Comparing Simulated and Observed Gross Primary Productivity

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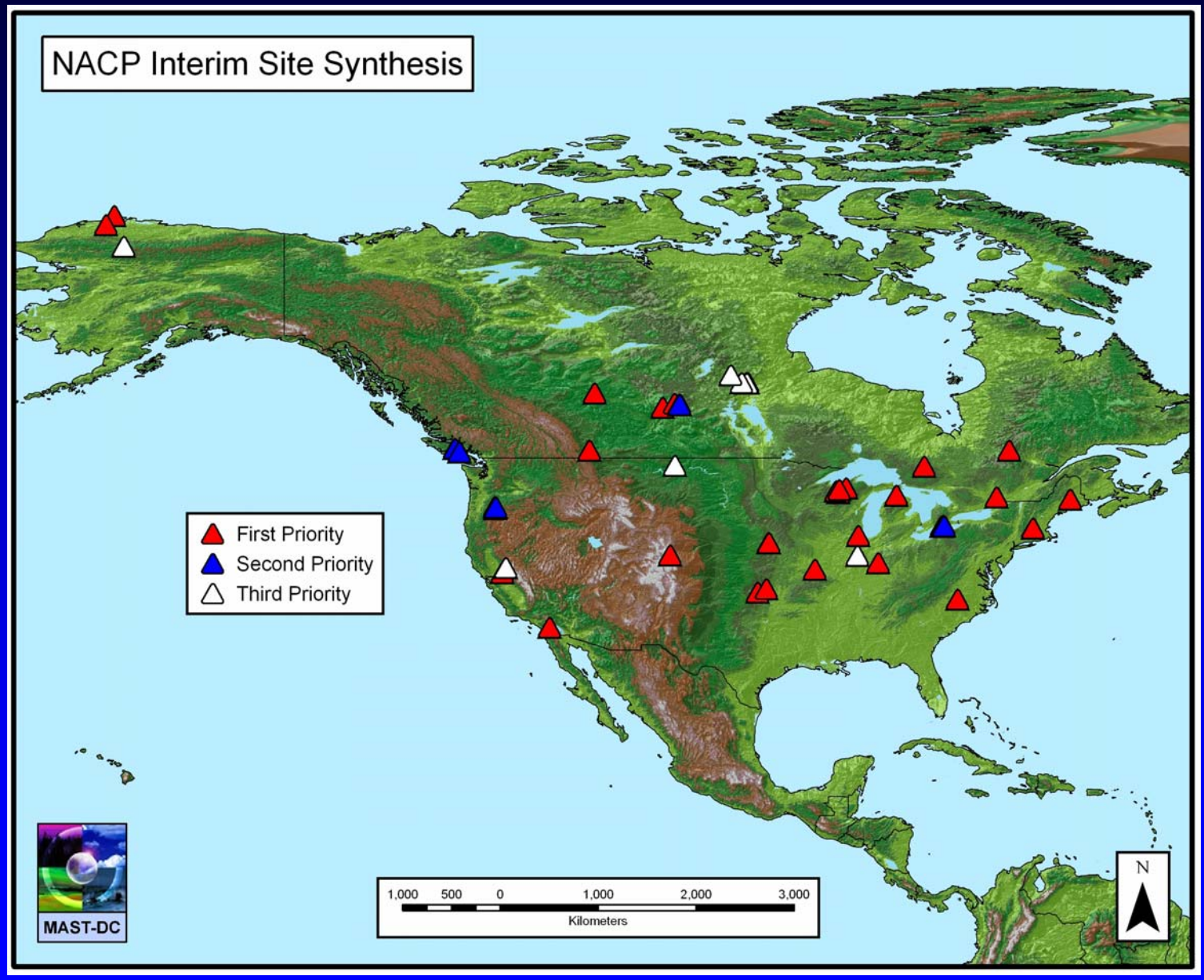
Objectives

- Quantify how well models simulate estimated GPP
- Identify sources of error

32 Flux Tower Sites



21 Models + Model Mean

AGROIBIS	ISOLSM
BEPS	LOTEC
BIOMEBGC	LPJ
CAN-IBIS	ORCHIDEE
CNCLASS	SIB
DLEM	SIBCASA
DNDC	SIBCROP
ECLUEEDCM	SSIB2
ECOSYS	TECO
ED2	TRIPLEX
ISAM	Mean

