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FluxLetter

THE NEWSLETTER OF FLUXNET

ISSUE DEVOTED TO FLUXNET ENGINEERS AND TECHNICIANS

Celebrating a few of the FLUXNET network's technicians and engineers

In this issue of the FLUXLETTER we profile a few engineers and technicians who have maintained the sites for years to decades and have developed new measurement systems to augment the flux measurements. However, this special issue is dedicated to all the engineers and technicians of Fluxnet who ensure the sensors keep running and are well calibrated. Without their extensive efforts, the huge database we are using and sharing would not be possible. In this newsletter we profile a few groups and encourage the engineers and technicians to communicate with one another to build the community further.

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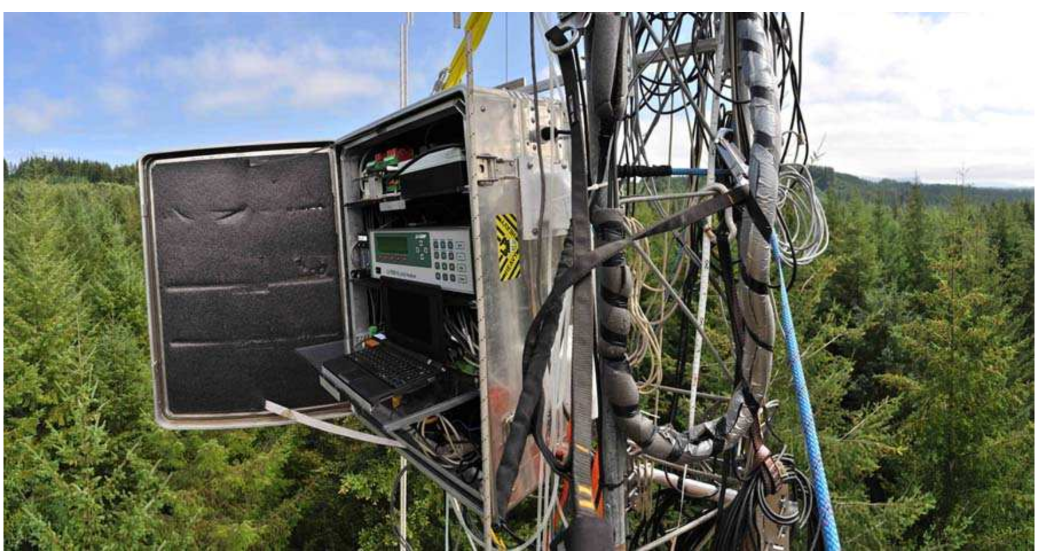
Report from the AmeriFlux Quality Assurance Group: Who We Are and What We Do

Chad Hanson and Andres Schmidt

The AmeriFlux QA/QC group was created to minimize uncertainty in flux measurements. The QA group consists of Dr. Bev Law, our lab manager, Chad Hanson, and two post-docs (Dr. Andres Schmidt and Dr. James Kathilankal) responsible for the comparisons of the roving systems measurements with those of the towers. A large portion of AmeriFlux QA/QC group efforts are spent conducting site inter-comparisons with our two portable eddy covariance systems and processing and analyzing the data generated. The group also provides secondary standards and reference sensors (e.g. lab quality PPFD sensors) to AmeriFlux sites to help improve the cohesiveness of network data. As new sen-



Mary's River Fir Site, Mary's River, Oregon, USA at 35 m elevation.

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sors become available, we conduct beta tests to evaluate performance in a variety of field conditions. We have been actively working with beta and prototype sensors from several manufacturers as new technology emerges. This helps us to understand and develop new methods and allows us to give important application-specific feedback to help manufacturers develop appropriate technologies for the flux community.

Chad Hanson

The QA/QC lab site visits are most useful during the growing season to measure and compare fluxes that are as pronounced as possible. The variety of ecosystems covered by the growing AmeriFlux network ranges from desert grasslands to tall forest tower sites and from flooded swampland sites in Florida to cold tundra sites in Alaska. Every site condition requires the adoption of the measurement equipment and the course of action during the preparation of the measurements and also needs to be accounted for during the analyses of the EC data.

The planning and execution of every site visit is also a logistical challenge with lots of work behind the scenes. This comprises the alignment of tight schedules, previous gold-file comparisons to assess data processing routines, travelling, logistical issues that are associated with maintaining and calibrating, and transportation and shipping of complete eddy covariance systems and supplementary material, such as calibration gas cylinders. This allows about 6 site visits per person/system per year, each taking about 10 days to ensure a sufficient size of the dataset with a range of environmental conditions for a robust comparison and evaluation. Our modular system and a group of dedicated people in the QA/QC lab allows quick and effective responses to even major problems, such as repairs of complex parts of the roving system during measurements thousands of miles away from the lab.

