Sensitivity of site-level CLM simulations to input meteorology

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Framework for PTCLM multisite ensembles

Multisite fullrun

(copy run directories and modify namelists for n sites)

4 generic cases Spinups and transient

Main script: Call_PTCLM

1. Run PTCLM

- mkgriddata
- mksurfdata (use site-level soil, pft info)
- mkdatadomain
- Ncl script for ndep
- Ncl script for aerdep
- create_newcase
- Xmlchange (env_run, conf)
- Namelist creation

2. Compile and submit

- Configure case
- Apply srcmods
- Pft-physiology mods
- Build cesm
- Namelist customizations
- Create PBS script
- Submit to queue

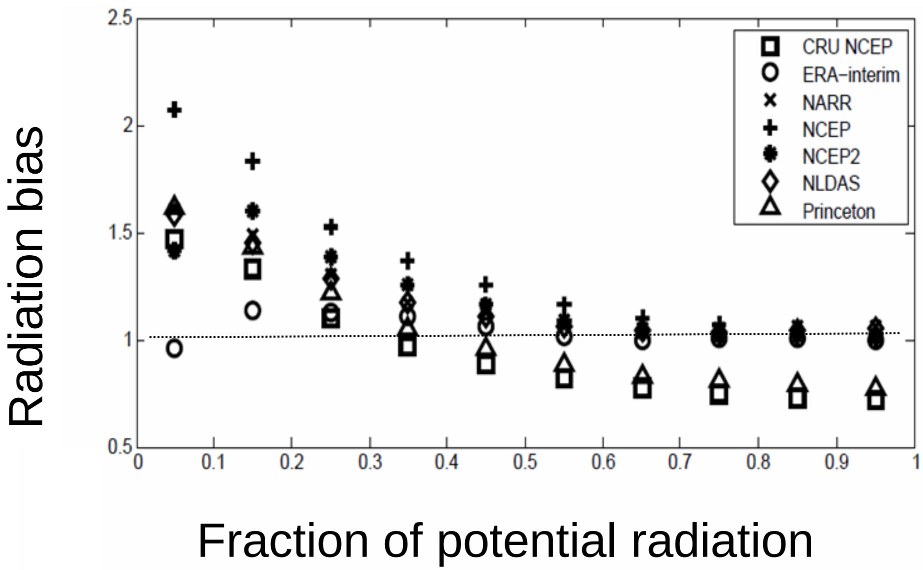
Gap-filled tower driver datasets

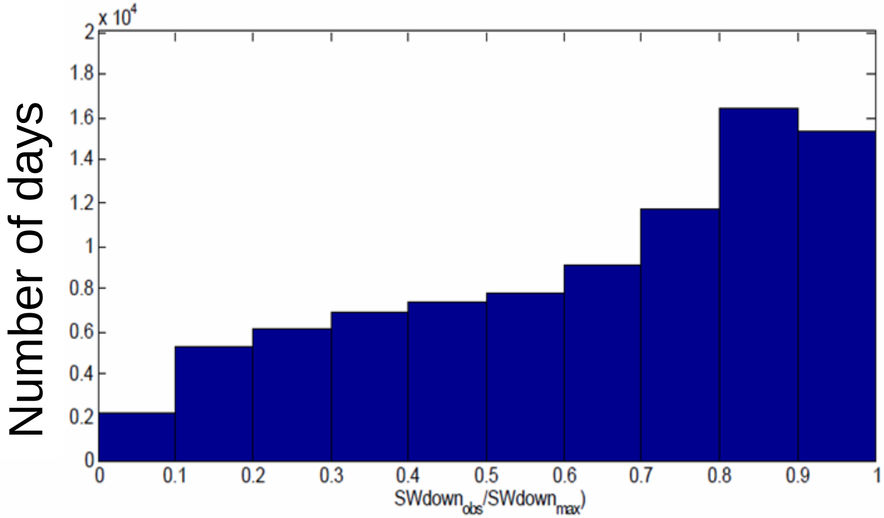
- Tower observations usually have ~10-20% gaps in meteorological observations (power outages, quality control, etc.)
- Gaps are filled with:
  - Nearby flux towers (within 50 km and 100m elevation)
  - Nearby NCDC reporting station, bias corrected (hourly or if daily, diurnal cycle imposed using simple relationships) – T, precip, sometimes cloud cover
  - Multiyear mean monthly diurnal cycle
- CLM forcing files currently available for NACP flux tower sites (~45 sites)
- Can be generated for FLUXNET sites on demand.
- Can extract single-point reanalysis datasets to CLM format

