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Managing risks from radon and NORM

1° Annua Meeting (online)
6-7 September 2021

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Session 2: Stakeholder' Priorities Challenges & Perspectives

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Session 2: Stakeholder' Priorities Challenges & Perspectives

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1. The improvement of the geogenic radon mapping by using spatial multivariate techniques to provide maps of what Earth delivers in term of radon exhalation and/or buildings and areas with high indoor radon levels (Radon Priority Areas). A lot of techniques are used in the literature to construct different radon maps also including indoor measurements and vulnerability (i.e., population)
2. Optimization of the use and the performance of continuous radon monitors for the control of preventive measures and/or corrective actions (i.e., RESPIRE ventilation system).
3. Within the LIFE-Respire project we are also conducting experiments on the modelling of the radon diffusion in confined environments.
4. Conducting experiments about anti-radon constructive materials by activating research agreement with industry leader in the production of adhesives, sealants and chemical products that can prevent radon entry from the soil and/or from the construction materials.

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Research in mapping techniques

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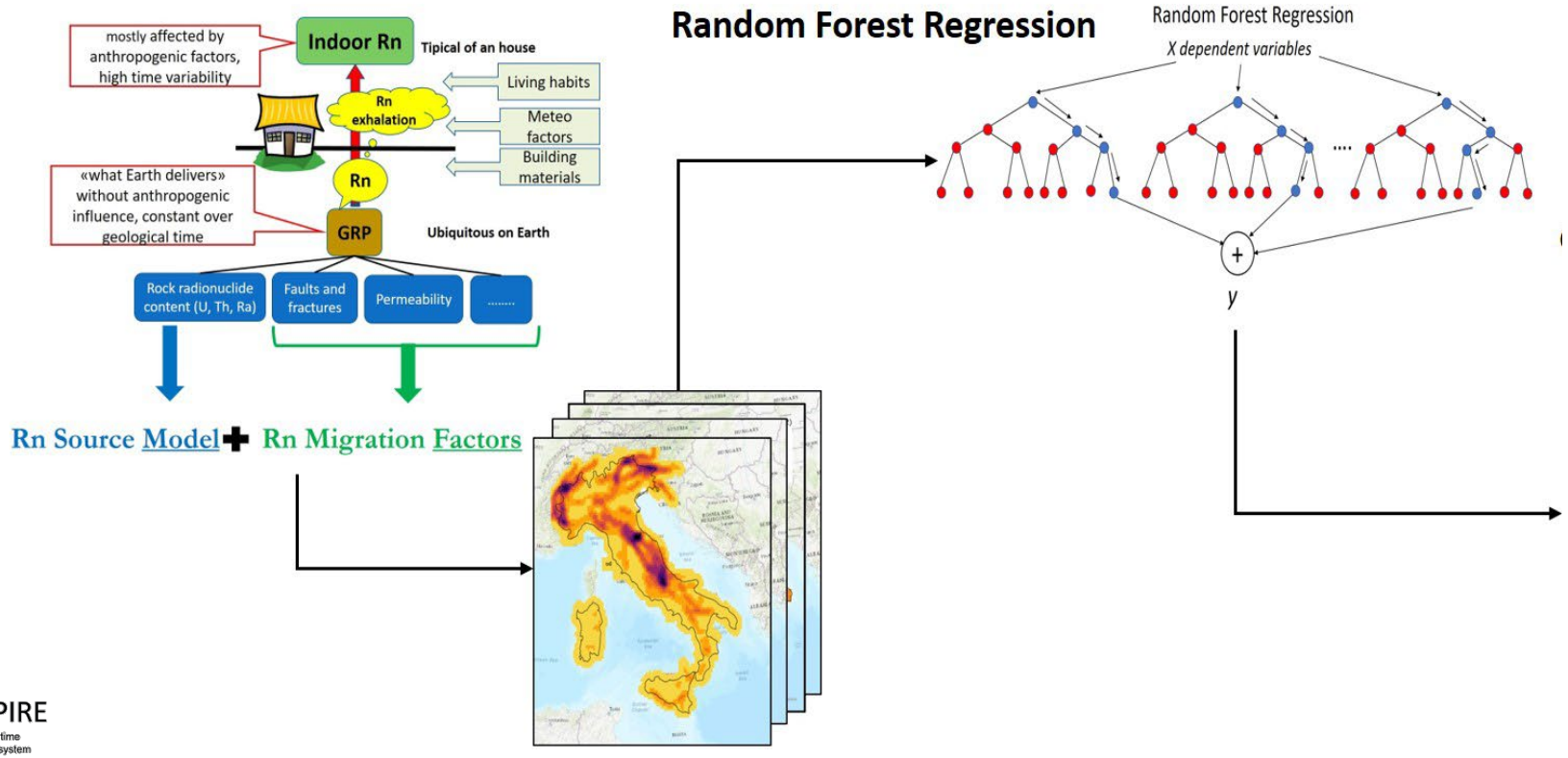
1. Improve the geogenic radon mapping with the use of multivariate regression technique (also machine learning approach) to construct maps of the GRP moving toward the radon risk maps by including indoor measurements, as well as the exposure of inhabitants for the individuation of the RPA as required by the Directive 2013/59/Euratom