The roving system, at the heart of our work, has improved over time and is constantly equipped with new instruments and adapted to requirements of state-of-the-art eddy covariance measurements, as well as the measurements of other important meteorological parameters. During the 2010 season, for instance, the set of infrared gas analyzers has been enhanced by the new open/closed path LI-7200, which reduces the challenges of running a closed path analyzer in a portable system. Also, the radiation sensors were updated by adding the sunshine pyranometer SPN1 for measuring diffuse radiation. Since the last major revision in 2007, we have enjoyed a 100% success rate for site visits.

The AmeriFlux QA/QC lab group always aims for the highest data quality possible. For this purpose, the measurement devices are calibrated before and during the comparison measurements, strictly following standardized procedures that can be found in the guidelines on the

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AmeriFlux website (http://public.ornl.gov/ameriflux/sop.shtml).

After the site visit the data analysis is the next important step. At this point, we would like to gratefully acknowledge the help of the principle investigators and their coworkers, as we depend on the submission of their results to compare our measurements and to finish the project successfully. A detailed report covering the comparison of all available measured variables is generated. Although the AmeriFlux QA/QC lab goal is to standardize flux measurements and analyses to make the data comparable over the various ecosystems and years, flux measurements and the associated analyses are still a subject of active scientific progress. Therefore, the comparison is not considered a control procedure but a service that, in case of disagreements, focuses on the initiation of a scientific discussion between the QA/QC lab and the PIs. We aim to solve potential problems and to promote the development of EC measurements of the highest quality in the AmeriFlux network.

Andres Schmidt

One problem issue that is worth mentioning is PAR measurements. This is an important measurement that can have a large influence on results of synthesis activities. Like many of the theoretically simple measurements, we find that many sites have unacceptably large errors in PAR. Lack of regular calibration is the most frequent cause. This is unfortunate because the most common and affordable sensors absolutely require annual calibration, and even then they are usually specified as 5% sensors. Some of you may have experience with individual sensors that have been stable for years, however, inconsistent and unpredictable drift is common, and you cannot be sure of your sensor without calibrating.

In order to facilitate PAR calibration the QA/QC group maintains ~ 40 reference PAR sensors that we make available to AmeriFlux sites every year for use in short term side by side field calibrations. We calibrate our sensors to a NIST traceable spectral irradiance lamp in an LI-1800-02 calibration bench in house. As we developed our reference sensor program we have discovered important differences between factory calibration methods and spectral performance of different sensors. While these differences are interesting and important, the vast majority of error in network PAR measurements would be eliminated by regular calibrations of any of the sensors, regardless of manufacturer.

In addition to PAR sensors the QA/QC group maintains 4 reference temperature sensors using a NIST gallium cell for a triple point calibration. We produce secondary CO_2 standards with an uncertainty of ±0.17 ppm from our set of 5 WMO standards. The QA/QC lab secondary standards are available on request for sites that do not have their own.

We would like to take this opportunity to thank all of the great people in the AmeriFlux network with whom we get to work.

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Growing the FLUXNET Community: The Young Scientists Network

Sebastian Wolf, Laurie Koteen, Matthias J. Zeeman

The time devoted to training for a career in science is a challenging and inspiring period for all who pursue it. During that period, students and postdocs learn sophisticated measurement, modelling and data analysis techniques that are crucial for becoming a scientist. However, there are additional training and resources that may not be available within the confines of each research group or university, and which may be better-accessed through contact with the global community of scientists in a similar stage of their career. This includes the ability to discuss questions regarding research, career and funding opportunities.

The Young Scientist Network (YSN) provides a platform for information sharing within the FLUXNET community and consists of a mailing list (young-scientist@george.lbl.gov) and an interactive Website (www.fluxdata.org/YoungScientist; login required) with a forum for questions, wiki, calendar of events and a shared document section containing information on how to write research papers and important publications.

Since the update and reorganization of the YSN in summer 2009 (see October 2009 issue of FluxLetter, Vol. 2, No. 3) its membership has been continually growing (Fig. 1). By January 2011, the YSN had 216 members from 25 countries and from all regional networks (Fig. 2a). More than half of the members are Ph.D. students (55%) followed by Postdocs (30%) and M.Sc. students (9%; Fig. 2b).

