11th Workshop on the Theory and Use of Regional Climate Models

ICTP

Diurnal cycle of rainfall and convection in eastern Mexico during 2018

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50 ANIVERSARIO CICESE

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Trieste, Italy

Further information:
http://indico.ictp.it/event/10215/
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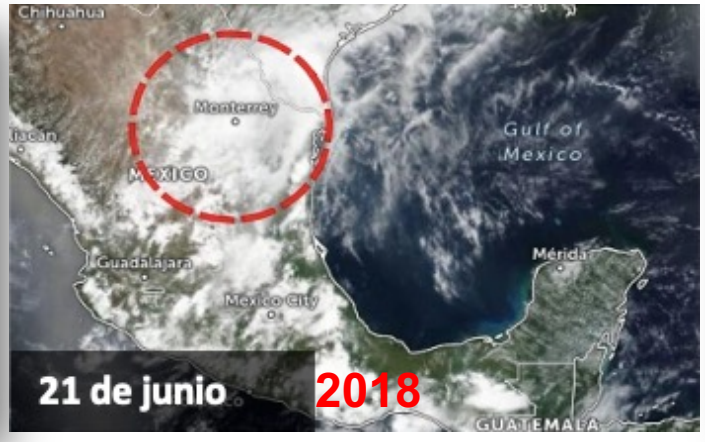
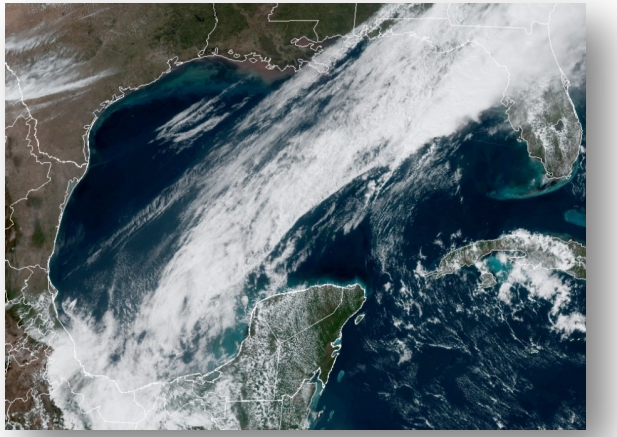
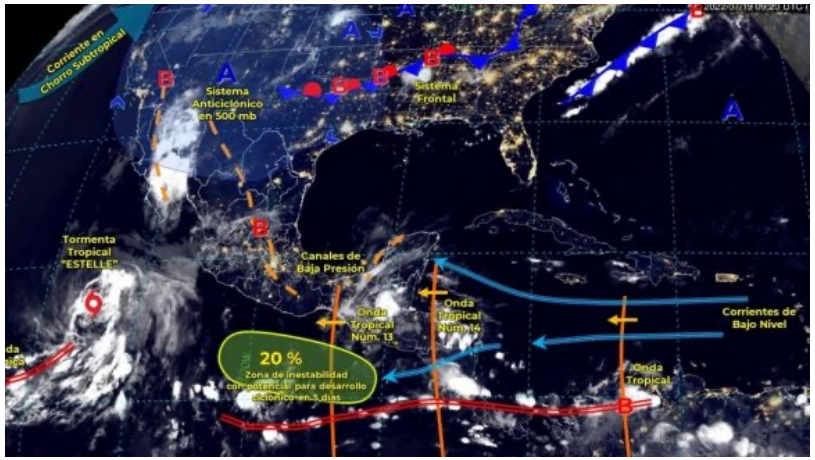
Depto. Oceanografía Física 50 Aniversario

Introduction

Meteorological phenomena that produce heavy rainfall in the Gulf of Mexico region: TCs, atmospheric disturbances, CFs, easterly waves, MCSs







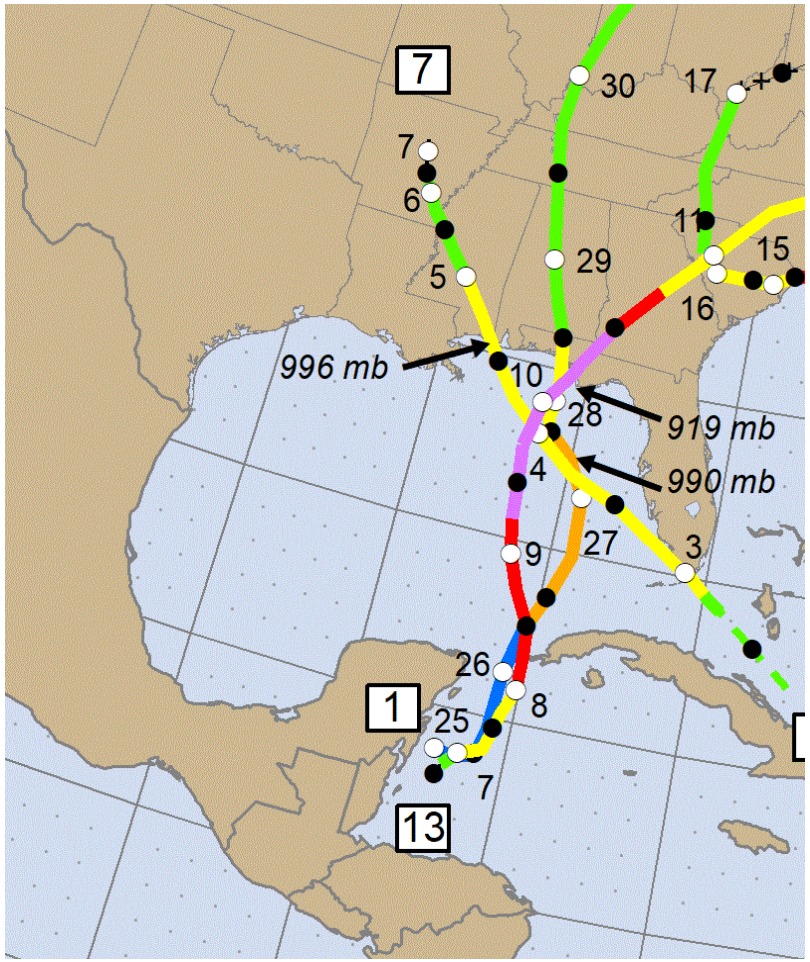
IMPACTS:

- Floods and landslides (-)
- Population (+, -)
- Agriculture and ranching (+, -)
- Housing, transportation (-)
- Dams (+, -)