Methods

- Gap-filled observed weather
- Steady state
- Observed NEE partitioned into GPP & respiration
- GPP Uncertainty
  - Random
  - U* filtering
  - Gap-filling
  - Partitioning
- Daily average GPP
- Drop filled data/model points

Statistics

Chi-squared

$$X^2 = \frac{1}{n}\sum\left(\frac{GPP_{mod} - GPP_{est}}{\varepsilon_{GPP}}\right)^2$$

$X^2 \sim 1$ model matches data within uncertainty

Root Mean Square Error

$$RMSE = \sqrt{\frac{1}{n}\sum\left(GPP_{mod} - GPP_{est}\right)^2}$$

$RMSE = 0$ perfect fit with data

Bias

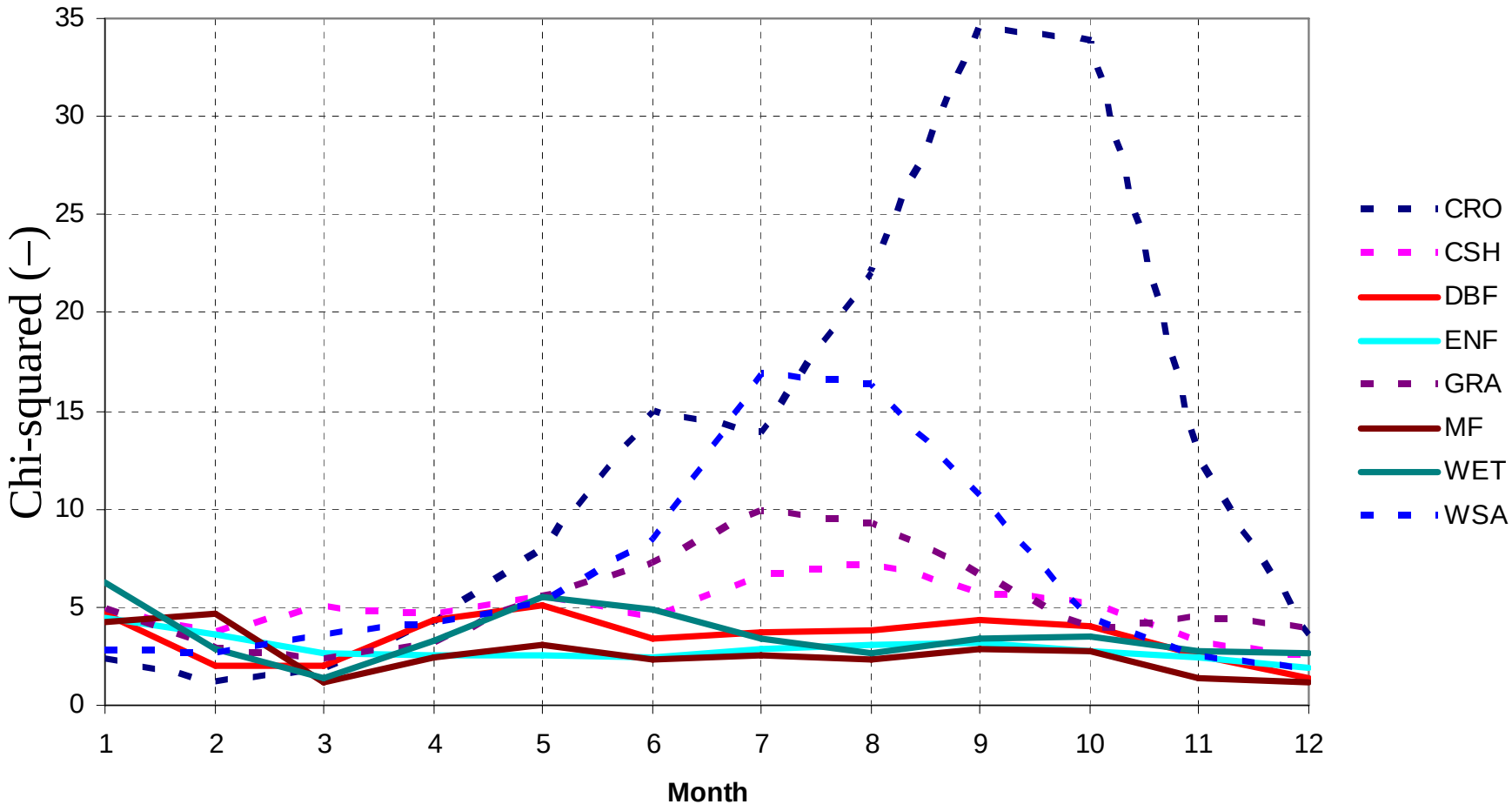
$$B = \frac{1}{n}\sum\left(GPP_{mod} - GPP_{est}\right)$$

