The American Midsummer Drought in CMIP5

Multi-Model Evaluation and Projections

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1. Brief introduction to the midsummer drought

- What, when, where, why?

2. How we quantify the midsummer drought

- MESA algorithm

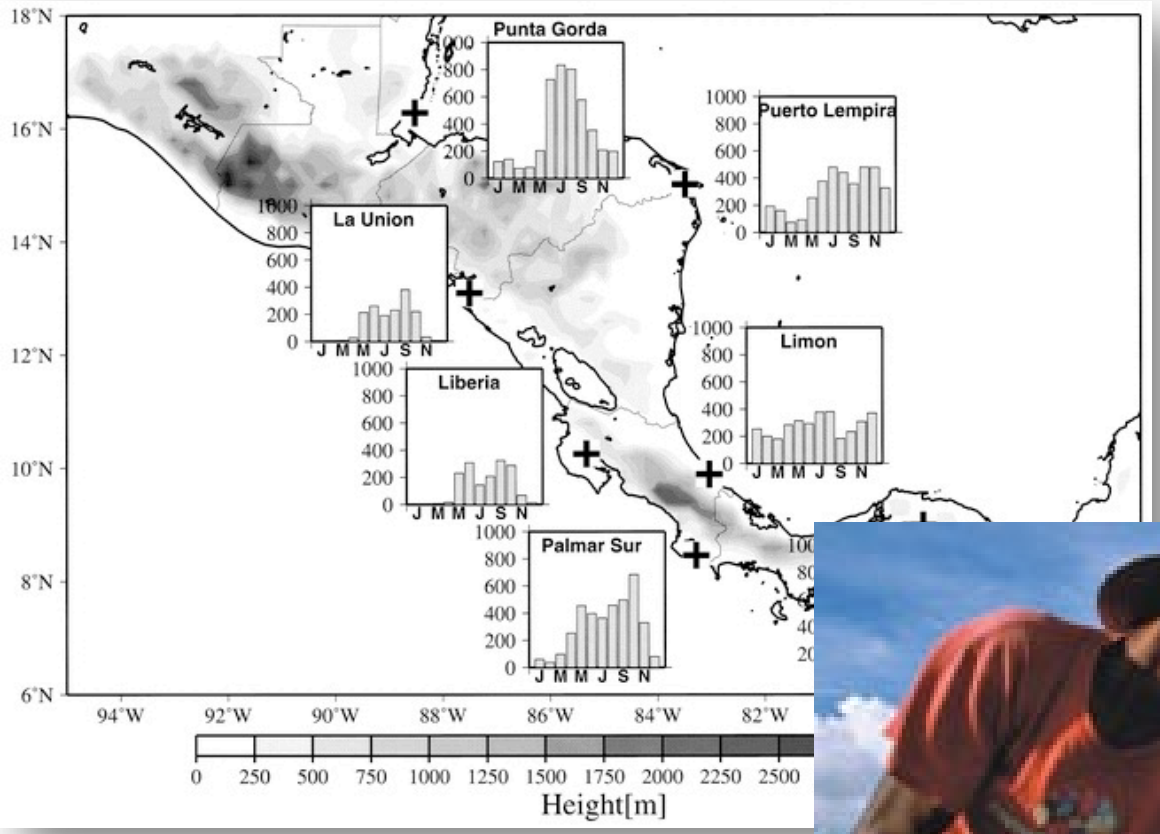
3. CMIP5 model performance

- Historical experiment

4. CMIP5 projections of future MSD

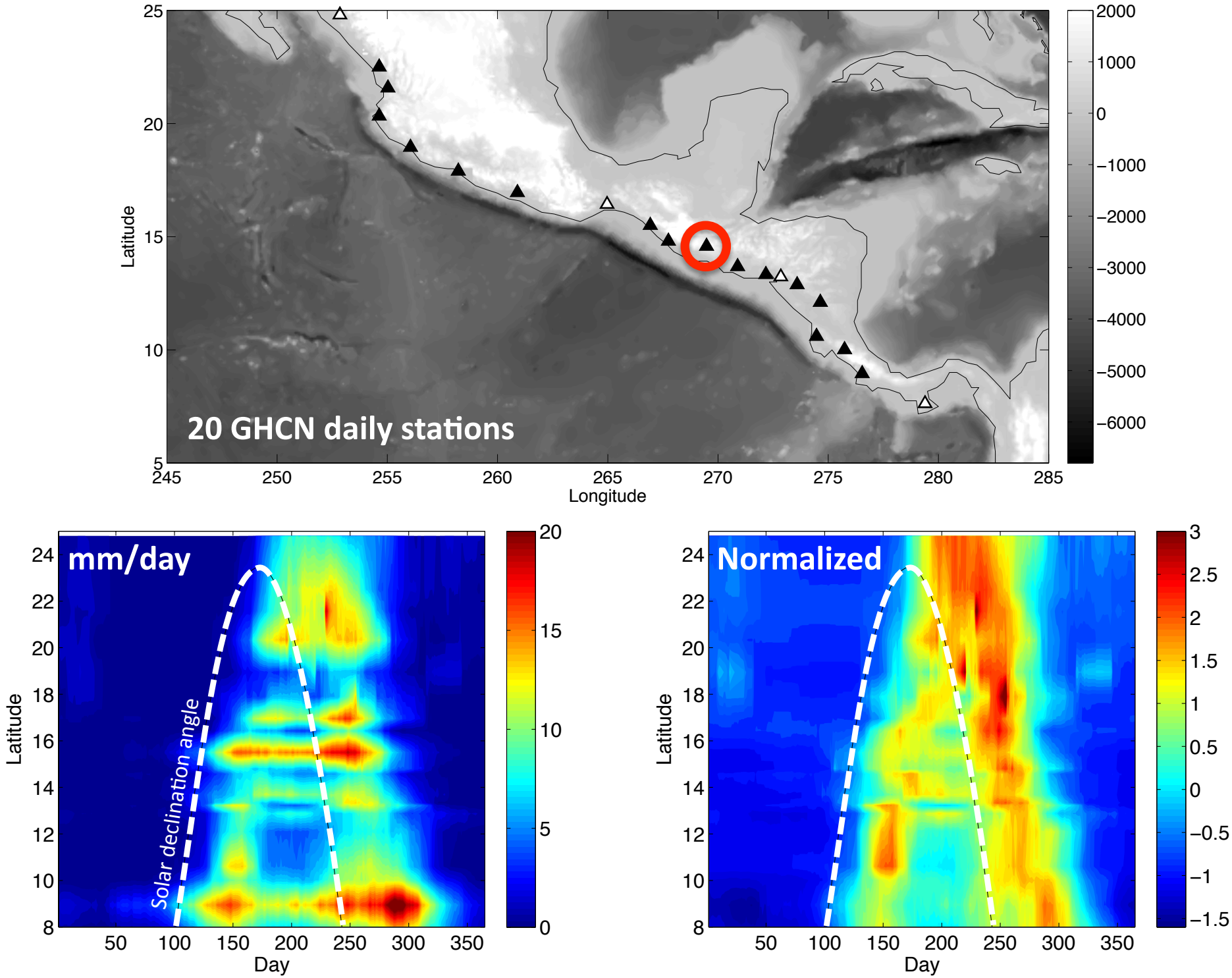
