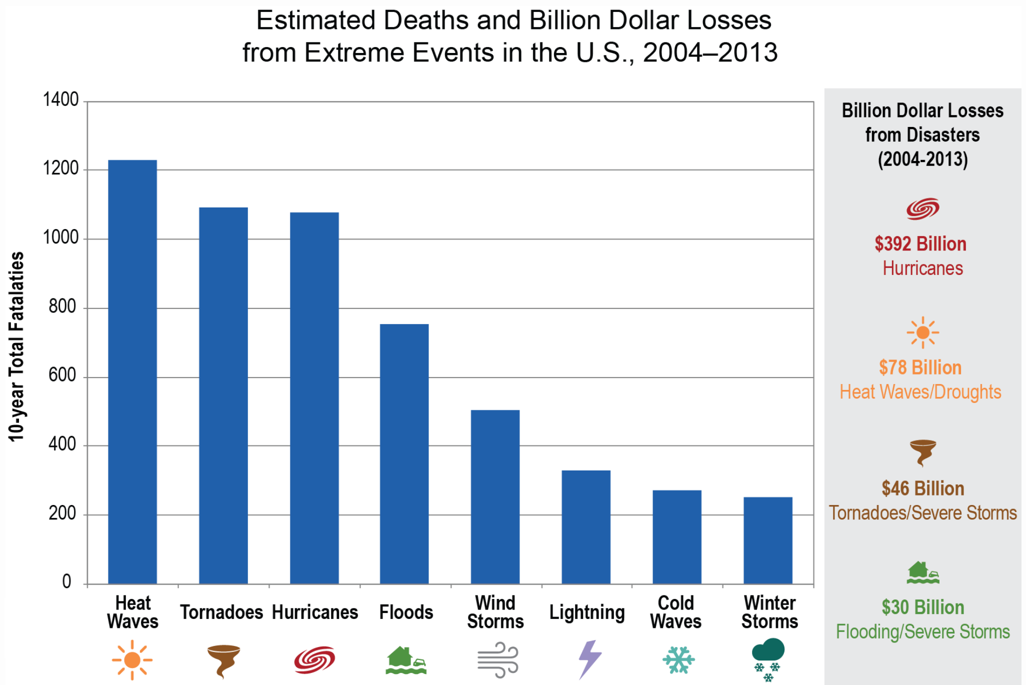
Outline

- Introduction
- Objective
- Regions of study
- Methodology
- Preliminary results

Introduction

- Tropical cyclones (TCs) are among the most destructive natural phenomena on Earth, responsible for great social and economic losses (Camargo and Wing, 2016).
- Several scientists have reported an increase in tropical cyclone intensity over the last 30 years (IPCC, 2007).



Mendelsohn et al. 2012

Introduction

- Previous studies project an increase in the globally averaged frequency of the strongest tropical cyclones (Knutson et al. 2010).

- They also noted that there remains much uncertainty about changes in regional TC activity, implying the need for further regional investigations.

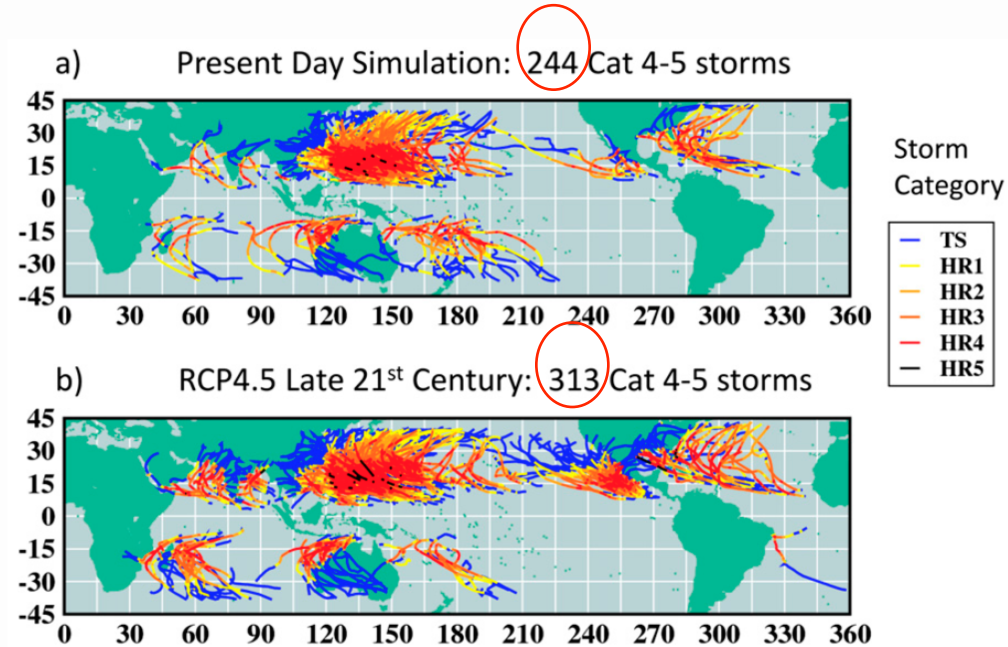


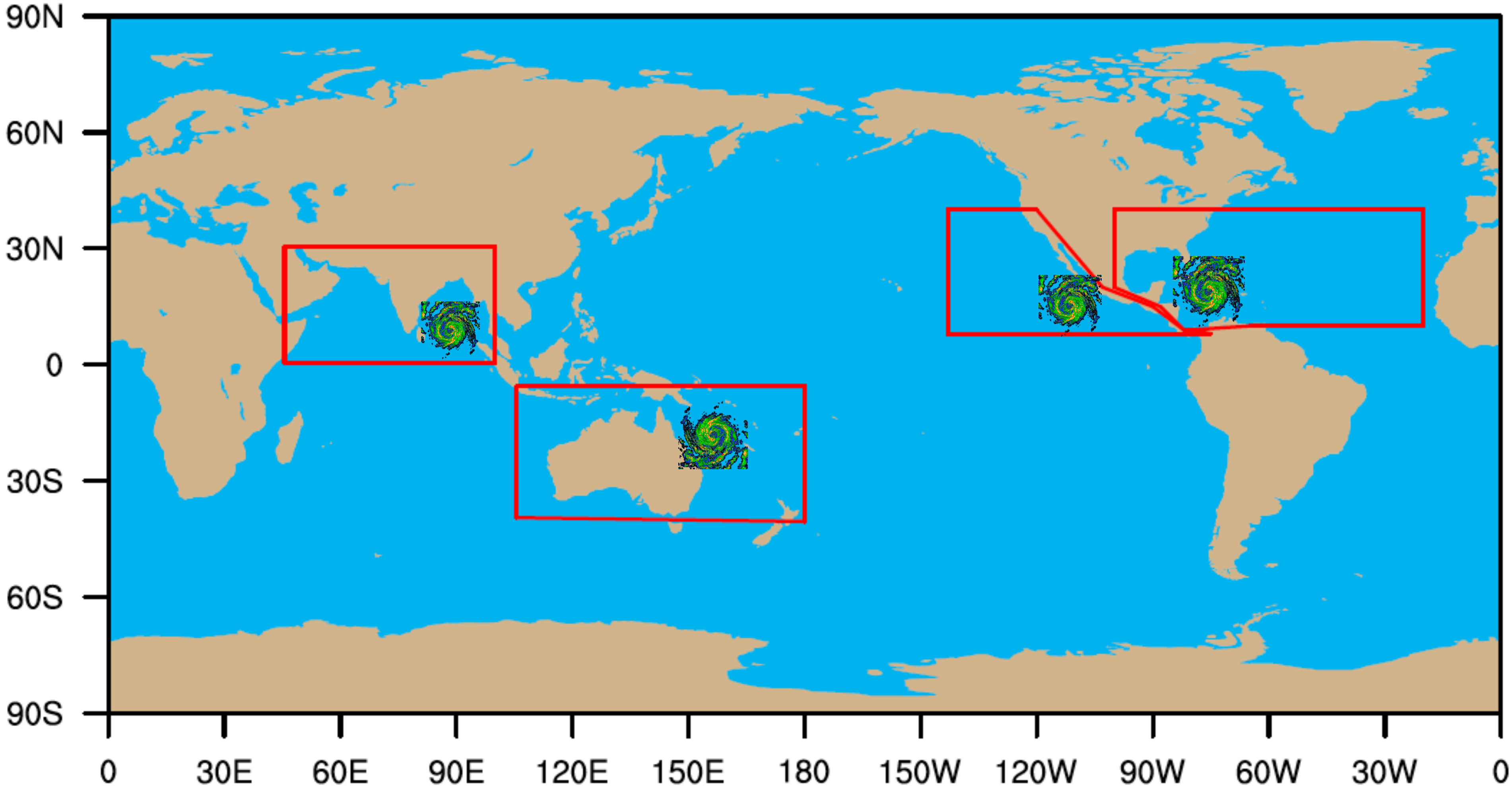
FIG. 7. Tracks of simulated cat 4–5 tropical cyclones for (a) present-day or (b) late-twenty-first-century (RCP4.5; CMIP5 multimodel ensemble) conditions. Simulated tropical cyclone

