Evaluation of climatologies and extreme events over Mexico

Sixth ICTP Workshop on the Theory and Use of Regional Climate Models

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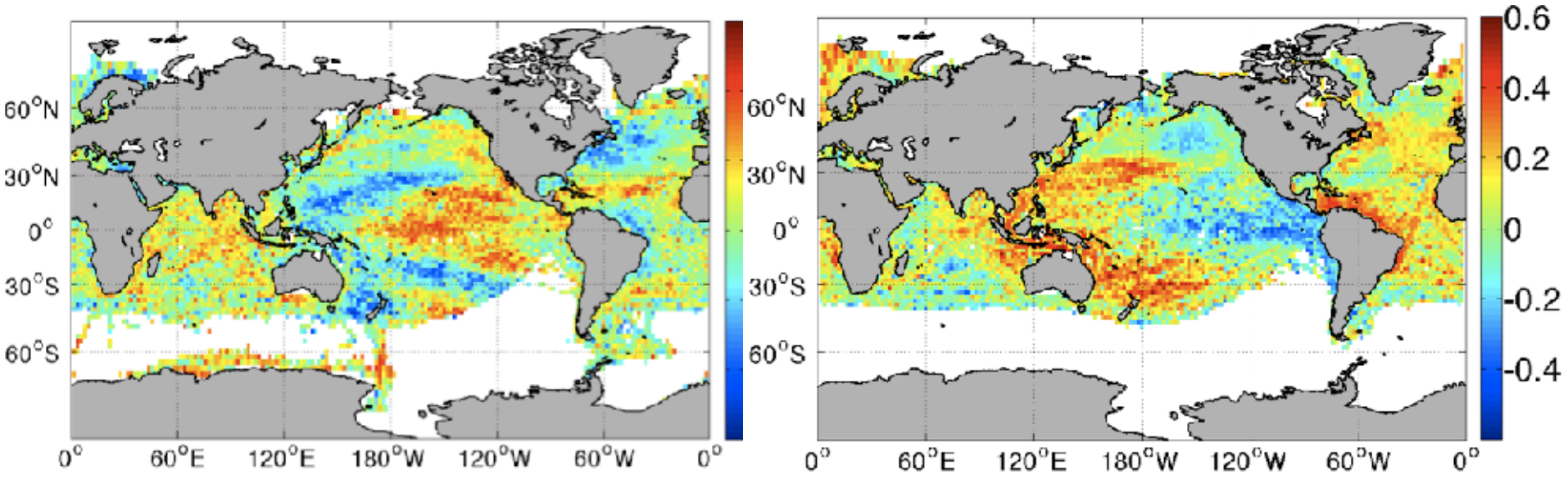
Outline

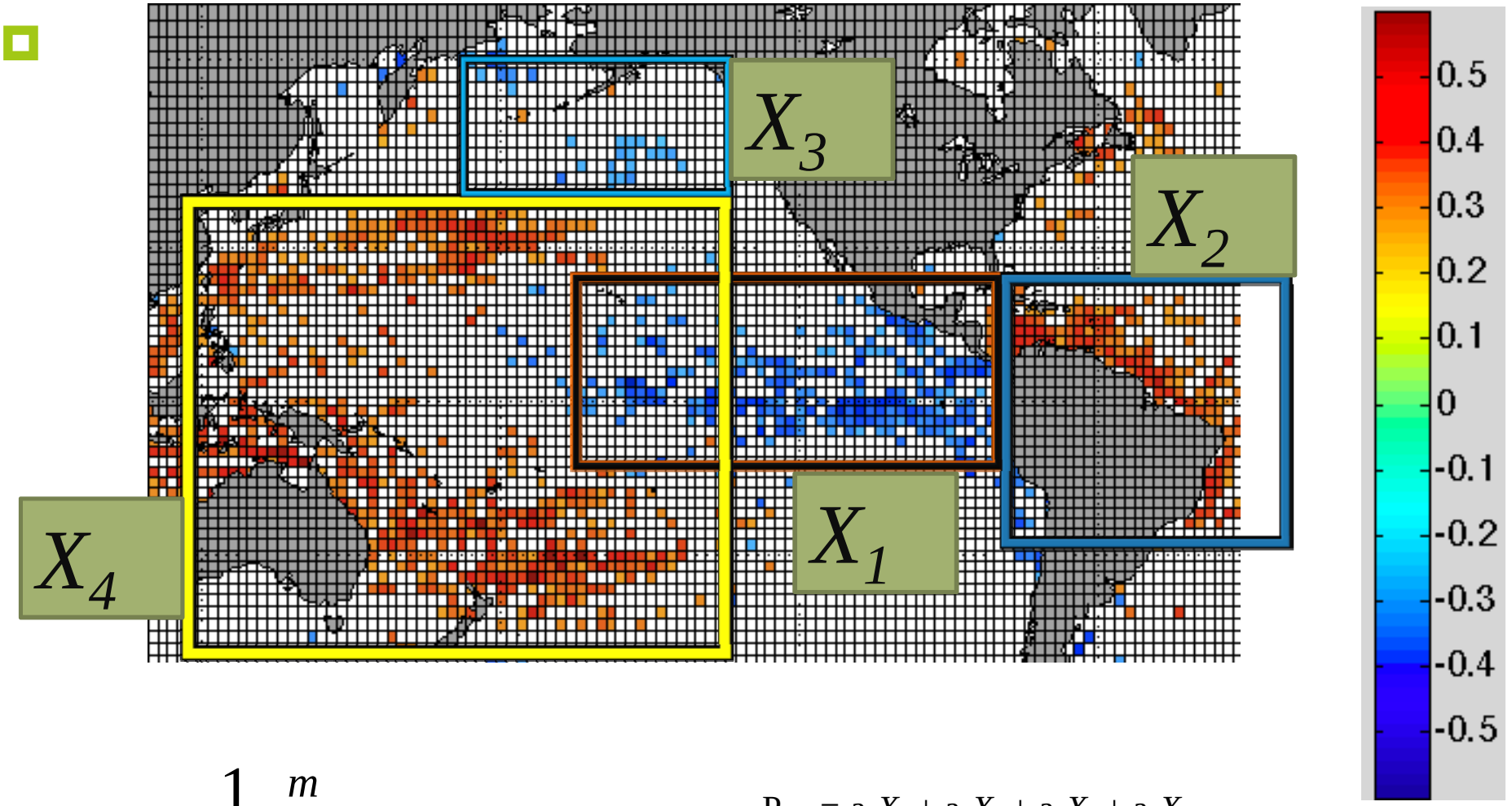
- Relationship of precipitation and temperature over Mexico with global variables: observations and statistical modelling aproach
- Model configuration
- Observed and simulated climatologies of seasonal precipitation and mean daily temperature
- Comparison of observed and simulated extreme events over Mexico
- Some conclusions