- RCP4.5 and RCP8.5 experiments

Magaña *et al.* (1999)



Hellmuth *et al.* (2009)

The climate presents a challenge to small-scale farmers and can significantly limit their options; Scott Wallace/World Bank



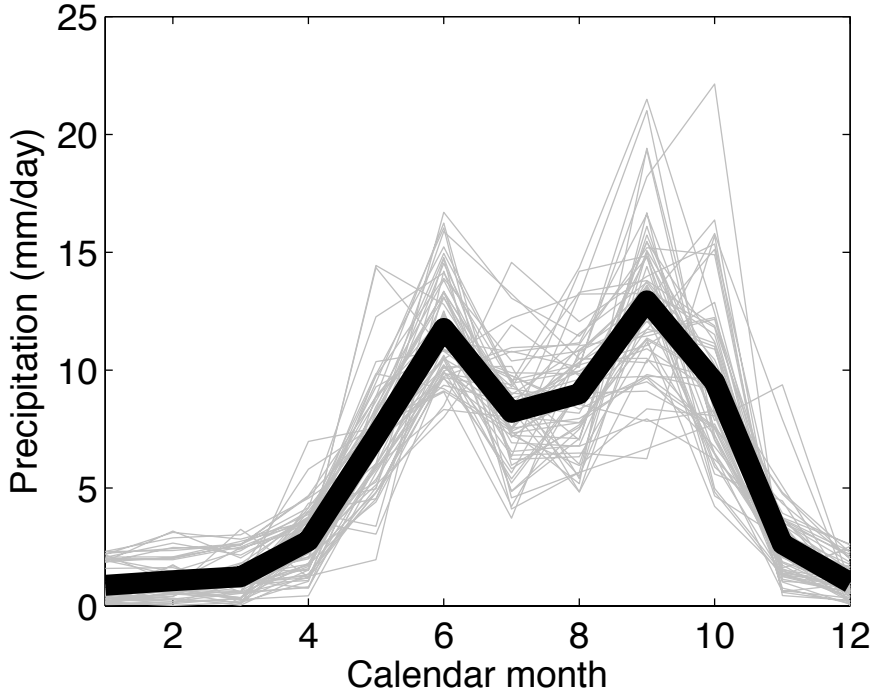
Karnauskas, K.B., A. Giannini, R. Seager, and A.J. Busalacchi (2012) A simple mechanism for the climatological midsummer drought along the Pacific coast of Central America. *Atmósfera*, accepted.