In order to receive feedback from the community on how the network can be improved and on how to inspire more active involvement and interactions of the YSN members, a survey was conducted in November 2010 by the YSN organizers (SW, LK, MZ). About 25% of the members participated in the survey and following are the main results:

- Word of mouth from colleagues is the main 'point of entry' to the YSN (40%), followed by visitation to the FLUXNET website, mailing list and supervisors.
- The mailing list is the main component used by members of the YSN.
- Job postings via the mailing list are very helpful and some of the respondents indicated that they had found their current position through YSN postings. Redundancies of job postings with other mailing list are frequent for members that are well networked already (many Postdocs), but not for the majority of the YSN members.
- Awareness regarding the interactive website is limited and needs to be improved. Only 58% of the community have registered for an account to the website so far.
- Social meetings (such as at AGU and EGU) are considered useful but have been used

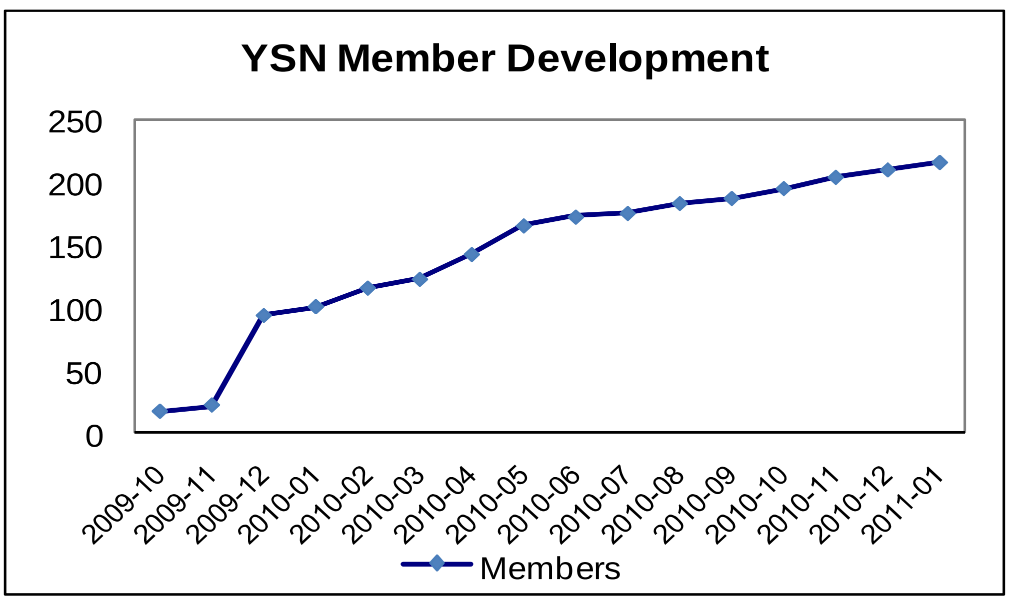

Figure 1: Growth of the Young Scientist Network since it began in October 2009.

Growing the FLUXNET Community: The Young Scientists Network

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only to a very limited extent so far.

- Only 13% of the respondents had actively contributed to the YSN to date (*i.e.* sending emails to the mailing list or uploading documents to the website) but many of the respondents (76%) indicated that they would like to contribute more actively to the YSN in the future.
- The organizers should keep the YSN going, try to initiate discussions on scientific topics and share information about recent publications of relevance to the community.

(Note: detailed results of the survey are available at the interactive website)

The organizers have discussed the survey results in a meeting at the recent AGU Fall Meeting in San Francisco and are currently working to implement improvements.

Outside of organizers initiatives, the active participation of the YSN members is crucial for our community and thus we would like to encourage YSN members to become more involved by asking questions to initiate discussions, more frequent use of the website & mailing list, by informing your colleagues about relevant workshops, conferences, and publications, and by sharing your experiences regarding funding and career opportunities with other young scientists.

To contact the YSN organizers, please write an email to: young-scientist-owner@george.lbl.gov. Further information on the YSN can be found at the FLUXNET Website: www.fluxnet.ornl.gov

Acknowledgements

We are thankful to Deb Agarwal (LBNL Berkeley), Robert Cook (ORNL) and Rodrigo Vargas (CICESE) for their invaluable, continued support of the FLUXNET YSN.

