11th ICSHMO

International Conference on Southern Hemisphere Meteorology and Oceanography

October 5th to 9th, 2015

Campus Beaucheff
Facultad de Ciencias Físicas y Matemáticas
Universidad de Chile

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Abstract eBook

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Observed (1970-1999) climate variability in Central America using a high-resolution meteorological dataset with potential for climate change studies

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Abstract

Average temperature (Tavg) data from stations and station-based gridded datasets at 50 km resolution were used to provide a high-resolution (5 km grid) dataset for Central America from 1970 to 1999. The procedure used was a modification of the PRISM (Parameter-elevation Regressions on Independent Slopes) method. A high-resolution precipitation (P) data was used along with the air temperature (Tavg) data to study climate variability. Adapting to climate variability helps to adapt to climate change. The high spatial resolution of the P and Tavg data is ideal for determining the spatial patterns associated with large-scale atmospheric and oceanic indexes. Consistently with other studies, it was found that the 1970-1999 trends in P are generally non-significant, with the exception of a few small locations. In the case of Tavg, there were significant warming trends in most of Central America, and cooling trends in Honduras and northern Panama. The contrast or agreement in the sign of the sea surface temperature (SST) anomalies between the tropical Pacific and tropical Atlantic is a good indicator of the sign of the P and Tavg annual anomalies. El Niño-Southern Oscillation (ENSO) is related to precipitation in a large part of the Pacific slope of Central America. The influence of the contrast between the Pacific and Atlantic SSTs, and also of the Caribbean Low-Level Jet (CLLJ) on P is very important. Tavg is related to ENSO, the Tropical North Atlantic index and the summation of both indexes. Within the modes of variability obtained from Rotated Empirical Orthogonal Function (REOF) Analysis and Canonical Correlation Analysis a P-REOF mode representing the variations above 10oN is strongly correlated with the CLLJ. Other modes representing Pacific and Caribbean climatic variations, as well as trends were identified from the analyses. Possible uses of the datasets for climate change studies such as supporting detection and attribution, statistical downscaling and to fit hydrological models in climate change projections are mentioned.

Theme: Tropical climate and teleconnections

Observed (1970-1999) climate variability in Central America using a high-resolution meteorological dataset with potential for climate change studies.

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Abstract: Average air temperature (Tavg) data from stations and station-based gridded datasets at 50 km resolution were used to generate a high-resolution (5 km grid) dataset for Central America from 1970 to 1999. A high-resolution precipitation (P, from CHIRPS data, according to Pedreros 2009) data was used along with the new Tavg data to study climate variability (Fig. 1). Adapting to climate variability helps to adapt to climate change and the data generated are used for studying some aspects of observed climatic variability. The high spatial resolution of the P and Tavg data is ideal for determining the spatial patterns associated with large-scale atmospheric and oceanic indexes. Consistently with other studies, it was found that the 1970-1999 trends in P are generally non-significant, with the exception of a few small locations (Fig. 2). In the case of Tavg, there were significant warming trends in most of Central America, and cooling trends in Honduras and northern Panama (Fig. 2). The contrast or agreement in the sign of the sea surface temperature (SST) anomalies between the tropical Pacific and tropical Atlantic is a good indicator of the sign of the P and Tavg annual anomalies. El Niño-Southern Oscillation (ENSO) is related to precipitation in a large part of the Pacific slope of Central America. The influence of the contrast between the Pacific and Atlantic SSTs, and also of the Caribbean Low-Level Jet (CLLJ) on P is very important (Fig. 3). Tavg is related to ENSO, the Tropical North Atlantic index and the summation of both indexes (Fig. 3). Within the modes of variability obtained from Rotated Empirical Orthogonal Function (REOF) Analysis and Canonical Correlation Analysis a P-REOF mode representing the variations above 10ºN is strongly correlated with the CLLJ (Fig. 4). Other modes representing Pacific and Caribbean climatic variations, as well as trends were identified from the analyses (Fig. 4). Possible uses of the datasets for climate change studies such as supporting detection and attribution, statistical downscaling and to feed hydrological models in climate change projections are mentioned.

