Climate Change in the Pacific Northwest: Do Global Models Tell the Whole Story?

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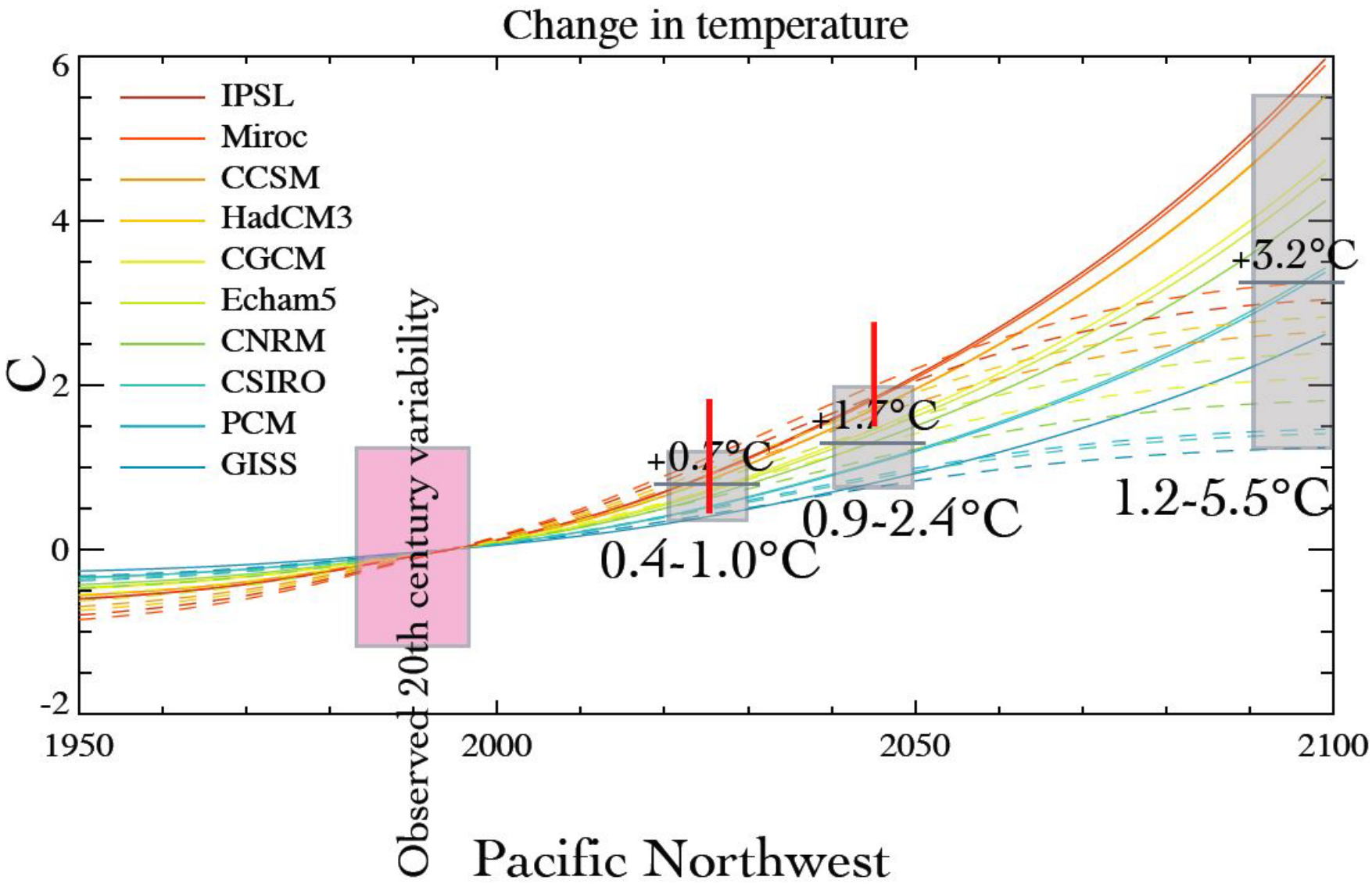
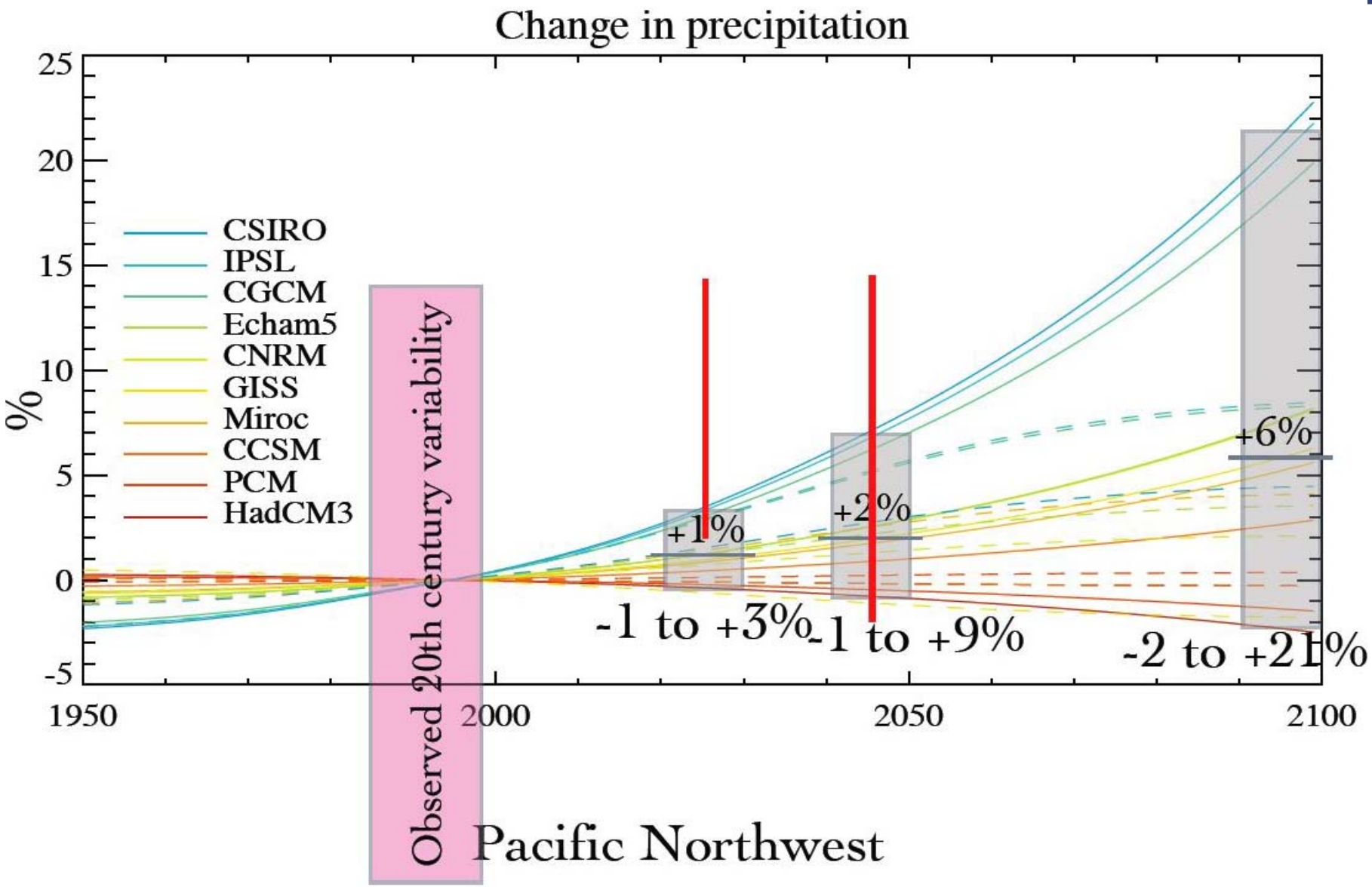
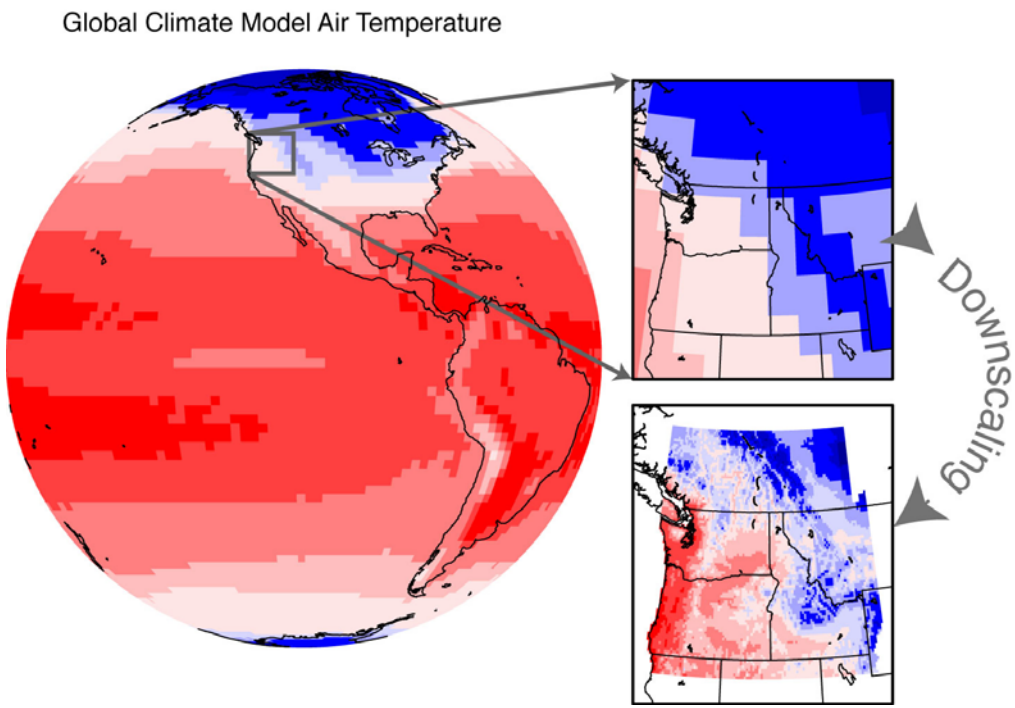
IPCC Scenarios for Pacific Northwest Climate Change