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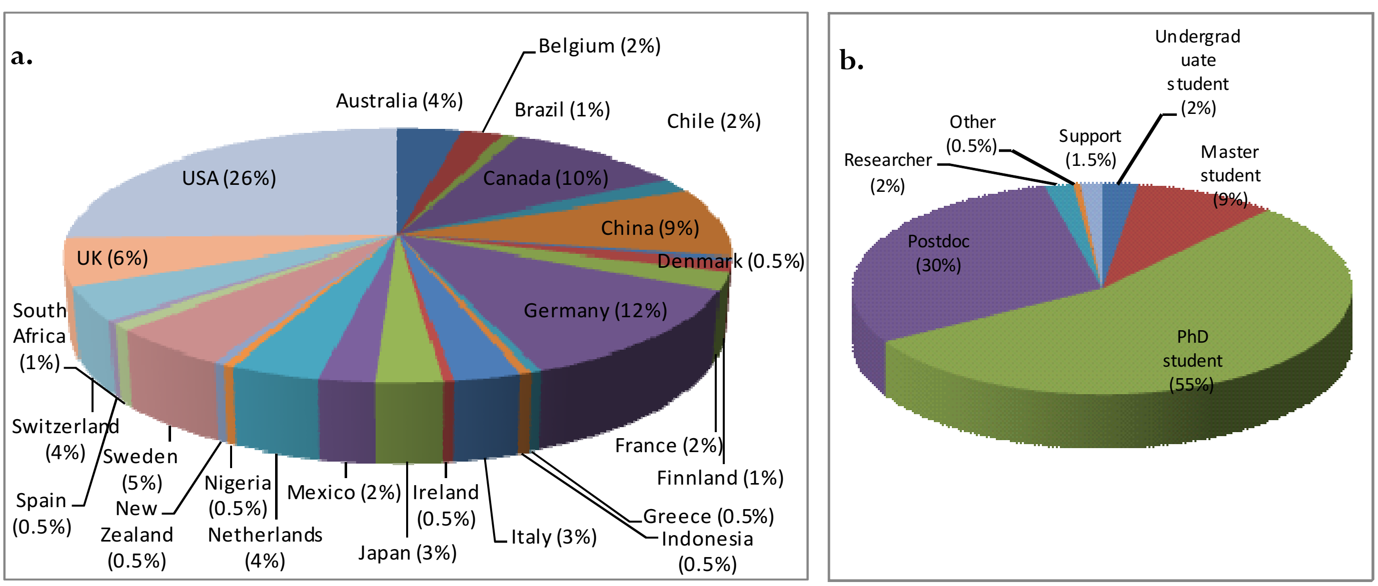

Figure 2: YSN membership by country (a) and student/work status (b)

What Do You Do?

Joseph Verfaillie

When I'm asked what I do and where I work, I start by saying that I am a technician for a research group at UC Berkeley. Some people want to know more and I explain that the research group I work for studies ecology, measuring mostly weather and the carbon cycle through measurements of carbon dioxide and methane. A few want to know even more and then I pause because it is hard to know where to start. The problem is that my day to day activities are so varied and somewhat unusual.

Likewise, when I was asked to write this article I did not know where to start. Maybe one way is to see what an average week in the life of Joe at the Biomet Lab at UC Berkeley is like.

Joe at the Vaira Ranch site in Ione, California, USA

Monday: Today I am helping to prepare a tower for deployment in our new wetland site. The tower will have two horizontal arms holding solar radiation sensors over plots we wish to measure. The arms are movable so that the sensors can be lowered, cleaned, and returned to their measurement location. I made some custom aluminum mounts to make it all work together. I am also helping with the programming of the data logger.

Also today I fixed a bug in a PHP based web page that was preventing our online field notes from displaying properly. And I checked on a gas analyzer that I sent in for repair.

Tuesday: Field trip. Our first stop was at our rice paddy site. The closed path methane sensor there had hung up in rebooting after a power outage.

The next stop was our cow pasture site where we swapped out a radiation sensor that had begun to give bad readings.

The last stop was the wetland site where we installed the new tower. We spent the afternoon carrying equipment and tools through a meter of water and trying not to drop anything in the water as we set up the tower.

Wednesday: Today I spent my time checking the data we collected from the field sites the day before, writing up field notes and doing paperwork. The data included 10Hz eddy flux data on flash memory cards and 30 minute averages and camera imagery on a USB flash drive. The field notes are a narrative of what I did and observed in the field. These will be entered in our online database with photos and data from the field trip. The other paperwork was mostly documentation of purchases in support of the lab.

Thursday: More data management. I prepared a number of images from our automated camera at the wetland site that show different wave patterns on the water surface. We think there might be a way to analyze these images to extract information about the mixing of the water column. I'm also planning for a field trip next week to our sites in an oak woodland and a grassland. Along with the usual maintenance and fieldwork, we are making plans for a root survey of the oak trees and grass understory that will likely include pits and ground penetrating radar.

