Downscaled Climate Data for Bull Run Watershed

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NW RISA: Climate Impacts Research Consortium (CIRC)

RISA Regional Integrated Sciences and Assessments

CIRC Climate Impacts Research Consortium A NOAA RISA TEAM

University of Idaho

Future Climate Data

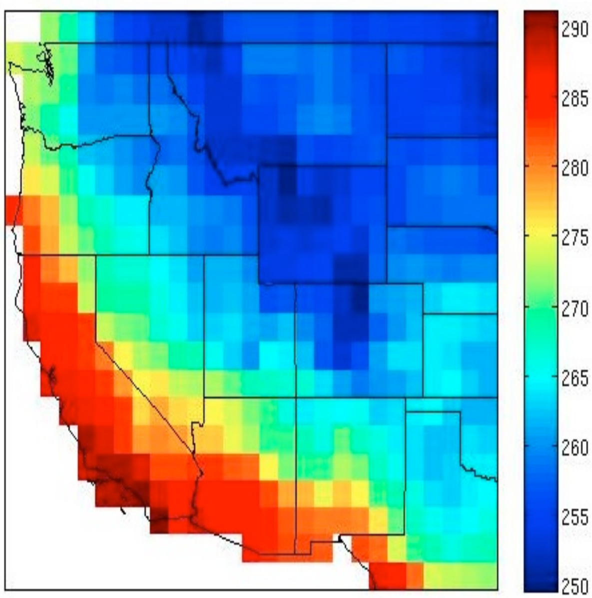
- Project:
  - Coupled Model Inter-Comparison Project phase 5 (CMIP5)
- Scenarios:
  - Historical (1950-2005)
  - Future (2006-2099 RCP 4.5, RCP 8.5
- Daily Variables:
  - Minimum/maximum temperature
  - Precipitation
  - Specific Humidity
  - Wind Speed
  - Downwelling Shortwave Radiation
- Models:
  - 20 global climate model (GCMs) outputs

Downscaling Process

Increases the resolution of the data

Daily Output from a Global Climate Model

Global Scale: 2-3º (~300 km)



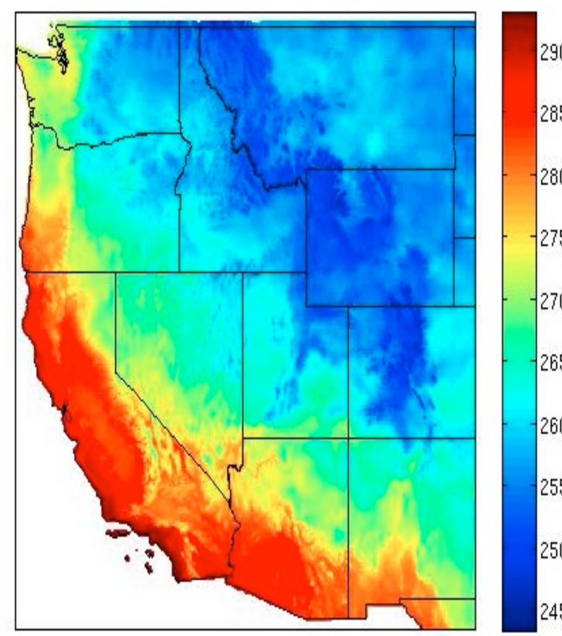
1 day, 1 year

Downscaling Max Daily Temperature

→

Daily Output from Downscaled GCM Data

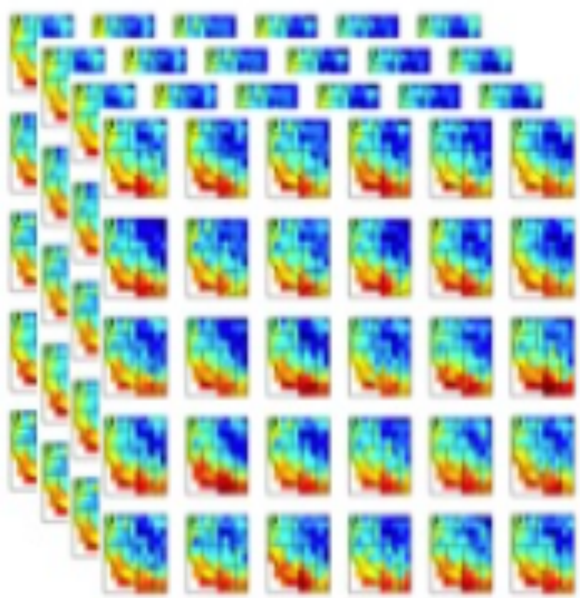
Local Scale: 1/16^0 (~6-7 km)



