

# Distribution and intensity of extreme winter precipitation in seasonal forecasts

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## Questions or comments:

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## I. Introduction

An objective of the Multi-RCM Ensemble Downscaling (MRED) Project is to answer this question:

**Does downscaling using RCMs provide skillful monthly and seasonal forecasts of extreme precipitation compared to the global model and observations?**

## II. Models

- **Global model:** National Center for Environmental Prediction (NCEP) Climate Forecast Systems version 1 (CFS Native)
- **Regional climate models:**
  - Experimental Climate Prediction Center RSM (ECPC RSM)
  - Two versions of the WRF model
    - Pacific Northwest National Lab WRF-Advanced Research WRF (PNNL WRF-ARW)
    - Illinois State Water Survey Climate WRF (ISWS CWRF)
  - Iowa State University MM5 (ISU MM5)
  - Colorado State University RAMS (CSU RAMS)
  - University of California-Los Angeles Eta (UCLA ETA)

## Observations

- North American Regional Reanalysis (NARR)
- Climate Prediction Center (CPC) US Unified Precipitation (UNI)

## III. Method

- The NCEP CFS runs ten ensemble members by starting from a different initial date to produce retrospective forecasts from 1982-2003.
- Each CFS ensemble forecasts is downscaled using each of the RCMs over the contiguous United States.
- The horizontal resolution of the CFS Native is ~200km, the RCMs, CFS MRED and NARR are 32km and the UNI is ~28km.