Correlation of precipitation over Mexico with SST at seasonal scale



DJF JJA

Oceanic regions with influence on precipitation over Mexico



$$X_N(t) = \frac{1}{m}\sum_{k=1}^{m} TSM_k$$

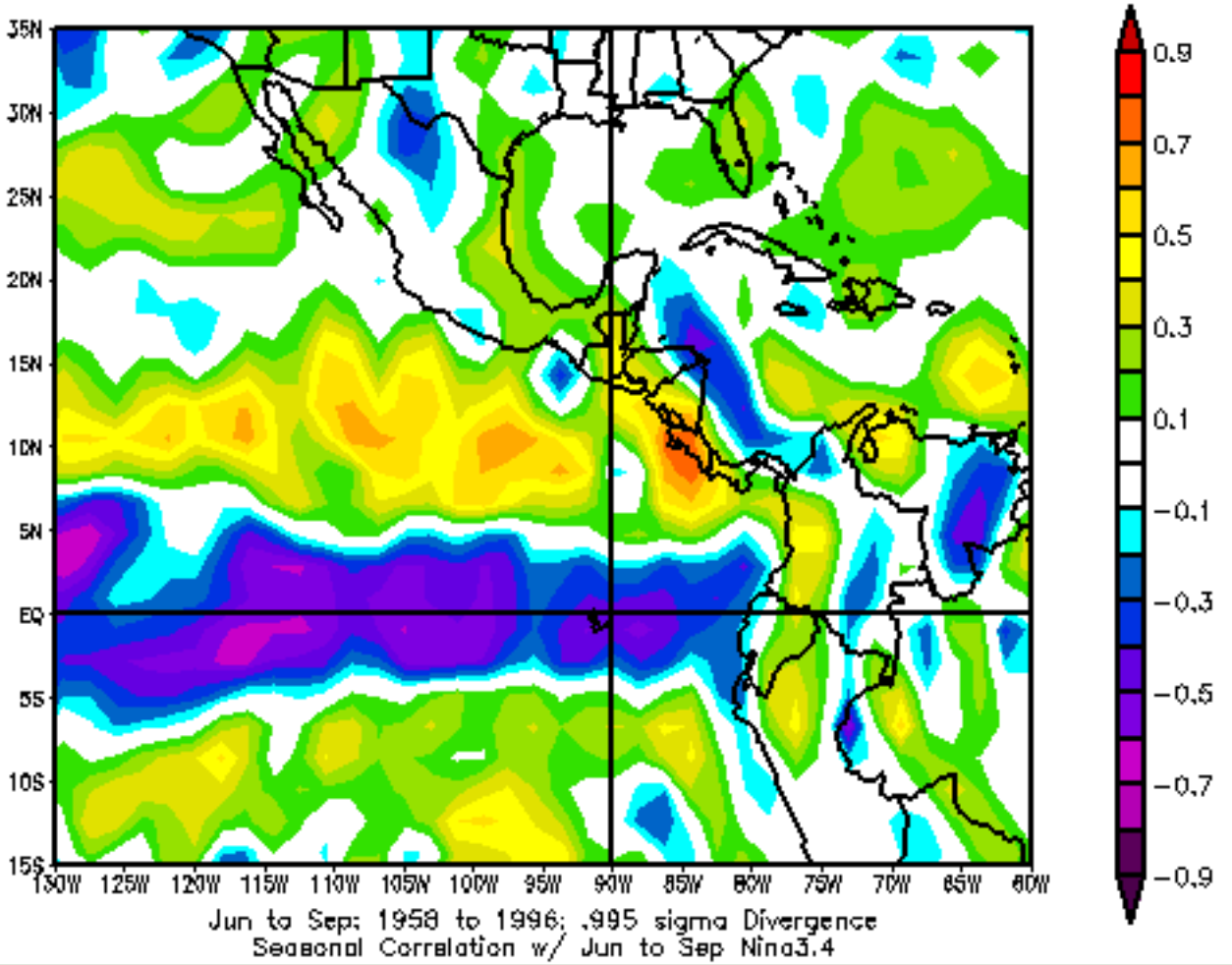
m number of gridpoints

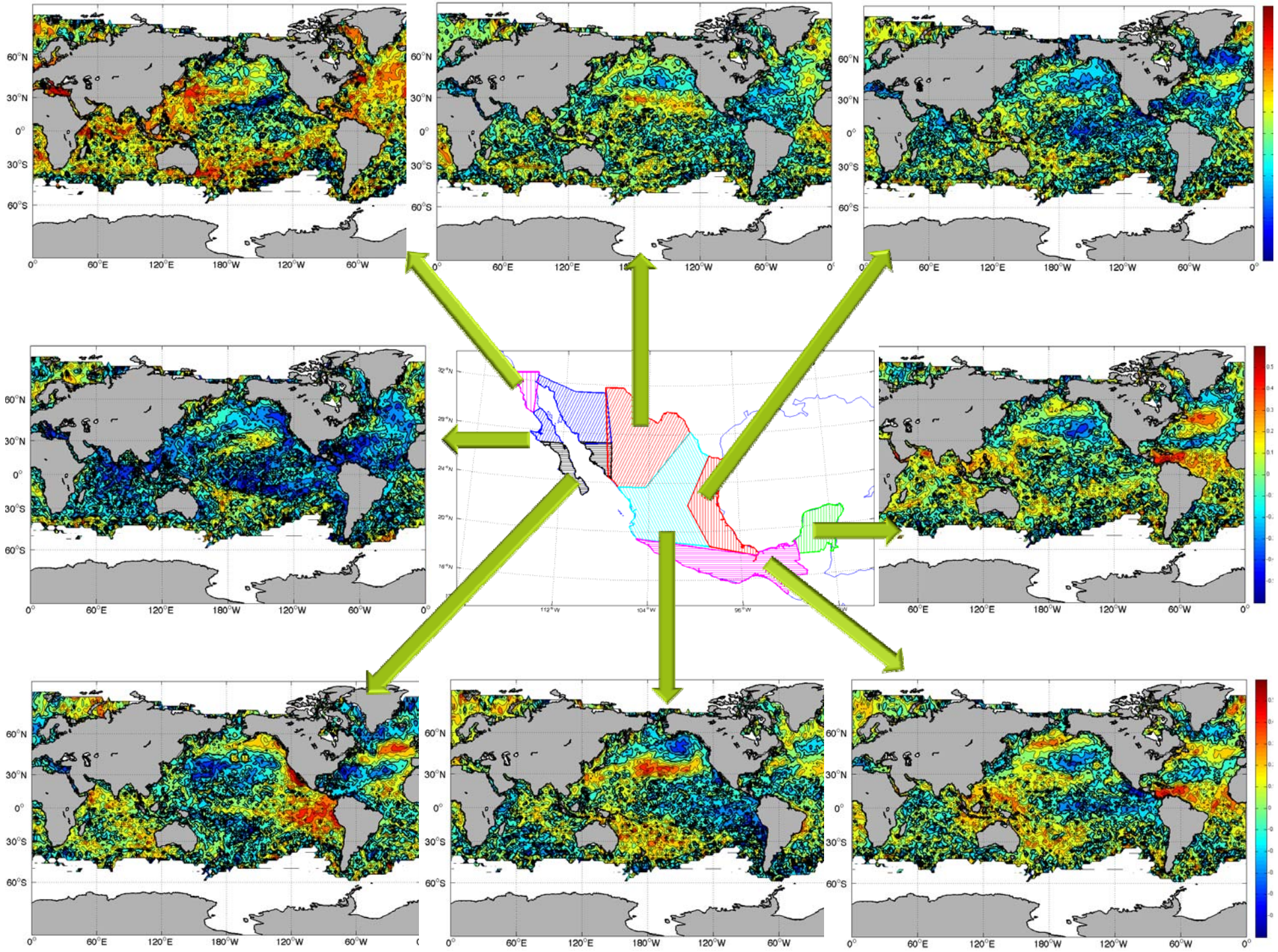
