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Multi-scale Radon Prone Areas Assessment in Campania Region (Southern Italy)

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Nowadays, it is well established, among the world wide scientific community, that the largest contribution to the indoor Radon (i.e., Radon-222) levels, inside dwellings, is provided by the source of the exhalated Radon, produced both directly from the soil located underneath the buildings and from the neighbour soils. This shared awareness has induced many European public institutions, responsible in matter of public health, to issue directives aimed at the assessment, on a regional scale, of the potential Radon exhalation from the soils, in order to achieve a planning of the radiogenic risk both in the residential buildings and in the working places.

However, the lack of consolidated methodologies and procedures about the matter, shared among the experts' community, while has produced a valuable intense investigation research activity, on one side, on the other hand, different routes starting from diversified approaches have been proposed.

Synthetically, all the approaches can be, simply, classified according to the following typologies: i) indoor Radon measurements campaign-based approaches, ii) geology-based and geology-indoor correlation based, and iii) integrated ones.

On the base of the latter kind of approach, we have started an interdisciplinary research program with contributions from several fields: geology, geomorphology, pedology,

environmental physics and building engineering, aimed to develop a standard methodology, based on a multi-scalar hierarchical (regional - provincial - sector- zone - site) procedure of assessment of the Radon exhalation from soils, which, for the first time enables us to establish the basic steps and tools necessary to the realization of a such methodology.

We report a short account of the main features of this procedure, even though still in development, and the preliminary results obtained so far.

Such a procedure is based on an integrated approach to the problem as it requires the use of techniques of analysis, which are differentiated at the different scales of the territorial investigation, but, at the same time, are interactive and progressively more deepened and more specific, from the zone mapping at the regional scale to the modelling at the scale of single site.

Our research work is based on a complete cartographic database consisting of both suitable land use information and experimental data provided by Radon concentration measurements in soil gas performed in several sites and indoor measurements, integrated in a GIS-based management procedure and performed using the equipment made of a Durridge Electronic Radon Detector RAD7 together with an AMS Soil Gas Probe, plus a Rad Elec E- PERM (Electret - Passive Environmental Radon Monitor) system. On the basis of the retrieved geostratigraphic and geomorphologic informations some simple “pictures” of the investigated soils have been made, showing essentially a two-component system behaviour: the true soil and the bedrock underneath, across which the Radon concentration in the soil gas varies only according to the depth from the surface due to the Radon transport phenomenon, taking place mainly in the unsaturated zone This can be described, at first order, mainly by a one-dimensional model, the so-called TRACI model, (standing in French for Radon Transport within the Unsaturated Layer). This model, has been already successfully applied by French researchers, from the Institut de Protection et de Sŭreté Nucléaire (I.R.S.N.), to the evaluation of the properties of cover layers for Uranium Mill Tailings.

The preliminary results show a reasonable and encouraging agreement between the expected values, from this very simplified model of soil, implemented into the context we have envisaged, and the experimental data, collected during the measurements campaign and performed at the sector, zone and site scale. Further, they confirm the validity of the procedure, so far implemented and that the realization and proposal of a standard unified and integrated methodology for the assessment of Radon Prone Areas on the territory can be accomplished.