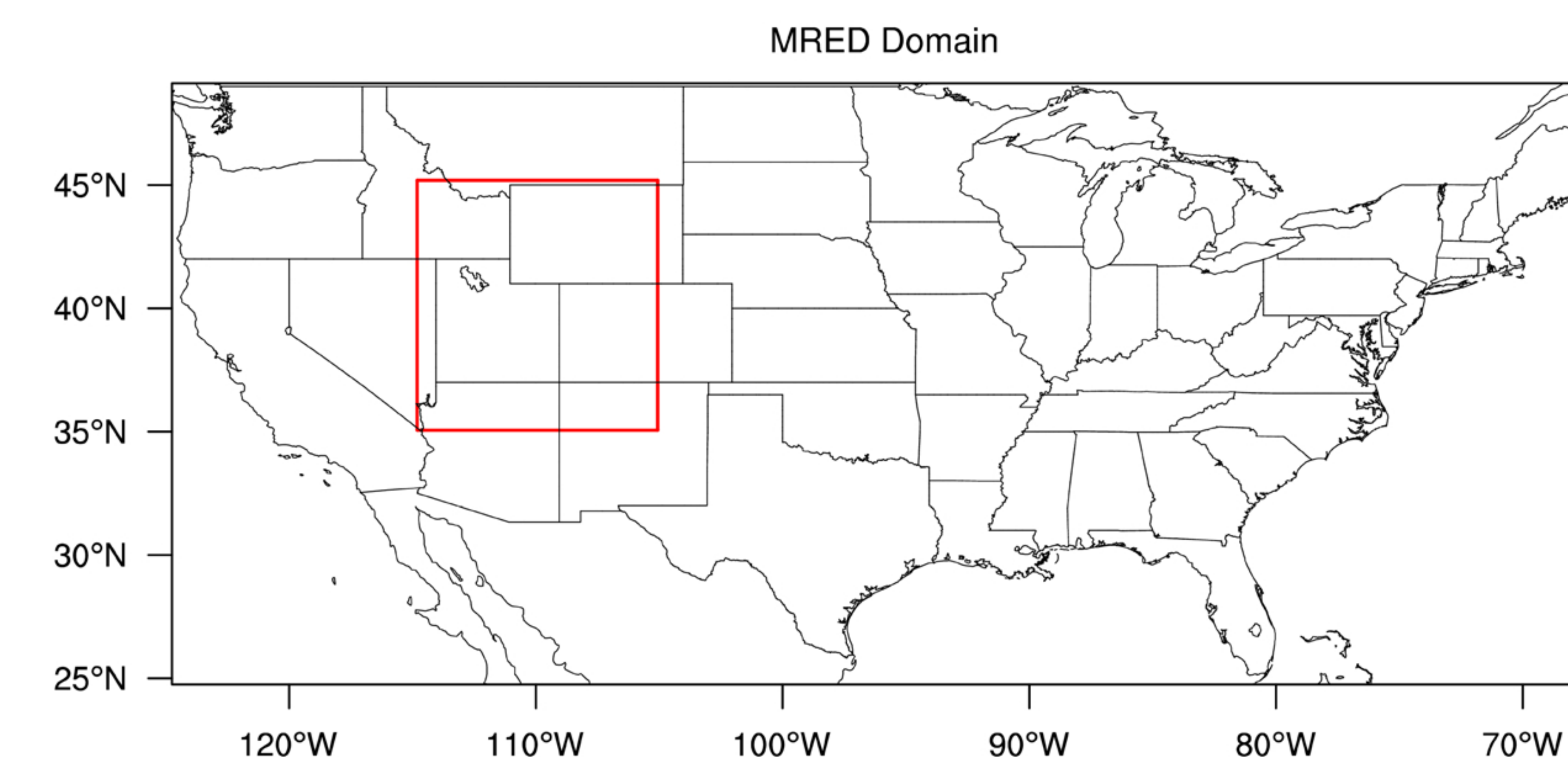


Figure 1: The MRED domain and the central Rocky Mountains analysis region (red box).

## IV. Precipitation intensity

- We examined daily accumulated precipitation for the months of January through April and the JFM and FMA seasons.
- Our focus is on the distribution of daily precipitation intensity, including **extreme precipitation** defined as **greater than 50mm/day**.
- We chose the central Rocky Mountains (Figure 1, red box) to assess the potential usefulness of higher resolution RCMs.

## V. Results

### Sum of the frequency of extreme precipitation (Figure 2)

- We evaluated the frequency of extreme precipitation in both the model output and after fitting gamma distributions to the output (Figure 2a).
- **The downscaled RCMs produce extreme precipitation (>50mm/day) too frequently while the CFS Native has generated little or no extreme precipitation (Figure 2b).**
- Frequencies of extreme precipitation derived from the fitted gamma distributions do not match the frequencies in the corresponding model results or observations. This implies the gamma distribution is not able to represent the more extreme precipitation events.