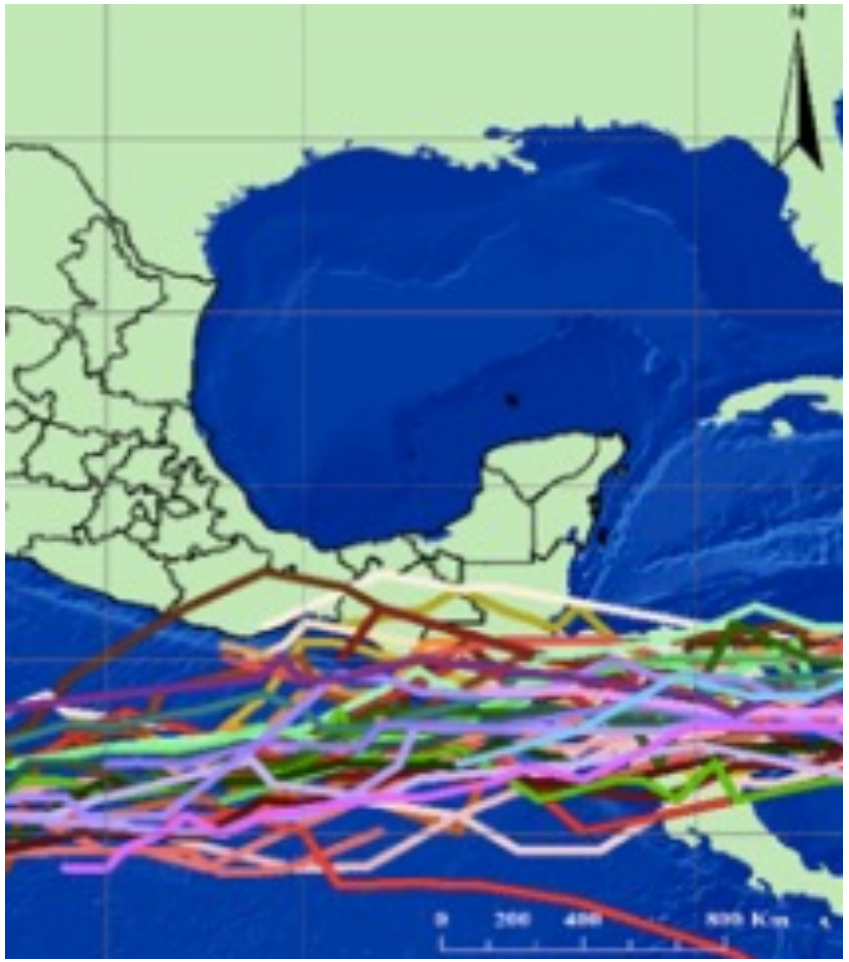
Synoptic events in summer 2018

ENSO Neutral year

Tropical cyclones

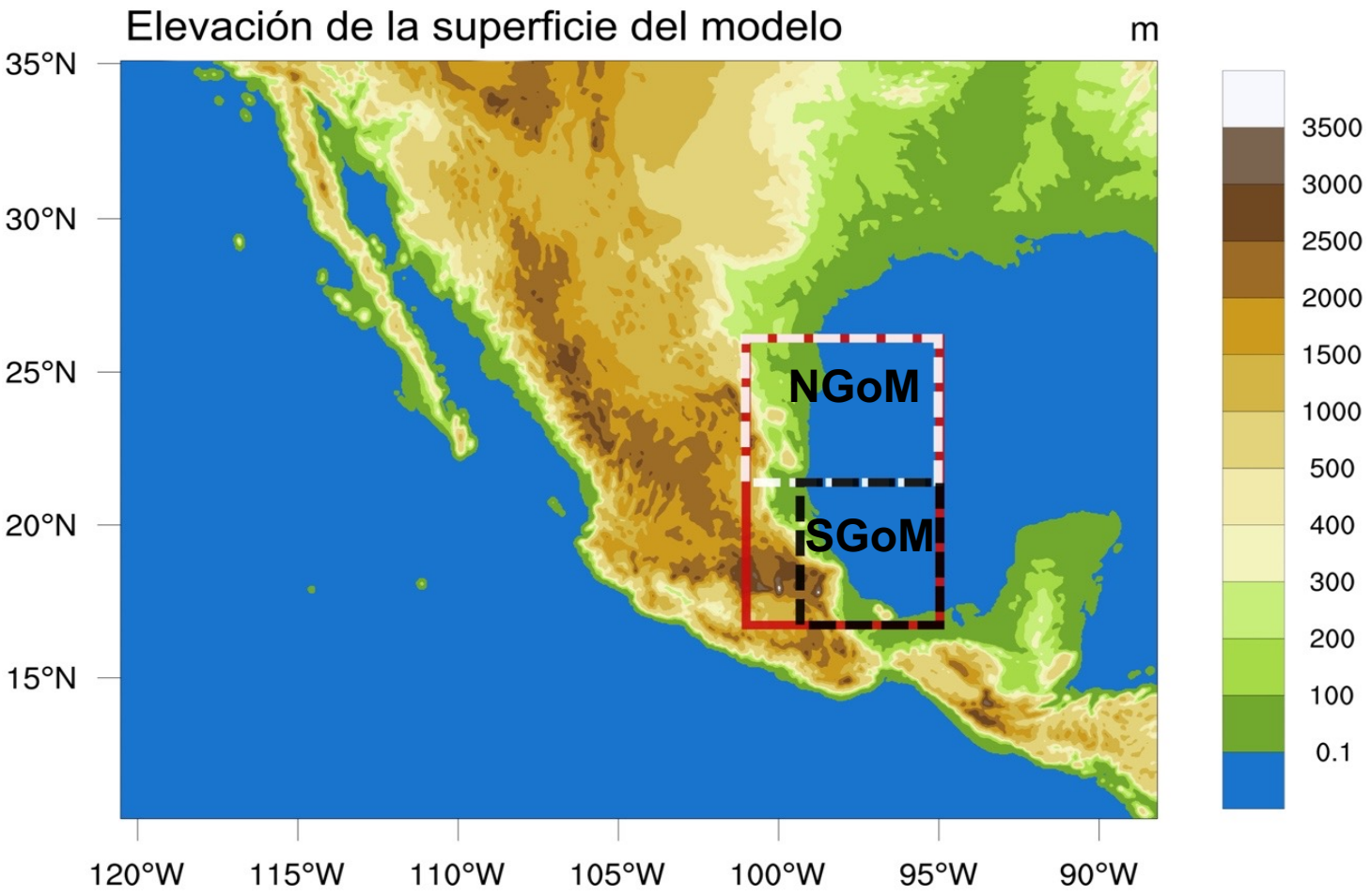


Easterly waves



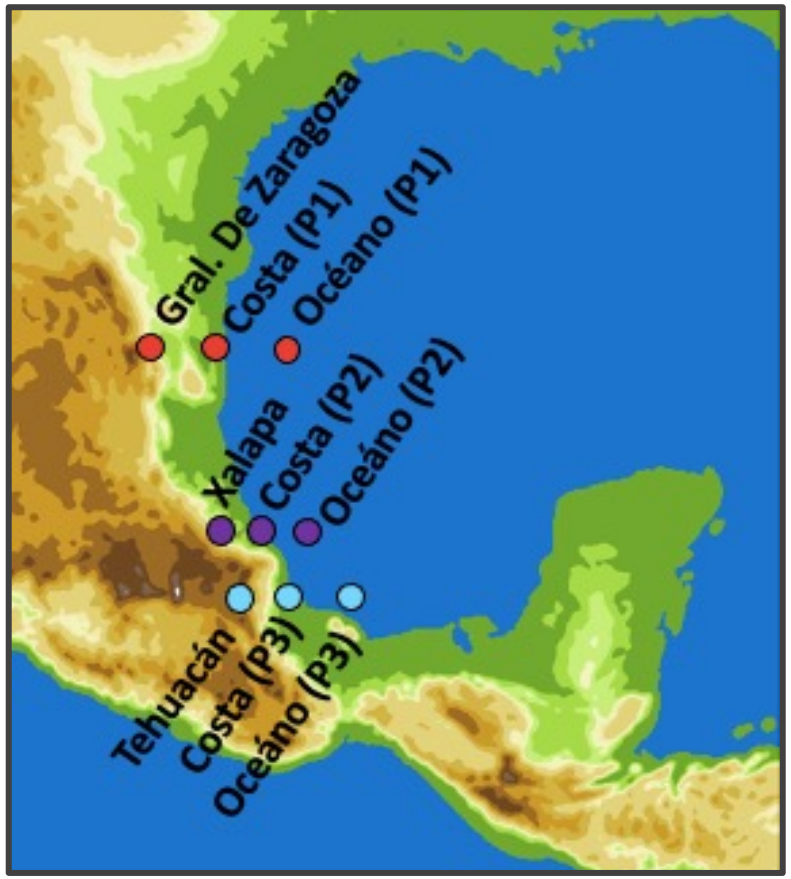
Study Region: Eastern Mexico

Domains: RegCM4-NH climate mode



Forecast mode

Diurnal cycle of precip and CAPE



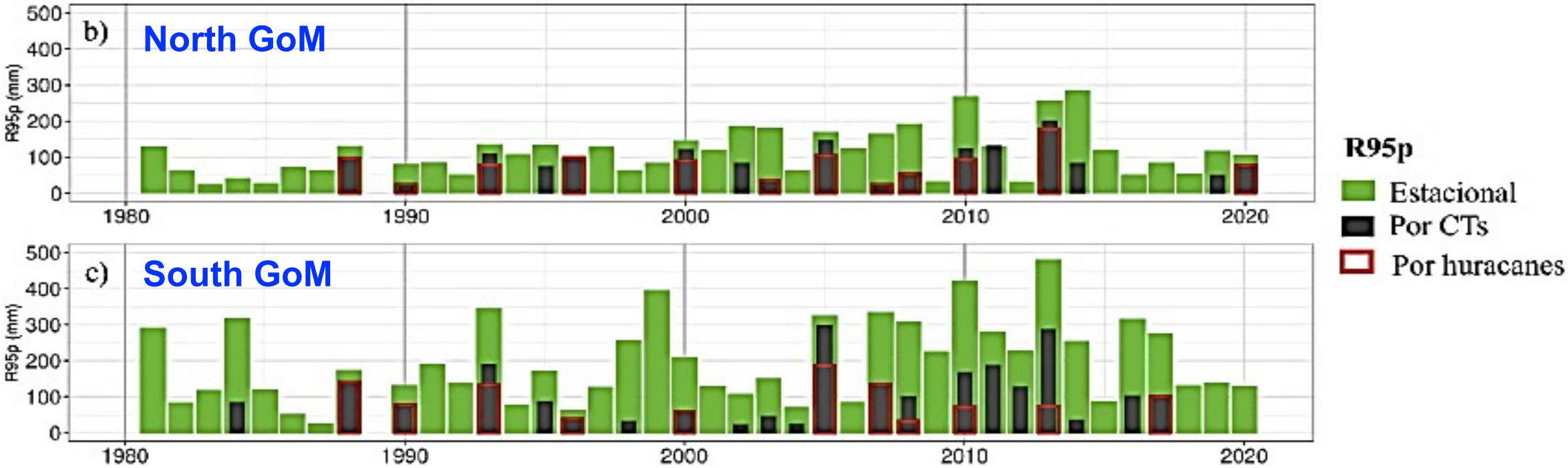
Summer extreme rainfall events (R95p) in Eastern Mexico

Role of TCs and non-TCs

65% of the extreme rainfall in Eastern Mexico is derived from non-TCs events (1981-2020).

Role of ENSO conditions:

+ Extreme rainfall during Neutral years and during La Niña and +AMO than during El Niño



(Colorado-Ruiz and Cavazos; in prep.)

Data

Daily gridded precipitation: CHIRPS at 6.5 Km

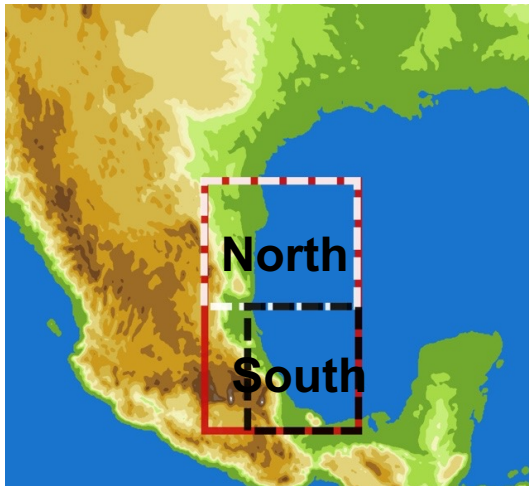
Hourly precip: PERSIANN-CCS at 4 km

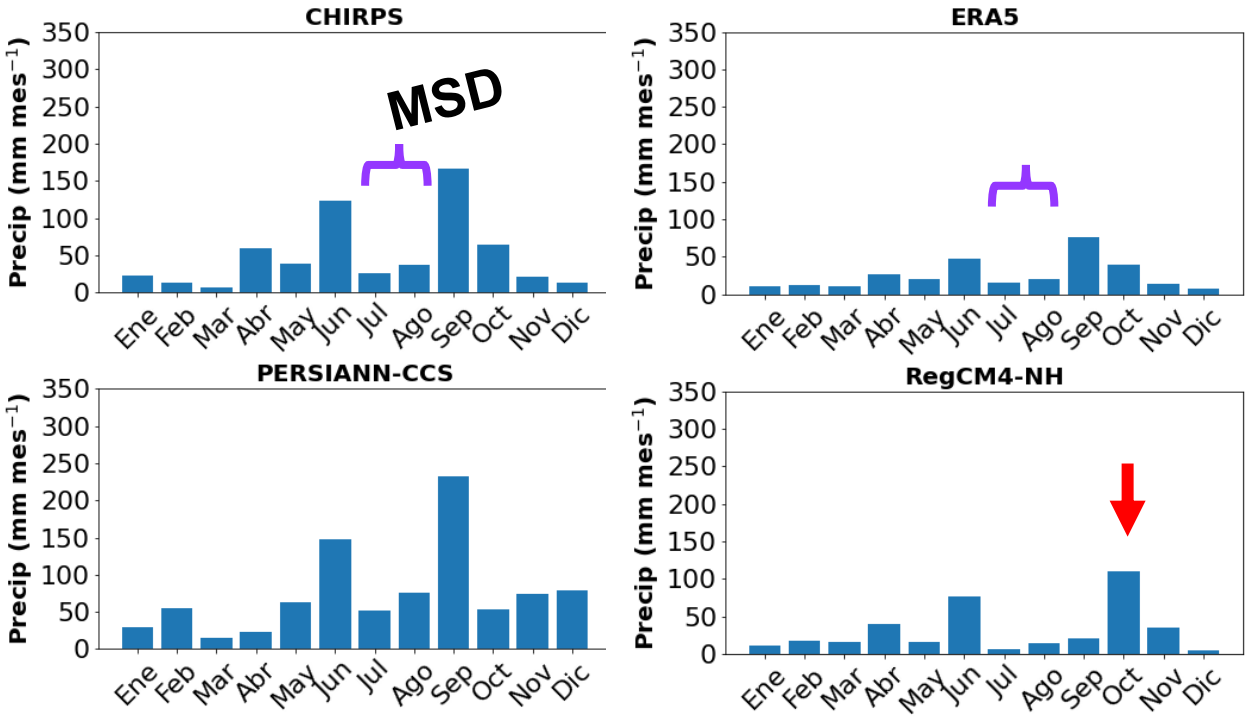
Daily gridded observations: CLICOM en Malla – CICESE at 6 km
http://clicom-mex.cicese.mx/malla

Reanálisis: ERA5 at 32 km

RegCM4.7-NH, RegCM4.7-NH_forecast → ERA5 at 4.5 km

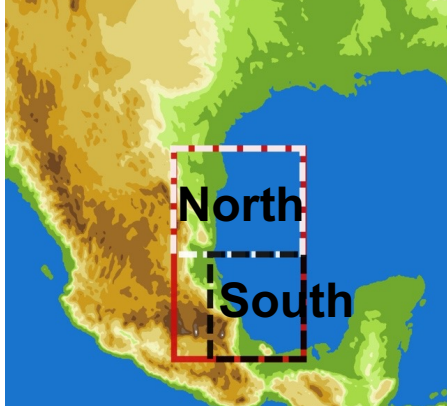
RESULTS
Annual cycle of precipitation in 2018



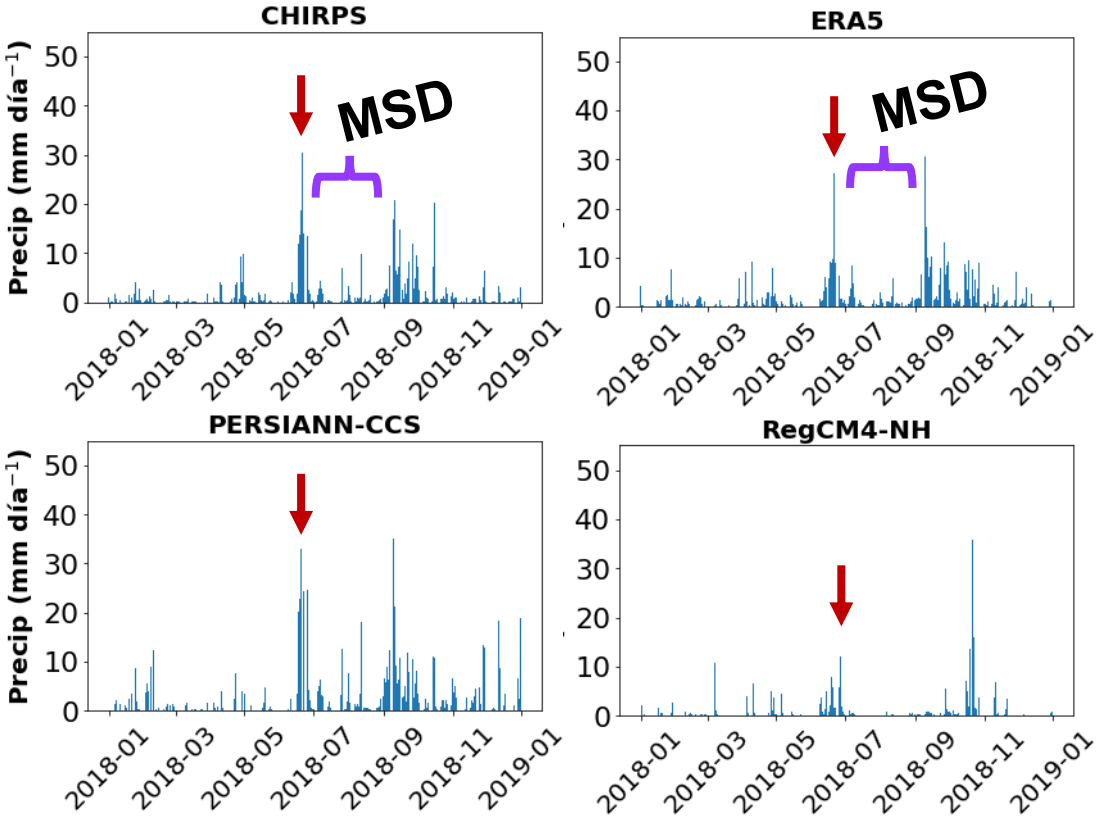


North GoM

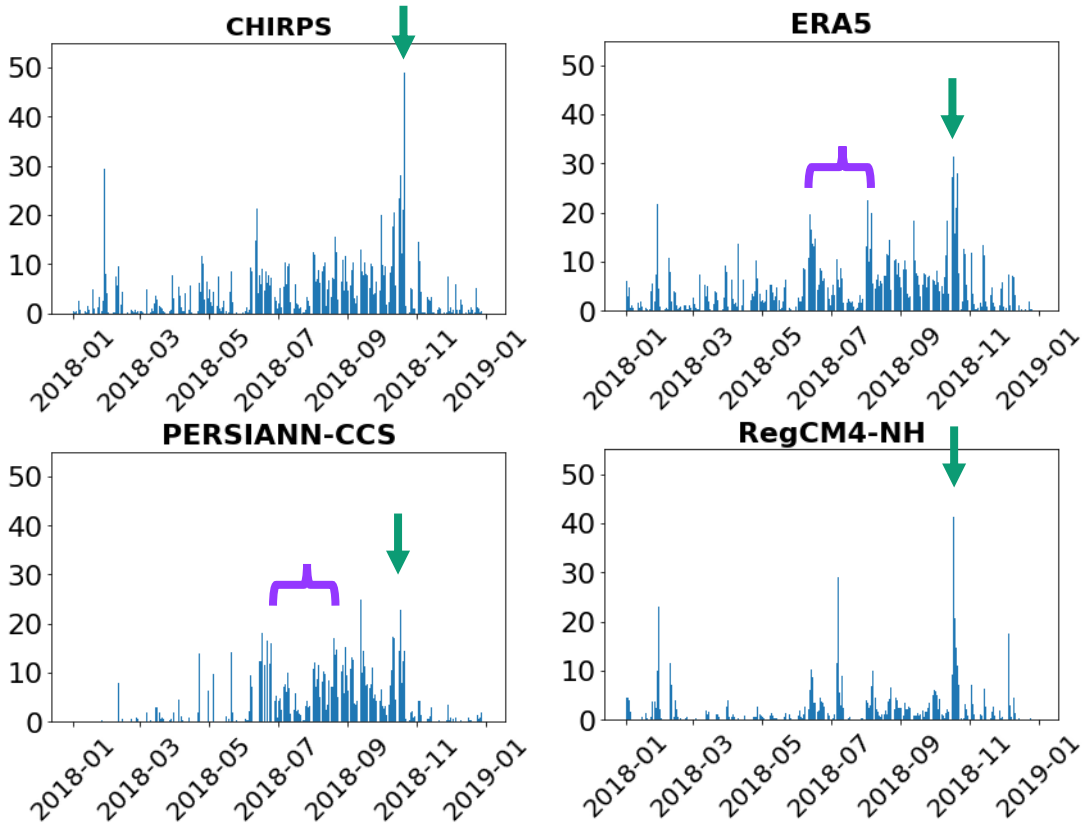
Daily precipitation in Eastern Mexico during 2018



