

Curriculum Vitae

Lawrence B. Flanagan

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Birth Date: May 21, 1959

Citizenship: Canadian

Education

B.Sc.	University of Alberta	June 1982
M.Sc.	University of Alberta	October 1984
Ph.D.	University of Toronto	November 1988

Academic Positions

2001 - present	Professor	Dept of Biological Sciences	University of Lethbridge
2016	Visiting Scholar	Biometeorology/Soil Physics	UBC-Vancouver
2015	Visiting Scholar	Tree Ring Lab	University of Arizona
2009	Visiting Scholar	Res. School Biological Sci.	Australian National Uni.
2004	Visiting Scholar	Dept of Integrative Biology	UC Berkeley
1997 - 2002	Adjunct Research Professor	Department of Biology	University of Utah
1997 - 2001	Associate Professor	Dept of Biological Sciences	University of Lethbridge
1995 - 1997	Associate Professor	Department of Biology	Carleton University
1991 - 1995	Assistant Professor	Department of Biology	Carleton University
1988 - 1991	Postdoctoral Fellow	Department of Biology	University of Utah

Research Fellowships and Awards

Ingrid Speaker Medal for Distinguished Research University of Lethbridge	May 2008
Board of Governors Research Chair University of Lethbridge	2003-2020
Research Achievement Award Carleton University	1995-1996
NSERC Postdoctoral Fellowship	Dec 1988 - Dec 1990
Elizabeth Wintercorbyn Award in Botany University of Toronto	June 1988
Ontario Graduate Scholarship	Jan 1988 - Dec 1988
NSERC Postgraduate Scholarship	Jan 1985 - Dec 1987

Research Program

1. Research Program and Objectives

The Earth is being influenced by environmental changes such as elevated atmospheric trace gas concentrations and associated shifts in climate. There is much uncertainty about the consequences of these changes for ecosystem function and for potential feedbacks to the climate system. Terrestrial ecosystems, in particular, present a significant problem for analyzing global change because of the great diversity among ecosystems in species composition, physiological properties, physical structure and environmental conditions. A major objective of my research program is to further understand the fundamental processes that occur during terrestrial ecosystem-atmosphere interactions. In my research I make use of tools and technologies from a range of disciplines (plant physiology, ecology, geochemistry meteorology and remote sensing).

I am currently studying ecosystem CO₂, water vapor and energy exchange using the eddy covariance technique in grassland and peatland ecosystems in Alberta as part of the Fluxnet-Canada and Ameriflux research networks. These long-term measurement programs contribute in a number of ways to better understand ecosystem response to global environmental change. First, collection of empirical information is necessary for the development, assessment and improvement of mechanistic models of ecosystem physiology that can be used to predict response to future environmental changes. In collaboration with Canadian colleagues, measurements of ecosystem-level CO₂, water and energy exchange at my research sites have been used to test and evaluate the *ecosys* and CLASS models. Both the *ecosys* and CLASS models are being used to support studies of carbon accounting and management. In addition, the CLASS model is used as a component in the Canadian Regional and Global Climate models. Second, long-term measurements at a specific location may be directly relevant to large areas with similar vegetation and climate. In this way the measurements can be used to monitor and document changes as they occur in specific ecosystems or geographic regions. Third, comparison of ecosystem processes and physiological properties across a range of ecosystem types in coordinated, multi-site analyses can lead to new insights and ideas about the functioning of ecosystems. I have participated in a number of national and international synthesis projects that make use of information collected at my research sites in order to better understand the functioning of terrestrial ecosystems and their role in continental and global carbon and water cycles.

