THE EFFECT OF WEIGHTING ON THE NARCCAP ENSEMBLE MEAN

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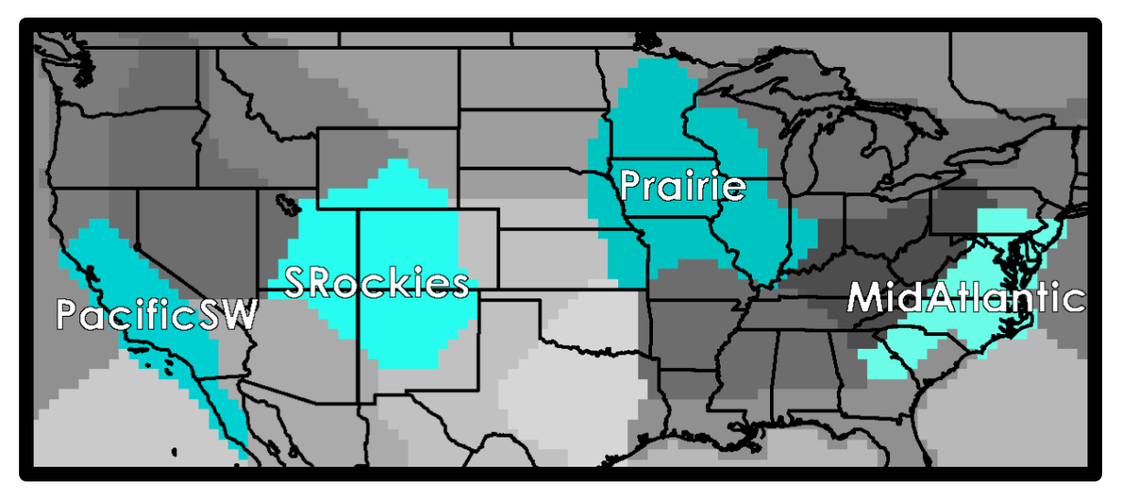
INTRODUCTION

As part of the European ENSEMBLES regional climate modeling project, six performance-based weighting metrics were developed in an effort to define differential model contributions to an ensemble mean. In this study, we will examine the effect of those weighting metrics on the ensemble of regional climate model (RCM) simulations produced as a part of the North American Regional Climate Change Assessment Program (NARCCAP). We will assess the impact of these performance-based weights versus equal weighting on the representation of the mean climate produced by the NARCCAP ensemble of reanalysis-driven RCMs in the baseline/current climate period over several sub-regions of North America.

REGIONAL CLIMATE MODELS/DATASETS

NARCCAP

NCEP/DOE Reanalysis II driven simulations examined here. Analysis period: 1980-2003. Horizontal resolution: 50-km. Analysis completed over subregions of the U.S. shown to the right.



RCMS

CRCM	Canadian Regional Climate Model
ECP2	Regional Spectral Model
HRM3	Hadley Centre Regional Model version 3
MM5I	Penn State/NCAR Mesoscale Model version 5
RCM3	Regional Climate Model version 3
WRFG	Weather Research and Forecasting Model

www.narccap.ucar.edu

OBSERVATION-BASED, GRIDDED DATASETS

CRU	TS3.0 analysis from the Climate Research Unit at the Univ. of East Anglia. ½ degree resolution, global, monthly averages only. http://badc.nerc.ac.uk/data/cru
Maurer	Maurer et al. (2002). 1/8 degree resolution, U.S. only, daily averages. Used in daily metrics. http://www.engr.scu.edu/~emaurer/data.shtml

RCM WEIGHTING METRICS

Results

Full descriptions can be found in *Climate Research* Special Issue 23 'Regional Climate Model Evaluation and Weighting', 2010, Vol. 44: 179-194.

f1

Large-scale circulation metric.

Tests the degree to which RCMs can reproduce observed weather regimes at 500-hPa. (Not yet completed.)

f2

Mesoscale metric.