$B > 0$ model greater than data

Results by biome

Biome	Chi-sqr (-)	RMSE (μmole m^{-2} s^{-1})	Bias (μmole m^{-2} s^{-1})
MF	2.44	4.44	-0.65
ENF	2.80	5.34	-1.96
WET	3.52	4.27	1.74
DBF	3.63	5.68	-0.65
CSH	5.05	4.81	2.11
GRA	5.54	5.84	0.43
WSA	6.81	6.20	-0.08
CRO	13.78	12.92	-0.56

X^2 Seasonal Variation



X^2 by Model

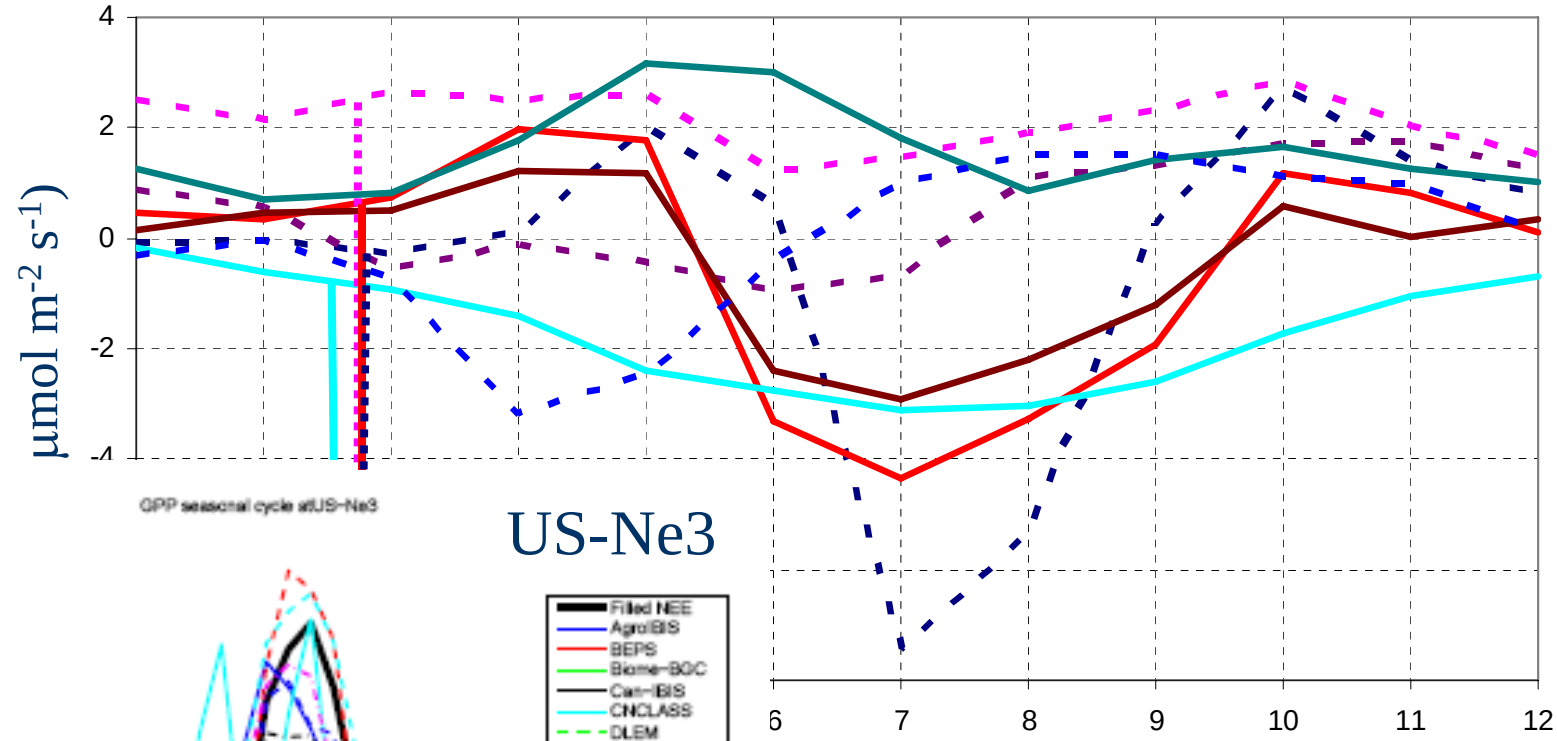
Mean is best

Optimized with data assimilation

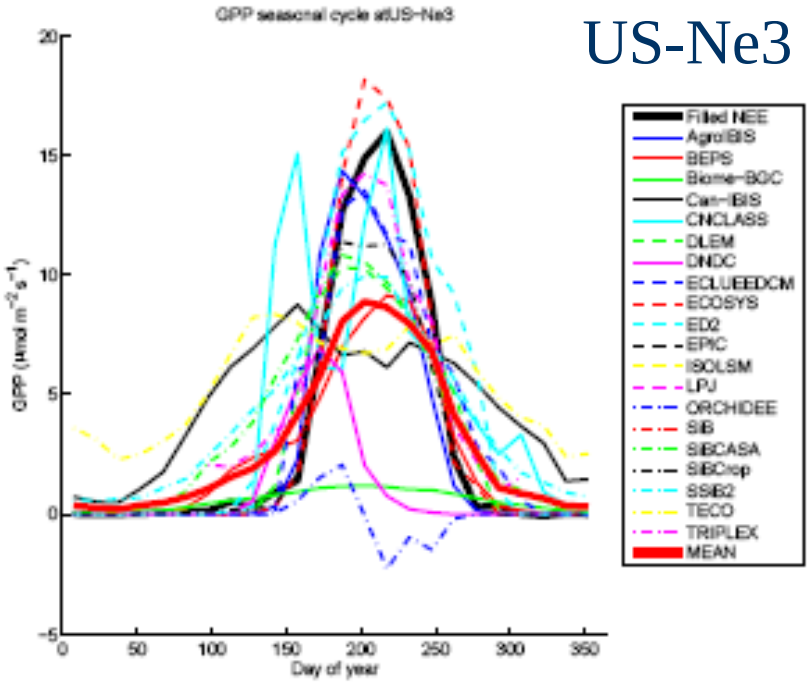
Unit Problems?

Model	chisqr (-)	RMSE (mole m^{-2} s^{-1})
Mean	1.59	4.02
LOTEC	1.96	4.45
SIB	2.13	4.43
ISOLSM	2.31	3.93
DLEM	2.35	5.9
SIBCASA	2.51	4.5
BIOMEBGC	2.96	7.24
LPJ	3.02	6
ISAM	3.04	5.15
BEPS	3.09	6.49
ECLUEEDCM	3.14	6.63
ECOSYS	3.22	4.78
SIBCROP	3.44	7.4
CAN-IBIS	3.65	5.13
ORCHIDEE	4.07	5.9
DNDC	4.16	12.15
TRIPLEX	4.24	8.36
ED2	4.27	6.96
AGROIBIS	4.39	7.97
SSIB2	8.11	6.72
TECO	10.66	7.76
CNCLASS	15.63	12.35

