How accurately are climatological characteristics represented for some Colombian drainage basins?

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Motivation

- First National Communication (FNC) to the United Nations Framework Convention on Climate Change (Alarcón et al., 2001), recommended to identify global/regional models that represent the Colombian climate in a better way than the models taken into account in FNC

- There are features of the Colombian climatology obtained only from NCEP reanalyses, so they need to be revisited in other datasets. Poveda and Mesa, 2000: "Using the NCEP/NCAR reanalysis data, we sow that the ocean-land atmosphere interaction over the easternmost fringe of the tropical Pacific, enhanced by the dynamics of a low level westerly jet ("CHOCO")... in Colombia"

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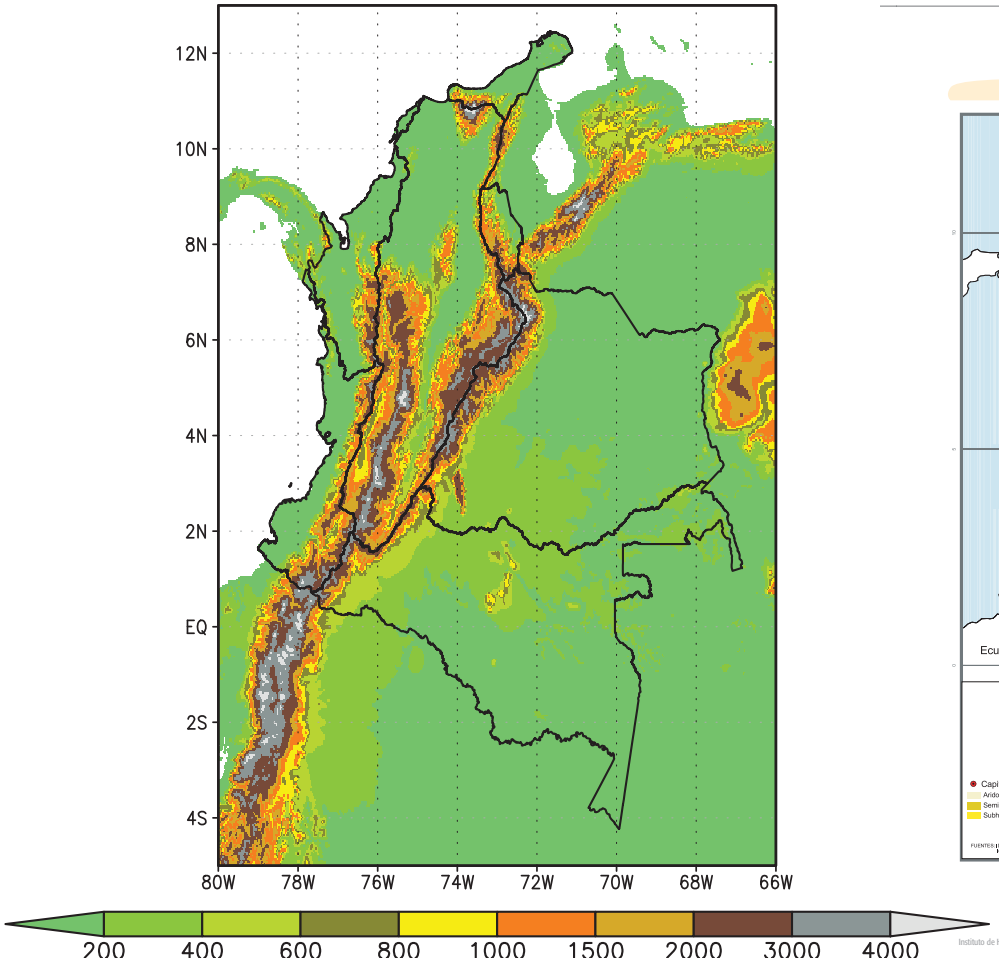
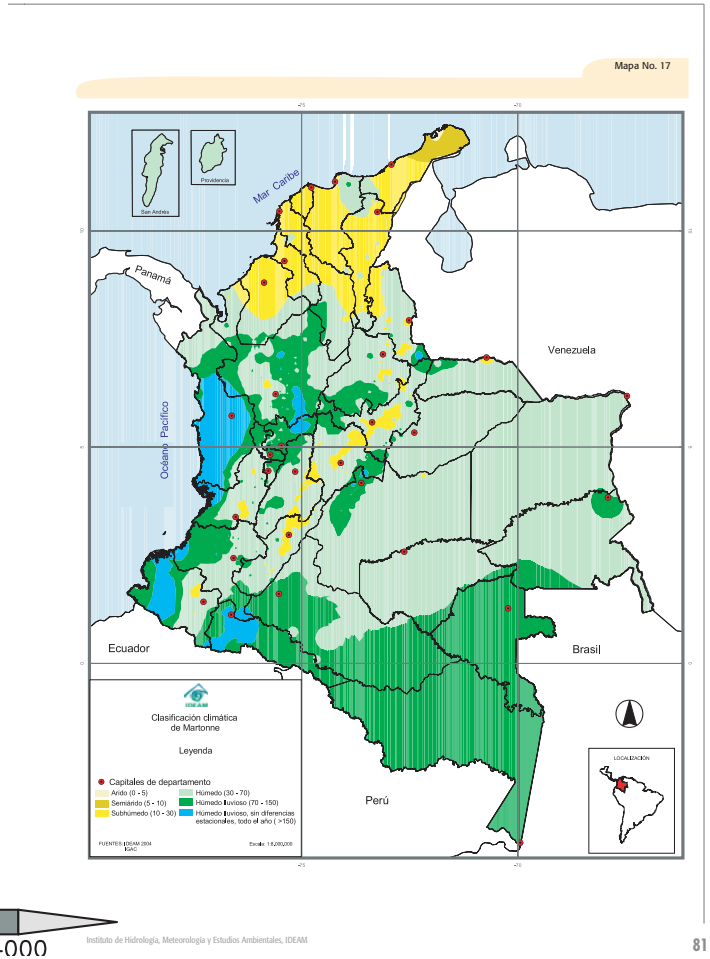
Areas of study: Colombian Caribbean and Orinoco Catchment Basins





