Projections and Uncertainties Concerning Climate Impacts on Water Availability in Western Texas

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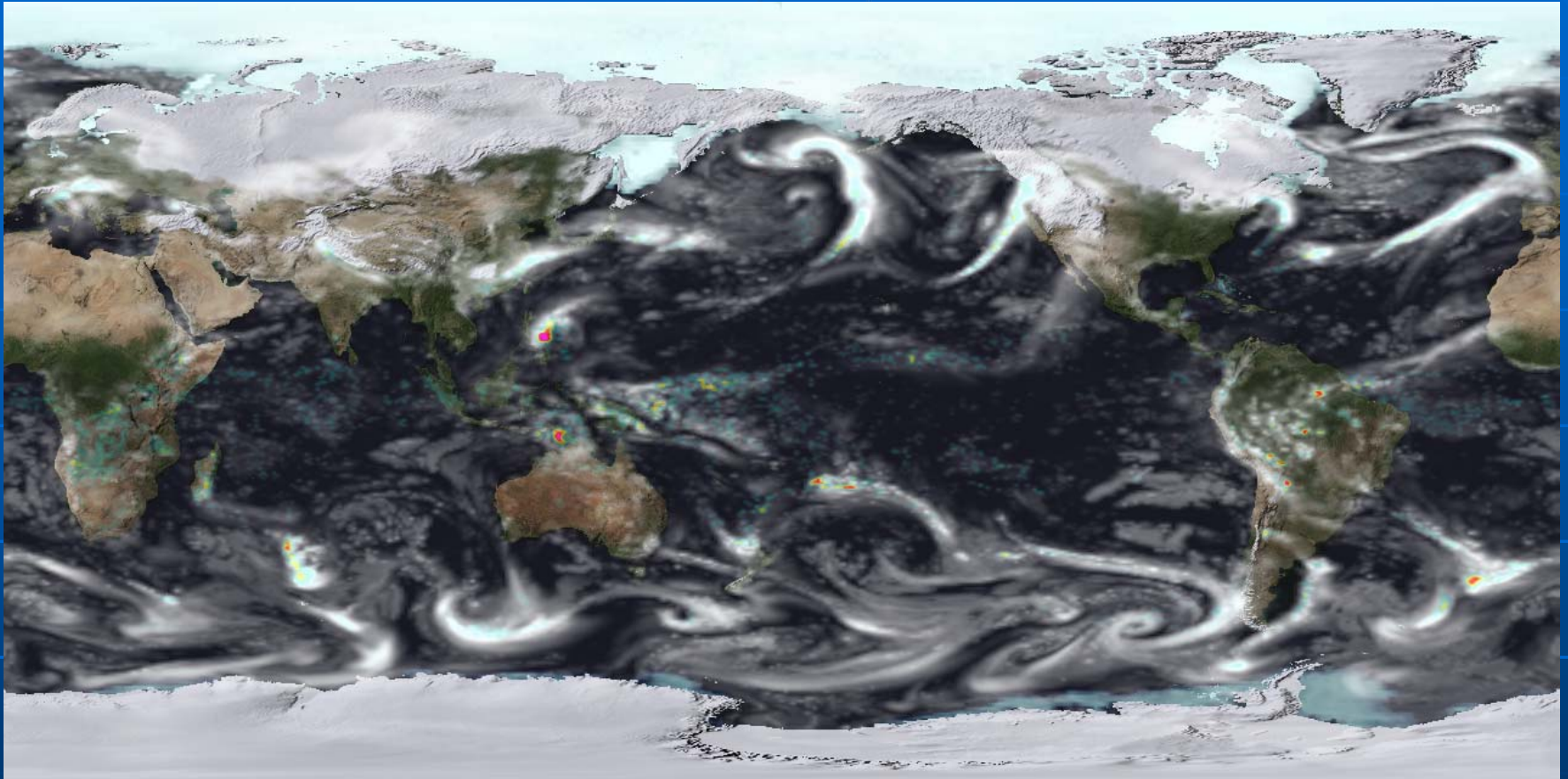JACKSON

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Inputs to a climate model

- sun light
- composition of atmosphere
- topography
- seasonal vegetation
- an understanding of how unresolved scales impact resolved scales and vice versa.

Outputs from a climate model

- winds
- temperature
- precipitation
- evaporation
- clouds
- ocean currents
- ocean salinity

NUGAM (N216 HadGAM1a)   7 FEB 1979 08h UTC   UK-Japan Climate Collaboration
Model by the UJCC Team and UKMO/NCAS collaborators: http://www.earthsimulator.org.uk
Movie by: R. Stöckli (NASA Earth Observatory, USA) and P.L. Vidale (NCAS, UK)

~60km resolution

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Weather versus Climate Models

Climate models only mimic the behavior of weather. They do not predict specific events.

We look to see that the internal variability of a model is broadly consistent with what is observed.

Weather models predict a few days time given information about present conditions.
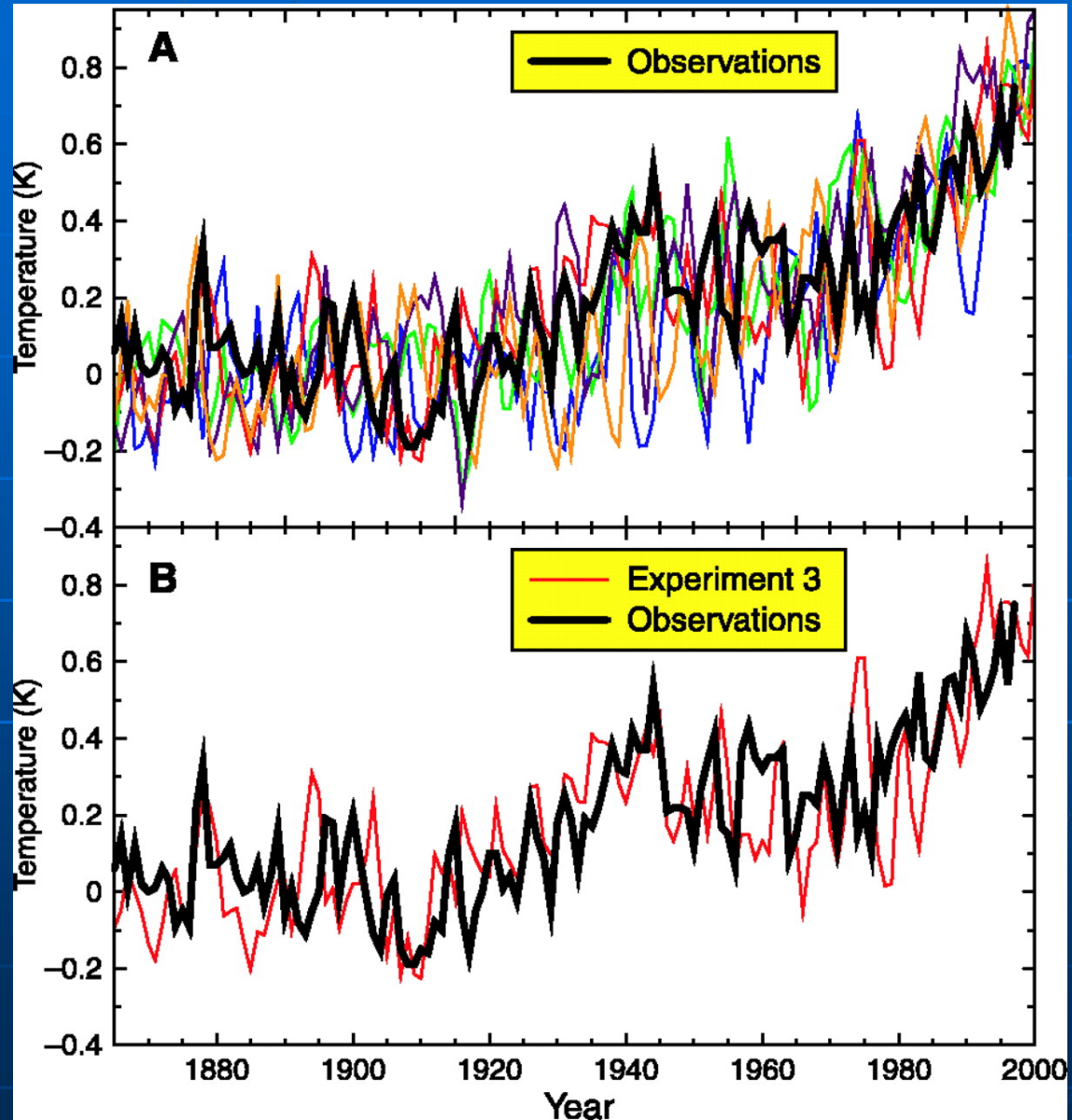
(Delworth and Knutson, 2000)