IPCC Scenarios for Pacific Northwest Climate Change



Downscaling Methods Used in CIG Impacts studies



Empirical Downscaling

• *Assumes climate model captures temperature and precipitation trends*

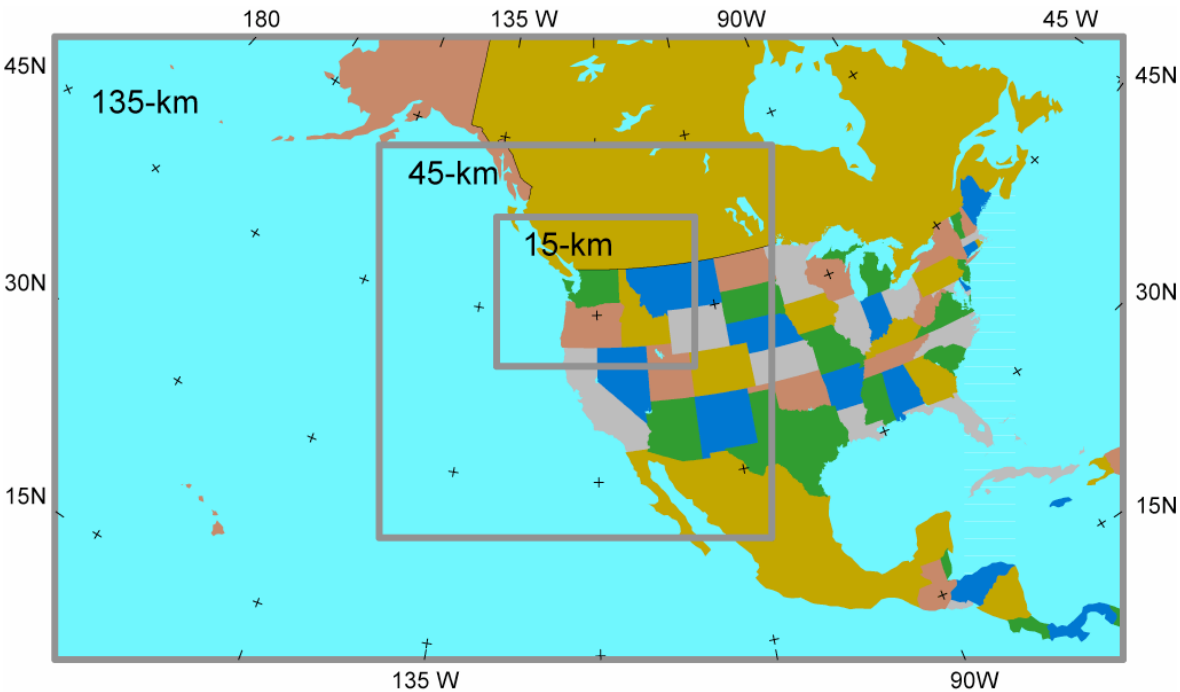
Regional Climate Model

•*Represents regional weather processes*

• *May produce local trends not depicted by global models*

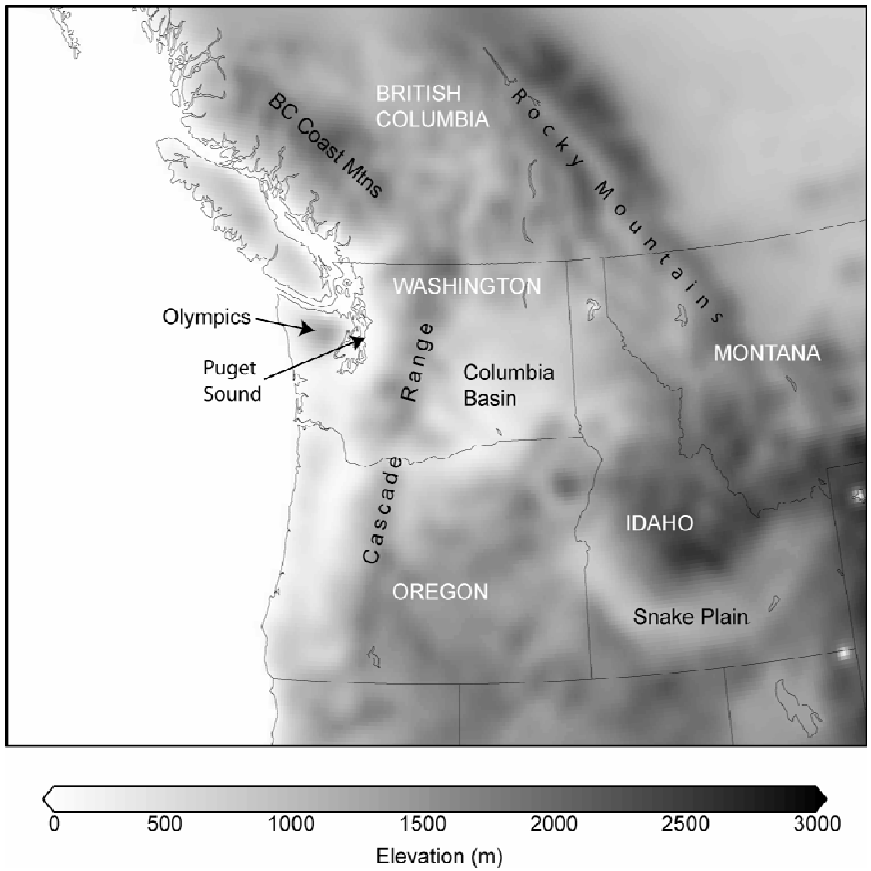
Mesoscale Climate Model -- MM5

- Based on **MM5 Weather Model**
- ECHAM5 Climate Model used to force Mesoscale Simulation
- Nested grids 135-45-**15** km
- **Nudging** on outermost grid by forcing **global model**
- Advanced land-surface model (NOAH) with interactive deep soil temperature

