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

Eric J. Alfaro (1,2,3), Hugo G. Hidalgo (1,2) & Beatriz Quesada-Montano (1,4): *1-Centre for Geophysical Research, 2-School of Physics, 3-Marine Sciences and Limnology Research Centre - University of Costa Rica & 4-Department of Earth Sciences, Uppsala University, Uppsala, Sweden.*

CIGEFI
Centro de Investigaciones Geofísicas
Universidad de Costa Rica

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/)

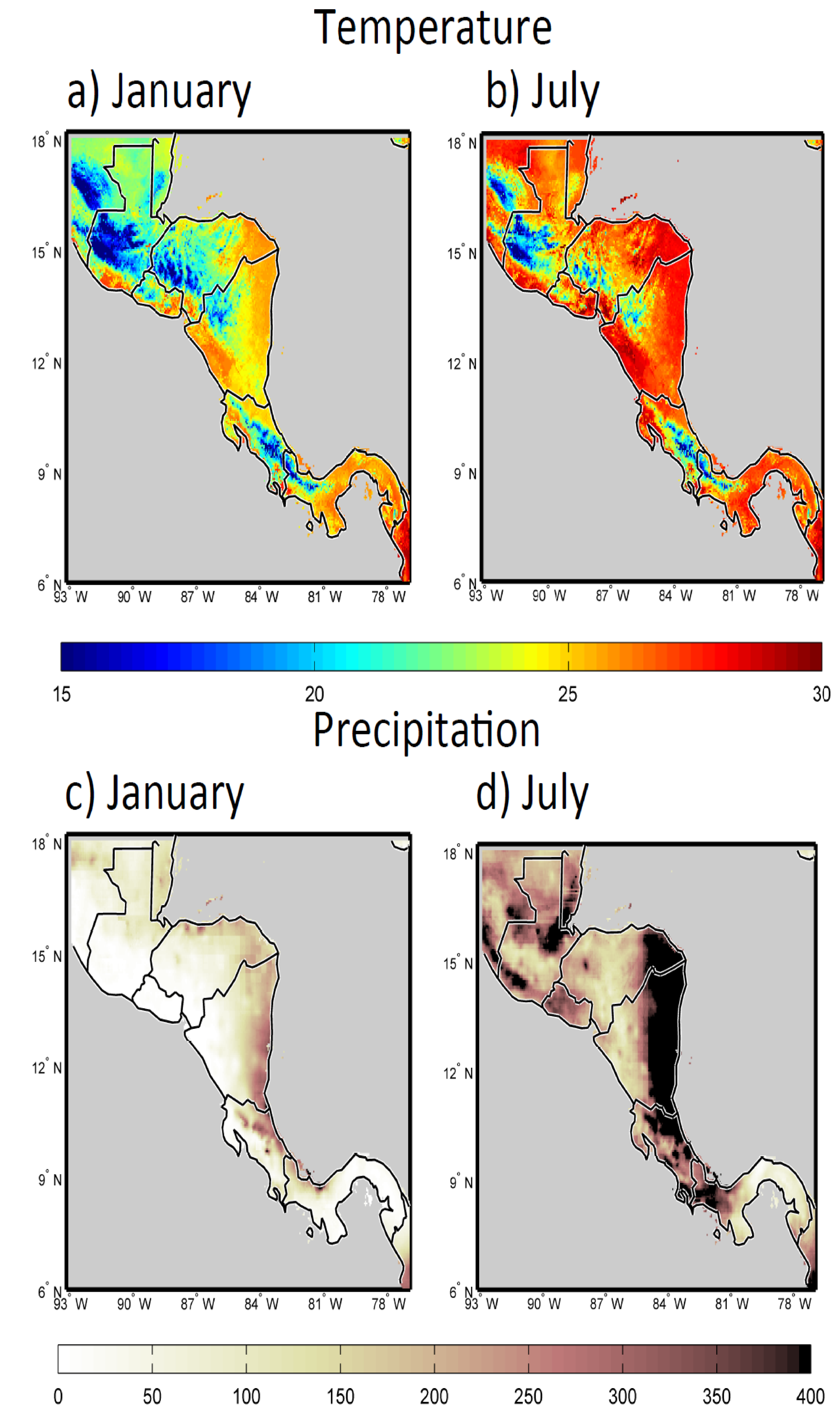

Fig. 1 – January and July climate normals of surface temperature (ºC) and precipitation (mm month^{-1}). The period of the data is 1970-1999.

