Minutes of two round-table discussions at the "10th International Workshop on the Geological Aspects of Radon Risk Mapping"

Prague, 24 September 2010

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Morning discussions:
"Geogenic radon potential map of Europe"
Chair: Tore Tollefsen, EC, JRC Ispra

Afternoon discussions:
"Classification of radon risk and radon mapping based on radon potential and on indoor radon, advantages and disadvantages"
Chair: Milan Matolin, Charles University, Prague

Participants:
Roselyne Améon, Don Appleton, Ivan Barnet, Peter Bossew, Zornitza Daraktchieva, Boris Dehandschutter, Britt-Marie Ek, Ken Ford, Valeria Gruber, Martha Gruson, Cecilia Jelinek, Krista Jüriado, Milan Matolin, Luis Neves, Petra Pacherová, Werner Preusse, Catherine Scheib, Katalin Szabó, Tore Tollefsen, François Tondeur, Tuomas Valmari, Paulina Wach-Jankowska

For contact details (e-mail addresses), see Annex 1.

Agenda
The discussions essentially followed the agenda suggested by JRC (items 1-3) and Prof. Matolin (item 4):
1. Simplified geological classification of Europe
2. Available variables for geogenic map in the countries
3. What approaches should/will be followed for the geogenic map?
4. Classification of radon risk

For the detailed agenda, see Annex 2.

1. Simplified geological classification of Europe

Problems:
(1) Geological classification and terminology are often not compatible between countries, or even regions of one country (e.g. Germany).
(2) Common geological classification systems based on stratigraphy (age), genesis and petrography or lithology are not necessarily the ones needed for classifying radon after geological control. After all, what is needed for the geogenic map is characterization of risk or hazard areas and not of geological units.
(3) When can a geological unit be called homogeneous with respect to radon?
(4) The levels of detail of geological maps (resolution) are different between countries.

On problems (1) and (2):

Are already simplified geological maps available? In which countries (extracted or compiled e.g. out of national maps or of the 1:1 M European geological map)?

Suggestion: Simplifying should be done by geological surveys, because they have the expertise and they have access to the data which are otherwise expensive to obtain in GIS format. For harmonizing geological classes across border areas, cooperation of geologists of neighbouring countries is indispensable.

OneGeology Project: http://www.onegeology.org. Age and lithology are important. This could be a starting point for simplification of units over Europe and/or within countries. Geologists from countries participating to the geogenic radon map project should have a look at it.

Suggestion: Test usability of OneGeology classification in e.g. 3 countries.

Alternative approach: Is a small group of geologists able to cover Europe in simplified units? – This seems to be a question of resources because all participants are doing this more or less in their spare time. A Europe-wide panel of geologists is hardly feasible.

On problem (3):

What is criterion for a "homogenous" radon-relevant unit? One can not expect homogeneity of radon within one geological unit in the sense of "constant". The subject is related to problem (4), because every geological unit can be decomposed into local sub-units down to almost 1:1 scale. Additionally, radon is a result of several factors, not only of "geological unit" (defined through stratigraphy, genesis and lithology), and its variability is strongly affected by the variability within geological units due to e.g. texture, local tectonics, micro-variability of all kind whose scales are generally below the one on which geological units are defined. A degree of "non-explained" variability will therefore always be present. Also, reducing it means increasing the level of geological detail, in contradiction to what one attempts, namely simplification.

On the other hand, as a criterion, even leaving variability as "random noise", no major "drift" of radon within units should be present. It seems that this is a particular problem for quaternary units.

The round-table did not come to a conclusion on this point; maybe there is no unique answer and the question must be asked differently. Probably, one should aim for what is feasible given the data situation.

On problem (4):
Problem of scale and resolution: The Czech Republic has identified 23 simplified zones (Barnet and Pacherová, proceedings of this workshop) – how many are needed for larger countries? Agreement: this depends largely on the geological complexity of a region.

The result must be a compromise between targeted resolution (10 km x 10 km grid cells), simplification as much as reasonably achievable, and data availability (needed to "gauge" the scheme).

Summary:

While having a common simplified (after radon criteria) geological map would be highly desirable, it may not be achievable soon, but overly ambitious for the time being. As a pragmatic and achievable way out, the round-table agreed on suggesting that national experts sit together with their colleagues across each border and resolve homogenization in a bilateral way. Classification and terminology within countries would then be left to national schemes. However, at the end of the process this requires a "multilateral" agreement on the "ranking" of the regionally (uni- or bilaterally) defined units with respect to radon, if a scoring system is envisaged like in USA, CZ or DE. Otherwise, regional scorings would again not be compatible. For instance what is called "high-radon" in an overall low-radon country like NL is certainly low for CZ standards, which happens to be an overall strongly affected country.

2. Available variables for geogenic map in the countries

Additional variables for list: special geological features (e.g. cavities, mining, eskers, …). Other possible data bases/maps for input: OneGeology Project.

Suggestion: For each country identify 1 national contact point who could collect all available data from his/her country.

Outcome: Updated list of available variables attached. To be continued.

