

Downscaling of precipitation and temperature fields using the method of constructed analogues

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Michael Dettinger^{2,1} and
Daniel Cayan^{1,2}

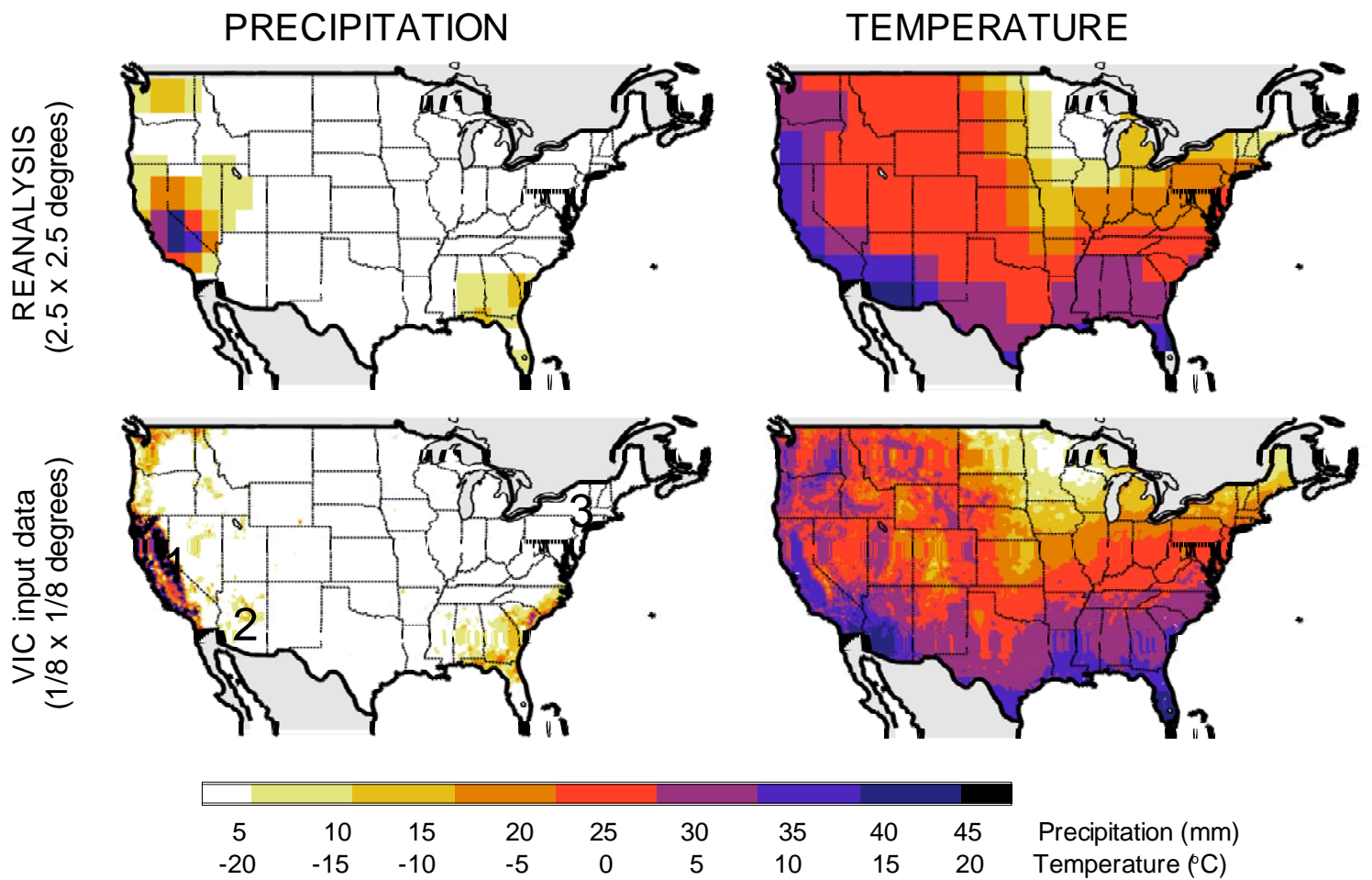
¹ Scripps Institution of Oceanography

² United States Geological Survey

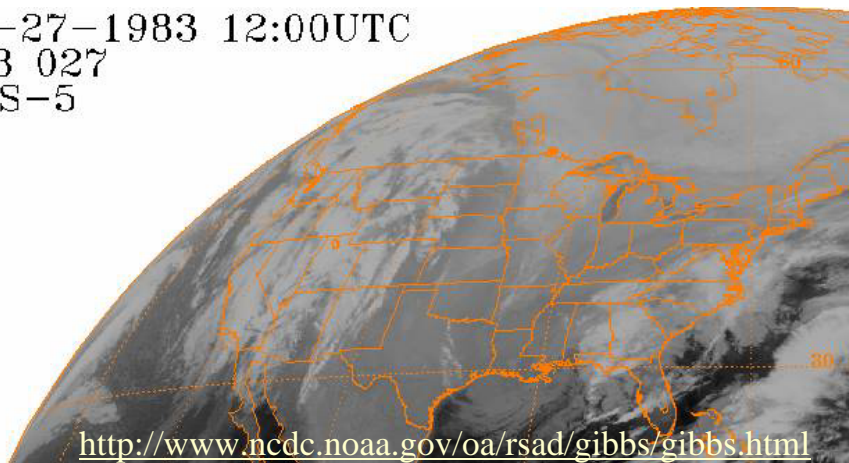
September, 2007

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January 27, 1983

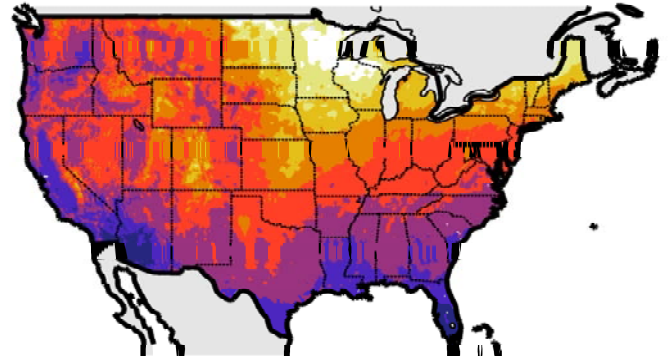
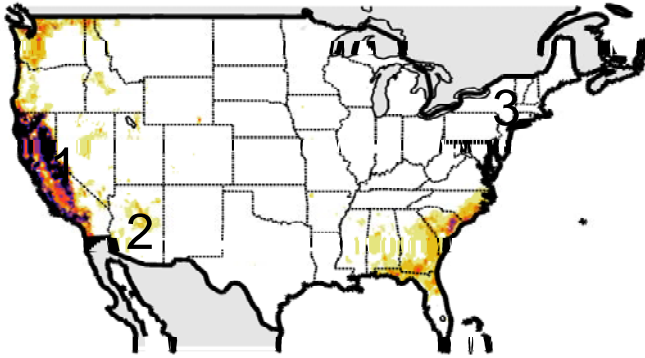


Jan-27-1983 12:00UTC