North GoM



South GoM

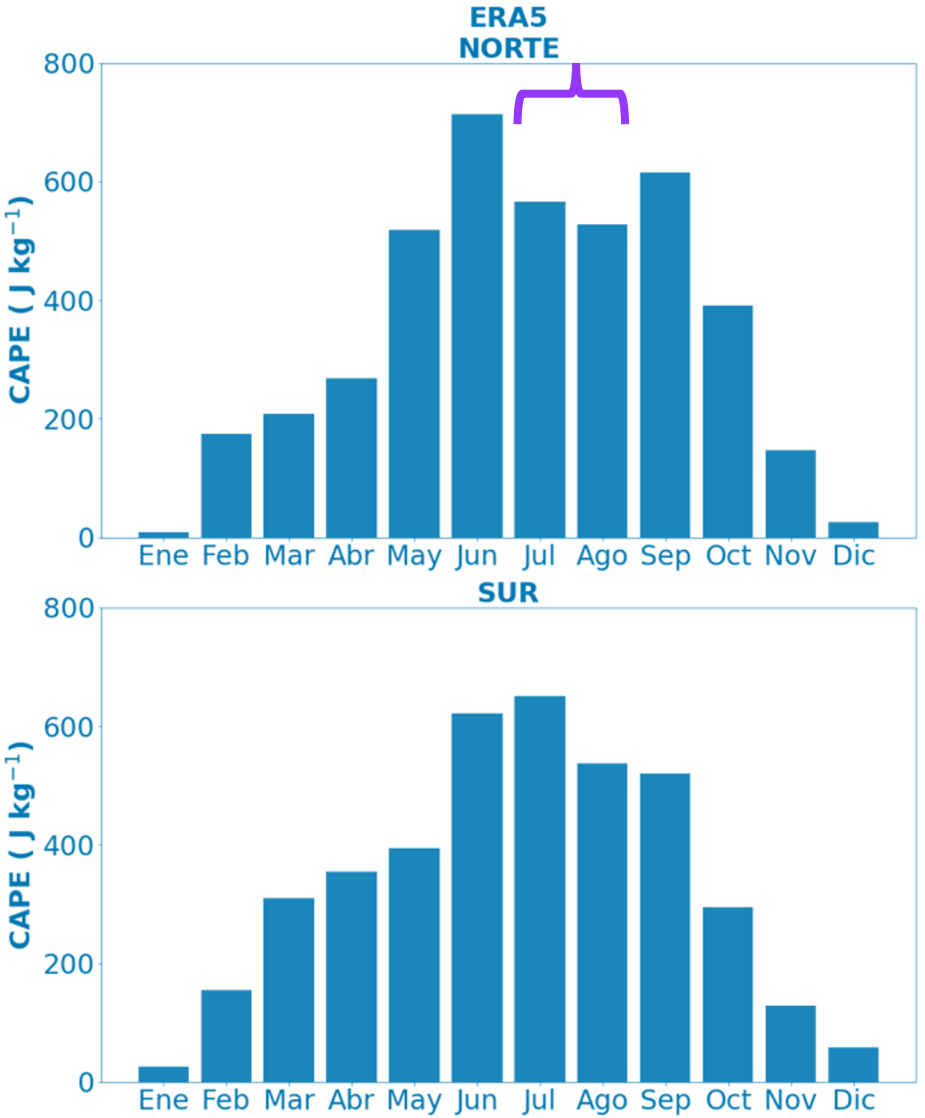


Selection of extreme events for case studies: **21 June** and **17 October**

Mean monthly CAPE from ERA5 during 2018

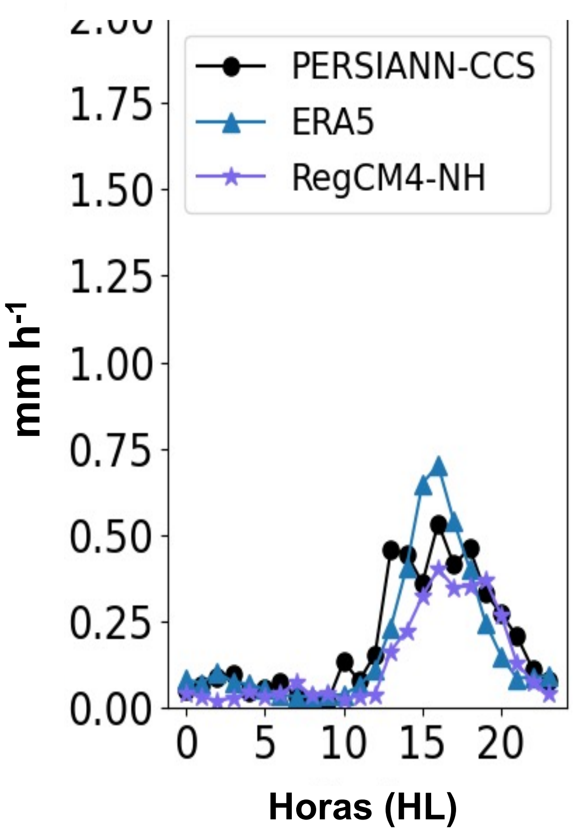
North GoM

South GoM

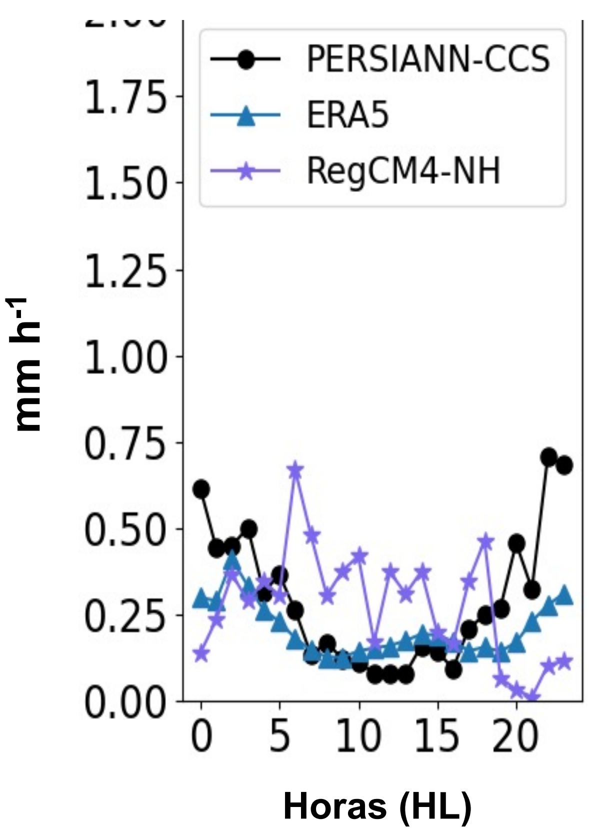


Mean diurnal cycle of rainfall during Jun-Oct 2018

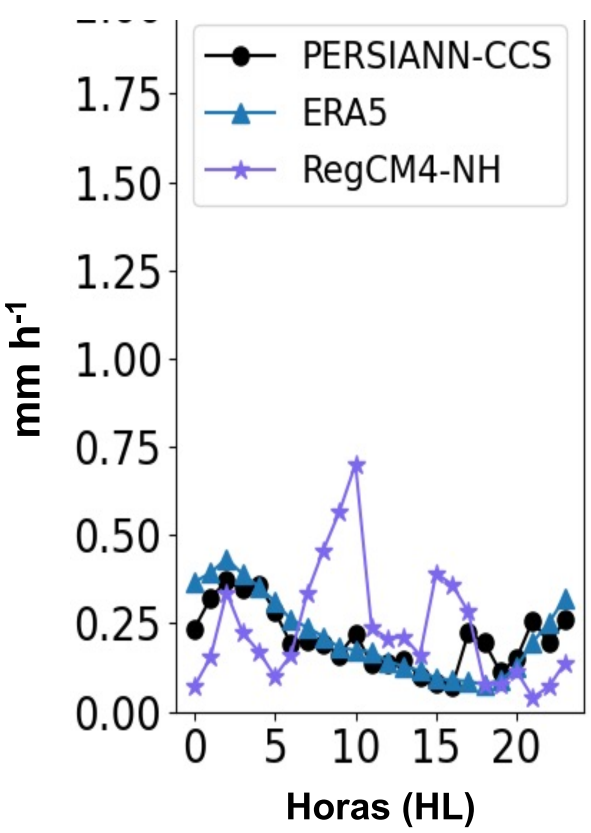
Mountain: Early aftern.

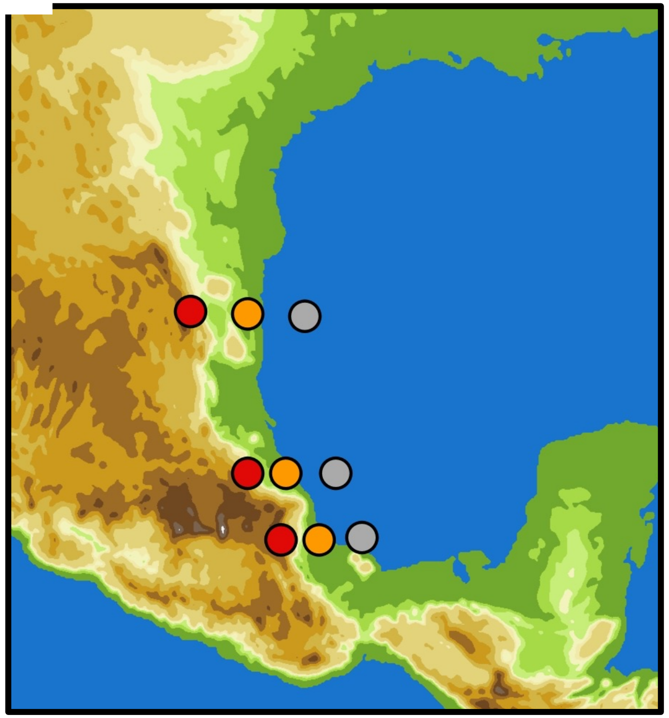


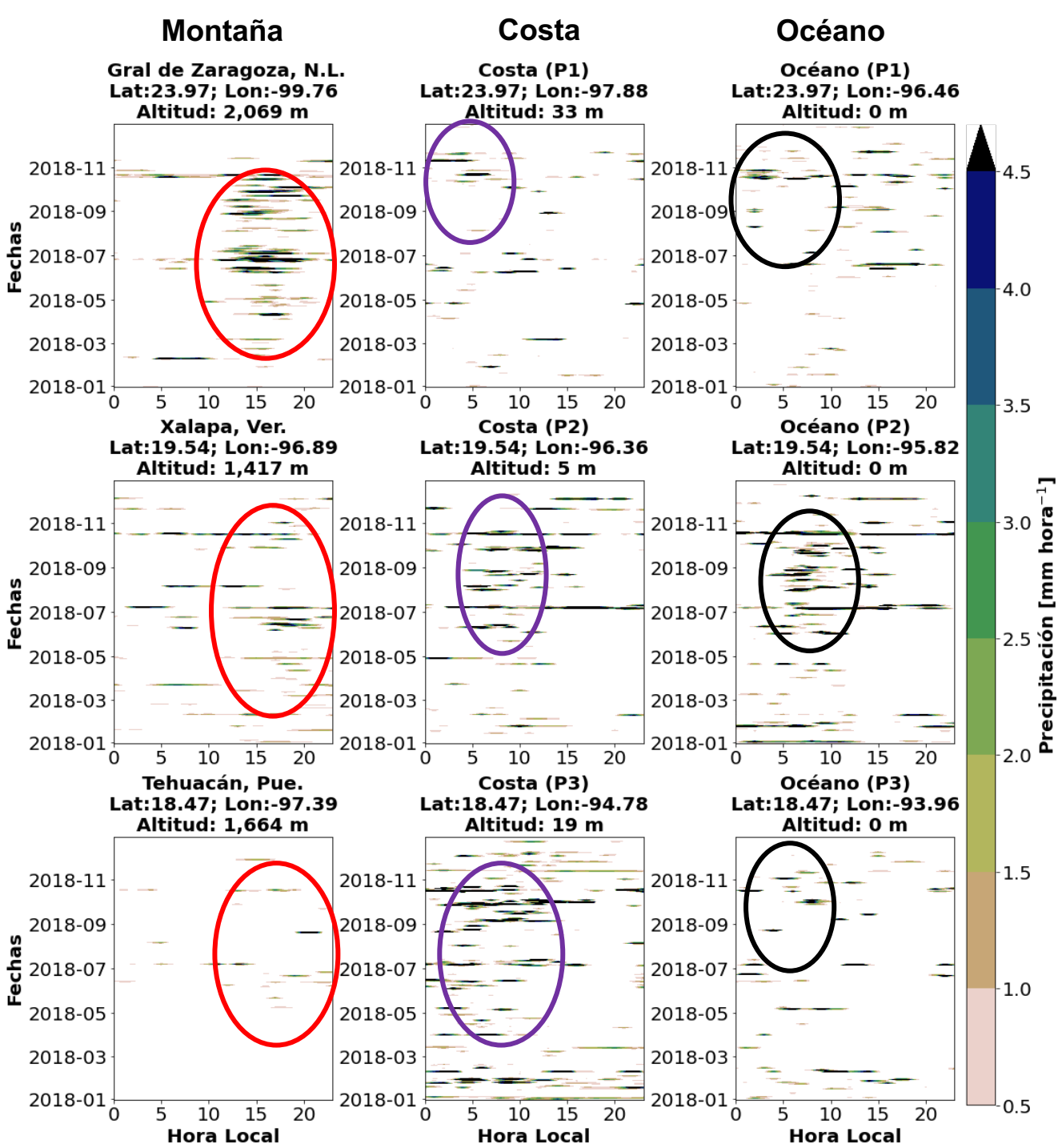
Coast: night/E_morn.