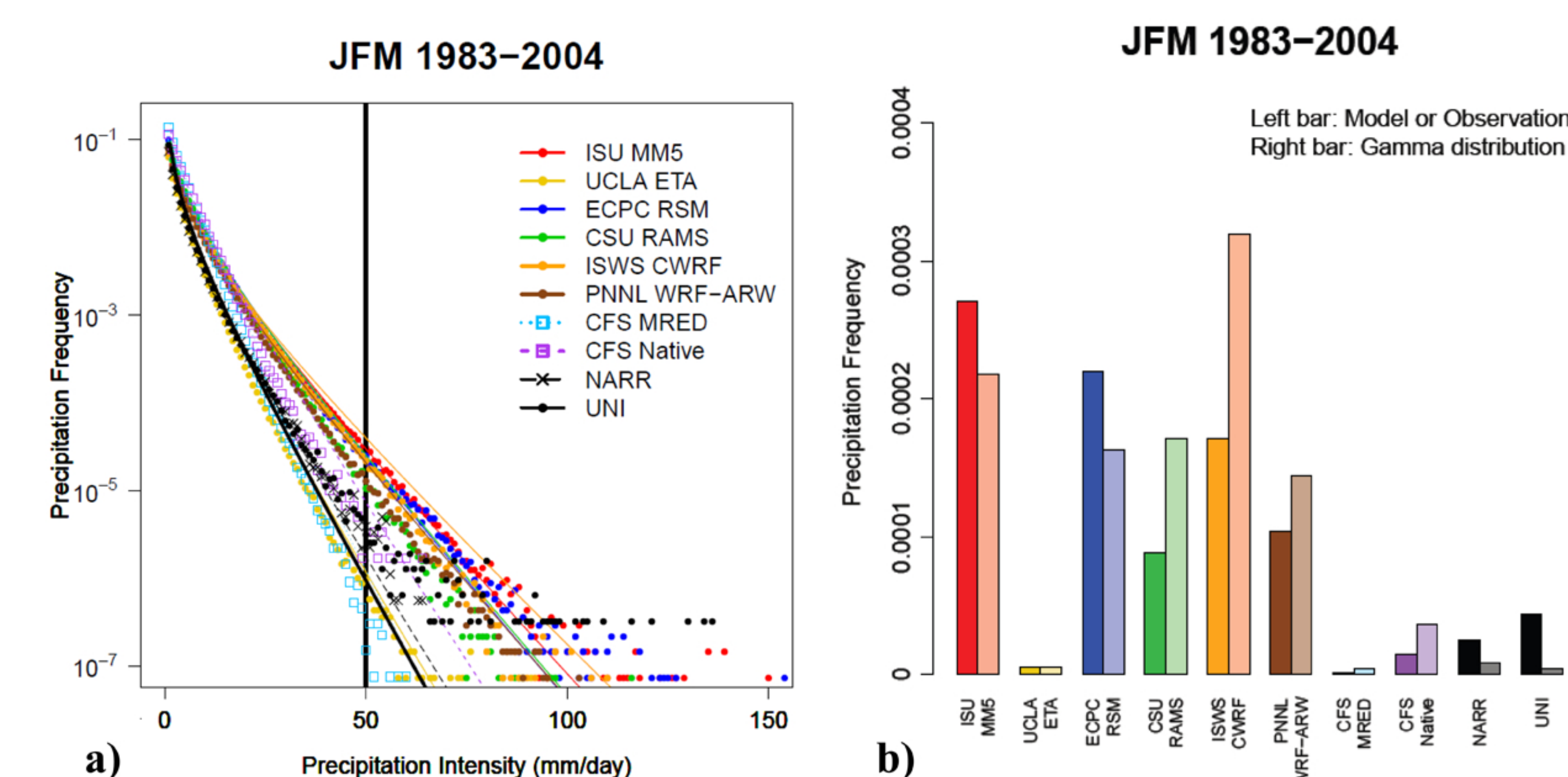


Figure 2: a) Precipitation frequency vs. intensity with dots representing model output or observations and lines representing gamma distributions. b) Sum of the frequency of precipitation above 50mm/day where the bars represent the modeled or observed frequency (left bar) and the estimated gamma distribution frequency (right bar).

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## Difference between observed CDF and RCMs CDF (Figure 3)

For February and FMA, several RCMs are closer to the UNI observed frequency compared to the CFS Native, meaning **the forecast has been aided by downscaling**. In January and JFM, the impact of downscaling is less (not shown).