1 day, 1 year

Multivariate Adaptive Constructed Analogs (MACA) Method

- A Statistical Downscaling Method utilizes a training dataset for statistical relationships

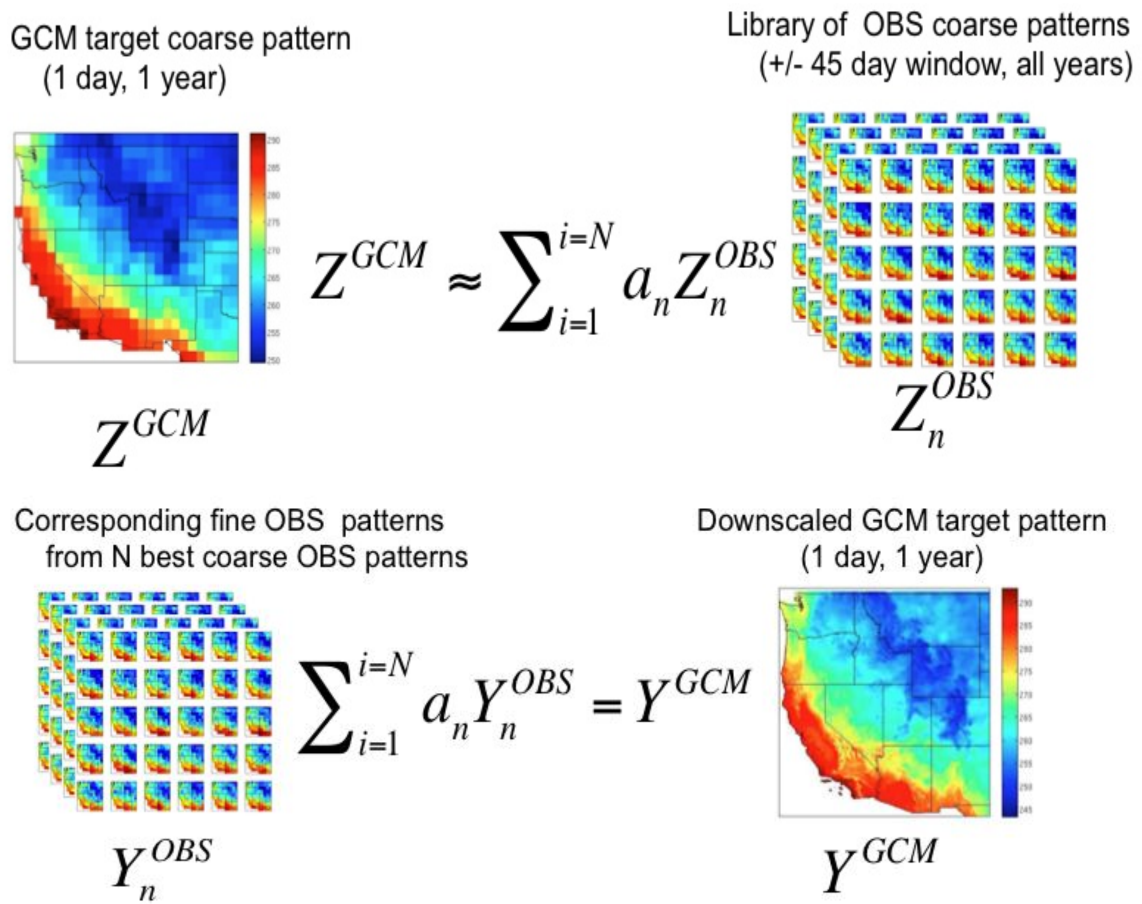


Training dataset:
Livneh Meteorological Gridded Observations

- 1/16 deg (~6-7 km)
- 61 years of daily data
- (1950-2011)
- Temperature,Precipitation, Humidity, Wind Speed