$P_{mod} = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4$

Calculate a_1, a_2, a_3, a_4 with multiple regression

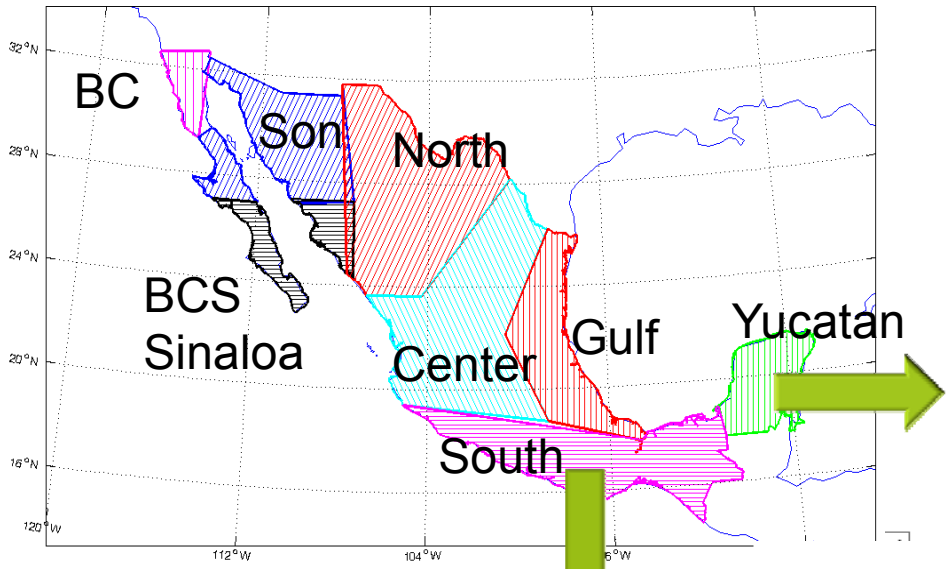
Inter-annual seasonal precipitation dependence of equatorial dynamics

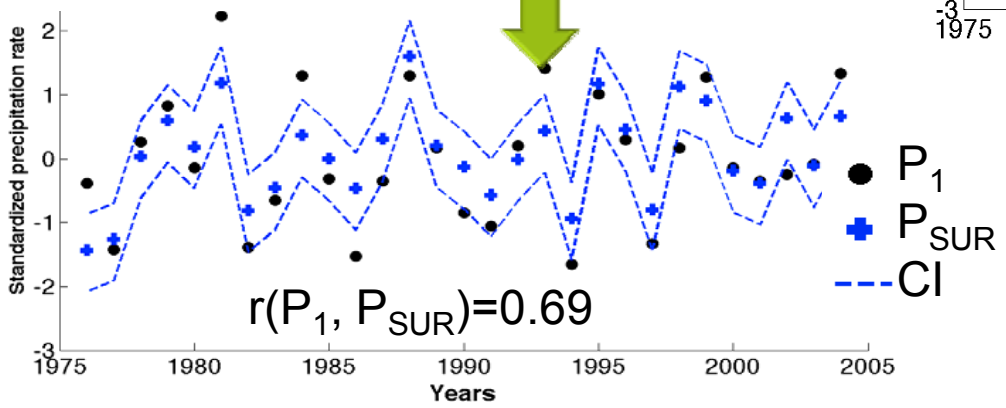
Seasonal correlation of air divergence in the surface level with SST EN 3.4