Ocean: night/E_morn.



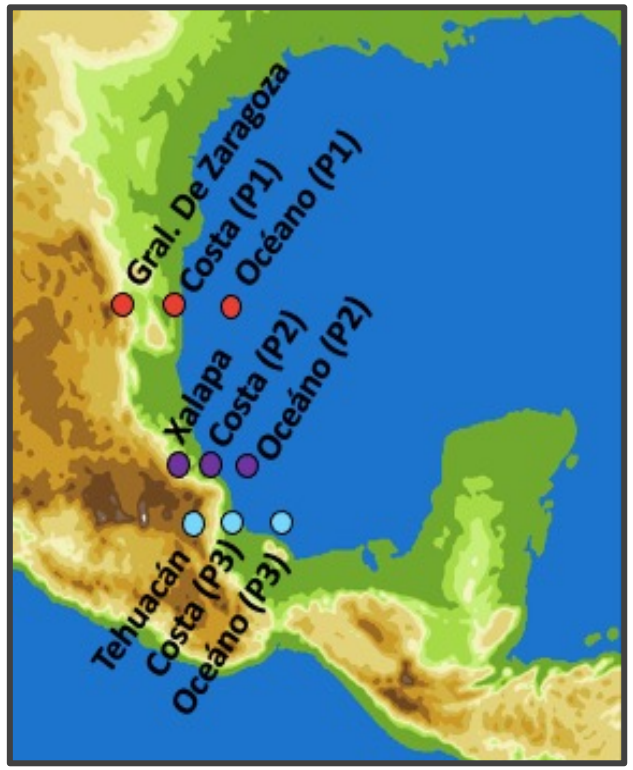




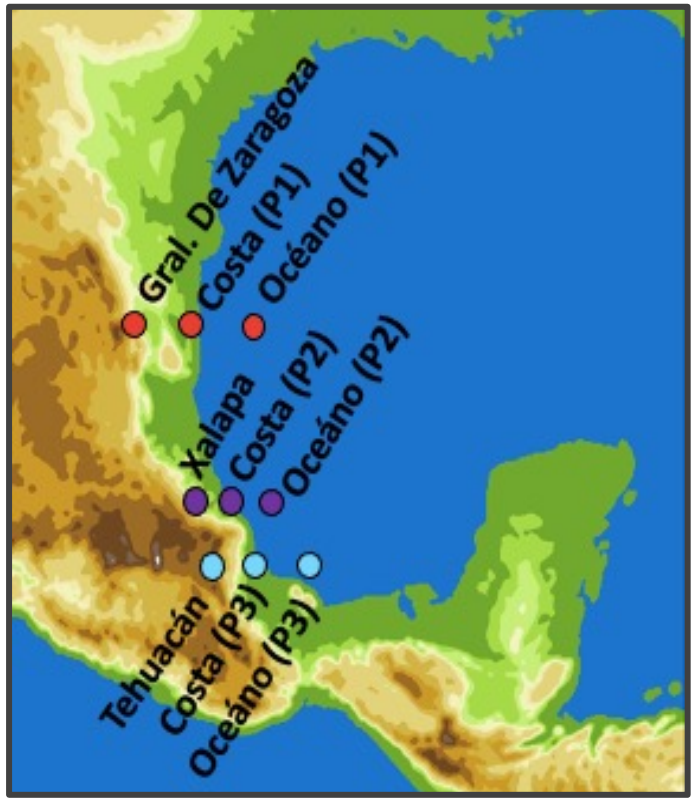
Ciclo horario estacional de precipitación

