Survey of the Uncertainties in Regional Climate Simulations of California and Environments

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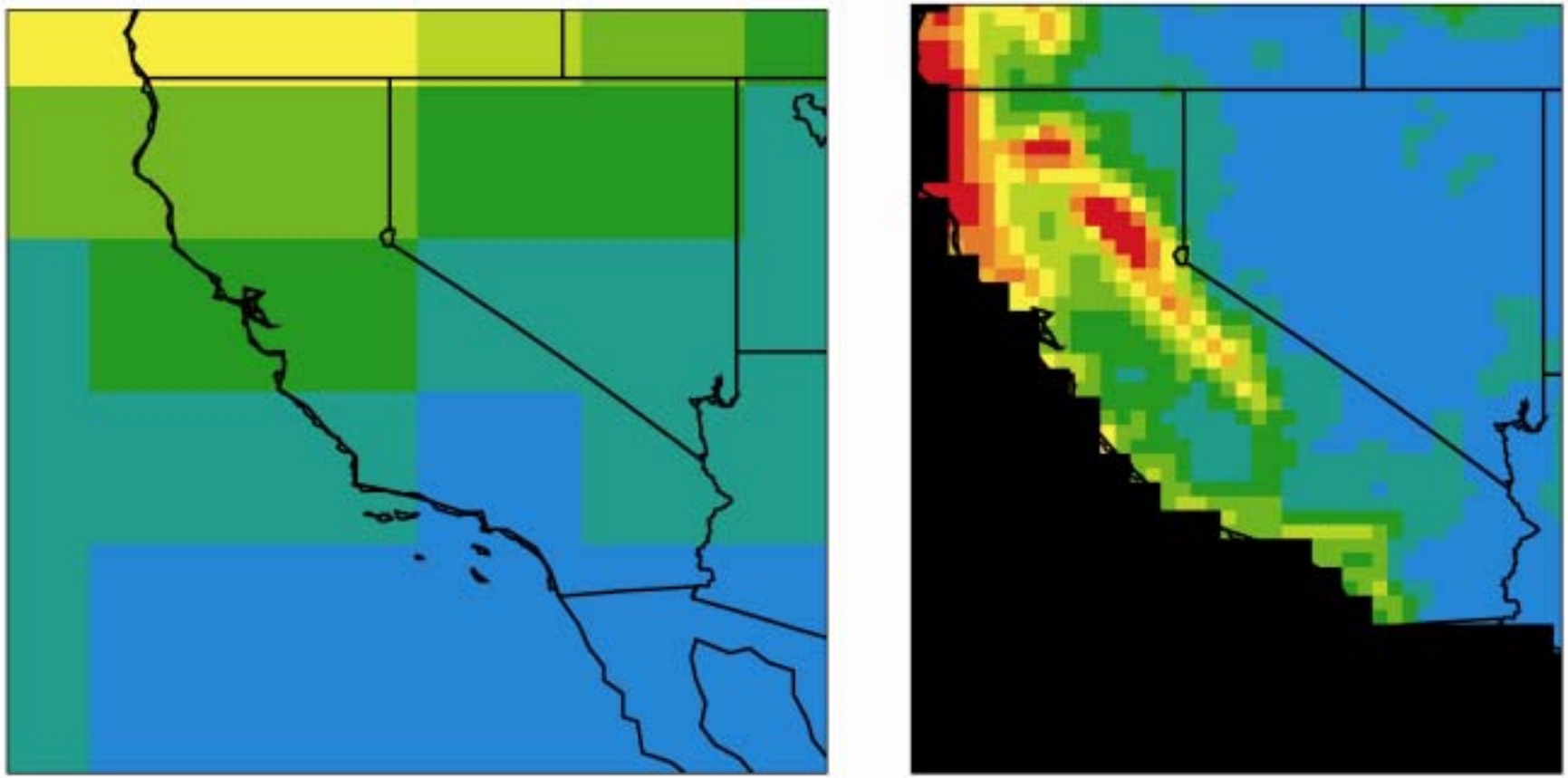
Climate Change

- Changes in climate have implications for human health, water availability, the skiing industry and increases the likelihood for extreme climatic events.
- Climate simulations can help predict future changes in temperature, precipitation, soil moisture, snow content, and ENSO effects due to climate change.

