The University of Costa Rica Regional Training Center (UCR-RTC). Part II: Contribution to research 1979-2017

Erick R. Rivera[1,2]

[1] Department of Atmospheric, Oceanic and Planetary Physics (DAOPP), School of Physics and [2]Center for Geophysical Research (CIGEFI)

University of Costa Rica, San Jose 11501-2060, Costa Rica

Email: erick.rivera@ucr.ac.cr

Introduction

Research activities at UCR RTC on atmospheric phenomena are maily related to some Key Scientific Issues of the Intra Americas Seas (IAS) región (Fig. 1).

Societal Motivation

The IAS region is home for more than one hundred million people. Some countries in this región are among the poorest in the Americas.

The IAS Climate

The Western Hemisphere Warm Pool, tropical ciclones, tropical waves, cold fronts, the Inter Tropical Convergence Zone, the Caribbean Low-Level Jet (Fig. 2., 3.), and Mid-Summer Drought (Fig. 4., 5., 6.), are among the atmospheric and oceanic features characterizing the IAS. Climate variability at different time and space scales produces catastrophic losses of life and destruction of infrastructure and property.

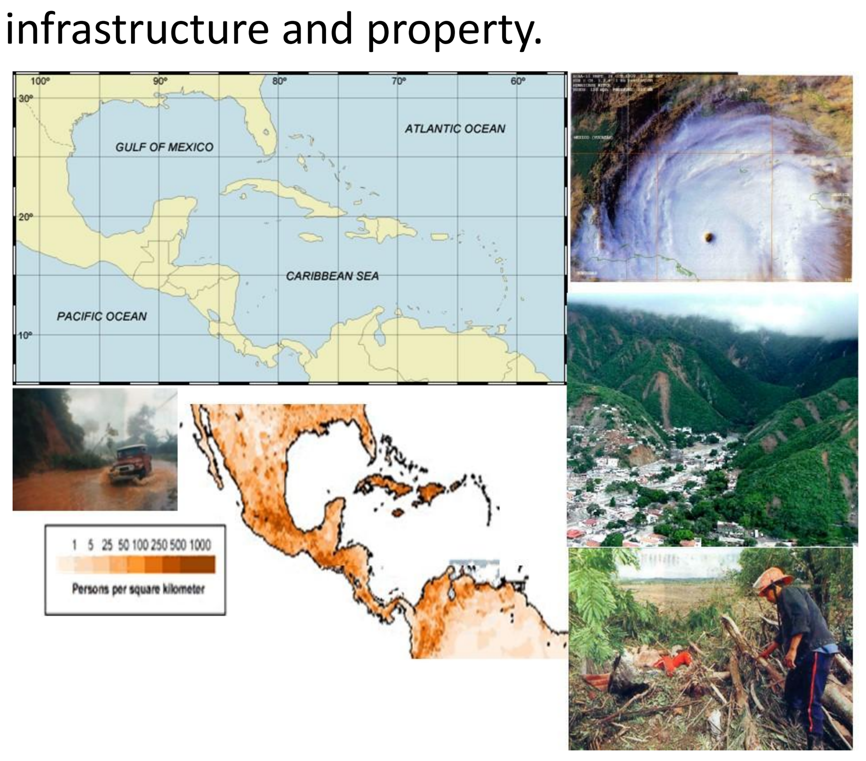


Figure 1. The IAS region.

Some Key Scientific Issues of the IAS

1- The Caribbean Low-Level Jet (CLLJ)

Amador (1998), Amador (2008), Amador et al. (2010)