References:

Pedreros, D., 2009: The Effect of El Niño on Agricultural Water Balances in Guatemala. Masters Thesis in Geography. University of California, Santa Barbara. California, EUA. (see http://chg.geog.ucsb.edu/data/chirps/)
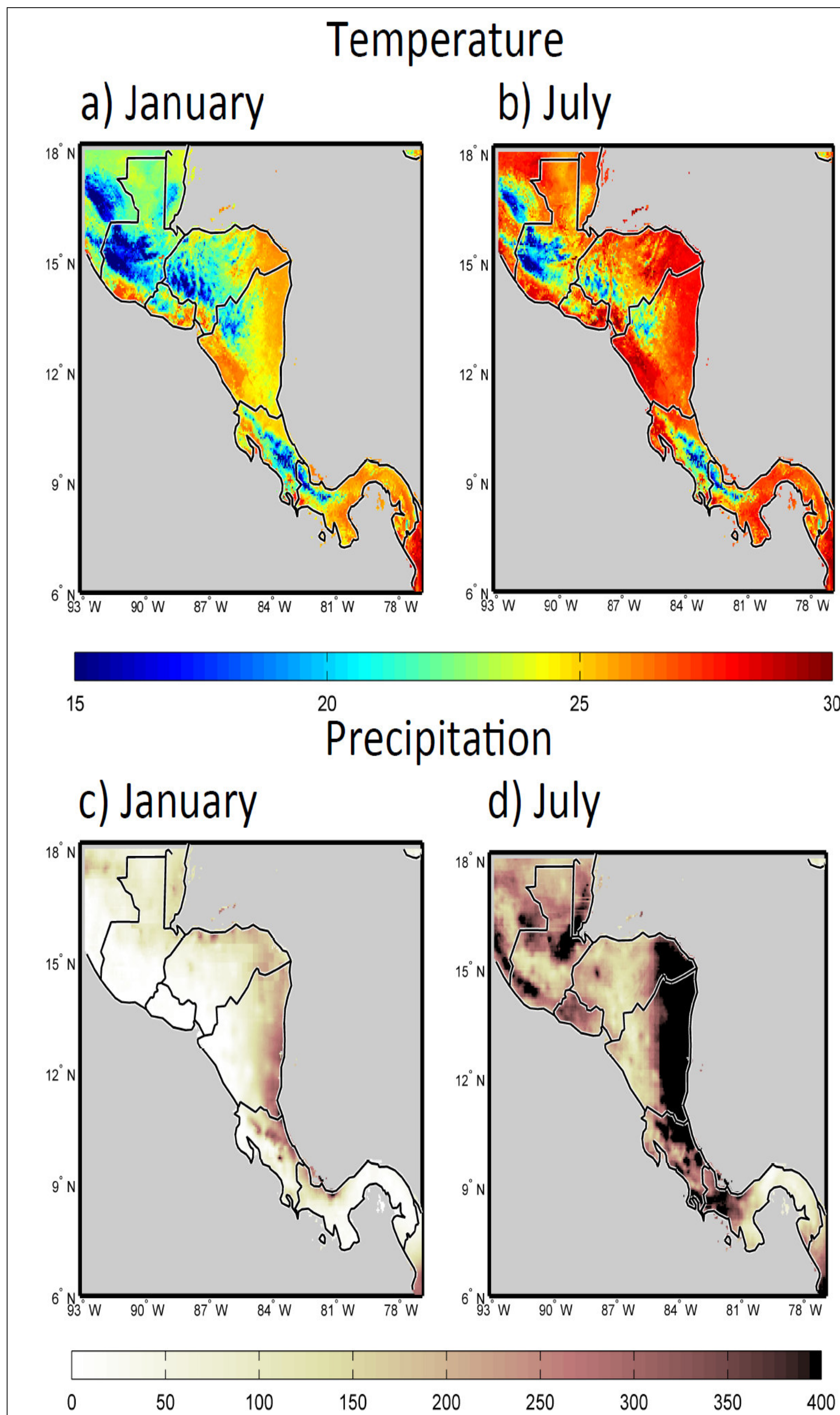
Temperature

a) January b) July

Precipitation

c) January d) July

Fig. 1 – January and July climate normals of surface temperature (ºC) and precipitation (mm month^{-1}). The period of the data is 1970-1999.

