Pacific Northwest
NATIONAL LABORATORY

Climate Model Emulation: Two Variations on a Theme

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U.S. DEPARTMENT OF ENERGY BATTELLE

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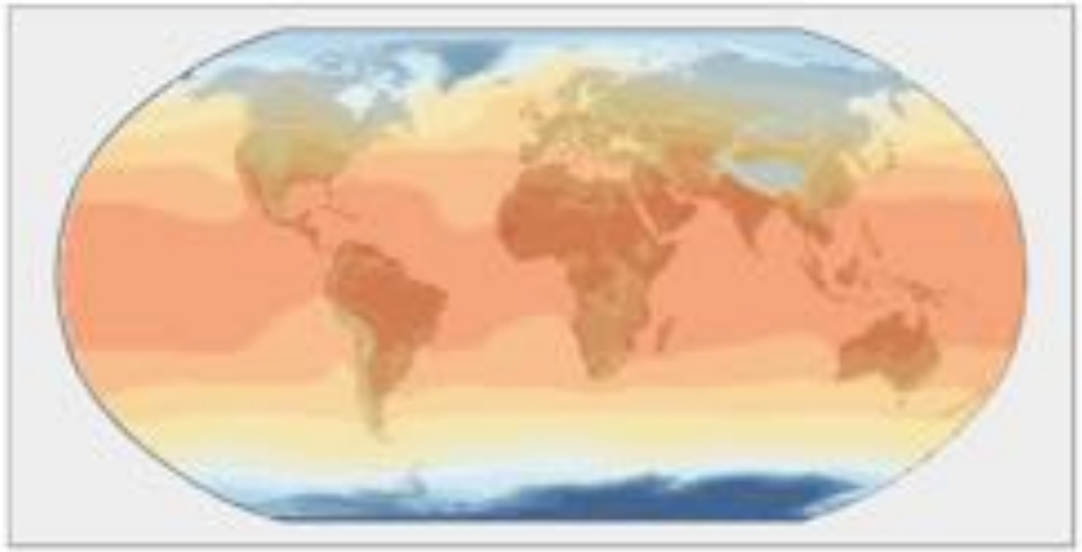
Why emulate climate models?



Temperature (K)

