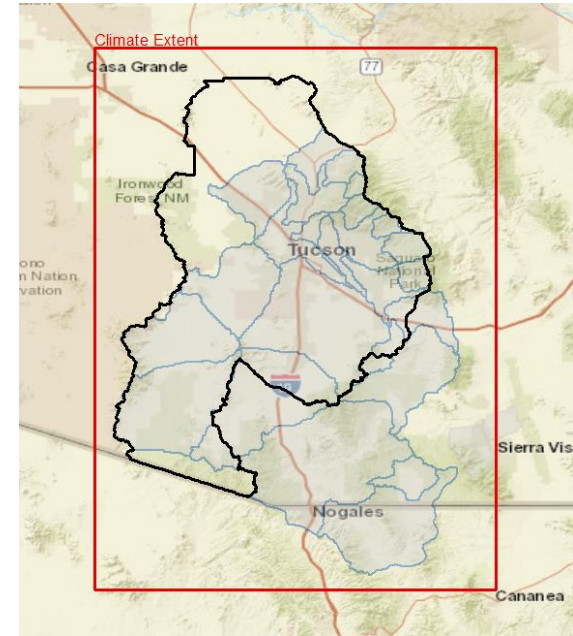# Lower Santa Cruz River Basin climate analysis progress report

APRIL 2ND, 2018

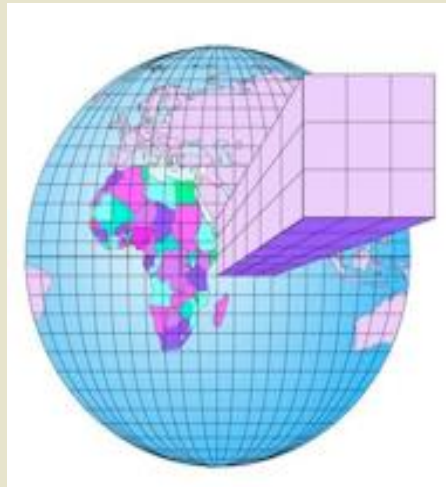HSIN-I CHANG

UNIVERSITY OF ARIZONA, HYDROLOGY AND ATMOSPHERIC SCIENCES
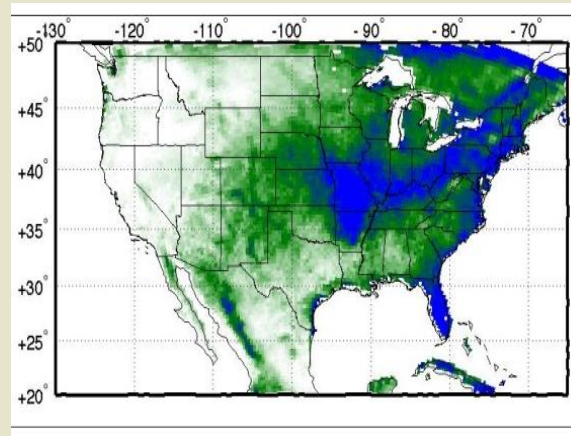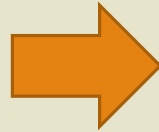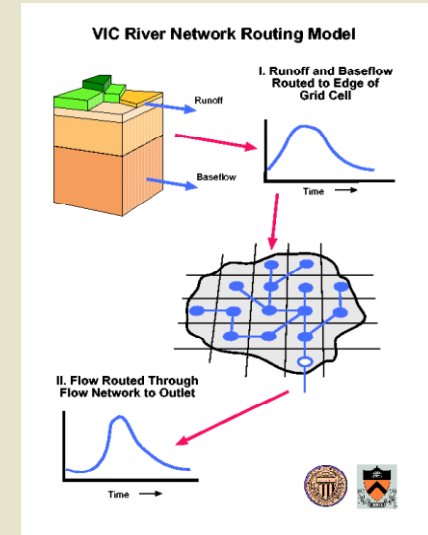
hchang05@email.arizona.edu

Physics-based Climate Data [Dynamical Downscaling]: Translating Global Climate Models to basin-scale hydroclimate projections

Dynamical downscaling

Bias correction

Global Climate Data (pixel size: 1-2°)

UA-Regional Climate Data [Dynamical Downscaling] (pixel size: 25km)

Basin-scale hydroclimate data (approximately 12.5 km resolution)

Regional Climate Data:
Coordinated Regional Climate Downscaling Experiment – North America (NA-CORDEX)

▪ Allows comparison of physics-based downscaling climate simulations

▪ Climate Change Scenarios: RCP* 8.5 (**Worse Case / High Risk Climate**)

▪ Core Datasets: 12

Two of the three selected GCMs are reasonably performing models for North America

Representative Concentration Pathways - "Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases…."

