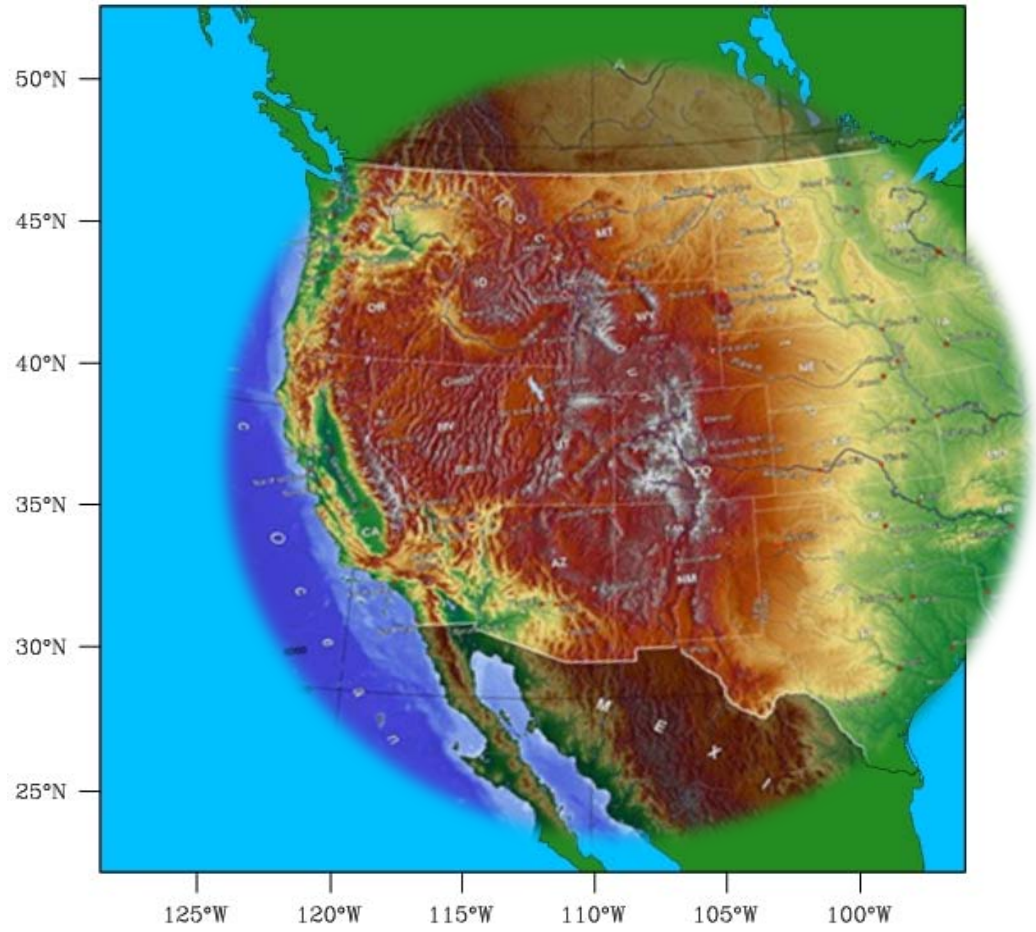
Seasonal Temperature and Precipitation Biases in WRF as a Result of CCSM Forcing Data

Ripley McCoy[1], Jiming Jin, Simon Wang,
Chuck Hawkins, David Tarboton
[1]Utah State University

Purpose

- Improve regional climate simulations for the western United States
- Provide monthly temperature and precipitation data to drive hydrologic models
- Identify biases in forcing data; quantify and find causes

Domain

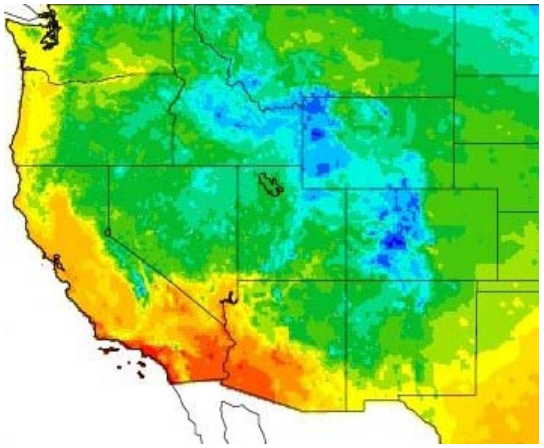


- 110 X 110 Grid
- 32 km Spacing
- Lambert Projection

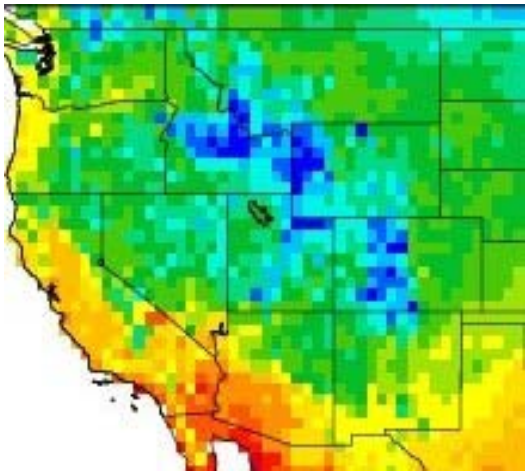
WRF Model	Version 3.2
Microphysics	Goddard
Cumulus	New Grell
PBL	MYNN 2.5
Shortwave Radiation	CAM
Longwave Radiation	CAM
Land Surface	Coupled CLM v3.5*
Forcing Data	NCEP/NCAR Reanalysis (WRFncep), CCSM 20th Century (WRFccsm)

Why CLM?