Summary of selected reanalysis products

Product	Spatial resolution	Temporal resolution (hr)	Reference
Tower observed	Site-level	0.5 or 1	Ricciuto et al. (in prep)
CRU-NCEP	0.5^o x 0.5^o	6	Viovy and Ciais
ERA-interim	1.5^o x 1.5^o	6 or 12	Uppala et al. (2005)
NARR	32km	3	Mesinger et al. (2004)
NCEP	1.9^o x 1.9^o	6	Kalnay et al. (1996)
NCEP2	1.9^o x 1.9^o	6	Kalnay et al. (1996)
NLDAS*	$1/8^o$ x $1/8^o$	1	Cosgrove et al. (2003)
Daymet	1km	24*	Thornton et al. (2012)
Princeton	1^o x 1^o	3	Sheffield et al. (2006)

Radiation biases in reanalysis products



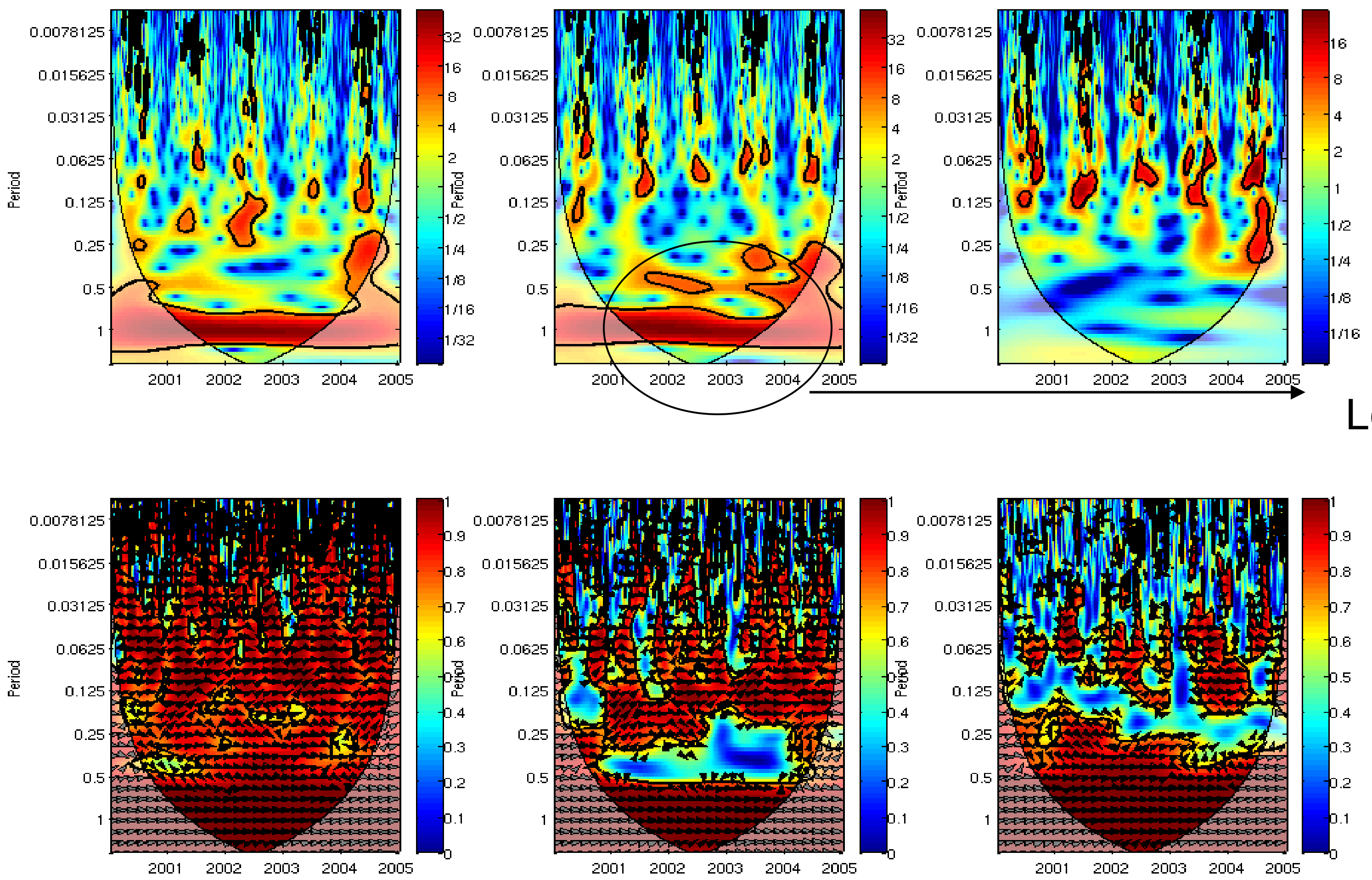


Average over 34 AmeriFlux and FLUXNET Canada sites

Highest bias overall under cloudy conditions (except ERA-interim)

CRU-NCEP, Princeton (Sheffield) product have lower biases overall but low-biased under high-light (correction factor applies on a monthly basis)