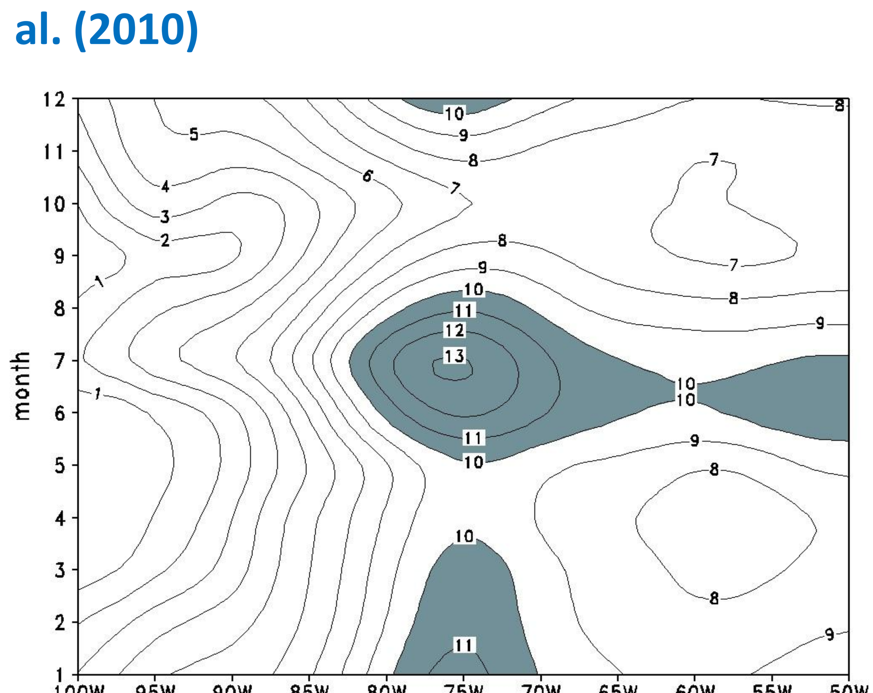


Figure 2. *Time–longitude cross section of monthly mean wind speed (m/s) at 925 hPa averaged from 12.5 to 17.5°N from Reanalysis. (From Amador 2008)*

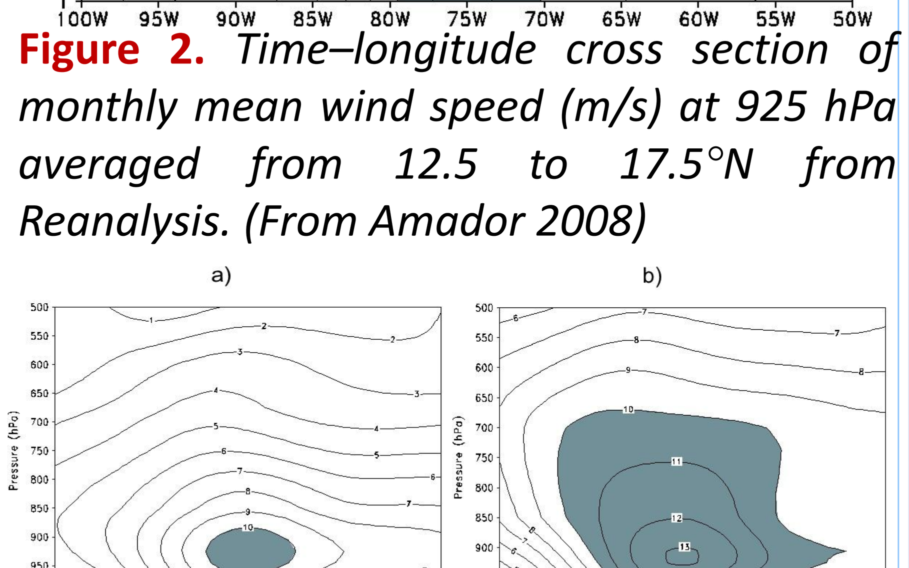


Figure 3. *Vertical profile of monthly mean wind speed (ms-1) averaged from 12.5 to 17.5 N for (a) February and (b) as in (a) but for July from Reanalysis. (From Amador 2008)*

