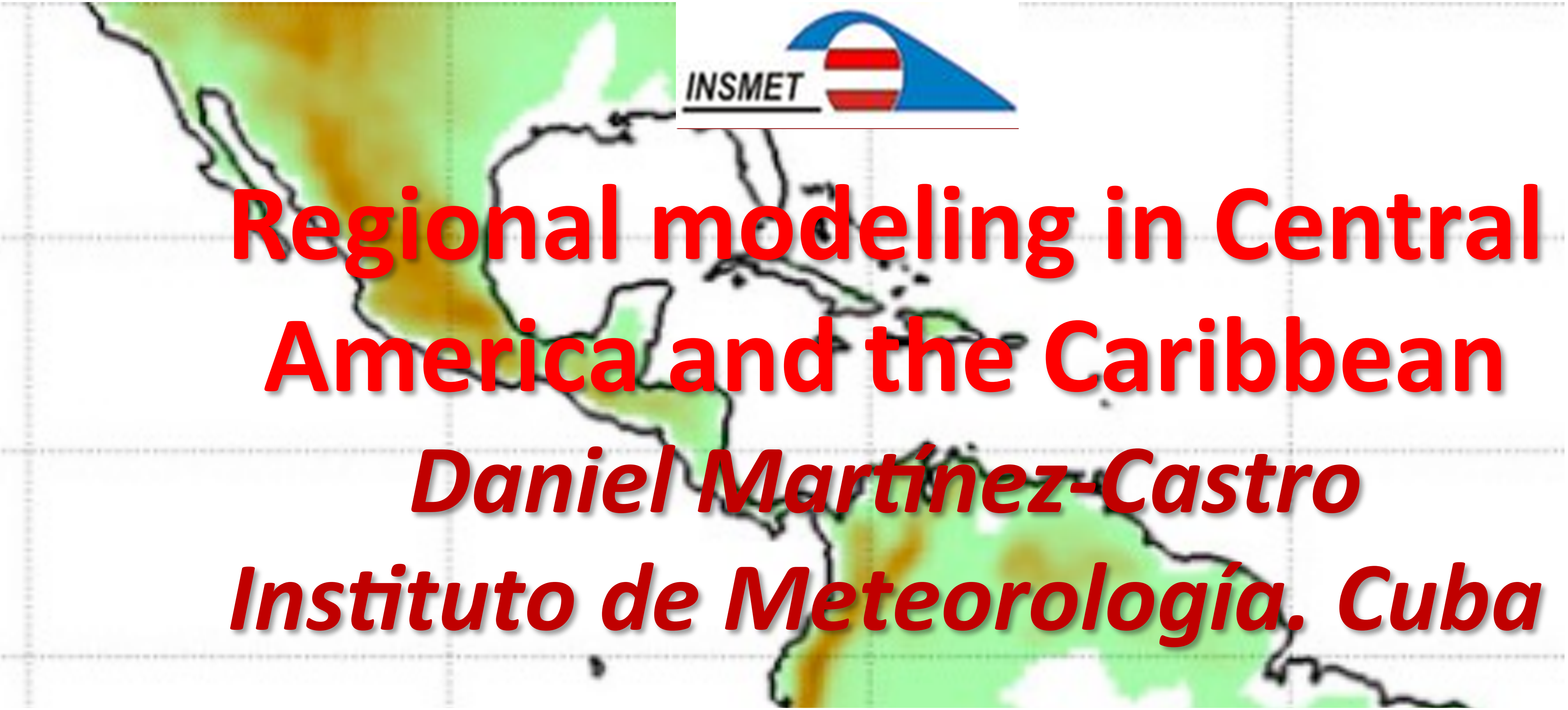
Workshop on the Science of Climate Change:
a focus on Central America and the Caribbean Islands

14 - 16 March 2017

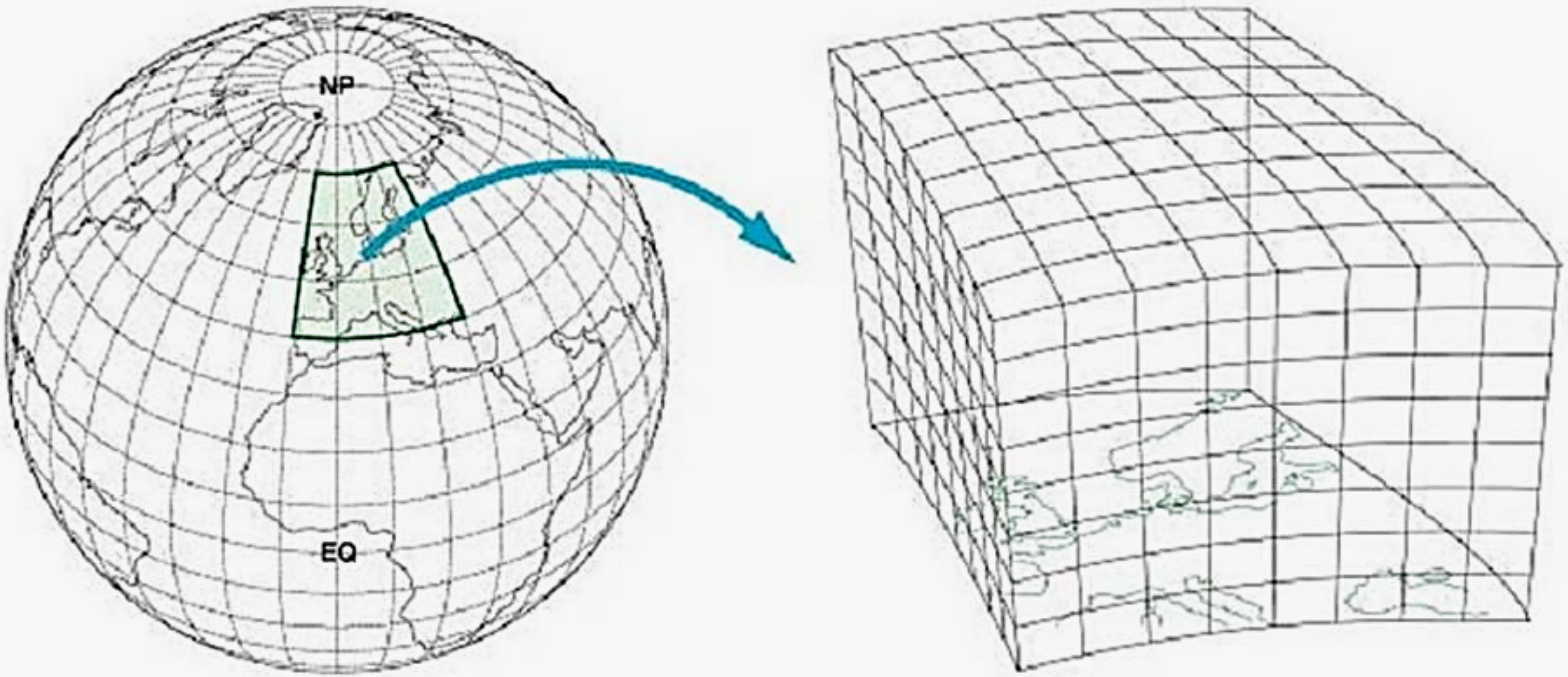


Regional modeling in Central America and the Caribbean

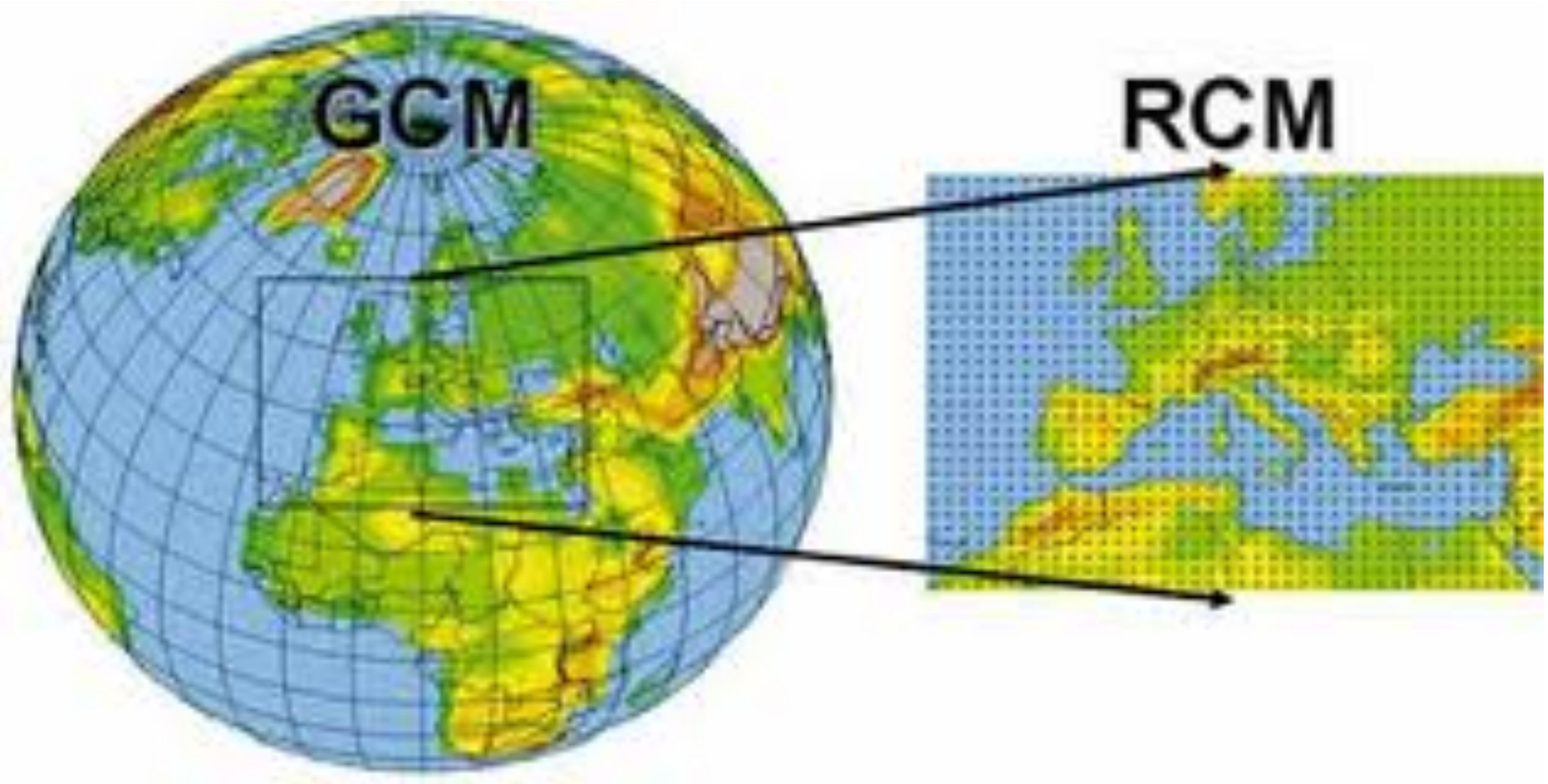
Daniel Martínez-Castro

Instituto de Meteorología. Cuba

Regional Climate Models



Regional atmospheric modelling: nesting into a global state


GCM
RCM

Regional Climate Models

The main goal of regional climate models (RCMs) is to reproduce the main climatic features in complex terrain, where mesoscale forcing becomes important and coarse-resolution global climate models (GCMs) are not sufficient for assessing local climate variability. Very high resolution GCMs are an extremely costly alternative solution.

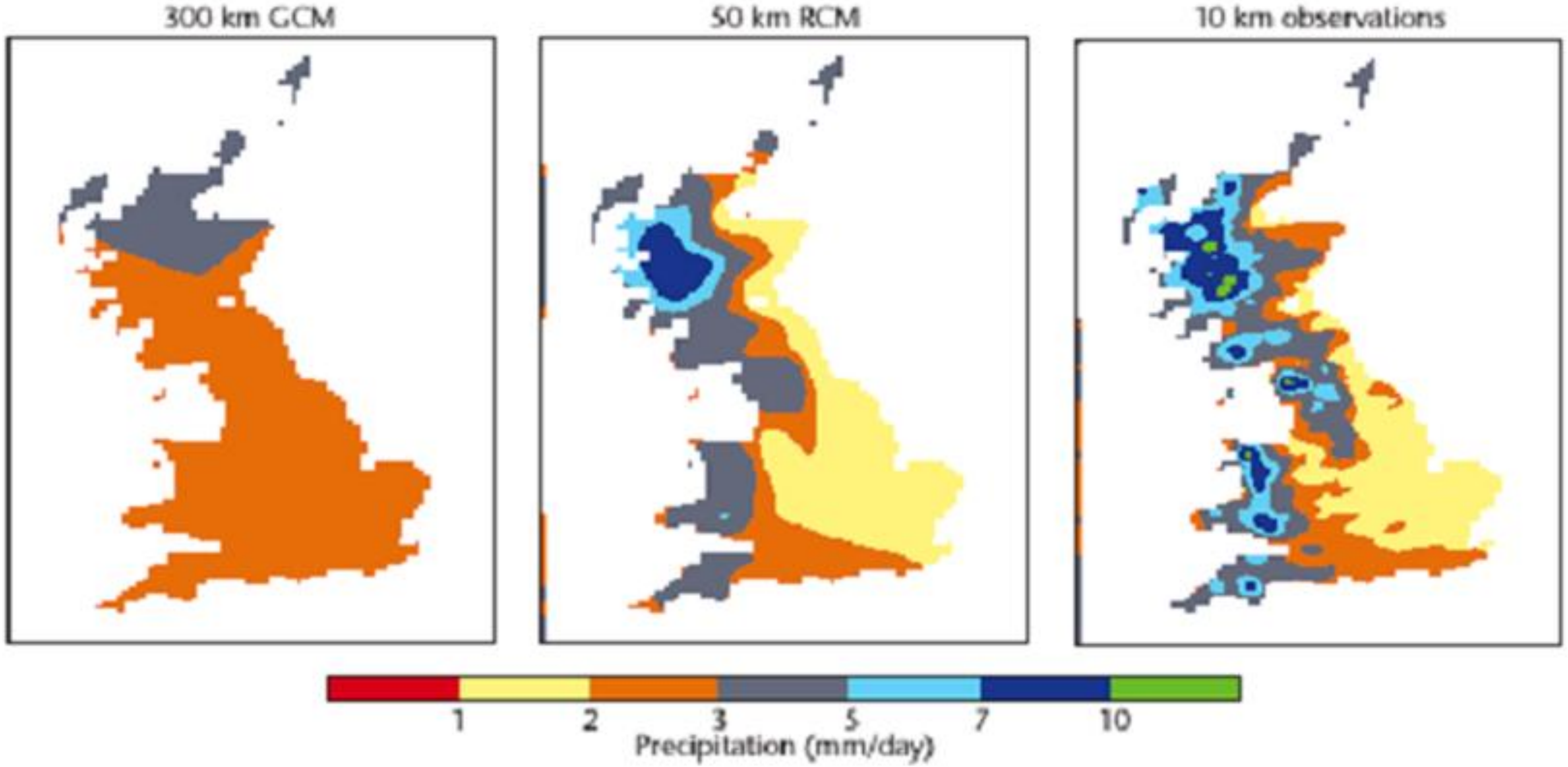
The Caribbean islands and adjacent territories are an example of the usefulness of RCM.

Regional climate modeling technique

The nested regional climate modeling technique consists of defining a limited region (e.g., Europe, South America, the Caribbean Region) and run a high resolution model only for that region, using the output of a GCM as boundary conditions.

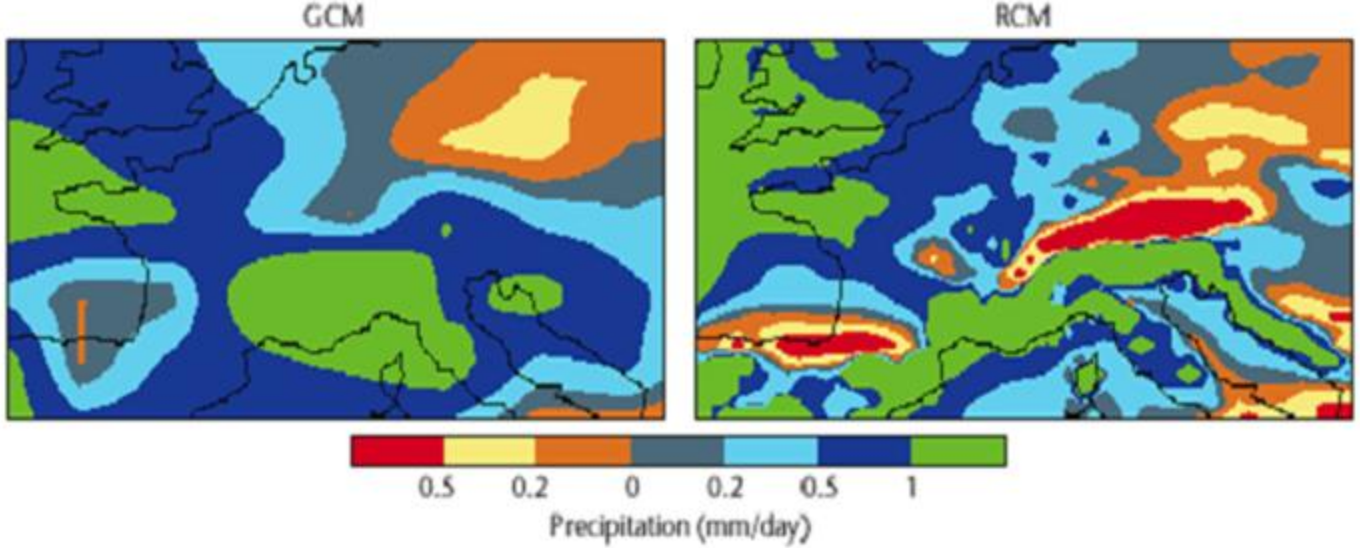
This technique has been mostly used only in one-way mode, i.e. with no feedback from the RCM simulation to the driving GCM. The basic strategy is thus to use the global model to simulate the response of the global circulation to large scale forcings (synoptic scale systems) and the RCM to account for sub-GCM grid scale forcings (e.g. local circulations, complex topographical features and land cover inhomogeneity).

RCMs simulate current climate more realistically



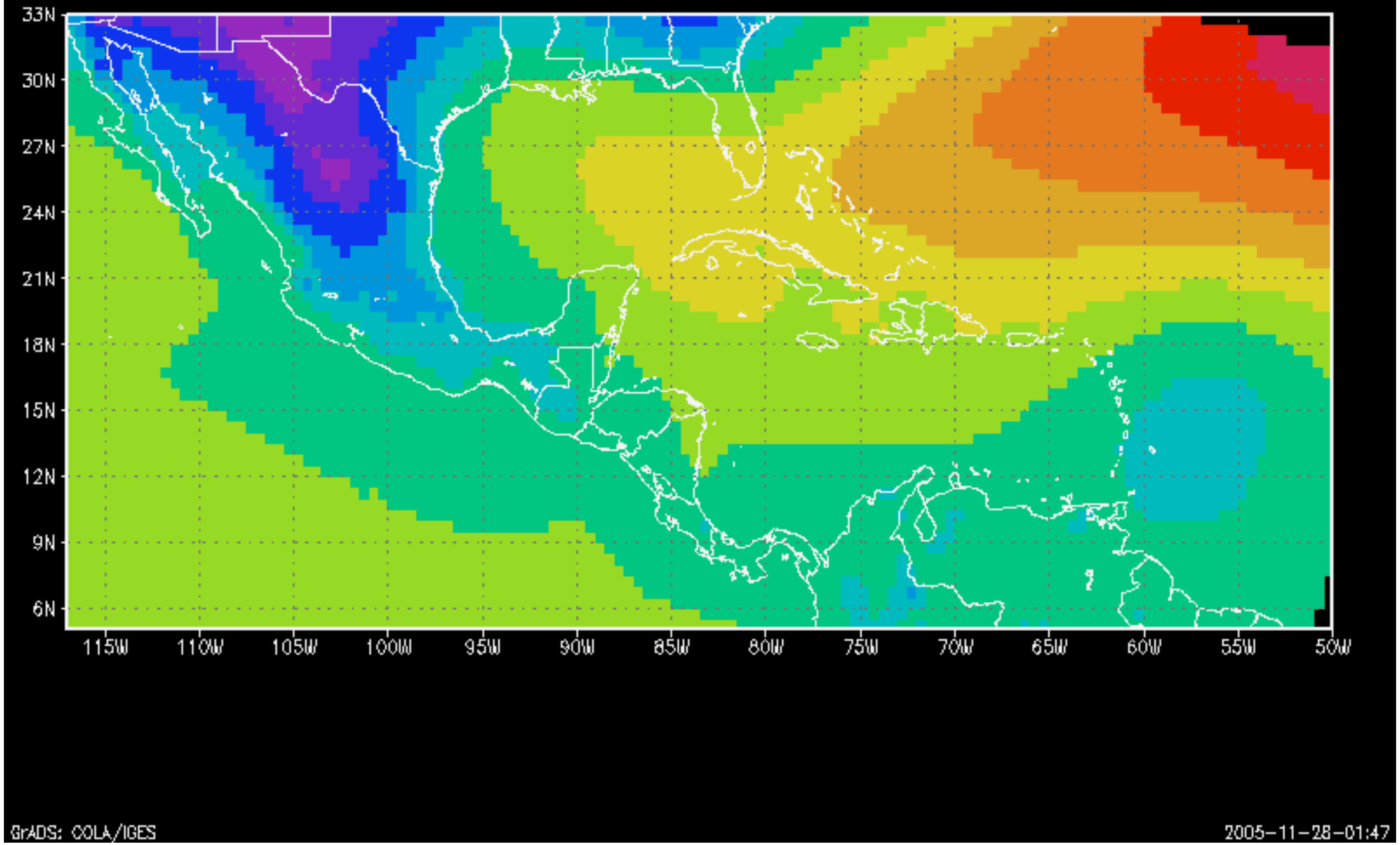
Patterns of present-day winter precipitation over Great Britain

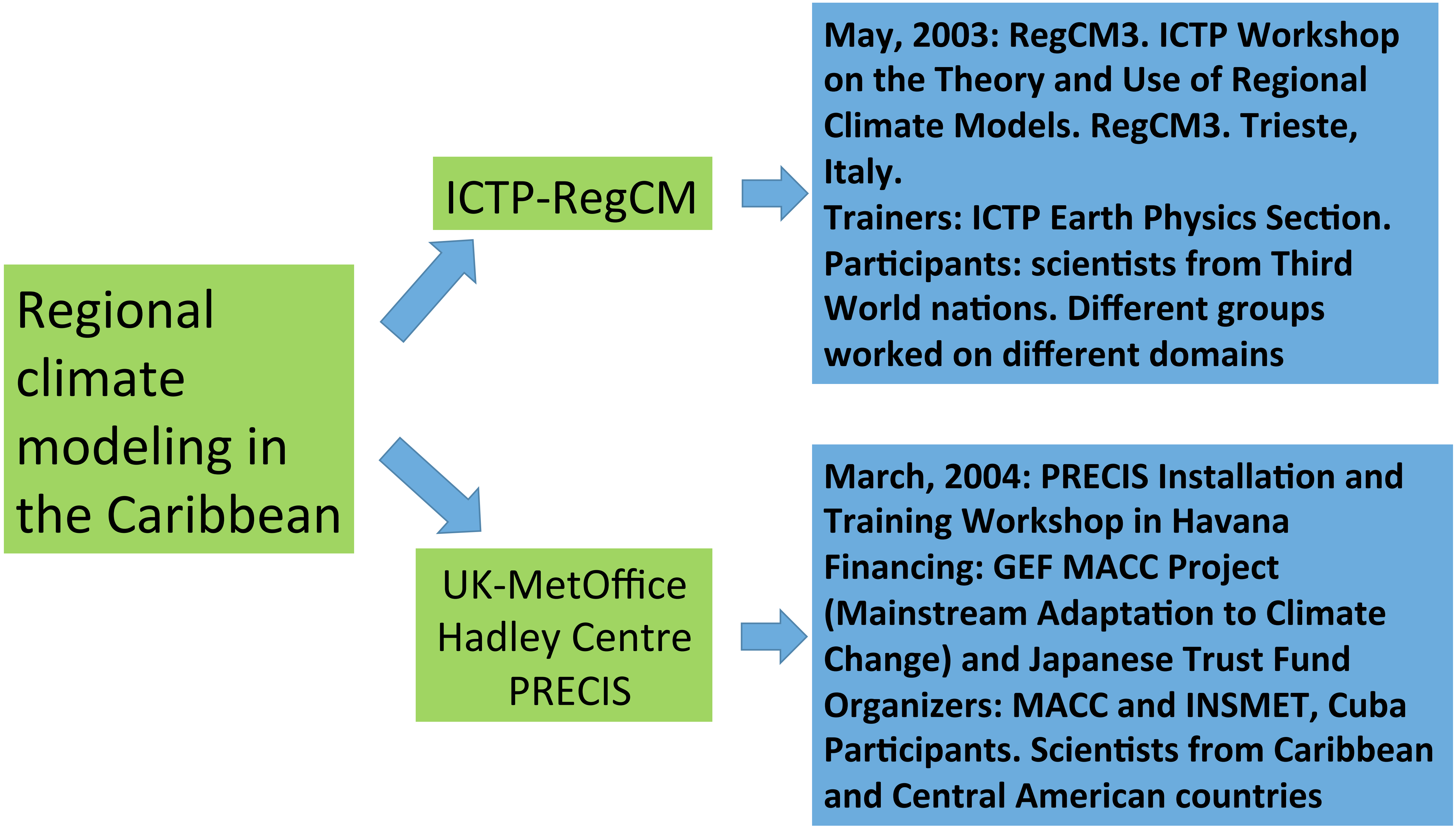
Predict climate change with more detail



Projected changes in winter precipitation between now and 2080s.