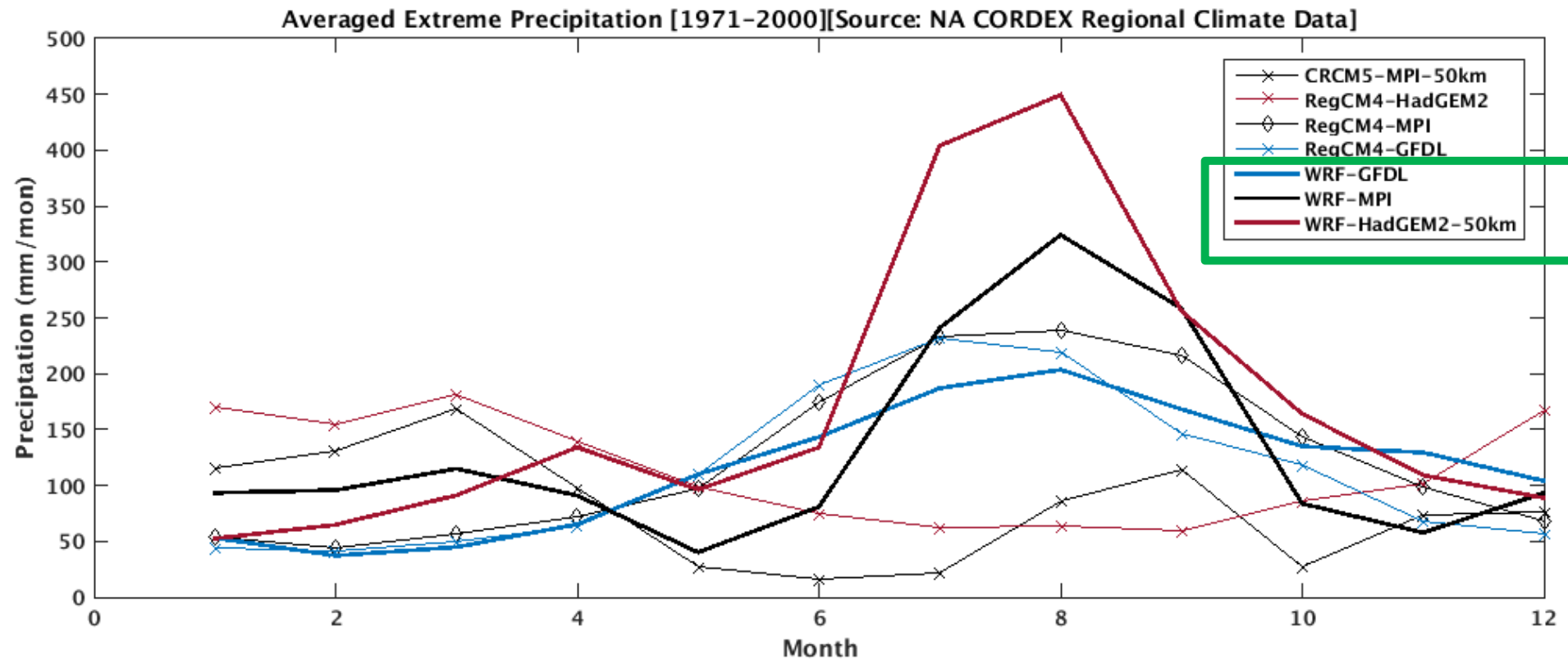|	CRCM5 (UQAM)	CRCM5 (OURANOS)	RCA4	RegCM4	WRF	CanRCM4	HIRHAM5	RCP	ECS (°C)
ERA-Int	0.44° 0.22° 0.11°	0.44°†	0.44°	50km 25km	50km 25km	0.44° 0.22°	0.44°		
HadGEM2-ES				50km 25km	50km 25km			4.5 8.5	4.6
CanESM2	0.44°		0.44°			0.44° 0.22°		4.5	3.7
	0.44°	0.22°†	0.44°			0.44° 0.22°		8.5	
MPI-ESM-LR	0.44°							4.5	3.6
	0.44°† 0.22°†	0.22°†		50km* 25km*	50km† 25km†			8.5	
MPI-ESM-MR								4.5	3.4
	0.44°							8.5	
EC-EARTH‡			0.44°					2.6	~3.3
			0.44°			0.44°		4.5	
			0.44°			0.44°		8.5	
GFDL-ESM2M								4.5	2.4
		0.22°†		50km 25km	50km 25km			8.5	
Access	PoC	PoC	ESGF	PoC	PoC	CCCma	ESGF		
Institution	UQAM	OURANOS	SMHI	Iowa State •NCAR	U Arizona	CCCma	DMI		
Modeler	K. Winger	S. Biner	G. Nikulin	R. Arritt •M. Bukovsky	C. Castro, H-I Chang	J. Scinocca	O. Christensen		

