EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

trace Radon

EURAMET

# Radon: An issue in radiation protection and climate observation

## EMPIR 19ENV01 traceRadon

*This project 19ENV01 traceRadon has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.*

***19ENV01 traceRadon** denotes the EMPIR project reference.*

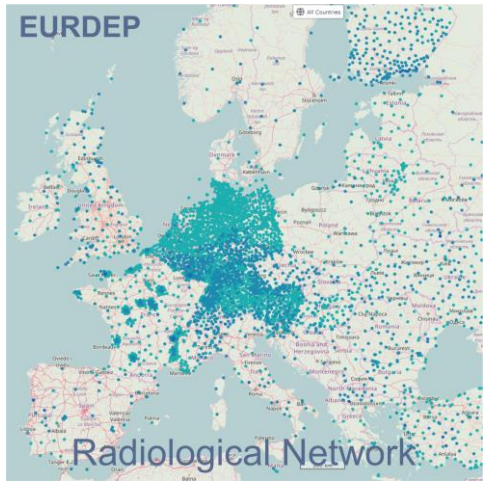
PTB Physikalisch-Technische Bundesanstalt Braunschweig und Berlin · Budapest Főváros Kormányhivatala · CMI Czech Metrology Institute · ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile · IFIN-HH · NPL National Physical Laboratory · AGES · LQR · ICOS Atmosphere Thematic Centre · ICOS Carbon Portal · INESCTEC · European Commission Joint Research Centre · University of Bristol · UC Universidad de Cantabria · UPC · ideas

Annette Röttger, Coordinator of 19ENV01 traceRadon

TC-IR Meeting 2021

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

# EMPIR 19ENV01 traceRadon


**Climate change is one of the greatest challenges of our time.**

The temperature rise of the atmosphere of our planet, due to the greenhouse effect, is caused by the increase of GHG emissions.

- ICOS: Monitoring of GHG emissions, the dispersion of GHGs and the resulting GHG concentrations in air, is of utmost importance for appropriate climate change mitigation measures.
- EURDEP: Collection and exchange of radiological monitoring data between participating countries of the radiation in the environment.

Both networks could profit from radon measurements at the outdoor level. But **traceability to the SI system** is not established yet.

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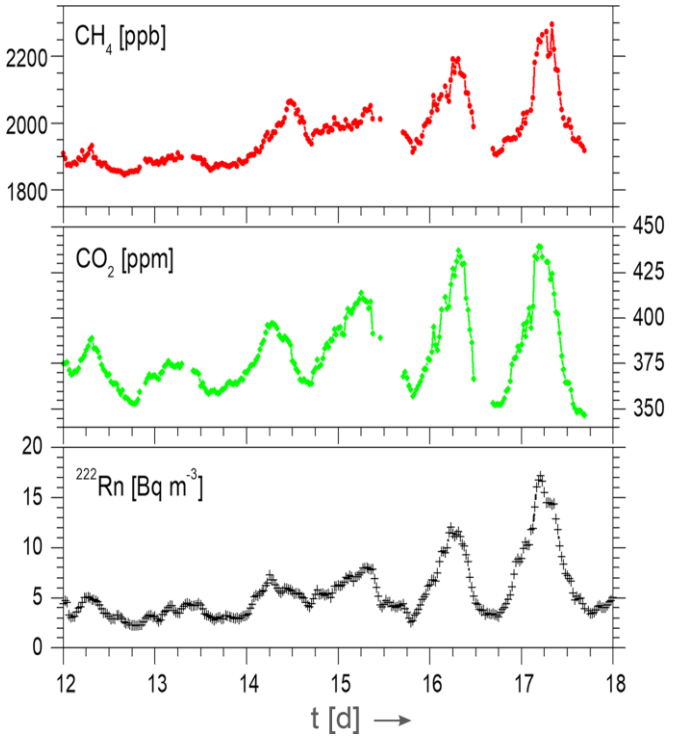
Why is Radon an issue in **climate observation**?