Represent Tropical cyclones




Regional climate modeling in the Caribbean
ICTP-RegCM
May, 2003: RegCM3. ICTP Workshop on the Theory and Use of Regional Climate Models. RegCM3. Trieste, Italy.
Trainers: ICTP Earth Physics Section.
Participants: scientists from Third World nations. Different groups worked on different domains
UK-MetOffice Hadley Centre PRECIS
March, 2004: PRECIS Installation and Training Workshop in Havana
Financing: GEF MACC Project (Mainstream Adaptation to Climate Change) and Japanese Trust Fund
Organizers: MACC and INSMET, Cuba
Participants. Scientists from Caribbean and Central American countries

THE PRECIS CARIBBEAN STORY

Lessons and Legacies

BY MICHAEL A. TAYLOR, ABEL CENTELLA, JOHN CHARLERY, ARNOLDO BEZANILLA, JAYAKA CAMPBELL, ISRAEL BORRAJERO, TANNECIA STEPHENSON, AND RIAD NURMOHAMED

UWI Mona and Cave Hill, INSMET, Univ. of Surinam

BAMS July, 2013

PRECIS: Providing Regional Climates for Impacts Studies

Atmospheric and land surface high resolution LAM locatable in any region

Horizontal resolution: 0.44°C (50 km) or 0.22°C (25 km)

Forced by GCM: HadAM3H; ECHAM4 or other versions

Built by Hadley Centre but run locally on linux

Available on line at www.metoffice.gov.uk

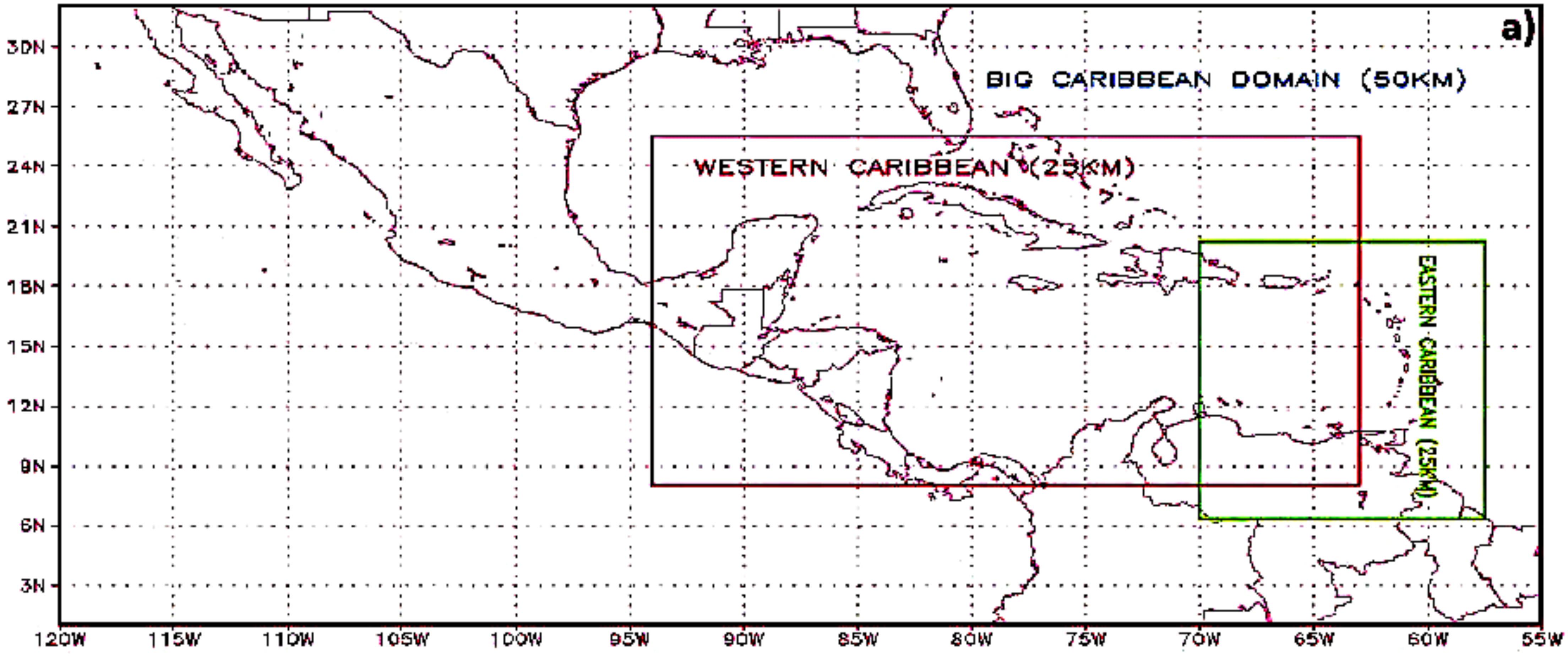
The PRECIS Caribbean Agenda: Multicountry collaboration initiative to run the model in different domains following a coordinated strategy to share effort and resources.
UWI (Jamaica, Barbados), INSMET (Cuba), CCCCC (Caribbean Community Climate Change Centre, Belize)

Three domains :CAM-Caribbean Region (50-km), Eastern Caribbean (Lesser Antilles 25 km) and Western Caribbean (Greater Antilles 25 km). and) GCM: HadAM3H; later HadAM3P and ECHAM4. Time-slice approach. Present (1960–90) and end-of-century (2071–99) . A2 and B2 SRES scenarios

Table 1. Initial division of runs.

Cuba (INSMET)	Caribbean basin, 50 × 50 km^2	B1 (30 yr) and A2 (30 yr), baseline (30 yr), reanalysis (15 yr)
Jamaica, UWI (Mona)	Caribbean basin, 50 × 50 km^2	A2 (30 yr) and B2 (30 yr), baseline (30 yr)
Barbados, UWI (Cave Hill)	Eastern Caribbean, 25 × 25 km^2	A2 (30 yr) and B2 (30 yr), baseline (30 yr)
Belize, 5Cs	Caribbean and eastern Caribbean	Multiple runs

PRECIS CARIBBEAN DOMAINS



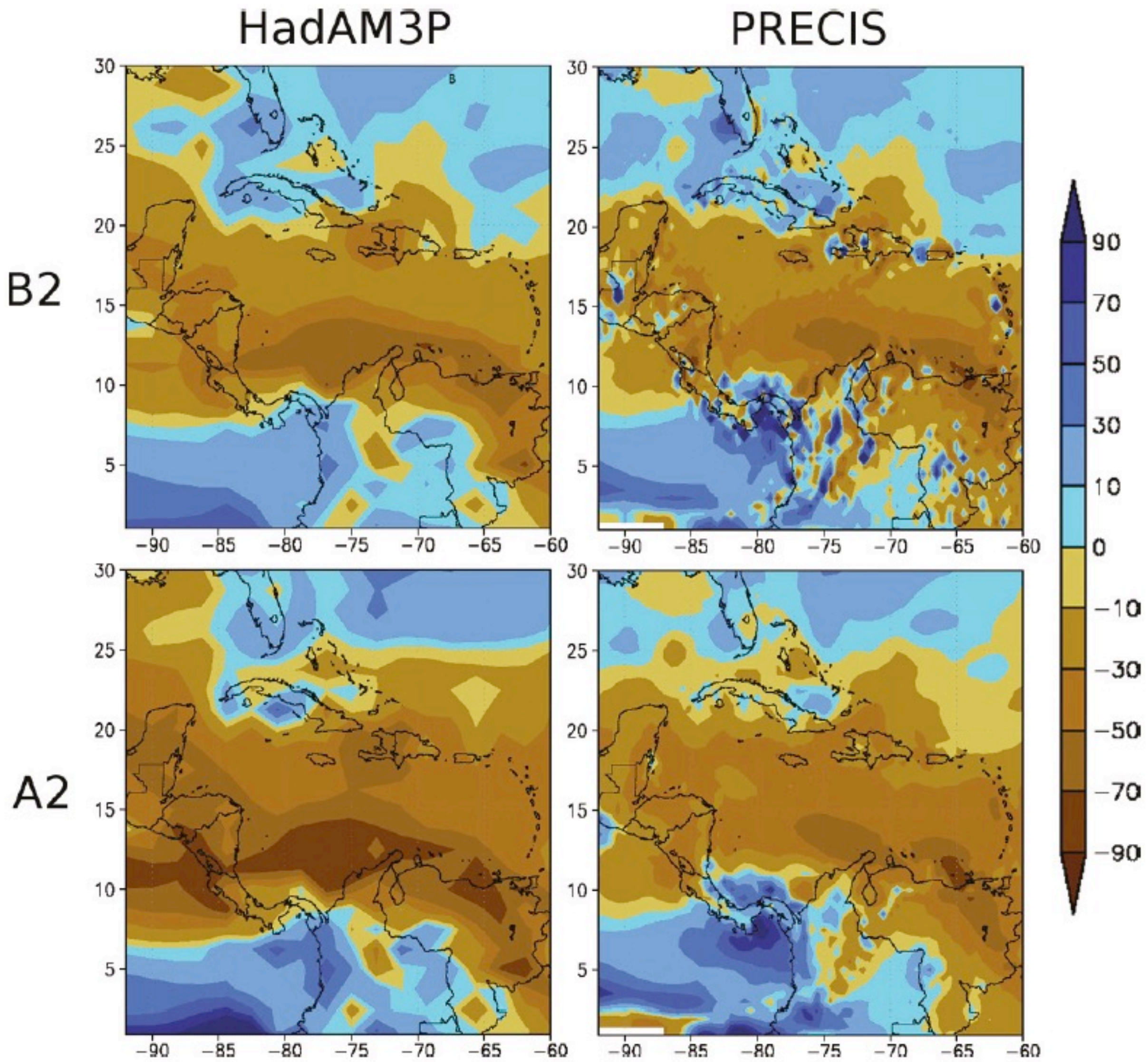


FIG. 4. Annual mean changes in precipitation (%) for 2071–99 with respect to 1961–89 as simulated by (left) HadAM3P and (right) PRECIS. Top (bottom) shows results for the B2 (A2) emission scenario.

Some papers produced by PRECIS Caribbean initiative

- **Campbell J. D., M. A. Taylor, T. S. Stephenson, R. A. Watson and F. S. Whyte, 2010.** Future climate of the Caribbean from a regional climate model. Int. J. Clim. 31, 1866-1878, doi:10.1002/joc.2200.
- **Martínez-Castro D., Borrajero I., Bezanilla A. and Centella A., 2011:** The occurrence of tropical cyclones in the Caribbean and Mexico and global warming. Application of a regional climate model. "Rev. Ciencias de la Tierra y el Espacio", 12, 2011. http://www.iga.cu/publicaciones/revista/cte_12/CTE12.html
- **Karmalkar A. V., R. S. Bradley and H. F. Diaz, 2011.** Climate change in Central America and Mexico: Regional climate model validation and climate change projections. Clim. Dyn. 37,605-629, doi:10.1007/s00382-011-1099-9.
- **Taylor MA, Whyte F., Stephenson TS. and Campbell JD, 2012:** Why dry? Investigating the future evolution of the Caribbean Low Level Jet to explain projected Caribbean drying. Int. Journ. Climatology. DOI: 10.1002/joc.3461
- **Karmalkar A. V., M. A. Taylor, J. Campbell, T. Stephenson, M. New, A. Centella, A. Bezanilla and J. Charlery, 2013**. A review of observed and projected changes in climate for the islands in the Caribbean. Atmósfera 26(2), 283-309
- **Taylor MA, Centella A, Charlery J, Bezanilla A, Campbell J, Borrajero I, Stephenson T, Nurmohamed R, 2013:** The Precis Caribbean Story: Lessons and Legacies. Bulletin of the American Meteorological Society. 94: 1065-1073.
- **Centella-Artola A, Taylor MA, Bezanilla-Morlot A, Martínez-Castro D, Campbell J, Stephenson T, and Vichot-Llano A, 2015** Assessing the effect of domain size over the Caribbean region using the PRECIS regional climate model. Clim. Dyn. 44. 1901-1918. DOI 10.1007/s00382-014-2272-8.

Future climate of the Caribbean from a regional climate model

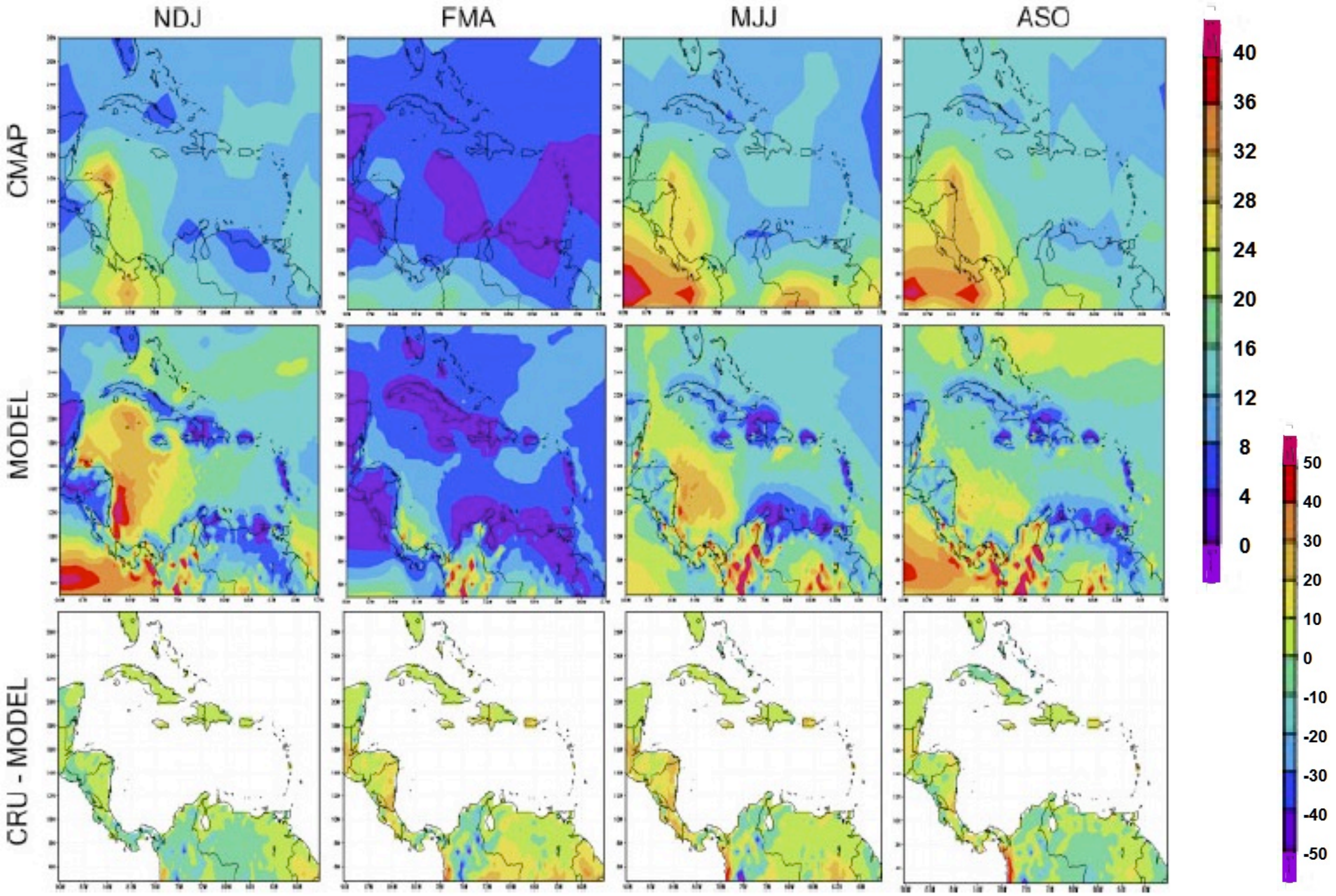
Int. Journ. Climatol. (2010)

Jayaka D. Campbell, Michael A. Taylor,* Tannecia S. Stephenson, Rhodene A. Watson and Felicia S. Whyte

The Climate Studies Group Mona, The University of the West Indies, Mona, Kingston 7, Jamaica, West Indies

Present time Precipitation

Bias



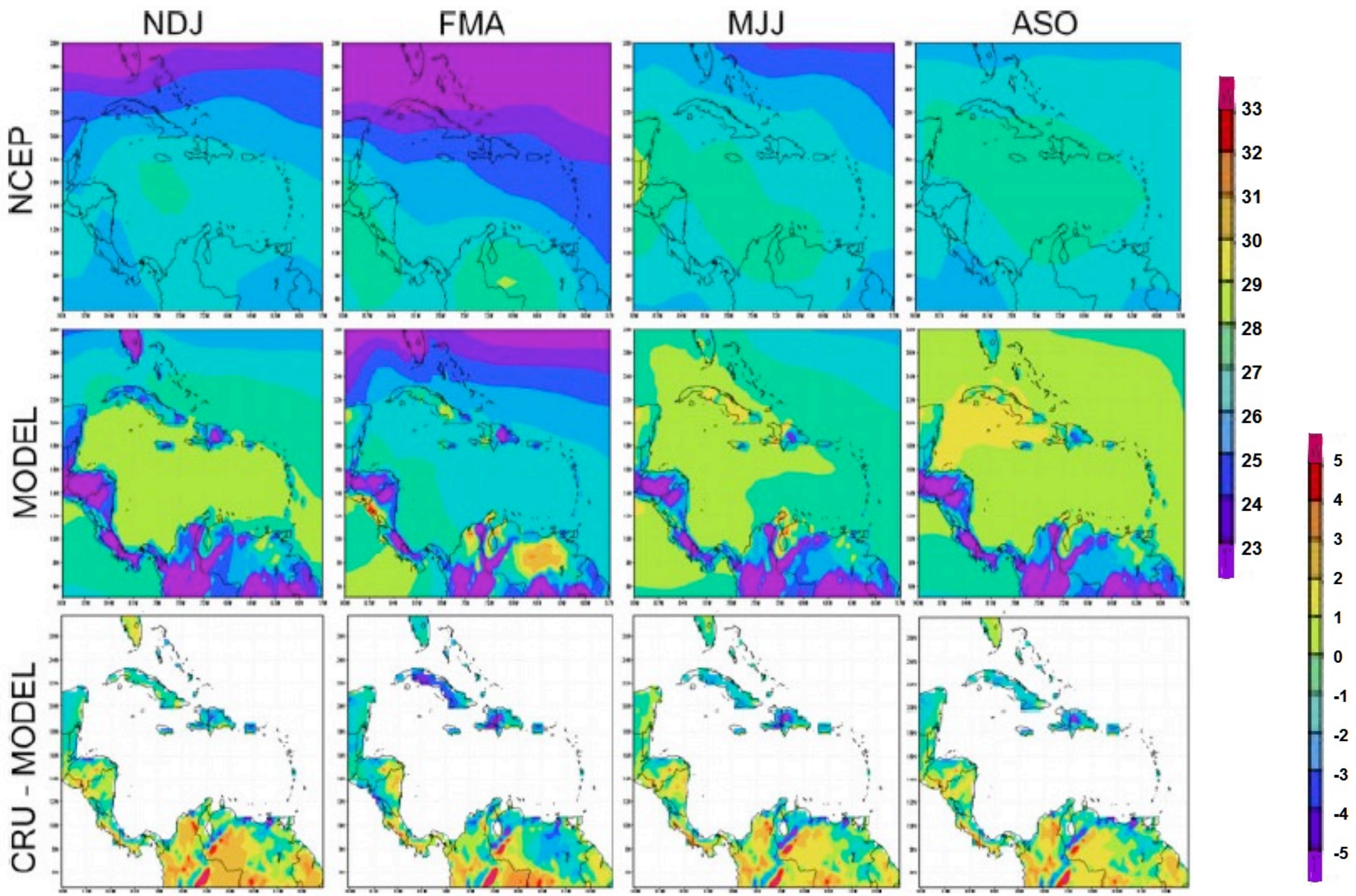
PRECIS Hor.Res: 50 km

Reanalysis: ERA15

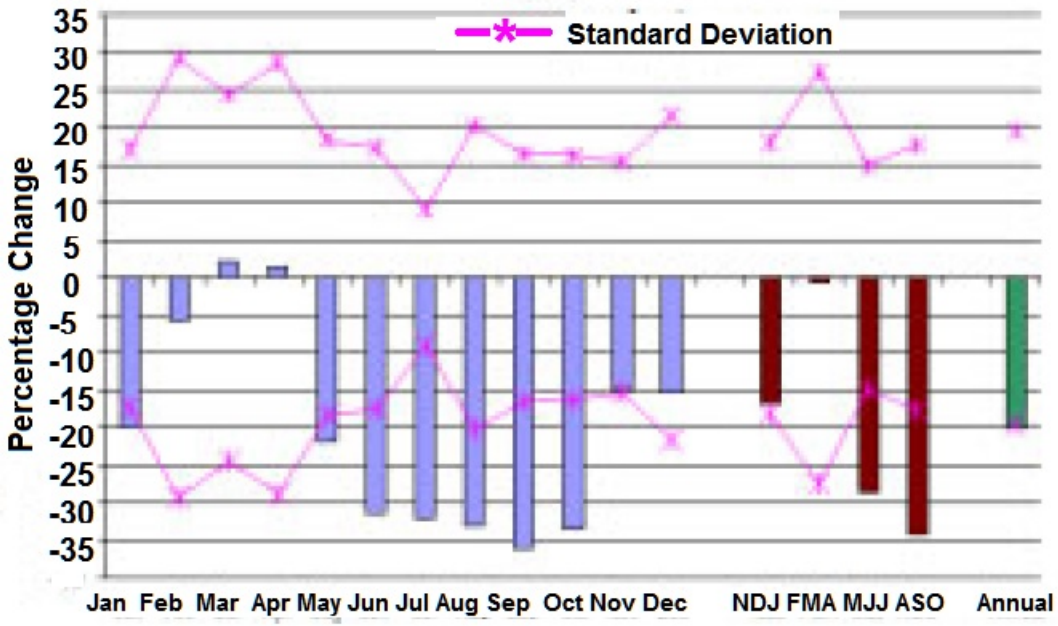
Projectios GCM HADAM3P; SRES A2

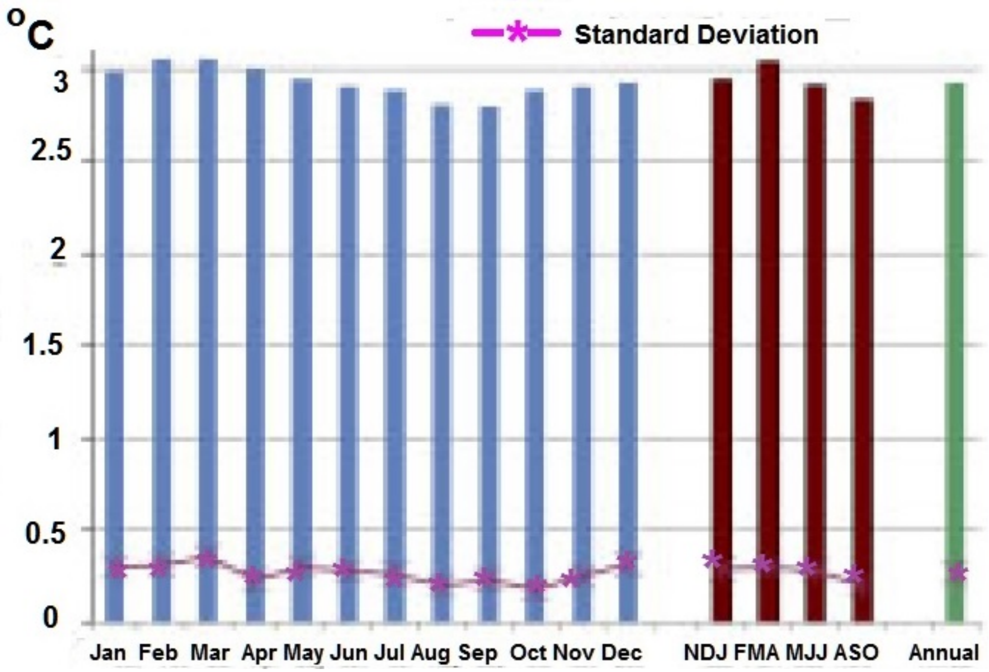
Present time Temperature

Bias



PROJECTIONS
(2071-2100) - (1961-1990)