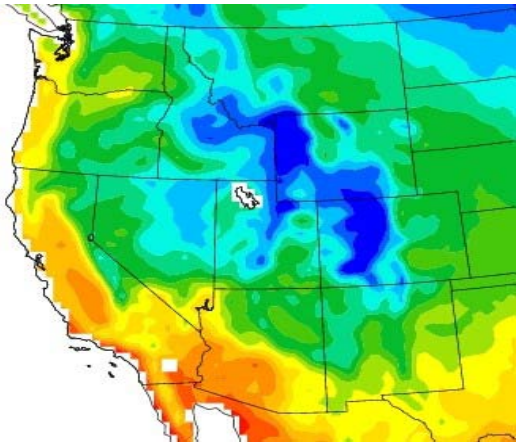
PRISM Obs

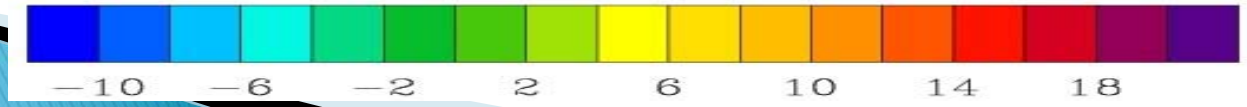


University of Delaware



WRF with Noah
Original Land Surface Model



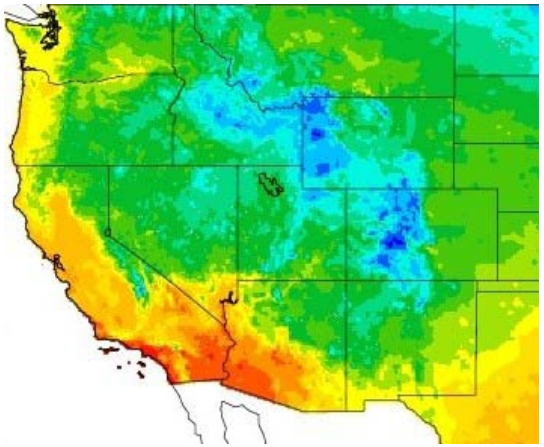


Dec. 1999

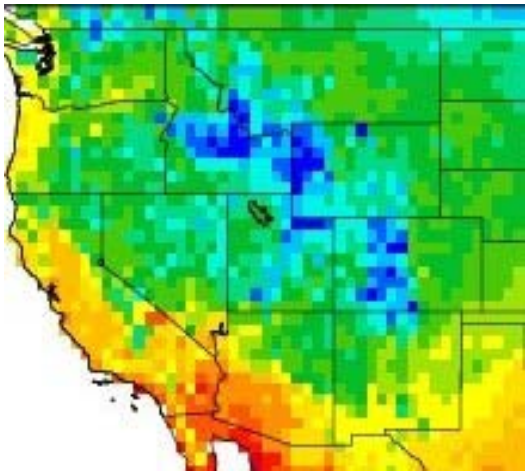
From AGU Fall Meeting 2010

Why CLM?

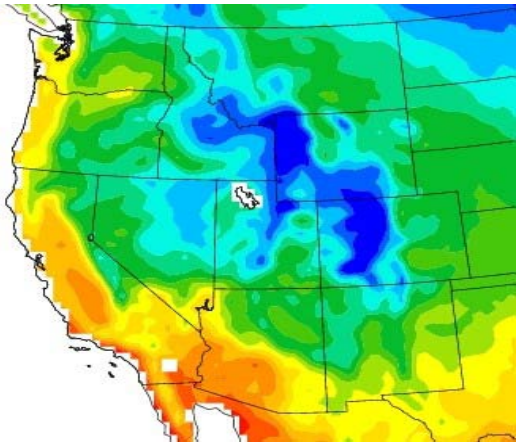
PRISM Obs



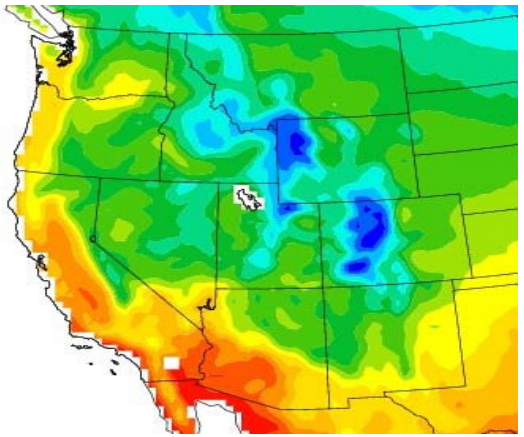
University of Delaware

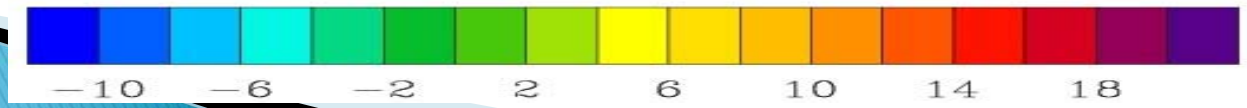


WRF with Noah
Original Land Surface Model



WRF with coupled Community
Land Model version 3.5





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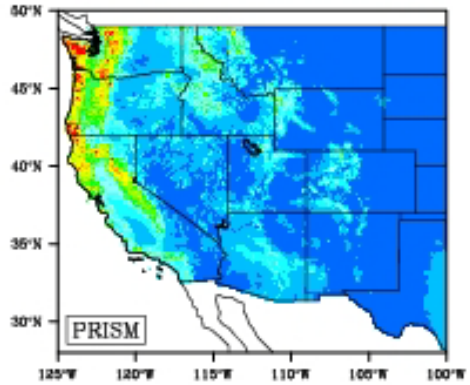
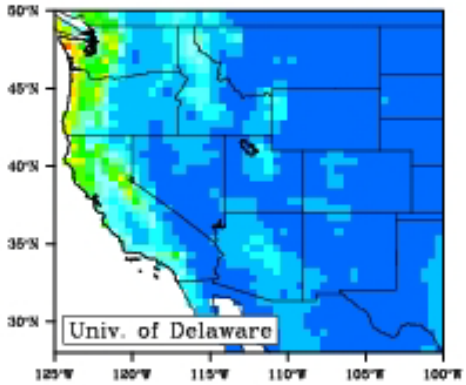
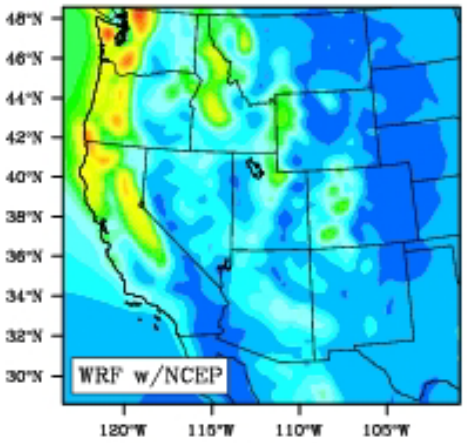
PRISM Obs