Wavelet analysis of selected products



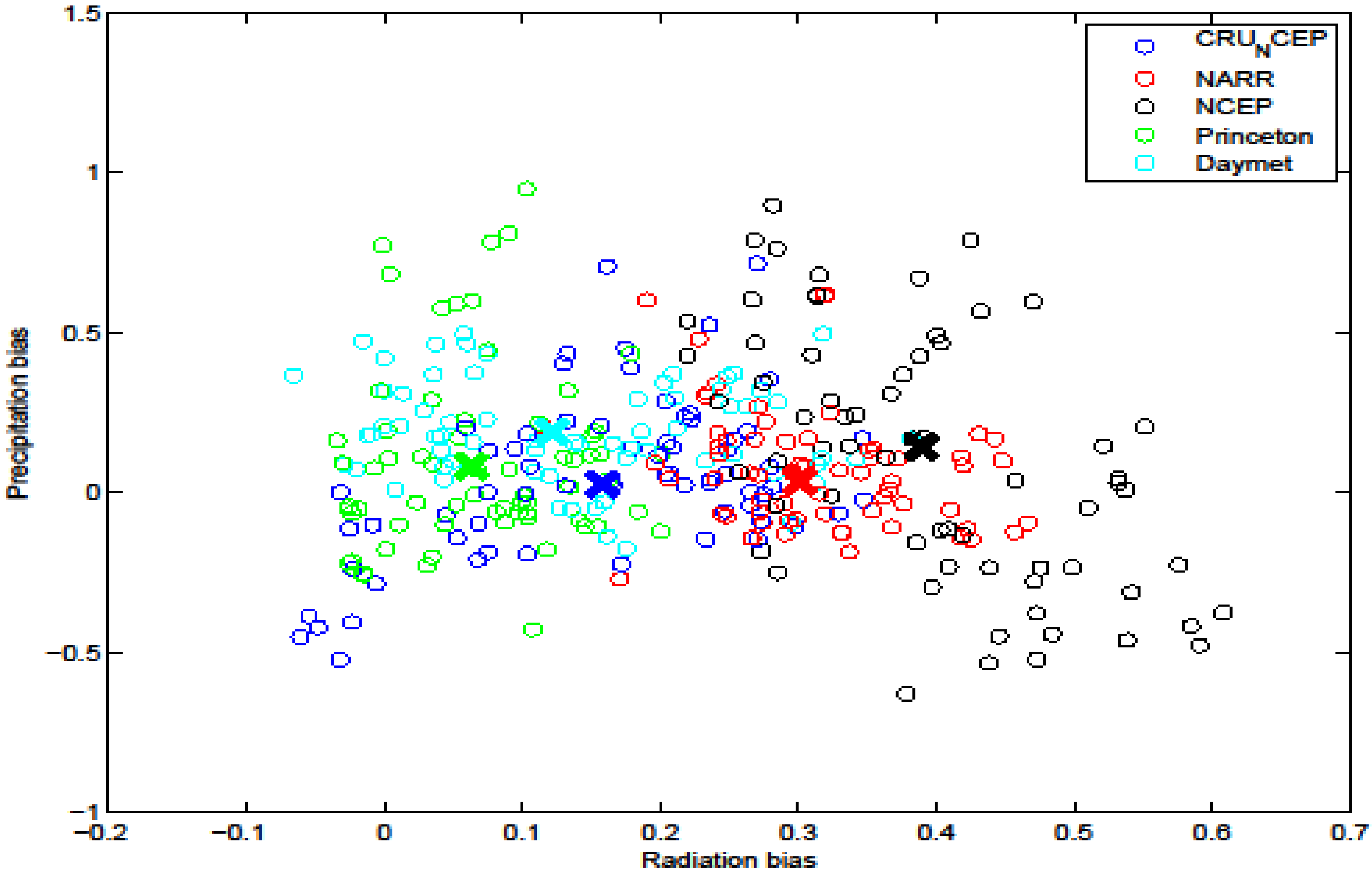
Residual power

Long-term bias

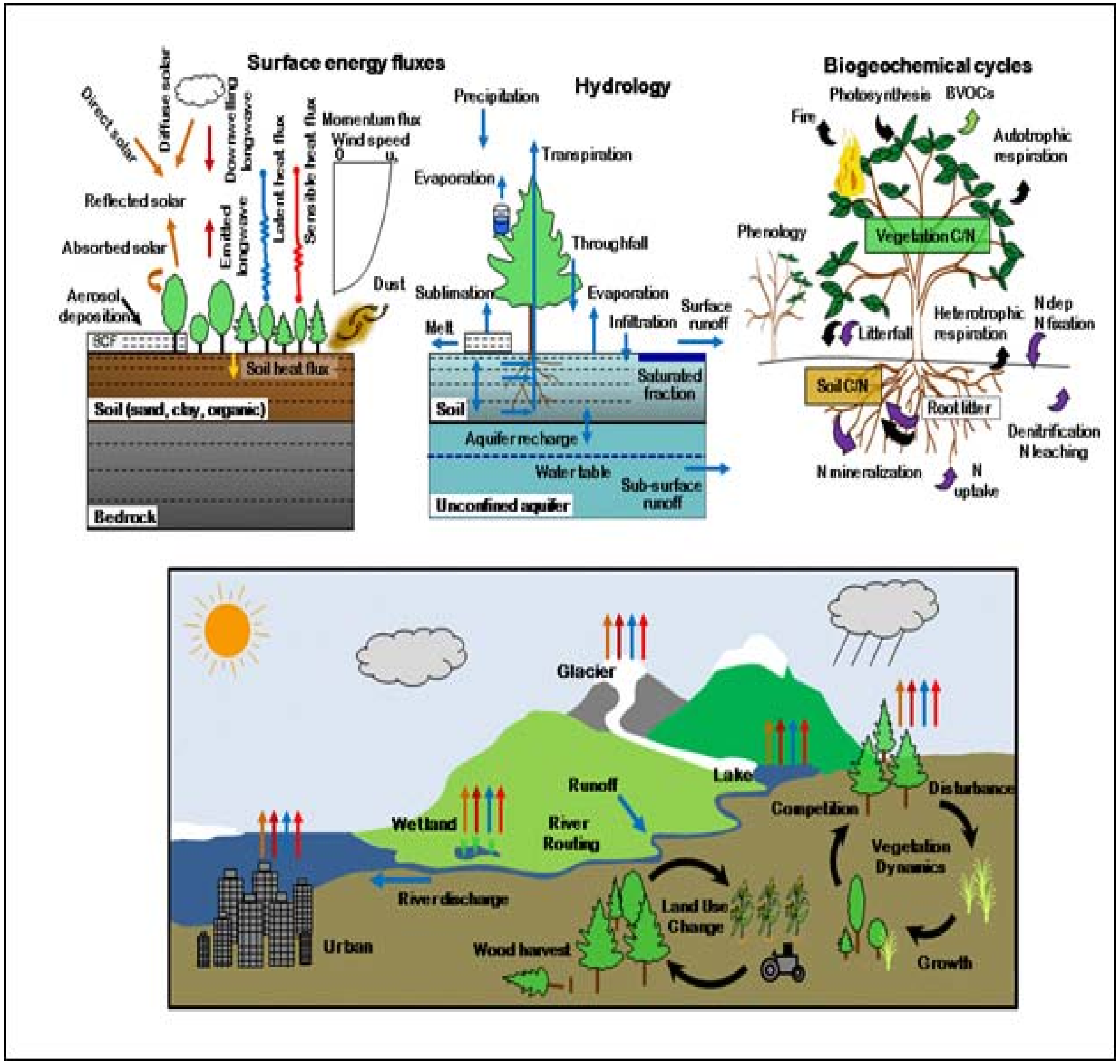
Coherence

ERA-interim NCEP Sheffield