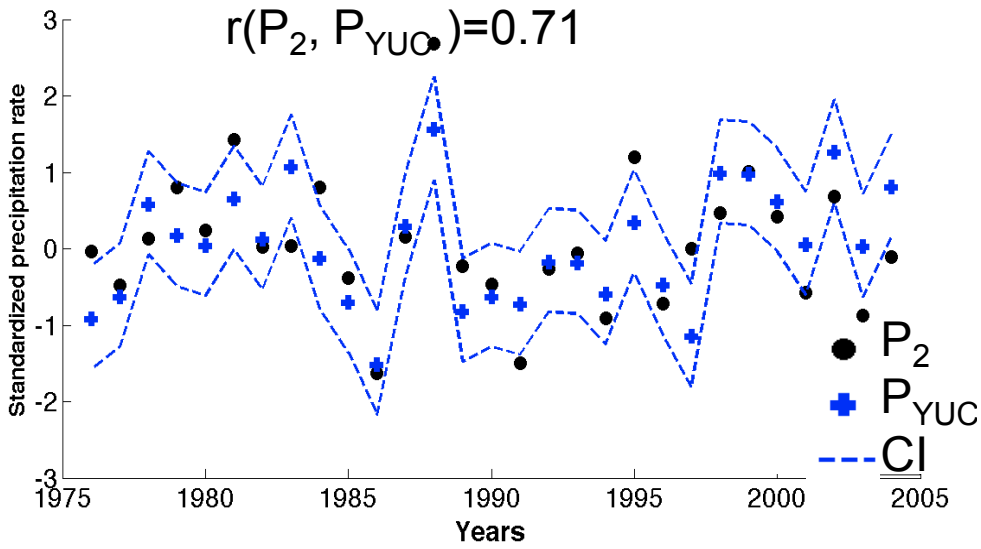


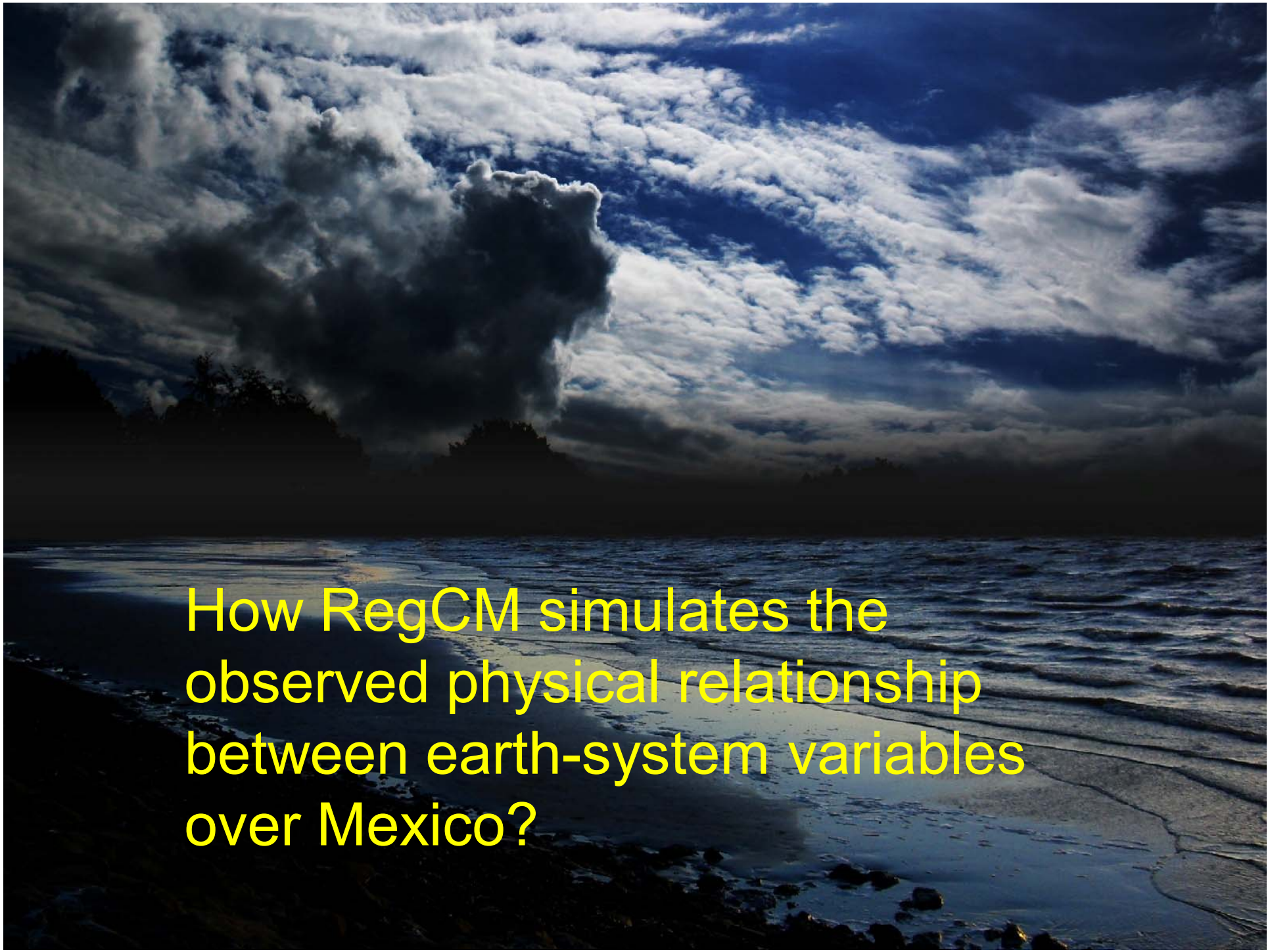

60°N
30°N
0°
30°S
60°S
0°
60°E
120°E
180°W
120°W
60°W
32°N
28°N
24°N
20°N
16°N
112°W
104°W
96°W

Statistical modelling of seasonal precipitation at regional scale








How RegCM simulates the observed physical relationship between earth-system variables over Mexico?

RegCM configuration

- Cumulous convection scheme = Emanuel (1991) over ocean, Grell over land;
- Convective closure assumption "Fritsch & Chappell (1980)" ;
- Boundary layer scheme = "Holtslag PBL (Holtslag, 1990)" ;
- Large scale precip scheme = "Explicit moisture (SUBEX; Pal et al 2000)" ;
- Ocean flux scheme = "Zeng et al (1998);
- Boundary conditions: ERA Interim 1982 - 2008

RegCM configuration

- Simulation using BATS
- Mexico-Central America CORDEX domain, with horizontal resolution of 50km.
- 18 vertical levels.
- Diurnal cycle activated.

