Best and Worse - Case Future Climate
Preparation for Input to the Weather Generator

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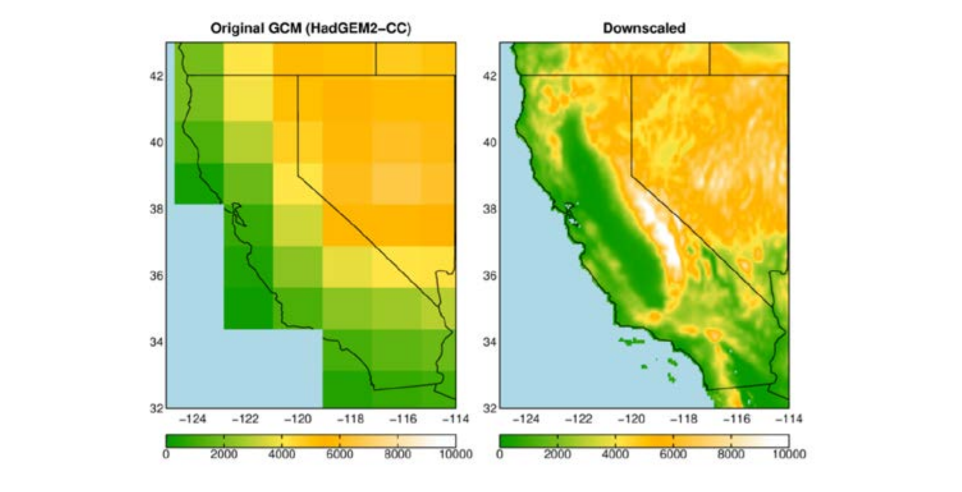
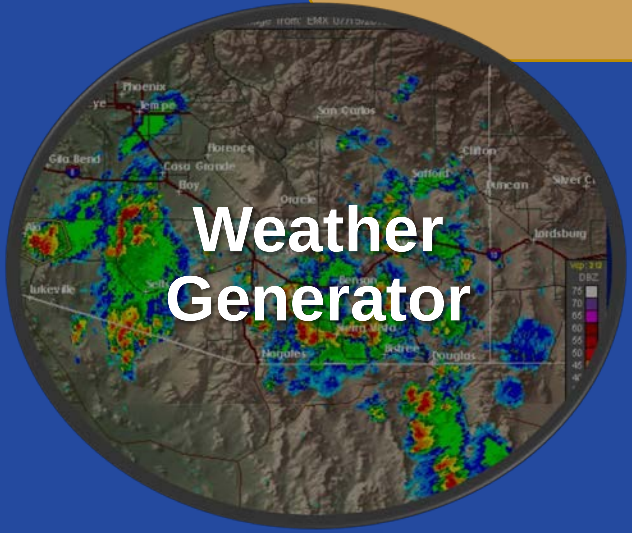
August 22, 2018

