

# Paul C Stoy

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## Research Interests

Biosphere – atmosphere exchange of mass and energy with an emphasis on modeling long-term (inter-annual) CO<sub>2</sub> and H<sub>2</sub>O flux at the plot, regional and global scale. Collaboration with the international terrestrial carbon cycle community (FLUXNET). Quantifying biosphere-climate feedbacks. Eddy covariance, sap flow, respiration chamber and flux-gradient methodologies. Wavelet and data assimilation techniques. Information theory. Thermodynamics.

## Education

Ph. D., Duke University, 2006.

*Major:* Ecology. *Minor:* Environmental Engineering.

*Dissertation:* The interplay between the carbon and water cycles along a successional gradient in the southeastern U.S.

B.A. University of Wisconsin, 2001.

*Majors:* Botany, Zoology. *Minor:* Environmental Studies.

Comprehensive Honors. Holstrom Scholarship for Environmental Research.

*Honors thesis:* Assessing the impacts of tallgrass prairie restoration on soil carbon storage.

## Research Experience

Marie Curie Fellow. University of Edinburgh

Awarded competitive Marie Curie Fellowship from the European Union to quantify the effects of landcover change on surface temperature change in global ecosystems with a focus on the Arctic. March 2009 –

Research Associate. University of Edinburgh, Dr. Mathew Williams.

Coupled soil-plant-atmosphere-remote sensing measurements with process-based models using data assimilation techniques as part of the ABACUS (Arctic Biosphere Atmosphere Coupling at Multiple Scales) consortium. Arctic fieldwork. Cold-season CO<sub>2</sub> flux research. October 2006-March 2009.

Research Assistant. Duke University, Prof. Gabriel Katul.

Helped implement and maintain four long-term eddy covariance systems in the Duke Forest, NC. Organized a database with over 21 site-years of carbon, water, and energy flux, meteorological and ancillary environmental measurements. Coordinated data sharing. Published and presented both methodological and modeling research. 2001-2006.

Field /Laboratory Assistant. University of Bayreuth, Germany. Prof. John Tenhunen.

Installed remote field stations for measuring sap flow and micrometeorology in the Fichtelgebirge and Bavarian Alps, Germany. Developed data management protocols and analyzed data using a suite of empirical, phenomenological, and mechanistic physiological models. 2001.

Field /Laboratory Assistant. University of Wisconsin-Madison. Prof. Jonathan Foley.

Designed and completed a project to measure soil C and N along a novel prairie restoration chronosequence and other regional natural and restored prairies, showing minor effects of restoration on soil C sequestration. 1999-2000.

### **Teaching and Student Advising**

#### Phd. Supervisor:

Abdulwasey Mohammed (co-supervisor). Upscaling peatland methane emission estimates using high resolution remote sensing data. University of Edinburgh. Expected spring 2009.

#### Phd. Advisory Committee:

Andrew Cross  
Lorna Street

#### MSc. Supervisor:

Caitlin Walker. Autotrophic and heterotrophic sources of respiration in the cold season of Abisko, Sweden. School of GeoSciences. University of Edinburgh. 2008.

Course Assistant. University of Edinburgh. Gave guest lectures and taught laboratory sessions in plant physiology, ecological modeling, and biosphere-atmosphere exchange.

Teaching Assistant. Duke University Nicholas School of the Environment and Earth Sciences.

Assisted students and the professor in Watershed Hydrology, developed computer labs for teaching MATLAB and MS Excel with an emphasis on hydrologic modeling. Fall 2004 & 2005.

Teaching Assistant. Departments of Botany and Plant Pathology, UW-Madison.

Taught laboratory section for Botany/Plant Pathology Plants, Parasites, and People introductory science course for non-science majors. Emphasis on scientific method as applied to plant/ pathogen/human interactions. Spring 2000.

German Tutor. GUTS Tutorial Service, University of Wisconsin. Assisted students in basic written and spoken German. 1999-2000.

### **Publications**

#### In Review / Conditionally Accepted

Stoy PC, Williams M, Disney M, Prieto-Blanco A, Huntley B, Baxter R, Lewis P (in review) Upscaling as ecological information transfer: A simple framework with application to arctic ecosystem carbon exchange. Submitted to *Landscape Ecology*.