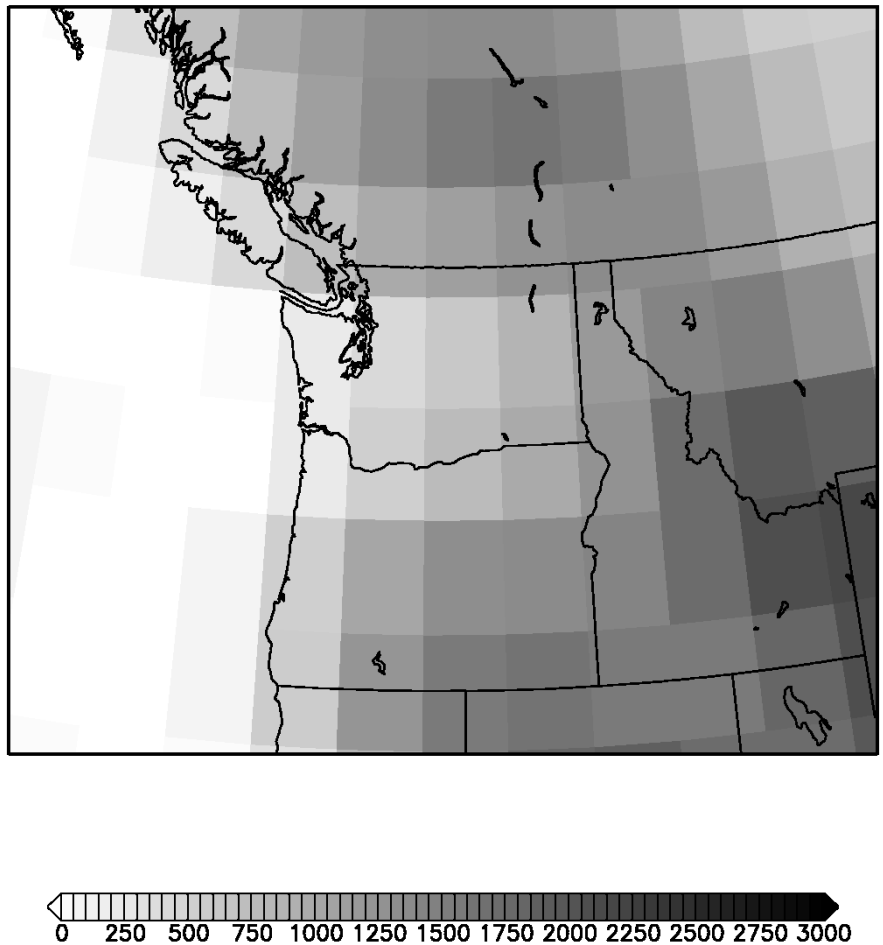


Model Topography and Resolution

MM5 Topo (15 km)



ECHAM5 Topo (150km)



