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Analyzing CO2, CH4 and N2O Concentrations in the Vadose Zone of Several Aquifers of the South of Spain

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Greenhouse gas (GHG: CO_2, CH_4 and N_2O) concentrations continue to increase in the earth's atmosphere and they are fully implicated in current global warming. There is a critical need to understand of the cause–effect relationships of GHG emissions and quantify their sources/sinks in the natural systems, as well as its main reservoirs and quantity. In particular, there is a need to understand and quantify GHGs within the vadose zone (as an unknown reservoir), because depending on its porosity it can store different amounts of these gases. The vadose zone, the space between the surface and the groundwater, has an important contribution to the global GHG due to both its high concentrations and the enormous capacity to store gases in its pore space.

At present, the measurements of these three GHGs have been widely studied mainly in the first few meters of the soil, not taking into account the transport and storage processes in deep areas. However, the study of the whole column of the vadose zone should not be neglected since it can make an important contribution to the global GHG balance.

This study analyses GHG concentrations in the vadose zones of several aquifers of the Andalusian Mediterranean basins. For this purpose, air samples were taken from more than one hundred wells in a total of 22 aquifers with water table depths between 7-240 meters; samples were collected at different depths: 12.5, 25, 50, 100 and 200 meters and one sample was collected at the groundwater boundary; for these reasons, the number of samples per well varied depending on the depth to the water table. These samples and analyses provide profiles of GHG concentrations: with values for CO_2 between 103-75030 ppm, for CH_4 between 0.02-755 ppm and for N_2O between 0.31-1504 ppm. The ultimate objective of the project is to know the GHG profile, the porosity, depth to the water table, groundwater chemistry and aquifer extension, to estimate underground GHG storage.