Wintertime precipitation in California and Nevada



Model at 300 km resolution

Observations (NOAA)

Regional Climate Simulations

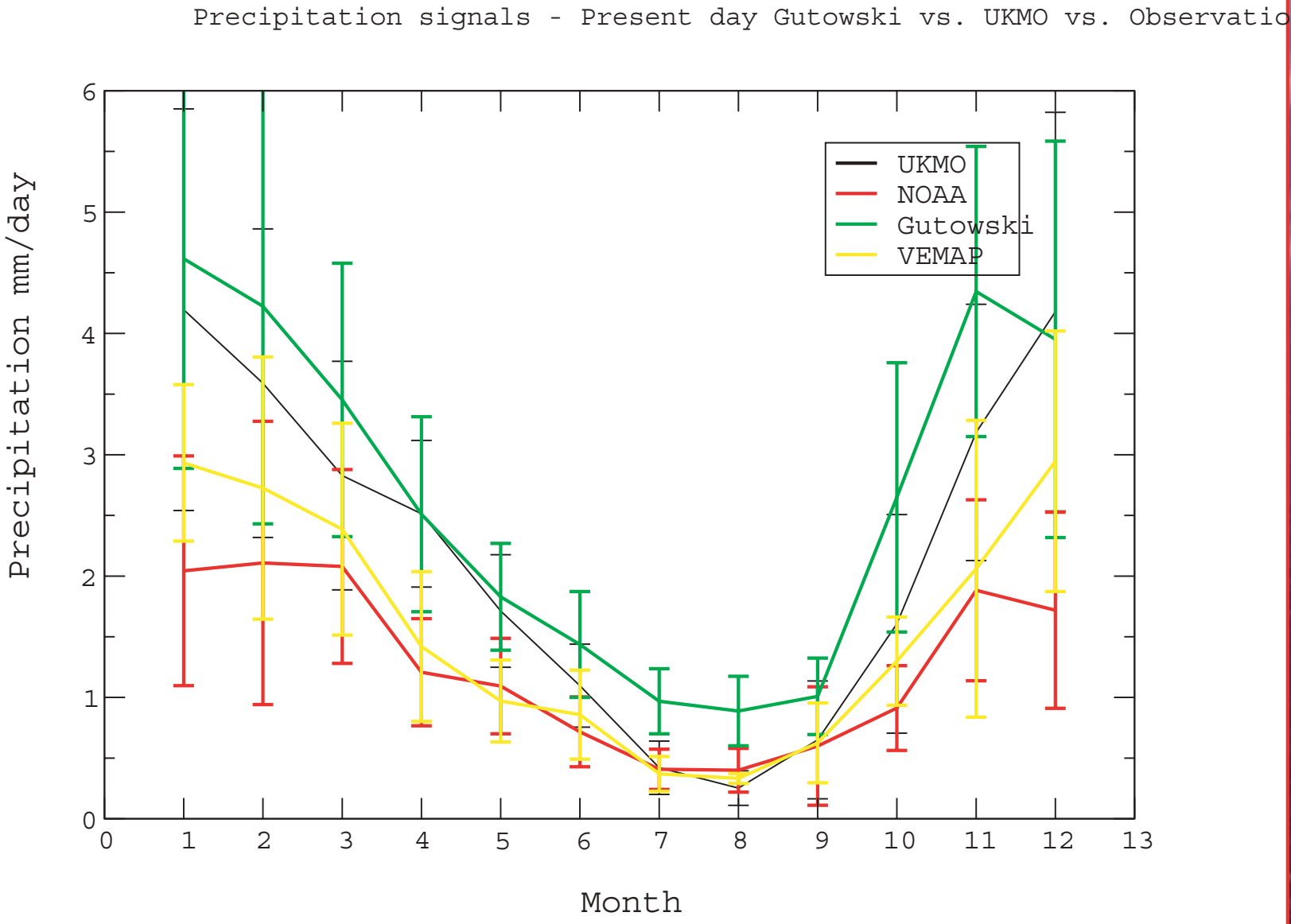
- Due to coarse resolution and inability to account for orographic features, global models are not the best tools for analyzing particular regions.
- Regional models more accurately define a region and take into consideration orographic features such as the Sierras.

