Status of the European Atlas of Natural Radiation

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IES - Institute for Environment and Sustainability

Ispra - Italy

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;

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

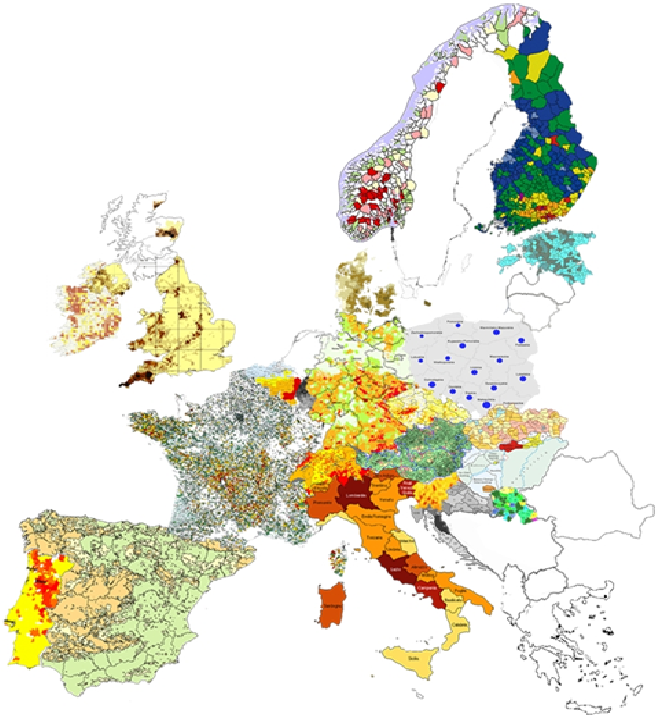
requires extensive modelling & additional spatial demographic data

References and literature review

European Atlas of Natural Radiation
Under way: Indoor Radon maps (1/2)