Climate Analysis Metrics from Partner Input

- Extreme event: intensity and frequency
  - Daily precipitation
  - Daily temperature change

- Monsoon onset: timing
  - Five-day running average of daily dew point temperature

- Dry period:
  - Timing
  - Length of dry period before monsoon onset

# LSCRB Historic Mean Precipitation [Observation vs Model Simulations]

Averaged Mean Precipitation [1971-2000][Source: NA CORDEX Regional Climate Data]
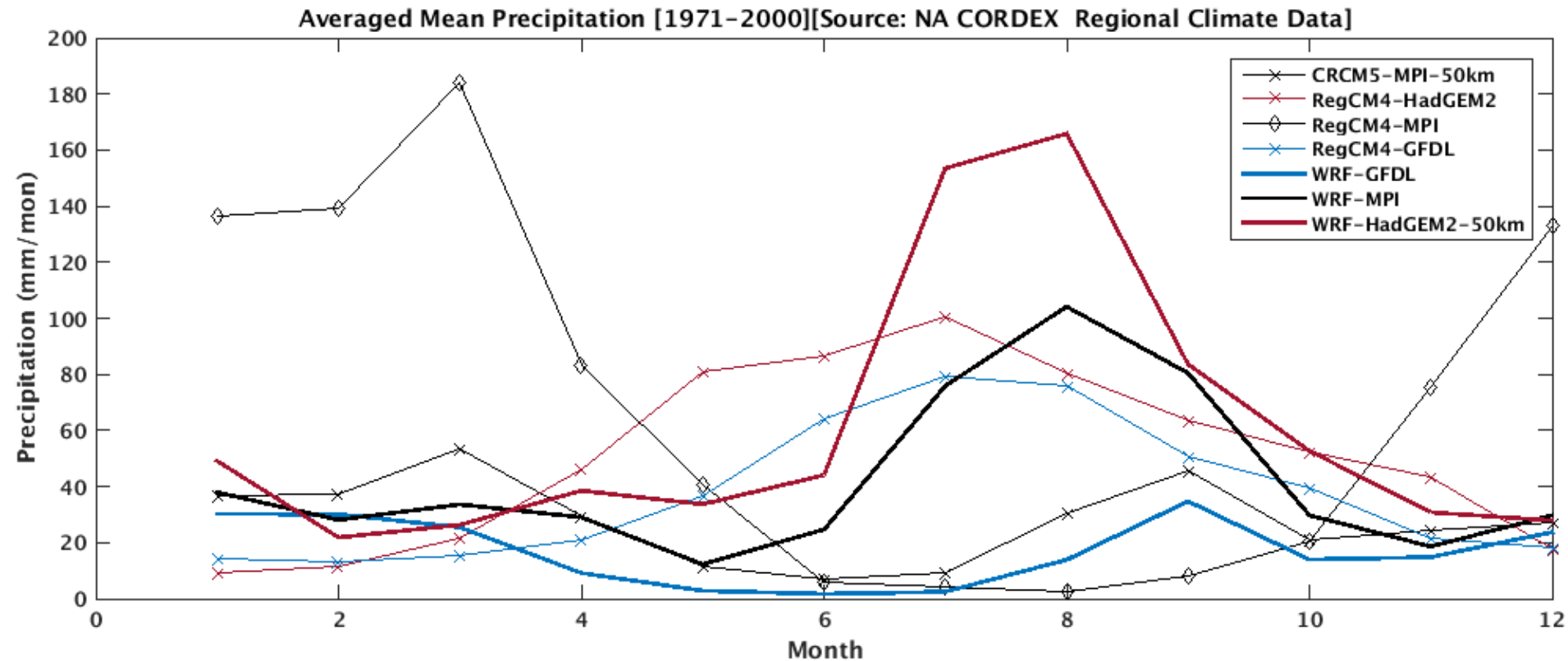
LSCRB Historic Extreme Precipitation [top 10% monthly value, Model simulations]