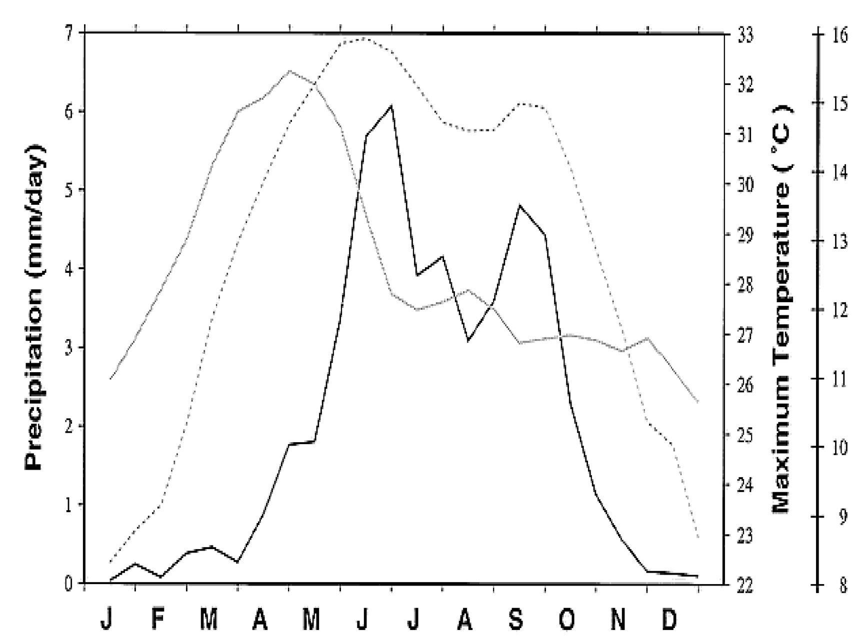
(a) What is the dynamics of the CLLJ?

(b) How well do global and regional models reproduce the CLLJ?

(c) What are the major uncertainties and problems with Reanalysis?

(d) What are the l*inkages between the Caribbean and the Pacific? CLLJ and Choco Jet?*

2- Mid-Summer Drought (MSD)



(a) How does land affect surface and low-level pressure distributions?

(b) Why do many, if not most, GCMs misrepresent the spatial distribution of precipitation in the IAS region?

(c) What are the relative importance of NASH, ITCZ, SST, IALLJ, land effects, and related local atmospheric circulation in the MSD and its inter-annual variability?

(d) What are the typical errors in global and regional models in their simulation and prediction of the MSD?

Figure 4. *Biweekly climatology of precipitation (black solid line), maximum temperature (gray solid line), and minimum temperature (dotted line) for Oaxaca, Mexico (17.8˚N, 97.8˚W). (From Magana et al. 1999)*

