

# **EVALUATION OF WRF MODEL METEOROLOGY FORECAST ENSEMBLE MEMBERS**

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# Pilot Project Background & Goals

- The WRF model will be run with multiple parameterization schemes; CMAQ will be run for each WRF run
- Differences in WRF model simulations as well as differences in CMAQ simulations will be evaluated
- To better understand how meteorological model performance affects downstream air quality model performance (i.e., how correlated are WRF bias/errors with eventual CMAQ bias/errors).
- To better understand which meteorological parameters are most important to replicate in order to maximize AQ model performance.
- To better understand the potential variability in met model configurations (model physics initially, but perhaps also grid resolution) can affect the resultant met inputs and AQ model outputs.

# Methodology

- Modeling period: July 2005 (with additional spinup period), a time of poor AQ and available AQ model files
- Modeling domain: EPA large EUS 12km domain
- Meteorology: WRF Model version 3.1.1, with alternate boundary layer parameterizations and land surface models.
- Emissions: SMOKE, will not attempt to account for meteorological impacts on emissions.
- Air quality modeling: CMAQ v4.7.1
- Evaluation:
  - WRF: Key meteorological variables (Temp, WS, WD, PBL, Precip, Radiation, etc.)
  - CMAQ: Daily Average PM2.5, Daily Maximum 8h O3
  - Integrated analyses of AQ and meteorological variables

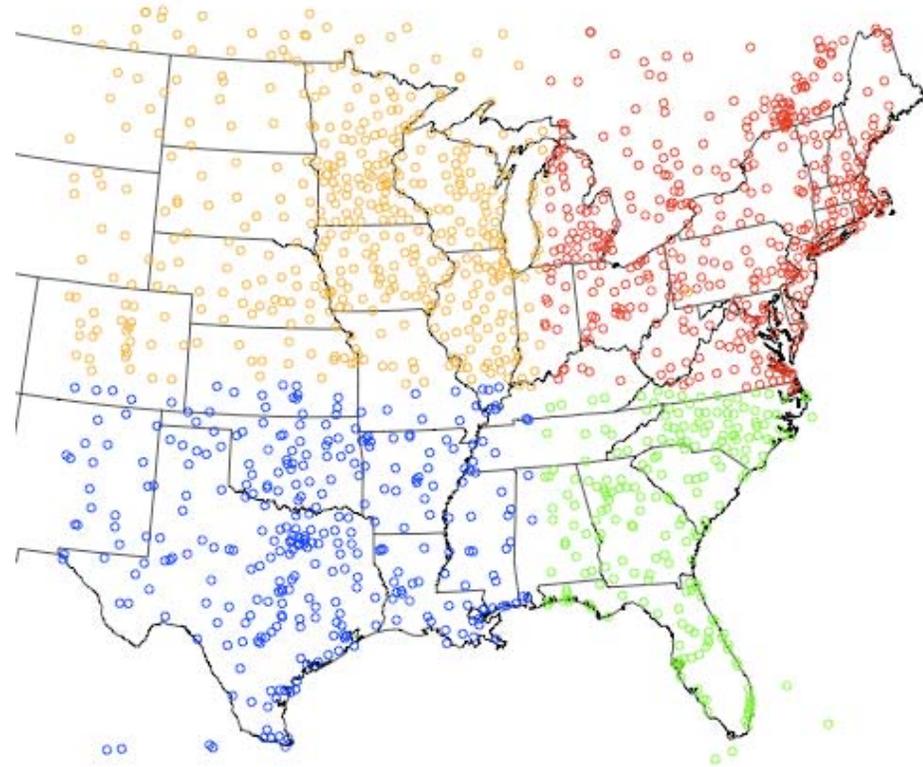
# WRF Ensemble Members

CODE	INIT/BDRY CONDITIONS	MOIST PHYSICS	LONG WAVE	SHORT WAVE	LAND SURFACE	SOIL LAYERS	PBL	SURFACE	CUMULUS
RENCI0	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	PX(7)	2	PX(7)	PX(7)	KF (1)
RENCI1	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	PX(7)	2	QNSE(4)	QNSE(4)	KF (1)
RENCI2	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	PX(7)	2	M-O Eta (2)	MYJ (2)	KF (1)
RENCI3	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	PX(7)	2	M-O (1)	YSU (1)	KF (1)
RENCI4	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	RUC(3)	6	PX(7)	PX(7)	KF (1)
RENCI5	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	RUC(3)	6	QNSE(4)	QNSE(4)	KF (1)
RENCI6	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	RUC(3)	6	MYJ (2)	MYJ (2)	KF (1)
RENCI7	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	RUC(3)	6	YSU (1)	YSU (1)	KF (1)
RENCI8	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	NOAH(2)	4	PX(7)	PX(7)	KF (1)
RENCI9	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	NOAH(2)	4	QNSE(4)	QNSE(4)	KF (1)
RENCI10	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	NOAH(2)	4	MYJ (2)	MYJ (2)	KF (1)
RENCI11	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	NOAH(2)	4	YSU (1)	YSU (1)	KF (1)
RENCI12	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	MM5(1)	5	PX(7)	PX(7)	KF (1)
RENCI13	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	MM5(1)	5	QNSE(4)	QNSE(4)	KF (1)
RENCI14	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	MM5(1)	5	MYJ (2)	MYJ (2)	KF (1)
RENCI15	NAM 12	Morrison(10)	RRTMG(4)	RRTMG(4)	MM5(1)	5	YSU (1)	YSU (1)	KF (1)