Response of Different Climate Models to a Doubling of CO_2

(IPCC 2001)
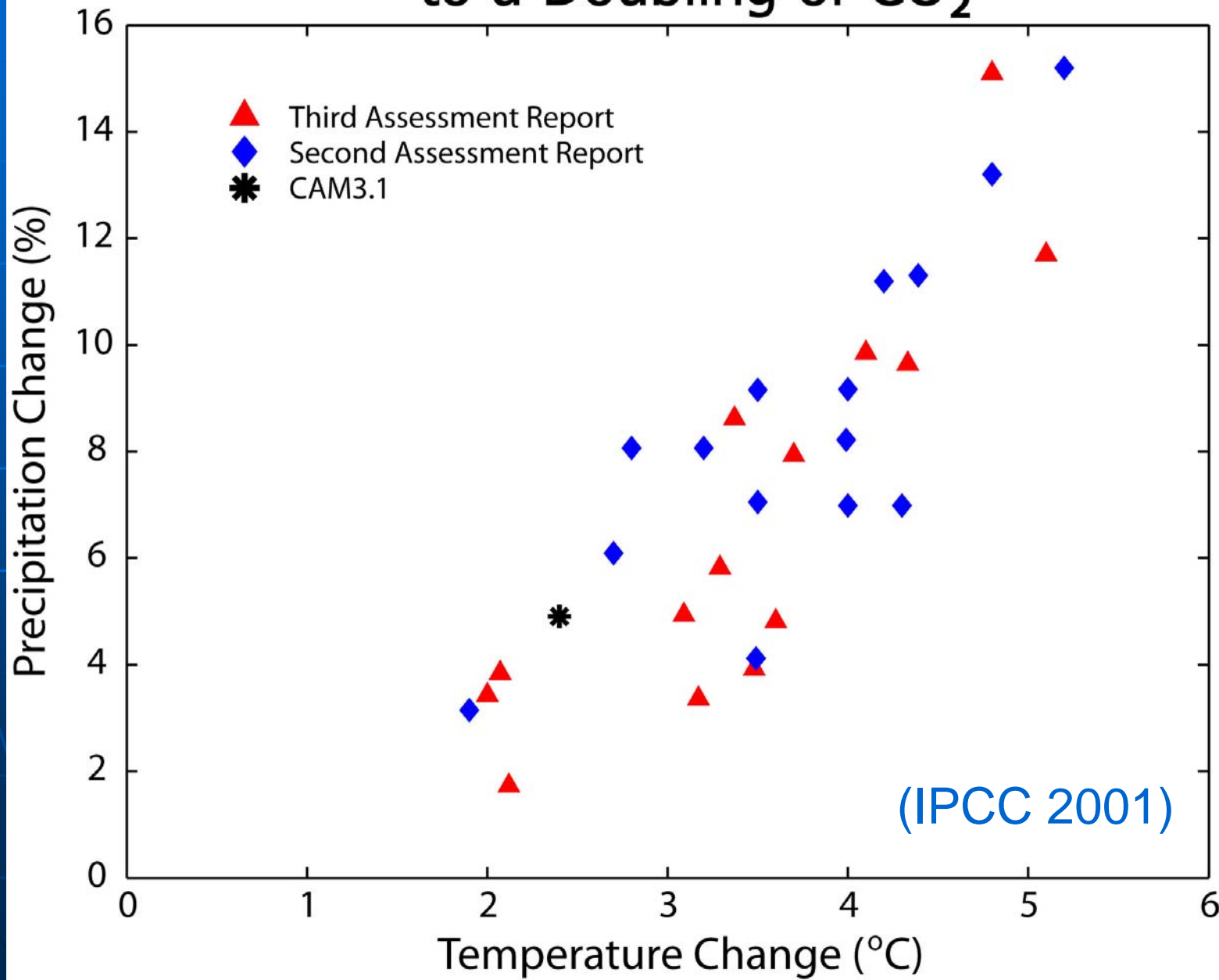
Uncertainty estimation

- Estimate effects of internal variability by repeating climate projections with different starting conditions.

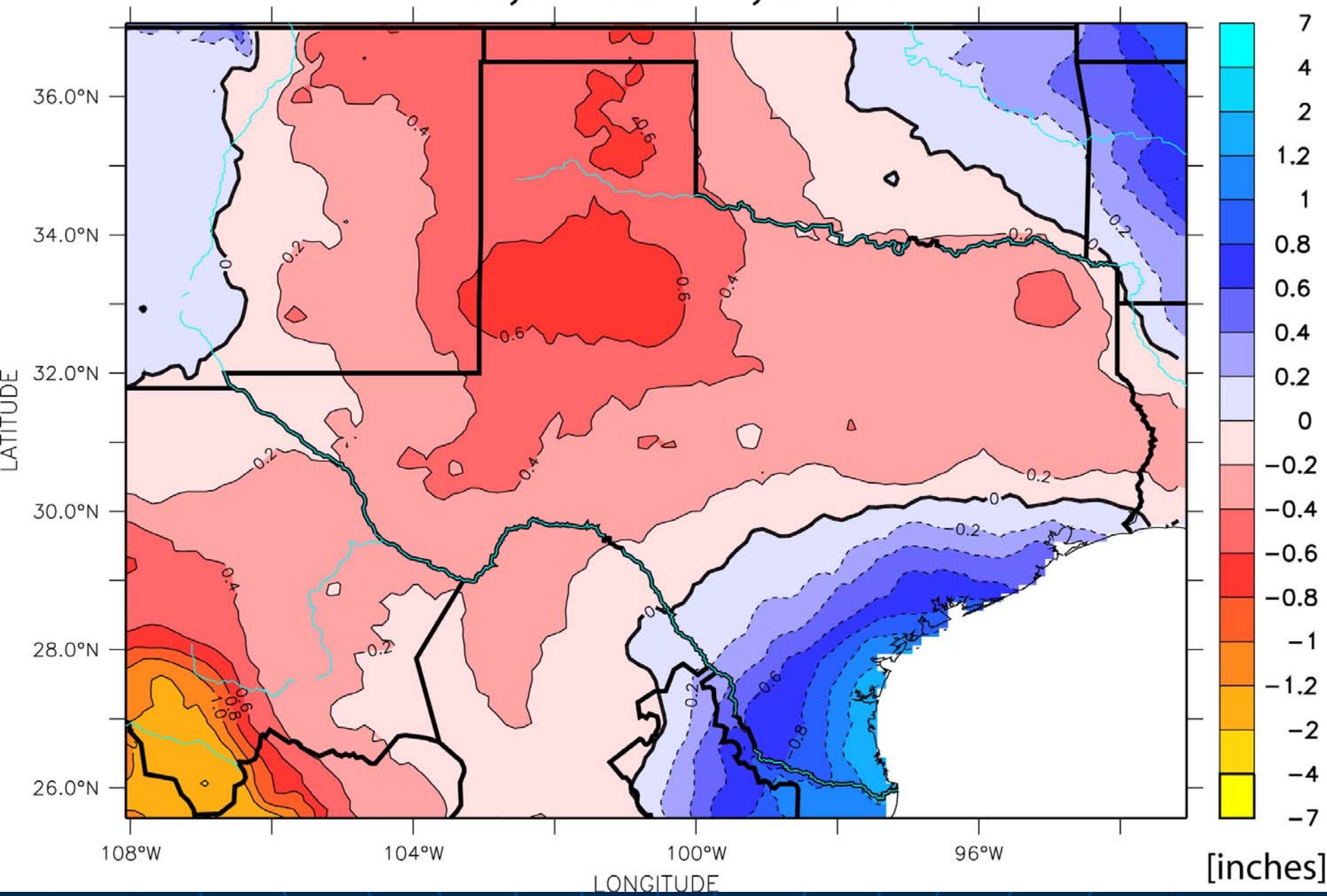- Use climate models from different laboratories to sample uncertainties in model development.