Basin Study Project Team Meeting

Process Overview

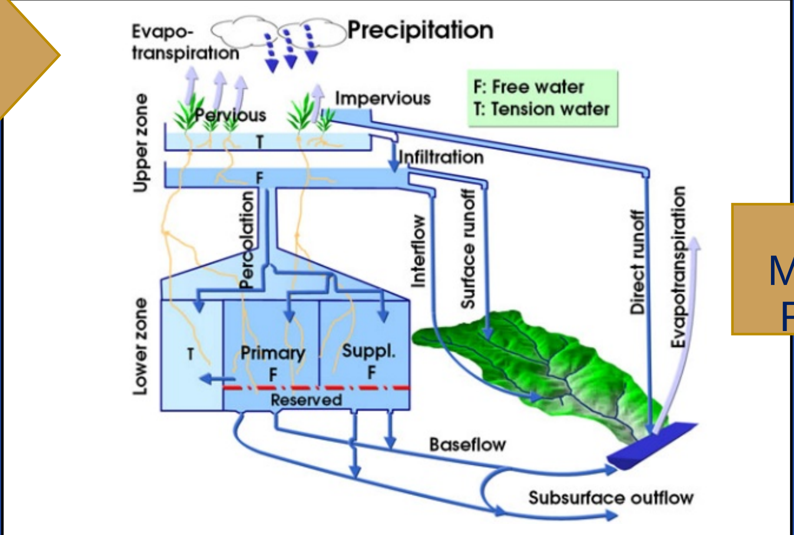
1. Downscaled Climate Projections





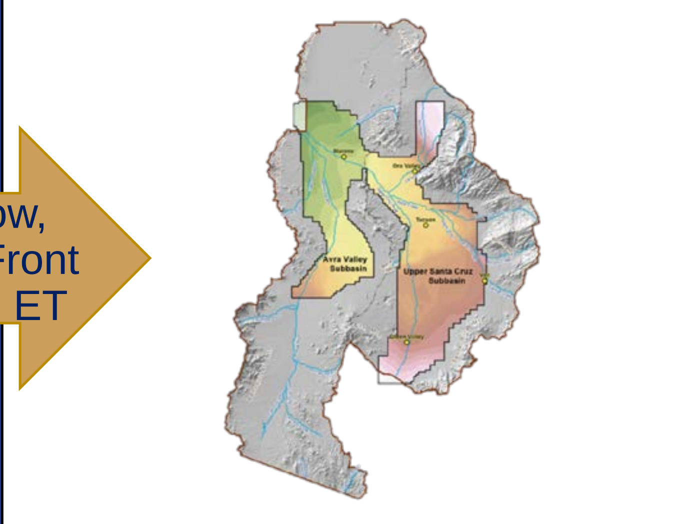
Precipitation
& Temperature

2. Surface water Modeling



Streamflow,
Mountain Front
Recharge, ET

3. Groundwater Modeling

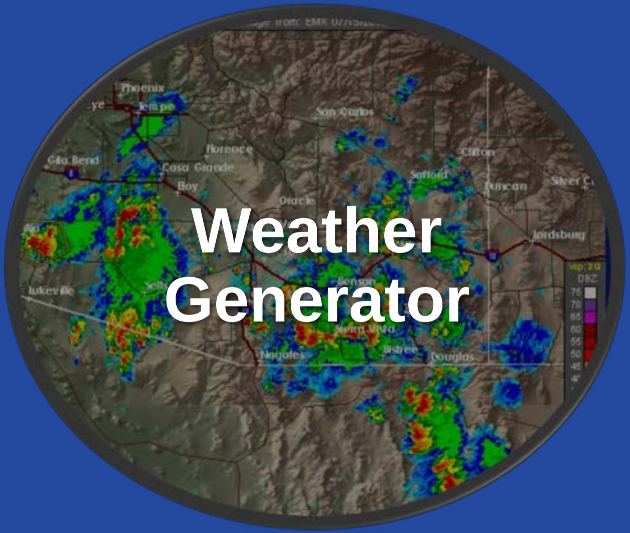


Weather Generator Introduction

Purpose: simulate plausible future weather scenarios based on climate projections for the Lower Santa Cruz River Basin

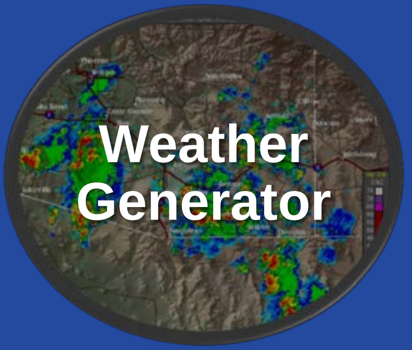
Training data
- CBRFC's SAC-SMA calibration dataset
- Categorized into *three states* (i.e. seasons)

Future climate time series
- Best case
- Worse case



Future scenarios of precipitation and temperature inputs to SAC-SMA surface water model.

Weather Generator – Why?

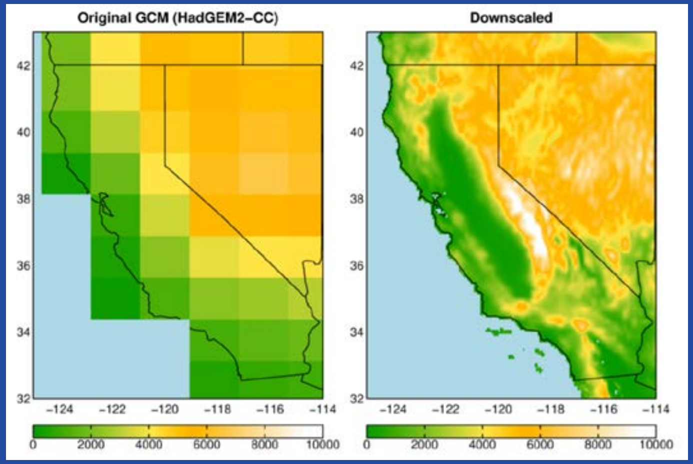


- Scale (spatial and temporal) that is relevant for local surface water modeling
- Natural precipitation variability is particularly important in this region. The weather generator is used to introduce uncertainty around the broader climate projection trends.
- The resulting ensemble (large group) of likely rainfall timeseries represents a range of possible amounts, daily patterns, and seasonality that will drive a resulting range of streamflows.

Model Refresher

Statistically Downscaled (SD): LOCA - Localized Constructed Analogs (http://loca.ucsd.edu/)

Dynamically Downscaled (DD): WRF – Weather Research and Forecasting Model (https://www.mmm.ucar.edu/weather-research-and-forecasting-model)

