



# FluxLetter

The Newsletter of FLUXNET

Vol. 1 No. 1 February, 2008

## Highlight FLUXNET site Tumbarumba

*An outdoor laboratory to study the interaction between the terrestrial biosphere and the atmosphere*  
by Eva van Gorsel

Tumbarumba flux station is located in south eastern New South Wales, Australia. Tumbarumba is one of the southern hemisphere sites with long flux records since 2000 and it is one of only two sites situated in temperate open Eucalypt forest. Our group is active in making various measurements and organising intensive measurement campaigns to understand the exchanges of energy, carbon dioxide and trace gases. Measurements of Volatile Organic Compound (VOC) concentrations and fluxes, as well as long-term aerosol measurements, all contribute to a comprehensive data set which make Tumbarumba Fluxnet site special.

The site is located in moderately complex topography. It is therefore important to know all the terms contributing to Net Ecosystem Exchange and ideally to have independent estimates as well. Hence we have not only standard flux measurements (eddy flux and CO<sub>2</sub> concentration profile to derive the change in storage as well as the measurements of all the necessary meteorological variables) but we also:

1) Set up a 50 × 50 × 6 m<sup>3</sup> control volume to assess the full mass balance of CO<sub>2</sub> i.e. to determine the contribution of horizontal and vertical advection

to net ecosystem exchange. This gives us a good idea of the size of the advective terms and their dynamics; <sup>[1]</sup> and helped us to



*Instrumentation on top of the 70 m flux tower*

develop an algorithm to filter nighttime data to calculate respiration <sup>[2]</sup>.

2) Use chambers placed on soil and plant components to measure carbon fluxes as inputs and outputs to the ecosystem and measure day- and nighttime fluxes in special campaigns in all seasons. Changes in carbon pools are assessed.

These measurements are used to constrain comprehensive ecosystem models<sup>[3]</sup> and to assess SVAT model predictions, resulting in the development of a new sub-model to calculate the

change in heat stored in the biomass, a significant component of the hourly energy budget at this site<sup>[4]</sup>.

We have good information on LAI from hemispheric photography but also of forest structure assessed with Echidna<sup>TM</sup> <sup>[5]</sup>, a ground based laser that scans a full hemisphere from a point on the canopy floor and provides output variables related to stem and foliage densities that may be used for ecological assessment, wood volume estimates and in forest growth models.

Dispersion models and hence footprint models need detailed information on the vertical variability of turbulence statistics in and above the canopy and how they vary with stability. We have simultaneously measured turbulence at 7 levels in the forest canopy for a time period of 10 days. To get a better picture of drainage flow characteristics we moved all instruments below the canopy where we also set up a high resolution temperature and CO<sub>2</sub> profile.

A large international campaign was organised to study the characteristics and dynamics of atmospheric ions, aerosol particles, and their precursors. Measurements were carried out to assess the forest's ability to produce new aerosol particles.

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## Tumbarumba...An outdoor laboratory

FLUXNET SITE cont. from page 1

The hygroscopic and chemical properties of these particles were investigated and the total concentration of ultrafine aerosol particles was measured. Furthermore, measurements of ambient concentrations and fluxes of volatile organic compounds (VOC), precursors to forest aerosols, were made from leaf level to forest stand. Measurements of SO<sub>2</sub>, NO<sub>x</sub>/NO<sub>y</sub>, and O<sub>3</sub> were carried out, too, as well as the concentrations of several trace gases. Combining these with the measurements of VOC will give an estimate of the concentration of sulphuric acid, an important precursor to new aerosol formation. To test radio-

activity as a source of high ion concentration, concentrations of radon and external radiation were measured.<sup>[5]</sup>

There are many things that make Tumbarumba a special place to work and we certainly won't fall short of scientific questions we would like to address. This is now even more pertinent, as the forest that we love may soon be logged. This is sad, but admittedly also exciting as it opens the door for other scientific questions to be answered.