Hollinger D, Ollinger S, Richardson AD, Meyers T, Dail B, Martin MS, Scott N, Arkebauer TJ, Baldocchi DD, Clark K, Curtis P, Davis K, Desai A, Dragoni D, Goulden M, Gu L, Katul GG, Pallardy S, Paw U KT, Schmid H-P, Stoy PC, Suyker A, Verma S (in review) Albedo estimates for land surface models and support for a new paradigm based on foliage nitrogen concentration. Submitted to *Global Change Biology*.

Rastetter EB, Williams M, Griffin KL, Kwiatkowski BL, Tomasky G, Potosnak MJ, Stoy PC, Shaver GR, Stieglitz M, Kling GW, Hobbie JE (in review) Application of the ensemble Kalman filter to assimilate eddy covariance flux data into a model of arctic carbon exchange. Submitted to *Global Change Biology*.

Lasslop G, Reichstein M, Papale D, Richardson AD, Arneth A, Barr A, Stoy PC, Wohlfahrt G (in review) Separation of net ecosystem exchange into assimilation and respiration using a light response curve approach: critical issues and global evaluation. Submitted to *Global Change Biology*.

Song C, Band LE, Tague CL, Stoy PC, McCarthy HR, Katul GG, Oren R (in review) Modeling the impacts of canopy structure on energy, water and carbon fluxes through a loblolly pine stand: uniform vs. gappy canopies. Submitted to *Agricultural and Forest Meteorology*.

#### In Open Review

Stoy PC, Richardson AD, Baldocchi DD, Katul GG, Stanovick J, Mahecha MD, Reichstein M, Detto M, Law BE, Wohlfahrt G, Arriga N, Campos J, McCaughey JH, Montagnani L, Paw U KT, Sevanto S, Williams M (2009) Biosphere-atmosphere exchange of CO<sub>2</sub> in relation to climate: a cross-biome analysis across multiple time scales. *Biogeosciences Discussions* 6: 4095-4141.

Williams, M, Richardson AD, Reichstein M, Stoy PC, Peylin P, Verbeeck H, Carvalhais N, Jung M, Hollinger DY, Kattge J, Leuning R, Luo Y, Tomelleri E, Trudinger C, Wang Y-P. (2009) Improving land surface models with FLUXNET data. *Biogeosciences Discussions* 6: 2785-2835.

#### In Print / In Press

29) Daly E, Palmroth S, Stoy PC, Siqueira MBS, Oishi AC, Juang J-Y, Oren R, Porporato A, Katul GG (2009) Subsurface CO<sub>2</sub> dynamics under different atmospheric CO<sub>2</sub> and soil nitrogen conditions in a pine forest. *Biogeochemistry*, in press.

28) Mohammed A, Stoy PC, Malthus T (2009) Information preservation and change detection across spatial scales in the assessment of peatland CH<sub>4</sub> emission estimates. *The International Journal of Climate Change*, in press.

27) Novick KA, Oren R, Stoy PC, Siqueira MBS, Katul GG (2009) Nocturnal evapotranspiration in eddy covariance records from three co-located ecosystems in the southeastern U.S. Submitted to *Agricultural and Forest Meteorology*, in press.

26) Merbold L, Kutsch WL, Kolle O, Zimov SA, Corradi C, Stoy PC, Schulze E-D (2009) Artificial drainage and associated carbon fluxes (CO<sub>2</sub>/CH<sub>4</sub>) in tundra ecosystems. *Global Change Biology*, in press.

25) Lin H, Cao M, Stoy PC, Zhang Y (2009) Assessing self-organization of plant communities – A thermodynamic approach. *Ecological Modelling*, in press.

24) Novick KA, Oren R, Stoy PC, Juang J-Y, Siqueira MBS, Katul GG (2009) The relationship between reference canopy conductance and simplified hydraulic architecture. *Advances in Water Resources*, doi:10.1016/j.advwatres.2009.02.004.

23) Stoy PC, Williams M, Bell R, Street LE, Prieto-Blanco A, Spadavecchia L, van Wijk M (2009) Using information theory to determine optimum pixel size and shape for ecological studies: Aggregating land surface characteristics in arctic ecosystems. *Ecosystems*, doi: 10.1007/s10021-009-9243-7.

22) Drake JE, Stoy PC, Jackson RB, DeLucia EH (2008) Fine root respiration in a loblolly pine (*Pinus taeda*) forest: Proximal limits, temperature dependence, and dynamic coupling with canopy photosynthesis. *Plant, Cell and Environment* 31: 1663-1672.