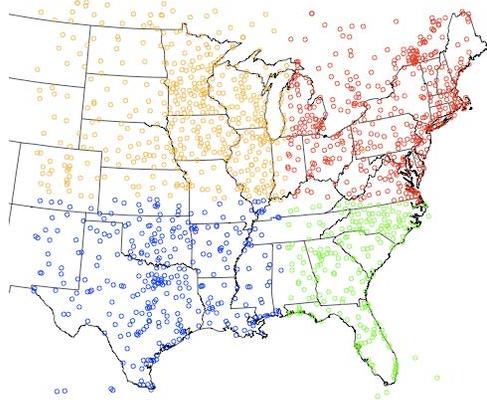
- MM5 LSM = thermal diffusion scheme
- PX PBL scheme is ACM2

# WRF Performance Evaluation

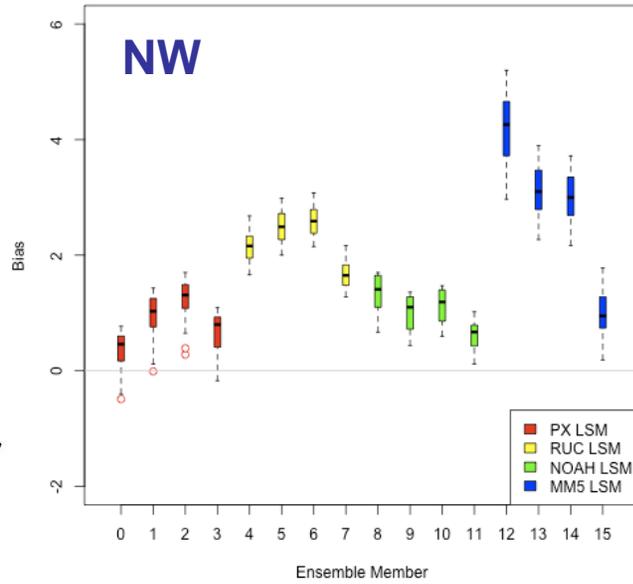
- 12EUS1 model domain
- METSTAT evaluation using NCAR ds472 surface observation data
- Temperature, wind speed, wind direction, and water mixing ratio
- Daily and hourly metrics for July 1-21, 2005 averaged over all monitors in 4 general geographic quadrants of the eastern U.S. model domain: NE, NW, SE, SW
- Daily metrics shown for all 21 days of the episode as box plot distributions for each ensemble member



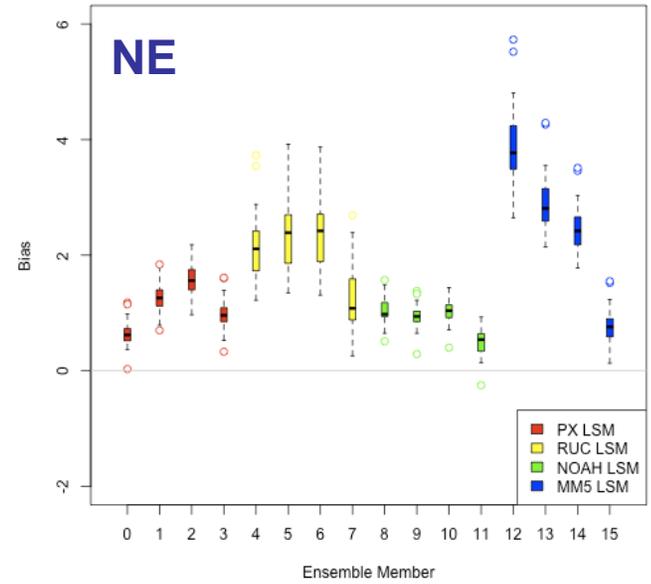
# Mixing Ratio Bias



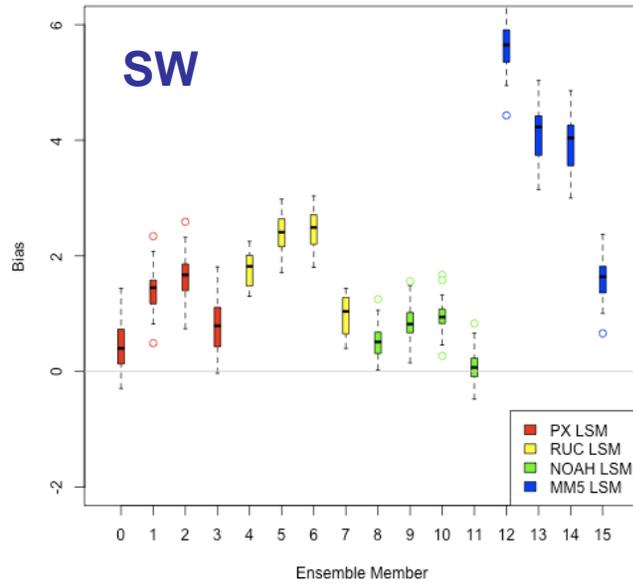
Water Mixing Ratio Bias (g/kg)



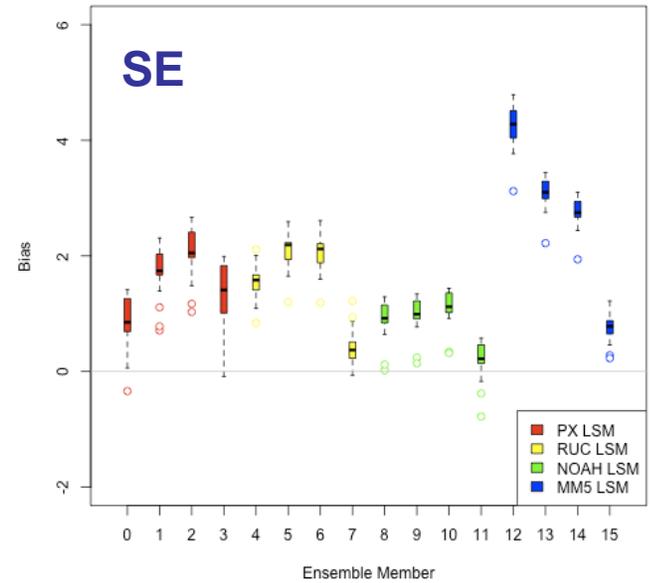
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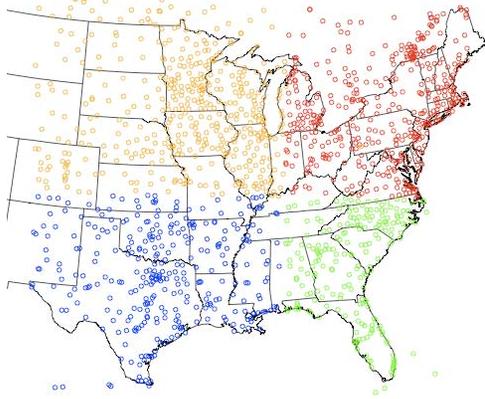