More Rain

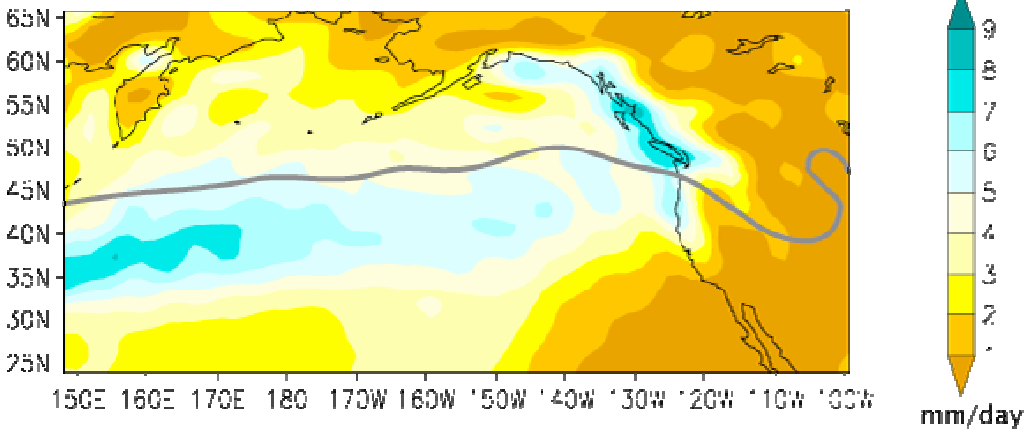
Shift in Pacific Storm Track

1950-2000 to 2050-2100 Nov-Dec-Jan

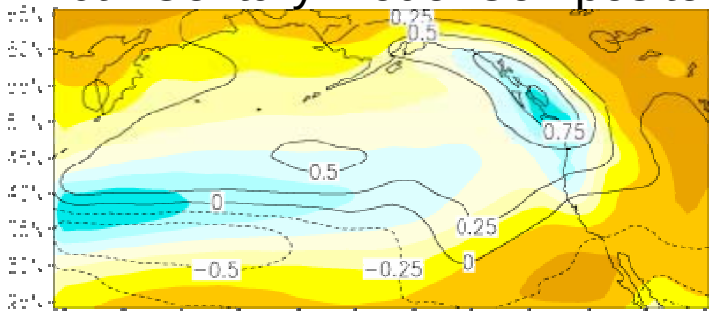
Composite of 10 Global Models

“Observed” Climate

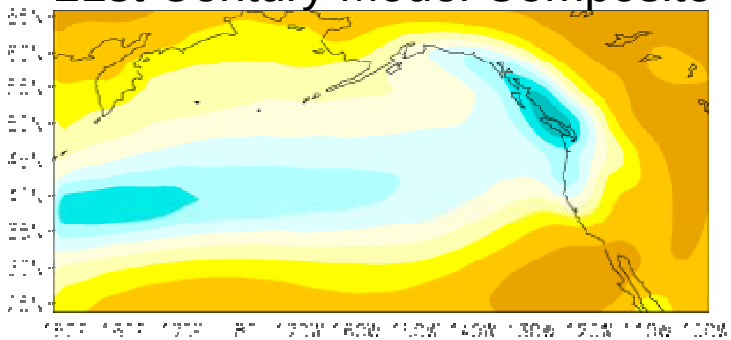
NCEP-NCAR Reanalysis



20th Century Model Composite

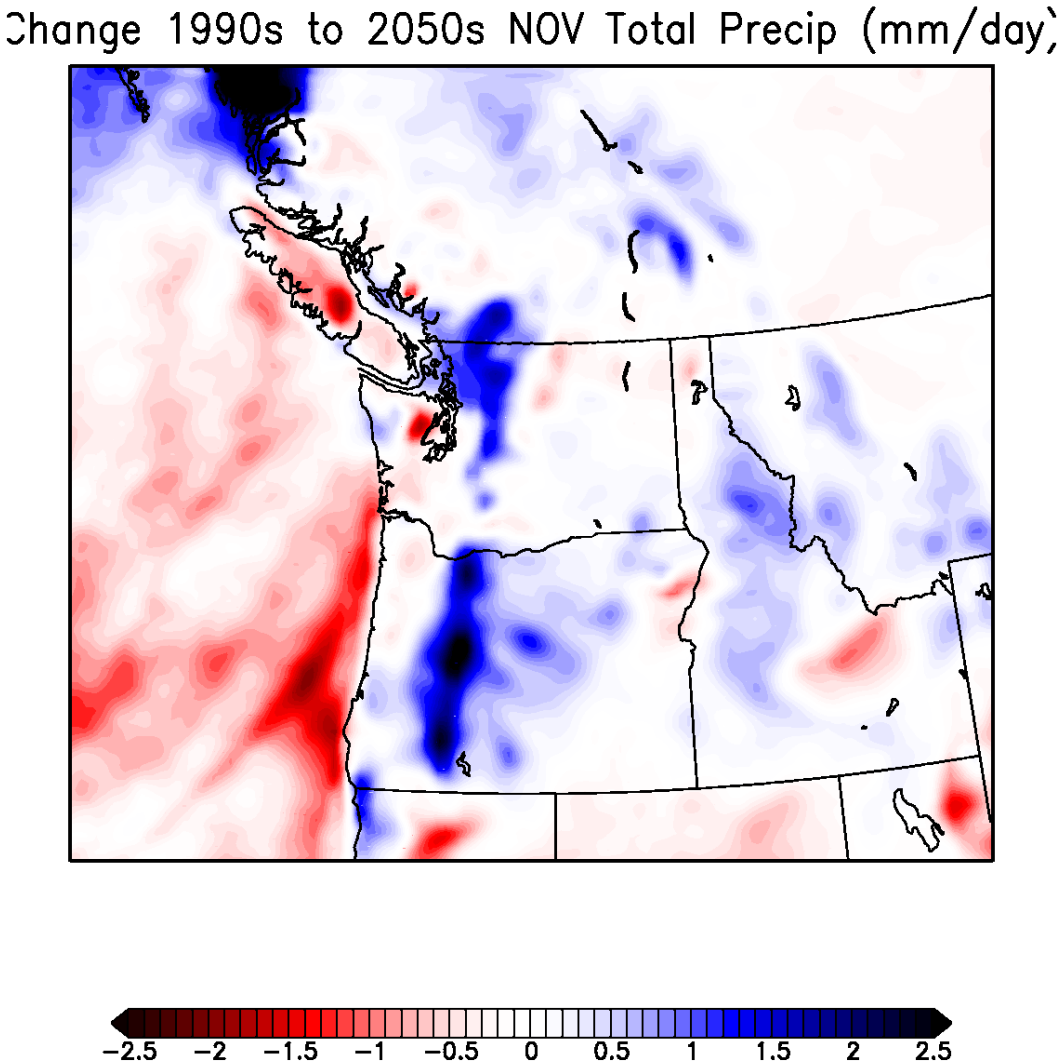


21st Century Model Composite



Salathé, Geophys Res Lett, 2006

MM5 Result for November



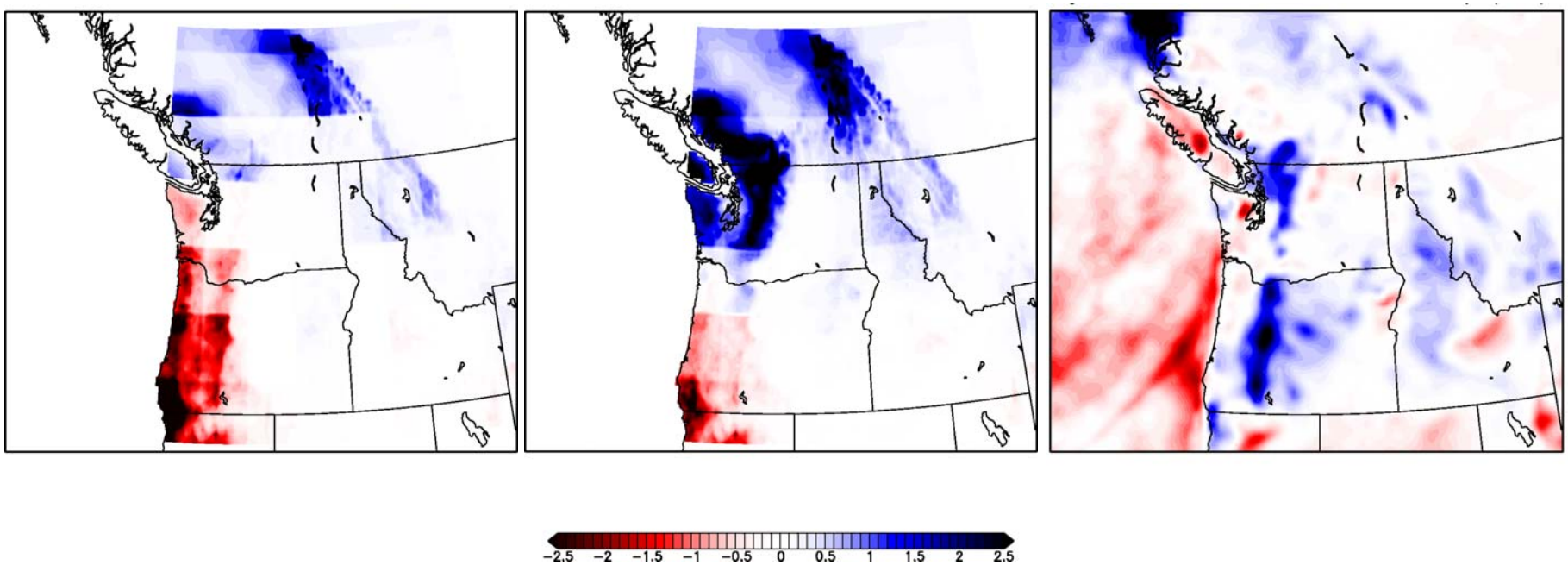
MM5 vs Statistical Downscaling

Statistical Downscaling

Precip only

Precip & Winds

MM5

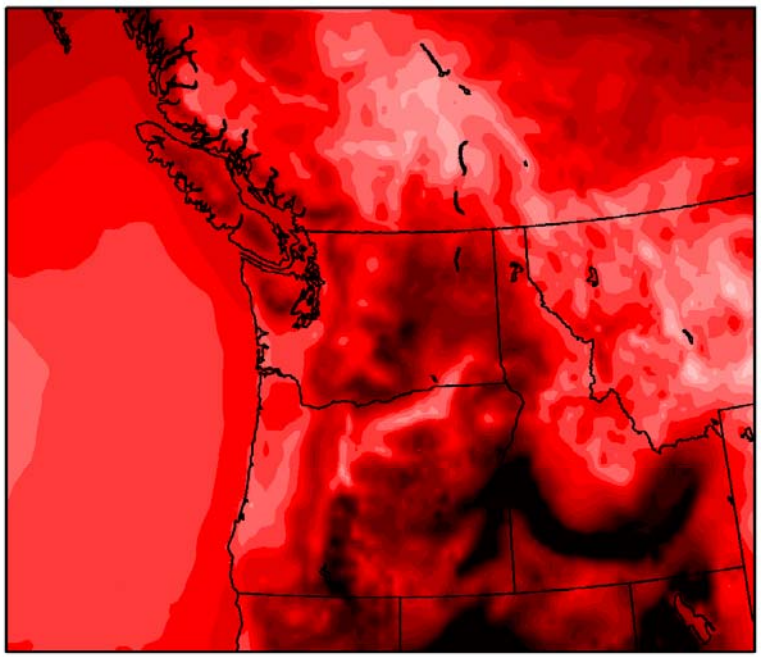


Change in November Precip (mm/day)
1990s to 2050s

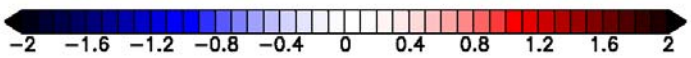
More Warming

Winter Warming in MM5

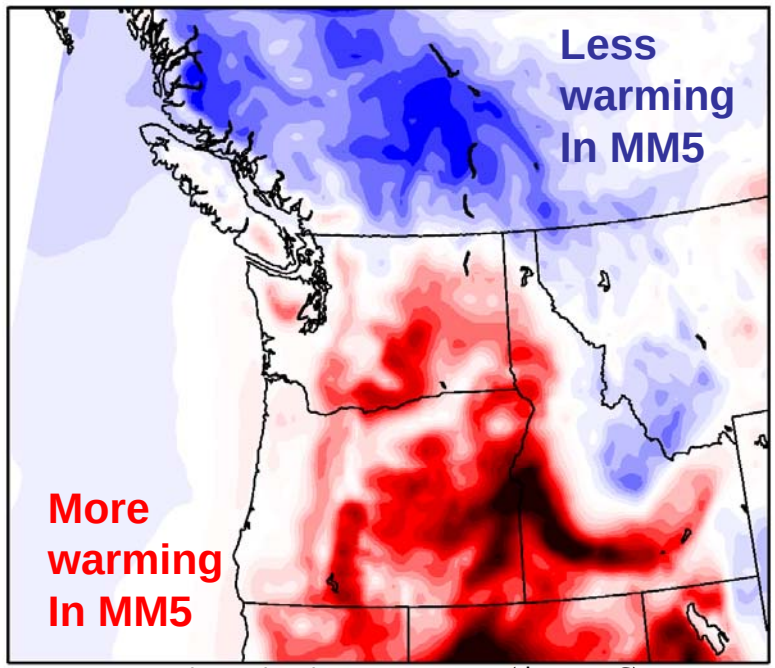
1990s to 2050s Temperature Change



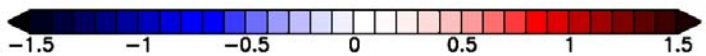
Change in Winter Temperature (degrees C)