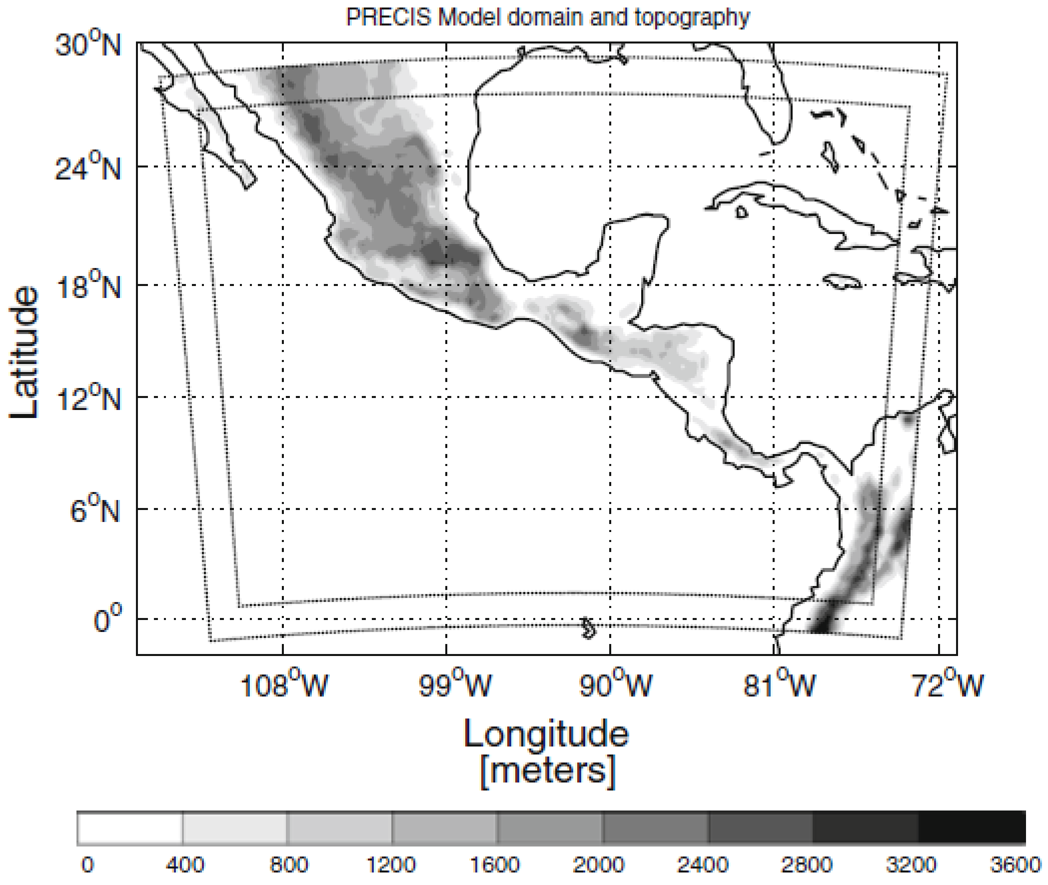




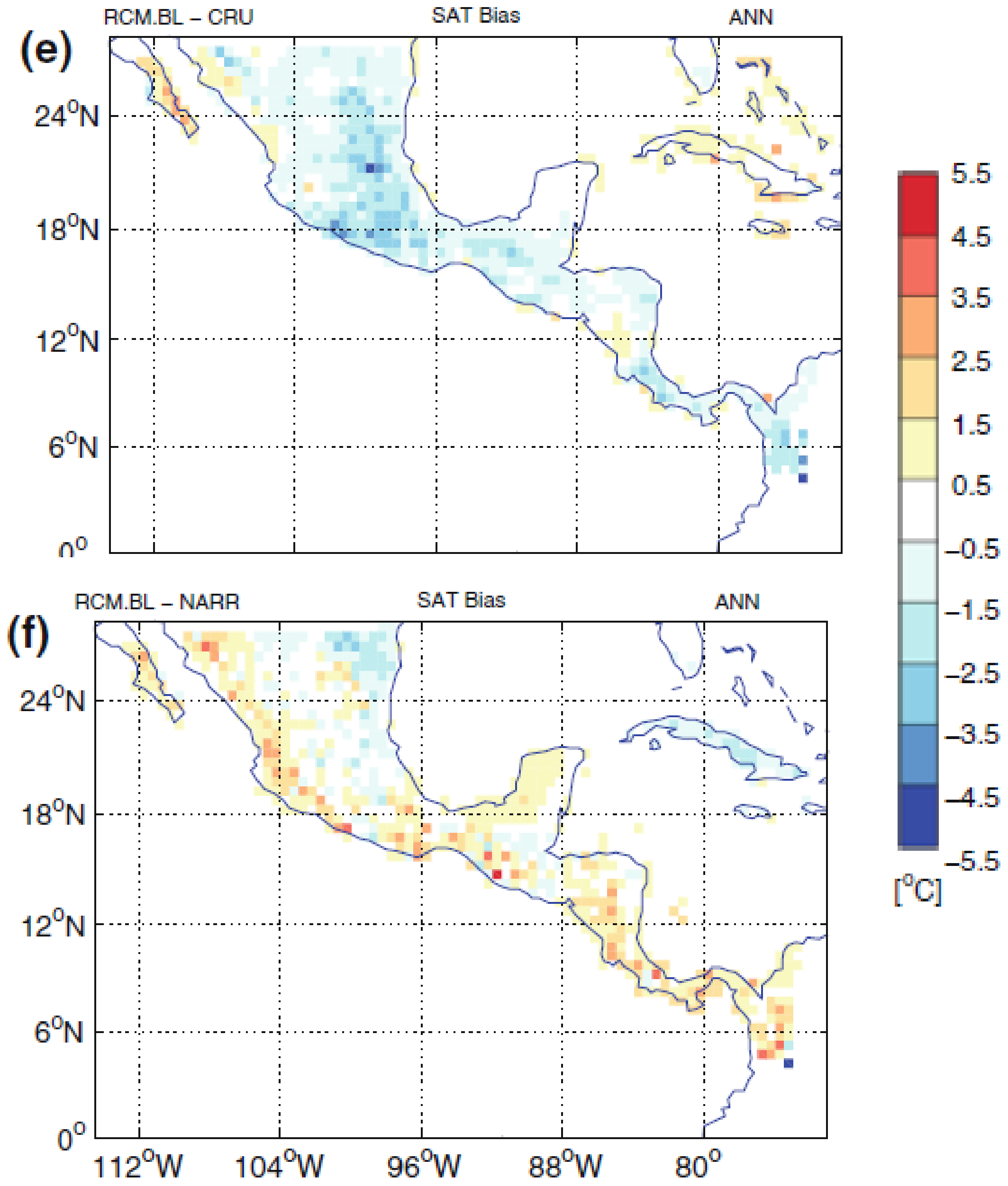
Climate change in Central America and Mexico: regional climate model validation and climate change projections

Ambarish V. Karmalkar · Raymond S. Bradley ·
Henry F. Diaz

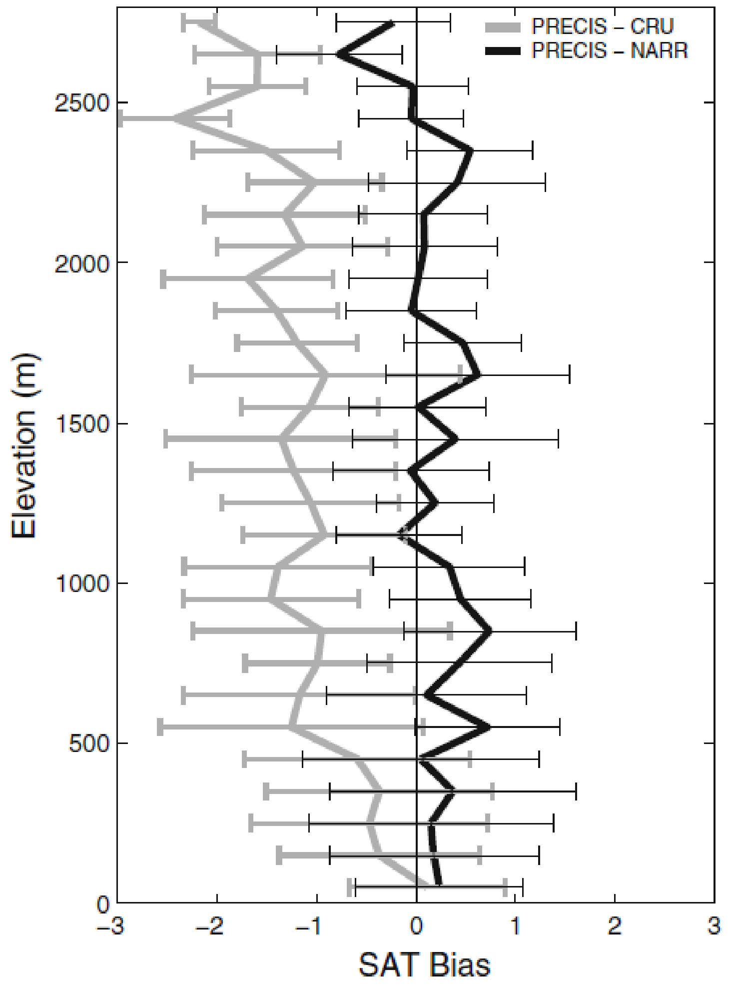
Clim. Dyn. **37**, 605-629, 2011 doi: 10.1007/s00382-011-1099-9



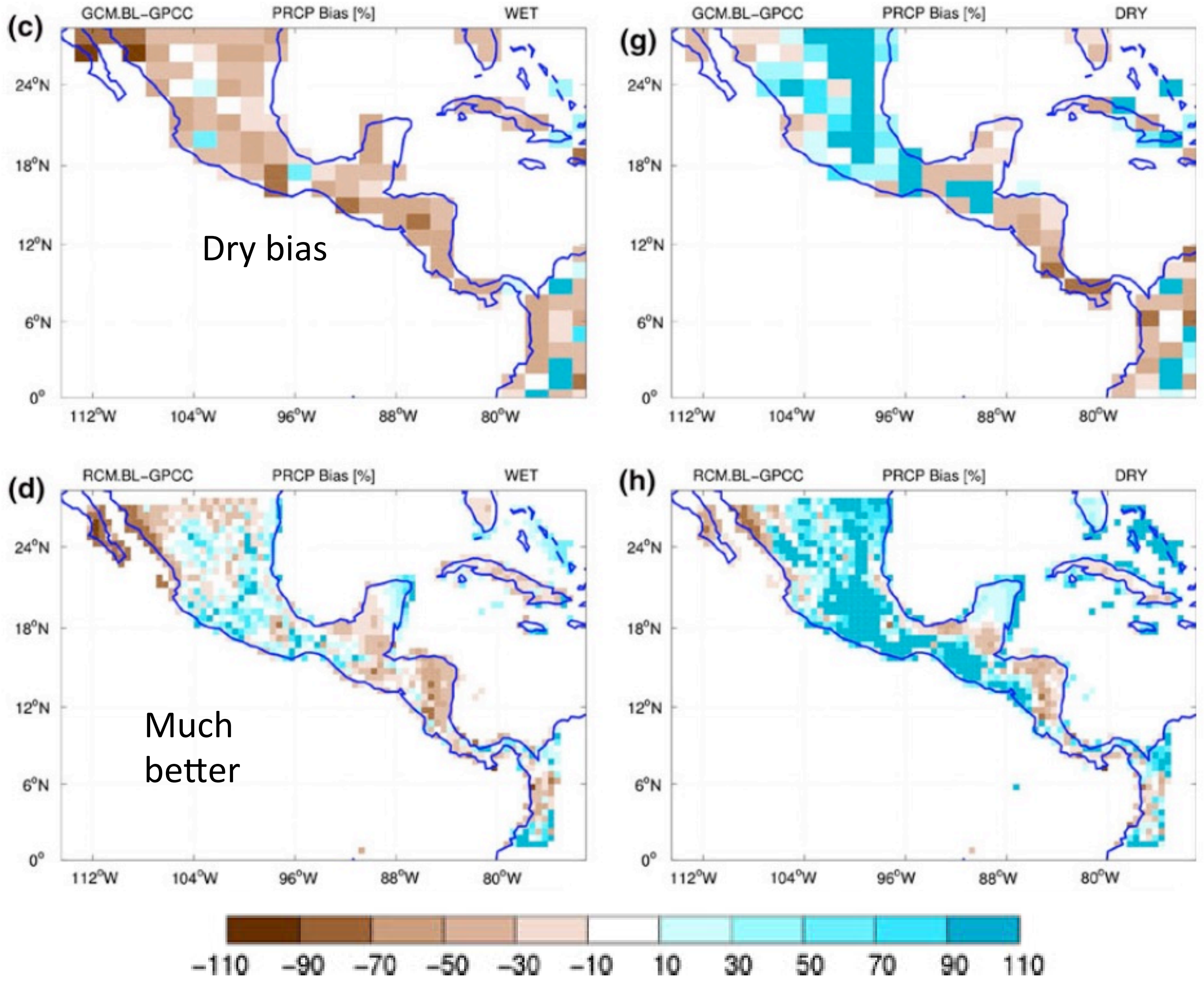
Baseline. Air Temperature bias (Relative to CRU (61-90)and NARR (80-90))



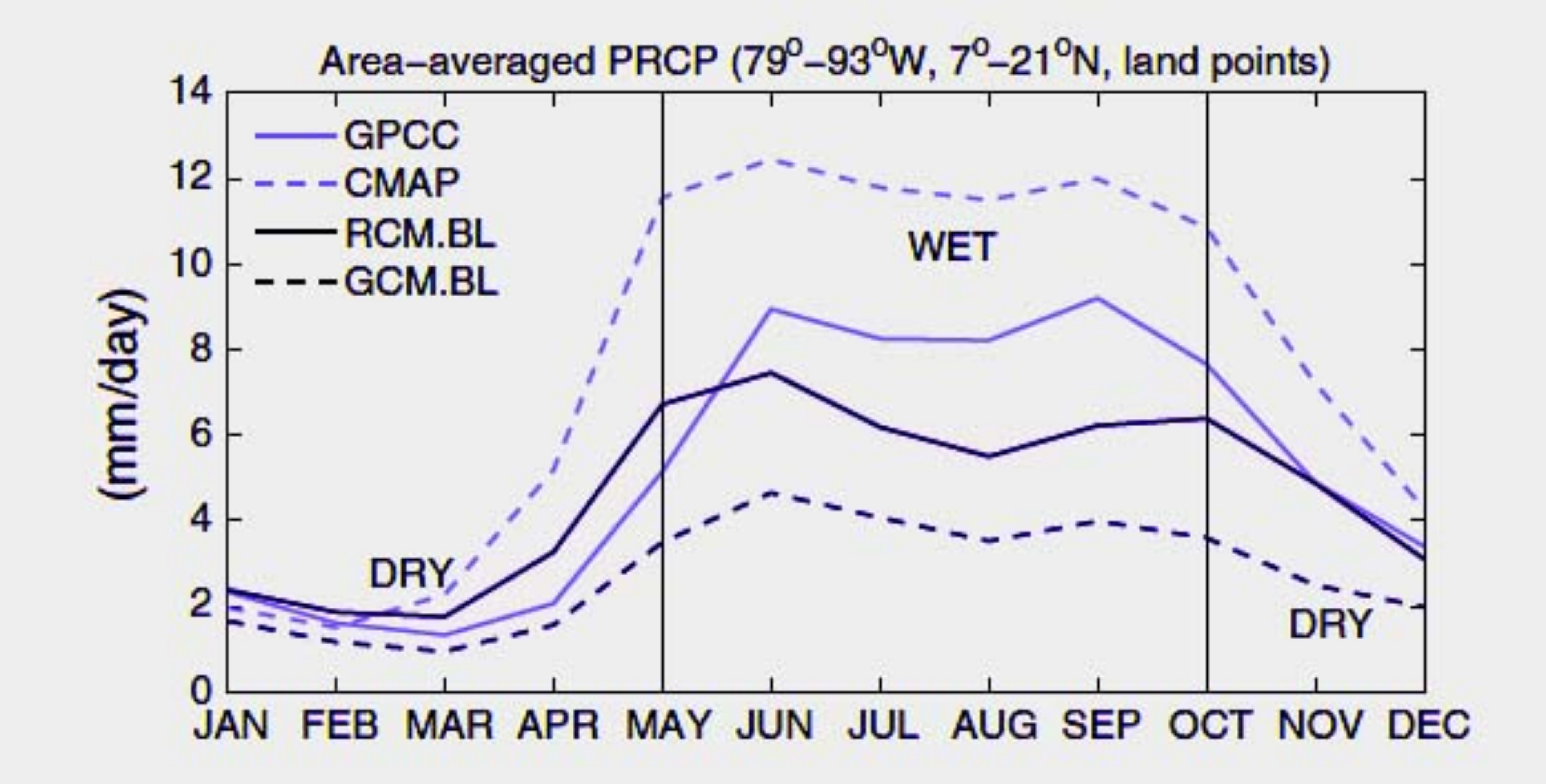
Dependence of bias on elevation



Baseline. GCM and RCM bias relative to GPCC



Precipitation seasonal cycle. Domain landmass



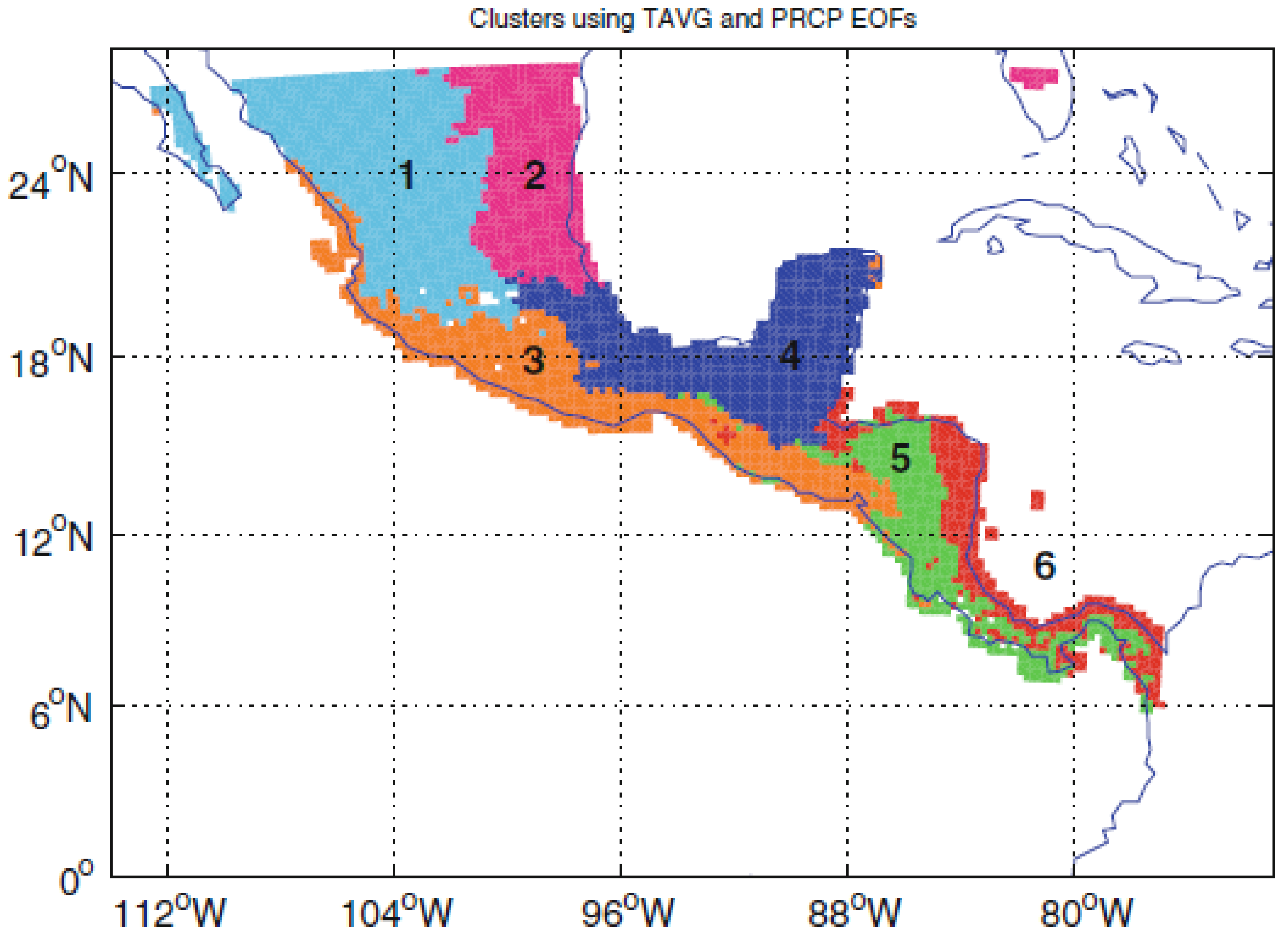


Fig. 7 Regional model domain divided into six regions using EOF and cluster analyses on simulated mean annual SAT and PRCP data

Table 3 Model bias in the mean (μ) and variability (σ; standard deviation) of seasonal PRCP relative to the GPCC data for six regions defined in Fig. 7

	Wet season				Dry season			
	μ_{bias} (%)		σ_{bias} (%)		μ_{bias} (%)		σ_{bias} (%)	
	GCM	RCM	GCM	RCM	GCM	RCM	GCM	RCM
1	−33	−9	−64	−39	30	35	−9	−2
2	−42	15	−57	6	95	78	10	15
3	−53	2	−72	−39	15	87	−26	59
4	−31	−3	−61	−40	25.5	30	−28	−15
5	−57	−23	−77	−45	−59	−18	−53	−1
6	−45.5	−21	−68	−30	−47	15	−58	−19

Table 2 Model bias in the mean (μ) and variability (σ; standard deviation) of seasonal SAT relative to the CRU data for six regions defined in Fig. 7

	Wet season				Dry season			
	μ_{bias} (°C)		σ_{bias} (%)		μ_{bias} (°C)		σ_{bias} (%)	
	GCM	RCM	GCM	RCM	GCM	RCM	GCM	RCM
1	0.2	−1.1	1	−10	−0.1	−0.7	10	0
2	−0.1	−1.5	9	−18	−1.5	−0.7	−4	−17
3	−0.5	−1.1	47	−22	−0.6	−0.3	46	−22
4	−0.7	−0.7	6	−17	−0.4	−0.3	1	−15
5	0.2	−0.4	13	−8	0.6	−0.1	29	−2
6	−0.9	0	−7	−38	−0.4	0	1	−41

MAIN CONCLUSIONS

RCM captures precipitation pattern, showing improvement over the GCMs
Negative bias in the wet season
Positive bias in the dry season
(Driving GCM underestimates precipitation in CAM)
Warming in CAM in the wet season higher than in the dry season and nearly 4°C.