Interaction and feedback between vegetation and the atmosphere occurs via exchanges of CO₂ and H₂O gases during photosynthesis, evapo-transpiration, and respiration. On seasonal and annual time scales, changes in the stable isotope ratio of atmospheric CO₂ result from isotope effects that occur during these ecosystem-atmosphere gas exchange processes. Monitoring shifts in the stable isotope ratio of atmospheric CO₂ can potentially be used as a tool to study large-scale ecosystem-atmosphere interactions. Such an application requires, however, a detailed understanding of the mechanisms causing the isotope effects. A long-term objective of my research program is to determine the physiological mechanisms causing stable isotope fractionation during photosynthesis, transpiration, and respiration at both the leaf and ecosystem levels. We have recently developed a mechanistic, ecosystem-scale model of stable carbon isotope effects that occur during photosynthesis and respiration. This model is currently being applied and tested with empirical measurements made during the Fluxnet-Canada program at several research sites across the country. We have also recently completed a synthesis study involving our stable isotope measurements in Canada in comparison with similar measurements made at Ameriflux sites in the USA. I have also served on the steering committee of the Biosphere-Atmosphere Stable Isotope Network (BASIN), which was a core project of Focus 1 (Ecosystem Physiology) of the Global Change and Terrestrial Ecosystems project of the International Geosphere Biosphere Program during 2000-2005. As part of this network I organized an international meeting, "Biological controls on the stable isotope composition of atmospheric carbon dioxide, methane and nitrous oxide: processes and applications", and I was the senior editor of a book based on presentations made at the meeting.

Remote sensing of biophysical properties of the land surface combined with climate data potentially allows calculation and extrapolation of ecological and physiological characteristics of ecosystems to larger spatial scales. The MODIS sensor on the Aqua and Terra satellites launched by NASA collects surface

reflectance data and uses this data in conjunction with ecosystem models to calculate a variety of physiological and ecological attributes of ecosystems on a global basis. Testing of the relationships between the reflectance characteristics of vegetation and associated physiological changes is an important aspect of current research being conducted to evaluate the performance and quality of information provided by the MODIS sensor. My grassland research site is one of a select number of research sites chosen for testing and evaluating the MODIS calculations used to convert reflectance measurements into ecosystem physiological and ecological information. We have been able to show that the light-use efficiency parameters for grassland ecosystems, currently used by the MODIS calculations of photosynthesis rates, are too low and need to be revised to improve accuracy. We are currently conducting additional leaf- and canopy-level reflectance measurements in association with our ecosystem CO₂ and water vapor exchange measurements. The primary objective of these measurements is to test our ability to obtain physiologically significant signals from reflectance measurements of plant canopies. Shifts in plant pigment concentration and water content associated with changes in physiological function should cause changes that can be observed in absorption and reflectance spectra. However, important changes in absorption/reflectance spectra may be confounded by interactions among illumination, view angle and the three-dimensional structure of the vegetation canopy. Further research is required to determine the magnitude of the errors and to determine whether it is possible to correct for these potential complicating factors.

Canada has between 40-50% of the world's peatlands and they cover approximately 10-12% of Canada's land surface. Peatland ecosystems are very tightly coupled to climate and the hydrological cycle, and are very susceptible to the effects of climate change. Relatively small changes in soil moisture and temperature can dramatically alter carbon cycling in peatlands. For example, warmer temperatures and a lowering of the water table may increase the release of CO₂ and convert these ecosystems from a net sink to a net source of carbon dioxide to the atmosphere. Shifts in the water table may also influence the production and release of methane to the atmosphere. I have initiated studies of the controls on methane exchange to complement my on-going studies of CO₂ and water vapor exchange in peatlands in northern Alberta. Our studies make use of a tunable diode laser to measure ecosystem-level methane fluxes using the eddy covariance technique. These experimental studies are associated with high precision measurements of atmospheric methane concentration being made at my peatland research site in collaboration with colleagues in the Environment Canada Greenhouse Gas Measurement Lab. The high precision atmospheric measurements will be used in model calculations of the sources and sinks of methane on a regional basis in western Canada as part of research conducted in the Canadian Carbon Program, a national research network that continues and extends work initiated in the Fluxnet-Canada Research Network.