Multivariate Adaptive Constructed Analogs (MACA) Method

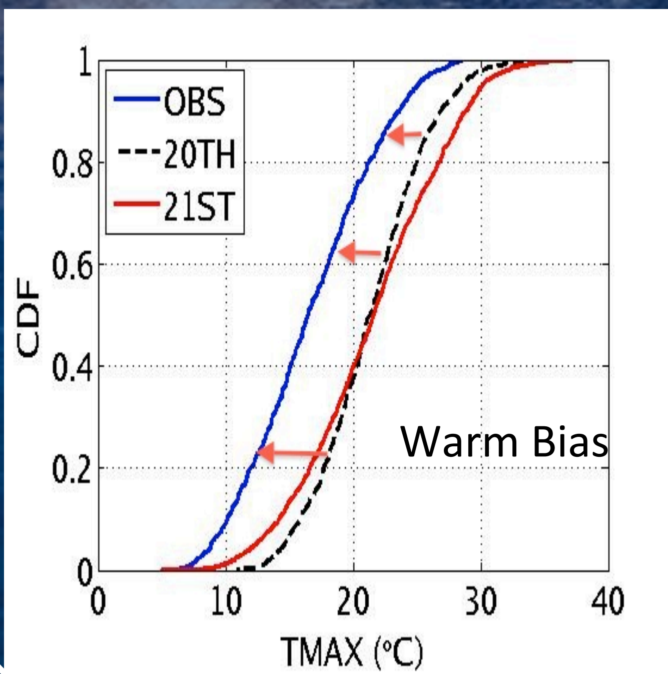
- **Constructed Analogs Method: pattern matching**