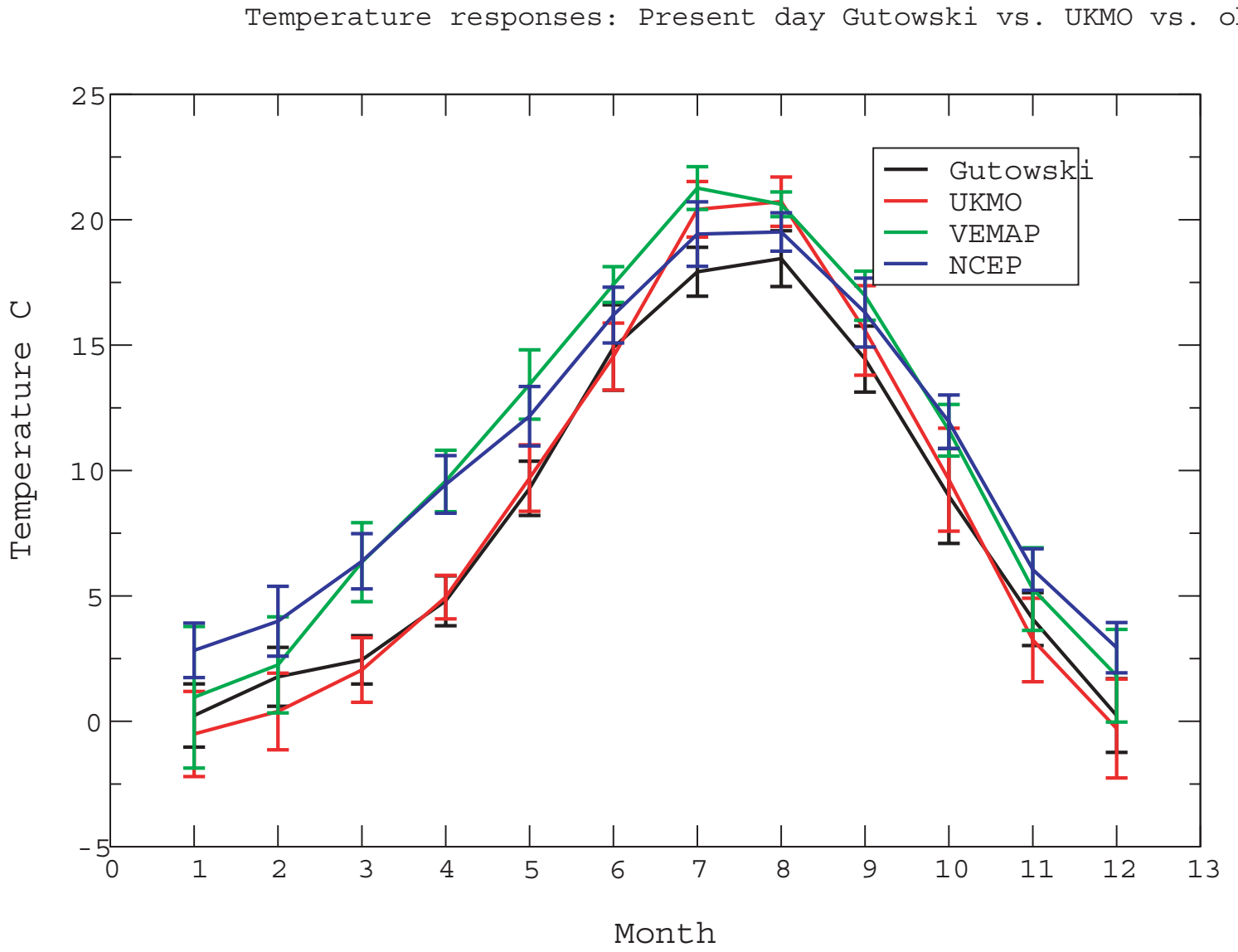
California

- Most of the precipitation occurs during the winter season and is stored in the form of snow.
- The snow then melts and reaches its peak in April and provides water for most of the state for the duration of the spring and summer.
- An increase in temperature would result in an earlier snowmelt peak which would result in more runoff in the winter (floods) and less in the spring and summer (droughts).

