Geophysical Research Abstracts
Vol. 16, EGU2014-2, 2014
EGU General Assembly 2014

Continuous atmospheric monitoring of the injected CO_2 behavior over geological storage sites using flux stations: latest technologies and resources

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Flux stations have been widely used to monitor emission rates of CO_2 from various ecosystems for climate research for over 30 years [1]. The stations provide accurate and continuous measurements of CO_2 emissions with high temporal resolution. Time scales range from 20 times per second for gas concentrations, to 15-minute, hourly, daily, and multi-year periods. The emissions are measured from the upwind area ranging from thousands of square meters to multiple square kilometers, depending on the measurement height.

The stations can nearly instantaneously detect rapid changes in emissions due to weather events, as well as changes caused by variations in human-triggered events (pressure leaks, control releases, etc.). Stations can also detect any slow changes related to seasonal dynamics and human-triggered low-frequency processes (leakage diffusion, etc.).

In the past, station configuration, data collection and processing were highly-customized, site-specific and greatly dependent on "school-of-thought" practiced by a particular research group. In the last 3-5 years, due to significant efforts of global and regional CO_2 monitoring networks (e.g., FluxNet, Ameriflux, Carbo-Europe, ICOS, etc.) and technological developments, the flux station methodology became fairly standardized and processing protocols became quite uniform [1].

A majority of current stations compute CO_2 emission rates using the eddy covariance method, one of the most direct and defensible micrometeorological techniques [1]. Presently, over 600 such flux stations are in operation in over 120 countries, using permanent and mobile towers or moving platforms (e.g., automobiles, helicopters, and airplanes).

Atmospheric monitoring of emission rates using such stations is now recognized as an effective method in regulatory and industrial applications, including carbon storage [2-8]. Emerging projects utilize flux stations to continuously monitor large areas before and after the injections, to locate and quantify leakages from the subsurface, to improve storage efficiency, and for other storage characterizations [5-8].

In this presentation, the latest regulatory and methodological updates are provided regarding atmospheric monitoring of the injected CO_2 behavior using flux stations. These include 2013 improvements in methodology, as well as the latest literature, including regulatory documents for using the method and step-by-step instructions on implementing it in the field.

Updates also include 2013 development of a fully automated remote unattended flux station capable of processing data on-the-go to continuously output final CO_2 emission rates in a similar manner as a standard weather station outputs weather parameters.

References:

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