For further information see:

<http://www.dar.csiro.au/lai/ozflux/monitoringsites/tumbarumba/index.html>

### Literature

- [1] Leuning, et al. 2007. Horizontal and vertical advection of CO<sub>2</sub> beneath a forest canopy. submitted to *Boundary-Layer Meteorology*.
- [2] van Gorsel, et al. 2007. Nocturnal carbon efflux: reconciliation of eddy covariance and chamber measurements using an alternative to the u<sup>2</sup>-threshold filtering technique. *Tellus*, 59B, 397–403
- [3] Kirschbaum, et al. 2007. Modelling net ecosystem carbon and water exchange of a temperate *Eucalyptus delegatensis* forest using multiple constraints. *Agric.For.Meteorol.* 145, 48-68.
- [4] Haverd, et al. 2007. Air and biomass heat storage fluxes in a forest canopy: Calculation within a soil vegetation atmosphere transfer model. *Agric.For.Meteorol.* 129, 151– 173.
- [5] Jupp, et al. 2007. Estimating forest LAI profiles and structural parameters using a ground based laser called "Echidna®". *Tree Physiology*, special issue.
- [6] Suni, et al. 2007. Formation and characteristics of ions and charged aerosol particles in a native Australian Eucalypt forest. *Atmos. Chem. Phys. Discuss.*, 7, 10343-10369

"There are many things that make Tumbarumba a special place to work and we certainly won't fall short of scientific questions we would like to address"

### team

Helen Cleugh, Vanessa Haverd, Dale Hughes, Heather Keith, Mark Kitchen, Ray Leuning, Tanja Suni, Eva van Gorsel, Steve Zegelin all working Canberra (CSIRO and Australian National University), except Tanja who went back to continue her research at the University of Helsinki in Finland.



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## Introducing FLUXNET Newsletter

*Dennis Baldocchi*

Welcome to the new FLUXNET Newsletter. Our intent is to produce a lively newsletter, on a quarterly basis, that will serve the community and bring new ways to communicate and interact, in addition the FLUXNET list-server and website. In this and future newsletters we will highlight individual field sites where exciting and multi-faceted research is occurring, we will provide a profile on a young scientist (graduate student/postdoc or junior scientist within 5 years of her/his Ph.D.), announce recent papers, and serve as a forum to discuss methodological and measurement issues, new directions of research and policy and science outcomes through the use of our data. In

this issue, we highlight the Tumbarumba site in Australia and profile Petra Kroon, a graduate student from the Netherlands who is working on carbon dioxide and methane exchange. We also provide an update on the new synthesis database that was produced for the 2007 LaThuile workshop. The community has a new and unprecedented dataset of over 900 site years of data from over 200 field sites ready for analysis and synthesis, that is expected to push us to the next stage towards understanding and predicting the 'breathing of the biosphere'.

Since this is a community newsletter, we strongly encourage and welcome contributions and suggestions from FLUXNET

participants and members. Suggestions for potential topics and contributions in the future could include: 1) use of our data for model development and parameterization, 2) the pros and cons of land-use change on mitigating greenhouse warming, 3) use of video cameras to monitor phenology and 4) access and sharing of data to the wider scientific community, 5) the role of scientists in policy making.

This newsletter is an outgrowth of new support of the FLUXNET project, through the National Science Foundation's Research Coordinated Networks program, which supports a postdoctoral scientist, Dr. Rodrigo Vargas, who will serve as editor and will interact with

the community on timely data submission, data sharing, data synthesis and targeted workshops.

The final point of business is the name of this newsletter. In this spirit of soliciting community involvement, we polled the Young Scientist forum to name the newsletter. Several suggestions were submitted, a vote followed and the winner is: **FluxLetter**.

We look forward to your participation, contributions and scientific developments in 2008.

Regards

*Dennis Baldocchi*

## News from the FLUXNET office

In October 2007, researchers met in Oak Ridge, Tennessee, USA for a FLUXNET workshop to discuss approaches for data and information management strategies for flux and related data. The goal of the meeting was to begin discussions on some standards (required flux parameters, standard names and units, common file formats, required ancillary data) with the aim to create a uniform/common database approach worldwide where improvements /tools made by one regional network can be readily applied to the others. To do this requires that each regional network follow a common approach and works in ways to create an interoperable

cluster of regional networks that will enable global synthesis of flux information.