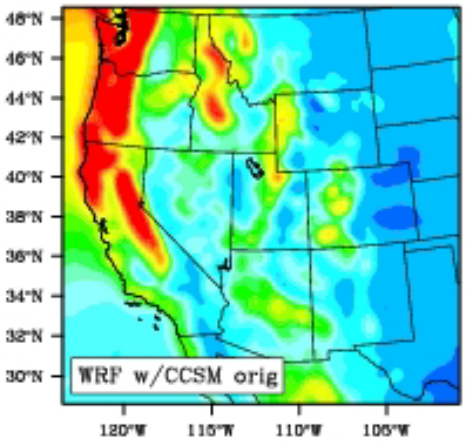




University of Delaware Obs

WRFncep

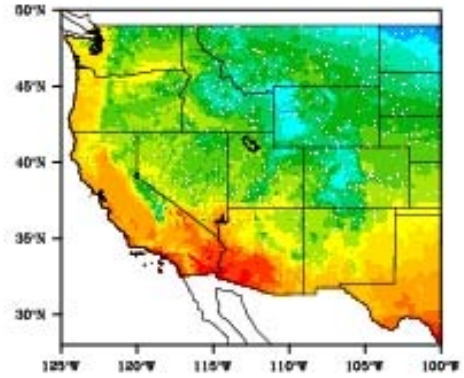


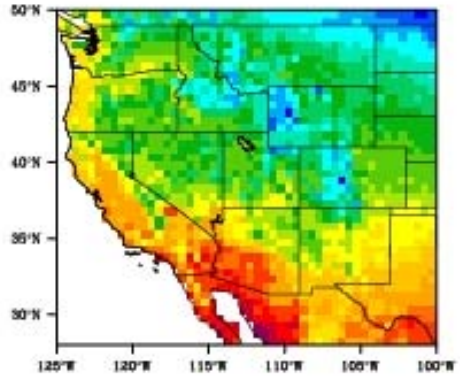


WRFccsm

DJF Monthly Precip (mm); years 1989 – 1999

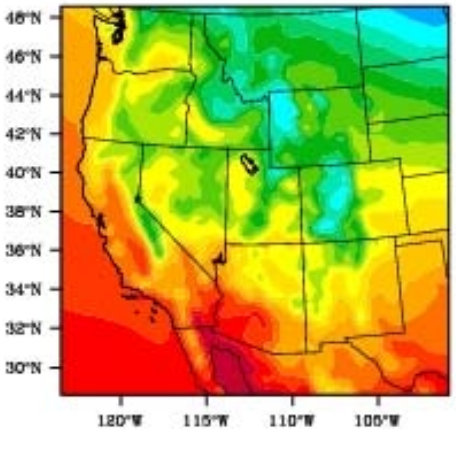
PRISM Obs

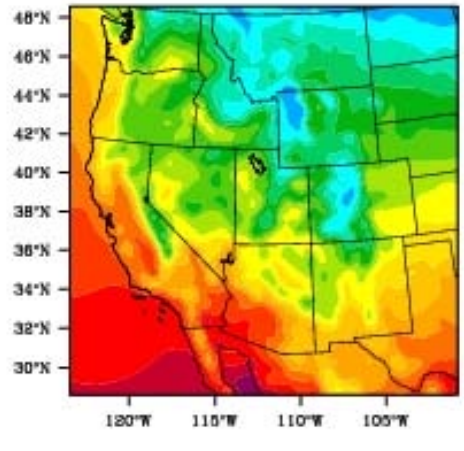




University of Delaware Obs

WRFncep





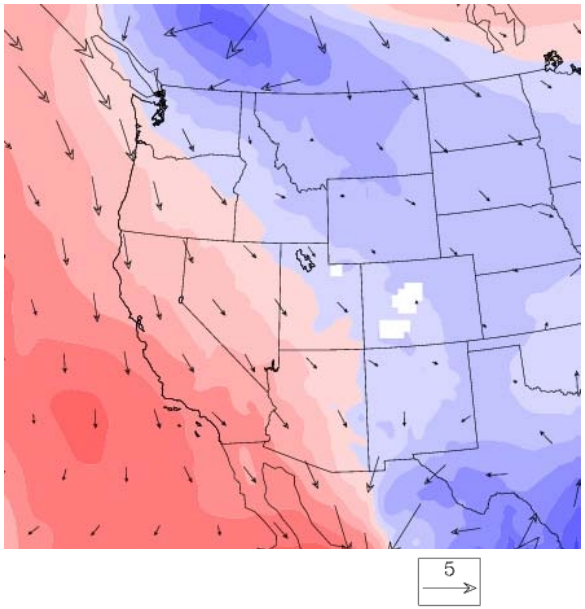
WRFccsm

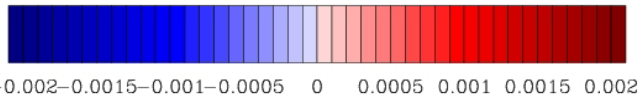
DJF Monthly Temp (°C); years 1989 – 1999

WRFccsm – WRFncep

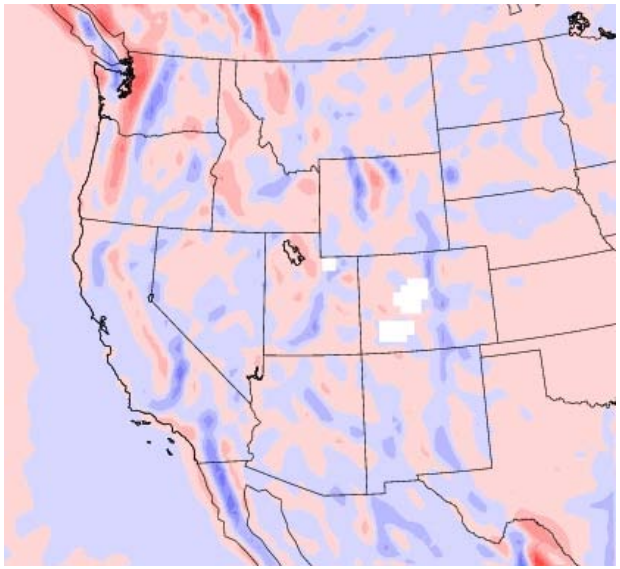
DJF 1990 – 1999

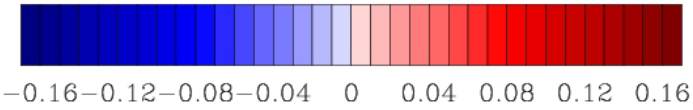
700mb Wind (m s-1)/Q(kg kg-1)





700mb W (m s-1)