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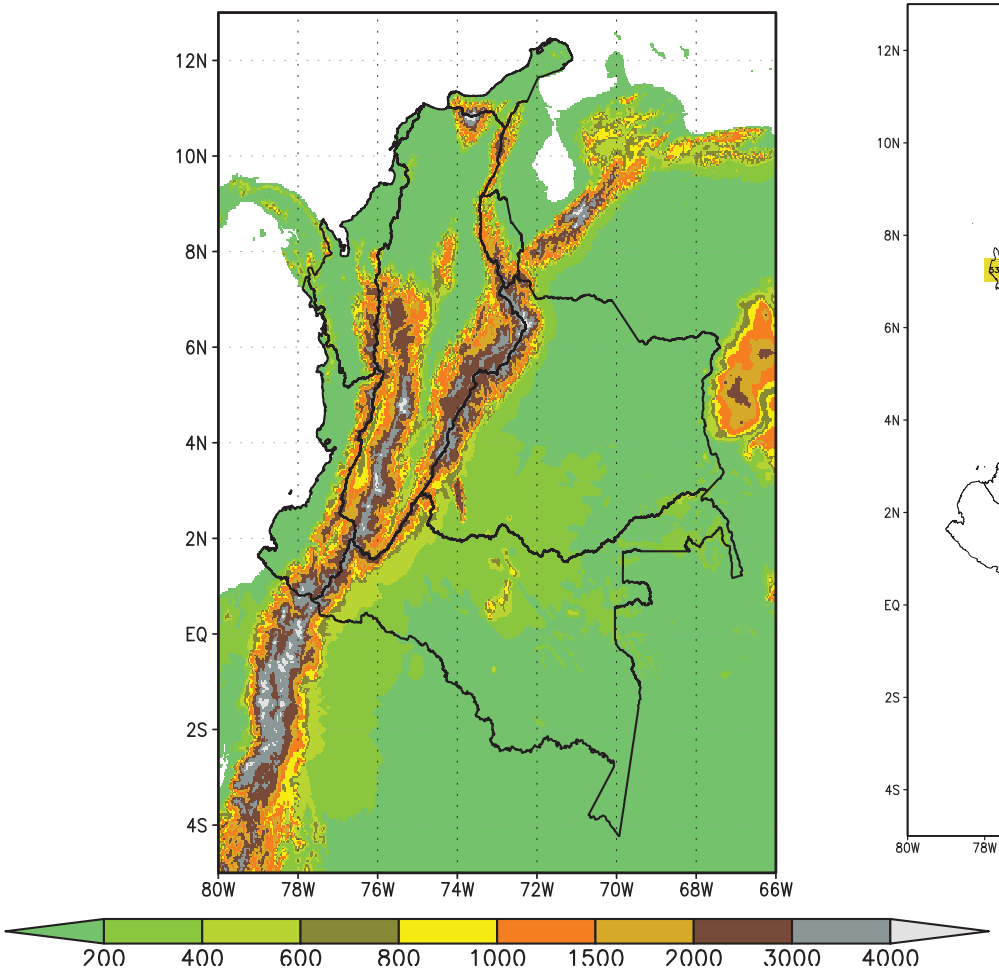
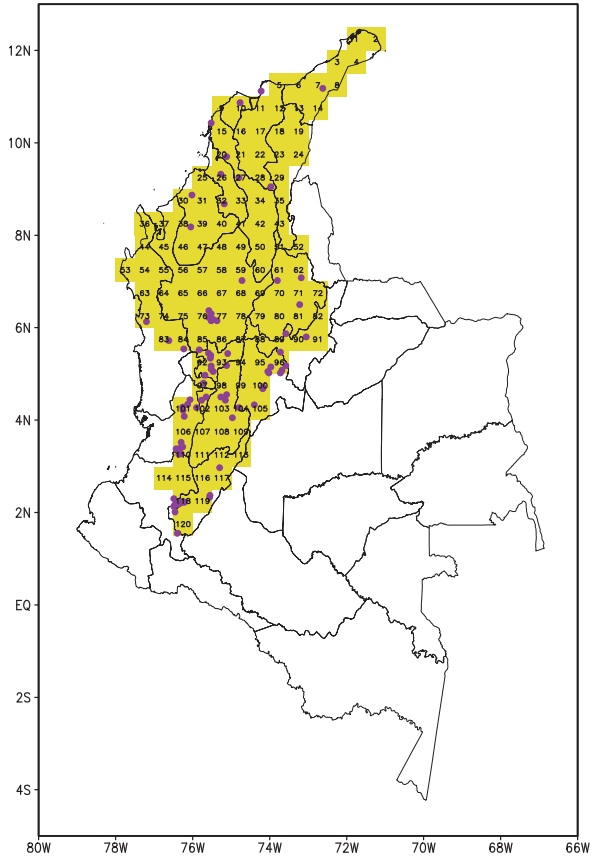
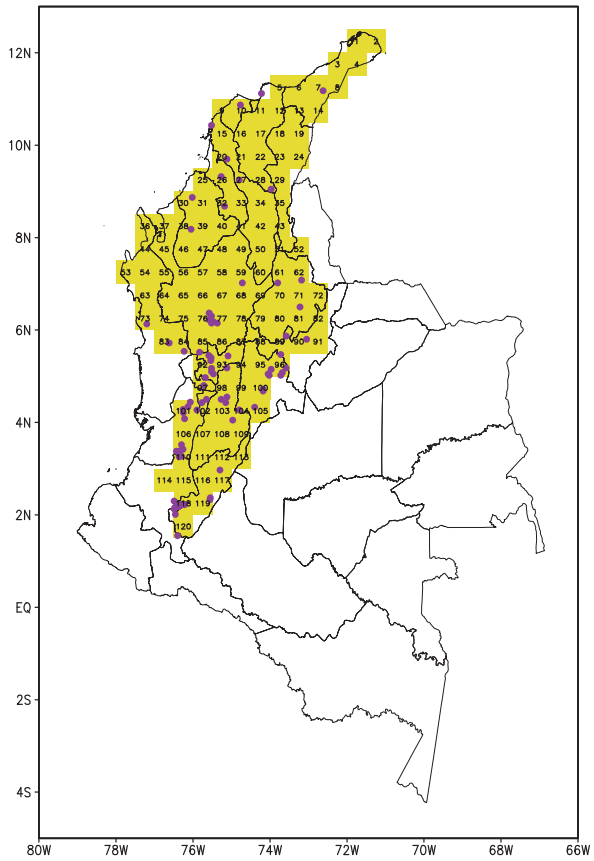
Area of study: Colombian Caribbean Catchment Basin





Area of study: Colombian Caribbean Catchment Basin



The comparison of different datasets over the CCCB is important because:

- it has over 80% of the population of the country
- in the CCCB the 85% of the GDP is produced
- the CCCB includes a mountainous region with three mountain chains, where the models can fail.

Dataset	Period	Variables							
		T	PP	EVT	E	FCL	FCS	RS	RT
REMO	1958-2000	X	X	X	X	X	X	X	X
ERA-40	1958-2000	X	X	X	X	X	X	X	X
NCEP-NCAR	1948-2009	X	X	X	X	X	X	X	X
Delaware	1950-1999	X	X						
CPC	1948-2000		X						
Observations	Different for each estation	X	X						

Temperatura (T); precipitation (PP); evapotranspiration (EVT); runoff (E); latent heat flux (FCL); sensible heat flux (FCS); solar radiation (RS), thermal radiation (RT).

All datasets were compared with station data after they were all transformed by an interpolation with a $0.5^\circ \times 0.5^\circ$ spatial resolution

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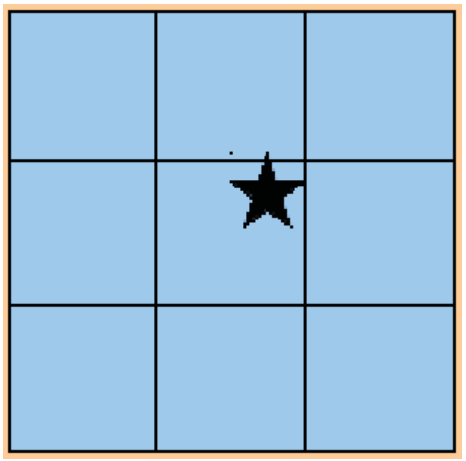
Methodology



- One single station was compared with at least 4 to 9 model grid boxes (Kjellstrom et al., 2007 and Silvestri et al., 2009).
- A height correction is applied to the model temperature data in order to account for height differences between station and model grid-box, considering a lapse rate of (6 °C/km, Pabón et al. 2001).
- Those grid points that have an altitudinal difference with the corresponding station exceeding 1,000 m have been excluded from the analysis.

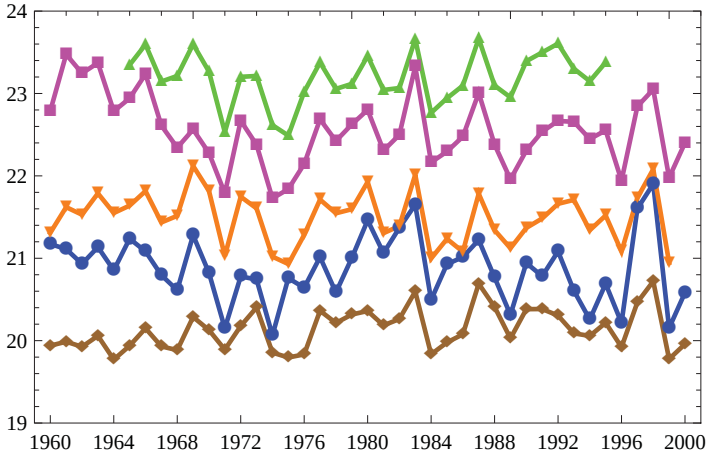
Contents

Means of temperature and precipitation

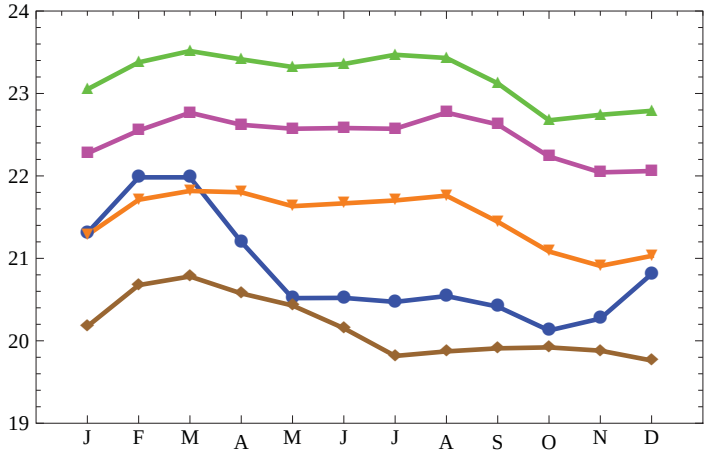
	Temperature		Precipitation	
Data	Mean (°C)	*Bias* (°C)	Mean (mm/day)	*Bias* (%)
Observations	23.2	-	4.57	-
REMO	20.8	-2.3	12.33	169
ERA-40	22.4	-0.7	9.85	115
NCEP-NCAR	20.1	-3.0	12.28	168
Delaware	21.5	-1.7	5.42	18
CPC	-	-	6.68	46