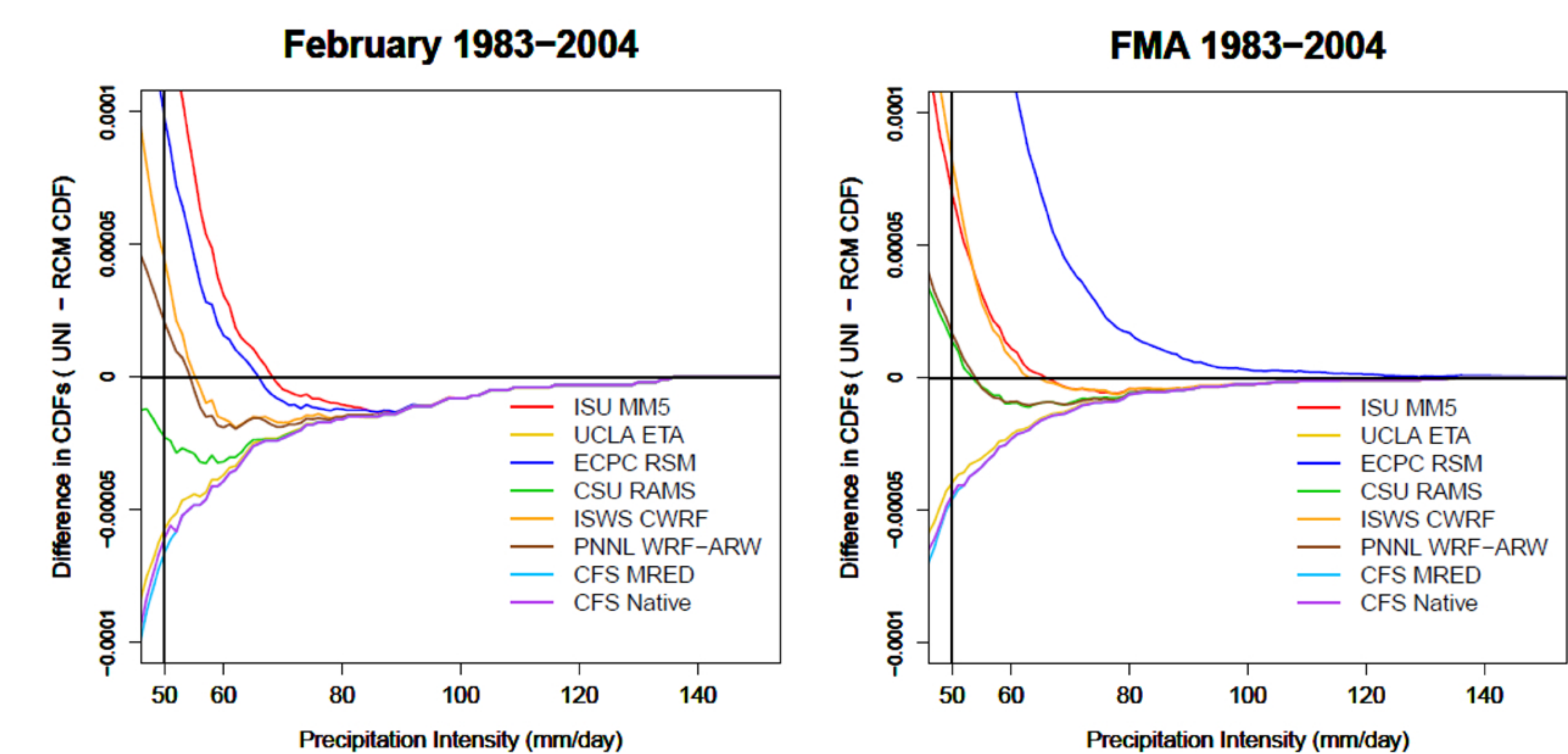


Figure 3: The difference between the observed and RCMs CDF. Plot only shows 50mm/day to 150mm/day.

## CDFs (Figure 4)

Both the CFS Native and CFS MRED have a steeper slope at lower intensities (<50mm/day) compared to UNI and most RCMs. **The RCMs are distributing precipitation to higher intensities, which may or may not be extreme.**

