



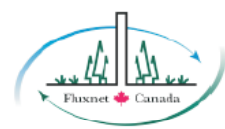
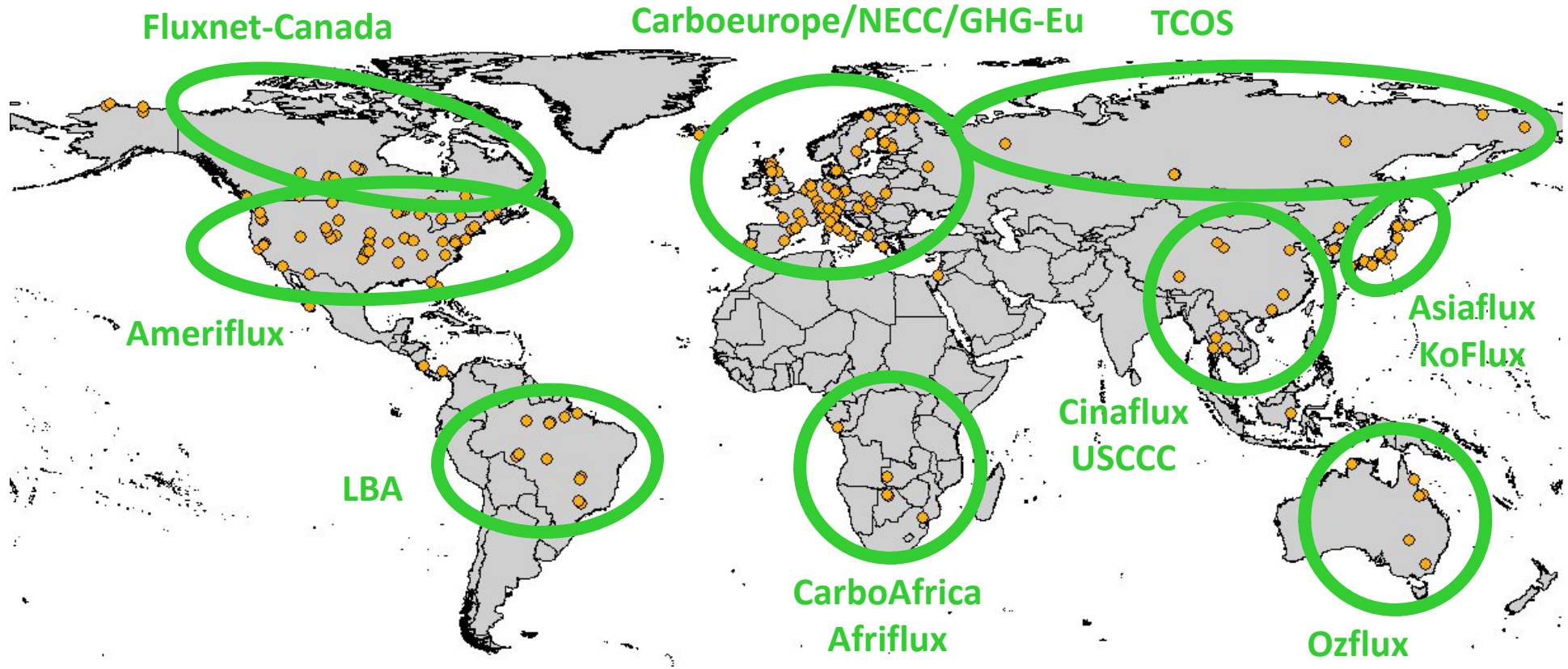
FLUXNET: network of networks to connect scientists and promote synthesis

Eva van Gorsel

for

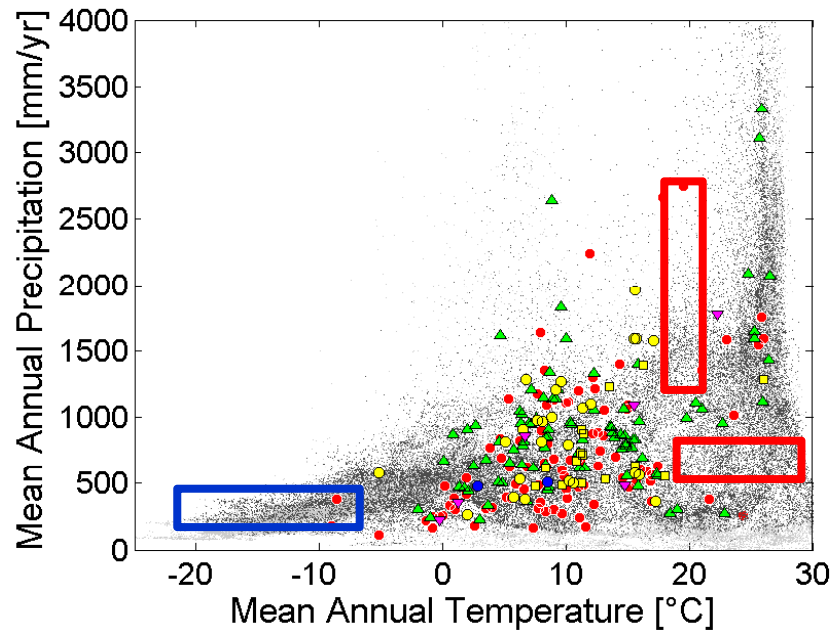
D. Papale, M. Reichstein, D. Baldocchi

Eddy covariance sites are world-wide distributed and organized in regional networks



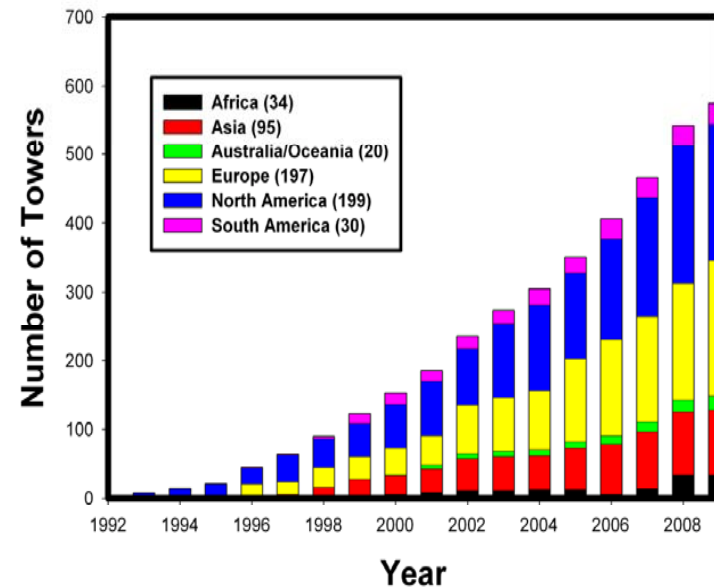
FLUXNET, network of networks

With the aim to connect scientists and promote synthesis studies



Can we learn general relationships between fluxes, properties and drivers for „filling the gaps“?

Growth of FLUXNET
576 Towers as of March 31, 2009



Standardization and harmonization are essential for synthesis activities

Global Change Biology (2005) 11, 1–16, doi: 10.1111/j.1365-2486.2005.001002.x

On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm

MARKUS REICHSTEIN^{*†}, EVA FALGE[‡], DENNIS BALDOCCI[§], MARC AUBINET[¶], PAUL BERBIGIER^{||}, CHRISTIAN BERNHARD^{||}, NINA BUCHMANN^{††‡‡}, TAGIR GILMANOV^{§§}, ANDRÉ GRIGNANI^{¶¶}, THOMAS GRÜNWALD^{**}, KATKA HAVRÁNKOVÁ^{|||}, HANNU DALIBOR JANOUS^{|||}, ALEXANDER KNOHL^{††§}, TUOMAS L

Biogeosciences, 3, 571–583, 2006
www.biogeosciences.net/3/571/2006/
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Towards a standardized processing of Net Ecosystem Exchange measured with eddy covariance technique: algorithm and uncertainty estimation

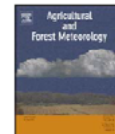
Agricultural and Forest Meteorology 149 (2009) 1919–1930



Contents lists available at ScienceDirect

Agricultural and Forest Meteorology

journal homepage: www.elsevier.com/locate/agrformet



Estimating nocturnal ecosystem respiration from the vertical turbulent flux and change in storage of CO₂

Eva van Gorsel^{a,b,*}, Nicolas Delpierre^c, Ray Leuning^{a,b}, Andy Black^d, J. William Munger^e, Steven Wofsy^e, Marc Aubinet^f, Christian Feigenwinter^{f,g}, Jason Beringer^h, Damien Bonalⁱ, Baozhang Chen^d, Jiquan Chen^j, Robert Clement^k, Kenneth J. Davis^l, Ankur R. Desai^m, Danilo Dragoniⁿ, Sophia Eitzold^o, Thomas Grünwald^p, Lianhong Gu^q, Bernhard Heinesch^r, Lucy R. Hutyyra^{c,r}, Wilma W.P. Jans^s, Werner Kutsch^t, B.E. Law^u, Monique Y. Leclerc^v, Ivan Mammarella^w, Leonardo Montagnani^x, Asko Noormets^y, Corinna Rebmann^t, Sonia Wharton^z