Knutson et al. 2015

Objective

To investigate the potential changes in tropical cyclone (TC) activity for future climate conditions over three CORDEX domains, using the latest version of the ICTP Regional Climate model (RegCM4.7).

Regions of study



From Cavazos- Perez T.

Tropical cyclone identification method

The objective tracking algorithm, TRACKS, Hodges 1999.
Detection criteria:

a. The T63 relative vorticity maxima at 850 hPa must be $>5\times10{-}5s^{-1}$.

b. The vorticity maxima must exist at 850, 700, 500, and 200 hPa.

c. The difference in vorticity between 850 and 250 hPa must be $>6\times10{-}5s^{-1}$.

d. The 10-m wind-speed maxima must be $>17.5ms^{-1}$.

e. Criteria a, b, c and d must exist for at least four consecutive (1 day) time steps over the ocean only.

Methodology

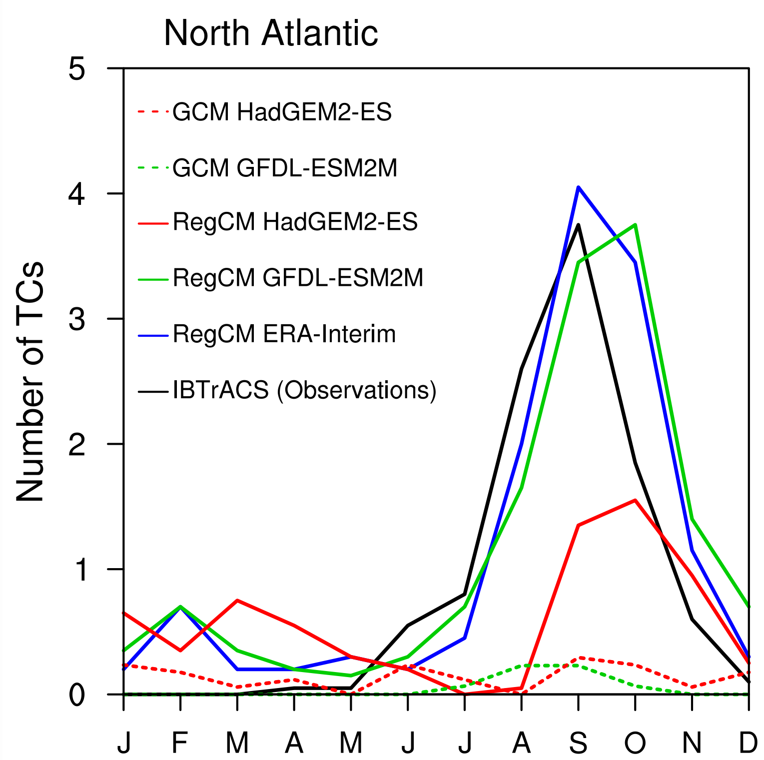
- Simulations driven by GCMs are evaluated for 1971–2000 by comparing them with the RegCM4.7-ERAI 1981 to 2010 and the observed TC data from the International Best Track Archive for Climate Stewardship (IBTrACS).

- We examine changes in the future period (2070–2099) relative to the baseline period (1971–2000) using two Representative Concentration Pathways (RCP): RCP2.6 and RCP8.5.

Methodology

Here we analyze:

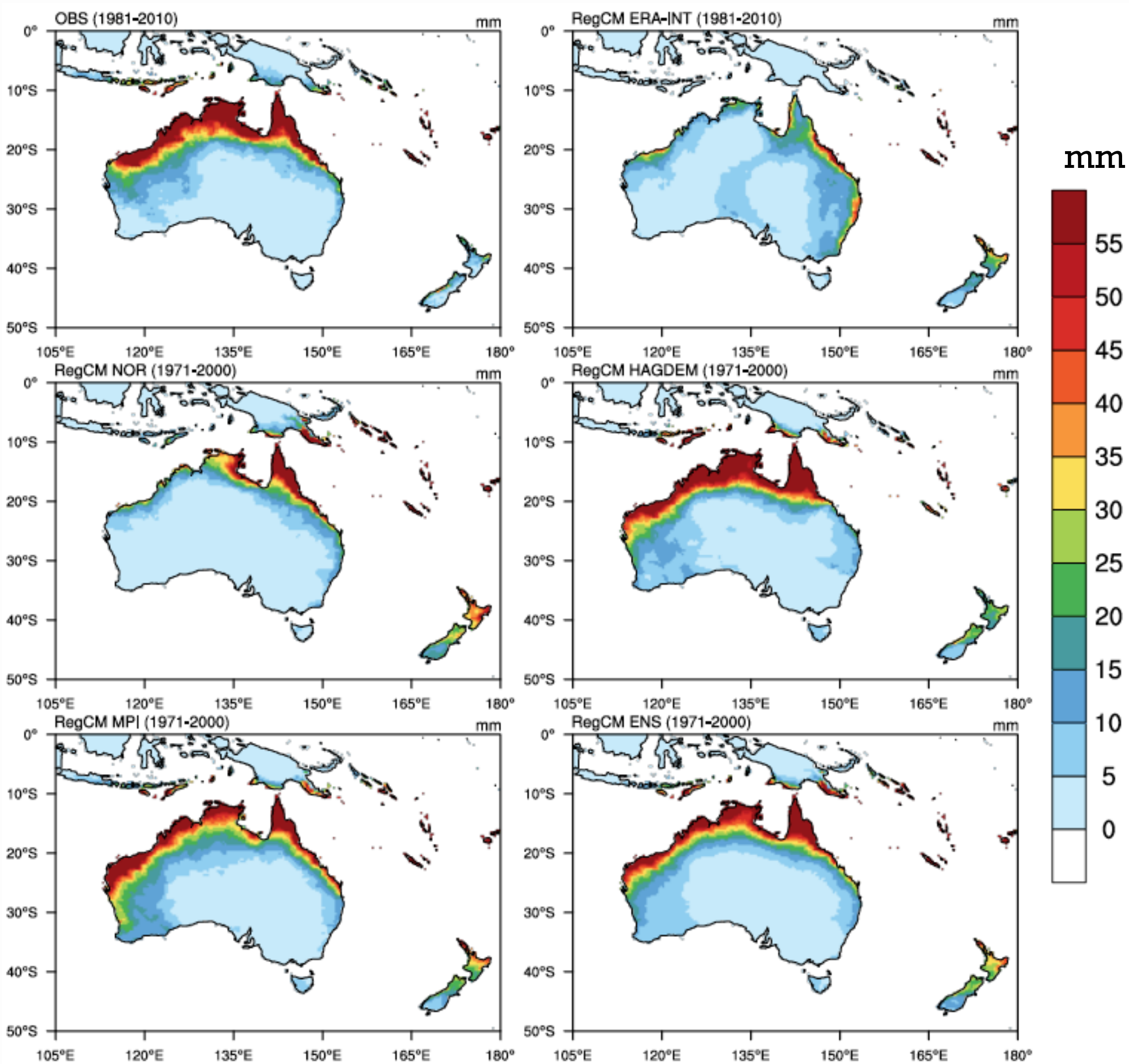
- Intensity (maximum wind speed)
- Geographical distribution
- Seasonal cycle
- Duration
- Precipitation-associated TCs
- Cyclone genesis index (CGI)



TC annual cycle over the Northern Atlantic during 1981-2000.

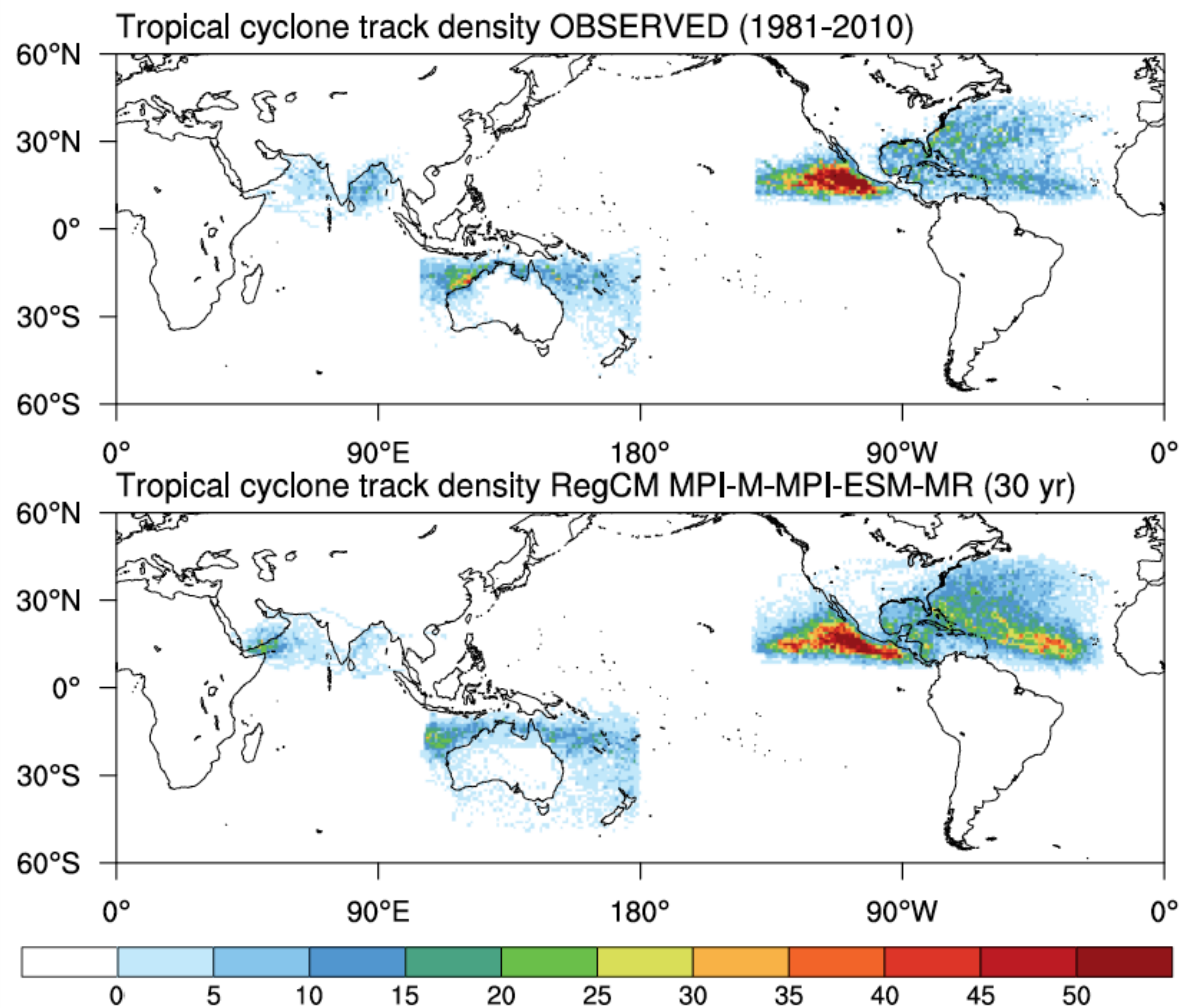
Preliminary results

Relative contribution of TCs to DJFMA precipitation



Climatology of DJFMA TC rainfall (units: mm) for the period 1981–2010.

