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Soil Respiration in Eddy Covariance Footprints: A Critical Look at Researcher Needs

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Eddy covariance (EC) systems have been widely used across the globe for more than 20 years, offering researchers invaluable measurements of parameters including Net Ecosystem Exchange and ecosystem respiration. However, recent research suggests that EC assumptions and technical obstacles may cause biased gas exchange estimates. Measurements of soil respiration (RS) at the ground level may help alleviate these biases; for example, by allowing researchers to reconcile nocturnal EC flux data with soil respiration or by providing a means to inform gap-filling models. RS measurements have been used sparingly alongside EC towers because of the large cost required to scale chamber systems to the EC footprint, as well as data integration and processing burdens. Here we present how the Forced Diffusion (FD) method is ideal for the measurement of RS at EC sites. The FD method allows for inexpensive and autonomous measurements, providing a scalable approach to matching the EC footprint compared to other RS systems.

Here, we briefly present the methodology and results from a pilot study at the Howland Forest AmeriFlux site (Maine), carried out during the summer and fall of 2016, measuring soil respiration using the FD chamber technique. The emphasis of the remainder of the research is on gathering, interpreting and actualizing feedback from soil scientists and eddy covariance researchers and technicians on aspects of the FD methodology, deployment style, integration with existing infrastructure and data quality. Our goal is to eventually provide a framework for “ideal soil respiration measurements” that can be used by researchers, engineers and companies to develop functional and reliable soil respiration data sets that are easily coupled with data measured by EC users, and larger EC networks such as AmeriFlux and EuroFlux.