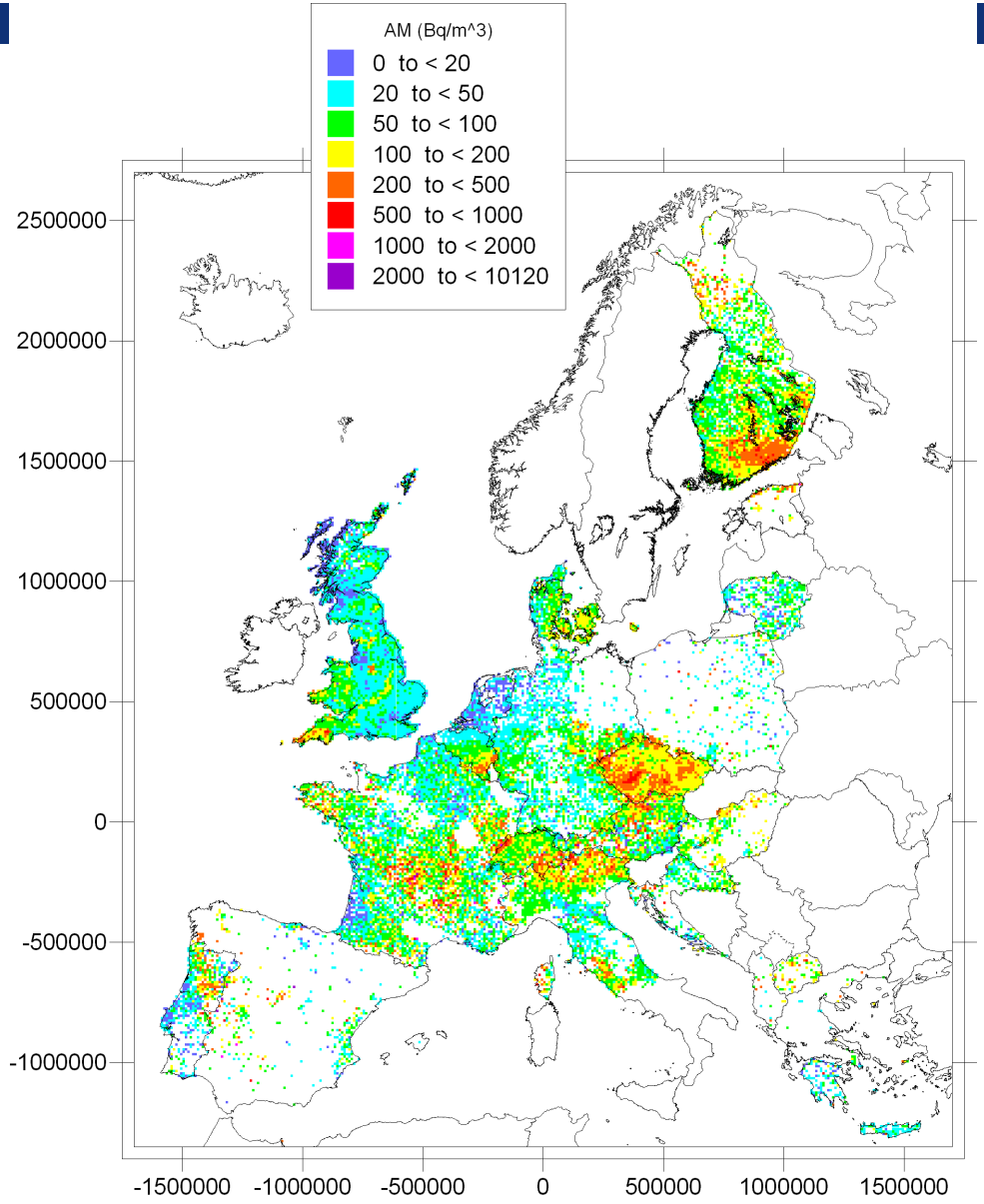
JRC Prague, September 2010

Status of EUR radon survey 2005

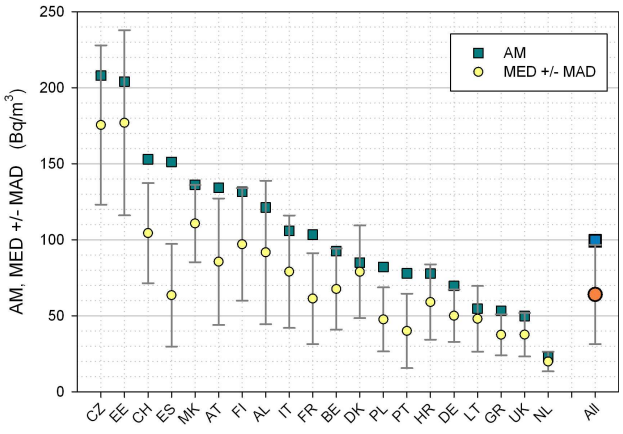


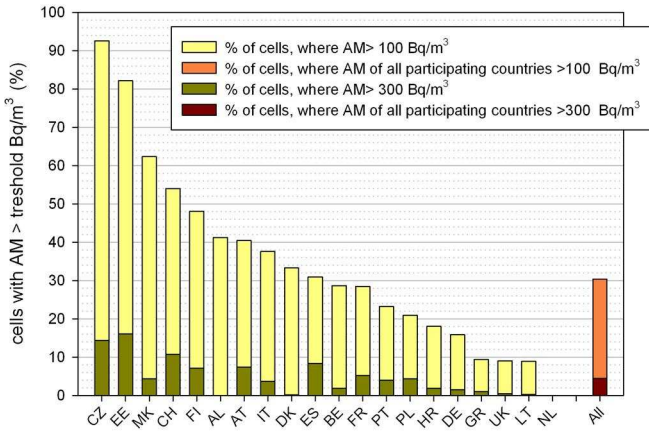
Decided at Prague conference, 2006:
10 x 10 km grid, annual mean in ground floor rooms

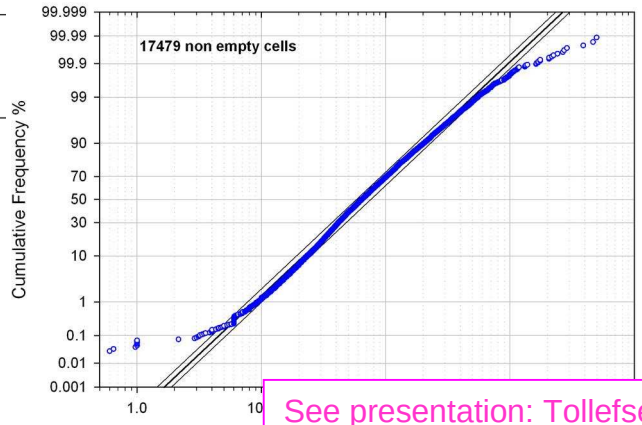
August 2010:
21 countries
17,922 non empty cells,
797,051 measurements