Methods

- Three groups of raw regional climate data with 50km resolution were obtained and placed in grid format and analyzed
- Ruby MM5 Mesoscale Model with PCM Parallel Coupled Model – 1.4 CO_2
- Gutowski model with HadCM2 (UKMO) Hadley Center Model – 1.8 CO_2
- Roads NCEP National Center for Environmental Prediction Model with PCM – 1.36 CO_2


Precipitation signals - Present day Gutowski vs. UKMO vs. Observatio
Precipitation mm/day
Month
UKMO
NOAA
Gutowski
VEMAP
0
1
2
3
4
5
6
7
8
9
10
11
12
13


Temperature responses: Present day Gutowski vs. UKMO vs. observat
Gutowski
UKMO
VEMAP
NCEP
Temperature C
Month
25
20
15
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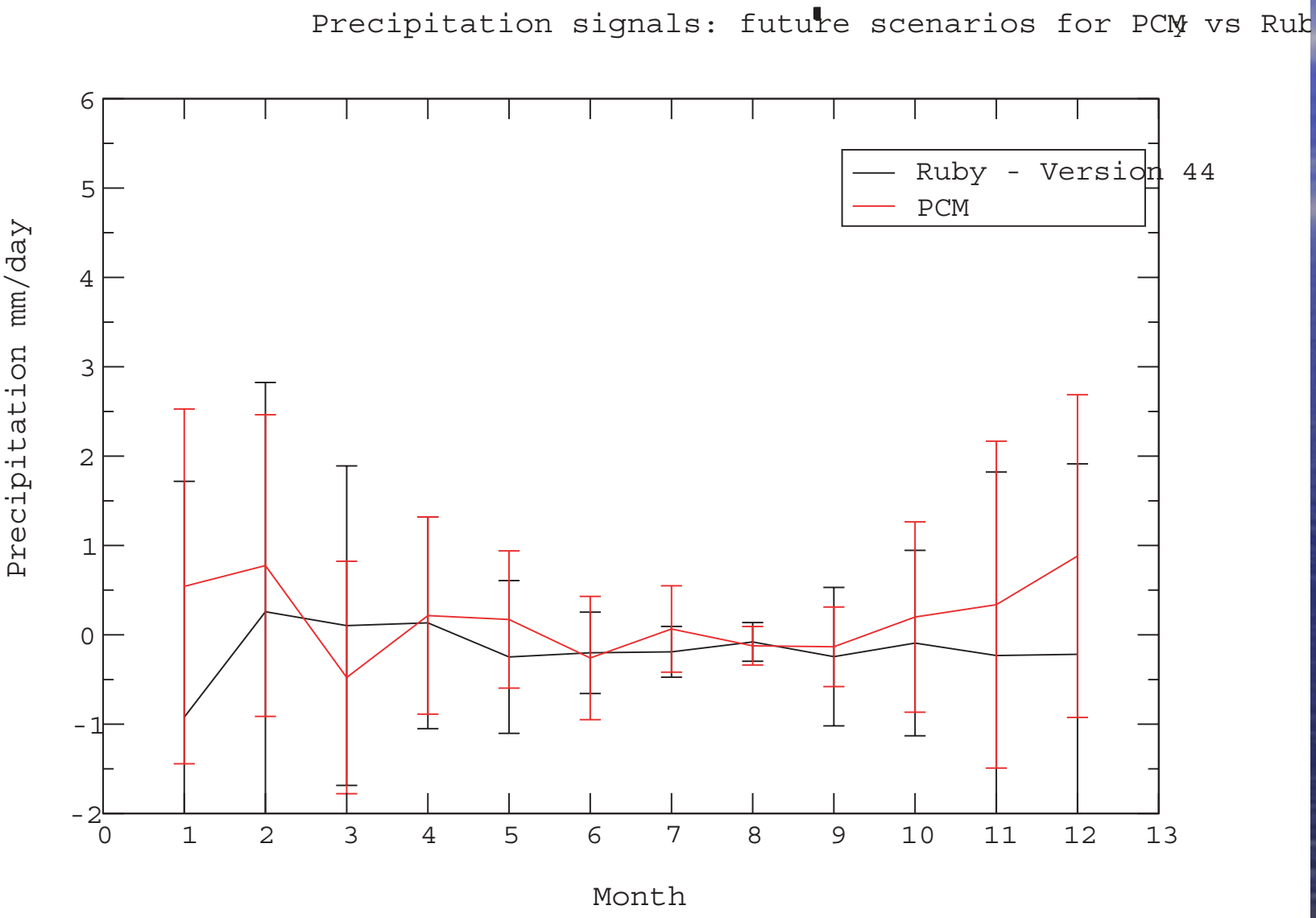
Precipitation signals: future scenarios for PCM vs Rub
Ruby - Version 44
PCM
Precipitation mm/day
Month
6
5
4
3
2
1
0
-1
-2
0
1
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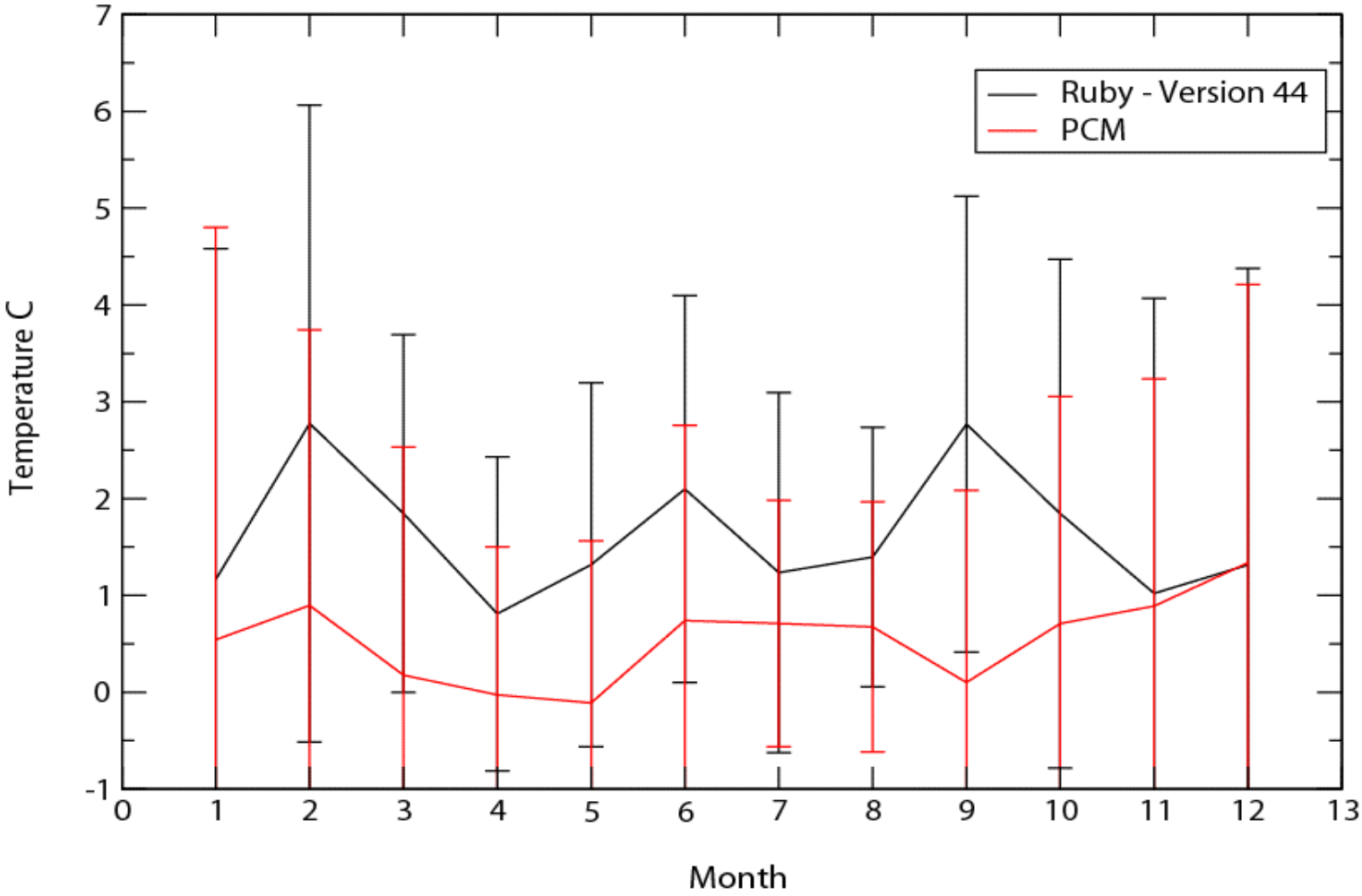
Temperature signals: Future scenarios for PCM vs Ruby

