Geophysical Research Abstracts
Vol. 13, EGU2011-31, 2011
EGU General Assembly 2011

Efficacy of using eddy covariance method for gas and energy flux measurements in disciplines and applications beyond micrometeorology

George Burba (1) and Dan Anderson (2)

(1) LI-COR Biosciences, Advanced Research & Development, Lincoln, Nebraska, USA, (2) LI-COR Biosciences, Environmental Technical Support, Lincoln, Nebraska, USA

The Eddy Covariance method is a micrometeorological technique of high-speed flux measurements of water, gas, heat, and momentum transport within the atmospheric boundary layer, above the soil surface, plant canopy, or industrial and urban terrains. Fluxes, emission and exchange rates could be carefully characterized from a single-point in-situ measurements using a permanent or mobile tower, or moving platforms such as automobile, helicopter, airplane, ship, boat, buoy, *etc.*

This technique is widely used by micrometeorologists all over the globe. However, a number of researchers from disciplines outside of micrometeorology may not have been introduced to the information about this method, or may not be familiar enough with it to assess its usefulness within their field. Modern instruments and software can potentially expand the use of this method beyond micrometeorology and prove valuable for plant physiology, hydrology, biology, ecology, entomology, and other areas of research, industrial and regulatory applications.

The Eddy Covariance method is one of the most direct, defensible ways to measure and calculate turbulent fluxes within the atmospheric boundary layer. However, the method is mathematically complex, and requires significant care to set up and process data. The main challenge of the method for a non-expert is the complexity of system design, implementation, and processing of the large volume of data. In the past several years, efforts of the flux networks (*e.g.*, iLEAPs. FluxNet, ICOS, CarboEurope, Ameriflux, Fluxnet-Canada, Asiaflux, *etc.*) have led to noticeable progress in unification of the terminology and general standardization of processing steps. The methodology itself, however, is difficult to unify, because various experimental sites and different purposes of studies dictate different treatments, and site-, measurement- and purpose-specific approaches.

With this in mind, step-by-step instructions were created to introduce a novice to general principles, requirements, applications, and processing steps of the conventional Eddy Covariance technique, to assist in further understanding the method through more advanced references such as textbooks on micrometeorology ([1],[2],[3],[4],[5]), network guidelines (ICOS, CarboEurope, Ameriflux, Fluxnet-Canada, Asiaflux, *etc.*), journal and technical papers.

These instructions are provided to the community in the form of the *free electronic resource*, a 211-page textbook titled "A Brief Practical Guide to Eddy Covariance Flux Measurements: Principles and Workflow Examples for Scientific and Industrial Applications" [6]. The book is based, largely, on frequently asked questions received from new users of the Eddy Covariance method and relevant instrumentation. The explanations are written in a non-technical language to be of practical use to those new to this field. Information is provided on theory of the method (basic derivations, major assumptions, sources of errors, *etc.*), practical workflow (experimental design, implementation, data processing, and quality control), and most frequently overlooked details of the field measurements.

These type of information may be especially useful to the following groups studying, using, or supporting the Eddy Covariance method, or utilizing its results:

- Undergraduate students studying the method as a part of the micrometeorology course

- Non-meteorology graduate students studying or using the method

- Field technicians, research assistants and student help, supporting data collection and processing

- Non-micrometeorology scientists and faculty interested in applying the method for their research

- Researchers and facility managers from industrial areas such a landfills, carbon sequestration facilities, feed lots, superfund sites, *etc.*, interested in quantifying the emissions using this method

- Regulating bodies, such as environmental protection agencies, state and local air quality boards, *etc.* interested in using Eddy Covariance as an official method

References:

[1] Foken T., 2008. Micrometeorology. Springer-Verlag, Berlin Heidelberg, Germany. Softcover, 308 pp.

[2] Monteith J., and M. Unsworth, 2008. Principles of Environmental Physics, Third Edition). Academic Press/Elsevier, London, UK. Hardcover, 434 pp.

[3] Lee X., W. Massman, and B. Law (Eds), 2004. Handbook of Micrometeorology: A Guide for Surface Flux Measurement and Analysis. Springer-Verlag, Berlin Heidelberg, Germany. Hardcover, 250 pp.

[4] Arya S., 2001. Introduction to Micrometeorology. Academic Press/Elsevier, Burlington, USA. Hardcover, 420 pp.

[5] Rosenberg N., B. Blad, and S.Verma, 1983. Microclimate: The Biological Environment. Wiley-Interscience Publishers, New York, USA. Hardcover, 495 pp.

[6] Burba, G., and D. Anderson, 2010. A Brief Practical Guide to Eddy Covariance Flux Measurements. LI-COR Biosciences, Lincoln, USA. Electronic, softcover and hardcover, 211 pp.