Available online at www.sciencedirect.com

ScienceDirect

Agricultural and Forest Meteorology 147 (2007) 209–232

AGRICULTURAL
AND
FOREST
METEOROLOGY

www.elsevier.com/locate/agrformet

Comprehensive comparison of gap-filling techniques for eddy covariance net carbon fluxes

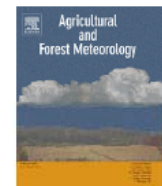
Antje M. Moffat^{a,*}, Dario Papale^b, Markus Reichstein^a, David Y. Hollinger^c, Andrew D. Richardson^d, Alan G. Barr^e, Clemens Beckstein^f, Bobby H. Braswell^g, Galina Churkina^a, Ankur R. Desai^h, Eva Falgeⁱ, Jeffrey H. Gove^c, Martin Heimann^a, Dafeng Hui^j, Andrew I. Jarvis^k



available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/agrformet



Comparison of eddy covariance GPP and RE techniques

Andrew D. Richardson^b, Antje M. Moffat^c, Jens Kattge^c, Alan G. Barr^e, Eva Falge^f, Asko Noormets^g, Clemens Beckstein^c, Vanessa J. Stauchⁱ

Fluxnet-Synthesis Sign In |

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Discussions

- Team Discussion

Sites

- Dataset Information
- Blog
- User Support
- Credits


People and Groups



Welcome to the Web Site for the FLUXNET Synthesis Data set.

This site provides information about and access to the FLUXNET Synthesis datasets, designated LaThuile and Asilomar. The overarching database consists of over 960 site-years of data from over 253 eddy covariance measurement sites, thereby updating and superceding the Marconi FLUXNET database that was produced in 2000 (with 97 years of data from 38 European and North American sites). The FLUXNET Synthesis database harmonizes, standardizes and gap-fills the 'raw' 30-minute data records of carbon dioxide, water vapour and energy fluxes submitted by members of regional networks from around the world: CarboeuropeIP, AmeriFlux, Fluxnet-Canada, LBA, Asiaflux, Chinaflux, USCCC, Ozflux, Carboafica, Koflux, NECC, TCOS-Siberia and Afriflux. More information about the FLUXNET project can be found [here](#). The database also includes value added products like gross primary productivity, ecosystem respiration, climate and site characteristic information.

This web site contains tools that assist scientists to acquire, query, plot and manipulate diverse combinations of data from many sites, for many years and with various independent variables. These tools are the product of a collaboration with database specialists at the national laboratories (Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory, Max Planck Institute of Biogeochemistry, Jena), Universities (Tuscia, Virginia, California-Berkeley) and industry (Microsoft). The collaboration was fostered by the fact that the FLUXNET network has grown to a large and unwieldy size (+500 sites) and the need to provide software tools to distribute and navigate through the database in an effective and efficient manner.



Announcements

Epot units 7/23/2009 10:30 AM
by Deb Agarwal
Dear users, we are currently checking the units and equations used to calculate the potential evapotranspiration. If you are using this variable please wait further communications about the correctness of the calculation. Posted on behalf of Dario Papale.

FluxLetter vol 2 No 2 Now Available 6/26/2009 11:30 AM
by Deb Agarwal
The latest FluxLetter has just been released. This issue is dedicated to arctic ecosystems. The article can be found [here](#) or [here](#). It contains interesting articles about permafrost, measuring air-ice CO2, and flux conservation in a model. It also highlights...

How to Request an Account 6/4/2008 6:11 AM
by System Account
Please go to <https://pod.lbl.gov:31633/> to request an account to use this site. (Accept the certificate). You will need to know the "secret password". At this web page, you can also change your password if you have already registered.

The LaThuile 2007 collection

The LaThuile 2007 data collection gave a lot of visibility to FLUXNET and the eddy covariance technique in general. This visibility can be also useful to support the regional networks, critical for the FLUXNET success.

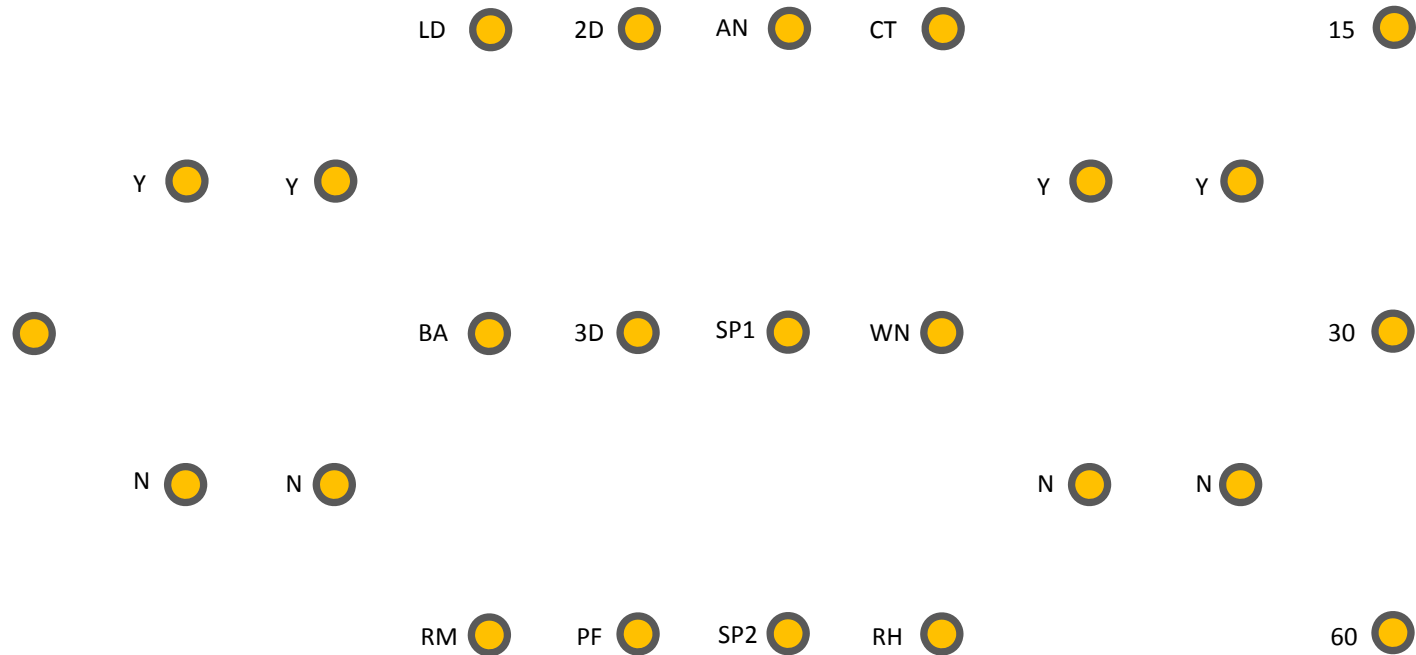
A good number of synthesis papers based on the data collection have been published and a lot are under preparation. This scientific activity gave also the possibility to establish new collaborations and links between scientists and networks.

However we also learned in these years what should be improved respect to the LaThuile 2007 collection in particular in the view of the new collection under preparation:

- Additional methods should be used in the data processing
- PI's version should be added if different from the others provided
- Different data sharing positions between PIs exist, so different policies could be proposed in particular given the interest from external communities.
- Ancillary data are important. Very important.
- Gaps in some region should be filled
- Uncertainties need to be estimated and added.