1983 027
GOES-5



January 27, 1983

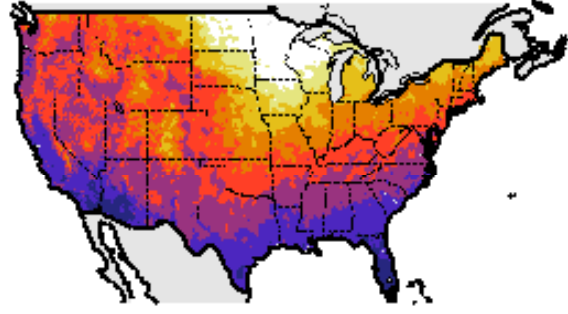
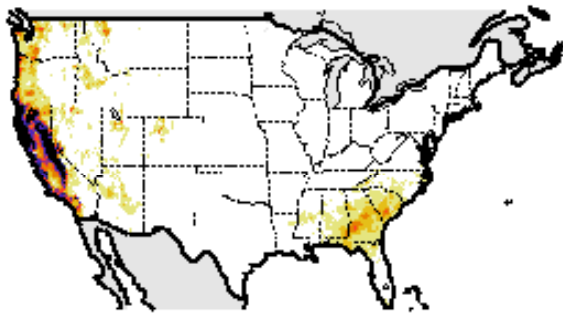
VIC input data
(1/8 x 1/8 degrees)



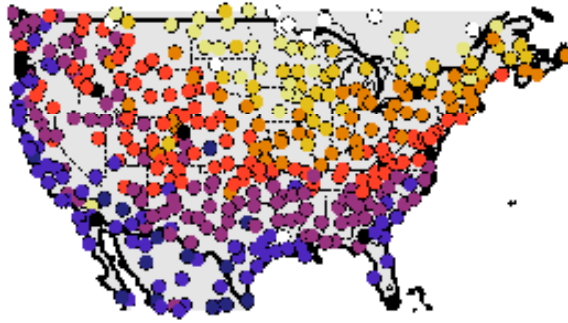
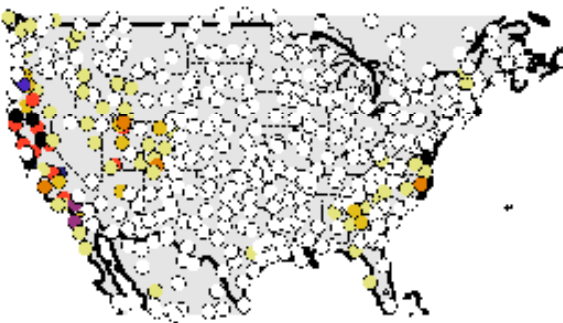
PRECIPITATION

TEMPERATURE

Downscaled coarse VIC
data to VIC input data

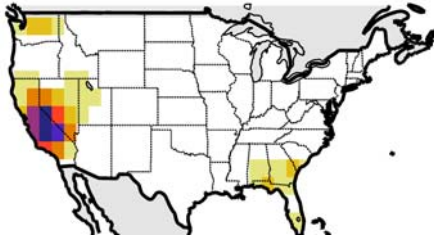


Downscaled coarse VIC
data to stations

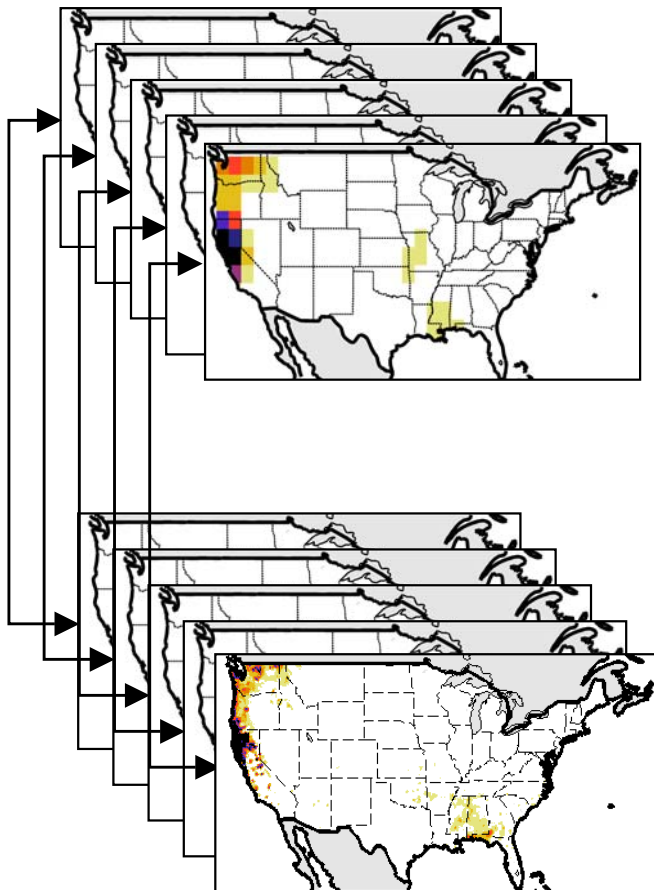


5 10 15 20 25 30 35 40 45 Precipitation (mm)
-20 -15 -10 -5 0 5 10 15 20 Temperature (°C)

