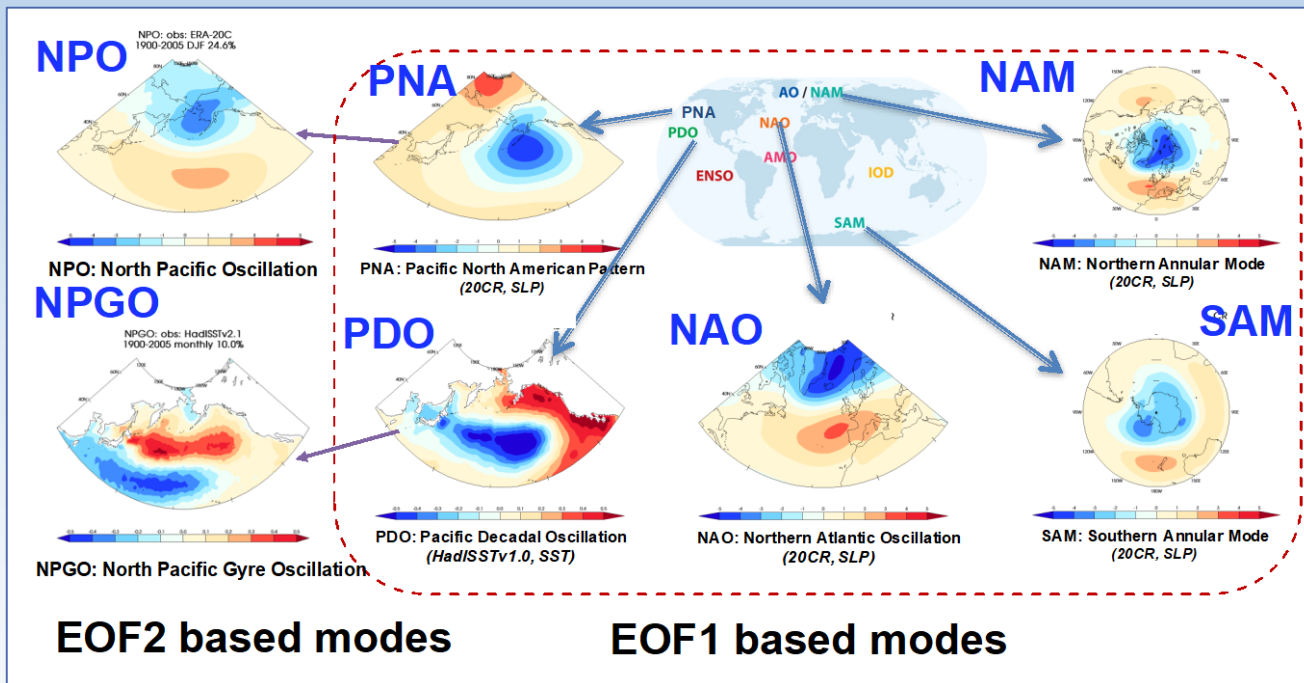


Are newer climate models better in simulating **extratropical modes of variability** than older ones? — *A comparison across multiple generations of climate models*

Jiwoo Lee, Ken Sperber, Peter Gleckler, Karl Taylor, and Celine Bonfils

PCMDI Lawrence Livermore National Laboratory



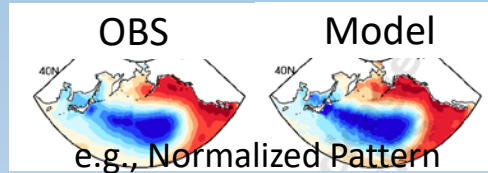
We apply multiple methods:

- Common Basis Function (CBF; Lee et al. 2019)
- Traditional EOF method

~800 of CMIP3, 5, 6 simulations.