21) Spadavecchia L, Williams M, Bell R, Stoy PC, Huntley B, van Wijk M (2008) Topographic controls on the leaf area index and plant functional type of a Fennoscandian tundra ecosystem. *Journal of Ecology* 96, 1238–1251.

20) Oishi AC, Oren R, Stoy PC (2008) Estimating components of forest evapotranspiration: A footprint approach for scaling sap flux measurements. *Agricultural and Forest Meteorology* 148: 1719-1732.

- 19) Detto M, Katul GG, Siqueira MBS, Juang J-Y, Stoy PC (2008) The structure of turbulence near a tall forest edge: The backward facing step flow analogy. *Ecological Applications* 18: 1420-1435.
- 18) Juang J-Y, Katul GG, Siqueira MBS, Stoy PC, McCarthy HR (2008) Hierarchy of Eulerian closure models for scalar transfer inside forested canopies. *Boundary-Layer Meteorology* 128: 1-32.
- 17) Stoy PC, Katul GG, Siqueira MBS, Juang J-Y, Novick KA, McCarthy HR, Oishi AC, Oren R (2008) Role of vegetation in determining carbon sequestration along ecological succession in the southeastern United States. *Global Change Biology* 14: 1409-1427.
- 16) Juang J-Y, Katul GG, Siqueira MBS, Stoy PC, Novick KA (2007) Separating the effects of albedo from eco-physiological changes on surface temperature along a successional chronosequence in the southeastern US. *Geophysical Research Letters* L21408.
- 15) Katul GG, Porporato A, Daly E, Oishi AC, Kim H-S, Stoy PC, Juang J-Y, Siqueira MBS (2007) On the spectrum of soil moisture in a shallow-rooted uniform pine forest: from hourly to inter-annual scales. *Water Resources Research* 43: W05428.
- 14) Stoy PC, Palmroth S, Oishi AC, Ward E, Siqueira MBS, Juang J-Y, Novick KA, Johnsen K, Katul GG, Oren R (2007). Are ecosystem carbon inputs and outputs coupled at short time scales? A case study from adjacent pine and hardwood forests using impulse-response analysis. *Plant, Cell and Environment* 30: 700-710.
- 13) Juang J-Y, Porporato A, Stoy PC, Siqueira MBS, Oishi AC, Detto M, Kim H-S, Katul GG (2007). Hydrologic and atmospheric controls on convective precipitation events in a southeastern US mosaic landscape. *Water Resources Research* 43: W03421.
- 12) Juang J-Y, Katul GG, Porporato A, Stoy PC, Siqueira MBS, Kim H-S, Oren R (2007). Eco-hydrological controls on summertime convective rainfall triggers. *Global Change Biology* 13: 887-896.
- 11) Owen KE, Tenhunen J, Reichstein M, Wang Q, Falge E, Geyer R, Xiao X, Stoy PC, Amman C, Arain A, Aubinet M, Aurela M, Bernhofer C, Chojnicki B, Granier A, Gruenwald T, Hadley J, Heinesch B, Hollinger D, Knohl A, Kutsch W, Laurila T, Lohila A, Meyers T, Moors E, Moureaux C, Verma S, Vesala T, Vogel C (2007). Linking flux network measurements to continental scale simulations: Ecosystem gas exchange capacity along a European transect under non-water-stressed conditions. *Global Change Biology* 13: 734-760.
- 10) Yuan W, Liu S, Zhou G, Zhou G, Tieszen LL, Baldocchi D, Bernhofer C, Gholz H, Hollinger DY, Hu Y, Law BE, Stoy PC, Vesala T, other AmeriFlux collaborators (2007). Deriving a light use efficiency model from eddy covariance flux data for predicting daily gross primary production across biomes. *Agricultural and Forest Meteorology* 143: 189-207.
- 9) Stoy PC, Katul GG, Siqueira MBS, Juang J-Y, Novick KA, Oren R (2006). An evaluation of methods for partitioning eddy covariance-measured net ecosystem exchange into photosynthesis and respiration. *Agricultural and Forest Meteorology* 141: 2-18.
- 8) Stoy PC, Katul GG, Siqueira MBS, Juang J-Y, McCarthy HR, Oishi AC, Uebelherr JM, Kim H-S, Oren R (2006). Separating the effects of climate and vegetation on evapotranspiration along a successional chronosequence in the southeastern U.S. *Global Change Biology* 12: 2115-2135.
- 7) Heinsch FA, Zhao M, Running SW, Kimball JS, Nemani RR, Davis KJ, Bolstad PV, Cook BD, Desai AR, Ricciuto DM, Law BE, Oechel WC, Kwon H, Luo H, Wofsy SC, Dunn AL, Munger JW,

Baldocchi DD, Xu L, Hollinger DY, Richardson AD, Stoy PC, Siqueira MBS, Monson RK, Burns S, Flanagan LB (2006). Evaluation of remote sensing based terrestrial productivity from MODIS using regional tower eddy flux network observations. *IEEE Transactions on Geoscience and Remote Sensing* 44: 1908-1925.