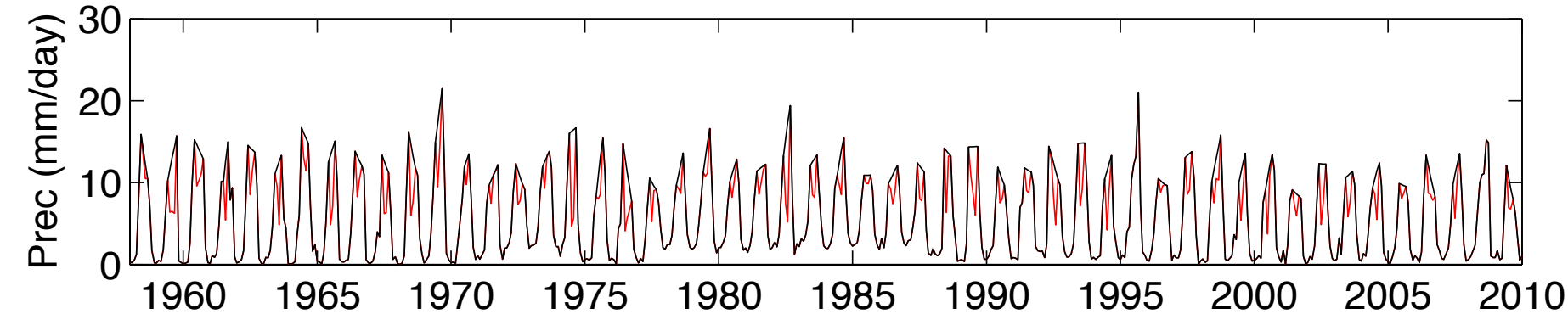
Interannual variability

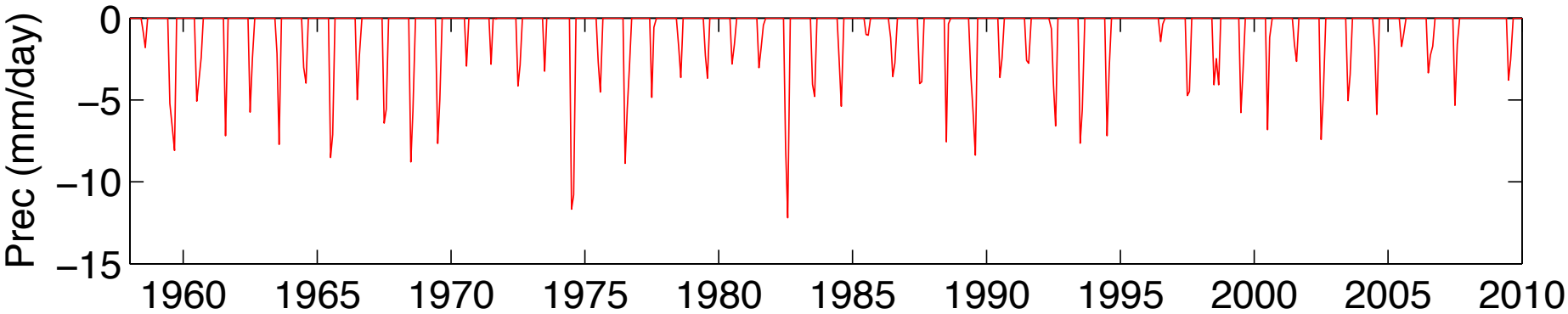
@ 91°W, 14°N

~Guatemala City

PREC/L (Chen *et al.* 2002)







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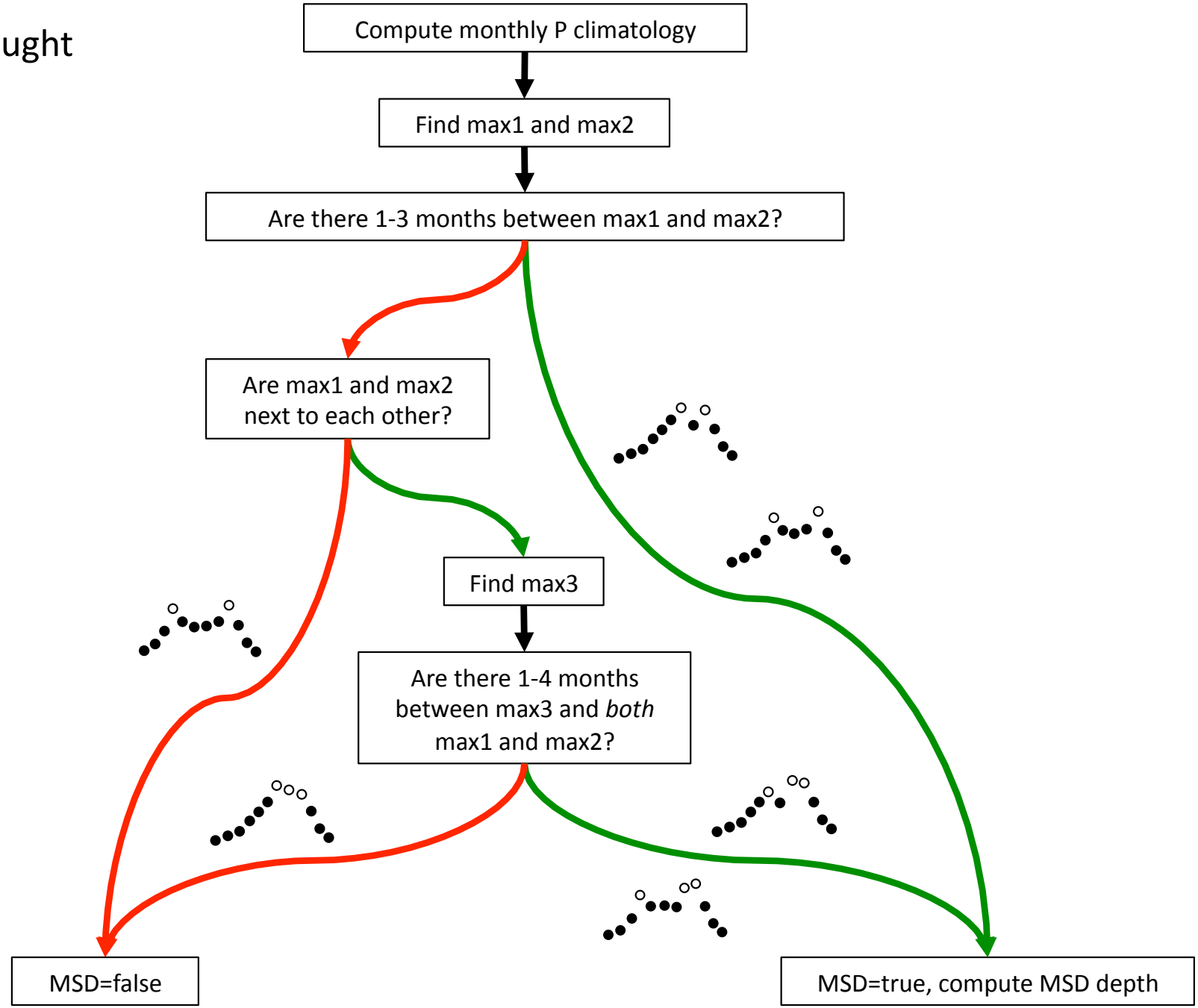
Midsummer drought
Existence &
Strength
Algorithm



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ID	Model	Historical	RCP4.5	RCP8.5
1	bcc-csm1-1	x	x	x
2	CanCM4	x		
3	CanESM2	x	x	x
4	CCSM4	x	x	x
5	CNRM-CM5	x	x	x
6	CSIRO-Mk3-6-0	x	x	x
7	GFDL-CM3	x	x	x
8	GFDL-ESM2G	x	x	x
9	GFDL-ESM2M	x		x
10	GISS-E2-H	x		
11	GISS-E2-R	x	x	x
12	HadCM3	x		
13	HadGEM2-CC	x		x
14	HadGEM2-ES	x	x	x
15	inmcm4	x	x	x
16	IPSL-CM5A-LR	x		x
17	IPSL-CM5A-MR	x	x	x
18	MIROC5	x	x	x
19	MIROC-ESM	x	x	x
20	MIROC-ESM-CHEM	x	x	x
21	MPI-ESM-LR	x	x	x
22	MRI-CGCM3	x	x	x
23	NorESM1-M	x	x	x
		23	**17**	**20**