Future challenges include designing and implementing the infrastructure for a global database, coordinating and synchronizing data management and processing across regional networks, standardizing and enhancing data quality analysis, and implementing proper security protocols. These requirements will define the structure and components of future data management systems that will help the scientific community to undertake synthesis studies, testing of hypotheses or model predictions, and for development of new global models. The main

topic discussed during the workshop was development of a common data and information management approach to address these challenges.

The FLUXNET community has been a leading example of data acquisition and sharing for over 13 years and has built trust within the scientific community. Currently, the data management team is including new technologies and working across disciplines. An example is the involvement of computer scientists from the Berkeley Water Center, University of Virginia, and Microsoft in developing an online analytical processing-based (OLAP) system to summarize the flux datasets from the

AmeriFlux regional network and the La Thuile synthesis dataset. This approach provides an arrangement of the data into multi-dimensional arrays, called data cubes, to allow fast analysis. The benefit of data cubes is a near instantaneous analysis of large datasets that provides useful information for selection of variables, sites or data summaries.

View full workshop report::

Vargas R, Cook R, Agarwal D, Boden T, Papale D, van Ingen C, Yang B, Baldocchi DD.(2007) The Future of the Worldwide Flux Tower Databases. Mini-workshop report.

[www.fluxnet.ornl.gov/fluxnet/Other/Fluxnet\\_workshop\\_ORNL\\_2007v5.pdf](http://www.fluxnet.ornl.gov/fluxnet/Other/Fluxnet_workshop_ORNL_2007v5.pdf)

## Highlight Graduate Student

Petra Kroon

When Rodrigo Vargas asked me a few weeks ago to contribute to the section “student of the month” of the FLUXNET newsletter, I was a little bit surprised that I should write my own student of the month column. However, it is a very good initiative to introduce PhD-students in our field. Therefore, it is a pleasure to introduce myself, my name is Petra Kroon and I studied Applied Physics at the Technical University of Delft in the Netherlands. My master projects were focused on turbulence topics, like the closure of the surface energy balance and the turbulent energy spectrum during stable atmospheric conditions. I started my PhD-project, in narrow collaboration with the Technical University of Delft, at ECN in the Netherlands in 2005.

The research project I am working on is again related to atmospheric turbulence. The main goal is to determine the exchange of  $\text{CH}_4$  and  $\text{N}_2\text{O}$  from a managed peat land site in the Netherlands. I operate together with my ECN colleagues an eddy covariance (EC) system consisting of a quantum cascade laser and a sonic anemometer. During the first year of my PhD, we tested the suitability of a quantum cascade laser to perform EC measurements of  $\text{CH}_4$  and  $\text{N}_2\text{O}$ . The results are recently published (Kroon et al., BG, Vol. 4, 715-728, 2007). At the moment, I am working on several projects to quantify the quality of our EC measurements. With my colleagues from Delft University, I use LES (Large Eddy Simulations) to check the goodness of one

point measurements and LDA (Laser Doppler Anemometer) measurements to investigate the small scales during stable atmospheric conditions. We also perform spectral analyses to validate different filtering techniques. I hope to show you some results at the Workshop on EC measurement of  $\text{CH}_4$  and  $\text{N}_2\text{O}$  in Finland next April!! ([www.workshopEC2008.org](http://www.workshopEC2008.org))

“During the first year of my PhD, we tested the suitability of a quantum cascade laser to perform EC measurements of  $\text{CH}_4$  and  $\text{N}_2\text{O}$ ”

Selected publication:

*P.S. Kroon, A. Hensen, H.J.J. Jonker, M.S. Zahniser, W.H. van 't Veen and A.T. Vermeulen. (2007) Suitability of quantum cascade laser spectroscopy for  $\text{CH}_4$  and  $\text{N}_2\text{O}$  eddy covariance flux measurements, Biogeosciences, 4: 715-728*



Petra Kroon



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## FLUXNET Synthesis Dataset Collaboration Infrastructure