Multi-model Projections for Texas

- 16 different climate models of climate from 1950 to 2100

- Results at ~150 km resolution have been statistically downscaled to ~12 km resolution. (http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/)

- Specific models considered use a 3-member ensemble average of 2040 to 2060 minus 1990 to 2010.

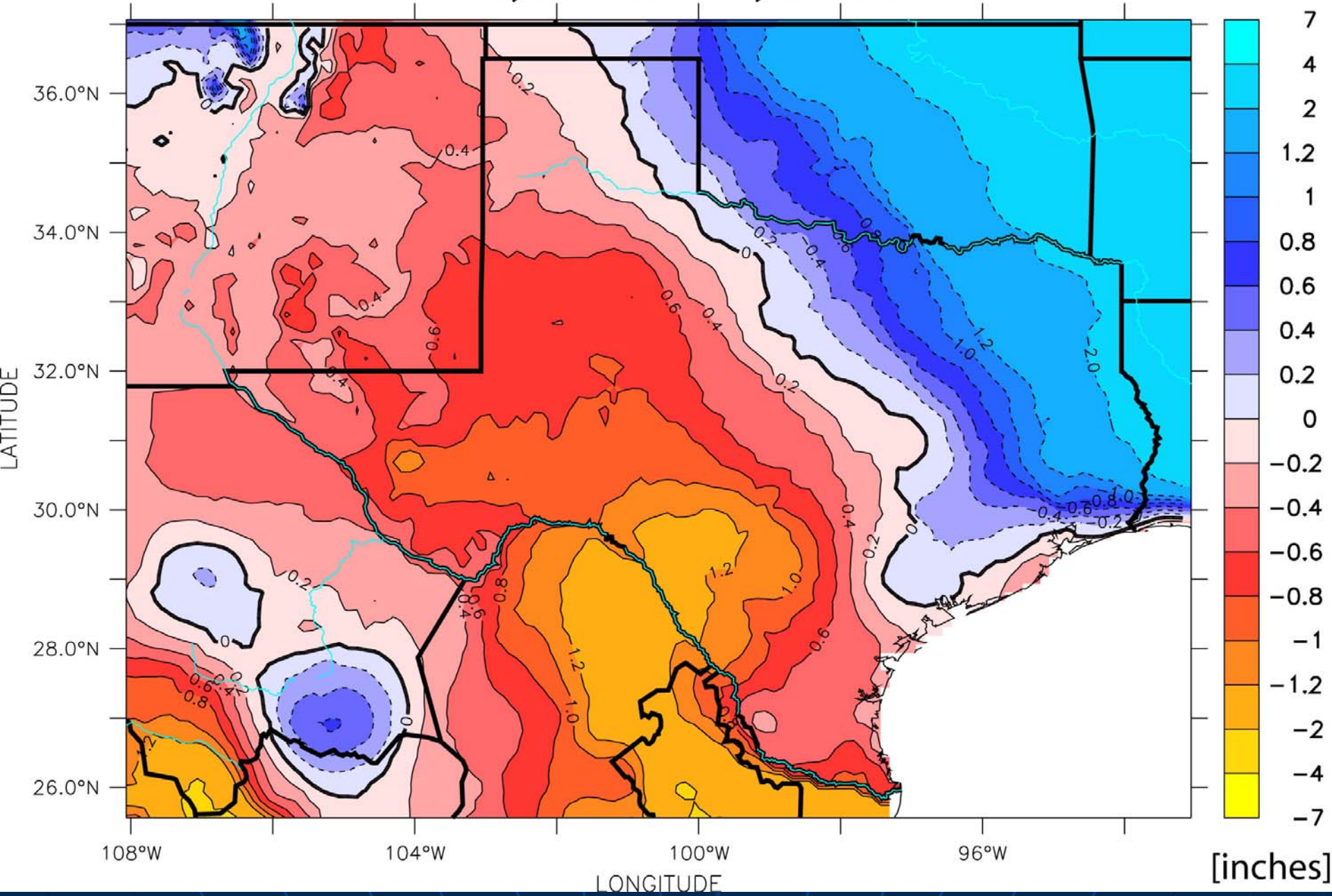# Multi-model Multi-ensemble annual mean temperature change at year 2050 from year 2000
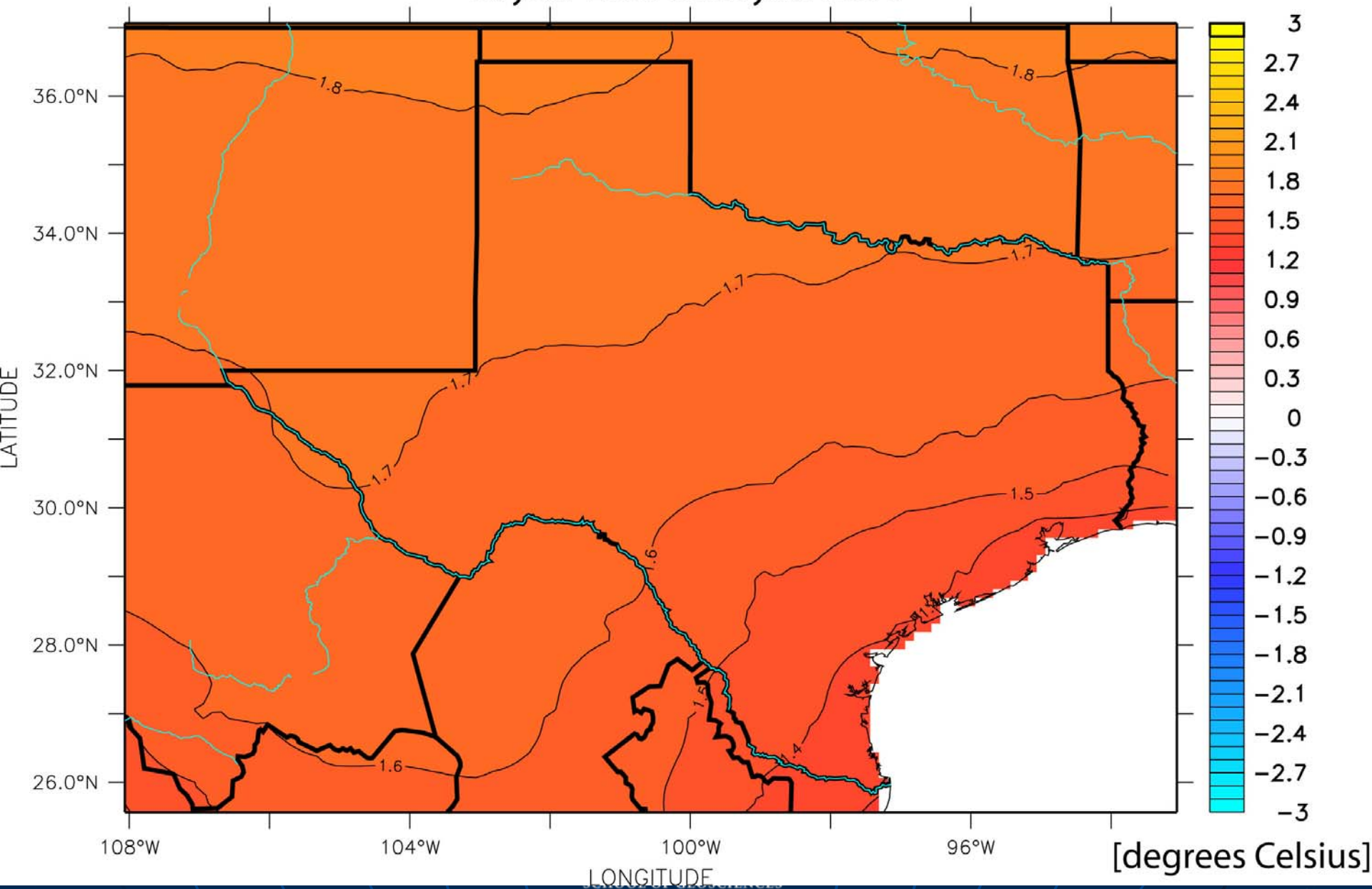
[degrees Celsius]