Averaged Extreme Precipitation [1971–2000][Source: NA CORDEX Regional Climate Data]

August Historic Extreme Temperature
[top 10% monthly value, Observation vs Model Simulations]

AUGUST: Extreme daily temperatures (1979-2010)
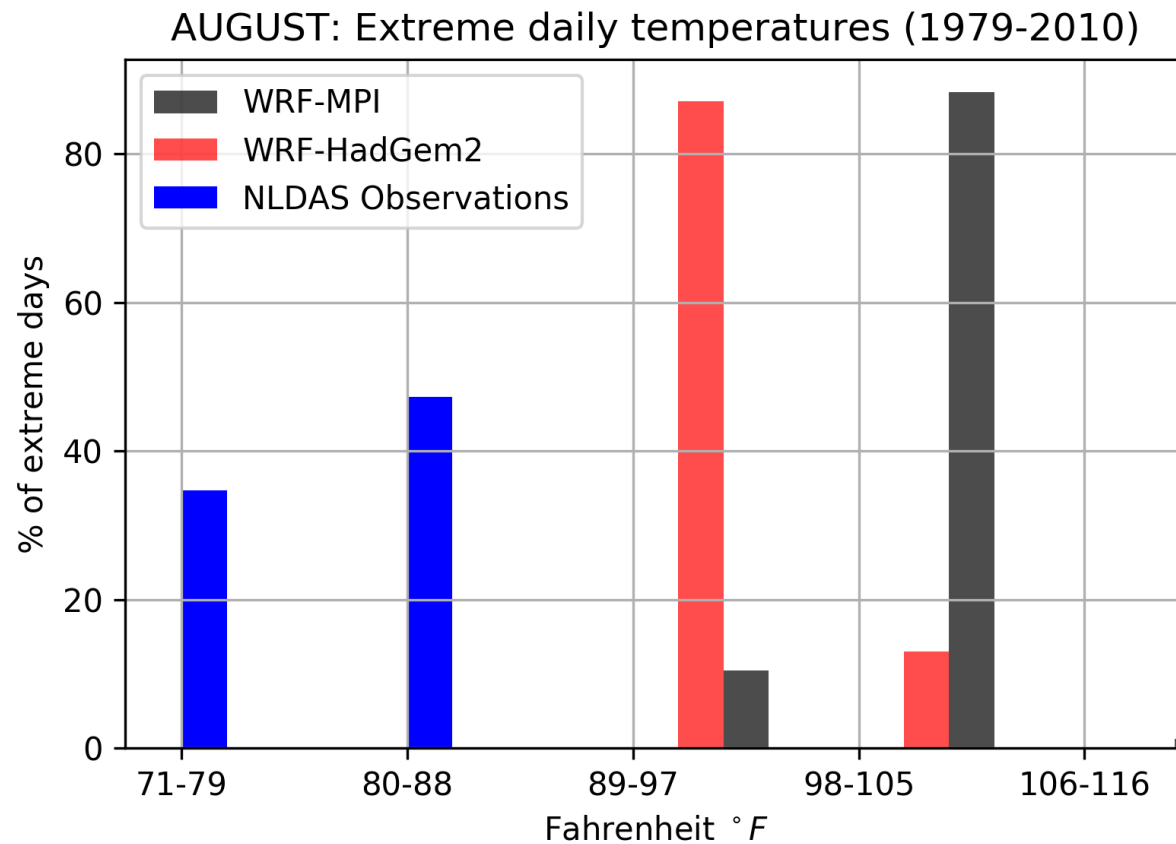
- Summer temperature trend: One model simulation (WRF-MPI) extreme distribution shape similar to observation
- The other simulation (WRF-HadGem2) generated extreme categories contrast to observation
- Both models are warmer than observation

December Historic Extreme Temperature
[top 10% monthly value, Observation vs Model Simulations]