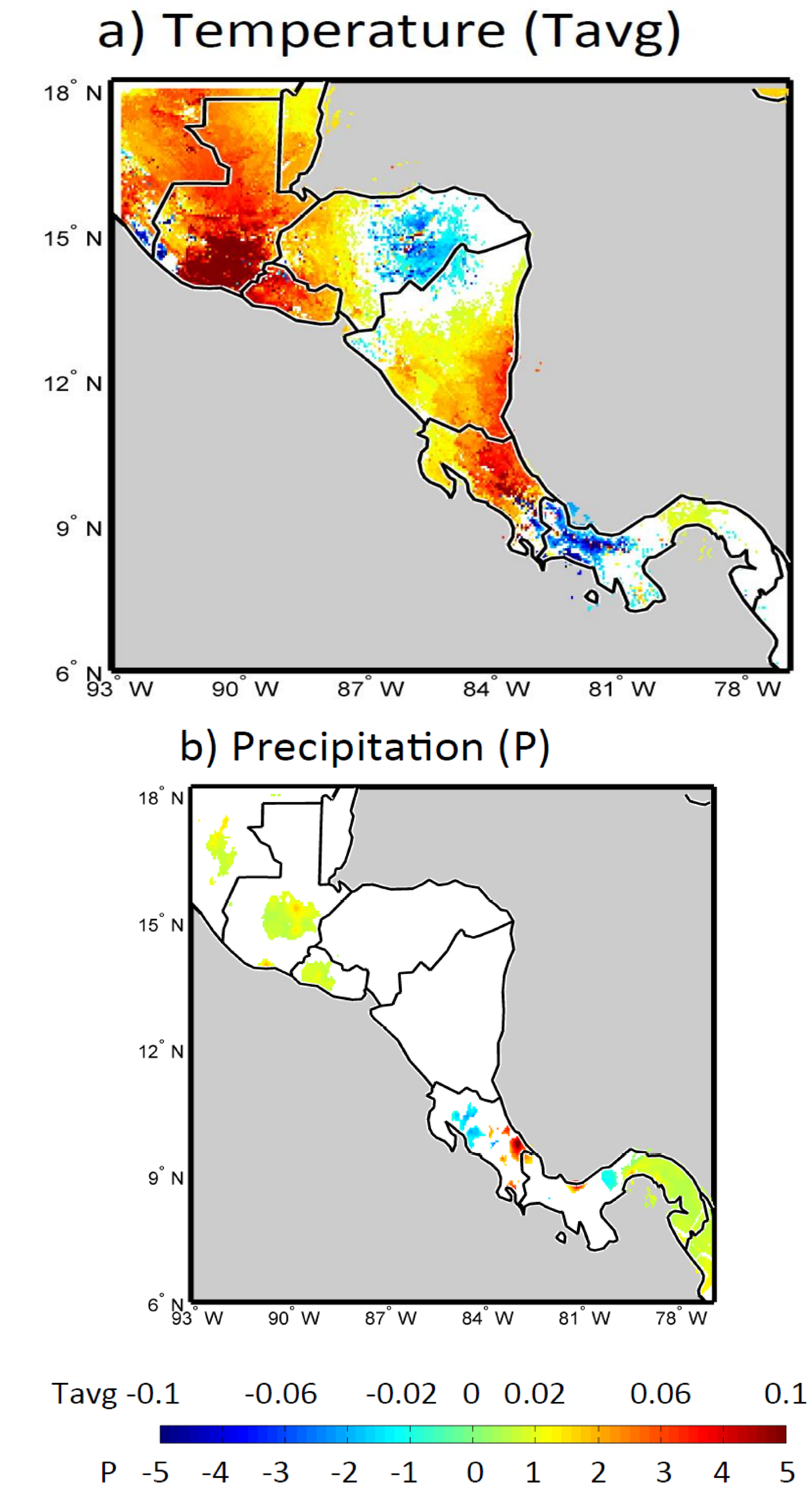

Fig. 2 – Annual trends (1970-1999) of average temperature in ºC yr^{-1} (top) and precipitation in mm month^{-1} yr^{-1} (bottom). Only significant trends at the p=0.05 level are shown (as colored regions).