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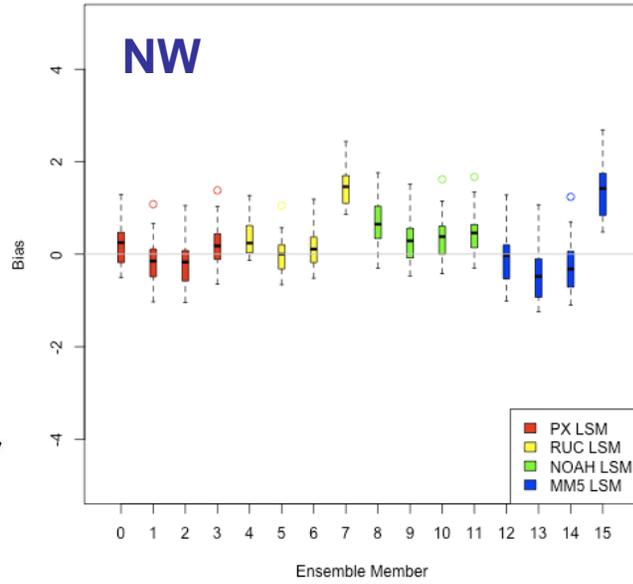


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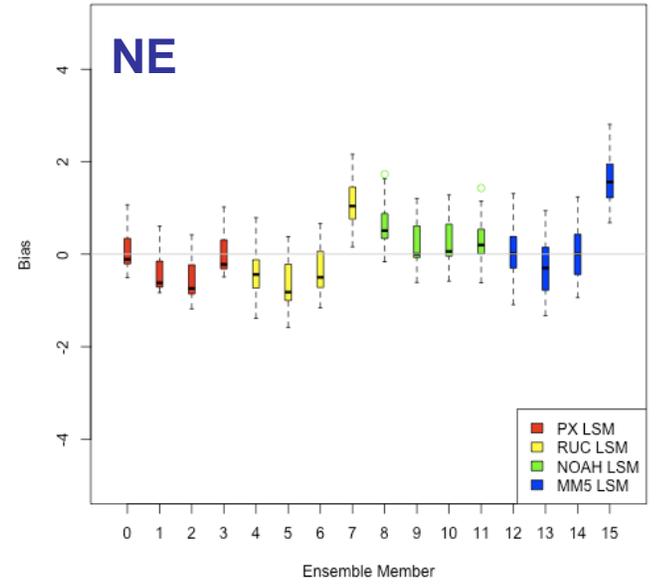
# Temperature Bias



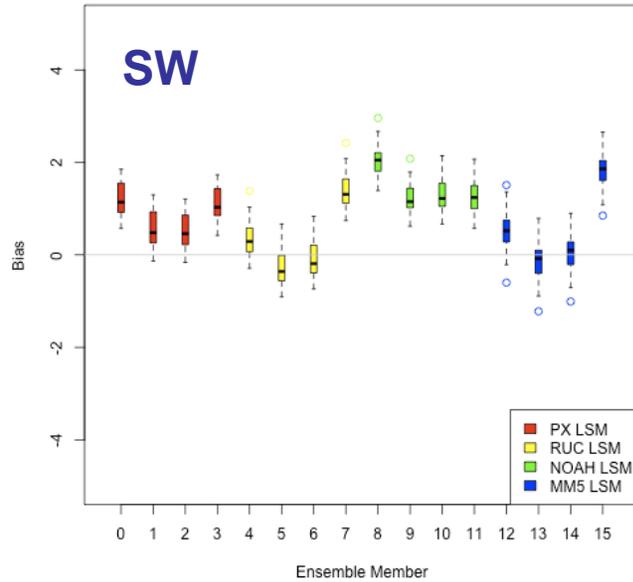
Temperature Bias (C)



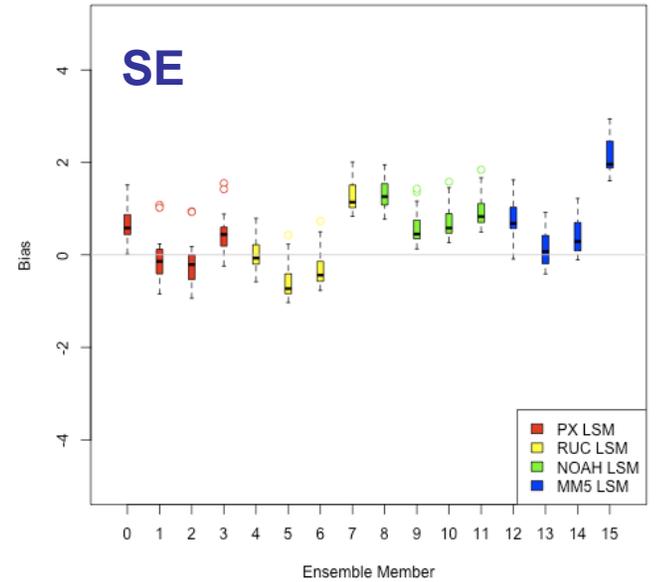
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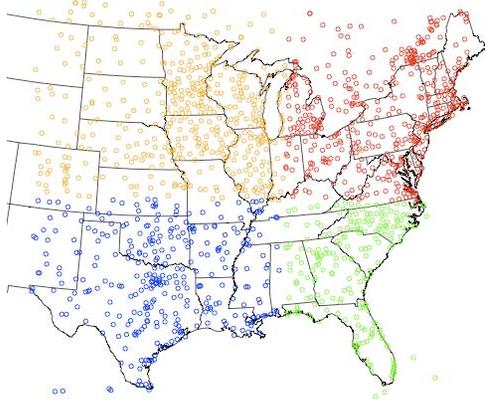