↓

RegCM4-NH

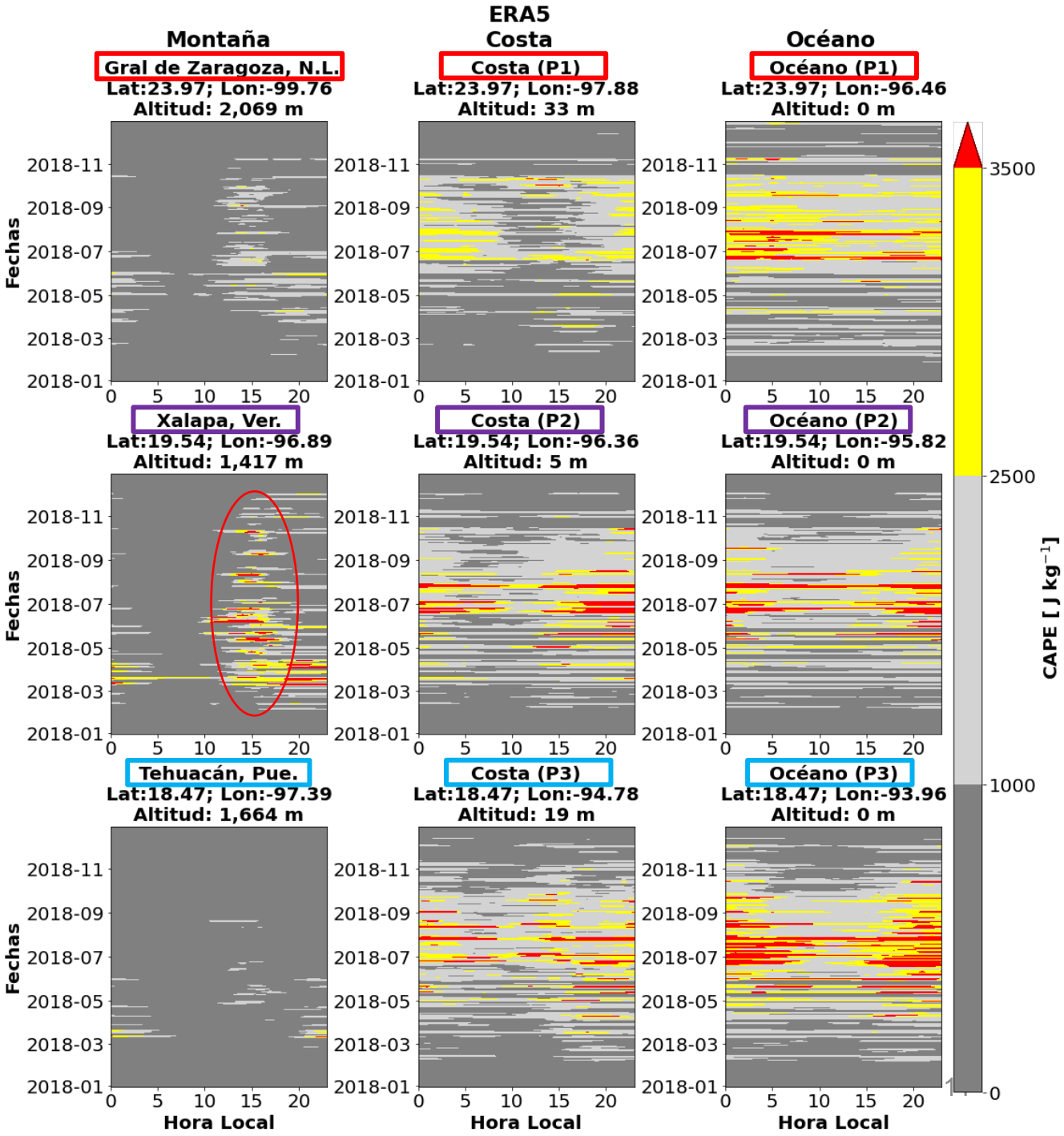


CAPE diurnal cycle during 2018 from ERA5

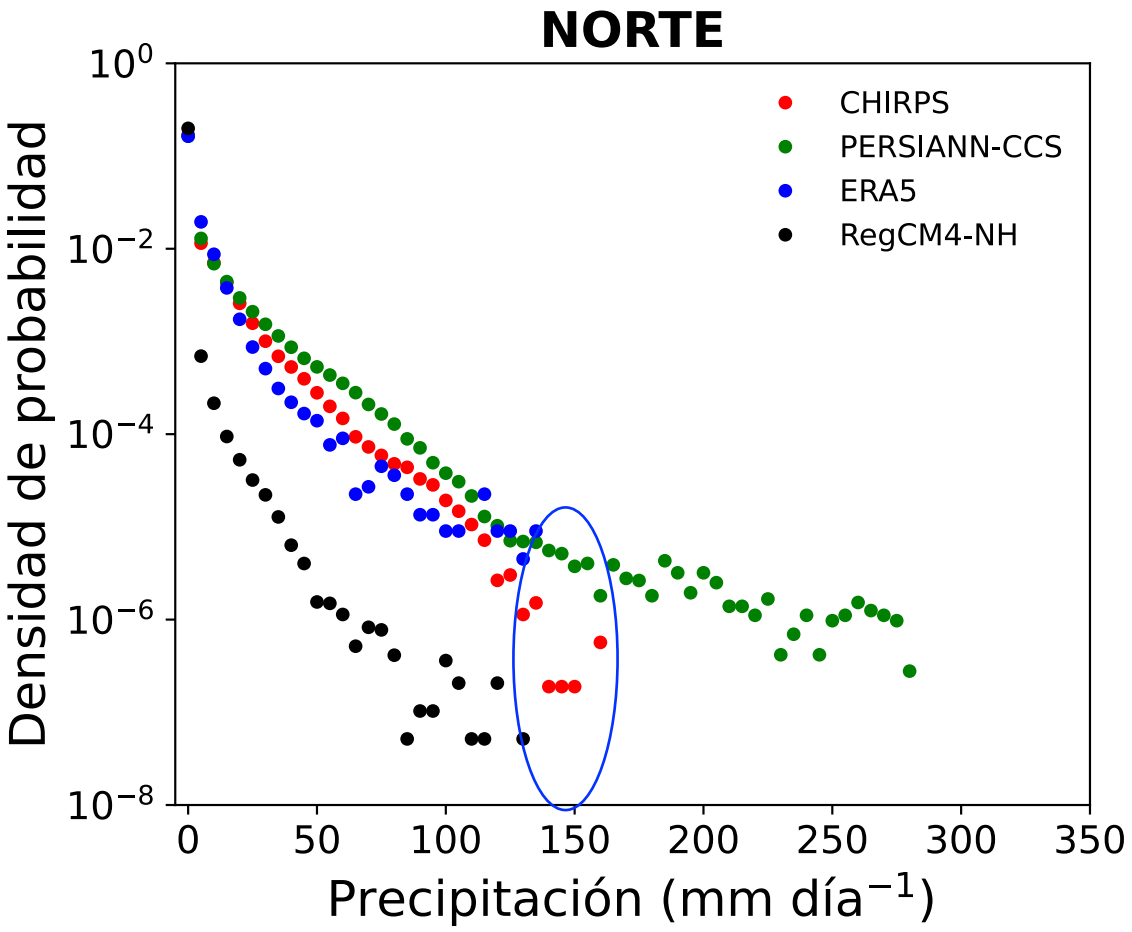


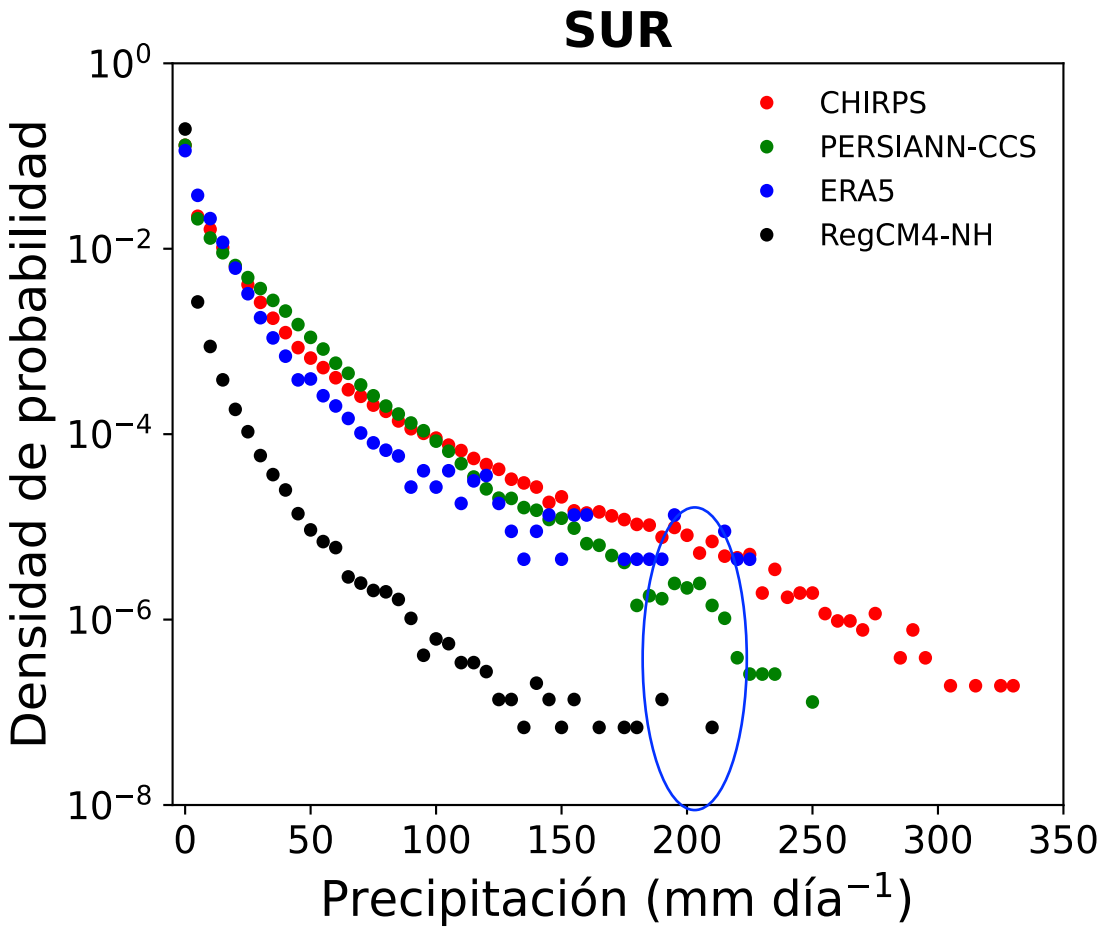
Mountain: afteroon

Coast and ocean: night – early morning

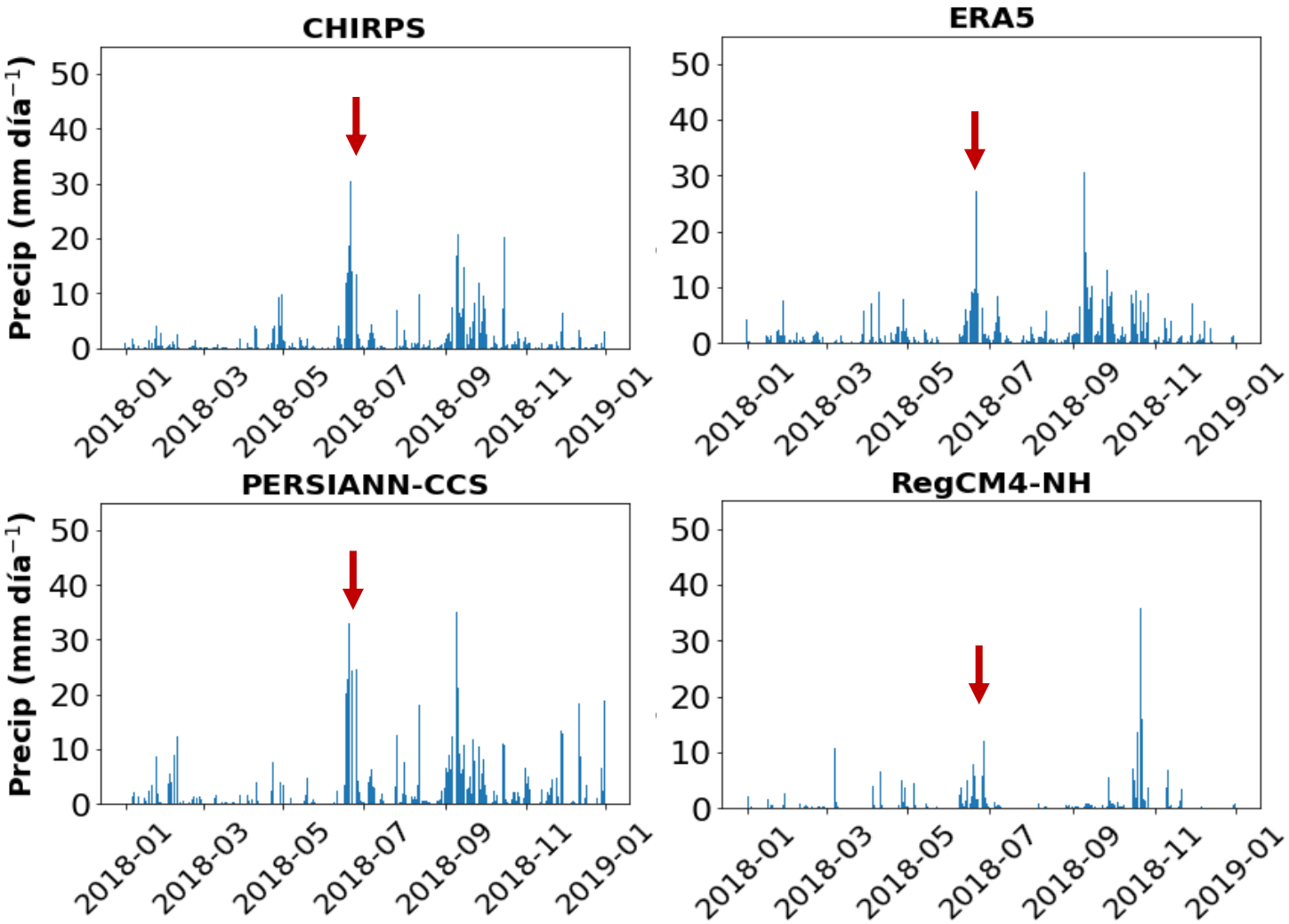


PDF of daily precipitation (mm/d) during Jun-Oct 2018



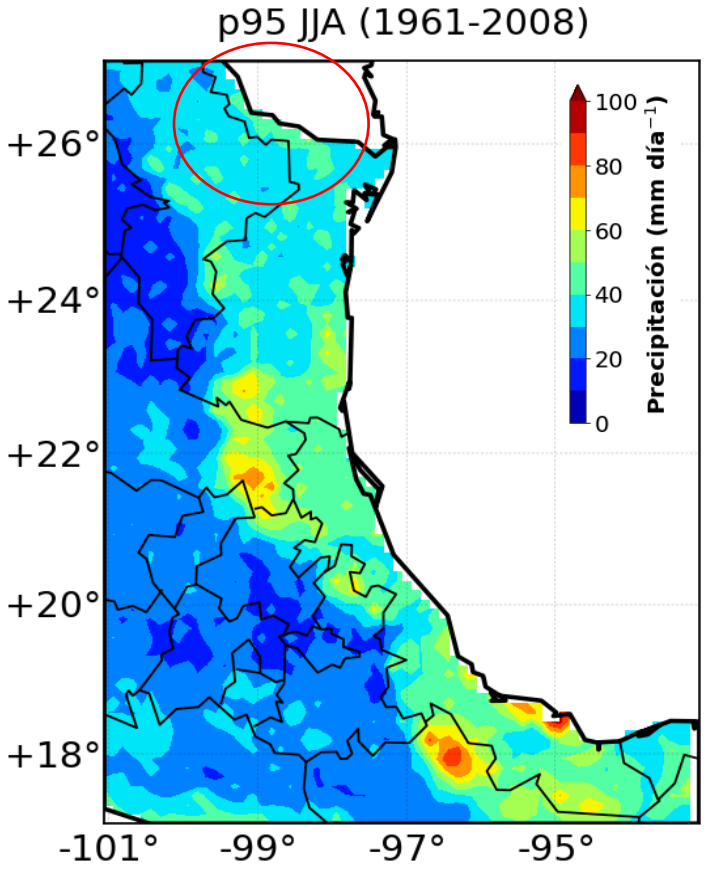


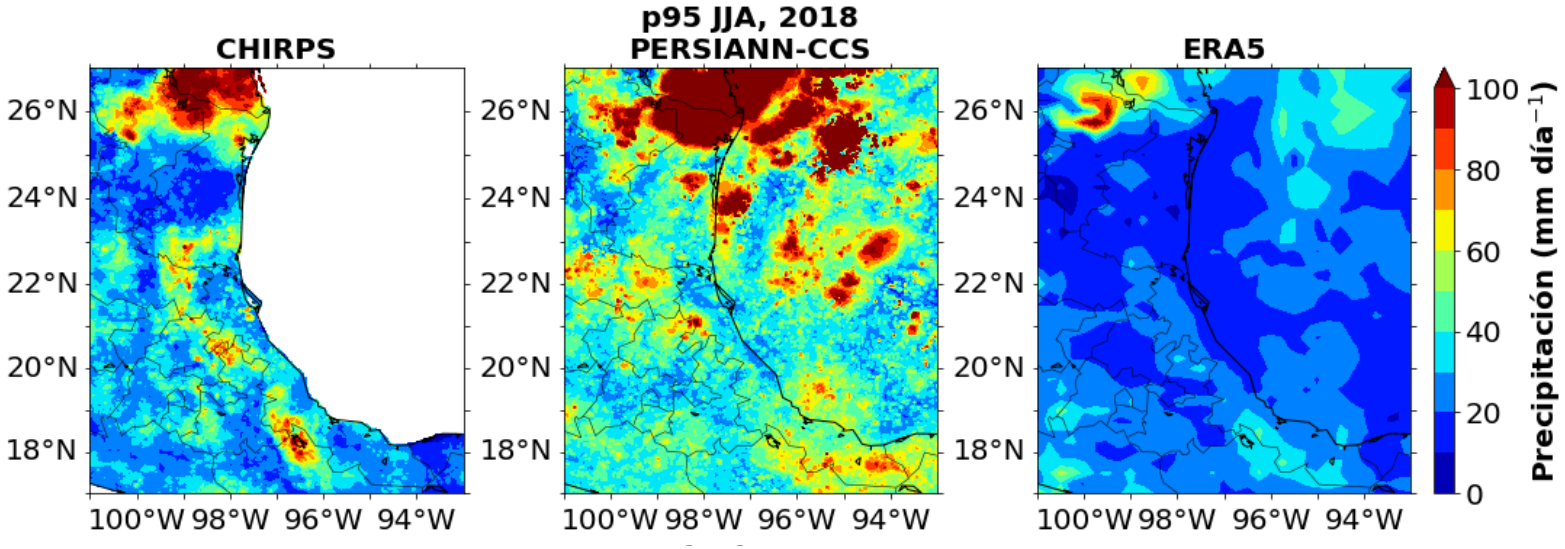
Case study of an extreme rainfall event: North GoM - 21 Jun 2018



Climatological P95 threshold of precipitation (mm/d) for Jun-Aug

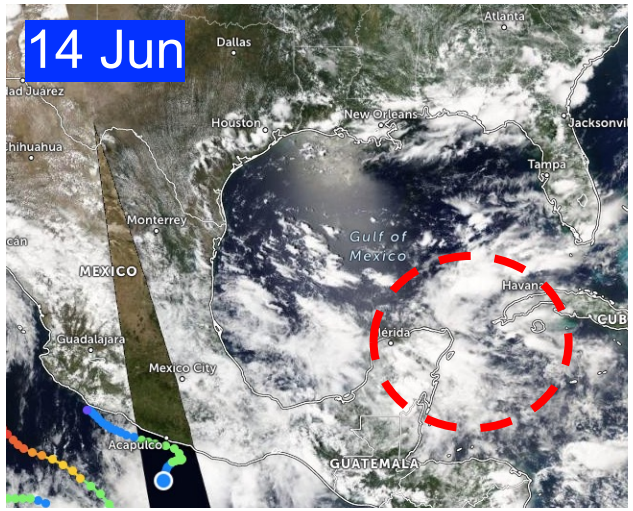
P95 Jun-Aug (1961-2008)

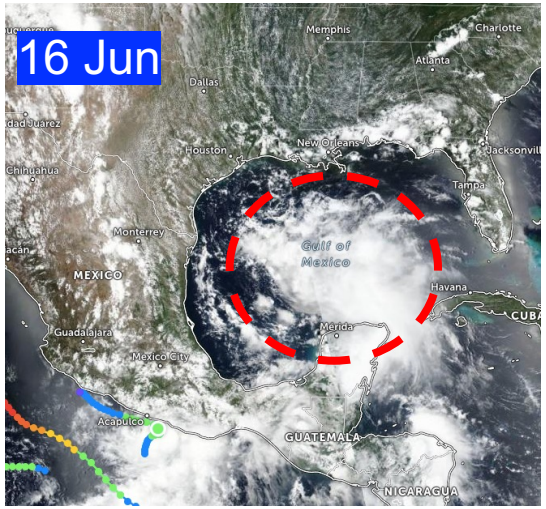


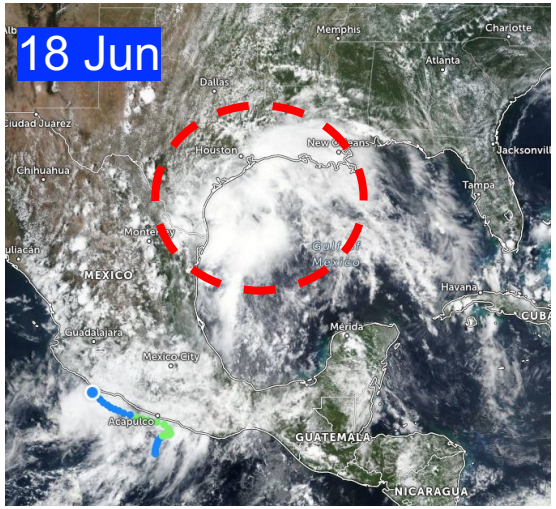


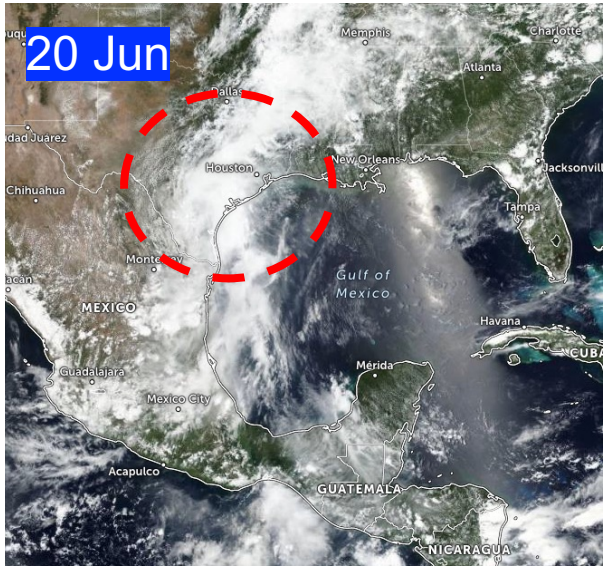
(CLICOM-MALLA, CICESE)
http://clicom.cicese.mx

