



NCAR

An Overview of Progress in NA-CORDEX

Linda O. Mearns
National Center for Atmospheric Research

R. Arritt, M. Bukovsky, C. Castro, H-I Chang, J. Christensen, O. Christensen,
W. Gutowski, A. Frigon, E. Kjellström, R. Laprise, S. McGinnis, G. Nikulin,
J. Sinocca, L. Sushama, and K. Winger

ICRC-CORDEX Meeting
Stockholm, Sweden
May 17, 2016

National Center for Atmospheric Research



Talk Outline

- Description of NA-CORDEX Program
- ERA-Interim driven runs
- GCM-driven historical runs
- Climate projections
- Next Steps

- Domain – most of North America (many larger than NARCCAP domain)
- ERA-Interim Simulations: 1990-2009
 - 9 RCMs – 50, 25, 12 kms (CRCM5)
- 6 RCMs, 5 CMIP5 GCMs (1950-2100)
 - Some 25-km & 50-km resolution (RegCM4, WRF, and CanRCM4)
 - RCP8.5 scenario (some also with RCP 4.5)
- Hosting most commonly used variables from all completed simulations at NCAR, with access at na-cordex.org

NA-CORDEX



CS	GFDL-ESM2M (2.5)	MPI-ESM-LR (3.6)	HadGEM2-ES (4.6)	CanESM2 (3.7)	EC-EARTH (3.3)
RegCM4 (Iowa State & NCAR)	25km 50km	25km 50km	25km 50km		
WRF (U. of Arizona & NCAR)	25km* 50km*	25km 50km	25km* 50km		
HIRHAM5 (DMI)					50km
CanRCM4 (CCCma)				25km 50km	
RCA4 (SMHI)				50km	50km
CRCM5 (UQAM)		50km 4.5 = LR, 8.5 = MR		50km	

Orange = RCP4.5 and RCP8.5, all others RCP 8.5 only; * runs in progress

RCM4-gfdl 50km

RCM4-mpi 50km

RCM4-hadgem 50km

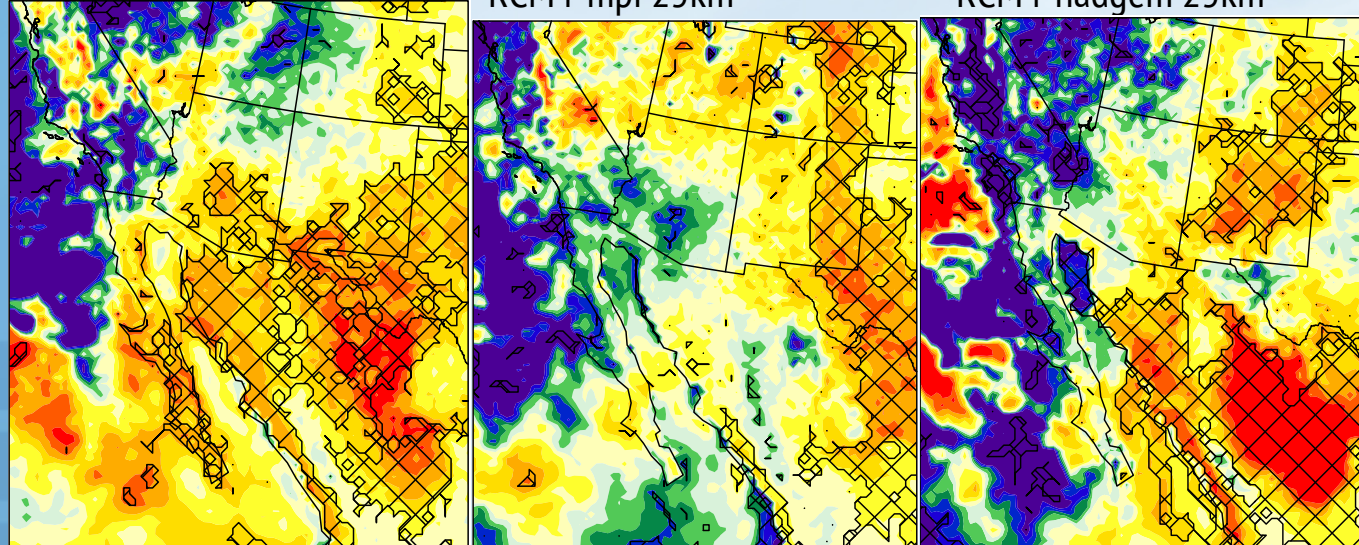


NCAR

RCM4-gfdl 25km

RCM4-mpi 25km

RCM4-hadgem 25km



1971-99
2041- 69
July-August
Average
Precip Change:
CORDEX RCP8.5

(Hatching =
statistically significant)