Difference between MM5 and ECHAM5

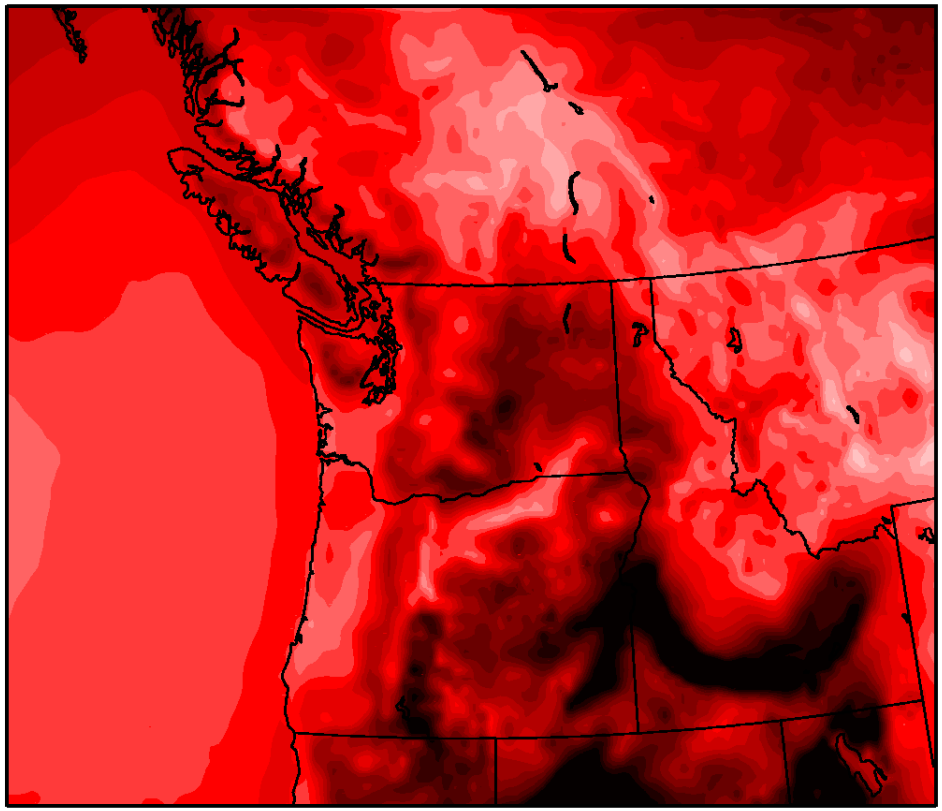


Change in Winter Temperature (degrees C)



Loss of Snow cover and Warming

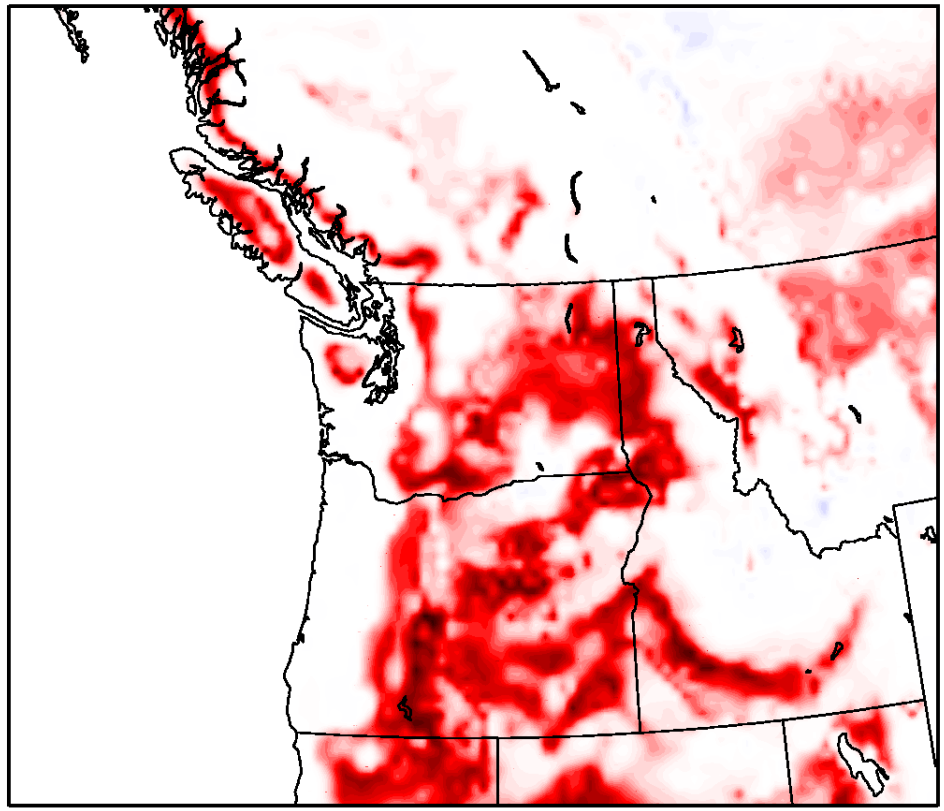
Temperature Change



Change in Winter Temperature (degrees C)

