

Researching Consistencies and Discrepancies of Regional Climate Models

Christian McGillen

Why Climate Models?

Climate models are the most sophisticated tool climate scientist have in their arsenal.

General Circulation Models (GCMs)

- GCMs can operate on resolutions as large as 500km but typically within 150-200km

GCMs can overlook regional influences, primarily topography

Regional Climate Models (RCMs)

- Downscaled from GCM pairings



[1]

Research Qs

Can robust patterns be observed across RCMs?

Can explicit differences be observed?

Further Questions:

What might account for these differences?

Methodology

Focus on 4 Primary Variables

- Tmax, Tmin, Precip, snow water equivalent (SWE)
- All contained in netCDF format

Focus on PNW domain

- However spatial domain was not identical across all 3 models

All data was analyzed in MatLab programming language

Assumed correctly processed data

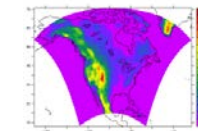
USGS Regional Climate Downloader

Scenario: A2 Emission Scenario
 Time Interval: Monthly
 Domain: Merged Grid
 Model: MPI ECHAM5
 Variable: 10 GT P LT 25 mm/3hr
 Level:
 Time: 1968-1-16
 Month Filter: None
 Color Palette: Rainbow (Purple/Red)

USGS Dynamic Downscaled Regional Climate
 Publisher: U.S. Geological Survey

Summary: We have completed an array of high-resolution simulations of present and future climate over Western North America (WNA) and Eastern North America (ENA) by dynamically downscaling global climate simulations using a regional climate model, RegCM3. The simulations are intended to provide long time series of internally consistent surface and atmospheric variables for use in climate-related research. In addition to providing high-resolution weather and climate data for the past, present, and future, we have developed an integrated data flow and methodology for processing, summarizing, viewing, and delivering the climate

North American Regional Climate Change Assessment Program (NARCCAP)



The NARCCAP dataset contains high-resolution climate change scenario simulation output from multiple RCMs (regional climate models) nested within multiple AOGCMs (atmosphere-ocean general circulation models) for 30-year current and future periods.

The RCMs are run at 50-km spatial resolution over a domain covering the conterminous United States and most of Canada; results are recorded at 3-hourly intervals. The driving AOGCMs are forced with the A2 SRES emissions scenario in the future period. This dataset also includes output from two timeslice experiments and a set of 25-year RCM simulations driven with NCEP-2 reanalysis data. These simulation results are useful for impacts analysis, further downscaling experiments, and analysis of model performance and uncertainty in regional scale projections of future climate.

When publishing research based on NARCCAP data, please include a citation for the dataset itself, such as the following:

Mearns, L.O., et al., 2007, updated 2014. *The North American Regional Climate Change Assessment Program dataset*, National Center for Atmospheric Research Earth System Gnd data portal, Boulder, CO. Data downloaded 2014-08-01. [[doi:10.5065/D6RN35ST](https://doi.org/10.5065/D6RN35ST)]

[NARCCAP Homepage](#)
[Model Information](#)

This dataset is open access. Registration is not required, but we encourage NARCCAP data users to share their research interests at the [NARCCAP User Directory](#).

RCM	Driving Model				
	NCEP	CCSM	CGCM3	GFDL	HadCM3
CRCM	data	data	data		
ECP2	data			data	data
HRM3	data			data	data
MM5I	data	data			data
RCM3	data		data	data	
WRFG	data	data	data		
Timeslice	data	data		data	
ECPC	data				
WRFP	data				

[Download HadCM3 Boundary Condition Data](#)

Focused on 3 RCMs for Analysis

Dynamically Downscaled vs Statistically Downscaled

Dynamically Downscaled RCMs

NARCCAP (1968-1999, 2038-2069)

50km resolution

10 GCM-RCM pairing

regCPDN (1985-2005, 2029-2049)

25km resolution

1 GCM-RCM pairing

Super-ensemble (Thousands of runs as part of weather@home project)

