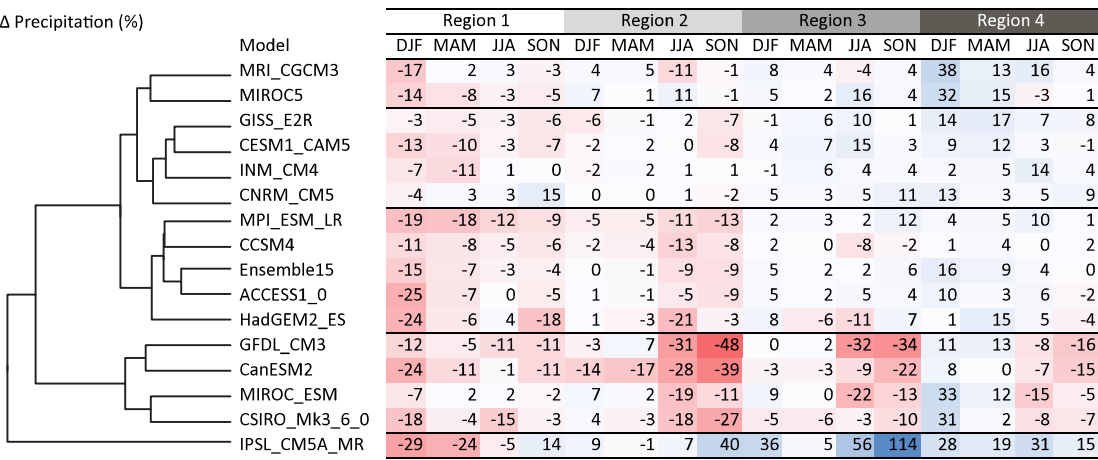


Figure 4. Temperature and precipitation anomalies for the 2050s, relative to the 1961-1990 normal period predicted by 15 AOGCMs of the CMIP5 model generation, corresponding to the 5th IPCC Assessment Report (AR5). Seasonal changes are shown for clusters of grid cells that show similar projected climate change patterns.

Table 1. R² values and average deviation in absolute values, and for precipitation also as percentage from observed values, to compare the quality of estimates for the 1961-1990 climate normal from ClimateSA and from observed weather station data. The dataset was divided into plains regions (<1,000m ASL), and mountainous regions (>1,000m ASL).

Variable	< 1,000m ASL		> 1,000m ASL	
	R ²	MAE	R ²	MAE
January Temperature	0.97	0.59 °C	0.94	0.73 °C
Dec-Jan-Feb Temp	0.97	0.56 °C	0.94	0.71 °C
Mean Annual Temperature	0.99	0.53 °C	0.94	0.74 °C
January Precipitation	0.95	10mm (9%)	0.80	17mm (15%)
Dec-Jan-Feb Precipitation	0.95	26mm (7%)	0.83	51mm (15%)
Mean Annual Precipitation	0.96	101mm (5%)	0.90	211mm (12%)