−2 −1.6 −1.2 −0.8 −0.4 0 0.4 0.8 1.2 1.6 2

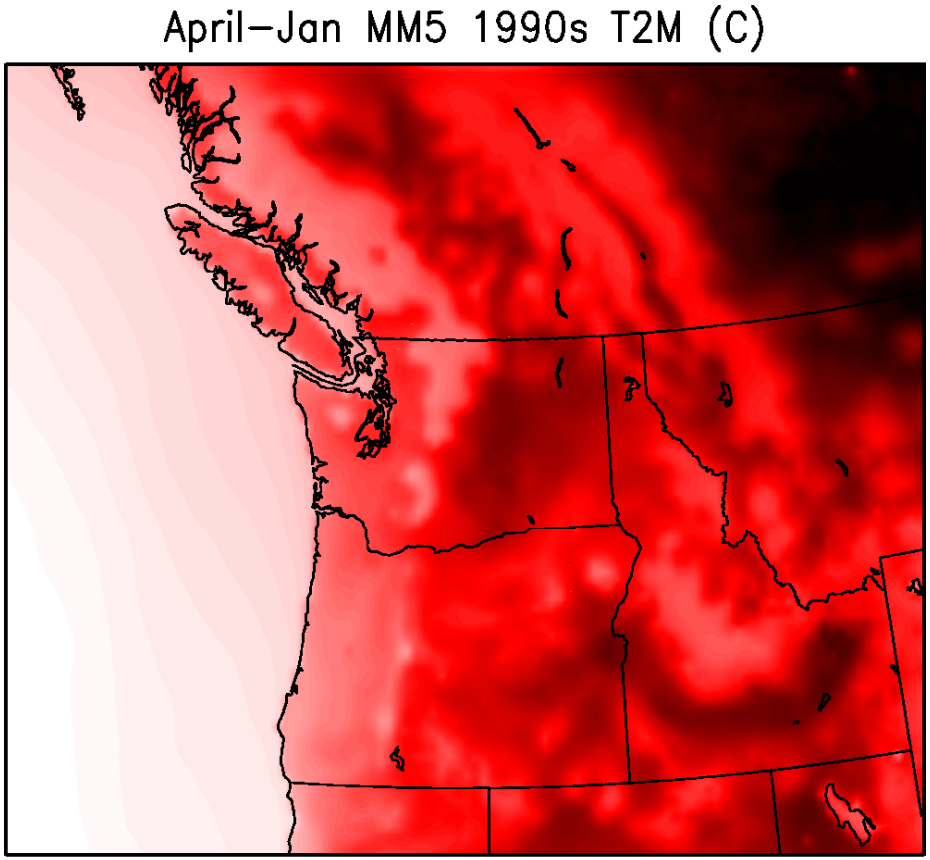
Snow Cover Change

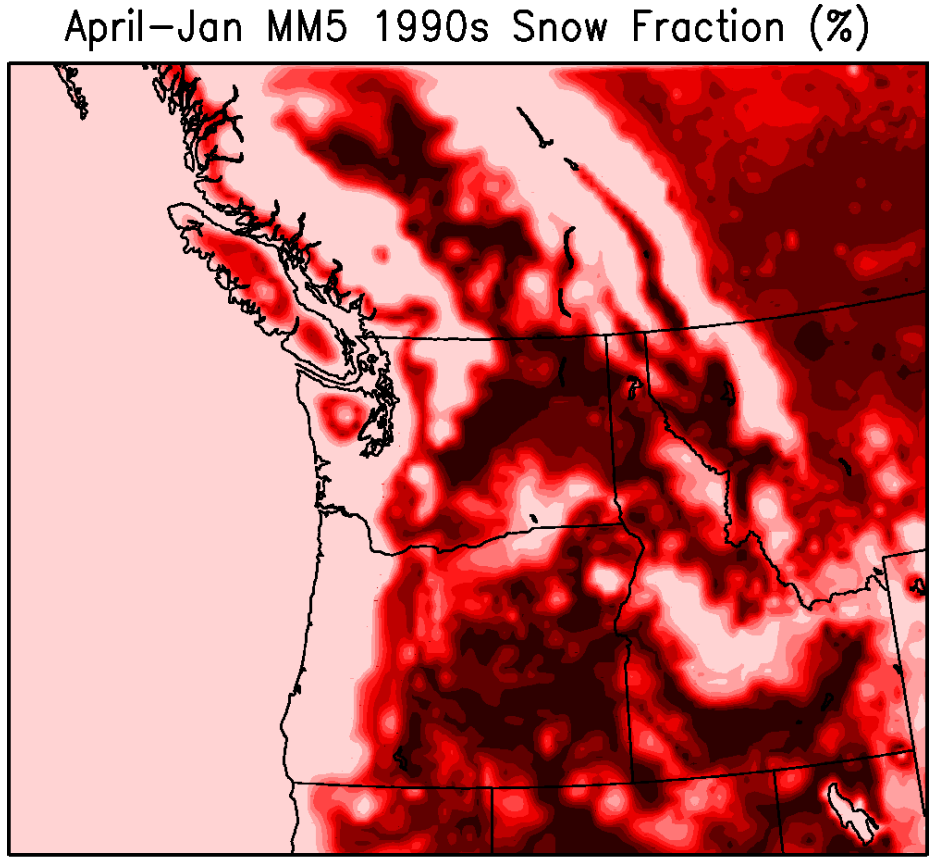


Change in fraction of days with snow cover

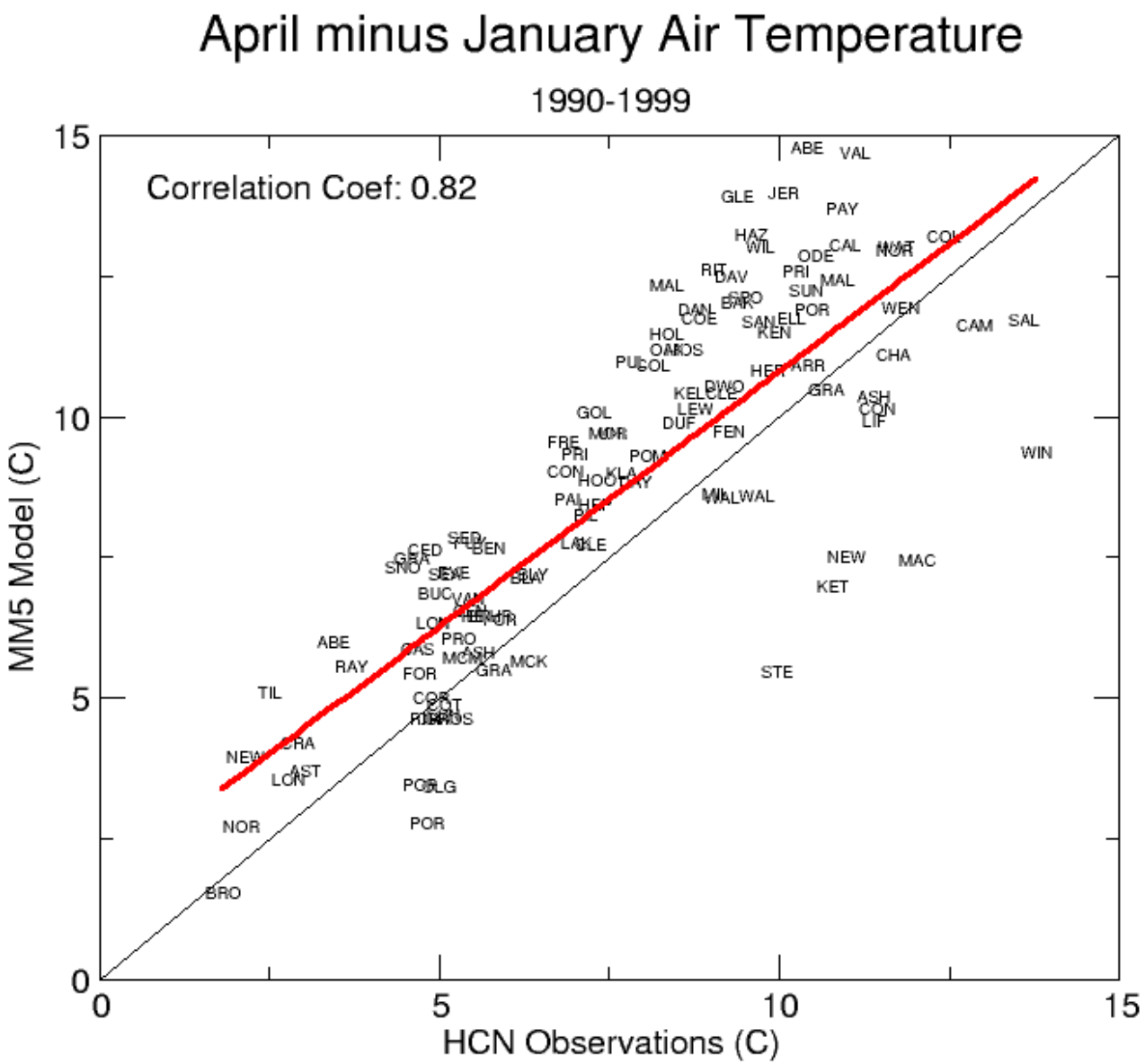
−0.5 −0.4 −0.3 −0.2 −0.1 0 0.1 0.2 0.3 0.4 0.5