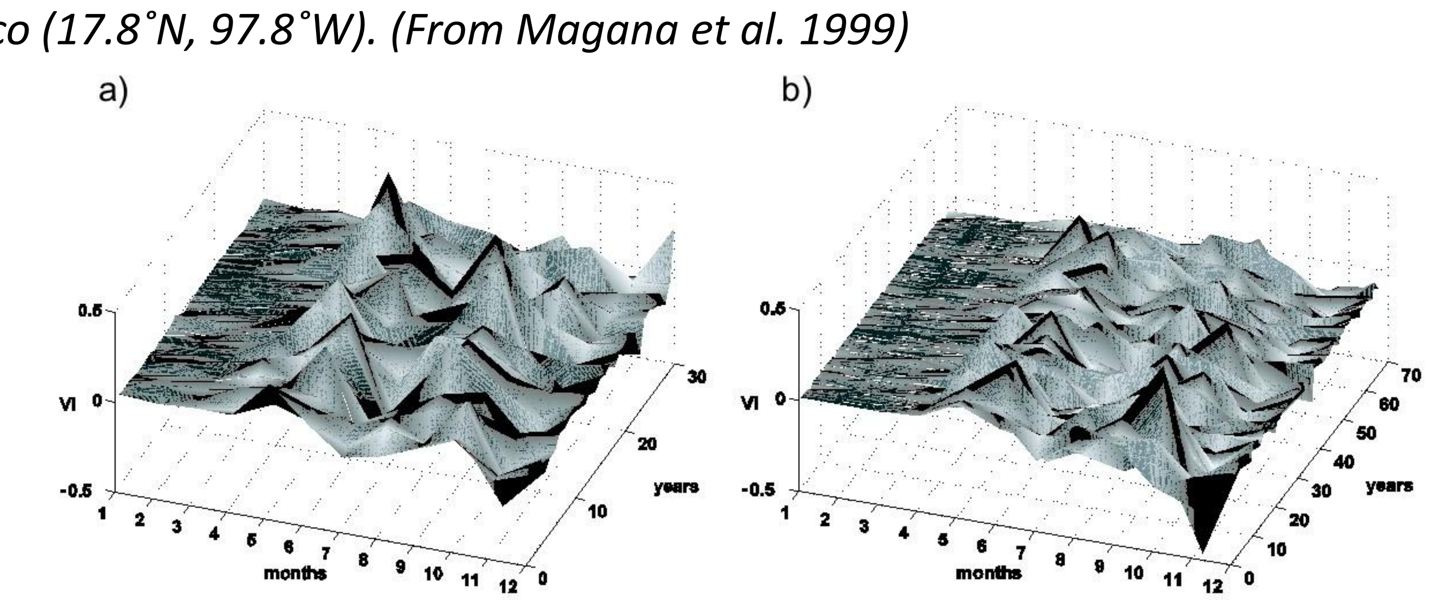


Figure 5. *Interannual variability of the veranillo, canícula or Mid Summer Drought (MSD) at (a) Barbacoa in Nicaragua, and (b) Usulutan in El Salvador, both in the Pacific coast of