DECEMBER: Extreme daily temperatures (1979-2010)
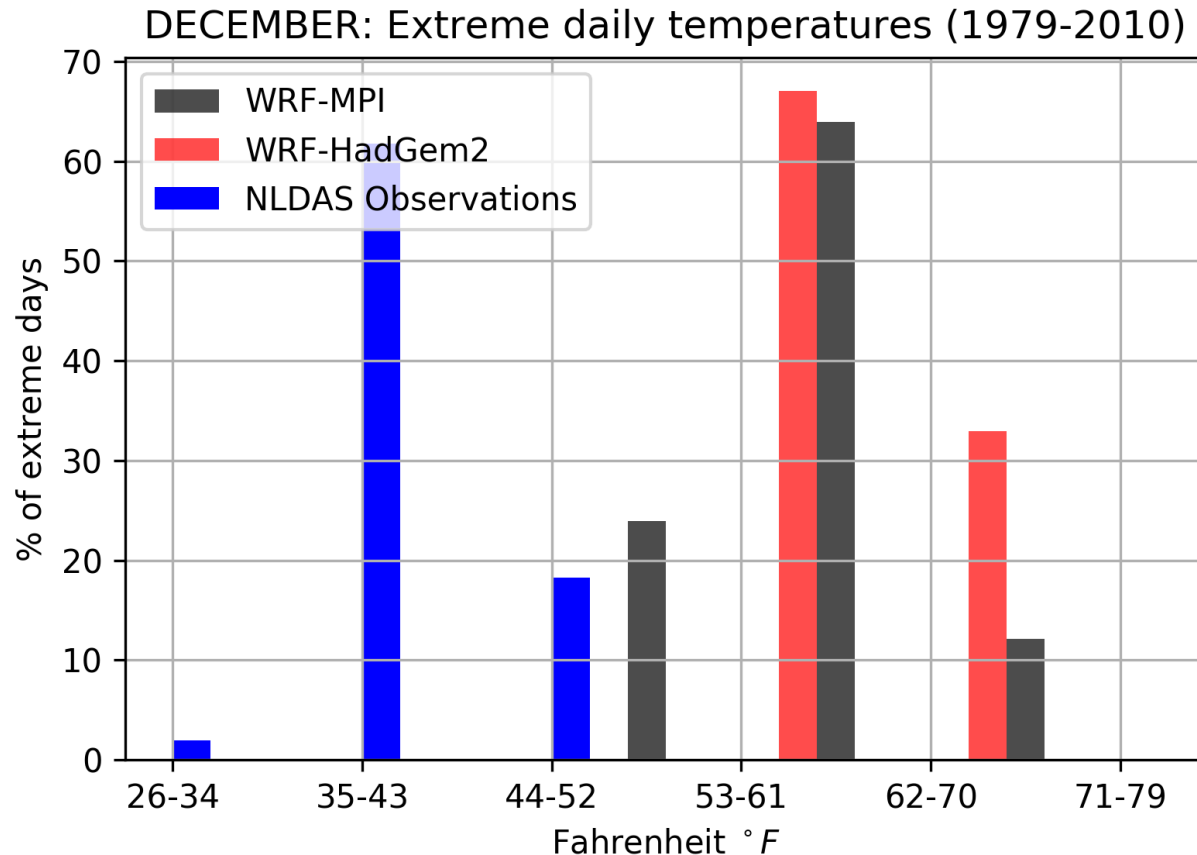
- **Consistent winter temperature pattern**
- One model simulation (WRF-MPI) extreme distribution shape similar to observation