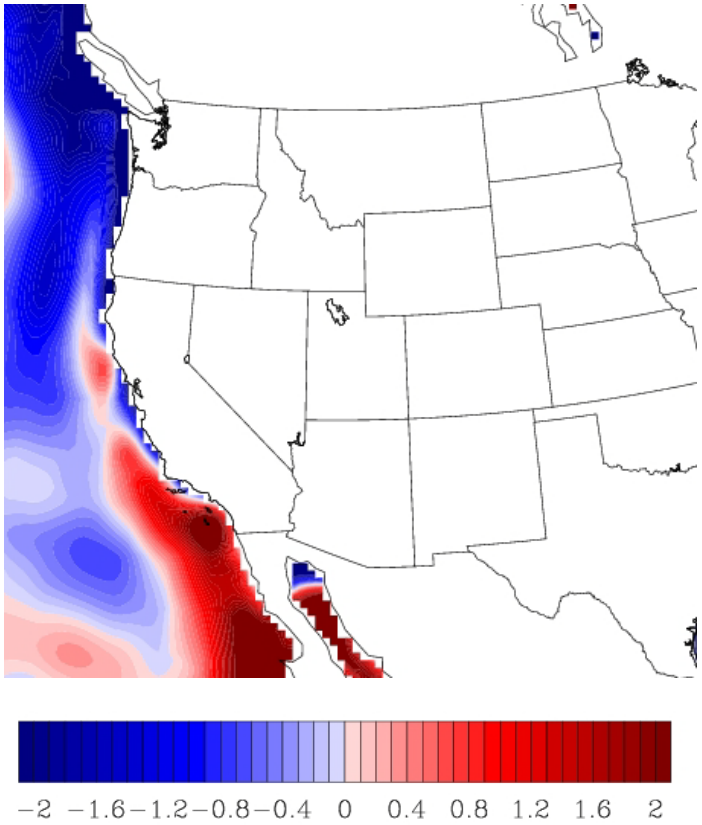




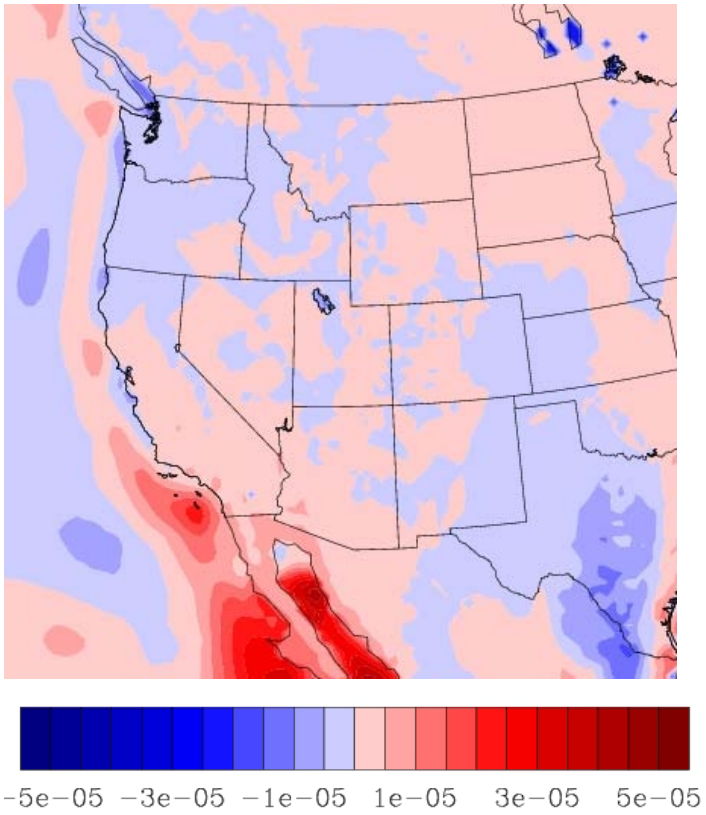
WRFccsm – WRFncep

DJF 1990 – 1999

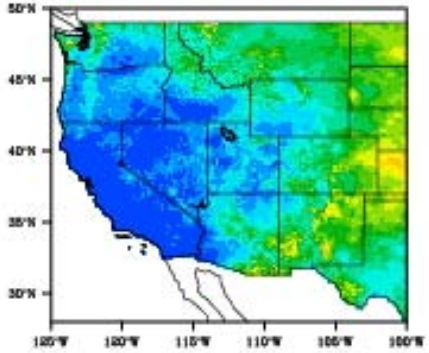
SST (K)

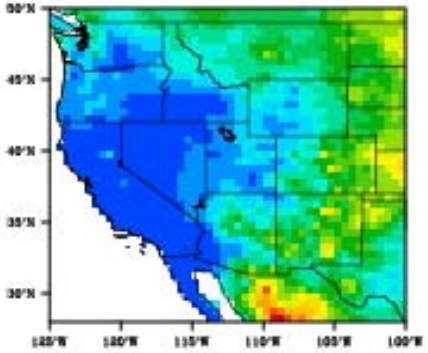


QFX (kg m−2 s−1)



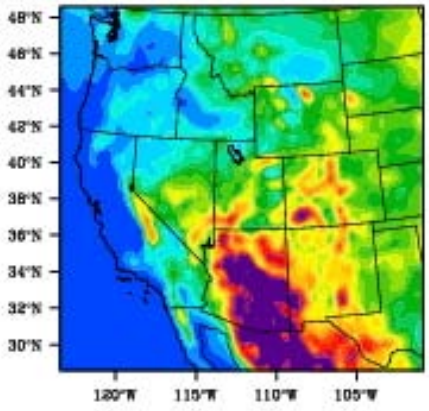
PRISM Obs

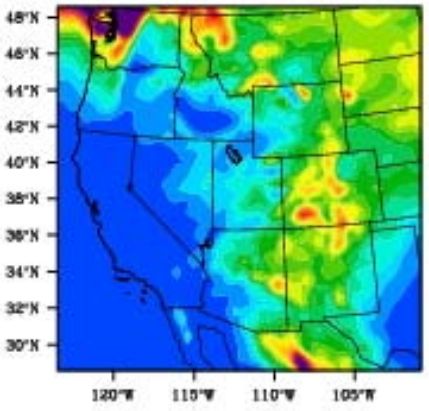




University of Delaware Obs

WRFncep





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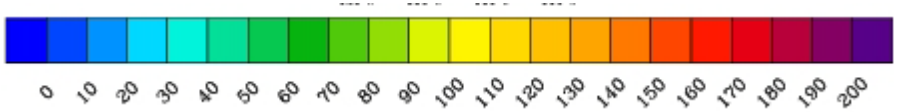
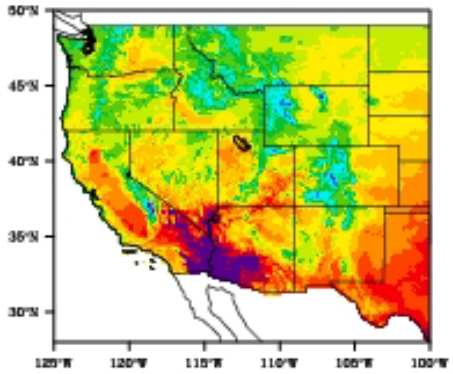
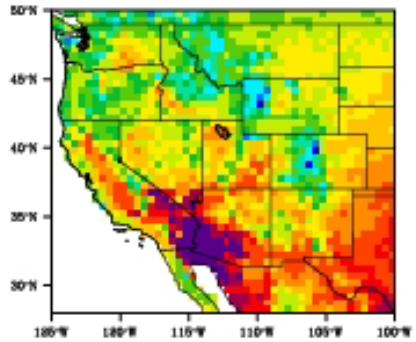