Temperature Bias (C)

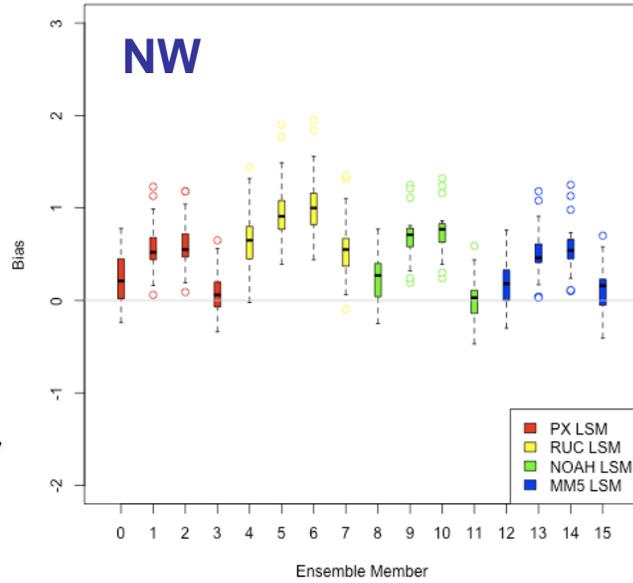


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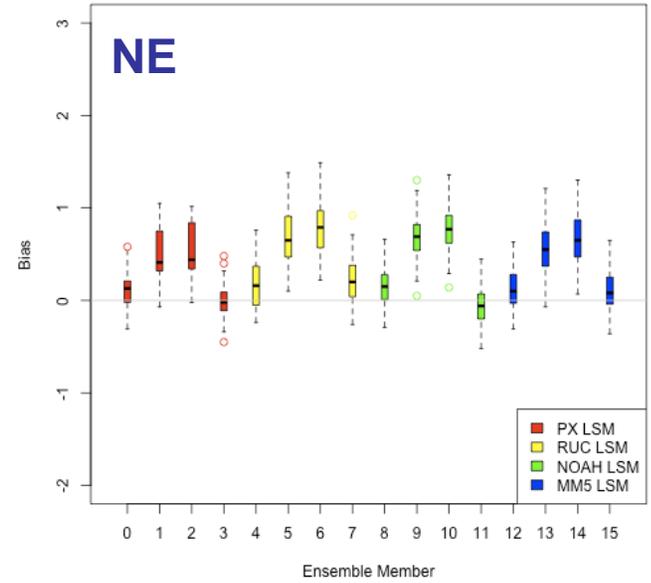
# Wind Speed Bias



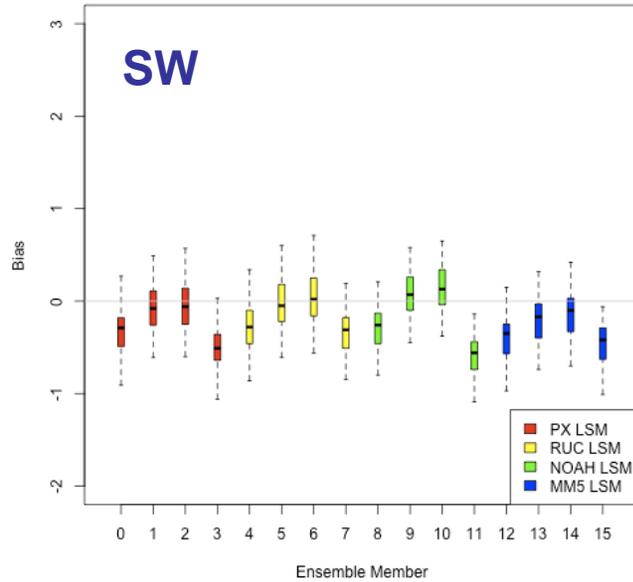
Wind Speed Bias (m/s)



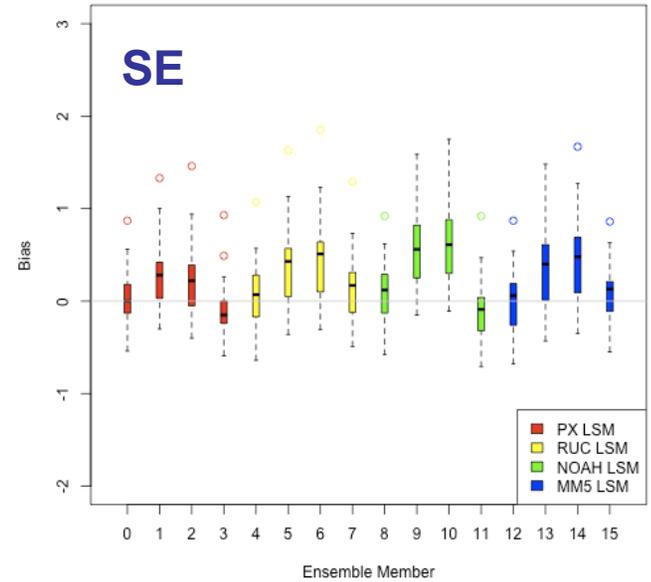
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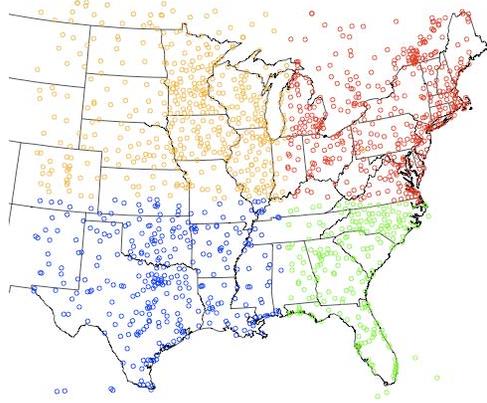