Tests the added information at the mesoscale (50-km) after filtering out the larger-scale component (200-km) in seasonal precipitation and 2-m temperature. Evaluates spatial correlation, interannual variability, and correlation between precipitation and temperature after scale filtering.

f3

Probability density distribution metric.

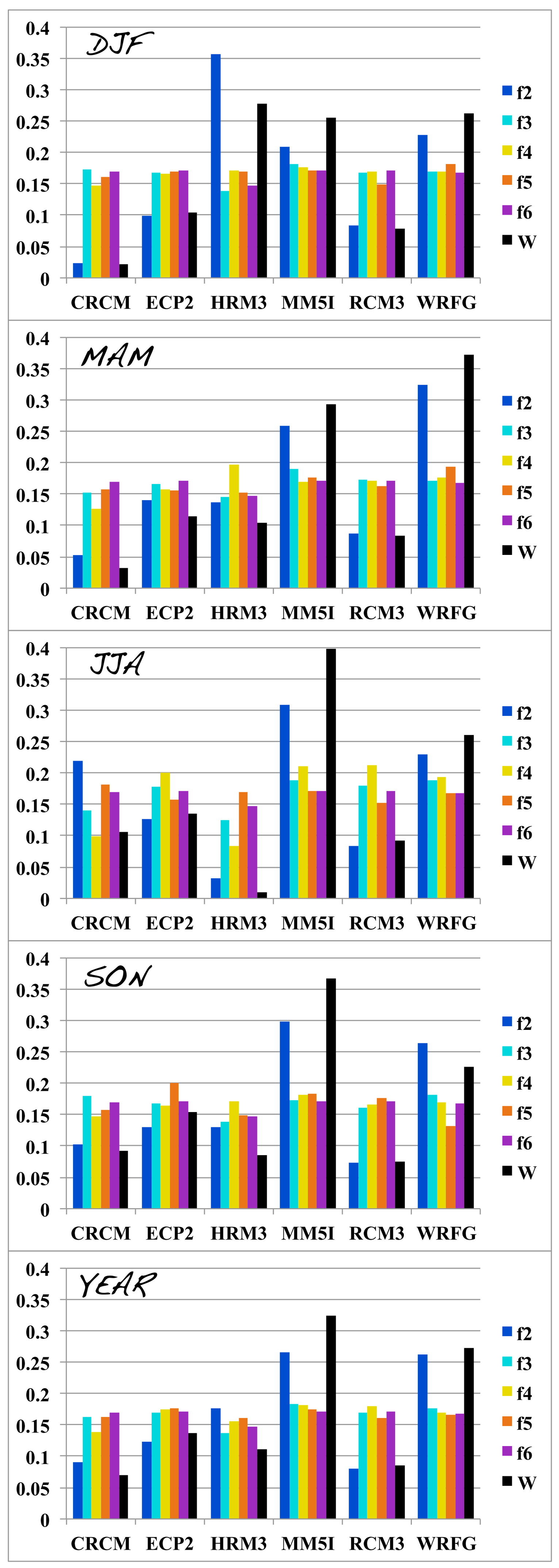
Examines statistical properties of empirical probability density functions of daily and monthly precipitation and daily maximum and minimum temperature.