M. Bukovsky

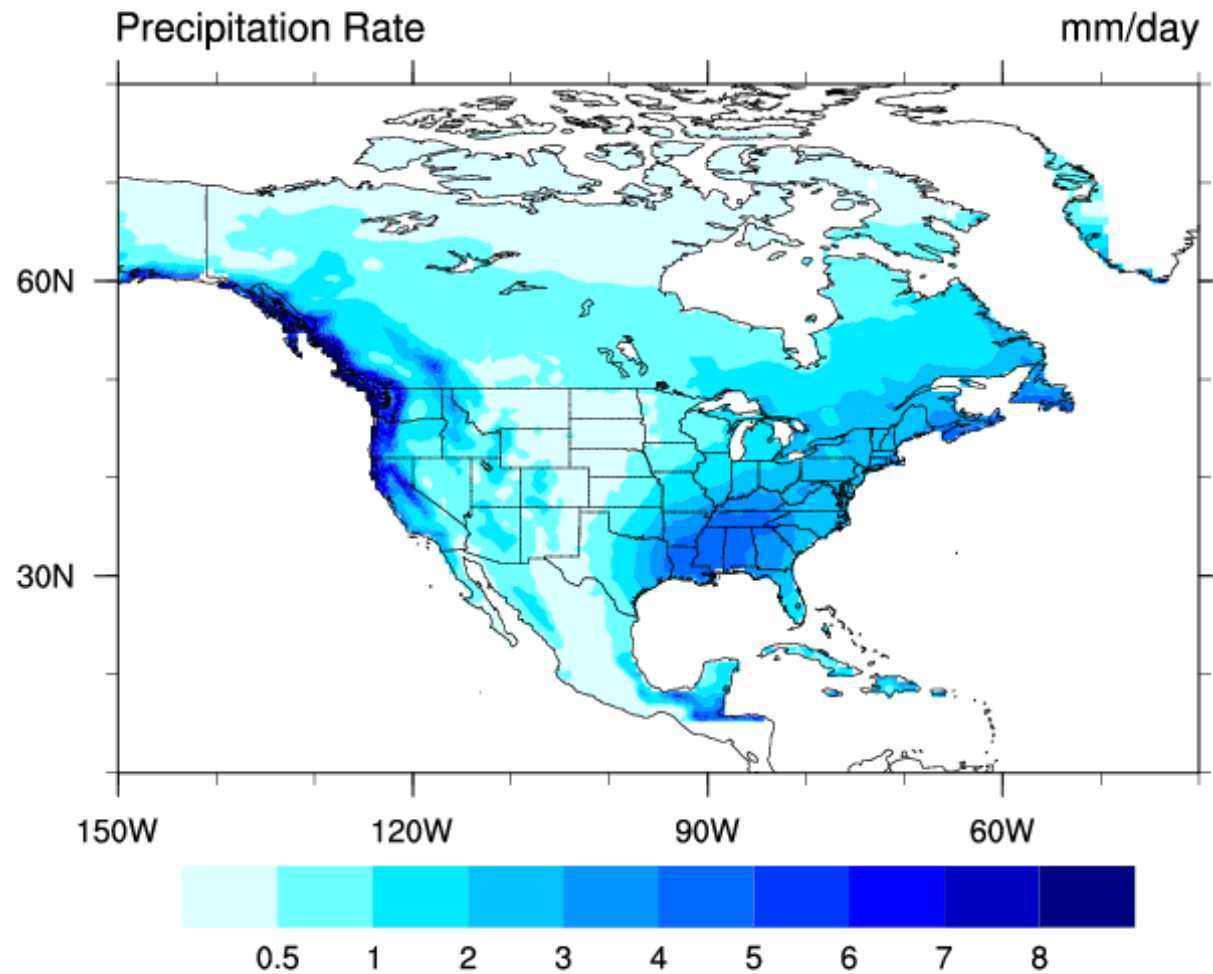


NCAR

ERA-Interim Driven Runs

Comparison with Observations,
Seasonal Temperature and
Precipitation
1990 -2010

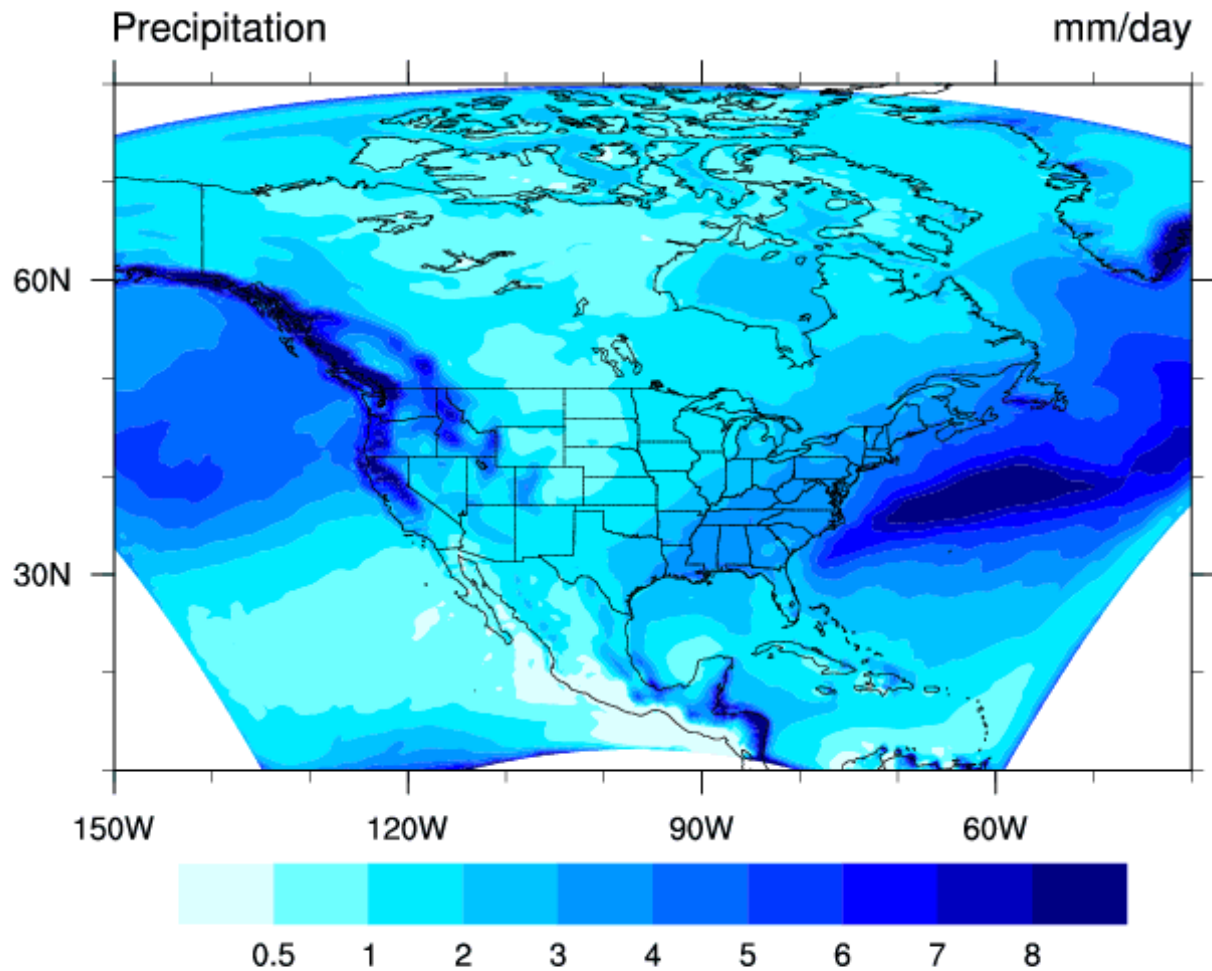
MERRA NAM-44 DJF





NCAR

RegCM4 NAM-44 DJF





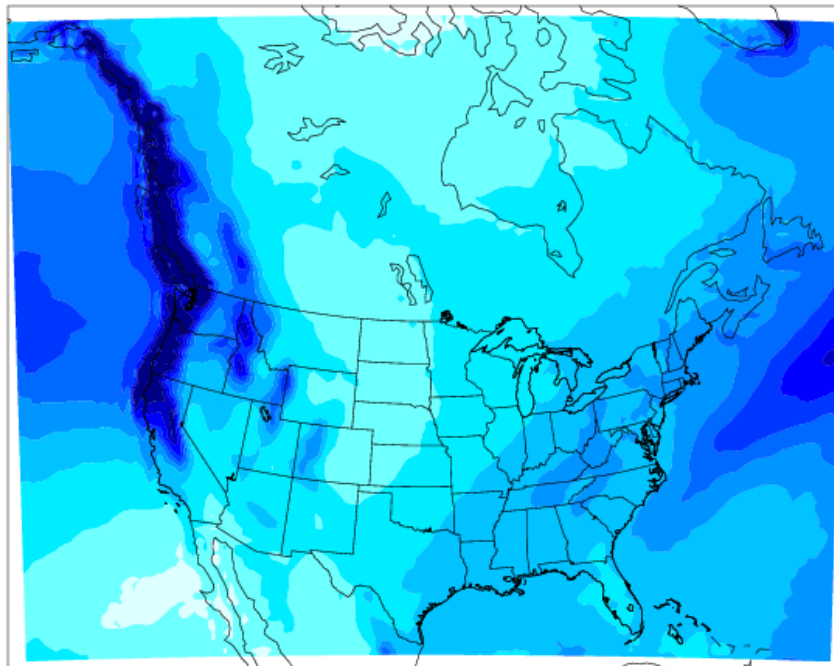
NCAR

NARCCAP
RegCM3

RCM3+NCEP, DJF Avg, 1979-2004

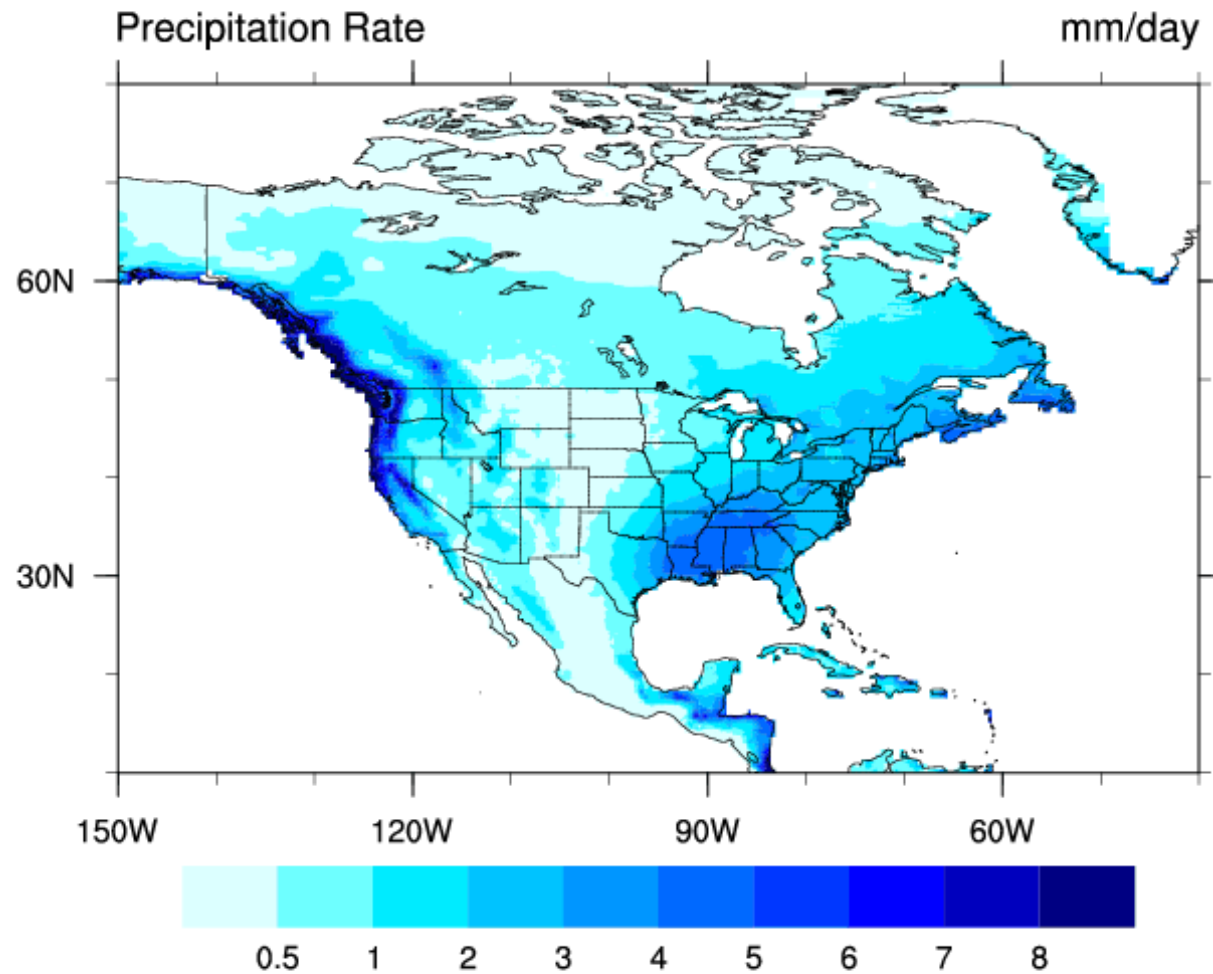
Precipitation

mm/day

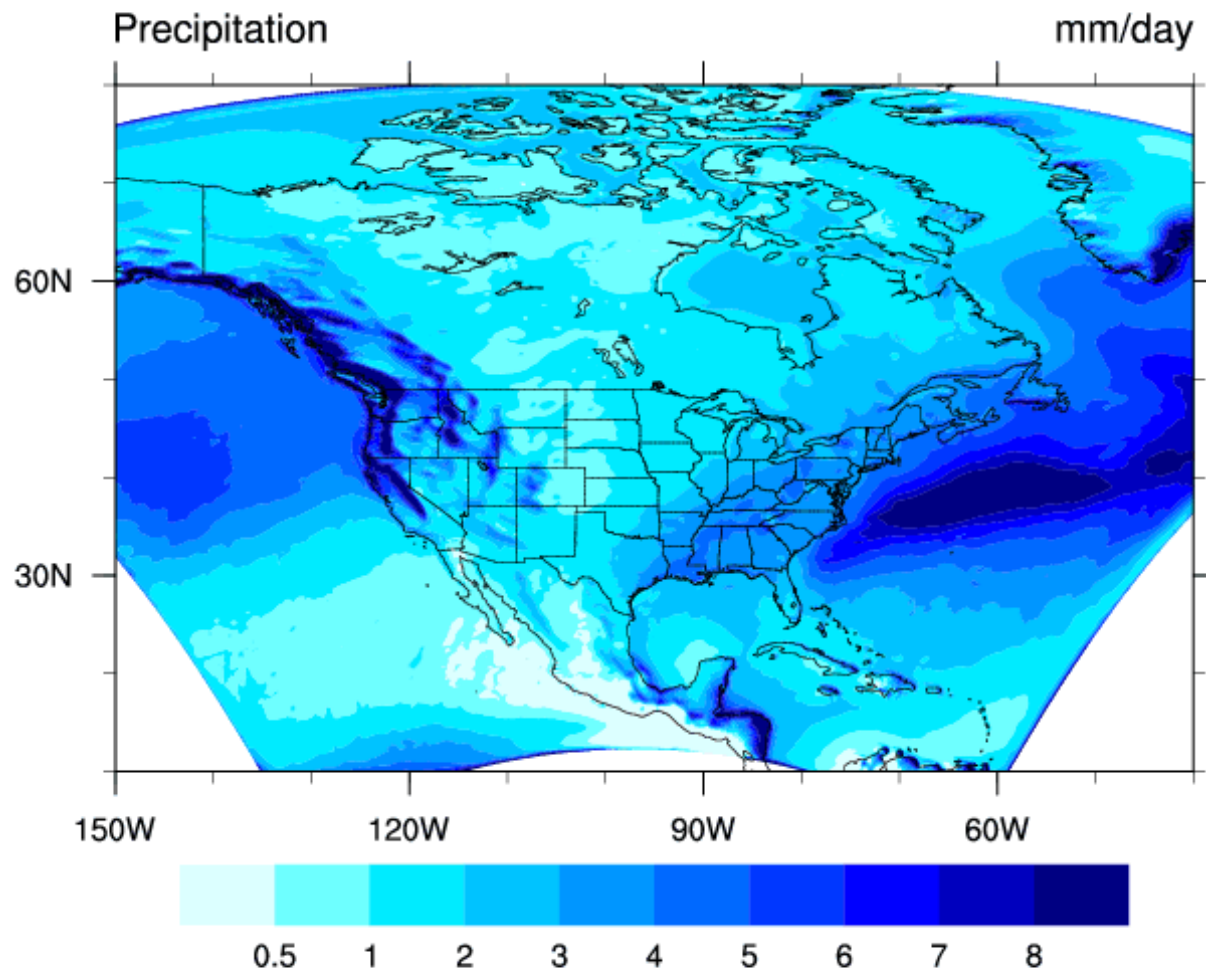


0.5 1 2 3 4 5 6 7 8

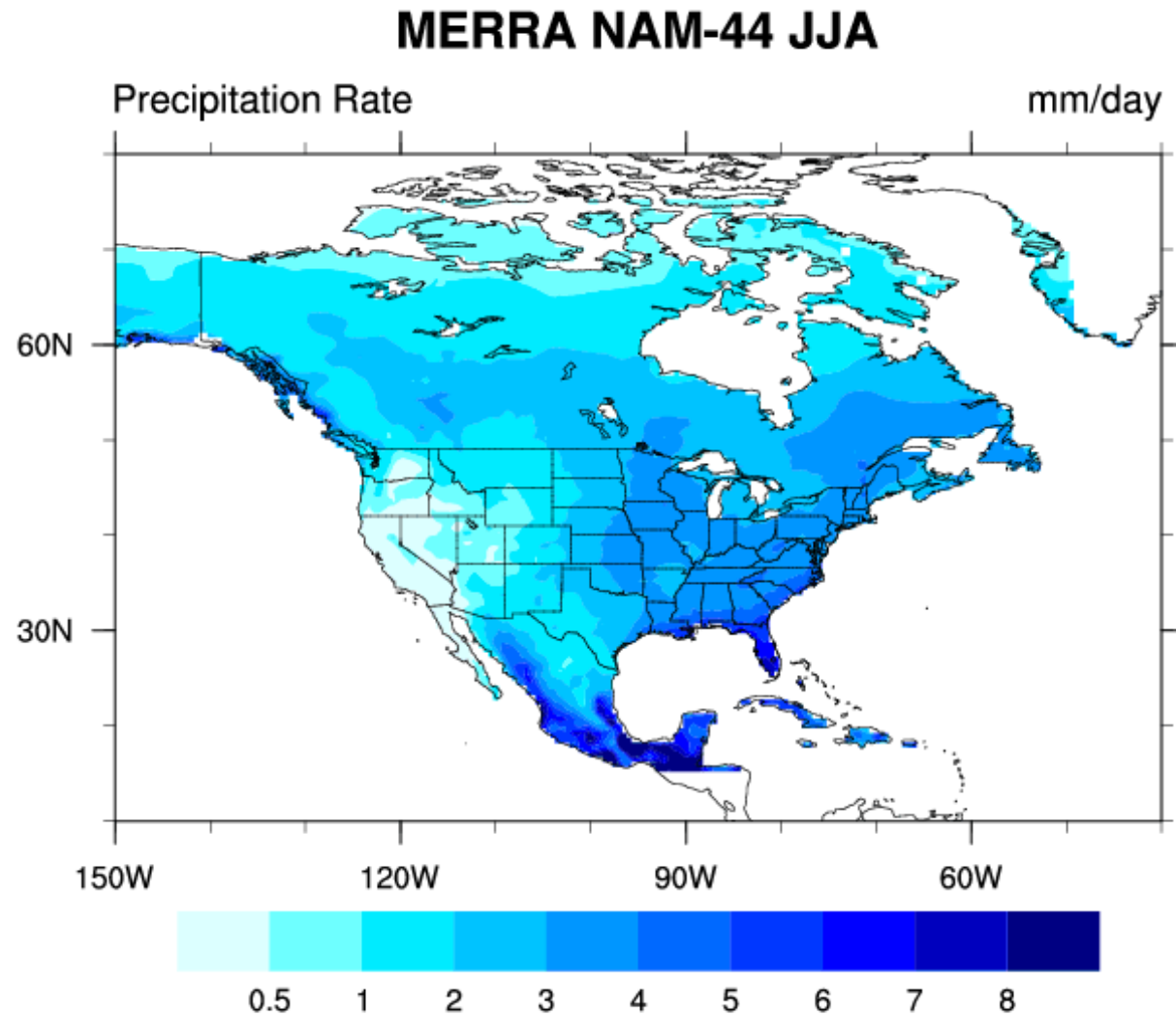
MERRA NAM-22 DJF



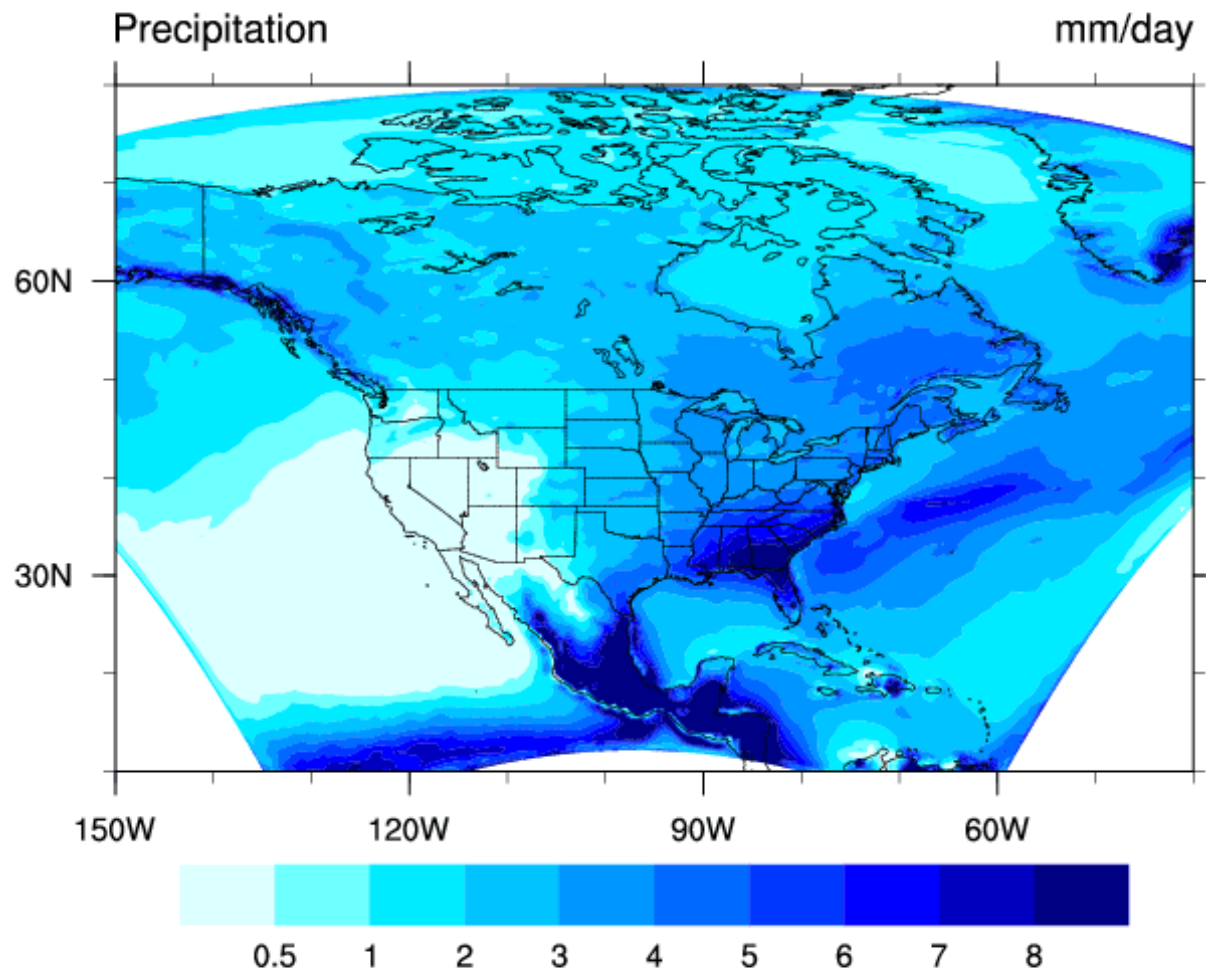
RegCM4 NAM-22 DJF



Summer



RegCM4 NAM-44 JJA



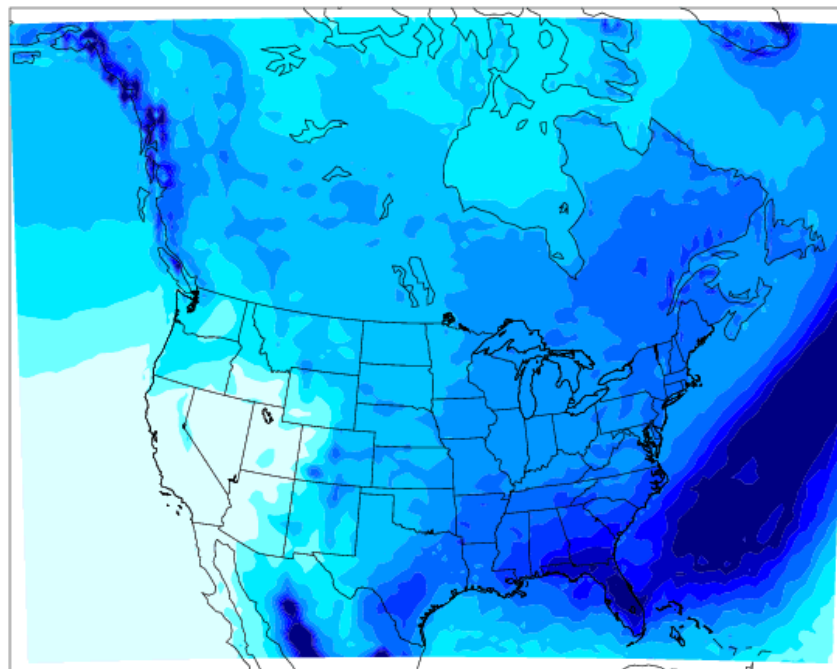
NARCCAP Summer



NCAR

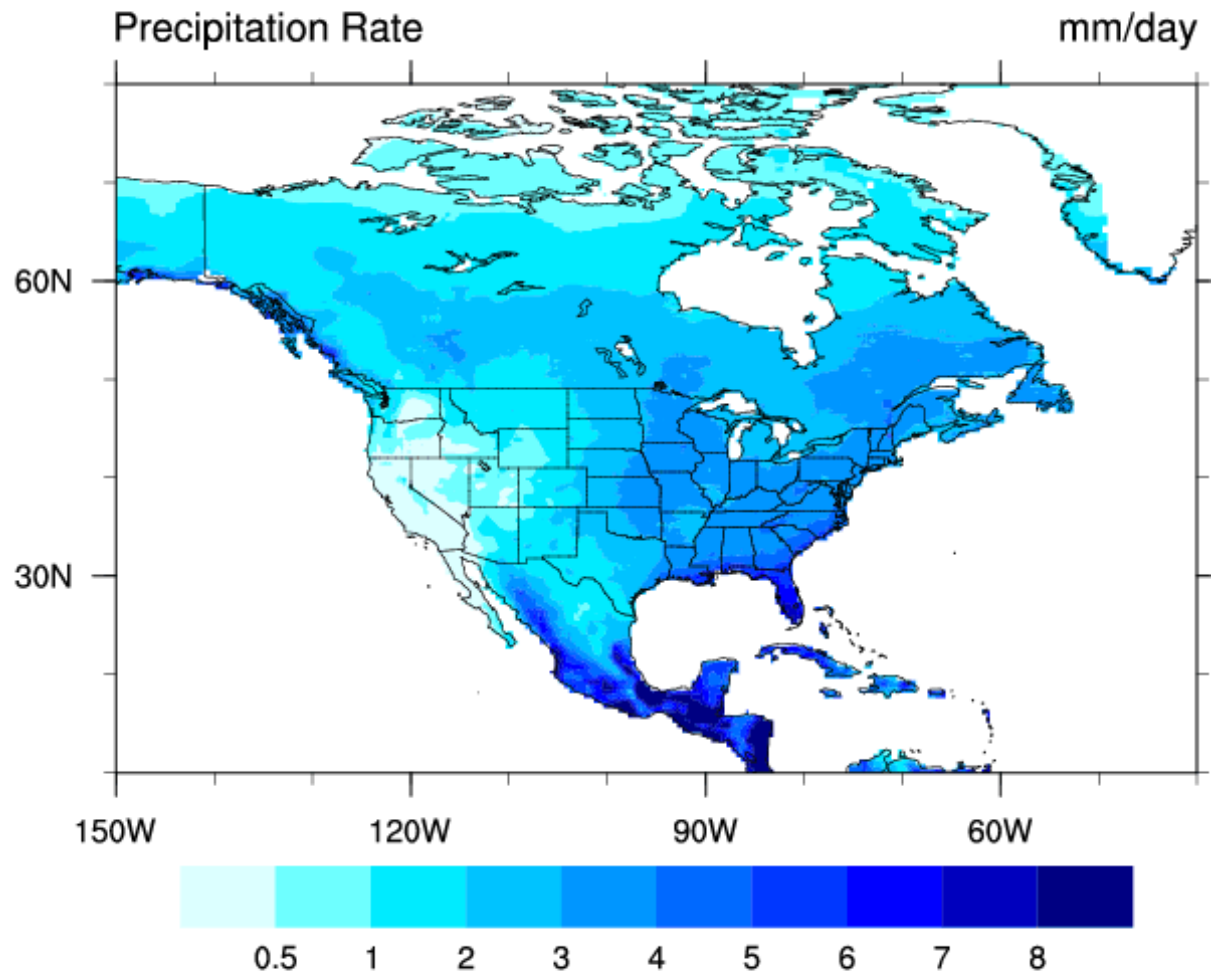
RCM3+NCEP, JJA Avg, 1979-2004

Precipitation mm/day

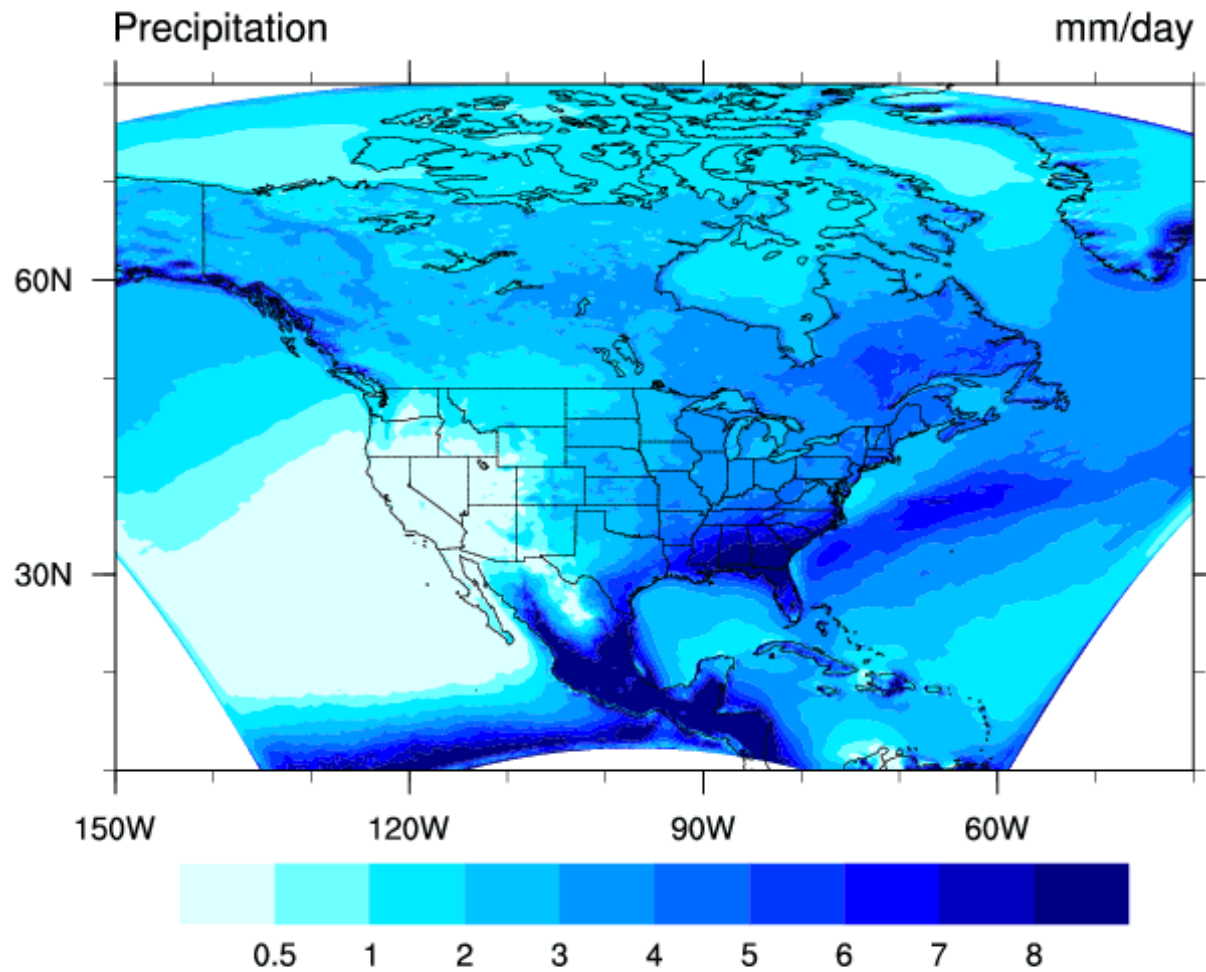


0.5 1 2 3 4 5 6 7 8

MERRA NAM-22 JJA

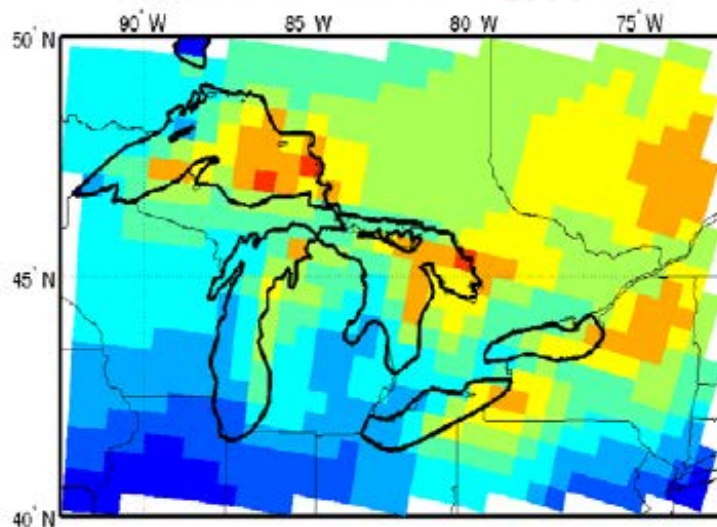


RegCM4 NAM-22 JJA