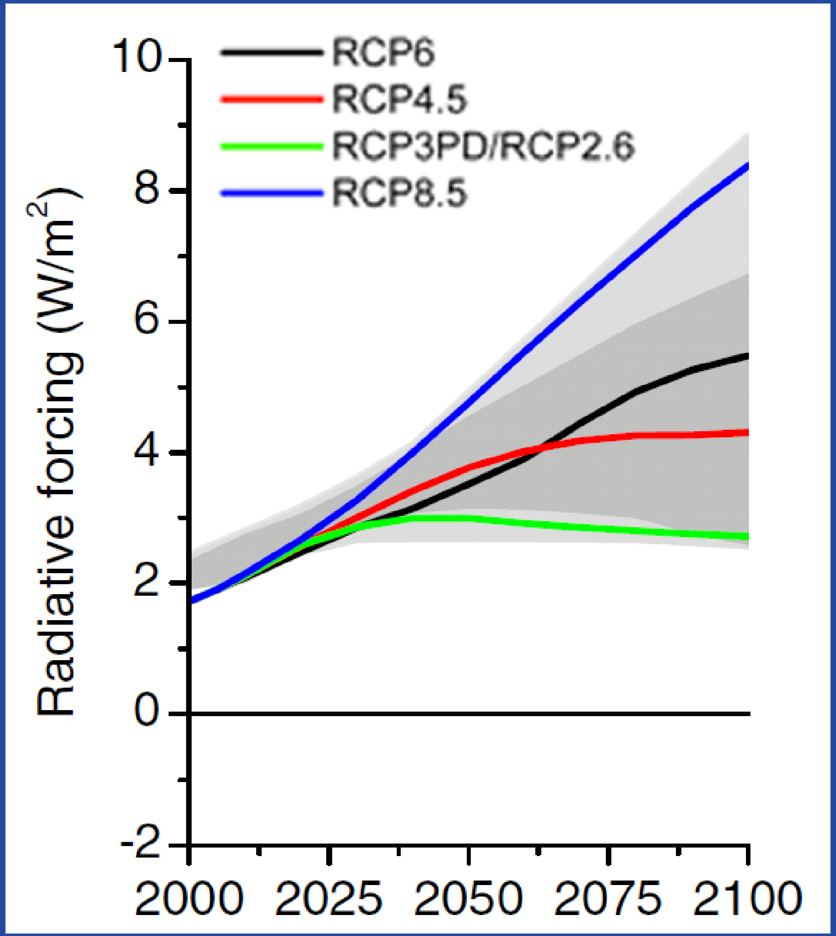


Climate Model Scenarios

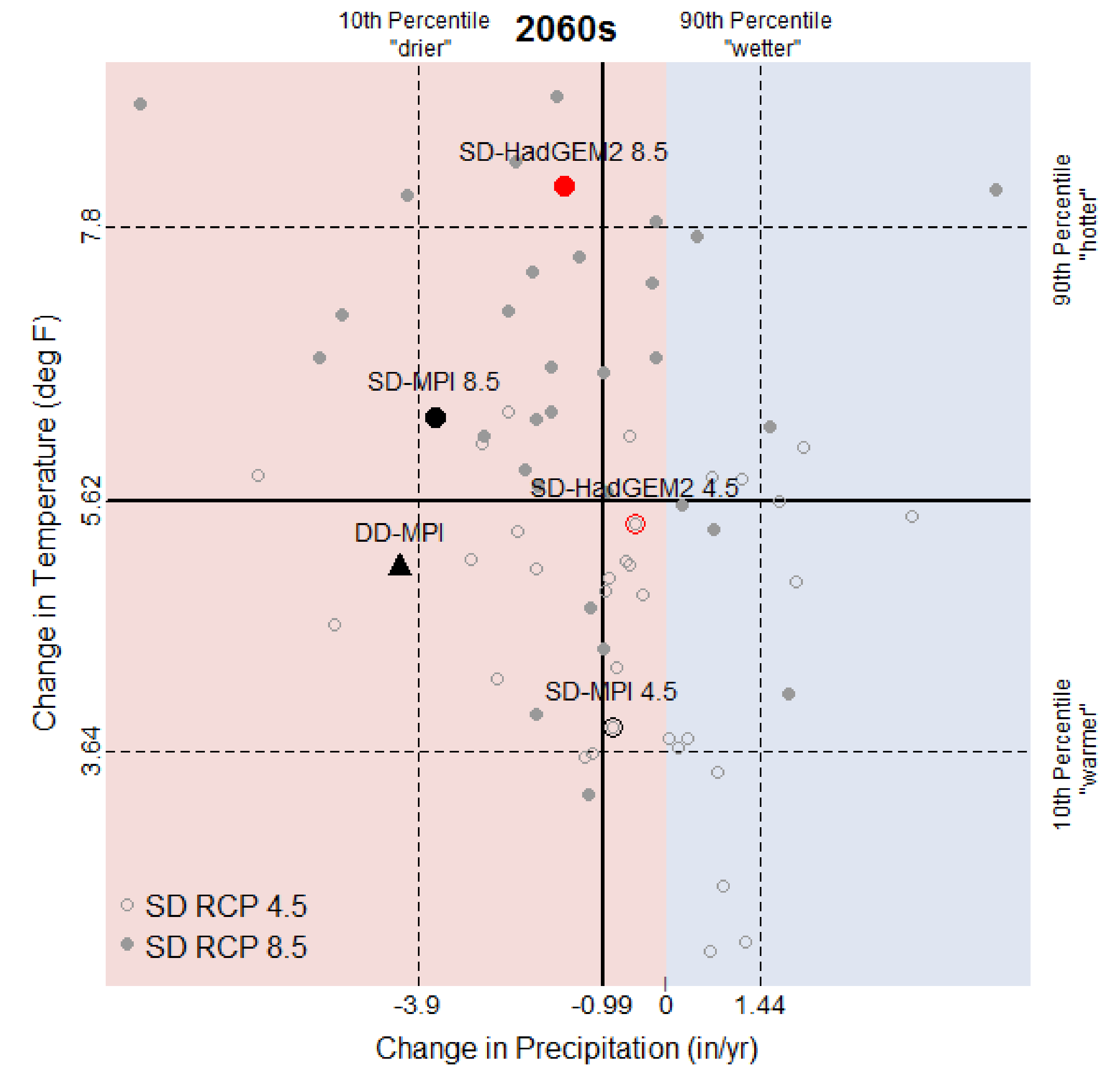
Worse: Based on RCP8.5 DD data

Best: Based on RCP4.5 SD data

RCP = Representative Concentration Pathways
Result from different future emission scenarios
Data from the CMIP5 climate model intercomparison