*Deb Agarwal, Marty Humphrey, Catharine van Ingen, Norm Beekwilder, Monte Goode, Keith Jackson, Matt Rodriguez, and Robin Weber*

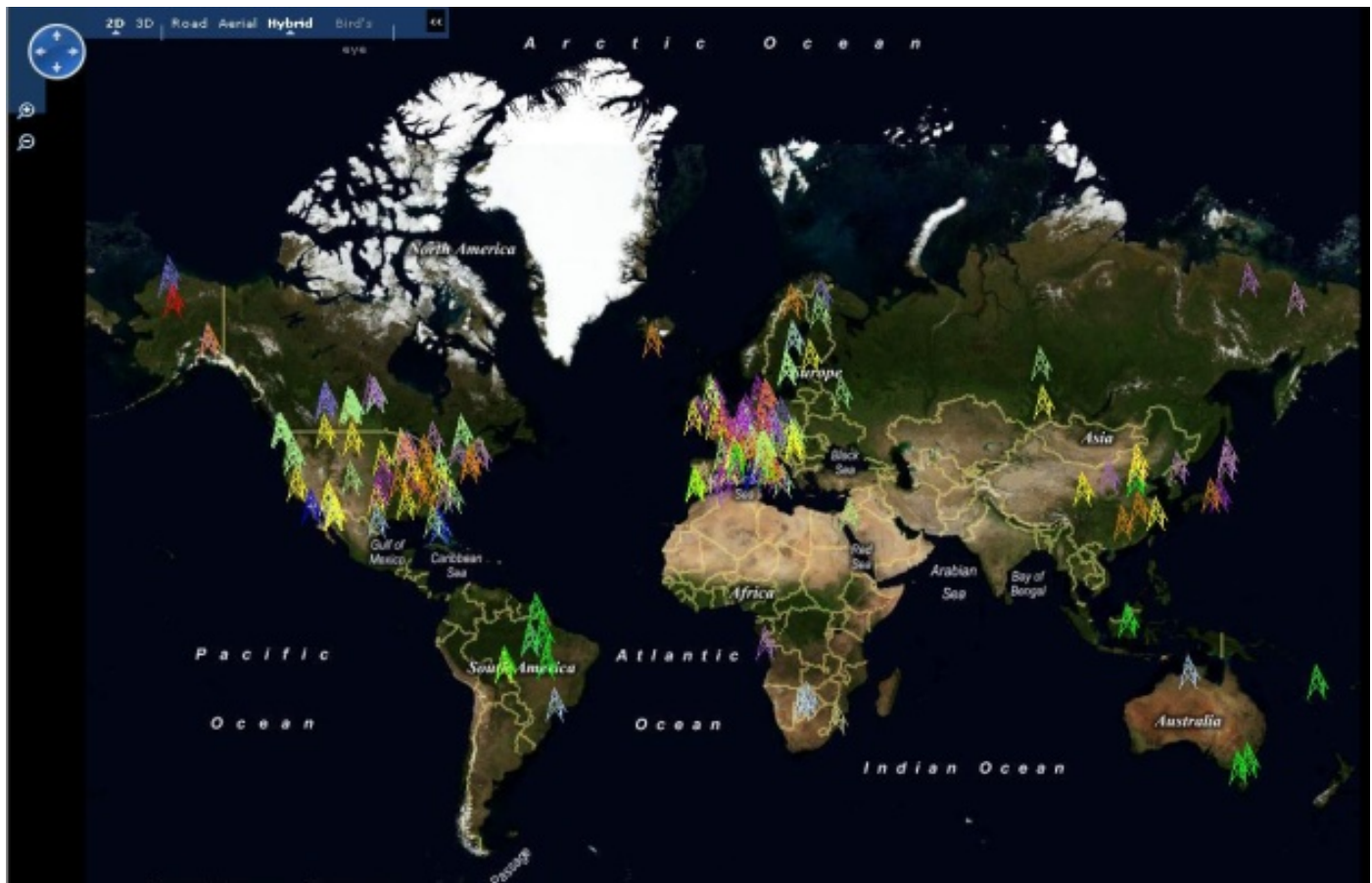
The Fluxnet synthesis dataset originally compiled for the La Thuile workshop contained approximately 600 site years. Since the workshop, several additional site years have been added and the dataset now contains over 920 site years from over 240 sites. A data refresh update is expected to increase those numbers in the next few months.