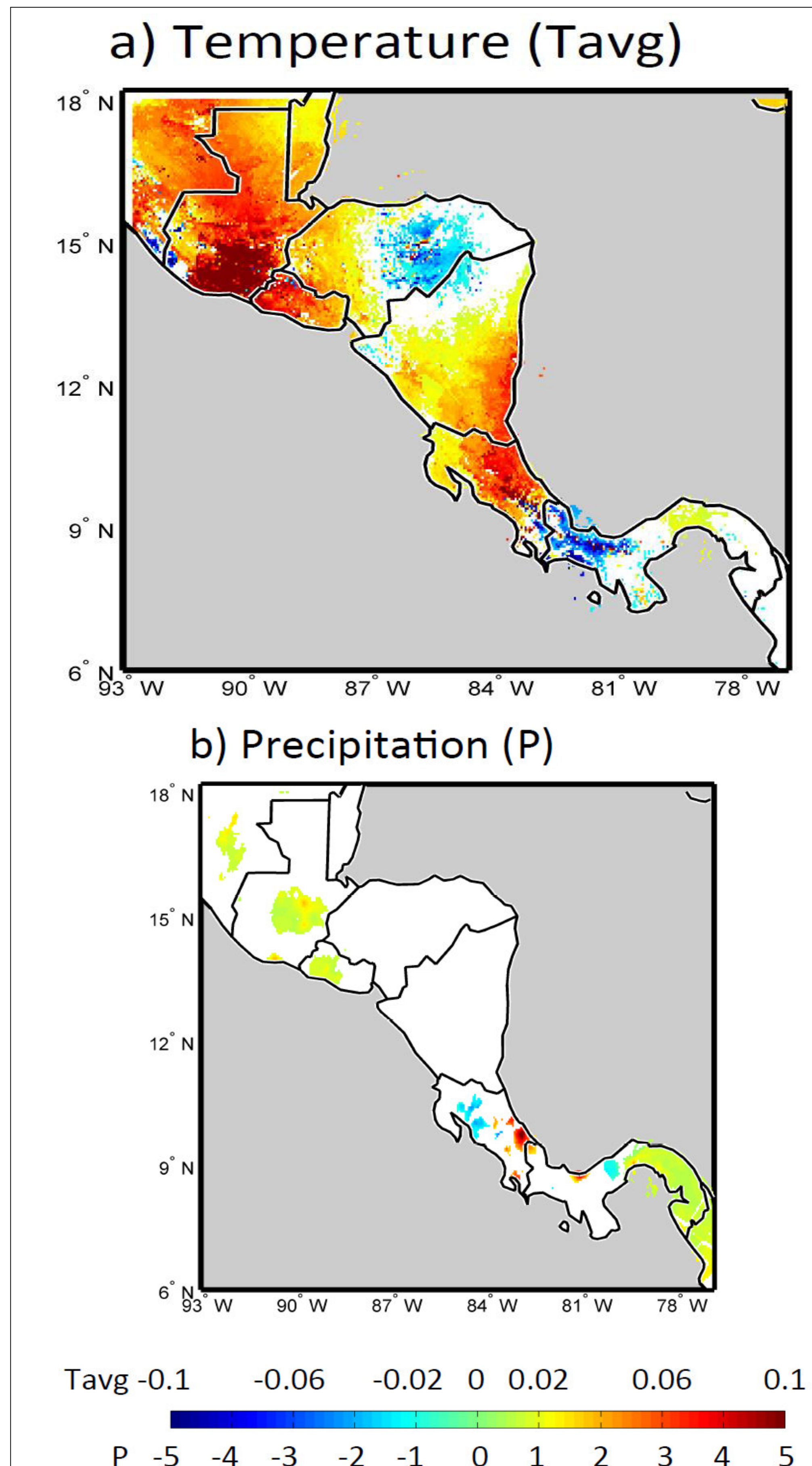## a) Temperature (Tavg)

b) Precipitation (P)

Tavg -0.1 -0.06 -0.02 0 0.02 0.06 0.1

P -5 -4 -3 -2 -1 0 1 2 3 4 5

Fig. 2 – Annual trends (1970-1999) of average temperature in ºC yr^{-1} (top) and precipitation in mm month^{-1} yr^{-1} (bottom). Only significant trends at the p=0.05 level are shown (as colored regions).

