Asilomar FLUXNET Workshop

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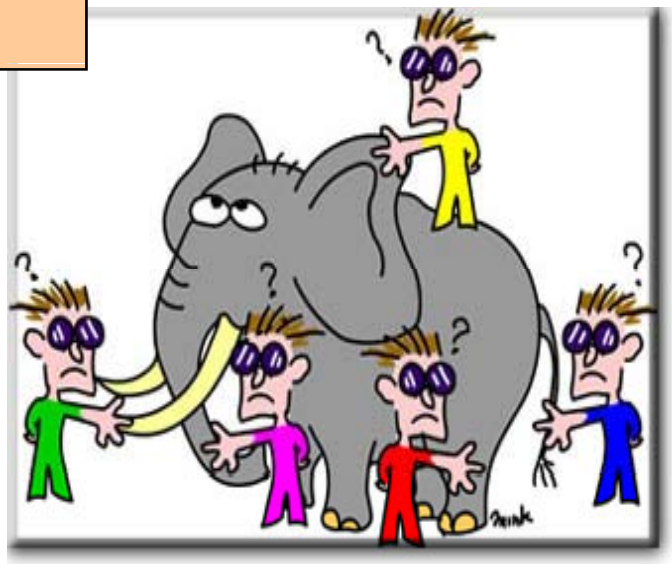
Bag of Tools To Assess Terrestrial Carbon Budgets at Across Scales

Global and Regional Inversion Modeling

Eddy Flux Measurements/ FLUXNET

Remote Sensing/ MODIS



Forest/Biomass Inventories

Biogeochemical/Ecosystem Modeling

Philosophy

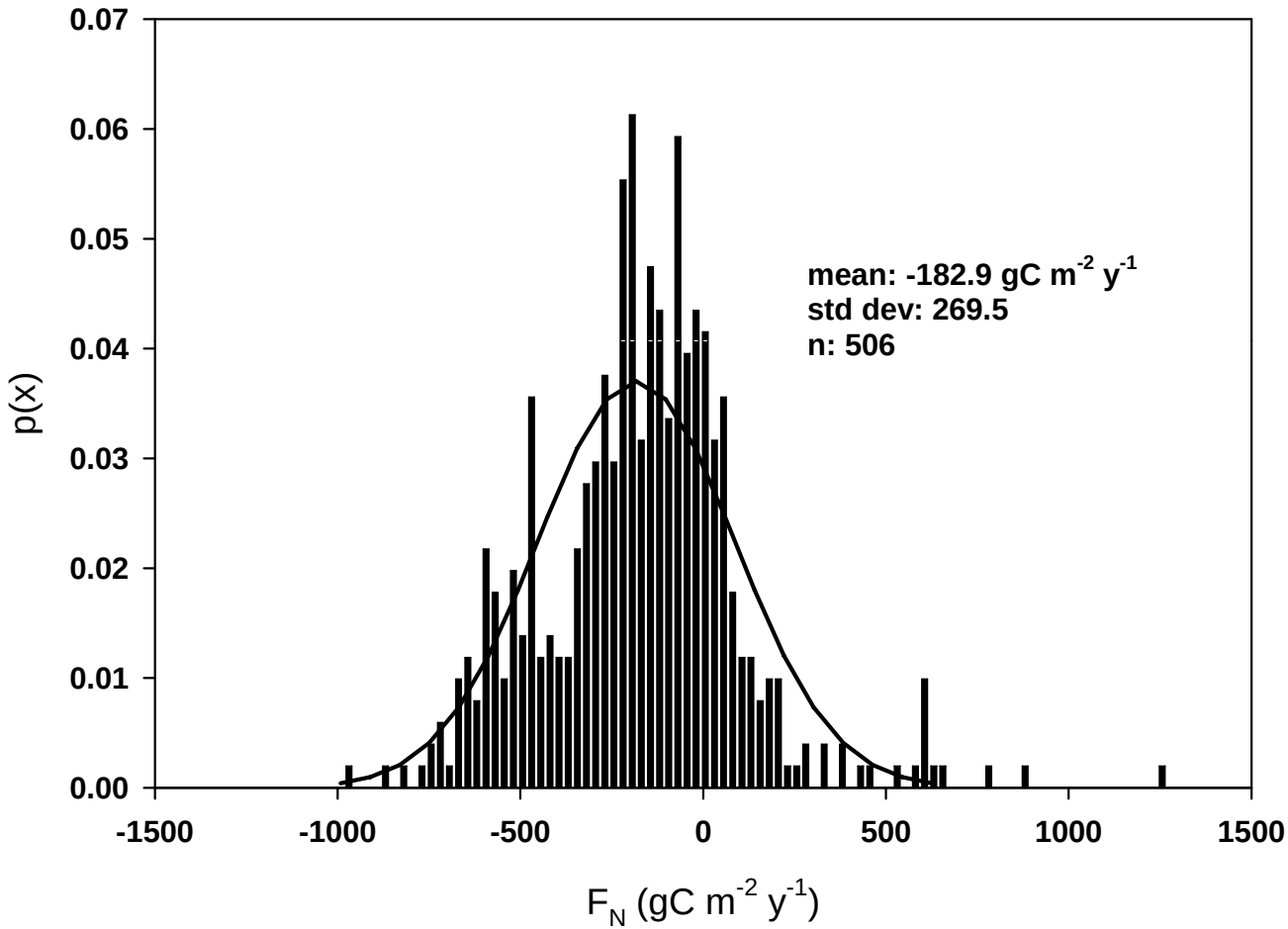
- We are Scientists, Not Experimentalists or Modelers
- We need multiple constraints to understand the ‘breathing of the biosphere’ because it is a complex, non-linear process that spans 14 orders of magnitude in time and space
- We are applying the Linux model to science, open access/open source
  - Improves the product via its use by multiple agents
  - It is built on trust, sharing, collaboration and two-way interaction

Ideas

- Produce and Provide Data to parameterize and refine complex, coupled models
- Validate Models at Tower Sites, via time series
- Validate Models across climate and ecosystem gradients
- Develop value added products, e.g. grid average fluxes
- Use models to diagnose limits with measurements
- Use Models to ask and answer scientific questions pertaining to the ‘breathing of the biosphere’ across a spectrum of time and space scales

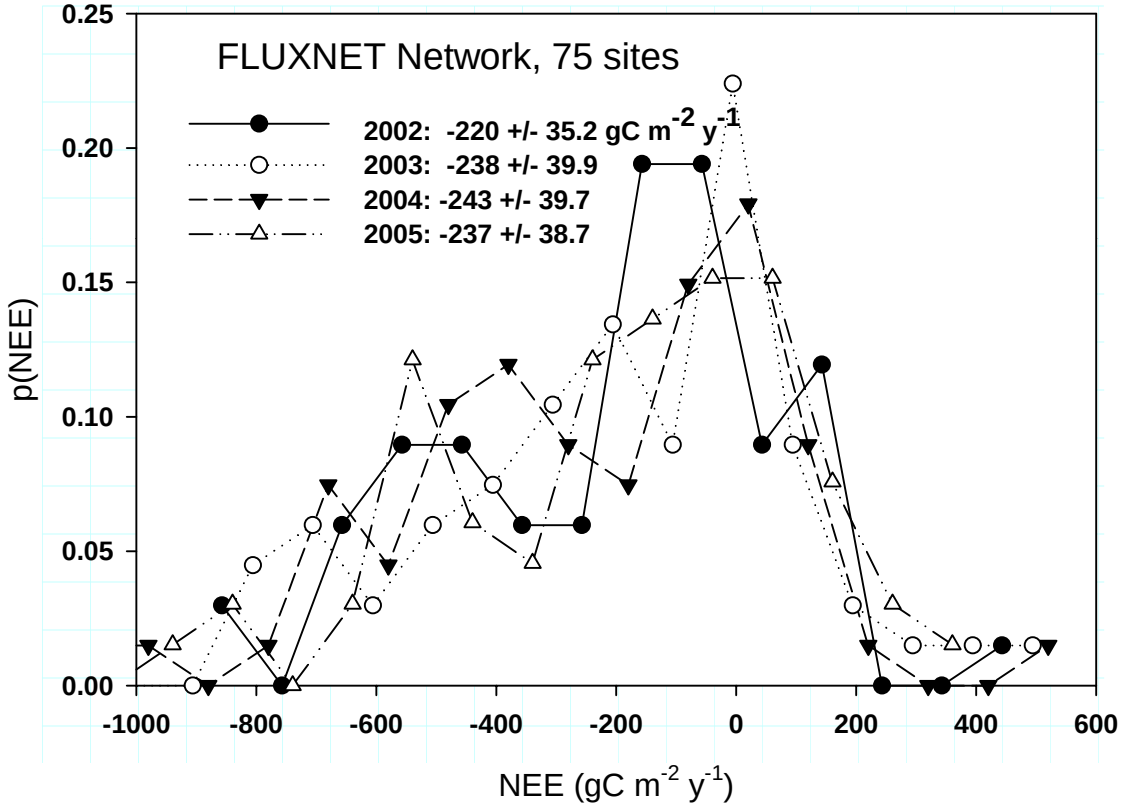
Data and Results

Probability Distribution of Published NEE Measurements, Integrated Annually

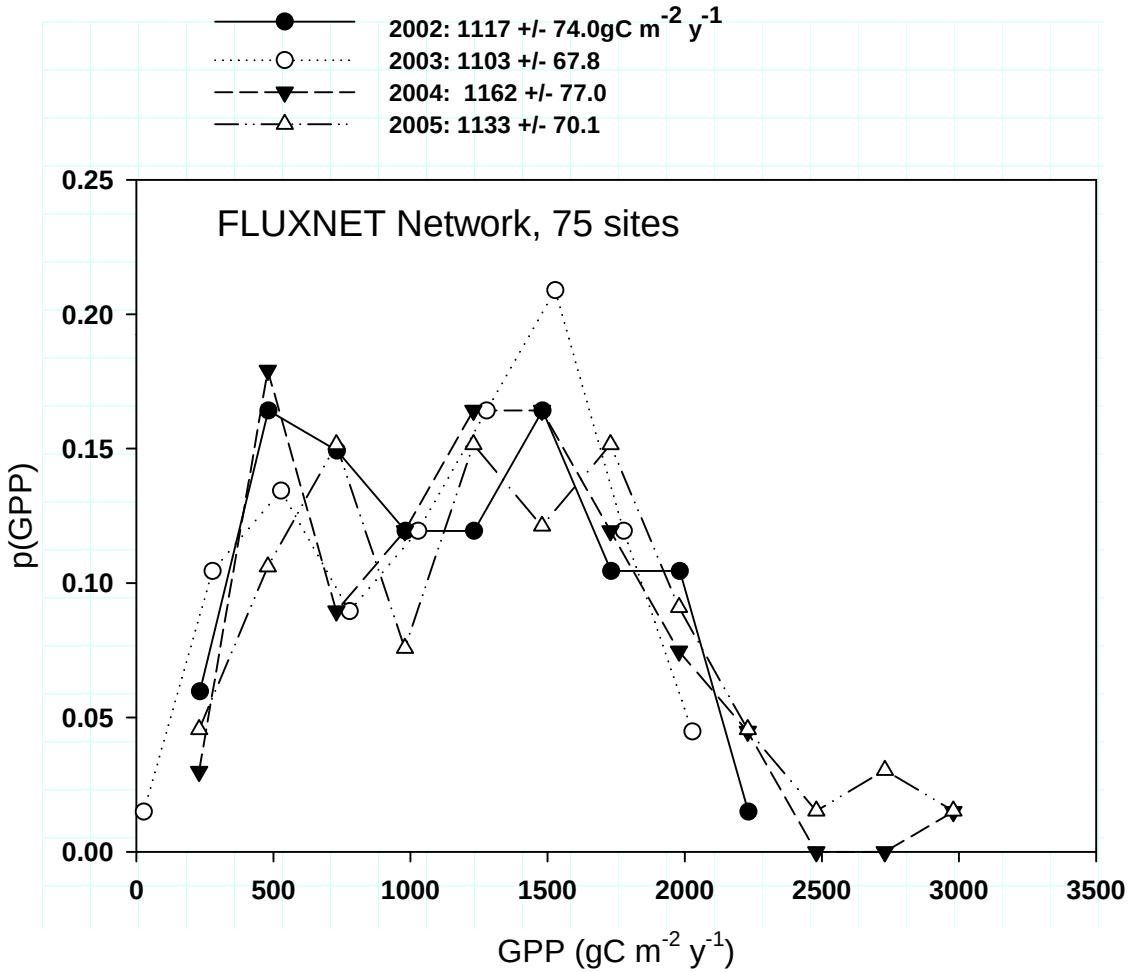


Baldocchi, Austral J Botany, 2008

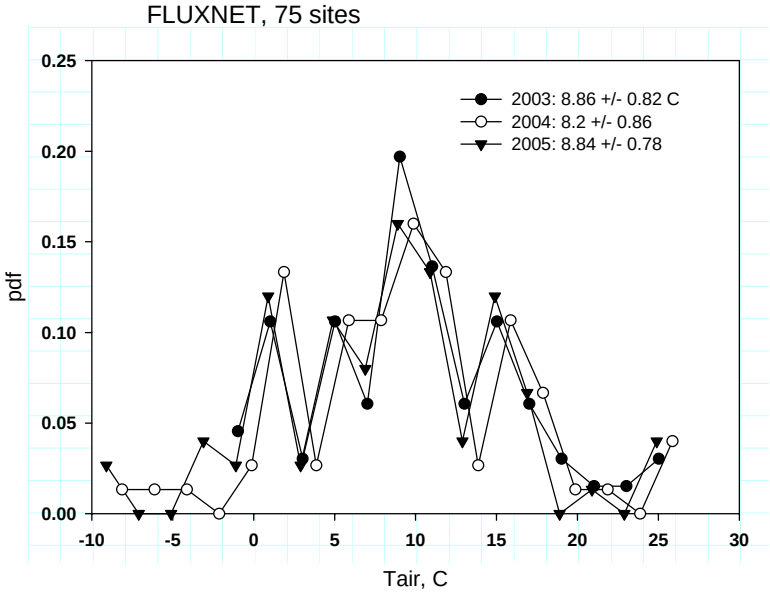
Interannual Variability in NEE is tiny across the Global Network