Geogenic Radon Potential Map

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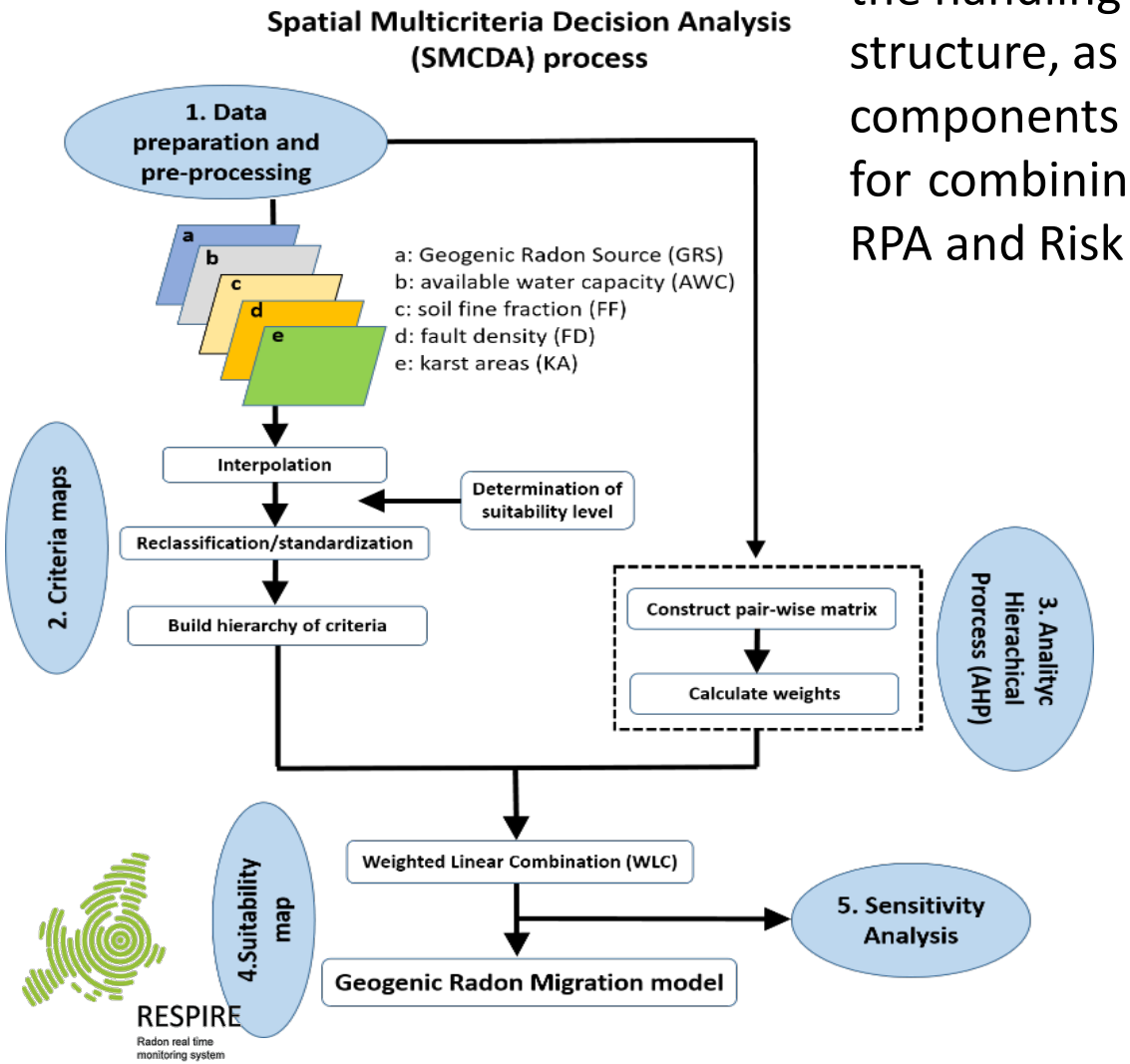
Research in mapping techniques