January to April in MM5



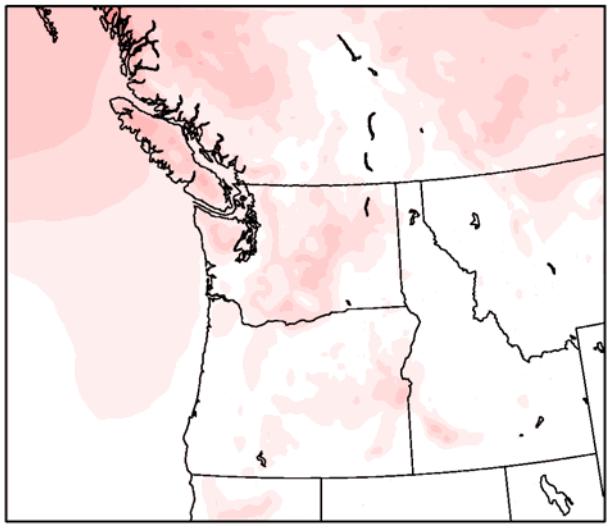


Comparison of MM5 and HCN Observations

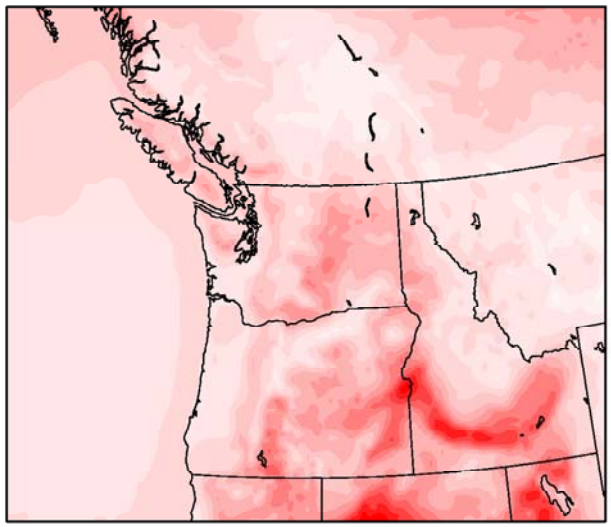


Consistent trend over 21st Century

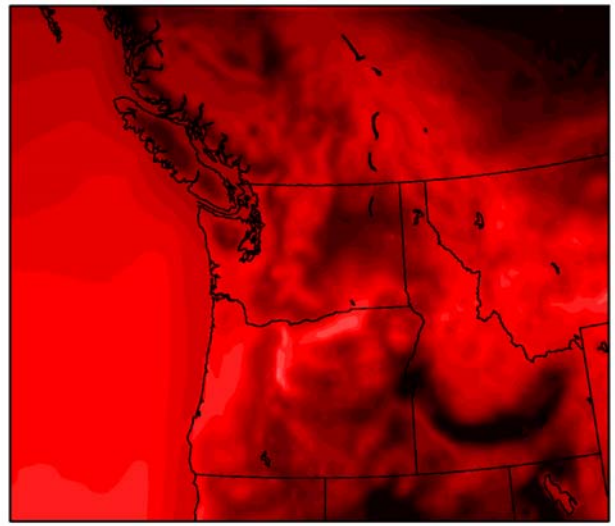
2020s



2050s



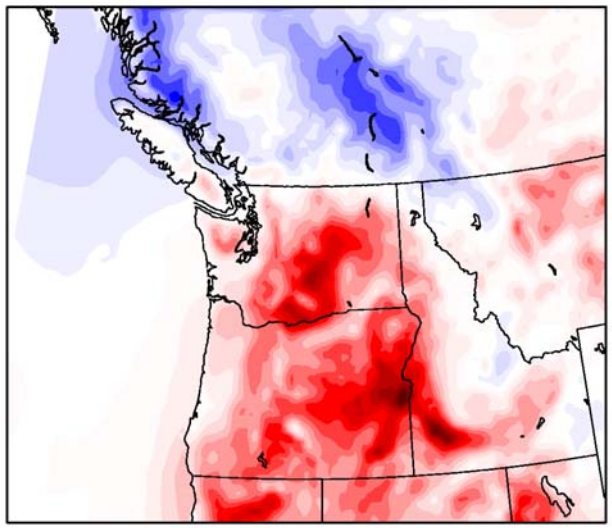
2090s



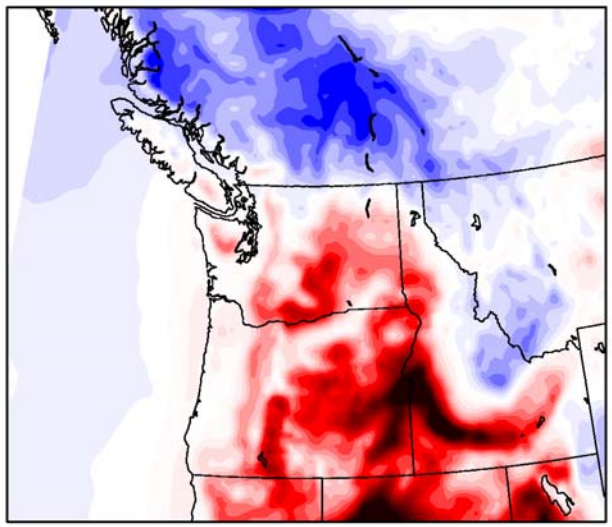
Change in Winter Temperature (degrees C)

Regional Model Compared to Global Model

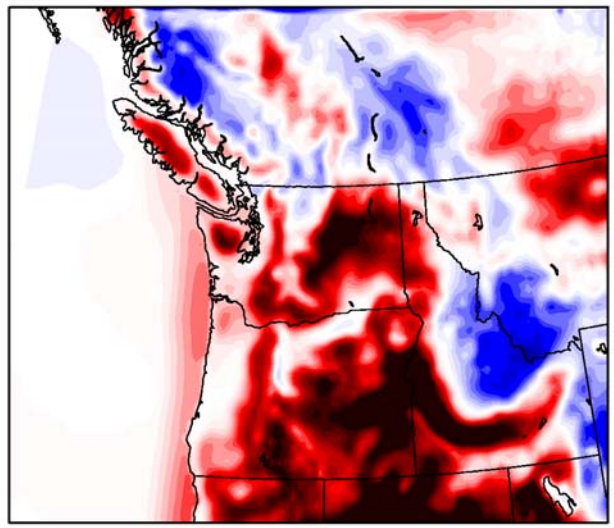
2020s

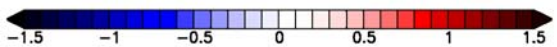


2050s



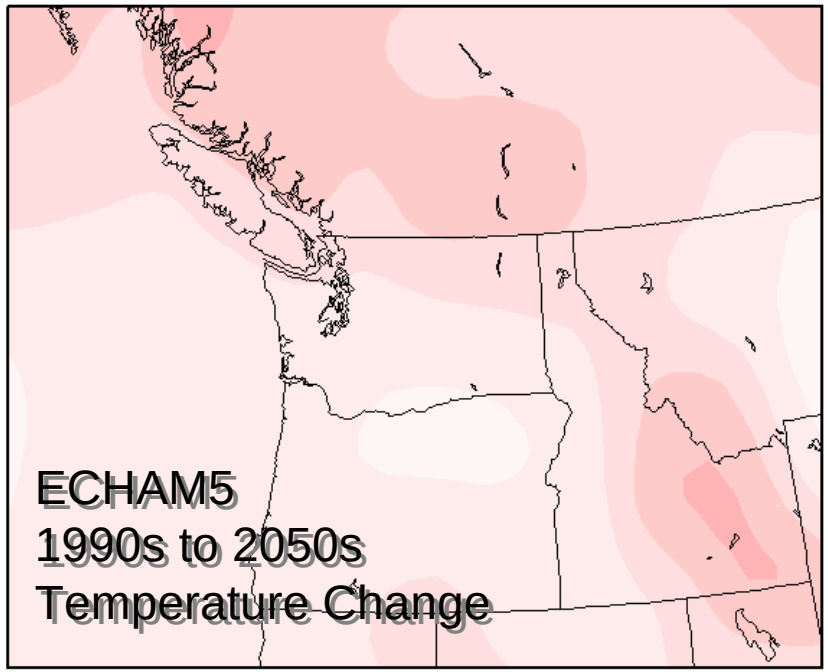
2090s

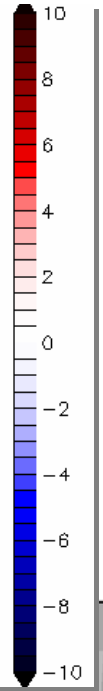


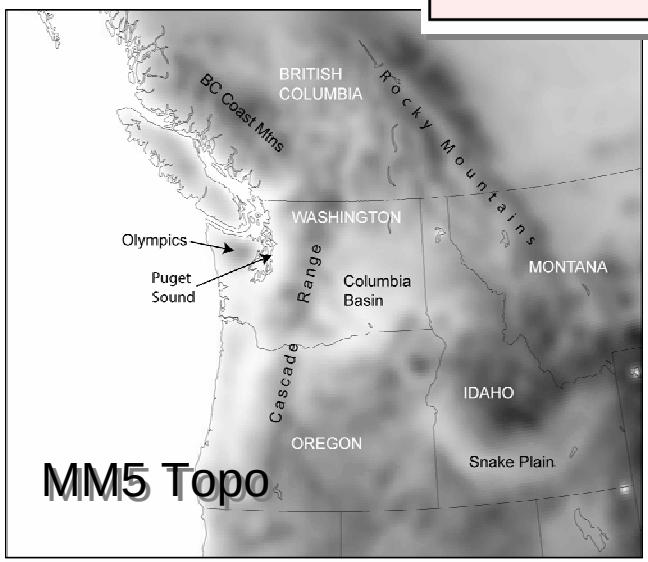


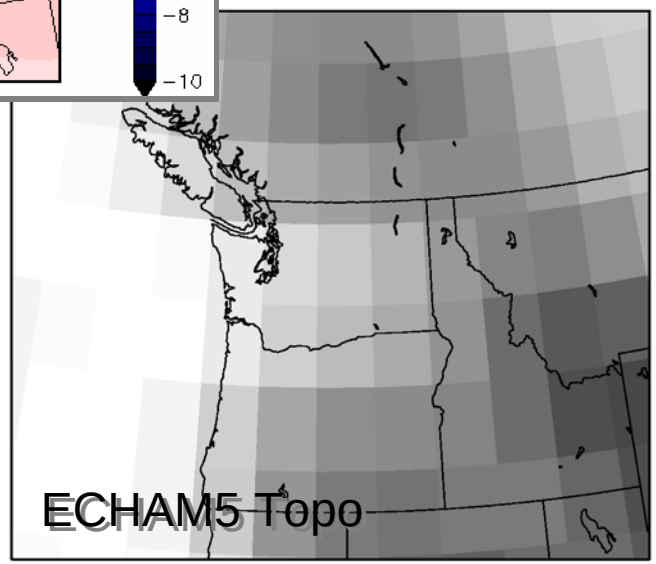
Change in Winter Temperature (degrees C)