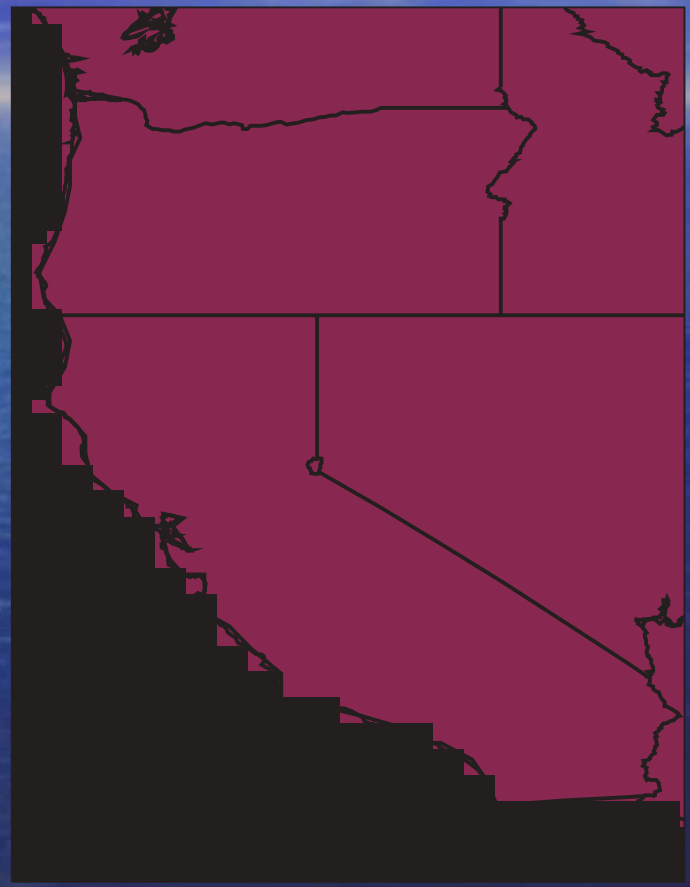


Method – Measuring Uncertainities

- The RCM was compared with its corresponding GCM and observations for present day climate.
- A 19 year window was chosen for the GCM in accordance to the CO2 forcing (e.g. Gutowski 1.8 CO2)
- Delta plots were made to compare the differences between the RCM and its corresponding GCM.
- T-statistics and probability maps were made for DJF, JJA, and Annual for future regional climate scenarios.