July Precip (mm); years 1989 – 1999

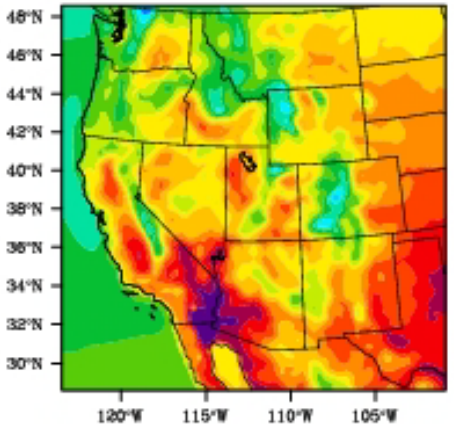
PRISM Obs

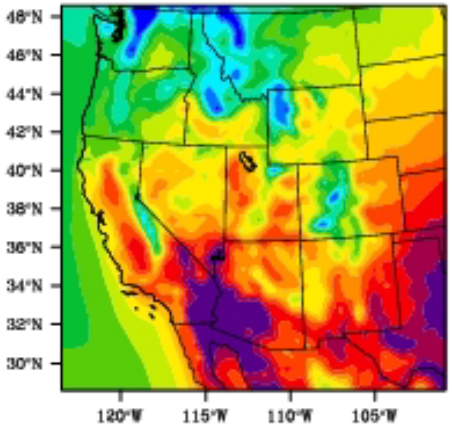




University of Delaware Obs

WRFncep



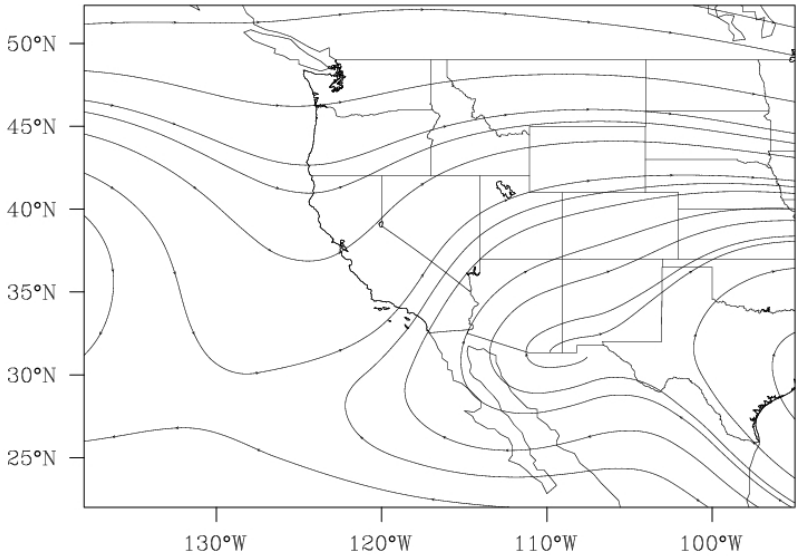


WRFccsm

July Temp (°C); years 1989 – 1999

July 1990 – 1999 700mb Streamlines

NCEP



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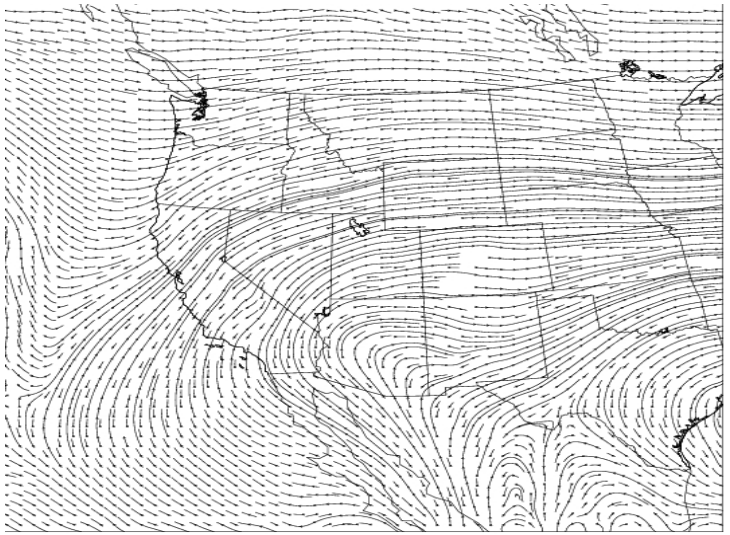
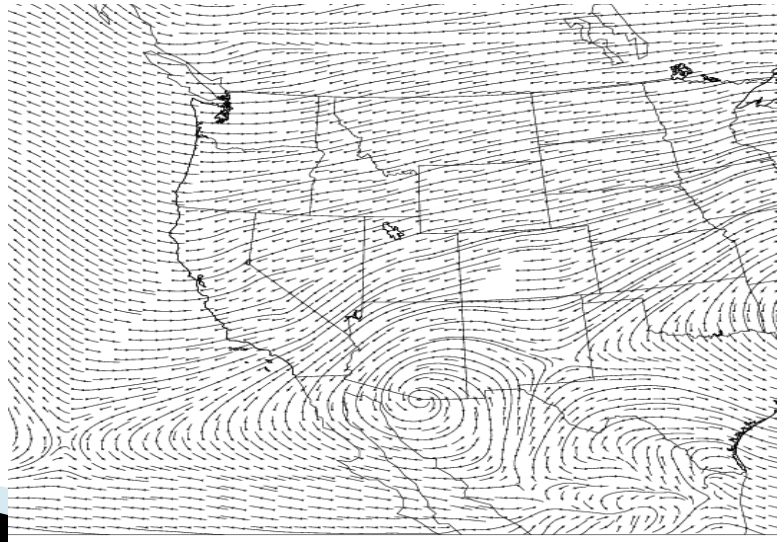
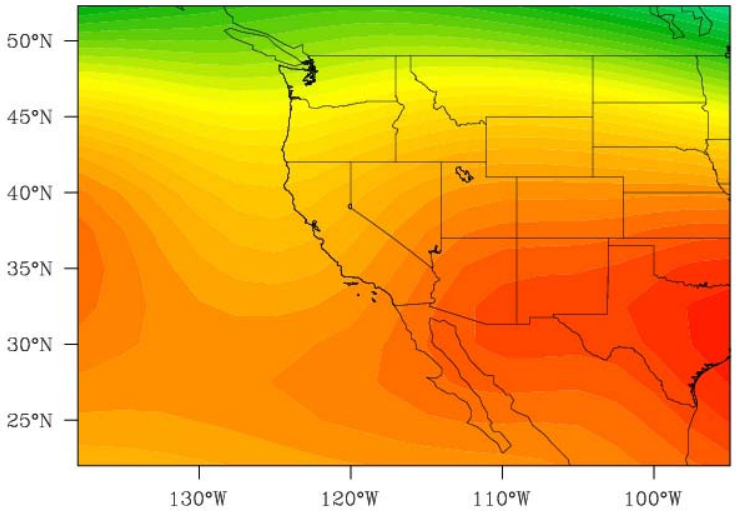




WRFccsm

July 1990 – 1999 700mb Geopotential Height

NCEP



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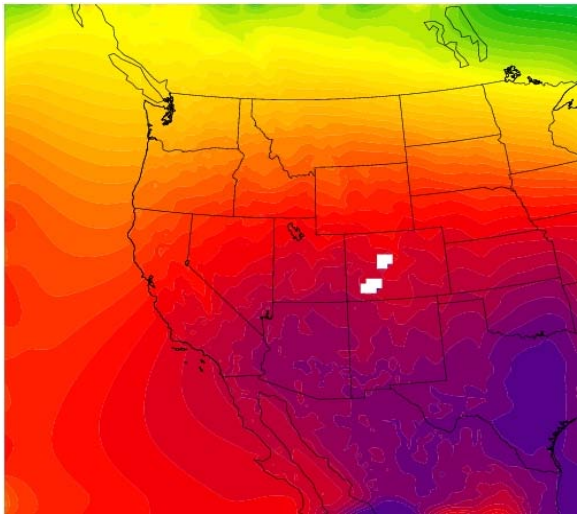
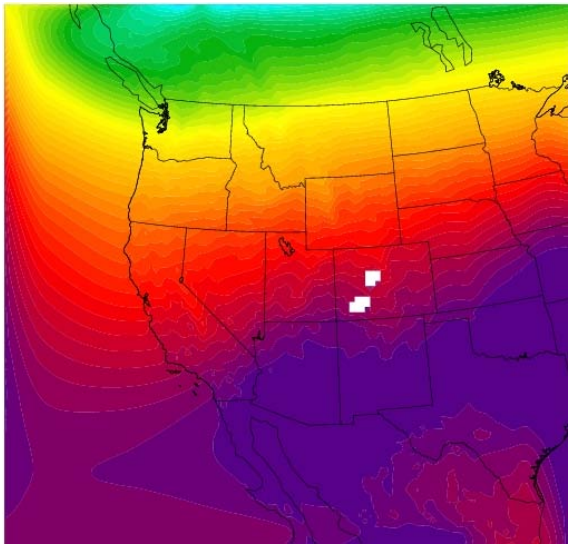