Preliminary results



The Abdus Salam International Centre for Theoretical Physics

Future projections in the climatology of the low−level jets using RegCM4.7

José Abraham Torres Alavez, Arturo Corrales, Sushant Das, Antonio Salinas, Diego Souza and Melissa Bukovsky

Paper-writing Workshop on the Analysis of CORDEX-CORE Climate

Trieste, Italia

6 - 10 May 2019

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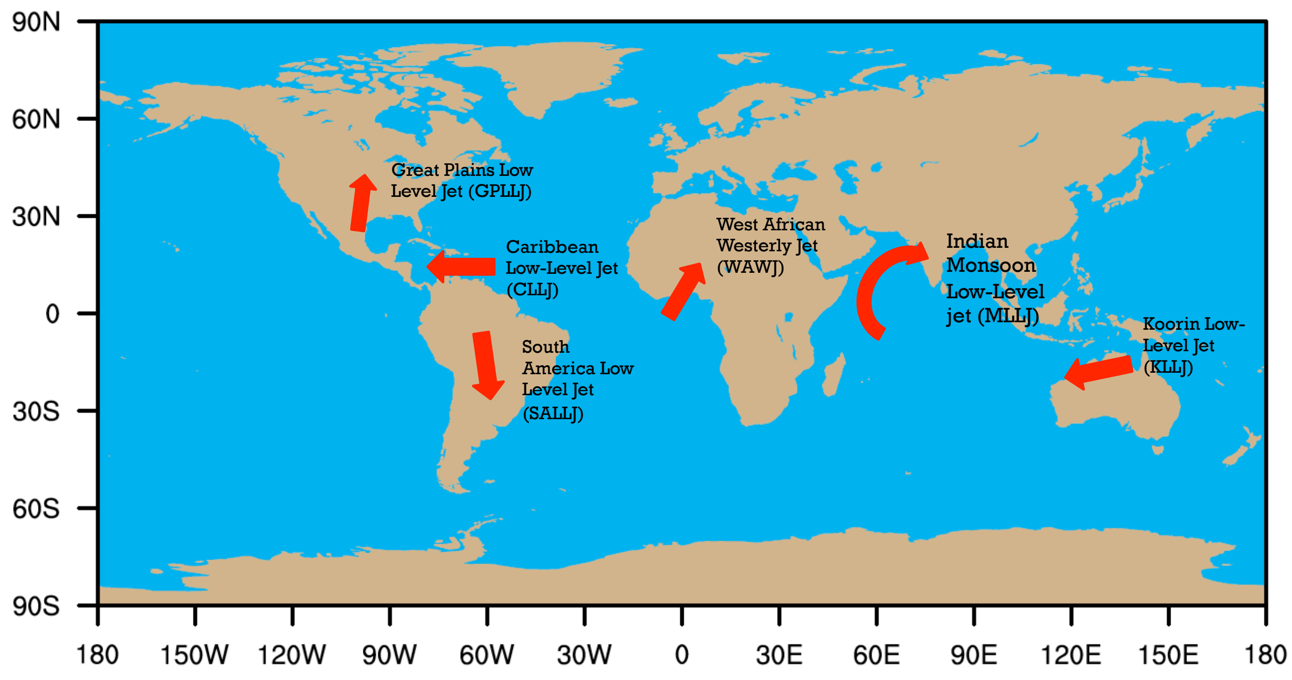
Introduction

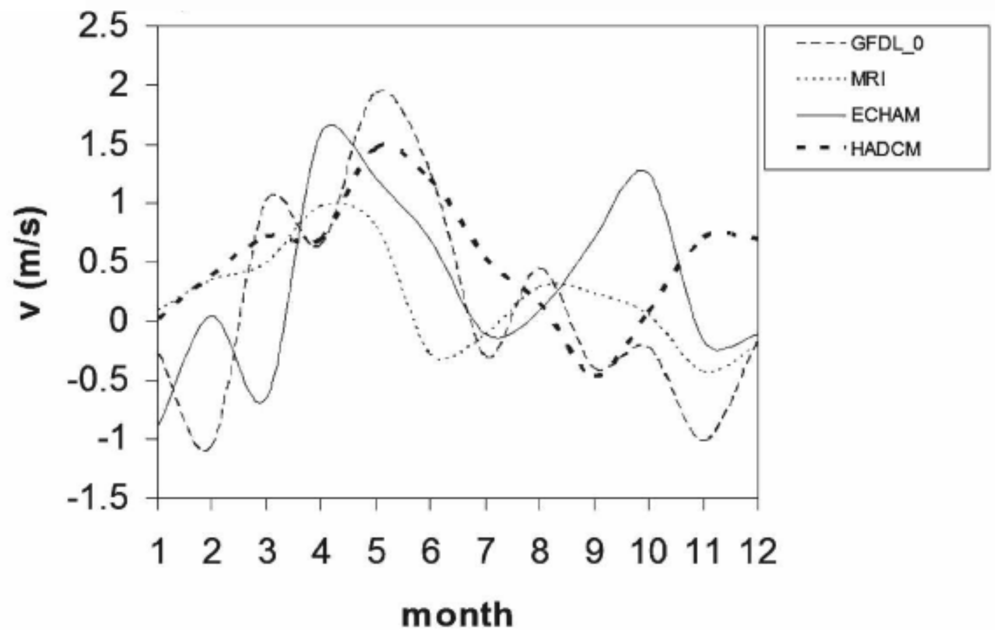
- The low-level jet (LLJ) is a significant wind maximum within the first 1.5 km of the atmosphere (Blackadar, 1957).
- LLJs are closely related to extreme weather and climate events, wind energy utilization, aviation safety, and air quality.



Introduction

- Future changes in LLJ climatology remain poorly investigated using high-resolution simulations (Tang et al., 2017).

- The few previous studies define the jets in terms of mean airflow on a constant pressure surface, ignoring the discrete nature of the LLJs, as jets occur on some days, but not on others.