3. What approaches should/will be followed for the geogenic map?

Question: How to define a target quantity which measures the geogenic RP, given all available information, from physical controls (geology etc.) to measured data?

3.1 Classification approach

Classification approach: with all input variables for geogenic map from list (see Section 2 and list attached). The fact that different countries have different variables out of which a common RP must be defined and estimated makes the procedure more complicated than in individual countries, where the data realm in general is more homogeneous.

Suggestion: It should be explored if, and how, the US classification scheme (U.S. Geological survey, Open file report 93-292-E) can be modified and adapted for Europe and the available variables and discussed by the experts as homework. This scheme seems to be the most flexible developed so far, and has proven robust through more than 15 years of use in the USA.

3.2 Probabilistic approach

In Peter Bossew's probabilistic (multivariate estimation) approach, combine all available input variables in a theoretical model. Then essentially derive the target variable from the joint probability distribution of the input variables.

3.3 Transfer approach

In Harry Friedmann's transfer approach (explained by Peter Bossew), the two most important control variables are radon in soil gas and permeability. If they are not available, calculate them from other variables or take default values from tables:

- could be a problem for large countries which have no soil gas measurements (e.g. France);
- example CZ – a very rough map was made in the 1980s out of 150 soil gas measurements in different geological zones – default values can be used for soil gas measurements for the same/a similar geological zone.

3.4 An additional problem

Are data/variables comparable between countries (e.g. uranium, permeability, soil gas measurements)? This is not trivial, because sampling and measurement protocols and techniques may be different for the same nominal quantity.

Suggestion: For soil gas measurements, Czech sampling and measurement protocol could be standard for soil gas measurements because of most experience. Comparison measurements or standardization to them could be done by the other countries – but it will be a problem for at least some countries (e.g. the UK). It should be discussed whether this is feasible.

4. Classification of radon risk

(This corresponds to the classification approach in Section 3.1 above.)

Classification for the geogenic radon potential map:

- Should have an uneven number of classes – 5 classes would be reasonable.
- If the classification is formed out of a numerical RP variable, one must ask how to divide the range of the variable into classes. Could be non-linear classes.
- Must be adopted to highest and lowest appearing values – so that a range can be shown in the map.
- Classification error – if classes are too narrow, the rate of misclassification increases. Misclassification of 1 class is tolerable, but > 1 (i.e. the true class is more than 1 class away from the estimated one) is problematic. On the other hand, having too few classes results in an uninformative map, and may leave large areas of Europe undistinguishable from a radon point of view. A compromise can only be found by trying. Misclassification rates must be assessed by cross-validation.

As an important, often somewhat neglected issue the "didactic" aspect has been addressed: What do classes mean? How to explain them to the public? – Risk/hazard. Related to probabilities? Of what? – Probabilities are difficult to explain to most people. Who will be the main audience of the map?

Action items

What	Who	Deadline (TBC)
Simplified (radon-relevant) geological map of every country present in discussions	Geologists/Experts of Countries	28.02.2011
Identify experts from neighbouring countries for border-discussion	Geologists/Experts of Countries	Variable (country-dependent)
Check usability of OneGeology project	Geologists/Experts of Countries	15.11.2010
Send out updated list of variables and classification scheme example (US)	REM group, JRC	31.10.2010
Discussion/Adaption of US classification scheme for Europe	Geogenic Expert Group	31.03.2011
Provide discussion forum (by e-mail)	REM group, JRC	31.10.2010
Provide platform for document exchange (website)	REM group, JRC	31.10.2010
Update, maintain list of variables	REM group, JRC	ongoing
Update, refine list of contact points, documents etc.	REM, group JRC	ongoing
Collect information about relation ("transfer function") between radon variables; communicate relevant references, reports etc.	All	ongoing
Organize next workshop for geogenic expert group	REM group, JRC	May 2011

Agenda

(with items 1-3 suggested by JRC and 4 by Prof. Matolin)

1. **Simplified geological classification of Europe**
    Questions: What could a simplified and unified geological (radon-relevant) classification look like? What is the opinion of geologists? Who could develop it? What are the requirements for "homogenous" geological units?
    Objectives:
    - Criterion for a geological unit to be called "homogenous" with respect to radon
    - List of simplified geological units which cover Europe and fulfil the criterion

2. **Available variables for geogenic map in the countries**
    Questions: Refer to existing list of possible input data – are all relevant variables covered? Should something else be taken into account? What other existing data (European) data bases could be used for the geogenic map?
    Objectives:
    - List of available variables
    - List of contact person for each variable

3. **What approaches should/will be followed for the geogenic map?**
    Questions: For classification – define classification rules/matrix; how to quantify misclassification uncertainty? For other approaches (e.g. transfer/probabilistic) – definition of target variable?
    Objectives:
    - Classification approach based on list (see 2.) and geological units (see 1.) – table!
    - Other approaches: List of open questions needed for research (e.g. correlation between variables,…) and list of people who are interested and willing to contribute

4. **Classification of radon risk**

List of participants

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