2. List of Publications

A. Refereed Journal Publications

- Yang, H., S.B. Rood, L.B. Flanagan. 2018. Controls on water-use and water-use efficiency: Insights from a comparison between grassland and riparian forest in the northern Great Plains. *Agricultural and Forest Meteorology*, *submitted*
- Tai, X., D.S. Mackay, J.S. Sperry, P. Brooks, W.R.L. Anderegg, L.B. Flanagan, S.B. Rood, C. Hopkinson. 2018. Distributed plant hydraulic and hydrological modeling to understand the susceptibility of riparian woodland trees to drought-induced mortality. *Water Resources Research* 54: doi.org/10.1029/2018WR022801
- Flanagan, L.B., J.E.M. Flanagan. 2018. Seasonal controls on ecosystem-scale CO₂ and energy exchange in a Sonoran Desert characterized by the saguaro cactus (*Carnegiea gigantea*). *Oecologia* 187: 977-994
- Qiu, C., D. Zhu, P. Ciais, B Guenet, G. Krinner, S. Peng, M. Aurela, C. Bernhofer, C. Brummer, S. Bret-Harte, H. Chu, J. Chen, A.R. Desai, J. Dusek, E.S. Euskirchen, K. Fortuniak, L.B. Flanagan, T. Friborg, M. Grygoruk, S. Gao, T Grunwald, B.U. Hansen, D Holl, E. Humphreys, M. Hurkuck, G. Kiely, J. Klatt, L. Kutzbach, C. Largeiron, F. Laggoun-Defarge, M. Lund, P.M. Lafleur, X. Li, I. Mammarella, L. Merbold, M.B. Nilsson, J. Olejnik, M. Ottosson-Lofvenius, W. Oechel, F-J.W. Parmentier, M. Peichl, N. Pirk, O. Peltola, W. Pawlak, C. Rebmann, D. Rasse, J. Rinne, G. Shaver, H.P. Schmid, M. Sottocornola, R. Steinbrecher, T. Sachs, M. Urbaniak, D. Zona, K. Ziemblinska. 2018. ORCHIDEE-PEAT (revision 4596), a model for northern peatland CO₂, water and energy fluxes on daily to annual scales. *Geoscientific Model Development* 11: 497-519 (<https://doi.org/10.5194/gmd-11-497-2018>)
- Mezbahuddin, M., R.F. Grant, L.B. Flanagan. 2017. Coupled eco-hydrology and biogeochemistry algorithms enable simulation of water table depth effects on boreal peatland net CO₂ exchange. *Biogeosciences*: 14: 5507-5531 (<https://doi.org/10.5194/bg-14-5507-2017>)
- Huemmrich, K.F., P.P.K. Campbell, B-C. Gao, L.B. Flanagan, M. Goulden. 2017. ISS (International Space Station) as a platform for optical remote sensing of ecosystem carbon fluxes: A case study using HICO (Hyperspectral Imager for Coastal Ocean). *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (J-STARS)* 10: 4360-4375 doi: 10.1109/JSTARS.2017.2725825
- Flanagan, L.B., T.E. Orchard, G.S.J. Logie, C.A. Coburn, S.B. Rood. 2017. Water use in a riparian cottonwood ecosystem: eddy covariance measurements and scaling along a river corridor. *Agricultural and Forest Meteorology* 232: 332-348
- Mezbahuddin, M., R.F. Grant, L.B. Flanagan. 2016. Modeling hydrological controls on variations in peat water content, water table depth and surface energy exchange of a boreal western Canadian fen peatland. *Journal of Geophysical Research (Biogeosciences)* 121: 2216-2242, doi:10.1002/2016JG003501
- Petrie, M.D., N.A. Brunsell, R. Vargas, S.L. Collins, L.B. Flanagan, N.P. Hanan, M.E. Litvak, A.E. Suker. 2016. The sensitivity of carbon exchanges in Great Plains grasslands to precipitation variability. *Journal of Geophysical Research (Biogeosciences)* 121: 280-294, doi: 10.1002/2015JG003205
- Hufkens, K., T.F. Keenan, L.B. Flanagan, R.S. Scott, C.J. Bernacchi, E. Joo, N.A. Brunsell, J. Verfaillie, A.D. Richardson. 2016. Productivity of North American grasslands is increased under future climate scenarios despite rising aridity. *Nature Climate Change* 6: 710-714

