

THE EFFECT OF DOUBLE DYNAMICAL DOWNSCALING ON CLIMATE CHANGE SIMULATIONS FOR THE WESTERN U.S.

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INTRODUCTION

We have further dynamically downscaled WRF simulations driven by the NCAR Community Climate System Model (CCSM) version 3 from the North American Regional Climate Change Assessment Program (NARCCAP) from 50-km to 10-km over the Western U.S. using a different version of WRF. Downscaling does modify the climate changes projected by each simulation. Here, we provide an overview of the basic climate changes from each level of simulation.

MODEL CONFIGURATIONS

WRFG-ccsm: 50-km (NARCCAP Simulation)

Parent: CCSM 3.0, Run 5, 20c3m & A2 emission scenarios

Years: 1971-1999, 2041-2069

Version: Heavily modified 2.0.1

Timestep: 150s

Microphysics: WSM4

Radiation: CAM

CPS: Grell-Devenyi

PBL: YSU

Surface: Noah

www.narccap.ucar.edu

WRFH-wccsm: 10-km

Parent: WRF-ccsm

Years: 1982-1991, 2046-2055

Version: 3.3.1

Timestep: 24 – 36s

Radiation: CAM

CPS: Grell-Devenyi

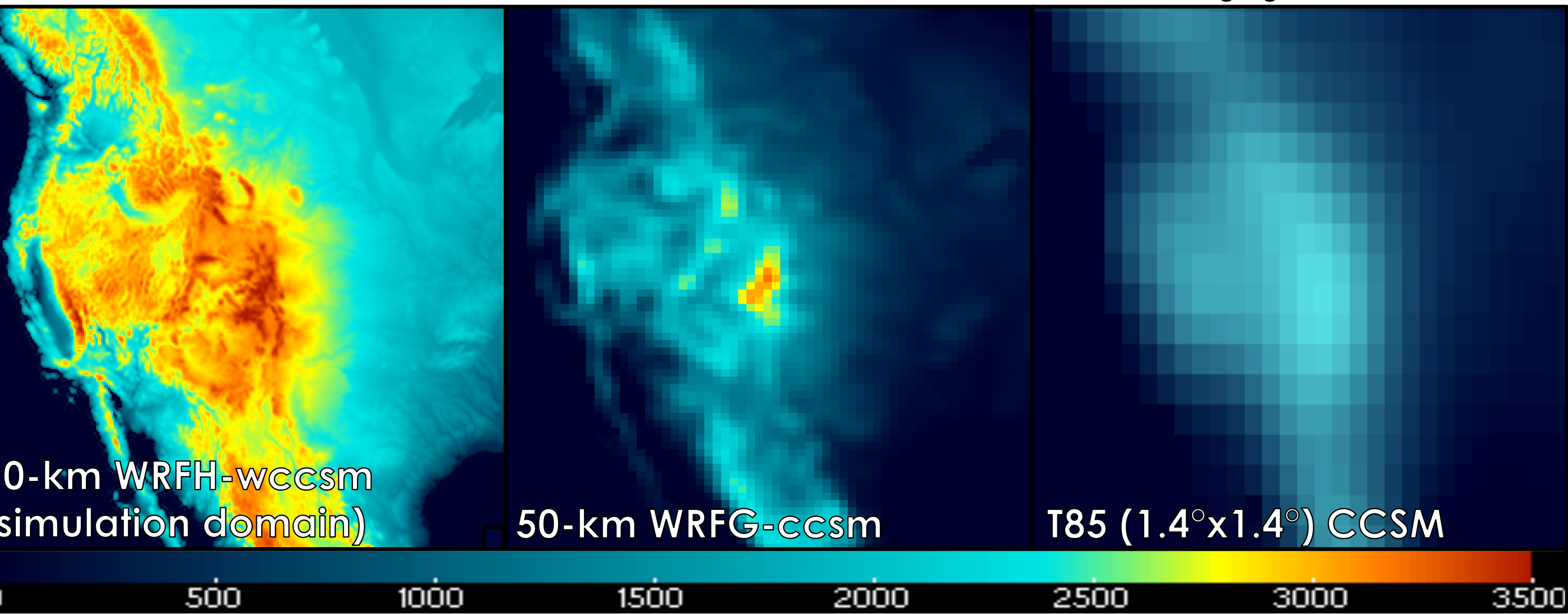
PBL: YSU

Surface: Noah

Parameter tuning: LVCOEF = 1, albedo changes in vegparm.tbl, and modified roughness length over snow in SNOWZ0.