Multi-model Multi-ensemble annual mean precipitation change at year 2050 from year 2000

CCSM Multi-ensemble annual mean precipitation change at year 2050 from year 2000
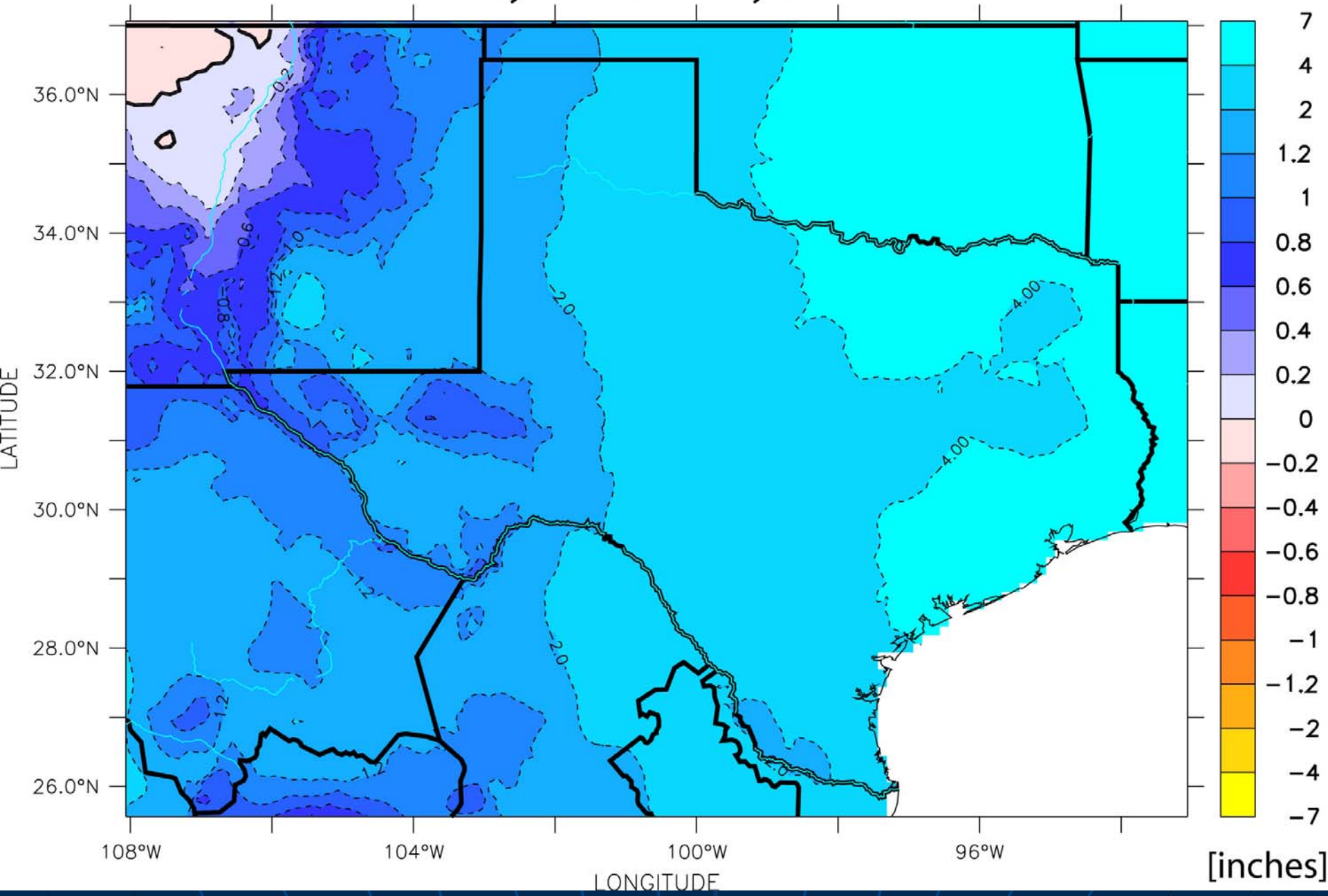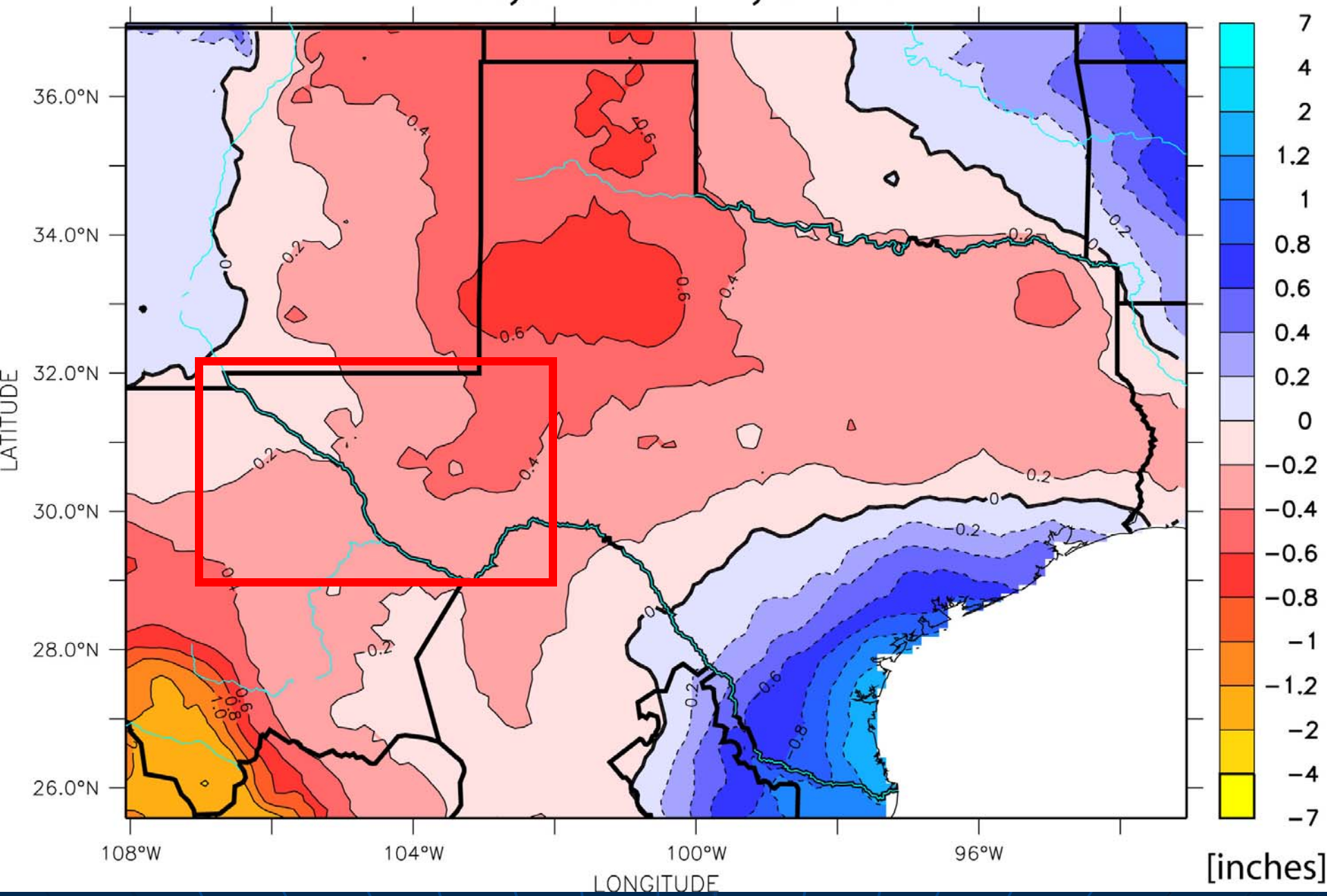
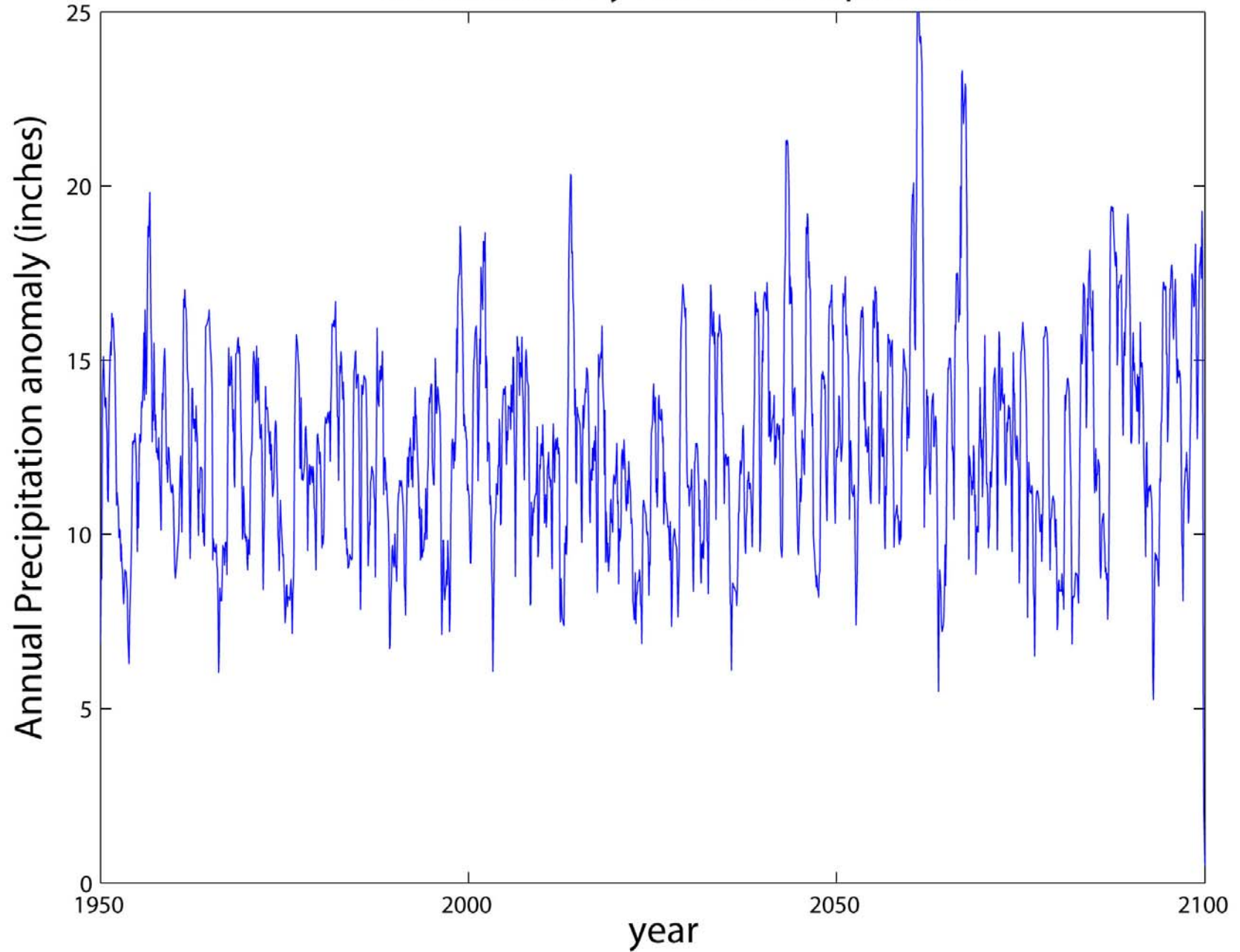ECHAM5 Multi-ensemble annual mean precipitation change at year 2050 from year 2000