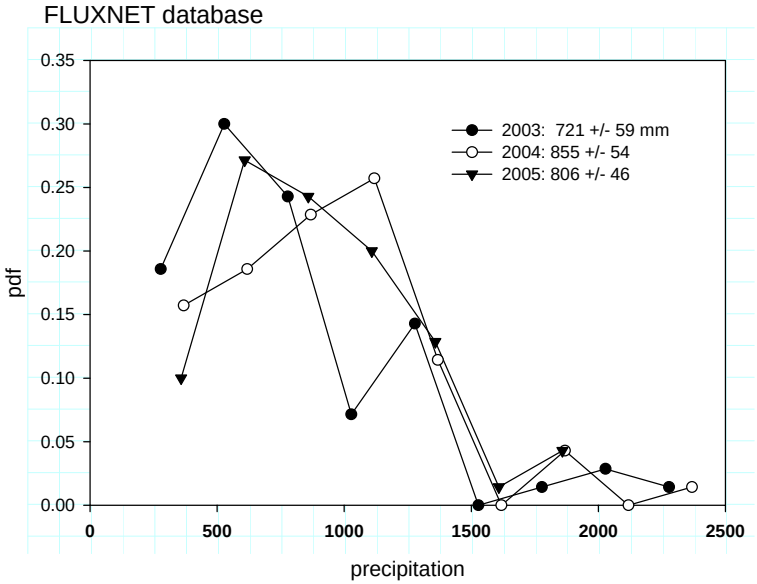


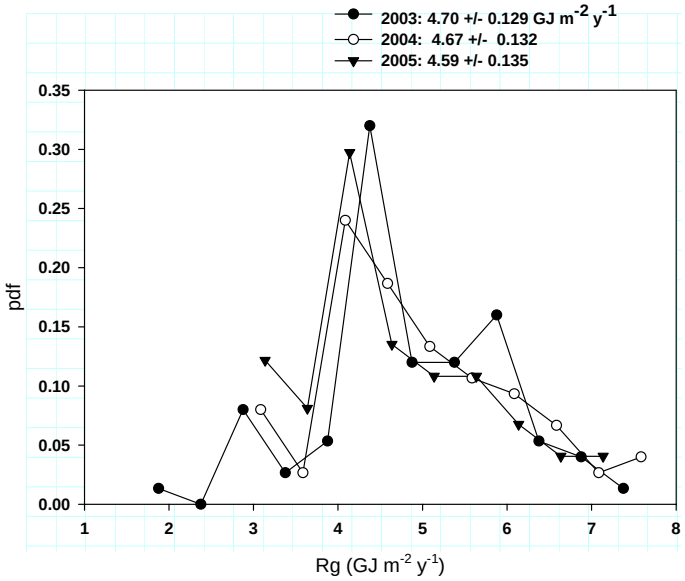
Interannual Variability in GPP is tiny across the Global Network, too



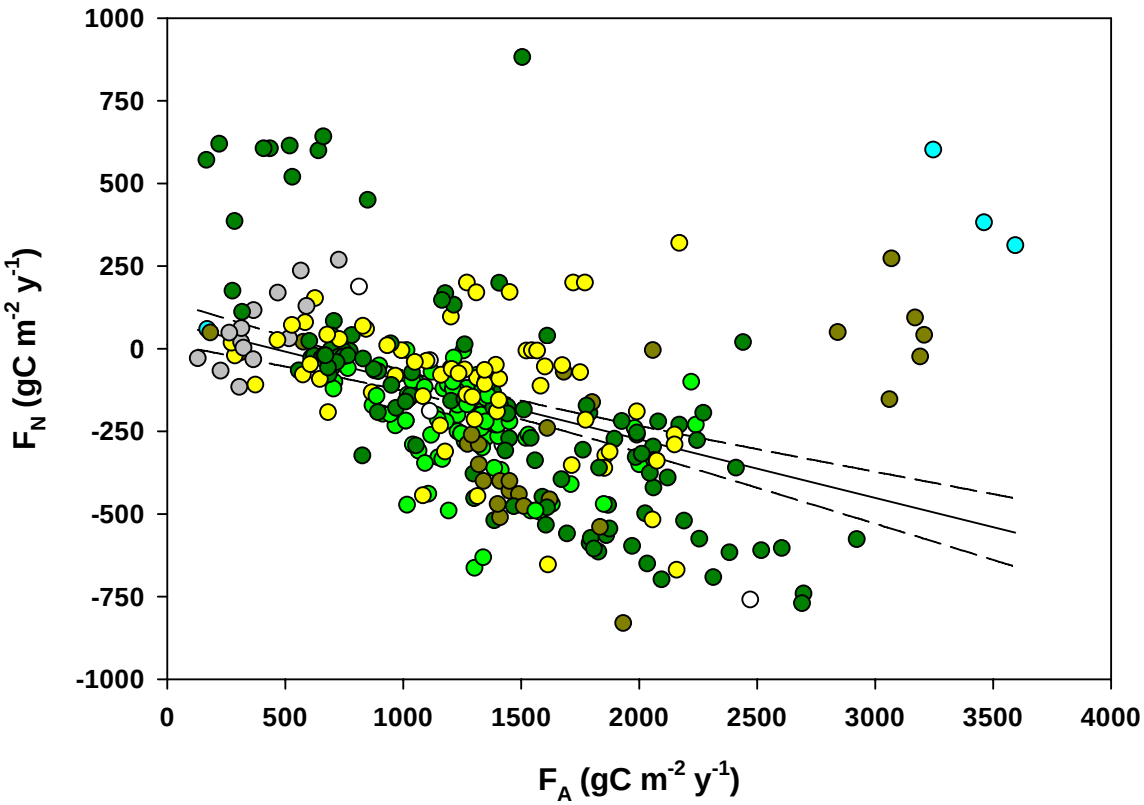
Little Change in Abiotic Drivers--annual Rg, ppt --across Network







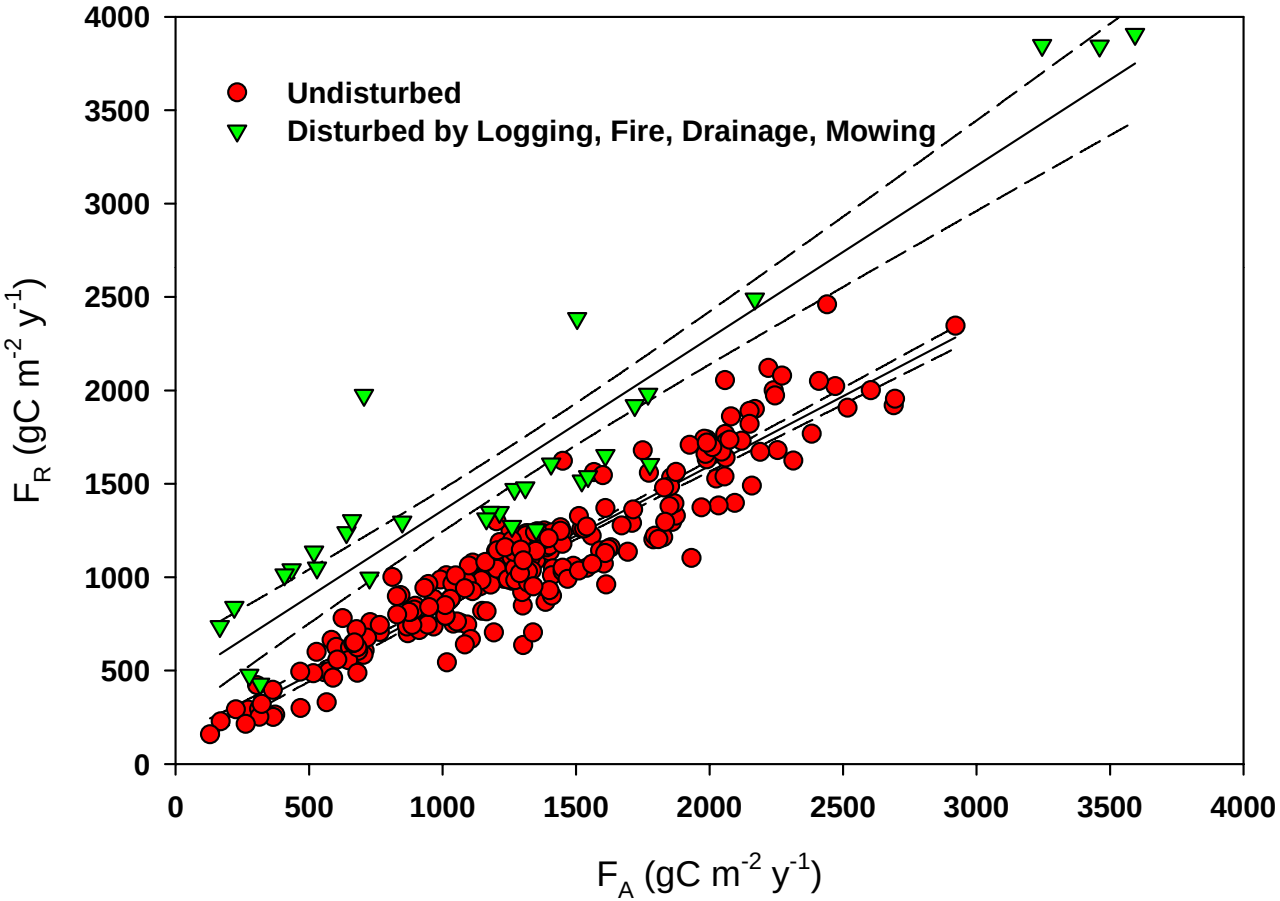
Does Net Ecosystem Carbon Exchange Scale with Photosynthesis?



Ecosystems with greatest GPP don't necessarily experience greatest NEE

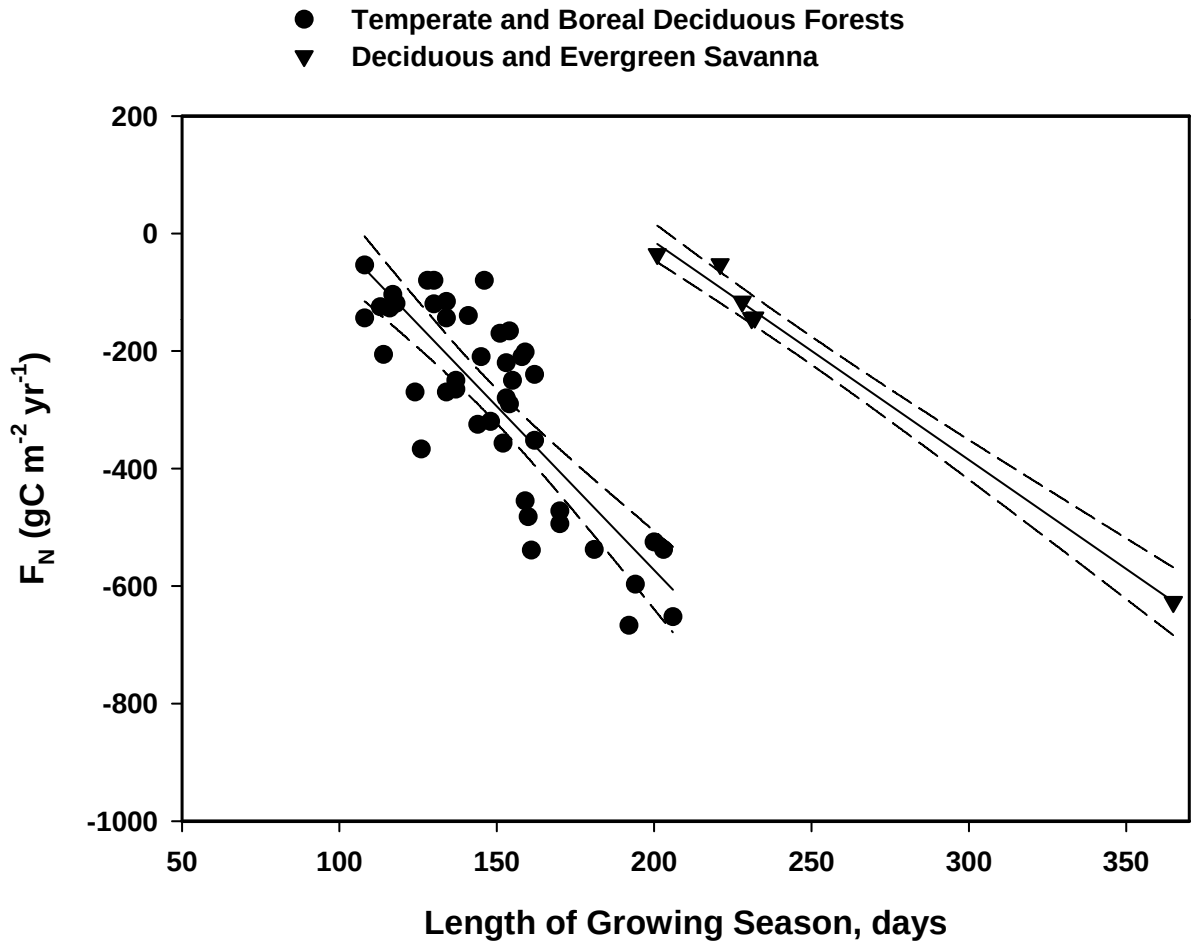
Baldocchi, Austral J Botany, 2008

Ecosystem Respiration Scales Tightly with Ecosystem Photosynthesis, But Is with Offset by Disturbance