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





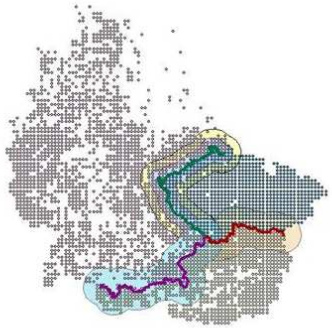


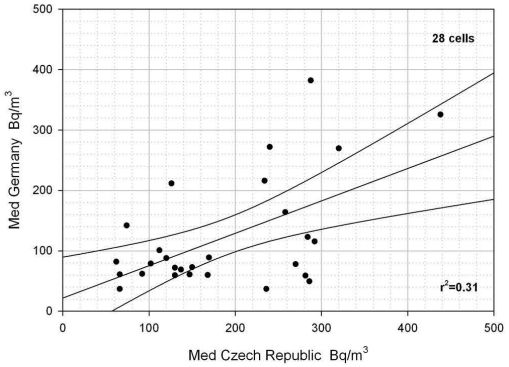
See presentation: Tollefsen et al.: Status of the European indoor Rn map, last week

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**





Please note: The questions in parts 2 and 3 should be answered in view of the indoor radon data set provided to us (the survey, measurements, statistical treatment behind this data set)

2. Sampling and measurement methods

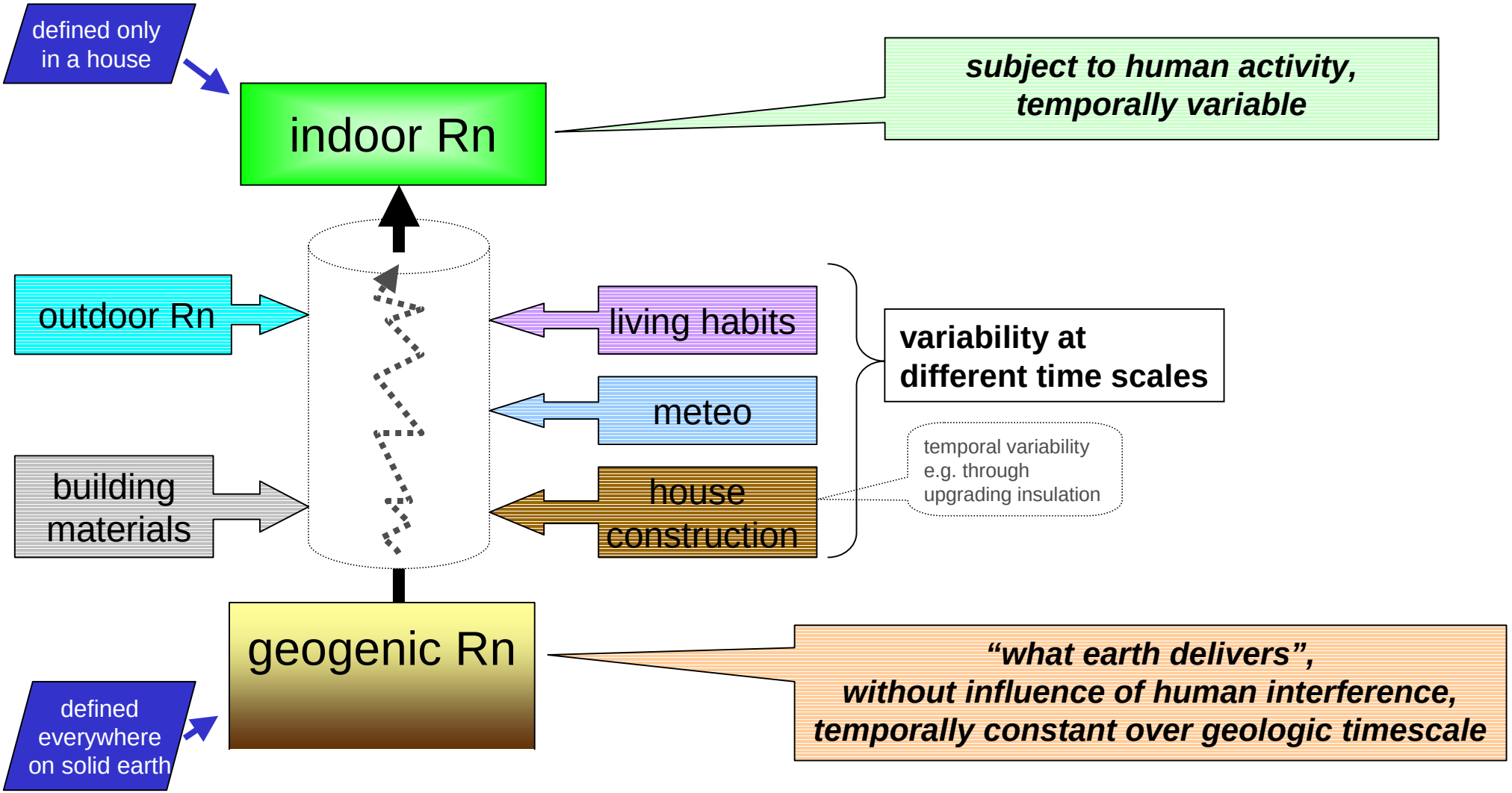
2.1. Which characteristic best describes the design of your survey(s)? *(Please select all appropriate ones and specify them in the 'remarks' field)*

