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On equalizing pressure in a soil respiration chamber with pressure in the ambient air under windy conditions

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Chamber-based methods offer useful and simple approaches for measuring soil CO_2efflux (F_{CO2}) that are widely used. Many studies have demonstrated that a small pressure change inside the chamber can cause a large bias in measured F_{CO2}. Therefore, it is necessary to minimize pressure differences between the chamber and ambient air if measured values of F_{CO2} are to accurately represent rates outside the chamber.

An open vent tube has often been used to equalize pressure between chambers and the surrounding air (e.g. Davidson, et al., 2002. *Agric and Forest Meteorol* 113:21; Hutchinson and Mosier, 1981. *Soil Sci Am. J* 45:311; Hutchinson and Livingston, 2001. *European J Soil Sci* 52:675); however, this approach is likely to be effective only under calm conditions. Under windy conditions, the venturi effect will cause a negative pressure excursion in the chamber as wind blows over the open end of the vent tube, causing a mass flow of CO_2-rich air from the soil into the chamber, which leads to a significant overestimation of F_{CO2}. Some researchers (e.g. Conen F., Smith K.A., 1998. *European J Soil Sci* 49:701) have recommended eliminating the vent tube after recognizing this problem.

In this paper, we present and test a new vent design used in the LI-8100 Automated Soil Respiration System that resolves these problems. We demonstrate that a vent is necessary to prevent significant pressure deviations from ambient and show that the new vent design allows pressure in the chamber to track ambient pressure under calm and windy conditions, virtually eliminating fluctuations due to the venturi effect. In order to accurately measure pressure fluctuations the chamber must be sealed on a solid base. We found pressure fluctuations cannot be measured effectively when a

chamber is placed on the soil because even small pressure fluctuations cause bulk air flow out of the soil dampening the pressure pulses. This will lead to the erroneous conclusion that pressure is not a problem precisely when it is causing serious artifacts. Data from field tests will be shown that illustrate these points. The new vent design can be applied to other chamber-based flux measurements to effectively equalize pressure between a chamber and ambient air.