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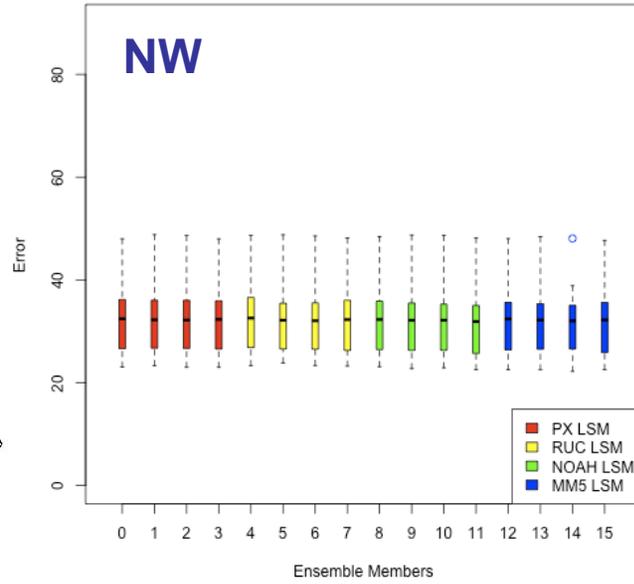


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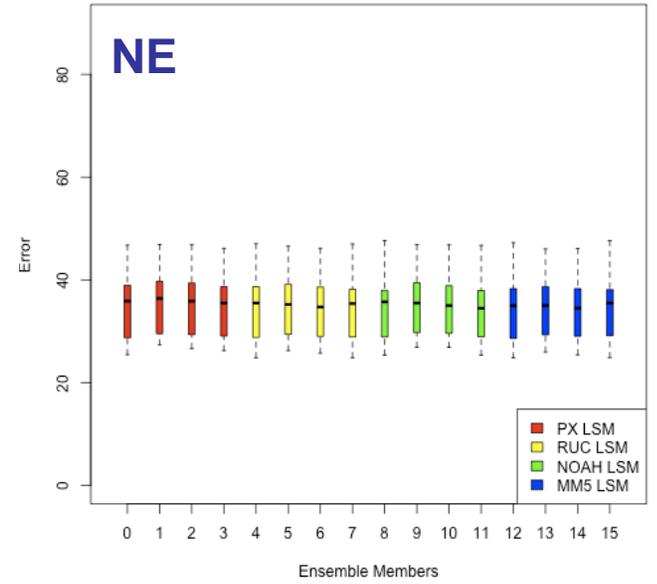
# Wind Direction Error



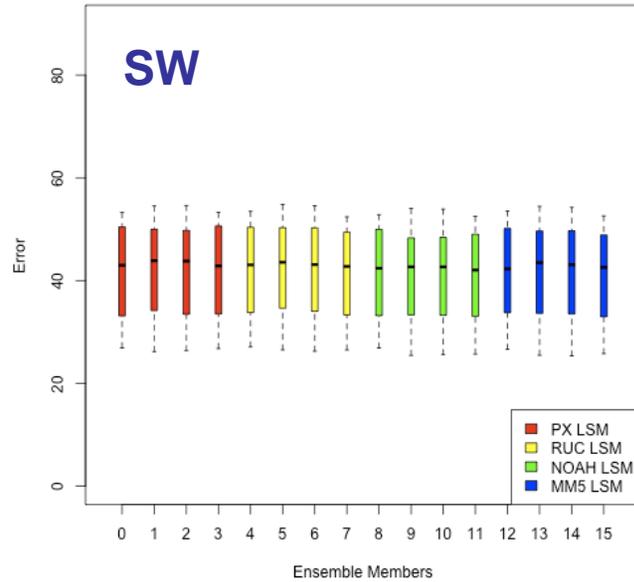
Wind Direction Error (compass degrees)



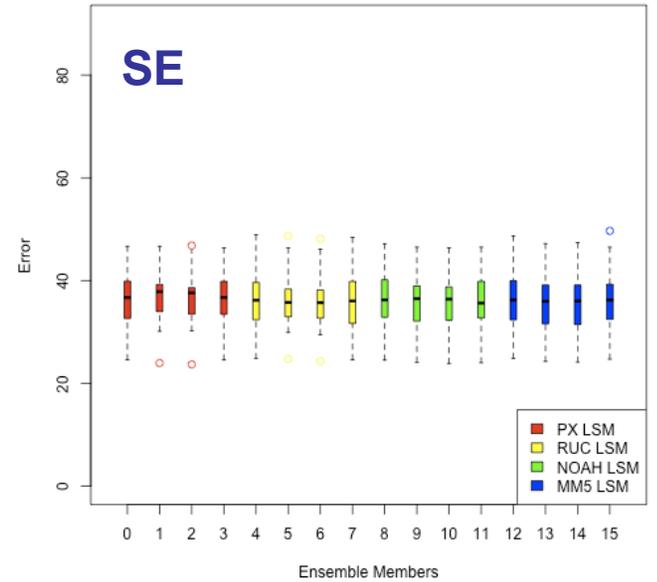
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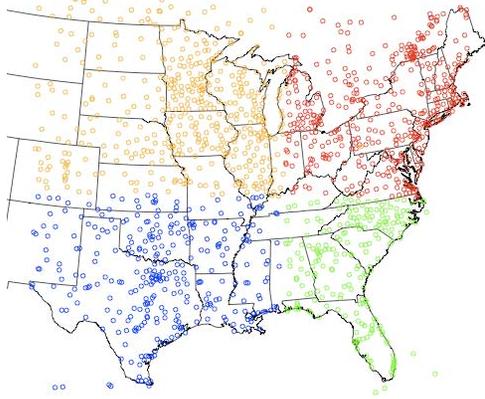