Validation

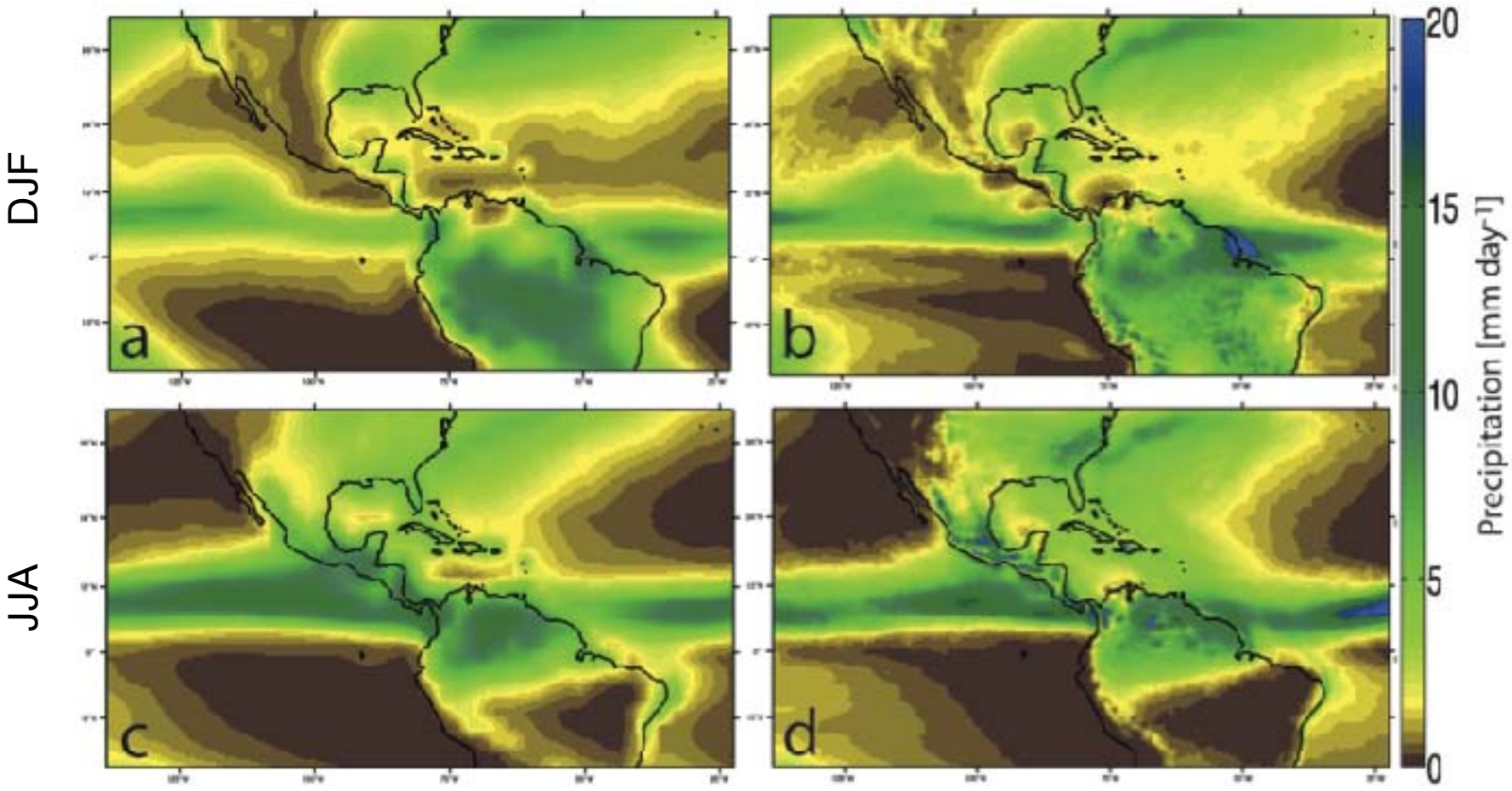
Central America Domain

University of Delaware ➔ Temperature
GPCP ➔ Precipitation
Surface wind ➔ NCEP DOE
Atmospheric humidity ➔ NCEP DOE
Hurricane tracks ➔ Best track data base from the US National Weather Service Tropical Prediction Center