Biases in radiation and precip by site-year

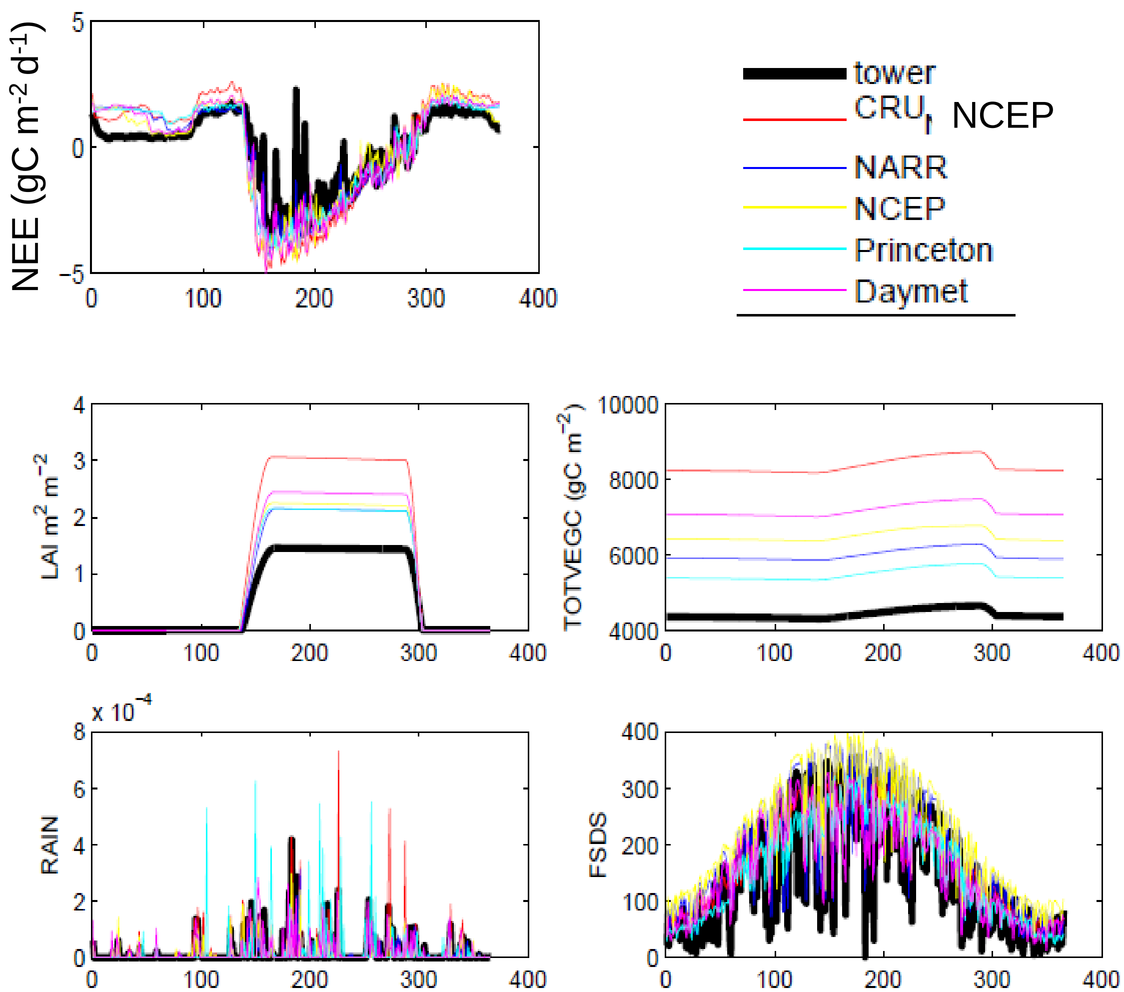


CLM4-CN version



- clm4_0_40 - ORNL
- Simulations for 8 sites, 6 products
- Modifications:
  - Plant N pool
  - Site-level harvest
- T-sensitivity
  - Q10_Vcmax modification
  - Cold-temperature photosynthesis modification

Differences in CLM-CN model output



UMBS site (Michigan)