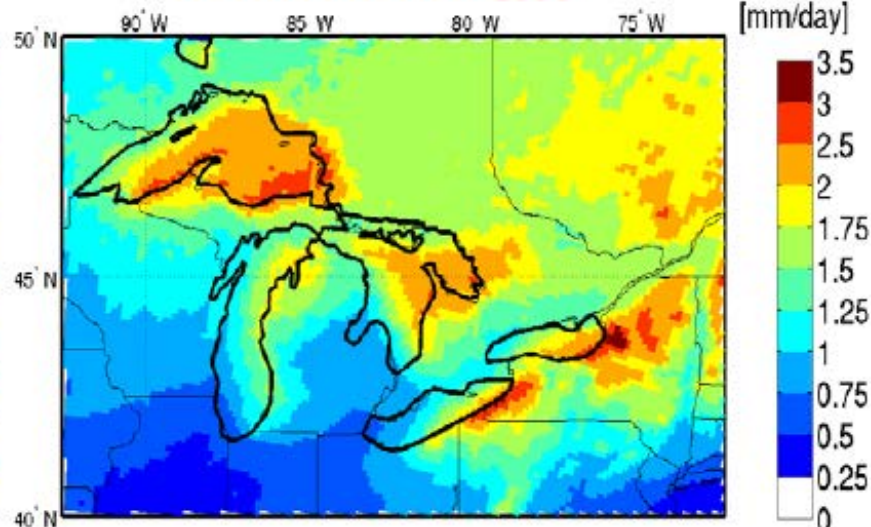


Snow fall, DJF 1988-1997, Great Lakes

North America **0.44°**



North America **0.11°**



CRCM5

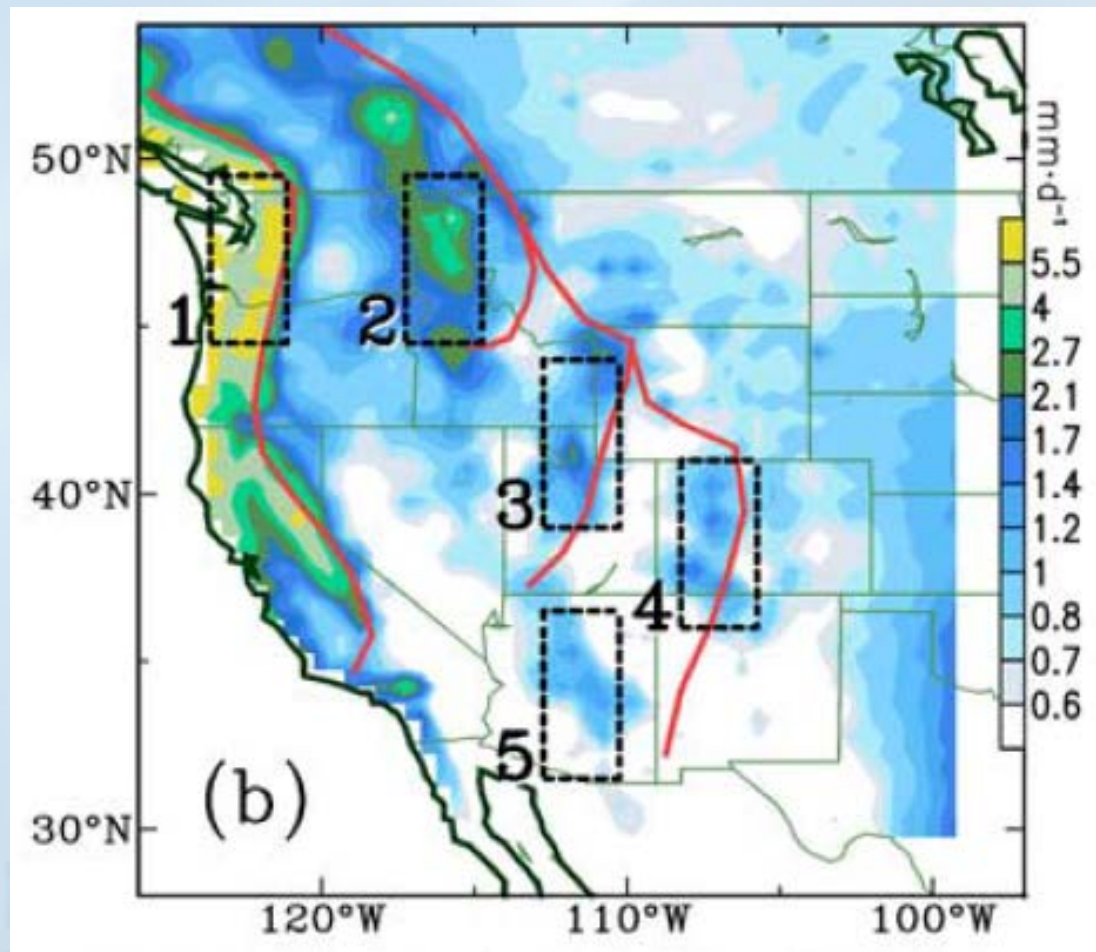




NCAR

Resolution Limitations

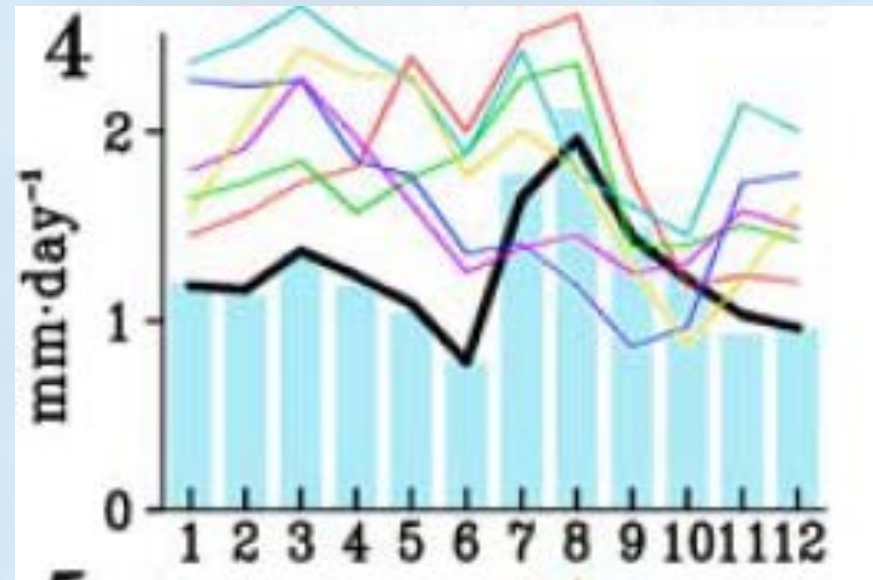
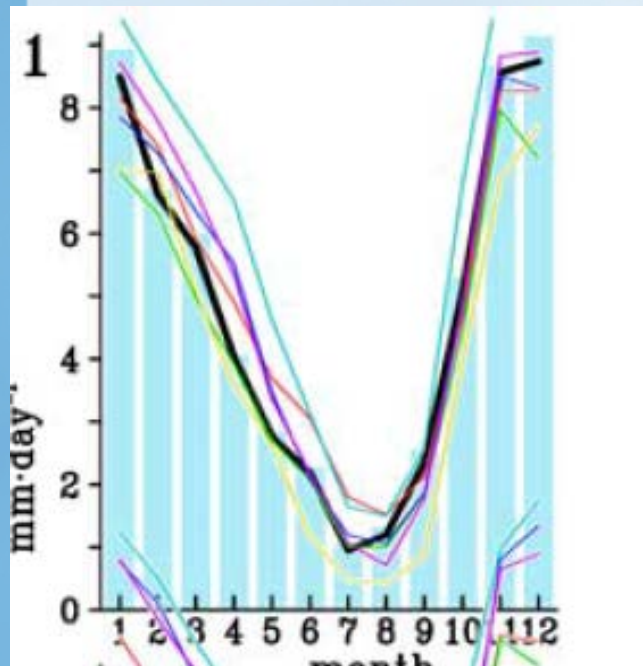
Regions of Intermountain West



Winter Precip,
UDEL obs

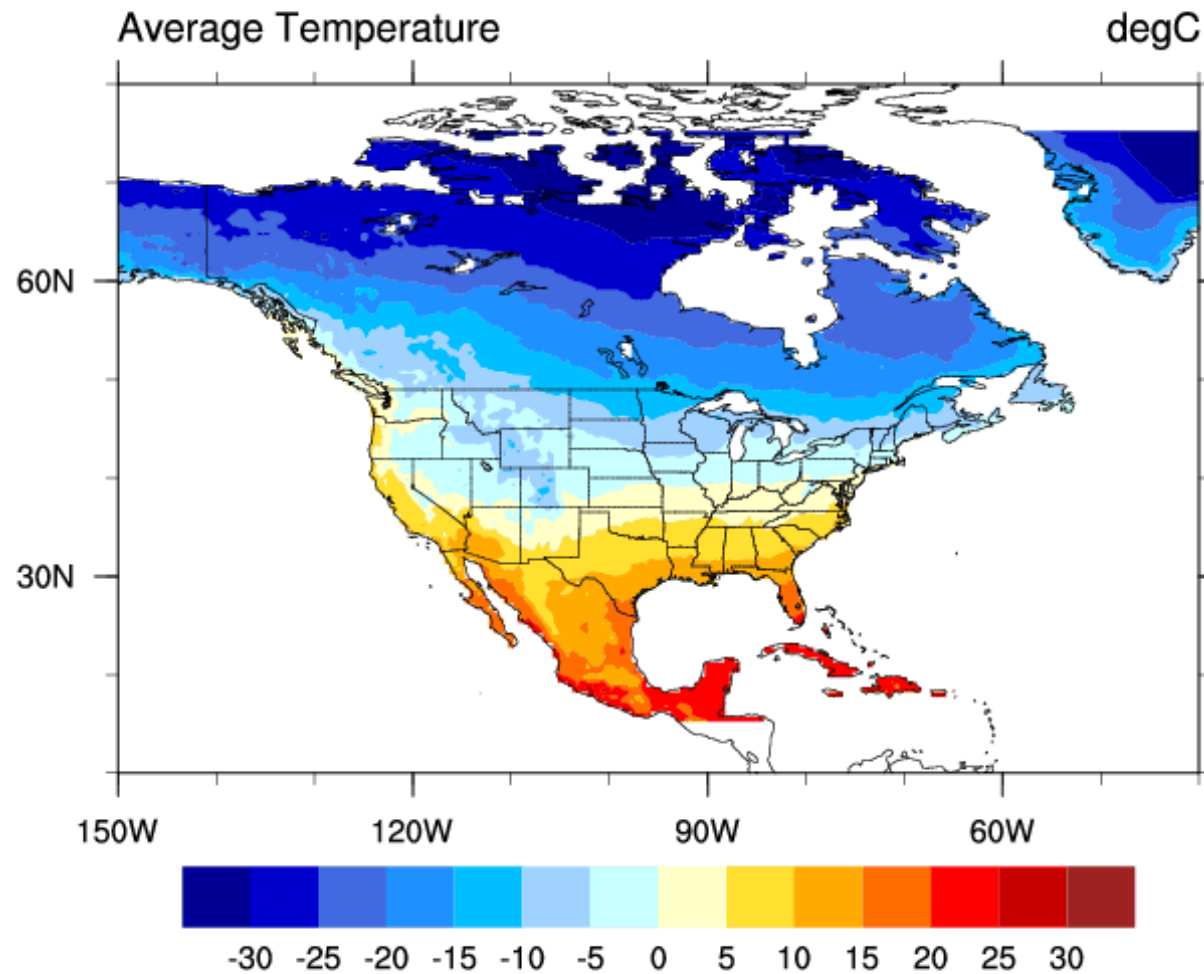


NCAR



- North American Regional Reanalysis (NARR) —
- Canadian Regional Climate Model (CRCM) —
- Exp. CPC Regional Spectral Model (ECPC) —
- MM5-PSU/NCAR mesoscale model (MM5I) —
- Regional Climate Model version 3 (RCM3) —
- Weather Research & Forecasting model (WRFP) —
- Hadley Center Regional Model v.3 (HRM3) —

MERRA NAM-44 DJF





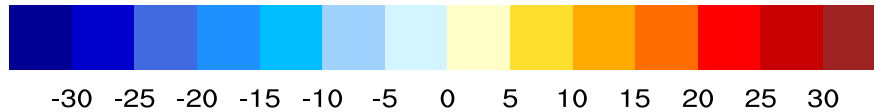
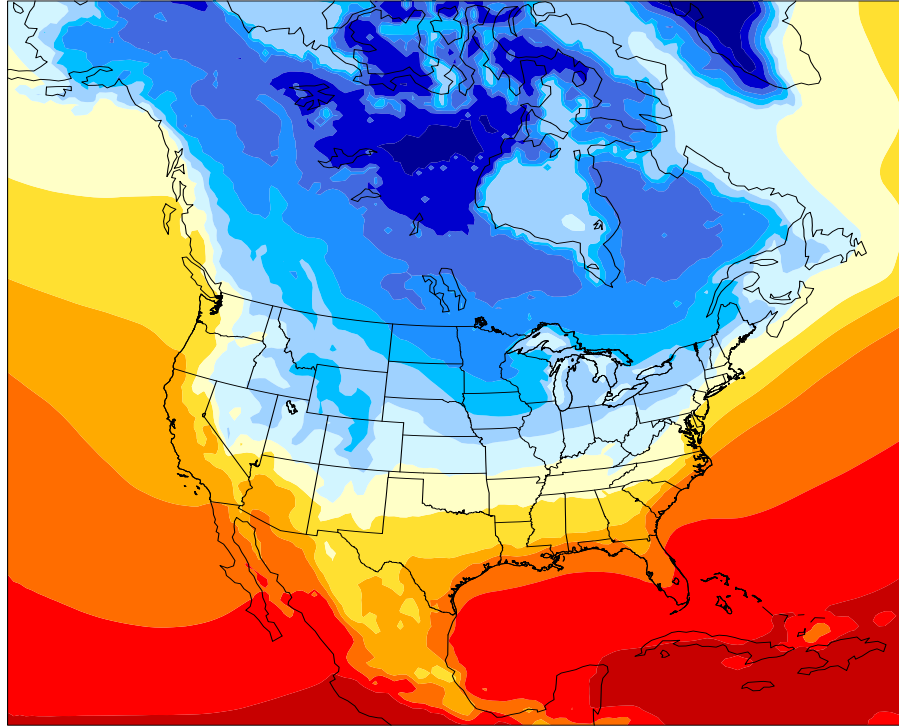
NCAR

WRF50_erain

1980-2010 Mons: 1,2,12

2 m Air Temperature

C

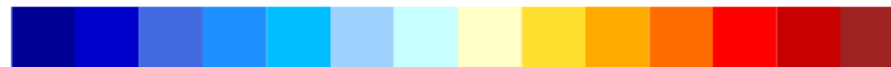
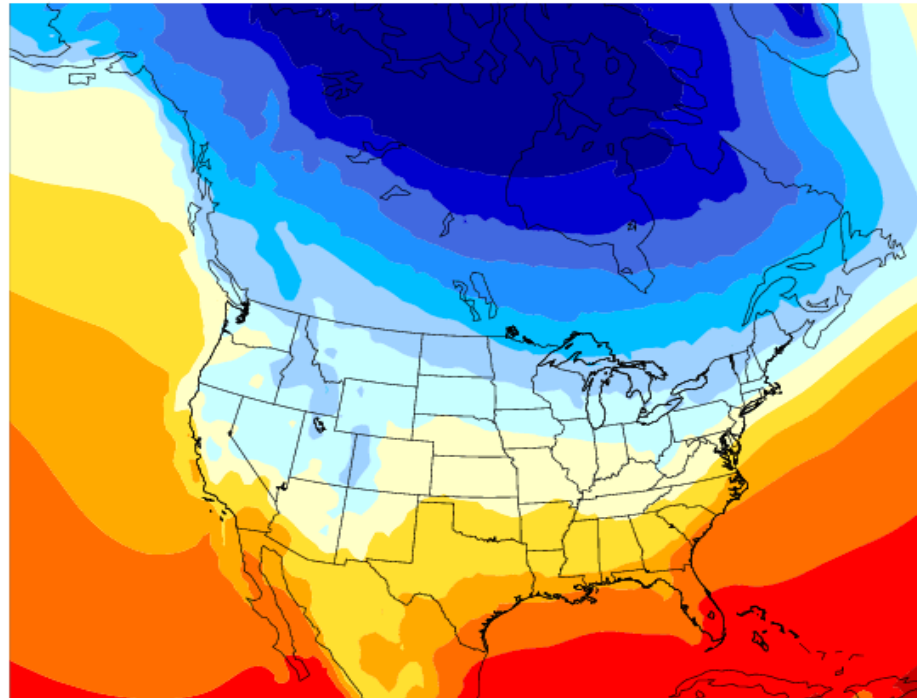