A review of observed and projected changes in climate for the islands in the Caribbean

Atmósfera 26(2), 283-309 (2013)

Karlmakar (Oxford Univ. UK); Taylor, Campbell, Stephenson (UWI. Mona, Jamaica); New (Univ Cape Town, SA); Centella, Bezanilla (INSMET, Cuba); Charlery (UWI, Cave Hill, Barbados)

DOMAIN: The same as in Campbell et al. (2010)

STUDY AREAS

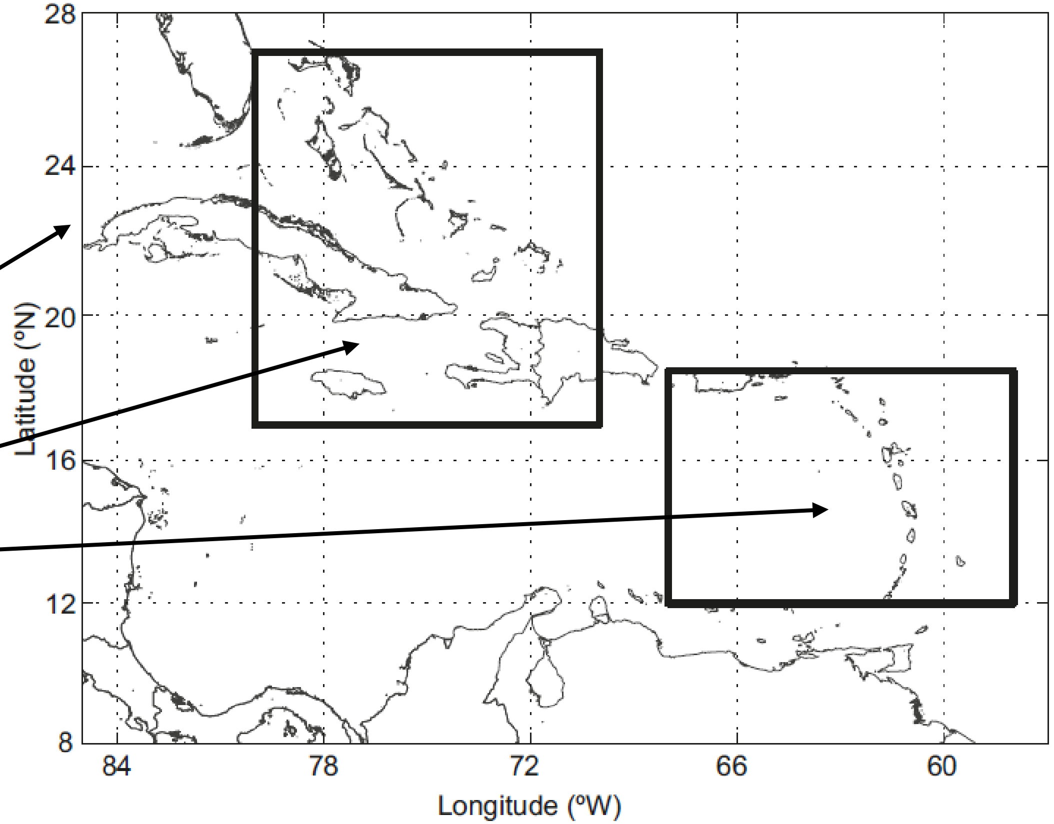


Fig. 1. Two regions of the Caribbean—western (70-80° W) and eastern (58-68° W)—for which zonal means are calculated.

RCM: PRECIS
GCM: HadamP; ECHAM4

Present: 1970-1089
Future: 2080-2089

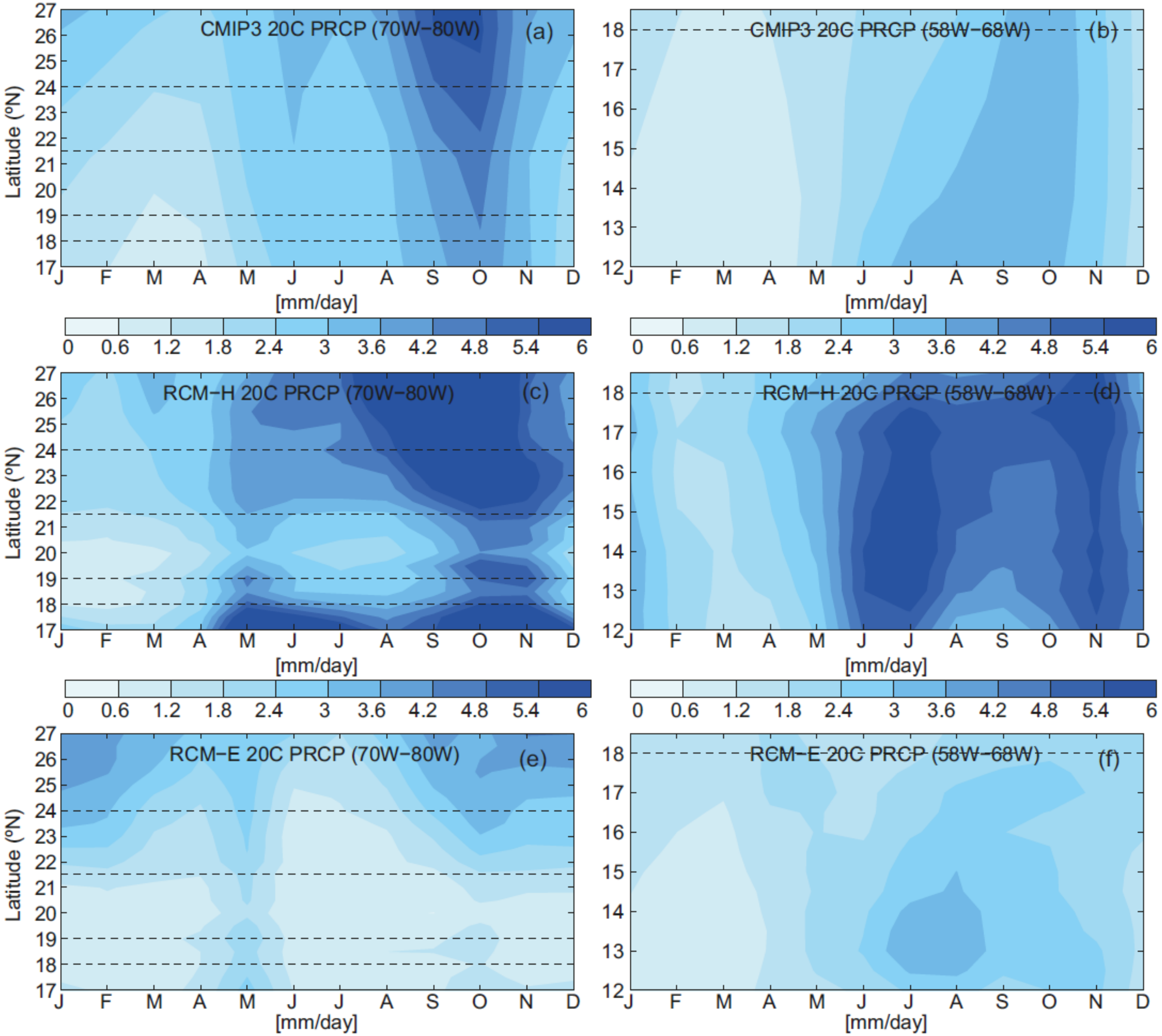
Present time precipitation (70-89) CMIP3 and PRECIS

Western Caribbean | Eastern Caribbean

CMIP3 ensemble

PRECIS RCM-Hadley

PRECIS RCM-ECHAM



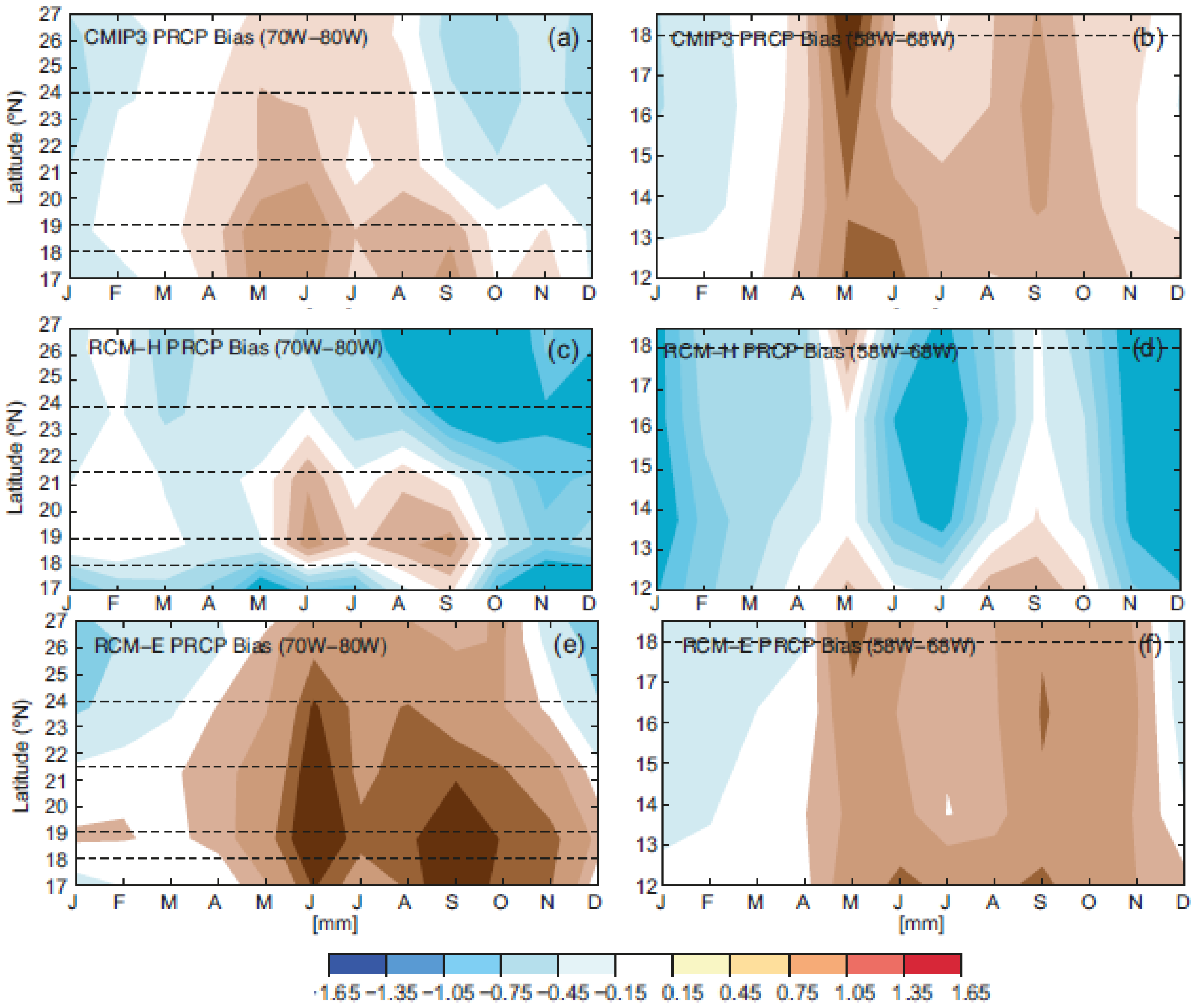
BIAS (Models-CMAP)

Western Caribbean | Eastern Caribbean

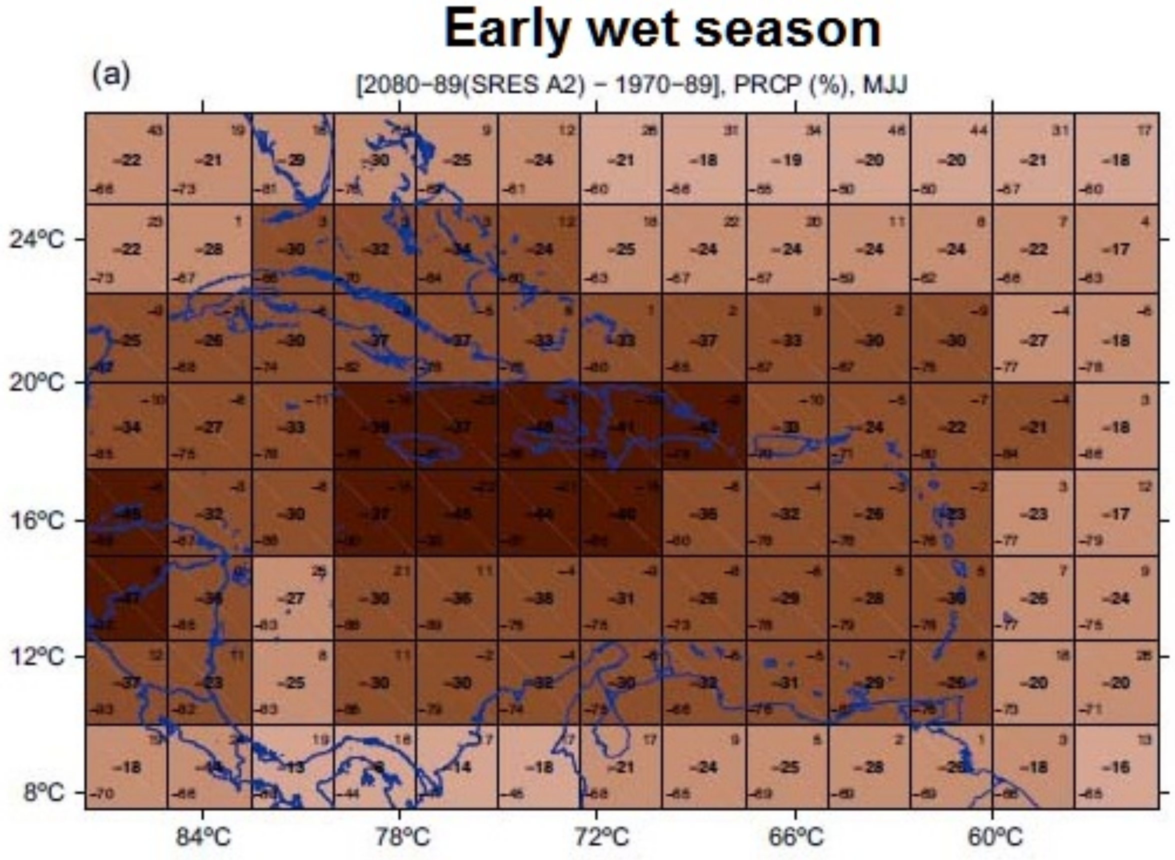
CMIP3 ensemble

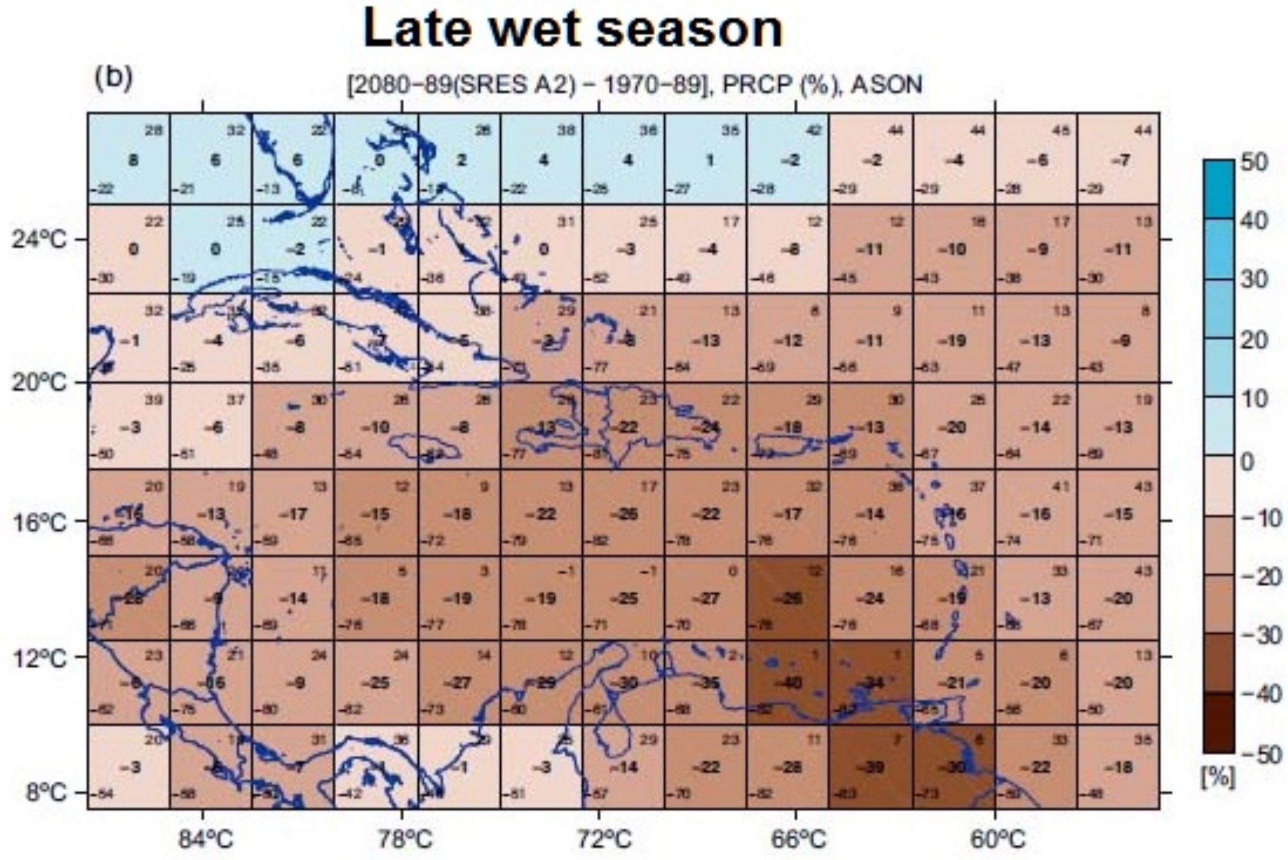
PRECIS RCM-Hadley

PRECIS RCM-ECHAM



Projected changes in precipitation by 2080 under SRES A2
CMIP3 Wet season





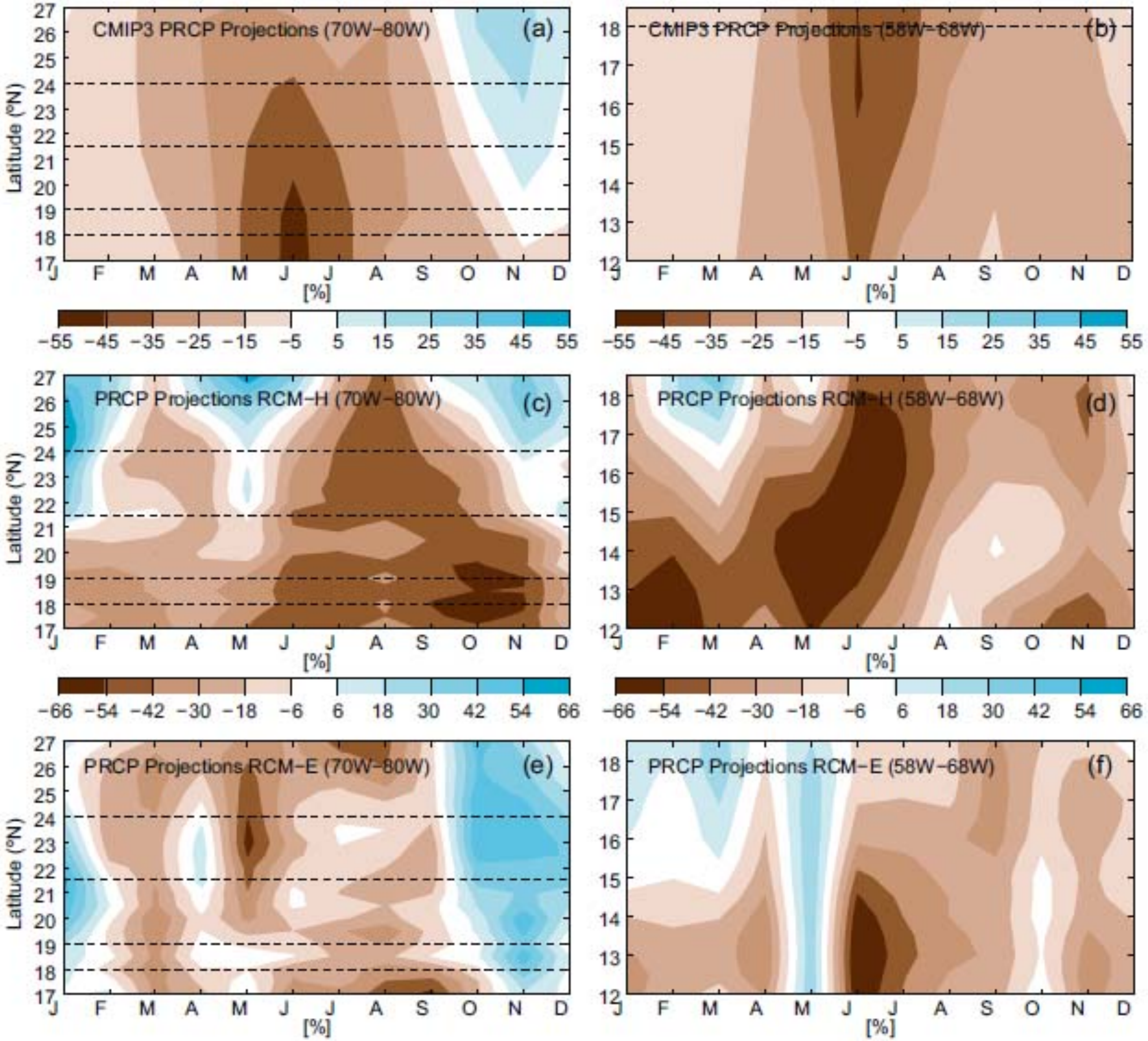
Projected changes in precipitation by 2080 under SRES A2
PRECIS Wet season

Western Caribbean — Eastern Caribbean

CMIP3 ensemble

PRECIS RCM-Hadley

PRECIS RCM-ECHAM

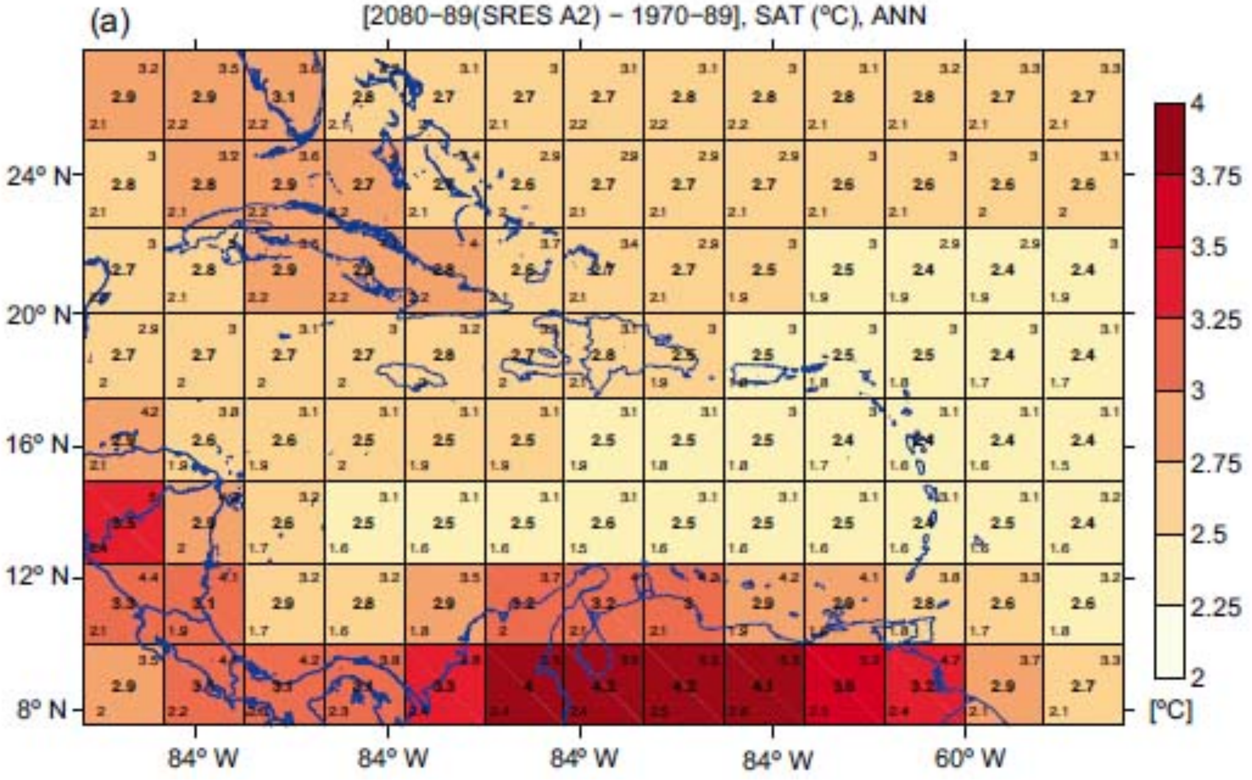


MAIN CONCLUSIONS

RCM project more intense drying in the wet season than GCM.
GCM and RCM project higher warming over NW Caribbean. RCM projects higher warming.
MSD is reproduced and projected.