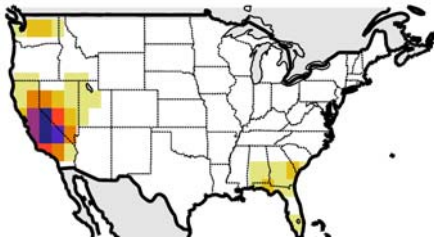
Given:



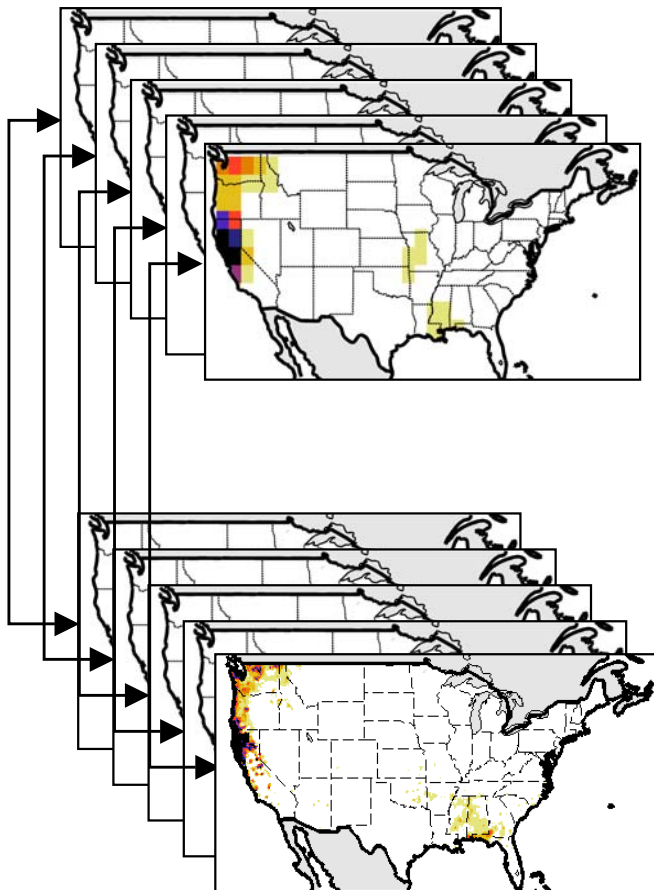
Library of previously observed patterns:



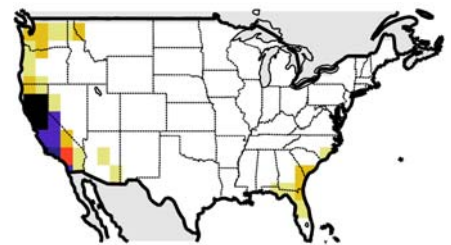
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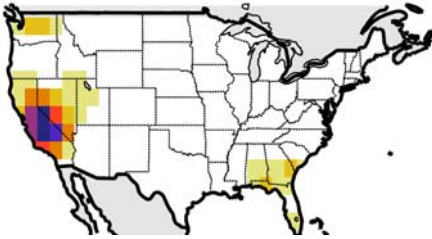
Library of previously observed patterns:



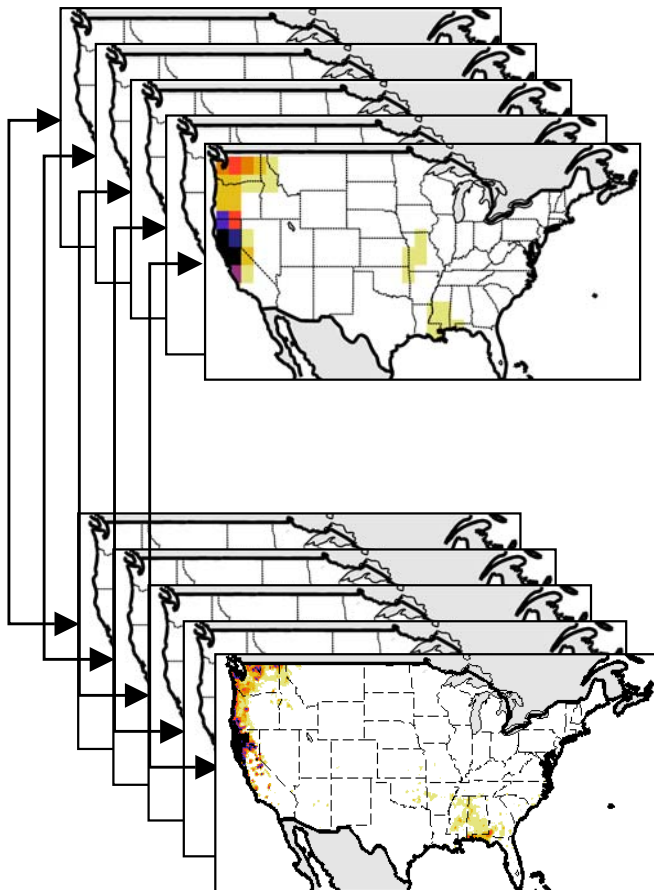
Coarse resolution analogue:



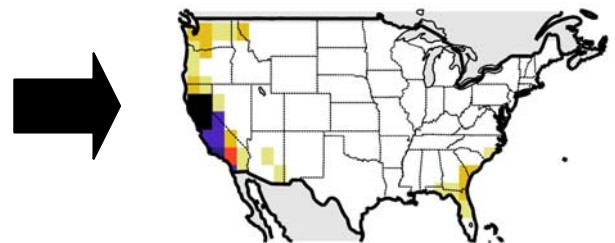
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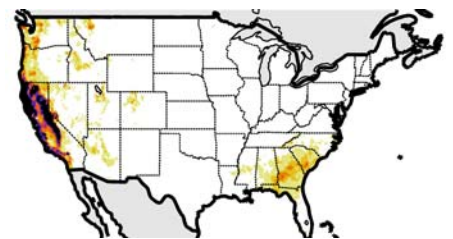
Library of previously observed patterns:



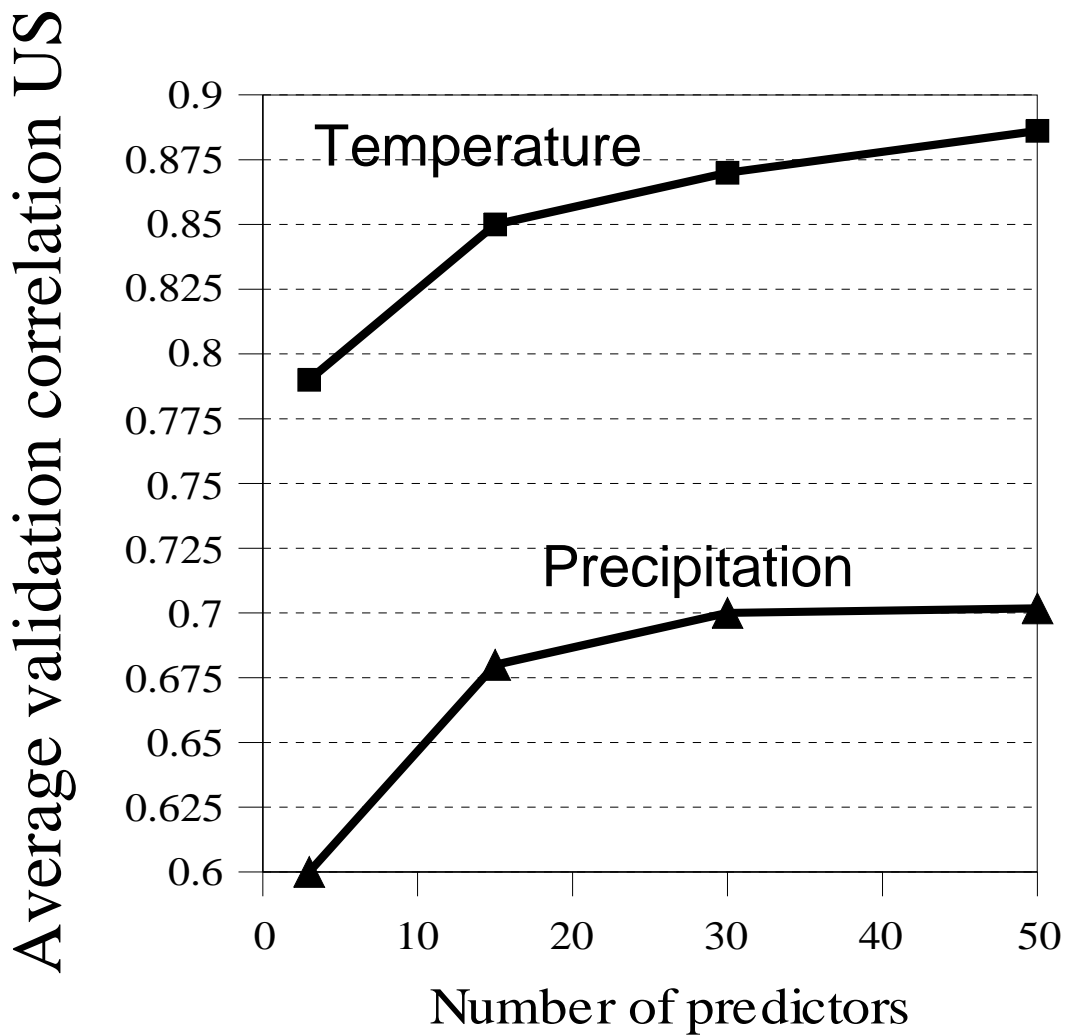
Coarse resolution analogue:



Downscaled estimate



Number of predictors to use

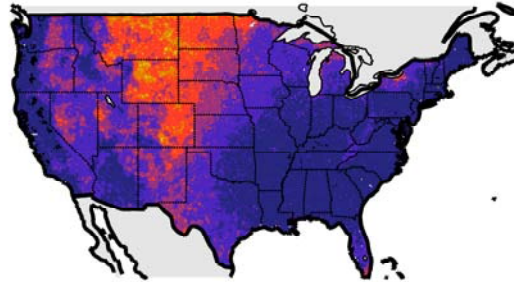


Effect of using different predictors

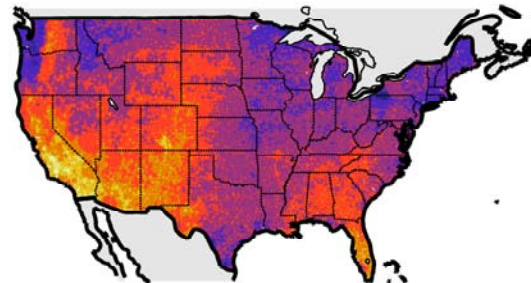
	Precipitation ^{1/2}	Temperature
a) VIC data aggregated to 2.5 x 2.5 degree as the coarse scale field		
Average correlation US	0.71	0.90
b) Reanalysis P and T data as the coarse scale field		
Average correlation US	0.51	0.82
c) Reanalysis precipitable water as the coarse scale field		
Average correlation US	0.35	
d) Reanalysis 700 hPa geopotential heights as the coarse scale field		
Average correlation US	0.23	0.52

P validation correlation (obs vs. downscaled)

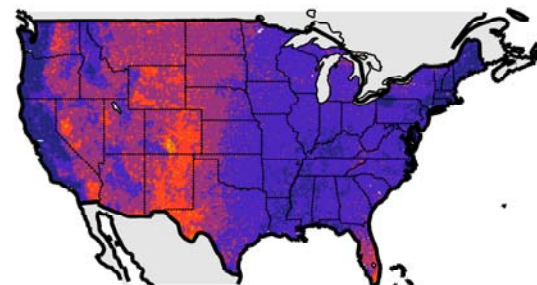
Winter



Summer

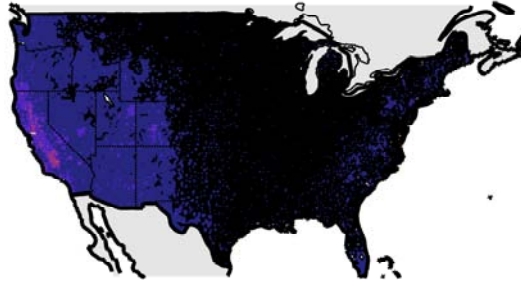


Annual

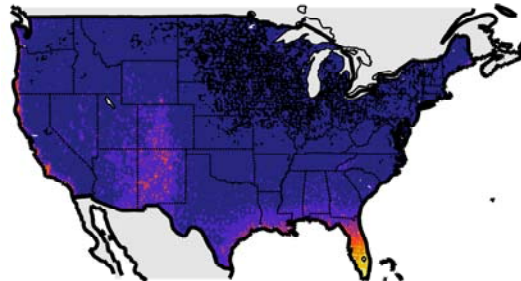


T validation correlation (obs vs. downscaled)