Temperature (°C) in CCCB 1965 - 1995

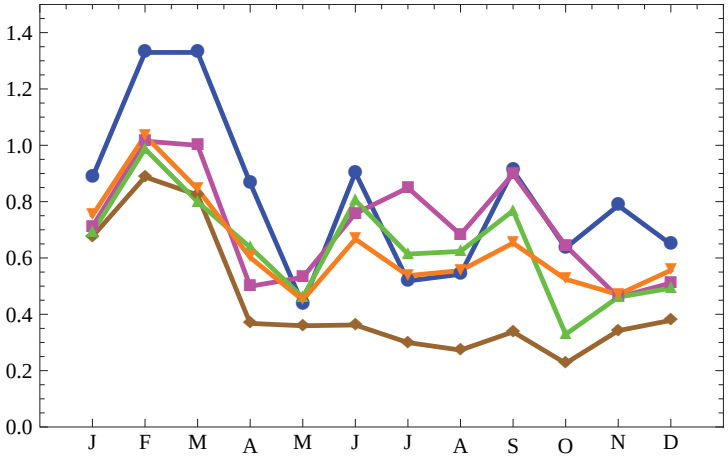
Annual mean



Annual cycle

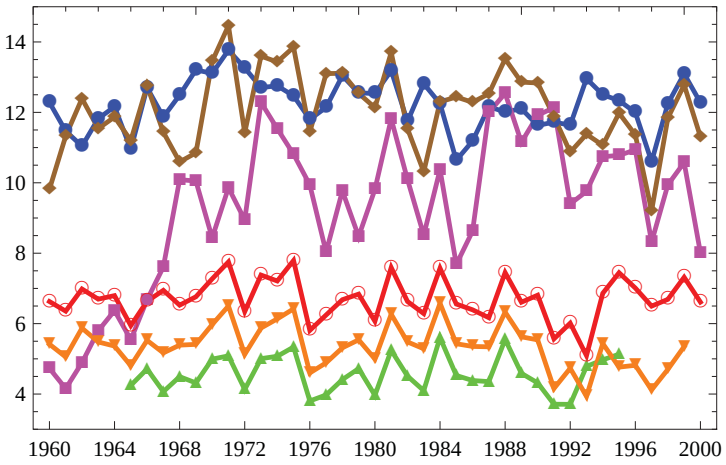


Interquartile range

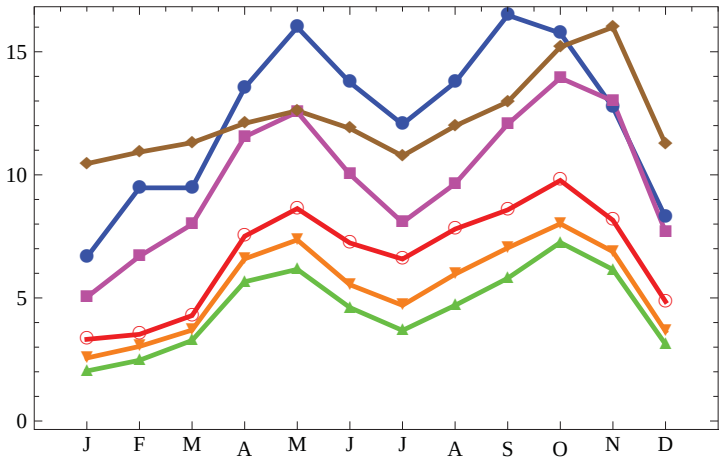


Precipitation (mm/day) in CCCB 1965 - 1995

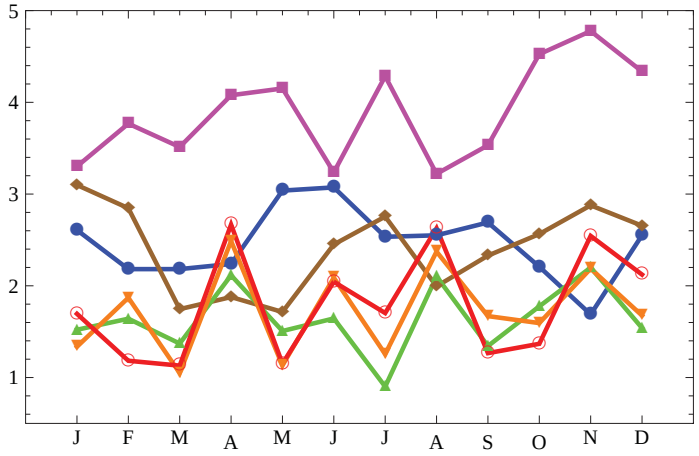
Annual means



Annual cycle

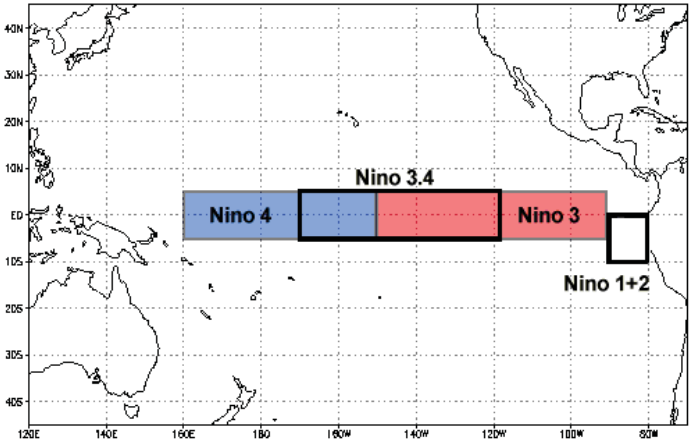


Interquartile range (IQR)

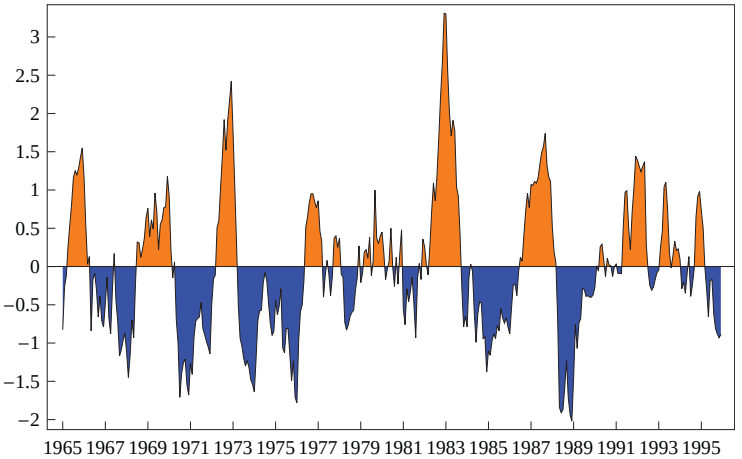


Temperature, precipitation and ENSO 1965 - 1995.