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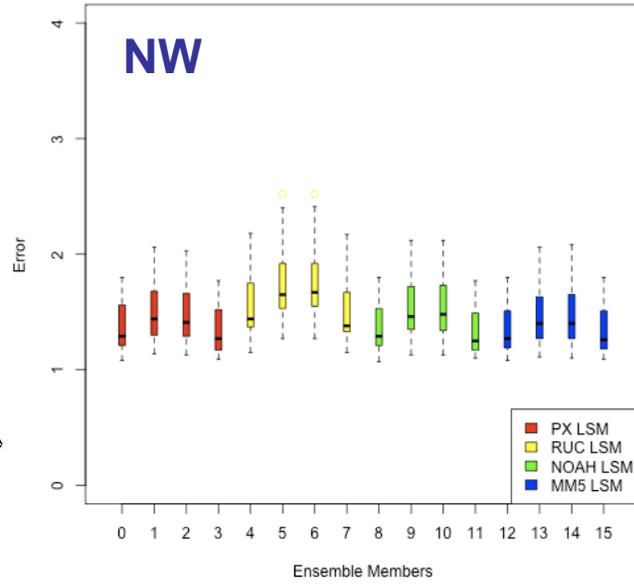


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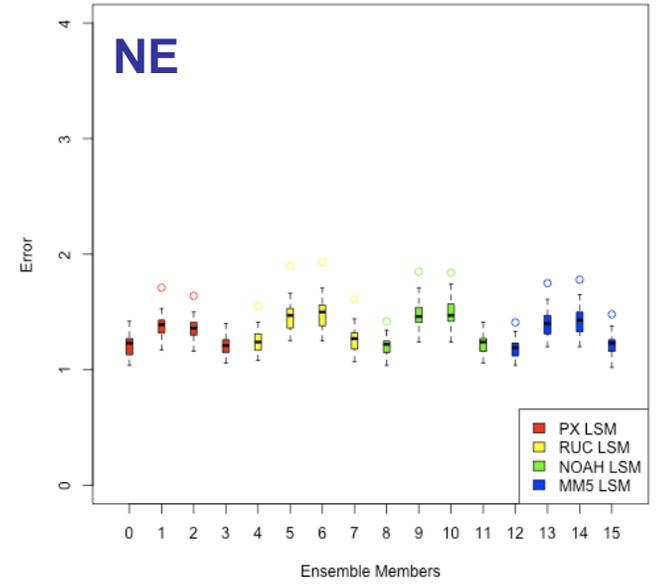
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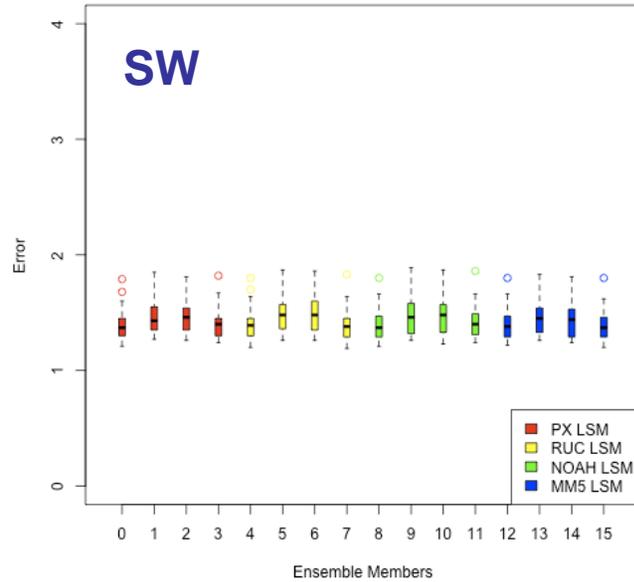
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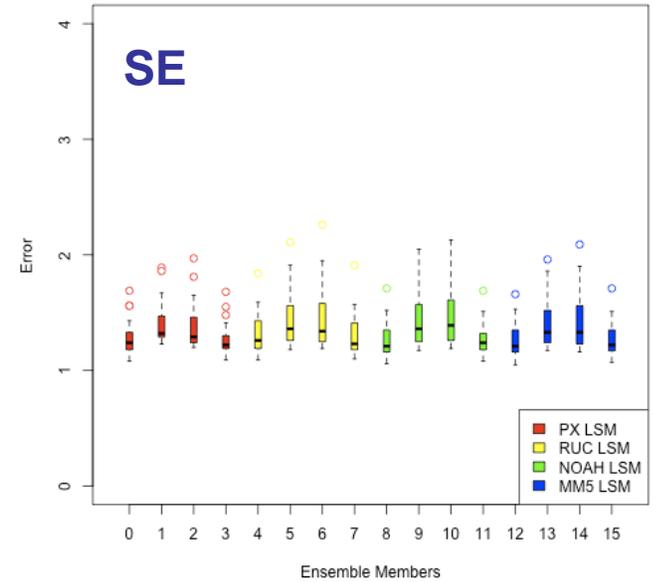
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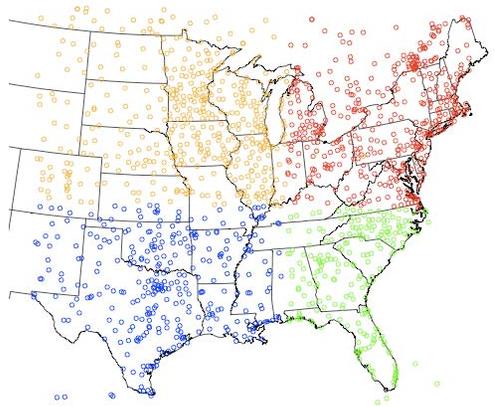