Multicriteria decision analysis (MCDA) concerns the combination and the handling of different criteria by organising them into a hierarchical structure, as well as studying the relationships among the several components of a problem. GIS-based MCDA can be used as a process for combining and transforming input data into decision output (GRP, RPA and Risk maps)



Geogenic Radon Potential Map

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Radon Mapping: Challenges and Perspectives

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1. Radon maps have different objectives. They depend from

- the used data
- the mapping scale
- the estimation techniques

2. Challenge

- Data and model uncertainty
- Data variability caused by outliers (spatial? temporal?)
- Data harmonization at the boundaries, for example geological maps are often very different in correspondence of the boundaries between neighbour countries (i.e., MAUP)
- Consider that Radon in the environment is a complicated multivariate phenomenon, thus including not only parameters linked to the radon source and migration in the subsoil, but also those affecting radon exhalation from the soil such as meteorological parameters, and radon entry in buildings, i.e., dwelling and soil characteristics
- another aspect that should not to be underestimated is How to communicate the significance of this maps to the public and/or to the politics to be accepted.

3. Perspectives

- what to map: hazard, vulnerability, risk
- Which is the target audience (scientists, public, administrations, politics,…..)

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Mitigation: performance of radon monitoring techniques

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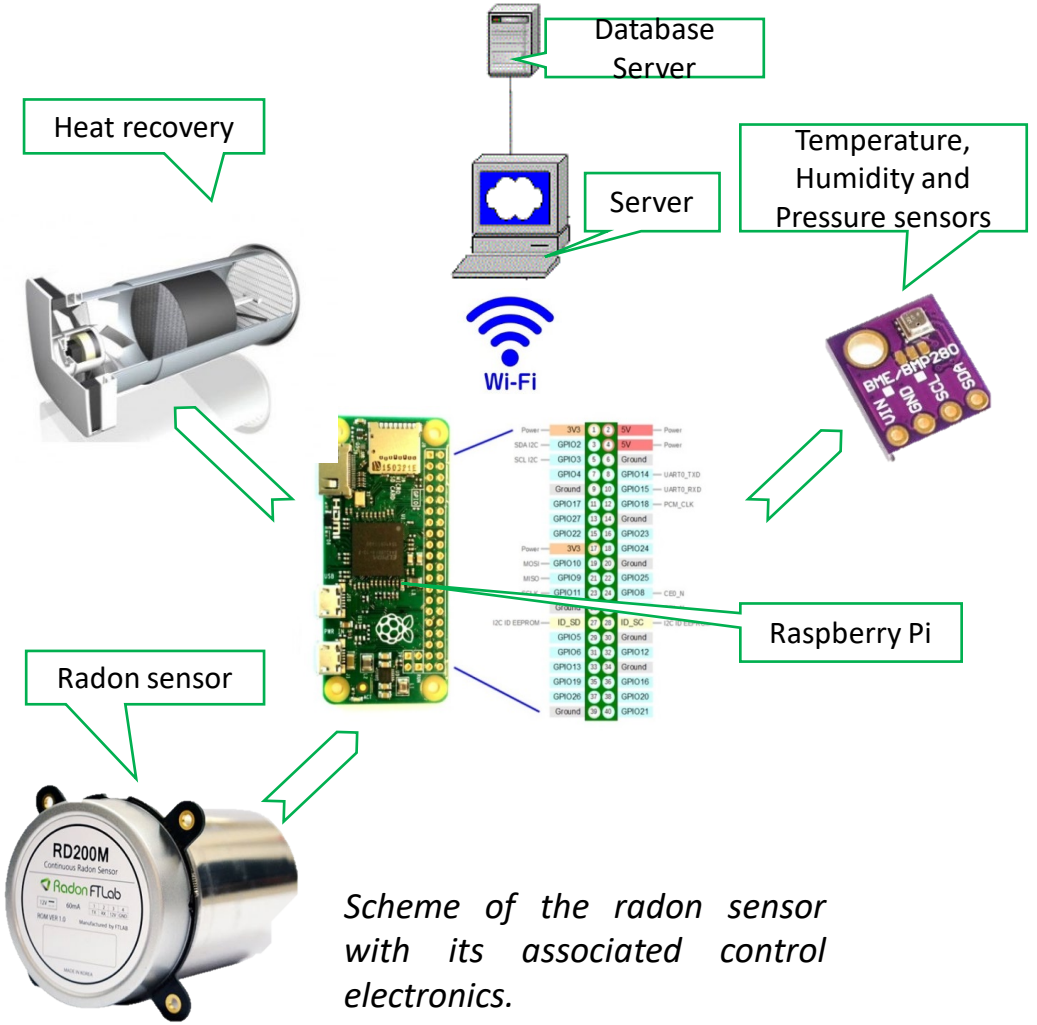
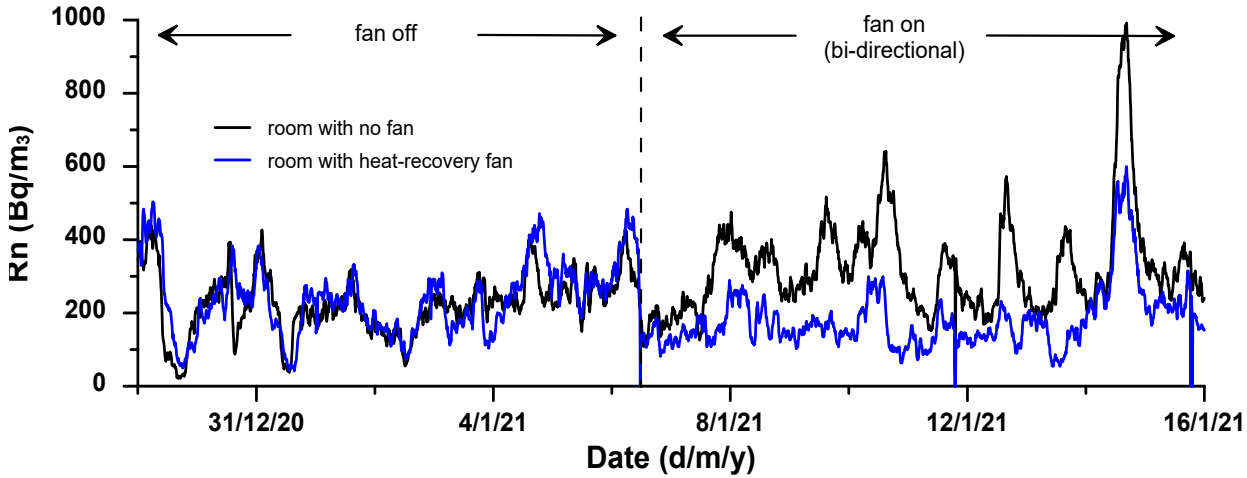


Scheme of the radon sensor with its associated control electronics.

2. Optimization of the performance of the existing ventilation system, the use of continuous radon monitors for the control of preventive measures and corrective actions (the example of the LIFE-Respire Remediation System).



Radon concentrations in two adjacent rooms, one with and one without a heat-recovery unit. Note that for the period when the fan is off the concentrations are very similar, whereas once the fan is turned on the radon concentrations in the test room are significantly lower than those in the control room.

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Radon Mitigation: Challenges and Perspectives

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1. Radon monitoring objectives.