Example of raw data processing possibilities

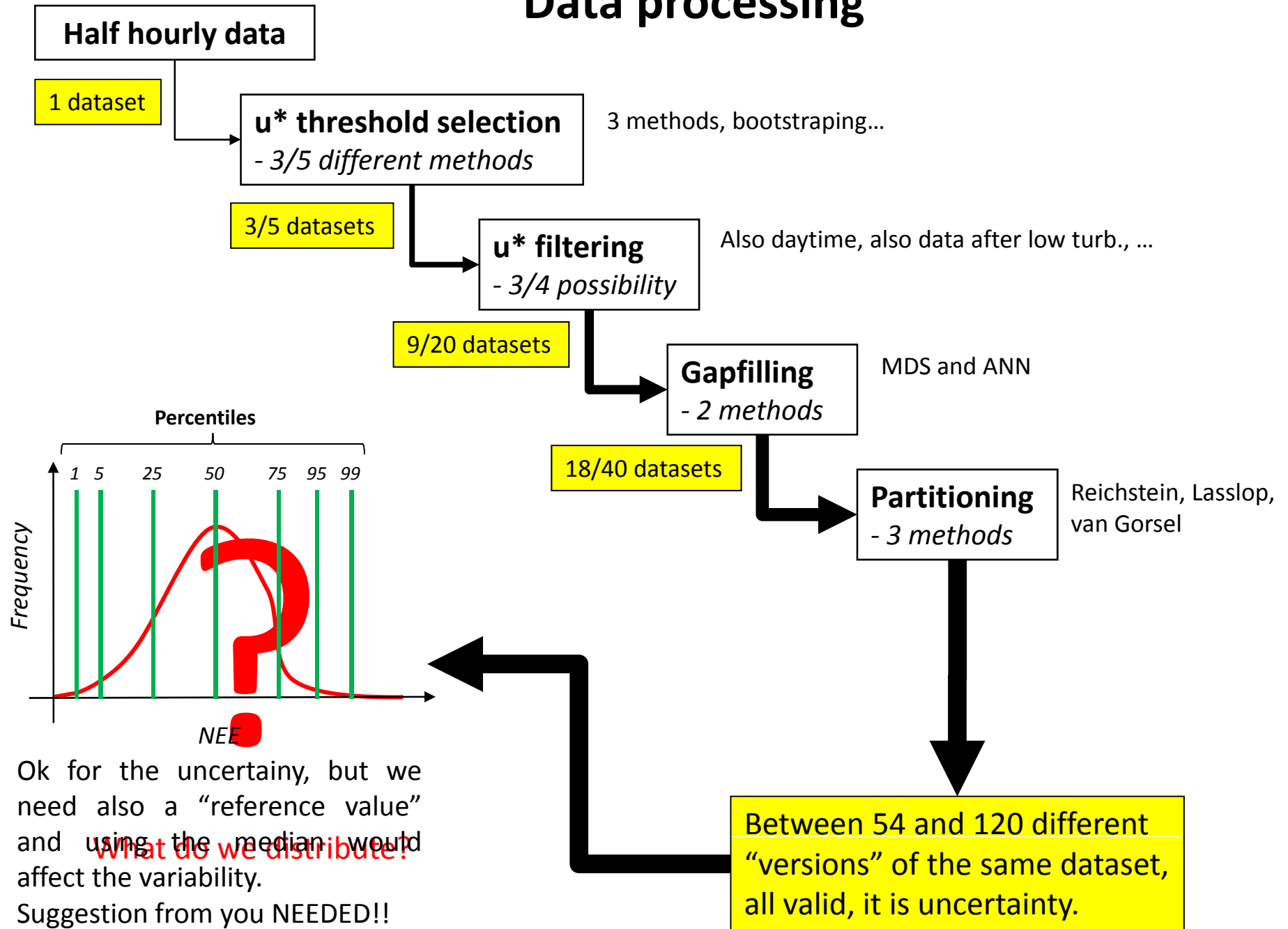
	raw data	stat screening	a-o-a correction	detrending	tilt correction	low-freq correction	time lag compensation	high-freq correction	off-season uptake	variable avrg time
order	0	1	2	3	4	5	6	7	8	9
no. of choices	0	2	2	3	3	3	3	2	2	3



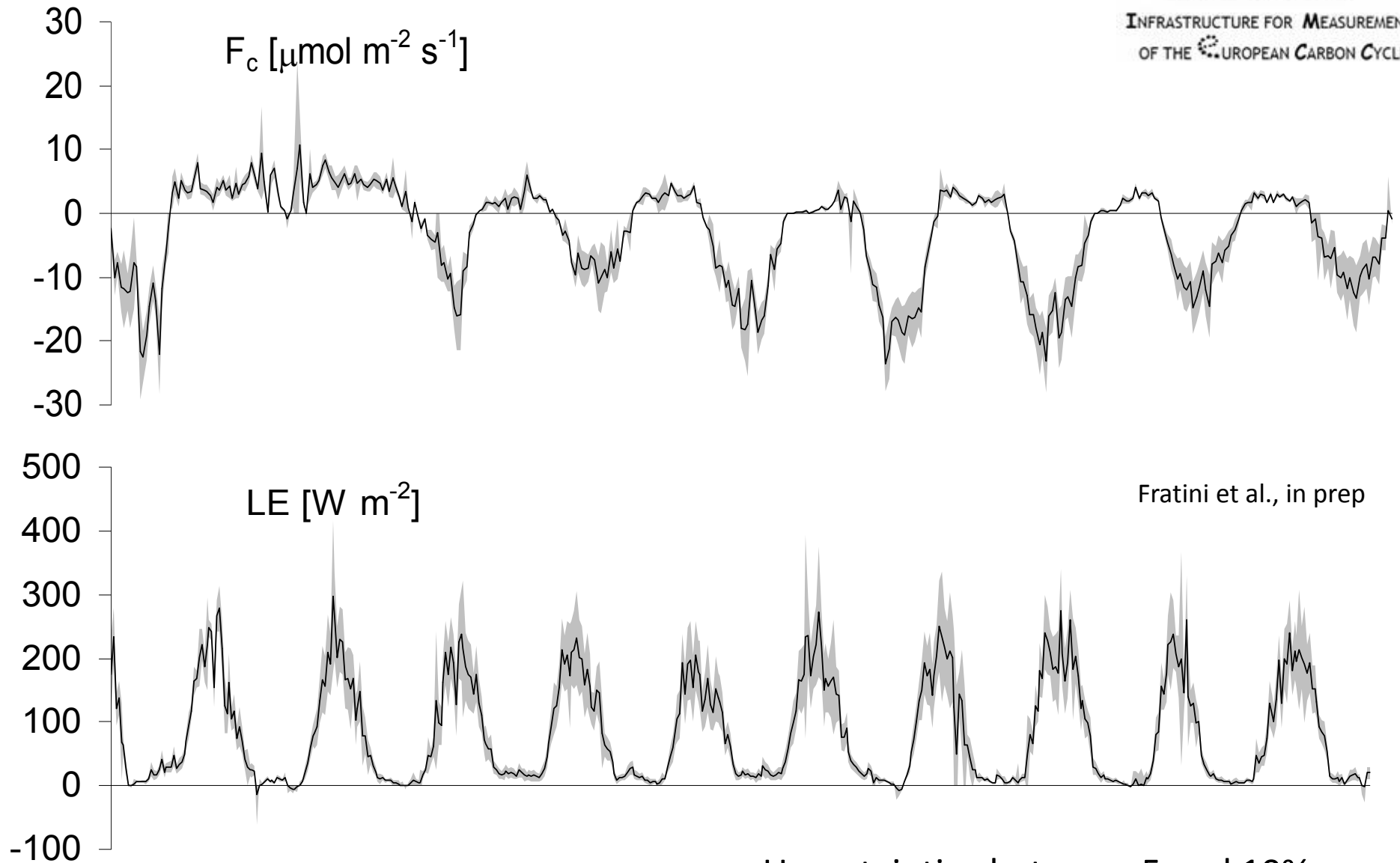
Number of possible schemes: **> 2500**

Y= applied; N= not applied; AN= Moncrieff et al. 2007; SP1= Aubinet et al. 2001; SP2= Ibrom et al. 2007; LD= linear detrending; BA= block average; RM= running mean; 2D= 2d rotations; 3D= 3d rotations; PF= planar fit; CT= constant; WN=max in fixed window; RH= max in rh-dependent window.

Data processing



Uncertainties due to raw-data processing



Fratini et al., in prep

H_{avrg} (black line) and $H_{\text{avrg}} \pm 3.5\sigma$ (gray shade)