The ancillary data describing the sites continues to evolve as well. There are on the order of 120 site contacts and 60 proposals have been approved to use the data. These proposals involve around 120 researchers. The size and complexity of the dataset and collaboration has led to a new approach to providing access to the data and collabora-

tion support and the support team attended the workshop and worked closely with the attendees and the Fluxnet project office to define the requirements for the support infrastructure.

As a result of this effort, a new web site (<http://www.fluxdata.org>) has been created to provide access to the

Fluxnet synthesis dataset. This new web site is based on a scientific data server which enables browsing of the data on-line, data download, and version tracking. We leverage database and data analysis tools such as OLAP data cubes and web reports to enable browser and Excel pivot table access to the data. The data cubes pro-



Above: World distribution of FLUXNET participating sites (See web site <http://www.fluxdata.org>)

# FLUXNET Synthesis Dataset

FLUXNET Synthesis cont. from page 5

vide organization and aggregation of data along dimensions such as time to allow easy retrieval of daily, monthly, and yearly aggregated values. In addition, we have leveraged available collaboration technology (SharePoint) to provide web pages describing the dataset, provide proposer and site PI data access, track data ver-

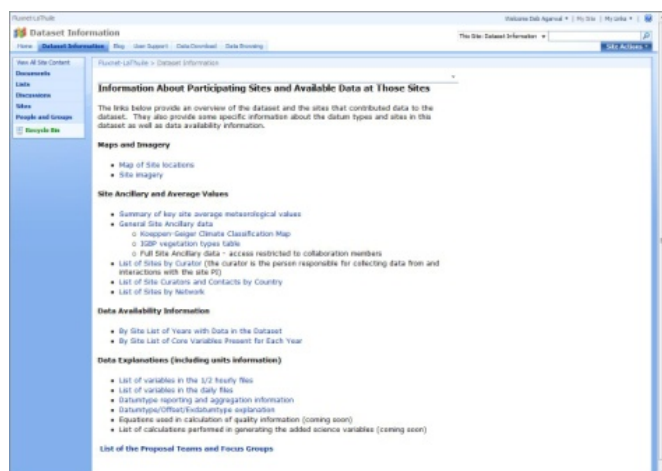
sions and updates, notify users of data updates, and enable support for contact between site PIs and researchers hoping to use their data.

The Fluxdata web site makes available extensive information about the dataset most of which is available under the "Dataset Information" tab. Here you will find interactive site maps, basic

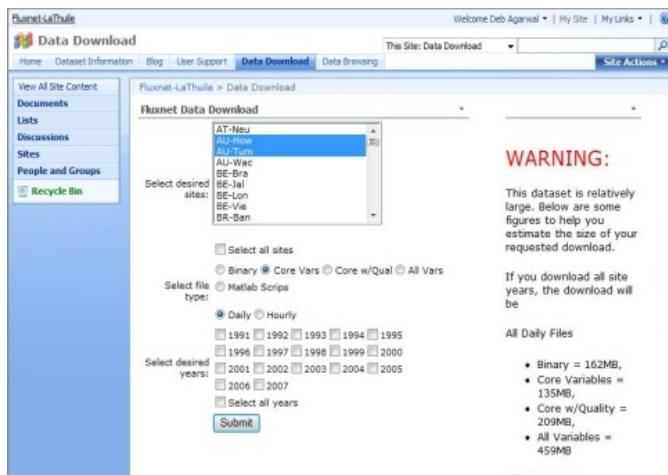
site information, average values, and data availability information as well as descriptions and explanations of the dataset variables and data levels. These reports are presented as spreadsheets for ease of download and are derived from a database containing the Fluxnet data and are refreshed periodically. A list of the approved proposals along

with the coordinator and collaborators on the proposal as well as the sites planned for use in the analysis. Links to network specific information are also provided. Currently only the AmeriFlux network has information posted but other networks are welcome to contribute information as well.