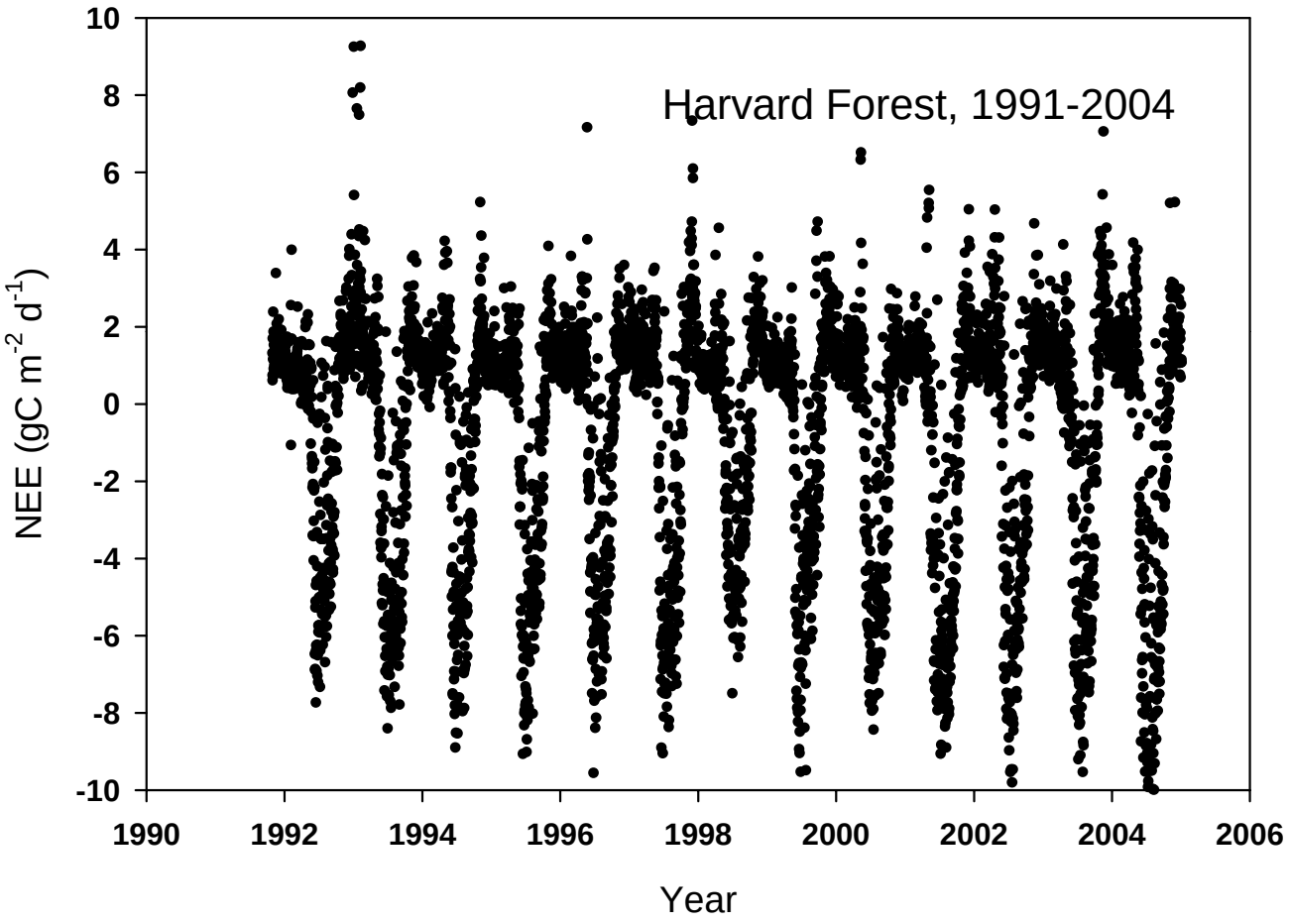
Baldocchi, Austral J Botany, 2008

Net Ecosystem Carbon Exchange Scales with Length of Growing Season



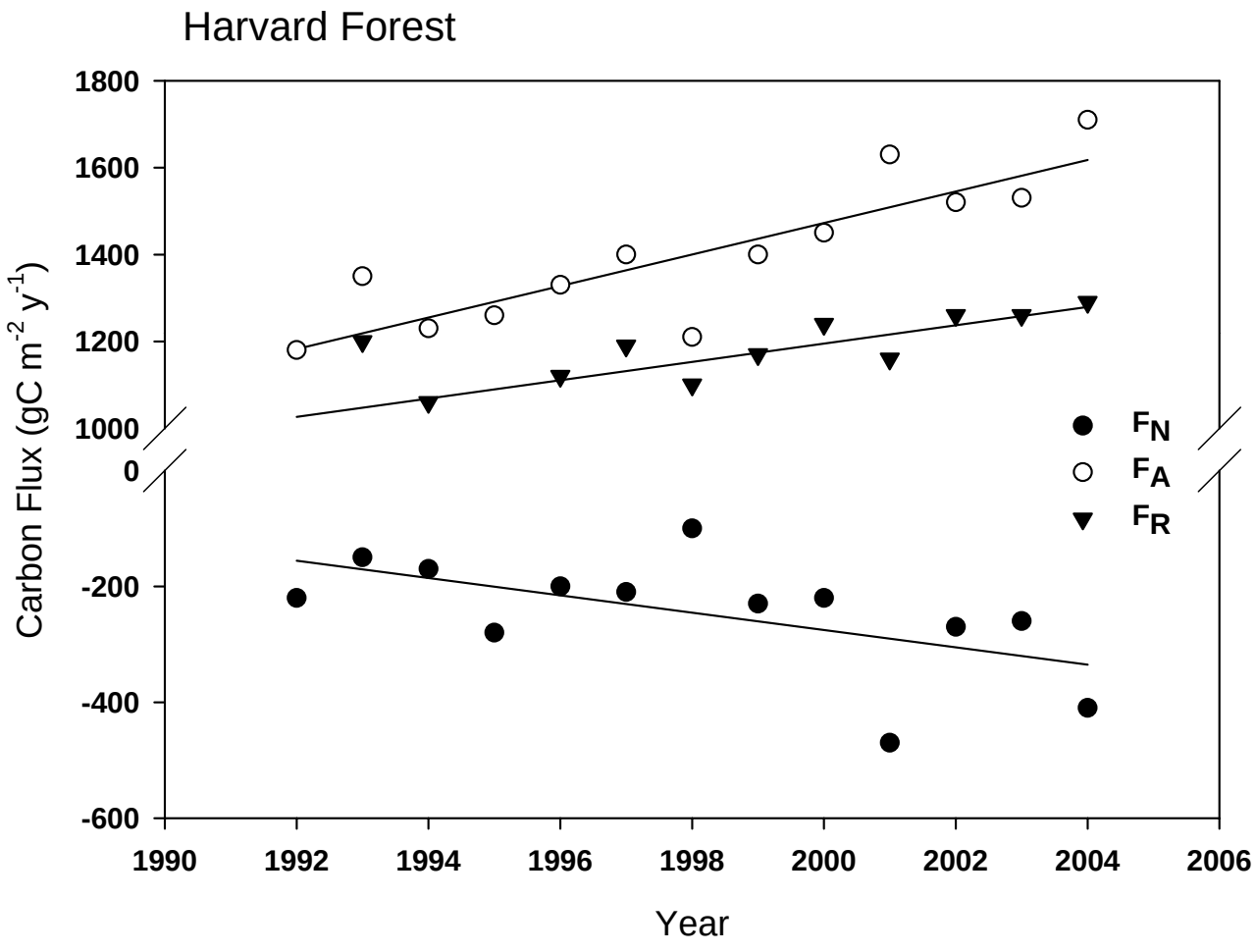
Baldocchi, Austral J Botany, 2008

Decadal Plus Time Series of NEE:
Flux version of the Keeling's Mauna Loa Graph



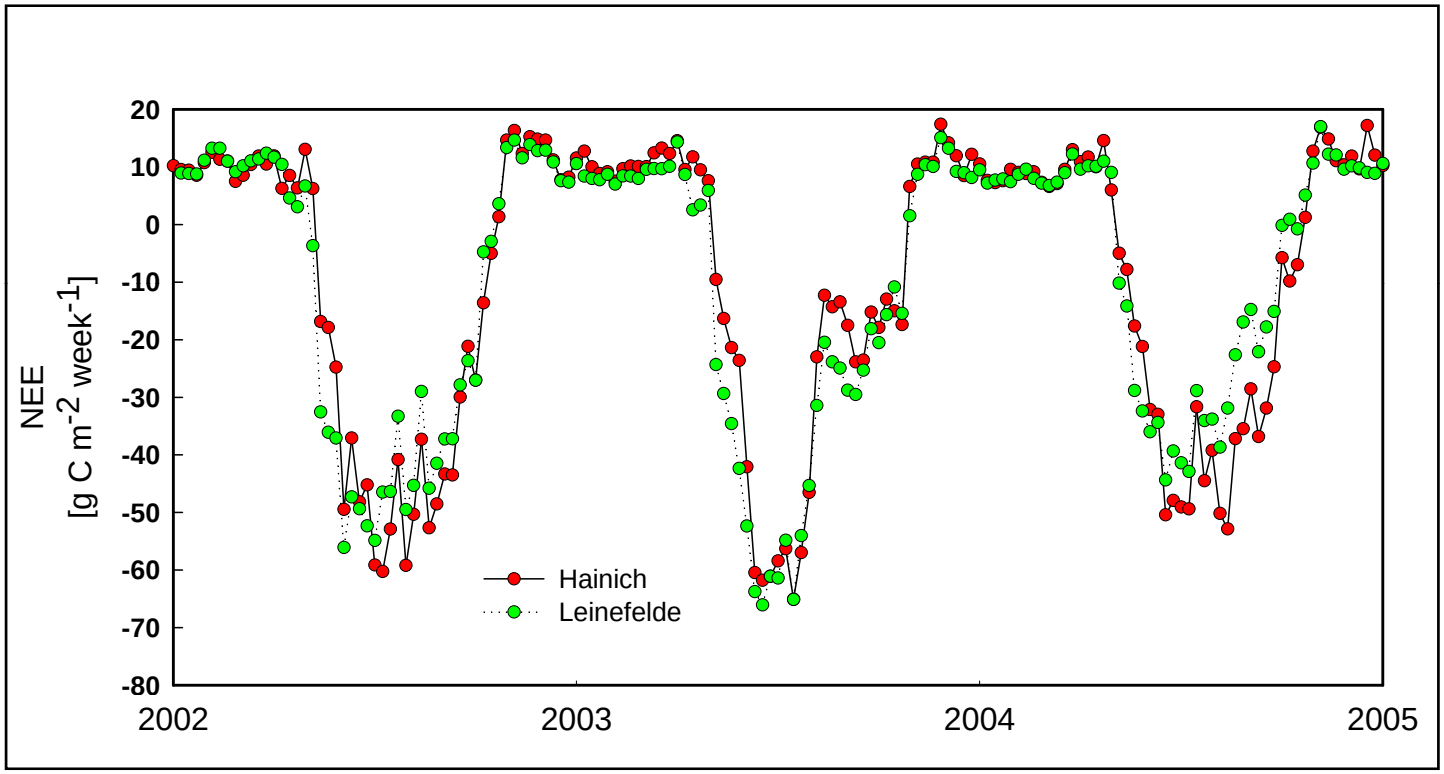
Data of Wofsy, Munger, Goulden, et al.

Interannual Variation and Long Term Trends
in Net Ecosystem Carbon Exchange (F_N), Photosynthesis (F_A) and Respiration (F_R)