Multivariate Adaptive Constructed Analogs (MACA) Method

- **Bias Correction adjust outputs to match statistics from observations**

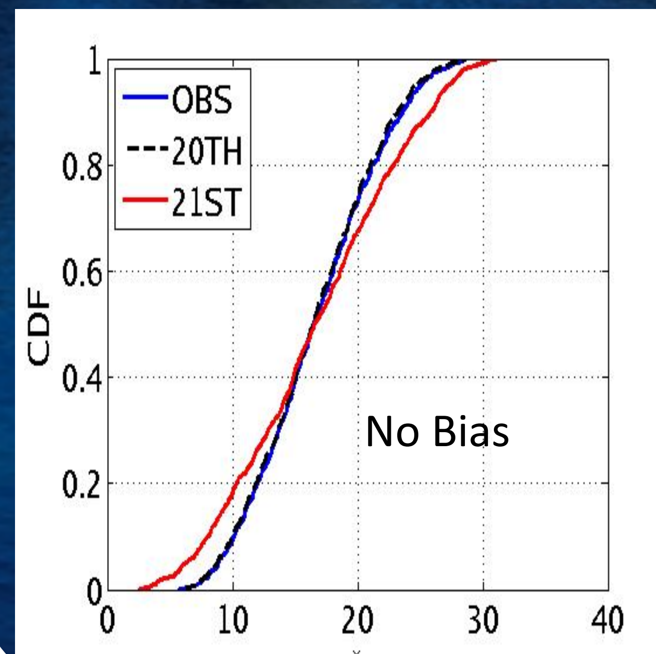
Before Bias Correction



Bias Correction

→

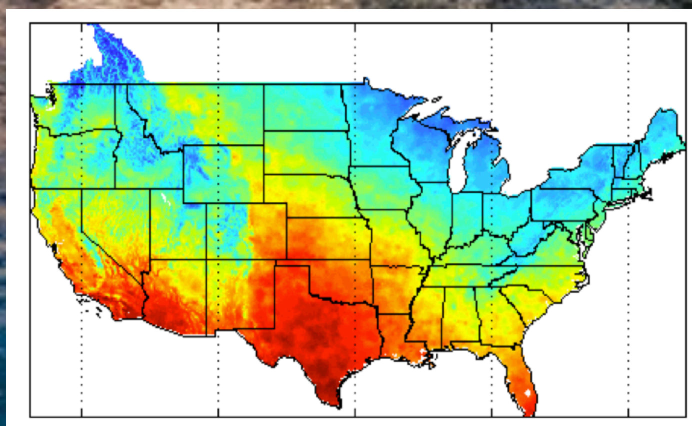
After Bias Correction



Note: we perform joint Bias Correction of Temperature/Precipitation

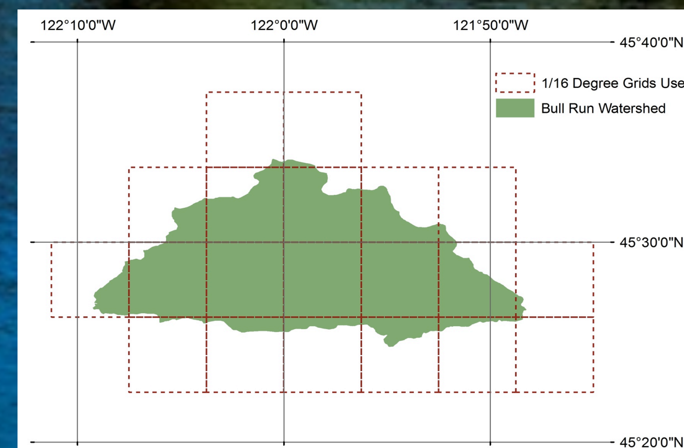
Downscaling for Bull Run

Started with:
CMIP5
statistical downscaling w/ MACA
w/ Livneh training data



Bias Correction →

Finished with:
CMIP5
statistical downscaling w/ MACA
w/ adjusted Livneh training data



- MACA data bias corrected to 'adjusted Livneh data'
- Data formatted as text file inputs for PRMS hydro- model
- Input files for 20 GCMs: Historical, RCP 4.5, RCP 8.5

Climate Model Evaluation and Advice

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OCCRI

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NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

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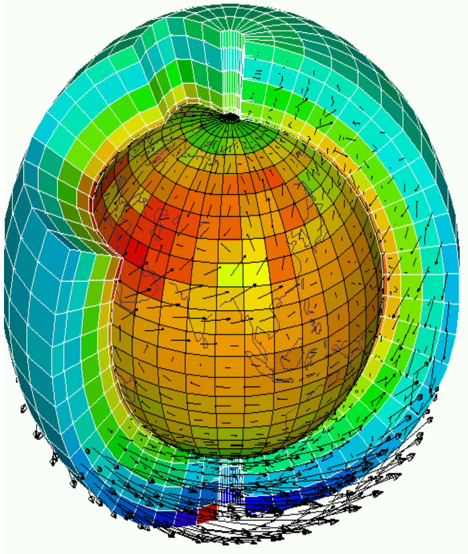
Which GCMs should PWB Use?

Models are sensitive systems

- models can respond differently to the *same* radiative forcing
- different models can give different answers to the same problem
- some models may over/under-estimate factors more uncertain than others



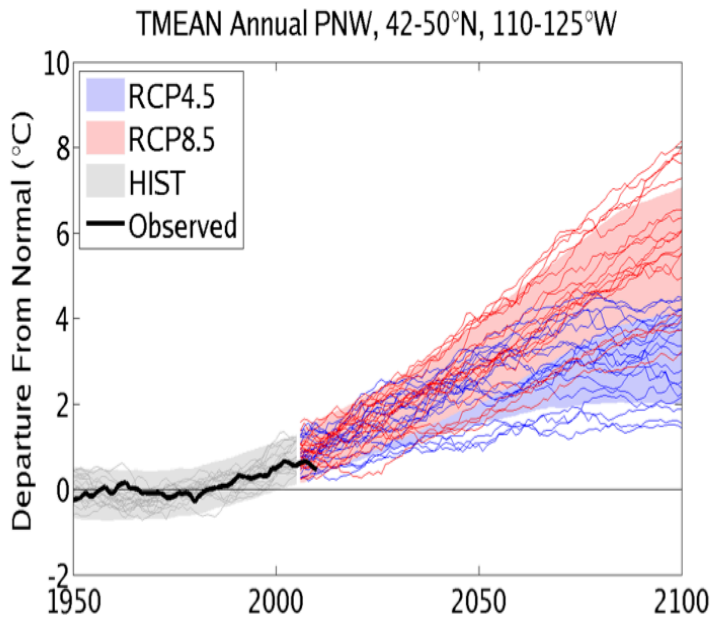
Differences in the models:

- Range of model projections
- Skill of the models in simulating observed regional climate
- Skill of the models in simulating extreme precipitation events