Bias: GPP scaling and phenology

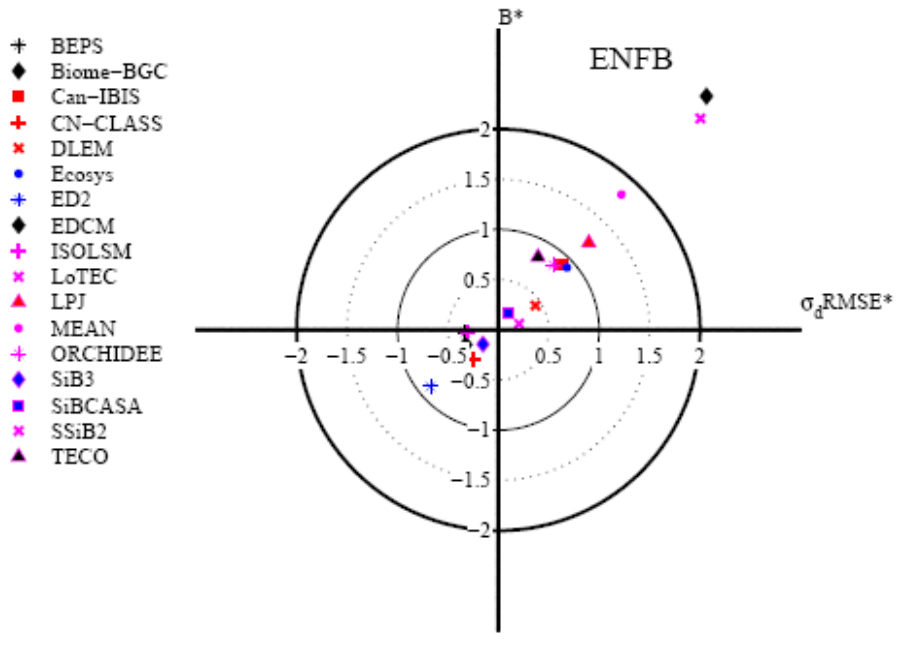


US-Ne3

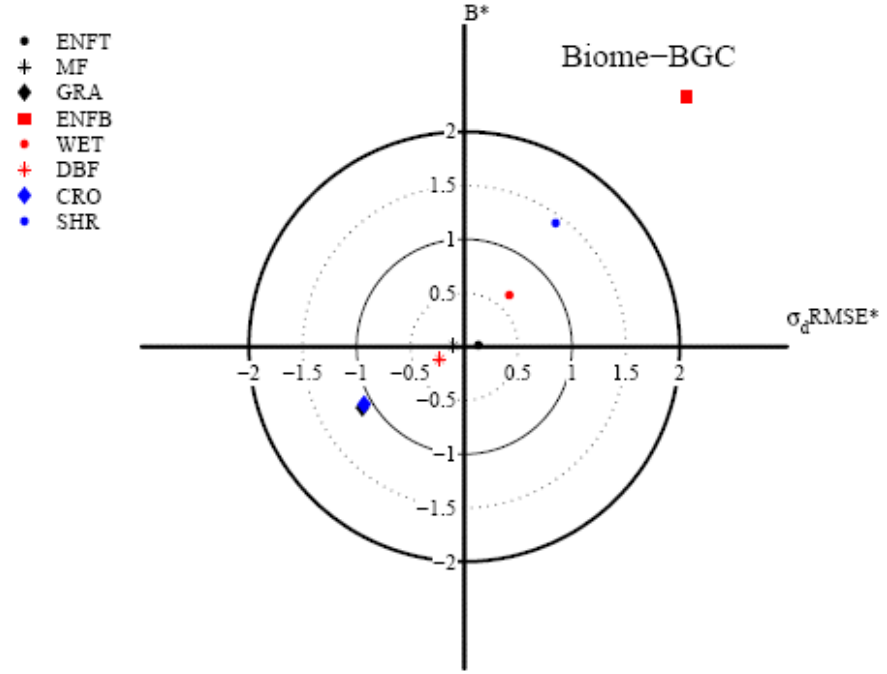


Bias Dominates X^2 and RMSE

ENFB; all models



Biome-BGC; all biomes



Conclusions

- Models simulate forest GPP best
- Model mean does best
- Bias & phenology dominate model-data mismatch
- Next: statistical tests to isolate cause of model-data mismatch

