Tropical cyclones and their associated precipitation under climate change conditions from a set of RCA projections over Central and North America

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Objectives

- To evaluate the representation of Tropical Cyclones (TCs) on the RCA simulations.

- Identify processes involved on the good (or bad) representation of the spatial distribution of TCs.

- To identify climate change signals from the ensemble of GCM and RCA projections, which are related to changes on the distribution of TCs and their associated precipitation.

- To assess changes in the contribution of TCs-induced precipitation to total precipitation.
GCM simulations

List of GCMs
- CanESM2
- CSIRO-Mk3-6-0
- CNRM-CM5
- EC-Earth
- GFDL-ESM2M
- HadGEM2-ES
- IPSL-CM5A-MR
- MIROC5
- MPI-ESM-LR
- NorESM1-M

Forcings:
- Historical simulation.
- RCP8.5 (2.6,4.5,6,8.5)

Periods analyzed:
- RCP8.5: 2071-2100.
Tropical Cyclones tracker

https://github.com/kyklop-climate/kyklop
Historical period (1976-2005)
SST bias for MJJASON (GCMs minus ERA-Interim)
Mean wind shear MJJASON (U200 – U850) on GCM driven RCA historical simulations
TCs in RCA (1976-2005)
Biases of TCs in RCA compared with observations

RCA (EIN) - OBS

RCA (ENSEMBLE) - OBS

RCA (ENSEMBLE) – RCA (EIN)
Precipitation associated to tropical cyclones

Examples of TCs and their induced rainfall totals (mm). Each panel shows the TC track (black line) and the recorded amount of rain (colors) at stations located within 500 km (dashed line) from the center of each storm track.

- **Irene** Aug 24-30, 2011
- **Tip** Oct 9-20, 1979
- **Yasi** Jan 30 to Feb 04, 2011
- **Kathleen** Sep 7 -11, 1976

Khouakhim, Villarini and Vecchi 2017
Relative contribution of TCs to the mean seasonal rainfall (100 * TC precipitation/Total precipitation)

Khouakhim, Villarini and Vecchi 2017
Mean precipitation associated to tropical cyclones in RCA (1976-2005)
Relative contribution of TCs to the mean seasonal rainfall
(100 * TC precipitation/Total precipitation)
Future period (2071-2100)
SST change
(2071-2100 minus 1976-2005)
Wind shear change
(2071-2100 minus 1976-2005)

CSIRO-QCCCE-CSIRO-MK3-6-0

CCCma-CanESM2

CNRM-CERFACS-CNRM-CM5

IPSL-IPSL-CM5A-MR

MIROC-MIROCS5

MOHC-HadGEM2-ES

MPI-M-MPI-ESM-LR

NCC-NorESM1-M

NOAA-GFDL-GFDL-ESM2M

m/s

-4 -2 0 2 4
TCs density and its change
Ratio TCs precipitation

1976-2005

Mean change from ensemble (%)

Total precipitation

2071-2100

TCs precipitation
Summary

- The density of TCs in the future show a change towards a higher concentration towards the North subtropical Atlantic ocean, and a decrease over the Tropical Atlantic. Similarly it is found a higher concentration away from the Mexican coasts and a decrease of TCs concentration close to coastal regions.

- Although the total precipitation shows a decrease all along Mexico, the TCs-associated precipitation shows an increase over Northwest Mexico, especially over the Gulf of California, increasing the contribution of TCs-associated precipitation to total precipitation over that region.