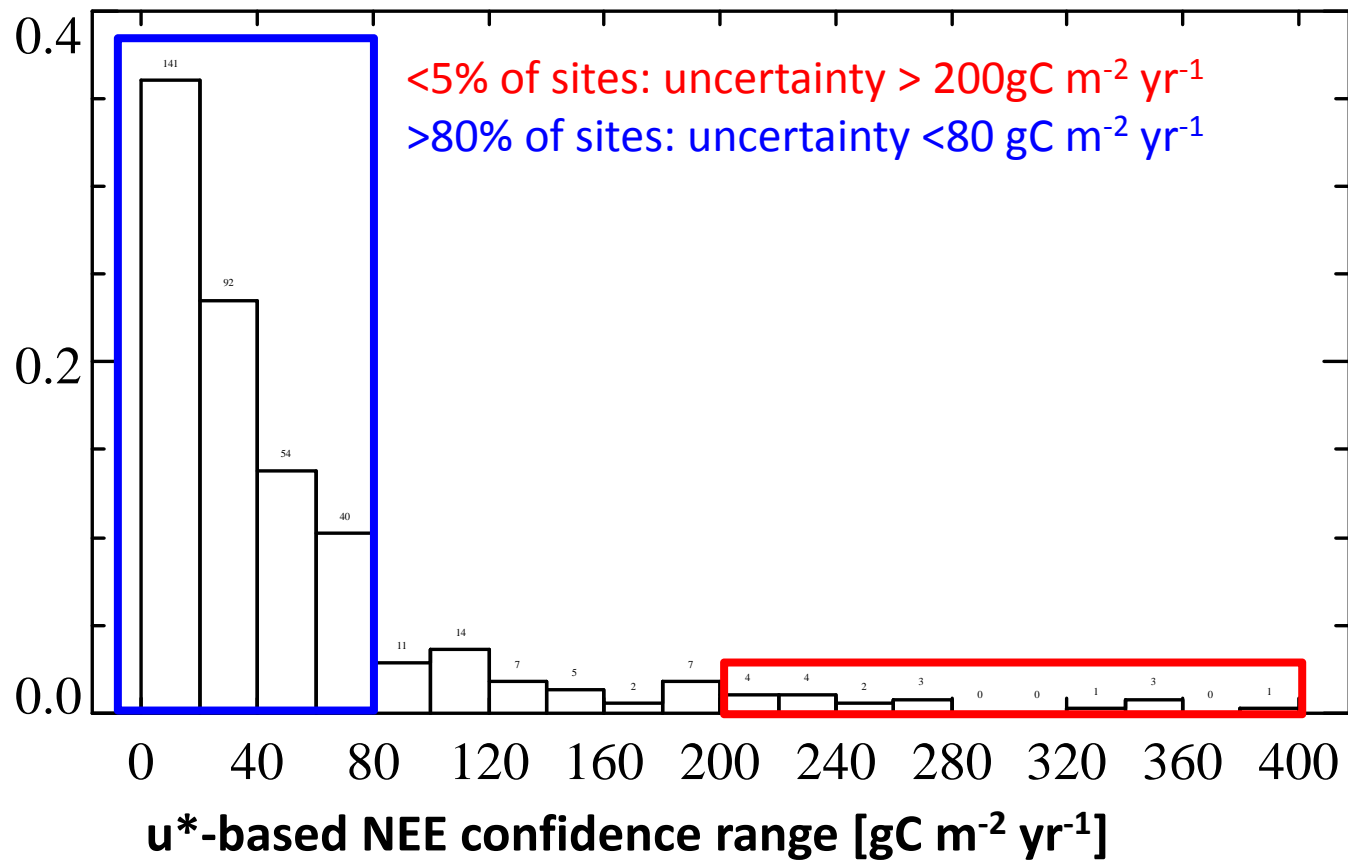
Uncertainties between 5 and 10%

Important if half hourly data are used!

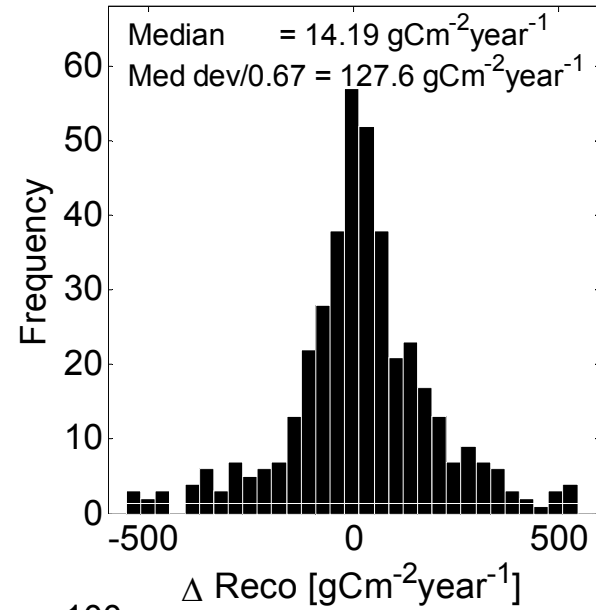
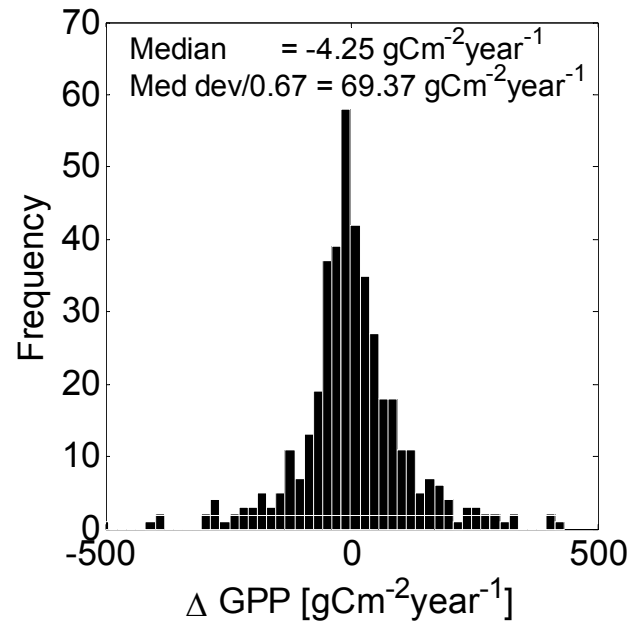
u^* - based uncertainties across sites

u^* filtering is needed to remove data acquired during low turbulence periods.

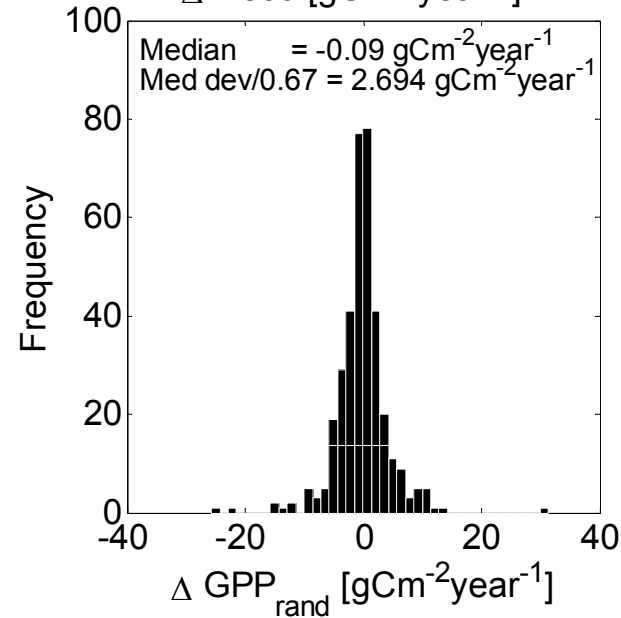
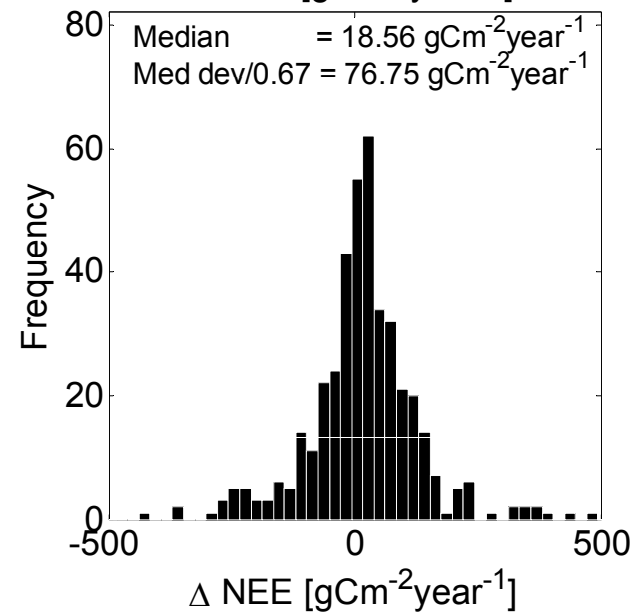
The u^* threshold is site specific and often difficult to set and for this reason actually the largest uncertainty source in the annual budgets.