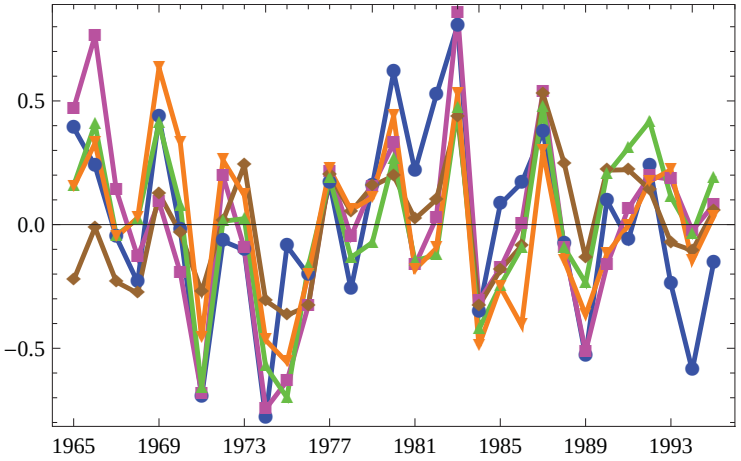
Niño regions



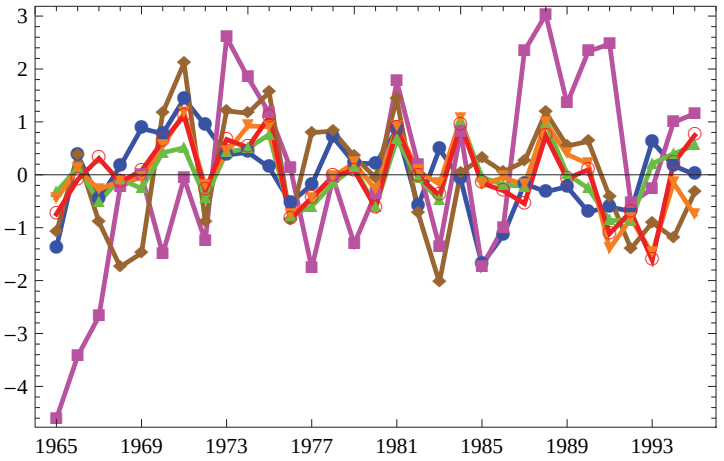
Anomalies of SST (°C) - region Niño3



Anomalies of temperature



Anomalies of precipitation



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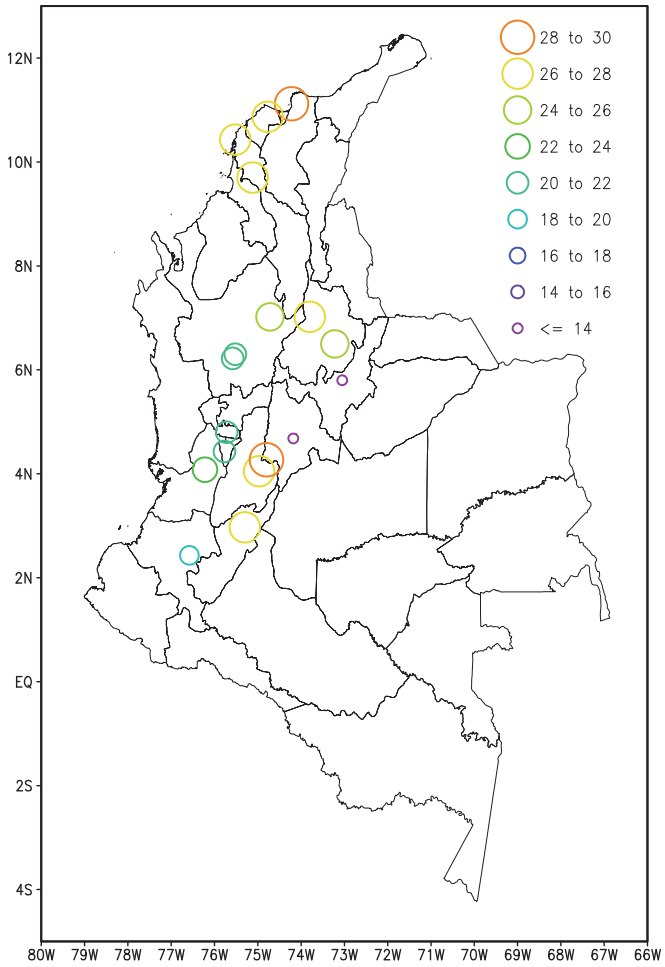
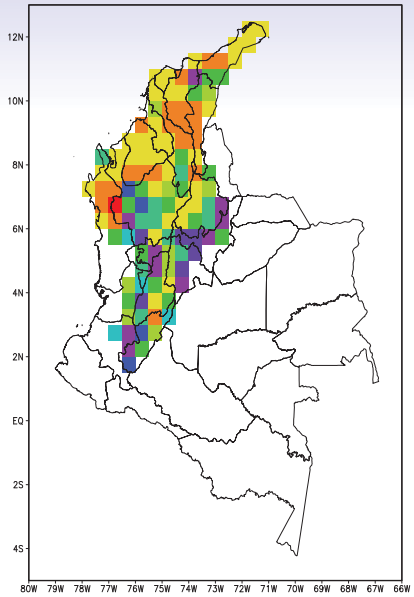
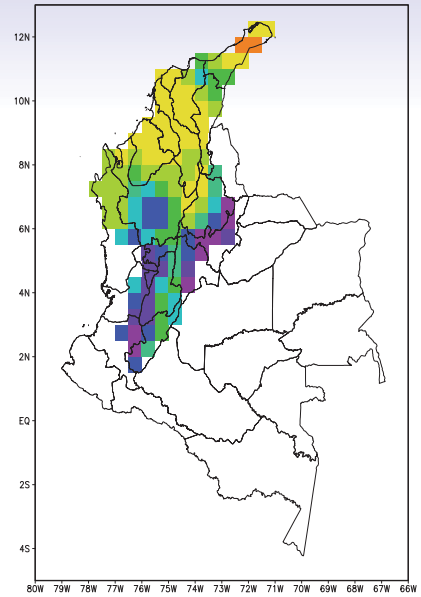
Temperature (°C)