- Flanagan, L.B., E.J. Sharp, J.A. Gamon. 2015. Canopy light absorption and the light-use efficiency model of photosynthesis in a northern Great Plains grassland. *Remote Sensing of Environment* 168: 239-251
- Xia, J., Y. Luo, S. Niu, P. Ciais, I. Janssens, J. Chen, C. Ammann, P.D. Blanken, A. Cescatti, D. Bonal, N. Buchmann, P.S. Curtis, S. Chen, J. Dong, L.B. Flanagan, C. Frankenberg, T. Georgiadis, C.M. Gough, D. Hui, G. Kiely, J. Li, M. Lind, V. Magliulo, B. Marcolla, L. Merbold, L. Montagnani, E. Moors, J.E. Olesen, S. Piao, A. Raschi, O. Roupsard, A. Suyker, M. Urbaniak, F. Vaccari, A. Varlagi, T. Vesala, M. Wilkinson, E. Weng, G. Wohlfahrt, L. Yan. 2015. Joint control of annual terrestrial carbon uptake by plant phenology and physiology. *Proceedings of the National Academy of Sciences USA* 112: 2788-2793, doi: 10.1073/pnas.1413090112
- Petrescu, A.M.R., A. Lohila, D. Baldocchi, A.R. Desai, T. Vesala, W.C. Oechel, N. Roulet, T. Friborg, A.J. Dolman, J. Rinne, J. Hatala Matthes, L. Merbold, A. Meijide, B. Marcolla, G. Kiely, M. Sottocornola, T. Sachs, D. Zona, A. Varlagin, D.Y.F. Lai, E. Veenendaal, F.J.W. Parmentier, J.P. Tuovinen, U. Skiba, M. Lund, A. Henson, J. van Huissteden, L.B. Flanagan, N. Shurpali, T. Grunwald, E. Humphreys, M. Jackowicz-Korczynski, M. Aurela, T. Laurila, C. Gruning, C.A.R. Corradi, A.P. Schrier-Uijl, T.R. Christensen, M.P. Tamstorf, M. Mastepanov, P. Martikainen, S.B. Verma, A. Cescatti. 2015. Carbon sink and methane source: the two-faced nature of wetlands under anthropogenic perturbation. *Proceedings of the National Academy of Sciences USA* 112: 4594-4599, doi: 10.1073/pnas.1416267112
- Kross, A.S.E., N.T. Roulet, T.R. Moore, P.M. Lafleur, E.R. Humphreys, J.W. Seaquist, L.B. Flanagan, M. Aurela. 2014. Phenology and its role in carbon dioxide exchange processes in northern peatlands. *Journal of Geophysical Research (Biogeosciences)* 119: 1370-1384, doi:10.1002/2014JG002666.
- Flanagan, L.B., G.D. Farquhar. 2014. Variation in the carbon and oxygen isotope composition of plant biomass and its relationship to water-use efficiency at the leaf- and ecosystem-scales in a northern Great Plains grassland. *Plant Cell and Environment* 37: 425-438
- Flanagan, L.B., E.J. Sharp, M.G. Letts. 2013. Response of plant biomass and soil respiration to experimental warming and precipitation manipulation in a northern Great Plains grassland. *Agricultural and Forest Meteorology* 173: 40-52
- Peichl, M., O. Sonnentag, G. Wohlfahrt, L.B. Flanagan, D.D. Baldocchi, G. Kiely, M. Galvagno, D. Gianelle, B. Marcolla, C. Pio, M. Migliavacca, M.B. Jones, M. Saunders. 2013. Convergence of potential net ecosystem production among contrasting C₃ grasslands. *Ecology Letters* 16: 502-512
- Chen, B., N.C. Coops, D. Fu, H.A. Margolis, B.D. Amiro, T.A. Black, M.A. Arrain, A.G. Barr, C.P.A. Bourque, L.B. Flanagan, P.M. Lafleur, J.H. McCaughey, S.C. Wofsy. 2012. Characterizing spatial representativeness of flux tower eddy-covariance measurements across the Canadian Carbon Program Network using remote sensing and footprint analysis. *Remote Sensing of Environment* 124: 742-755
- Andrews, S.F., L.B. Flanagan, E.J. Sharp, T. Cai. 2012. Variation in water potential, hydraulic characteristics and water source use in montane Douglas-fir and lodgepole pine trees in southwestern Alberta and consequences for seasonal changes in photosynthetic capacity. *Tree Physiology* 32: 146-160, doi: 10.1093/treephys/tpr136
- Sulman, B.N., A.R. Desai, N.M. Schroeder, D. Ricciuto, A. Barr, A. Richardson, D. Hollinger, L.B. Flanagan, P.M. Lafleur, H. Tian, G. Chen, R.F. Grant, B. Poulter, H. Verbeeck, P. Ciais, P. Peylin, B. Ringeval, I.T. Baker, K. Schaefer, Y. Luo, E. Weng. 2012. Impact of hydrological variations on modeling of peatland CO₂ fluxes: results of the North American Carbon Program site synthesis. *Journal of Geophysical Research (Biogeosciences)* 117, G01031, doi: 10.1029/2011JG001862.