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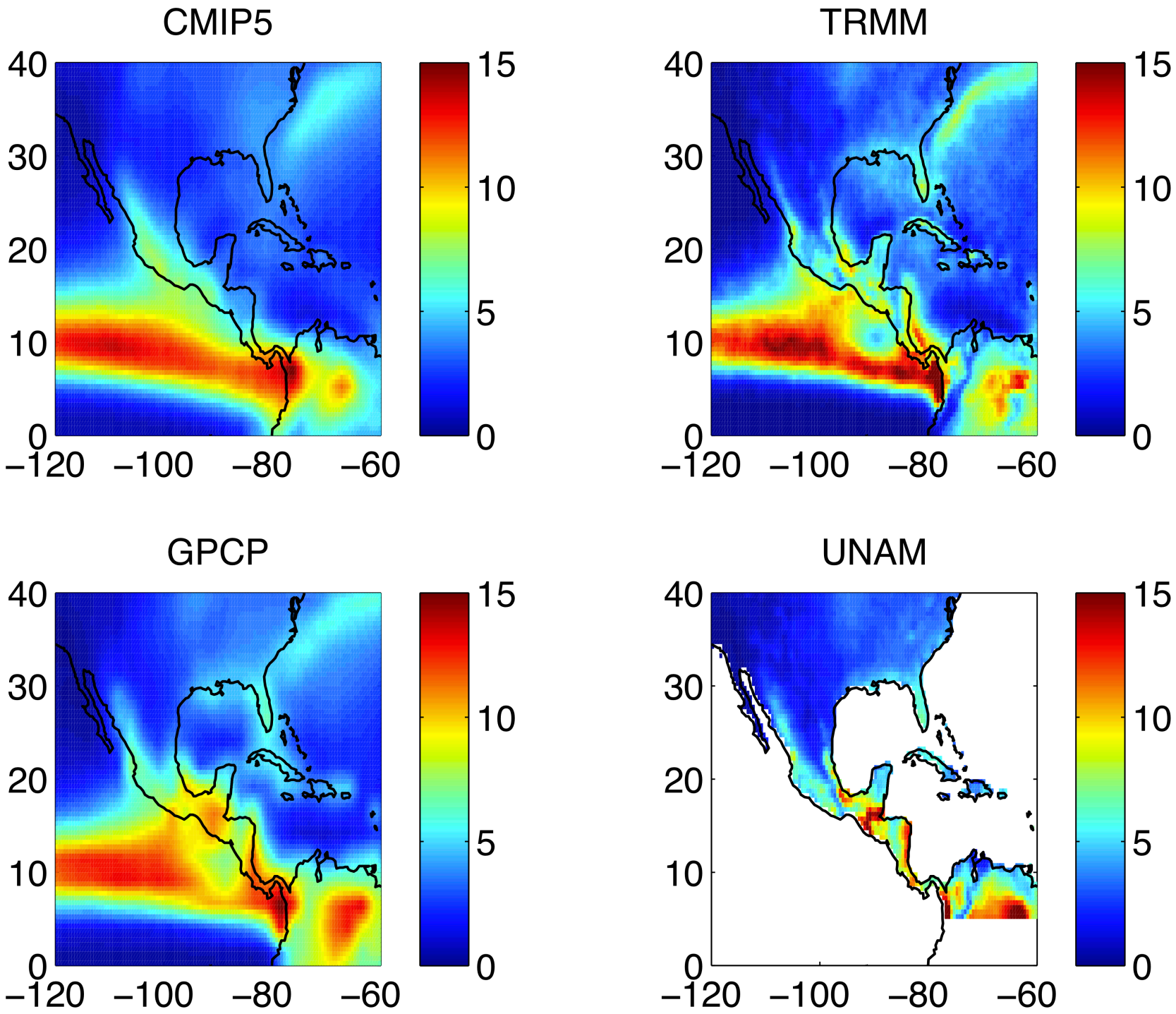