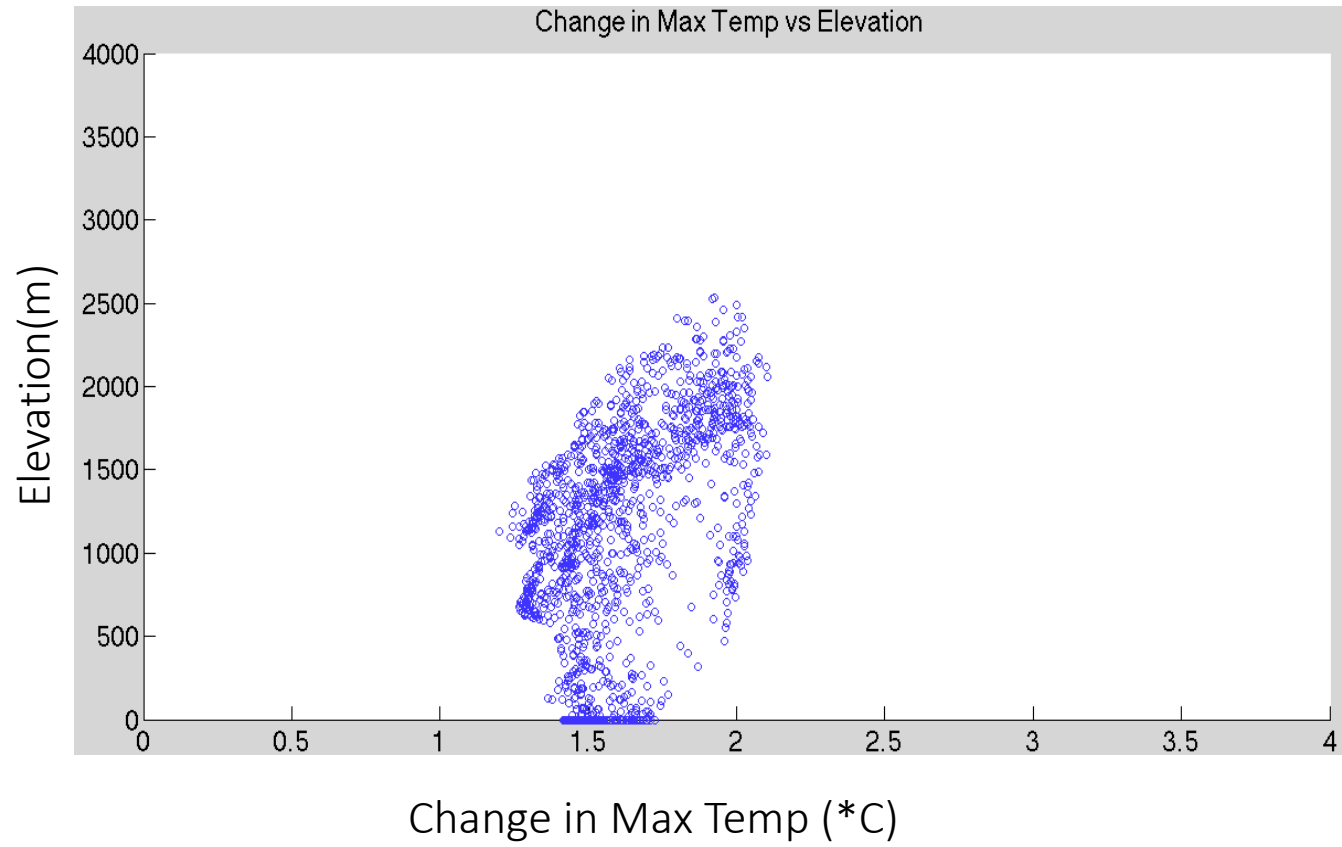
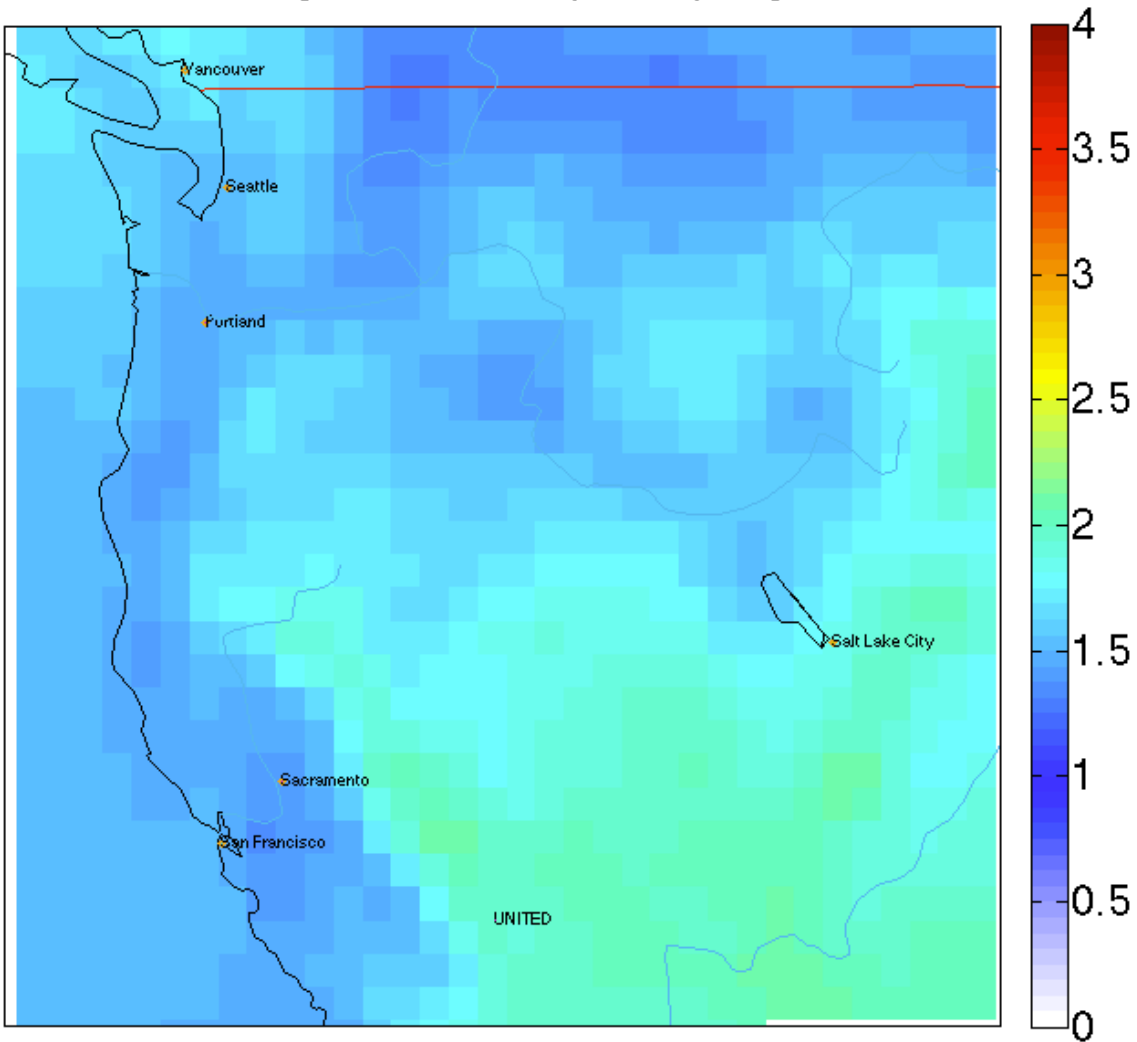
regCLIM (1969-1999, 2039-2069)