- The other simulation (WRF-HadGem2) generated extreme categories contrast to observation
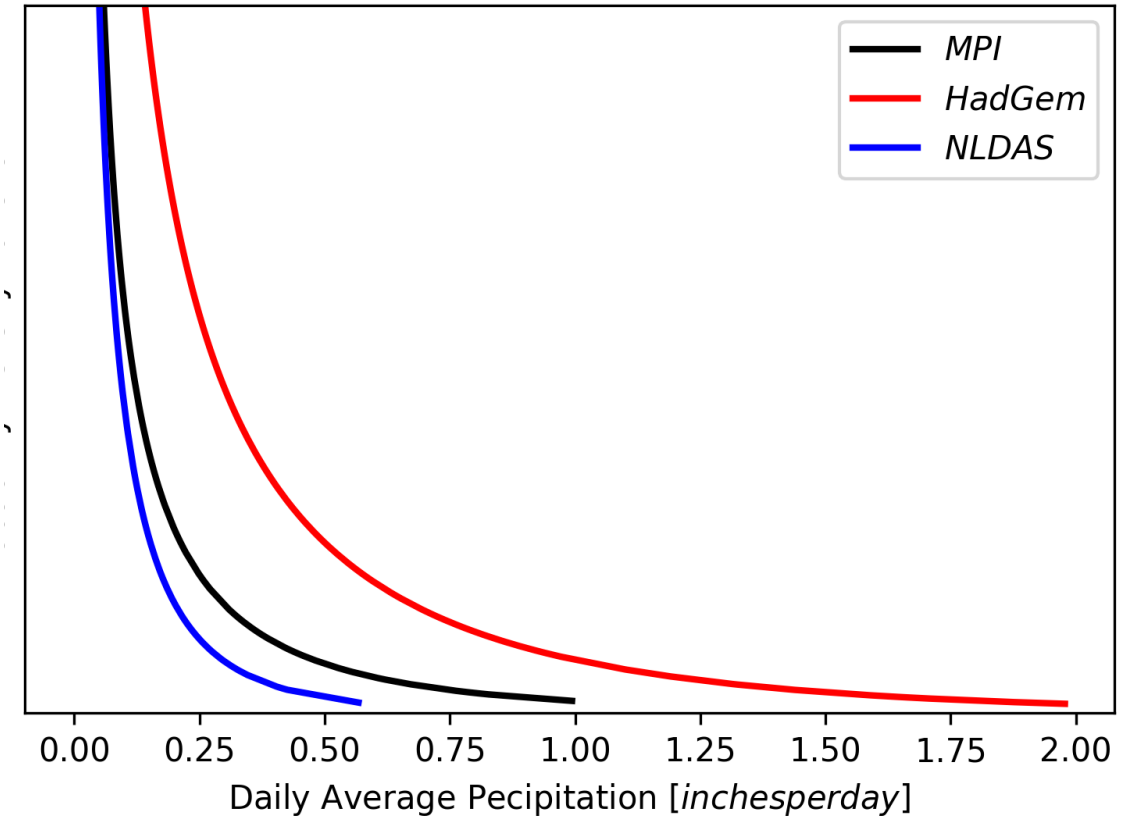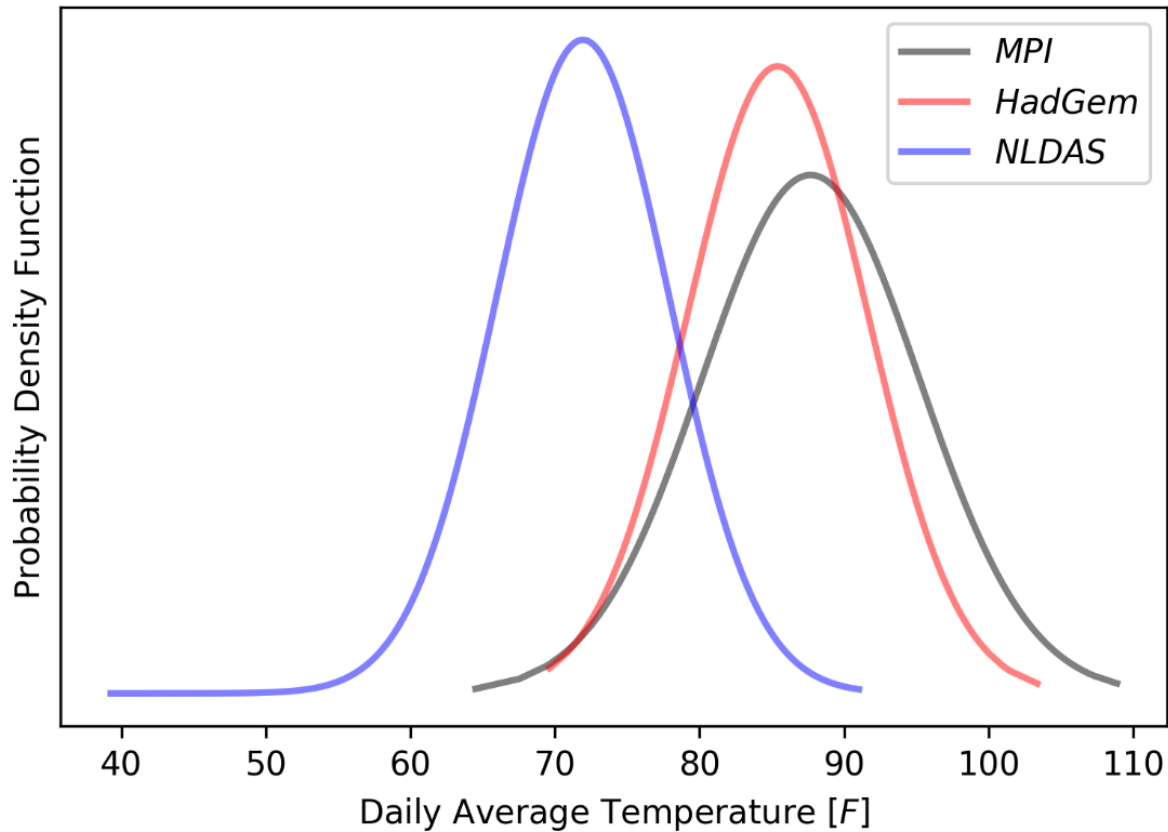
August Historic Extreme Precipitation
[top 10% monthly value, Observation vs Model Simulations]