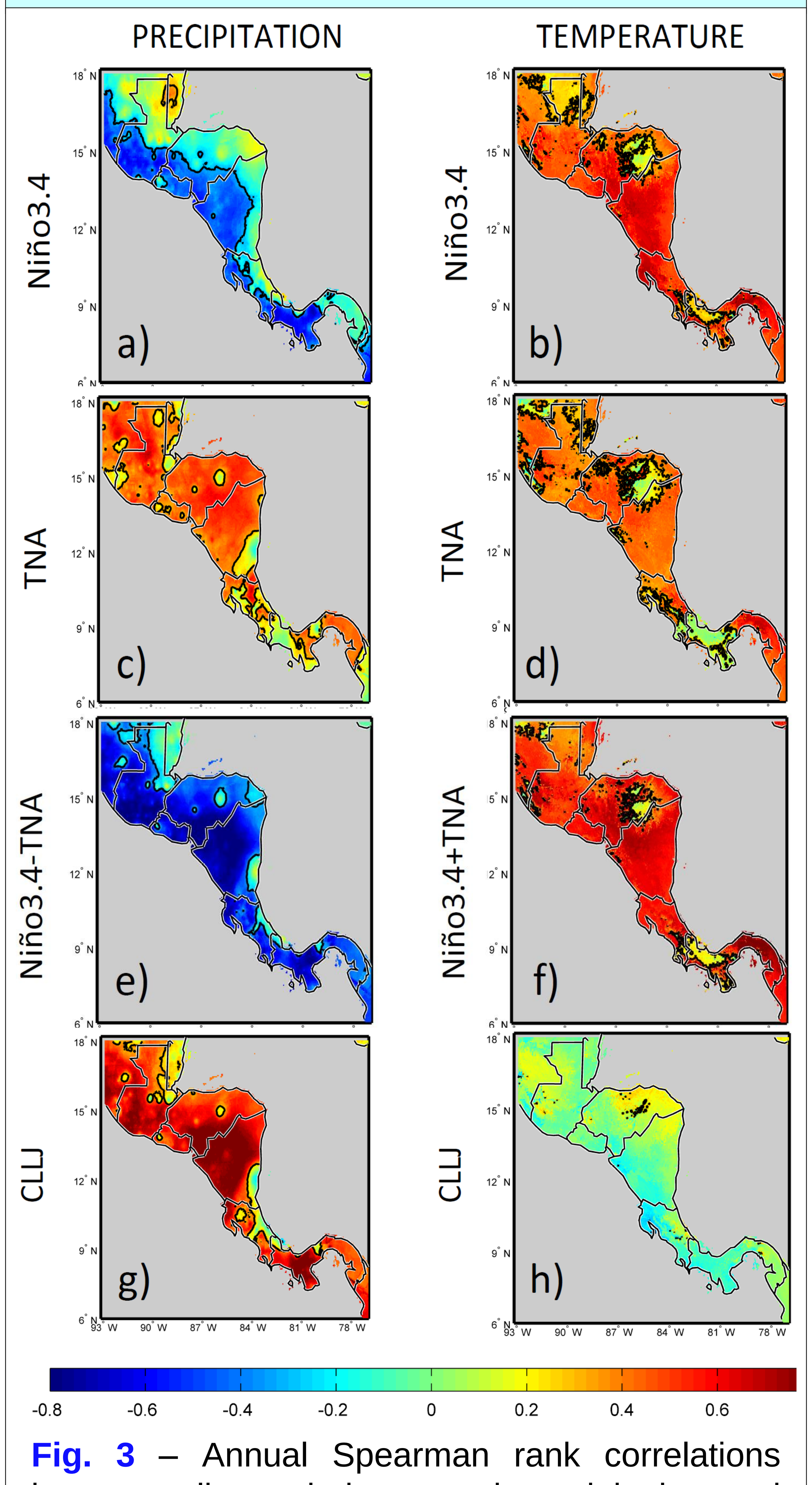

Fig. 3 – Annual Spearman rank correlations between climate indexes and precipitation and temperature. The significant correlation at the p=0.05 level is shown with a black line. The period of the data is 1970-1999.