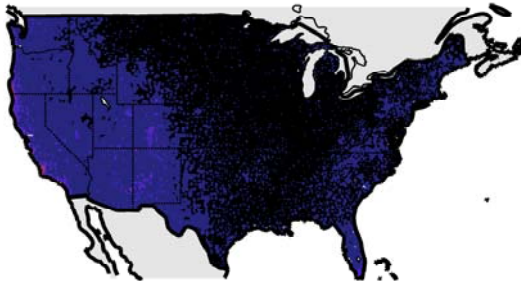
Winter



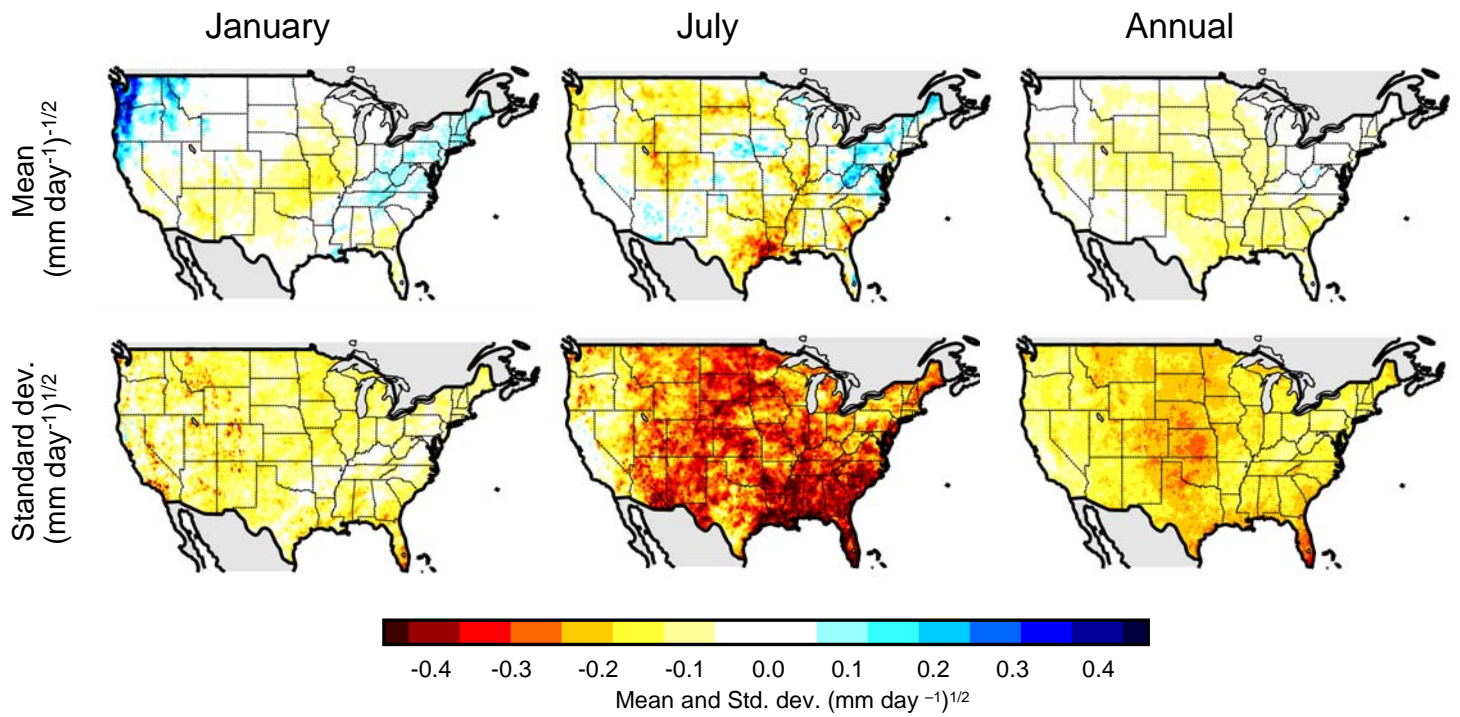
Summer



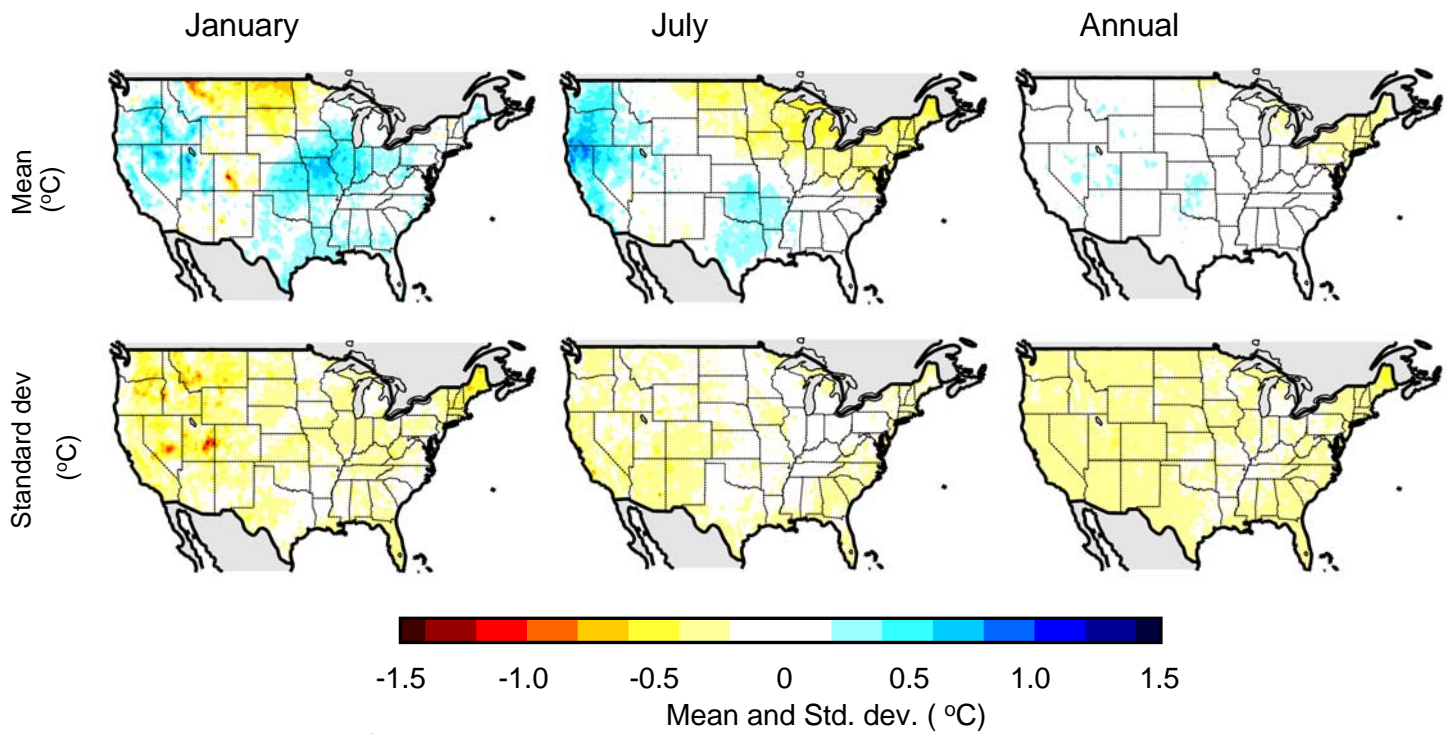
Annual



