Executive Summary

The 3-year Research Project MetroRADON (Metrology for Radon Monitoring), funded within the European Metrology Programme for Innovation and Research (EMPIR), is now in its last year. The purpose of the project is to develop reliable techniques and methodologies to enable SI traceable radon activity concentration measurements. More information can be found on the MetroRADON website.

The results gained within the project need to be shared and discussed with the stakeholders. First MetroRADON workshops and meetings for stakeholders took place and more will follow. In addition co-operations with existing networks and research programmes were established. The high interest in collaboration and in the topics of MetroRADON confirms the importance of the project for a variety of European stakeholders in the field of radon. Results were presented at several conferences all over Europe and are available as reports on the MetroRADON website.

This newsletter highlights some recent actions from the project, lists some of the dissemination activities and announces upcoming MetroRADON events. Details of the project tasks and results are discussed in the "Status Report" that can also be found on the website. All the mentioned material is available on the Document section of the MetroRADON website and directly linked in this newsletter.

If you are interested in collaborating with MetroRADON or want to join the Industry Interest Group, please contact us!

Contact

Franz Josef Maringer, Michael Stietka,
JRP coordinator
Bundesamt für Eich- und Vermessungswesen
Physikalisch-Technischer Prüfdienst
contact@metroradon.eu
www.metroradon.eu

MetroRADON Partnership

BEV-PTP: Physikalisch-Technischer Prüfdienst des Bundesamts für Eich- und Vermessungswesen, Austria (coordinator)

BFKH: Budapest Főváros Kormányhivatala, Hungary

CEA: Commissariat à l'énergie atomique et aux énergies alternatives, France

CMI: Cesky Metrologicky Institut, Czech Republic

IFIN-HH: Institutul National de Cercetare-Dezvoltare pentru Fizica si Inginerie Nucleara "Horia Hulubei", Romania

PTB: Physikalisch-Technische Bundesanstalt, Germany

STUK: Sateilyturvakeskus, Finland

VINS: Institut Za Nuklearne Nauke Vinca, Serbia

AGES: Österreichische Agentur für Gesundheit und Ernährungssicherheit, Austria

BfS: Bundesamt für Strahlenschutz, Germany

CLOR: Centralne Laboratorium Ochrony Radiologicznej, Poland

IRSN: Institut de Radioprotection et de Surete Nucleaire, France

JRC: Joint Research Centre - European Commission, Europe

SUJCHBO: Státní ústav jaderné, chemické a biologické ochrany, v.v.i., Czech Republic

SUBG: Sofiiski Universitet Sveti Kliment Ohridski, Bulgaria

UC: Universidad de Cantabria, Spain

METAS: Eidgenössisches Institut für Metrologie, Switzerland

MetroRADON collaborators

DiMEILA Centro Ricerche INAIL, Italy

EURADOS, international

Istituto Superiore di Sanità, Italy

LIFE-Respire-Consortium, international

Radonova, Sweden

University of Babeș-Bolyai, Romania

Universidade de Coimbra, Portugal

University of Novi Sad, Serbia

HIGHLIGHTS

Save the date! Upcoming MetroRADON workshops and training course

To present the results of MetroRADON, two workshops and a training course will take place in spring 2020. We invite all our stakeholders from national authorities, industry, scientific sector, end users and all other interested parties to participate. Please, save the date, more information will follow in autumn!

Workshop about "Harmonisation of radon measurement methodologies and radon priority areas": *25-26 February 2020, Vienna*

This workshop will be combined with a European Commission JRC workshop about "Challenges in the implementation of EU-BSS" (*27-28 February 2020, Vienna)* and the European Radon Association (ERA)-workshop about "Radon Research" (*24 February 2020, Vienna*)

Workshop "New procedures for radon monitoring"*: 12 May 2020, Berlin*

Training seminar for radon instrument calibration and measurements: *13 May 2020, Berlin*

Comparison of existing radon gas primary standards according to CCRI(II) rules

Within MetroRADON comparisons of existing radon gas primary / national standards at European NMIs/DIs in the few kBq range have been performed from April to June 2019. The ^{222}Rn comparison is registered at EURAMET under the number 1475. More details can be found here. The samples have been sent to the eight participants. The results will be shared as soon as finished.

Patent submitted within MetroRADON!

SUBG has studied radon penetration by diffusion into closed volumes that use polymer foils as anti-thoron barriers, at different temperatures. SUBG developed a method that reduces the influence of the temperature and thoron on passive radon detectors and submitted a patent application entitled: *Compensating Module For Sensors For Measuring Of Radioactive Noble Gases* (Bulg. Pat. Appl. Reg. Nr. 12897, priority 19.03.2019, inventor: D. Pressyanov, assignee: SUBG).

Stakeholder Involvement – workshop, meeting, discussion forum

A dedicated workshop on *Transport of Radon and Thoron in Polymers* was organized in Sofia in 21-22 March 2019 by SUBG. The outcomes and achievements of different groups and researchers engaged in research in this field were reported on the workshop. More information and presentations are available on the MetroRADON website.