NARCCAP
Winter

WRFG+NCEP, DJF Avg, 1979-2004

Temperature

Deg C



-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30

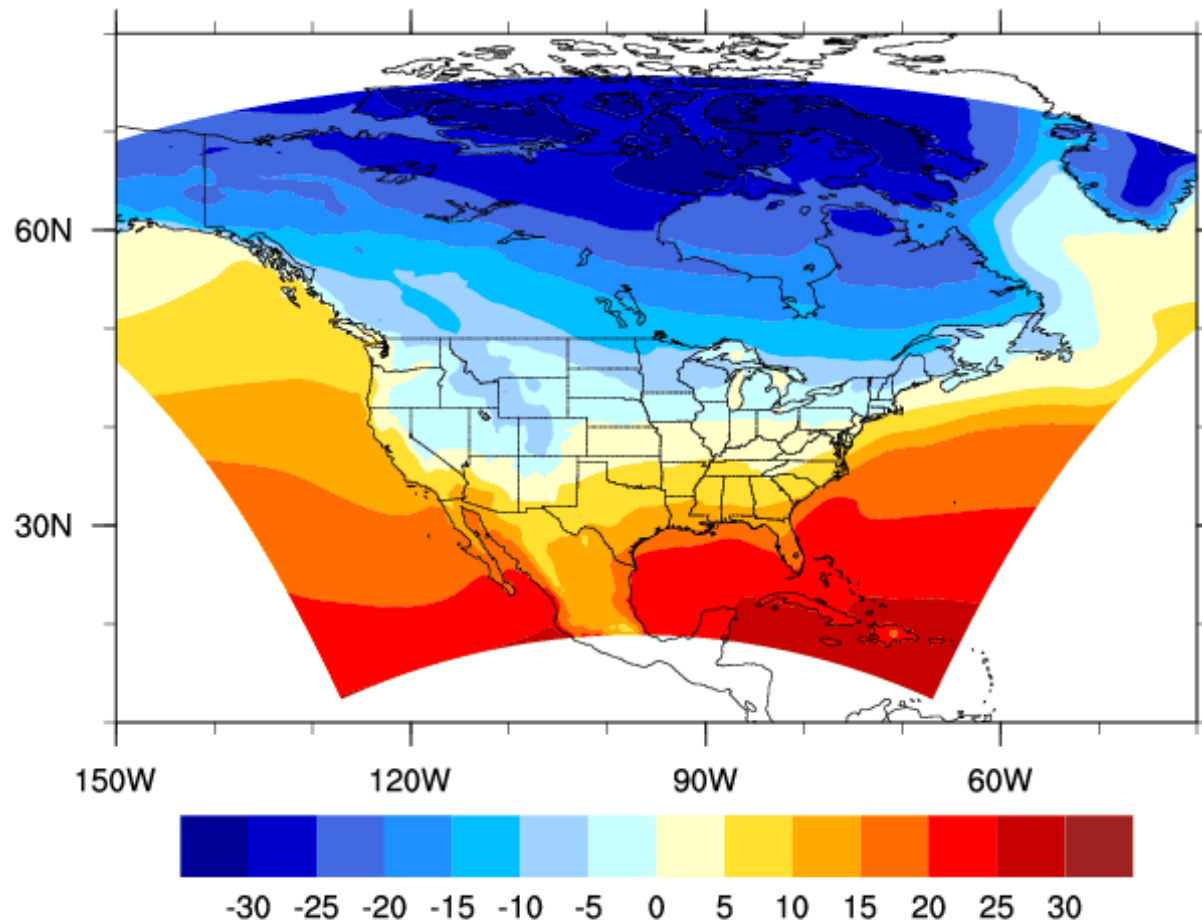


NCAR

CanRCM4 NAM-44 DJF

Near-Surface Air Temperature

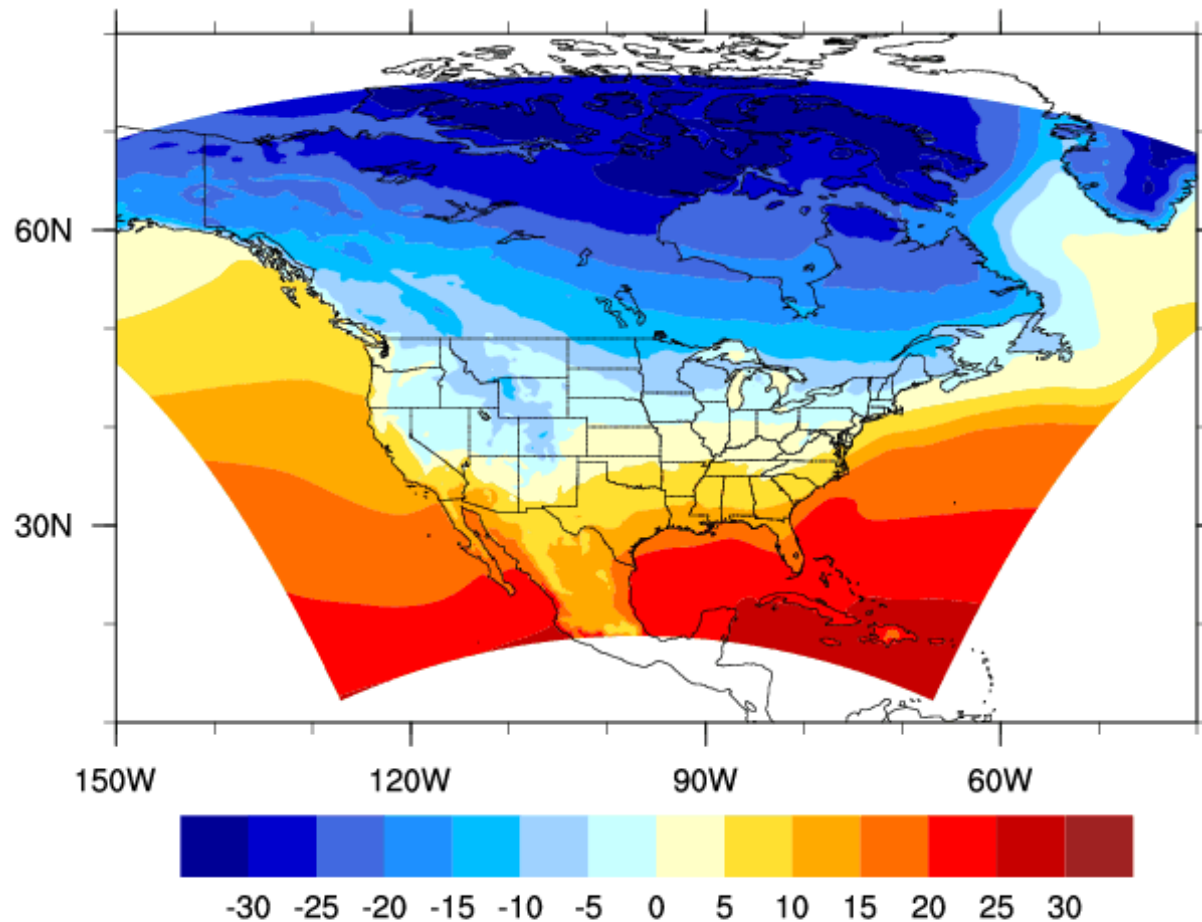
degC



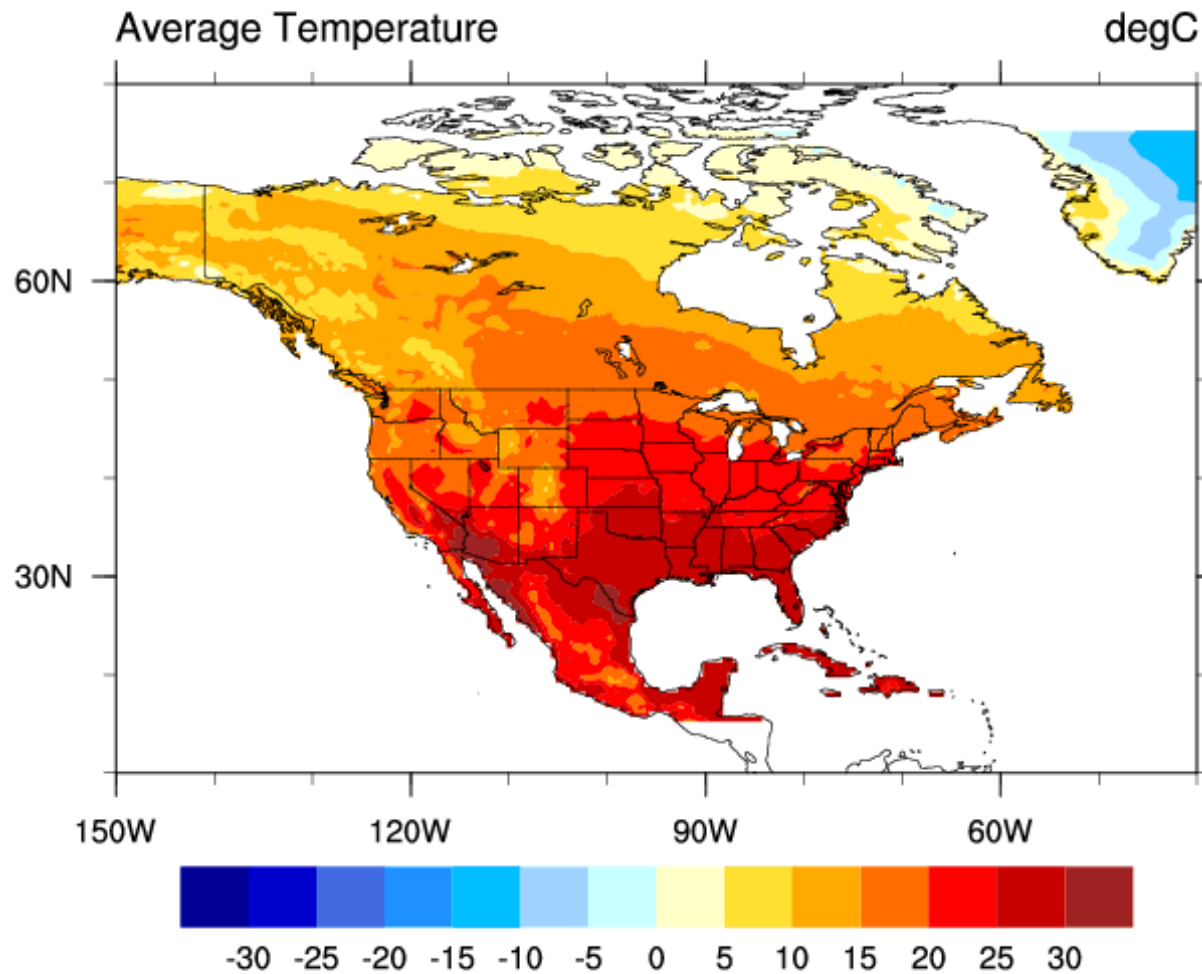
CanRCM4 NAM-22 DJF

Near-Surface Air Temperature

degC



MERRA NAM-44 JJA



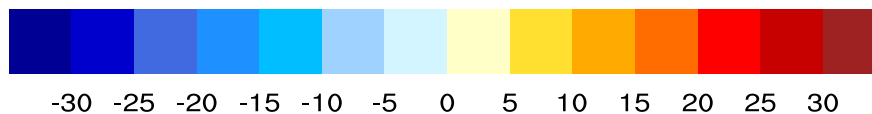
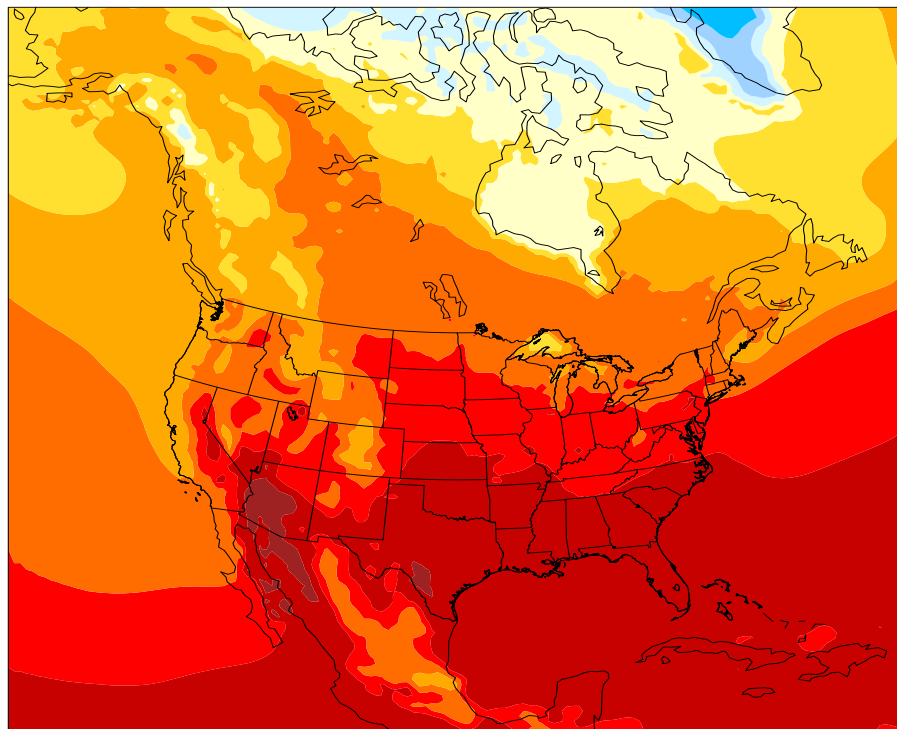
Summer