15km resolution

3 GCM-RCM pairing

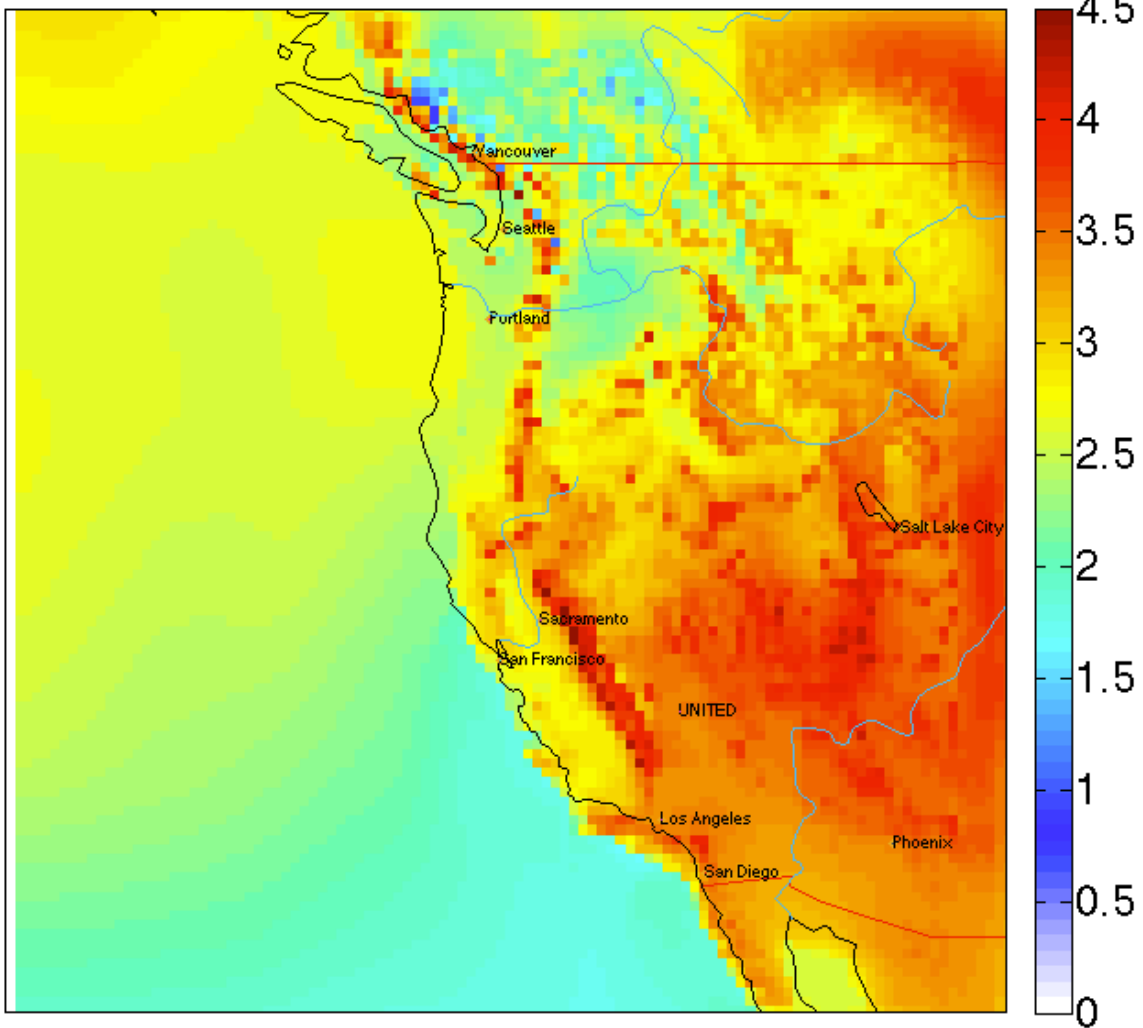
NARCCAP

Change in Max Temp for Spring

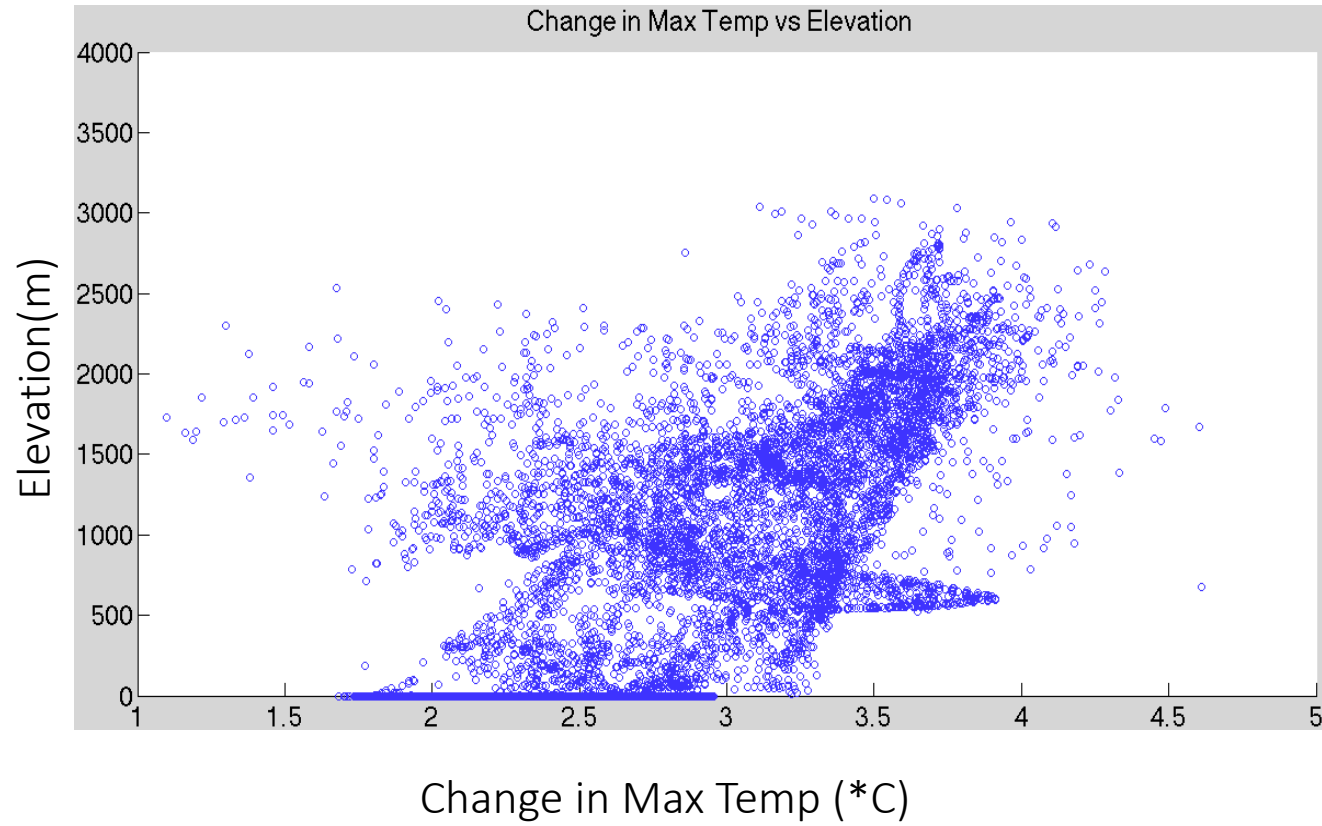


regCPDN

Change in Max Temp for Spring

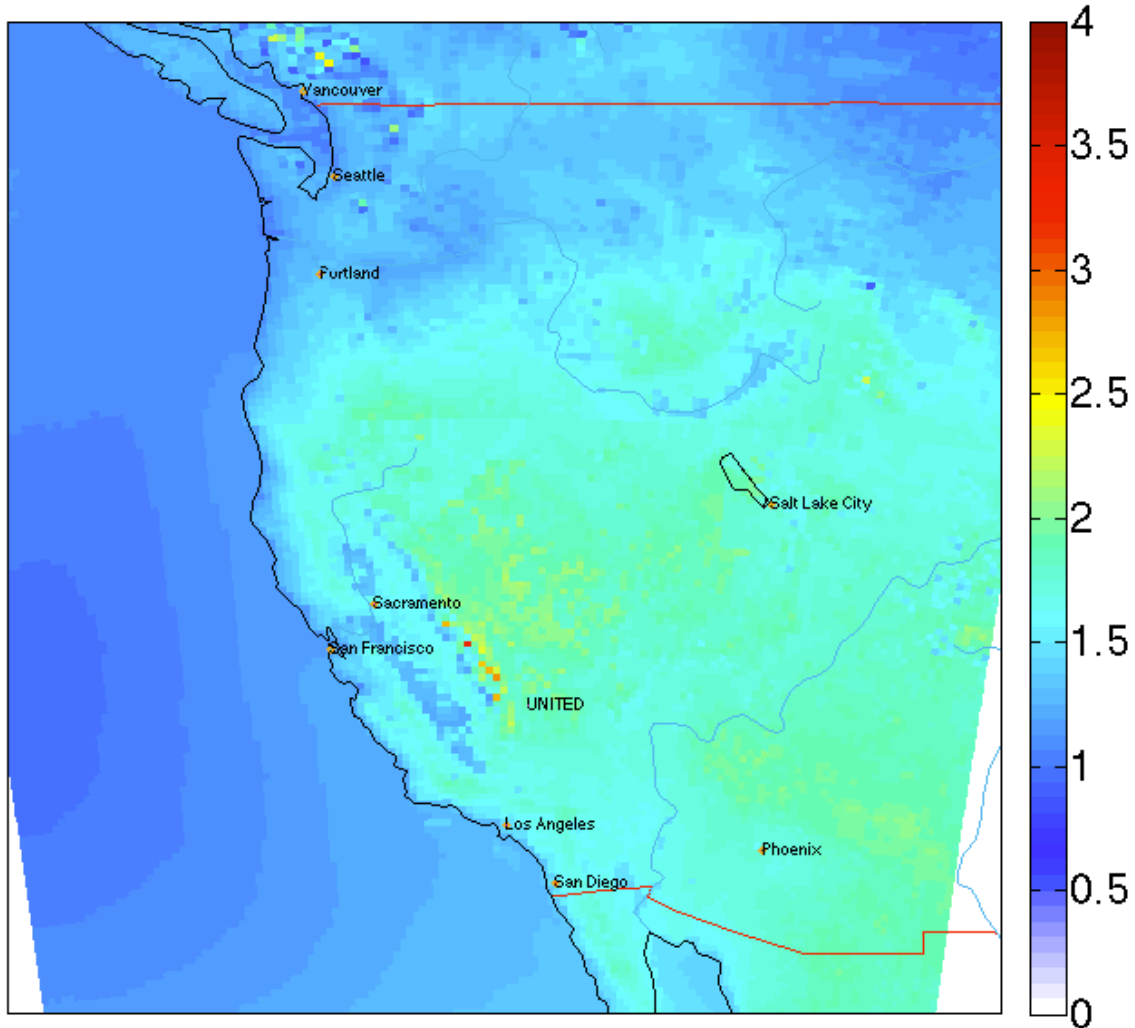


Change in Max Temp vs Elevation