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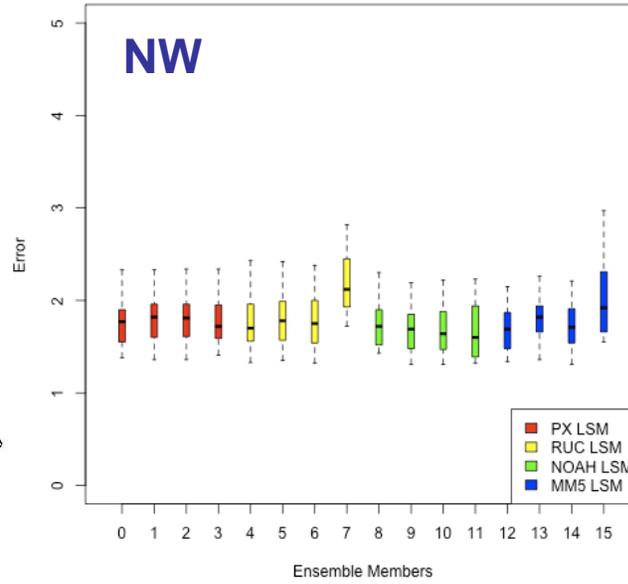


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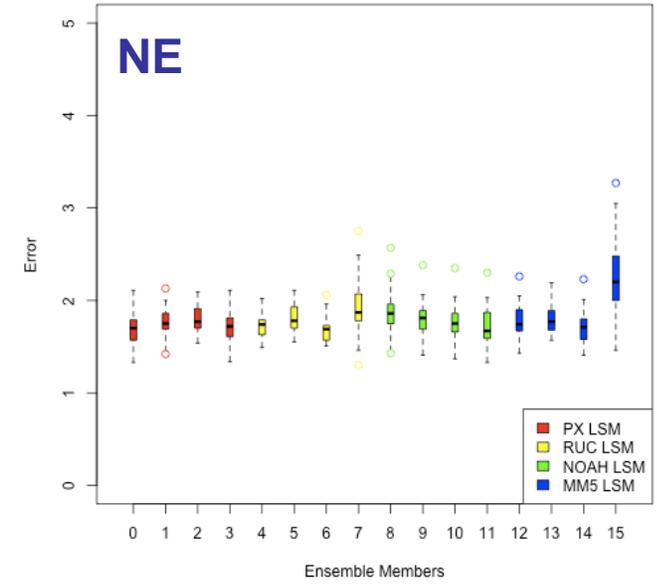
# Temperature Error



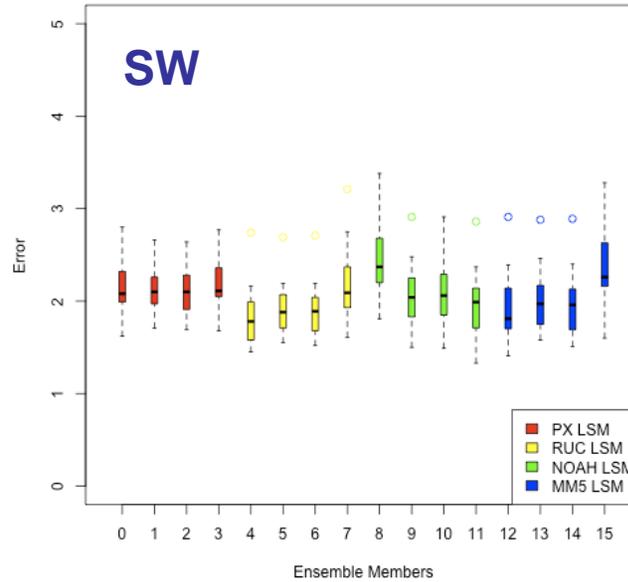
Temperature Error (C)



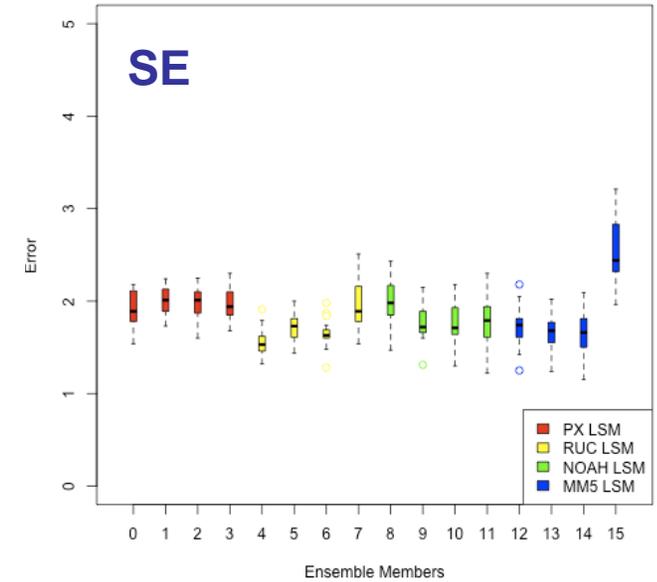
Temperature Error (C)