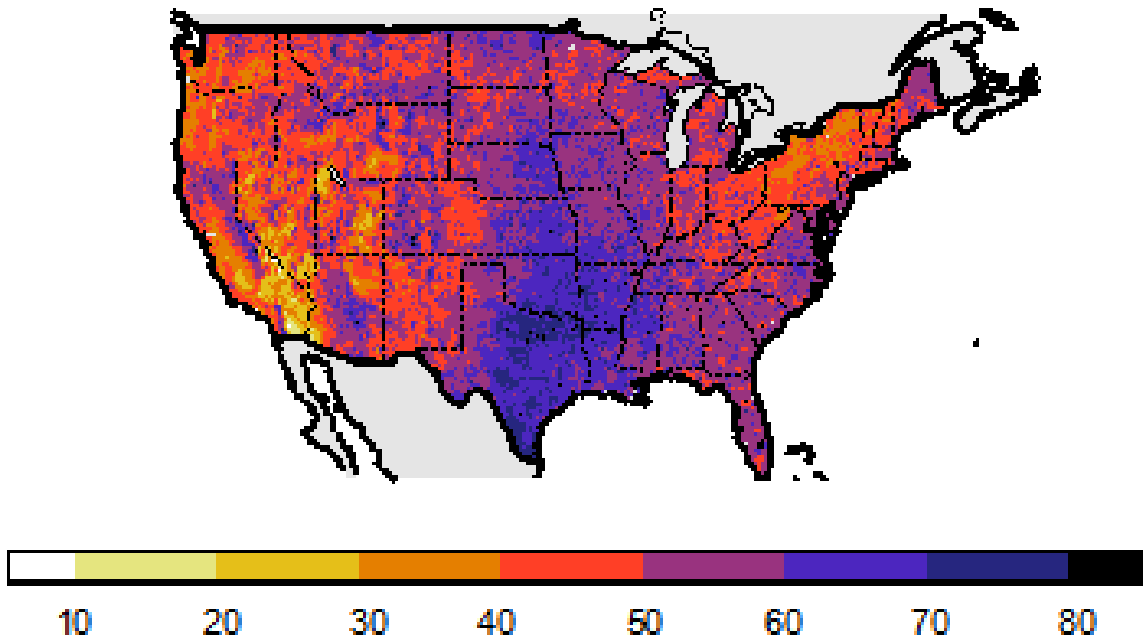
P biases



T biases

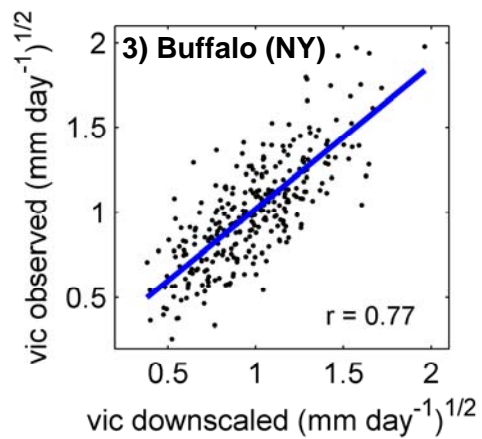
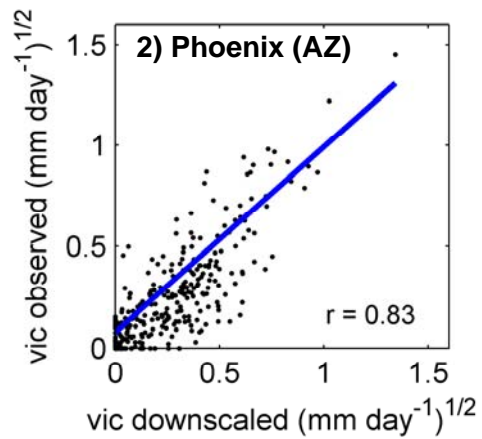
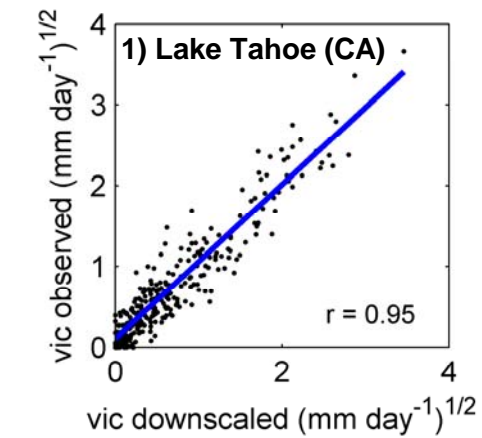