f4

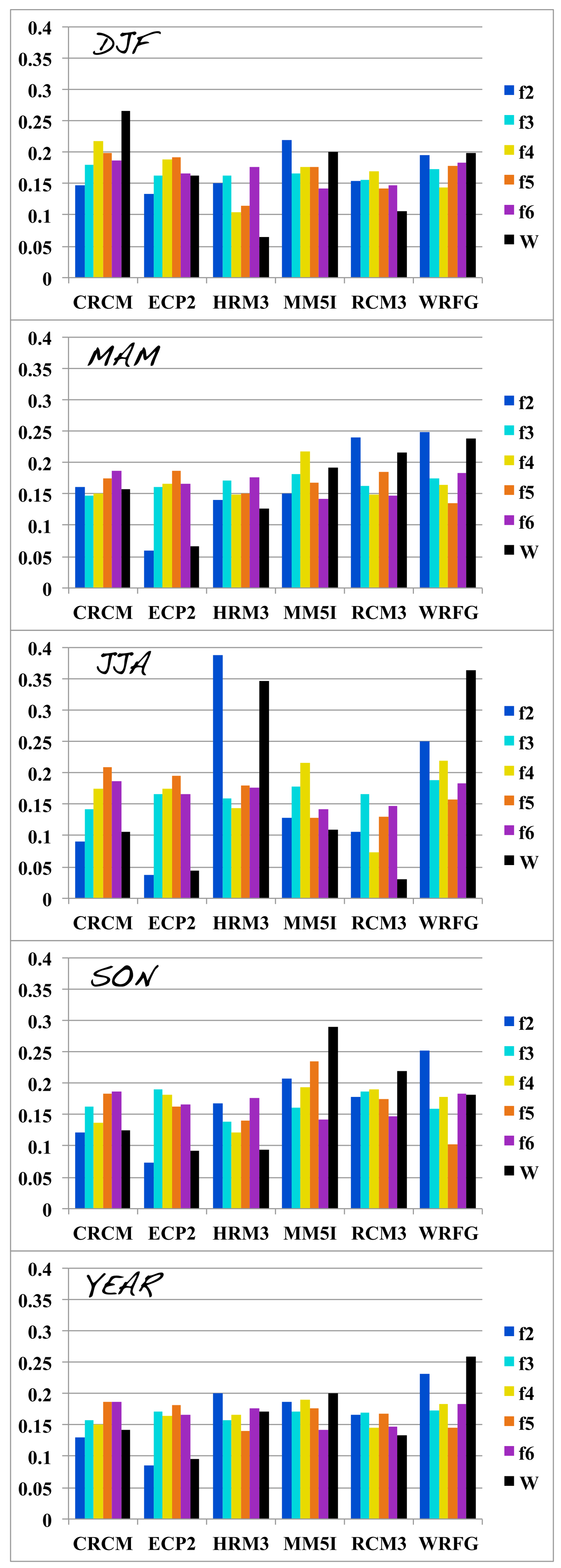
Extremes metric.

Tests the RCMs ability to reproduce 99th, 99.9th and 99.99th percentile daily precipitation and also uses generalized extreme-value theory to assess the 5-year return period in daily precipitation and maximum and minimum temperature.