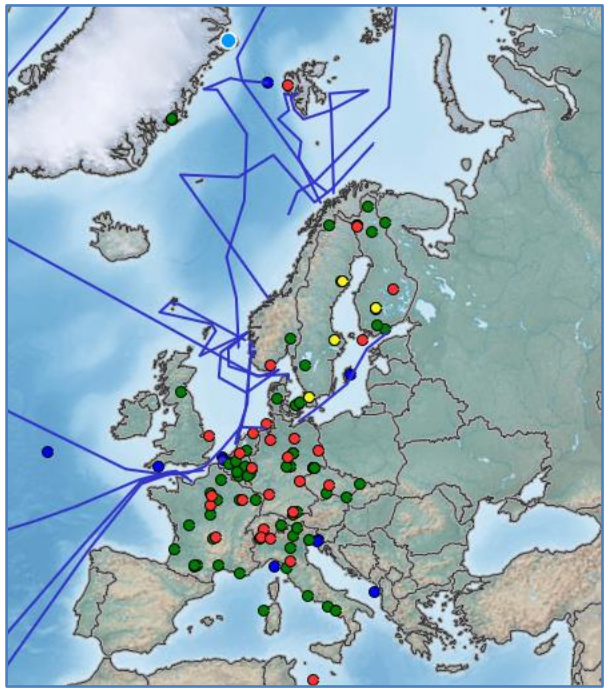
- GHG **flux measurements** are difficult though GHG concentration measurements are established.
- With radon activity concentration and radon flux measurements GHG fluxes can be **traced**!




***ICOS Atmospheric Station Specifications:***

Radon monitor: "At the present stage, Radon-222 measurements are not mandatory in ICOS. However, Radon-222 is recognized as a very valuable measurement, in particular for trace gas flux estimates."

- Determine source terms of GHG



# EMPIR 19ENV01 traceRadon


1. To develop traceable methods for the measurement of **outdoor low-level radon activity concentration** in the range of **1 Bq m$^{-3}$ to 100 Bq m$^{-3}$**, with uncertainties of **10 % for k = 1**, to be used in climate monitoring (…) .
2. To develop the capability for traceable **radon flux measurements in the field**, based on the development of a radon exhalation reference system “exhalation bed” and a transfer standard (…) .

Flux ⟷ Concen-tration

$$j_{\mathrm{CH_4}} = j_{\mathrm{Rn}} \cdot \frac{\Delta c_{\mathrm{CH_4}}}{\Delta c_{\mathrm{Rn}}}$$

3. To **validate current radon flux models and inventories** by the new traceable measurements of radon activity concentration and radon flux (…).

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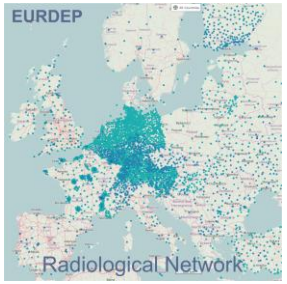
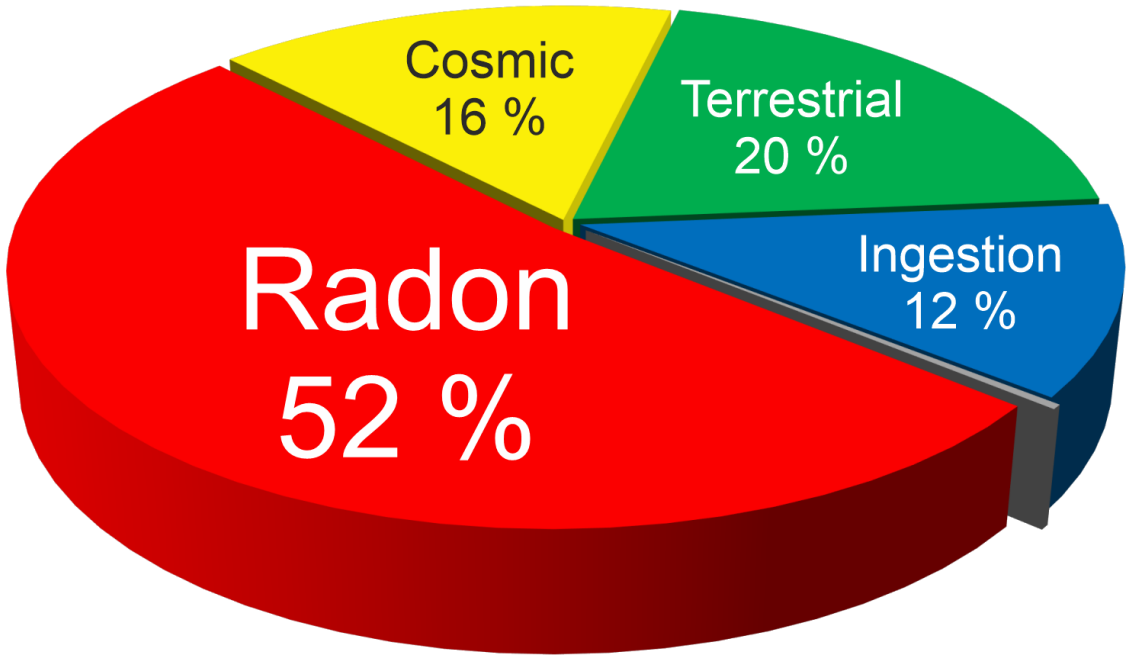