Comparison of nighttime and daytime based GPP/Reco/NEE estimates

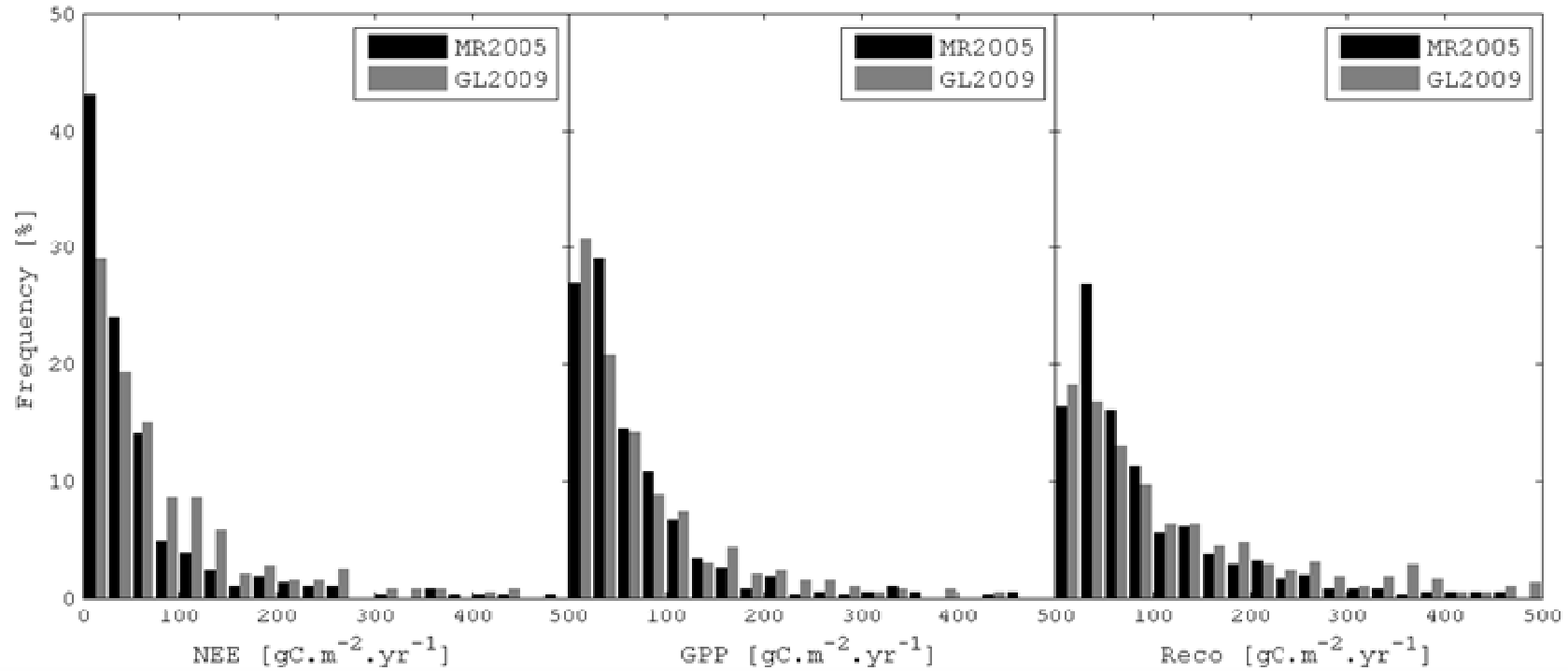


417 siteyears



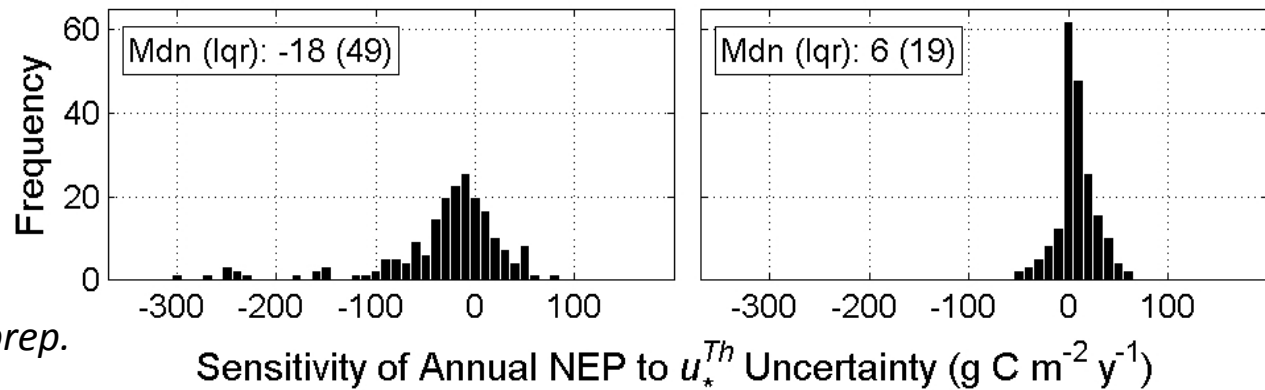
Uncertainty quantification

Ustar and partitioning – NEE, GPP, Reco



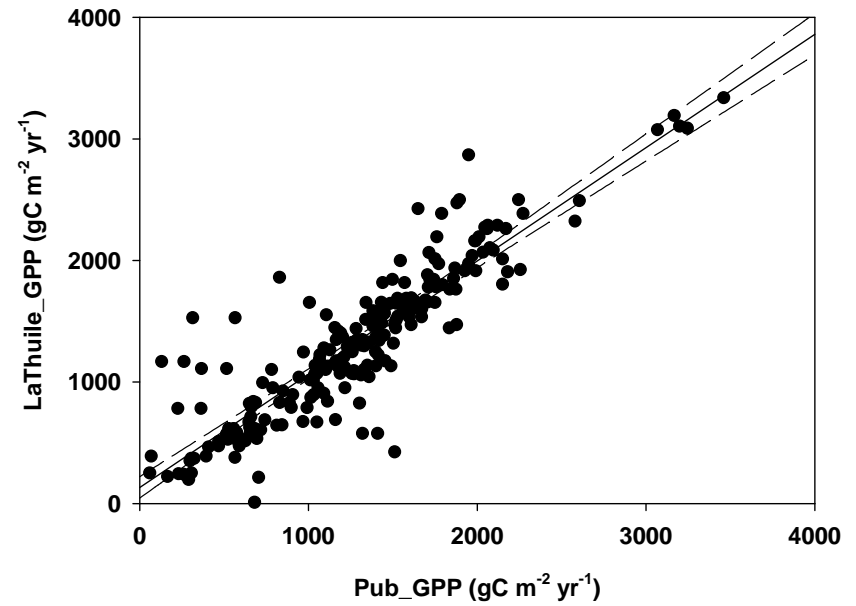
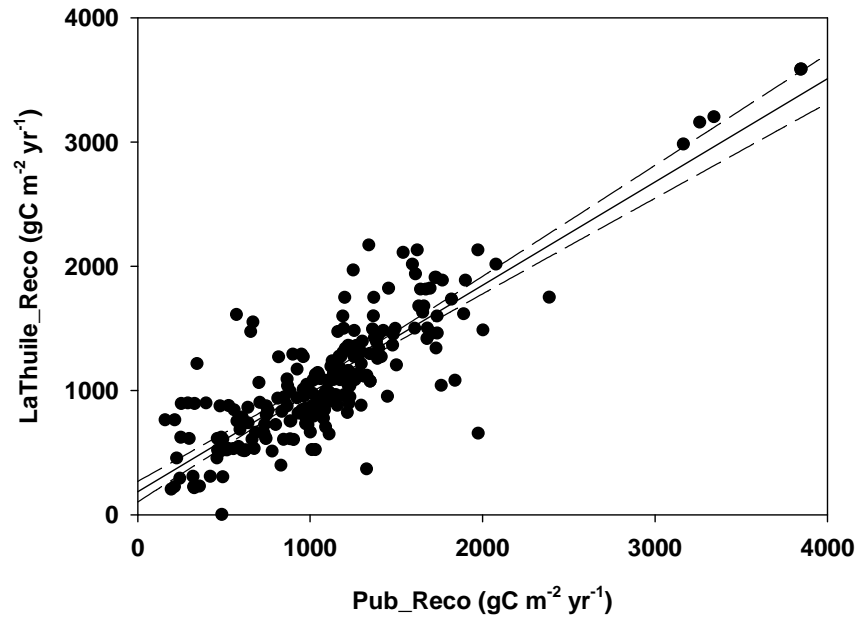
Reichstein et al in prep.

Ustar methods and uncertainty – NEE



Barr et al in prep.

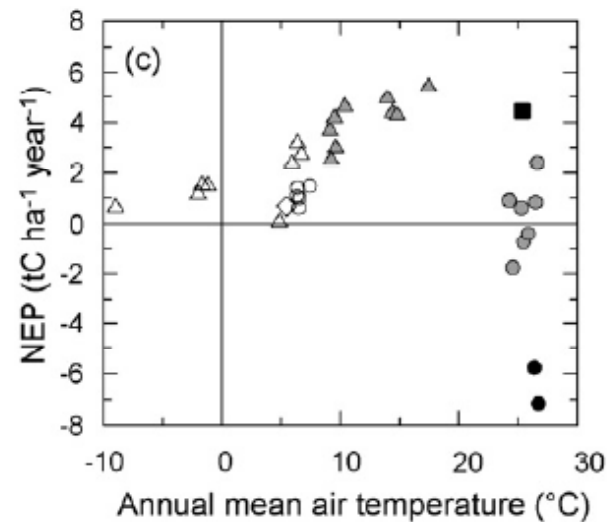
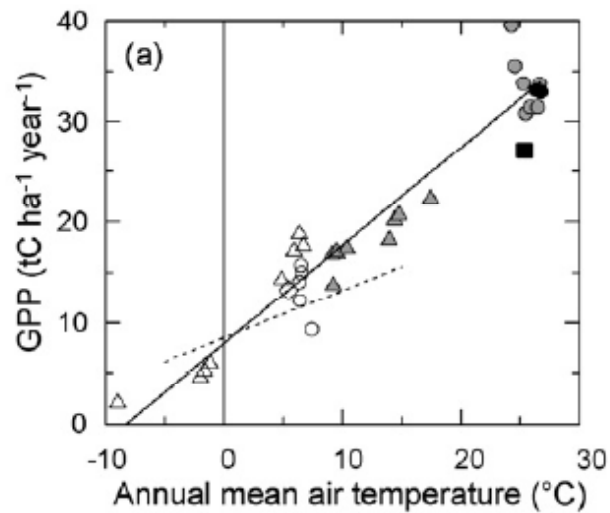
Standard Processing Procedure vs non-standard, but Expert Based