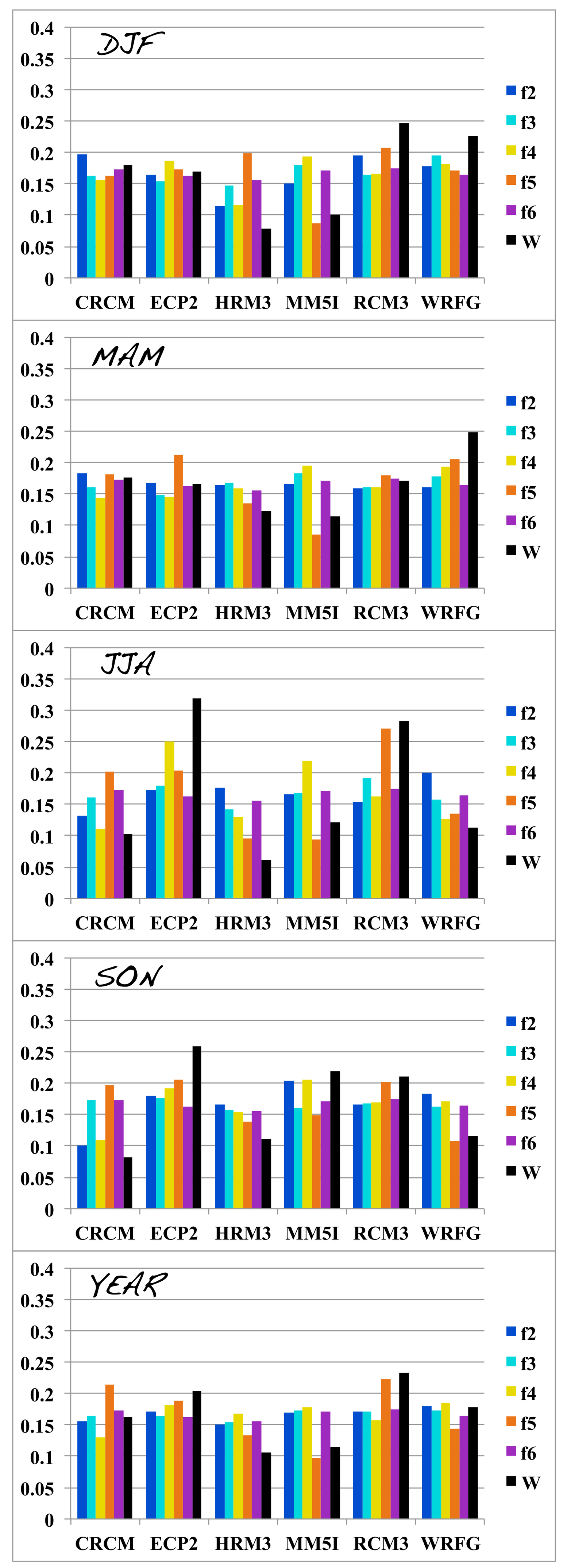
PacificSW



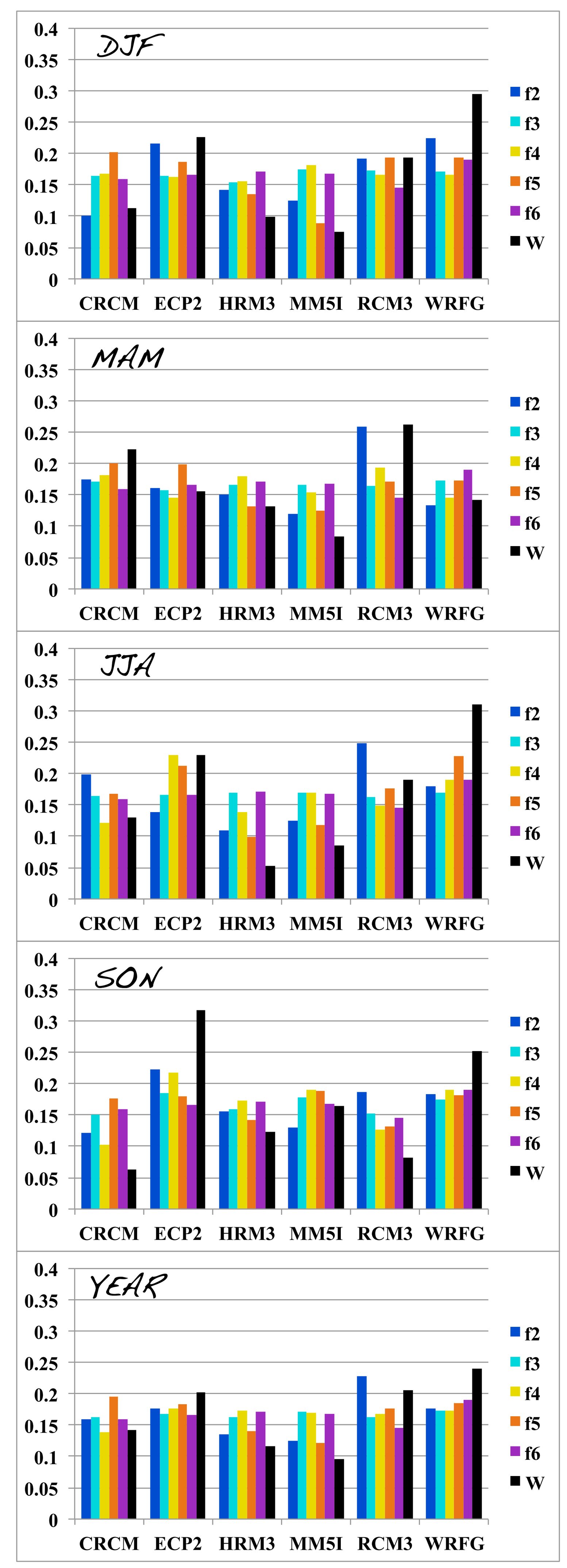
SRockies



Prairie



MidAtlantic



f5

Temperature trends metric.

Assesses seasonal 2-m temperature trends by comparing the slope of the linear trend to that of observations.

f6

Annual cycle metric.

Examines an RCM's ability to reproduce the annual cycle of monthly temperature and precipitation.

W

Final RCM weight.

Combination of metrics f1 – f6. (Here, combination of metrics f2 – f6 only.) Each individual metric is first normalized to have a sum equal to one. All metrics are then multiplied together. The final weight, W, is the product of the metrics normalized again to have a sum equal to one (to allow application to the ensemble mean. Using the