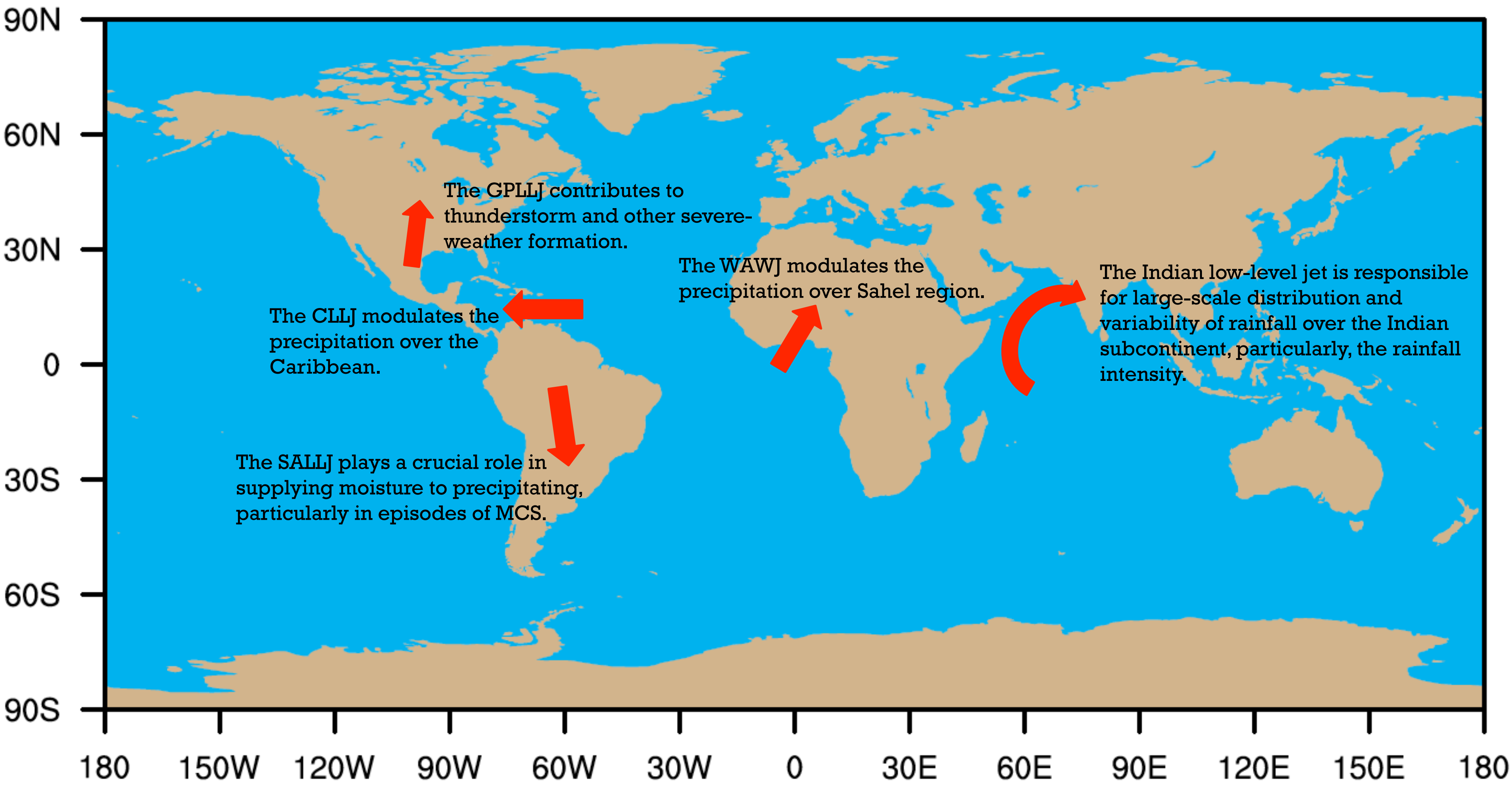


Differences in the meridional wind averaged over the southern Great Plains (30°–38°N, 102°–92°W) for 2079–99 minus 1979–99 (Cook et al. 2008)

Objective

To assess future changes in the climatology of prominent LLJs around the world, using the latest version of the ICTP Regional Climate model (RegCM4.7).

Regions of study



Methodology

The first part of the study evaluates the RegCM4.7 performance in simulating some climatological features of the LLJs. Simulations driven by GCMs are evaluated for the period of 1981–2000 by comparison with the RegCM4.7-ERAI (1991 to 2010) and the ERA-Interim reanalysis.

We examine changes in the future period (2080–2099) relative to the baseline period (1981–2000) using two Representative Concentration Pathways (RCP): RCP2.6 and RCP8.5.

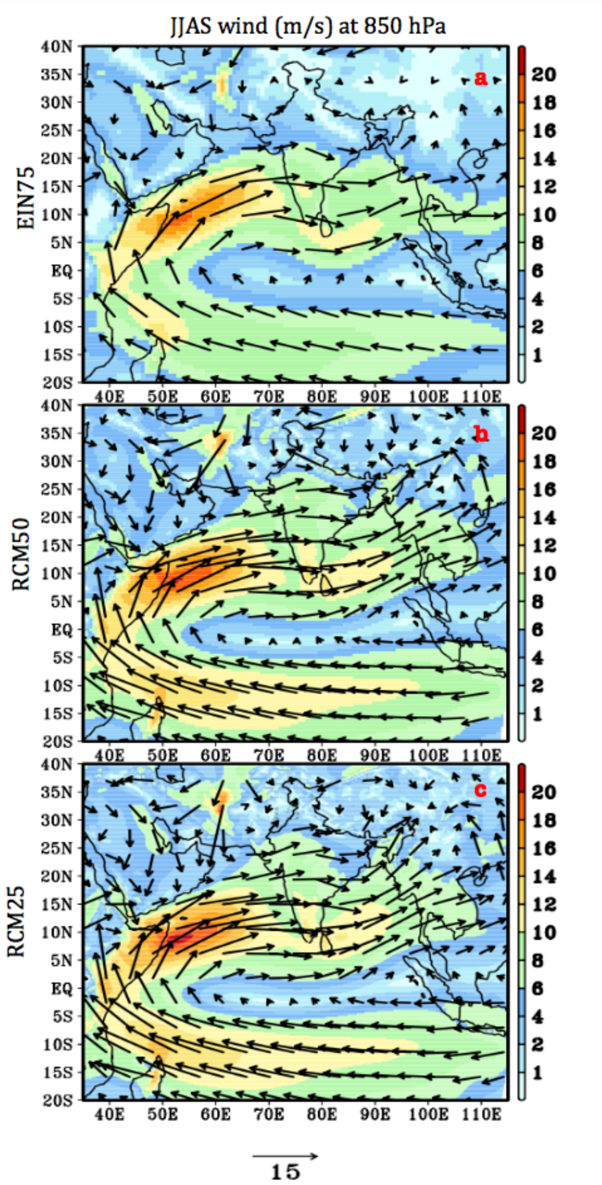
Methodology

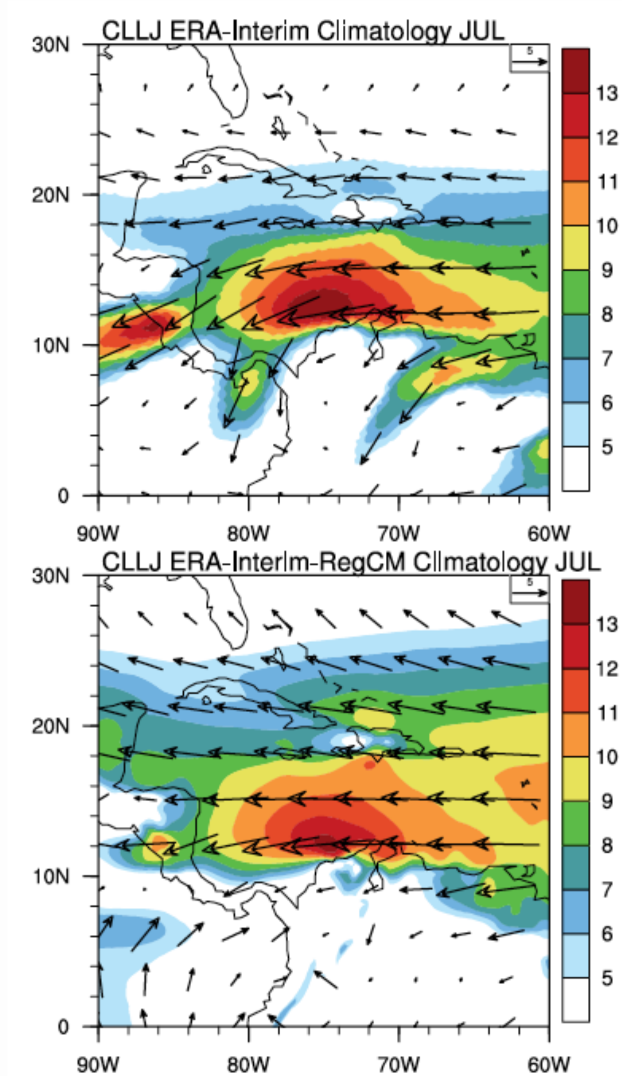
For this study, we analyzed:

- Number of jet occurrences per month
- Maximum jet speed
- Position (vertical and horizontal)
- Annual and diurnal cycle
- Geopotential heights

Following Bonner (1968), a LLJ is identified if the simulated vertical wind profile at a particular grid point meets the following two criteria: (1) A wind-speed maximum no less than 12 m s^{-1} below 3000 m above ground level (AGL) and (2) a decrease of wind speed from the maximum to the next minimum no less than 6 m s^{-1}.