Annual Change
Model Space



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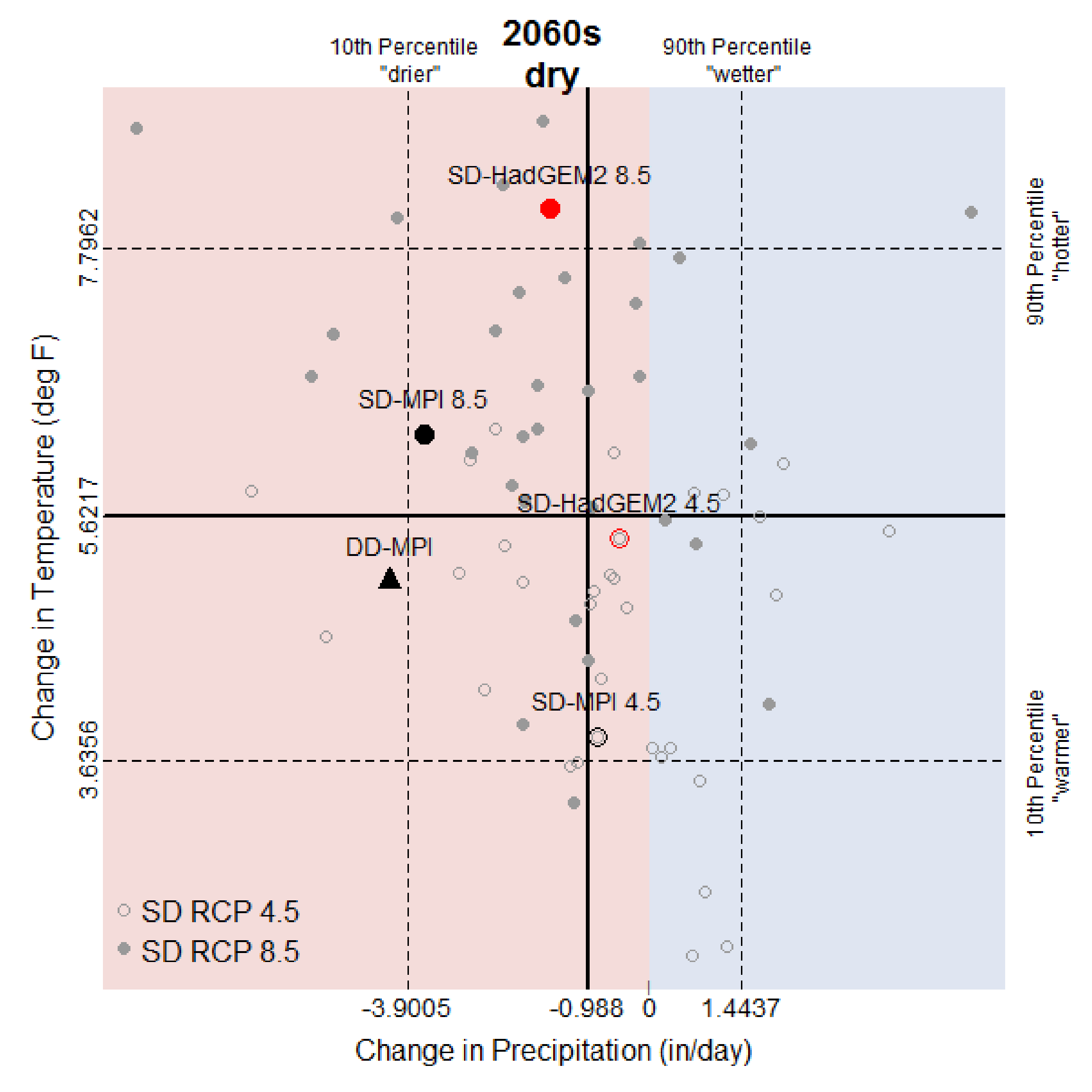
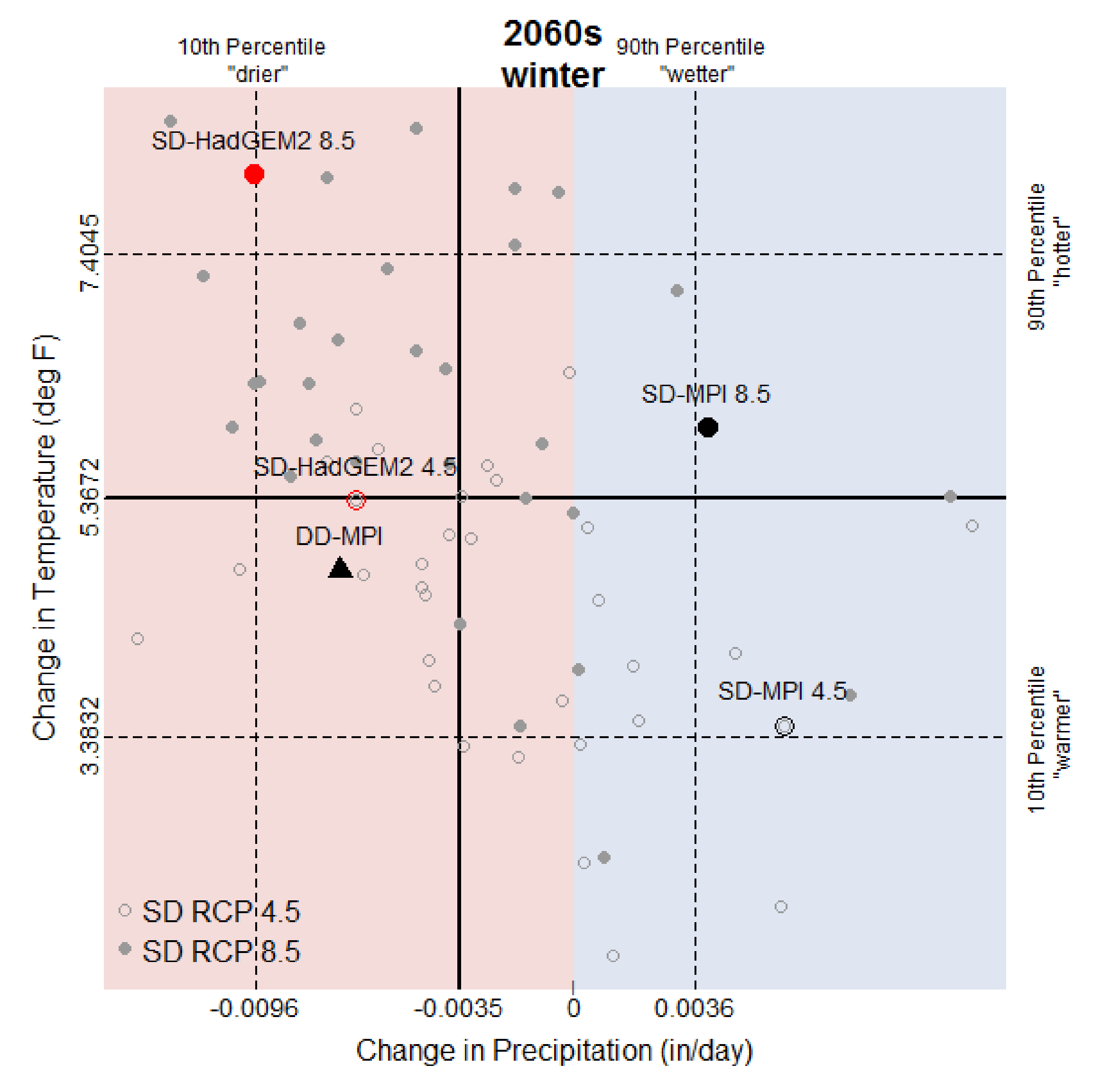
Seasonal Change - Model Space