Friday: Today I am upgrading a desktop with Windows 7 and office 2010; it always takes longer than you expect. I also answered some email regarding logistics for a third party project at our oak woodland site. Simultaneously, I started putting together an instrument box to hold a data logger, multiplexor and 12 transmitters to measure soil CO_2; fabricating parts from aluminum and acrylic. This box will swap out an existing one in the field that is in need of repairs.

As varied as this week has been, next week will be largely different. Because my daily tasks are so diverse, there is no way to cover them all here. So instead I'll talk about a few

What Do You Do?

Joseph Verfaillie

things I am working on now that I find new and exciting.

Open path methane: We have been using a Licor LI-7700 to measure CH_4 for almost a year now. This is still a relatively new instrument and I am still figuring out how to make it work for us. Currently we are running the Ethernet output from the LI-7700 directly into a CR1000 data logger. I still need to work on improving the program on the CR1000 and the automated washing cycle of the LI-7700 mirrors needs to be optimized. This instrument has freed us from the support equipment and power needed by other methane analyzers and let us measure methane in locations that we would otherwise not be able to measure.

Joe and his son at Tonzi Ranch, an oak savanna Fluxnet site in Ione, CA.

Using camera imagery: I think this is a very interesting field. We have been using web cameras to monitor seasonal changes in phenology for a while. More recently, we mounted three cameras looking at the oak tree canopy to monitor gap fraction and leaf area. The latest idea is to look at photos of waves on the water surface at our wetland site. I think there is a lot of potential in this technique, but one of the stumbling blocks is the availability of suitable cameras. There are lots of inexpensive "security" and web cam cameras that usually have very low resolution and a few very expensive network cameras with better resolution. These cameras are easily set up to take photos at regular intervals, but except for the very expensive ones, usually have poor image quality and typically require a computer for control and storage of the photos. For our most recent cameras, we have gone with a different solution. We are using cheap point-and-shoot digital cameras with 7 to 10 megapixel resolutions modifying the firmware and or hardware to make them controllable by a data logger or to automatically take and store images.

Online data base: We collect gigabytes and gigabytes of data and imagery and have hundreds of pieces of equipment. Keeping track of all this is a real challenge. We have begun using a MySQL database and PHP based web interface to organize data, photos, and field notes and equipment logs. This gives me a quick way to check for instrument and equipment trouble, and provides a centralized location and structure for field notes and other information.

All of this discussion of equipment and technology has missed another important element; the science. While I don't refer to myself as a scientist, I think to be a good technician, I need to understand the questions that are trying to be answered. To do this, I work closely with the other members of the lab to figure out how technology can be used to help answer their questions. All of this equipment is just equipment unless it is being used in a thoughtful way.

I have been working in this field for nearly 13 years now and I have been lucky to be part of many different projects in many different locations. The variety and number of opportunities has kept my work interesting. There are always new challenges and the equipment and techniques continue to advance.

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How I Became a FLUXNET Engineer

Alain Rocheteau

My name is Alain Rocheteau, and I am glad to have the opportunity to describe how I became an engineer within the Fluxnet network. I chose to write "How I Became a Fluxnet Engineer" because I did not get this position directly.

My career started in 1984 as a technician in electrical and air conditioning infrastructure maintenance and installation of new equipment at IRD (Institut de Recherche pour le Développement). IRD is a French research center that works with developing countries on topics such as food security, tropical disease control, biodiversity conservation, water management, and human migrations, among others. My first laboratory was the IRD center in Abidjan (Ivory Coast). I stayed there for 5 years. Following this time period, I went back to university in Paris to study electrical engineering and industrial computing. The knowledge I gained during these two years allowed me to join a research unit, and to be linked with scientific activities. Indeed, 1993 is when I consider my scientific career to have begun.

Alain Rocheteau, Drought Experiment, Puéchabon, France

My position was assistant engineer in instrumental ecophysiology at IRD center in Dakar (Senegal). During the 5 years I worked there, my work was performed at an experimental site established in a savanna ecosystem. The primary objective of the study was to understand the pattern of water use by the *Acacia tortilis* in Sahelian Africa. My main activities consisted of installing and maintaining sensors that measured several climatic parameters, sapflow in trunks and roots, and micro-diameter variation of trunks. I also began processing a part of the raw data. Technologically, I contributed to improving the thermal dissipation method for measuring sapflow by adapting this technique for its use under extreme climatic conditions and low tree density.