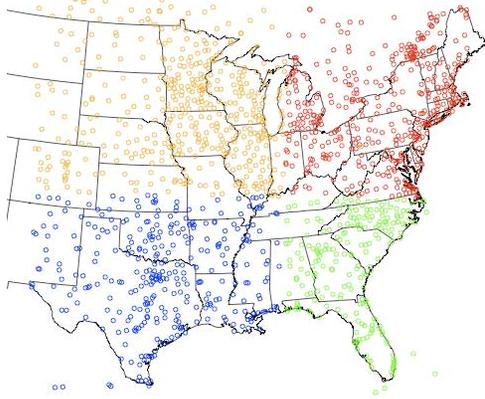
Temperature Error (C)



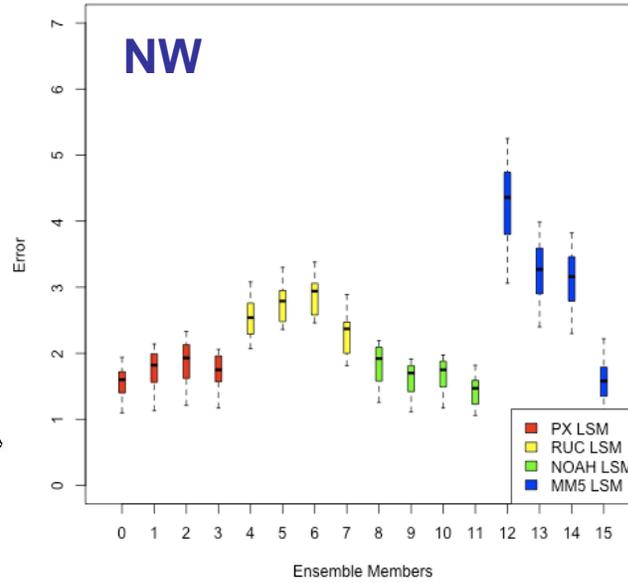
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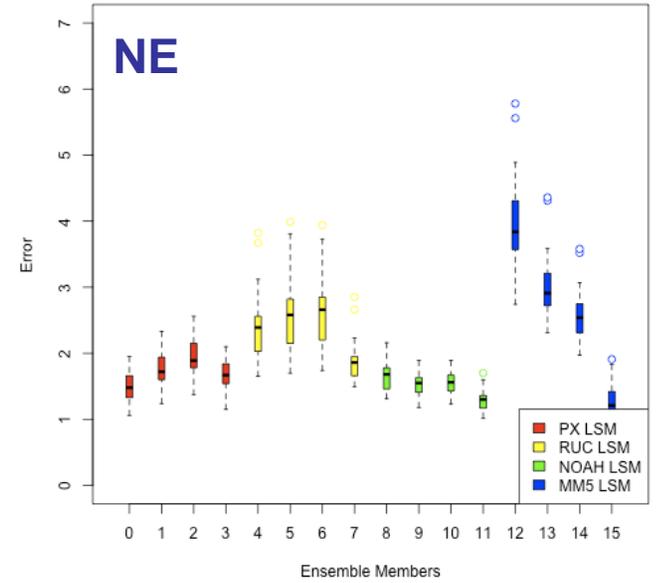
# Mixing Ratio Error



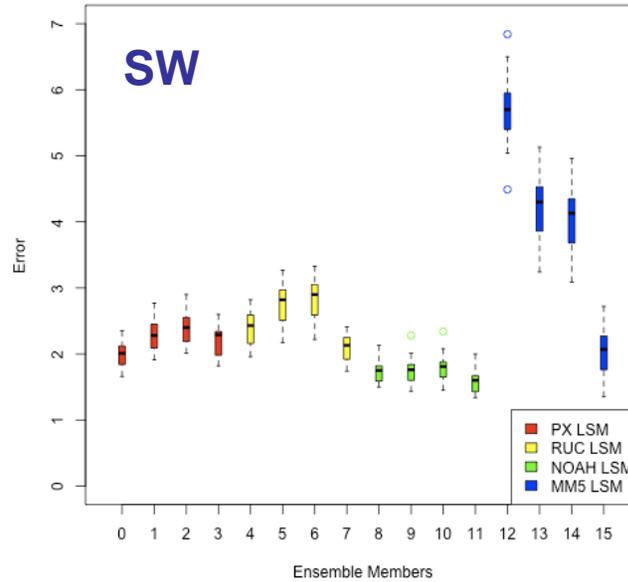
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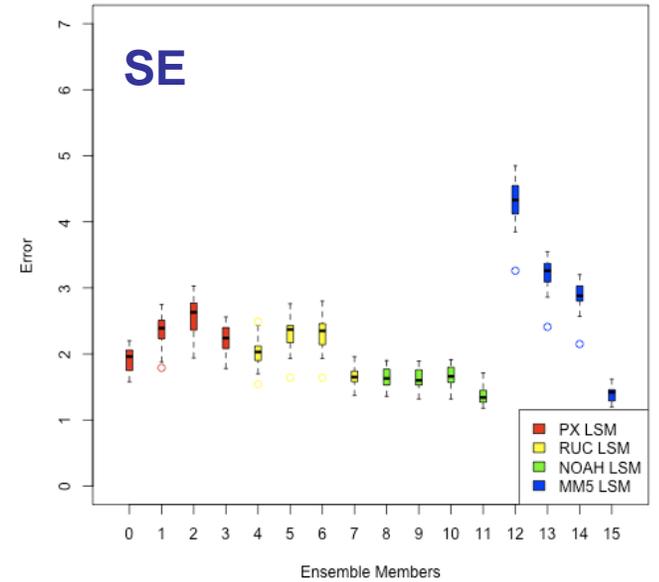
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