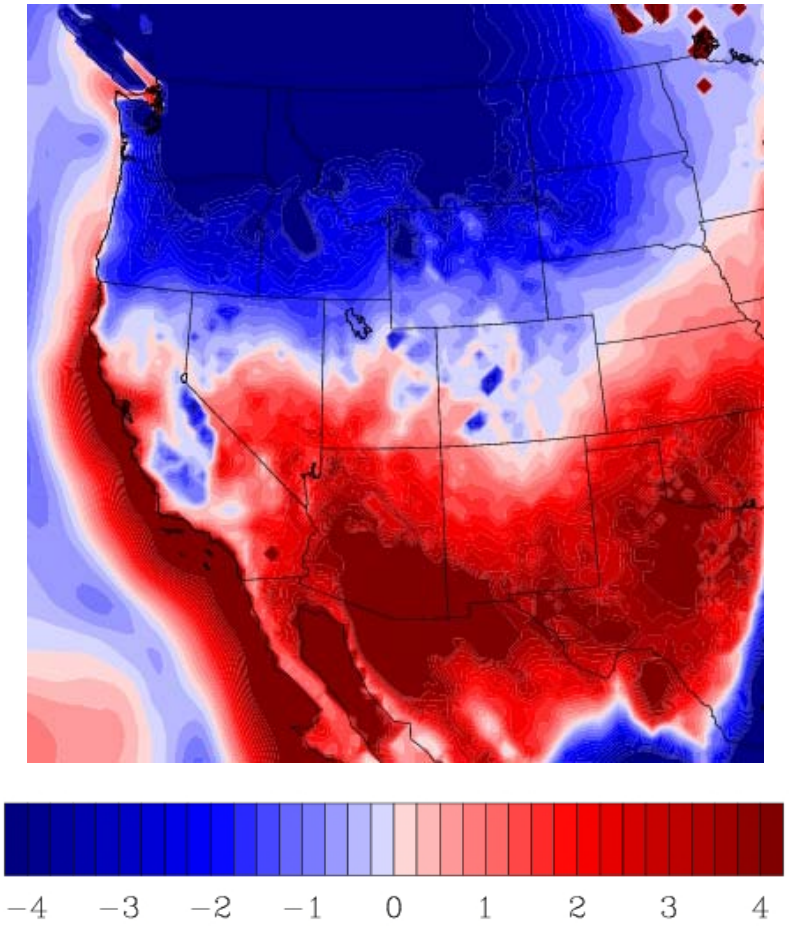


WRFccsm

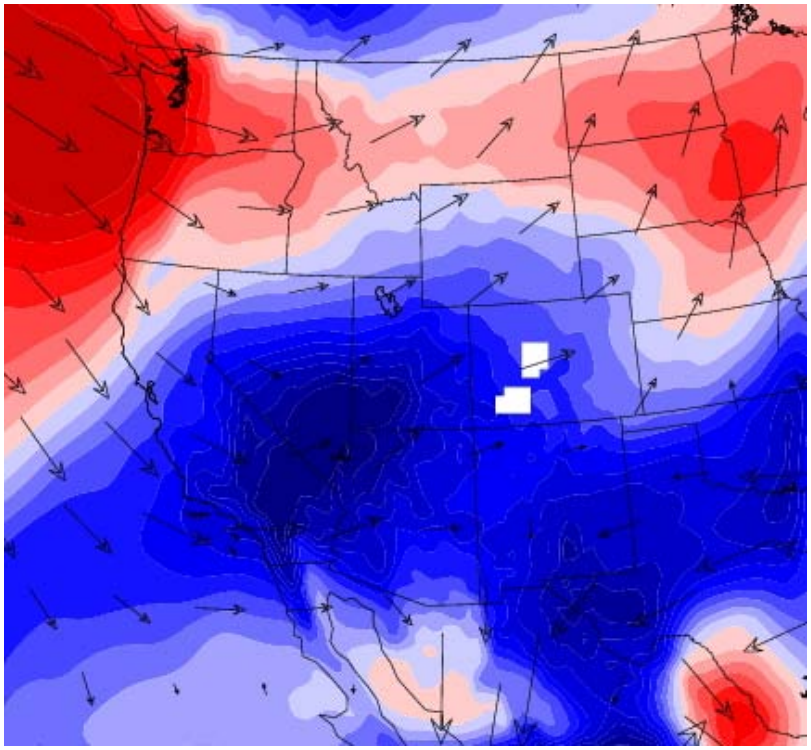
WRFccsm – WRFncep

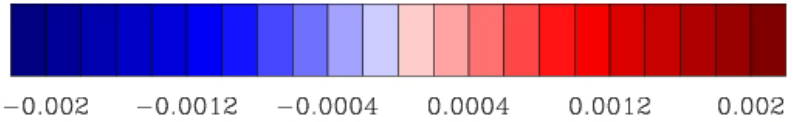
July1990 – 1999

SKINTEMP (K)