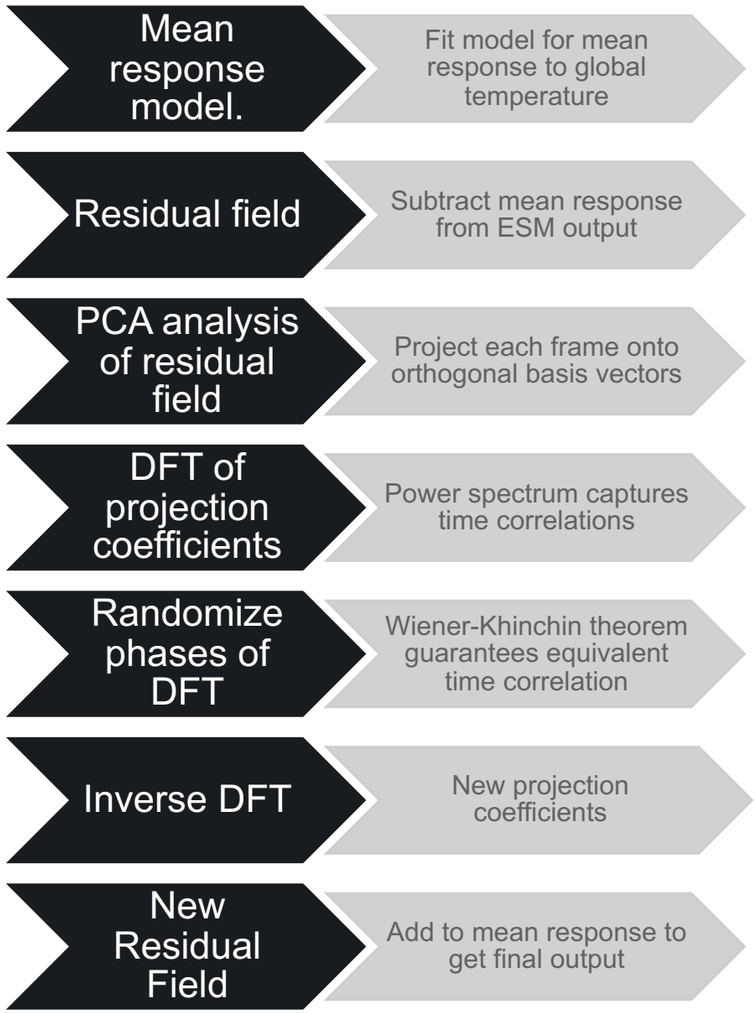
250 275 300

Precipitation (mm/day)