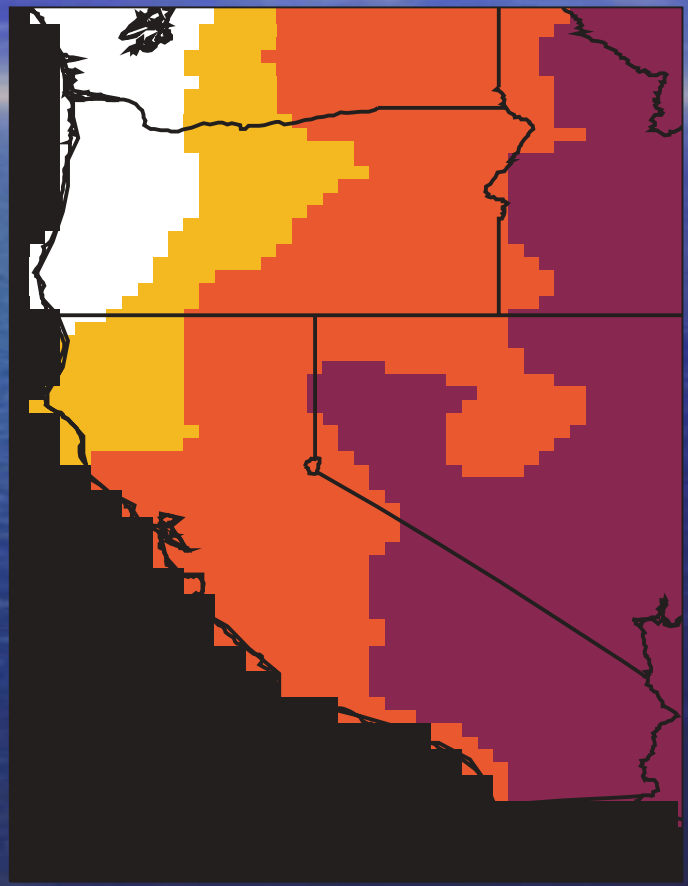
Ruby44: Probability(%) of Present Annual Tsfc = Future Annual Tsfc

Mean 5.4492E-5



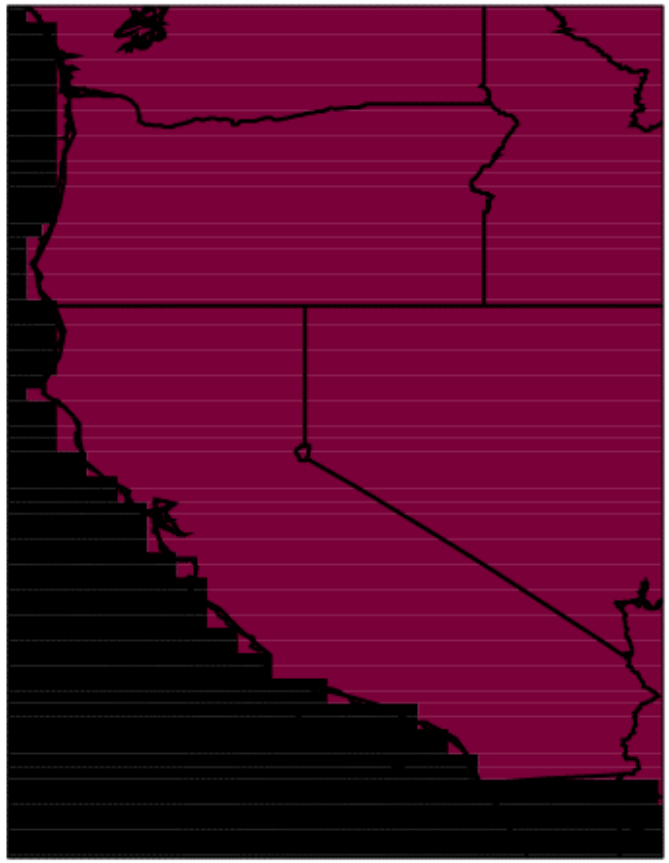
Roads: Probability(%) of Present Annual Tsfc = Future Annual Tsfc