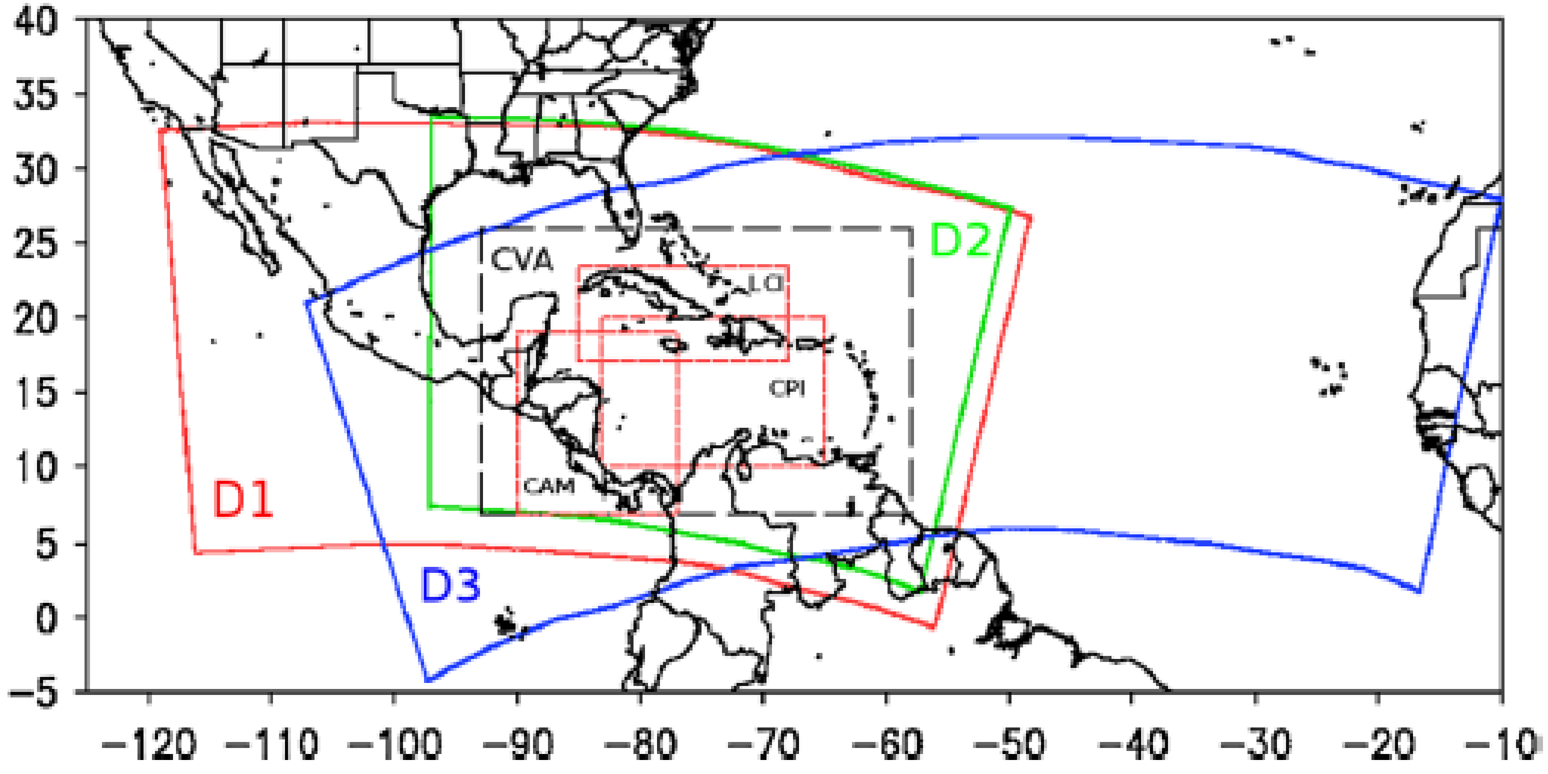
Projected changes in air temperature by 2080 under SRES A2

CMIP3 Annual



Assessing the effect of domain size over the Caribbean region using the PRECIS regional climate model

Abel Centella-Artola · Michael A. Taylor · Arnoldo Bezanilla-Morlot · Daniel Martinez-Castro · Jayaka D. Campbell · Tannecia S. Stephenson · Alejandro Vichot



Climate Dynamics 44. 1901-1918. DOI 10.1007/ s00382-014-2272-8.

Main conclusions

Precipitation, cloud cover, evaporation:. D1, D2, D3 comparable

Reproduction of MSD and NASH: D2 best

Wind circulation, wind shear: D1, D2 best

The extension of the domain through the Atlantic does not improve simulations

REGIONAL CLIMATE MODELING FOR THE DEVELOPING WORLD

The ICTP RegCM3 and RegCNET

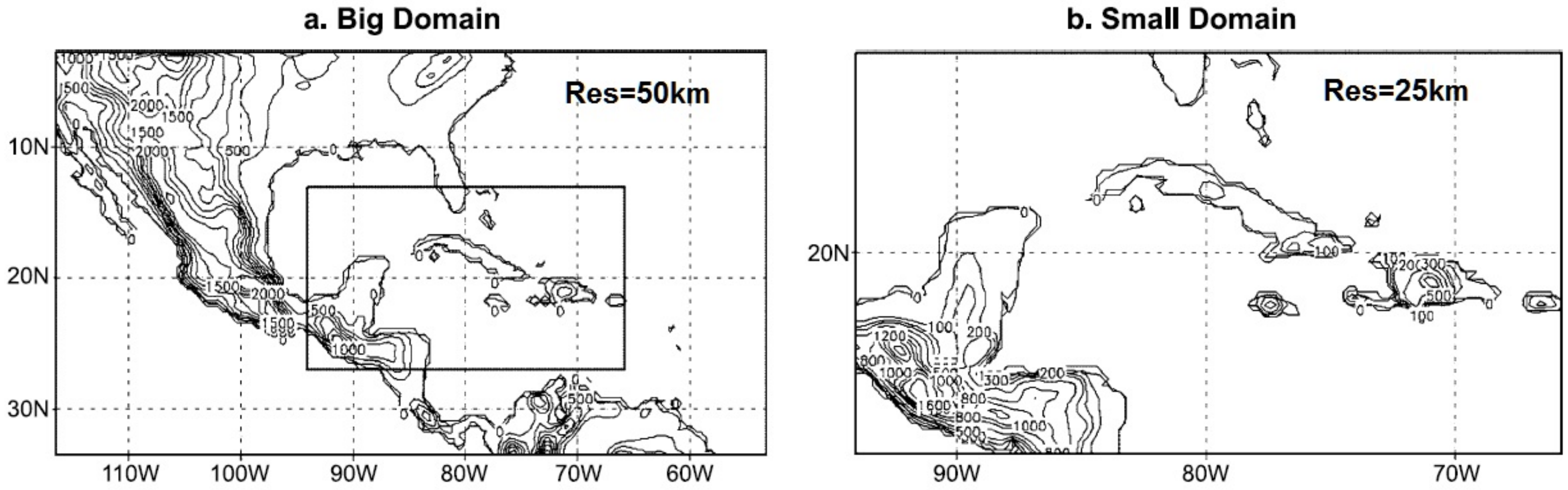
BY JEREMY S. PAL, FILIPPO GIORGI, XU
NELLIE ELGUINDI, FABIEN SOLMON, X
SARA A. RAUSCHER, RAQUEL FRANC
ASHRAF ZAKEY, JONATHAN WIN
MOETASIM ASHFAQ, FA
JASON L. BELL, NOAH
JAGADISH KARMA
ABOURAHAMAN
DANIEL MARTI
ROSMER
LISA C
ALL

- **Martínez-Castro D, Porfirio da Rocha R, Bezanilla-Morlot A, Alvarez-Escudero L, Reyes J. P, Silva-Vidal Y, Arrit RW (2006):** Sensitivity studies of the RegCM3 simulation of summer precipitation, temperature and local wind field in the Caribbean Region. Theor. Appl. Climatol. 86, 1-4, p.5-22
- **Diro GT, Rauscher SA, Giorgi F, Tompkins AM (2012):** Sensitivity of seasonal climate and diurnal precipitation over Central America to land and sea surface schemes in RegCM4. Clim. Res. Vol. 52: 31-48, doi:10.3354/cr01049
- **Vichot-Llano A, Martínez-Castro D, Centella-Artola A, Bezanilla-Morlot A (2014):** Sensibilidad al cambio de dominio y resolución de tres configuraciones del modelo climático regional RegCM 4.3 para la región de América Central y el Caribe. Rev. Climatol., 14:45-62.
- **Fuentes-Franco R, Coppola E, Giorgi F, Graef F and Pavía EG, (2014):** Assessment of RegCM4 simulated inter-annual variability and daily-scale statistics of temperature and precipitation over Mexico. Clim Dyn, 42:629-647. DOI 10.1007/s00382-013-1686-z
- **Fuentes-Franco R. · Coppola E. Giorgi F. ·. Pavia E. G. · Diro · G. T, Graef F. (2014):** Inter-annual variability of precipitation over Southern Mexico and Central America and its relationship to sea surface temperature from a set of future projections from CMIP5 GCMs and RegCM4 CORDEX **sim**ulations. DOI 10.1007/s00382-014-2258-6
- **GT Diro, F Giorgi, R Fuentes-Franco, KJE Walsh, G Giuliani, E Coppola (2014):** Tropical cyclones in a regional climate change projection with RegCM4 over the CORDEX Central America domain. Climatic change 125 (1), 79-94.
- **Martínez-Castro D., Vichot-Llano A., ,Bezanilla-Morlot, A., Centella-Artola A., Campbell J. and Viloria-Holguin C..(2016):** Performance of RegCM-4.3 over the Caribbean region using different configurations of the Tiedtke convective parameterization scheme. Rev. Climat. 16 (2016): 77-98. http://webs.ono.com/reclim11/reclim16f.pdf

Sensitivity studies of the RegCM3 simulation of summer precipitation, temperature and local wind field in the Caribbean Region

Theor. Appl. Climatol. 86, 5–22 (2006)
DOI 10.1007/s00704-005-0201-9

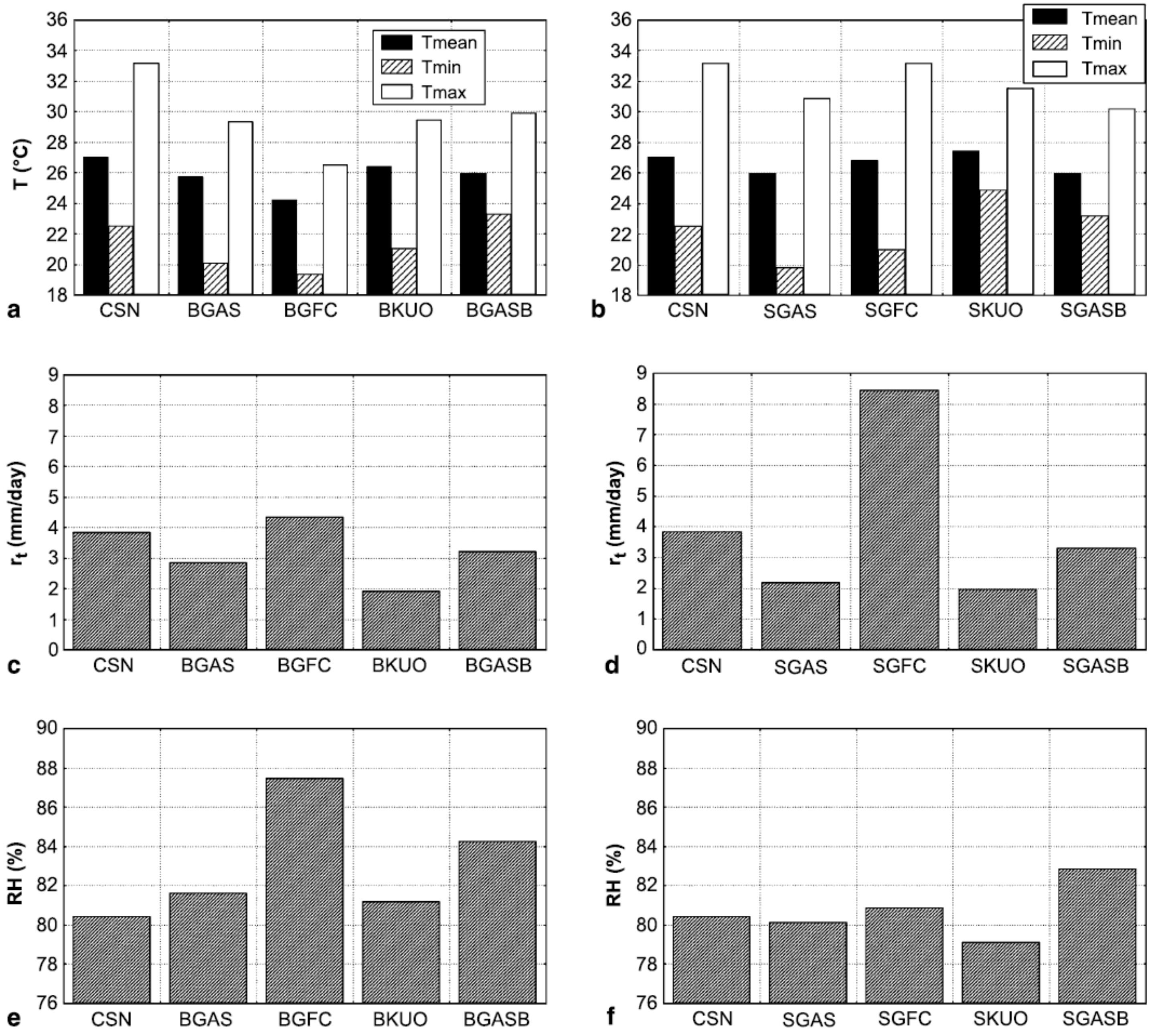
D. Martínez-Castro , R. Porfirio da Rocha , A. Bezanilla-Morlot , L. Alvarez-Escudero , J. P. Reyes-Fernández , Y. Silva-Vidal , and R. W. Arritt



Numerical experiments with RegCM3

Experiment	Domain	Hor. Res. (km)	Conv.Sch.	Closure	Surf.Flux over Ocean
BGAS	Big	50	Grell	Arak-S	Zeng
BGFC	Big	50	Grell	Fritsch-C	Zeng
BGKuo	Big	50	Kuo	--	Zeng
BGASB	Big	50	Grell	Arak-S	BATS
SGAS	Small	25	Grell	Arak-S	Zeng
SGFC	Small	25	Grell	Fritsch-C	Zeng
SKuo	Small	25	Kuo	--	Zeng
SGASB	Small	25	Grell	Arak-S	BATS

Period of simulation: A rainy season + 1 month spin-up



MAIN CONCLUSIONS

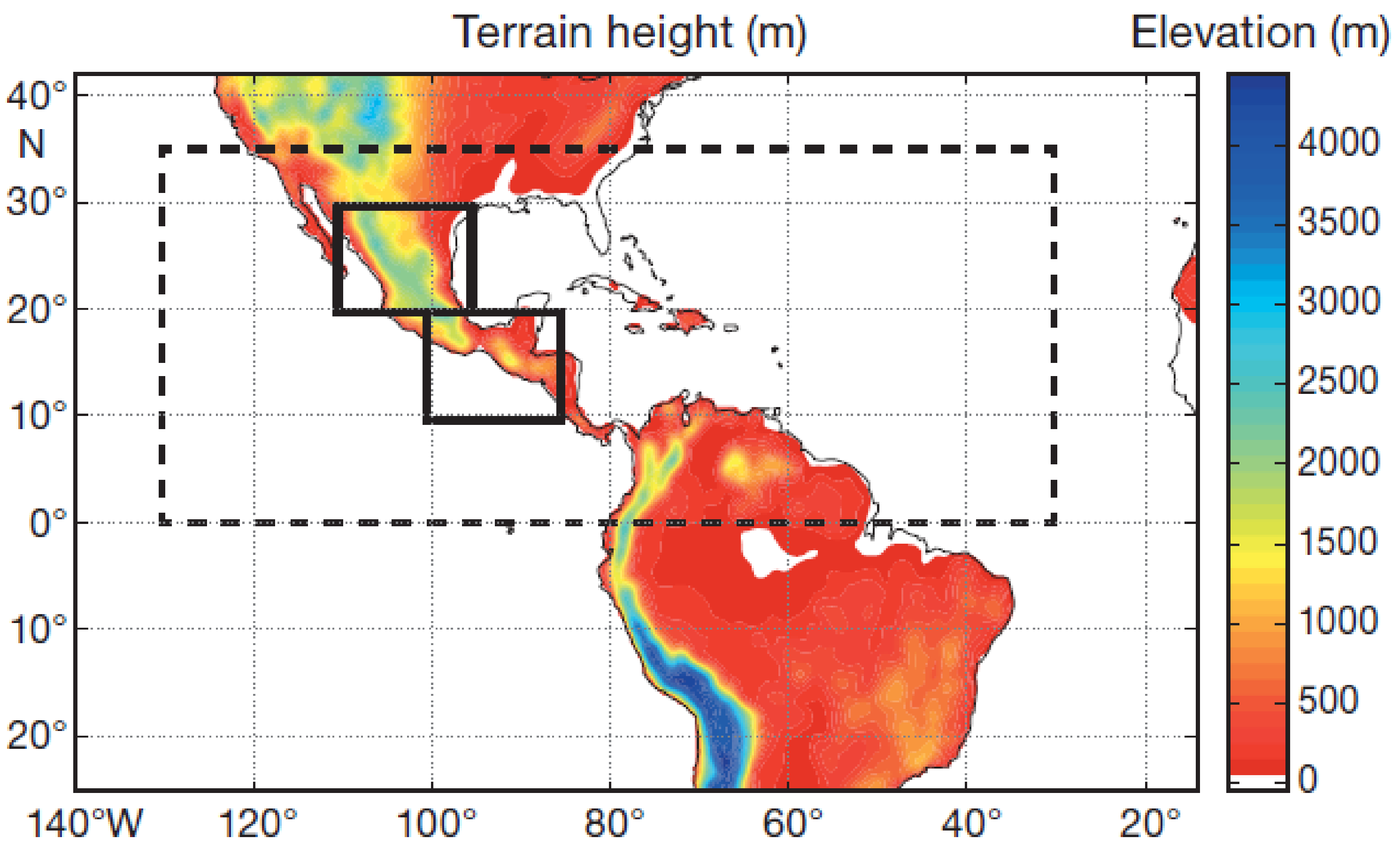
Grell_AS was the less sensitive to change of domain and resolution and in reproducing local circulations. Kuo fails to reproduce local circulation and diurnal cycle.