For my next job I went back "home" to France in 1998 and worked at the Centre d'Ecologie Fonctionnelle et Evolutive (CEFE) in Montpellier, in the south of France. This transition was facilitated by a collaboration established between researchers from my institute, IRD, and researchers from the Centre National de la Recherche Scientifique (CNRS) on the Puéchabon Holm Oak (*Quercus ilex*) study site, near Montpellier, (Flux Letter vol. 1 No. 2, May 2008). While still working on specific instrumentation for developing countries with a specific focus, I also rapidly became involved in the first automated measurements at the Puéchabon study site within the MEDEFLUX project. Specifically, I was involved in installing the eddy correlation sensors for measuring water, carbon and energy exchanges between the biosphere and the atmosphere; a new and exciting challenge for me. These measurements were coupled with sap flow and meteorological measurements; instruments which I had already gained experience with from my previous activities.

From 2003 onward, research activities in the Dynamique réactionelle des ecosystèmes, analyse spatiale et modélisation (DREAM) unit at CEFE focused on understanding the mechanisms of *Quercus ilex* response to increasing drought through two successive projects: i) a European project (Mediter-

How I Became a Fluxnet Engineer

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ranean Terrestrial Ecosystems and Increasing Drought: MIND), and ii) a French national Project (DROUGHT+ Mediterranean Ecosystems Face Increasing Droughts: Vulnerability Assessment). For the MIND project, we tested the forest response to a 30% rainfall interception both beneath the forest canopy, and under a 30% forest clearing. For this project, I fully equipped 4 stands covering 100 m^2 with automated sensors for soil water content, tree growth, sapflow, and soil and trunk temperature. For the DROUGHT project, we tested forest response to extremely long droughts by fully intercepting rainfall over a period of 6 months with a moving roof over 150 m^2. For this project, I had to create a system for automated movement of the roof when rainfall events were occurring: the system should be able to 1) start a generator when a rain event happens, 2) move the roof from the parking position to the rain exclusion position, 3) stop the generator and wait for 4 hours after the last rain event, 4) start the generator and back the roof to the parking position 5) stop the generator. We also fully equipped several ecophysiological automated measurements (soil water content, tree growth, sapflow, soil CO_2 concentration and soil temperature). There were many challenges associated with this work. One of the main challenges was to measure soil respiration continuously. This also required additional measurements of water content and temperature in upper soil layers because they have a key role in soil CO_2 efflux for our ecosystem.

The eddy flux measurements in 1998 were supposed to last for 3 months! Thirteen years later, the number of automated sensors at the site have more than doubled. Over time we have equipped the site with many more instruments, such as PRI, NDVI, diffuse PAR, and fAPAR sensors, etc., and two rainfall interception experiments have been completed. As a consequence, I am now responsible for the maintenance of 400 sensors logging semi-hourly variables. I started this collaboration with experienced researchers who made decisions about the number of replicates and the locations of sensors. Over time, I came to be in charge of maintenance, follow-up, and repair and renewal of sensors when necessary. Over the course of the project, I was faced with progressively challenging issues, such as organizing the electric alimentation (solar power and generators) for sensors and data loggers, or transitioning manual measurements of soil respiration through the conception and realization of an automated system (prototype with 12 chambers).

Alain Rocheteau, Viacha Site, France

Through this work, I have achieved enough trust from my colleagues, and self confidence in my knowledge to participate in teaching classes, supervision of student experiments, and to help in processing the raw data. And still after 13 years, new challenges continue to come up. For example, recent challenges include the installation of a network for all the data loggers with data transfer to the laboratory, and full electrification of the site. We found site electrification desirable because it means we will no longer be limited by electrical power in installing new equip-

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Alain Rocheteau

ment or systems. It will also be easier to accommodate teams of researchers initiating new experiments. Full electrification of the site entailed connecting to the public high voltage electrical grid about 1.5 km from the site, installing a transformer, and distributing the power in low voltage to the different experimentations.

My experience within the Fluxnet network and other international networks at the Puéchabon study site (CEFE Montpellier) is now very valuable for my institute, IRD, and I have been assigned to transfer this technology to developing countries through various projects. I am now requested to work in quinoa plantations in Bolivia, to evaluate savanna functioning in Benin, to establish rubber tree sap flow measurements in Thailand, to quantify environmental services and rural uses of space in Madagascar, and to understand fire prone ecosystem functioning under imposed extreme drought conditions in Tunisia. After working so many exhausting years installing sensors, I now spend my time with more serenity. My primary focus today is divided between maintaining the sensors, and learning new tools and methods to increase my understanding of how ecosystems function, and transferring this knowledge to developing countries within ongoing projects in my institute.

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Alain Rocheteau, Puéchabon, France, MIND experiment.