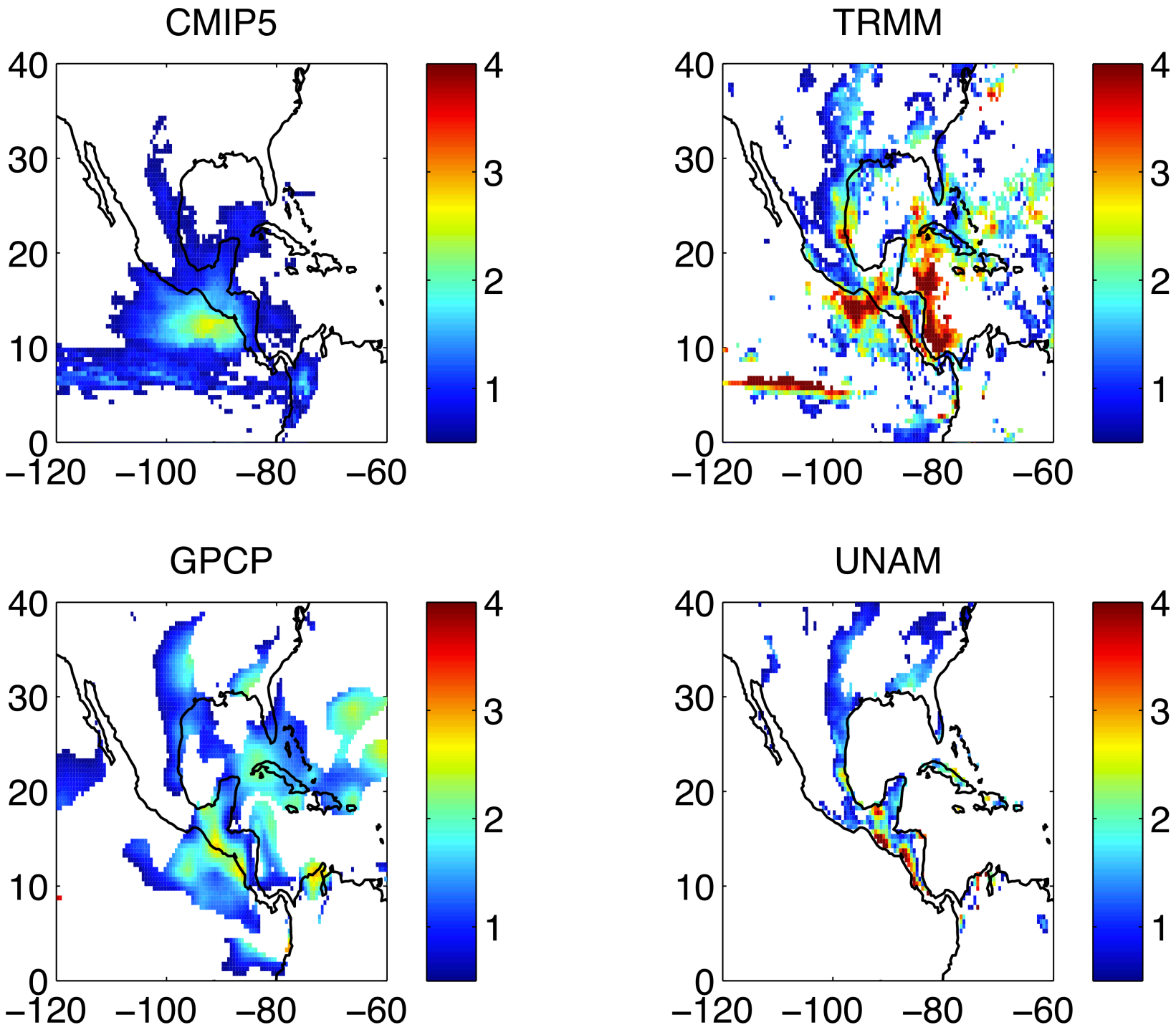
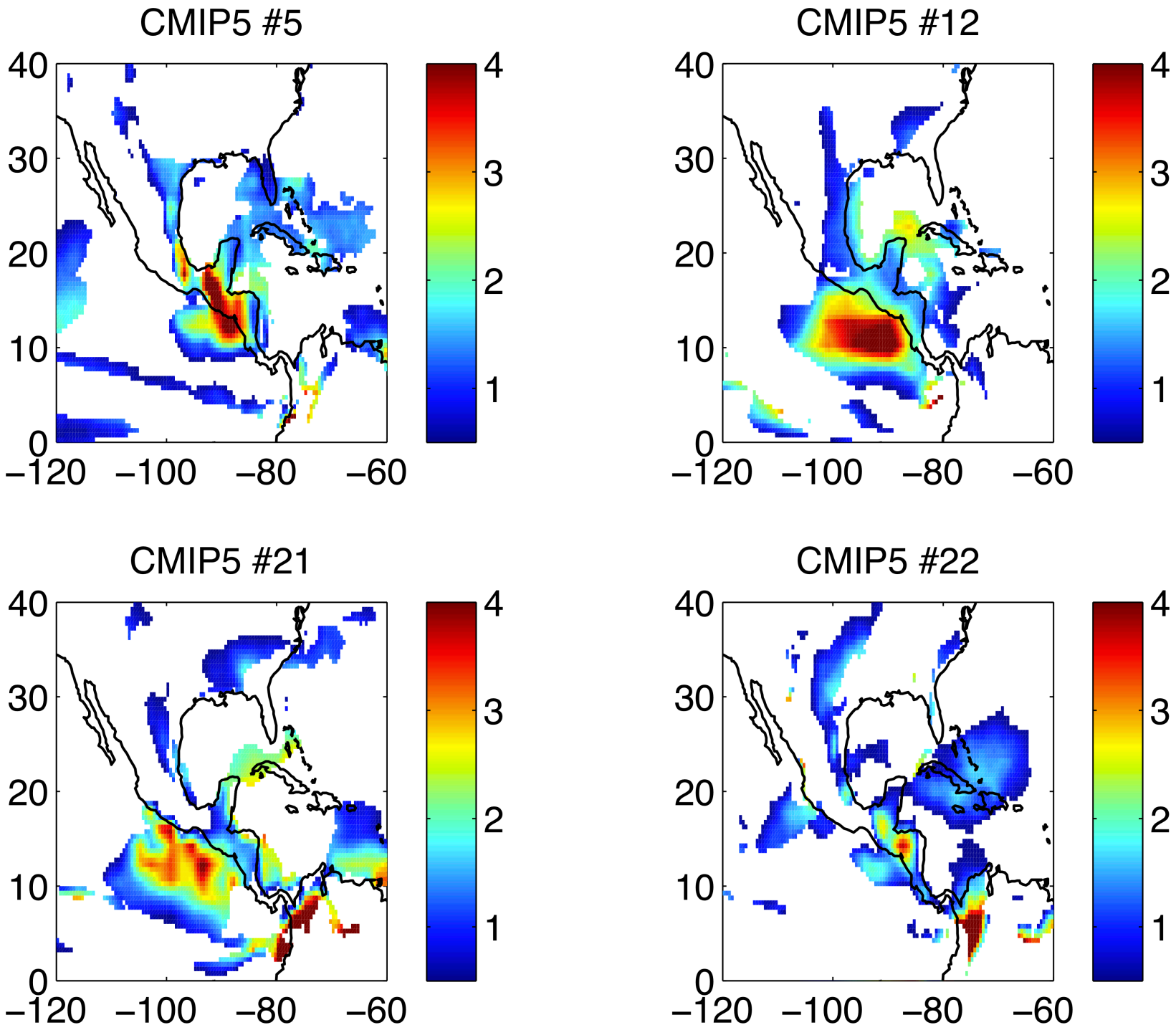
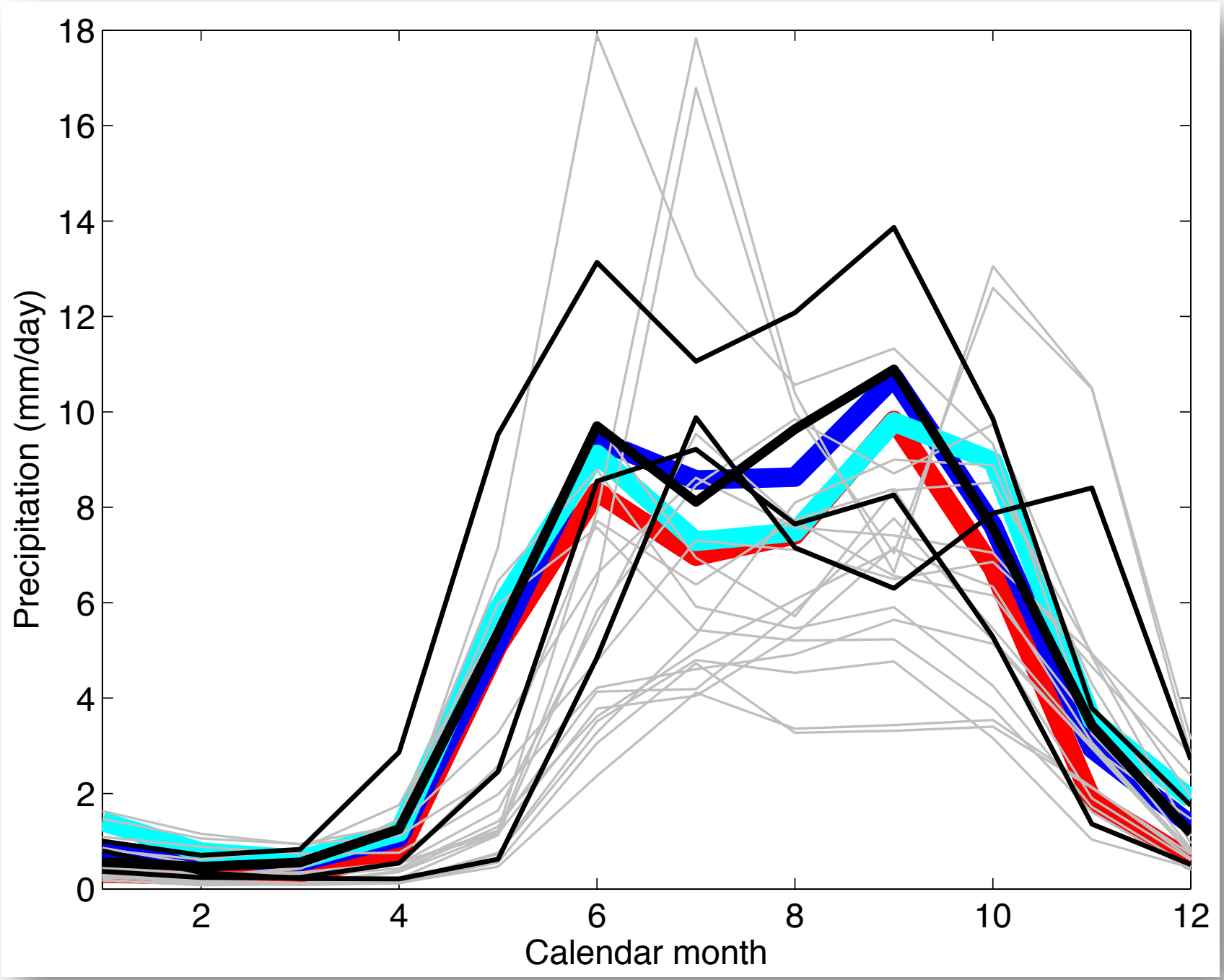

