



# Università degli Studi di Ferrara

## DOTTORATO DI RICERCA IN "Scienze della Terra"

CICLO XXX

COORDINATORE Prof. Massimo Coltorti

### **Smart Sensor Technology for Environmental Monitoring Applications**

Settore Scientifico Disciplinare GEO/09

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## Abstract

Research Project focused on developing innovative devices using the low-cost sensors to obtain the concentrations of greenhouse gases (GHGs) such as carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) as well as obtain a good water quality as a 2<sup>nd</sup> treatment in the Wastewater Treatment Plant. In addition to sensor calibration, the multi-parameter monitor prototype were tested in several contexts: a) Laboratory scale with natural soil columns, to figure out the sensor response under controlled conditions, calibration and validation; b) Field scale in many geological contexts, for Air-Soil quality (methane and carbon dioxide measurements): Natural Gas Storage Site in Minerbio, Italy; Drilling and Hydraulic Fracturing activities in Greeley, CO, USA; for Water Quality: Wastewater Treatment Plant in Algarve, Portugal. The monitoring system provided a huge set of data for which can be used statistical analysis, management and processing (Big DATA). The source identification of greenhouse gas emissions is identified in several IPCC reports that climate change is the major emergency for the socio / economic / environmental equilibrium of Earth planet. No outliers were identified as methane gas concentrations at Minerbio gas storage site, Italy and at Hydraulic activities in Greeley, Colorado. The soil column experiments for infiltration basins in the Wastewater treatment plant in Algarve, Portugal, gave us good results, the water quality was improved after the 2<sup>nd</sup> treatment. The low-cost sensors (gas – water) gave as a good calibration and validation with R<sup>2</sup> coefficient of correlation of 0.70 – 0.96.