- keep under constant observation the concentration of radon in confined environment in order to identify exceedances of the recommended value and to evaluate and prevent the radiological risk

2. Challenges

- optimize radon monitoring in various public and private environments and buildings (in terms of size and construction type) also in different countries
- the duration of the measurement minimises the uncertainty of the measurement and eliminate human errors
- sensitivity and accuracy of the sensors, and sensor certification
- consider and estimate the problems relating to the habits of life of the inhabitants
- the main challenge is to interpret the data in the real world

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Radon: Mitigation techniques

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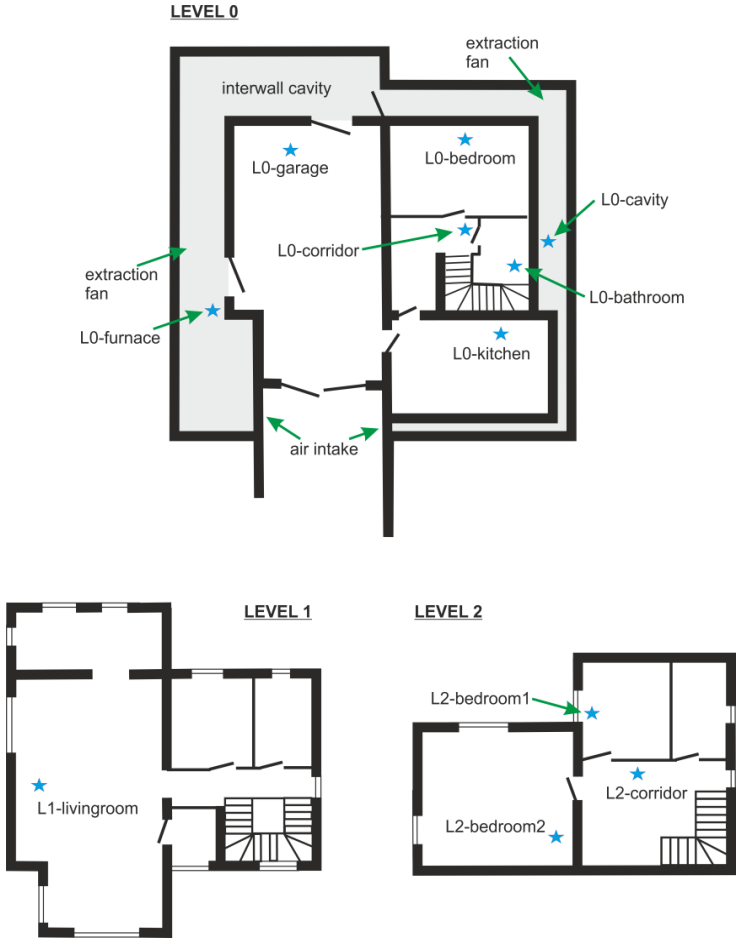
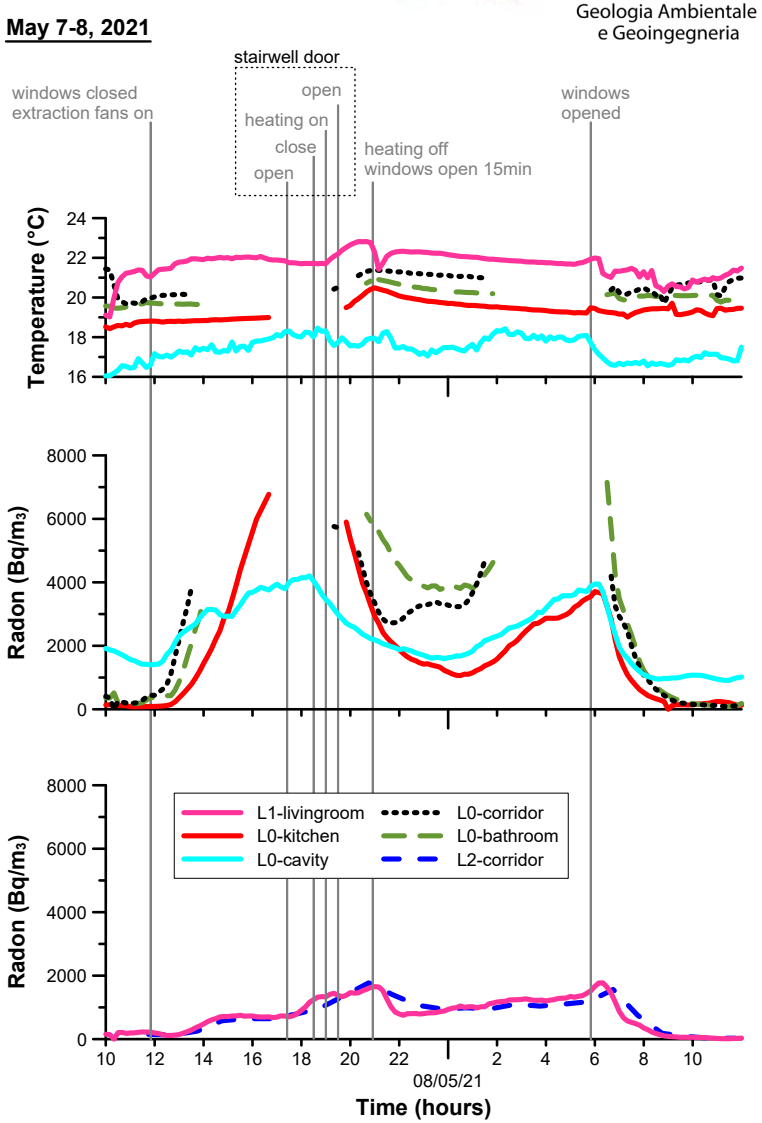