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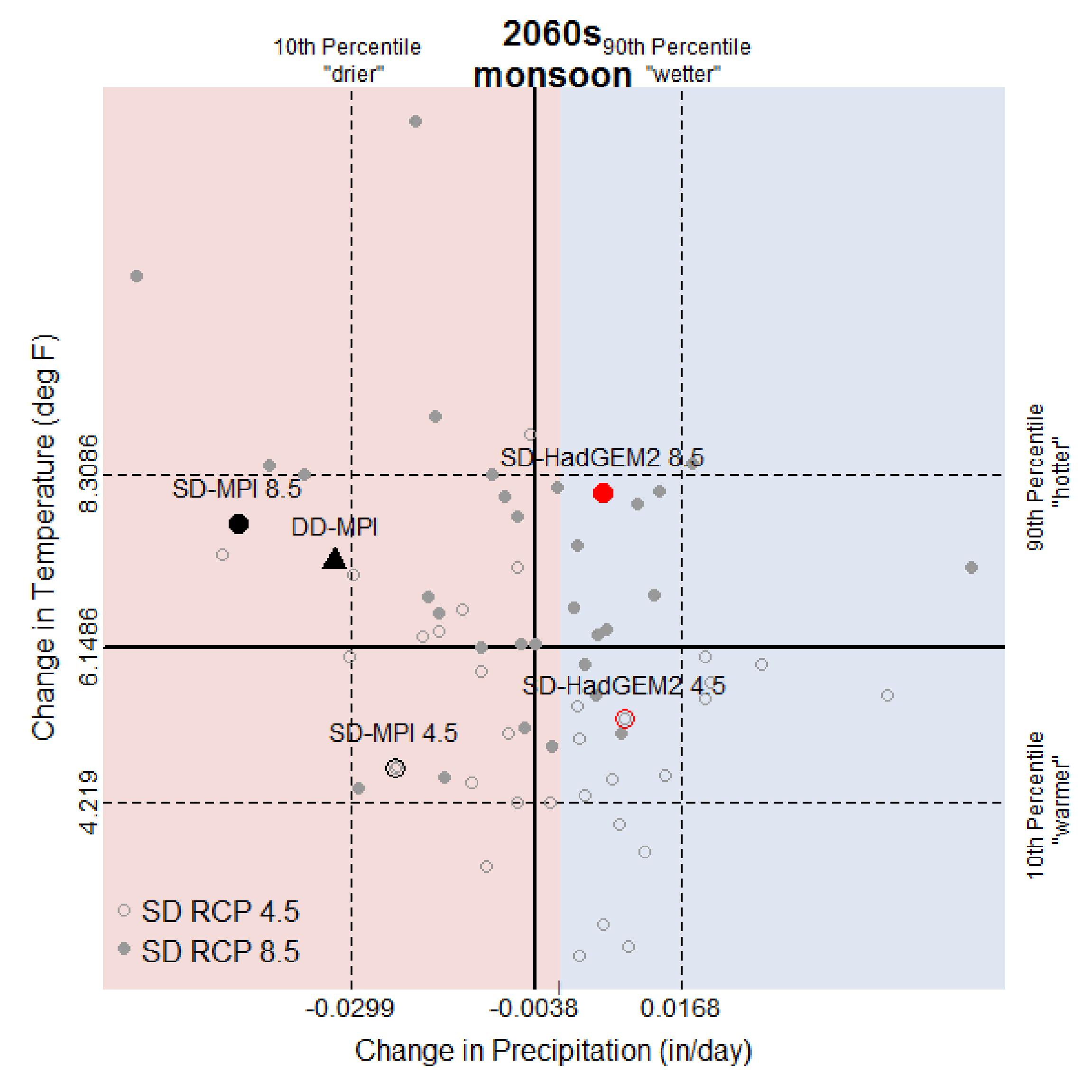
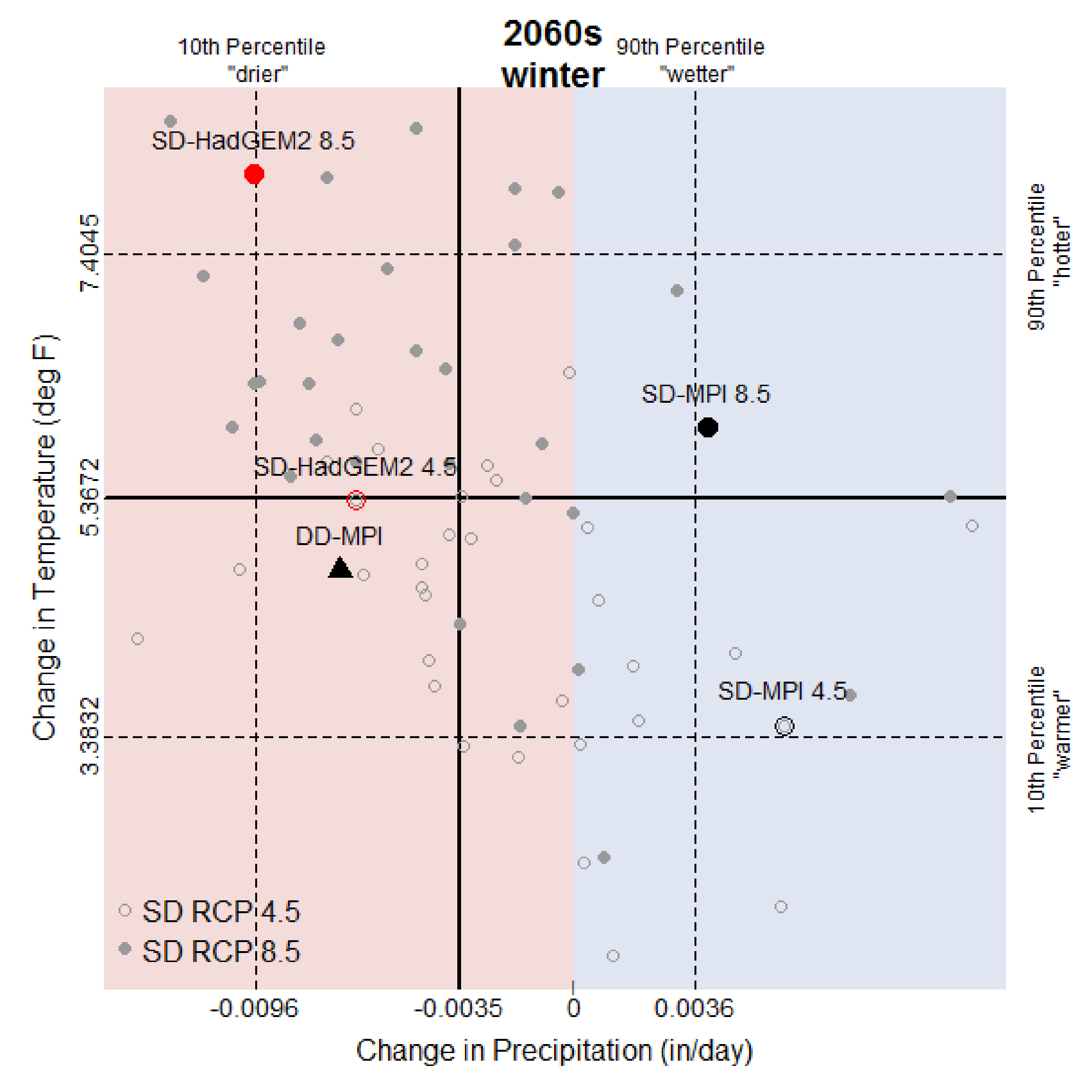
Seasonal Change - Model Space