AUGUST: Exteme daily precipitation (1979-2010)
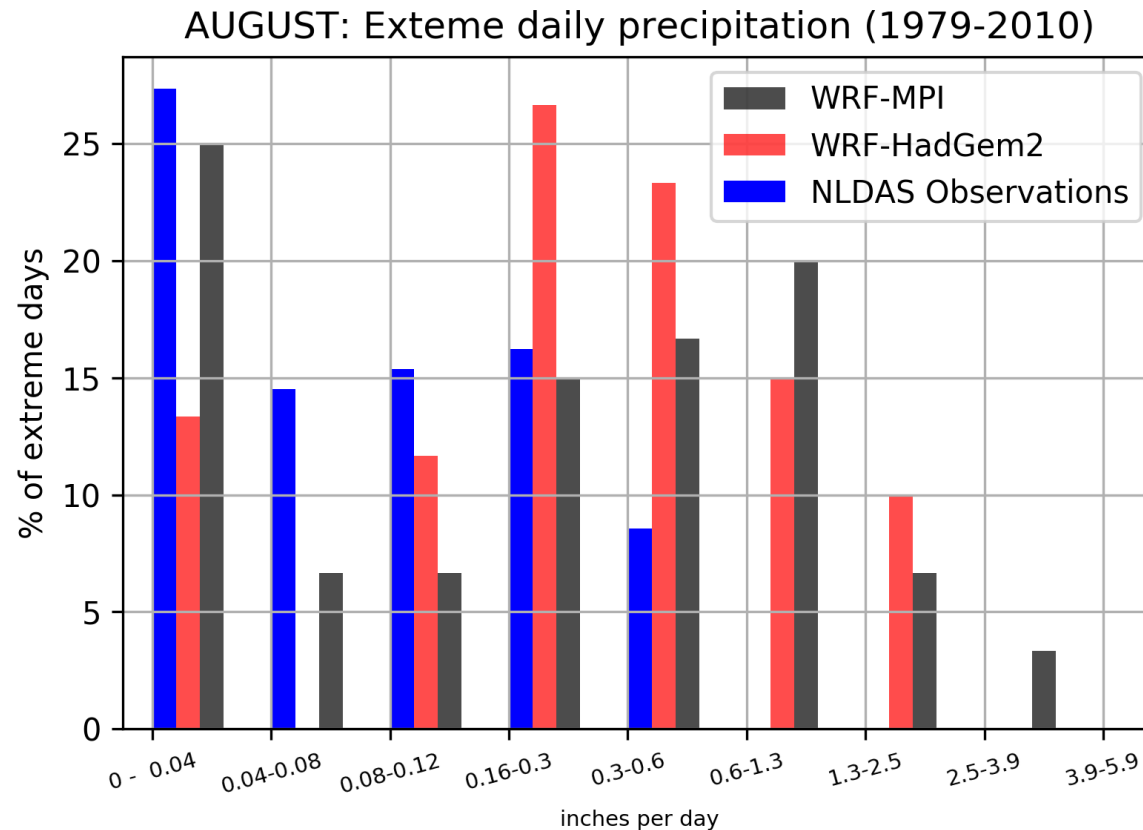
- **Consistent with extreme temperature trend**
- WRF-MPI show similar summer extreme shape distribution, as compared to observation
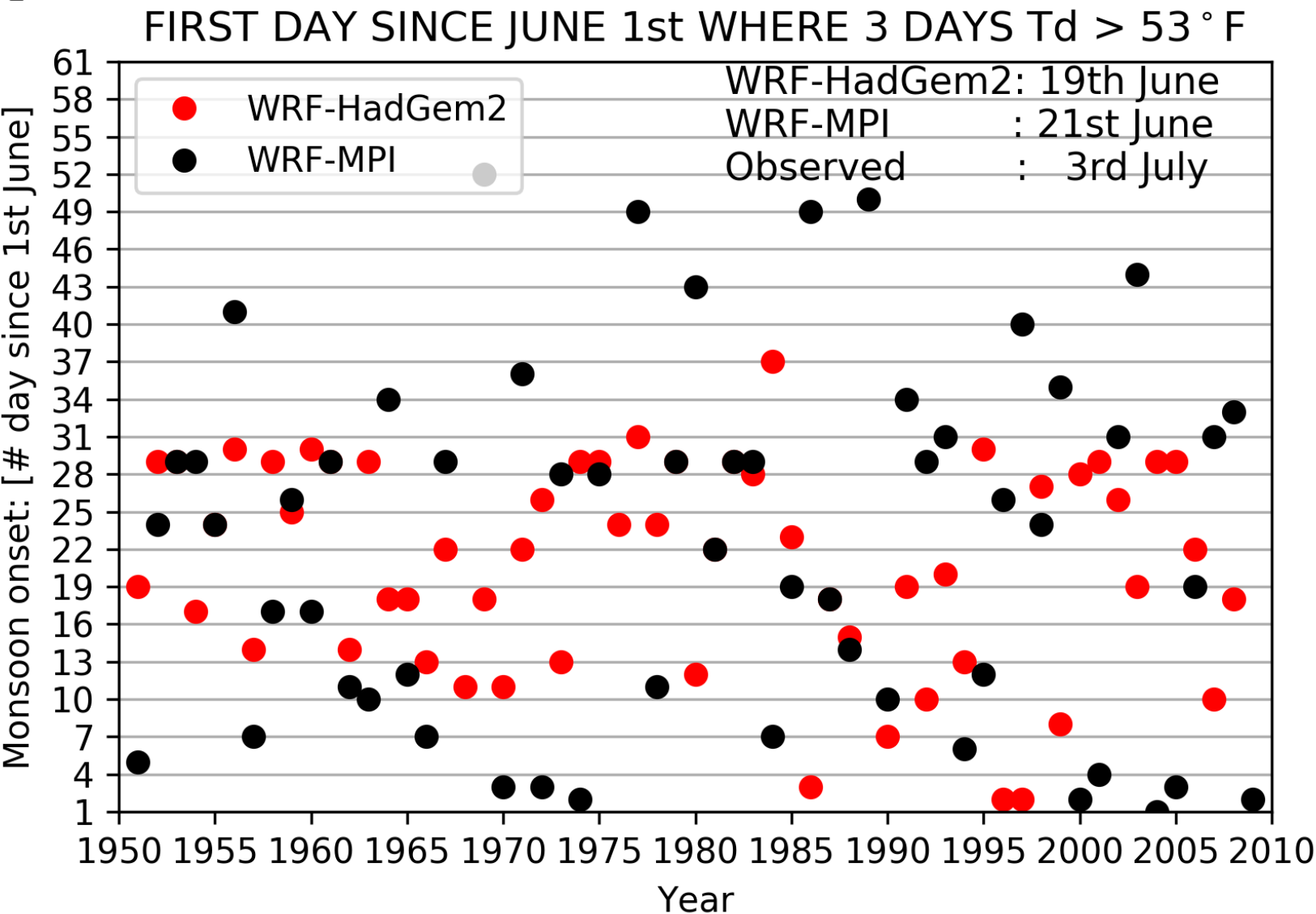- Both models are wetter than observation

Daily Average Temperature and precipitation PDF [Observation vs Model Simulations] Bias Correction needed

Historic Monsoon Onset Timing [Observation vs Modeled Simulations]:

FIRST DAY SINCE JUNE 1st WHERE 3 DAYS Td > 53°F

WRF-HadGem2: 19th June
WRF-MPI   : 21st June
Observed   :   3rd July

- Observation: July 3rd
- WRF-MPI: June 21st
- WRF-HadGem2: June 19th
- Models generally produced earlier monsoon start date

Next Step

- Compare physics-based climate downscaled products with statistics-based LOCA data

- Compare historic data with future projections

- Prepare the products for weather generator

- Perform bias correction (a standard exercise to use various input data), methodology and values after bias correction (internal), evaluation of model fit. Can shift the PDF, not changing the distribution.