Wiring up Canadian Forests

Zoran Nesic

I started my work at the University of British Columbia (UBC) in 1992. This was just in time to help Professor Andy Black and his students prepare for the BOREAS project (1993/96). This was the first time I worked on environmental measurements and my first introduction to eddy covariance (EC). BOREAS was the first multi-scale field experiment that fully implemented eddy covariance measurements. There were many participants from universities in the United States, Canada and Europe, as well as government agencies (NASA, Environment Canada).

Our group was responsible for the understory flux measurements at the Southern Old Aspen site in Prince Albert National Park, Saskatchewan, Canada. My job was to design a computer-based data acquisition system capable of measuring and storing 20-Hz data, a closed-path eddy covariance system (EC) and a tram system for integrating radiation measurements over the forest understory.

It is interesting to consider how measurement challenges have evolved over time. When we began, most of the challenges in the design of the data-acquisition systems were related to the state of computer technology; the inability to multitask and limited data storage capacity. The computer hard disk size was 120 MB; barely enough to store a couple of days of high frequency data, so the system had to automatically compress the data and move it to the backup tape (160 MB) once a day. All the calculations were done on-line, and this was just as well because performing them off-line required 3-4 hours for each 24-hour data set.

Losing data was not an option, or so I was told. Thus we had two computers running the same program and collecting the data simultaneously; our cheap version of the Space Shuttle's computer-system redundancies. The main challenge with respect to the design of our closed-path system was to protect a laboratory bench-top instrument (the LI-6262 infrared gas analyzer) and ensure that it could operate outdoors, and simultaneously minimize measurement error. We found that we needed to keep the instrument close to the point of measurements to reduce the high-frequency signal attenuation that happens when the air sample travels through a long tube. We also found that temperature changes were another main cause of measurement error, so the instrument had to be kept at a constant temperature (around 38°C, ±0.2°C) regardless of the outdoor temperatures (±40°C).

Aside from the many design challenges posed by this project, there was also a need to have somebody present at the site during the entire measurement period; every day for six months. Being an urban person and believing that electrical engineers should always work in a nice office behind a desk, I gladly passed to Andy and his graduate students this job of babysitting the eddy covariance system over the six-month period, while I worked on my Master's degree in Electrical Engineering. Luckily, the UBC crew did a great job of maintaining the system and making sure that calibrations were completed regularly, gas tanks were changed when needed and that the data backup tapes were swapped on time. It seemed to me that after so much field work done and so much data collected that

Southern Old Aspen Site, Saskatchewan Canada. Photo taken by Zoran Nesic.

Wiring up Canadian Forests

Zoran Nesic

we had enough EC data and that we would be moving on. No such luck.

In the post-BOREAS stage, our next project was to establish long-term research sites both at Southern Old Aspen (as part of the BERMS program) and, closer to home, on Vancouver Island (DF49 – a Douglas fir stand near Campbell River, British Columbia, Canada).

This time the luxury of having a permanent site crew keeping the instruments happy was not an option. Neither the students nor the budgets could tolerate 365-day long field seasons. I still hoped that I could do my job mostly from an office instead of going to the site every few weeks. So, with laziness as my main motivation, I set out to design a system that could be operated from a "safe" distance. As a result, we learned quickly that knowing how well our site systems were performing meant measuring as many diagnostic parameters as possible (temperatures in boxes, pressures in the gas tanks, pump pressures and flows) and seeing them in near-real time. In order to react to and control changes at the sites, we developed the capability to operate instruments, computers and gas flows remotely. Soon, more than a third of the signals we measured and recorded were diagnostic measurements. Our long-distance phone bills became a very significant budget item, as cell phones and computer modems were used to remotely access data and control computer operation.

By the year 2000, we were running four sites continuously year-round and already had 13 site-years of flux data among them. Moreover, it became clear that the value of the data sets provided by flux sites increased if choosing the site locations across a region was coordinated with scientists undertaking similar measurements, and if the measurements were standardized. As a result, our sites became part of the AmeriFlux network. When the Canadian flux network (Fluxnet-Canada, now the Canadian Carbon Program) was created in 2002, it was built with the experience of the AmeriFlux and EuroFlux networks. Fluxnet-Canada's goal was to standardize the site setup, measurements, calibrations, data-acquisition, data-processing, data quality control and data archiving.

Our group's experience in running multiple sites and our technical expertise became very important in the first stages of the new network's life. There was a need for many technical solutions (closed-path EC designs, automated chamber systems, CO_2 concentration profile measurements), so we found ourselves redesigning our already existing systems and reproducing them for the other groups that needed them. This created a

Commuting to the Southern Old Aspen Site, Saskatchewan, Canada. Photo by Dominic Lessard.