- Brümmer, C., T. A. Black, R.S. Jassal, N.J. Grant, D.L. Spittlehouse, B. Chen, Z. Nestic, B.D. Amiro, M.A. Arain, A.G. Barr, C.P.-A. Bourque, C. Coursolle, A.L. Dunn, L.B. Flanagan, E.R. Humphreys, P.M. Lafleur, H.A. Margolis, J. H. McCaughey, S.C. Wofsy. 2012. How climate and vegetation type influence evapotranspiration and water use efficiency in Canadian forest, peatland and grassland ecosystems. *Agricultural and Forest Meteorology* 153: 14-30, doi:10.1016/j.agrformet.2011.04.008
- Flanagan, L.B., T. Cai, T.A. Black, A.G. Barr, J.H. McCaughey, H.A. Margolis. 2012. Measuring and modeling ecosystem photosynthesis and the carbon isotope composition of ecosystem-respired CO₂ in three boreal coniferous forests. *Agricultural and Forest Meteorology* 153: 165-176
- Ryu, Y., D.D. Baldocchi, T.A. Black, M. Detto, B.E. Law, R. Leuning, A. Miyata, M. Reichstein, R. Vargas, C. Ammann, J. Beringer, L.B. Flanagan, L. Gu, L.B. Hutley, J. Kim, H. McCaughey, E.J. Moors, S. Rambal, T. Vesala. 2012. On the temporal upscaling of evapotranspiration from instantaneous remote sensing measurements to 8-day mean daily-sums. *Agricultural and Forest Meteorology* 152: 212-222, doi:10.1016/j.agrformet.2011.09.010
- Dietze, M.C., R. Vargas, A.D. Richardson, P.C. Stoy, A.G. Barr, R.S. Anderson, M.A. Arain, I.T. Baker, T.A. Black, J.M. Chen, P. Ciais, L.B. Flanagan, C.M. Gough, R.F. Grant, D. Hollinger, R.C. Izaurralde, C.J. Kucharik, P. Lafleur, S. Liu, E. Lokupitiya, Y. Luo, J.W. Munger, C. Peng, B. Poulter, D.T. Price, D.M. Ricciuto, W.J. Riley, A.K. Sahoo, K. Schaefer, A.E. Suyker, H. Tian, C. Tonitto, H. Verbeeck, S.B. Verma, W. Wang, E. Weng. 2011. Characterizing the performance of ecosystem models across time scales: A spectral analysis of the North American Carbon Program site-level synthesis. *Journal of Geophysical Research (Biogeosciences)* 116, G04029, doi: 10.1029/2011JG001661.
- Hanesiak, J.M., Stewart, R.E., Bonsal, B.R. (and 39 other authors including L.B. Flanagan). 2011. Characterization and summary of the 1999-2005 Canadian prairie drought. *Atmosphere-Ocean* 49: 421-452.
- Flanagan, L.B., A.C. Adkinson. 2011. Interacting controls on productivity in a northern Great Plains grassland and implications for response to ENSO events. *Global Change Biology* 17: 3293-3311 doi: 10.1111/j.1365-2486.2011.02461.x
- Flanagan, L.B., K.H. Syed. 2011. Stimulation of both photosynthesis and respiration in response to warmer and drier conditions in a boreal peatland ecosystem. *Global Change Biology* 17: 2271-2287, doi: 10.1111/j.1365-2486.2010.02378.x
- Adkinson, A.C., K.H. Syed, L.B. Flanagan. 2011. Contrasting responses of ecosystem CO₂ exchange to variation in temperature and water table depth in two peatlands in northern Alberta, Canada. *Journal of Geophysical Research (Biogeosciences)* 116, G01004, doi: 10.1029/2010JG001512.
- Chen, B., N.C. Coops, H.A. Margolis, B.D. Amiro, A.G. Barr, T.A. Black, M.A. Arrain, C.P.A. Bourque, L.B. Flanagan, P.M. Lafleur, J.H. McCaughey, S.C. Wofsy. 2011. Assessing eddy-covariance flux tower location bias across the Fluxnet-Canada Research Network based on remote sensing and footprint climatology modeling. *Agricultural and Forest Meteorology* 151: 87-100
- Coburn, C.A., E. Van Gaalen, D.R. Peddle, L.B. Flanagan. 2010. Anisotropic reflectance effects on the sensitivity of spectral indices for estimating ecophysiological parameters using a portable goniometer system. *Canadian Journal of Remote Sensing* 36: S355-S364.
- Gamon, J.A., C. Coburn, L.B. Flanagan, K.F. Huemmrich, C. Kiddle, G.A. Sanchez-Azofeifa, D. Thayer, L. Vescovo, D. Gianelle, D. Sims, A.F. Rahman, G. Zonta-Pastorello. 2010. SpecNet Revisited: Bridging flux and remote sensing communities. *Canadian Journal of Remote Sensing* 36: S376-S390.