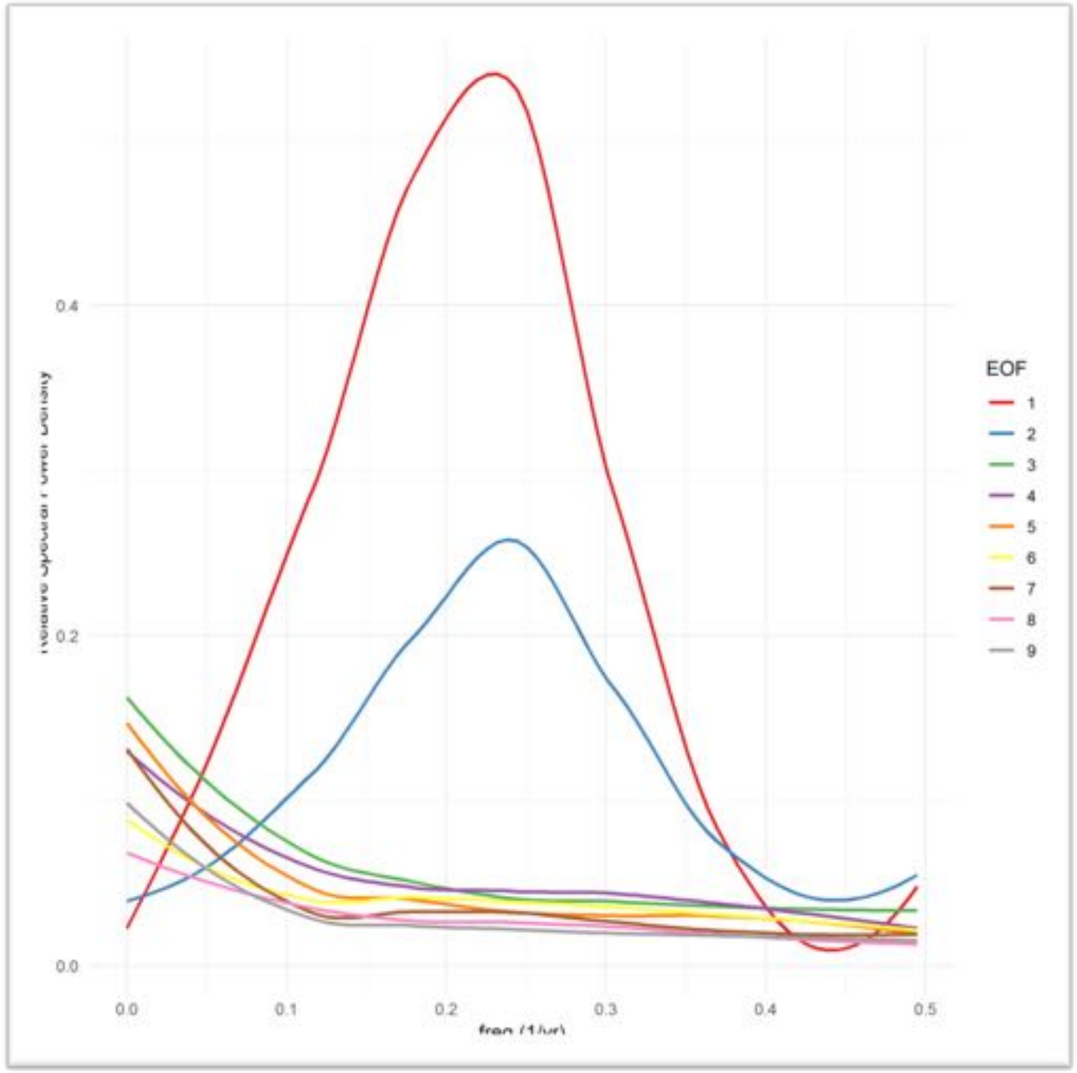
0 5 10 15

Climate field generator ('fldgen')

- Strategy:
  - Capture spatial structure using principal components analysis (PCA)
  - PCA also diagonalizes the covariance matrix
  - Capture time correlation using Fourier analysis



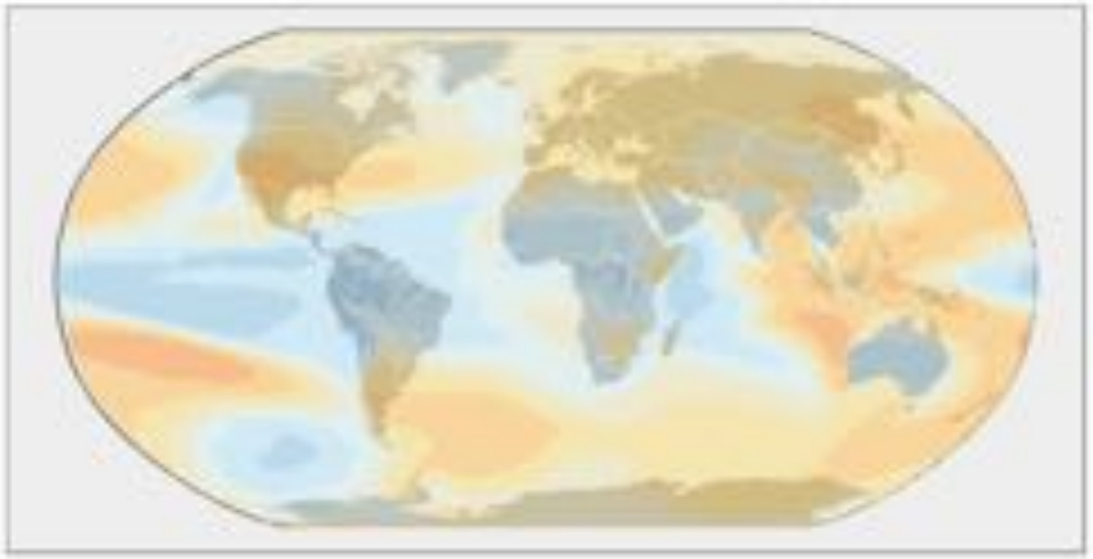
Temporal properties



- Power spectra of the first 9 basis vectors
- Peaks in first two bases indicate quasiperiodic behavior in the 2-5 year range for these components

Spatial properties (1st component)

EOF-1



T-portion (relative to max of T portion)

-0.50 -0.25 0.00 0.25 0.50

EOF-1

P-portion(relative to max of P portion

-0.50 -0.25 0.00 0.25 0.50

Spatial properties (3rd component)

EOF-3

T-portion (relative to max of T portion)