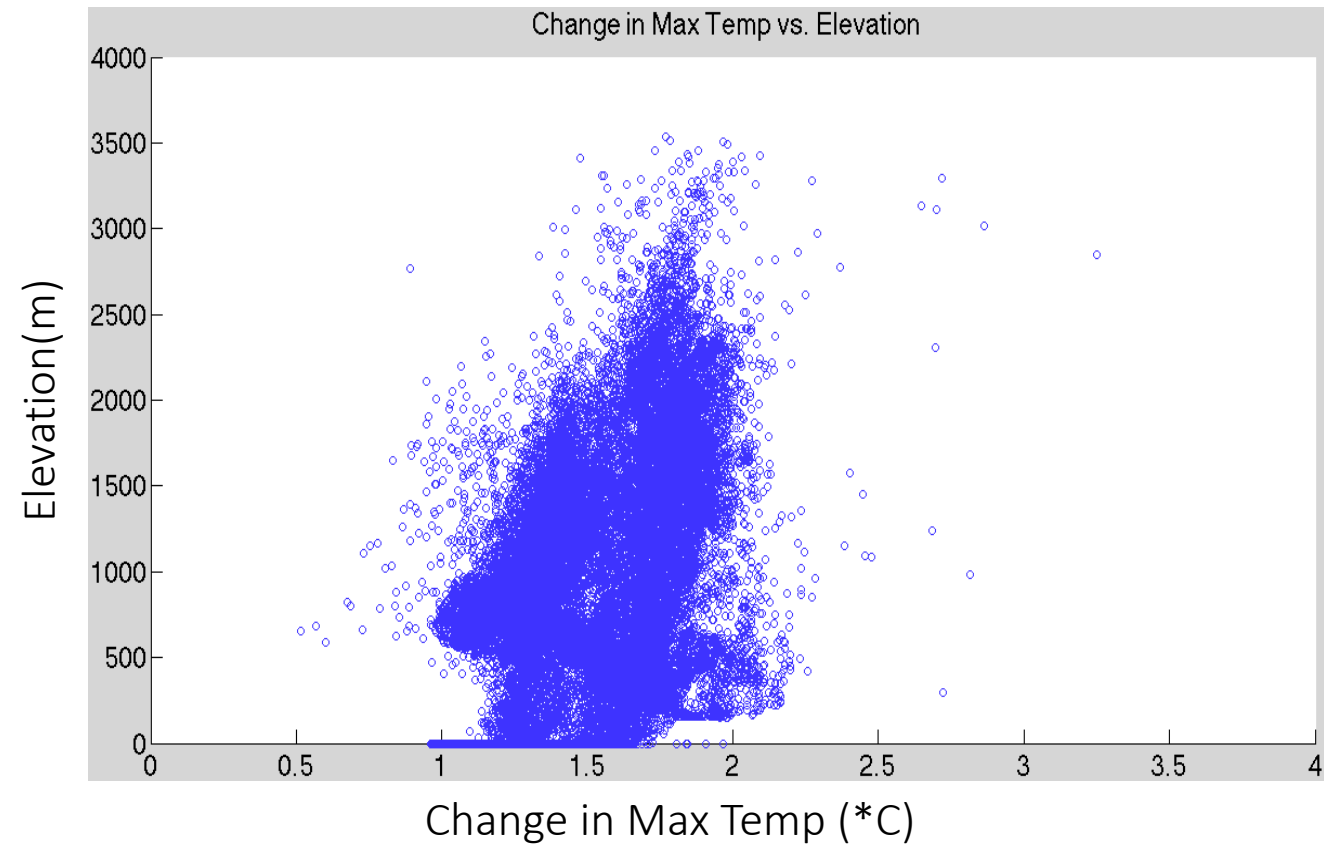


regCLIM

Change in Max Temp for Spring

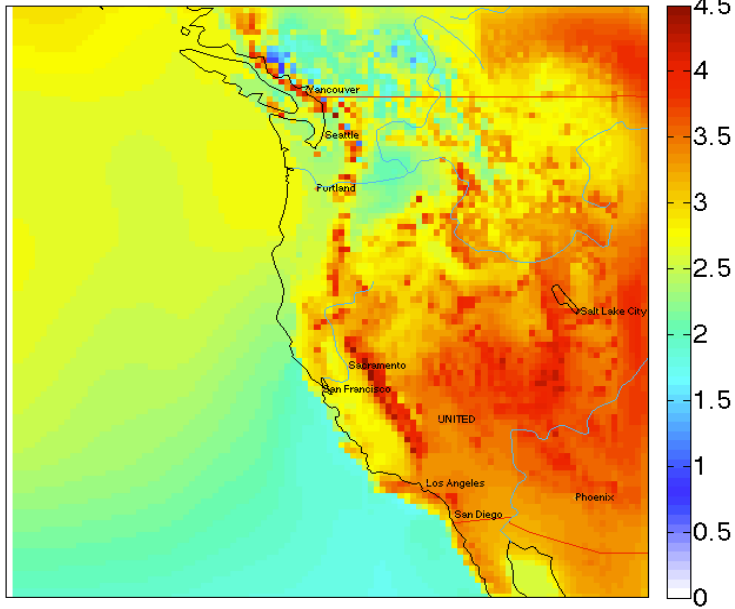


Change in Max Temp vs. Elevation



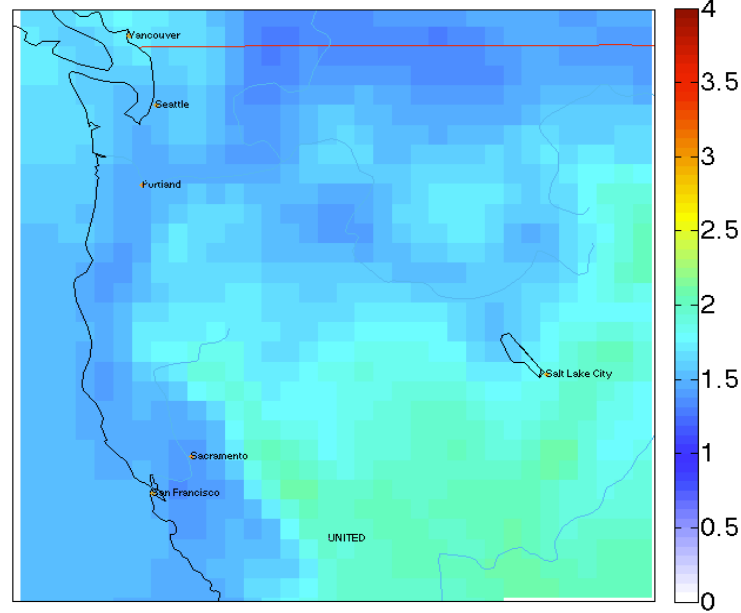
regCPDN

Change in Max Temp for Spring



