Observed Changes (1970-1999) in Extreme Hydroclimatic Events in Central America

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1. Motivation and introduction.

Changes in the composition of the atmosphere have caused detectable changes in hydroclimatic variables around the word (Barnett et al. 2008; Hidalgo et al. 2009). In regions were the hydrology is governed by the cycles of snow accumulation and melt, impacts of global warming are associated with trends toward earlier spring flows and a higher fraction of precipitation falling as rain instead of snow.

In tropical settings were snow is not an issue, but where climatological temperatures and radiation reaching the surface are generally high, warming can produce large increases in the demand of water from the atmosphere indexed by potential evapotranspiration (PET). If not offset by significant precipitation (P) increases, warming alone can result in drier soils, runoff reductions and higher aridity.

This poster is composed of two parts: in the first part we present a evaluation of the combined effect of trends in Temperature(T), PET, R, and aridity (P/PET) in the Central American region; and in the second part I examine the trends in diverse metrics for extremes in temperature and P. All using data from **1970-1999**

3. On the way to detection of higher aridity, drier soils and less water availability.

Although precipitation trends are generally non-significant (Fig. 1e), the warming effect can bring significant impacts on the hydrological state of the region, reflected in drier soils, higher PET and lower runoff.

The combined effect can be indexed in the first Principal Component (PC) of the combination of T, PET, and aridity, as can be seen in Fig. 2.

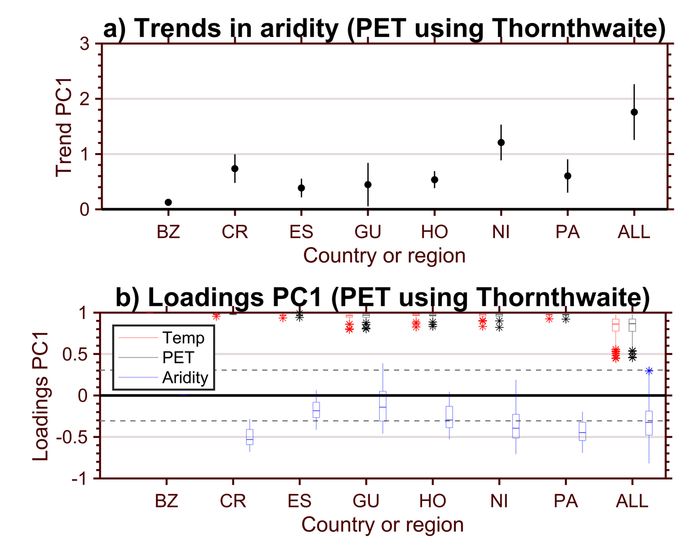


Figure 2. a) Trends and error bars of first PC of T, PET and, aridity, and b) loadings of the PC. BZ: Belize, CR: Costa Rica, ES: El Salvador, GU: Guatemala, HO: Honduras, NI: Nicaragua, PA: Panama.