6) Siqueira MBS, Katul GG, Sampson DA, Stoy PC, Juang J-Y, McCarthy HR, Oren R (2006). Multi-scale model inter-comparisons of CO<sub>2</sub> and H<sub>2</sub>O exchange in a maturing southeastern U.S. pine forest. *Global Change Biology* 12: 1189-1207.

5) Oren R, Hsieh C-I, Stoy PC, Albertson JD, McCarthy HR, Harrell P, Katul GG (2006). Estimating the uncertainty in annual net ecosystem carbon exchange: Spatial variation in turbulent fluxes and sampling errors in eddy-covariance measurements. *Global Change Biology* 12: 883-896.

4) Juang J-Y, Katul GG, Siqueira MBS, Stoy PC, Palmroth S, McCarthy HR, Kim H-S, Oren R (2006). Modeling nighttime ecosystem respiration from measured CO<sub>2</sub> concentration and air temperature profiles using inverse methods. *Journal of Geophysical Research* 111: D8, D08S05.

3) Richardson AD, Hollinger DY, Burba GG, Davis KJ, Flanagan LB, Katul GG, Munger JW, Ricciuto DM, Stoy PC, Suyker AE, Verma SB, Wofsy SC (2006). A multi-site analysis of random error in tower-based measurements of carbon and energy fluxes. *Agricultural and Forest Meteorology* 136: 1-18.

2) Stoy PC, Katul GG, Siqueira MBS, Juang J-Y, McCarthy HR, Kim H-S, Oishi AC, Oren R (2005) Variability in net ecosystem exchange from hourly to inter-annual time scales at adjacent pine and hardwood forests: a wavelet analysis. *Tree Physiology* 25: 887-902.

1) Novick KA, Stoy PC, Katul GG, Ellsworth DE, Siqueira MBS, Juang J-Y, Oren R (2004) Carbon dioxide and water vapor exchange in a warm temperate grassland. *Oecologia* 138: 259-274.

#### Book Chapters

1) Stoy PC (in press) Thermodynamic approaches to ecosystem behaviour. In: *Ecosystem Ecology: A New Synthesis* (eds. Raffaelli D, Frid C) British Ecological Society Review Series.

#### **Other Publications**

##### Published Conference Proceedings

2) Stoy PC, Williams M, Street LE, Walker C, Hartley IP, Evans J (2009) Cold-season CO<sub>2</sub> flux in subarctic tundra and birch ecosystems. In: Callaghan TV and Jonasson C (eds.) Proceedings of the ATANS (Enhanced Transnational Access To Abisko Scientific Research Station) Conference. Abisko, Sweden. In press.

1) Stoy PC, Katul GG, Siqueira MBS, Juang J-Y, McCarthy HR, Kim H-S, Oishi AC, Oren R (2004) Modeling net ecosystem exchange at multiple time scales in a pine and a hardwood forest. Pages 375-381. In: Hasenauer H and Mäkelä A (eds.) Proceedings of the International Conference on Modeling Forest Production. Department of Forest and Soil Sciences. BOKU University of Natural Resources and Applied Life Sciences, Vienna.

##### Scientific Communication

Williams M, Stoy PC, Richardson AD, Tomelleri E, Trudinger C (2008) Assimilating flux and ecosystem data into land surface models: the role of FLUXNET. In: Baldocchi DD and Vargas R (eds.) FLUXLETTER vol.1 no. 4.

Stoy PC (2008) Highlight Young Scientist. In: Baldocchi DD and Vargas R (eds.) FLUXLETTER vol.1 no. 4.