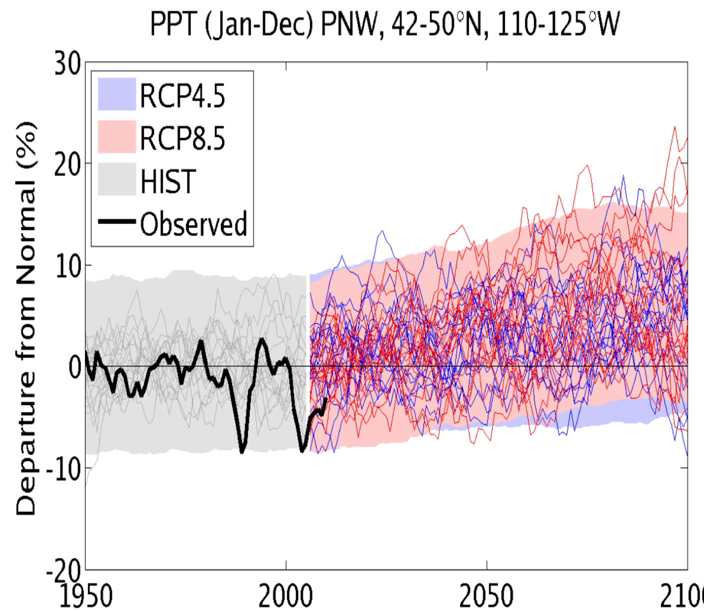
Which GCMs should PWB Use?

Range of Model Projections over Years: PNW

Mean Temperature



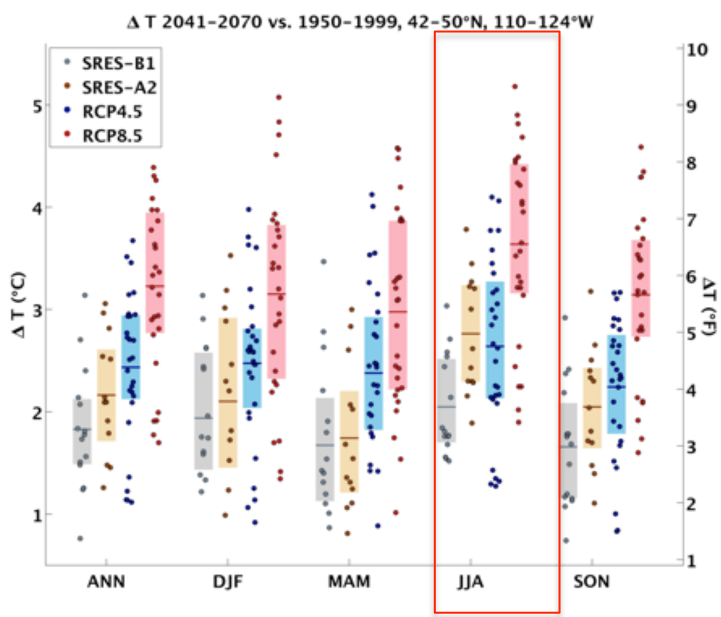
Precipitation



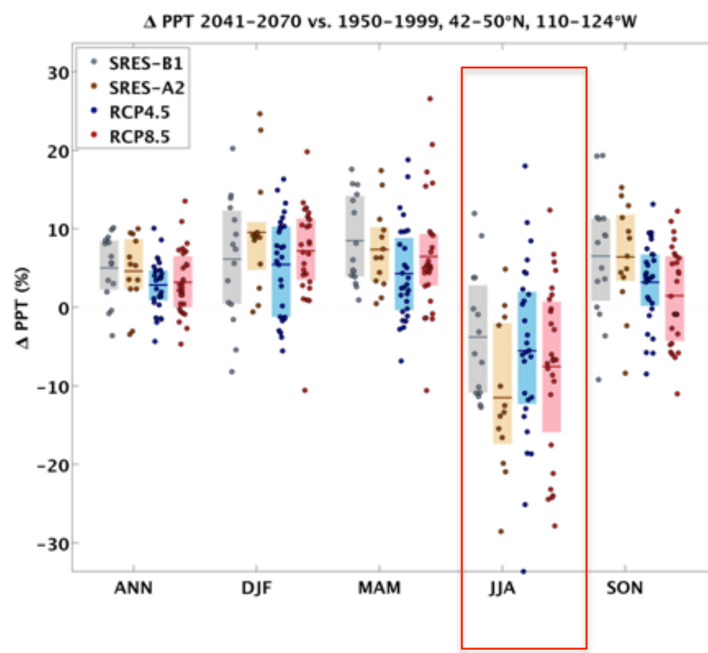
Which GCMs should PWB Use?

Range of Model Projections over Seasons: PNW

Mean Temperature



Precipitation



Which GCMs should PWB Use?