WRF50_erain

1980-2010 Mons: 6,7,8

2 m Air Temperature

C



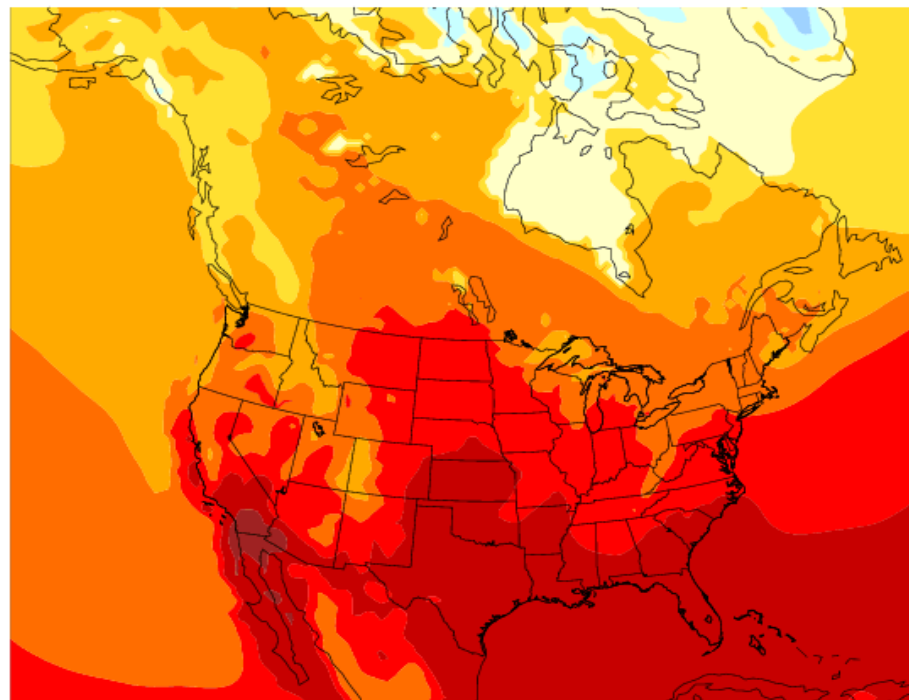
NCAR

NARCCAP
Summer

WRFG+NCEP, JJA Avg, 1979-2004

Temperature

Deg C



-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30

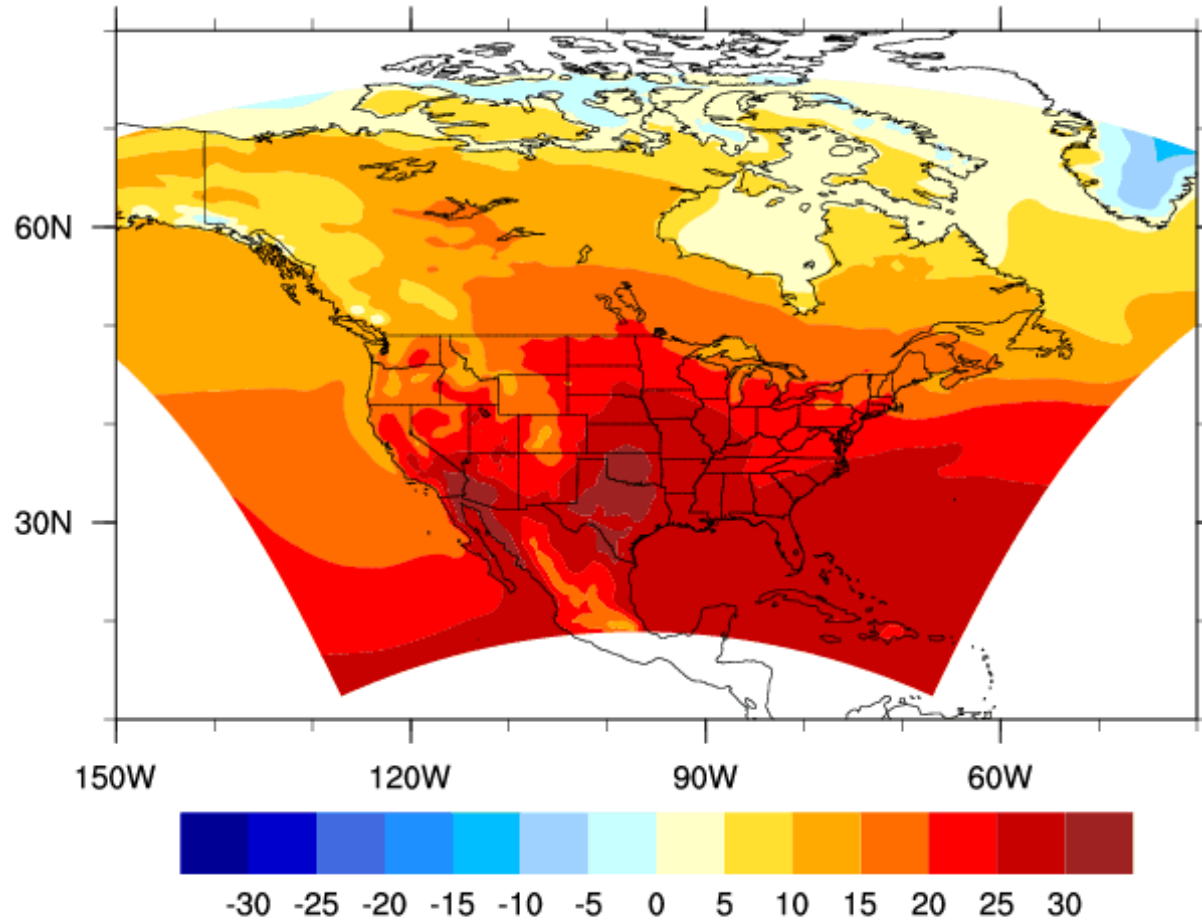


NCAR

CanRCM4 NAM-44 JJA

Near-Surface Air Temperature

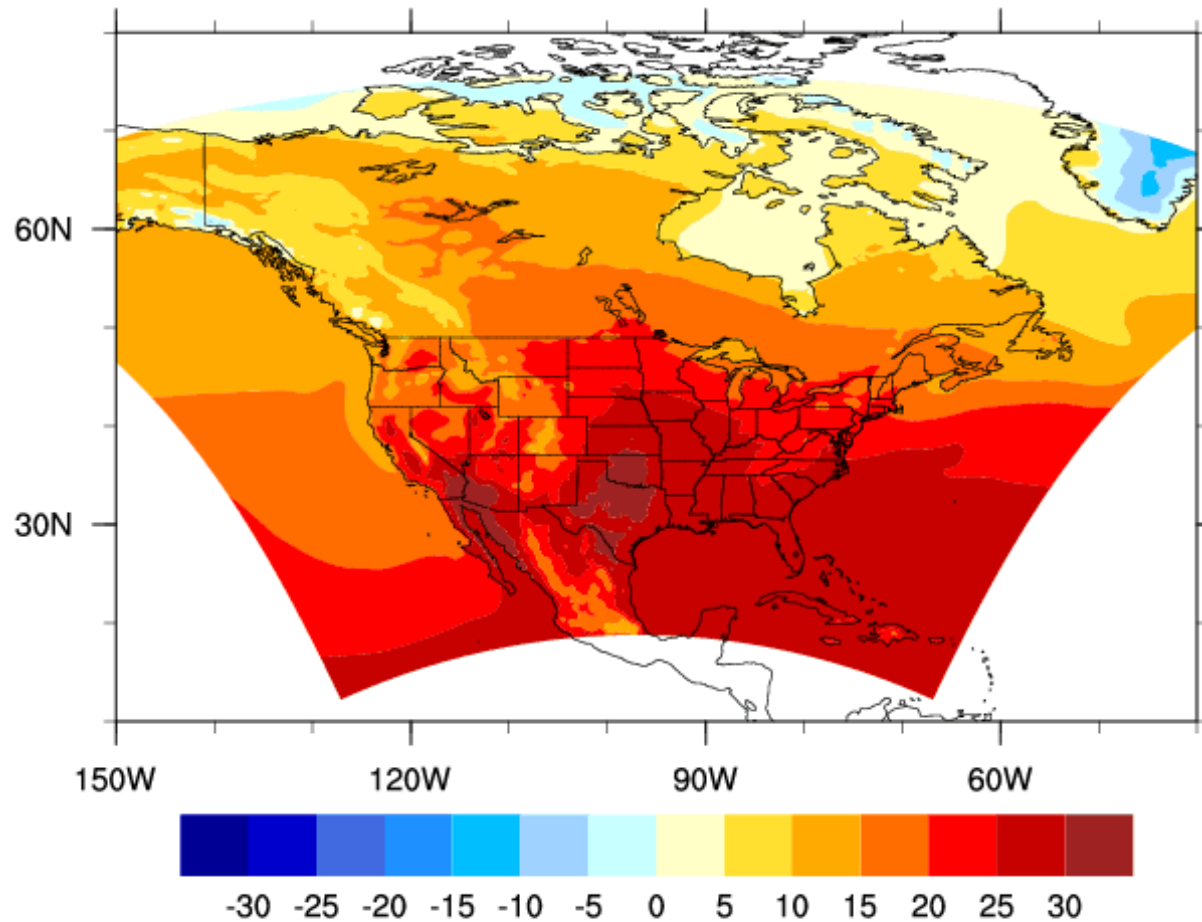
degC



CanRCM4 NAM-22 JJA

Near-Surface Air Temperature

degC





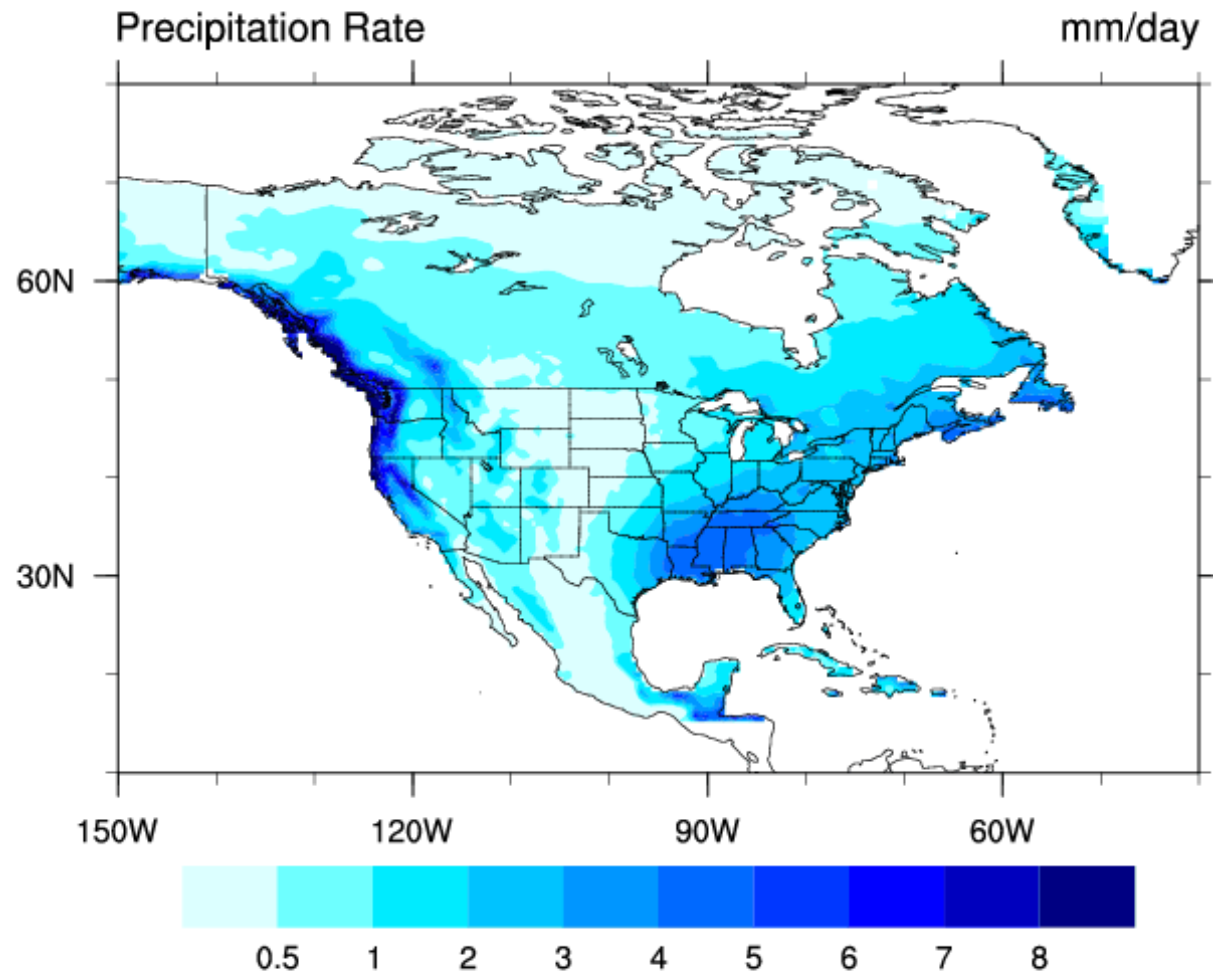
NCAR

Driven by GCM Historical Period

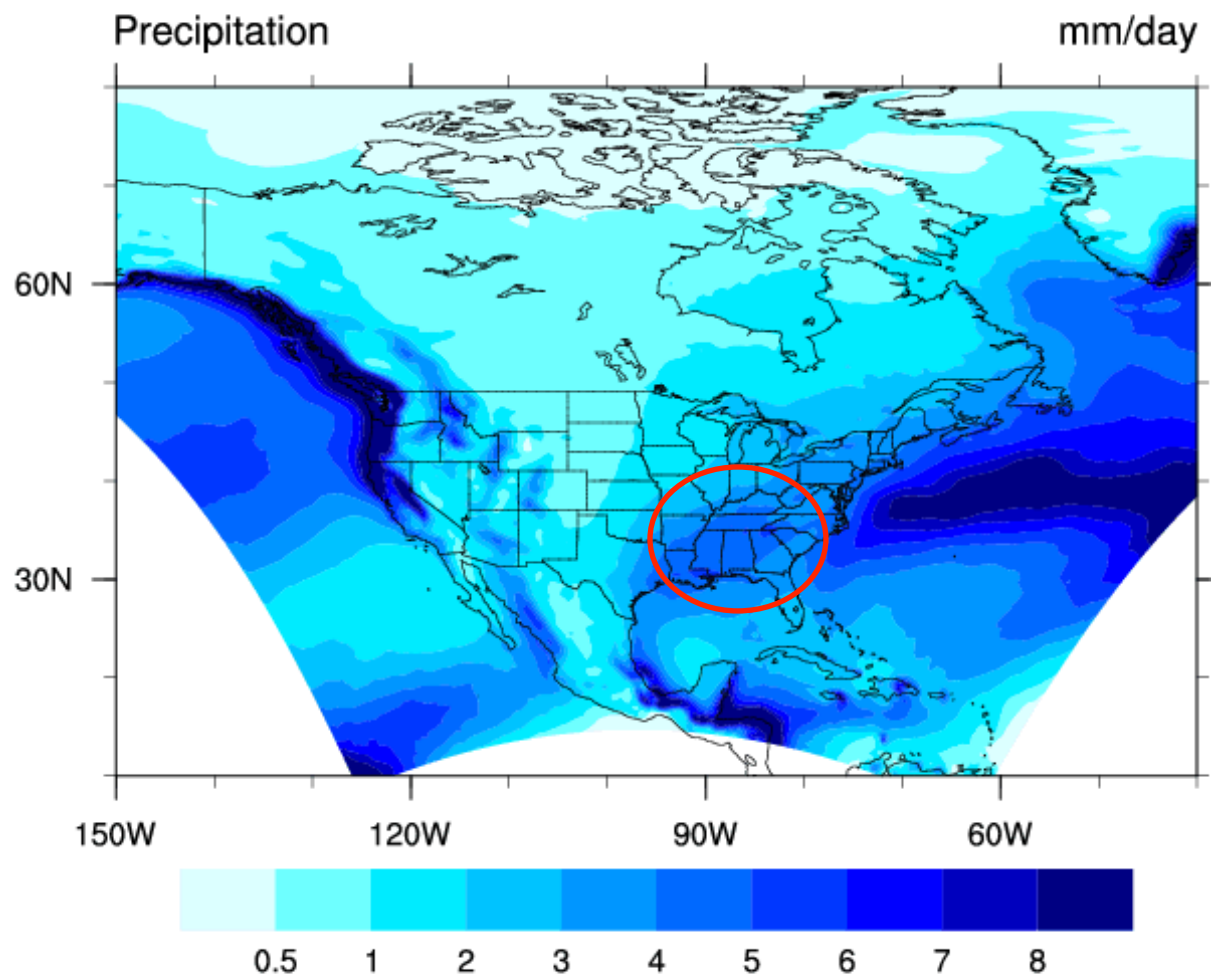
1970-1999

CRCM5 - MPI - CanESM

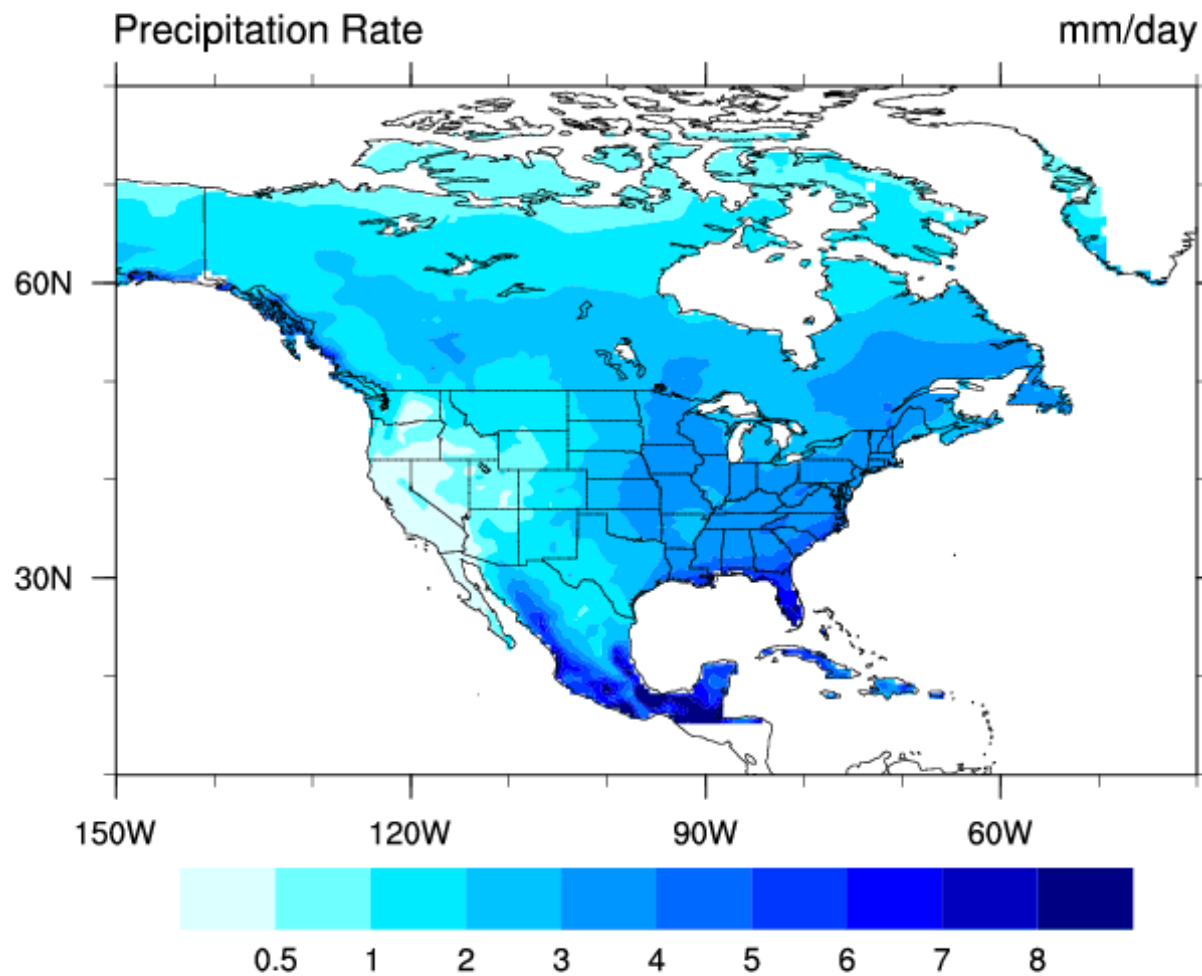
MERRA NAM-44 DJF



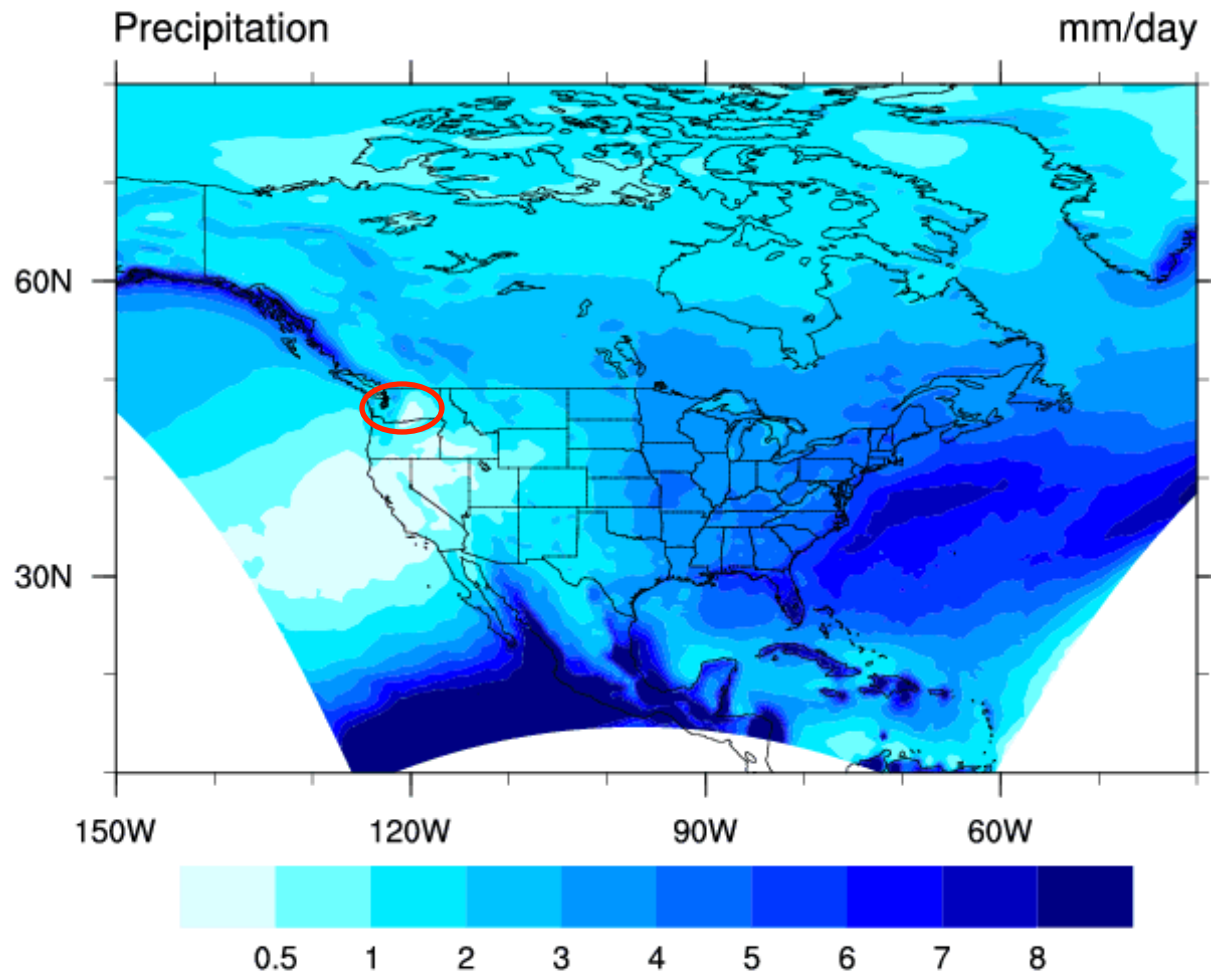
CRCM5-MPI NAM-44 hist DJF



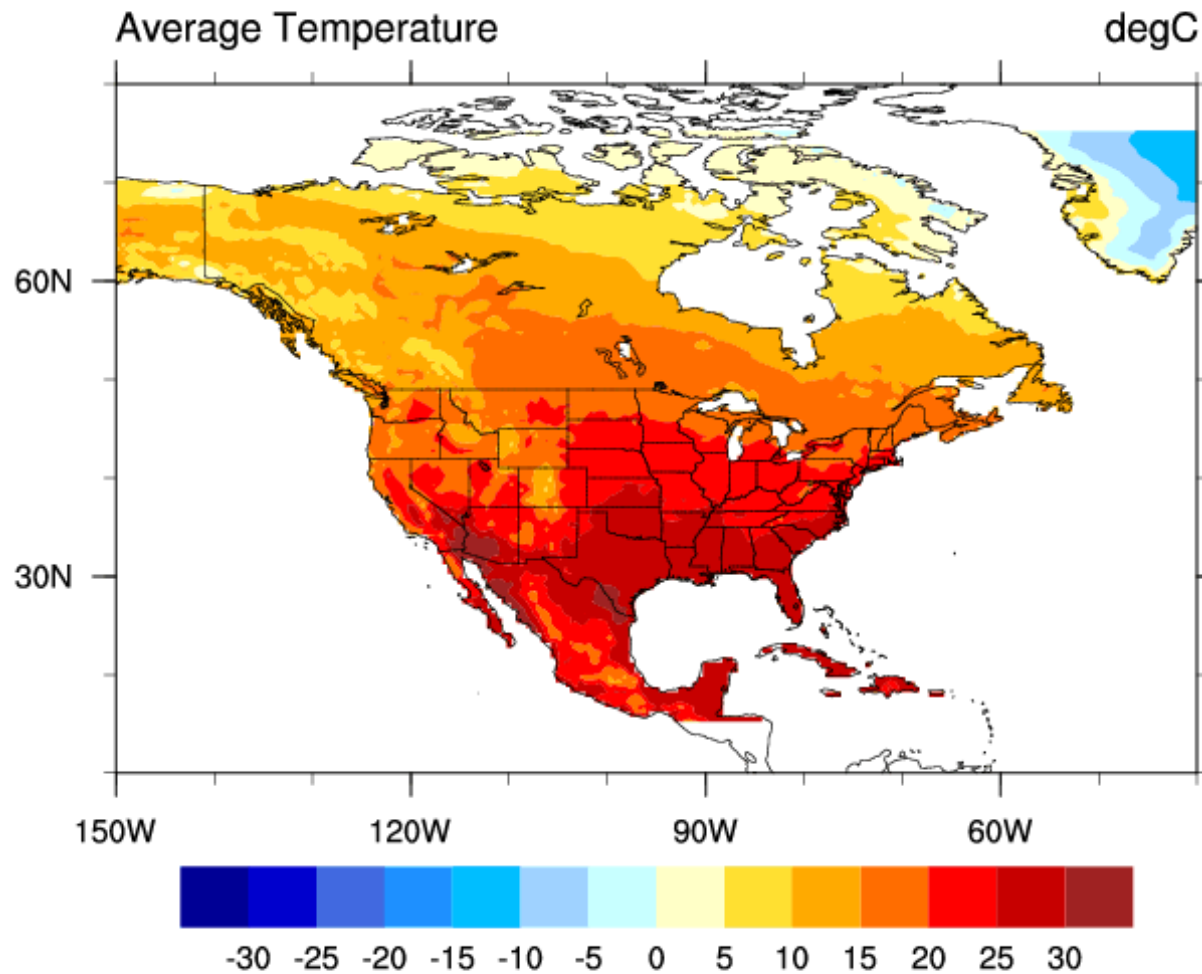
MERRA NAM-44 JJA



CRCM5-MPI NAM-44 hist JJA



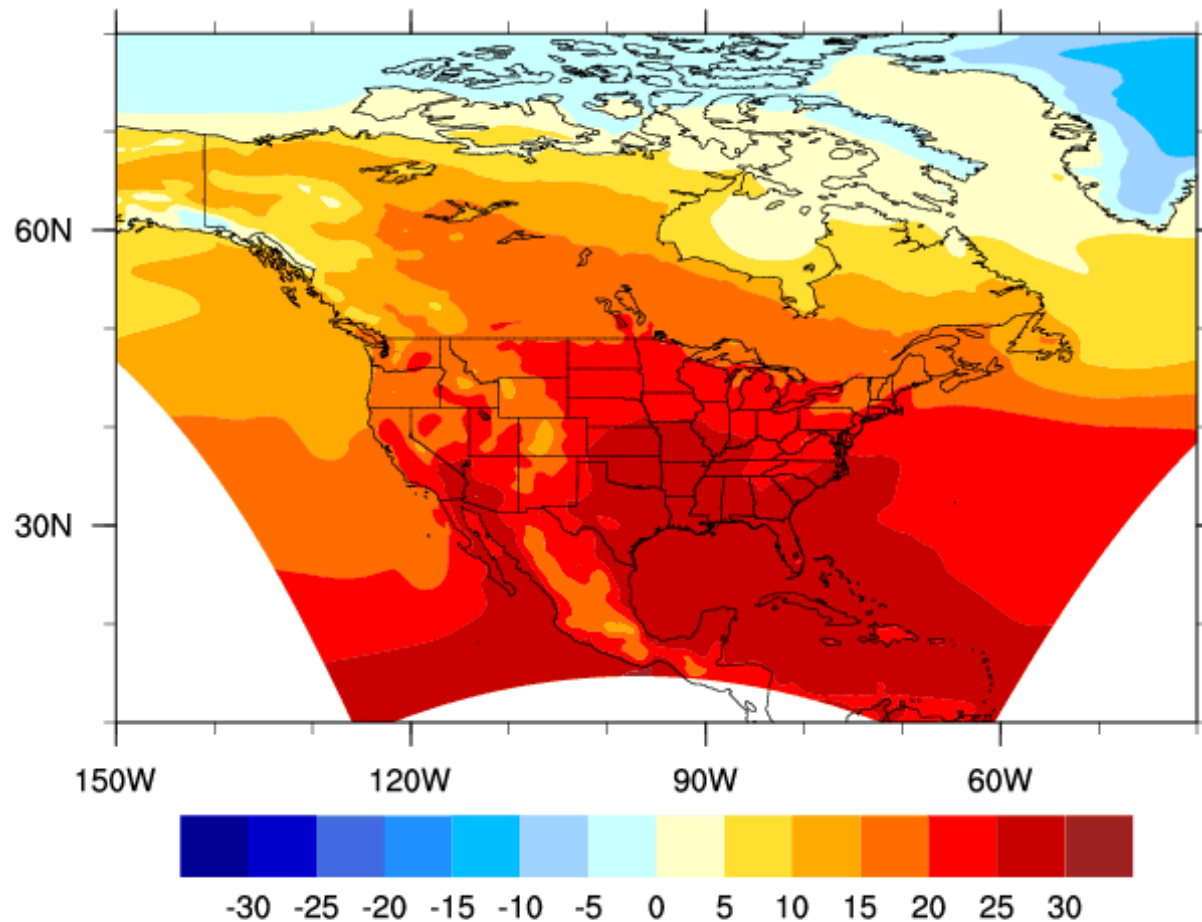
MERRA NAM-44 JJA



CRCM5-CanESM2 NAM-44 hist JJA

Near-Surface Air Temperature

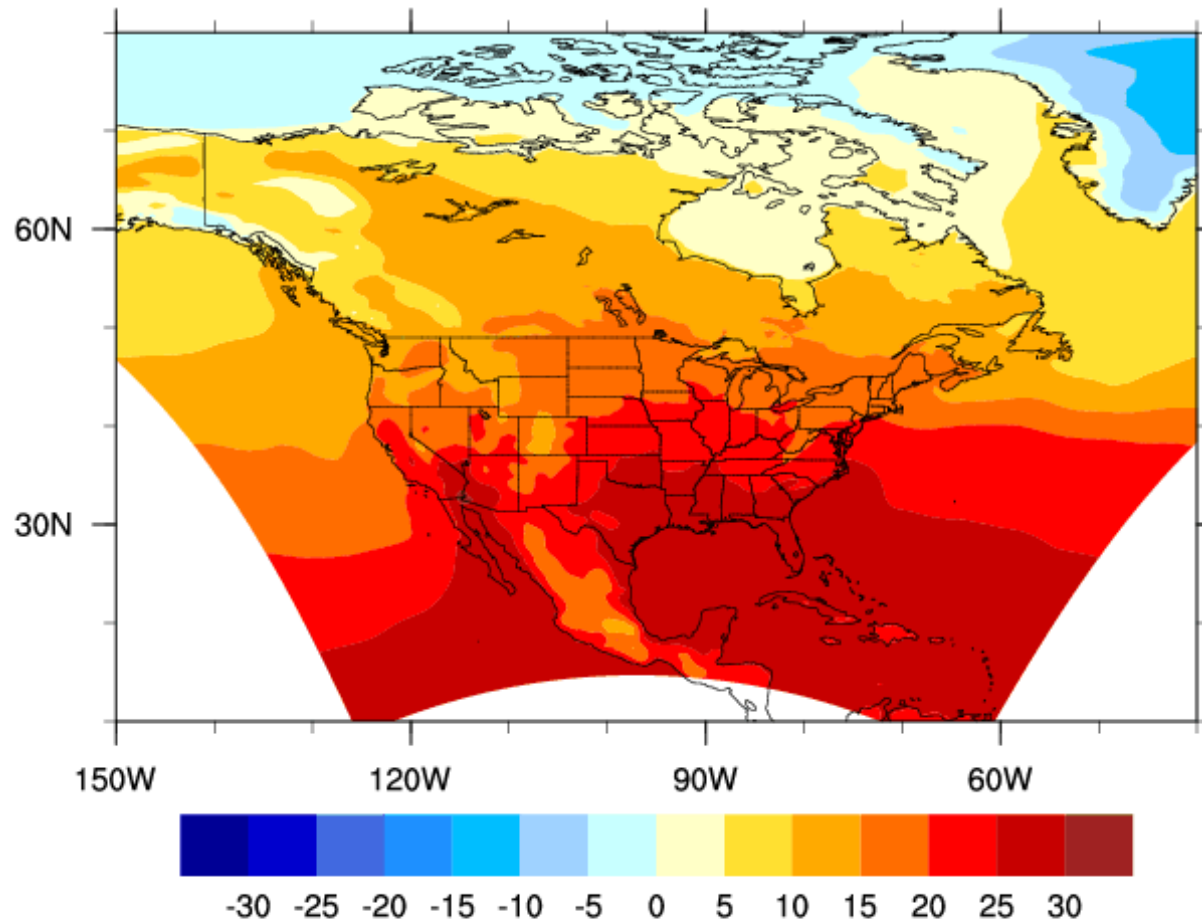
degC



CRCM5-MPI NAM-44 hist JJA

Near-Surface Air Temperature

degC





NCAR

Projections

RCP 8.5 Future (2041-2070) -
Historical (1970-1999)