3. Within the LIFE-Respire project, the Respire research group is conducting experiments on the diffusion of radon in confined environments. The main objective of this experiment was to better define the main radon source in the building and evaluate air exchange between the different levels in order to plan a more effective remediation system



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Radon modelling: Challenges and Perspectives

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1. Radon modelling objectives.

- The main objective of these experiments was to better define the main radon source in a building and evaluate air exchange between the different levels or rooms in order to plan a more effective remediation system.

2. Challenges

- The estimate of the radon growth entering in the room and if the amount of air moved by the fan is sufficient to reduce the radon concentration. Important parameter is the scale of the experiment (large size buildings, more levels, more rooms)
- how much air must be moved according to the type and size of the building? In order to appropriately size the ventilation system
- Evaluation of the use of more fans

3. Perspectives

- Propose a classification scheme of the building materials and a standard protocol for the measurement of the radon exhalation rates

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Mitigation techniques: constructive material

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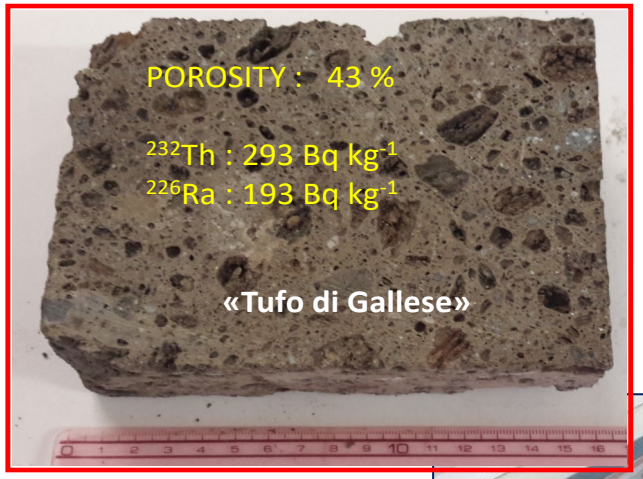
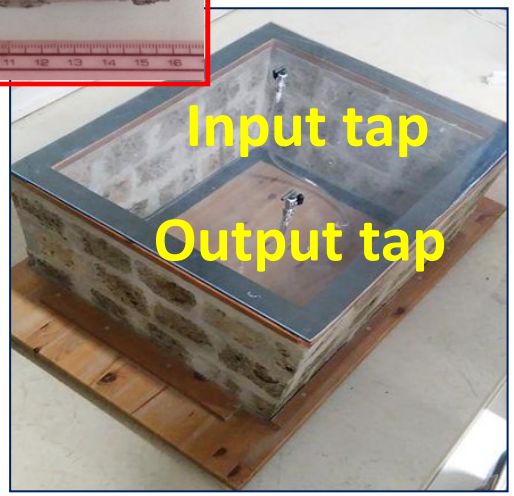
4. Conducting experiments about anti-radon constructive materials. We are activating a research agreement with MAPEI, an industrial partner known all over the world as leader in the production of adhesives, sealants and chemical products for the building industry. This activity is in collaboration with Prof. Paola Tuccimei, University of Roma TRE