Evolution of the easterly disturbance and convection: 14 – 22 Jun 2018

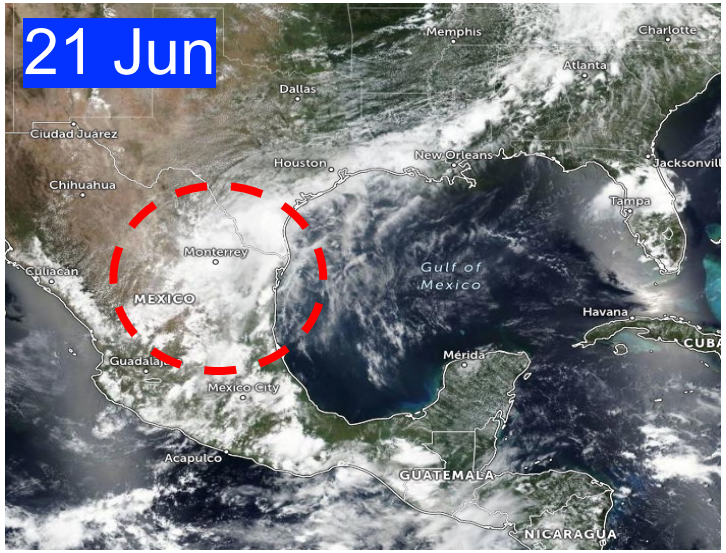








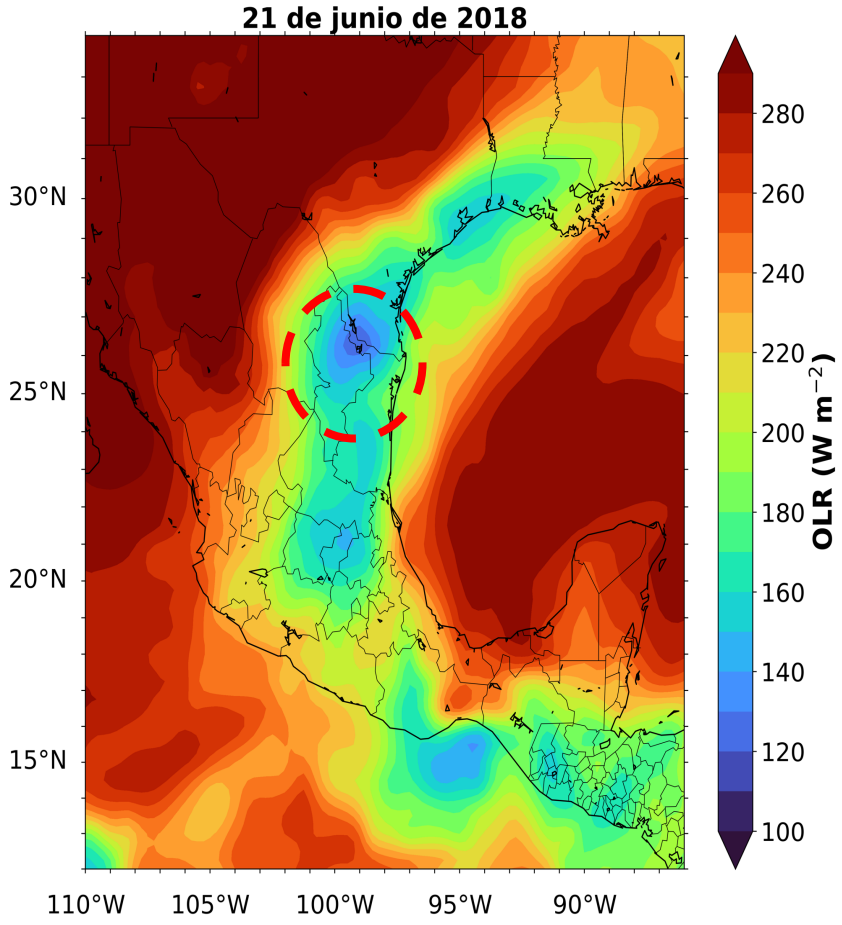
https://zoom.earth/



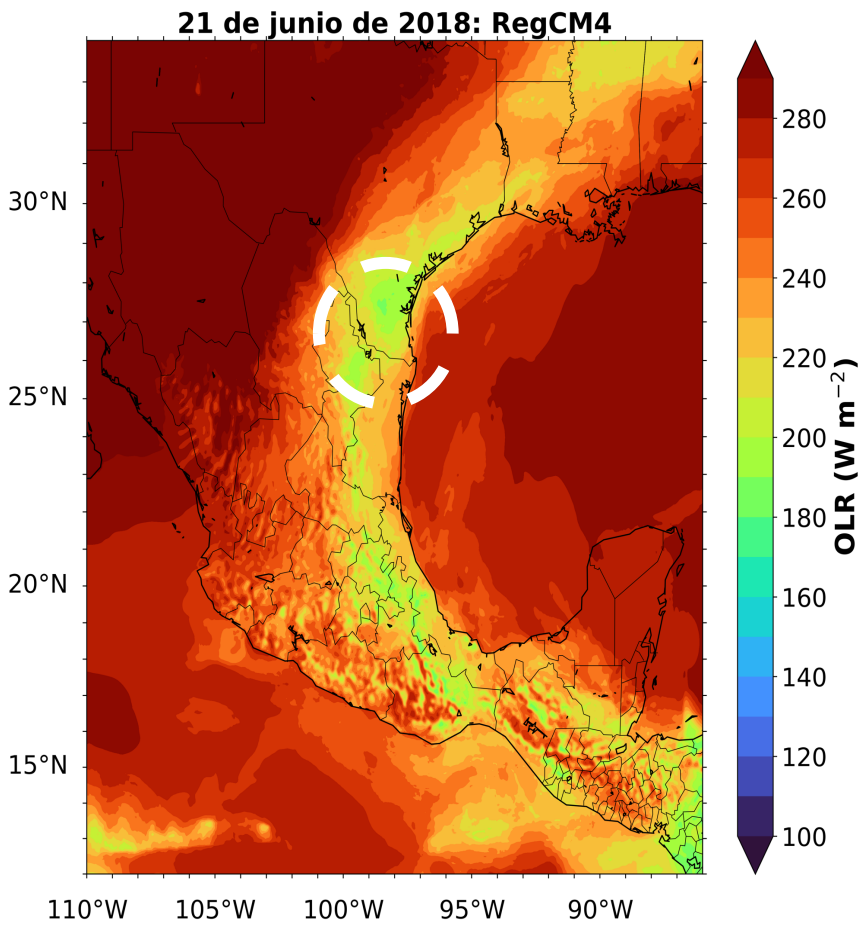
Main day of the storm

Outgoing longwave radiation (OLR) in 21 Jun 2018

ERA5



RegCM4-NH_forecast



IR image, 21 Jun 13 HL

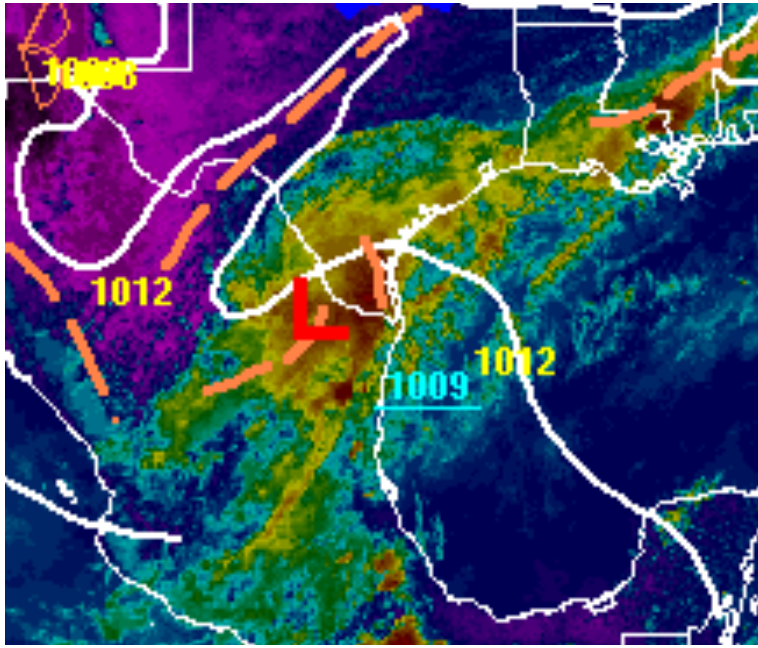
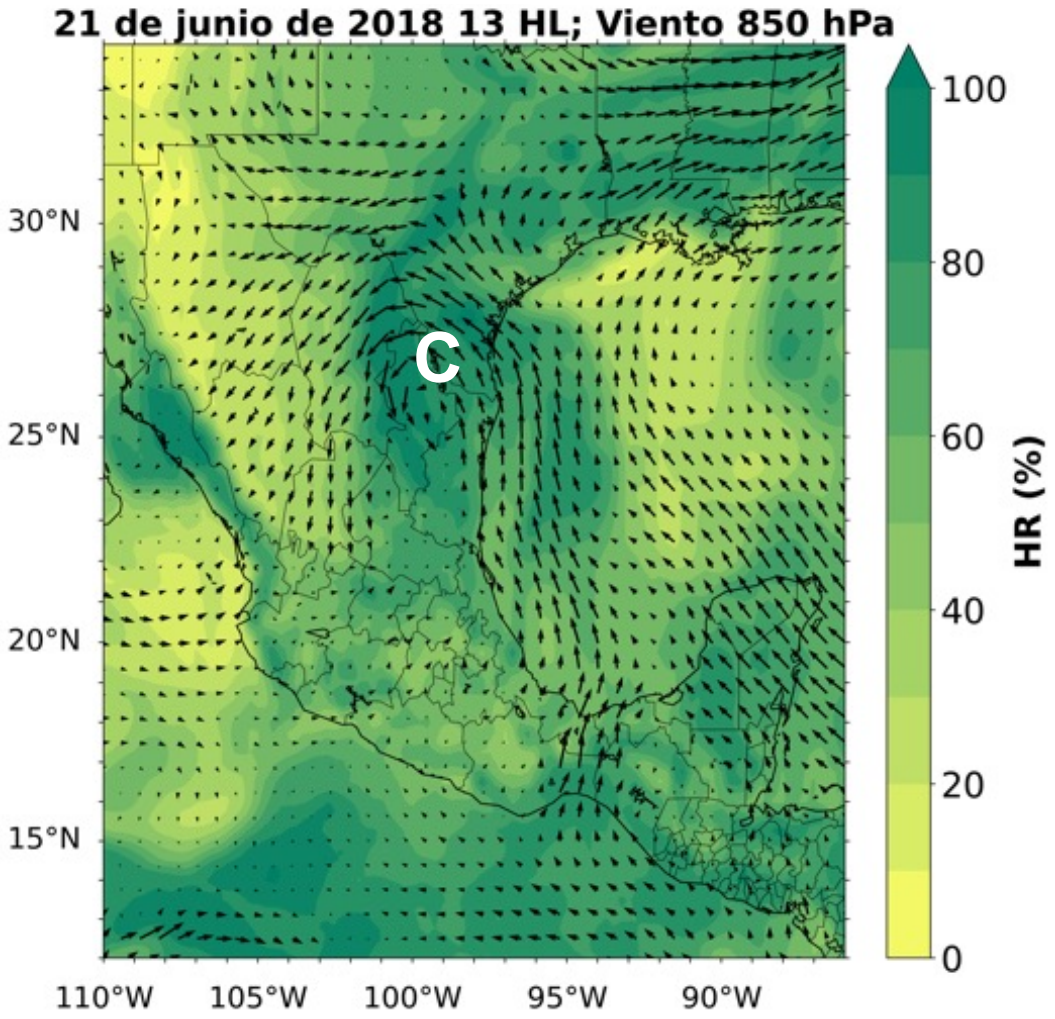


Imagen tomada de:
https://www.wpc.ncep.noaa.gov/archives/web_pages/sfc/sfc_archive.php.