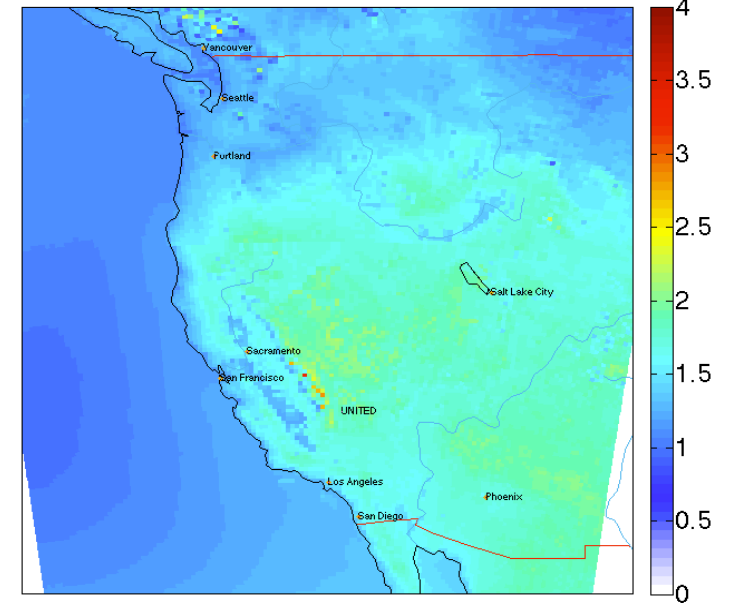
NARCCAP

Change in Max Temp for Spring

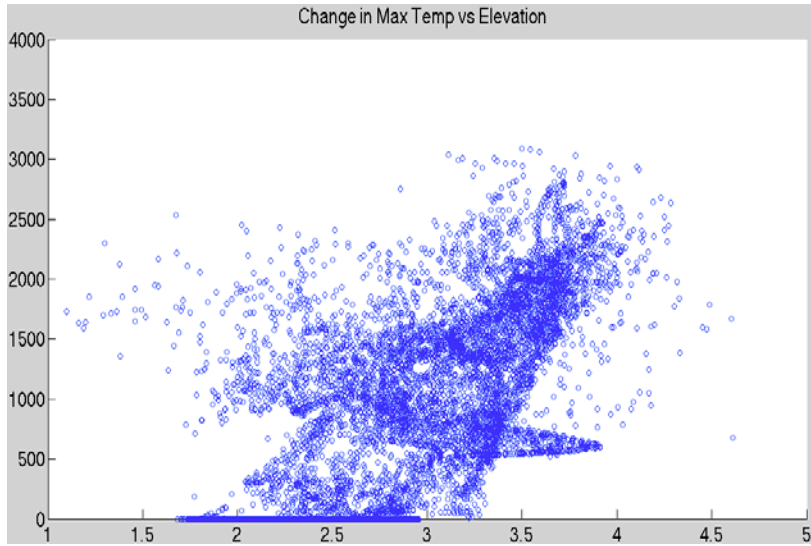


regCLIM

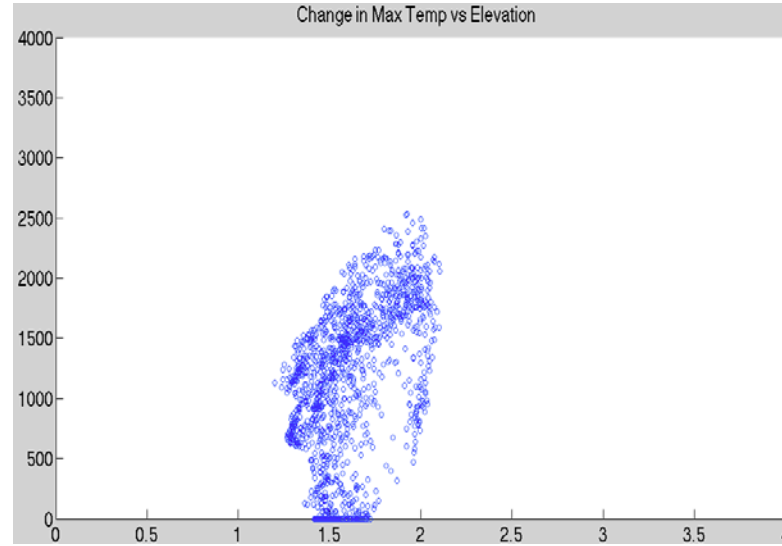
Change in Max Temp for Spring



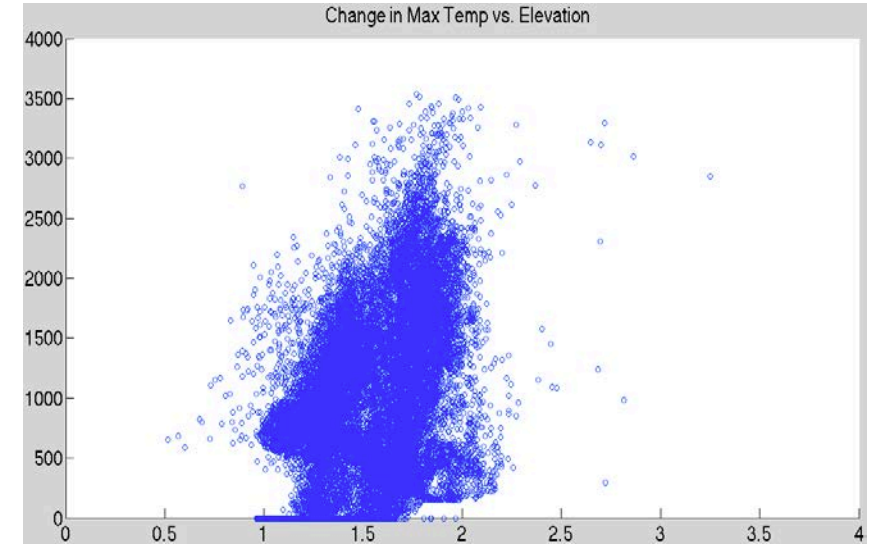
Change in Max Temp vs Elevation