The "Blog" contains news



Above: Information about participating sites (See web site <http://www.fluxdata.org>)



Above: FLUXNET data download screen

| Site ID   | Site Name                           | Country | Precip    | Ad    | Ni    | Ri     | SWC    | Ta     | Ts     |
|-----------|-------------------------------------|---------|-----------|-------|-------|--------|--------|--------|--------|
| AT-Neu    | Austria - Neuhof/Stubai Valley      | AUT     | 1,298,370 | 4,204 | 1,787 | 31,833 | 6,796  | 6,492  |        |
| AD-Hew    | Australia - Hewitt Springs          | USA     | 1,834,263 | 6,704 | 4,636 | 18,377 | 25,852 | 30,608 |        |
| 11 AU-Tun | Australia - Tambora                 | ESP     | 1,123,368 | 5,768 | 2,824 |        | 9,390  | 19,036 |        |
| 12 AU-Wac | Australia - Waddy Creek             | TSD     | 592,306   | 3,884 | 3,075 | 2,181  | 33,828 | 12,443 | 6,439  |
| 13 BE-Bra | Belgium - Braconard (De Bie)        | BE      | 827,847   | 5,564 | 1,833 |        | 11,248 | 18,537 |        |
| 14 BE-Jai | Belgium - Jai                       | BE      | 1,633,436 | 3,233 | 1,563 | 54,236 | 7,864  | 6,431  |        |
| 15 BE-Lon | Belgium - Loncin                    | CHG     | 853,782   | 3,449 | 1,889 | 38,618 | 18,849 | 11,448 |        |
| 16 BE-Vie | Belgium - Vieters                   | BE      | 821,436   | 3,462 | 2,496 |        | 8,396  | 8,217  |        |
| 17 BR-Ban | Brazil - Estacao Bioclimat Island   | TSD     | 1,003,087 | 5,285 | 3,181 | 44,987 | 28,437 | 23,022 |        |
| 18 BR-Cas | Brazil - Estacao Forestal Itaipava  | TSD     | 1,462,338 | 5,735 | 4,888 | 38,564 | 24,242 | 25,121 |        |
| 19 BR-Fai | Brazil - Fazenda Itaipava           | GUA     | 5,874     |       |       |        | 24,717 |        |        |
| 20 BR-SJ  | Brazil - Fazenda Jari               | TSD     | 1,444,000 | 3,696 |       |        | 25,240 |        |        |
| 21 BR-Mad | Brazil - Manaus - P2-1/4            | ESP     | 3,039,463 | 5,862 | 4,181 |        | 24,418 |        |        |
| 22 BR-Sac | Brazil - Santarem-EnvF-Primary      | ESP     | 1,362,824 | 4,670 | 4,450 |        | 25,283 | 25,437 |        |
| 23 BR-Sad | Brazil - Santarem-EnvF-Phytodiv     | CHG     | 1,794,478 | 6,376 |       |        | 25,886 | 26,947 | 28,783 |
| 24 BR-Sed | Brazil - Santarem-EnvF-Logged       | ESP     | 1,844,947 | 3,483 | 3,373 | 66,207 | 25,904 |        |        |
| 25 BR-Sad | Brazil - Sao Paulo Canavieas        | TSD     | 902,807   | 6,804 | 4,263 | 82,540 | 22,893 |        |        |
| 26 BR-SDS | Bahamas - Grand Creek Site          | SAV     | 1,000     | 1,843 | 0,280 |        | 25,247 | 28,894 |        |
| 27 BR-DWH | Bahamas - Grand Creek Site          | USA     | 1,000     | 2,128 | 0,217 |        | 26,227 | 29,791 |        |
| 28 BR-Mad | Bahamas - Mead - Moore              | USA     | 268,462   | 7,246 | 4,263 | 5,273  | 22,825 | 24,427 |        |
| 29 CA-Cas | Canada - British Columbia           | ESP     | 1,289,818 | 6,130 | 3,947 | 2,181  | 15,262 | 8,874  | 6,189  |
| 30 CA-Cas | Canada - British Columbia           | ESP     | 1,888,426 | 3,673 | 1,708 | 31,343 | 9,147  | 9,847  |        |
| 31 CA-Cas | Canada - British Columbia           | ESP     | 1,453,079 | 5,576 | 3,976 | 1,788  | 23,155 | 9,986  | 9,052  |
| 32 CA-Cas | Canada - Ontario - Grandgouze River | BE      | 622,257   | 3,083 | 2,647 | 1,080  | 3,825  | 6,103  |        |
| 33 CA-Lac | Canada - Lakeshore                  | GUA     | 742,198   | 4,474 | 2,197 |        | 6,856  | 7,872  |        |
| 34 CA-Mer | Canada - Eastern Prairies - Mer     | CHG     | 784,419   | 4,482 | 2,047 |        | 6,858  | 8,000  |        |
| 35 CA-Mid | Canada - WC 1838 Sun site           | ESP     | 384,833   | 3,293 | 2,205 | 57,163 | 1,324  | 3,198  |        |
| 36 CA-Mid | Canada - WC 1838 Sun site           | ESP     | 253,317   | 3,491 | 2,046 | 34,028 | 3,876  | 6,413  |        |