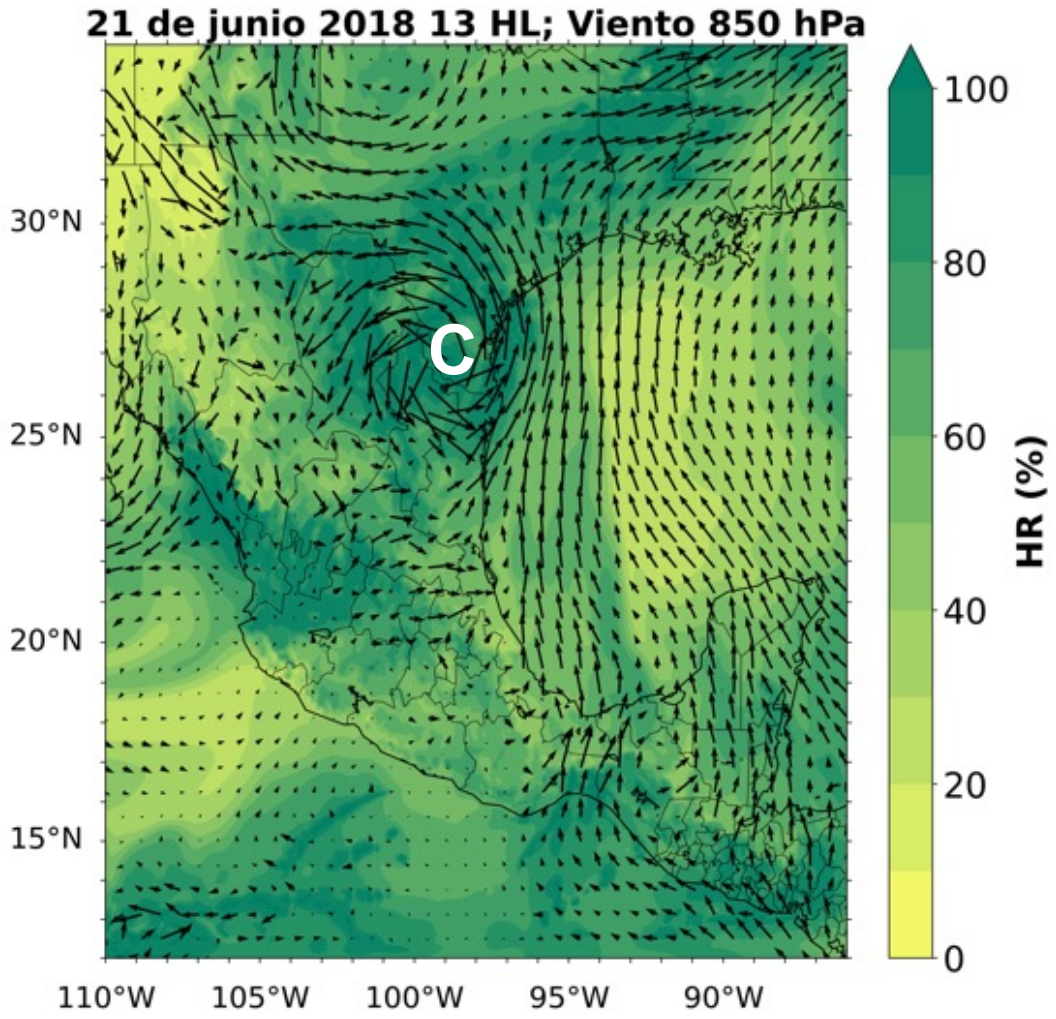
OLR < 180 W/m2 ➔ Deep convection

Relative humidity and winds at 850 hPa on 21 Jun 2018, 13 LT

ERA5

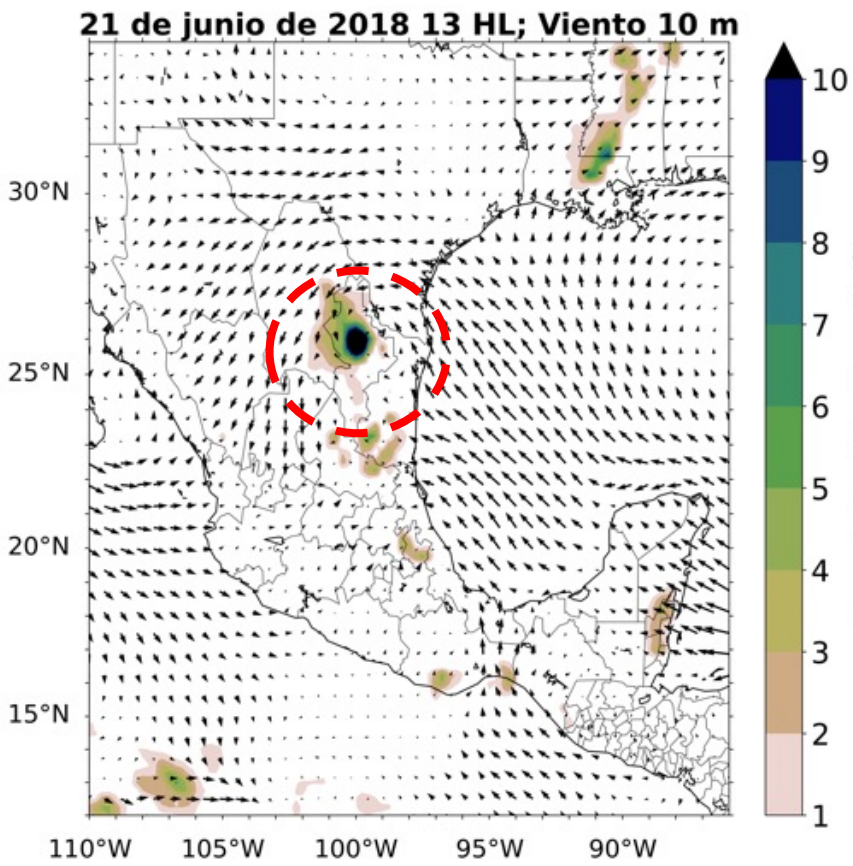


RegCM4-NH_Forecast

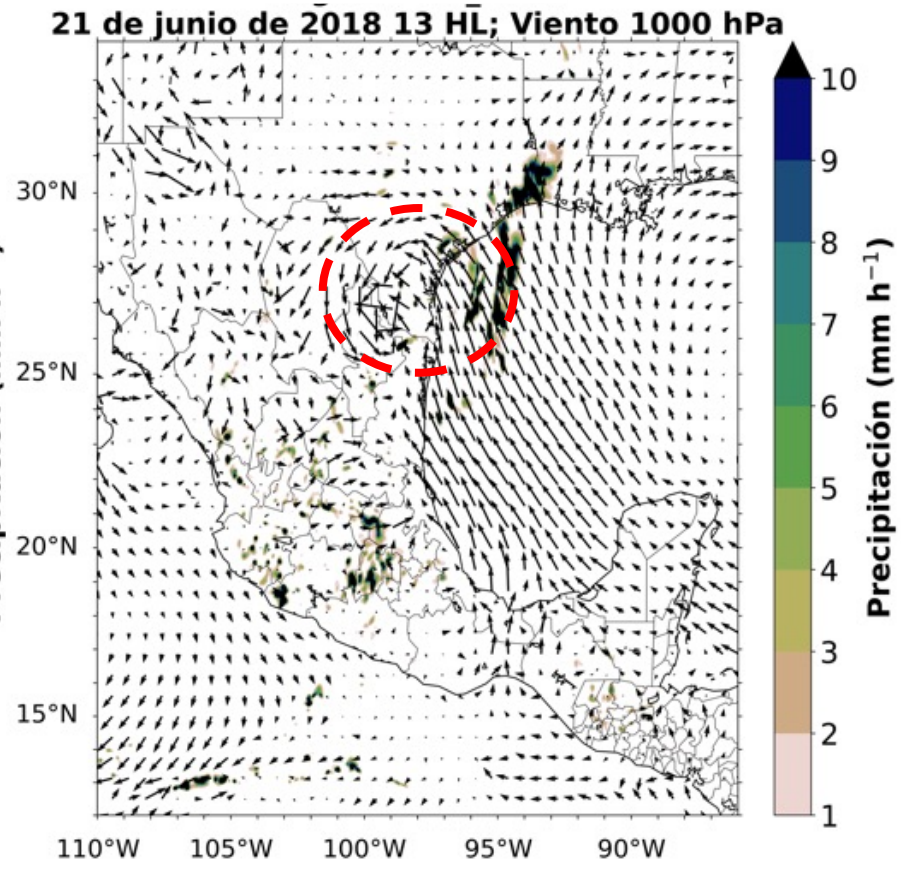


Precipitation and surface winds: 21 Jun 2018, 13 LT

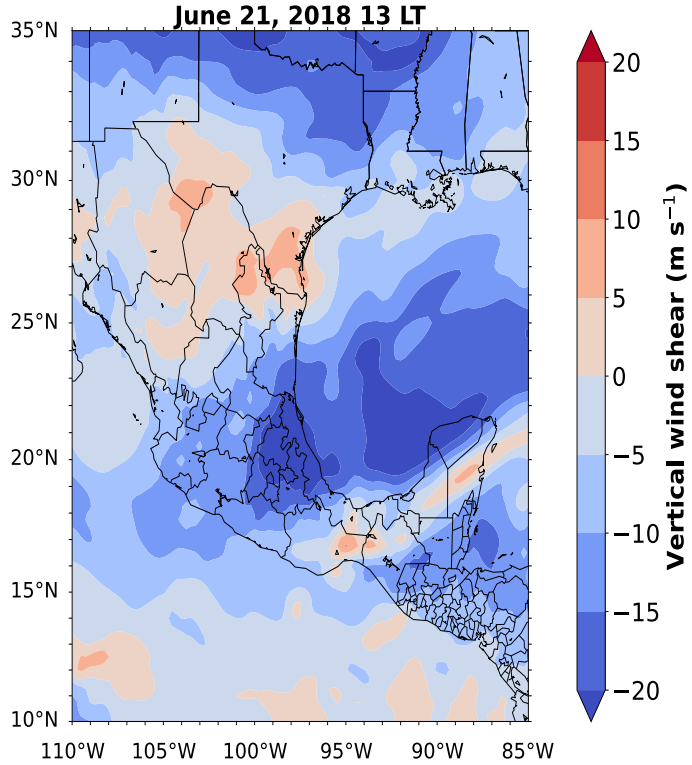
ERA5



RegCM4-NH_Forecast



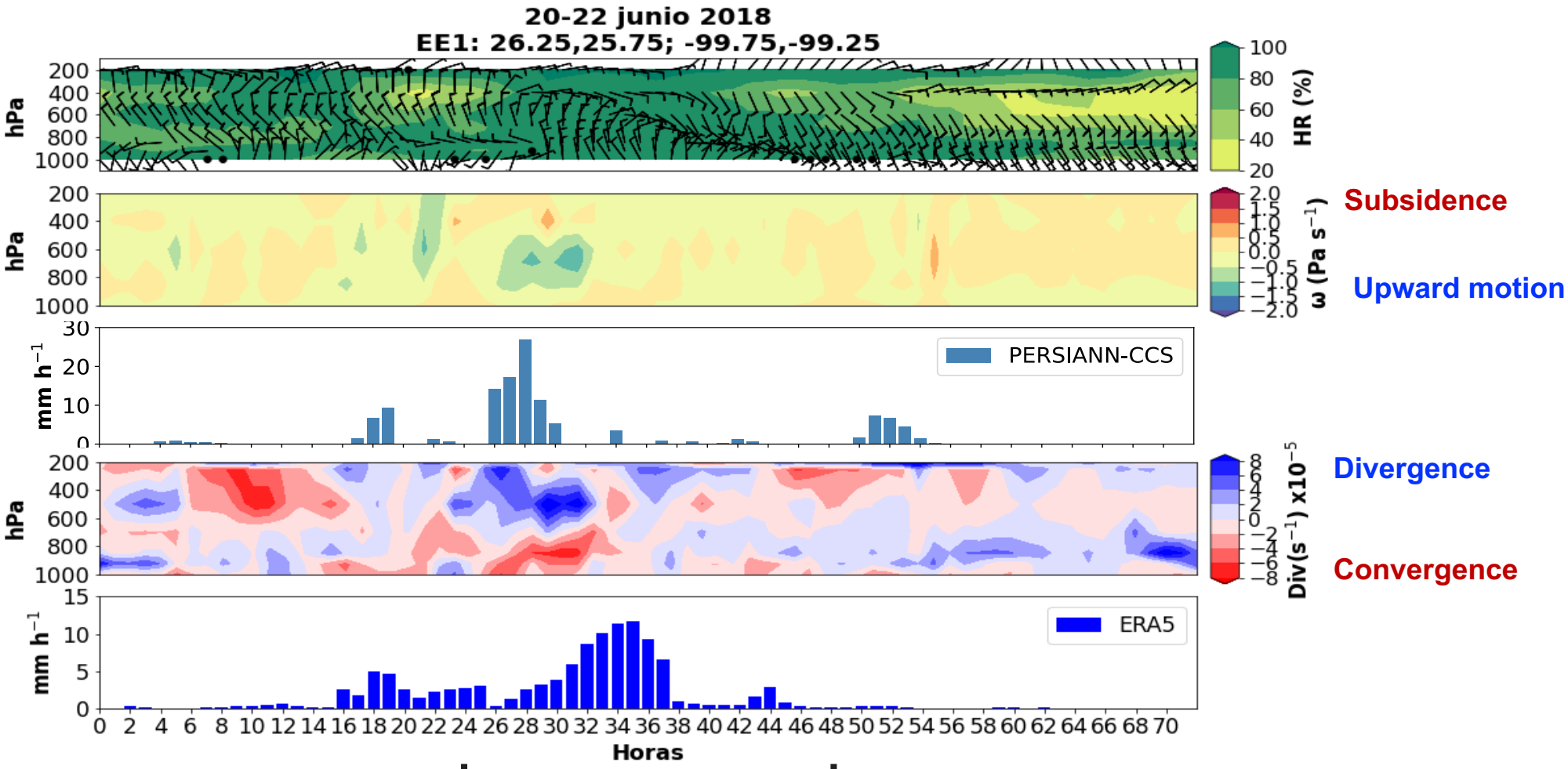
ERA5 Vert. wind shear



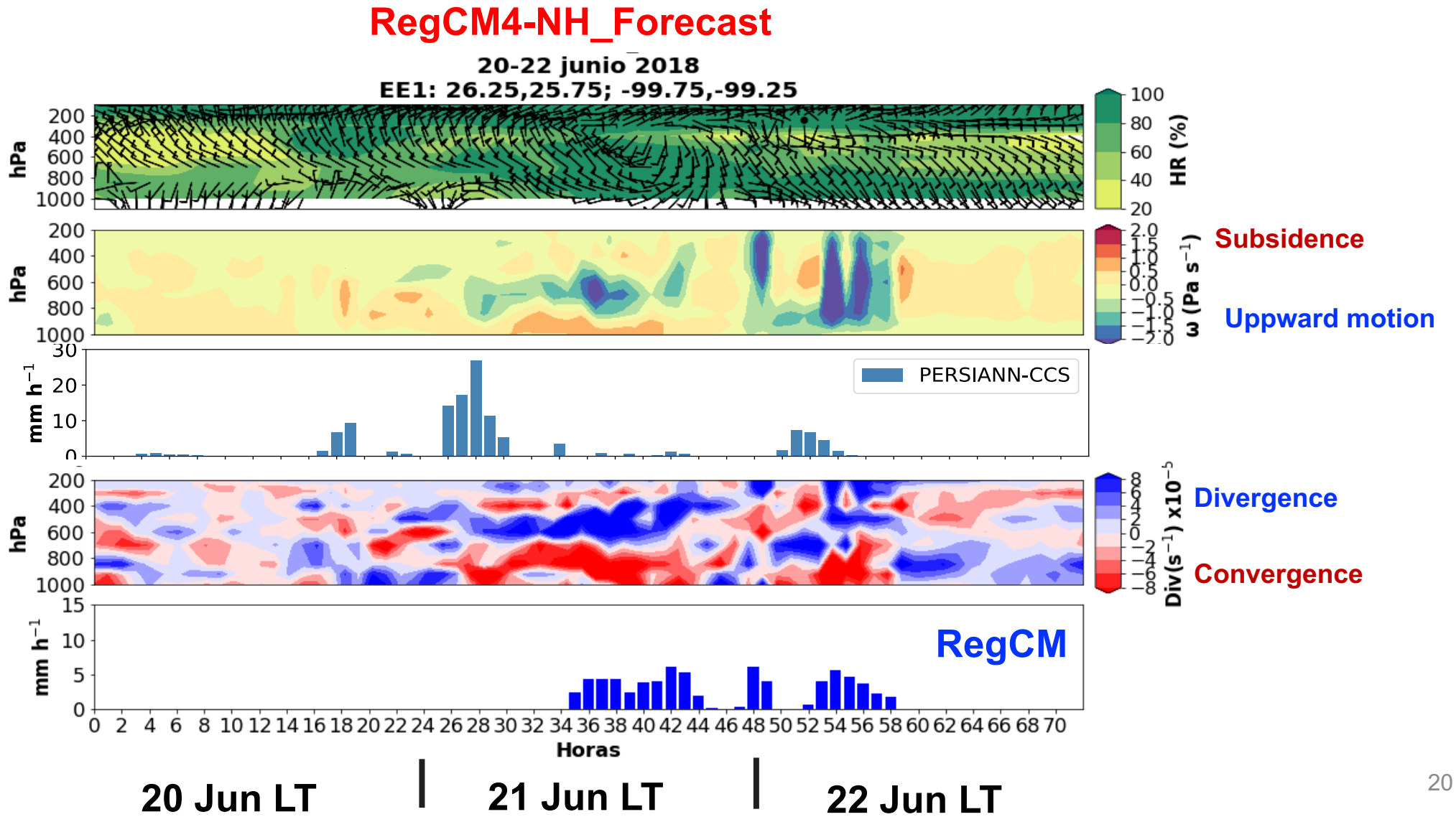
Vertical wind shear (200- 850) hPa, 13 HL

Hourly evolution of the storm from 20 to 22 Jun 2018

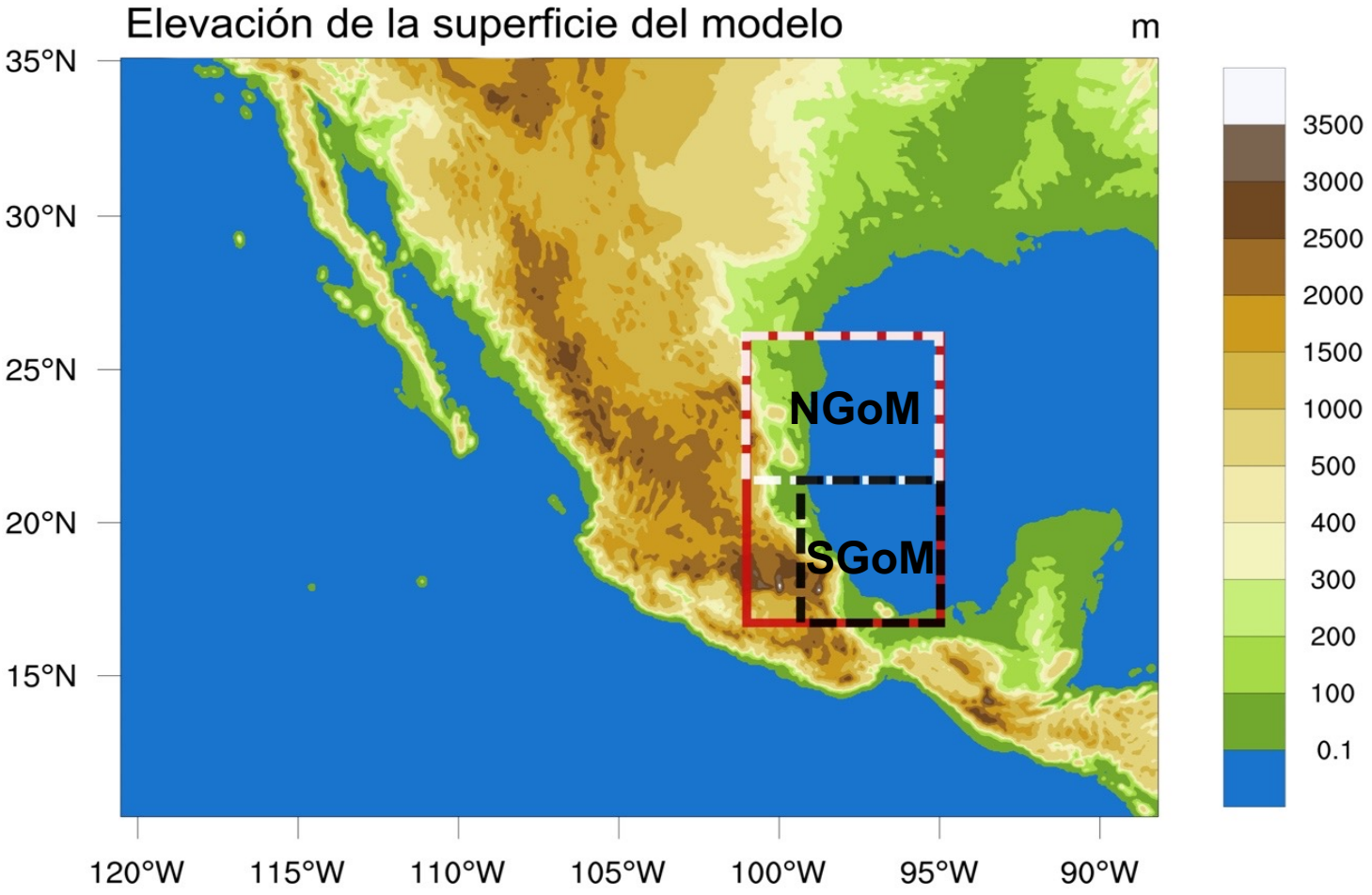
ERA5



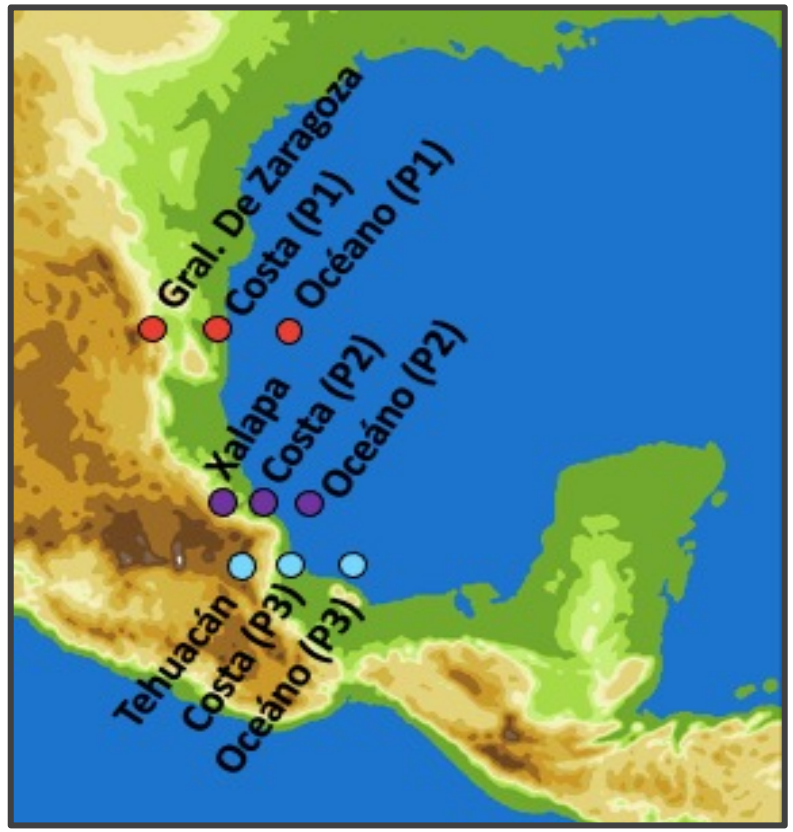
Hourly evolution of the storm from 20 to 22 Jun 2028