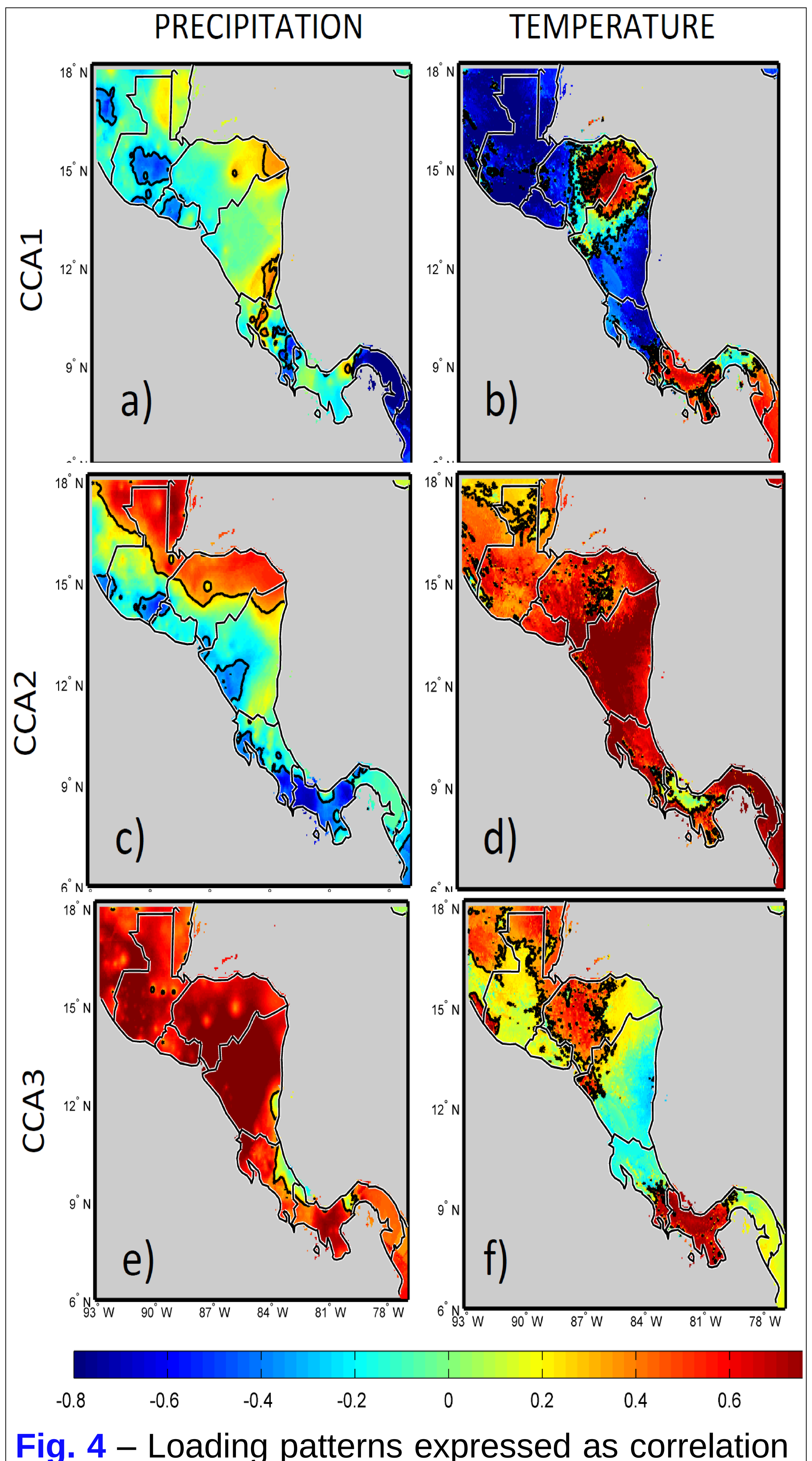

Fig. 4 – Loading patterns expressed as correlation between the scores and the original precipitation and temperature data for the three first Canonical Correlation modes between precipitation and temperature.

Acknowledgments. This work was partially funded by the International Climate Initiative (ICI) of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), as part of the CASCADE project ('Ecosystem-based Adaptation for Smallholder Subsistence and Coffee Farming Communities in Central America'). The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) supports this initiative on the basis of a decision adopted by the German Bundestag. Also by projects 805-B3-413, A9-224, B4-227, A9-532 (supported by CSUCA-ASDI), B3-600, A7-002 (supported by CRN2050 IAI), B0-810 and B0-065, from the Center for Geophysical Research (CIGEFI) of the University of Costa Rica (UCR). Thanks to the logistics support provided by the School of Physics of UCR. The authors thank Ricardo Herrera and Andrés Jiménez who formatted the data and collaborated in the calculation of some of the indexes.

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/

Authors e-mail:
erick.alfaro@ucr.ac.cr, hugo.hidalgo@ucr.ac.cr, beatriz.quesada@geo.uu.se