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Evaluation of local versus remote areas of CH4 sources at IC3 stations using a combined analysis of 222Rn tracer and Atmospheric Particles Transport Model (APTM) results. Application at the Gredos and Iruelas station (GIC3), Spain.

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The Gredos and Iruelas station (GIC3) is part of the IC3 (Institut Català de Ciències del Clima) atmospheric monitoring network. This station is located in the Gredos Natural Park (40.22º N; -5.14º E) in the Spanish central plateau. The IC3 network consists of 8 stations distributed across Spain. It has been developed with the aim of studying climatic processes and the responses of impacted systems at different temporal and spatial scales. Since 2012, CO_2, CH4, 222Rn (a natural radioactive gas) and meteorological variables are continuously measured at GIC3 at 20 m a.g.l. (1100 m a.s.l.). Furthermore, 4-days backward simulations are run daily for each IC3 station using the FLEXPART model. Simulations use ECMWF meteorological data as input and a horizontal spatial resolution of 0.2 degrees.

The Laboratory of the Atmosphere and the Oceans (LAO) of the IC3 has elaborated a new approach to evaluate the local or remote greenhouse gases emissions using the radon gas as tracer and the atmospheric particles transport model FLEXPART under nocturnal and winter conditions. The ratios between the normalized and rescaled measured concentrations of CH4 and 222Rn during nocturnal hours (21h, 00h, 03h and 06h) and in the winter season, in order to reduce local radon flux and methane source due to seasonal livestock migration and to get stable atmospheric conditions, have been analyzed in relation to the influence of the local area (set to an initial dimension of 20x20 km2). The influence area (IA) has been defined as the percentage of the ratio between the residence time of the fictitious particles released in FLEXPART simulations over the area of interest (TLocal Area) and the residence time of these fictitious particles over the total area included in the simulation (TTotal Area), i.e. IA = (TLocal Area/TTotal Area * 100).

First results considering an area of interest of 20x20 km2 show a linear increase of the radon concentration with IA until reaching a maximum when IA is about 50%. This can be explained taking into consideration that GIC3 station area has high radon exhalation rates according to the literature and the radon uptake from air masses can reach a plateau. On the other hand, CH4 concentrations do not seem to be significantly influenced by IA. The log-log plot between the ratio of normalized and rescaled gases concentrations (CH4/222Rn) and the percentage of the influence of the local area shows a negative linear relation under nocturnal and winter conditions which could depend on the increase of the radon not compensated by the methane increase. Indeed, when the influence of the local area of Gredos and Iruelas station is under the 20% the major methane contribution seems to come from outside the 20x20 km2 IA. Results considering a larger area of interest (up to 80x80 km2) may indicate possible methane sources detected at the GIC3 station.