On the way to a European Atlas of Natural Radiation

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Radioactivity Environmental Monitoring (REM)
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www.jrc.ec.europa.eu
Mission of the JRC: provide scientific support for EU policies “collect, validate and provide information about radioactivity levels in the environment” based on the Euratom Treaty – main task of the Radioactivity Environmental Monitoring (REM) group, JRC Ispra

http://rem.jrc.ec.europa.eu
The REM group

http://rem.jrc.ec.europa.eu

Activities

Since 1967, REM supports the European Commission (EC) in its responsibilities to provide qualified information to the European Commission, the European Parliament and the Member States on the levels of radioactive contamination of the various components of the environment (air, water, foodstuff).

Such a support is provided both for routine and emergency situations:

- Routine measurements are managed in the **REM database**. This database contains qualified environmental radioactivity data from all EU Member states for the most relevant compartments in the EU environment since 1994. The database provides the basic platform for preparing the annual monitoring reports, as well as specific publications (e.g., Chemotroph deposition atlas). EURDEP is another system used in routine for collecting daily gamma dose-rates provided by 25 European countries.
- In the case of a nuclear or radiological emergency, REM provides support for the exchange of essential data and information, namely:
  - Messages notifying that an accident has happened, as well as all subsequent official information which are sent through the official EC emergency network ECURIE.
  - Real-time monitoring information collected from national automatic surveillance systems by the EURDEP system which further redistributes the data to the national and international competent authorities;
- Atmospheric dispersion forecasts model results that are exchanged and intercompared within ENSEMBLE.

REM also deals with a number of research activities in the field of atmospheric dispersion modelling, geostatistics and radiocology.

Summary information on past projects and activities can still be found in our archives.

http://eurdep.jrc.ec.europa.eu
De Cort, M. et al. (1998): Atlas of Caesium Deposition on Europe after the Chernobyl Accident,
EU Report Nr. 16733, EC, Office for Official Publications of the European Communities, Luxembourg
**European Atlas of Natural Radiation**

**Why?**

**Primary objectives:**
- Increase public awareness (and indirectly political awareness): *didactic and educational goal*;
- Familiarize (reassure?) the public with its (radioactive) environment;
- Provide *reference material*, contribute to methodology and scientific aspects.

**Indirect objectives and results:**
- **Support and stimulate communication** within scientific community on a complex issue (such as radon mapping, definition and estimation of risks) through meetings, workshops and publications;
- Generate *harmonized data* for the scientific community to be used for e.g. epidemiological, geological, radioecological,... studies;
- Potential support to EU Member States for the *radon action plan* (draft European BSS, art. 38).

REM is not dealing directly with health issues!
The EC's European Atlas of Natural Radiation will not substitute for, or compete with national activities in the field!
European Atlas of Natural Radiation

**Articles**
(Motivation, General Radiation Physics, Radon, Legal Status, Geology, Methods and Measurement techniques)

**Results**
(Discussion of the projects which are not directly displayed in maps:
statistics, methodology, models,...)

**Maps**
- Indoor radon
- Geogenic radon
- Cosmic radiation
- Outdoor radon
- terrestrial gamma dose rate
- Sources of terrestrial radiation, geochemical maps (non series nuclides, decay series nuclides)
- Water (ground water, surface water)
- Exposure: internal, external
- Total dose by natural radiation

**References** and literature review

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*already quite advanced!*

*in advanced planning phase*

*in progress*

*in discussion phase*

requires extensive modelling & additional spatial demographic data
Europe, Radon Map (EIRM)

Idea and Status

Status of EUR radon survey 2005

**Prague Radon conference 2006**

- Annual mean, ground floor rooms
- Access to data and privacy issues
- JRC collecting statistics of these data from National Authorities on a 10 km x 10 km grid:
  
  \[\text{AM, SD, AM(ln), SD(ln), Min, Max, MED, n}\]

**May 2012**

- 25 countries
- 18,791 non empty cells
- 818,791 measurements

European Indoor Radon Map (EIRM)

Status

Indoor Rn, ground floor, 10 km x 10 km grid, AM per cell

**AM within cells:** 100.2 Bq/m³
**MED ± MAD:** 65.0 ± 33.2 Bq/m³

**MAD (Median absolute deviation)** = median_i { | x_i - median_j (x_j) | }

Number of measurements per 10 km x 10 km cell

**Median number measurements per cell:** 4 ± 3
European Indoor Radon Map (EIRM)

- Collect **more data**, contact countries (ongoing)

- **Plausibility** and **comparability** checks of data: high values, coordinates,...