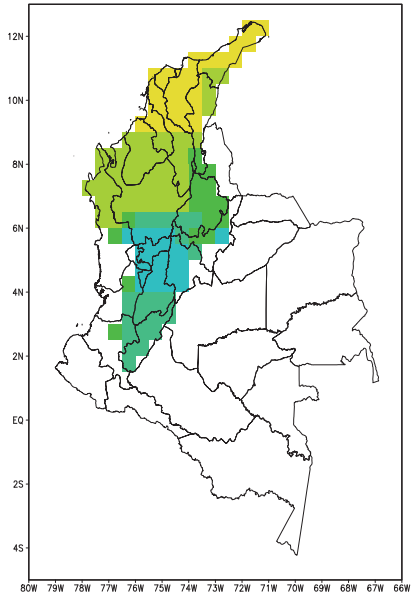
Observations



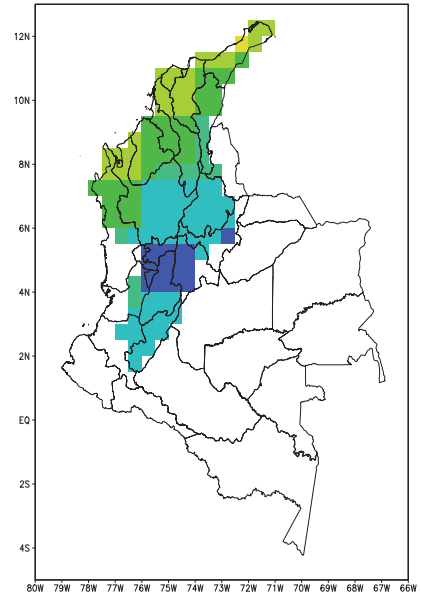
Delaware



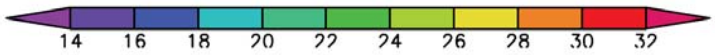
REMO



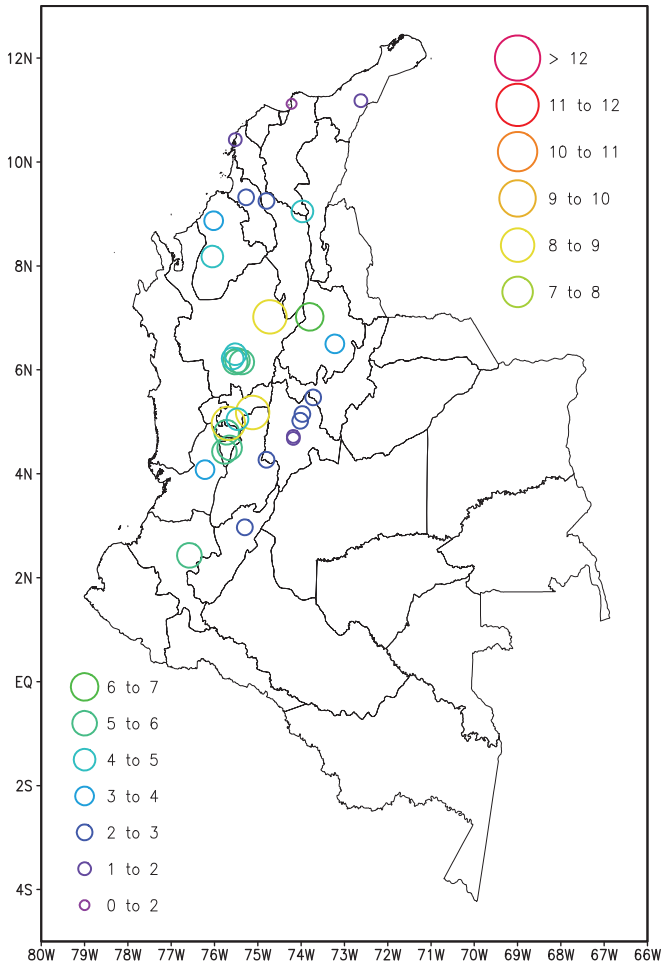
ERA-40



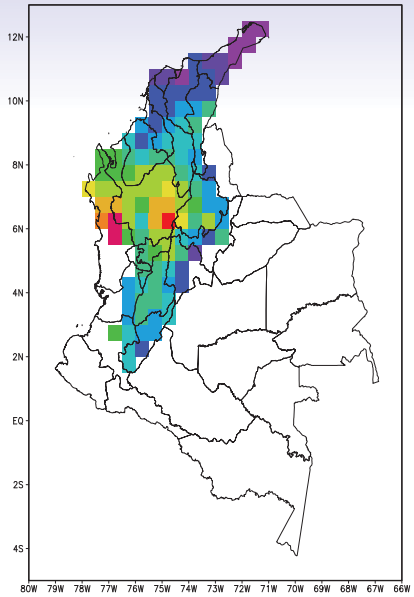
NCEP



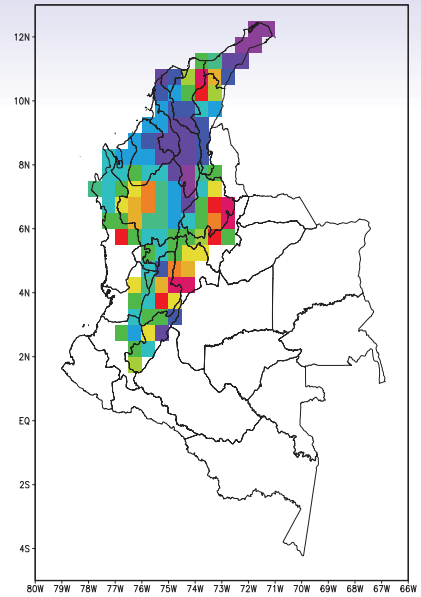
Precipitation (mm/day)



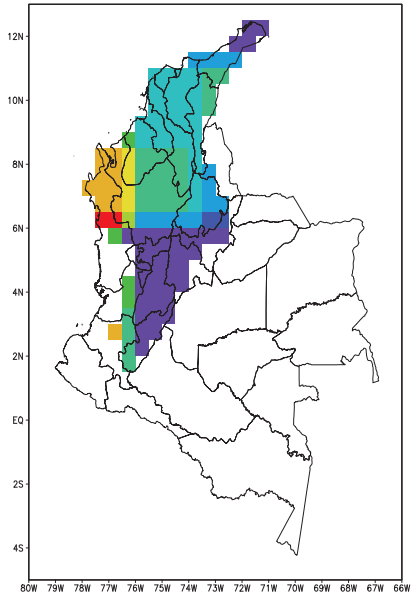
Observations



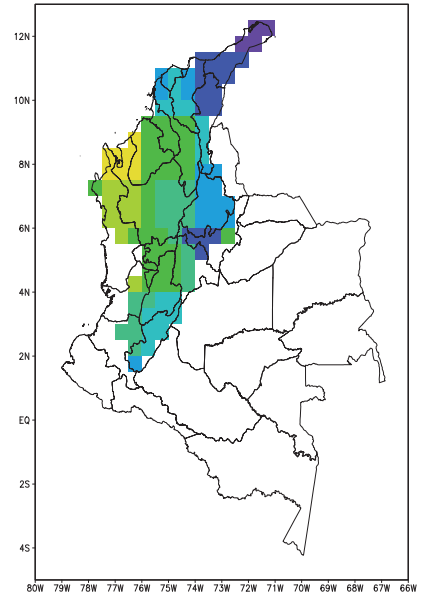
Delaware



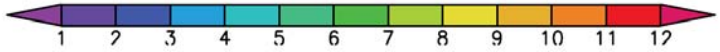
REMO



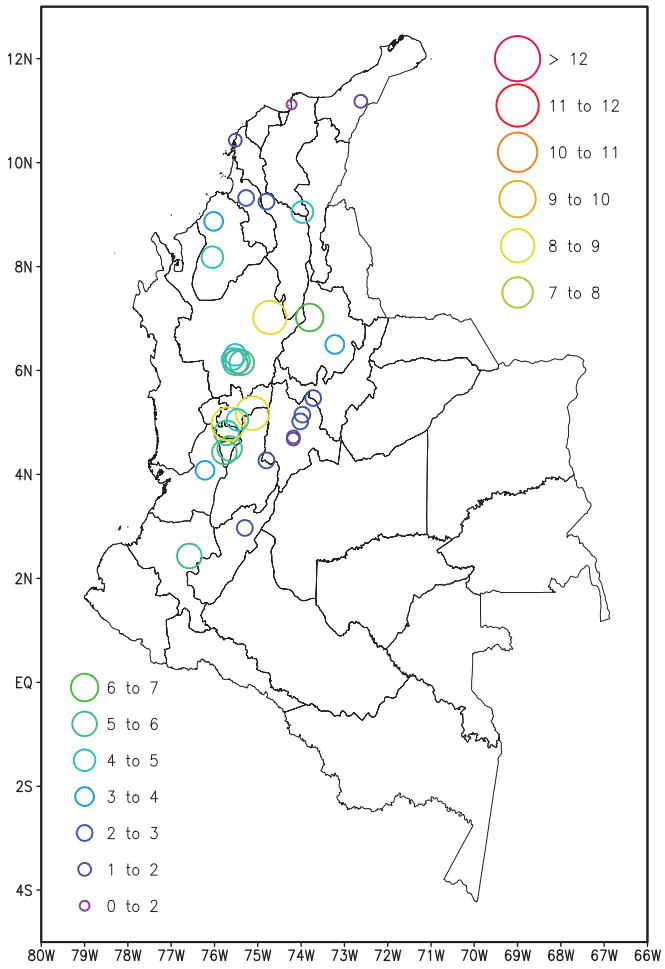
ERA-40



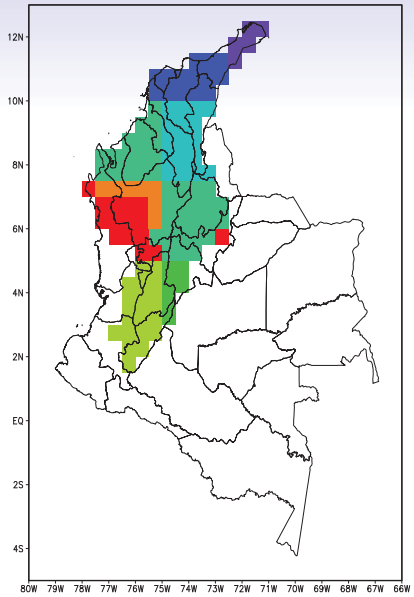
NCEP



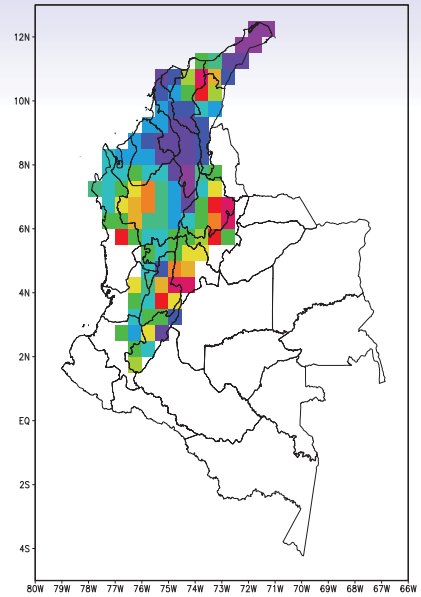
Precipitation (mm/day)