Preliminary results





Wind (m/s) at 925 hPa

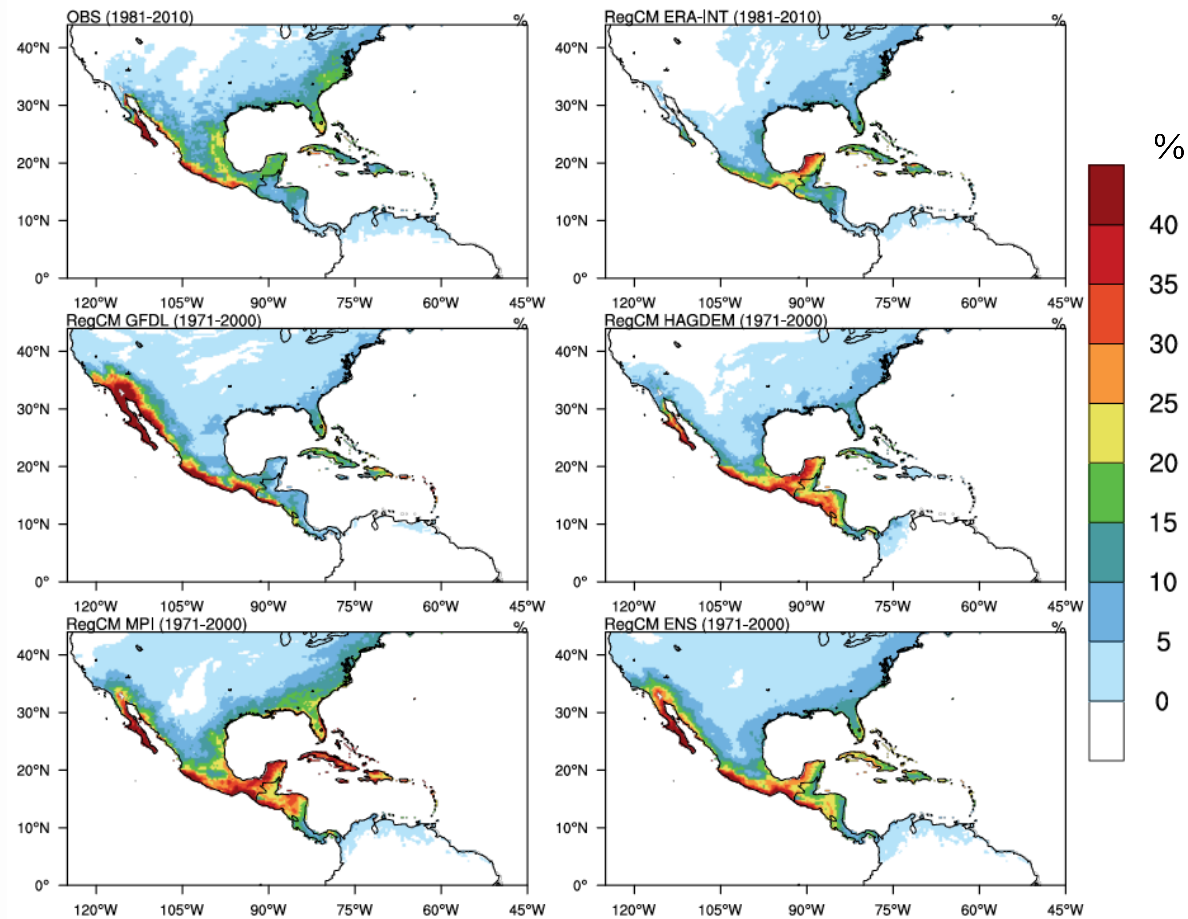
Thank You!

If anyone else is interested in collaborating on these studies, please let me know!

jtorres@ictp.it

I wasn't prepared…

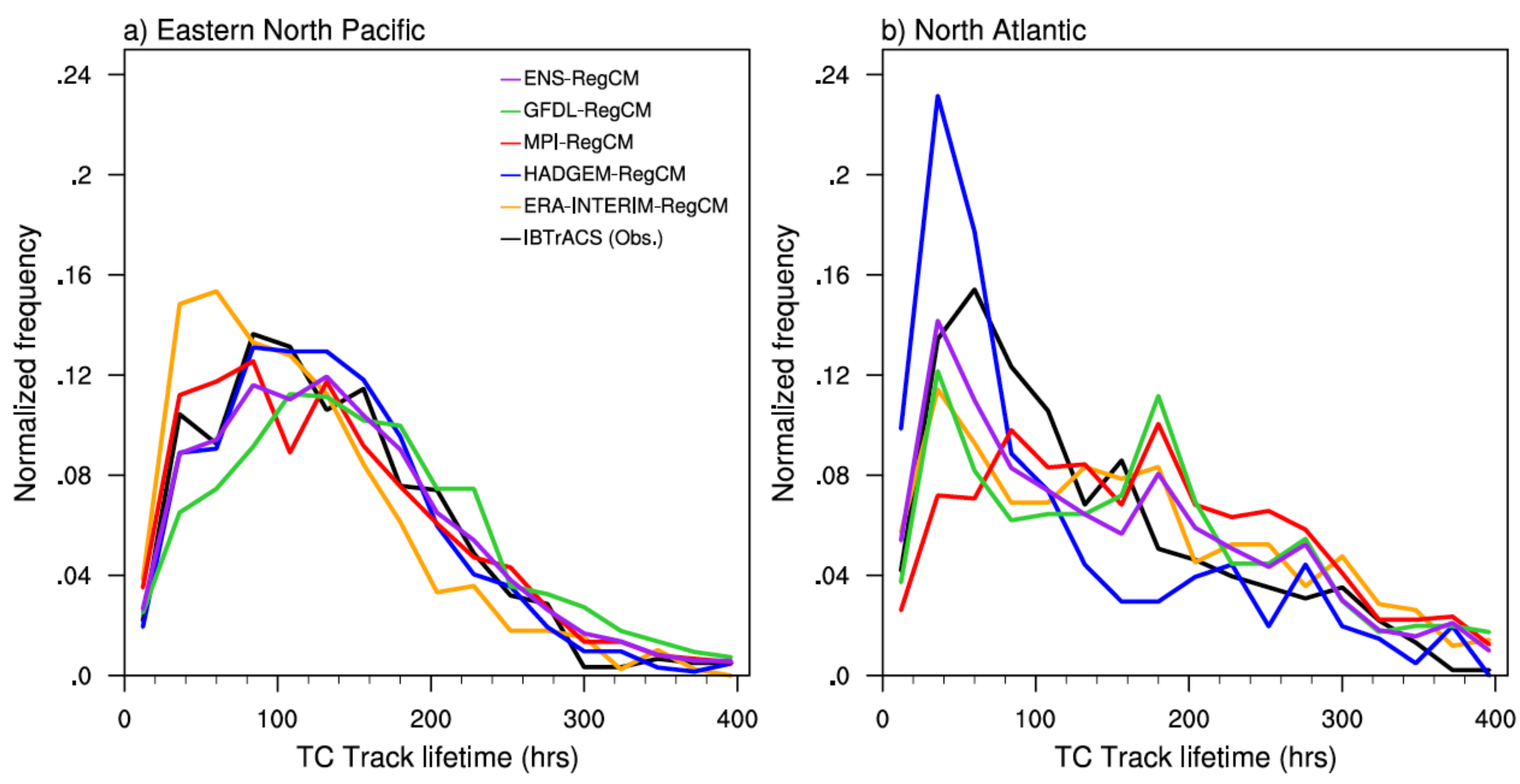
Relative contribution of TCs to extreme precipitation



We compute the number of days exceeding the 95th percentile for the rainy days. Considering daily rainfall to be TC induced if the center of circulation of the storm is located within 500 km radius from the grid point during a time window of ±1 day.