Characteristics		Remarks
Homogeneous coverage of the territory (uniformly or randomly distributed sampling points)	No	
Covering all administrative units sufficiently	No	
Covering all or most important geological regions sufficiently	No	
Sampling density proportional to population density	No	
Sampling density proportional to density of schools or other schemes	No	
Preferential sampling in regions already known to have higher Rn levels	No	
Other *(please specify)*	No	

2.2. How have the participants/sampling points been chosen? *(Please select all appropriate options and specify the relation to the surveys in 2.1)*

Sampling		Remarks
Random samples (e.g. telephone directory, inhabitants registry, registry of house stock,…)	No	
Samples on nodes or random draws of a geographical grid *(please specify)*	No	
Exhaustive sampling (e.g. regional, schools surveys,…)	No	
Participants (persons or houses) chosen according to predefined criteria *(please specify)*	No	
Participants chosen for their personal interest in the subject or other demographically non-representative schemes *(please specify)*	No	
Other *(please specify)*	No	

Geogenic Rn map = independent of anthropogenic factors



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) - Kibitzes: 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)

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

- **"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

further discussions – round table, Friday

Availability of geo-referenced possible input data

¤	indoor Rn¤	soil gas¤	geology¤	perm¤	ext. dose rate¤	U, Ra-conc, eU¤	fault lines¤
AL¤	¤	¤	¤	¤	¤	¤	¤
AT¤	many¤	few¤	¤	¤	¤	¤	¤
BE¤	many¤	y¤	y¤	¤	¤	¤	¤
BG¤	¤	¤	¤	¤	¤	¤	¤
BH¤	¤	¤	¤	¤	¤	¤	¤
CH¤	many¤	¤	¤	¤	¤	¤	¤

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

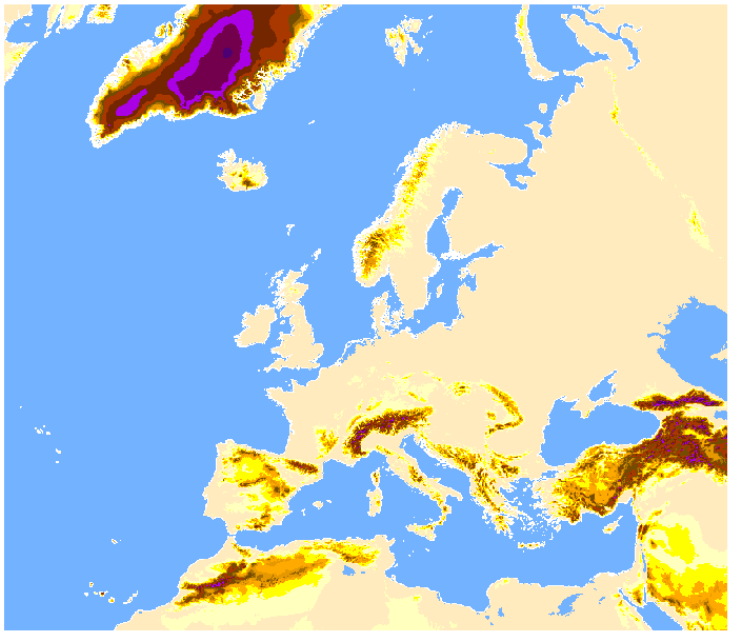
Outdoor Rn = result of flux from ground + dispersion in the atmosphere

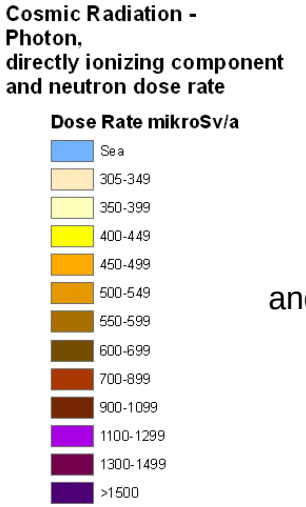
To do: next steps, necessary discussions:

- 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





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 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 *(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 (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 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 radioactivity 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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