CMIP5
TRMM
GPCP
UNAM
40
30
20
10
0
−120
−100
−80
−60
15
10
5
0


CMIP5
TRMM
GPCP
UNAM
40
30
20
10
0
−120
−100
−80
−60
4
3
2
1


CMIP5 #5
CMIP5 #12
CMIP5 #21
CMIP5 #22
40
30
20
10
0
−120
−100
−80
−60
4
3
2
1


Precipitation (mm/day)
Calendar month
0
2
4
6
8
10
12
14
16
18
2
4
6
8
10
12

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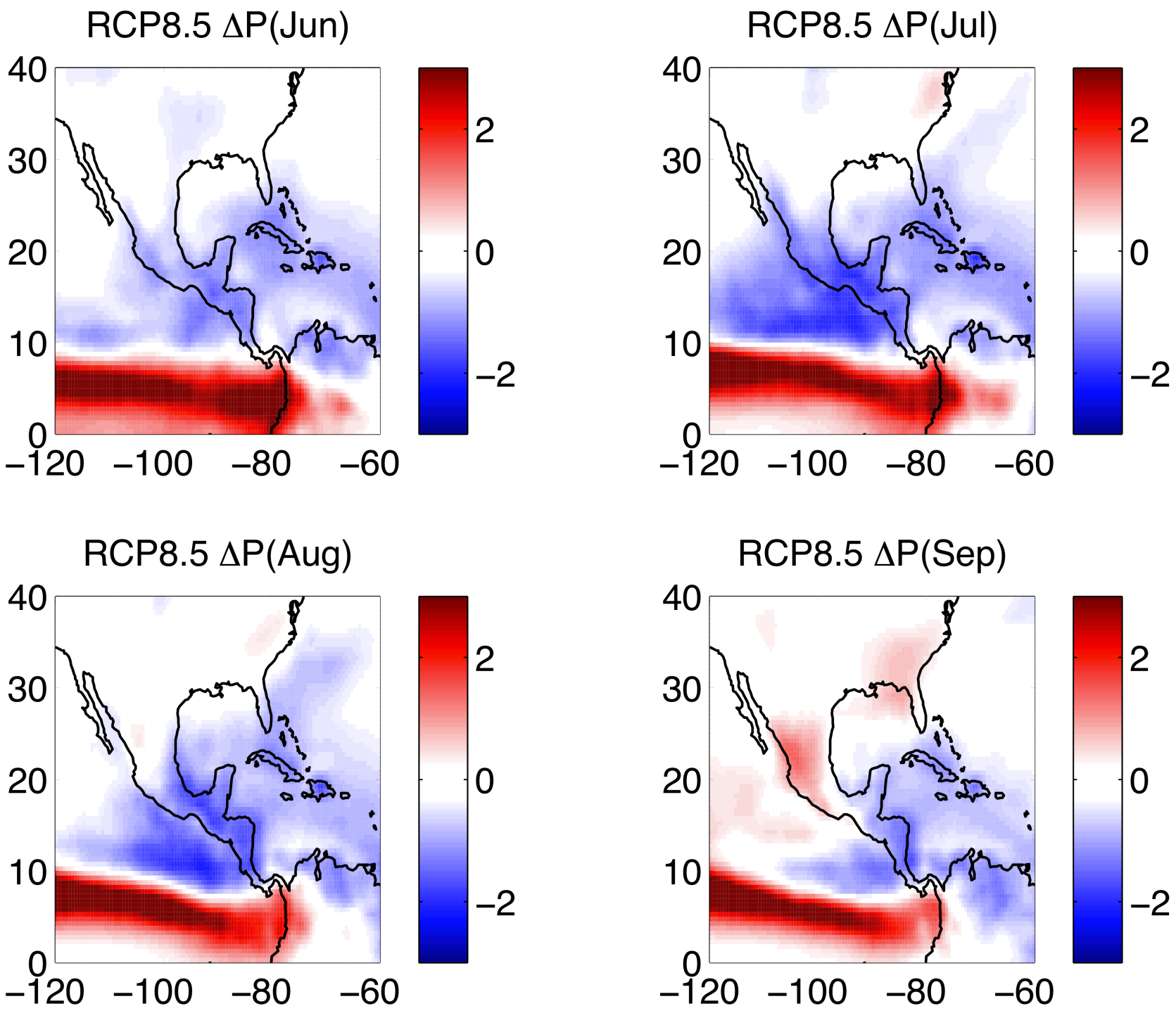
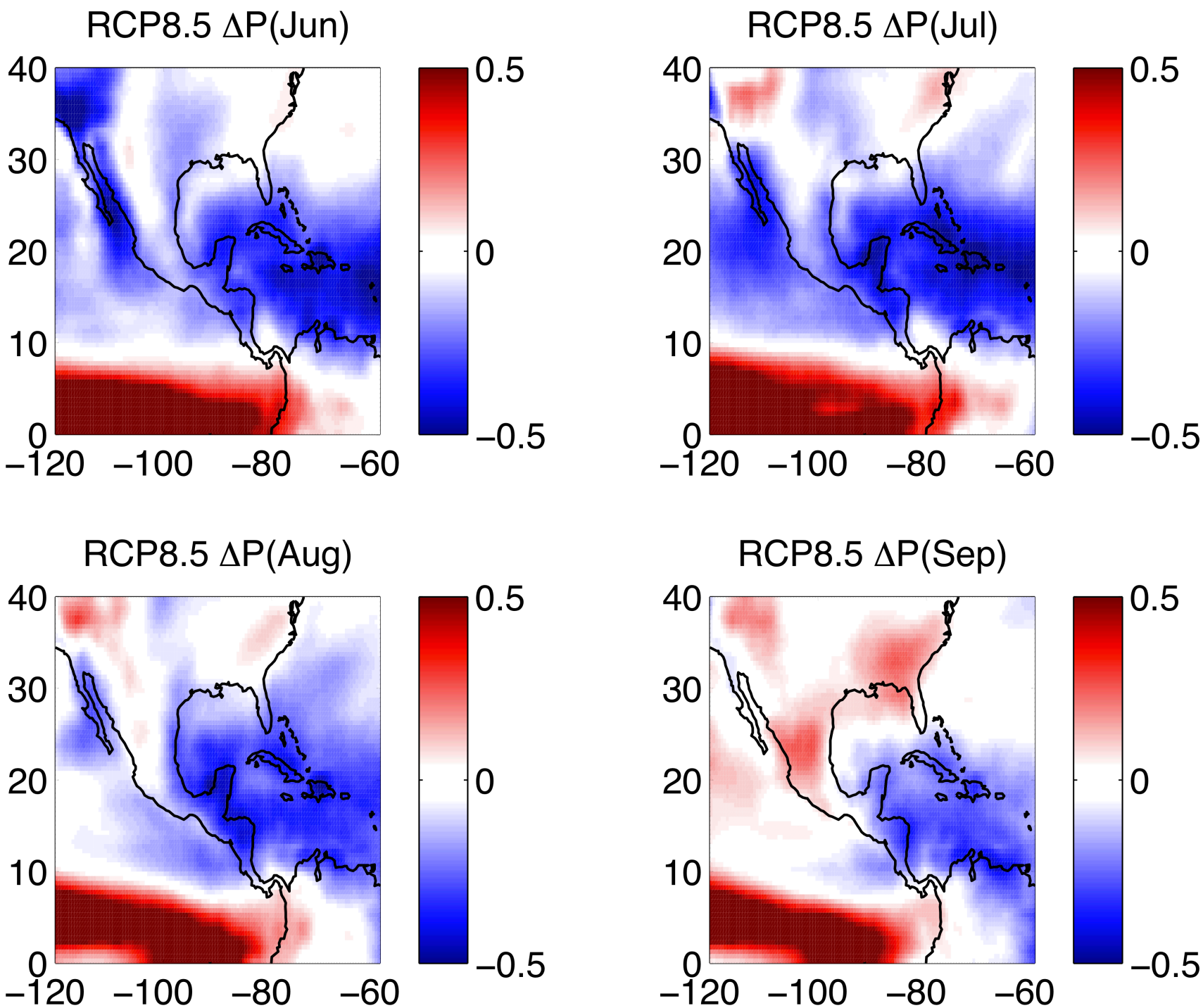
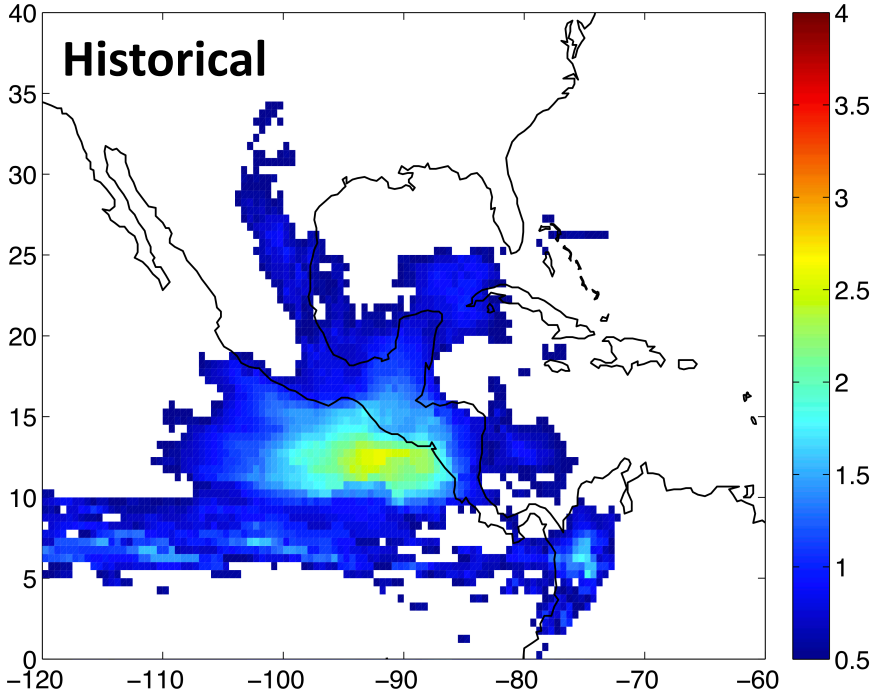
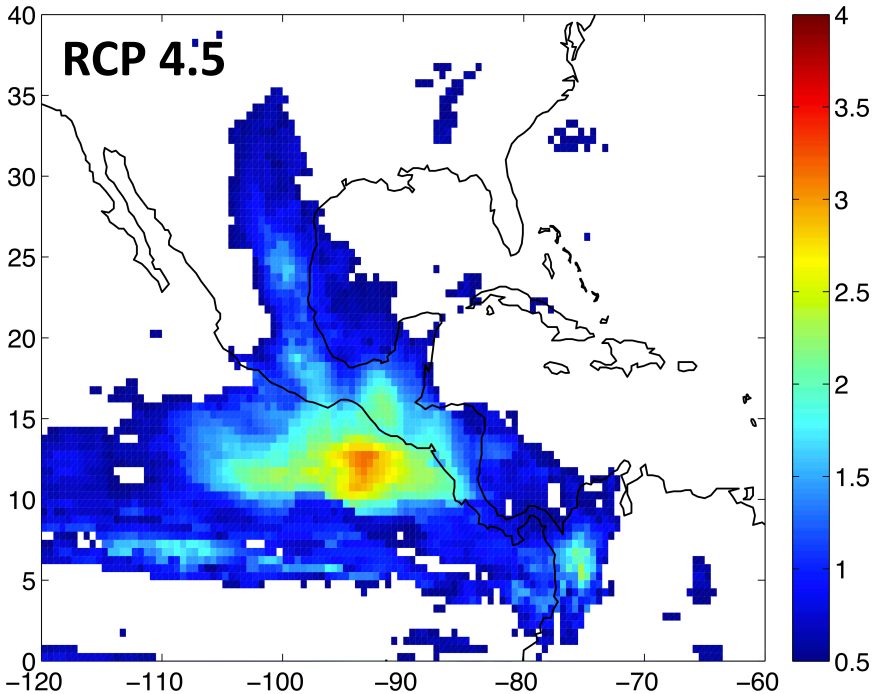