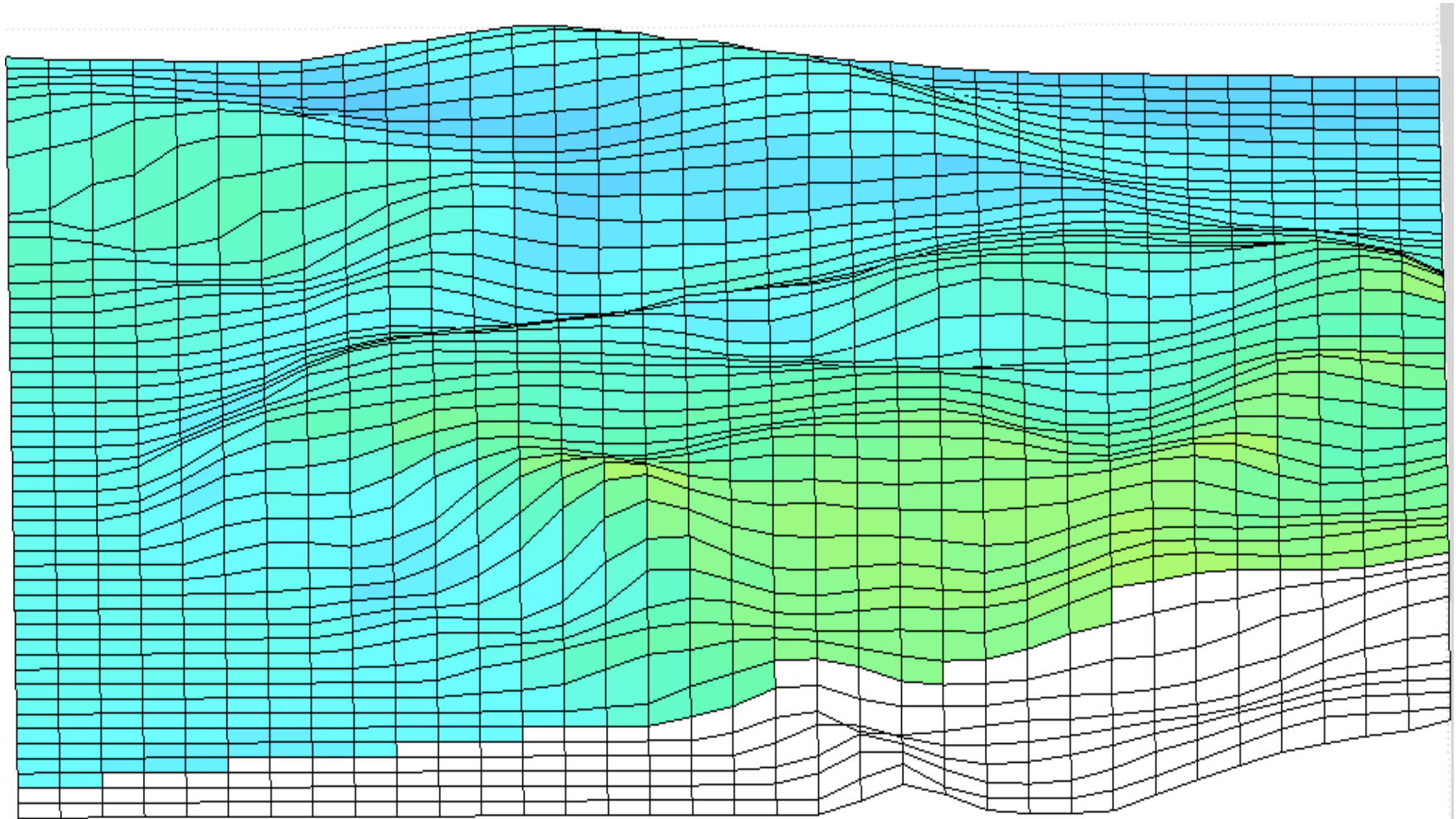
Change in Max Temp vs Elevation



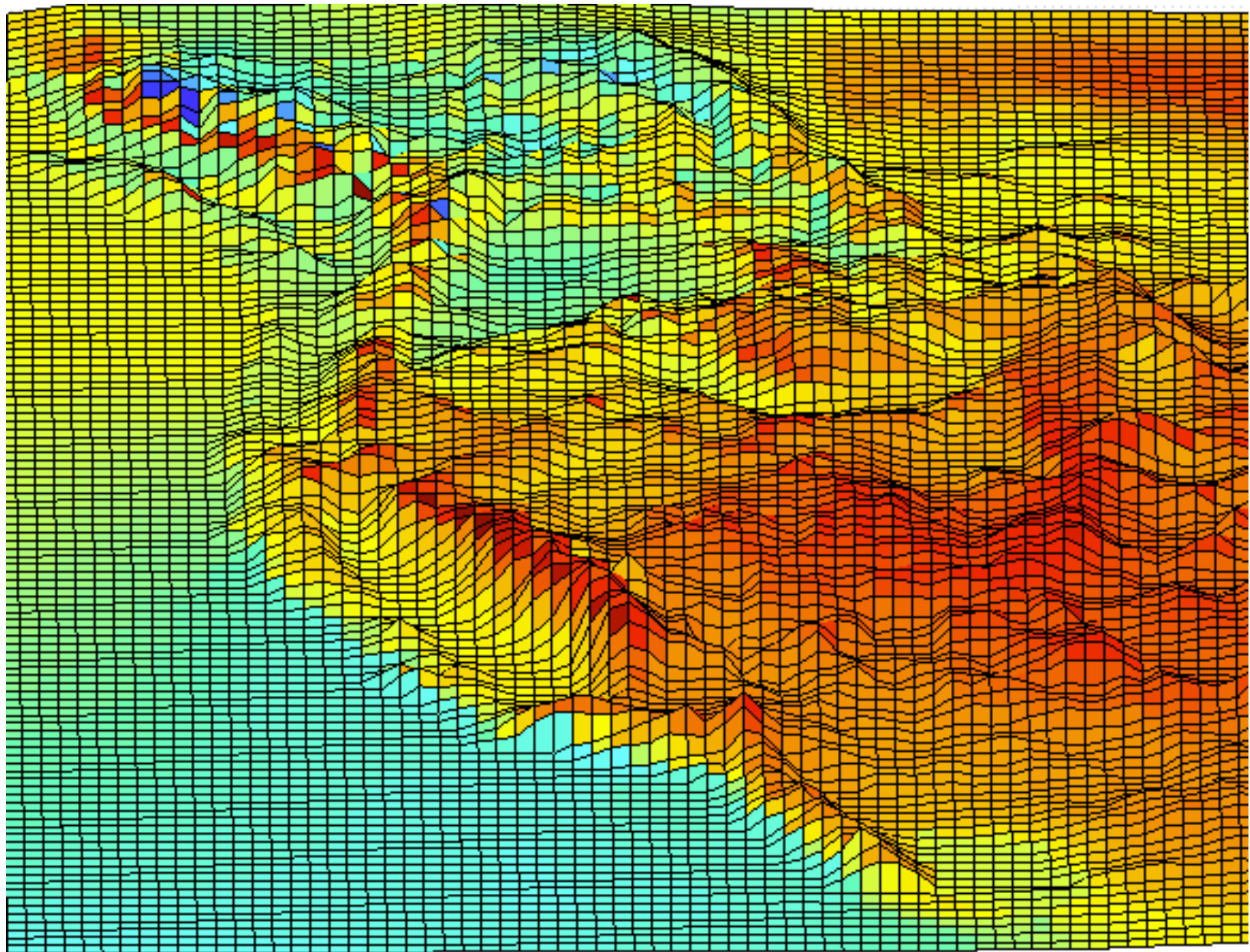
Change in Max Temp vs. Elevation



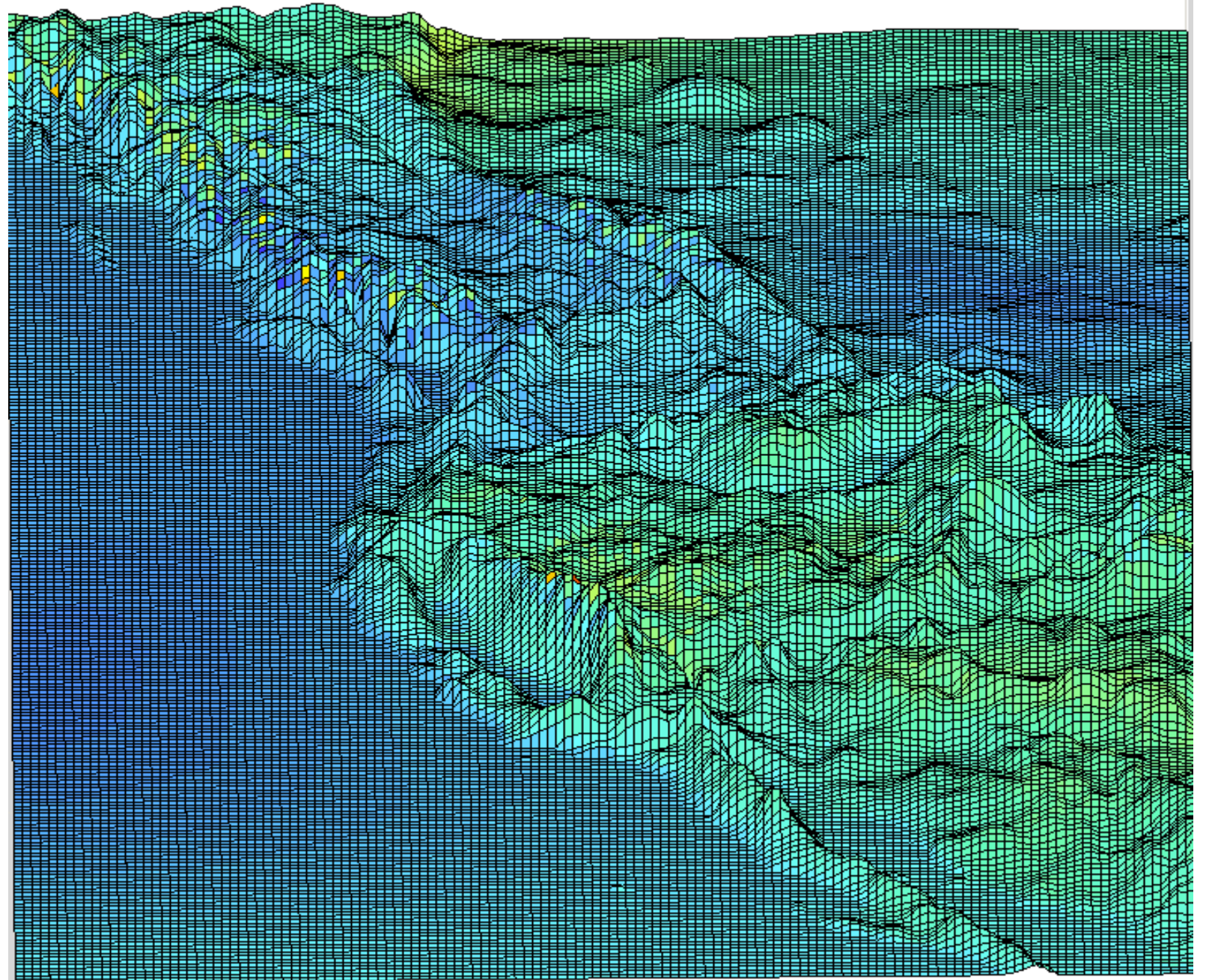
NARRCAP



regCPDN



regCLIM



How does this fit in?

Can help improve confidence in regional climate model projections because it hits on physical processes at play

- More useful for informing stakeholders and policy makers

Identify areas of weakness with the intent on future improvement

How does this fit into REACCH?

- Offers more regionally cognizant projections for agriculture

Take home points

1. Influence of elevation on change in temperature
2. Be diligent when interpreting a single model.

Acknowledgements

A big thank you to:

Dr. Phil Mote

Dr. David Rupp

Dean Vickers

PhD candidate Sihan Li