## **Presentations (\*Posters)**

### *Invited*

- Department of Land Resources and Environmental Science, Montana State University. February 2008.
- Department of Geography, Boston University. February 2008.
- Marine Biological Laboratory, Woods Hole, MA. December 2008.
- Complex Systems Research Center, University of New Hampshire. December 2008.
- Max-Planck-Institut für Biogeochemie, Jena. November 2008.
- Department of Environmental Science, Policy and Management. University of California - Berkeley. September 2008.
- Department of Geography, King's College London. May 2008.
- CNRS – Centre d'Ecologie Fonctionnelle et Evolutive, Montpellier, France. September 2007.
- INRA – Ephyse, Bordeaux, France. September 2007.
- Department of Biology, University of York (UK). August 2007.
- Potsdam Institute for Climate Impact Research, Potsdam, Germany. May 2007.
- Department of Atmospheric Sciences. Harvard University, May 2006.
- School of GeoSciences, University of Edinburgh. November 2006.
- University Program in Ecology, Duke University. September 2006.

### *Conference Presentations*

- European Geophysical Union General Assembly, Vienna, Austria. April 2009.
- ATANS (Access To Abisko Naturvetenskapliga Station) Conference, Abisko, Sweden. October 2008.
- 2007 AGU Fall Meeting, San Francisco.
- \* CarboEurope Open Science Conference on the GHG Cycle in the Northern Hemisphere, Sissi-Lassithi, Crete. November 2006.
- 91<sup>st</sup> ESA Annual Meeting, Memphis, TN. August 2006. *Honorable Mention, Billings Award for best student presentation in Physiological Ecology.*
- \* 2005 AGU Fall Meeting, San Francisco.
- 90<sup>th</sup> ESA Annual Meeting, Montreal. August 2005.
- 2005 Southeastern Evolution and Ecology Conference, Athens, GA. May 2005.
- \* 2004 AGU Fall Meeting, San Francisco.
- International Conference on Modeling Forest Production, Vienna, Austria. April 2004.
- 88<sup>th</sup> ESA Annual Meeting, Savannah, GA. August 2003.
- \* 2002 AGU Spring Meeting, Washington, DC.
- \* NIGEC 2002 Fall Meeting, Duke University.
- \* Duke University Biological Sciences Graduate Student Symposium, Fall 2001.

## **Academic Skills**

Assisted writing multiple annual reports and grants to the U.S. Department of Energy and National Science Foundation. MATLAB, database management, FORTRAN, R/S-plus. Some Mathematica, Python, ArcGIS, and ENVI. Academic German.

## **Field Skills**

Li-Cor 6262, 6400, 7500. Sonic anemometry. Campbell dataloggers and programs. Solid-state CO<sub>2</sub> sensors. Micrometeorological and radiation balance measurements. Soil bulk C and N analysis. Sap flow sensors. Respiration chamber measurements. Spectral reflectance measurements in field and laboratory settings. Field campaigns in remote and extreme environments. Trace gas flux through snow and snow properties.

## **Professional Activities**

Editorial Advisory Committee for:

- *The Open Forest Science Journal*

Reviewer for:

- *Agricultural and Forest Meteorology (excellence in reviewing award, 2007)*
- *Biogeosciences*
- *Ecology*
- *Ecosystems*
- *Forest Ecology and Management*
- *Global Biogeochemical Cycles*
- *Global Change Biology*
- *Hydrological Processes*
- *Journal of Applied Meteorology & Climatology*
- *Journal of Geophysical Research – Atmospheres*
- *Journal of Geophysical Research - Biogeosciences*
- *Science of the Total Environment*
- *The Open Forest Science Journal*
- *Water Resources Research*

### **Professional Affiliations**

Ecological Society of America (ESA)

American Geophysical Union (AGU)

### **Honors, Awards and Academic Leadership**

- Marie Curie Fellowship. Two years of fellowship research funding and administrative support, €172,434.
- ATANS transnational access research grant, ANS research station, Abisko, Sweden. 33100 SEK.
- FLUXNET Young Researcher Travel Award, October 2008.
- FLUXNET biophysical processes working group leader
- Honorable Mention, Billings Award (Best Student Presentation in the Physiological Ecology Section), 91<sup>st</sup> ESA Annual Meeting.
- Duke University Nicholas School of the Environment and Earth Sciences Professional Development Travel Award.
- Excellence in reviewing award, *Agricultural and Forest Meteorology*, 2007.
- Holstrom Scholarship for Environmental Research, UW-Madison. \$4000.
- Ecosystem Management in Cultural Landscapes Scholarship, UW-Madison. Semester tuition (\$4000).

### **Volunteer Activities**

Duke University Nicholas School of the Environment Technology Advisory Committee

Mentor/Reviewer, ESA SEEDS program for underrepresented students

Assistant Coach, Duke University Women's Rugby