PRECIPITATION   TEMPERATURE

Niño3.4 a) b)
TNA c) d)
Niño3.4-TNA e) Niño3.4+TNA f)
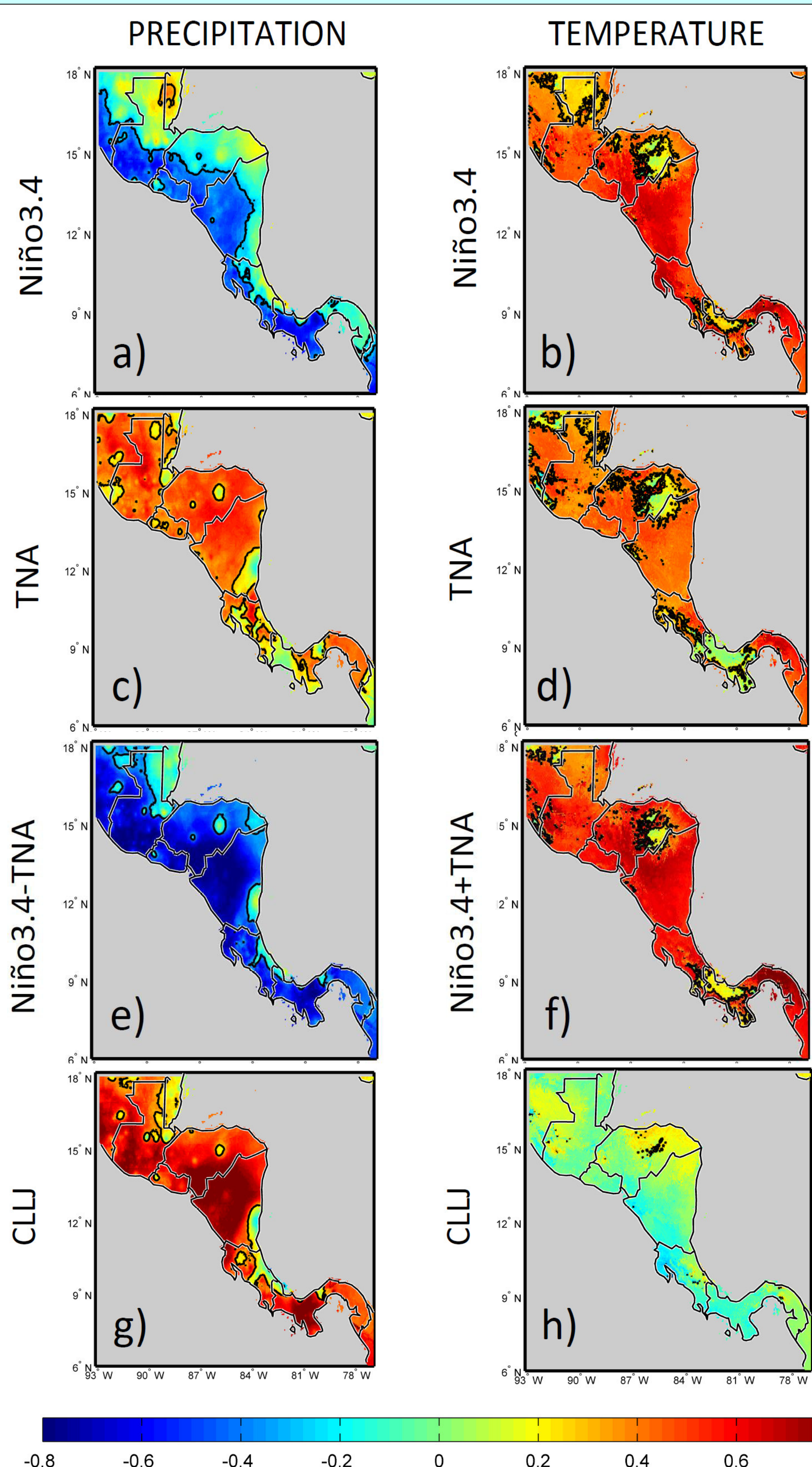CLLJ g) h)