Central America. The Variability Index (VI) is defined in the text (section 4.2.). Table 2 contains the station characteristics and periods used.*

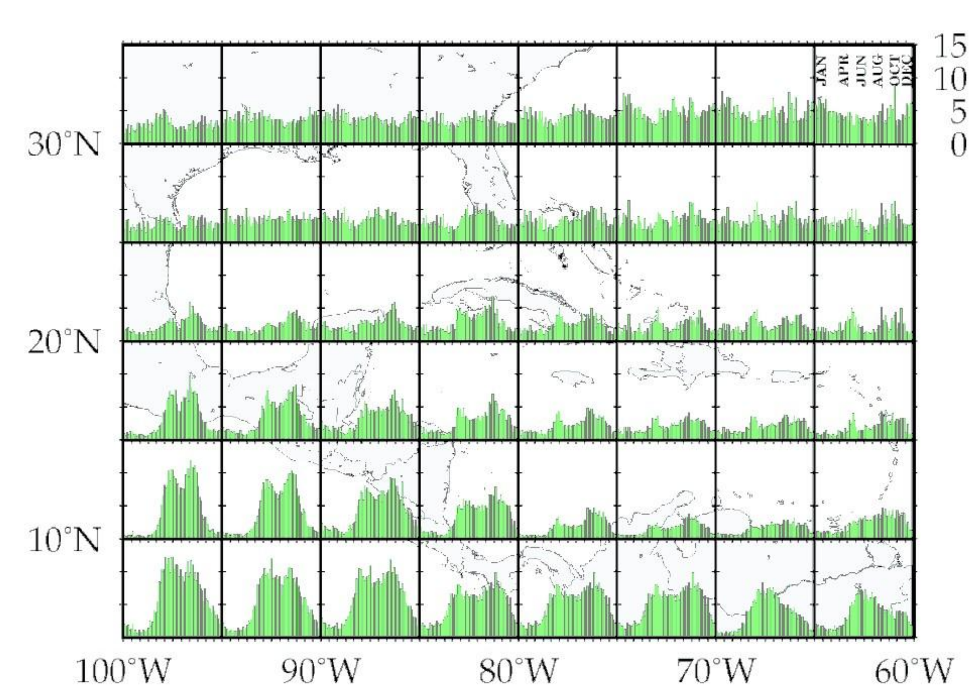
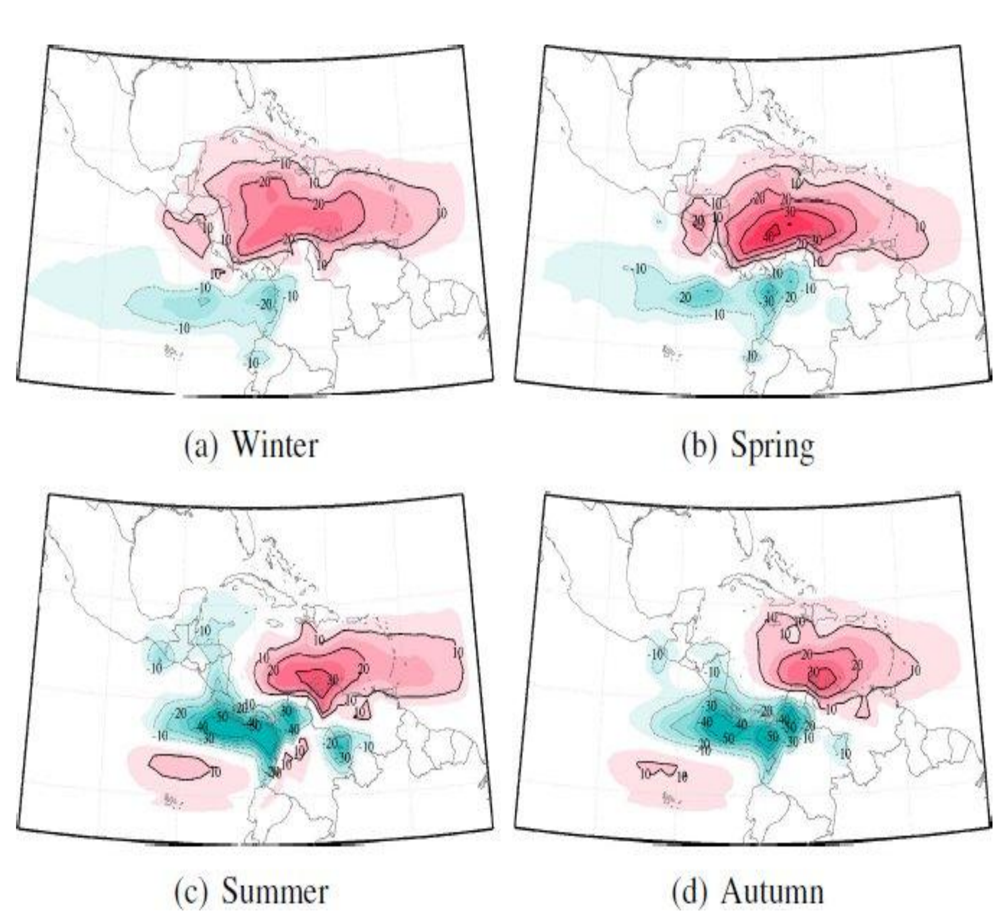