Review of Climate Metrics

1. **Monsoon onset: timing**

   First of 3 consecutive days with dewpoint temperature greater than 53°F (UA, NWS)

2. **Extreme events: intensity and frequency, temperature and precipitation**

   UA Analysis of top 10% of daily temperature and precipitation

3. **Dry period: last day of winter storm to first day of spring (following CLIMAS methodology)**

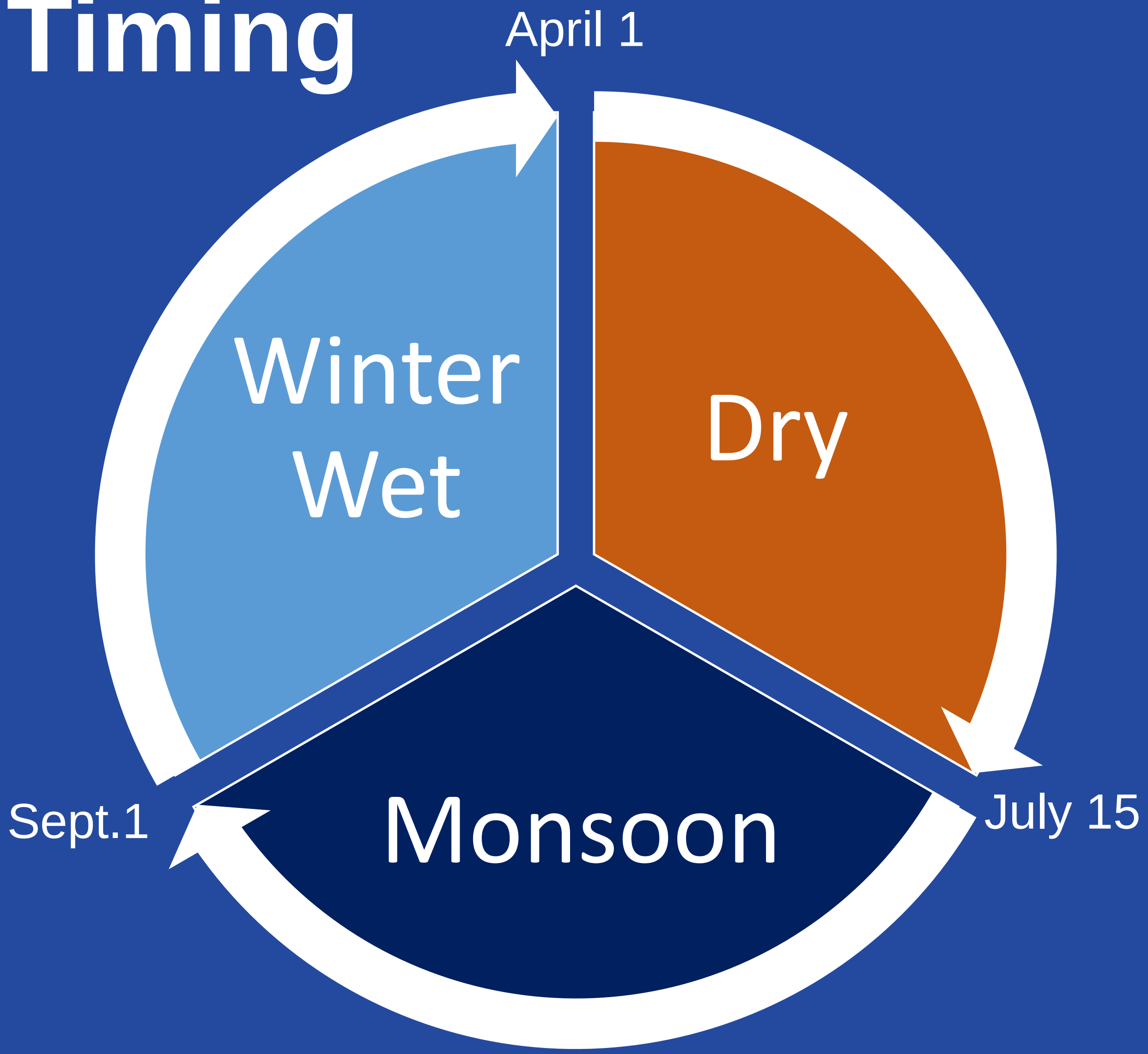
   Basin averaged rainfall less than 0.1 inches over 2 weeks (per May 8, 2018 meeting)

Future Climate – New Timing

The weather generator breaks the year into three seasons (referred to as ‘states’) from which to sample weather.

