

Air Enquirer's multi-sensor boxes as a tool for High School Education and Atmospheric Research

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An educational tool was designed with the aim of making more comprehensive the research done on Greenhouse Gases (GHGs) in the ClimaDat Spanish network of atmospheric observation stations (www.climadat.es). This tool is called Air Enquirer and it consists of a multi-sensor box. It is envisaged to build more than two hundred boxes to yield them to the Spanish High Schools through the Education department (www.educaixa.com) of the "Obra Social 'La Caixa'", who funds this research. The starting point for the development of the Air Enquirers was the experience at IC3 (www.ic3.cat) in the CarboSchools+ FP7 project (www.carboschools.cat, www.carboschools.eu).

The Air Enquirer's multi-sensor box is based in Arduino's architecture and contains sensors for CO₂, temperature, relative humidity, pressure, and both infrared and visible luminance. The Air Enquirer is designed for taking continuous measurements. Every Air Enquirer ensemble of measurements is used to convert values to standard units (water content in ppmv, and CO₂ in ppmv_{dry}). These values are referred to a calibration made with Cavity Ring Down Spectrometry (Picarro[®]) under different temperature, pressure, humidity and CO₂ concentrations. Multiple sets of Air Enquirers are intercalibrated for its use in parallel during the experiments.

The different experiments proposed to the students will be outdoor (observational) or indoor (experimental, in the lab) focusing on understanding the biogeochemistry of GHGs in the ecosystems (mainly CO₂), the exchange (flux) of gases, the organic matter production, respiration and decomposition processes, the influence of the anthropogenic activities on the gases (and particles) exchanges, and their interaction with the structure and composition of the atmosphere (temperature, water content, cooling and warming processes, radiative forcing, vertical gradients and horizontal patterns).

In order to ensure Air Enquirers a high-profile research performance the experimental designs and the device have been tested under research conditions by professional instruments. Results from several experiments are shown here: i) from vertical profiles obtained by drones (www.hemav.com) over Ebre Delta crops, ii) from measurements on lagoons, salt marshes and marine coastal research in the ClimaDat DEC3 station, iii) from horizontal patterns of variability over and under canopy, related to ecosystem patchiness in the highly instrumented Valderejo ClimaDat mountain station (www.modpow.es) and iv) from urban transects to reveal the urban atmosphere dynamic processes.