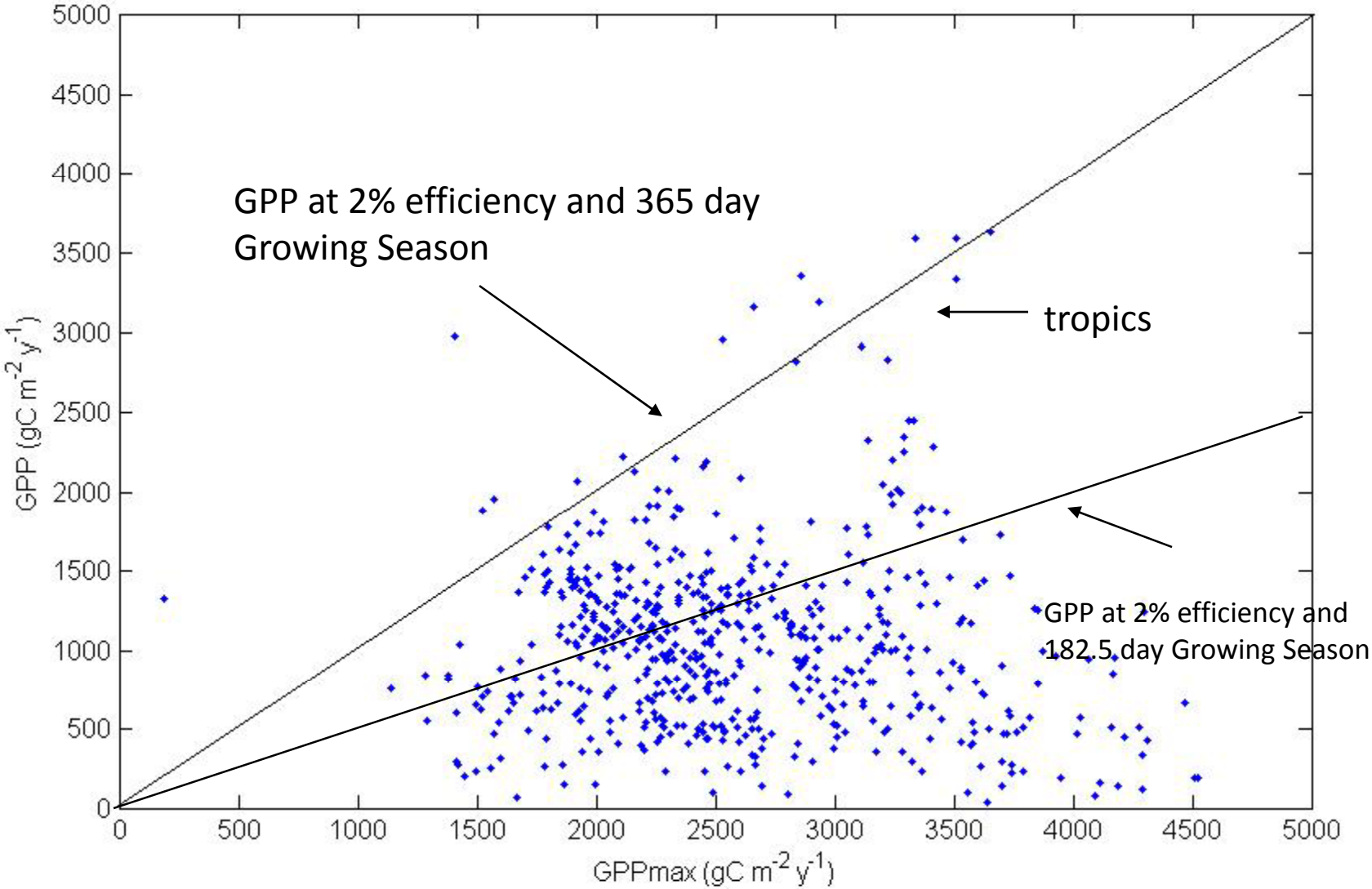
Urbanski et al 2007 JGR

Lag Effects Due to 2003 European Drought/Heat Stress



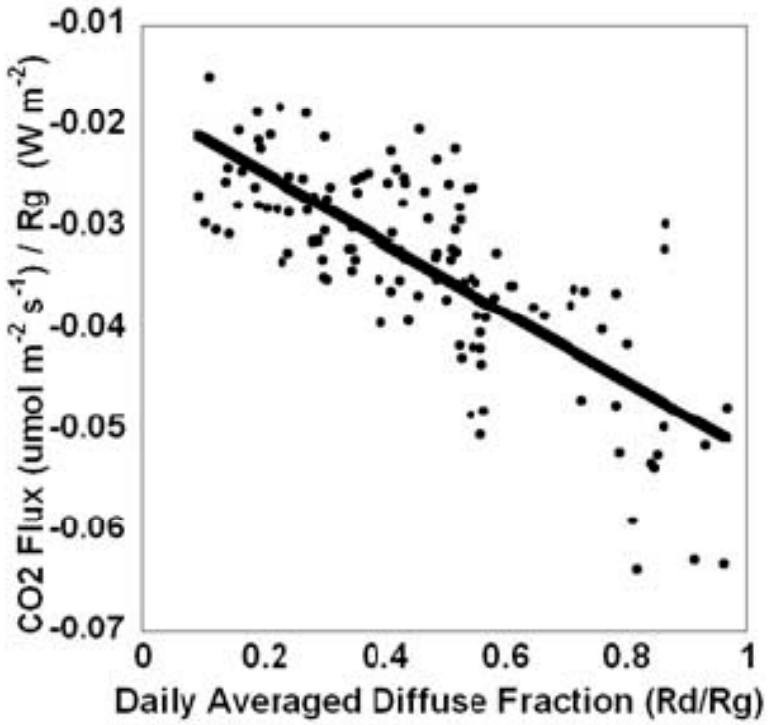
Knohl et al Max Planck, Jena

Potential and Real Rates of Gross Carbon Uptake by Vegetation:
Most Locations Never Reach Upper Potential



FLUXNET 2007 Database

Emergent Scale Process: CO_2 Flux and Diffuse Radiation

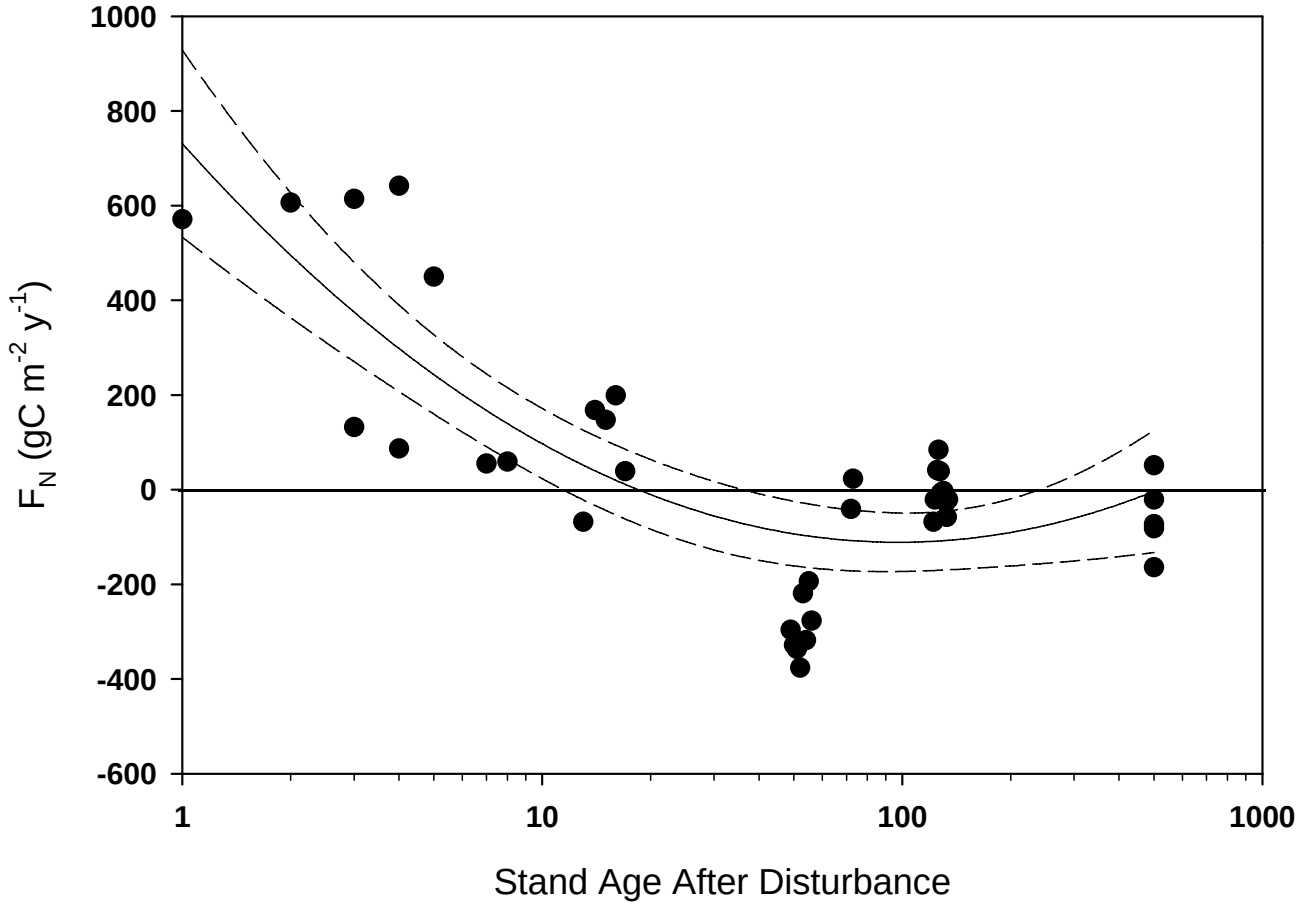


- We are poised to see effects of Cleaner/Dirtier Skies and Next Volcano

Niyogi et al., GRL 2004

Time Since Disturbance Affects Net Ecosystem Carbon Exchange

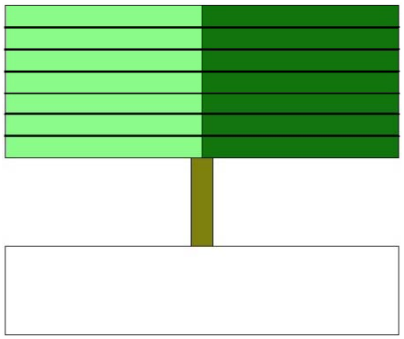
Conifer Forests, Canada and Pacific Northwest



Baldocchi, Austral J Botany, 2008

Data of teams lead by Amiro, Dunn, Paw U, Goulden

CANOAK



Role of Proper Model Abstraction

J.M. Chen et al. / Ecological Modelling 124 (1999) 99–119 117

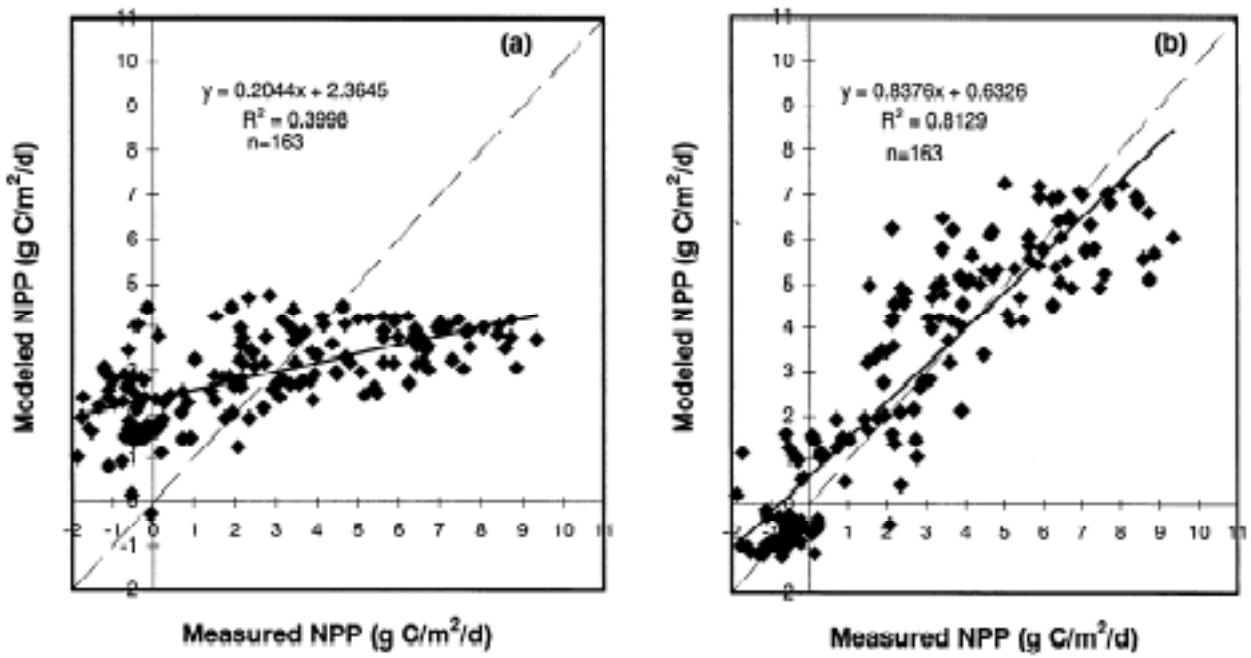
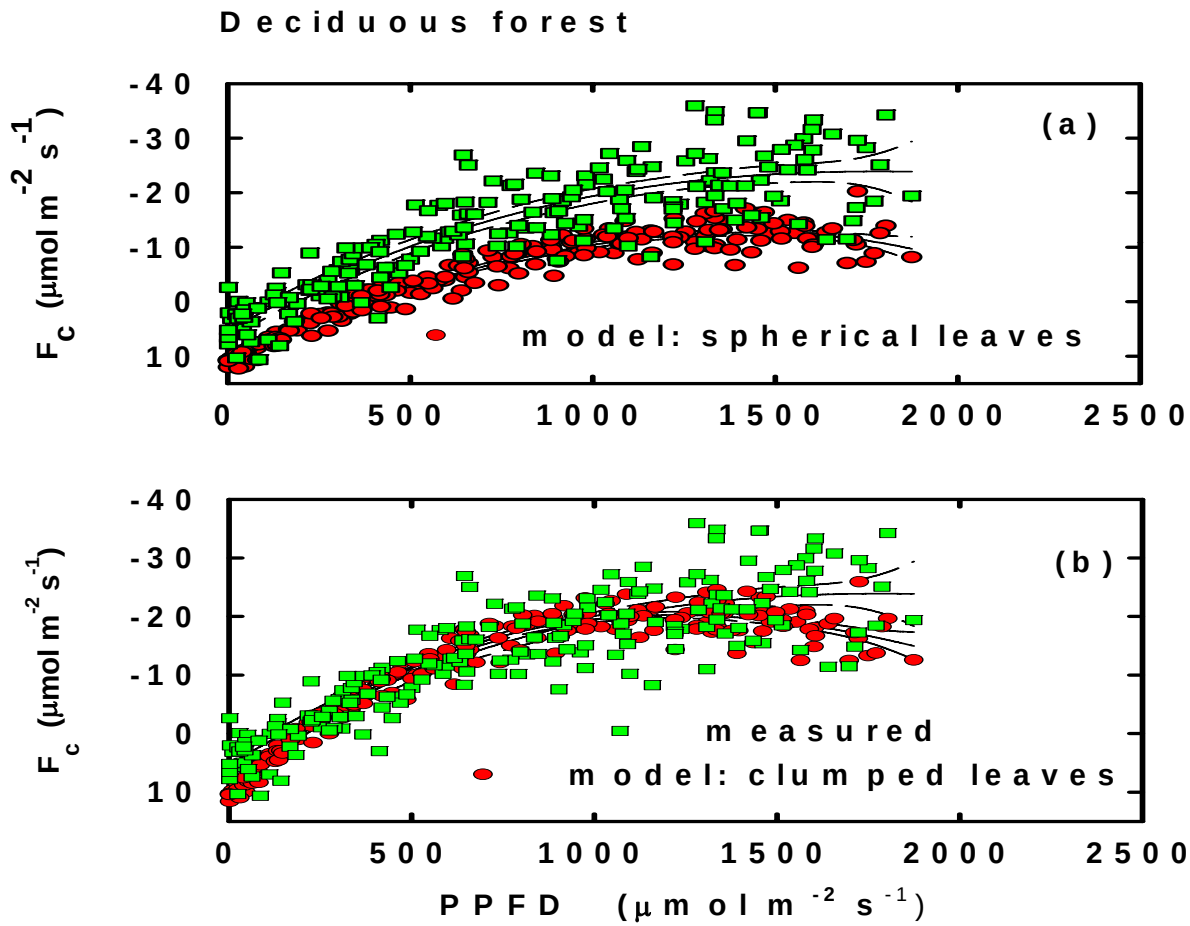