CGCM Multi-ensemble annual mean precipitation change at year 2050 from year 2000
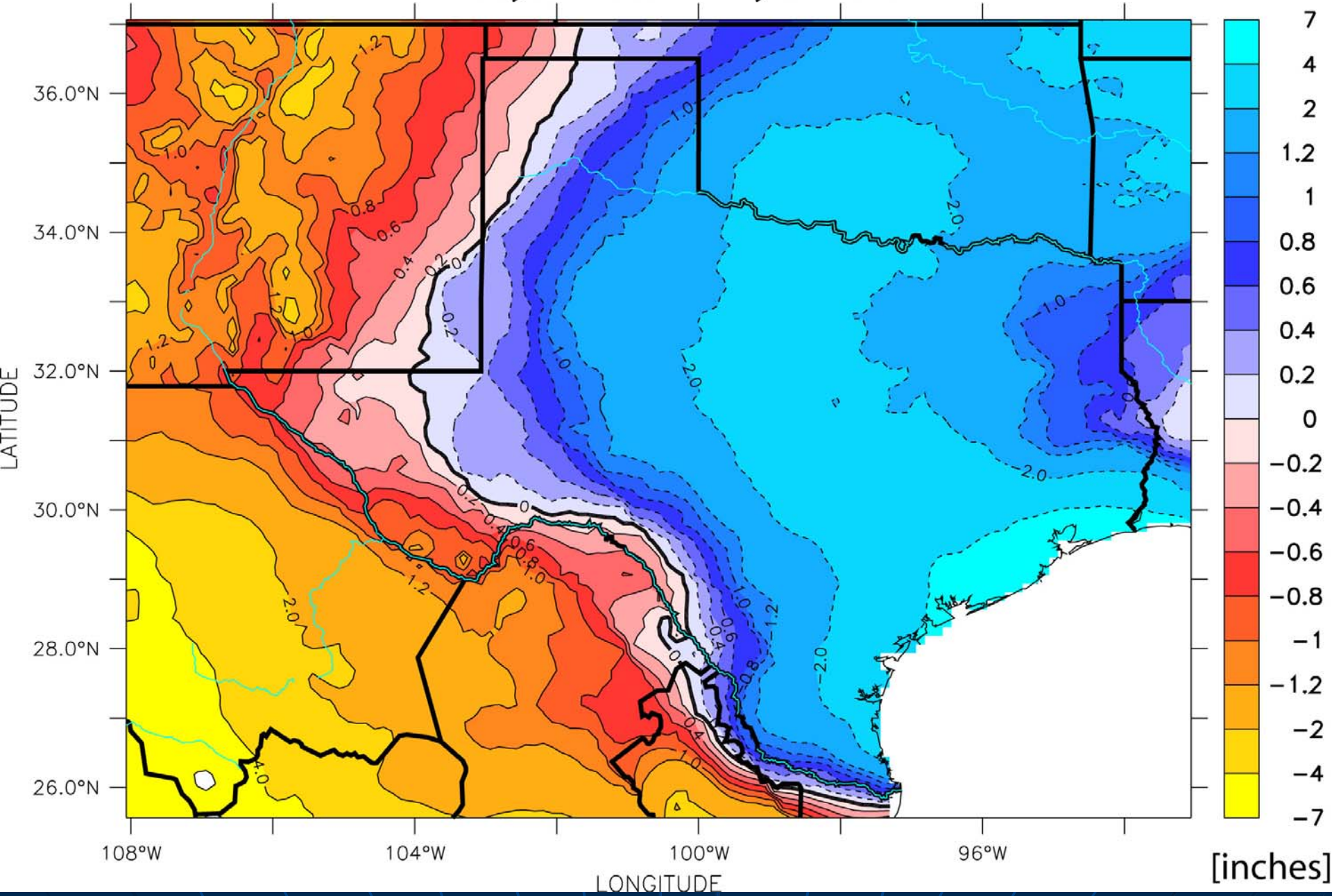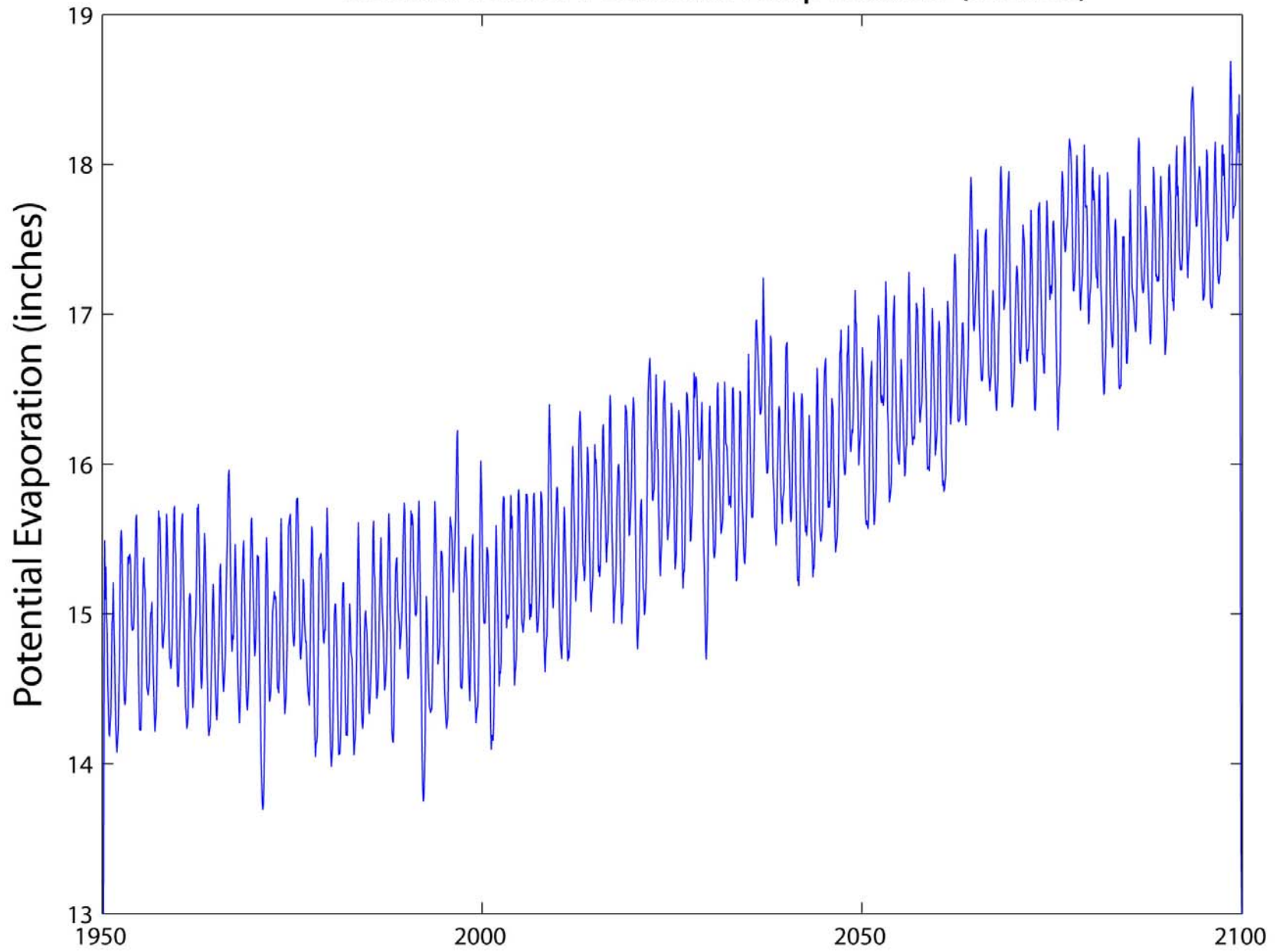
Multi-model Multi-ensemble annual mean precipitation