Recommendes schemes: Grell-AS with BATS

Sensitivity of seasonal climate and diurnal precipitation over Central America to land and sea surface schemes in RegCM4

CLIMATE RESEARCH
Vol. 52: 31–48, 2012
doi: 10.3354/cr01049

G. T. Diro , S. A. Rauscher , F. Giorgi , A. M. Tompkins



Convective scheme:
MIT_Emanuel over ocean
Grell (AS) over land

Period of simulation: Six years

Experiments:

Control: CTRL: Land surface scheme Biosphere-Atmosphere Transfer Scheme (BATS)

Sensitivity 1: CLM: Land Surface scheme Community Land Model 3.5 (CLM 3.5)

Sensitivity 2: DCSST: Diurnal cycle SST scheme

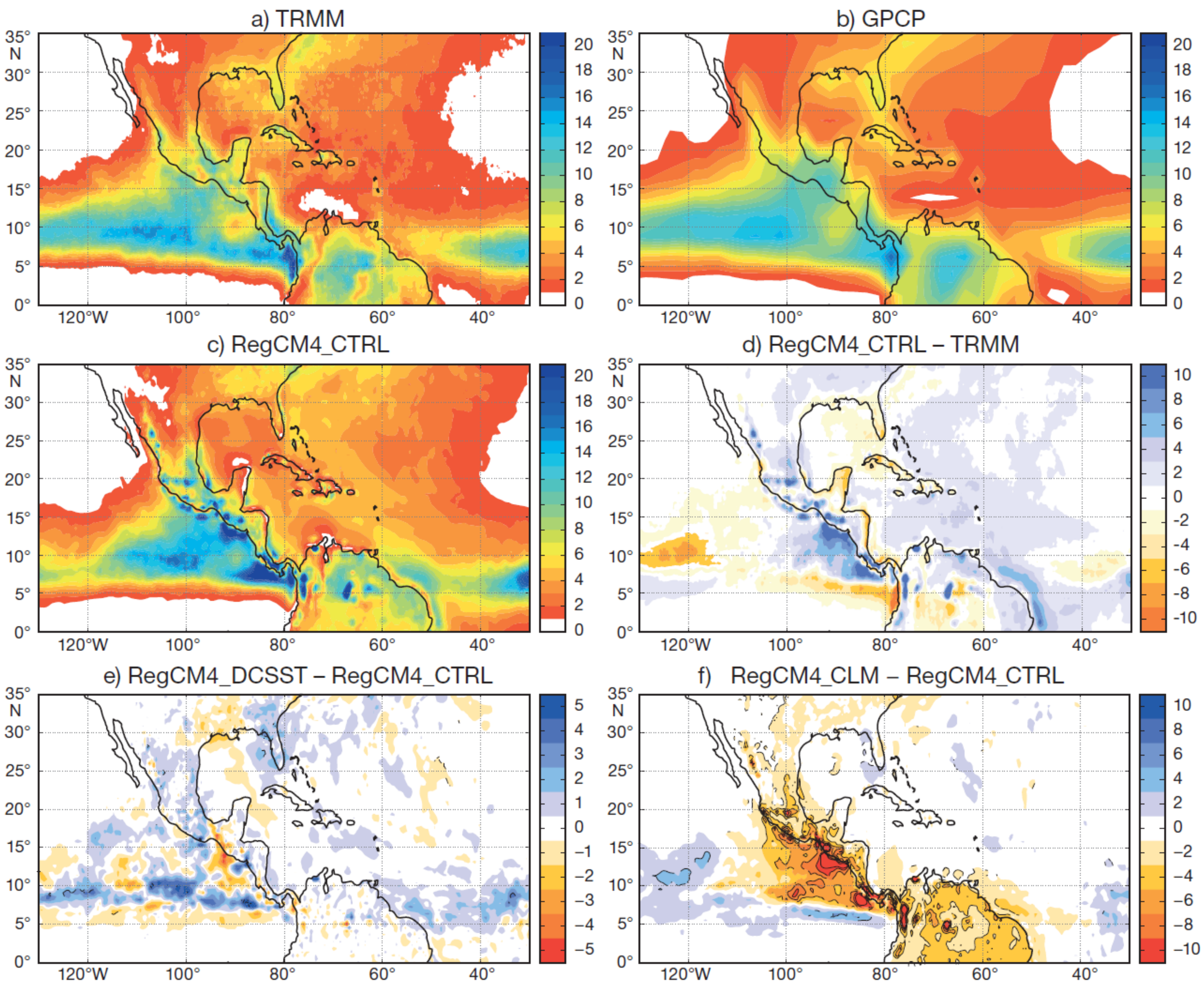


Fig. 2. JJAS mean precipitation (mm d^{-1}) for: (a) TRMM, (b) GPCP, (c) RegCM4_CTRL; and precipitation difference for (d) RegCM4_CTRL minus TRMM; (e) RegCM4_DCSST minus RegCM4_CTRL; and (f) RegCM4_CLM minus RegCM4_CTRL. Contour lines in the bottom-right panel: differences which are statistically significant at the 0.1 level

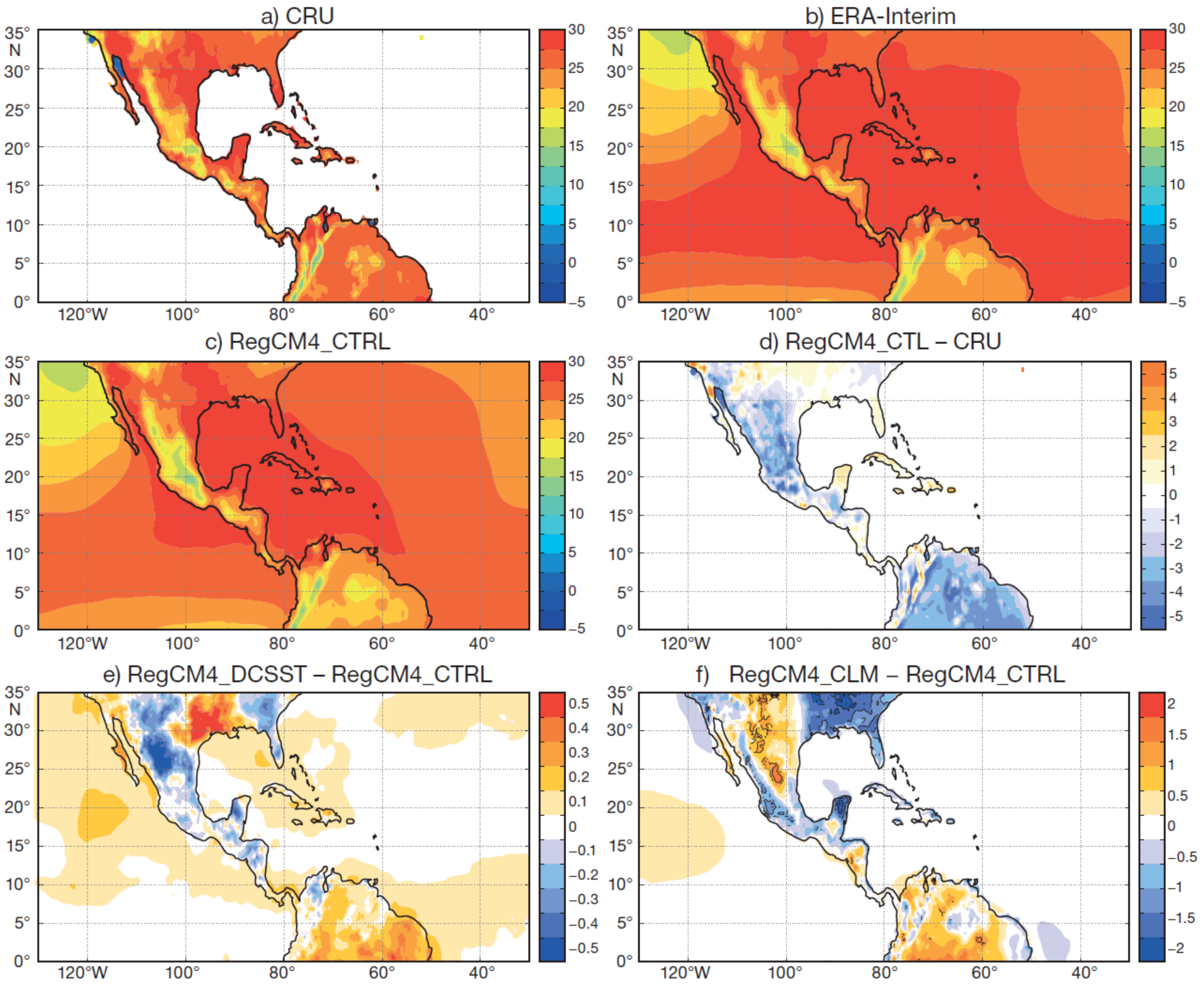


Fig. 7. JJAS mean temperature (°C), 1998–2002. (a) 2 m temperature from CRU, (b) ERA-Interim surface temperature, (c) RegCM4_CTRL, (d) RegCM4_CTRL minus CRU, (e) RegCM4_DCSST minus RegCM4_CTRL, and (f) RegCM4_CLM minus RegCM4_CTRL. The contour lines in the bottom-right panel represent values which are significant at 0.1 level

MAIN CONCLUSIONS

The model reproduces the spatial and seasonal
patterns of precipitation over the region.
Regional circulations are well reproduced
Low-level jet is underestimated
Sensitivity to land surface scheme.
Both schemes have biases in different regions of the domain
Lower sensitivity to SST diurnal cycle scheme

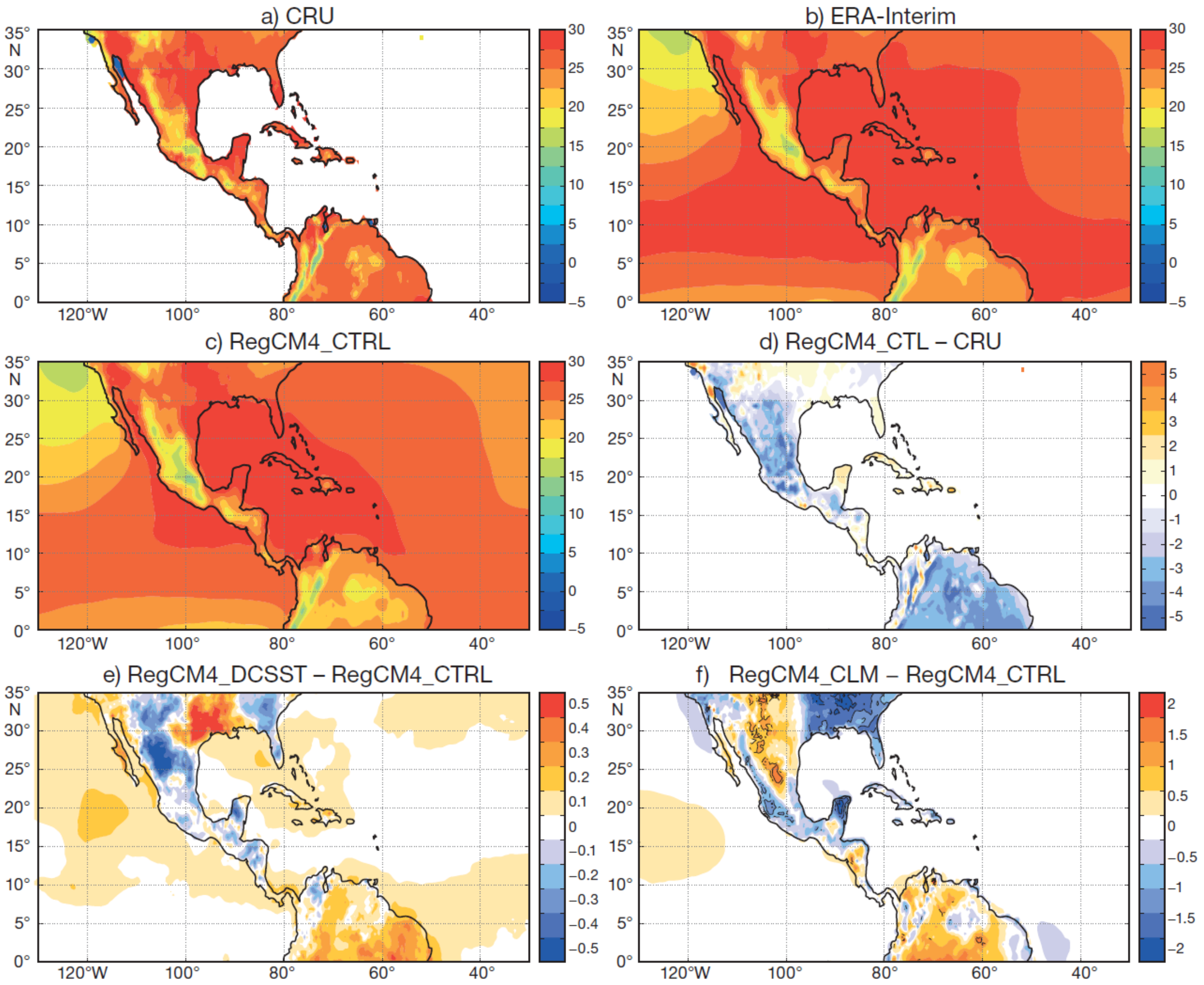


Fig. 7. JJAS mean temperature (°C), 1998–2002. (a) 2 m temperature from CRU, (b) ERA-Interim surface temperature, (c) RegCM4_CTRL, (d) RegCM4_CTRL minus CRU, (e) RegCM4_DCSST minus RegCM4_CTRL, and (f) RegCM4_CLM minus RegCM4_CTRL. The contour lines in the bottom-right panel represent values which are significant at 0.1 level

MAIN CONCLUSIONS

The model reproduces the spatial and seasonal
patterns of precipitation over the region.
Regional circulations are well reproduced
Low-level jet is underestimated
Sensitivity to land surface scheme.
Both schemes have biases in different regions of the domain
Lower sensitivity to SST diurnal cycle scheme

Assessment of RegCM4 simulated inter-annual variability and daily-scale statistics of temperature and precipitation over Mexico

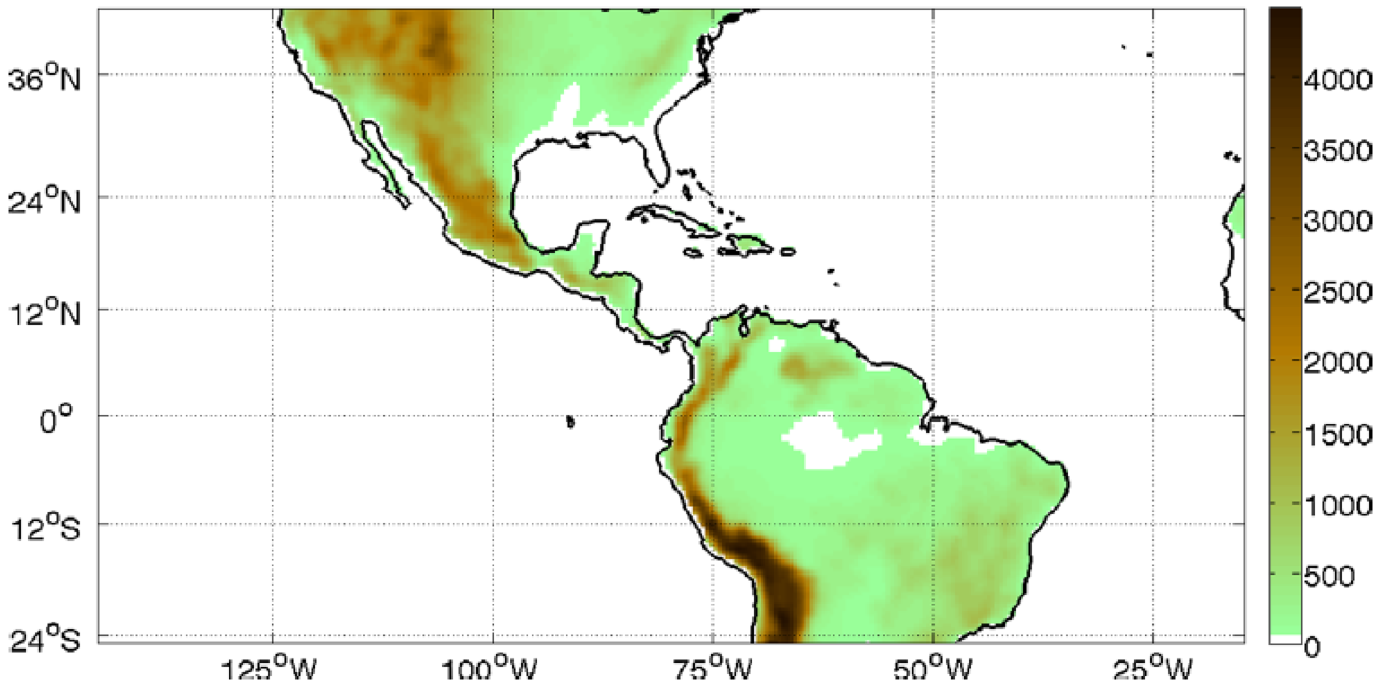
Clim Dyn (2014) 42:629–647
DOI 10.1007/s00382-013-1686-z

Ramón Fuentes-Franco · Erika Coppola ·
Filippo Giorgi · Federico Graef · Edgar G. Pavia

RegCM4 configuration:
Convective scheme:
MIT-Emanuel over Ocean
Grell over land

Land surface processes:
BATS

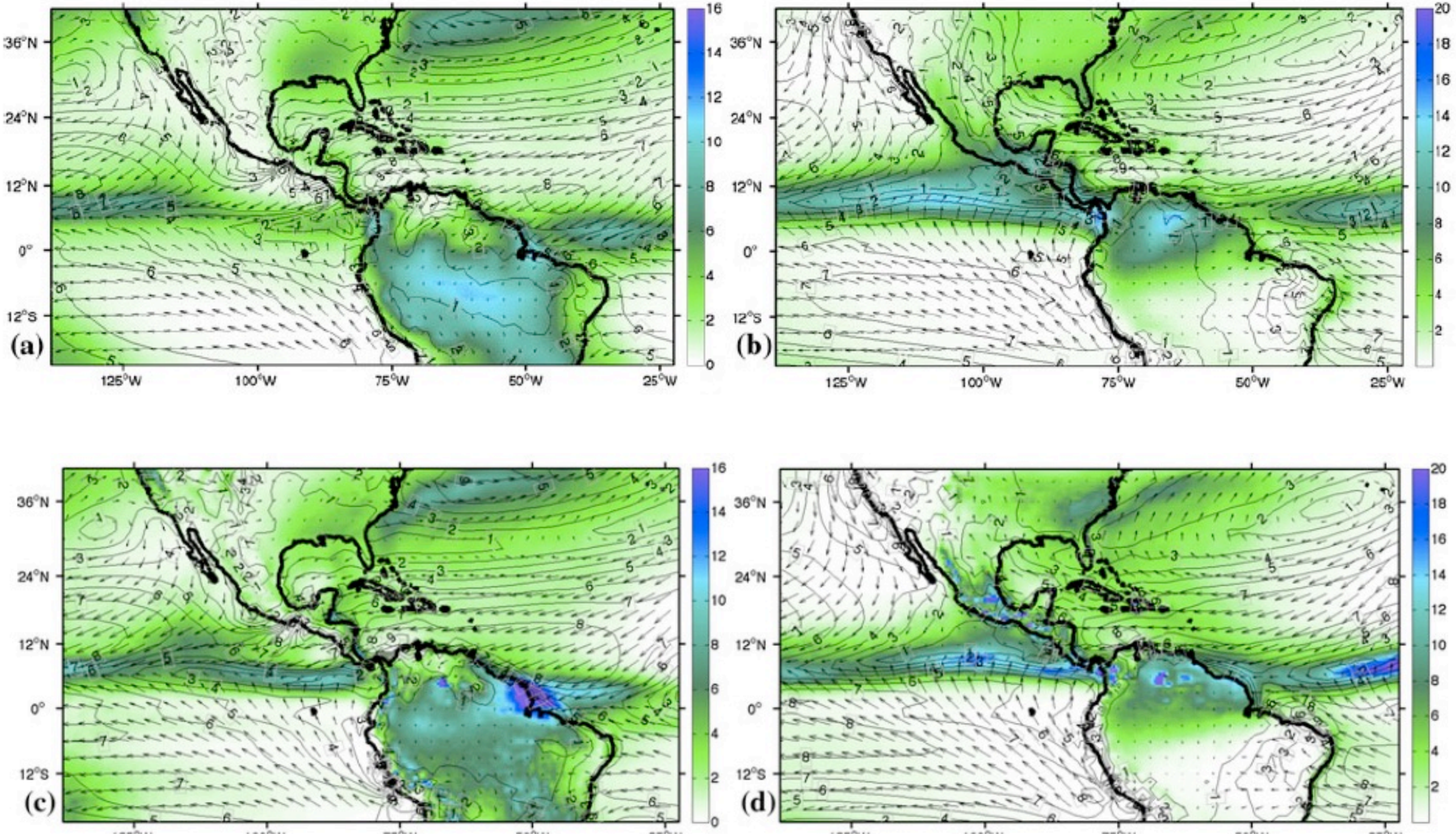
Simulation period:
1982-2008 (27 ysars)
BC: ERA Interim



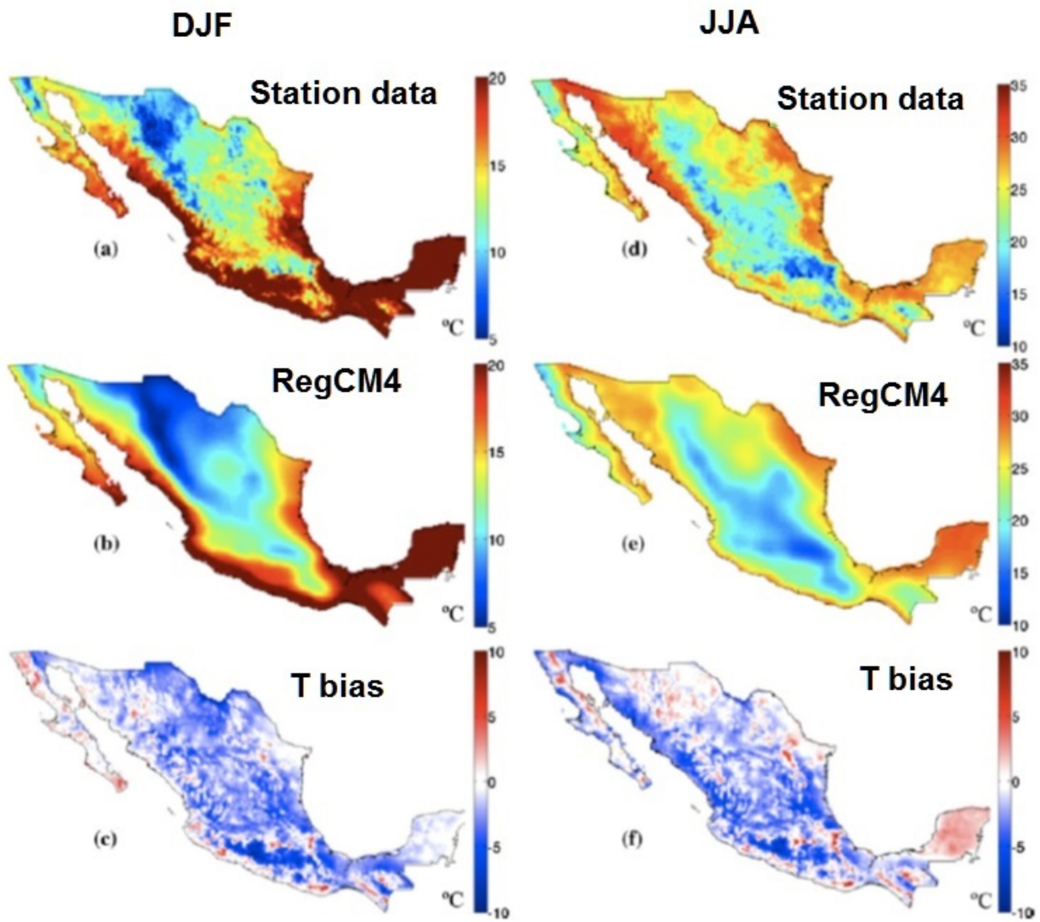
ERA wind –GPCP precip. RegCM4 wind and precip.

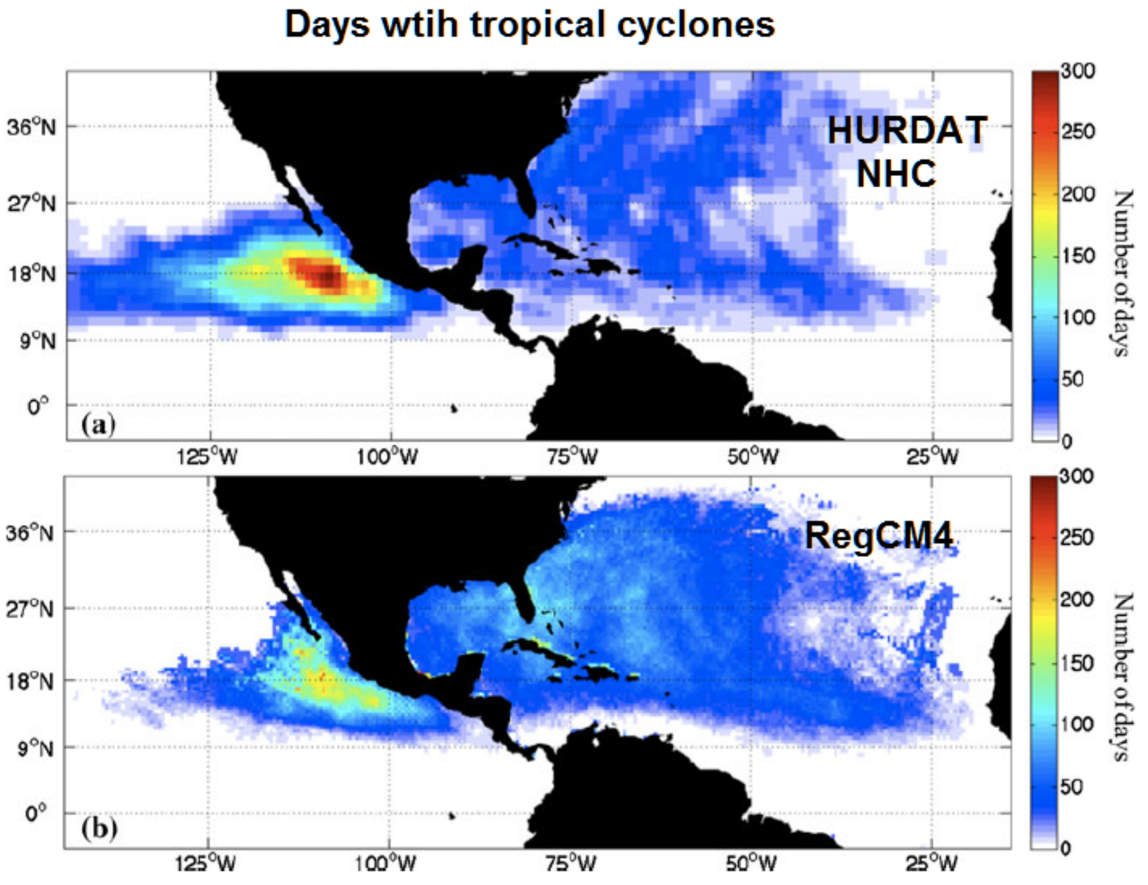
DJF

JJA



Precipitation and mean wind circulation





MAIN CONCLUSIONS

The model reproduced well the mean patterns of temperature and precipitation, interannual variability and extremes
Precipitation overestimated over mountains.
Reproduced well the annual cycle of precipitation.
Realistically represented tropical cyclone occurrence with simple detection criteria.