1. To develop traceable methods for the measurement of **outdoor low-level radon activity concentration** in the range of **1 Bq m$^{-3}$ to 100 Bq m$^{-3}$**, with uncertainties of **10 % for k = 1**, to be used in climate monitoring (…).
2. (…).
3. (…) To support the validation with dosimetric and spectrometric data from the **radiological early warning networks in Europe** (…).
4. To provide **easy to use dynamic radon and radon flux maps** for radiation protection in line with Council Directive 2013/59/EURATOM, including their use to identify RPA and radon wash-out peaks (…).

UNSCEAR, 2008:
Radon and its progeny contribute about half of the natural radiation dose to the public.

Public exposure to natural radiation:
Total average individual dose:
3 mSv a$^{-1}$

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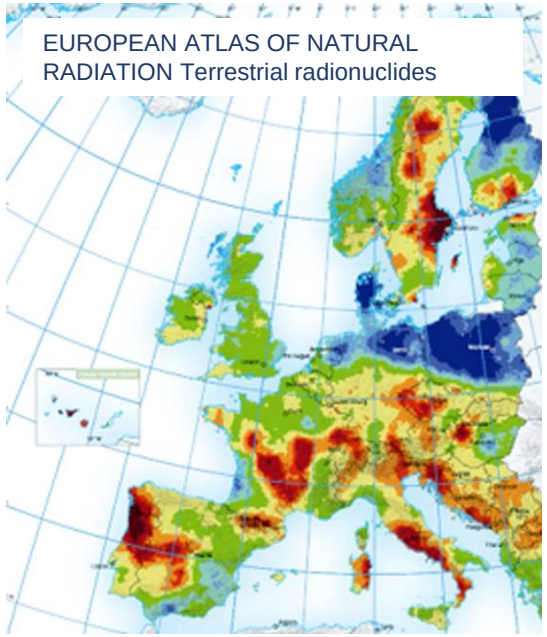
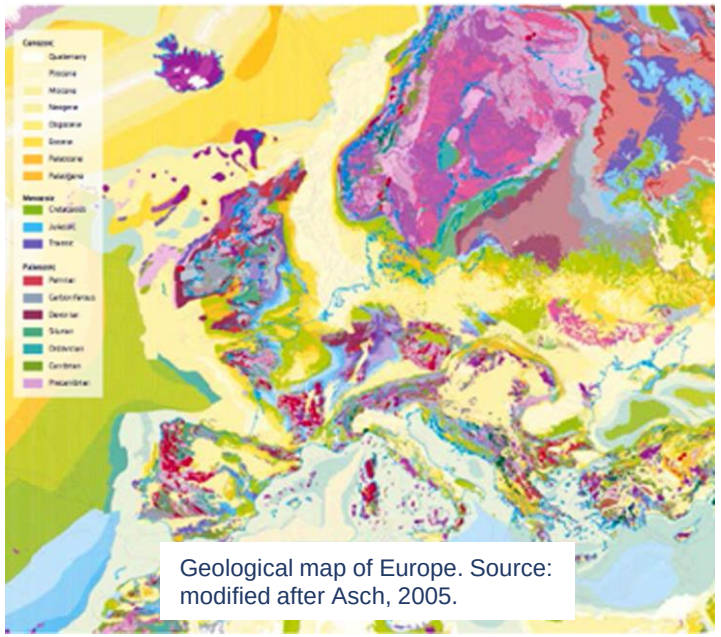
## Static maps:

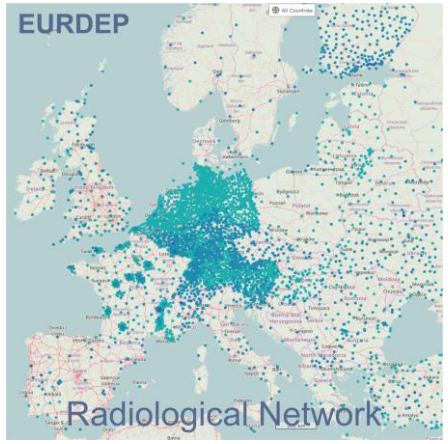


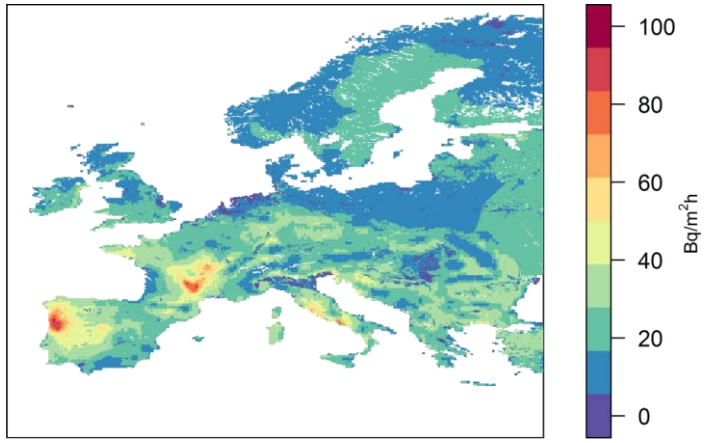



Geological map of Europe. Source: modified after Asch, 2005.

## Dynamic maps:

The early warning network shows online data for the dose rate. But **outdoor radon concentration** or even better online data on **radon flux** (emission) is missing!

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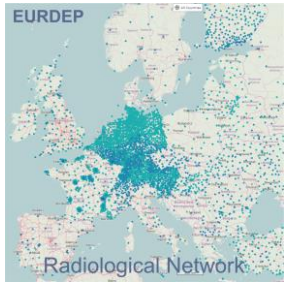
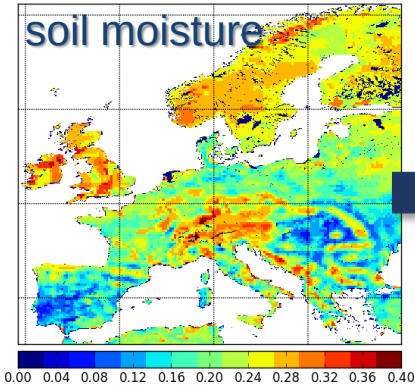
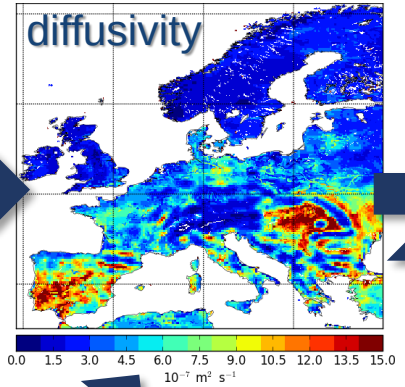
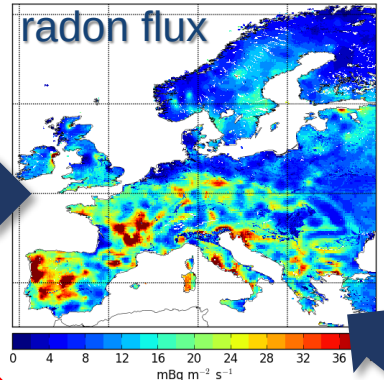
## Our task: Joining forces in the field of radon