change at year 2050 from year 2000
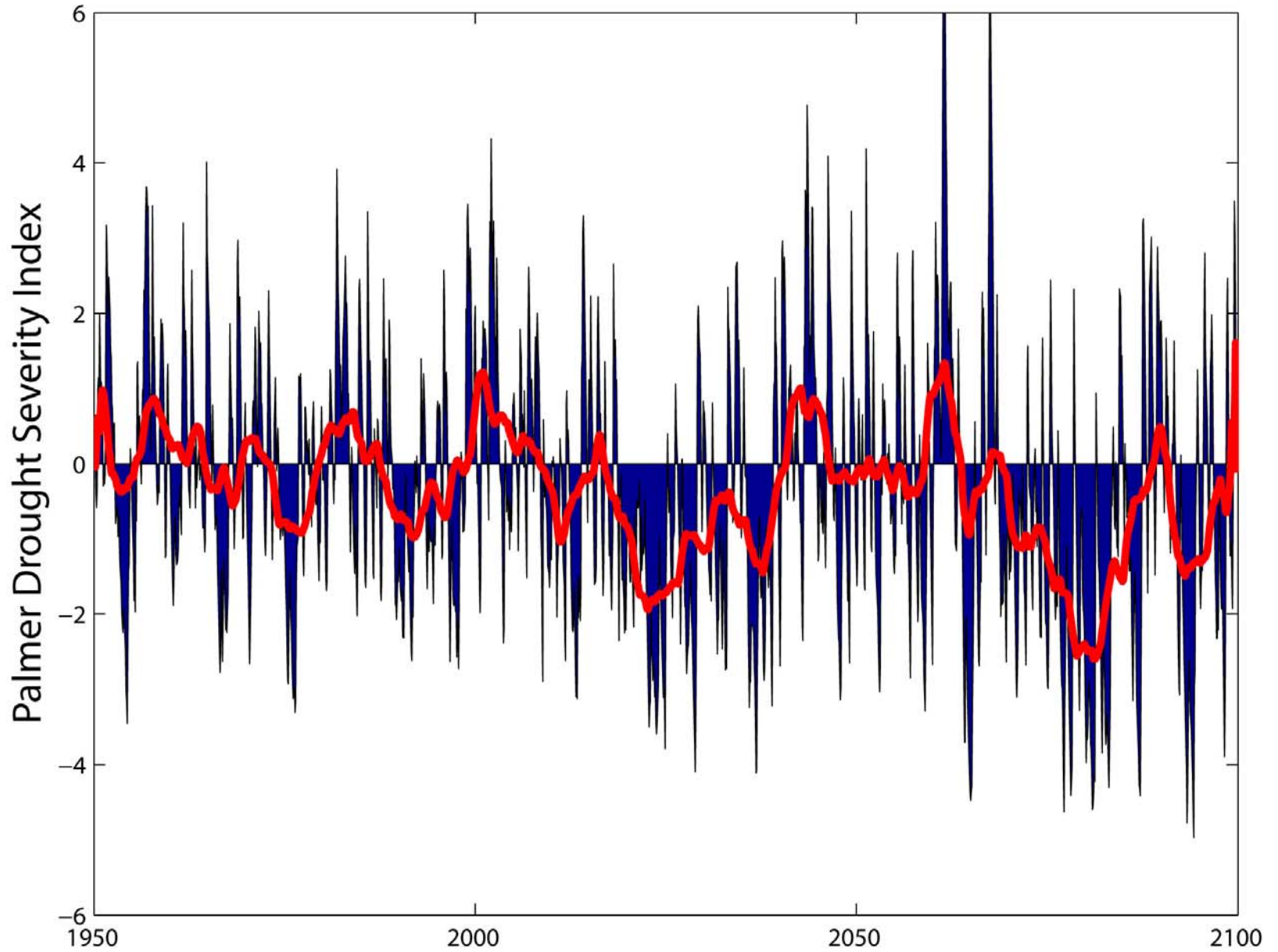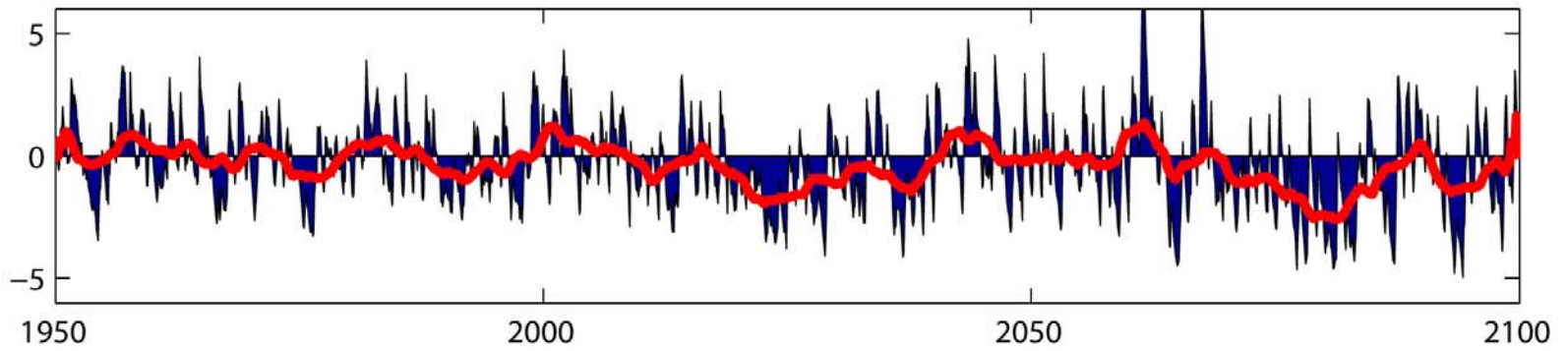
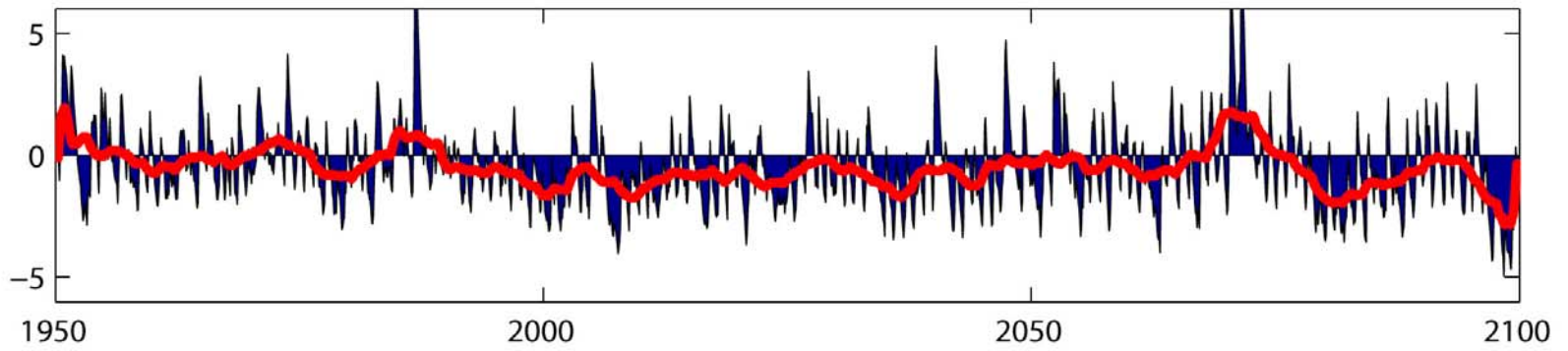CCSM Anomaly Annual Precipitation
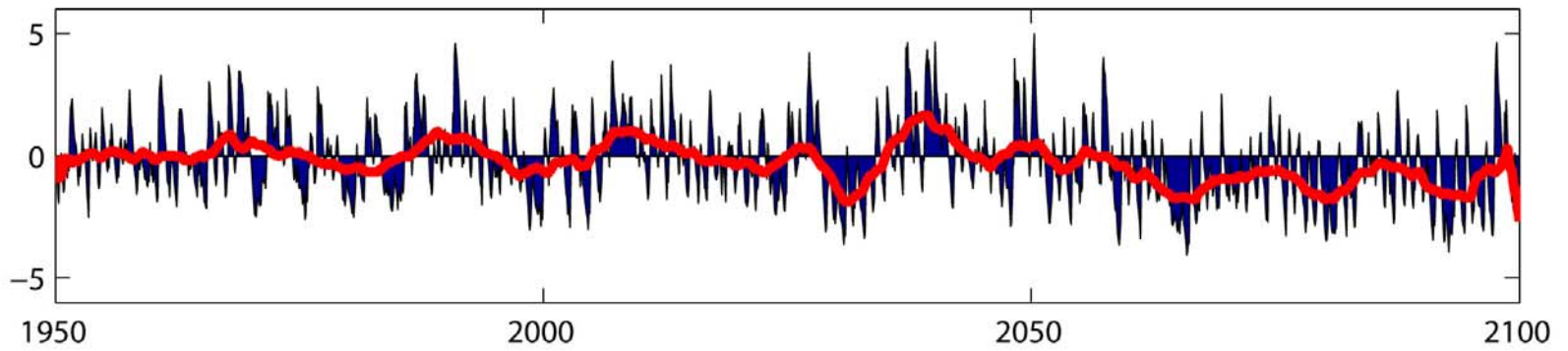