Acknowledgments

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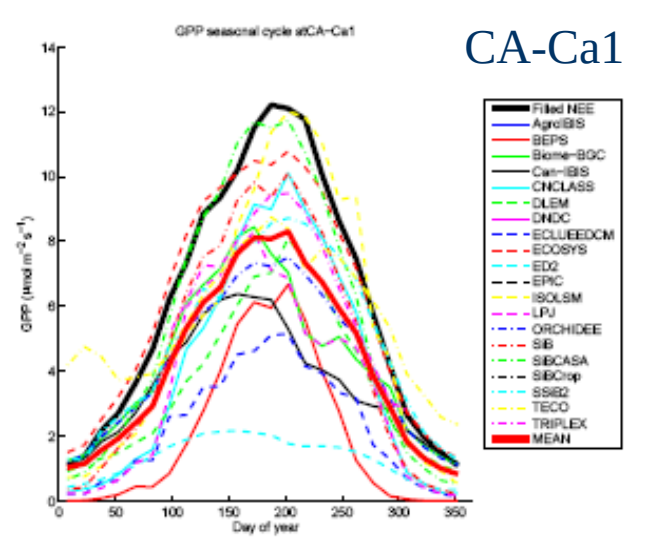
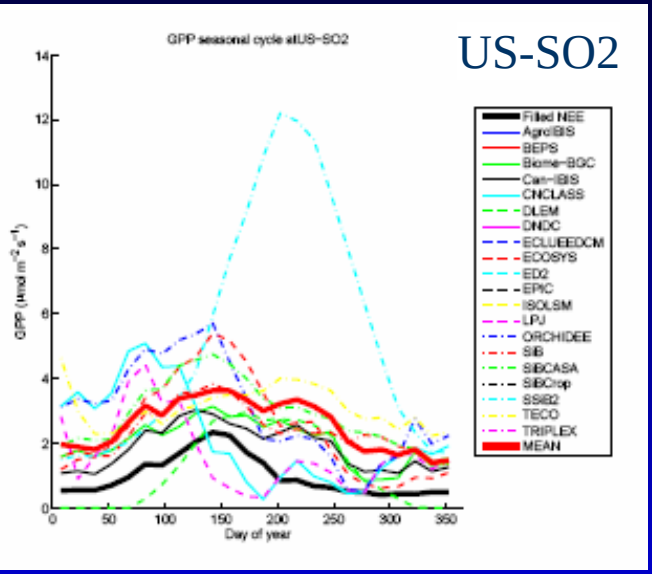
GPP Seasonal Plots

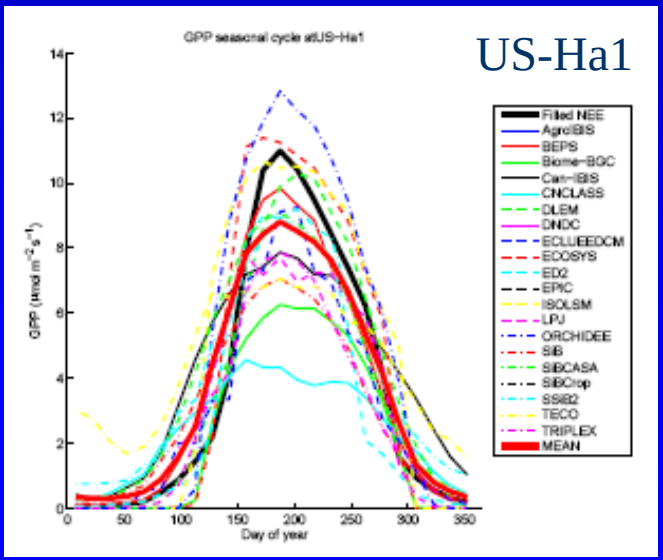
CA-Ca1



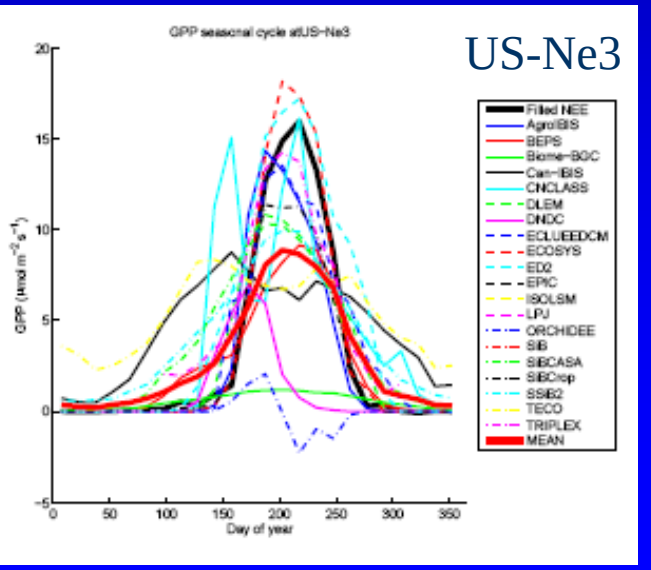
US-SO2



US-Ha1



US-Ne3



GPP Diurnal Plots