Status of the European Atlas of Natural Radiation

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IES - Institute for Environment and Sustainability

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http://ies.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/
http://rem.jrc.ec.europa.eu/
Mission of the JRC: provide scientific support for EU policies

One task: collect and provide information about the levels of radioactivity in the environment (carried out by REM group; based on Euratom Treaty)

After publishing European Atlas of Cs-137 deposition from the Chernobyl accident – REM started planning a *European Atlas of Natural Radiation*

**Primary objectives:**
- Increase public awareness (and indirectly political awareness): didactic and educational goal;
- Familiarise (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;
European Atlas of Natural Radiation: Projected content structure

**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
- Water (ground water, surface water)
- Exposure: internal, external
- Total dose by natural radiation

already quite advanced!
in planning phase
started
in discussion phase
requires extensive modelling & additional spatial demographic data

**References** and literature review
European Atlas of Natural Radiation
Under way: Indoor Radon maps (1/2)

Status of EUR radon survey 2005

**Decided at Prague conference, 2006:**
10 x 10 km grid, annual mean in ground floor rooms

**August 2010:**
21 countries
17,922 non empty cells,
797,051 measurements
Discussions, next steps:

- Collect more data, contact countries (ongoing)
- Plausibility and comparability checks of data: border problems, high values, coordinates, ...

→ questionnaire about data background already sent out
Geogenic Rn map = independent of anthropogenic factors

defined only in a house

indoor Rn

outdoor Rn

living habits

meteo

building materials

house construction

geogenic Rn

subject to human activity, temporally variable

variability at different time scales

temporal variability e.g. through upgrading insulation

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

defined everywhere on solid earth
What has happened so far?

(1) Radon mapping symposium and workshop, Oslo, IGC33, Aug. 2008:
Participants agreed using
• classification scheme to define the radon potential in the 10 x 10 km² grid
• with a multivariate categorical classification scheme (similar to CZ, DE, US)
• number of categories will be defined through a decision matrix

Expert group:
  Don Appleton (UK), Ivan Barnet (CZ), Boris Dehandschutter (BE), Britt Marie Ek (SE), Harry Friedmann (AT), Geraldine Ielsch (FR), Luis Santiago Quindos-Poncela (ES), Anne Liv Rudjord (NO), P. Bossew (DE)
  Coordinators: Ralf Klingel (DE), Marc De Cort (EC) - Kibitzers: T. Tollefsen

(2) Workshop, European Geogenic Radon Map, Ispra, October, 2009
- Presentations of national approaches (AT, BE, CZ, DE, EE, LT, NO, PL, SE, UK and US approach)
  - Participants from 12 European countries
- Discussions:
  • What can be learned from national approaches?
  • Which input variables are available in which countries? → first list established (next slide)
  • What could be the target variable? → several approaches presented and discussed: not only classification!
  • Which spatial data could be used and which categorization of these variables is useful concerning a European scale?
  • Which point variables could be used?
  • Is inclusion of indoor data useful?
  • How to combine areal or linear variables (e.g. geology, faults) with point data (measurements)?
  • What to do with missing local information or uncertainties?
  • How to design an optimal classification scheme?
Target variable named: “Geogenic Radon Potential of Europe”

So far 3 approaches proposed:

- **classification**
  (=classical, proven to work; proposal at Oslo 2008)
  used in CZ, DE, USA,…
  with contributing variables and factors in classes, cross-tabulation (possibly n-dimensional; “degenerate” case: only 1 variable)

- “**transfer approach**” (proposal H.Friedmann)
- “**stochastic approach**” - multivariate estimation (proposal Bossew)

Input variables:

- **Polygons and Lines**: geological units, lineaments, special geological phenomena, water table
- **Point data**: Soil gas radon concentration, Geochemical concentrations, Geophysical data, Terrestrial gamma dose rate, Soil permeability, Indoor Rn concentration, Outdoor radon concentration

details in presentation Bossew, Mayer & Bleher: “Towards multivariate modelling of geogenic radon”

further discussions – round table, Friday
To do: next steps, necessary discussions:

Data

• Continue completing and updating list of available variables – *please contribute!*
• Additional European databases (e.g. European Soil Database)?
• Literature research – *please provide us information!*
• Data property questions, possibilities of data exchange?

Modelling and estimating

• Simplified geological units (geologists !) according to radon relevance – *geogenic radon expert group*
• Define target variable and approach to be followed
• For classification approach: define classification rule
• For transfer and probabilistic approach: *see presentation Bossew, Meyer & Bleher!*

Next possibilities for discussions:
- *Round table discussion, within this workshop – Friday!*
- Planned: workshop, Ispra, Italy, spring 2011
Outdoor radon map

Outdoor Rn = result of flux from ground + dispersion in the atmosphere

To do: next steps, necessary discussions:

• In which countries are data available? (as far as known, data available in BG, DE, CH, CZ, ES, NL, IT, LT, SI → Literature research) and variables list → please contribute

• Discussion:
• What grid is reasonable for mapping for Europe?
• How to measure and map? – cooking recipe – example Germany

See presentation: Exposure to the German population to outdoor radon, Kuemmel et al., this afternoon
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
- Which elevation map – which grid should be used?
(External) terrestrial γ dose rate

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

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

• 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)

Geochemical maps – non series and decay chains

• 28 primordial nuclides – maps reasonable and feasible? K-40?

• Th, U, Ra isotopes \((\text{Bq/kg or ppm}), \text{Rn-222, Pb-210, Po-210}\)

• Flux of the nuclides from soil/rock to the environment

• Availability of data of U, Th, Ra and progenies in soil, rocks in a European scale?
Water maps

Ground water maps
• Concentrations in water bodies and in used water
• Exposure (different pathways / public and occupational in water works), dose, risk
• Characterization of water bodies/hydrogeological units possible? → Geologists!
  → Problem: Where does water come from – mapping complex!
• Availability of data? (variables list → please contribute!)

Surface water maps
• Has it relevance for population dose?

Total dose by natural radiation
• Goal: Combine all maps / data and calculate a total dose for the population caused by natural radioactive in a defined grid.
  → Problem: May have other than scientific consequences – political!
Please,
Discuss with us and help us to get on with the European Atlas for Natural Radiation!

- **Round table discussion, within this workshop – Friday!**
  - Planned: workshop, Ispra, Italy, spring 2011

- During the coffee breaks
- With a cold Czech beer in the evening

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Thank you!

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