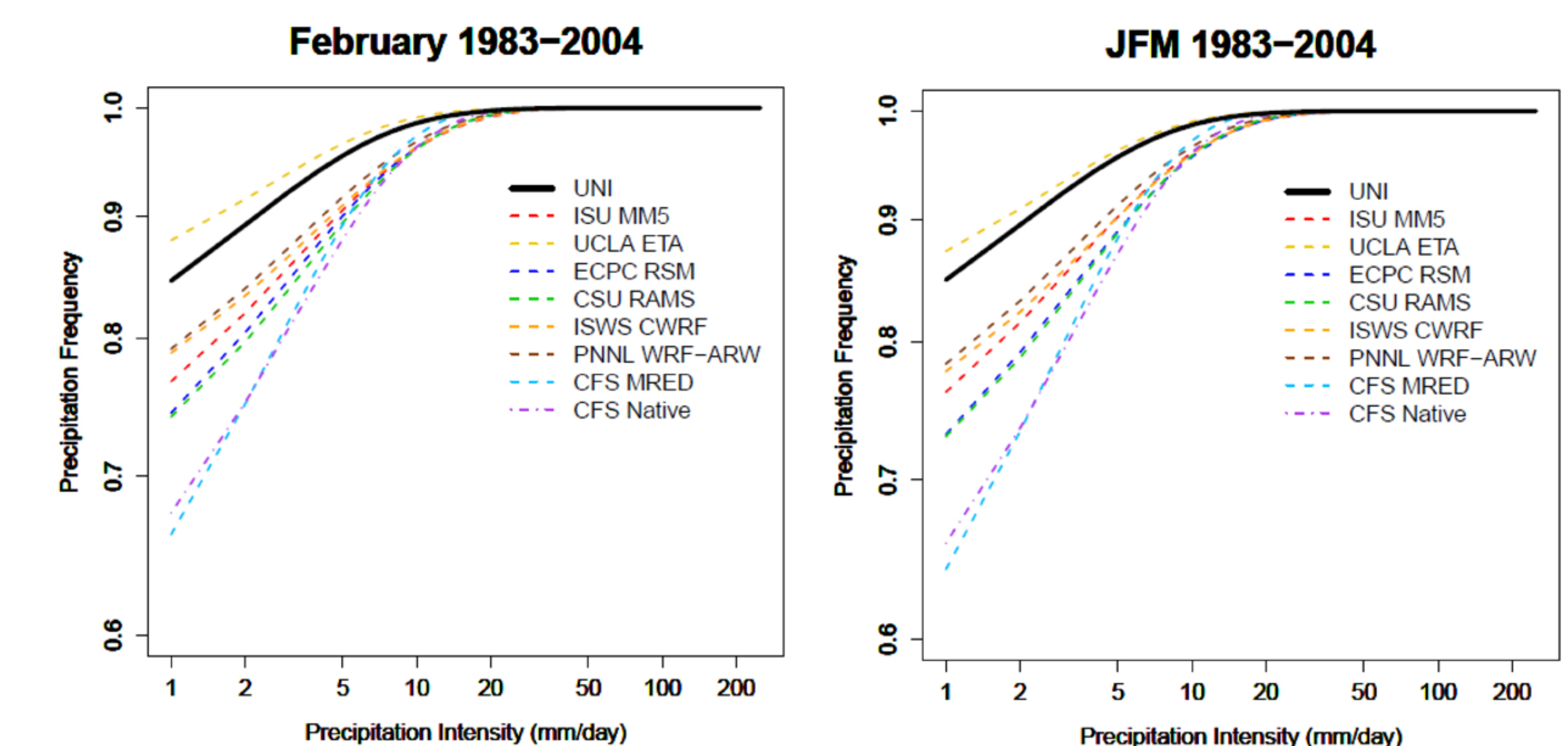
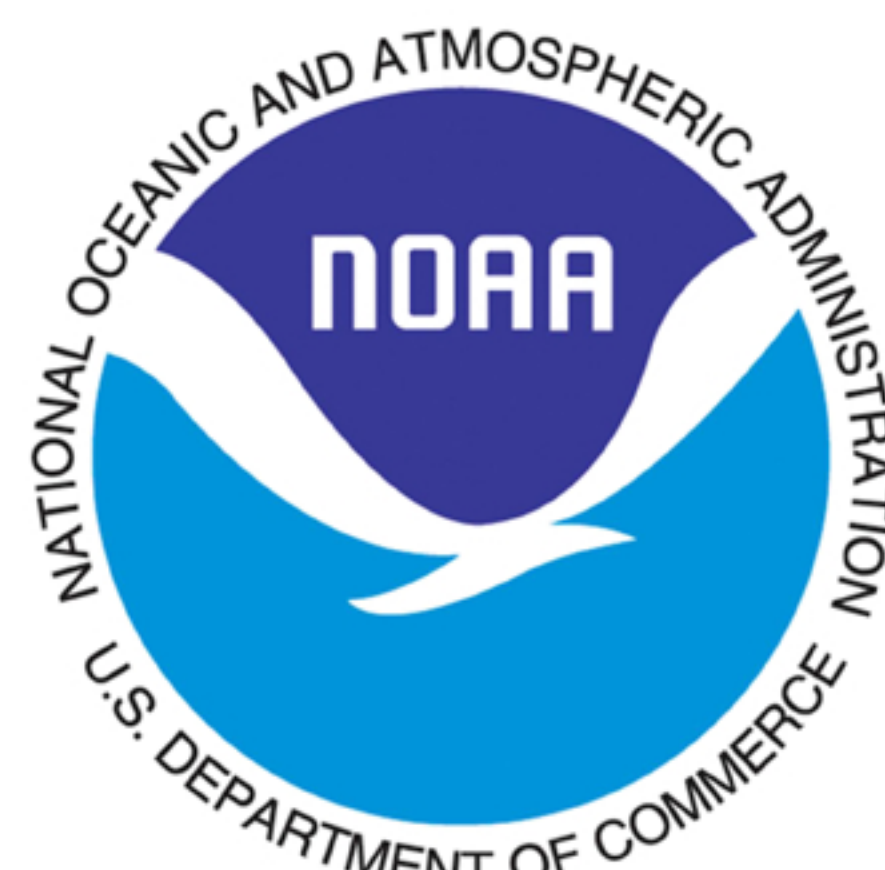


Figure 4: CDFs of the RCMs with UNI observations for precipitation intensities. Both axes are log scale and the y-axis begins at 0.6 and the x-axis ranges from 1mm/day to 250mm/day.



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