Lithoid ignimbrite from Vico apparatus



Model Room



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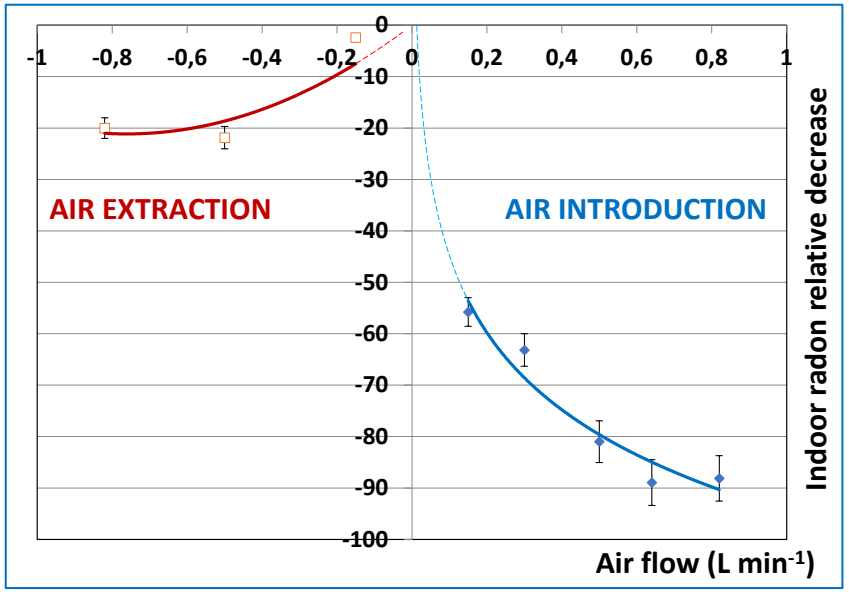

The influence of air introduction versus air extraction in the model room

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Radon Modeling: Challenges and Perspectives

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1. Radon mitigation objectives.

- Study of the radon exhalation rates from building materials in order to reduce the indoor radon exposure and potential health hazard to occupants

2. Challenges

- Evaluate the effects of the grain size, humidity and temperature on radon exhalation rates
- Evaluate the effects of the ventilation systems in the radon emanation from building materials
- Evaluate the effects of external membranes, adhesive, sealant and other chemical products in public and domestic buildings (especially in Near Zero Efficient Buildings)
- Evaluate the effects of the ventilation systems

3. Perspectives

- Propose a standard protocol for the measurement of the radon exhalation rates and a classification scheme of the building materials in terms of anti radon barriers

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Potential links with RADONORM

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Mapping

RADONORM WP2

Task 2.2: Transport of radon in the environment

- Subtask 2.2.1 Radon and thoron exhalation from the ground

Task 2.4: Improvement of methods to identify high indoor radon levels (radon mapping and other methods)

- Subtask 2.4.1. Methods for improving the identification of buildings and areas with high indoor radon levels
- Subtask 2.4.2. Studying the influence of local underground voids, both of karstic and anthropic (e.g., caves and catacombs) origins, on radon levels

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Potential links with RADONORM
Monitoring and modelling

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RADONORM WP5

- **Task 5.1 Overview of regulatory approaches and international standards focused on systems and methods (preventive measures, corrective actions) to control radon in workplaces and dwellings**
- Subtask 5.1.1 – Overview of radon risk mitigation measures used in dwellings
- Subtask 5.1.2 – Overview of regulatory approaches radon control systems and methods used at workplaces
- Subtask 5.1.3 Strategy for large scale buildings mitigation and prevention: overview of regulatory approaches and differences with strategy used for small buildings

- **Task 5.2 Innovative radon control technologies and strategies for mitigation systems in buildings**
- Subtask 5.2.1 – Harmonization of energy saving technologies and radon control technologies with respect to radiation protection and general indoor air quality requirements
- Subtask 5.2.3 – Utilization of continuous radon monitors for control of active operation elements of radon mitigation systems

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Potential links with RADONORM Building Materials

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RADONORM WP2

- **Task 2.3: Exposure to radon in buildings**
- Subtask 2.3.1. Building materials as a source of indoor radon exposure

RADONORM WP5

- **Task 5.2 Innovative radon control technologies and strategies for mitigation systems in buildings**
- Subtask 5.2.2 – Radon control technologies focused on mitigation of radon exhalation from building materials
- Subtask 5.2.4 – Advanced methods of radon diffusion coefficient determination in radon-proof membranes used as a passive radon preventive and remediation measures

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