-0.50 -0.25 0.00 0.25 0.50

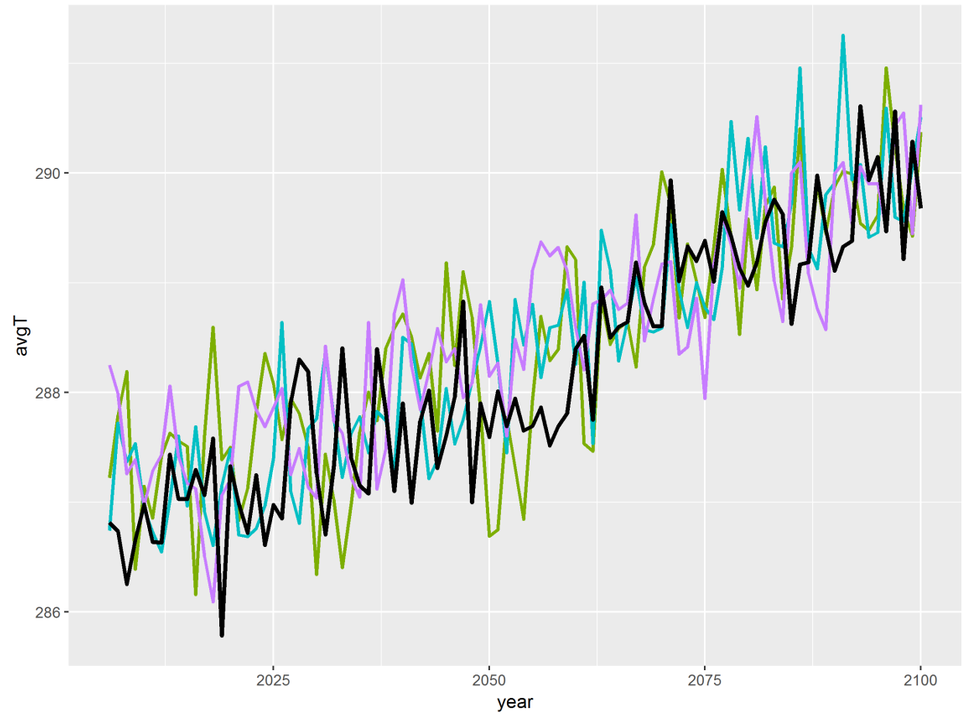
EOF-3

P-portion(relative to max of P portion

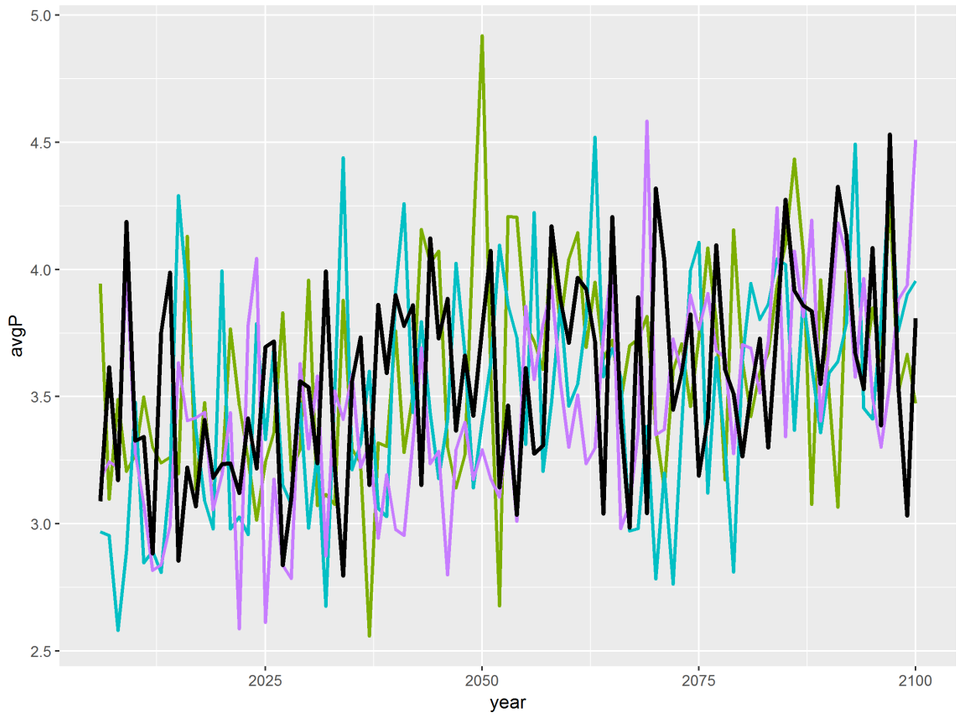
-0.50 -0.25 0.00 0.25 0.50