Range of Model Projections: T vs P

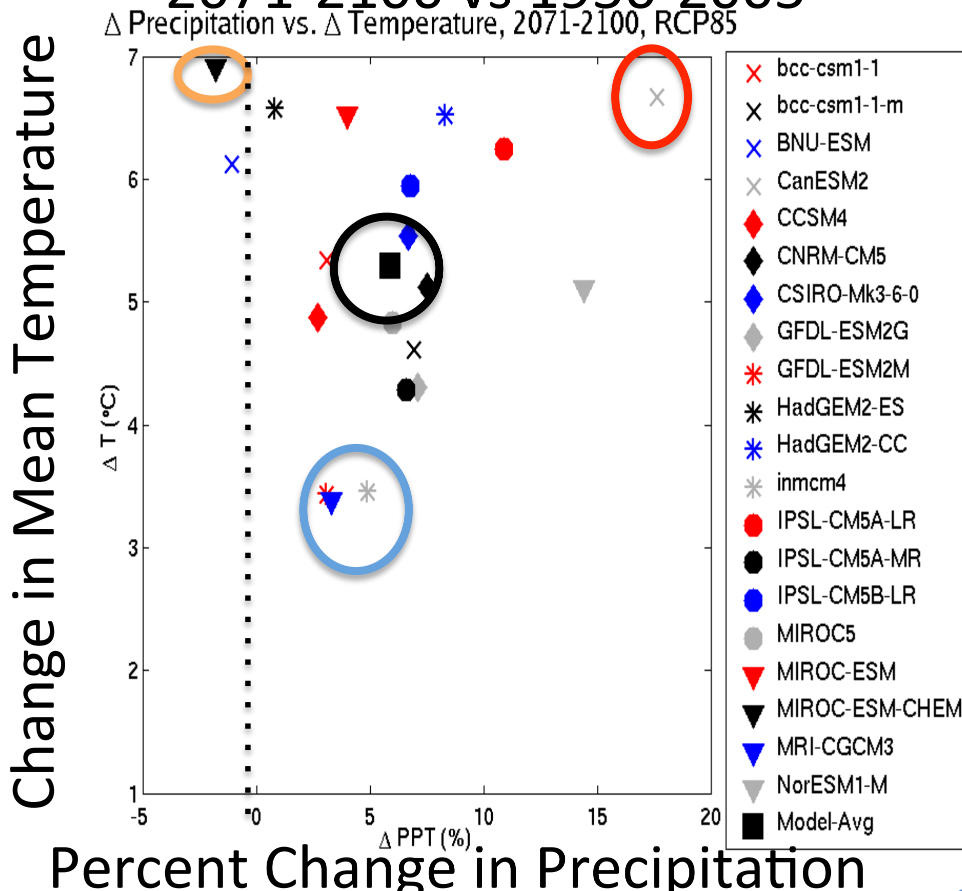
Most warming
Most wetting

Most warming
Some drying

Least warming
Little wetting

Most similar to
Model Average

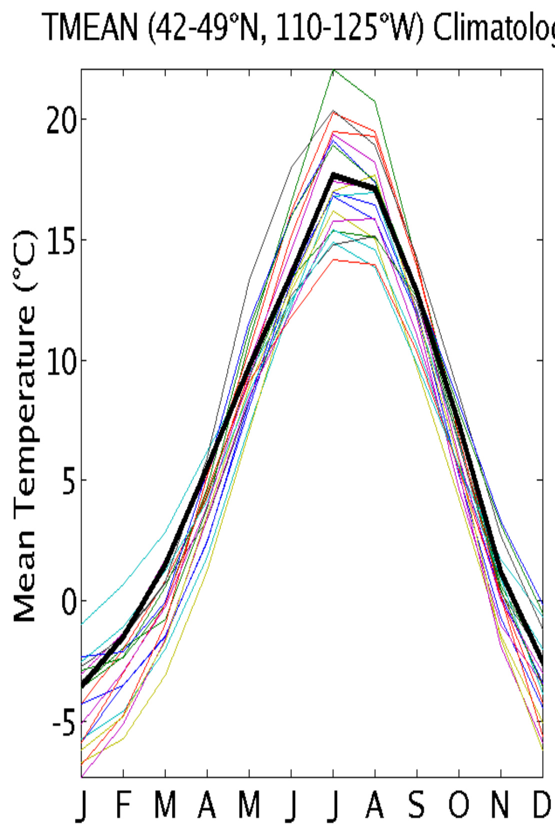
RCP 8.5 Future Changes:
2071-2100 vs 1950-2005