Dennis Baldocchi

Regional synthesis - temperature and GPP

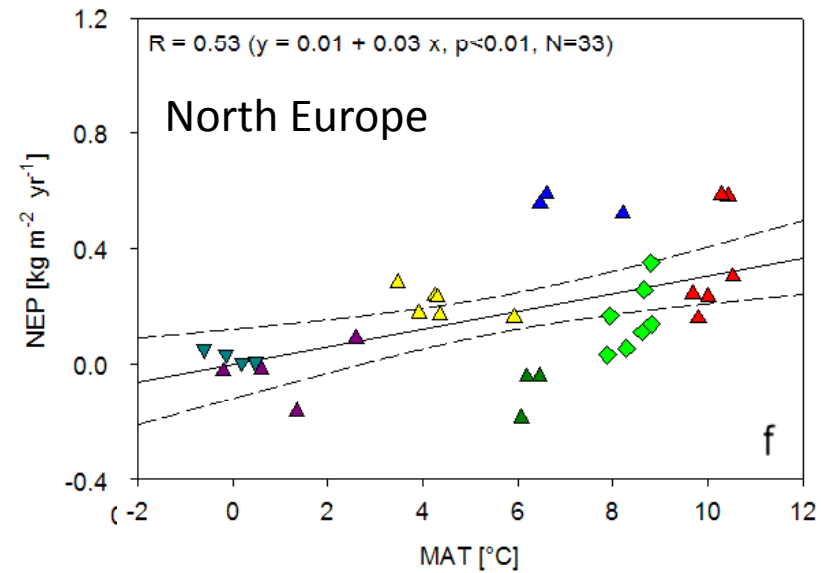
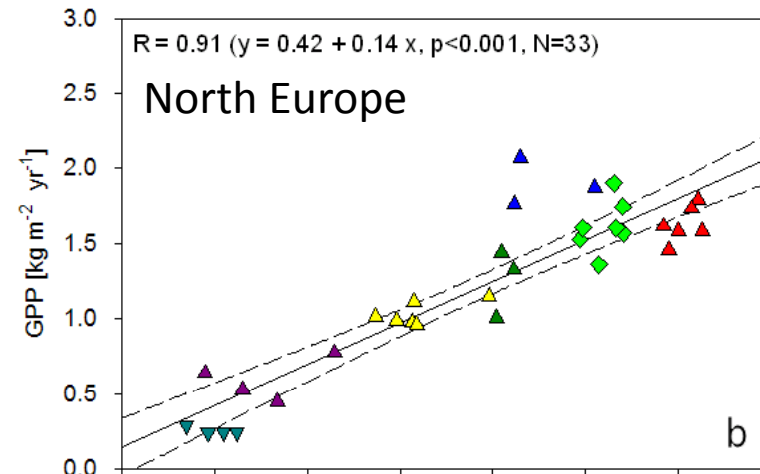
AsiaFlux network synthesis



Hirata et al. (2008) Ag. For. Met.

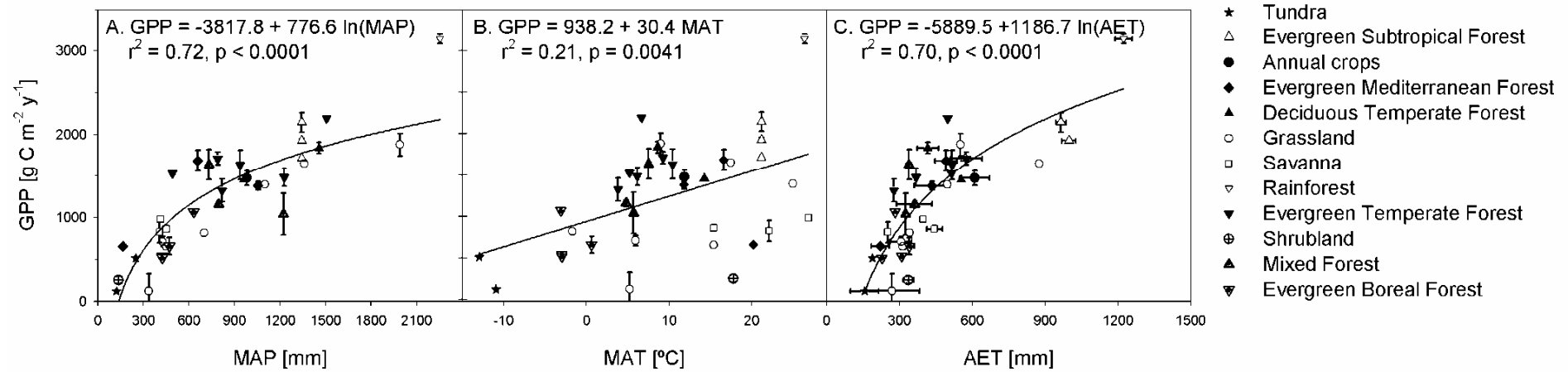
Comparable studies North/South-America: e.g. Law et al. 2002, Rocha et al. 2008

CARBO-Euroflux network synthesis

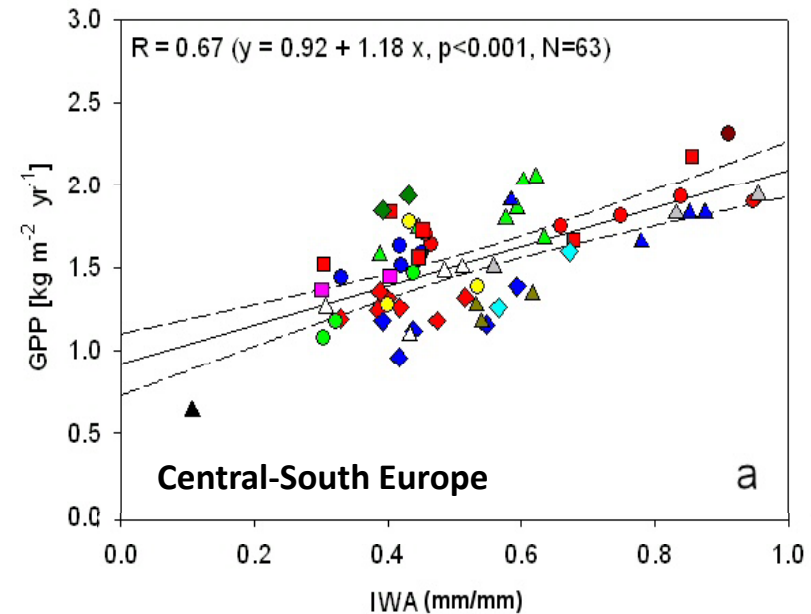


Reichstein et al. (2007) GRL

Global studies - precipitation and GPP

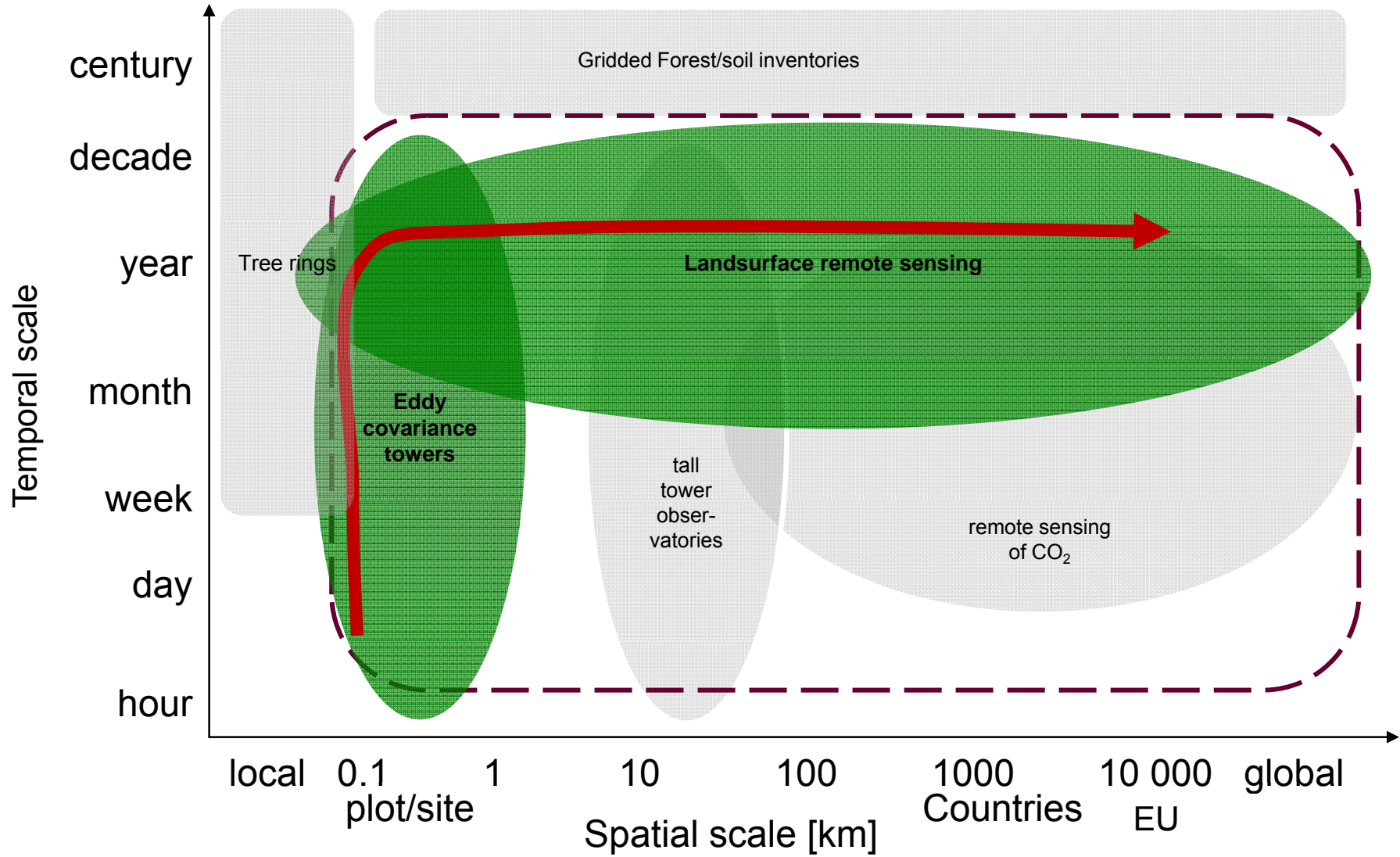


Garbulsky et al. 2010, Global Ecology and Biogeogr.