This allows us to incorporate metrics quantifying shifts in seasonality into the realizations of future weather.

*Here, dates shown represent typical values for Tucson (NWS and M. Crimmins, personal communication), not necessarily weather generator inputs.



Monsoon Onset

	Monsoon Onset Date
Observation (and Ellis et al 2004)	July 3
SAC-SMA historical mean/median	July 4 / July 3
WRF-MPI (worse case, DD)	July 2
WRF-HadGEM2 (worse case, DD)	June 30
MPI (worse case, SD)	July 3
HadGEM2 (worse case, SD)	June 30

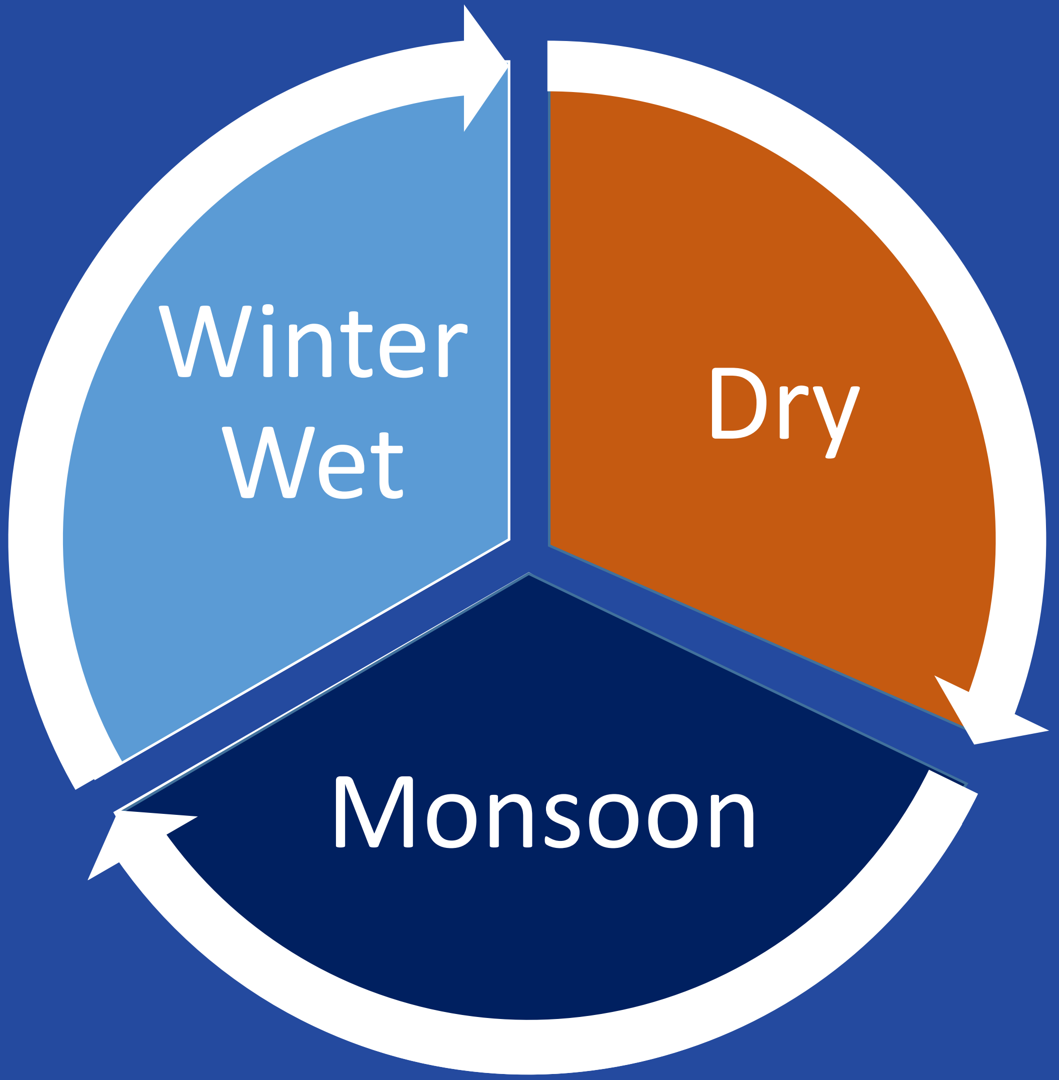
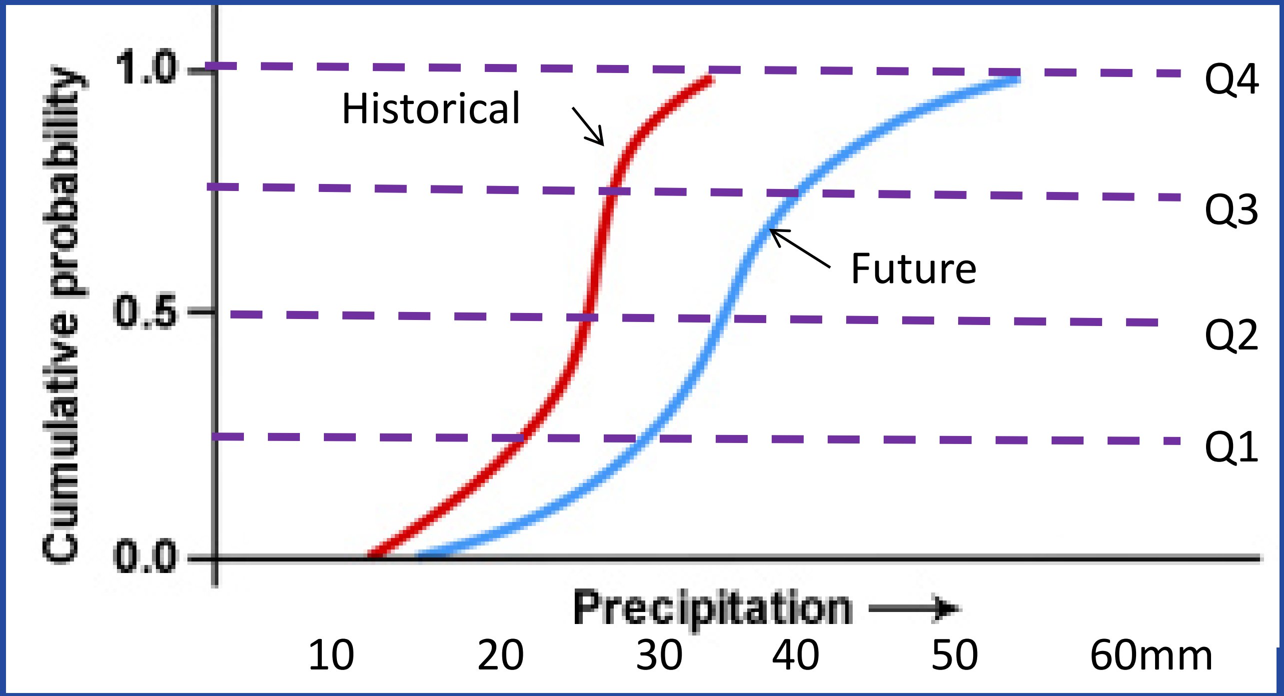