Figure 6. *Distribution of climatological five-day means precipitation rates (mm day-1) for contiguous 5° x 5° areas [45, 56]. Note the bimodal precipitation distribution, especially in the eastern tropical Pacific, showing the Mid-Summer Drought (MSD), canícula or veranillo, a reduction in rainfall, during July-August.(From Amador 2008)*

3- Water vapor transport

Figure 7. *Long term seasonal means of the conditional (E - P)-6 field in mm/day. Positive(red) and negative(green) contours indicated every 10mm/day starting in 10mm/day and -10mm/day respectively. (From Duran et al. 2010)*



(a) What are the main source regions of moisture in the IAS?

(b) *What are the mechanisms for the inter-annual variability of water vapor transports?*

Climate change

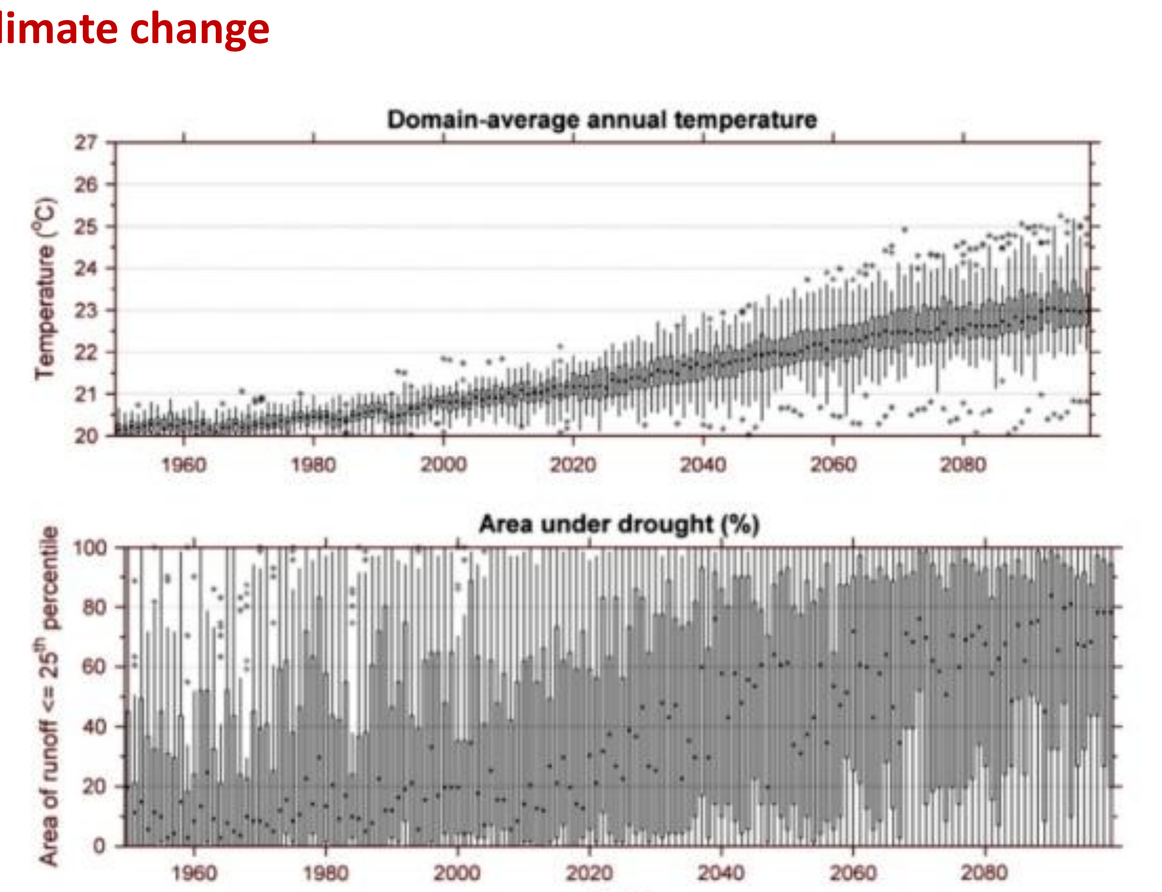


Figure 8. *Domain-average mean annual temperature in Central America. The spread of the boxes represent the different values for all 30 runs analyzed. Only those grid-points with Nash–Sutcliffe validation coefficients greater than zero were used in the figure. (From Hidalgo et al. 2013)*

UCR RTC teaching and research facilities

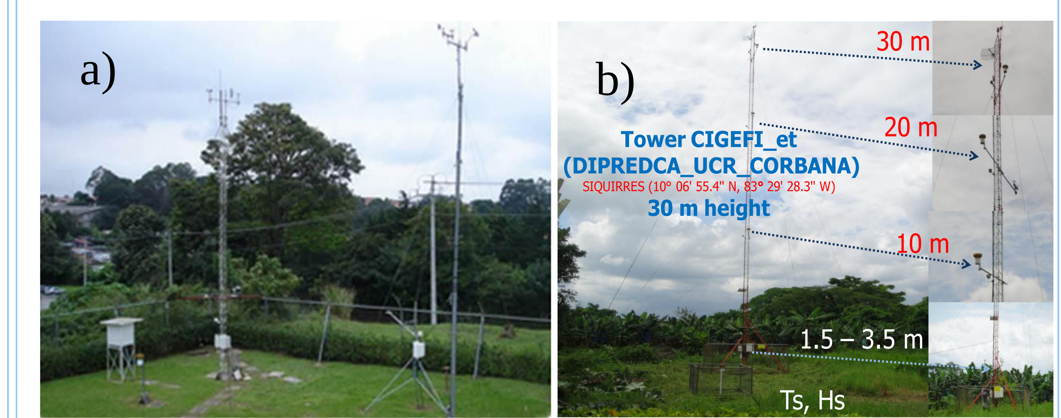


Figure 9. *a) Meteorological station at Center for Geophysical Reseach (CIGEFI in Spanish) (http://tooji.cigefi.ucr.ac.cr/wlink/test/), and b) the CIGEFI_et Observation Tower (30 m. height)*