Extratropical Modes of Variability in CMIP3, 5, and 6 models

Relative Error on Spatial Pattern

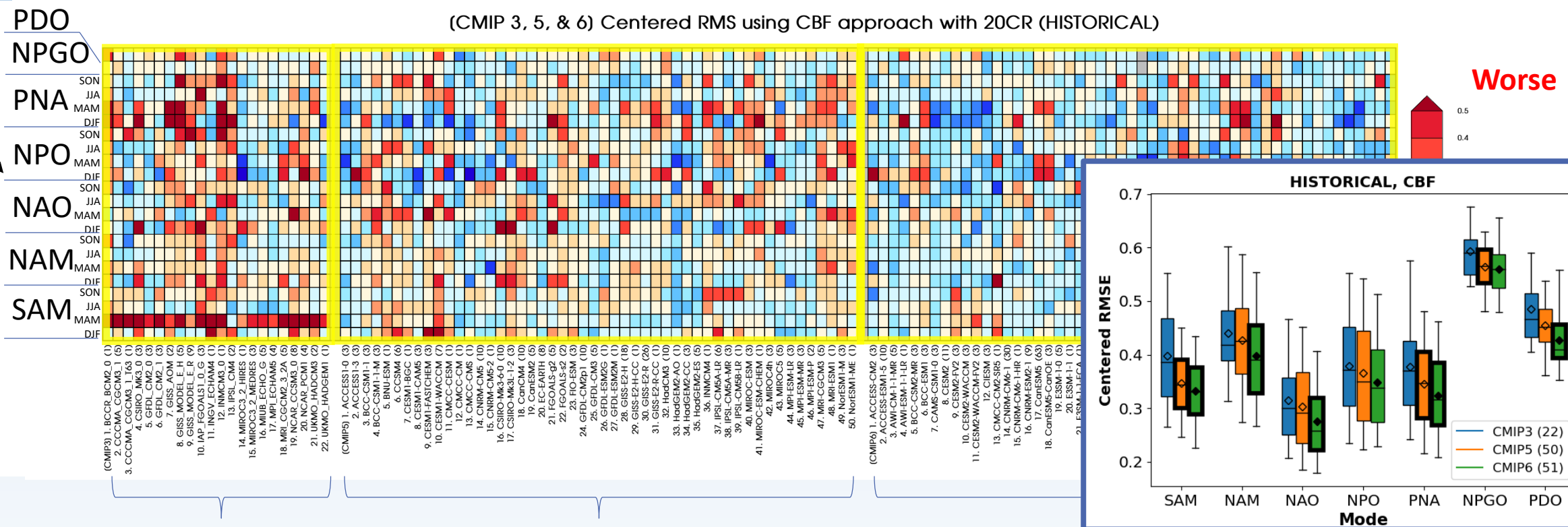


We analyze 775 *Historical* simulations from 123 models:

- 22 CMIP3 models (72 simulations)
- 50 CMIP5 models (216 simulations)
- 51 CMIP6 models (487 simulations)

Mode & Season

(CMIP 3, 5, & 6) Centered RMS using CBF approach with 20CR (HISTORICAL)

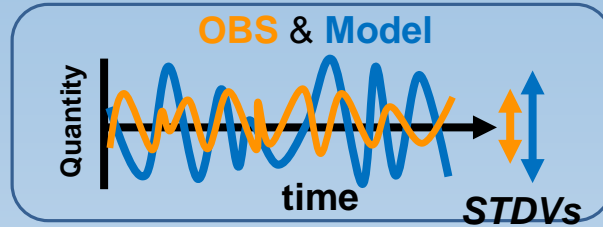


- Overall improvement is significant in many cases.