“drizzle” effect

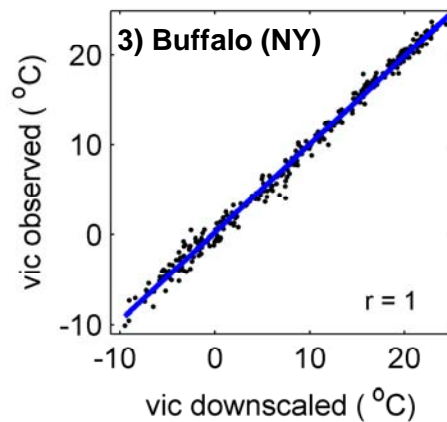
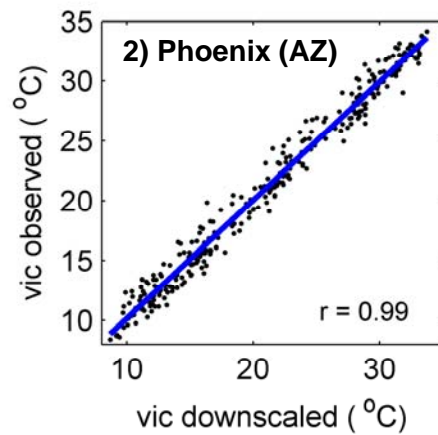
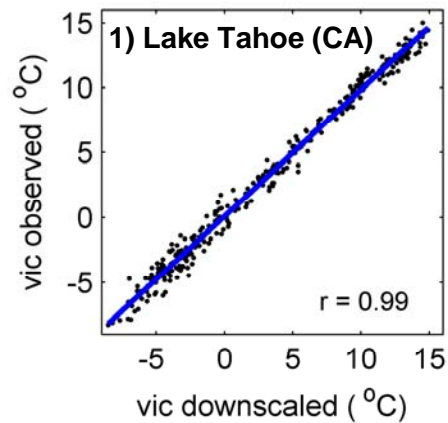


Extra wet days per year

P monthly skill

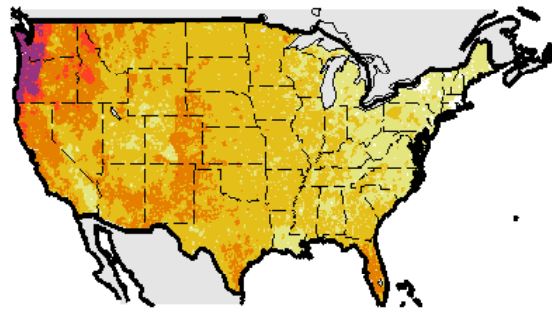


T monthly skill

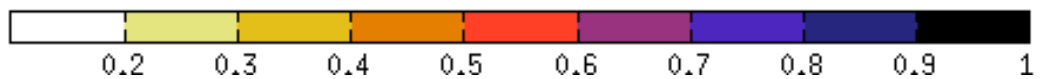
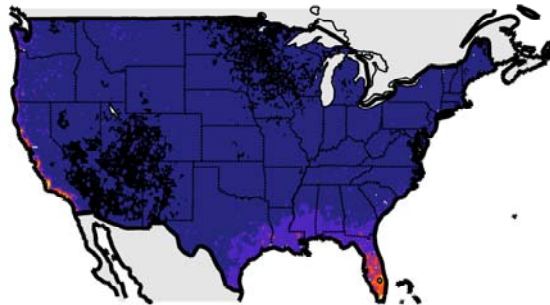


48-hours lead MRFs

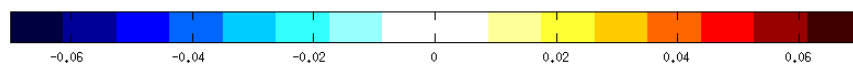
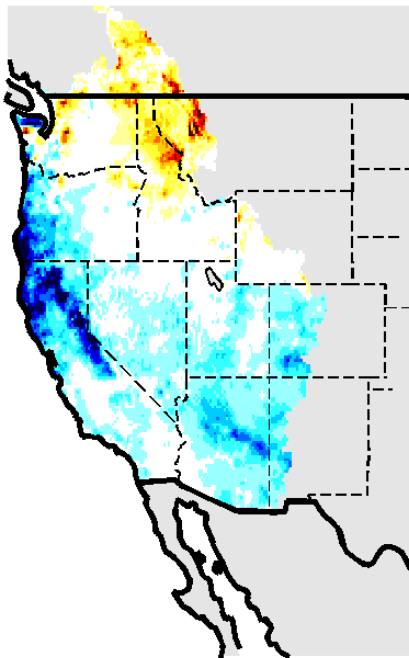
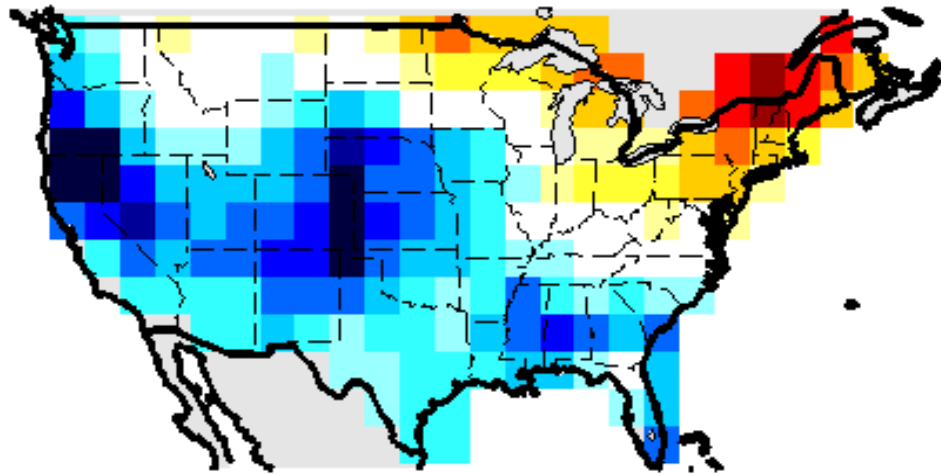
PRECIPITATION