Observations



CPC



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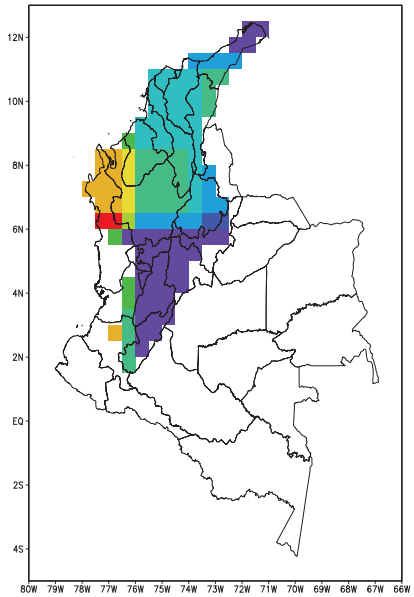
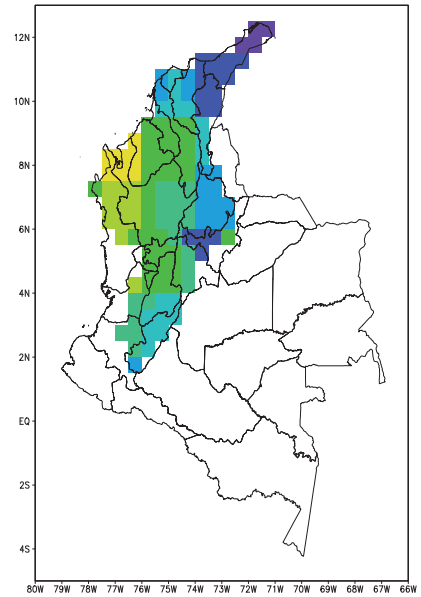


ERA-40



NCEP

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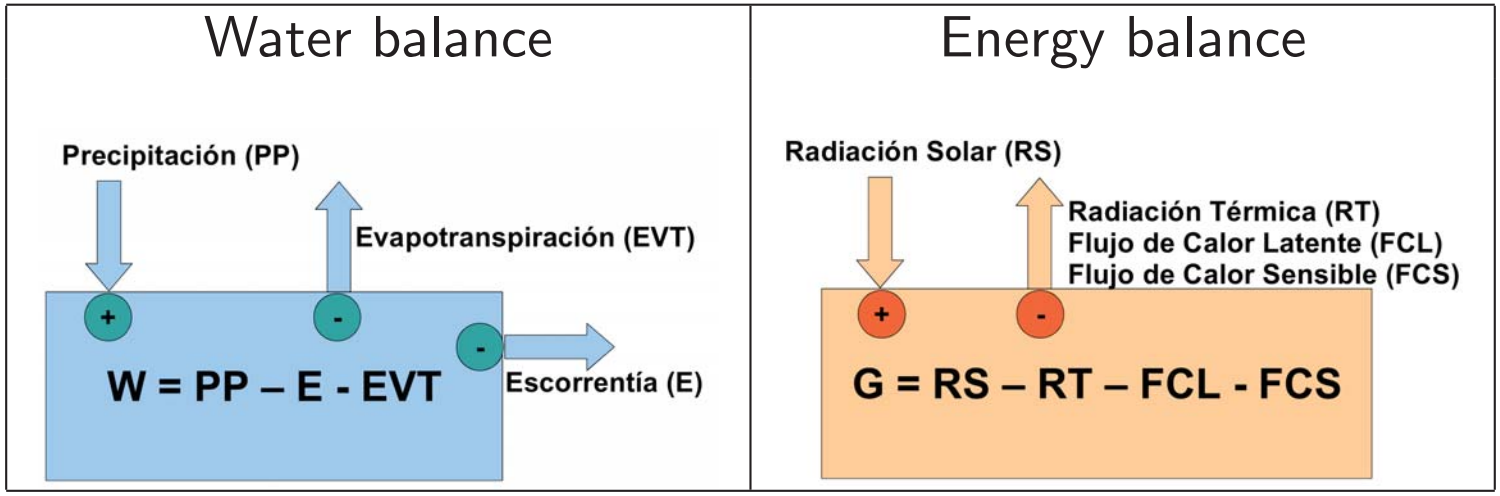
Surface water and energy balances in the CCCB

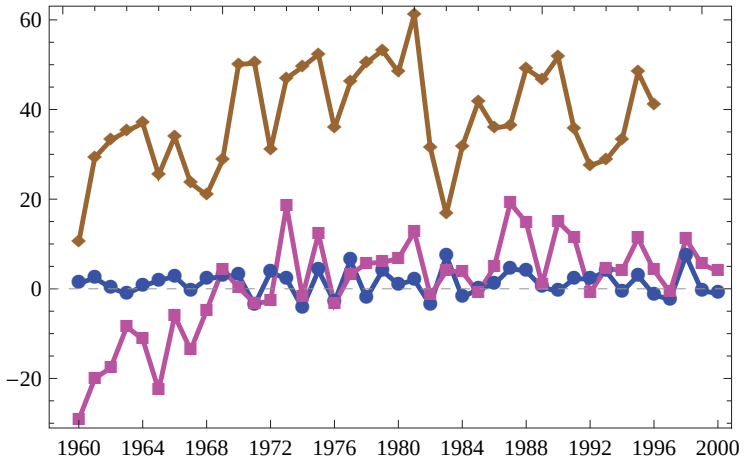


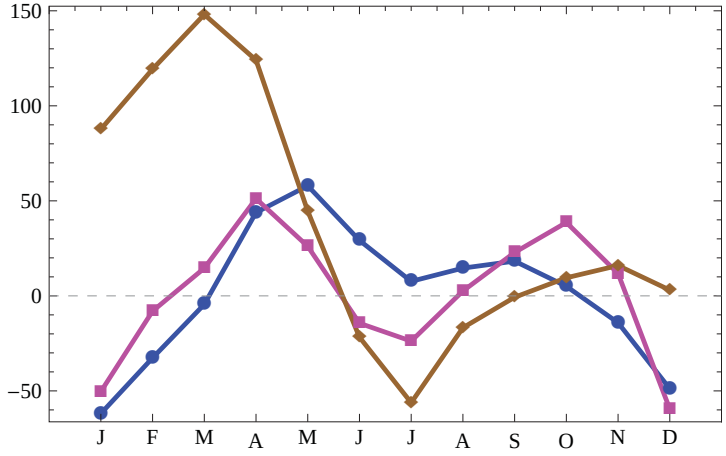
- Intercomparison period: 1960-2000
- The closure of the balances is reviewed

Individual components of the surface water balance in the CCCB during the years 1960-1996 (mm/month).

Data	PP	E	EVT	W
REMO	368.25	271.29 (73)	95.75	1.21
ERA-40	296.49	209.12 (70)	86.41	0.96
NCEP	334.23	165.85 (49)	130.32	38.06

Water storage - Intercomparison (mm/month)