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- Sulman, B.N., A.R. Desai, N.Z. Saliendra, P.M. Laflour, L.B. Flanagan, O. Sonnentag, D.S. Mackay, A.G. Barr, G. van der Kamp. 2010. Carbon fluxes at northern fens and bogs have opposite responses to inter-annual fluctuations in water table. *Geophysical Research Letters* 37, L19702, doi:10.1029/2010GL044018.
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- Cai, T., L.B. Flanagan, R.S. Jassal, and T.A. Black. 2008. Modeling environmental controls on photosynthesis and the carbon isotope composition of ecosystem respired CO₂ in a coastal Douglas-fir forest. *Plant Cell and Environment* 31: 435-453
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- Sims, D.A., A.F. Rahman, V.D. Cordova, B.Z. El-Masri, D.D. Baldocchi, L.B. Flanagan, A.H. Goldstein, D.Y. Hollinger, L. Mission, R.K. Monson, W.C. Oechel, H.P. Schmid, S.C. Wofsy, L. Xu. 2006. On the use of MODIS EVI to assess gross primary productivity of North American ecosystems. *Journal of Geophysical Research (Biogeosciences)* 111, G04015, doi 10.1029/2006JG000162
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- Syed, K.H., L.B. Flanagan, P.J. Carlson, A.J. Glenn, K.E. Van Gaalen. 2006. Environmental control of net ecosystem CO₂ exchange in a treed, moderately rich fen in northern Alberta. *Agricultural and Forest Meteorology* 140: 97-114, doi: 10.1016/j.agrformet.2006.03.022
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B. Edited Books

- Flanagan, L.B., J.R. Ehleringer, D.E. Pataki, (Editors). 2005. Stable isotopes and biosphere-atmosphere interactions: processes and biological controls. Elsevier-Academic Press, San Diego, California. ISBN: 012088447X

C. Other Refereed Contributions:

- Pendall, E., D. Bachelet, R. Conant, B. El Masri, L.B. Flanagan, A.K. Knapp, J. Lui, S. Lui, S. Schaeffer. 2018. Chapter 10. State of carbon in North American grasslands. *In* Second State of the Carbon Cycle Report (SOCCR-2), *Ed.* N. Cavallaro, R. Birdsey, M. Mayes, R. Najjar, S. Reed, P. Romero-Lankao. USA Global Change Research Program, pp. 380-412
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- Flanagan, L.B. 2005. Introduction: stable isotopes and earth system science. *In* Stable isotopes and biosphere-atmosphere interactions: processes and biological controls. *Ed.* L.B. Flanagan, J.R. Ehleringer, D.E. Pataki. Elsevier-Academic Press, San Diego, California, pp. 1-5
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D. Non-Refereed Contributions

- Margolis, H.A., L.B. Flanagan, B.D. Amiro. 2006. (Preface to Special Journal Issue) The Fluxnet-Canada Research Network: Influence of climate and disturbance on carbon cycling in forests and peatlands. *Agricultural and Forest Meteorology* 140: 1-5, doi: 10.1016/j.agrformet.2006.08.013
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4. Other Evidence of Impact and Contributions

A. Invited Lectures

Major Research Seminars Presented

I was invited to present a paper (and act as discussion session moderator) at an international workshop, "Partitioning of fluxes between the biosphere and atmosphere across spatial scales", sponsored by SIBAE of the European Science Foundation, held at Interlaken, Switzerland, March 31 – April 3, 2004.