The first meeting of the MetroRADON Industry Interest Group (IIG) was organized in Braunschweig on 18 June 2019 by PTB. The goals of the meeting were to present first MetroRADON results and discuss them and to establish an IIG network within MetroRADON community. The networking will be continued in a dedicated IIG online discussion forum. If you want to be part of it, contact us!

More information about the meeting and the forum is available on the MetroRADON website.

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

Development of calibration procedures at low activity concentration

The radon reference facility was established at the German Federal Office for Radiation Protection (BfS). The facility enables the creation of stable and traceable radon reference atmospheres for calibration purposes. Long-term stable activity concentrations are achieved by using an emanation source with a constant emanation rate. Figure 1 shows the time course of the calibration of a customer instrument (Alphaguard). Starting from an atmosphere without radon (measurement of the instrument background), the instrument then measured at different radon activity concentration levels (1-4). In addition to the approximation to the set radon values, the figure also shows the decrease in the radon activity concentration due to radioactive decay (5). The time course is interrupted between about 500 and 800 hours to reset the display of the device by exposure in a zero radon atmosphere. Exposures resumed for periods greater than 800 hours are used to verify measurements and to test the repeatability of exposures. Each of the set radon values was kept constant for about 4 days. The data provided by the customer instrument are on average about 5 % below the calculated radon activity concentrations.

The results will be used for the development of calibration procedures in the activity concentration range from 100 Bq/m^3 to 300 Bq/m^3.

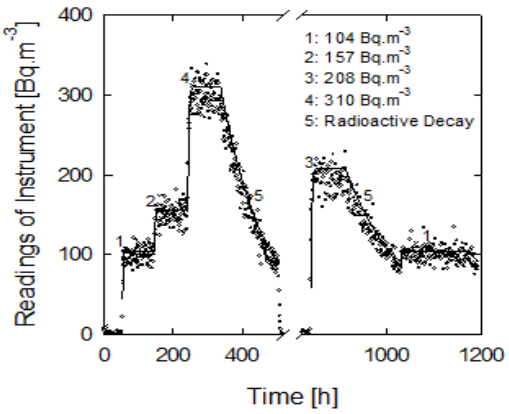

Fig. 1: Example for the time course of calibration exposures imposed on a costumer instrument (Alphaguard) Dots indicate the readings of the instruments, and lines the results of calculation

Field radon intercomparison exercise – report available!

The intercomparison was held from 5-8 November 2018 in the Laboratory of Natural Radiation (LNR) located at the facilities of the former uranium mine of Saelices el Chico (Salamanca, Spain). 20 participants from 13 countries took part in radon in air intercomparison, three in radon exhalation from soil and five in radon in soil exercise. Regarding to radon in air measurements, a total of 23 groups of passive detectors and 22 active monitors were exposed at LNR with variation of radon concentration from approximately 0.5 to 30 kBq/m^3. Two exposures were performed with reference values of E_1= (356 ± 8) kBq m^{-3} h and E_2= (1014 ± 13) kBq m^{-3} h obtained from participant results according to ISO 13528:2015 (Fig.2).

The full report of the comparison exercise is downloadable here and on the MetroRADON website.

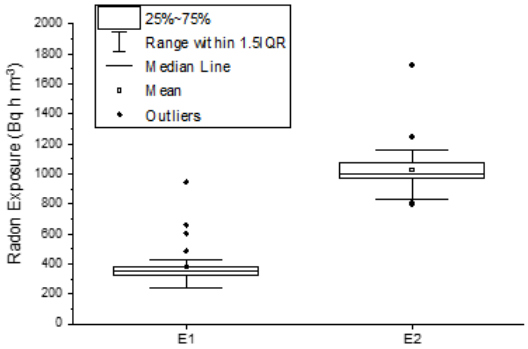

Fig.2: Boxplot diagram of the participant's results for exposures E1 and E2

Cross-interference testing of radon instruments in the thoron chamber

The validation of the cross-interference testing of radon instruments in the thoron chamber was started. For this, the repeatability of exposure concentration and cross-interference signal of an instrument as well as the stability of thoron concentration during the exposures needs to be ensured. In addition, the homogeneity of thoron inside the chamber - first by as-

sessing temporal variations of thoron concentration during exposures and later by aerogel traps – will be investigated. The humidity in the chamber will be stabilized by using salt slurry humidifier. The cross-interference signals will be fitted into the in-growth function of ^{212}Pb and the uncertainty calculations relating to the results will be considered. A standardized testing protocol for will be developed.