Figure 10. *a) First RTC computer cluster* **Sibu-Ara** *(built and assembled locally), and b) current computer cluster* **Tsaheva**

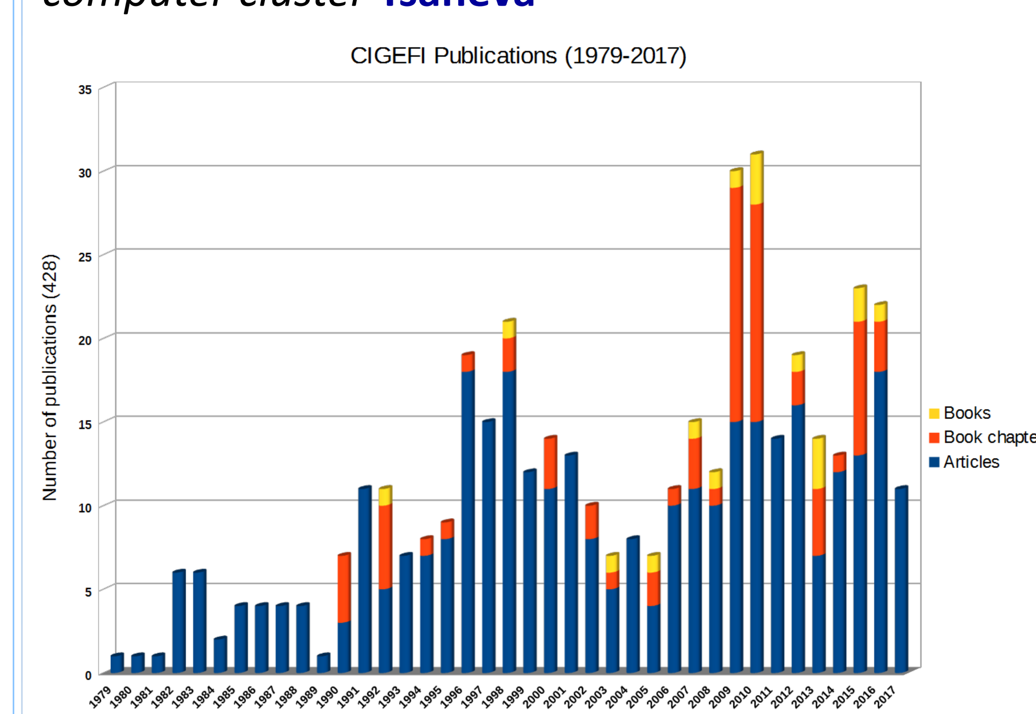


Figure 11. *Number of peer-reviewed publications of the UCR RTC per year during 1979-2017 (articles in blue, book chapters in orange and books in yellow).*

→**Publications (1979-2017) :** 428

http://cigefi.ucr.ac.cr/sites/all/themes/ucr3/files/Lista_Publicaciones_0.pdf

→**National and International Projects (1979-2017):** 91

http://cigefi.ucr.ac.cr/listado-de-proyectos

International media where the RTC has published

Advances in Geosciences; AGU (J. Geophys. Res., Rev. Geophy.); AMS (Bull. Amer. Meteor. Soc, J. Appl. Meteor., J. Climate, J. Climate Appl. Meteor., J. Hydrometeor., Mon. Wea. Rev.); Annals of the New York Academy of Sciences; Atmósfera; Bulletin Seismological Society of America; Climate Research; Elsevier (Agricultural and Forest Meteorology, COSPAR Information Bulletin, J. Hydrol., Progress in Oceanography, Soil Dynamics and Earthquake Engineering, Hurricanes and Climate Change); EOS, Trans. Amer. Geophys. Union; Geofísica Internacional, Holland: Kluwer Academic Publishers, Hydrological Processes; Hydrological Sciences Journal, Hydrology and Earth System Sciences, J. Climatol., Progress in Physical Geography; Revista de Climatología, RMS (Weather), Springer (Bulletin of Volcanology; Clim. Dyn.; EGU; Earth Science Series; Earth, Moon and Planets; Encyclopedia of World Climatology; Meteor. Atmos. Phys.; Natural Hazards; Ocean Evaporation and Precipitation in Earth System Monitoring); WMO Bull.

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