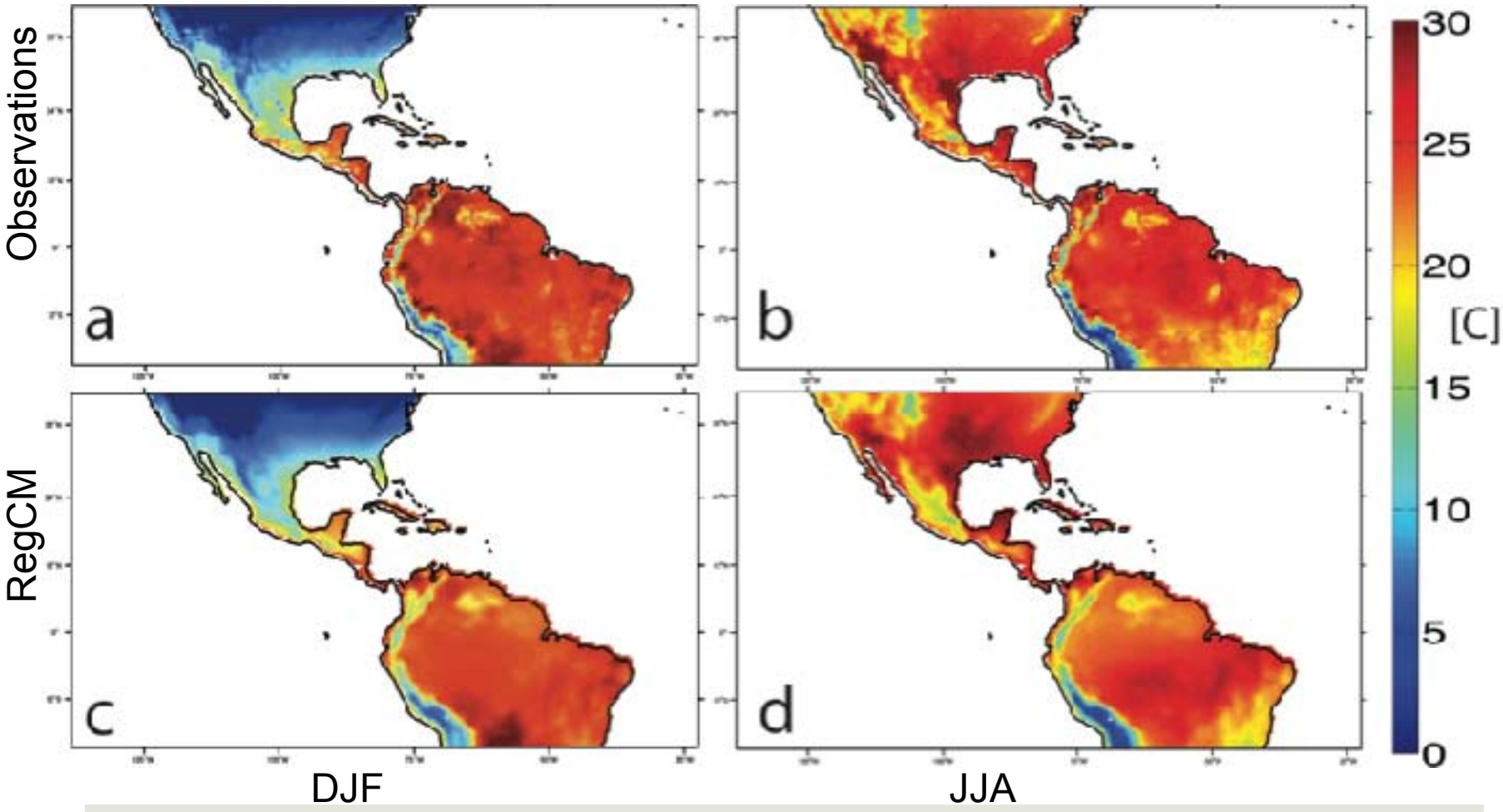
Mexico

CLICOM ➔ Temperature and precipitation

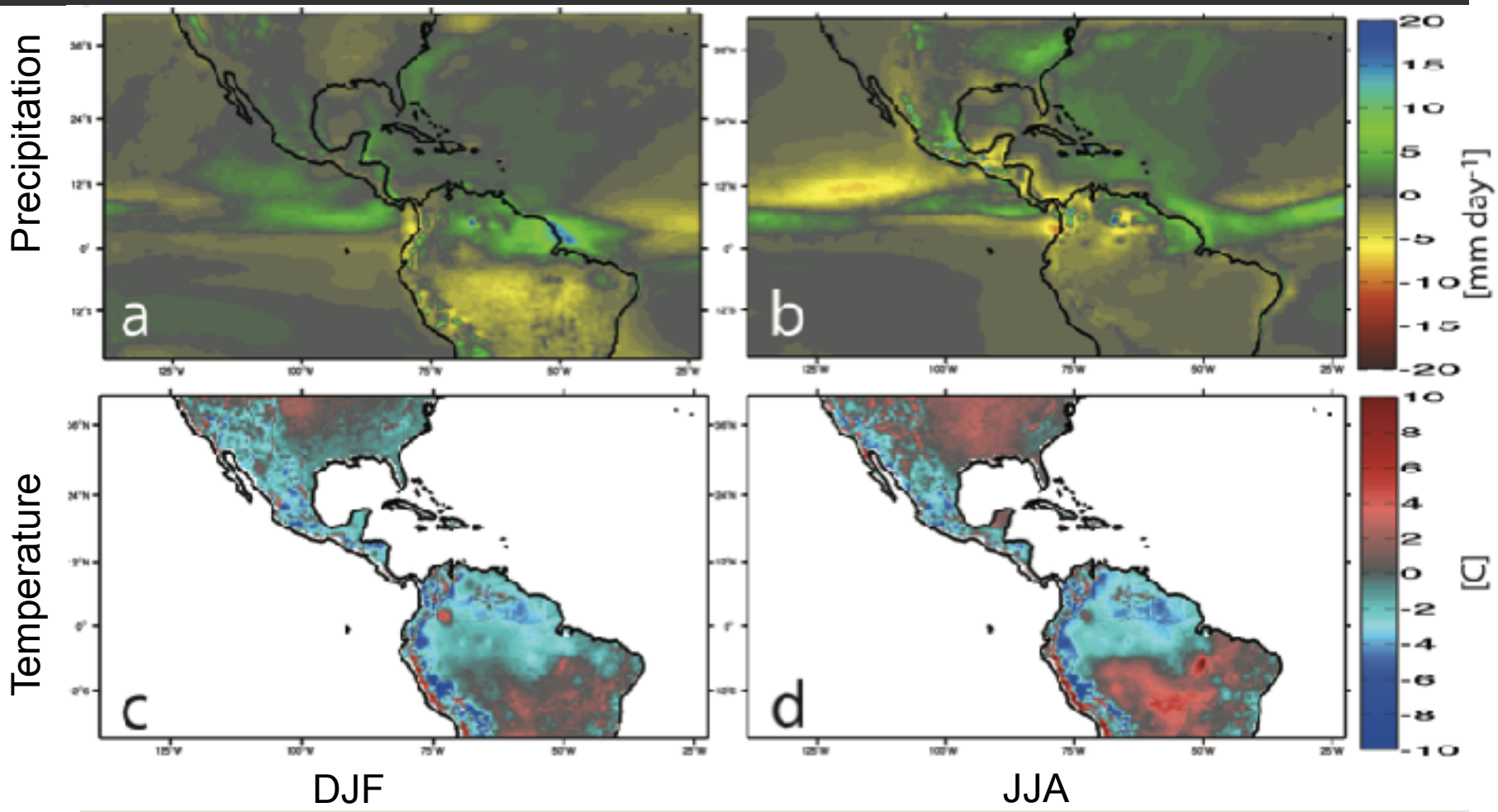
Seasonal precipitation simulation



Temperature simulation



RegCM − Observations



Extreme events analyzed

- Tmax 95 percentile
- Tmin 5 percentile
- Heat waves
- Cold waves
- Hurricane days

Definitions of extreme temperature and precipitation events at daily scale

Heat wave: event in which the daily Tmax > 5 ºC 1982-2008 Tmax clim.