I wasn't prepared…

Distribution of TC track lifetimes



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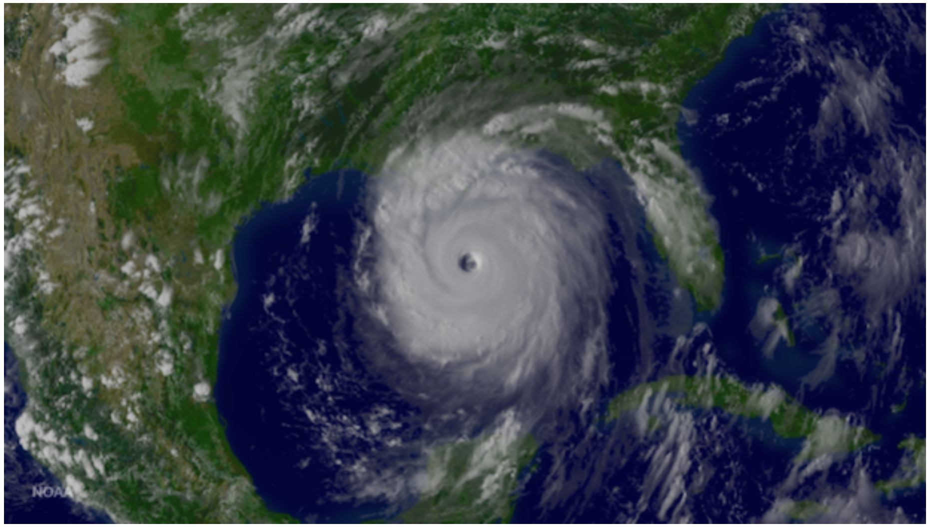
In terms of observed precipitation, we use the Multi-Source Weighted-Ensemble Precipitation (MSWEP) V2, which is based on a combination of rain gauge measurements, satellite products and reanalysis data (Beck et al. 2017a, b).



This satellite image was taken by GOES East at 2015Z on August 28, 2005 when Hurricane Katrina was at its maximum intensity of Category 5.

I wasn't prepared…

$$\mathrm{CGI} = \left(\frac{\mathrm{PI}}{70}\right)^3 [1 + 0.1(V_{\mathrm{shear}})]^{-2}.$$

$$V_m^2 = \frac{T_s}{T_0}\frac{C_k}{C_D}[CAPE^* - CAPE]|_m \qquad (3)$$

where $CAPE^*$ is the convective available potential energy of air lifted from saturation at sea level in reference to the environmental sounding, and $CAPE$ is that of boundary layer air. Both quantities are evaluated near the radius of maximum wind. Note that the effect of dissipative heating

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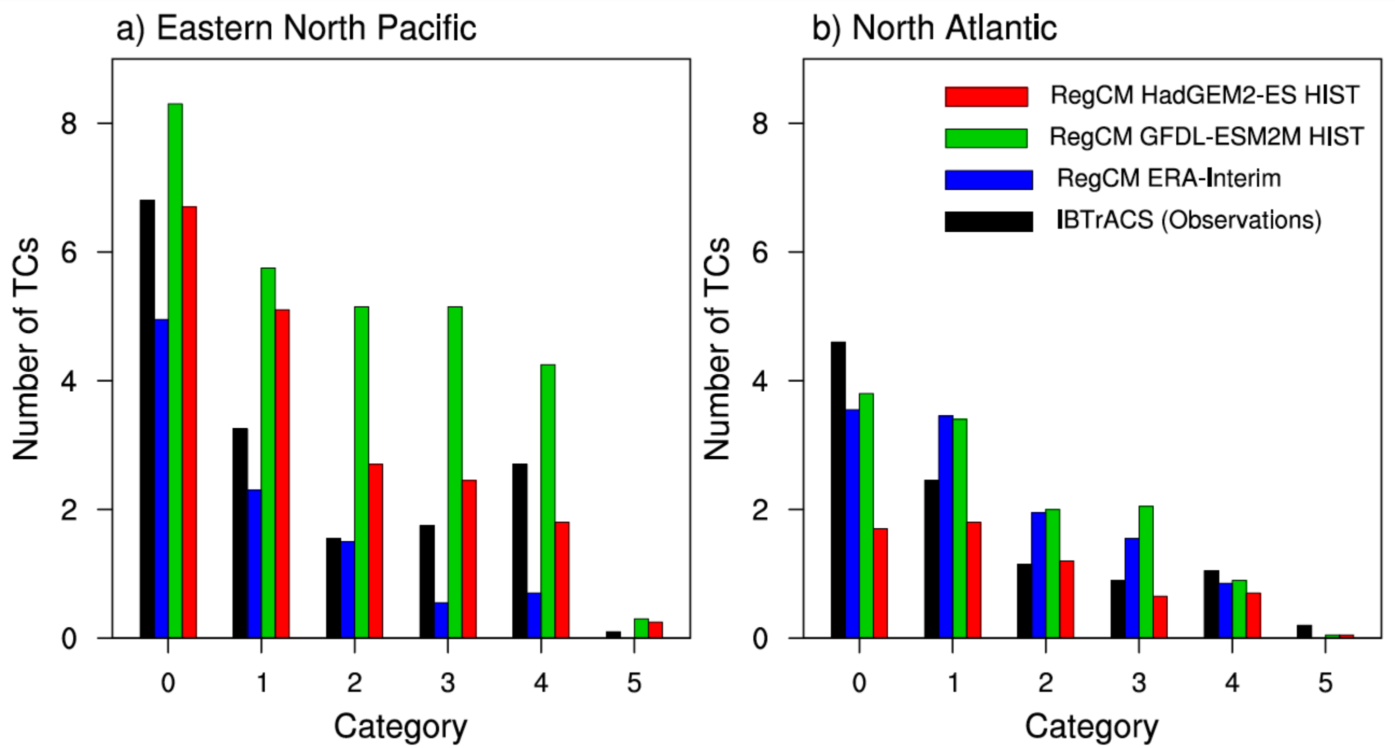