Same years used for spinup/transient simulation

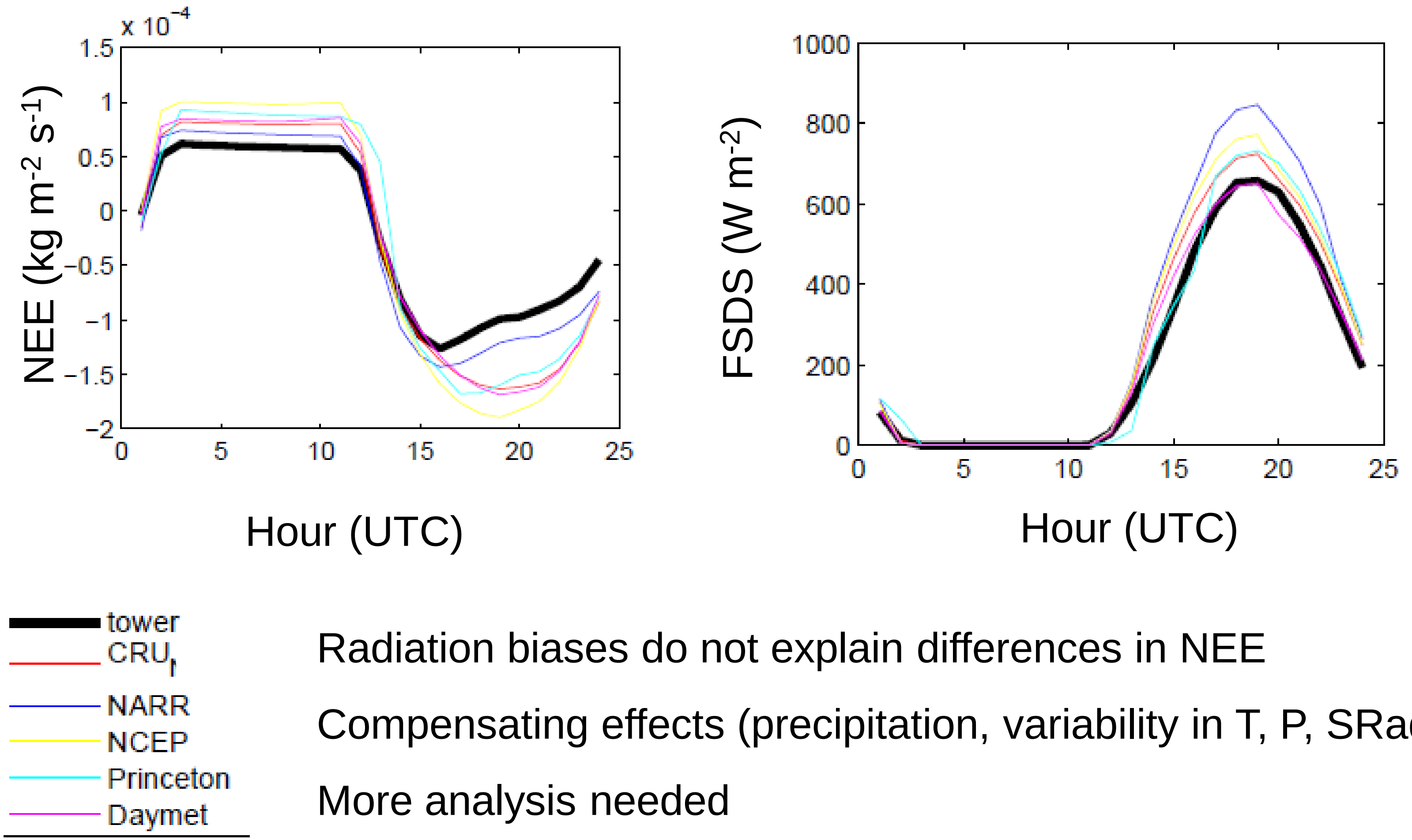
Large differences in soil carbon, LAI (up to 3x)