RCP8.5 ΔP(Jun)
RCP8.5 ΔP(Jul)
RCP8.5 ΔP(Aug)
RCP8.5 ΔP(Sep)
40
30
20
10
0
−120
−100
−80
−60
2
0
−2

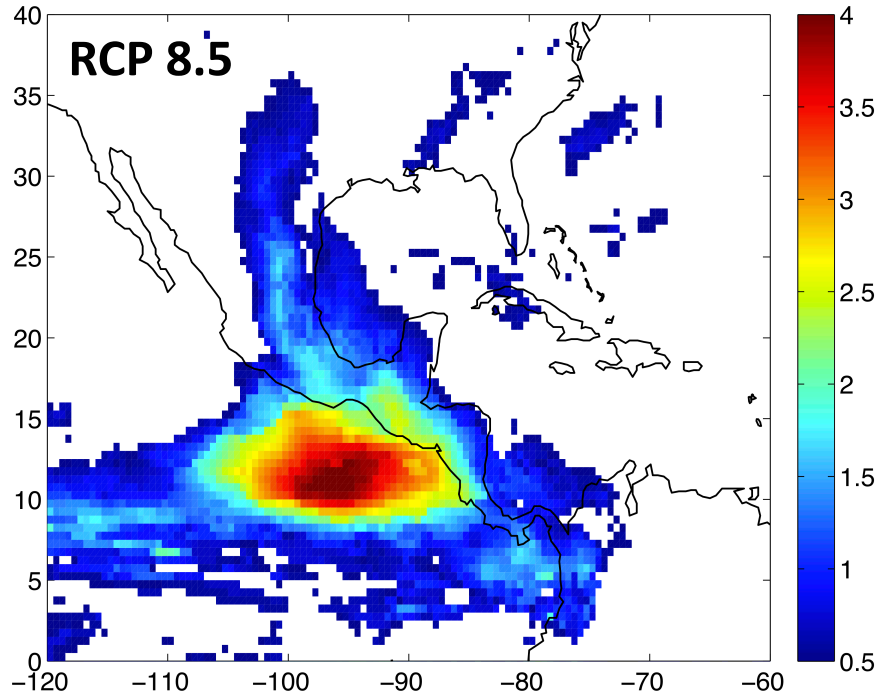

RCP8.5 ΔP(Jun)
RCP8.5 ΔP(Jul)
RCP8.5 ΔP(Aug)
RCP8.5 ΔP(Sep)
40
30
20
10
0
−120
−100
−80
−60
0.5
0
−0.5

MSD projections

Multi-model mean







Summary & ongoing/future work

- Despite biases in overall summertime rainfall amounts, the CMIP5 multi-model mean captures the essence of the MSD over much of the Inter-Americas region.

- Consistent with seasonal rainfall projections, the CMIP5 multi-model mean provides a robust projection of a stronger MSD for most regions that experience an MSD today.

- Mechanisms for projected future MSD strengthening… relationship to basic causal mechanisms and those of interannual variability?

- Does the MSD become more/less predictable in the future?