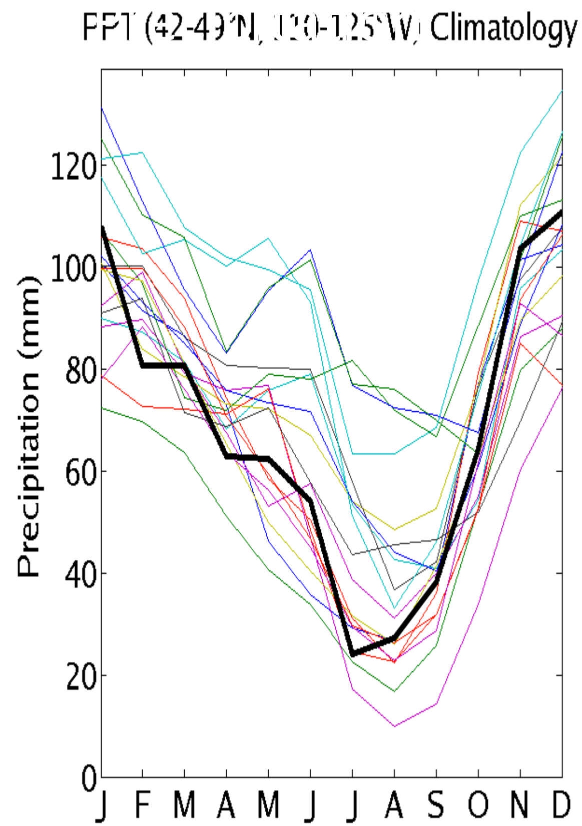
Which GCMs should PWB Use?

GCM Skill Evaluation: PNW

How Well Do GCMs Reproduce Observed Climate?