Putting it all together

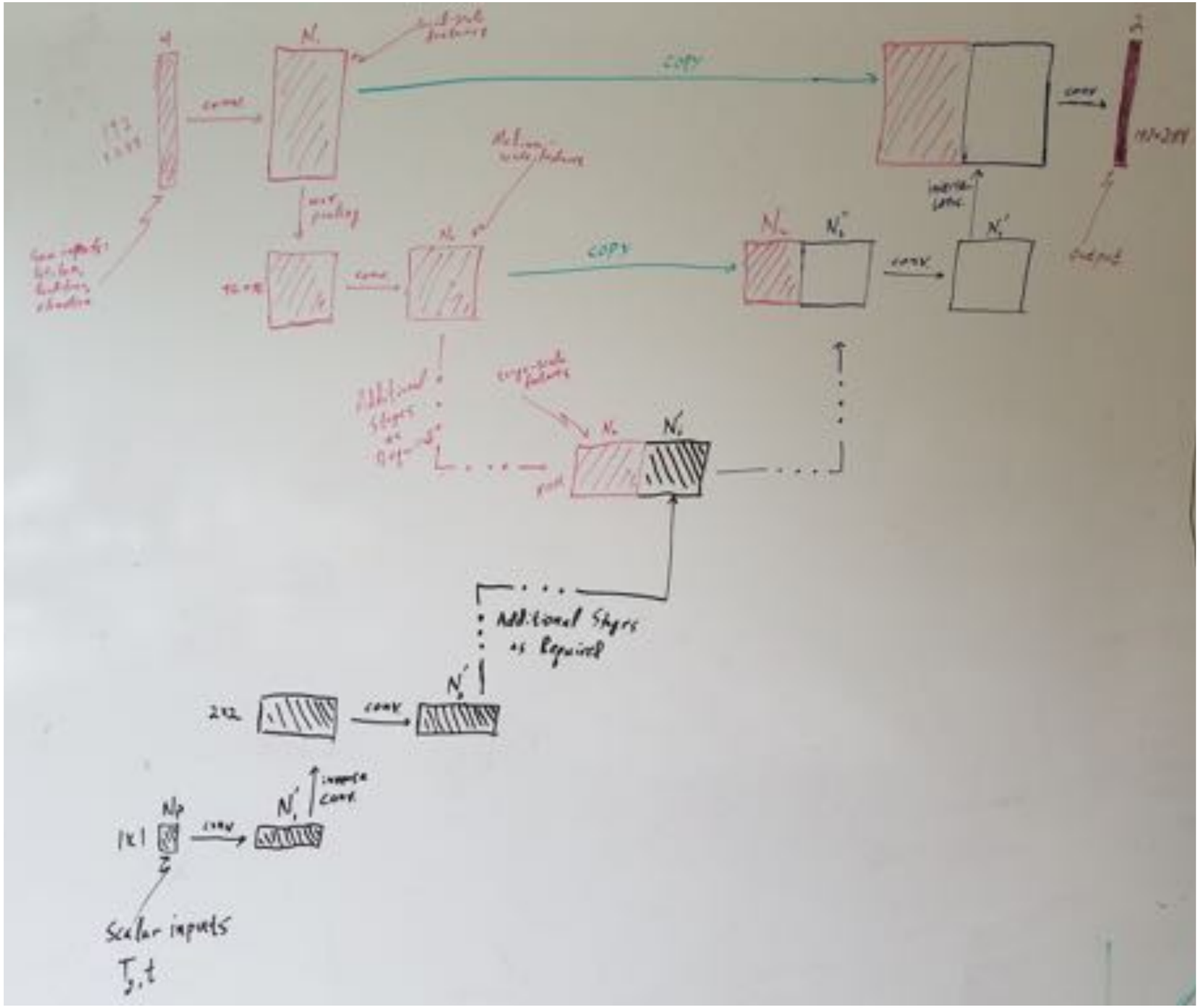
Temperature



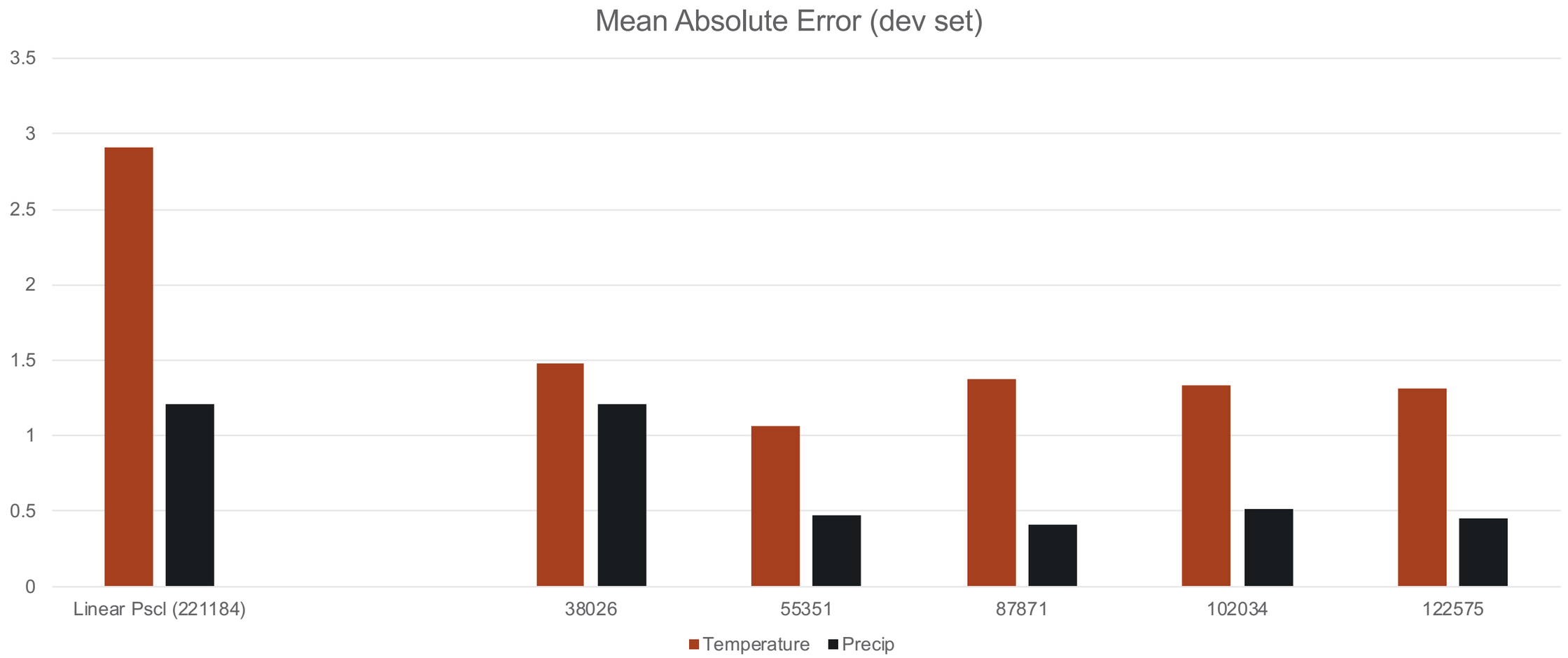
Precipitation



A deep convolutional neural network (CNN) model for mean response ('dnnclim')



Performance of mean response models



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Results of CNN mean response model