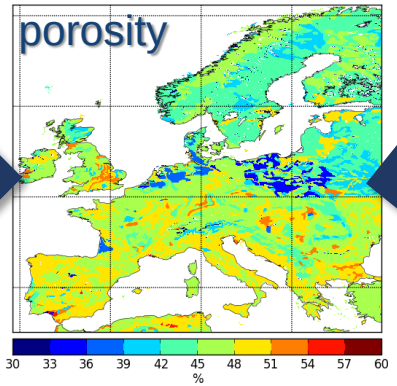



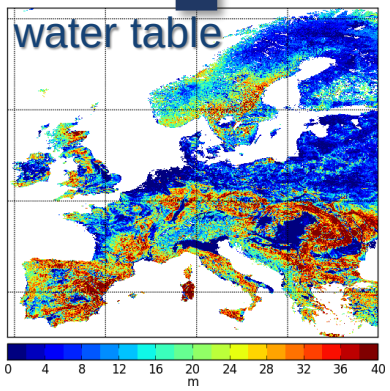



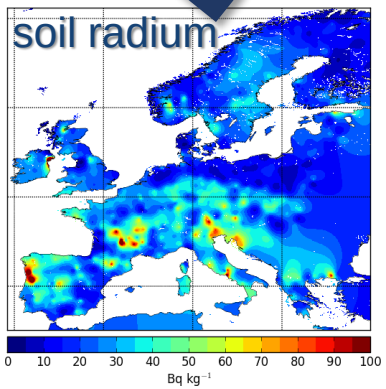




soil texture
% clay
% sand
% slit

bulk density




based on Karstens et.al. 2015

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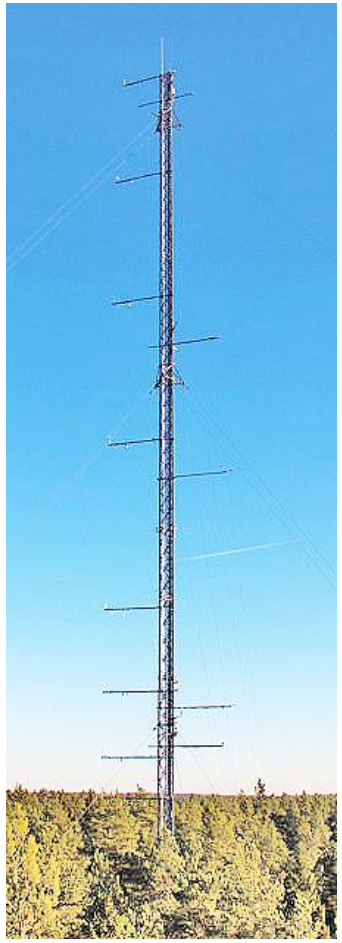
**traceRadon** serves the purpose to establish a **metrological base** which supports environmental **outdoor radon measurements** for the use in climate observation and in radiation protection for the public.



- Development of traceable methods for the measurements of outdoor low-level radon activity concentration in air in the range of 1 Bq/m³ to 100 Bq/m³ (WP1)
- To improve radon flux measurements for RPA and to develop standard protocols for radon tracer method to retrieve GHG fluxes (WP2)
- To validate existing radon flux inventories and models with new data from the radiological early warning networks in Europe as well as traceable radon activity concentration and radon flux measurements (WP3)
- To provide dynamic radon and radon flux maps (WP4)
- To facilitate the take up of the technology and measurement infrastructure developed in the JRP (WP5)

traceRadon will provide the **metrology for the growing radon measurement needs** for different purposes that influence all parts of modern society and facilitate the use of this data in industry, scientific communities, standard organisations and all kinds of end users like decision makers or the public.

# EMPIR 19ENV01 traceRadon

Bringing scientific achievements together for the benefit of two large Stakeholder groups:

- **Climate research** and **radiation protection research** needs support of traceable low-level outdoor radon measurements according to the needs of UNFCCC and the Council Directive 2013/59/Euratom.
- Radon and radon flux data is needed to estimate regional GHG emissions fluxes and radon priority areas (RPA) but the uncertainties are too large due to missing metrological capabilities.
- Working on the distinction from anthropogenic and natural GHG emissions!

*This presentation includes material from publications / presentations from partners and collaborators of the EMPIR 19ENV01 traceRadon project.*
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