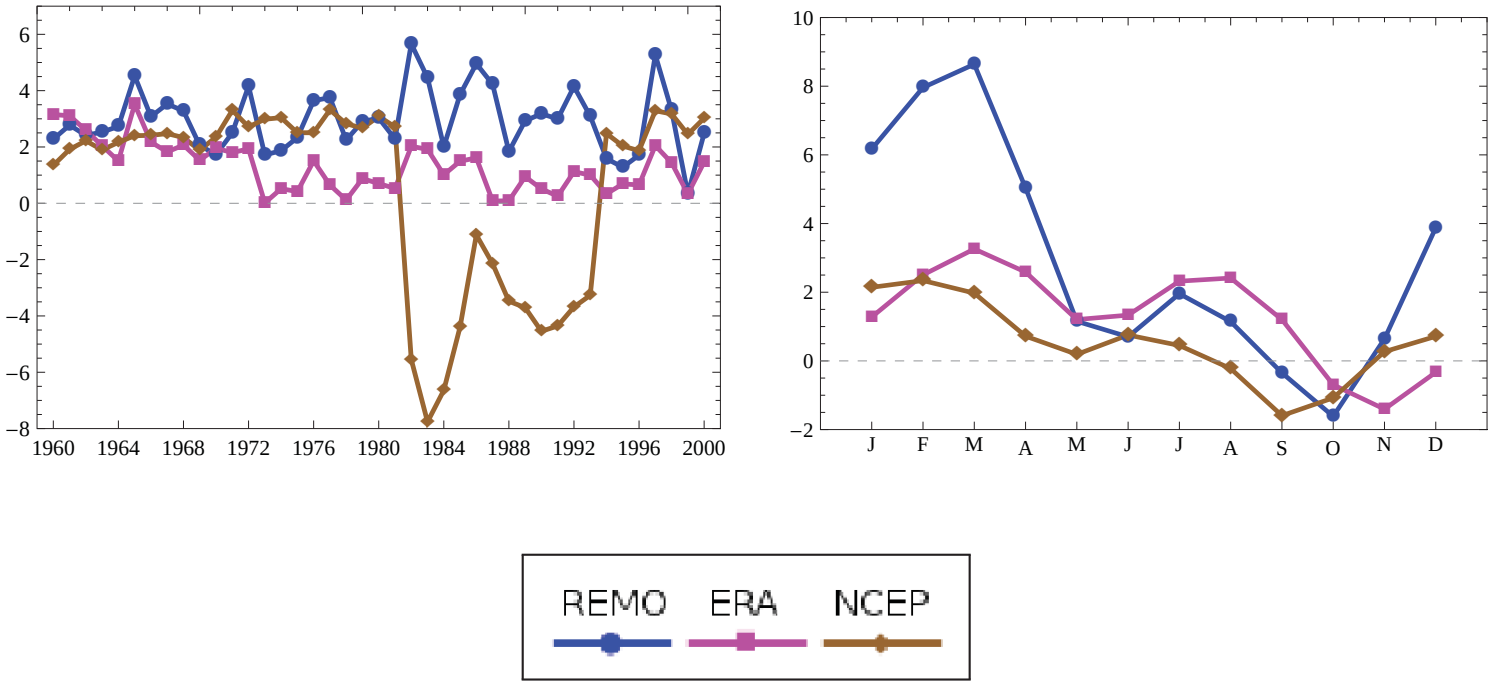




Individual components of the surface energy balance in the CCCB during the years 1960-1996 (W/m^2)

Data	RS	RT	FCL	FCS	G
REMO	142.71	35.81	92.44 (65)	11.52	2.94
ERA-40	137.71	33.36	82.17 (59)	20.86	1.31
NCEP	185.24	43.40	123.63 (66)	17.66	0.55

Energy storage - Intercomparison (mm/month) (W/m^2)



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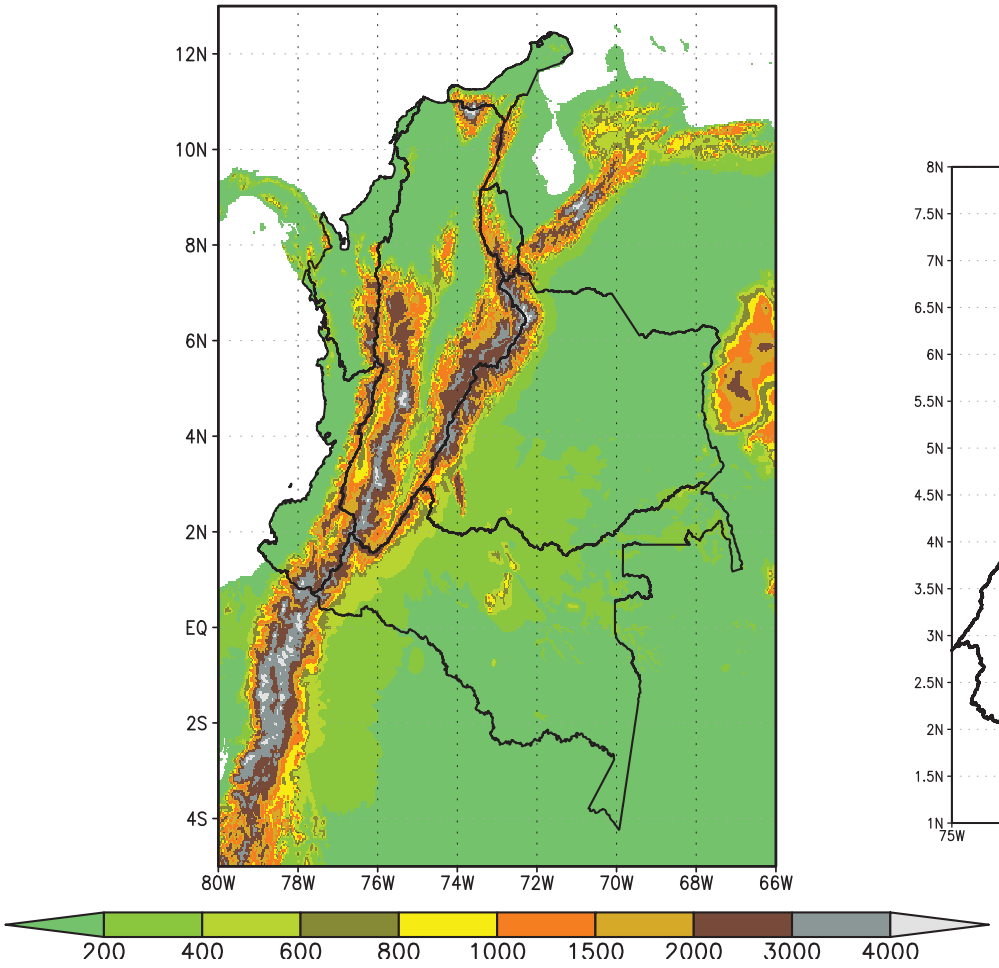
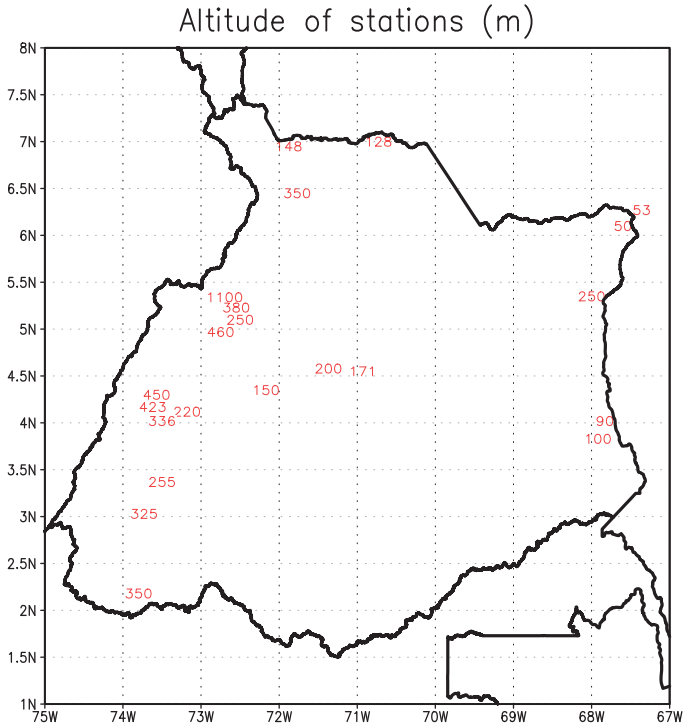
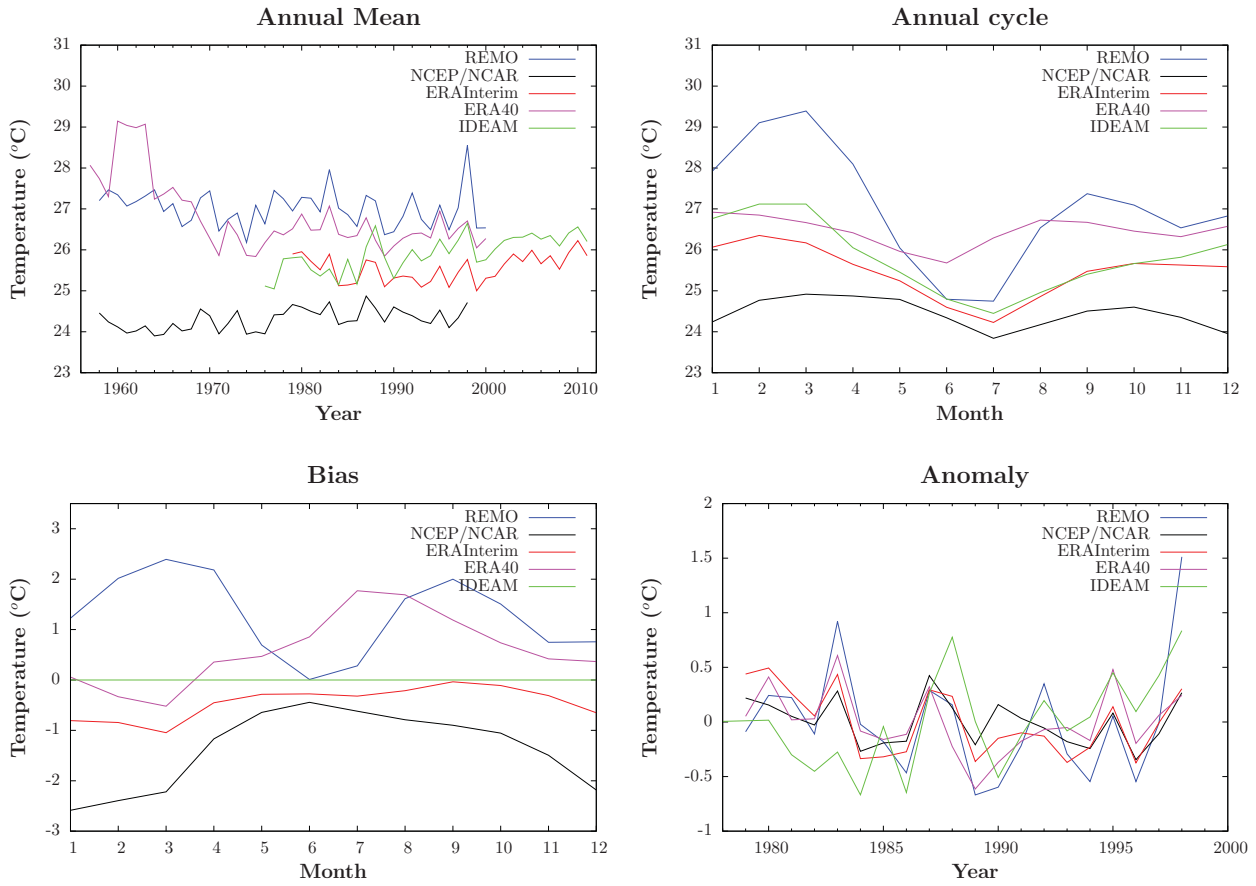
Colombian Orinoco Catchment Basin