- **Quality assurance**: cross border effect

- **Questionnaire**

- Evaluate: **impact of parameters** (survey style, measurement methods) on radon data and influence on EIRM
Geogenic Rn map = independent of anthropogenic factors

Geogenic Rn = defined everywhere on solid earth

Indoor Rn = subject to human activity, temporally variable

Outdoor Rn

Living habits

Meteo

House construction

Building materials

Variability at different time scales

"what earth delivers", without influence of human interference, temporally constant over geologic timescale

"defined only in a house"
**EGRM-Progress report**

Summary of discussions” and “Status of knowledge in the field” as basis for future discussions and decisions → over 40 experts/authors of different fields invited to contribute → >360 pages → proofreading → updated version planned for this summer

**Structure:**

**Physics basics**
- Rn generation, transport, spatial properties,..

**Geology**
- geological classification systems, quaternary geology, special structures, tectonics,..

**The variables**
- types, analytical properties, operational variables (protocols), relations between variables...

**Defining the RP**
- different approaches

**Spatial estimation**
- GIS, spatial aggregation, LN modelling, Bayesian methods,..  

**Rn prone zones**

**Mapping issues**: resolution, scale, anomalies,.. 

**Uncertainties, QA**

incl. many case studies from all over Europe!
**European Geogenic Radon Map (EGRM) Status**

**Start:** Radon mapping symposium and workshop, Oslo, IGC33, 2008 → expert group

- 3 workshops/experts meetings (2x Ispra, Prague), extended expert group, discussions of national approaches and methods how to come to a harmonized European map

**Workshop, Ispra, November 2011 and ongoing work now:**

- Follow a **classification (multivariate)** and **continuous approach** in parallel
- Used **input quantities** for classification scheme should be: standardized indoor radon, soil gas radon, permeability, eU, dose rate, geology class, presence of special geological feature - classified [0,1] and weighted
- Agreed on a proposed **RP** definition: \[ RP := \frac{C_{\infty}}{-10 \log(k) - 10} \]
- Creating **Geogenic Radon database** - based on a radon relevant geological classification (using OneGeology, where possible; using some countries as example; including geology like quaternary) and fill with data (measurements, proxies, defaults)
- Prepare “**cooking recipes**” to follow by the countries
- Collect **sampling** and **measuring protocols** from the countries for standardisation
- New version of “**EGRM-progress report**” this summer
- Prepare **first classification maps**


Effective annual dose by cosmic radiation calculated for neutrons, directly ionizing particles and photons according to UNSCEAR 2000 based on the SRTM elevation map – 1 km*1 km grid

Discussion, next steps:

- Which factors should be taken into account?  
  - altitude a.s.l., latitude, solar activity, shielding effect

- Which model should be used? – Next step: Compare models
(External) terrestrial γ dose rate

Ideas, next steps, discussions:

• preparing maps out of γ dose rate data (EURDEP)

• calculate terrestrial γ dose rate – take into account cosmic radiation, artificial nuclides, self effect (Ref. Uni Basel)

• How do different radionuclides contribute to the external terrestrial radiation?

• Multivariate estimation: Estimate dose rate out of different data sets (geological data, soil data, air-borne γ)

• What data are available in countries/on European scale?
Ideas, next steps, discussions:

- Non-series primordial nuclides – maps reasonable and feasible? K-40?
- Feasible for which isotopes? Th, U, Ra isotopes (Bq/kg or ppm), Rn-222, Pb-210, Po-210
- Flux of the nuclides from soil/rock to the environment?
- Availability of data of U, Th, Ra and progenies in soil, rocks on a European scale?
Ideas, next steps, discussions:

Ground water maps

- Concentrations in water bodies or in used water?
- Could be looked at from consumers’ or producers’ angle (Population exposure)
- Characterization of water bodies/hydrogeological units possible?
  → Geologists!
  → Problem: Where does water come from – complex mapping!
- Availability of data?

Surface water maps

- Are they relevant to population dose?
**Internal dose by terrestrial radiation**

- Mapping feasible? – complex models for exposure pathways required

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**Total dose by natural radiation**

- **Goal:** Combine all maps / data and calculate a total dose for the population caused by natural radioactivity in a defined grid.

→ **Problem:** May have other than scientific consequences – political!
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Please join us on this way....

Discuss with us!
Share your ideas!
Provide us information about available data and studies in your countries!

Thank you!

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