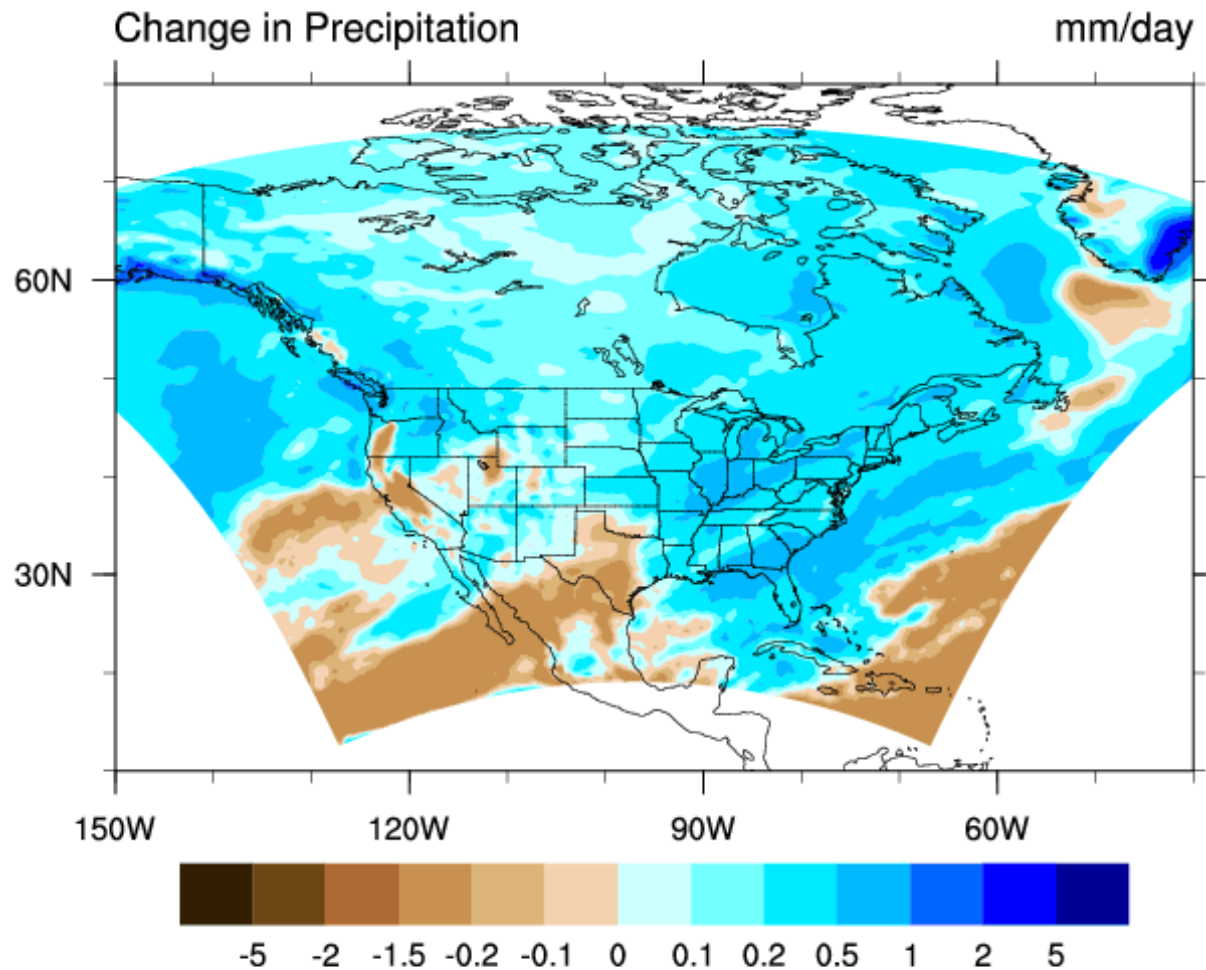


NCAR

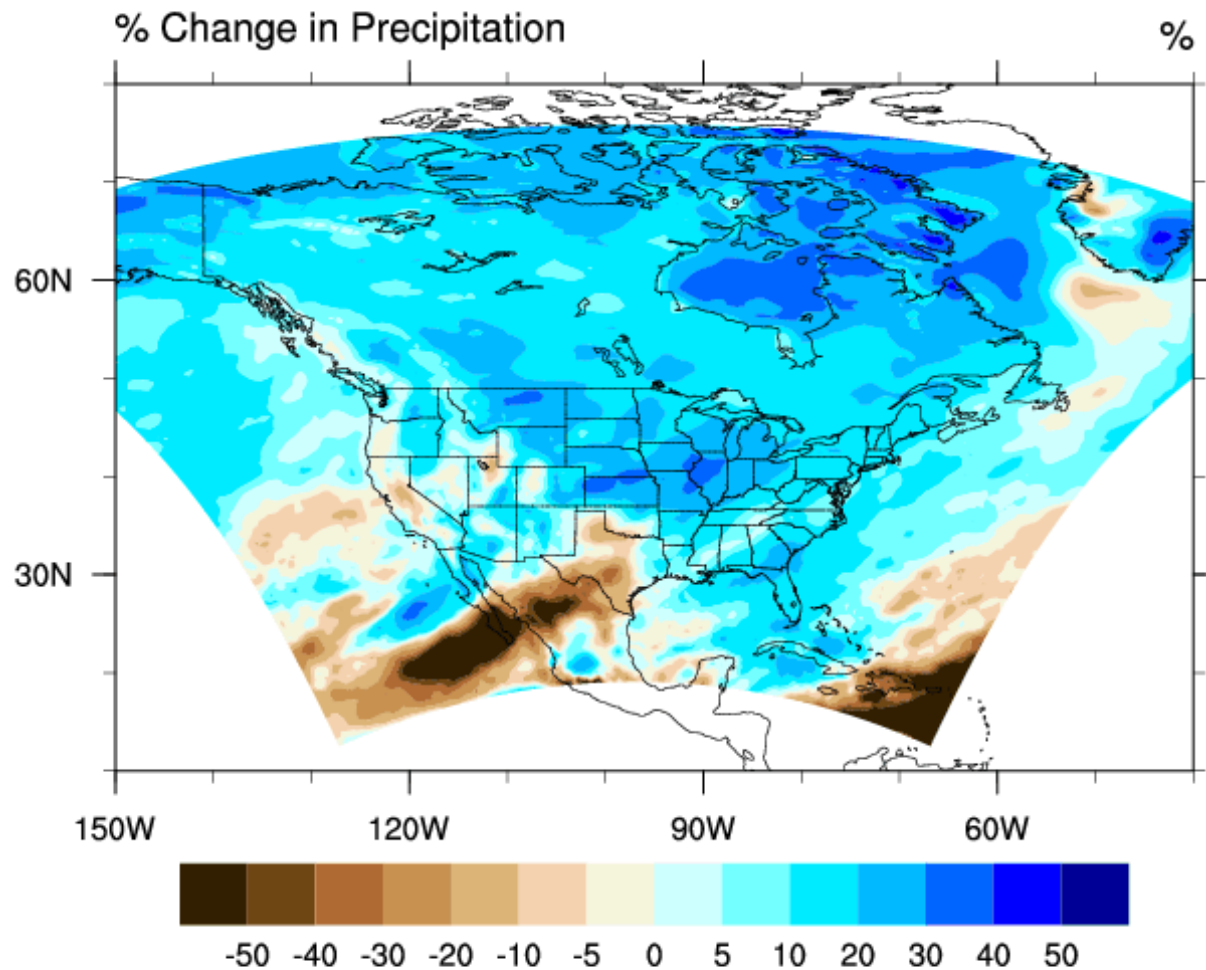
Precipitation Change



RCA4-EC-EARTH NAM-44 rcp85 DJF



RCA4-EC-EARTH NAM-44 rcp85 DJF

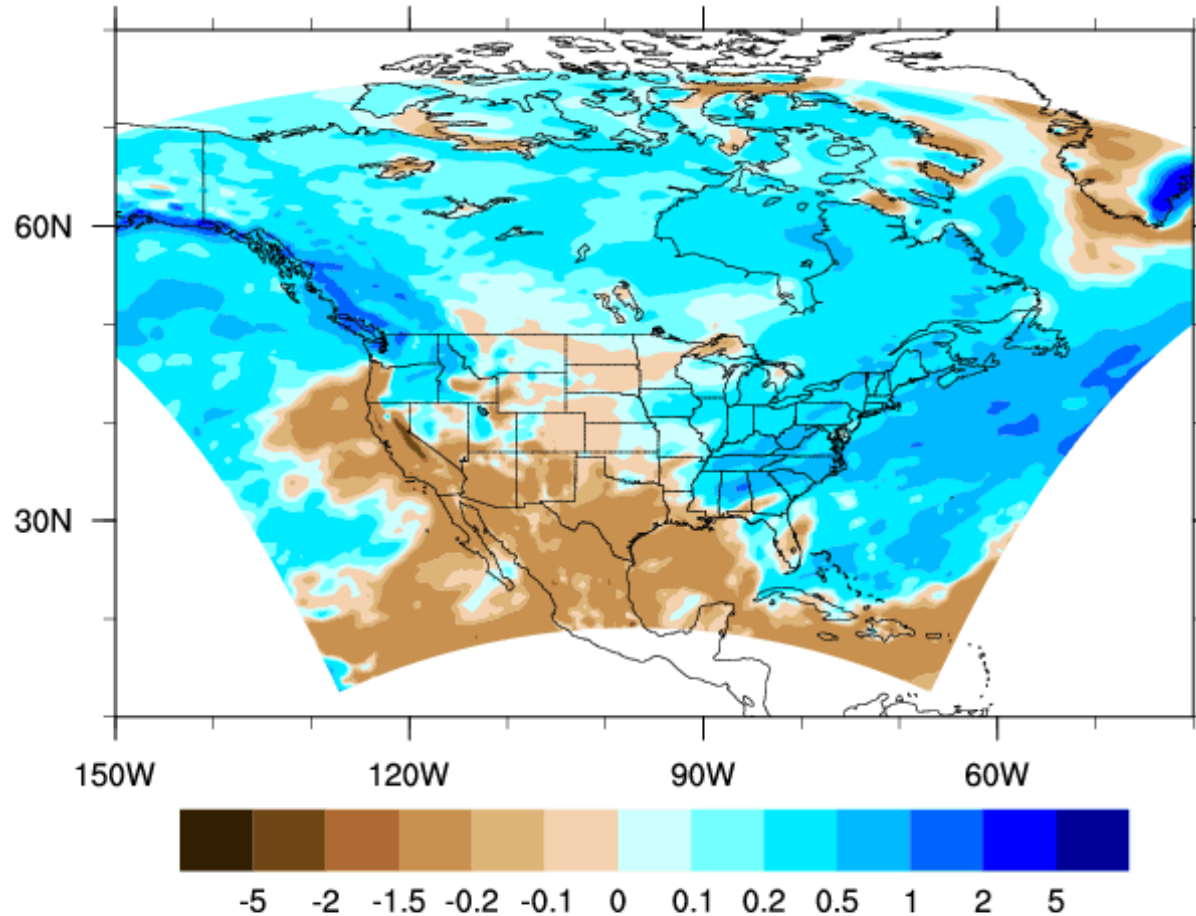


HIRHAM5-EC-EARTH NAM-44 rcp85 DJF

NCAR

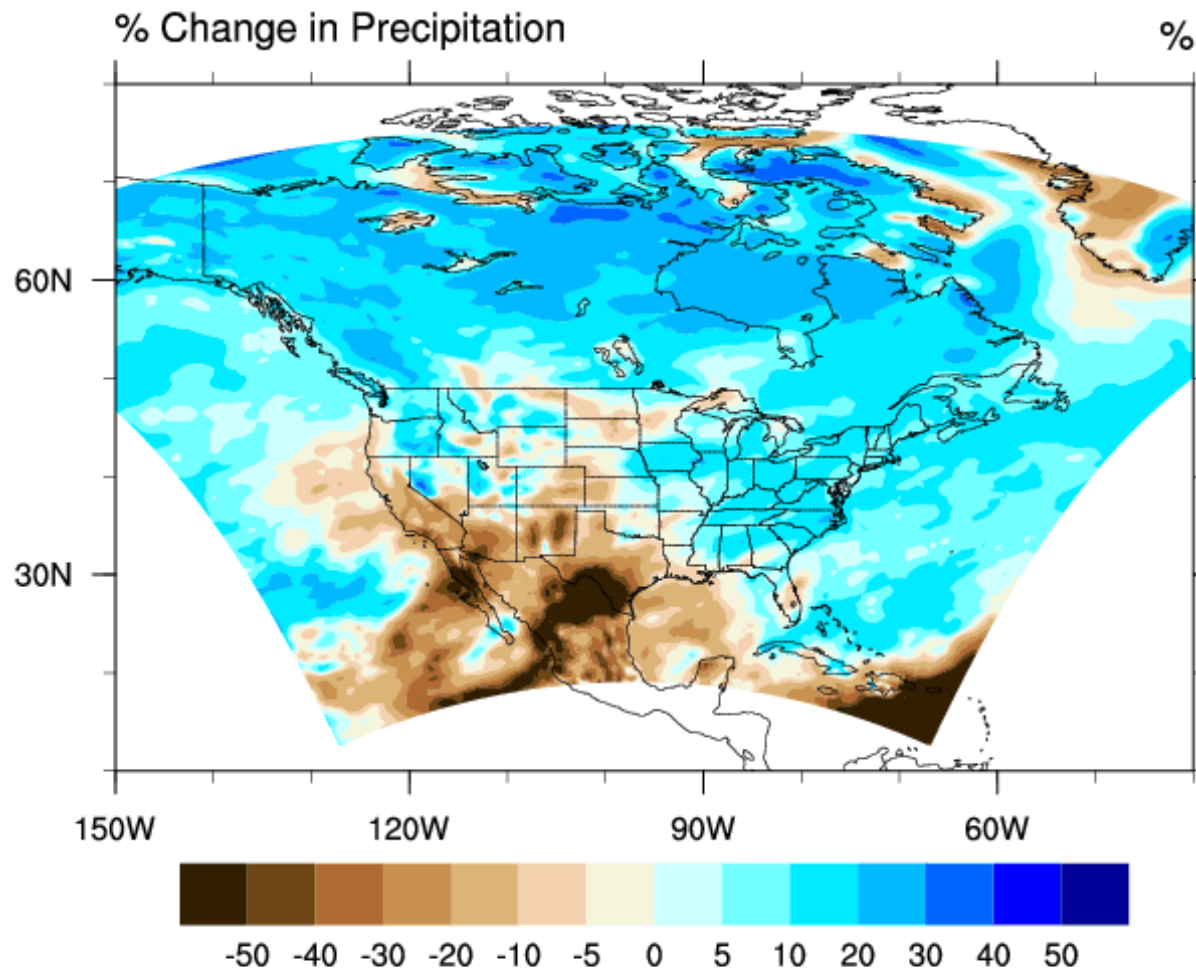
Change in Precipitation

mm/day

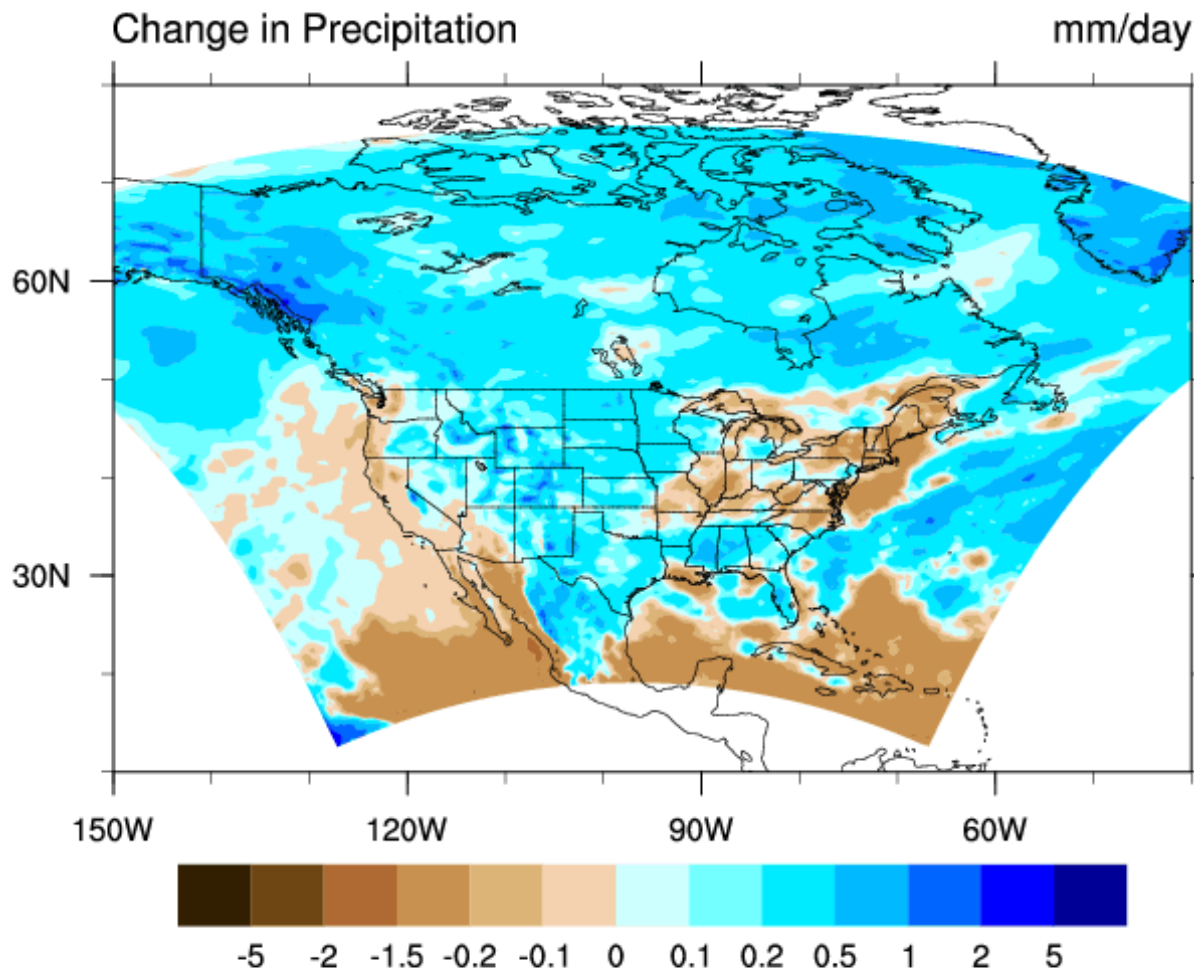


HIRHAM5-EC-EARTH NAM-44 rcp85 DJF

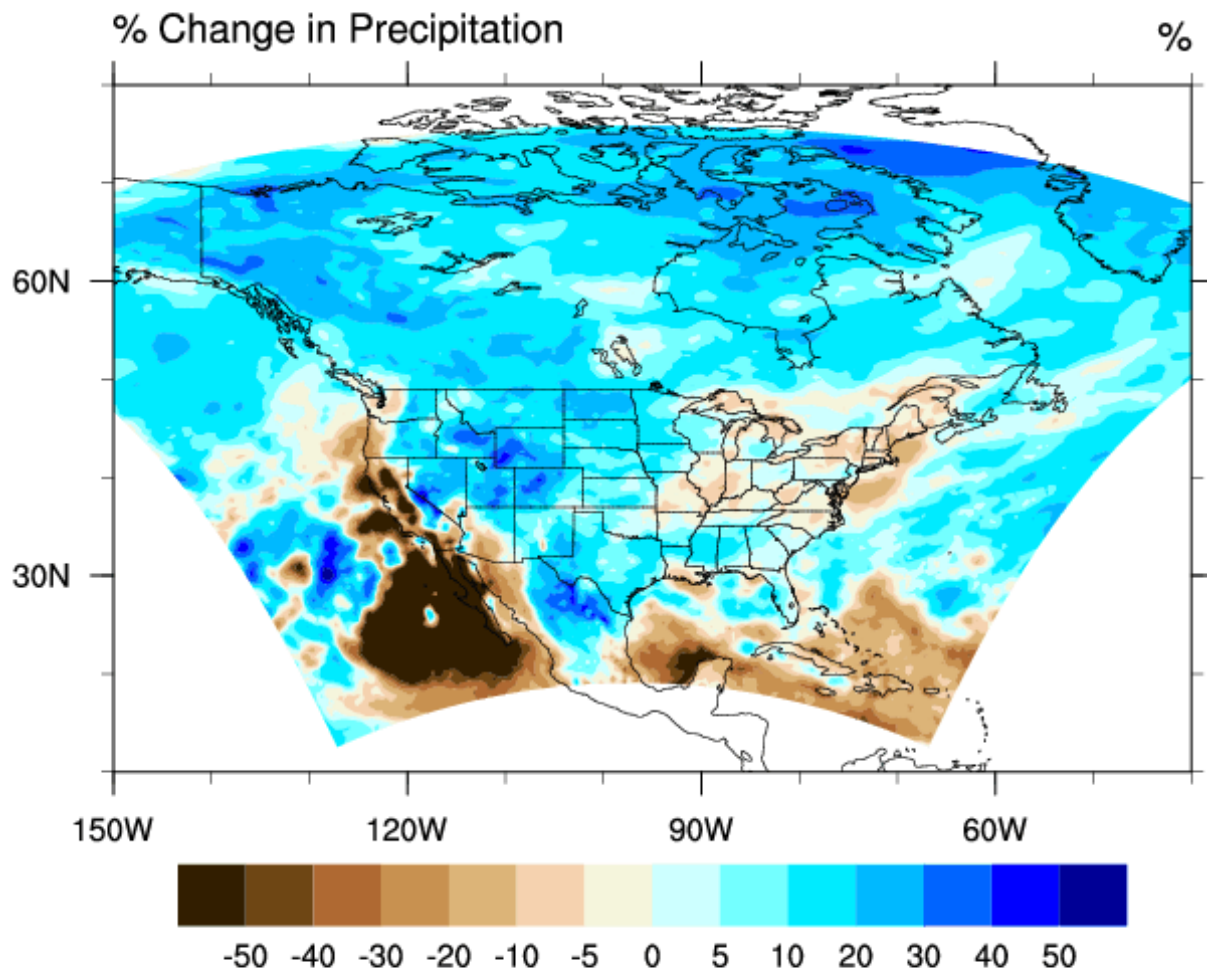
NCAR



RCA4-EC-EARTH NAM-44 rcp85 JJA



RCA4-EC-EARTH NAM-44 rcp85 JJA

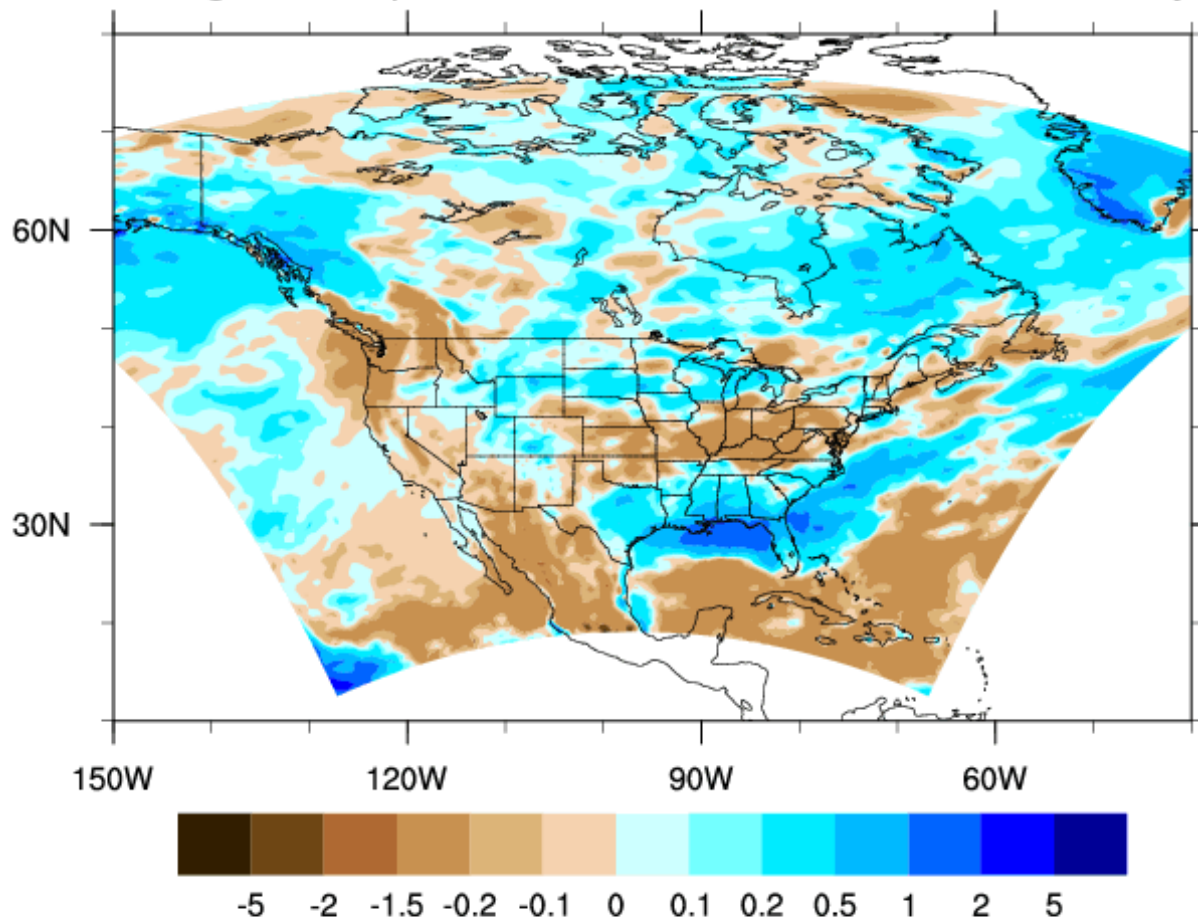