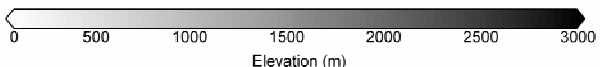
Overestimate in global model

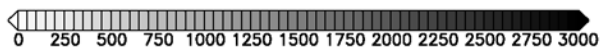






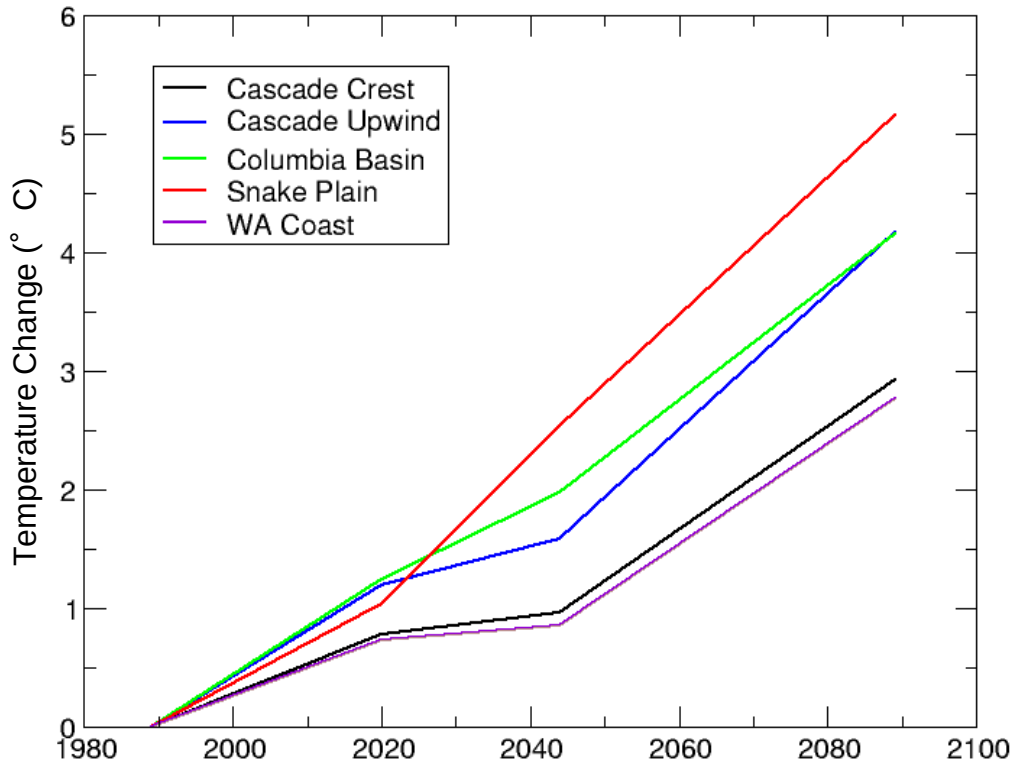






Winter Trends at Various Stations

MM5 - ECHAM5



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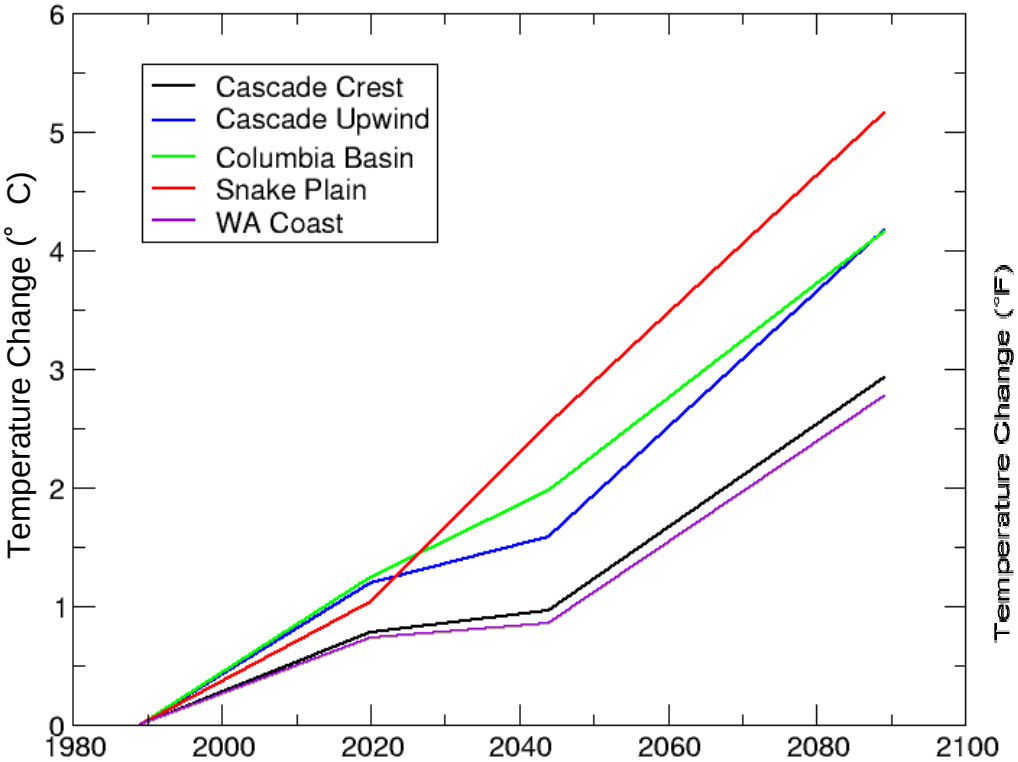
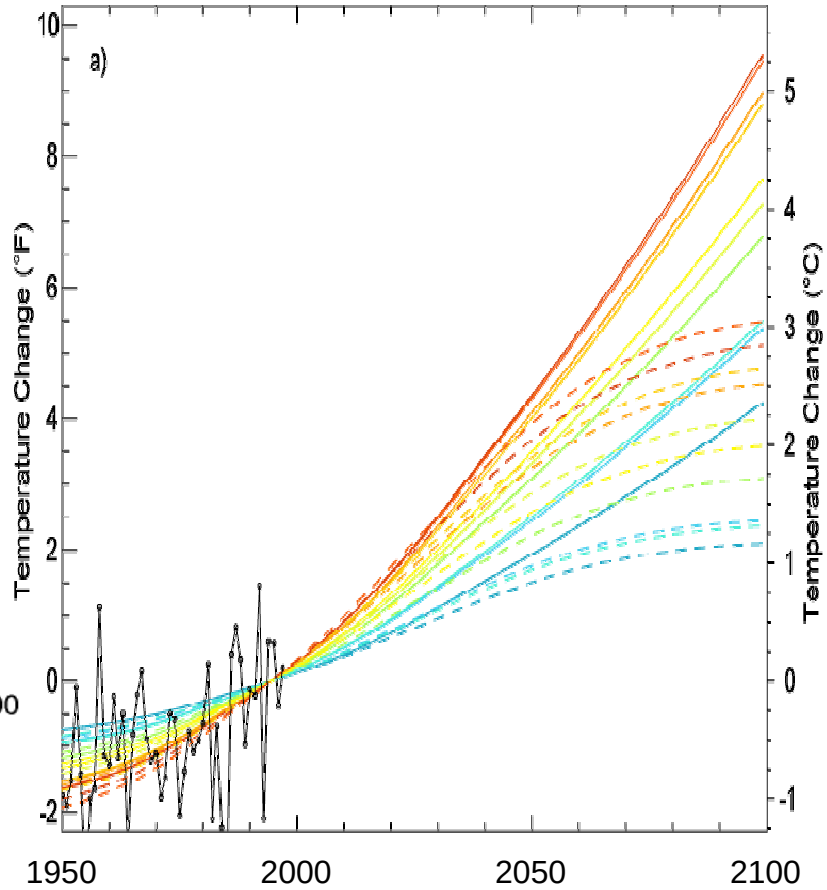


10 IPCC Models



Summary

Do Global Models Tell the Whole Story?

NO

- Circulation changes alter the orographic influences on precipitation
- Snow-albedo feedback works at very fine scales and produces large regional variations in warming