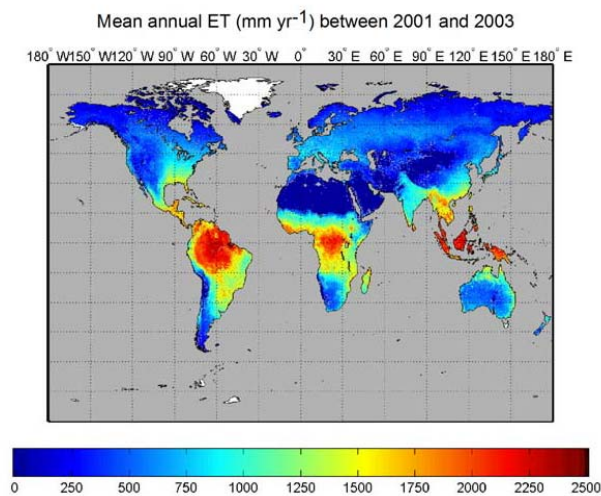
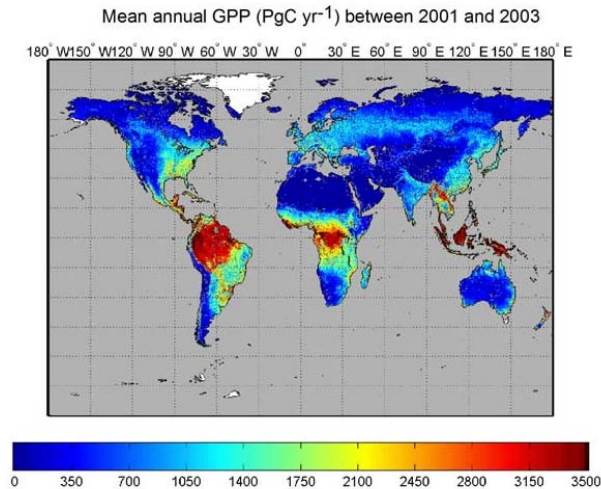


Reichstein et al. 2007, GRL

From point to globe via integration with remote sensing



From point to globe via integration with remote sensing, RTM and land surface modelling



upscaling method to quantify global gross primary productivity and evapotranspiration using MODIS Land and Atmosphere products with a spatial resolution of 1-5 km and a temporal resolution of 8 days.

► calculate atmospheric radiative transfer for photosynthetically active radiation and near infrared radiation wavebands.

► couple atmospheric and canopy radiative transfer processes, with models that computed leaf photosynthesis, stomatal conductance and transpiration on the sunlit and shaded portions of the vegetation and soil.

► the process-based BESS (breathing earth system simulator) is able to offer gridded biophysical variables everywhere from local to the total global land scales with an 8-day interval over multiple years.

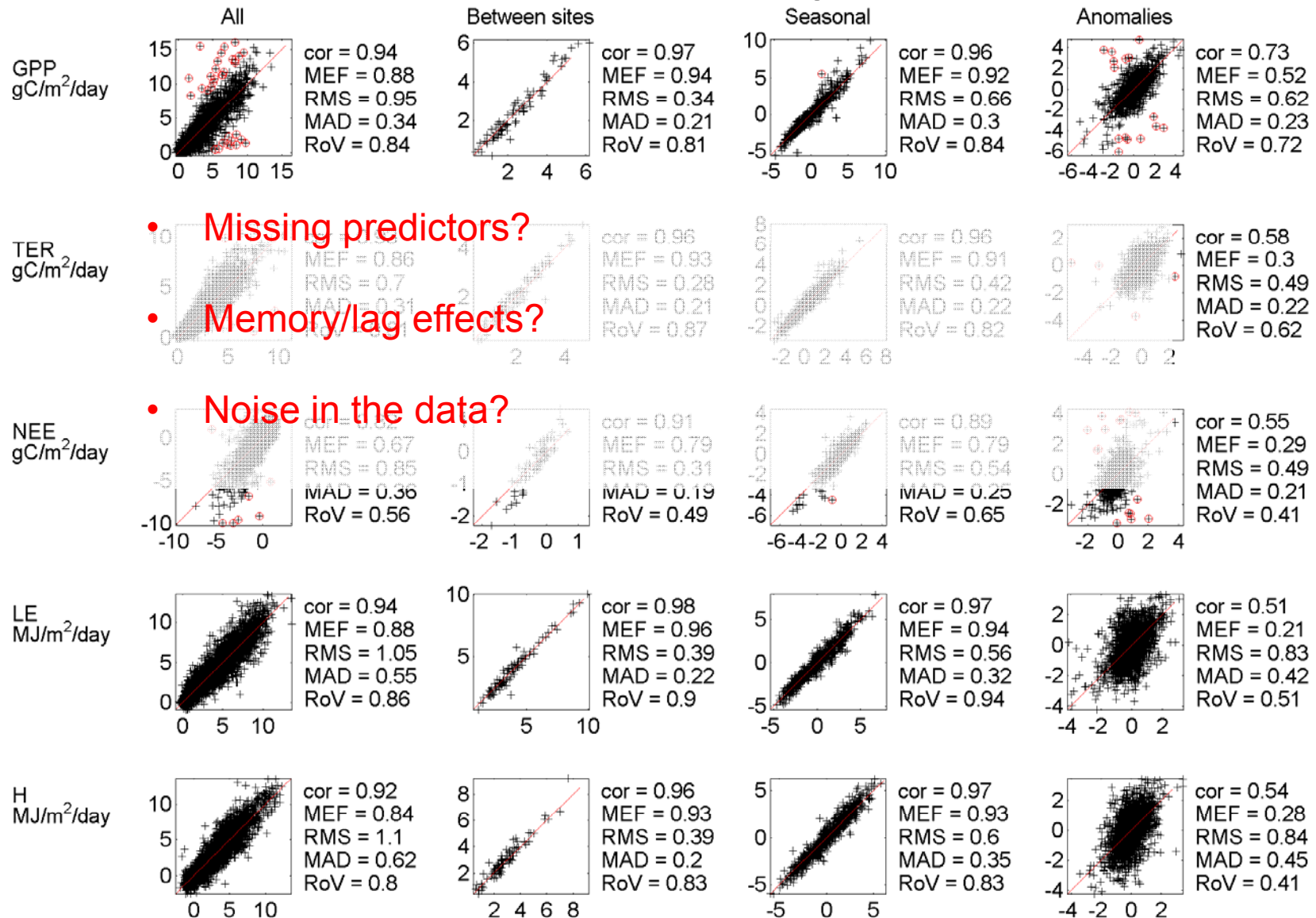
Upscaling gross primary productivity and evapotranspiration from 1 km to global scales with a coupled process model that is driven by MODIS Land and Atmosphere products Youngryel Ryu^{1*}, Dennis D. Baldocchi¹, Hideki Kobayashi¹, Catharine van Ingen², Jie Li³, T. Andy Black⁴, Jason Beringer⁵, Eva van Gorsel⁶, Alexander Knohl⁷, Beverly E. Law⁸, Andrew D. Richardson⁹, Olivier Roupsard¹⁰

Challenge and opportunities 1:

Interannual variability and lag effects

Cross-validation across time-scales

shows: room for improvement



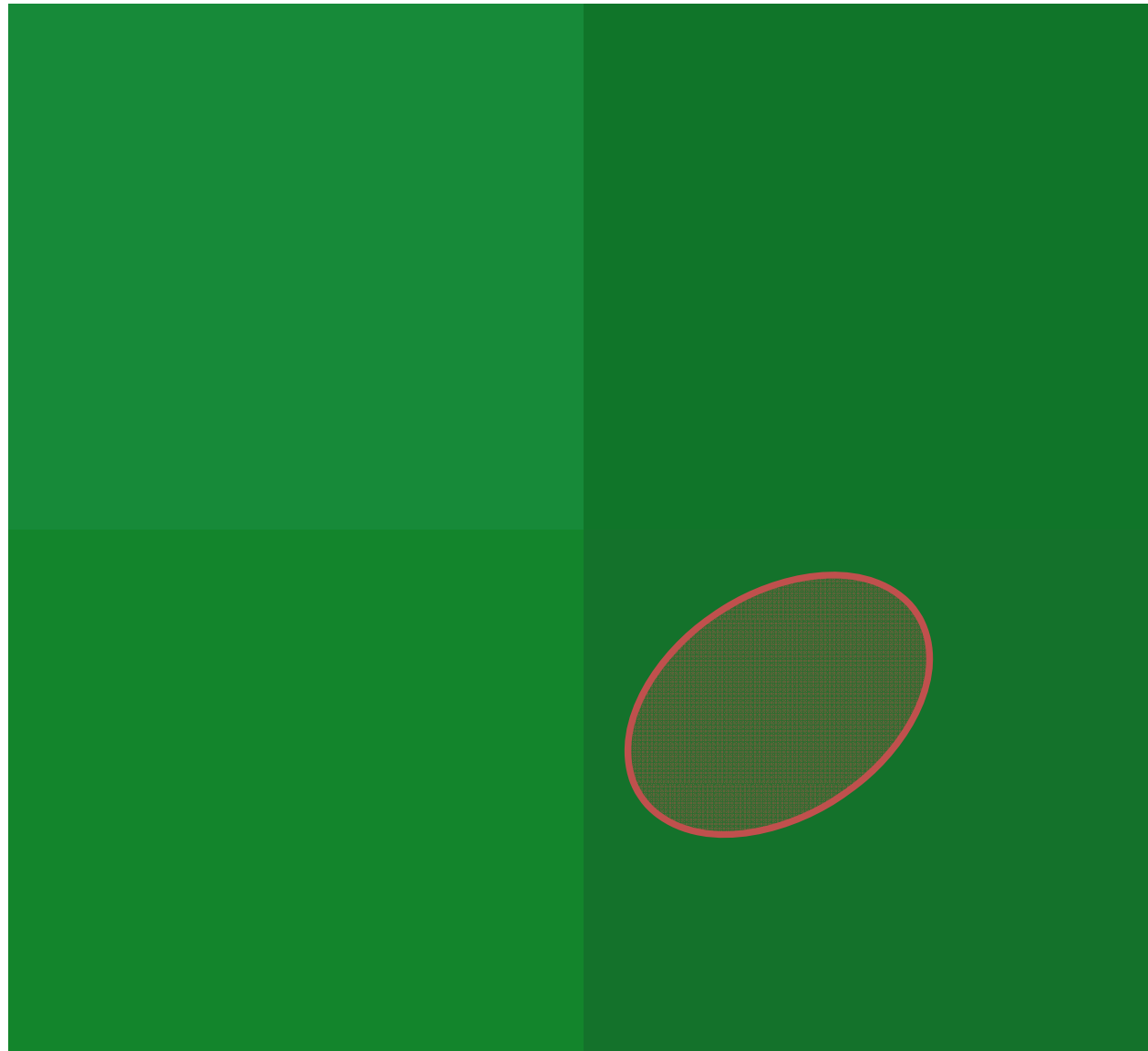
Challenge and opportunities 2: Local heterogeneity – matching pixel and footprint

Spatial heterogeneity...

Aerial photo

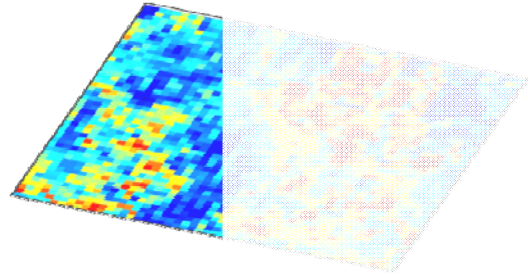
Landsat

MODIS



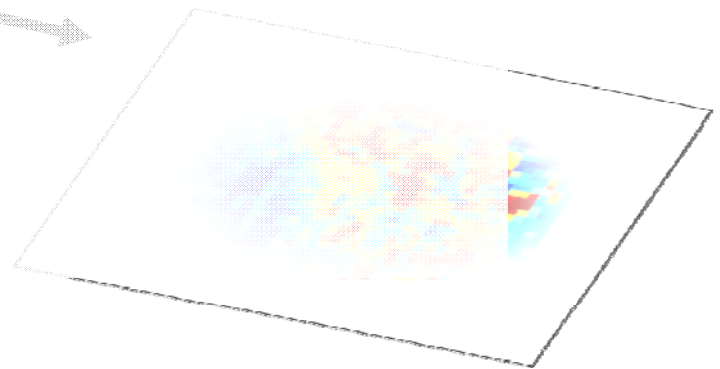
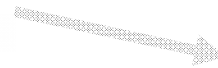
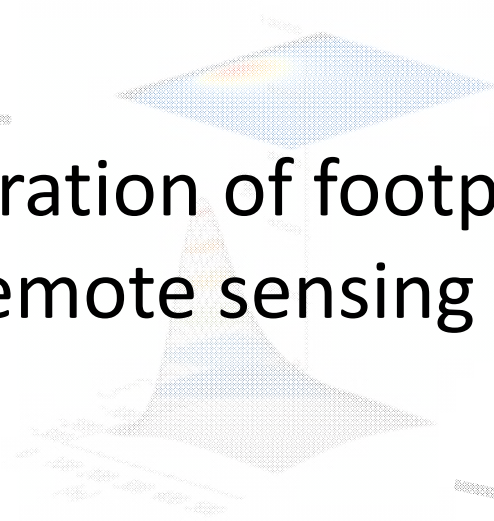
1 km

matching pixel and footprint



+

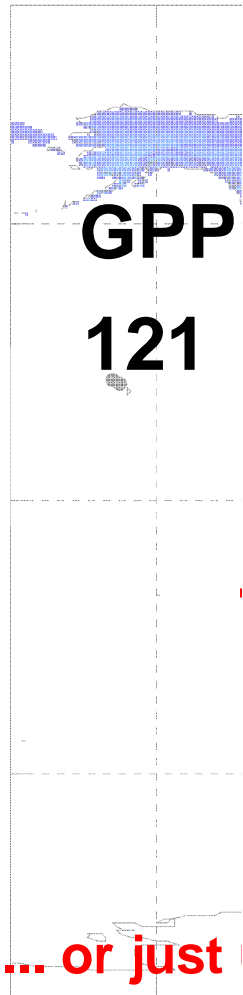
Integration of footprint and high-res remote sensing analysis !



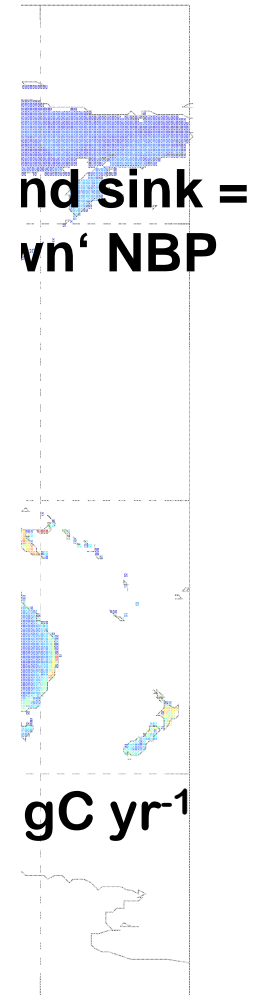
Challenge and opportunities 3:

Closing the global balance

Challenge: closing the global balance



1. What can we do now given the available data?
2. What can we design in the future?



Conclusions

- FLUXNET from-point-to-globe is feasible!
- Eddy covariance sites offer a unique set of measurements at ecosystem scale that includes carbon, water, energy and other GHGs fluxes and meteo data including all the radiation components
- FLUXNET is a network of networks, where all the sites involved provide and share data on the basis of PIs decisions
- Large efforts are ongoing to open the access of these data to the whole scientific community and already many sites made their measurements available
- All these data are standardized and there are activities ongoing to better quantify the uncertainty
- Young product, many improvements possible:
 - Include historical/memory effects for NEE patterns
 - Increase resolution (time and space)
- Visit www.fluxdata.org
 - If you are a PI, you can decide to share more openly your data or submit new versions
 - If you are a potential user you will find all the relevant information about data access and data policy

New collection plan, how to contribute

Deadline for new data submission passed and we are preparing the processing. **Last chance to participate is submitting the data before the end of the month.**

The objective is to have the new data collection ready this year, possibly before summer.

Fluxes and meteo data submission:

Ameriflux sites and sites in US in general: Tom Boden

Canadian sites: CCP database

European sites and sites managed by EU institutions: Dario Papale

African and Russian sites: Dario Papale

All others sites: Bob Cook

BADM and Metadata

All sites directly to fluxdata.org

Fluxes, meteo, BADM and metadata processing

All sites will be processed by the fluxdata.org team between Europe and US