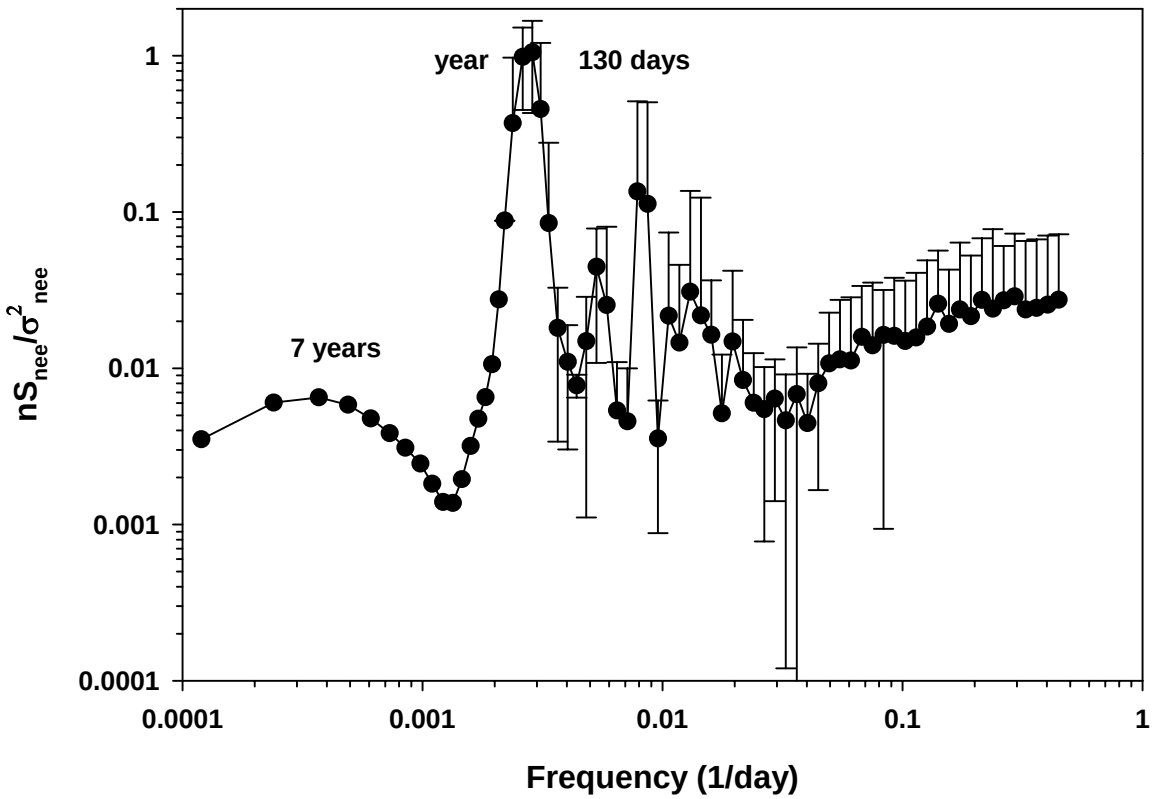
Fig. 9. One-to-one comparison of the measured NPP with the modeled NPP for a mature aspen stand. (a) big-leaf model, and (b) daily integrated model with sunlit–shaded leaf separation.