Annual number of TC by Saffir-Simpson scale for the a) Eastern Pacific and b) Northern Atlantic for the period, 1981-2000. A statistical bias correction was applied to the simulated maximum surface wind speed

Classification	1-minute sustained wind speed (m/s)
Tropical depression (TD)	< 17 m/s
Tropical Storm (TS)	17 – 32 m/s
Category 1 (TC1)	32 – 42 m/s
Category 2 (TC2)	42 – 49 m/s
Category 3 (TC3)	50 – 58 m/s
Category 4 (TC4)	58 – 70 m/s
Category 5 (TC5)	> 70 m/s

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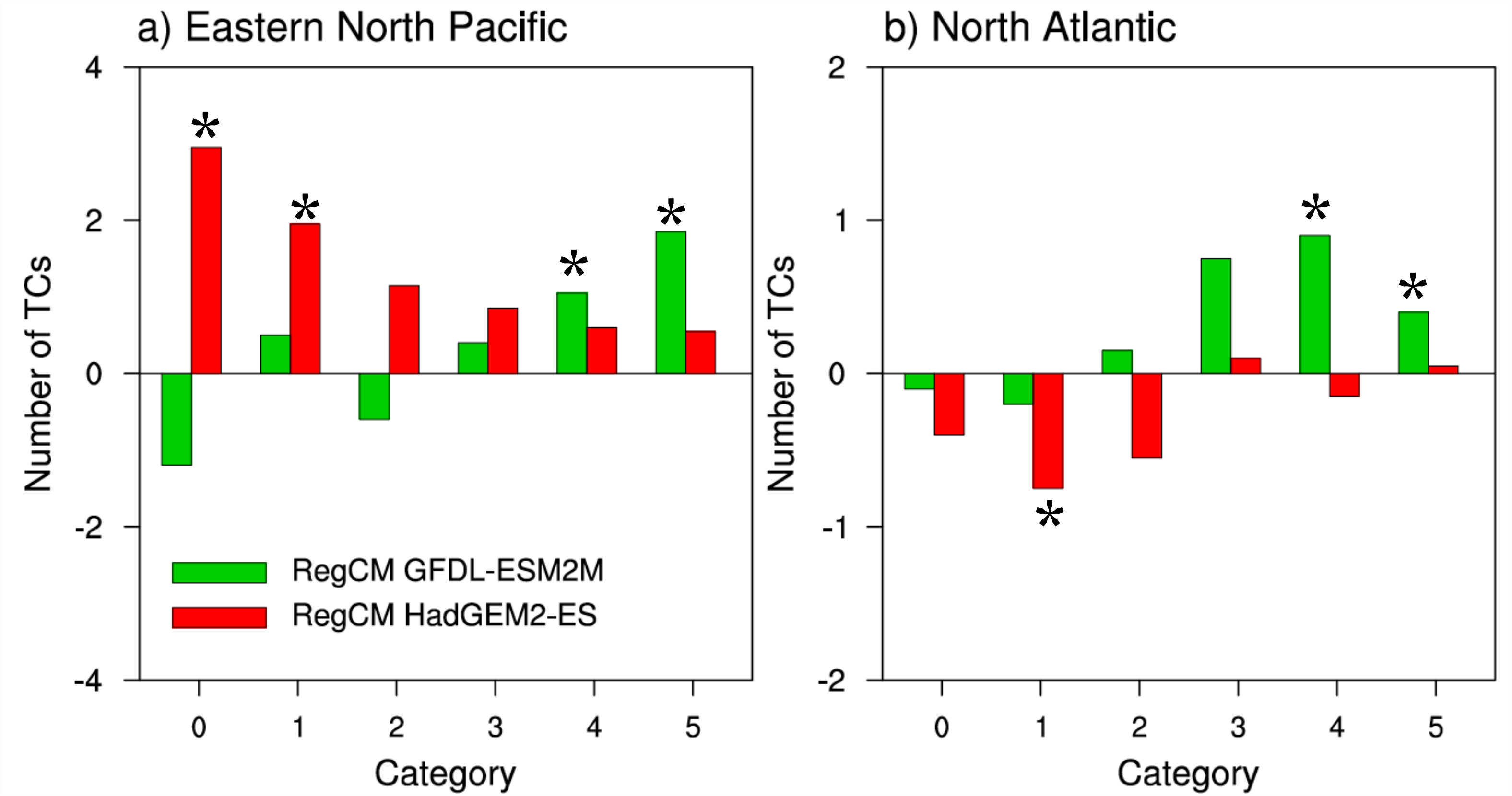

Changes in the annual number of TC by the Saffir-Simpson scale during 2071-2090 under the RCP8.5 scenario relative to that during the baseline, 1981-2000, for the a) Eastern Pacific and b) Northern Atlantic. Asterisk symbols show where changes are significant at a 95% confidence level, based on the Student’s t-test.

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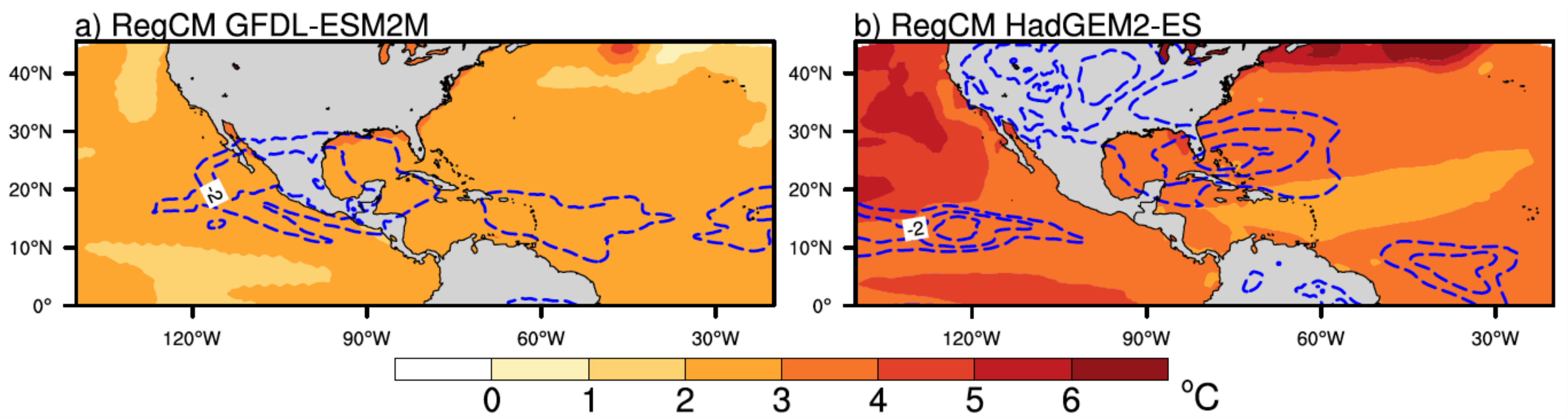

Negative changes in JASON mean vertical wind shear between 200-850 hPa (ms^{-1}; dashed lines) and changes in JASON mean SST (◦C; colors) in 2071-2090 under the RCP8.5 scenario, relative to that during the baseline, 1981-2000, for a) RegCM GFDL-ESM2M and b) RegCM HadGEM2-ES.

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