Table modified from University of Arizona's BOR-update-May07.pptx presentation on 5/8/2018 by Hsin-I Chang

Future Climate – Changes in Magnitude

Hybrid Delta Ensemble (HDE) approach based on seasonal changes of precipitation and temperature from climate models.

For example:



<u>Change %</u>

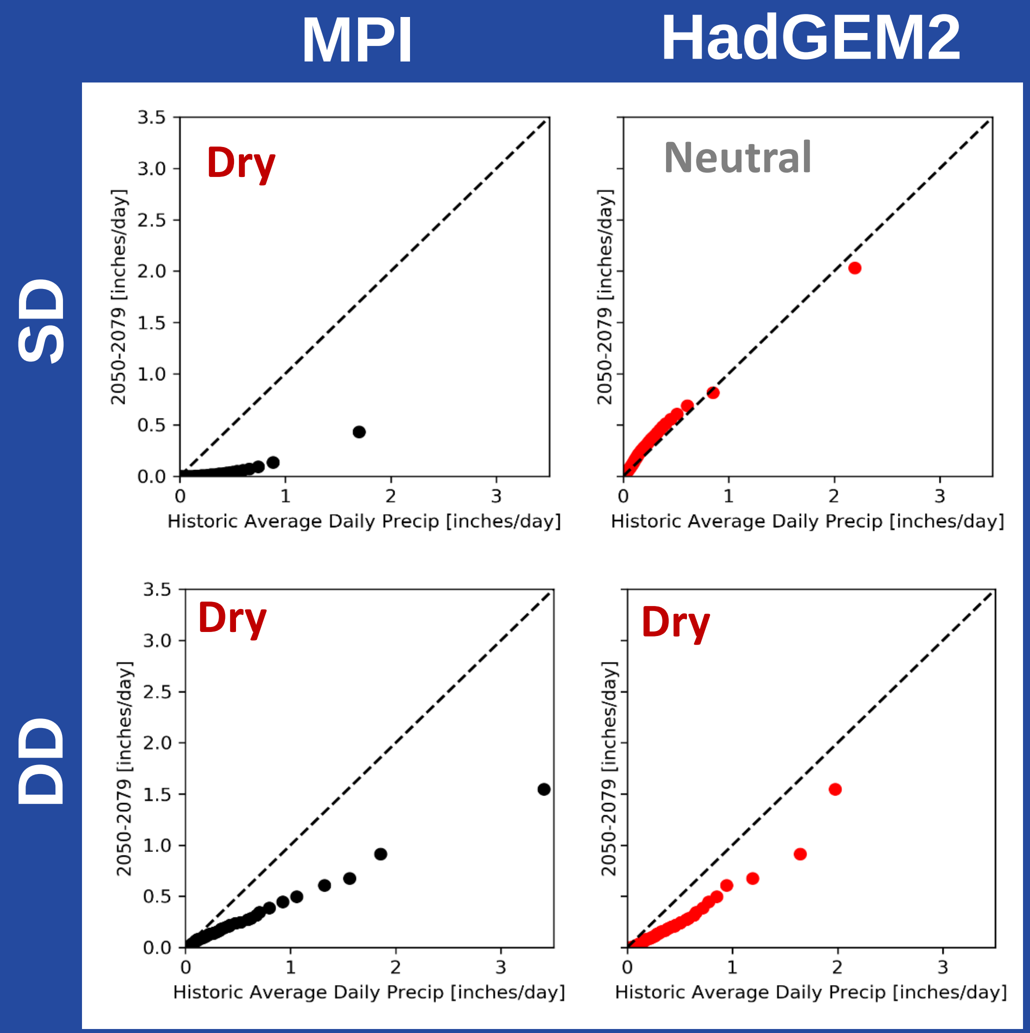
Quantile1 +28
Quantile2 +29
Quantile3 +34
Quantile4 +43

Figure Compliments of COMET Hydrologic Impacts Under Climate Change Virtual Course, 20-22 June 2017

Future Climate – Changes in Magnitude

August future daily precipitation distribution (2060s)

Figure modified from University of Arizona's BOR-update-May07.pptx presentation on 5/8/2018 by Hsin-I Chang



Summary

1) Worse case climate: average changes from two DD projections

2) Best case climate: “warm wet” cluster of LOCA models