Wiring up Canadian Forests

Zoran Nesic

unique challenge for me. Usually, the designs of the systems that I (and most of my colleagues at other universities) create, stop in what would otherwise be the prototyping stage. Budgetary and time constraints mean that every time a piece of equipment is made, whether it's a data logger box with its wiring or a fully automated chamber system, the work stops when the system becomes functional. Before we began deploying long-term flux sites, the need for a system to be serviceable for many years rarely was an issue. Most of the projects were over after only a few months. Designing systems that can be easily manufactured and replicated, therefore going beyond the prototyping phase, was also not very important; after all, we rarely made more than one system at a time. By the time we needed a second system, what we learned from the success or failure of the previous one, plus the advances in the technology would lead us to a completely different design. We watched a lot of "Red Green" shows at that time (http://www.red-green.com/), or so it appears when I look back at some of our designs.

The Fluxnet-Canada project was our opportunity to learn how to do things the right way, or at least to the best of our abilities. We wanted to design equipment that does its job well, can be easily maintained, and is simple to manufacture in our labs. Over a period of less than two years we redesigned and produced over 20 enclosures for LI-6262/7000 instruments in addition to 6 automated chamber systems. This required high quality technical staff which were usually hard to get with our project's limited research budgets. It was to our advantage that the dot-com bust made it very hard for young UBC engineers to find jobs, so we were able to recruit a few of them, and their help was crucial during this period.

Along the way, we've learned that an important aspect of long-term measurements is the ability to maintain high quality data acquisition over the entire period of time. This involves regular maintenance and sensor calibrations. To assure that the fluxes measured with different systems across a network are comparable, the standard practice is to run a portable system at each site, and evaluate the agreement between the two systems and across the network. Our group designed and ran a portable EC system (XSITE) that we used in Fluxnet-Canada to compare and standardize EC measurements across the network. The goal of XSITE measurement campaigns was not only to uncover discrepancies between site-based fluxes and the XSITE system, but also to find the sources of the discrepancies and try to eliminate them. This made XSITE system site visits longer, but led to more collaboration, learning and, ultimately, better measurements through the elimination of some common installation mistakes.

Some countries are now moving towards even better-designed long-term ecological measurement networks with a very long time horizon (10+ years) like NEON, ICOS and soon, we hope, a new Canadian network.

I am continuing my work at UBC where we are still developing new sensors, designing new systems and maintaining our eight eddy covariance sites in three different Canadian provinces. I enjoy collaborating with and learning from different scientists at UBC and other Canadian universities. I am also a member of NEON's Fundamental Instrument Working Group which lets me keep an eye on the progress being made in one of the largest environmental monitoring networks today.

Contrary to my initial desires to convert this job into a "normal" engineering job with a desk and a chair, I have learned to appreciate an occasional commute to an "office" using a snowmobile or an ATV.

I would like to acknowledge the effort and creativity of all the past and present Biomet-UBC technicians and engineers that have contributed to the success that we have had: Rick Ketler, Dominic Lessard, Alexander Kozma, Andrew Hum, Andrew Sauter, Chad Brown, Shawn O'Neill, David Moss, Claudio D'onofrio and Stephanie Thompson. Our jobs would be much harder without help from the site-contractors. They are also part of the technical support crew and they have saved us from making too many field visits: David Wieder, Greg Neufeld, Werner Bauer, Dwaine Young, and Paula Pacholek.

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Reminder…

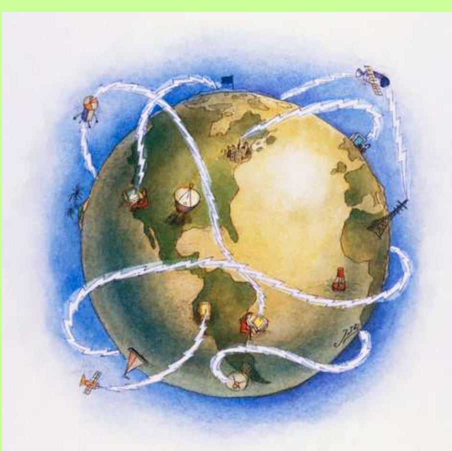
FLUXNET and Remote Sensing Open Workshop: Towards Upscaling Flux Information from Towers to the Globe

June 7-9, 2011
Berkeley, California, USA

To register, visit:
http://nature.berkeley.edu/biometlab/fluxnet2011/fluxwkshp.html

Registration is limited to 150 participants. Only a few spots remain available.

Workshop registration is free.
Travel funds are no longer available.



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We hope 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!!