Inter-annual variability of precipitation over Southern Mexico and Central America and its relationship to sea surface temperature from a set of future projections from CMIP5 GCMs and RegCM4 CORDEX simulations

Ramón Fuentes-Franco · Erika Coppola · Filippo Giorgi · Edgar G. Pavia · Gulilat Tefera Diro · Federico Graef

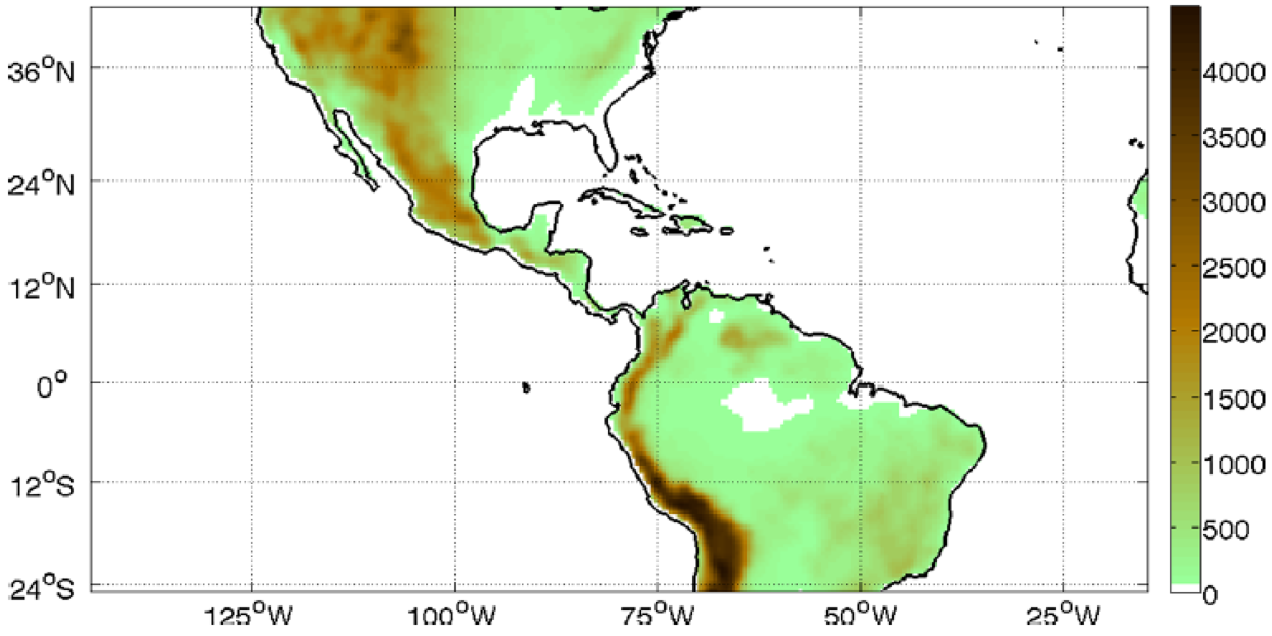
Clim Dyn
DOI 10.1007/s00382-014-2258-6

GCMs (CMIP5):
HasdGEM ES2
MPI-ES-MR

Regcm4
Configurations:
Em+CLM 50 km
Gr+BATS 50 km

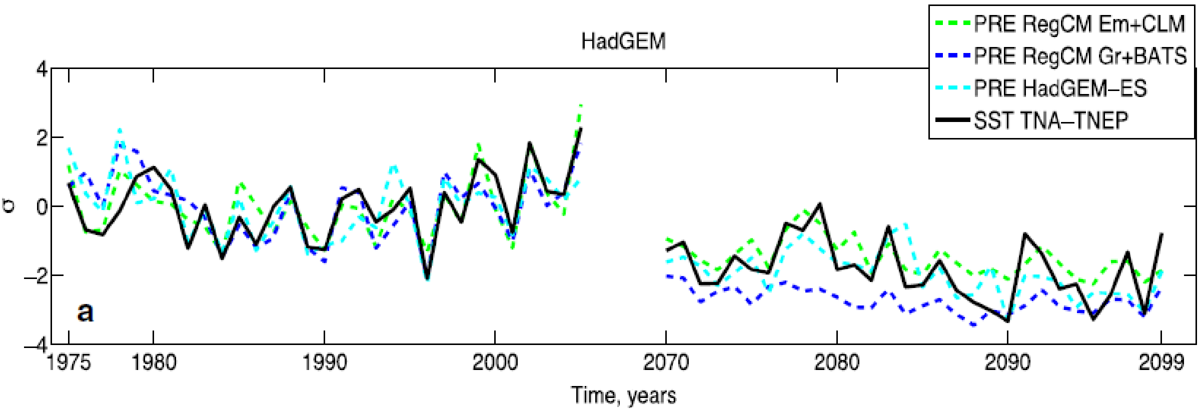
Simulations:
1970-2099
Present day:
1976-2005
Future:
GHG RCP 8.5

Focus: JJAS (rainy season)
Southern Mexico and Central America (SMECAM)

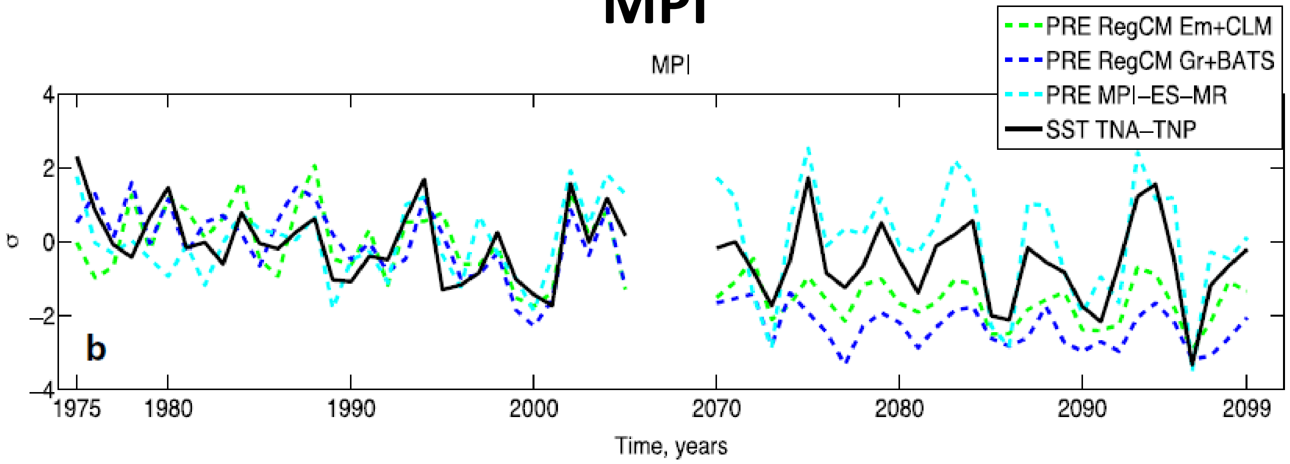


Model	Mean change in precipitation (%)	σ/μ in the 1976–2005 period	σ/μ in the 2070–2099 period	Change of σ/μ (%)
HadGEM	−40.6	0.34	0.44	+29.4
MPI	−0.5	0.23	0.34	+47.8
RegCM Em + CLM HadgGEM	−46.2	0.37	0.46	+24.3
RegCM Gr + BATS HadgGEM	−64.4	0.50	0.53	+6.0
RegCM Em + CLM MPI	−33.4	0.26	0.29	+11.5
RegCM Gr + BATS MPI	−43.2	0.34	0.40	+17.6

HadGM



MPI



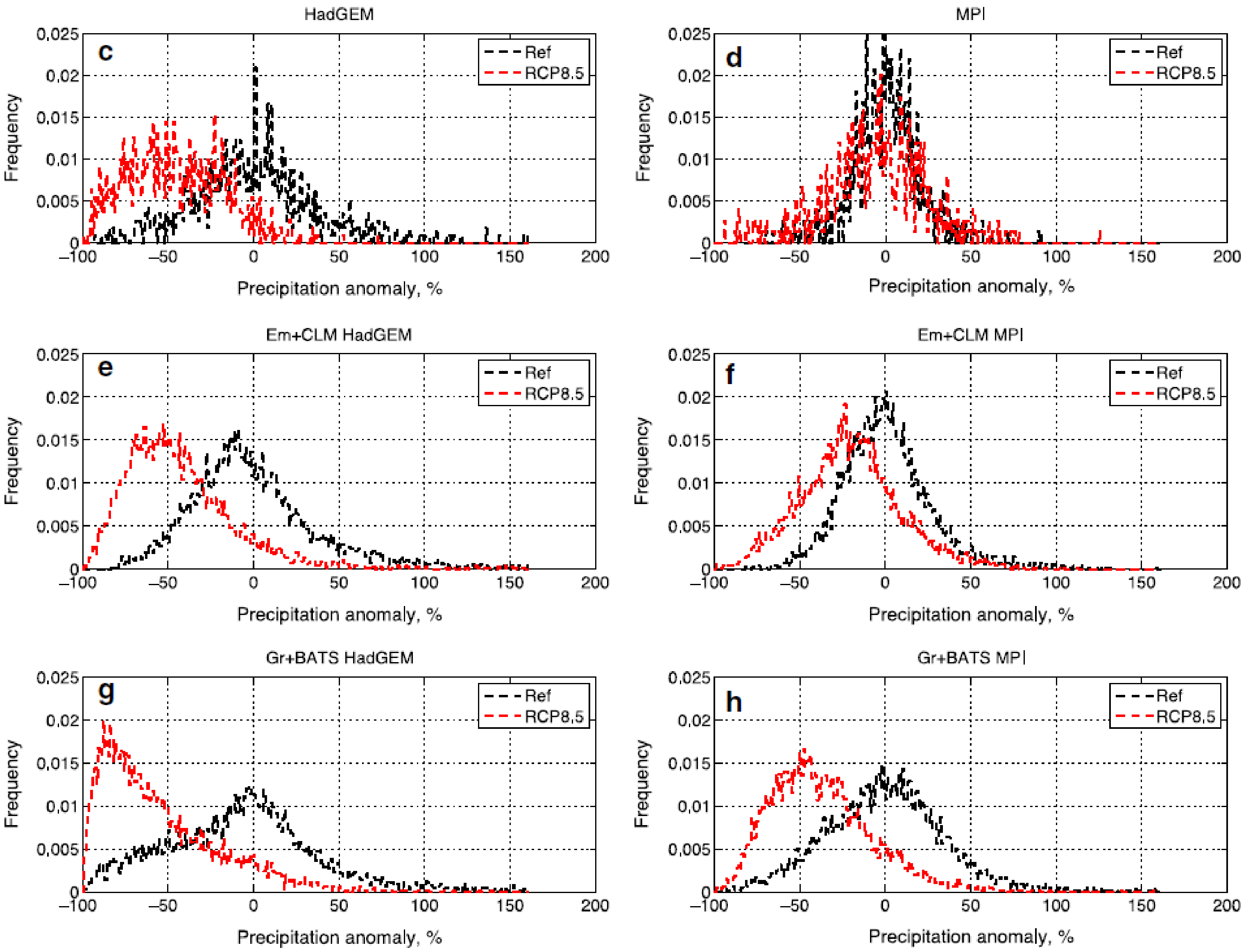
Present Future Present Future

MAIN CONCLUSIONS

Gradient TNA-TNP modulator of precipitation annual variability over SMECAM
Greater warming in TNP than TNA induces strong drying under RCP 8.5

Sources of uncertainty:

1. How GCMs simulate SST response
2. Resolution of the models (stronger response in RCM)
3. Convection and surface parameterizations



Tropical cyclones in a regional climate change projection with RegCM4 over the CORDEX Central America domain

G. T. Diro · F. Giorgi · R. Fuentes-Franco ·
K. J. E. Walsh · G. Giuliani · E. Coppola

Climatic Change (2014) 125:79–94
DOI 10.1007/s10584-014-1155-7

RegCM4. Grell and MIT_Emanuel parameterizations
Simulation period: 1982-1003. Perfect BC: ERA Interim.
GCM: 1970-2100
Present: 1982-2003. Future: 2078-2099 (RCP 8.5)

Detection parameters:

Relative vorticity at 850 hPa > $10^{-5}\ s^{-1}$

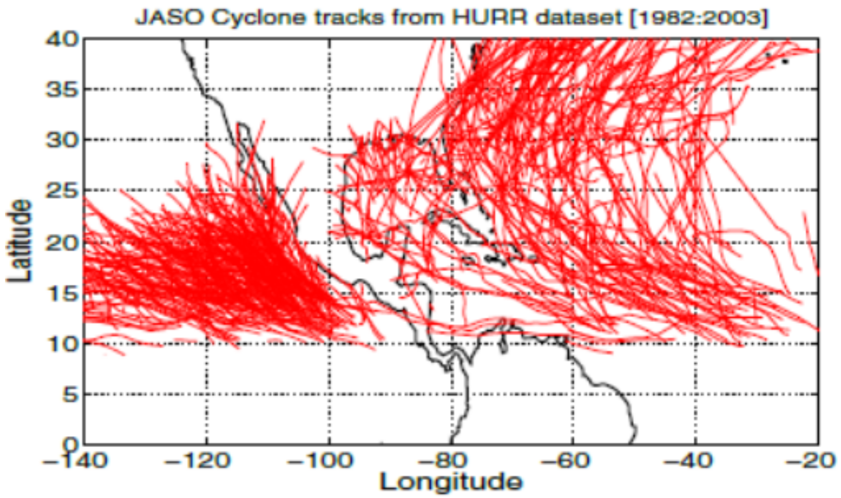
Closed pressure minimum within 100 km (At least 2 hPa less than neighborhood)

Surface wind > 17.5 ms^{-1}

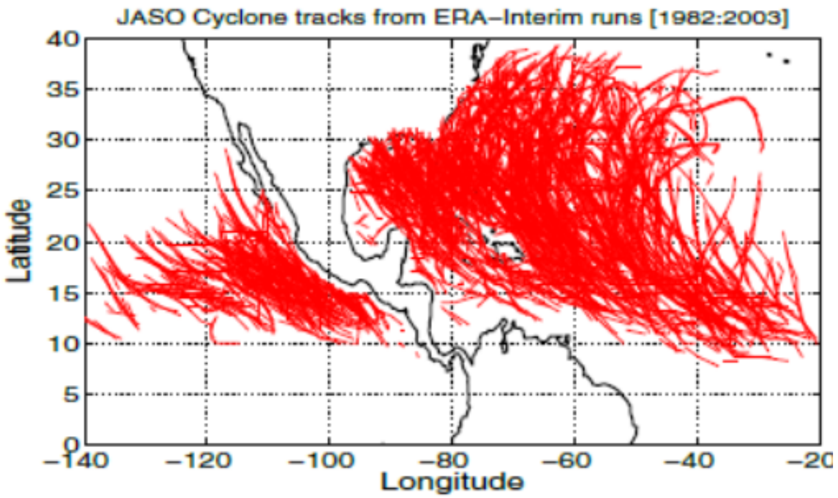
Warm core (700-300 hPa)

SST>26°C at the center

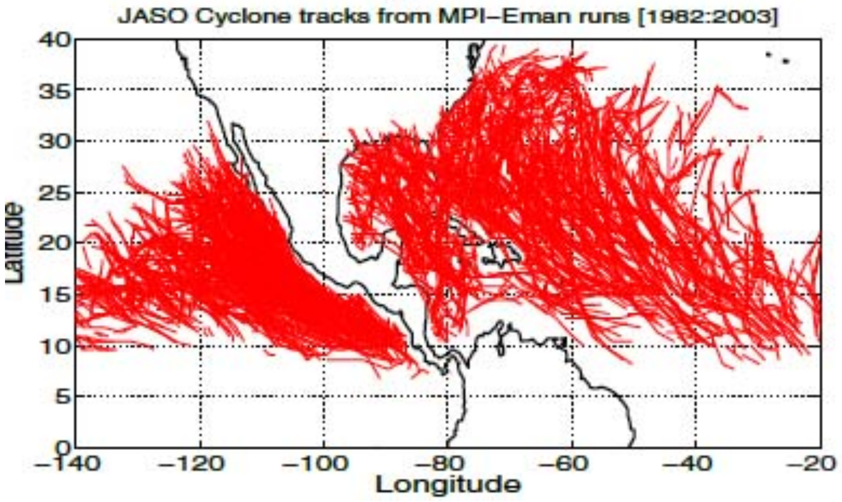
HURR-NHC



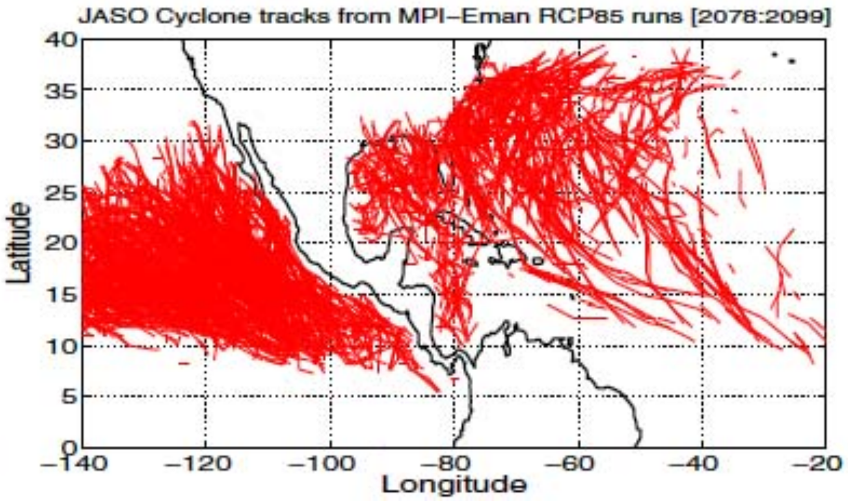
ERA

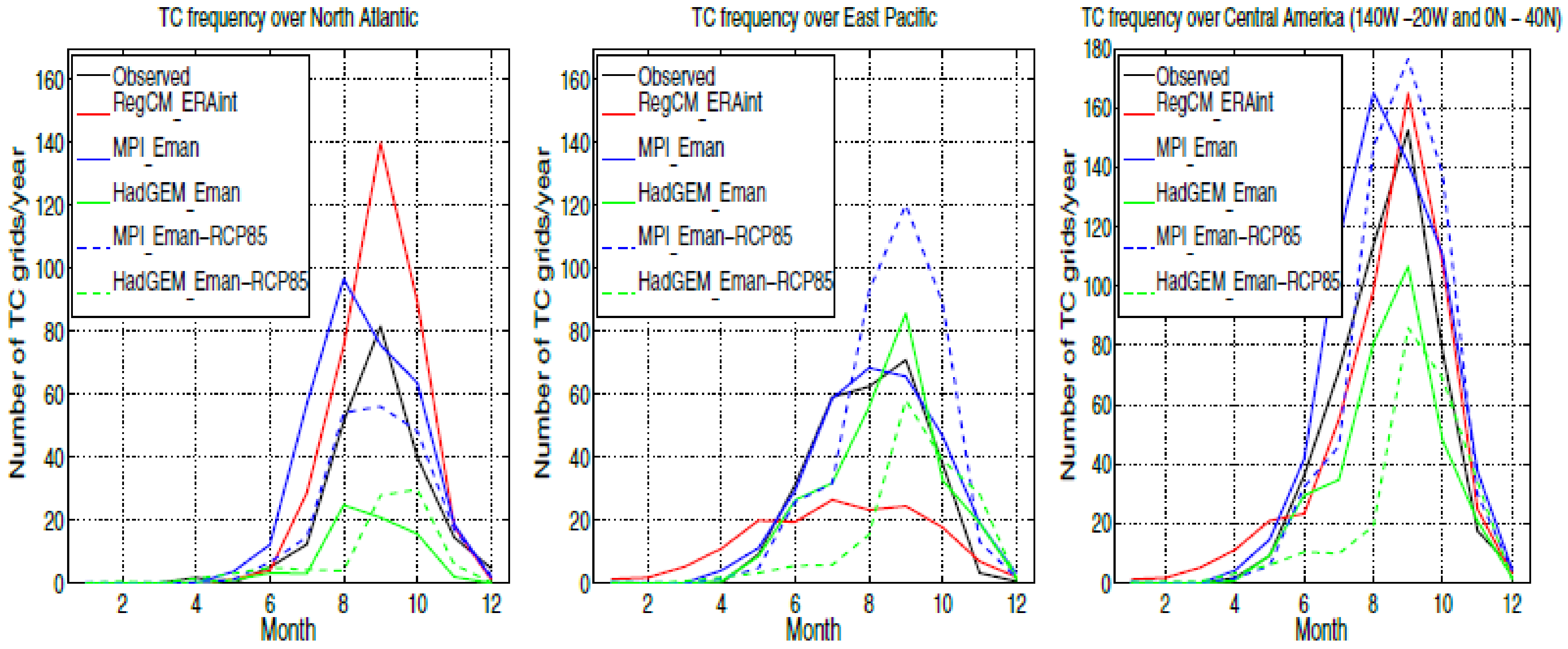


MPI_RegCM4 (present)



MPI_RegCM4 (Future RCP 8.5)





MAIN CONCLUSIONS

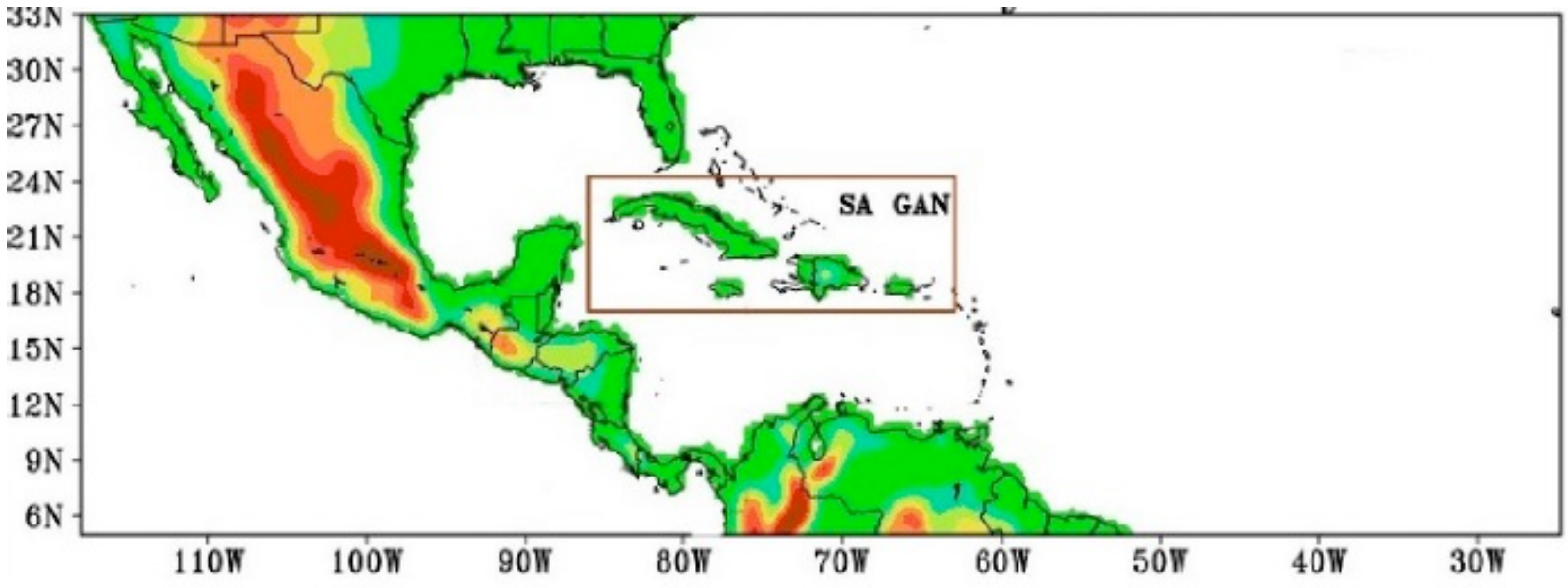
The MPI-ESM + RegCM4 (MIT_Emanuel) reproduces well the TC climatology for present climate and is recommended for projections.