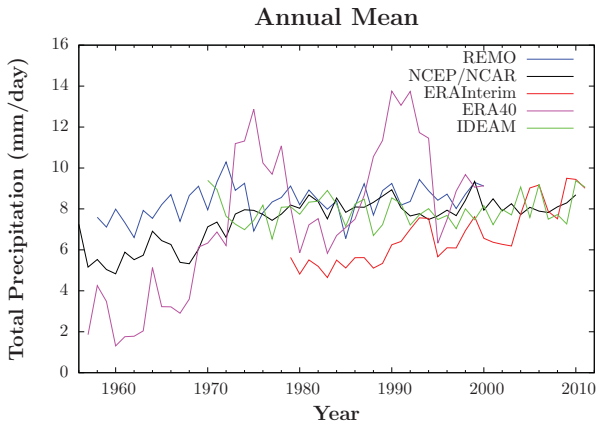


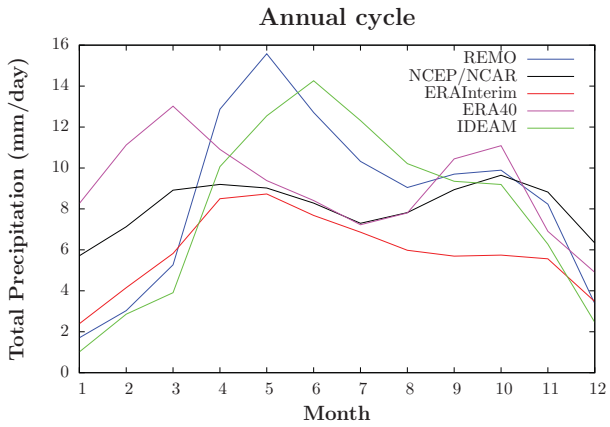


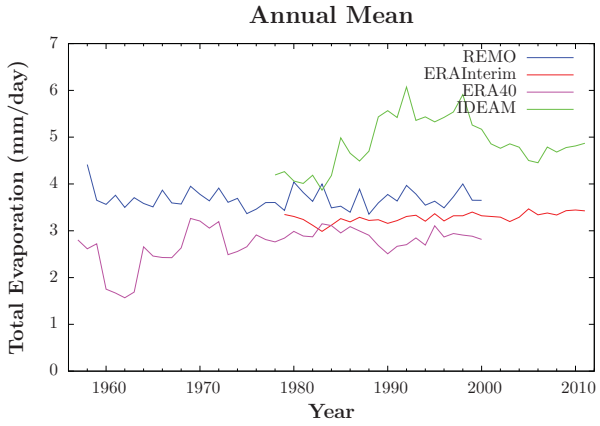
Temperature (°C) in COCB 1965 - 1995

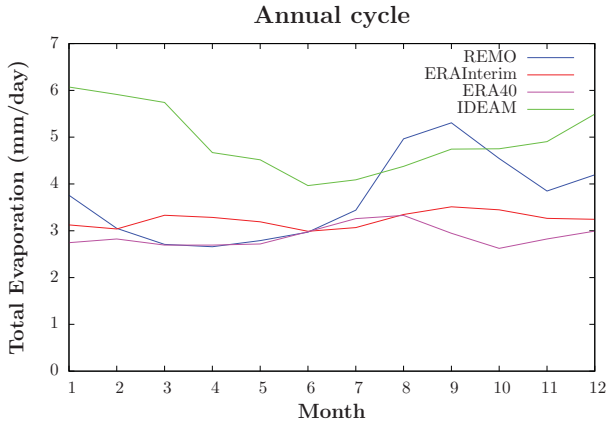


Precipitation (mm/day) in COCB 1955 2011









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Temperature

For the Colombian Caribbean catchment basin:

- Underestimated by all the datasets
- Cualitative good representation of the variability and the annual anomalies
- The annual temperature cycle is better represented by the ERA-40 and Delaware data, as they reproduce the bimodality found in the observational data
- Significant anomalies of temperature were detected during El Niño and La Niña

Temperature

For the Colombian Orinoco catchment basin:

- Better agreement for all the datasets

Precipitation

For the Colombian Caribbean catchment basin:

- The Delaware and CPC reconstructed data represent the precipitation behaviour of the CCCB to a better extent when analysed as a whole, both in the annual average and the annual cycle.
- Although they reproduced the bimodal pattern exhibited by the observational data, the REMO data and the reanalyses overestimated the precipitation ($\geqslant 115\%$), particularly during the rainy seasons
- There is coincidence between the annual anomaly peaks for precipitation (and temperature) with the warm and cold phases of the ENSO.

Precipitation & Evaporation

For the Colombian Orinoco catchment basin:

- Precipitation is underestimated by ERA-Interim
- Evaporation is underestimated by all datasets

Water and energy balances

- Precipitation is overestimated: solar radiation is underestimated
- The ERA-40 reanalysis during the years 1960-1968 shows a sustained increase in precipitation and run-off. This could be attributed to the introduction of new types of observations such as satellite observations and, to a more general extent, due to changes in instruments and data processing

Water and energy balances

- By contrast, beginning in 1996, the NCEP-NCAR data show a four- to fivefold increase in the run-off trend with respect to the time period studied immediately prior to that year. A review of the data (not shown) beyond the time period of interest for this study shows that this increase in evaporation remains constant until the present, when these reanalysis data are still available.
- However, and in contrast to the ERA-40 data, this behaviour is only detected in the run-off. Given the close relationship between run-off and precipitation, we favour the opinion that the reported increase is due to changes in the manner in which the run-off values were generated

Acknowledgments

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