Fig. 3 – Annual Spearman rank correlations between climate indexes and precipitation and temperature. The significant correlation at the p=0.05 level is shown with a black line. The period of the data is 1970-1999.
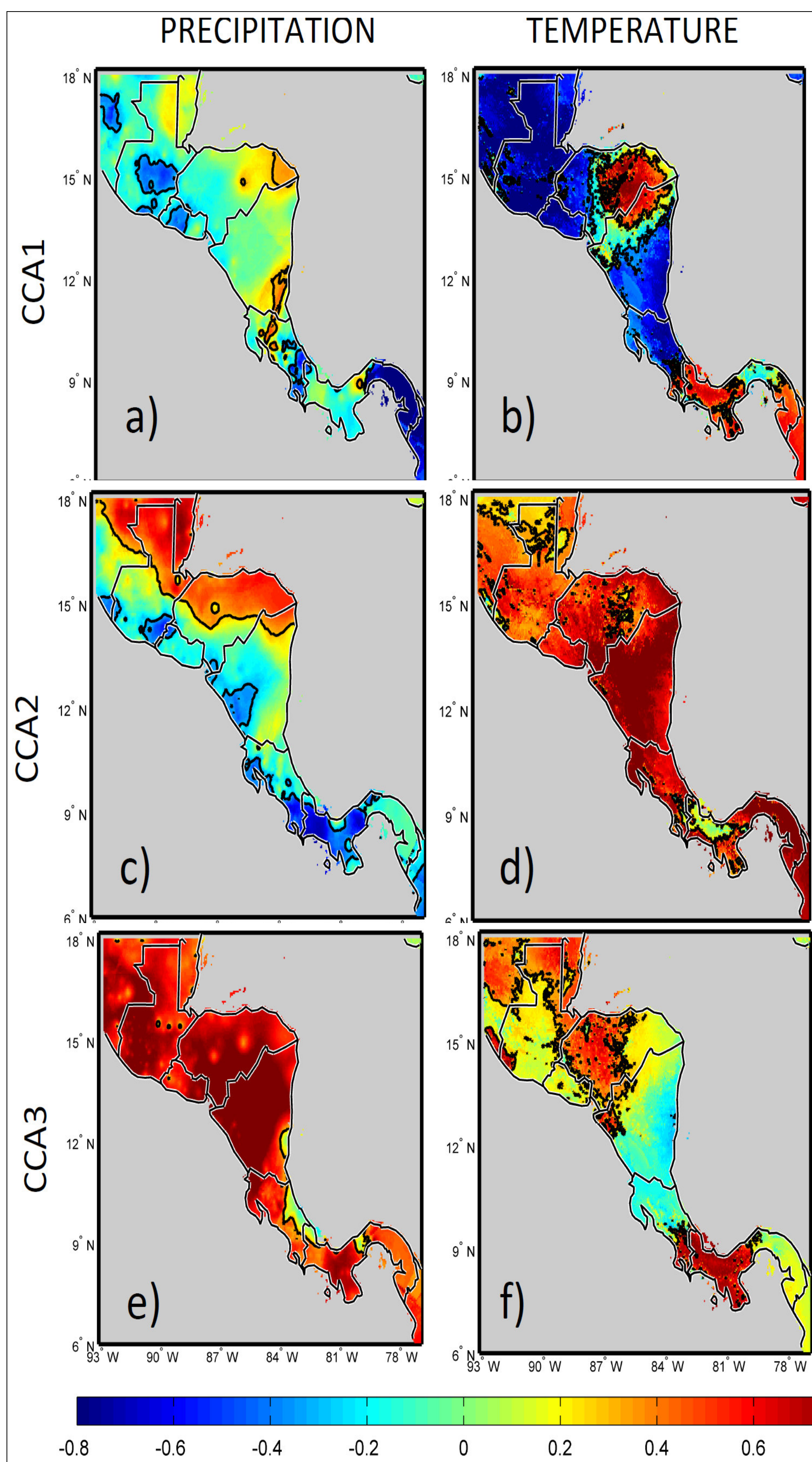
PRECIPITATION   TEMPERATURE

CCA1 a) b)
CCA2 c) d)
CCA3 e) f)

Fig. 4 – Loading patterns expressed as correlation between the scores and the original precipitation and temperature data for the three first Canonical Correlation modes between precipitation and temperature.

Based on the work: H.G. Hidalgo, E.J. Alfaro and B. Quesada-Montano, 2015. Observed (1970-1999) climate variability in Central America using a high-resolution meteorological dataset with potential for climate change studies. *In progress.*

Poster available after the event in : http://kerwa.ucr.ac.cr/

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