Projections RCP 8.5:
Long-lasting TC increase slightly
Oveall frequency of TCs decrease in AO and coastal EPO
increase in EPO far from the coast

Performance of RegCM4.3 over the Caribbean region using different configurations of the Tiedtke convective parameterization scheme

Daniel Martínez-Castro[1], Alejandro Vichot-Llano[1], Arnoldo Bezanilla-Morlot[1], Abel Centella-Artola[1], Jayaka Campbell[2] and Cecilia Viloria-Holguin[3].

Revista de Climatología



RegCM 4.3. BC: ERA Interim. Hor. Res: 50 km. Period: 2 years

Configurations: (Covection schemes)

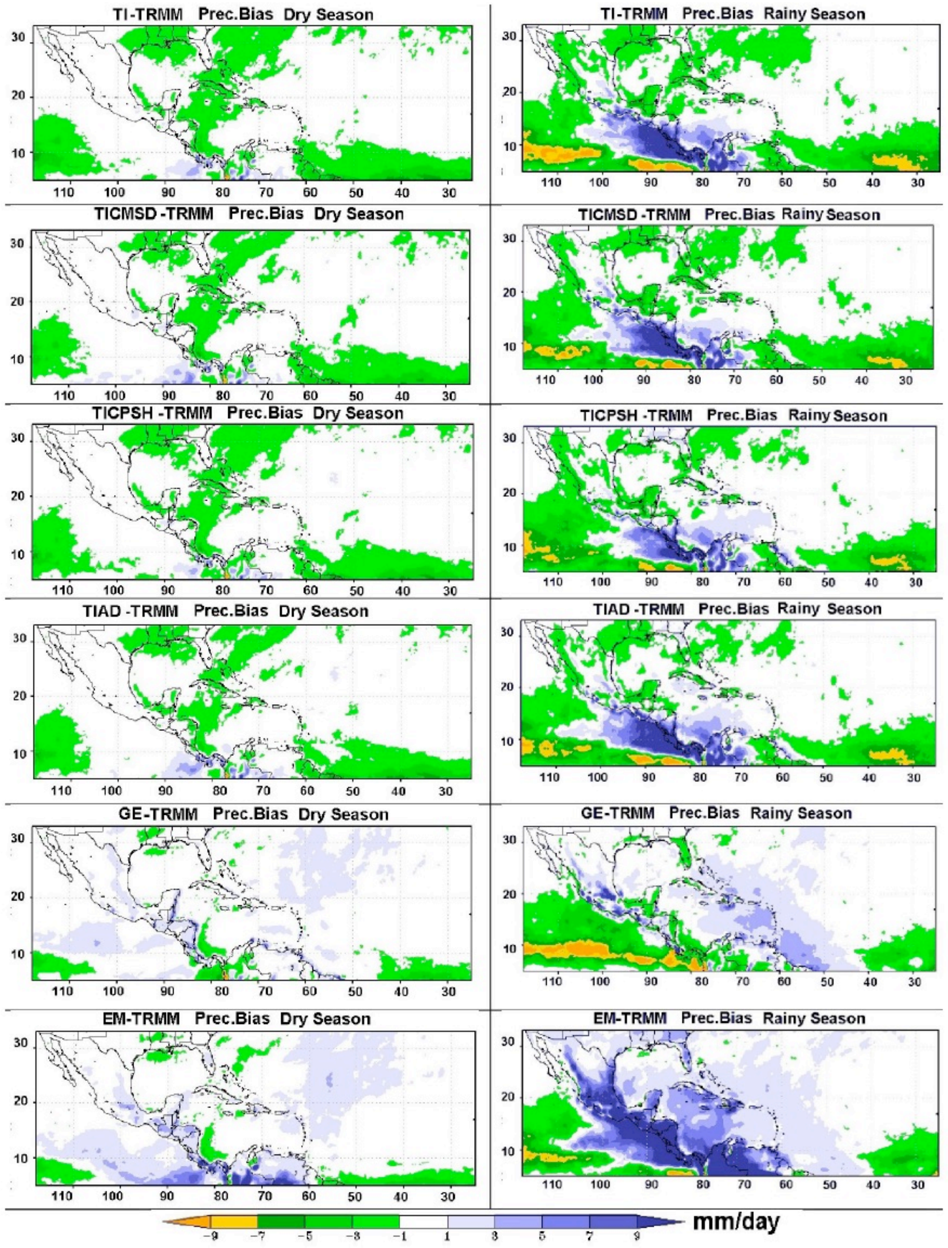
MIT Emanuel;

MIT_Emanuel over ocean; Grell over Land

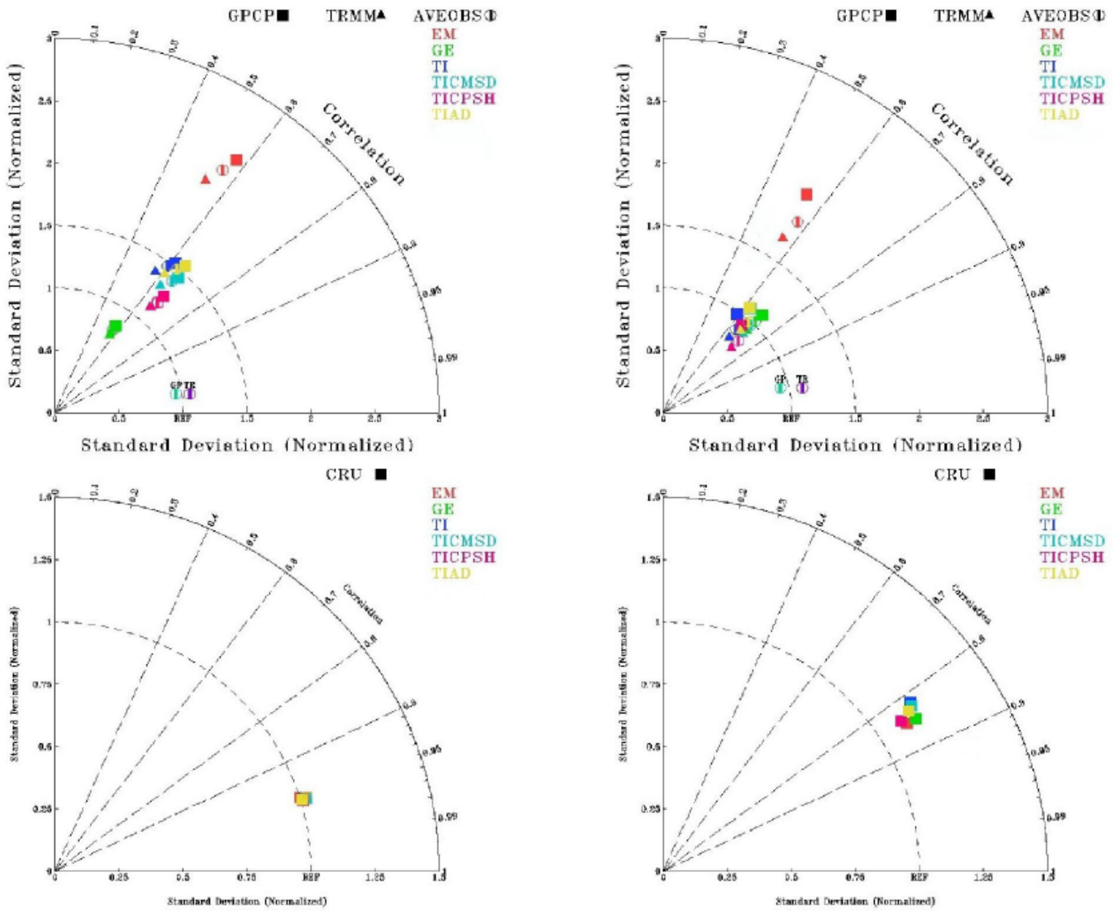
Tiedtke (16 multiparameter configurations)

Bias and variability

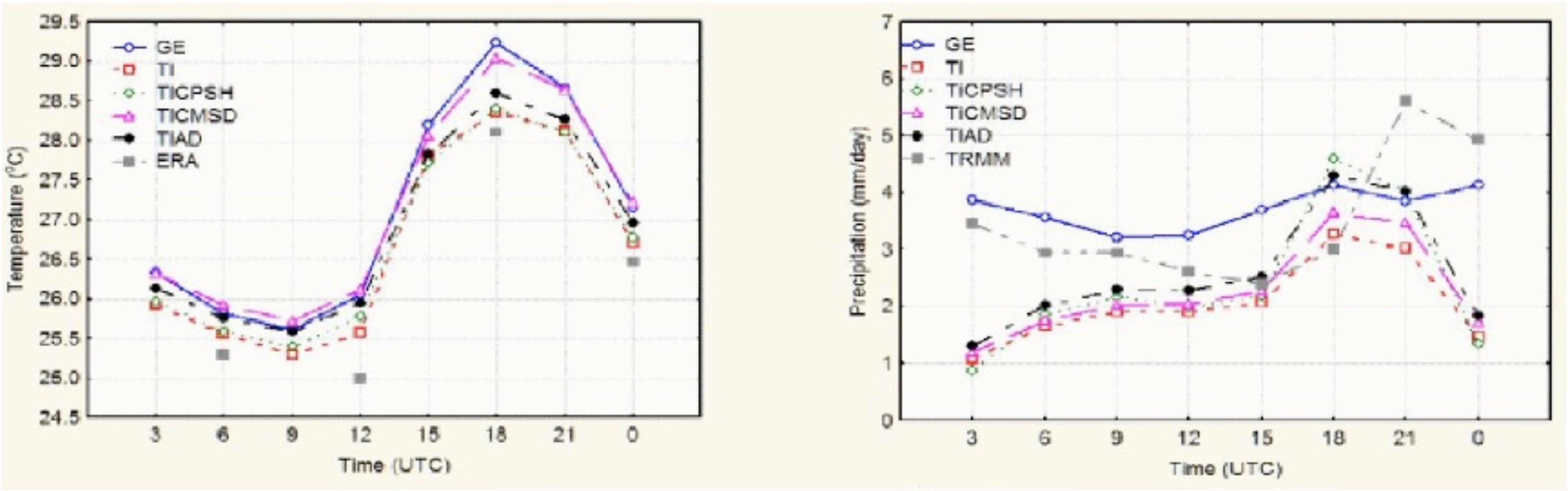
PRECIPITATION BIAS



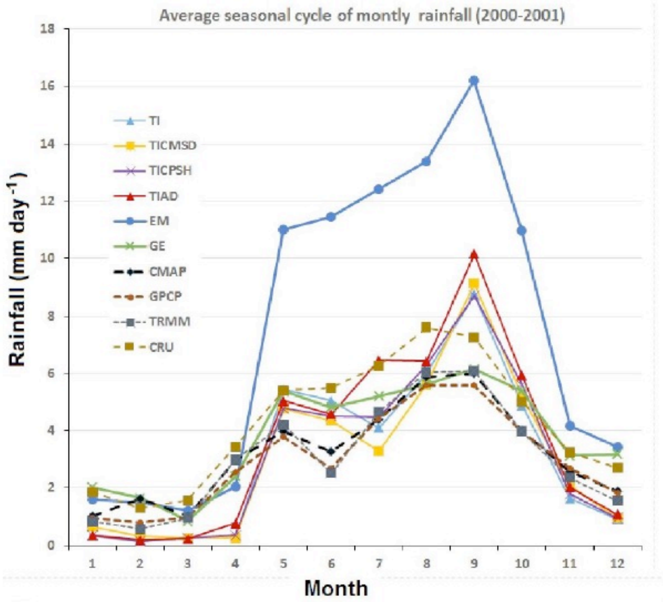
PRECIPITATION BIAS



Diurnal cycle GAN



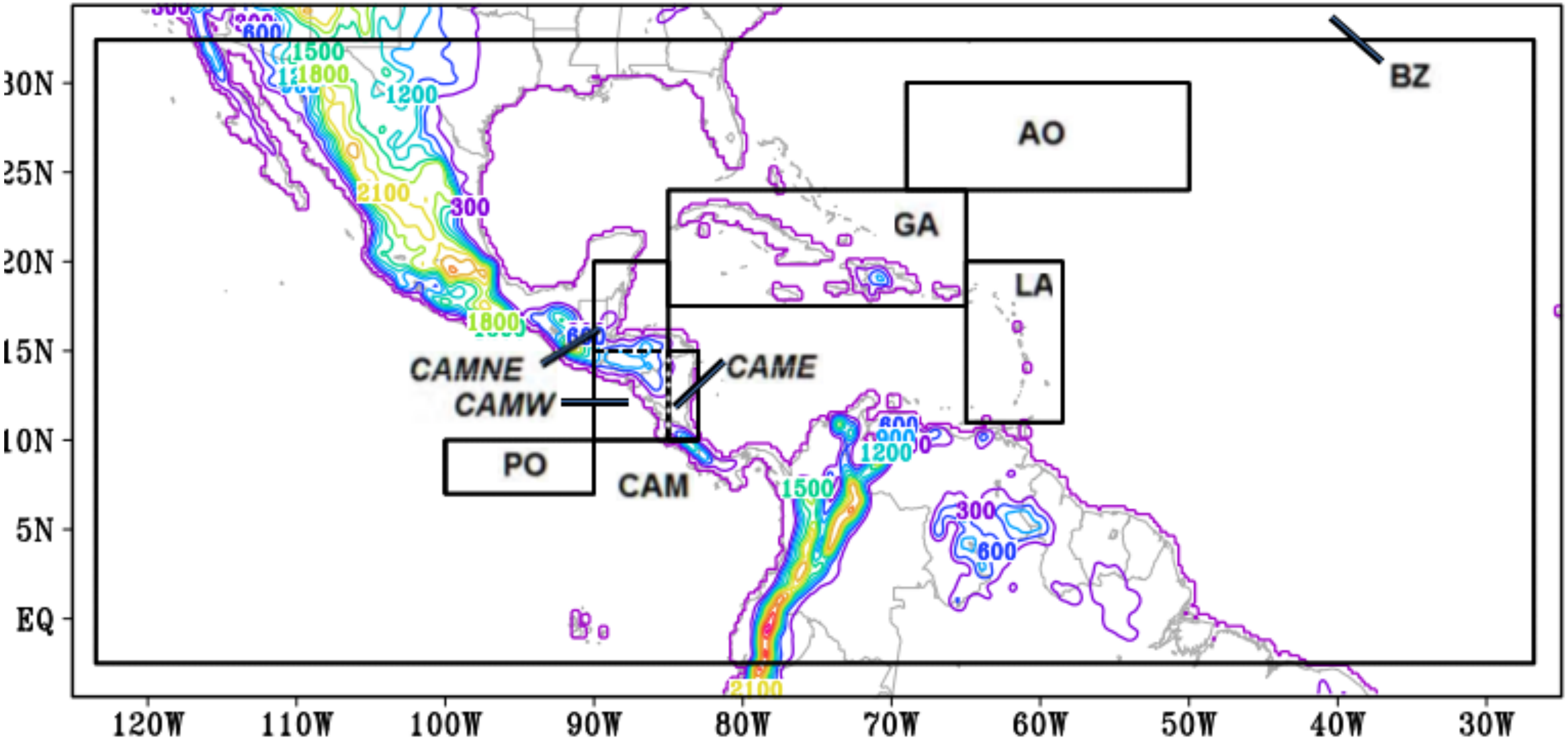
Seasonal cycle GAN



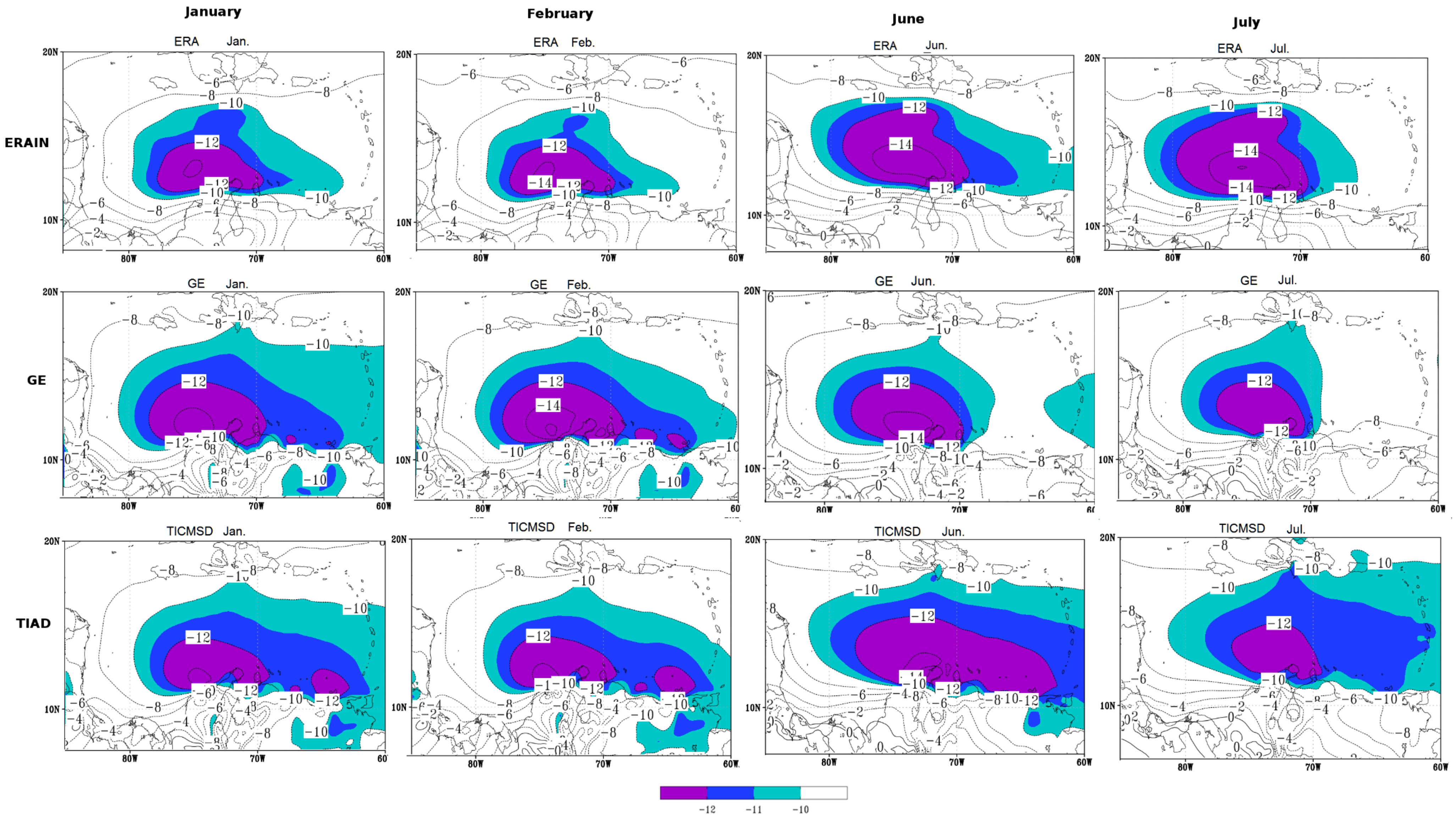
MAIN CONCLUSIONS

Tiedtke scheme with tuned entrainment and autoconversion parameters and G_E reproduce well climatic features and has relatively low biases for some regions of the domain.

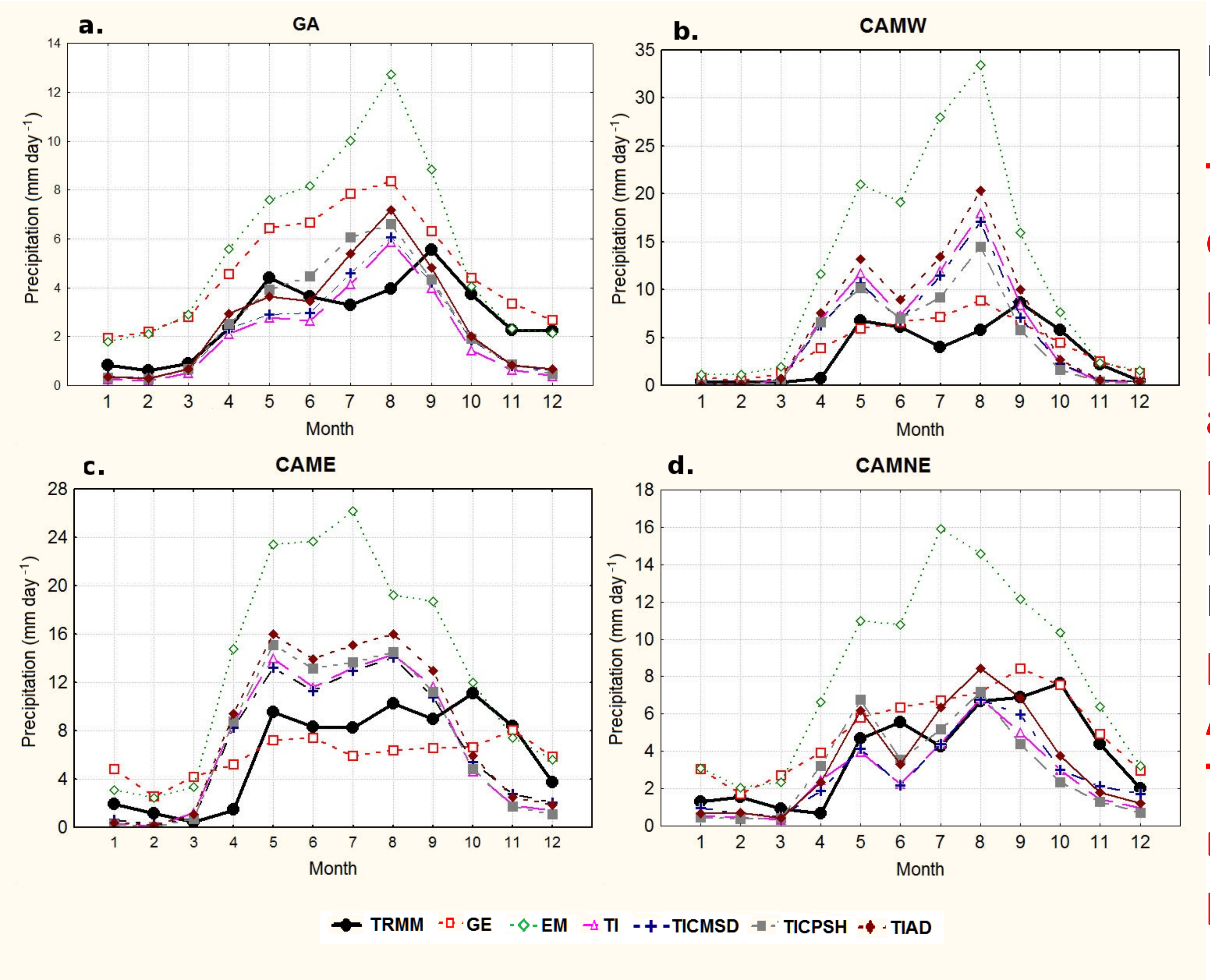
The performance of RegCM4.3 over the Central America and Caribbean region using different cumulus parameterizations.
Martínez-Castro et al. (submitted)



Caribbean Low Level Jet (925 hPa)



Caribbean-CAM Midsummer drought



MAIN CONCLUSIONs:

The Tiedtke scheme with t
entrainment and autocon
parameters has limited bi
reproduces well variability
and MSD. GE has lower pr
biases but is worst in repr
MSD and ITCZ
MIT_Emanuel overestmat
precipitation
An ensemble of GE and or
Tiedtke configurations is
recommended for climati
projections

Thank you!!