products of the metrics instead of averaging them requires that an RCM perform well in all metrics in order to obtain a high score. Averaging them would discount the importance of each metric. (Christensen et al. 2010)

REFERENCES

Christensen, J.J., E. Kjellström, F. Giorgi, G. Lenderink, and M. Rummukainen, 2012: Weight assignment in regional climate models. Climate Res., 44, 179-194.

Maurer, E.P., A.W. Wood, J.C. Adam, D.P. Lettenmaier, and B. Nijssen, 2002, A Long-Term Hydrologically-Based Data Set of Land Surface Fluxes and States for the Conterminous United States, J. Climate 15(22), 3237-3251

DISCUSSION

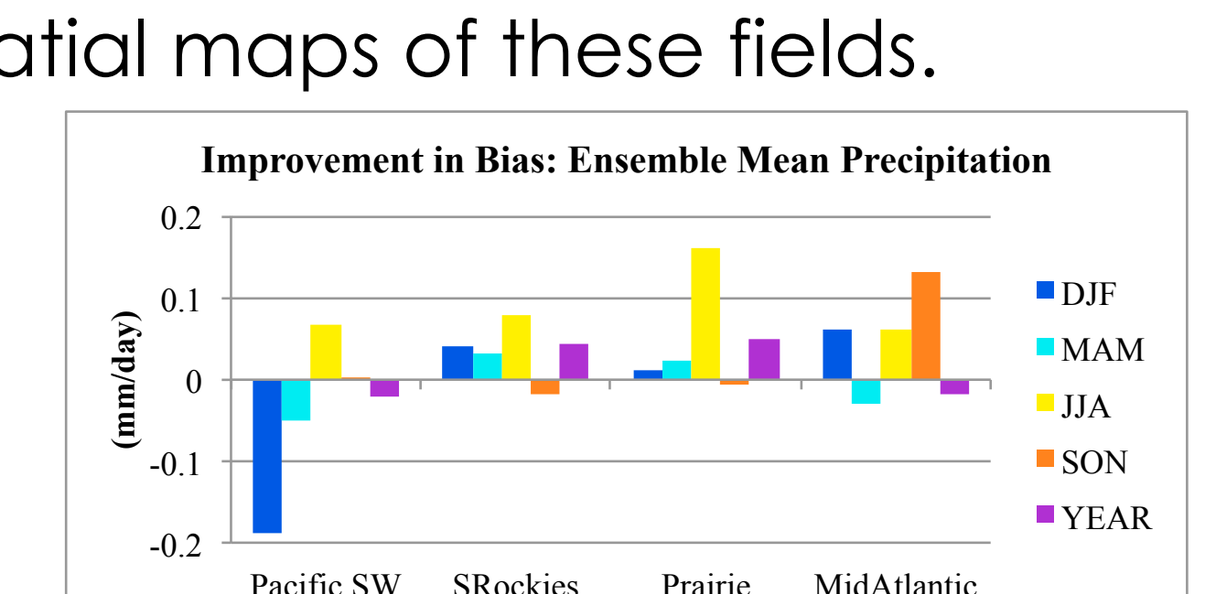
What does weighting do to ensemble mean temperature and precipitation?
Answer: Almost nothing.