Above: Excel pivot access to the summary data



## FLUXNET Synthesis Dataset

FLUXNET Synthesis cont. from page 6

items about the web site, dataset, and processing progress. The "User Support" tab provides access to a user manual describing how to use each of the areas of the site.

from their site and support for communication with proposal teams using the site.

Using the Fluxdata web site and Scientific Data Server, researchers can keep up-to-date



From left to right: M. Rodriguez, C. van Ingen, D. Papale, M. Reichstein, D. Agarwal, D. Baldocchi

Authorized members of the Fluxnet collaboration can sign-in at the web site and obtain access to a range of additional functions. The "Data Browsing" tab provides access to all available site ancillary data as well as summary annual values for the variables. It also provides direct connection to the data cube for direct browsing of the data. The "Data Download" tab enables download of site years selected by the user. Changes to site ancillary information can also be submitted via the "Ancillary Data Update" tab. Proposal coordinators are able to maintain the list of sites in use for their analysis and communicate with site PIs via e-mail. The next major functionality planned for the Fluxdata web site is to add site PI access to flux-met and ancillary data

with the latest updates to the dataset, select sites of interest for analysis, and communicate with others in the collaboration. The resulting site and capabilities we believe allow individual researchers to concentrate on science rather than data management. This site and server are brought to you by the Berkeley Water Center and University of Virginia in collaboration with the Fluxnet community and in particular Dario Papale. Funding for the site development has been provided by Microsoft Research's eScience program. This site is continually evolving and we welcome comments and input from the community.

You can reach the support team at:

[fluxdata-support@george.lbl.gov](mailto:fluxdata-support@george.lbl.gov)

*"This new web site is based on a scientific data server which enables browsing of the data on-line, data download, and version tracking."*

*"The data cubes provide organization and aggregation of data along dimensions such as time to allow easy retrieval of daily, monthly, and yearly aggregated values"*

### The name for FluxLetter



Zoltan Barcza proposed the name *FluxLetter* as a response to a poll in the FLUXNET

Young Scientist forum. Zoltan is an assistant professor at the Department of Meteorology, at Eötvös Loránd University. He earned his M.S. in Meteorology (1994), and a Ph.D. in Meteorology (2001), from Eötvös Loránd University, Budapest. His research area is the determination of the carbon budget of the Hegyhátsál region (Western Hungary) based on measurements on a tall tower. For more information visit:

<http://bzoli.web.elte.hu/index.html>

## FluxLetter The Newsletter of FLUXNET

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We plan to make the FLUXNET newsletter a powerful information, networking, and communication resource for the community. If you want to contribute to any section or propose a new one please contact the FLUXNET Office. THANKS!!