2. Trends in annual Temperature, PET, Precipitation, aridity and Runoff.

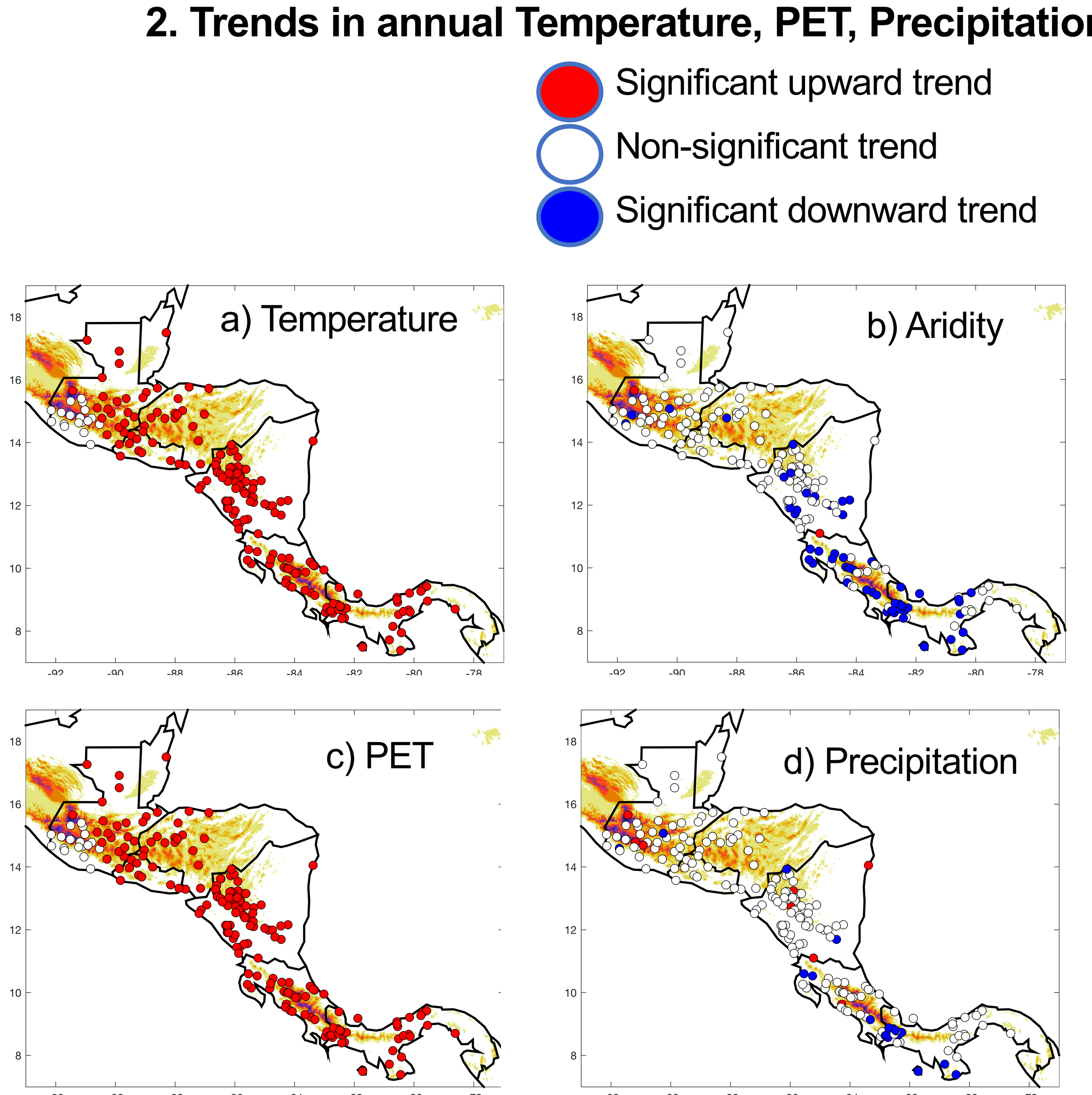
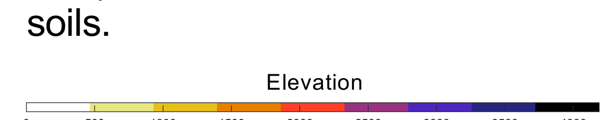


Figure 1. Significance and sign of trends in different hydrometeorological variables in Central America. Downward trends in the *aridity* variable (blue dots) mean drier conditions and soils.



4. Trends in extremes.

Precipitation, maximum temperature and minimum temperature data from the daily stations were used to construct the indices of Aguilar et al. (2005) shown in Table 1.

Table 1. Precipitation and temperature indices and their definition and units. From Aguilar et al, (2005)

ID	Indicator Name	Definitions	Units
TXx	max Tmax	annual maximum value of daily maximum temp	°C
TNx	max Tmin	annual maximum value of daily minimum temp	°C
TXn	min Tmax	annual minimum value of daily maximum temp	°C
TNn	min Tmin	annual minimum value of daily minimum temp	°C
TN10p	cool nights	percentage of days when TN < 10th percentile	% days
TX10p	cool days	percentage of days when TX < 10th percentile	% days
TN90p	warm nights	percentage of days when TN > 90th percentile	% days
TX90p	warm days	percentage of days when TX > 90th percentile	% days
WSDI	warm spell duration indicator	annual count of days with at least 6 consecutive days when TX > 90th percentile	% days
CSDI	cold spell duration indicator	annual count of days with at least 6 consecutive days when TN < 10th percentile	% days
DTR	diurnal temperature range	annual mean difference between TX and TN	°C
RX1day	max 1-day precipitation amount	annual maximum 1-day precipitation	mm
RX5day	max 5-day precipitation amount	annual maximum consecutive 5-day precipitation	mm
SDII	simple daily intensity index	annual total precipitation divided by the number of wet days (defined as precipitation >= 1.0mm) in the year	mm/day
R10mm	number of heavy precipitation days	annual count of days when precipitation >= 10mm	days
R20mm	number of very heavy precipitation days	annual count of days when precipitation >= 20mm	days
CDD	consecutive dry days	maximum number of consecutive days with daily rainfall < 1mm	days
CWD	consecutive wet days	maximum number of consecutive days with daily rainfall >= 1mm	days
R95p	very wet days	annual total PRCP when RR > 95th percentile	mm
R99p	extremely wet days	annual total PRCP when RR > 99th percentile	mm
PRCPTOT	annual total wet-day precipitation	annual total PRCP in wet days (RR >= 1mm)	mm

[a]TX is maximum daily temperature; TN is minimum daily temperature. Annual values are calculated from January to December. Indices in italic have been also calculated for standard seasons.