HIRHAM5-EC-EARTH NAM-44 rcp85 JJA

NCAR

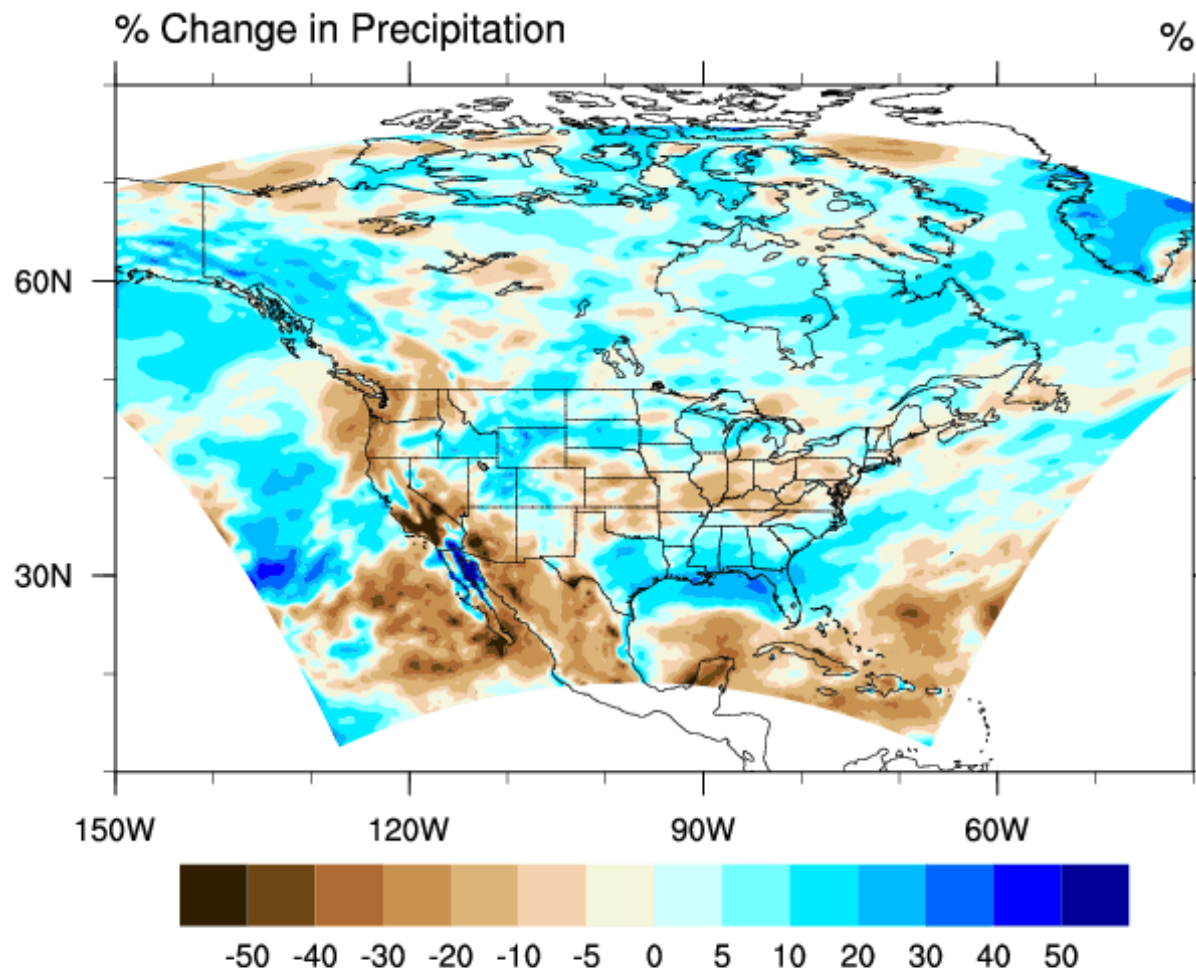
Change in Precipitation

mm/day



HIRHAM5-EC-EARTH NAM-44 rcp85 JJA

NCAR





NCAR

Precipitation Change

HadGEM

GFDL



RegCM4



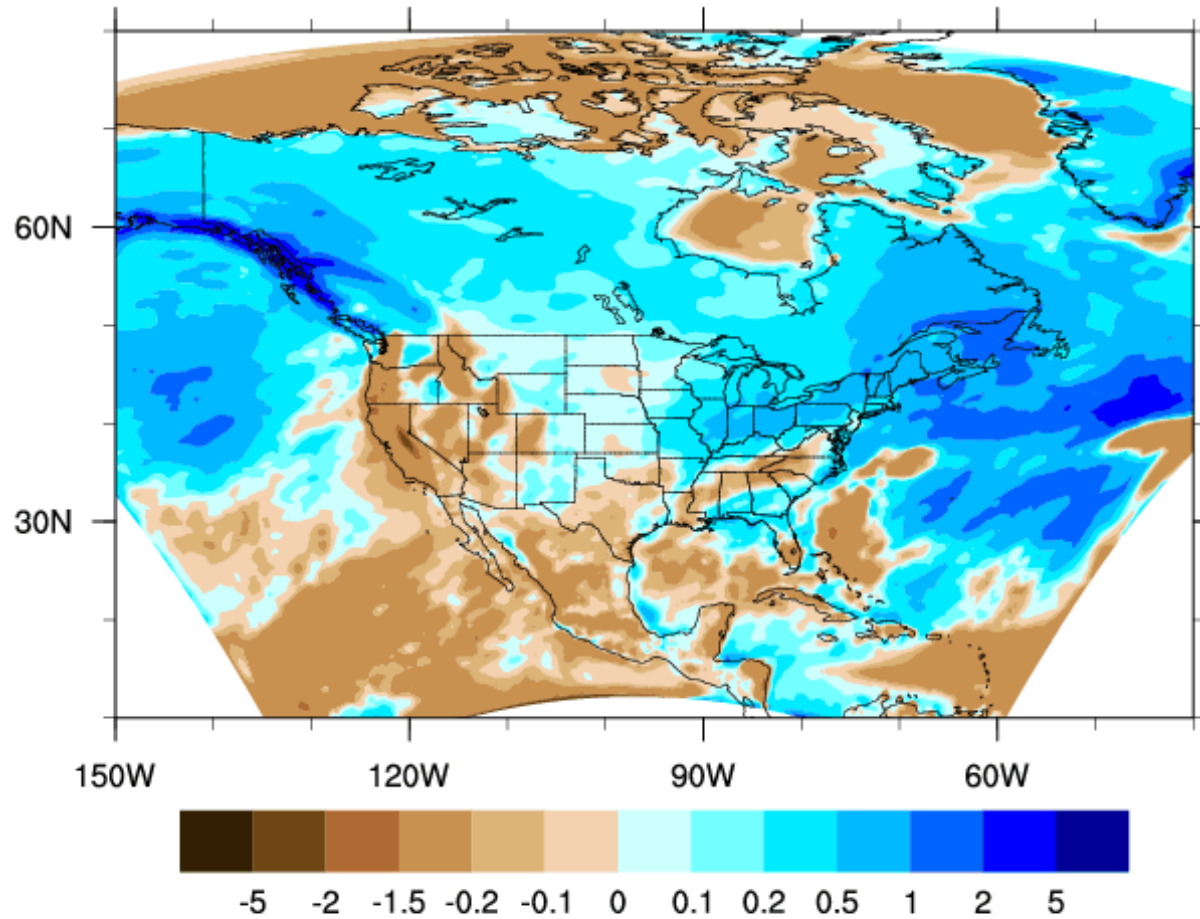
50 km

25 km

RegCM4-HadGEM2 NAM-44 rcp85 DJF

Change in Precipitation

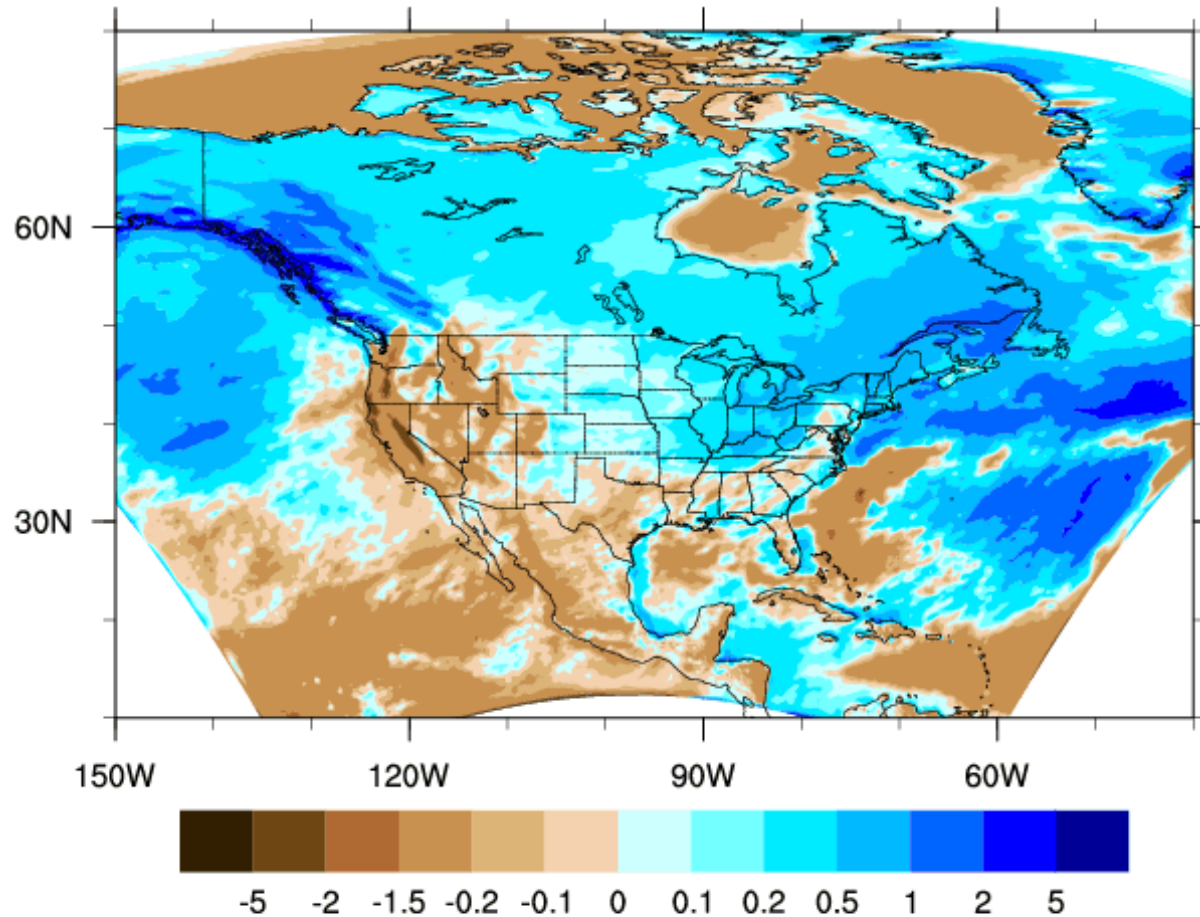
mm/day



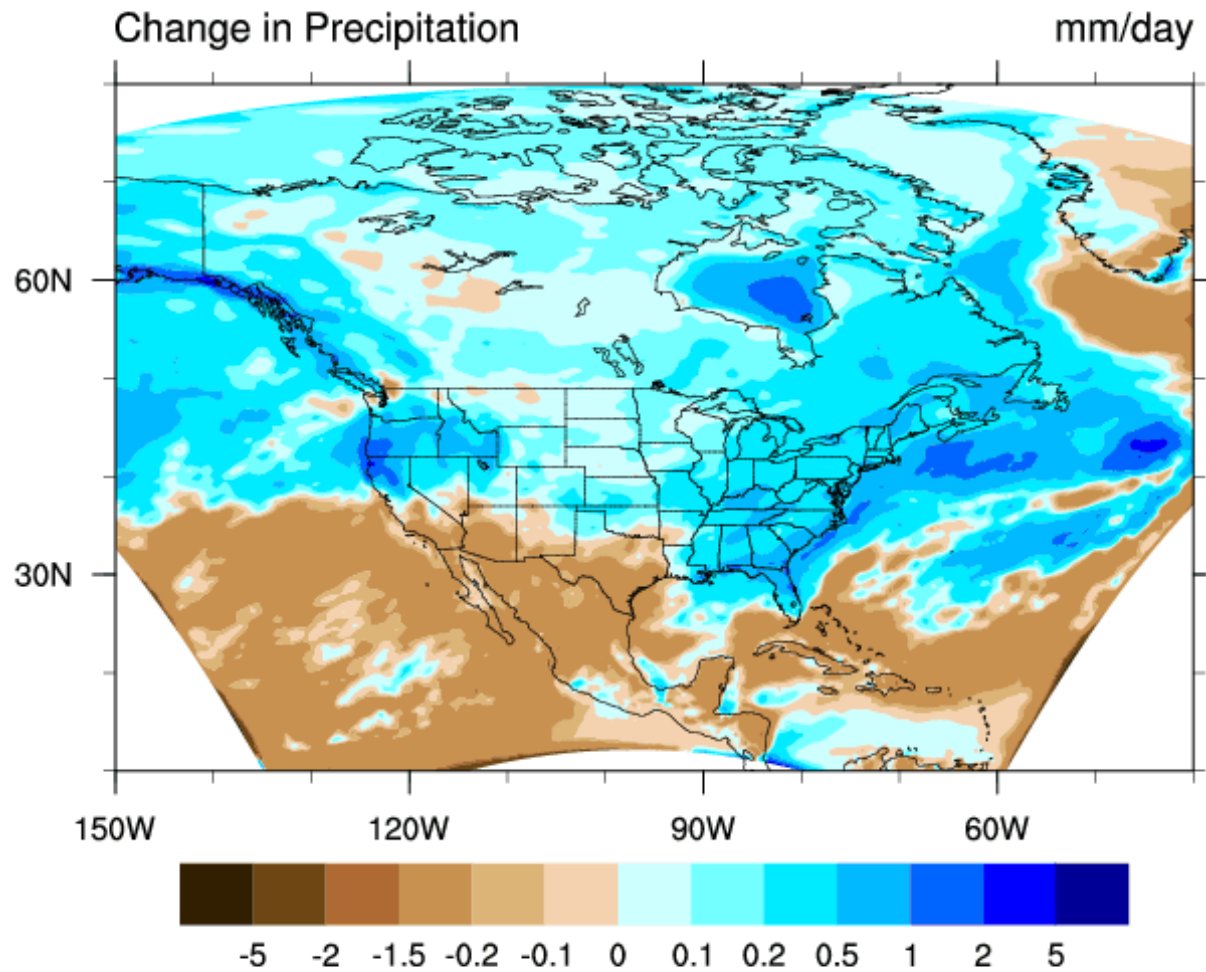
RegCM4-HadGEM2 NAM-22 rcp85 DJF

Change in Precipitation

mm/day

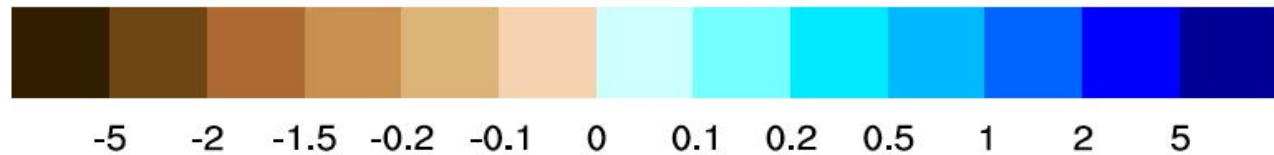
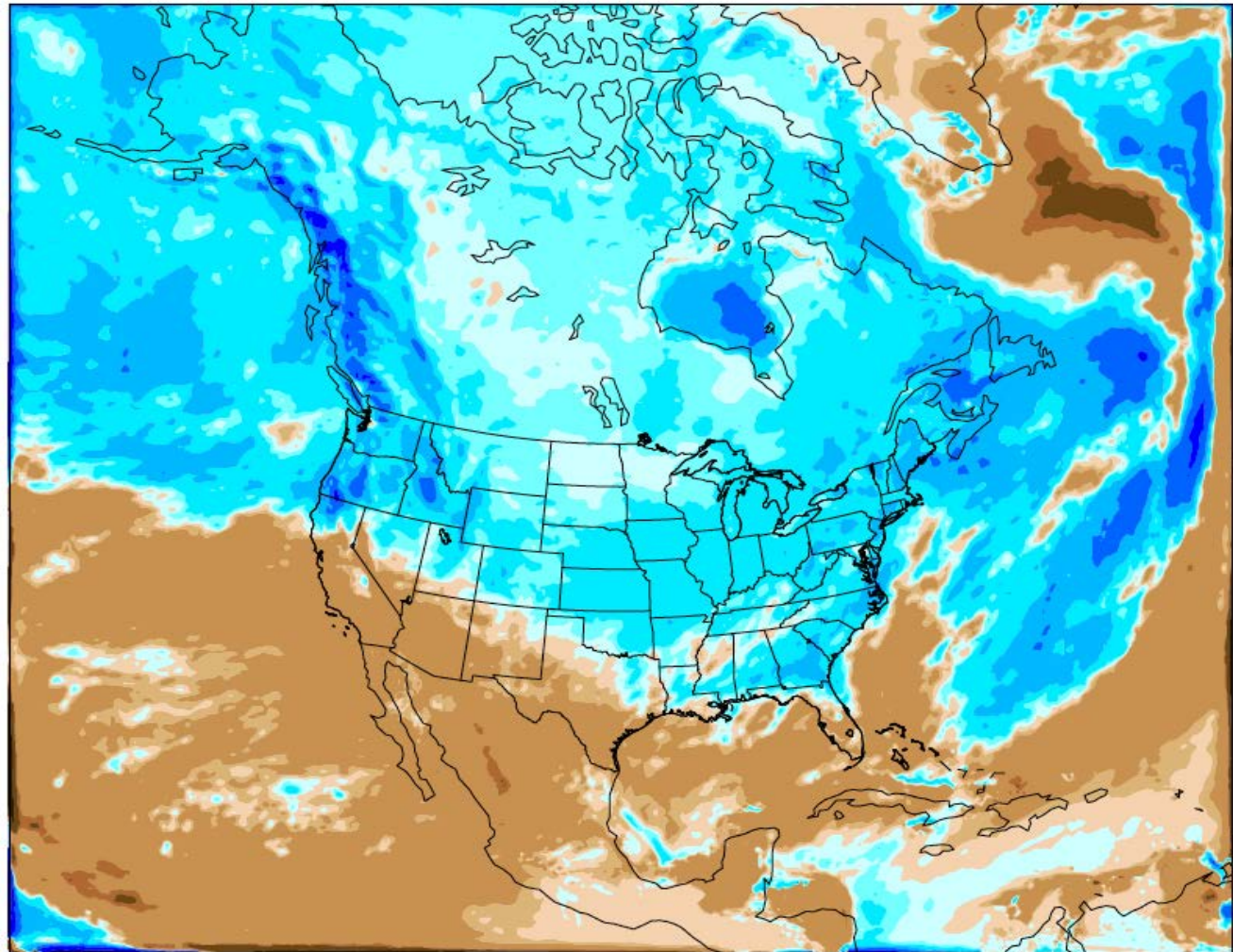