Terrain Height (m)

Note: Scale chosen to highlight terrain above 2500m



OTHER METHODS

- Differences shown are for 2041-2065 versus 1982-1991.
- Hatching (on seasonal precipitation change plots only) indicates statistical significance at the 0.1 level. Method: bootstrapping with bias correction and acceleration.

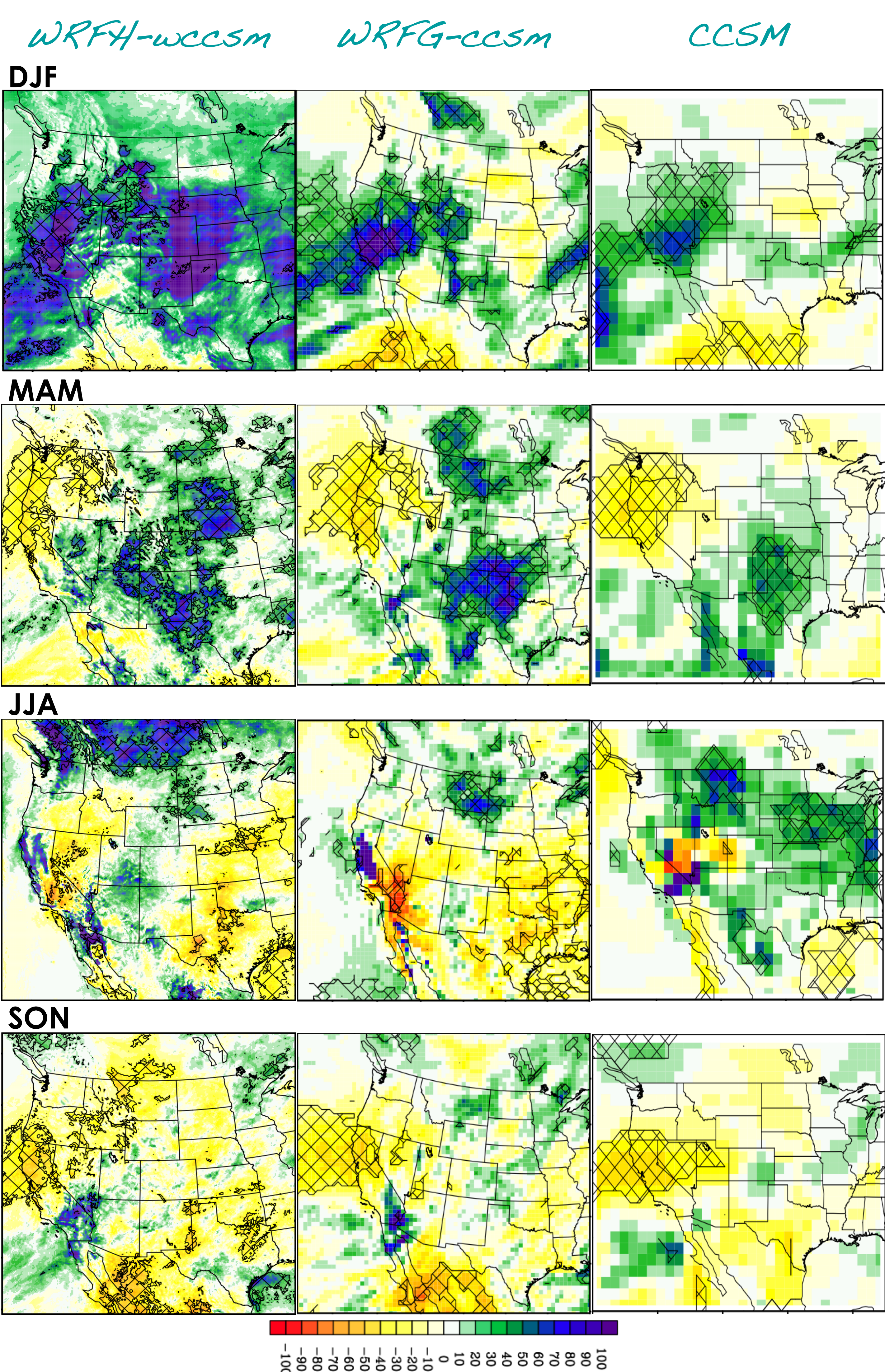
CONCLUSIONS/DISCUSSION

- Complex mesoscale spatial and temporal variability in temperature changes exist between levels of downscaling because of differences in topographical resolution.
- A snow-albedo feedback is the dominant mechanism for large late-Winter to Spring warming in the intermountain West and large late-Spring to Summer warming over the Canadian Rockies (the latter is not shown).
- The snow-albedo feedback is much stronger at 10-km than at 50-km, leading to an overall greater warming in daily maximum temperature at the higher resolution (not shown).
- Changes in seasonal precipitation are not modified to the same extent (on a large-scale) as temperature changes with further downscaling, though mesoscale differences caused by better resolved topography do exist.
- More work is in progress examining the differences between these simulations, including the effect of model bias as it propagates through the various levels of downscaling.

