

Sonic anemometer and gas analyser

A sonic anemometer and a gas analyser measuring water vapour and carbon dioxide are co-located within a compound dedicated to measuring fluxes using the eddy covariance method at Chilbolton Observatory. The broadband net flux radiometer is also located within this compound.



The eddy covariance technique is an atmospheric measurement method used to calculate vertical turbulent fluxes within the atmospheric boundary layer. This is the lowest region of the troposphere and is usually well mixed, particularly during daylight hours, due to convective heating from the sun. It is this motion in the lower troposphere that makes the technique possible. In order to properly measure the turbulent properties of the atmosphere the measurements must be made at a high frequency - 20 Hz for the Chilbolton Observatory system.

A sonic anemometer measures the 3 orthogonal components of the wind velocity by measuring the changes in the time of flight of sonic pulses between 3 transmitter/receiver pairs as a result of the air velocity. A gas analyser measures the absorptance of radiation along a fixed path and uses this to determine the concentration of a gas in air. For each gas the absorptance at 2 wavelengths is measured 152 times per second, one affected by that gas and the other unaffected. There are more accurate instruments available for measuring water vapour and carbon dioxide (e.g. a relative humidity sensor for water vapour) but the benefit of the gas analyser is that it has a sufficiently fast response to resolve the rapid changes in concentration as a result of turbulence.



The measurements produced by the sonic anemometer/gas analyser system (aside from gas concentrations and wind velocity resolved into 3 orthogonal components) are friction velocity, vertical water vapour and carbon dioxide fluxes and sensible and latent heat flux.

The specifications of the sonic anemometer and gas analyser are as follows:

Sonic anemometer	
Instrument manufacturer	Metek
Instrument model	USA-1
Wind speed range	0 – 50 m/s
Wind velocity range (1 component)	-50 – 50 m/s
Wind speed uncertainty	Wind speed 1 m/s to 4 m/s: ± 0.1 m/s 4 m/s to 10 m/s: ± 0.15 m/s >10 m/s: ± 0.2 m/s
Wind velocity resolution (1 component)	0.01 m/s

Air temperature measurement range (and operating range)	-30 – +50°C
Sound paths lengths	175 mm
Sensor height, unit height, diameter	320, 660, 240 mm
Height above ground	5 m
Weight	Sensor head: 1.8 kg, electronics unit: 3.8 kg
Power consumption	2.5 W
Data output format	RS232 9600 baud

Data Archive	
Sampling rate	20Hz
Data availability	Continuous recording
Archive data format	netCDF
Archived to British Atmospheric Data Centre	http://badc.nerc.ac.uk/
BADC datafile	gas-analyser-sonic-anemometer_chilbolton

Gas analyser	
Instrument manufacturer	Licor
Instrument model	7500
Carbon dioxide measurement range	0 – 3 mmol/mol of air
Water vapour measurement range	0 – 60 mmol/mol of air
Gas concentration uncertainty	Not specified by manufacturer
Wind velocity resolution (1 component)	0.01 m/s
Operating temperature range	-25 – +50°C
Measurement path length	125 mm
Sensor height, diameter	300, 65 mm
Weight	Sensor head: 0.75 kg Control box and cables: 4.8 kg
Power consumption	30 W during warm up, 10 W steady stage
Data output format	RS232 maximum baud 34800. Also analog outputs.

Data Archive	
Sampling rate	0.1Hz Also gas concentrations at 20Hz in sonic anemometer dataset.
Data availability	Continuous recording
Archive data format	netCDF
Archived to British Atmospheric Data Centre	http://badc.nerc.ac.uk/
BADC datafile	licor-gas-analyser-chilbolton

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