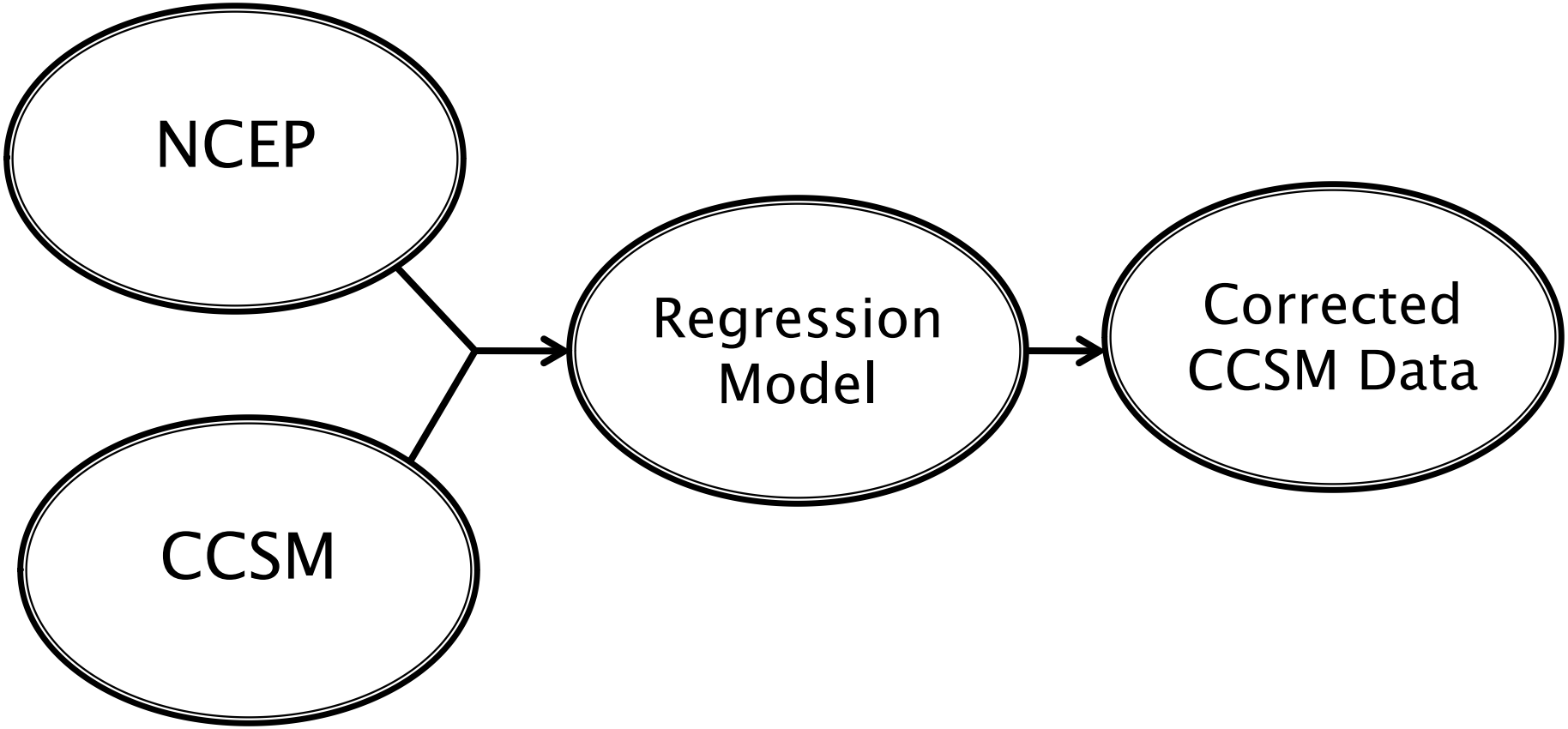


Wind (m s-1)/ Q (kg kg-1)

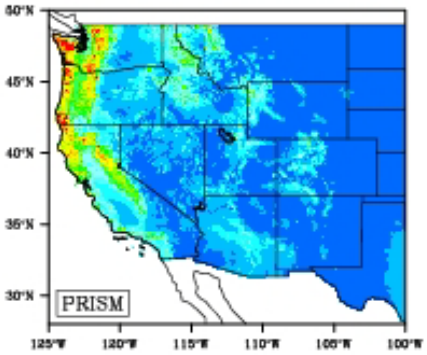


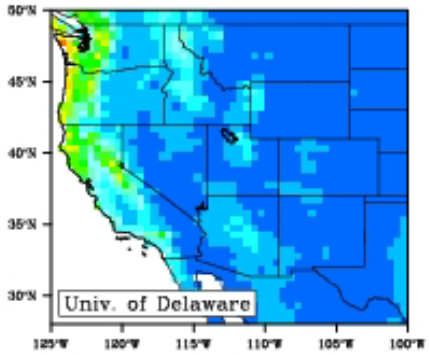


CCSM Forcing Data Correction



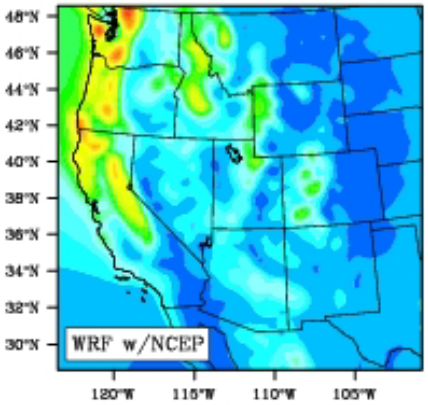
PRISM Obs

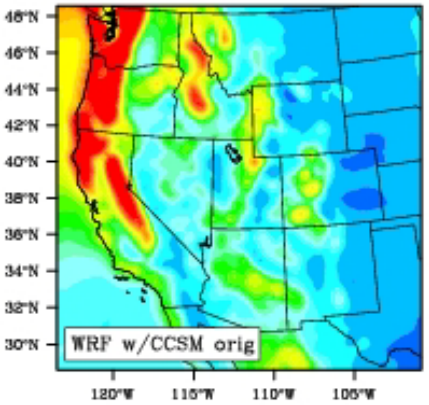




University of Delaware Obs

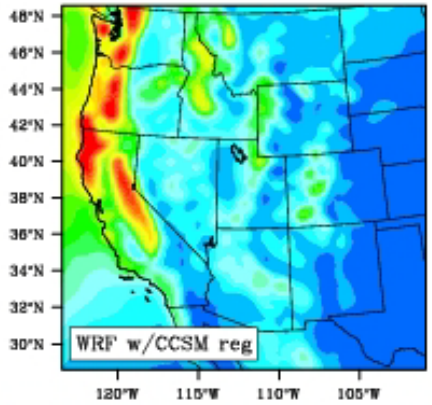
WRF forced with NCEP
σ = 42.211





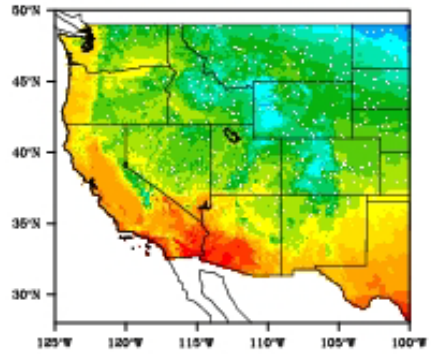
WRF forced with original CCSM
σ = 82.844

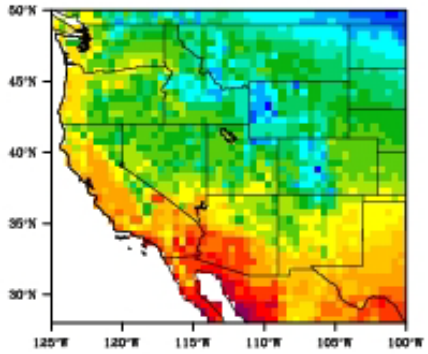
WRF forced with regressed CCSM
σ = 59.219