Emergent Processes: Impact of Leaf Clumping on Canopy Light Response Curves

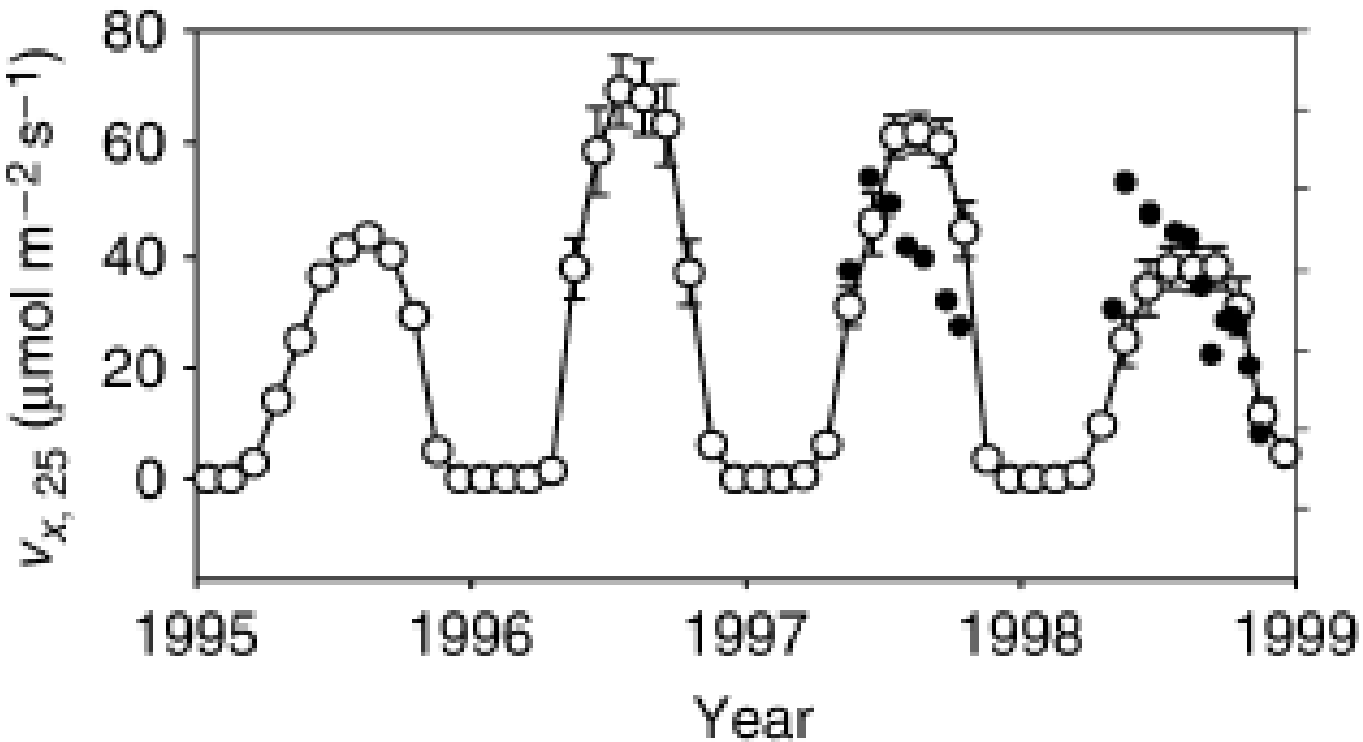


Scales of Interannual Variability

Walker Branch Watershed, TN: 1981-2001
CANOAK

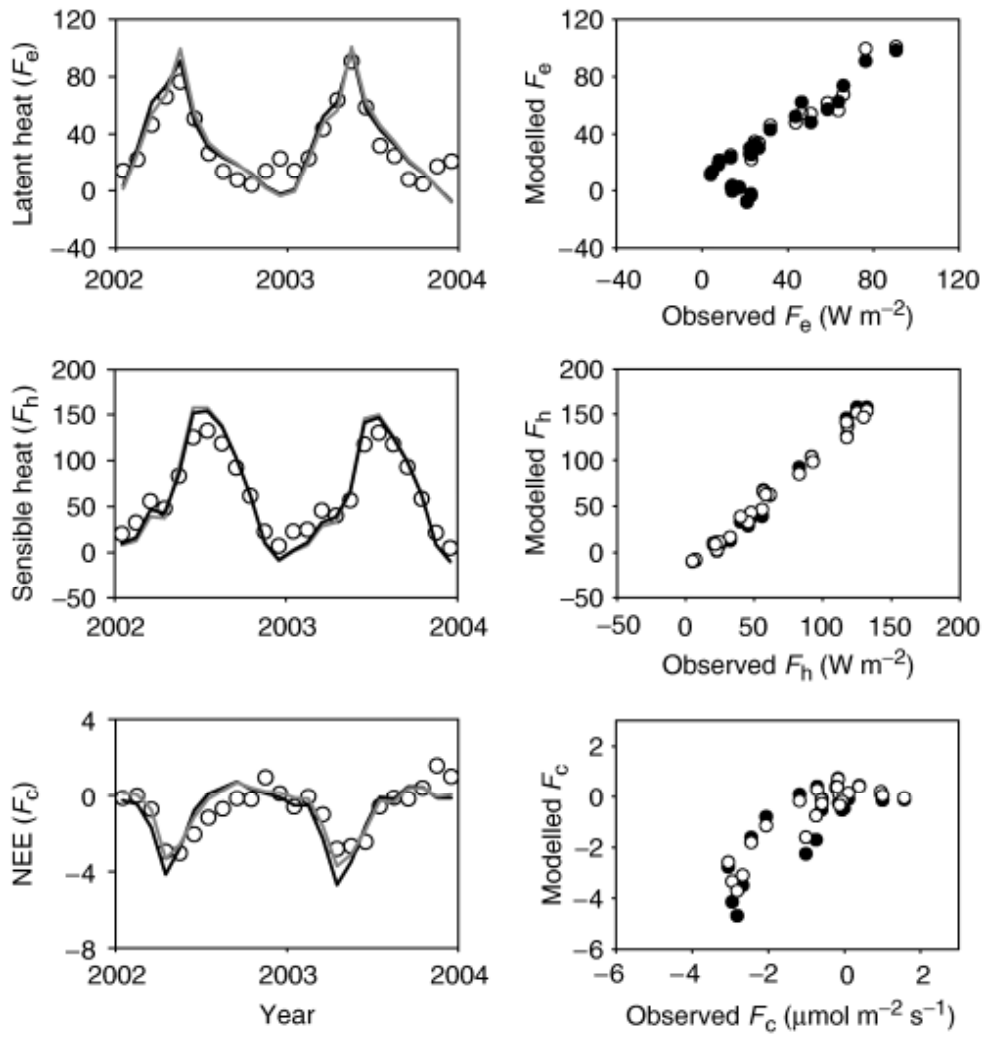


Seasonality of Photosynthetic Capacity



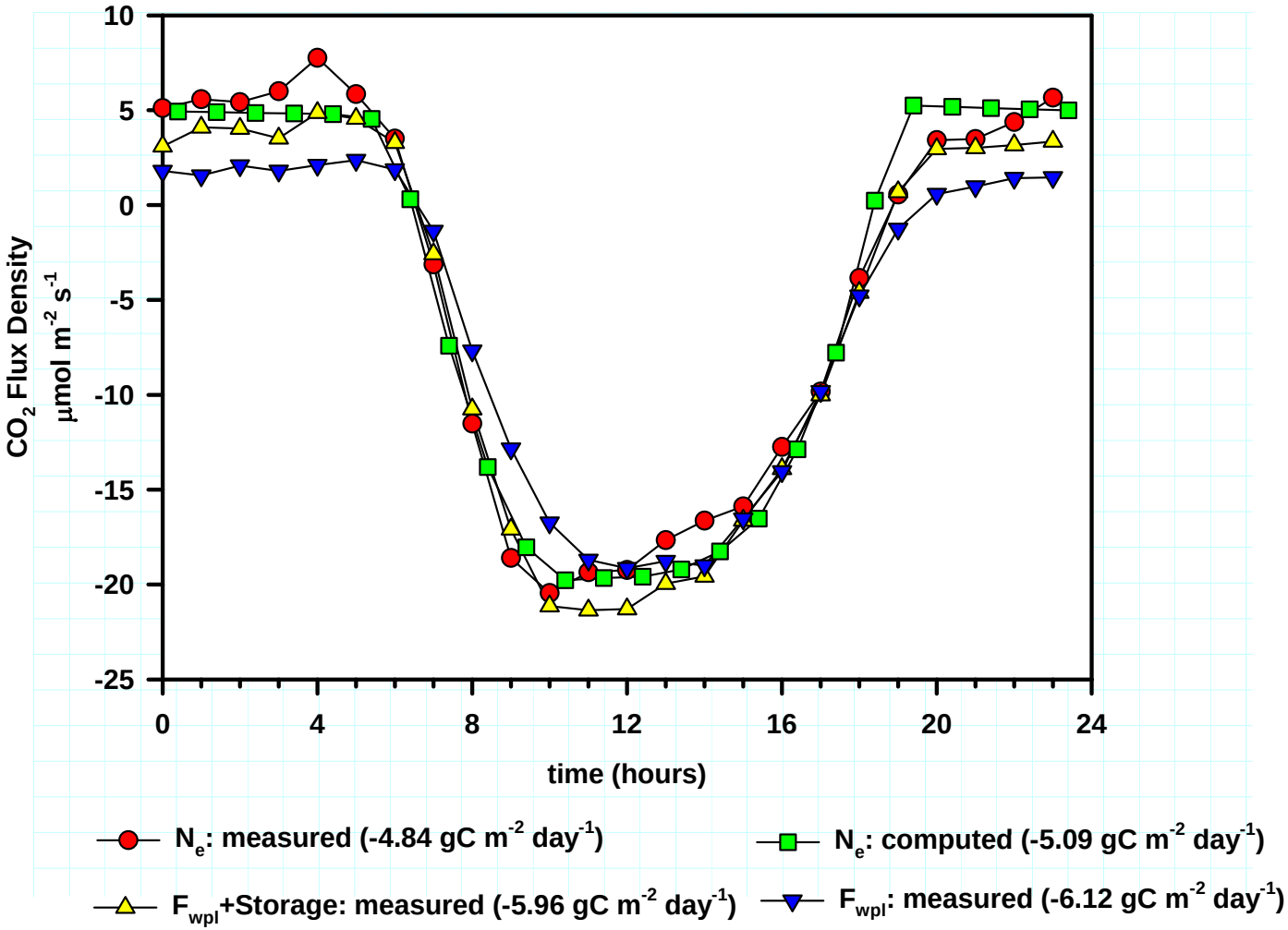
Wang et al, 2007 GCB

Optimizing Seasonality of Vcmax improves Prediction of Fluxes



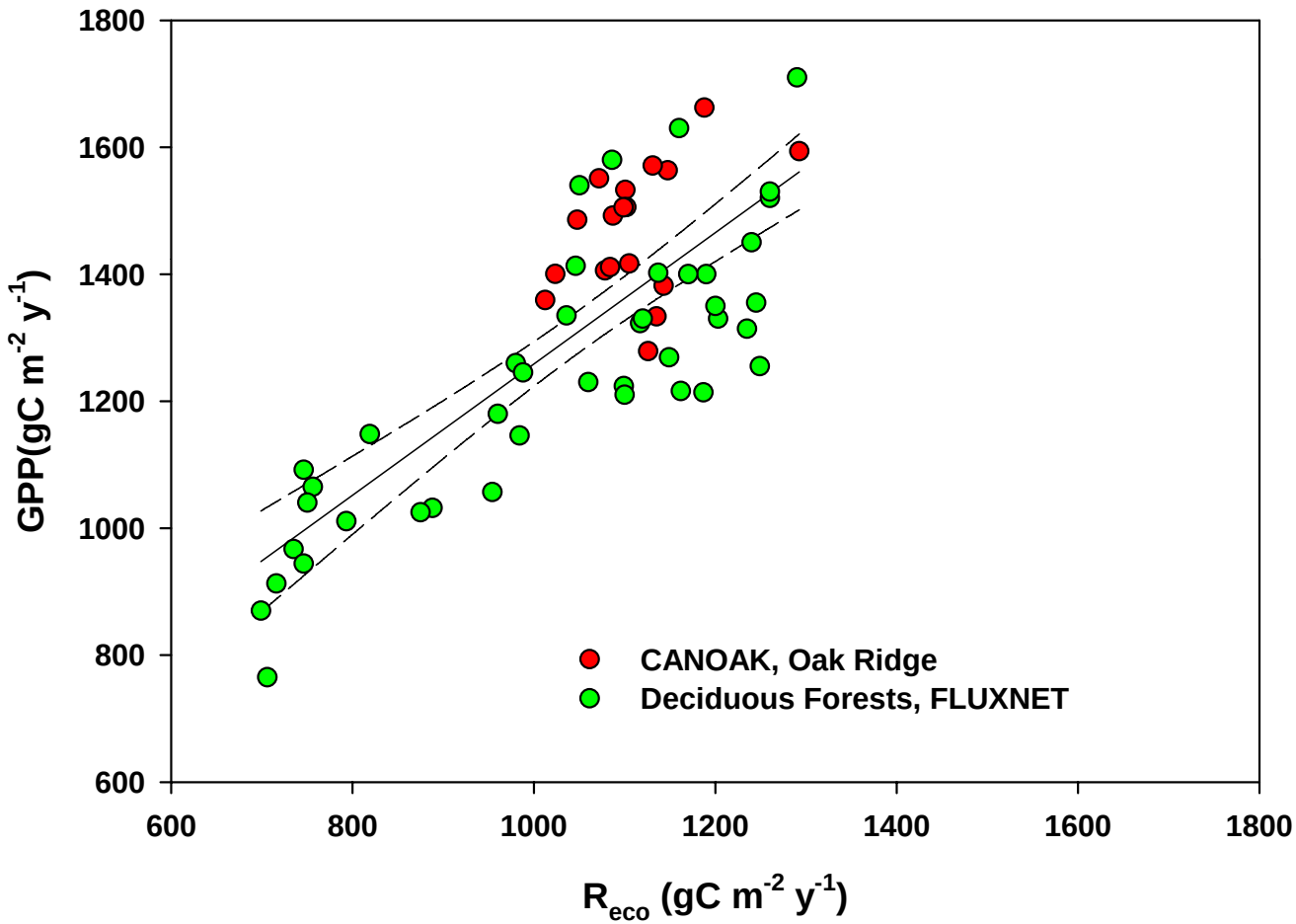
Wang et al, 2007 GCB

Flux data Aren't always the Perfect Truth

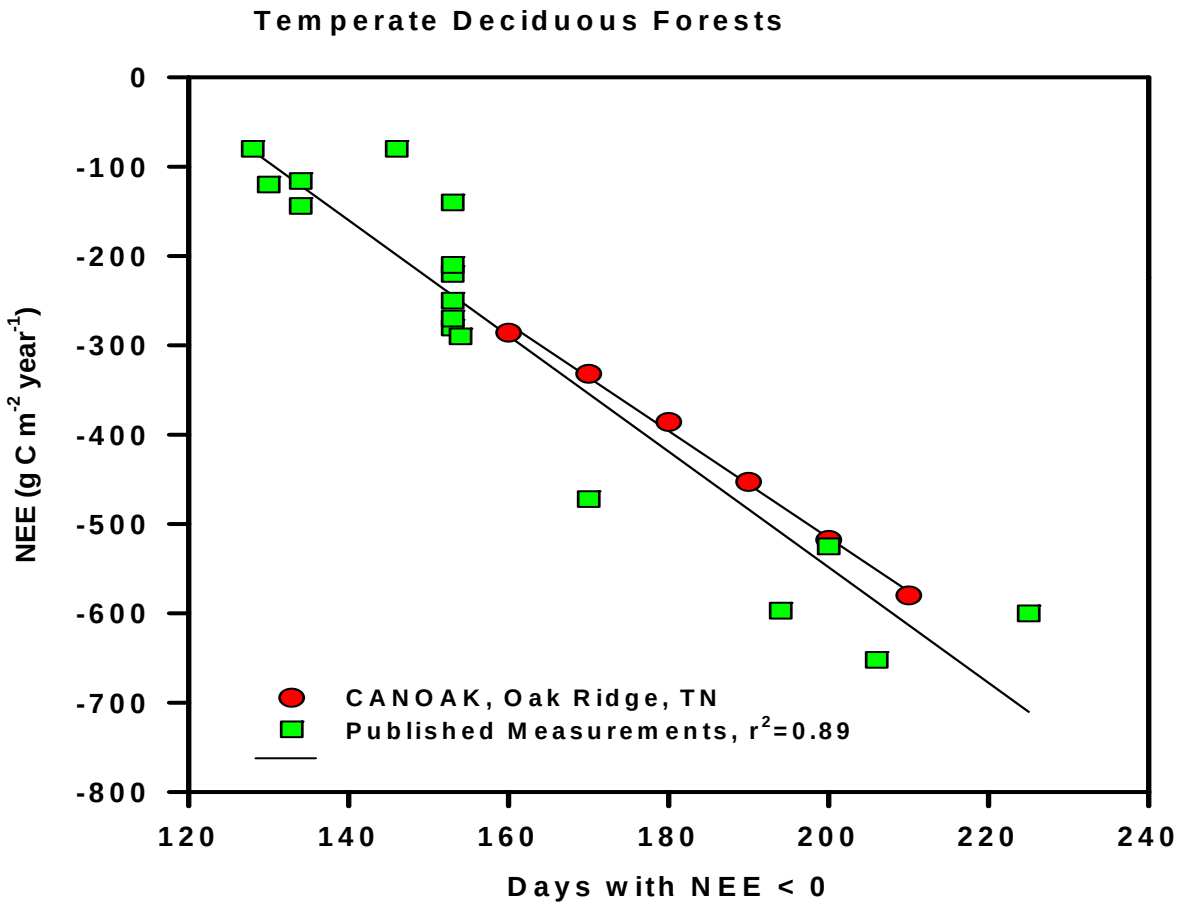


Test Model Response Functions with Data

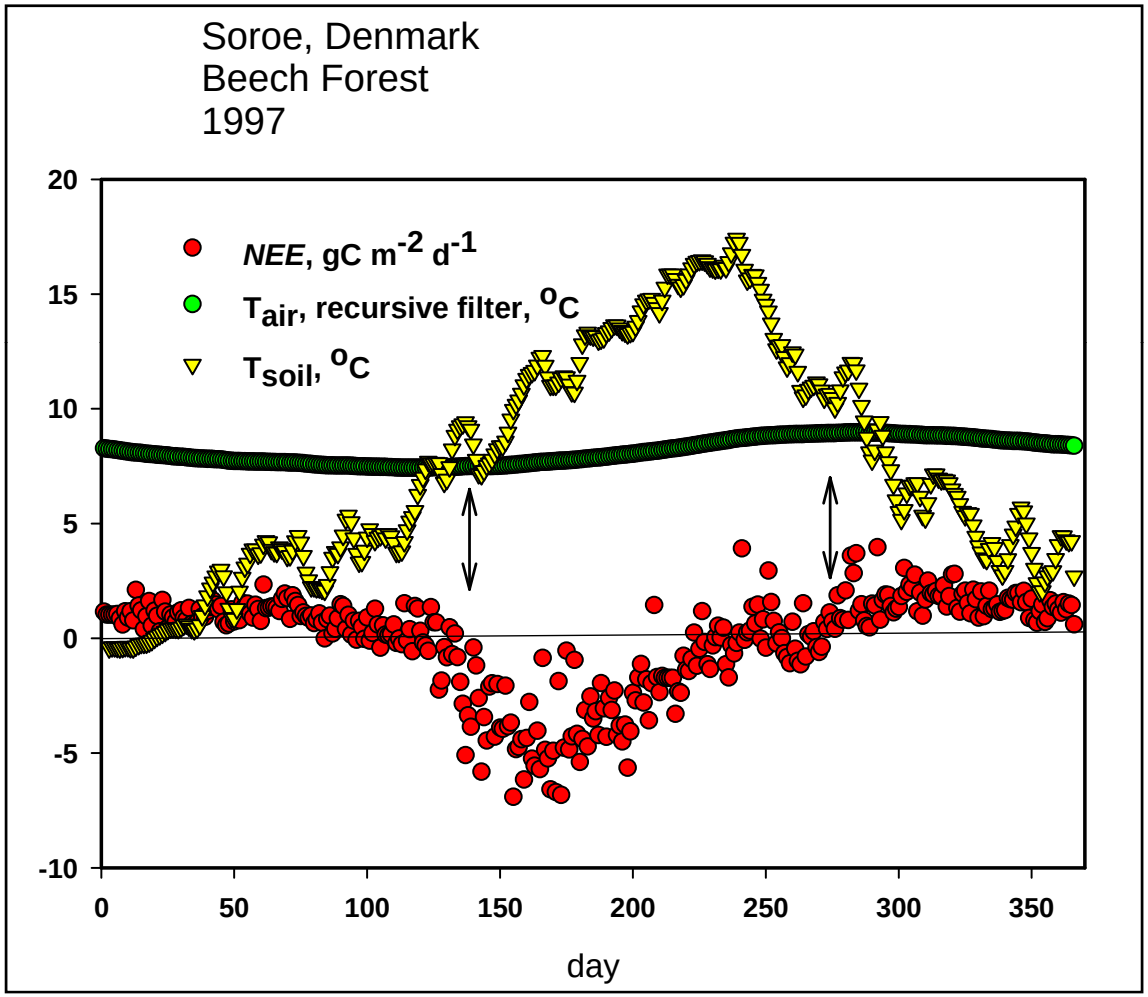
Canoak vs Deciduous Forests



NEE and Growing Season Length

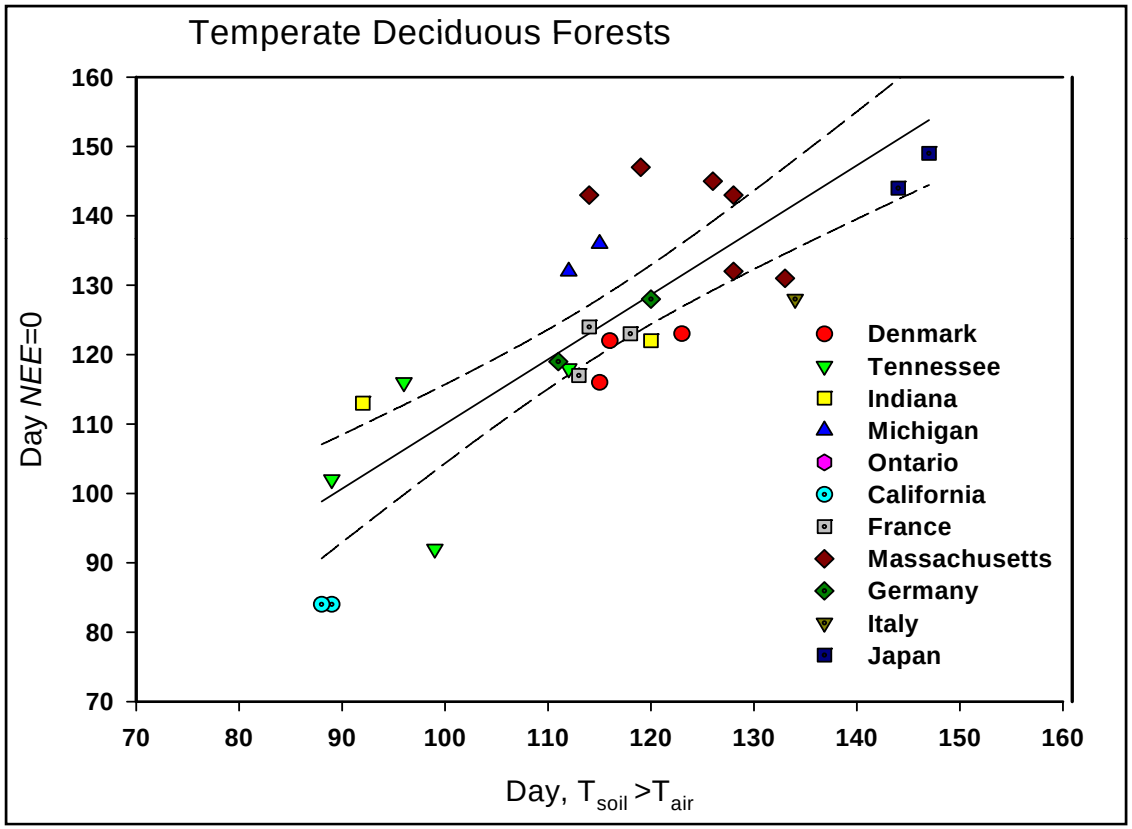


Soil Temperature:
An Objective Indicator of Phenology??