RegCM4-GFDL NAM-44 rcp85 DJF



RegCM4
.22

Mean total precipitation flux DJF difference mm/day



NCAR

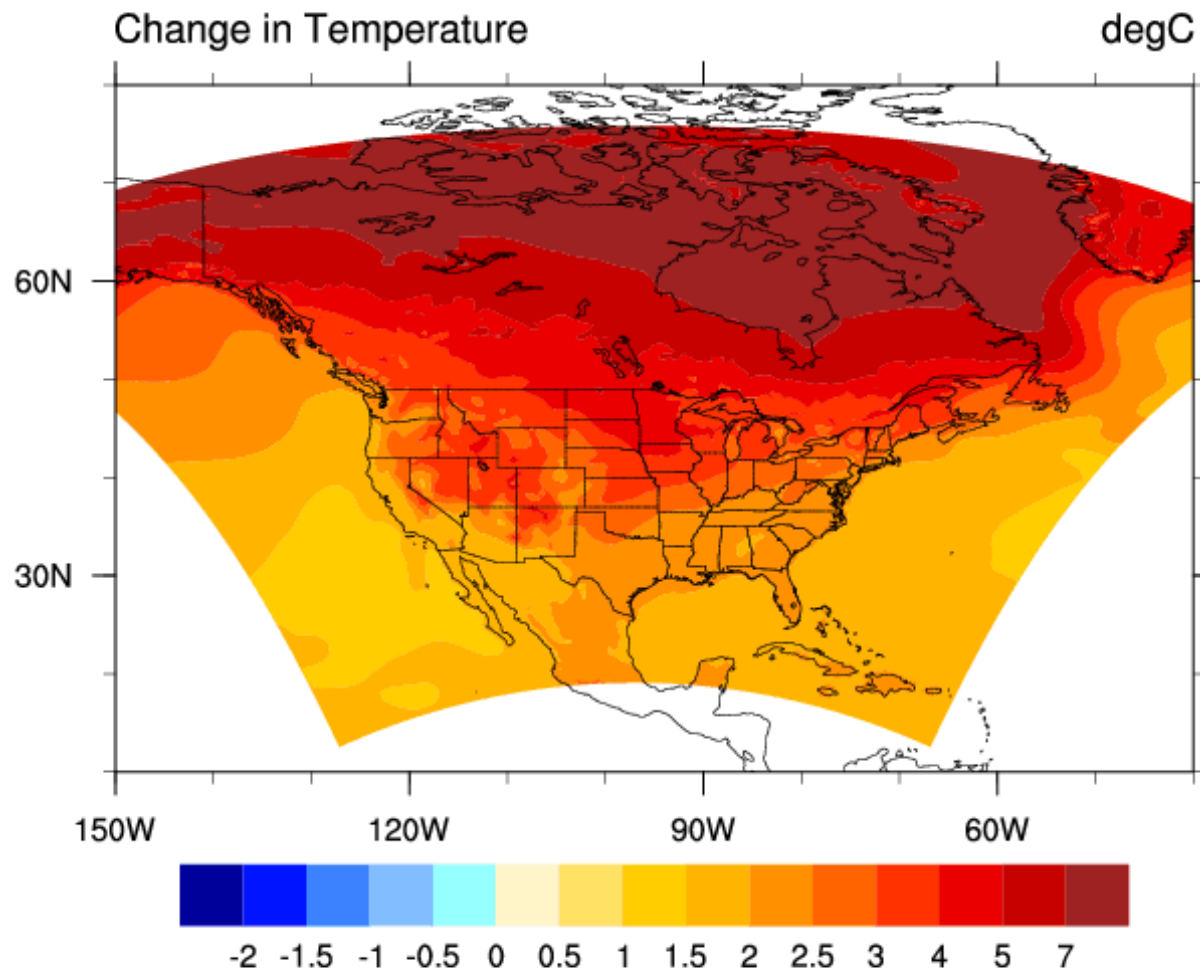


NCAR

Temperature Change



RCA4-EC-EARTH NAM-44 rcp85 DJF

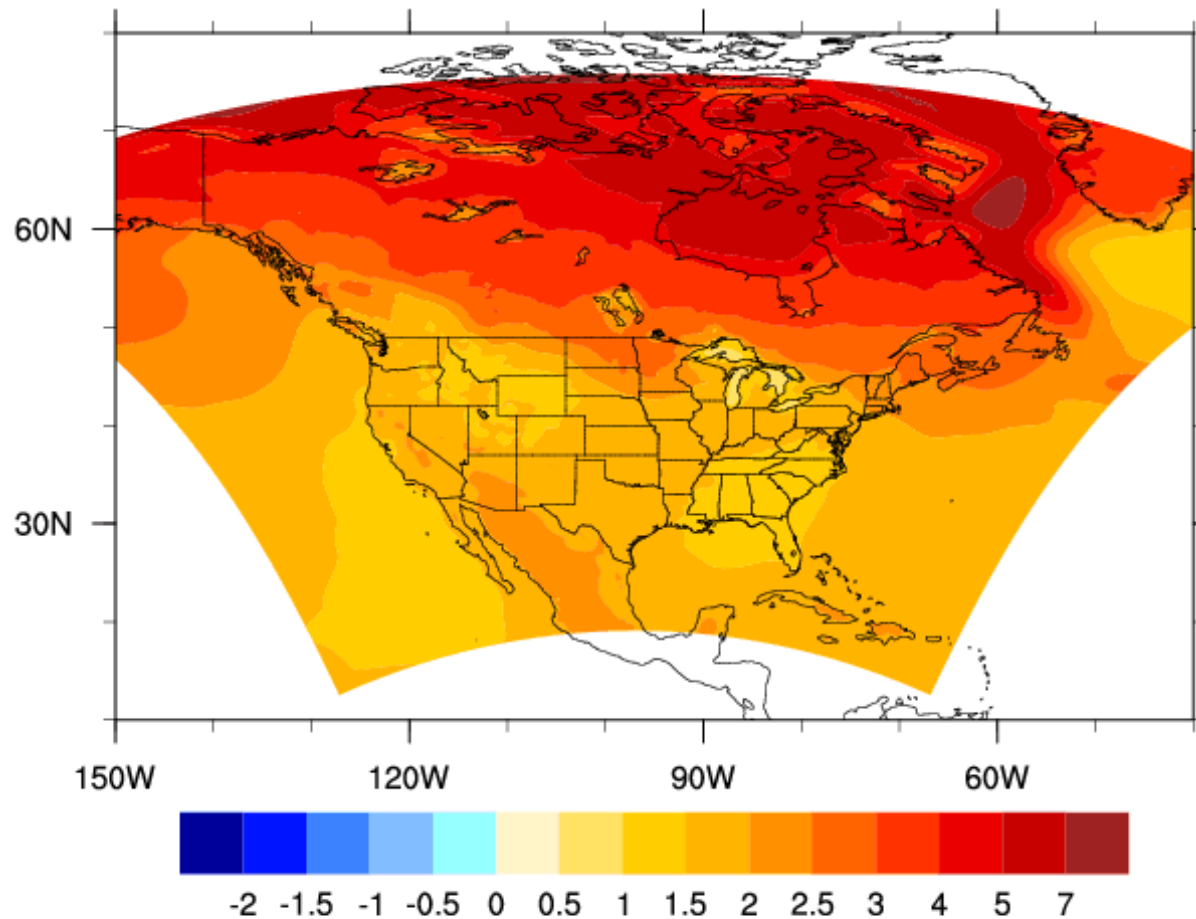


HIRHAM5-EC-EARTH NAM-44 rcp85 DJF

NCAR

Change in Temperature

degC





NCAR

Temperature Change

GFDL-CM2.1

GFDL-ESM2M

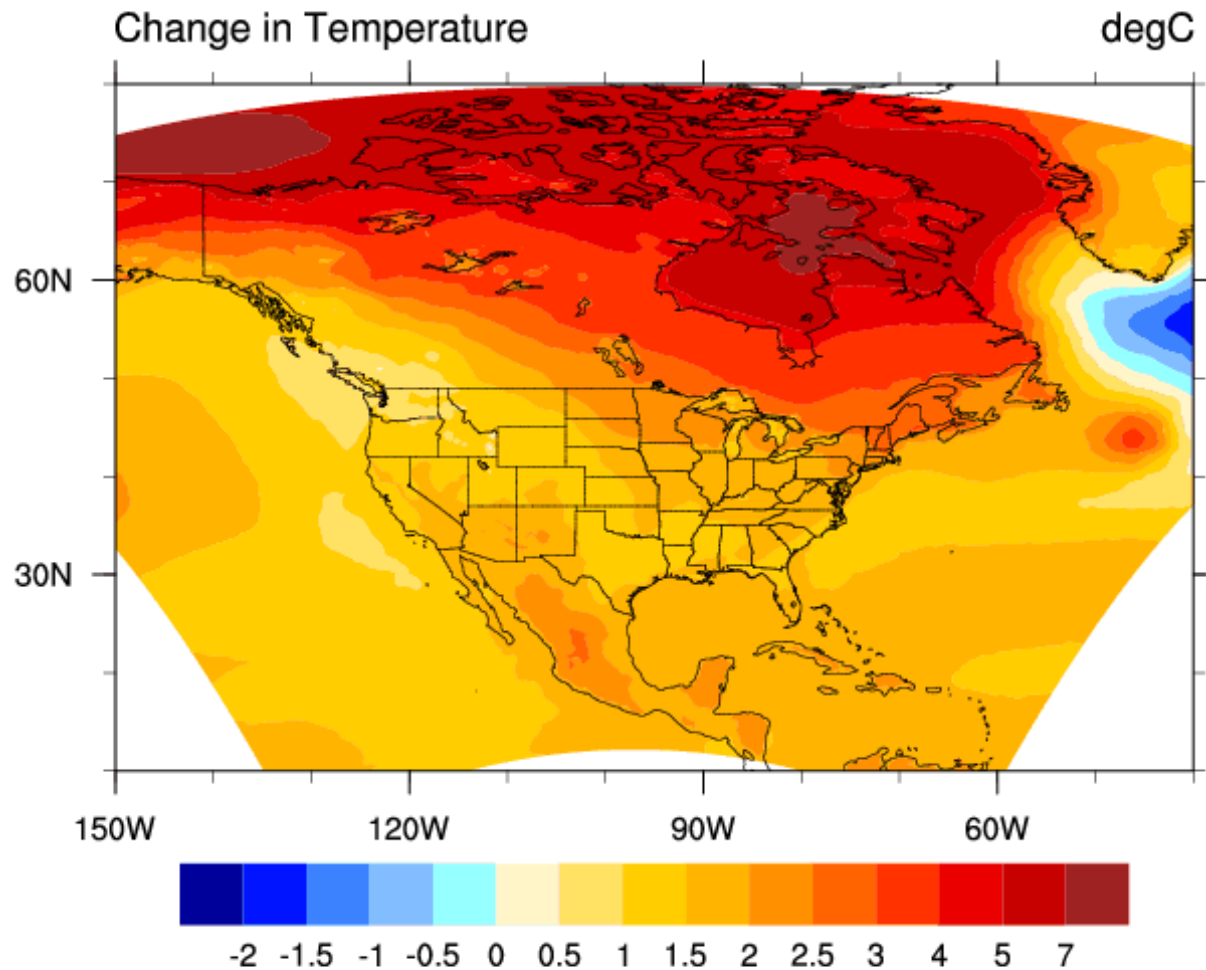


RegCM3



RegCM4

RegCM4-GFDL NAM-44 rcp85 DJF

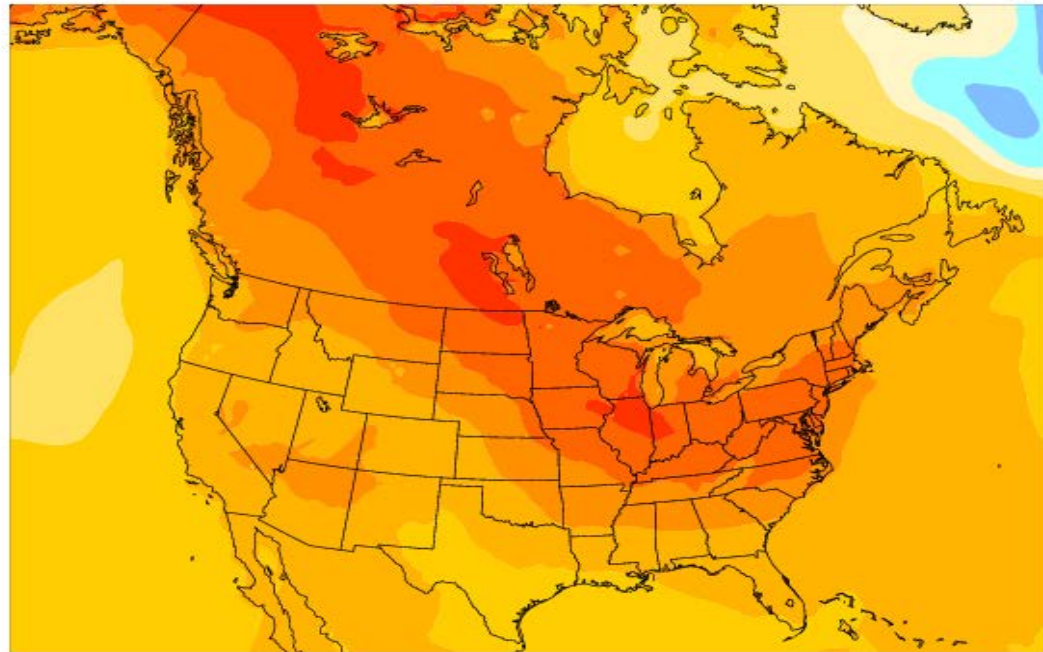


NARCCAP Winter

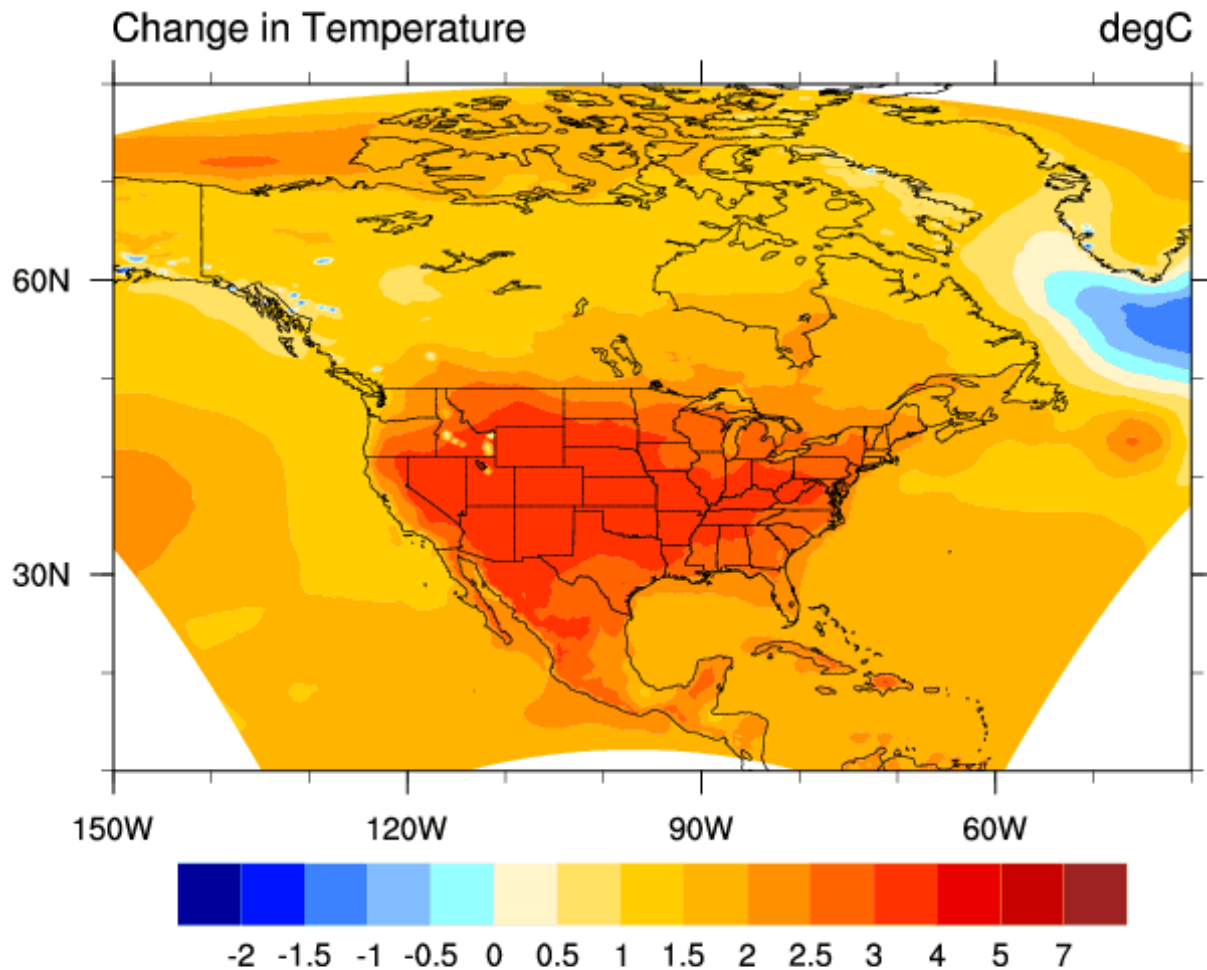
RCM3-gfdl DJF Temperature

Change in seasonal average

degC



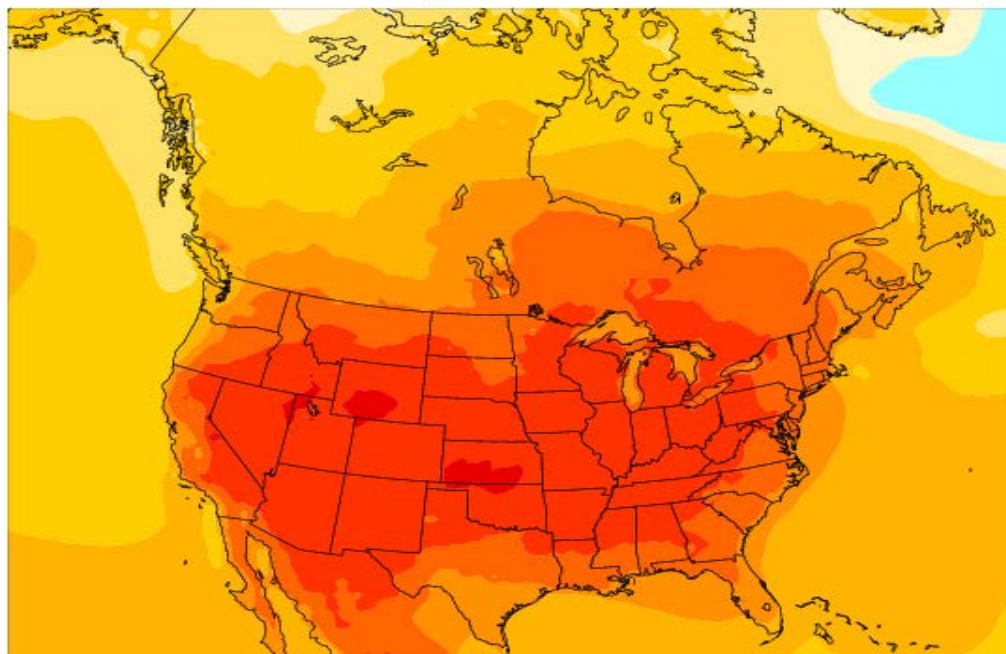
RegCM4-GFDL NAM-44 rcp85 JJA



RCM3-gfdl JJA Temperature

Change in seasonal average

degC



-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 4 5 7

So Now What?



NCAR

- Finish WRF runs (HadGEM, GFDL)
- Archive data (daily for most variables and perhaps subdaily for precipitation)
- Do bias corrections on surface variables
- Work with Ouranos on production of threshold event frequencies (through PAVICS program)
- Perform analyses on winter precipitation in south central and in the Colorado Basin (for DoD)
- Opportunity for some results to be used in the next US NCA

The END?