Simulations driven by tower forcing → lower stocks, productivity

Observed forcing and fluxes → more variability

Hypotheses: Radiation bias, variability, precipitation distribution

Comparison of simulated diurnal cycles

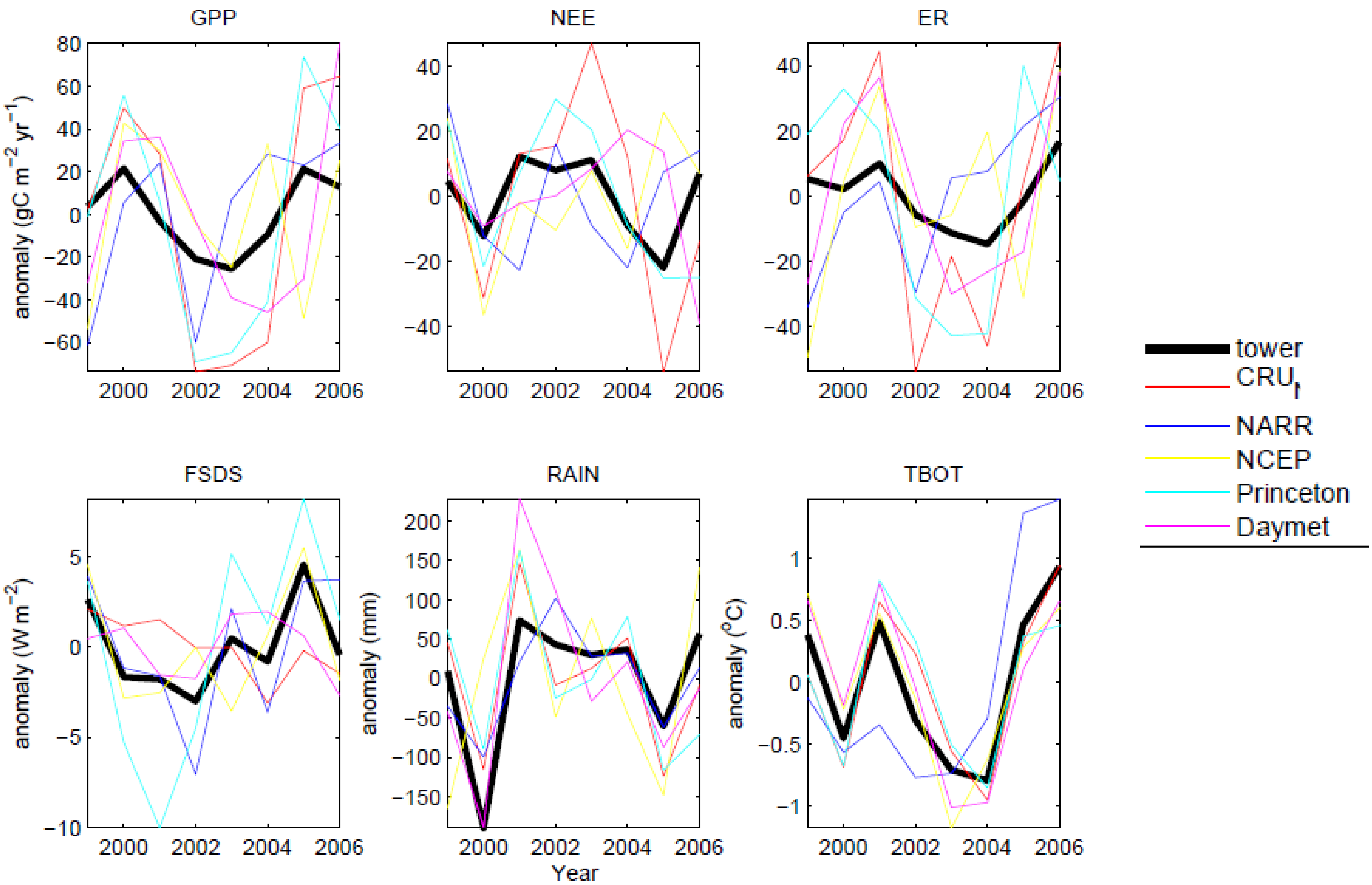


Radiation biases do not explain differences in NEE

Compensating effects (precipitation, variability in T, P, SRad)

More analysis needed

Effects on interannual variability



Take-home messages

- Using site-level forcing results consistently in less carbon and lower fluxes
  - Lower solar radiation, precipitation distribution and higher variability
  - If using site-level runs to do model tuning/validation, may not be relevant at global scales.
- The choice of reanalysis forcing dataset matters
  - Large source of uncertainty in predicted carbon balance (factor of 2)
  - Both long timescale biases and short-term variability are important
- Driver uncertainty should be considered in overall uncertainty analysis
  - As important or more important than parameter, structural differences