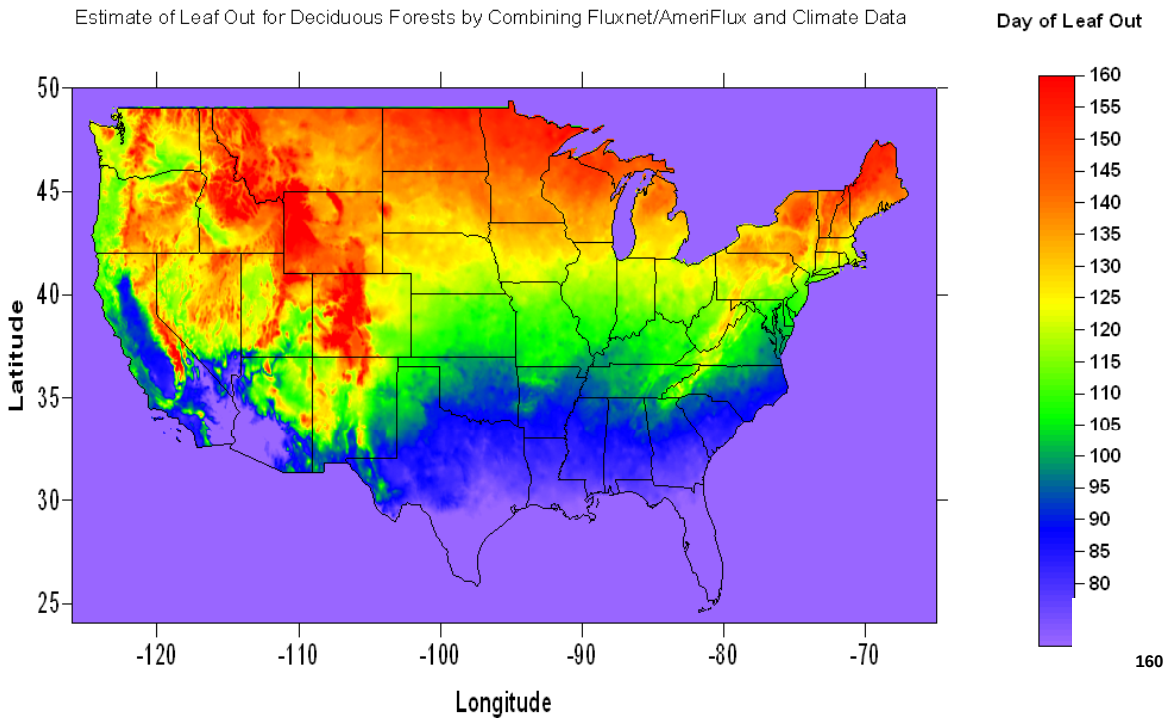
Data of Pilegaard et al.

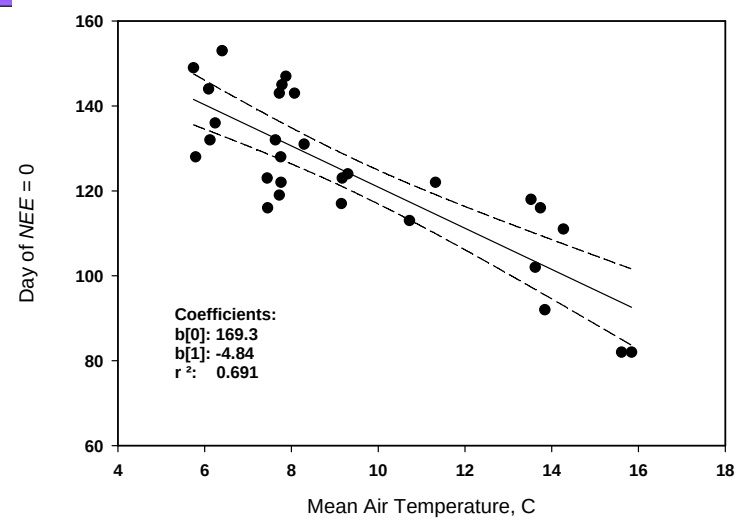
Soil Temperature:
An Objective Measure of Phenology, part 2



Baldocchi et al. Int J. Biomet, 2005

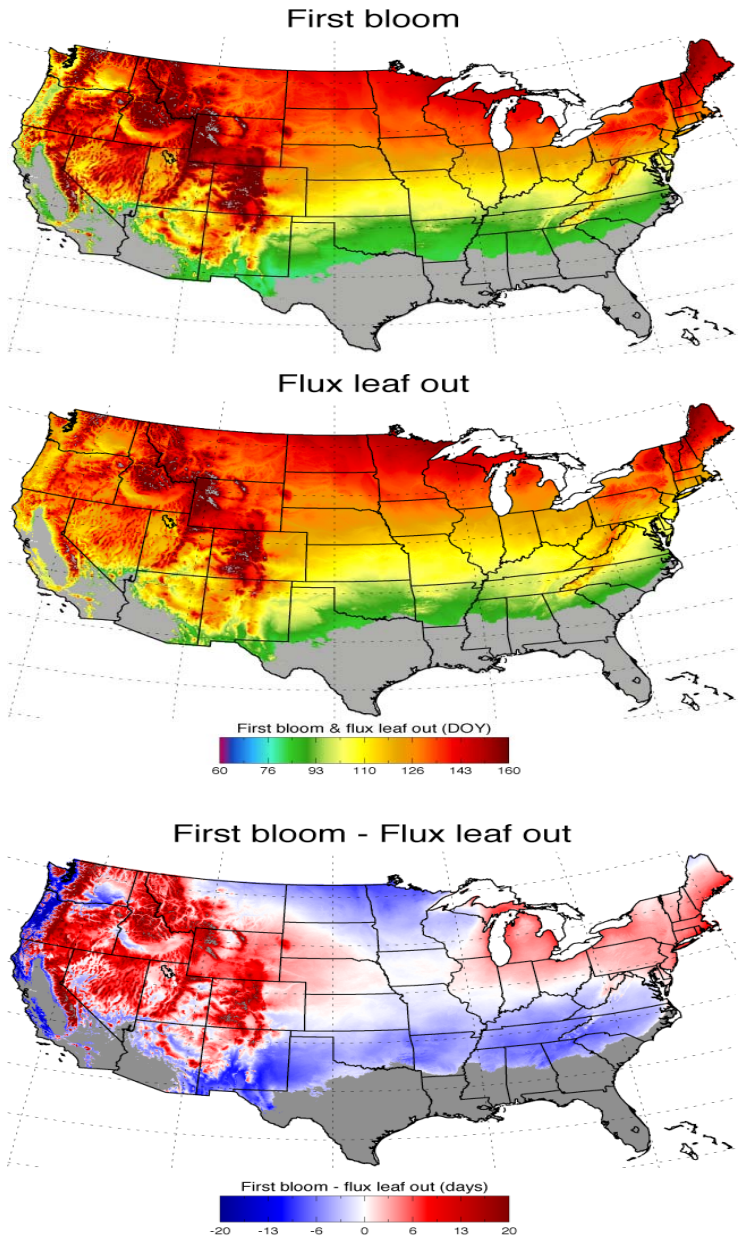
Spatialize Phenology with Transformation Using Climate Map





Baldocchi, White, Schwartz, unpublished

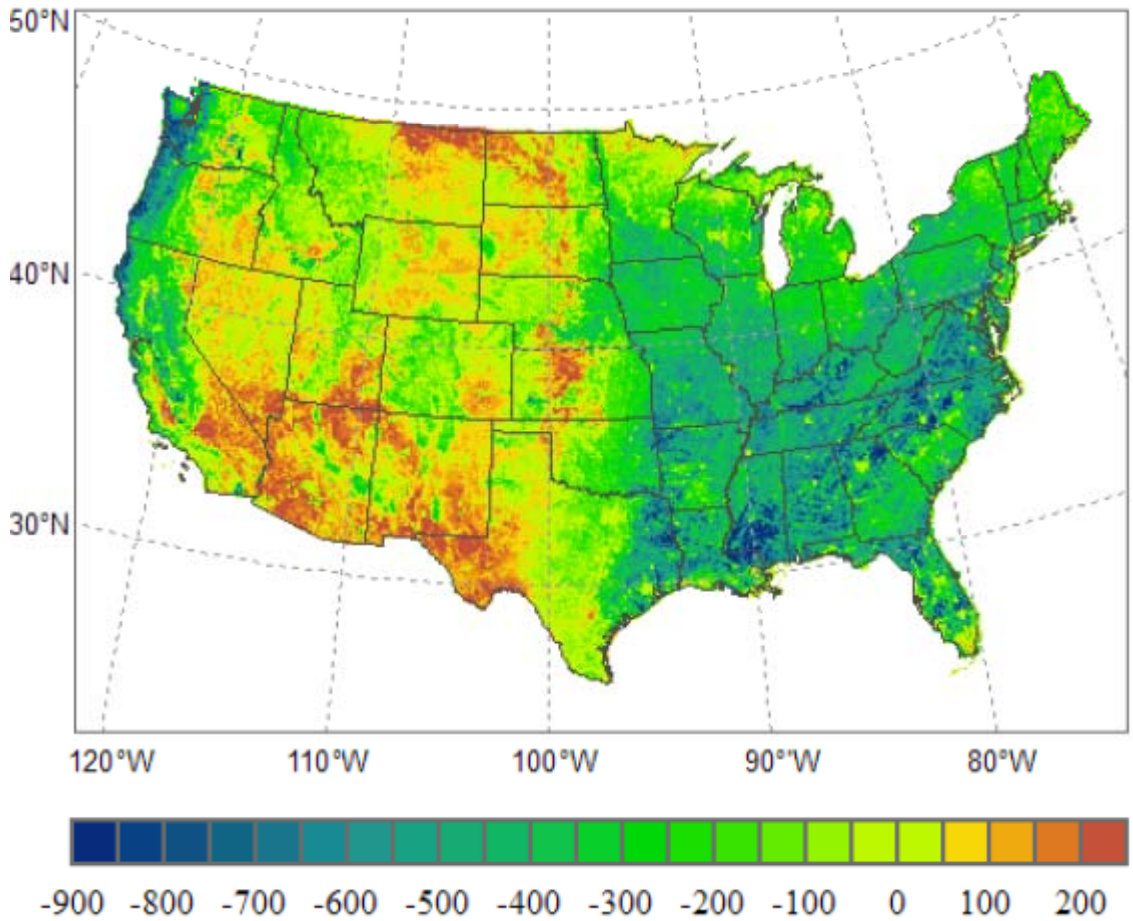
Flux Based Phenology Patterns with Match well with data from Phenology Network



White, Baldocchi and Schwartz, unpublished

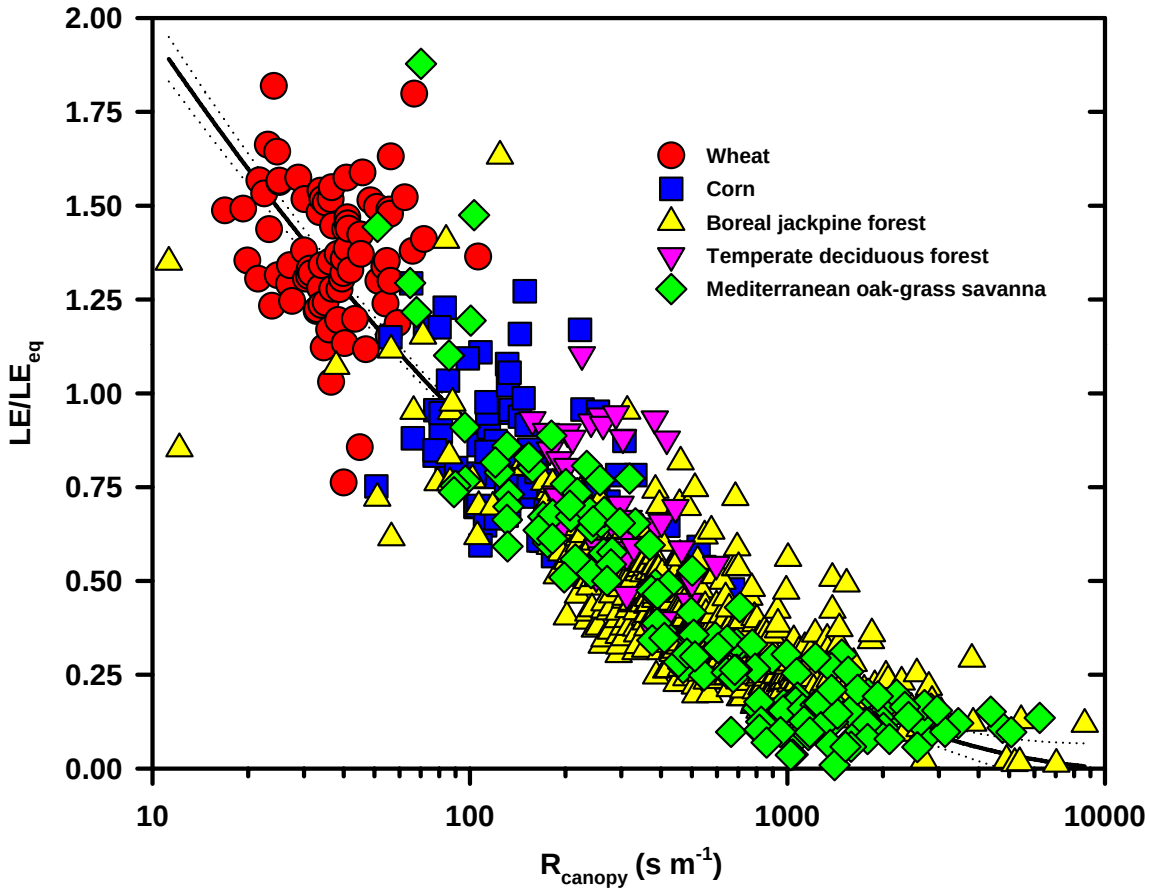
NEE, 2001-2006:

Upscaling Tower Fluxes with Remote Sensing, Climate and Regression Tree analysis



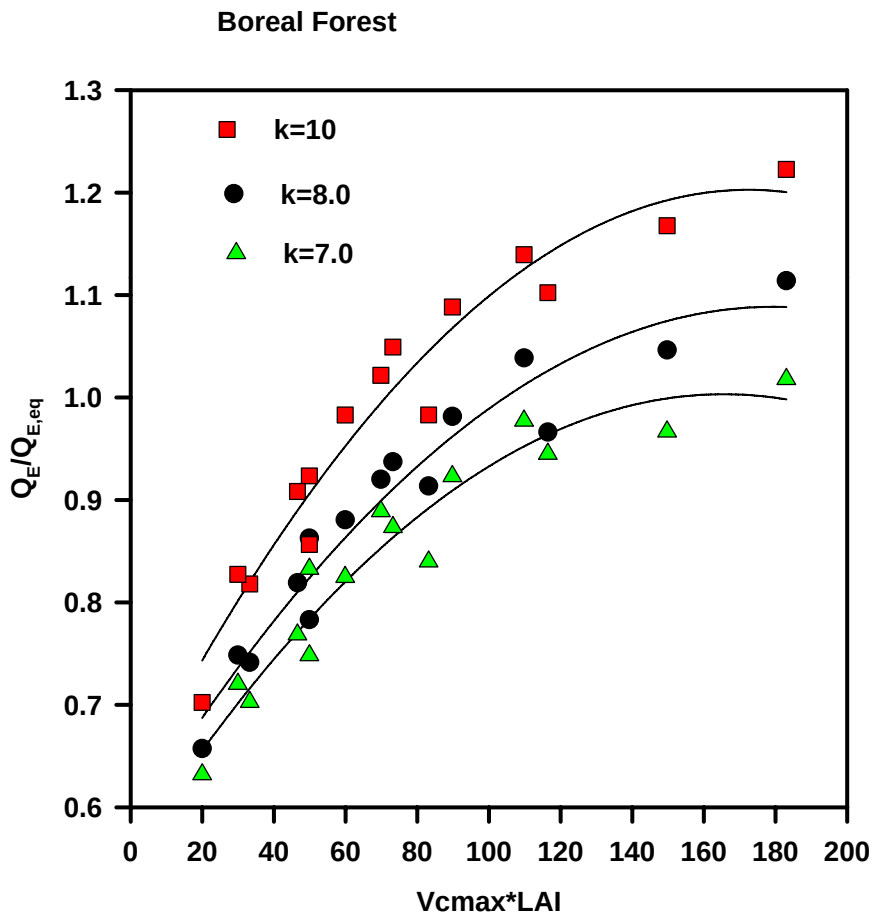
J. Xiao

Effects of Functional Types and R_{sfc} on Normalized Evaporation

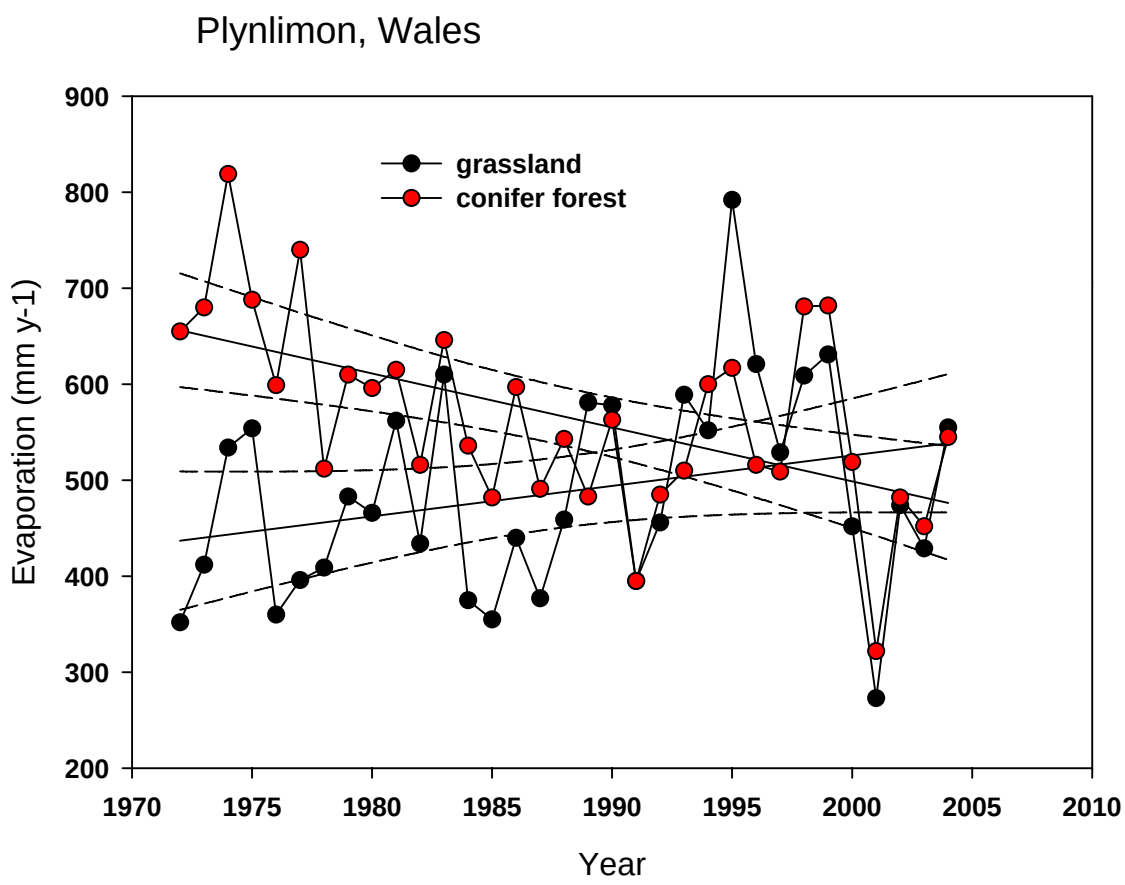


R_c is a f(LAI, N, soil moisture, Ps Pathway)

$$G_c \sim f(LAI, G_{s\max}, N, \theta_v)$$



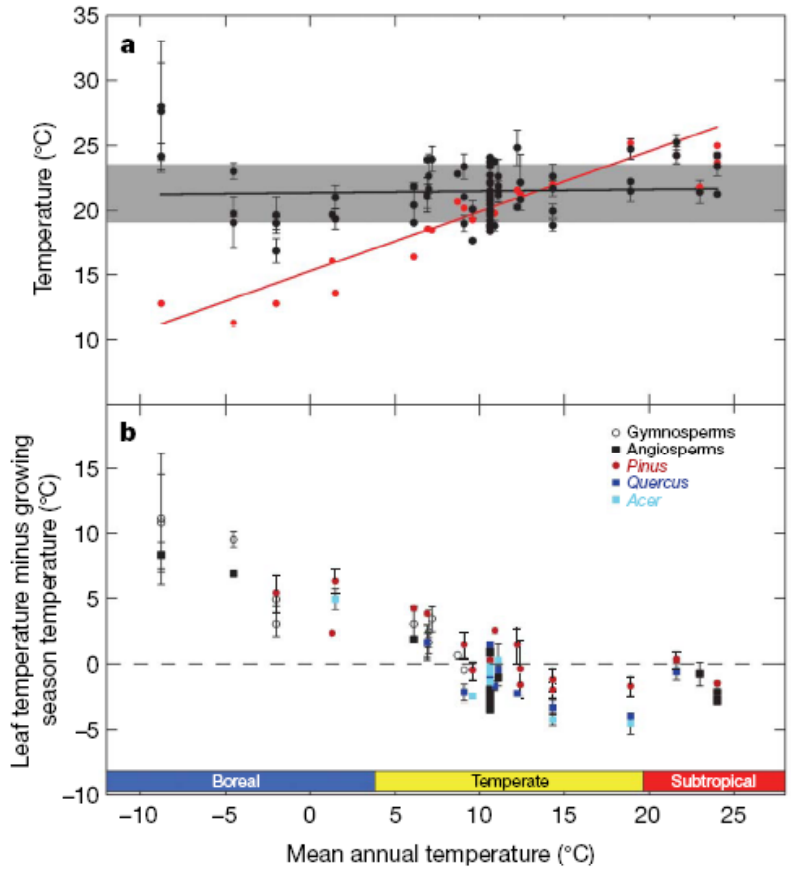
Stand Age also affects differences between ET of forest vs grassland



Marc and Robinson, 2007 HESS

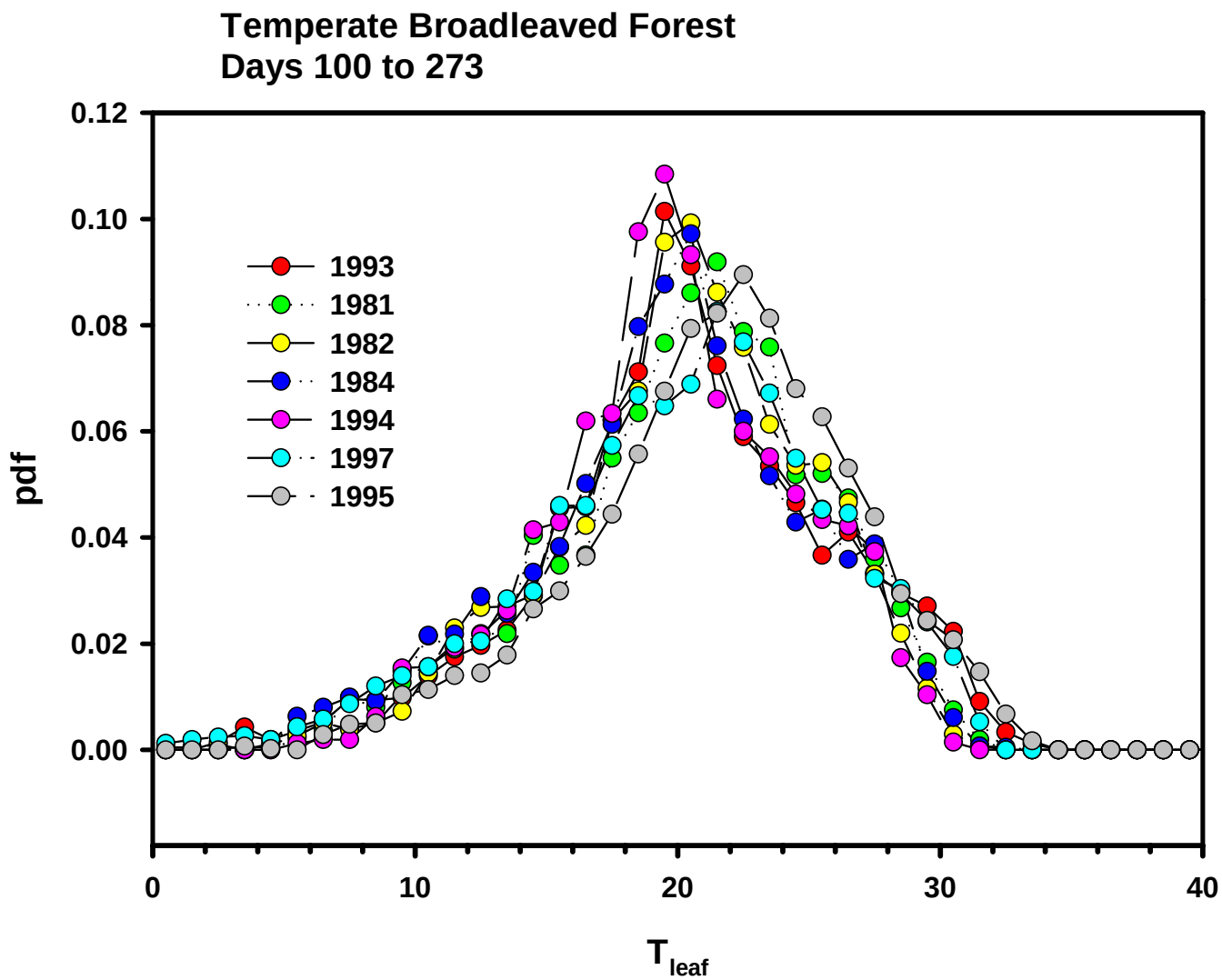
Use Models and Data to ask Science Questions

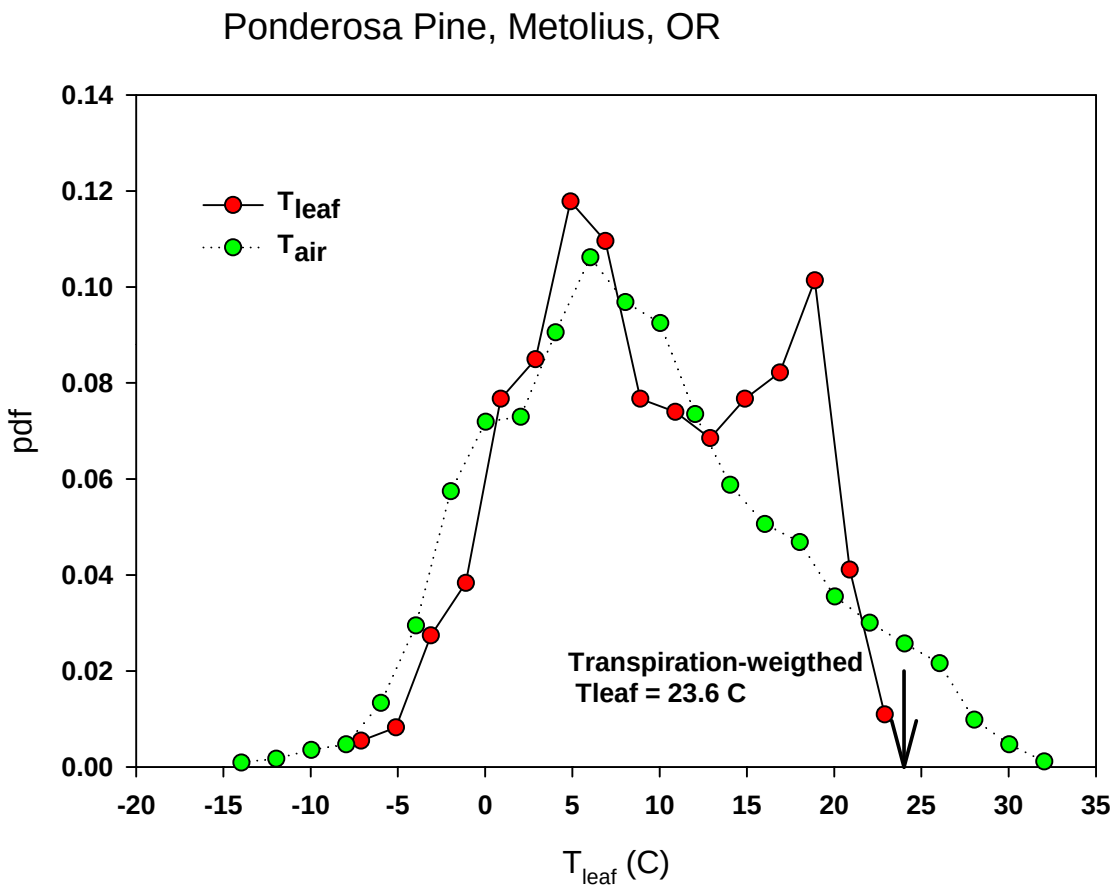
Global Convergence of Leaf Temperature (????)



Helliker and Richer 2008, Nature

Probability density function of mean leaf temperature of a broadleaved forest in Tennessee




Ponderosa Pine, Metolius, OR
0.14
0.12
0.10
0.08
0.06
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pdf
Tleaf
Tair
Transpiration-weigthed
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-20
-15
-10
-5
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Tleaf (C)