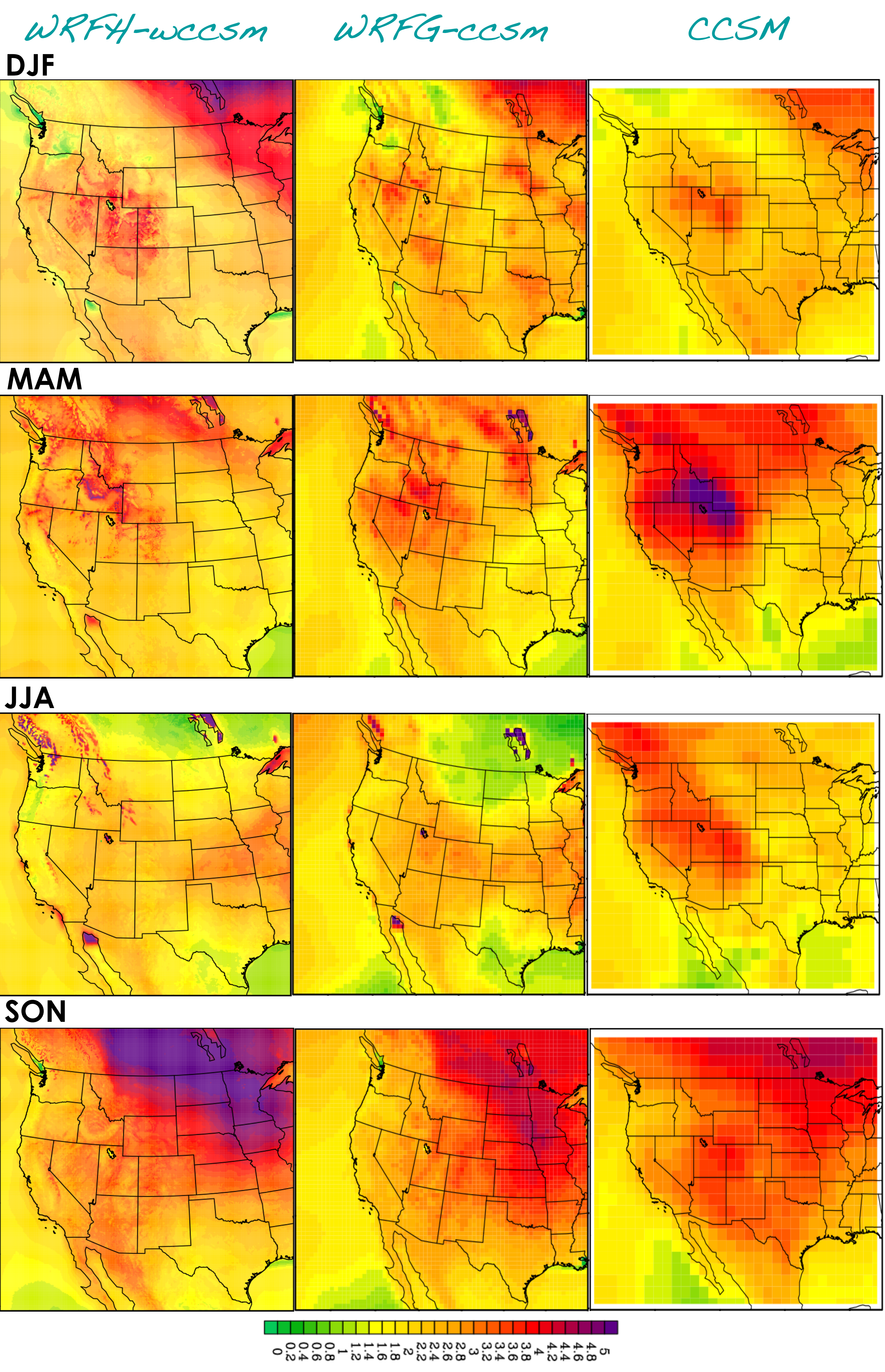
ACKNOWLEDGEMENTS

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SEASONAL PRECIPITATION CHANGE (%)



SEASONAL TEMPERATURE CHANGE (°C)



SNOW WATER EQUIVALENT (SWE), ALBEDO, & 2-M TEMPERATURE: MONTHLY MEAN CHANGES

An example of the snow-albedo feedback effect on temperature at 3 resolutions. Contour lines in plots indicate the present-future average 0°C line.