First results on the analysis of MetroRADON questionnaire data on indoor radon surveys

To answer the question, if existing indoor radon measurements procedures from different indoor radon surveys are comparable in Europe, a questionnaire was developed. The questionnaire was addressed to all European institutions working in this field - not only national authorities but also regional administrations, universities, research centres. They were invited to complete a separate questionnaire for each survey. Between December 2017 and July 2018, a total of 56 questionnaire forms on indoor radon surveys were completed on national and regional surveys from 24 European countries. The first results were presented at the III International Conference Radon in the Environment (27-31 May 2019, Krakow, Poland) and are available here and at the MetroRADON website. A report will be available later.

The Geogenic Radon Hazard Index (GRHI)

One central topic of Metro Radon is the development of the Geogenic Radon Hazard Index (GRHI).

The GRHI should be an optimal predictor for the geogenic contribution to indoor radon, independent of regionally available datasets, albeit if possible taking advantage of the information contained in them and it should be applicable irrespective borders. The GRHI shall serve as quantity to compare the geogenic radon hazard at different locations. In consequence, a European GRHI map can be generated which may serve to delineate radon priority areas on European scale.

There are two approaches: "Bottom-up", use input data from Europe-wide harmonized databases and "top-down", construct GRHIs from regionally available databases in a way that the resulting GRHIs are consistent between databases from which they have been calculated. Two test maps based on the bottom-up approach were presented at the III International Conference Radon in the Environment (27-31 May 2019, Krakow, Poland) (presentation available here and on MetroRADON website) and are shown in Figure 3. The left map use a machine learning algorithm including predictors as petrography, hydrogeological classes, hydraulic conductivity, soil types, silt and clay content, available water capacity, coarse fraction and bulk density, as well as the (x,y) coordinates. The right map uses a general linear model, with simplified geology, fine fraction, pH, bulk density, K_2O concentration and U concentration as predictors. The patterns coincide approximately. The methodology is developed further currently.

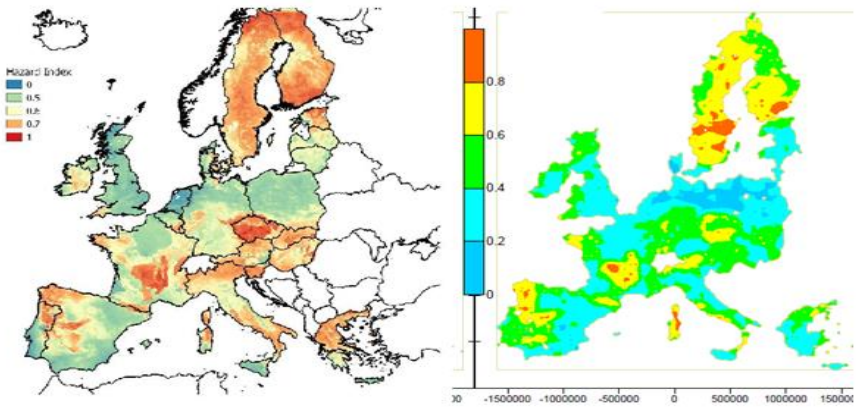

Fig.4: Test maps for GRHI based on machine learning algorithm (left) and general linear model (right) with different input variables

MetroRADON – publications

MetroRADON results were presented at several **conferences**, e.g. at III International Conference Radon in the Environment, May 2019, Krakow, Poland and the ICRM 2019, May 2019, Salamanca, Spain

A open access **peer-reviewed paper** was published by MetroRADON partners:

Gordana Pantelić, Igor Čeliković, Miloš Živanović, Ivana Vukanac, Jelena Krneta Nikolić Giorgia Cinelli, Valeria Gruber, 2019. Qualitative overview of indoor radon surveys in Europe. Journal of Environmental Radioactivity, Volume 204, August 2019, Pages 163-174. (*download*)

Additional and more detailed information on the presented highlights and can be found in the latest Status Report.

All Presentations, posters, reports and papers can be found in the Documents Section on the MetroRADON website.

Further information and contact

Franz Josef Maringer, Michael Stietka,
JRP coordinator
Bundesamt für Eich - und Vermessungswesen
Physikalisch-Technischer Prüfdienst
Arltgasse 35, 1160 Wien
AUSTRIA
www.metroradon.eu

MetroRADON – upcoming events

MetroRADON **workshops** and **training course**:

Workshop "Harmonisation of radon measurement methodologies and radon priority areas", Vienna, 25-26 February 2020

Workshop "New procedures for radon monitoring", Berlin, 12 May 2020

Training seminar for radon instrument calibration and measurements (WP2/WP5), Berlin, 13 May 2020

MetroRADON results will also be presented at several international **conferences**, e.g.:

Asia Oceania Geosciences Society (AOGS) 16th Annual Meeting, Singapore, 28 July - 2 August 2019

International Radon Symposium AARST 2019, Denver, Colorado, 9-11 September 2019

International Conference on Radiation Applications (RAP 2019), Beograd, 16-19 September 2019

9th International Conference on Protection against Radon at Home and at Work (Radon 2019), Prague, 16-20 September 2019

More details can be found in the Upcoming Activities Section on the MetroRADON website.