DJF Monthly Precip (mm); years 1989 – 1999

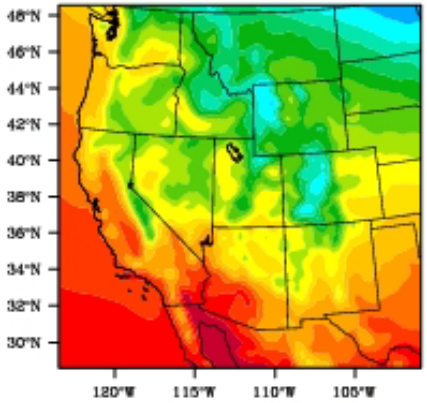
PRISM Obs

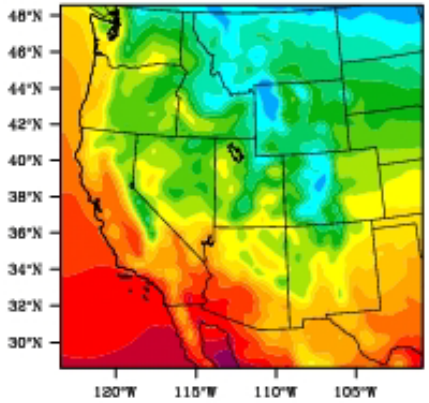




University of Delaware Obs

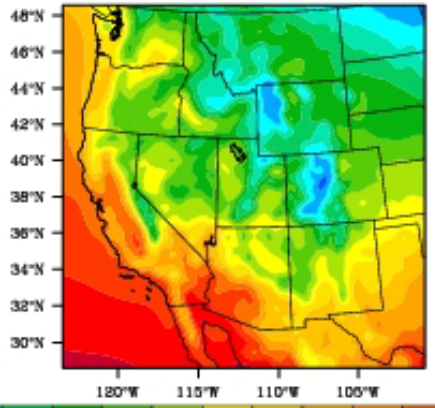
WRF forced with NCEP
$\sigma = 1.485$





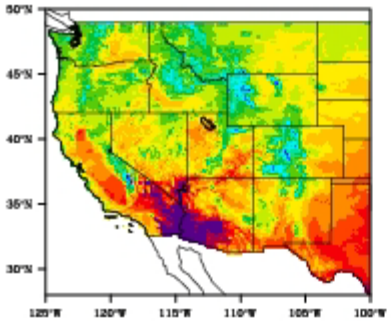
WRF forced with original CCSM
$\sigma = 1.880$

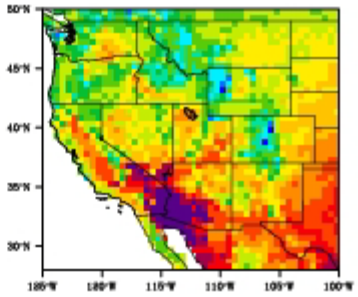
WRF forced with regressed CCSM
$\sigma = 1.343$



DJF Temp (°C);
years 1989 – 1999

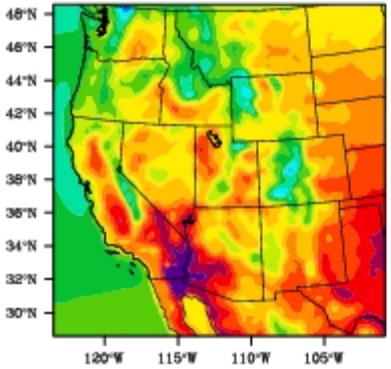
PRISM
Obs

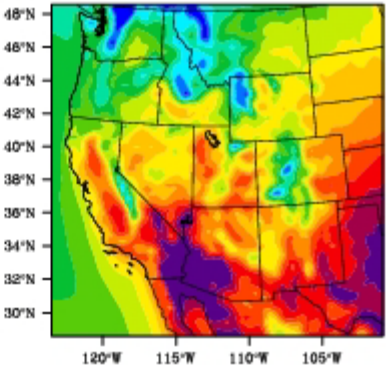




University of
Delaware Obs

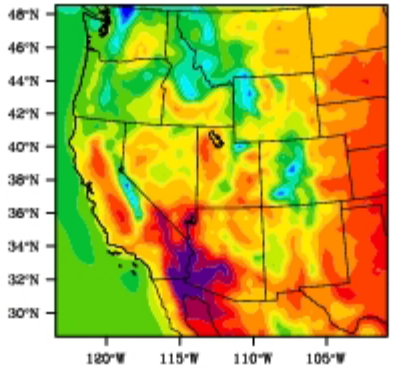
WRF forced
with NCEP
σ = 1.567





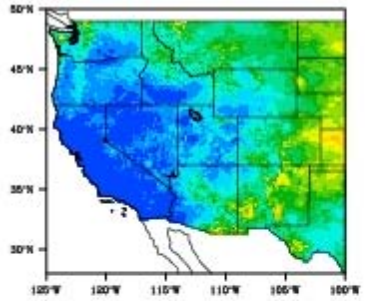
WRF forced with
original CCSM
σ = 2.581

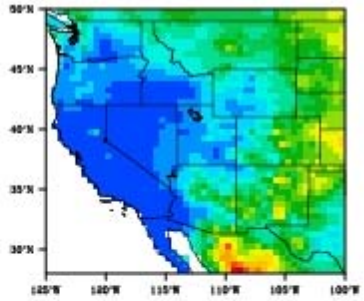
WRF forced with
regressed CCSM
σ = 2.080



July Temp (°C);
years 1989 – 1999

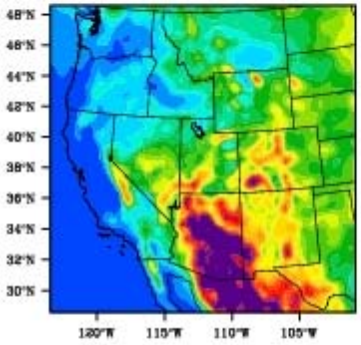
PRISM Obs

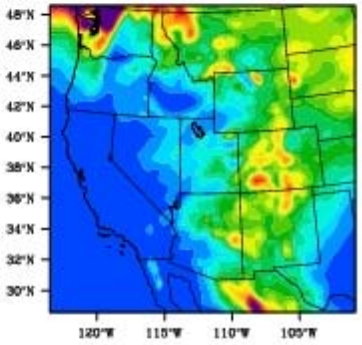




University of Delaware Obs

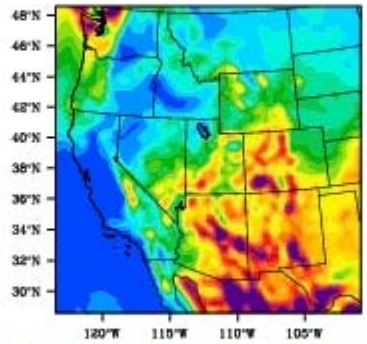
WRF forced with NCEP

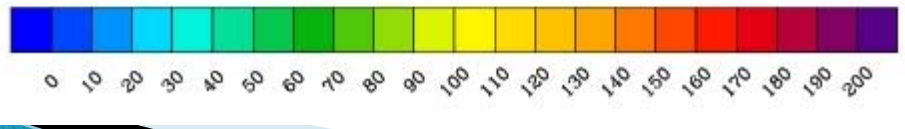




WRF forced with original CCSM

WRF forced with regressed CCSM





July Precip (mm); years 1989 – 1999

Future Work

- Sensitivity testing to reduce biases in July precipitation for NCEP forced simulation, check regression method
- (Forcing) Data consistency?

Conclusions

- Forcing with CCSM data leads to cold, wet biases across higher elevations during the cold season
- NCEP forcing performs well during cold season, but leads to overestimation of summer monsoon precipitation
- Biases in CCSM forcing can be reduced by bias correcting the input data

Acknowledgements

- Cluster time and other computer resources from the Center for High Performance Computing at Utah State University are gratefully acknowledged.

- This work was supported by the EPA grant No. RD83418601