Months

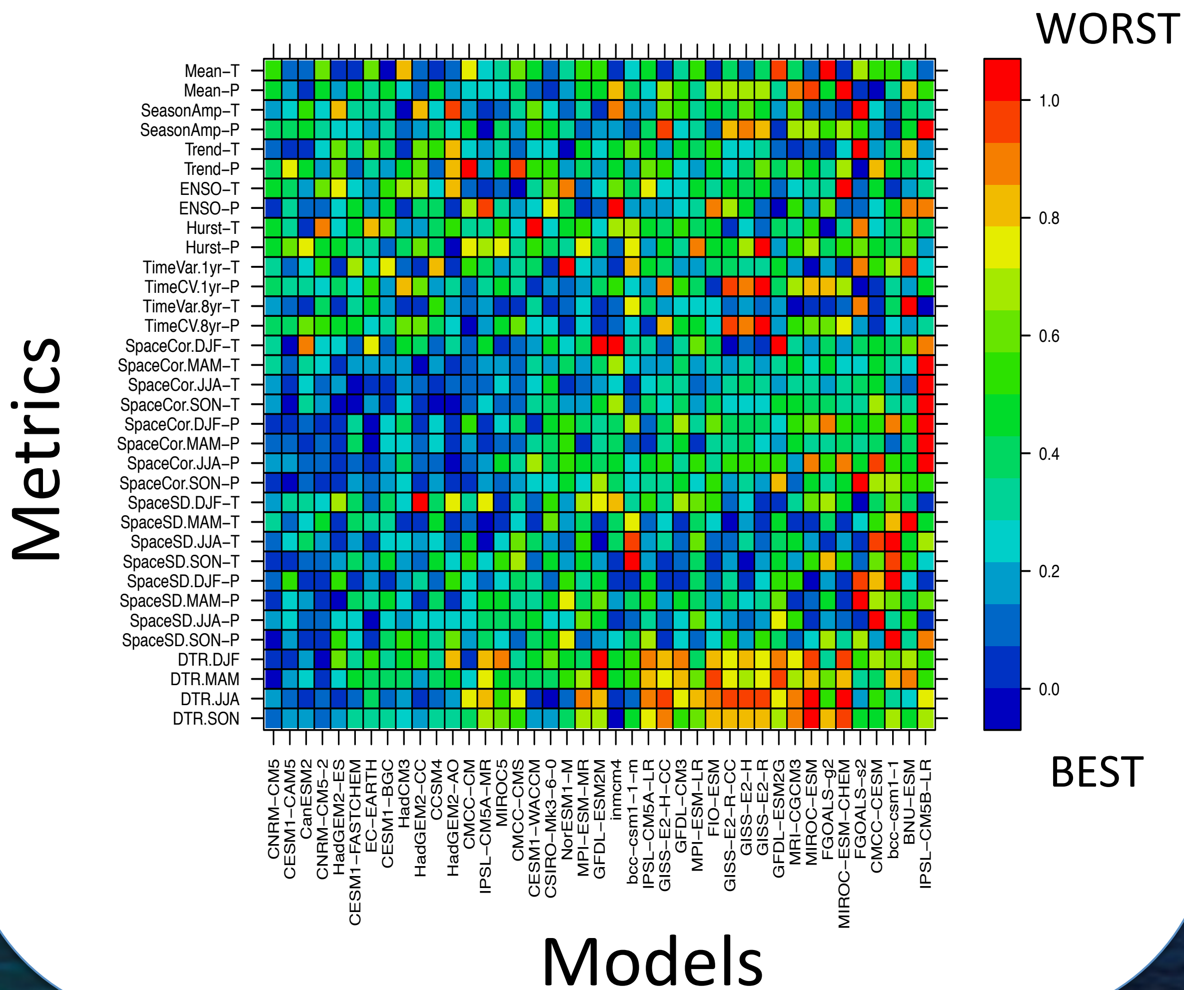


Months

Which GCMs should PWB Use?

GCM Skill Evaluation: PNW

Ranking the models (Rupp et al, 2013)



T/P METRICS

- Seasonal Cycles
- Diurnal Ranges

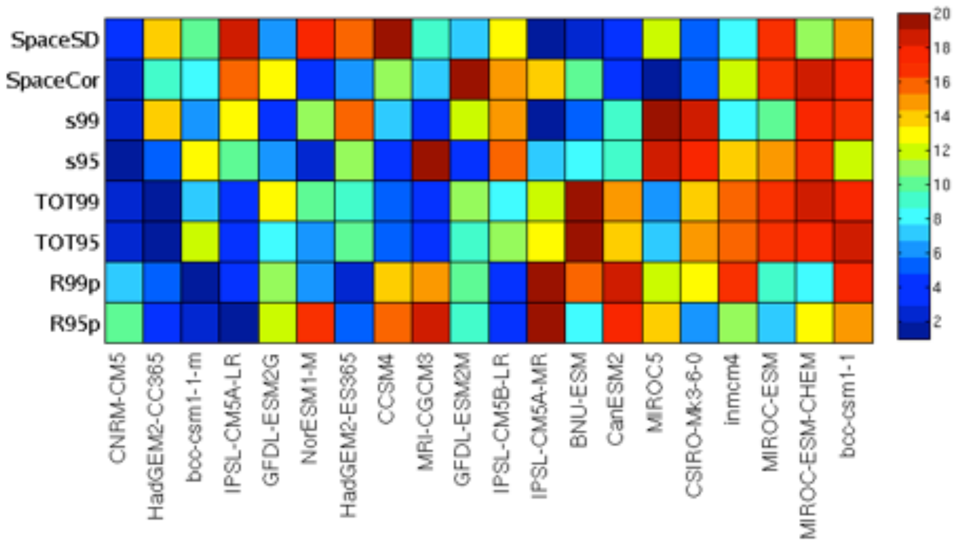
Spatial/Temporal:
- Variability
- Correlations
- Patterns/ Trends

- Strength of El Nino teleconnections

Which GCMs should PWB Use?

GCM Skill Evaluation

Extreme Precip. Events: NW OR



EXTREME P METRICS:

- Event Magnitude
- % of Annual Precipitation
- Event Seasonality
- Linkage to large scale synoptic patterns

Which GCMs did PWB Use?

Our Suggestions to PWB:

- When can, use as many models as possible(ensemble study)
  - Multi-Model Mean: projected signal of change
  - Spread/Range of projections: level of uncertainty
- When can use only a few, perform scenario study:
  - Near Multi-Model Mean: CSIRO-Mk3-6-0, CNRM-CM5
  - Strong warming, more dry: HadGEM2-ES
  - Less warming, more dry: GFDL-ESM2M
  - Strong warmer, more wet: CanESM2

What PWB ended up doing:

- PWB ran all 20 models x 2 scenarios w/ hydrologic model
- In their analysis, they used 20 GCM s for most metrics and 5 GCM when resources limited (i.e for projected demand)