Study region domains



Domain for forecast mode



Physical parametrizations for RegCM4-NH
(13 months simulation; one month for spin up)

Physical Schemes	Parametrización
Radiation	NCAR CCM3 (Kiehl et al. 1996)
Land Surface	CLM (Oleson et al. 2008)
Microphysics	WSM5 (Skamarok et al. 2008)
Planetary Boundary Layer (PBL)	Holtslag PBL (Holtslag et al. 1990)
Ocean flux	Zeng (Zeng et al. 1998)

Next Steps?

RegCM5
CP and non-CP
Change the domain

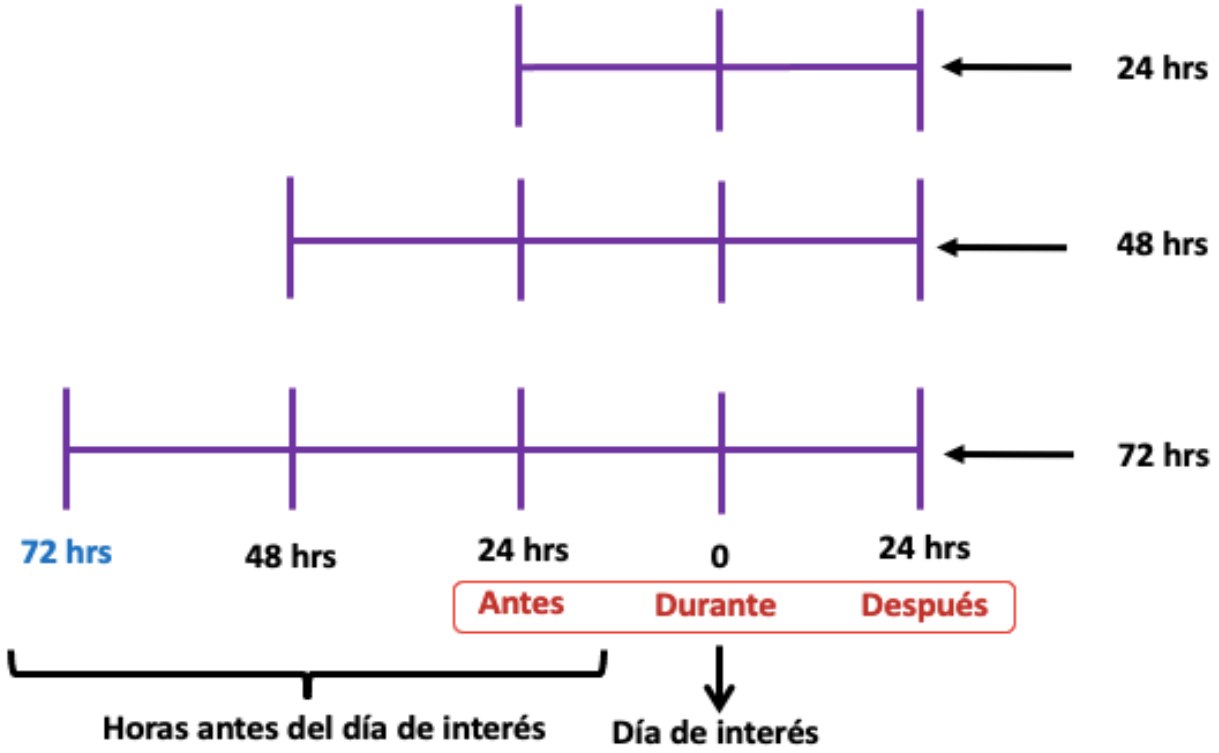
CLM4.5

NOTO

UV PBL

Collaborate with
Graciano, Moet, Rosy
Luna

RegCM4-NH_forecast mode



Initialization scheme for RegCM4-NH in forecast mode from 72 to 24 hrs before the extreme precipitation evento according to ERA5.

Grazie / Gracias / Thanks