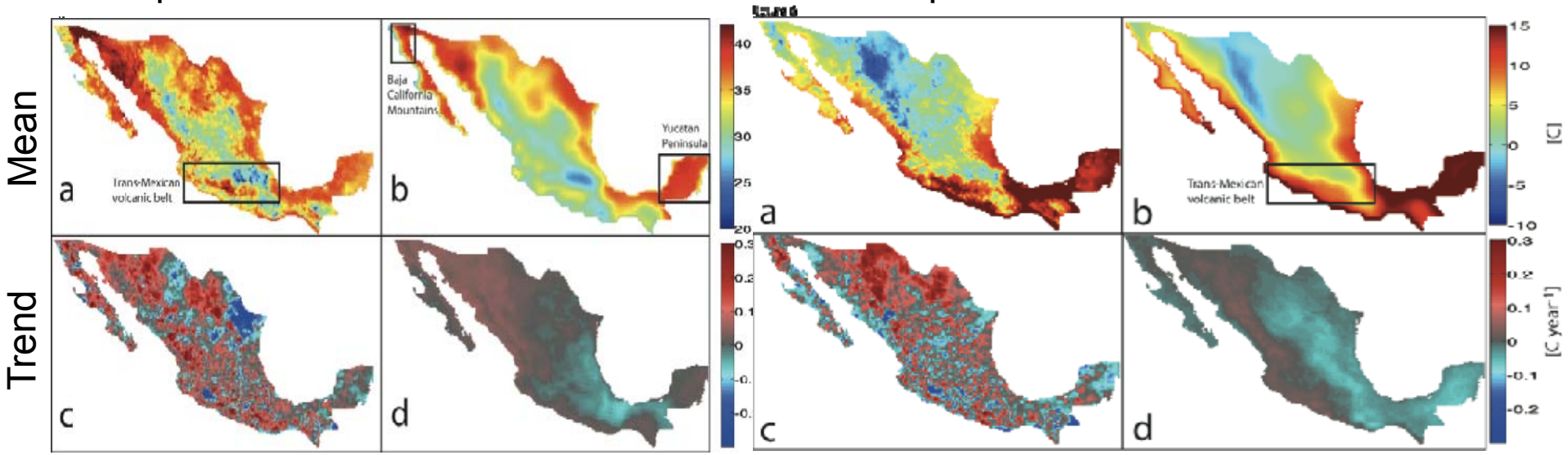
Cold wave: event in which the daily Tmin < 5 ºC 1982-2008 Tmin clim.

Hurricane day: wind speed ≥ 33 m s^{-1}, pressure ≤ 1005 hPa and precipitation ≥ 20 mm.

Temperature percentiles

95 percentile of Tmax

5 percentile of Tmin

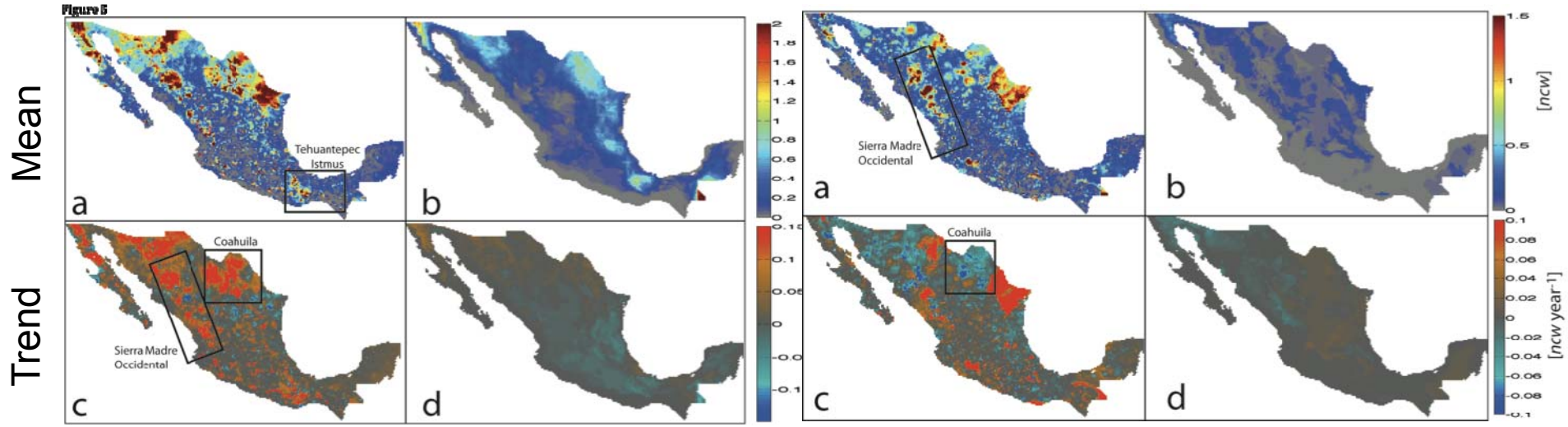


Observations RegCM Observations RegCM

Number of heat waves per year (1982-2008 avg)