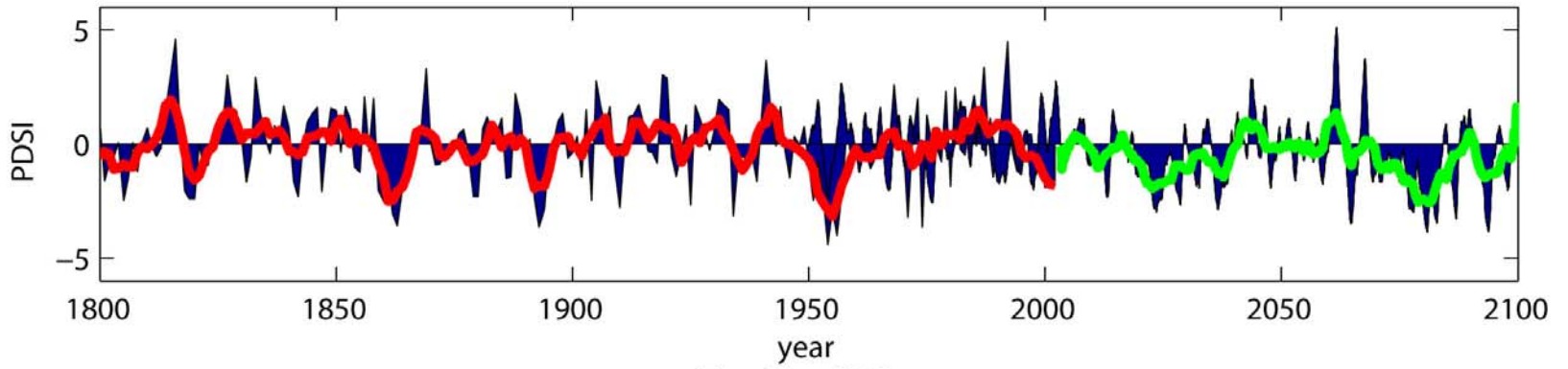CCSM Annual Potential Evaporation (inches)
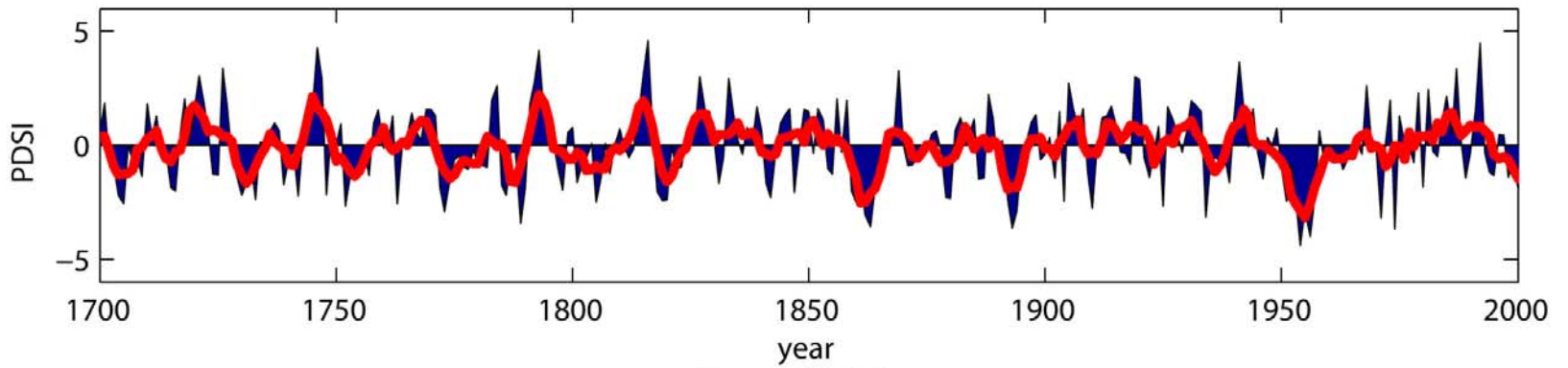
CCSM Modeled PDSI
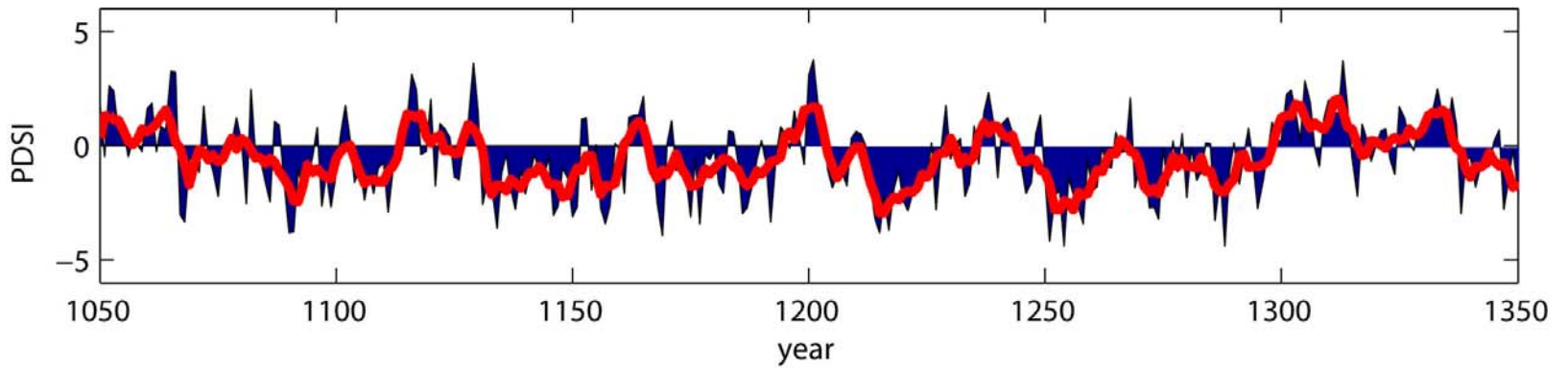
CCSM Modeled PDSI 1