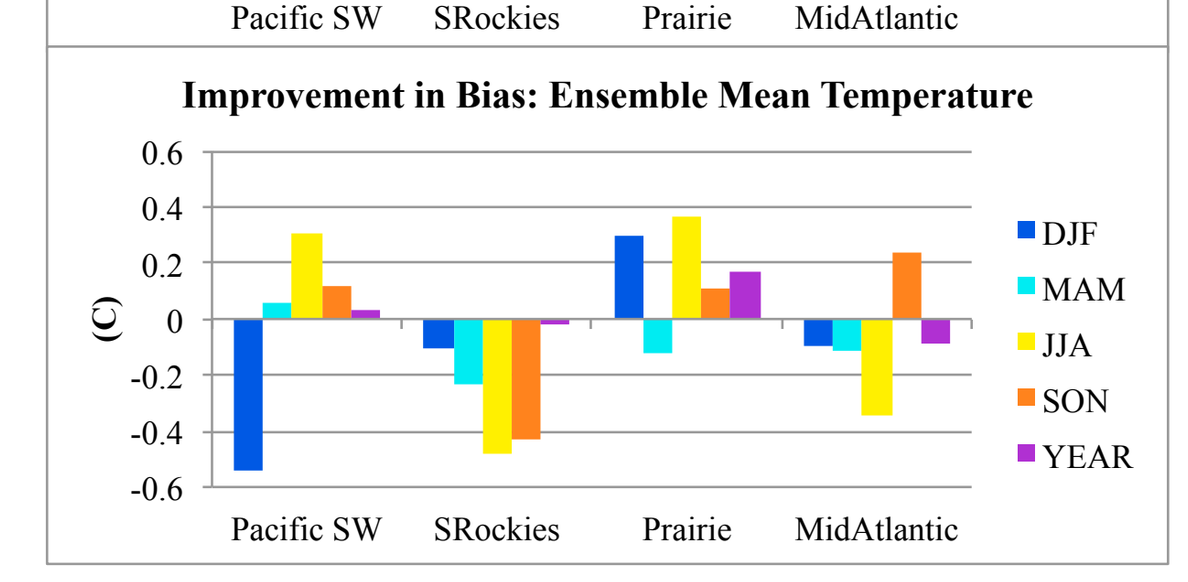
The 1980-2003 seasonal and annual average 2-m temperature and precipitation 6 member RCM ensemble mean does not change in any significant way when weighted with the final weight, W. This was concluded after examining regional average bias, RMSE, pattern correlations, and spatial maps of these fields.

The effect of weighting on the ensemble mean bias (compared to CRU) is illustrated to the right.

This lackluster result is not unexepected given the relatively small spread in the final weight, W, between the RCMs.

Here we followed the methodology used in ENSEMBLES for combining the submetrics (f1-f6) and their components, but other methods will be explored in an effort to better represent the spread in skill.





Improvement in bias from the non-weighted to the weighted ensemble mean. A positive value indicates that the ensemble mean bias improved by the given quantity after weighting.

Finally, weighting may not have had an impact on ensemble mean performance, but submetrics (f1-f6) do provide useful information on individual RCM performance.