TEMPERATURE

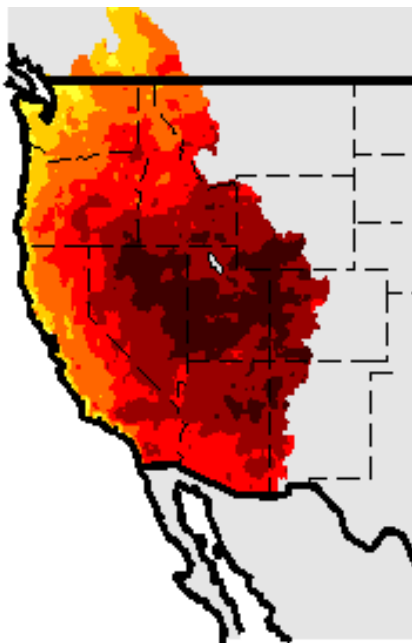
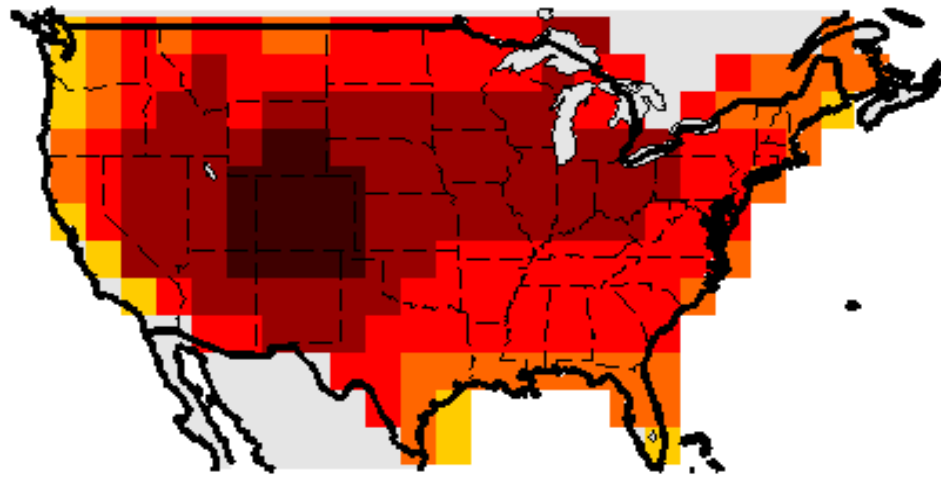


GFDL A2, 2001-2100 precipitation trends



TRENDS PER DECADE (mm/day)

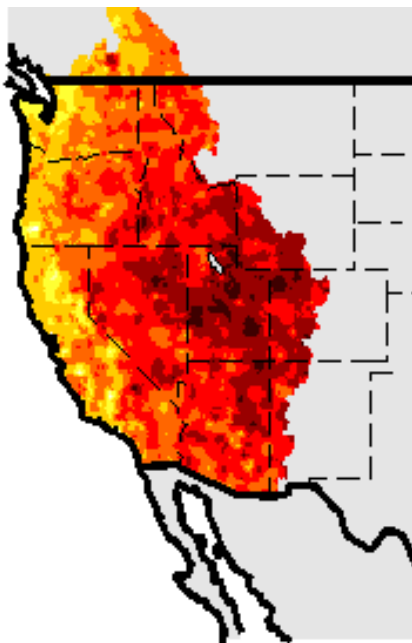
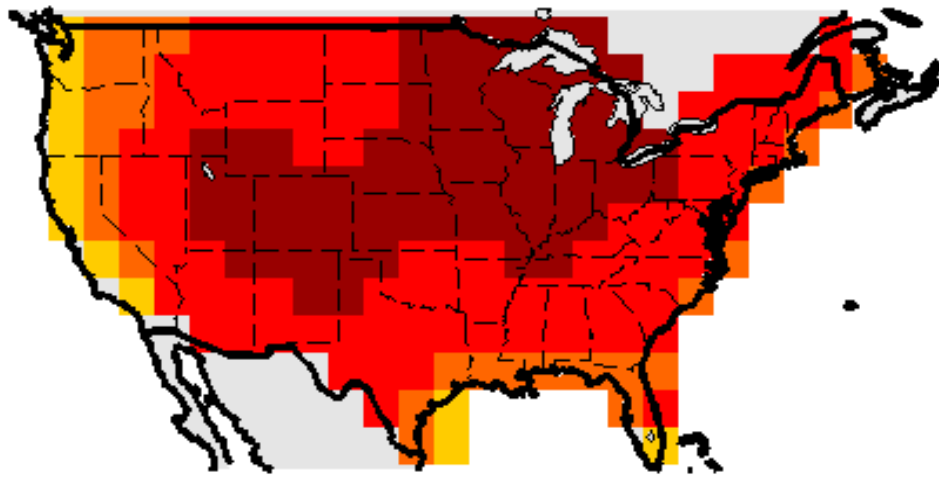
GFDL A2, 2001-2100 Tmax trends



TRENDS PER DECADE (°C)

GFDL A2, 2001-2100

Tmin trends



TRENDS PER DECADE (°C)

Conclusions

- The method presented here showed encouraging results for the downscaling of precipitation and temperature variations at continental-scale.
- Variables used for predictors and selection of the most suitable patterns are very important determinants of the method's skill, especially for P

Conclusions

- The method can be used to downscale the output from a variety of different climate applications like MRFs and long-term climate projections
- In climate change applications it will be important for the downscaling method to capture the high-resolution effects of largely unprecedented trends at GCM scales.