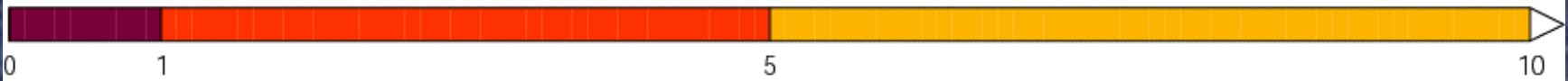
Mean 0.030818



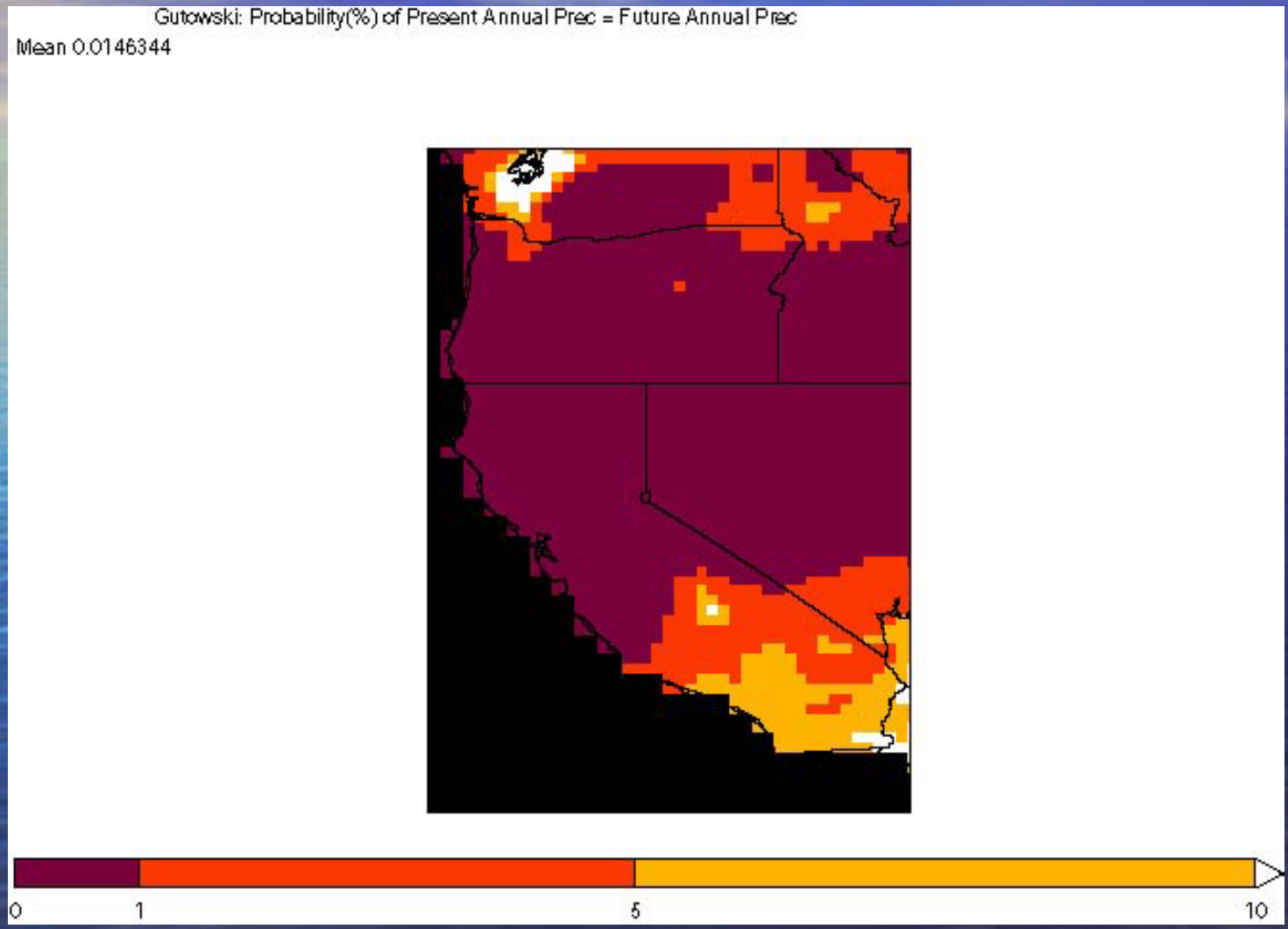
Gutowski: Probability(%) of Present Annual Tsfc = Future Annual Tsfc

Mean 7.35038E-7





All of the precipitation data was not significant except...



Limitations

- This is not the best way to measure uncertainity – all the models could have a common important error that could lead to misleading information.
- There is only a limited set of models and they are not carefully controlled, they are just analyzed.
- Different models have different predictions and we have a different driving GCM.
- Other forcings could have more of an effect than we assumed, such as delta in aerosols, solar humidity, volcanoes, etc.

Conclusions

- RCMs predict more precipitation than GCMs.
- RCMs and GCMs tend to overpredict precipitation and tend to be too cool.
- RCMs all predict increases in temperature and is statistically significant
- Ruby and Roads RCMs predict no significant changes in precipitation, while Gutowski's RCM predicts a significant increase in DJF precipitation. This could be due to its 1.8 CO2 increase.

Acknowledgements

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