Heat waves

Cold waves

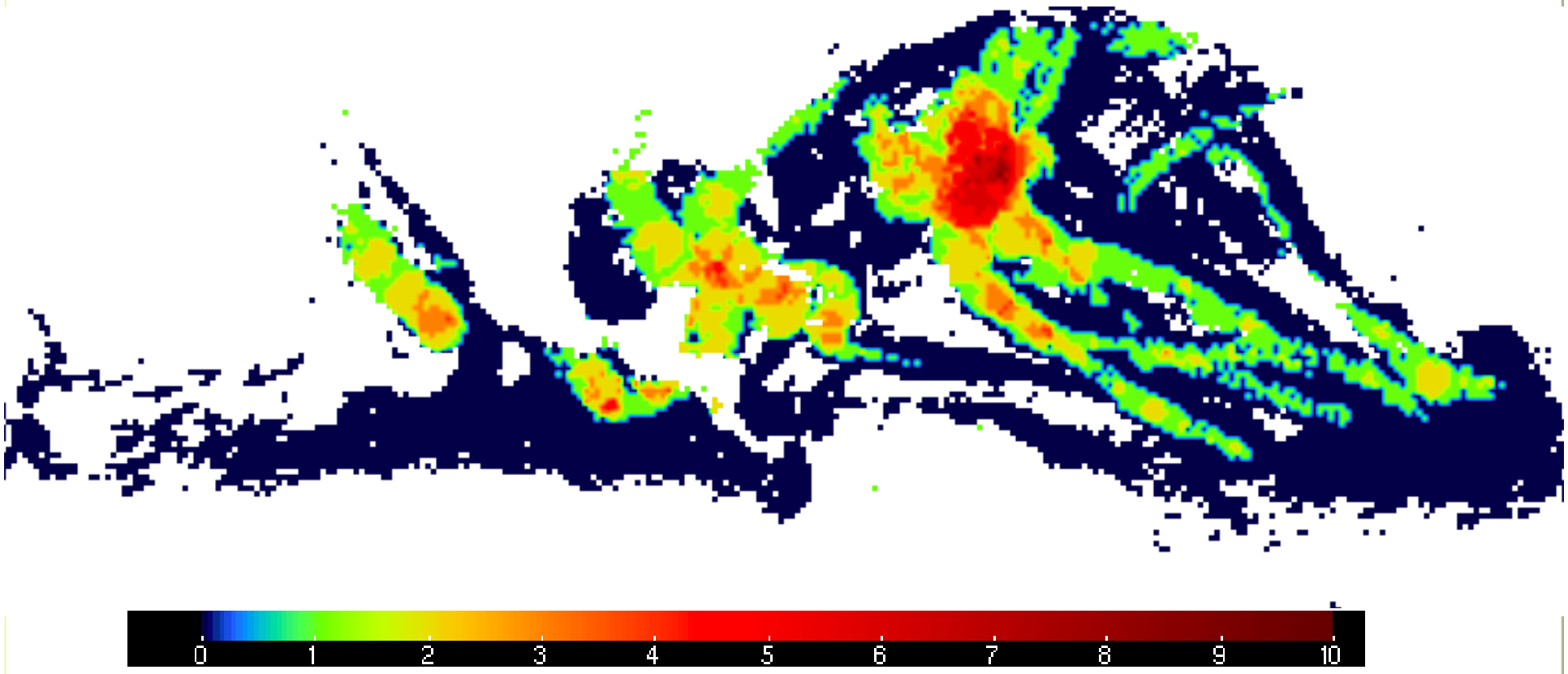


Observations RegCM

Observations RegCM

Number of hurricane days

September, 1984



Wind and atm. humidity bias between RegCM and NCEP DOE (Bias)

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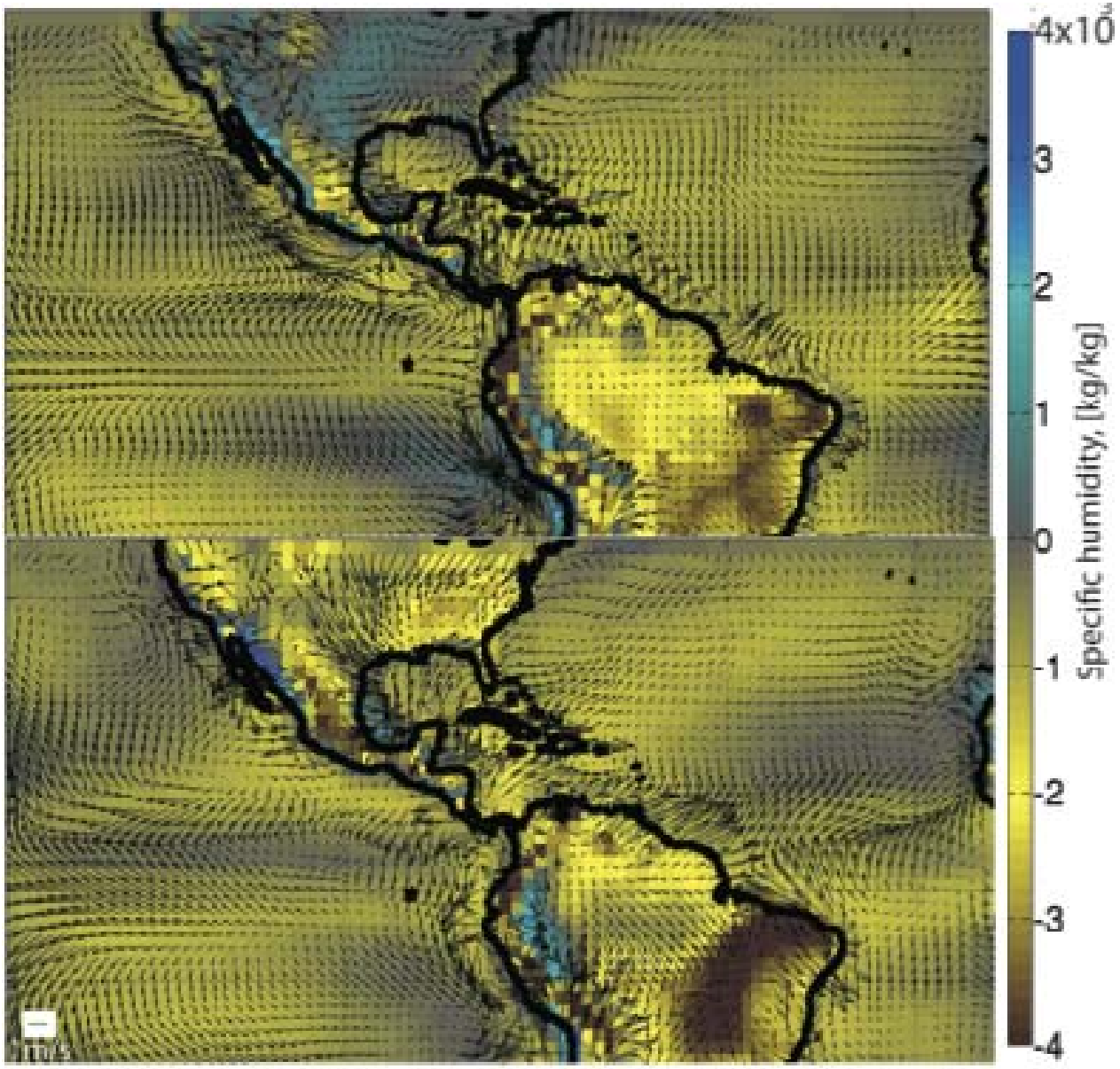

Conclusions

- The model reproduces accurately the long-term spatial patterns of temperature and precipitation, as well as their extremes; however linear trends are underestimated.
- The saturation thresholds used in the convective schemes produce a wet bias over the mountains in the Mexican territory.
- More rainy days in RegCM, increase the latent heat flux and decrease the sensible heat flux, causing a negative temperature bias.
- The RegCM underestimation of the NHD in the Pacific Ocean, near the Mexican coast seems to be partly due to the atypical atmospheric anticyclone observed in this region, causing humidity divergence and hindering cyclogenesis.

THANKS FOR YOUR ATTENTION

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