The trends of these indices are shown in Fig. 3.

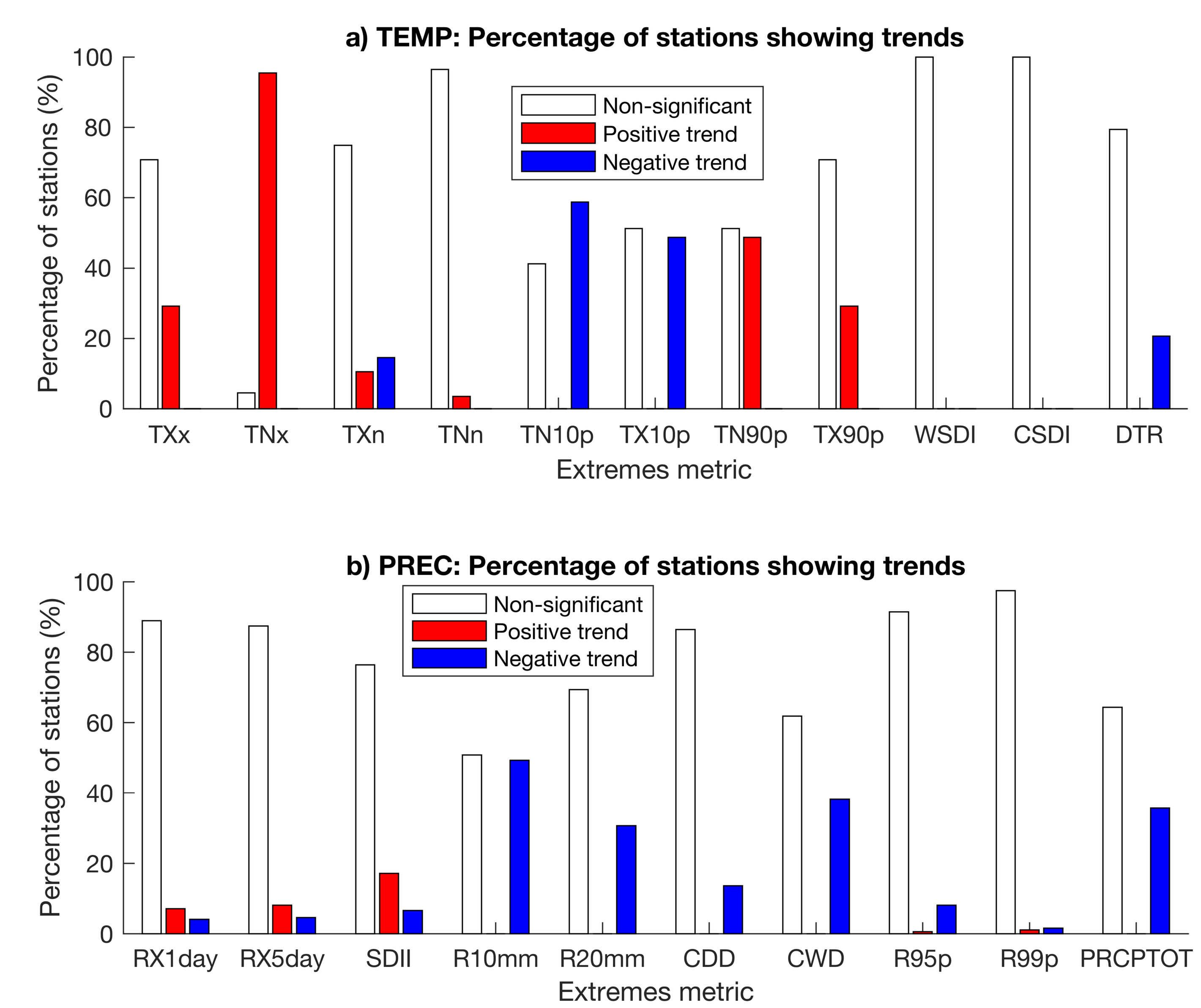


Figure 3. Percentage of stations showing non-significant, positive and negative trends in extreme indexes of temperature (a) and precipitation (b).

5. Discussion and conclusions.

Although precipitation trends have not been significant in general (see also Hidalgo et al. 2017), observed warming trends suggest that Central America may experience drier conditions related to drier soils and higher aridity (especially in Costa Rica's Pacific slope). Temperature extremes have also shown significant warming, in particular, those related to minimum annual temperatures. Cool nights and days have been reduced and warm nights and days have been increasing. There is an opportunity for a detection and attribution study including runoff data as part of the variables. Future work will expand this analysis to a more recent period.

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7.References.

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