I was invited to act as discussion leader/moderator at an international workshop session on the use of stable isotopes to partition component processes contributing to whole ecosystem carbon

dioxide exchange. This meeting, "Fluxnet Synthesis Workshop 2002", was held at Orvieto, Italy, June 19-21, 2002. The meeting was sponsored by: NASA/Fluxnet, GCTE/BASIN, and CarboEuroFlux programs.

I was invited to present a paper at an international workshop, "Biosphere - Atmosphere Stable Isotope Network (BASIN)", sponsored by the Global Change in Terrestrial Ecosystems (GCTE) project of the International Geosphere-Biosphere Programme (IGBP), held at Salt Lake City, Utah, Dec. 7-10, 1997.

I presented one of the keynote addresses at the 5th International Carbon Dioxide Conference in Cairns, Australia, September 8-12, 1997.

I was invited to present a paper at an international conference, "Stable Isotopes and the Integration of Biological, Ecological and Geochemical Processes", held in Newcastle upon Tyne, July 9-11, 1996.

I was invited to present a paper at the Fifteenth Annual Symposium in Plant Physiology, University of California, Riverside, January 9-11, 1992. Meeting Topic: Perspectives on Plant Carbon and Water Relations from Stable Isotopes.

B. Journal Editorships

Current member of the editorial review board of:

Plant Cell and Environment January 2010 – present

I was a member of the editorial review board of *Global Change Biology* during 2011-2013.

I was a member of the editorial review board of *Oecologia* during 1998-2005.

Guest Editor for Special Journal Issue of *Agricultural and Forest Meteorology* November 2006:
Fluxnet-Canada Special Issue: The influence of climate and disturbance on ecosystem-atmosphere exchange of Canadian forests and peatlands (Volume 140, Issues 1-4)

C. National and International Committees

Member (2016) of the NASA Terrestrial Ecology Peer Review Panel for grant proposals for the AboVE (Arctic-Boreal Vulnerability Experiment) Airborne Campaign.

Member (2014-16) of the NSERC RTI evaluation group committee for Biological Systems and Functions (EG1502).

Member (2006-2008) of the NSERC Discovery grant selection committee for Plant Biology and Food Science (GSC03). I was chair of this committee during 2007-08.

Member of the Science committee of the Canadian Carbon Program Research Network (2007-2010).

Member of the Science committee of the Fluxnet-Canada Research Network (2002-2007).

I was invited to participate in a planning committee organized by the International Atomic Energy Agency (Vienna) for a new global network to measure stable isotopes in plant and atmospheric water. The first meeting of this committee was held in Vienna on November 17-19, 2003.

I was the host and lead organizer for an international meeting, "Biological controls on the stable isotope composition of atmospheric carbon dioxide, methane and nitrous oxide: processes and applications". This meeting was held at the Banff Centre during May 12-14, 2002. I was the senior editor of a book based on presentations made at the meeting.

I was a member of the six-person steering committee for the Biosphere-Atmosphere Stable Isotope Network (BASIN), a core project of Focus 1 (Ecosystem Physiology) of the Global Change and Terrestrial Ecosystems project of the International Geosphere Biosphere Program during 2000-2005.

I was asked to review and write a report on a joint Environment Canada/Forestry Canada/Parks Canada program - BOREAL ECOSYSTEM RESEARCH AND MONITORING SITES (BERMS) Program.

I was a member of a committee that planned a workshop to further develop the Canadian participation in the GLOBAL CLIMATE OBSERVING SYSTEM (GCOS). A proposal to the Climate Change Action Fund was accepted to further develop Canadian involvement in GCOS. A report based on the workshop (with contributions from me) was submitted to federal agencies.