Extratropical Modes of Variability in CMIP3, 5, and 6 models

Temporal Amplitude

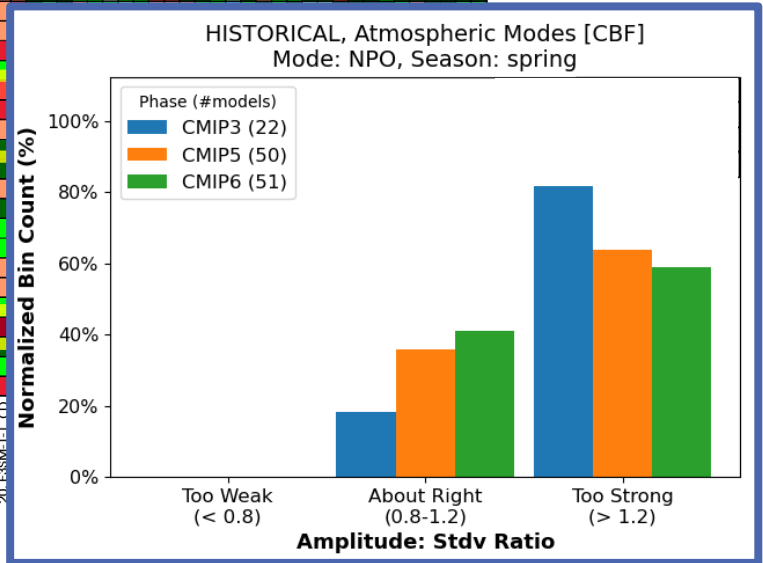
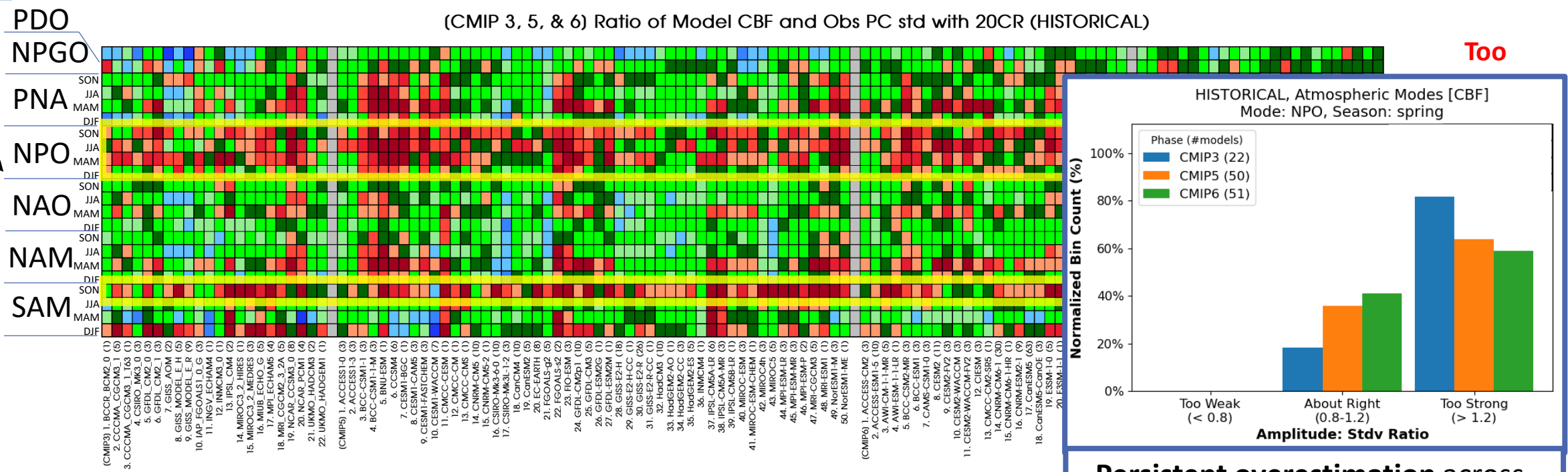


We analyze 775 *Historical* simulations from 123 models:

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Mode & Season

(CMIP 3, 5, & 6) Ratio of Model CBF and Obs PC std with 20CR (HISTORICAL)

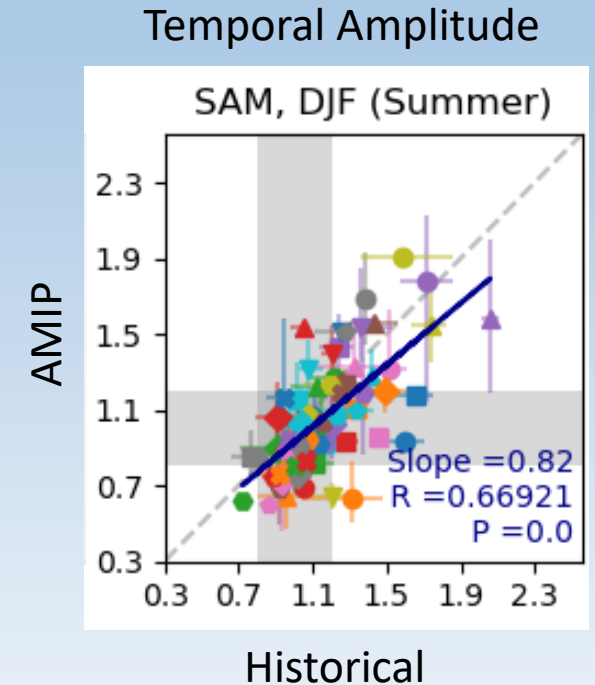


- Persistent overestimation across MIPs for some mode/season
 - Not much gain in performance for amplitude in newer models



Additional Remarks

- Comparison between Historical and AMIP
 - Outliers in AMIP often are also outliers in Historical
 - Easier to diagnose root-cause of errors in AMIP mode



Some results with interactive visualization are available at <https://cmec.llnl.gov/>