CCSM Modeled PDSI 2

CCSM Modeled PDSI 3
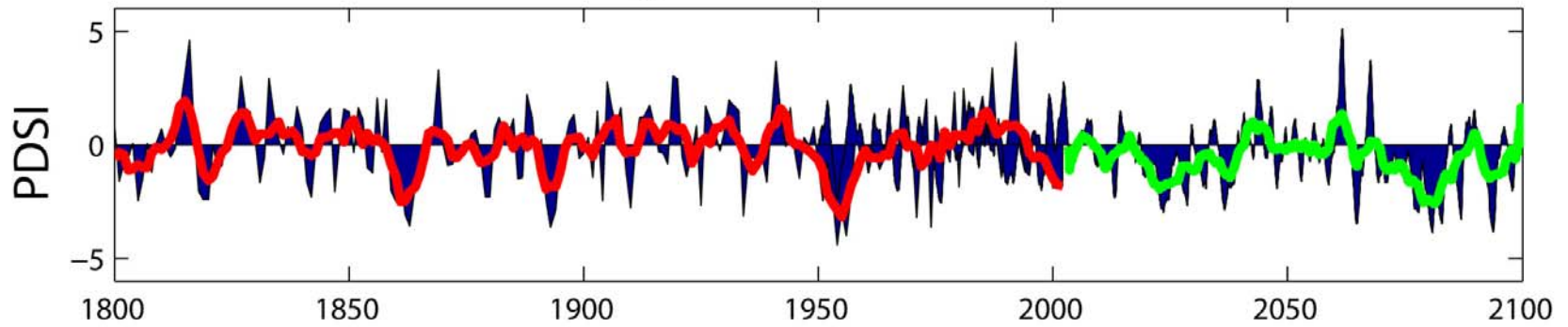
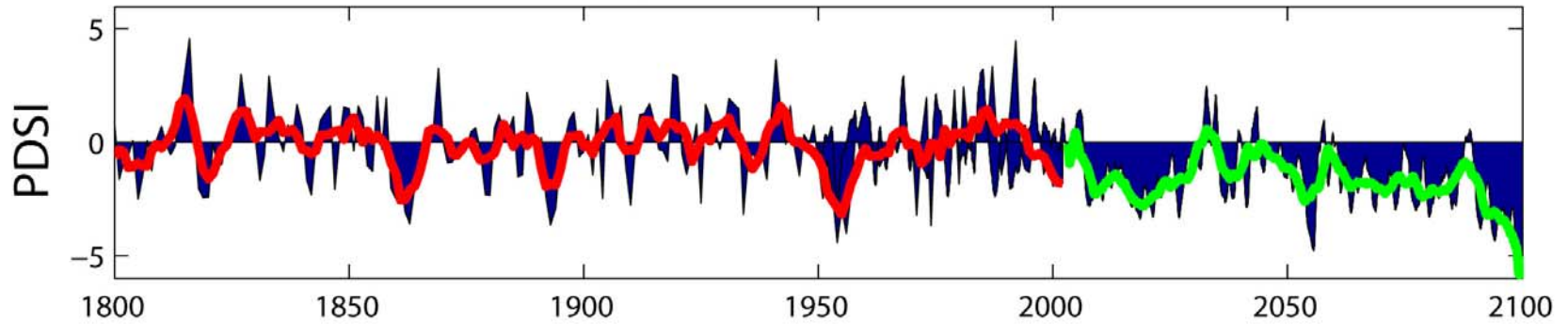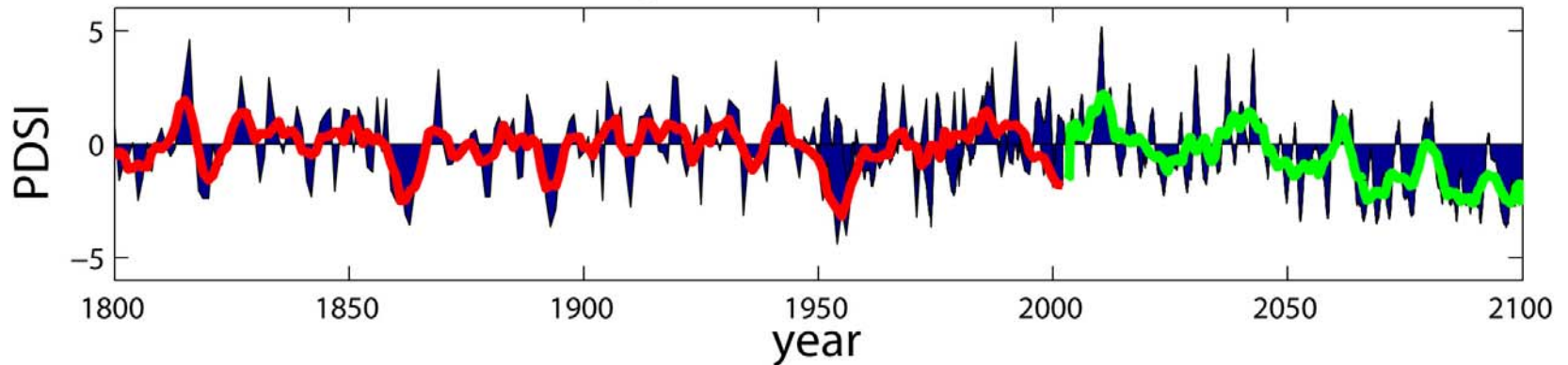Tree Ring and CCSM Modeled PDSI

Tree Ring PDSI

Tree Ring PDSI

Tree Ring and CCSM Modeled PDSI

Tree Ring and ECHAM Modeled PDSI

Tree Ring and CGCM Modeled PDSI

Conclusions

- Expected future warming will significantly increase potential evaporation.

- Reduced precipitation in western Texas expected, however large uncertainties remain.

- Future aridity appears to be significant relative to tree ring proxy records of PDSI.

Future directions

- Evaluate which models are better at capturing Texas climate.

- Identify the sources of uncertainty affecting predictions of Texas climate.

- Understand vulnerabilities of water resources to potential evaporation.