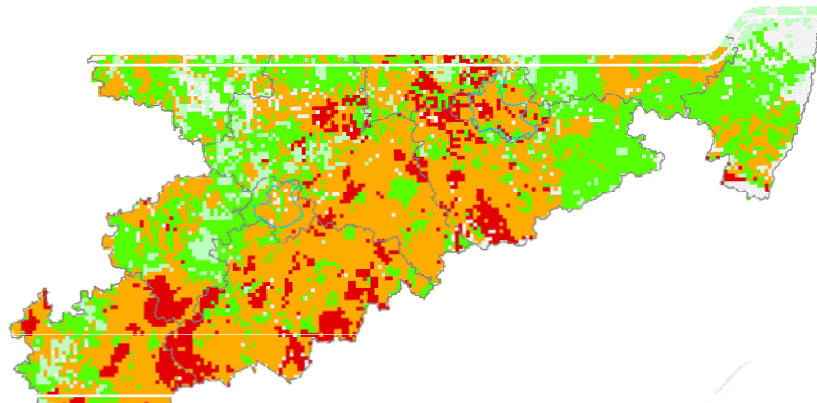


## The new geogenic radon map of Saxony

### Results of soil gas mapping



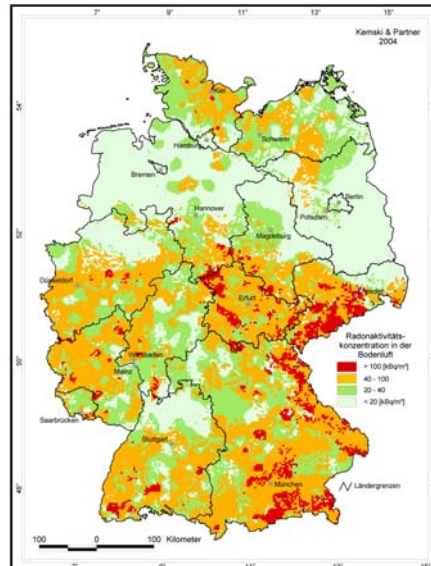
J. Kemski, R. Klingel, W. Preuße, H. Busch

## Content

- Geogenic radon potential – prognostic instrument
- Selection of municipalities for measurement campaign
- Sampling and measurement method
- Course of the measurement program
- Geological classification – interpolation background
- Geochemistry (uranium) and soil gas radon
- The new geogenic radon map of Saxony
- A map for ... but not for ...

## Geogenic radon potential

- Available indoor data from voluntary measurements cannot meet the need of a well founded radon prognosis for buildings all over Germany / Saxony.
- Saxony is one the most concerned states in Germany.
- Mapping of the geogenic potential (soil gas radon, BfS, Kemski et al.)  
→ methods for sampling & evaluation
- It's merely the source term of the problem but the only area-wide indication for clusters of buildings with elevated indoor radon in Germany.



3 | 25. September 2010 | Dr. Werner Preuße

## Radon in soil gas and indoors

- Drafts for federal radon legislation on the basis of research projects of the Federal Office for Radiation Protection:

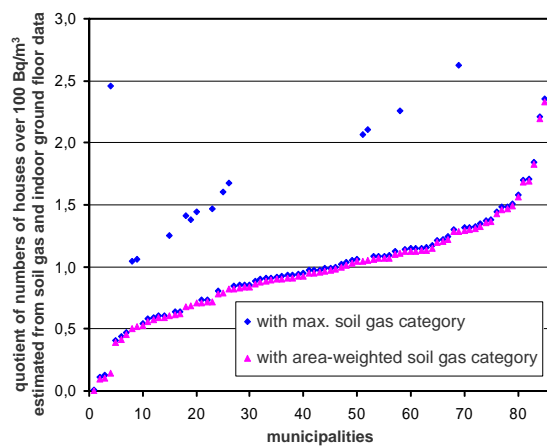
radon in soil gas (kBq/m <sup>3</sup> )	precaution category	% of houses with indoor radon > 100 Bq/m <sup>3</sup>	... used for estimation <sup>*)</sup>
< 20	-	-	-
20 ... 40	I	1 ... 10	5%
40 ... 100	II	10 ... 50	40%
> 100	III	> 50	80%

<sup>\*)</sup> can be varied

4 | 25. September 2010 | Dr. Werner Preuße

## Comparison of prognosis from soil gas / indoor radon

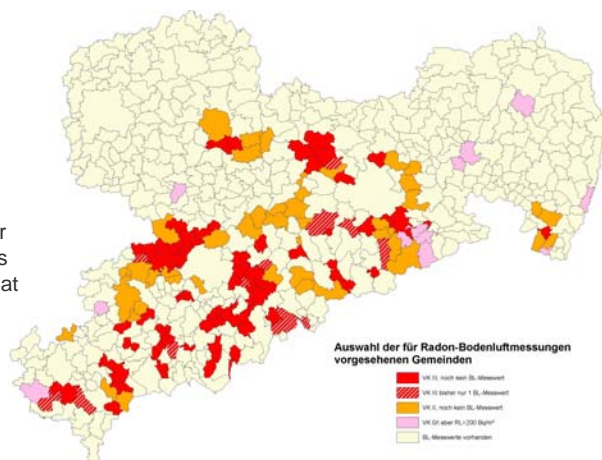
- under- or overestimation by more than a factor 2: each for up to 10% of the municipalities
- lower input for radon transfer (esp. for cat. II) worsen the correspondence
- ➔ decision for an improved mapping of the geogenic radon potential in Saxony



5 | 25. September 2010 | Dr. Werner Preuße

## Selection of municipalities

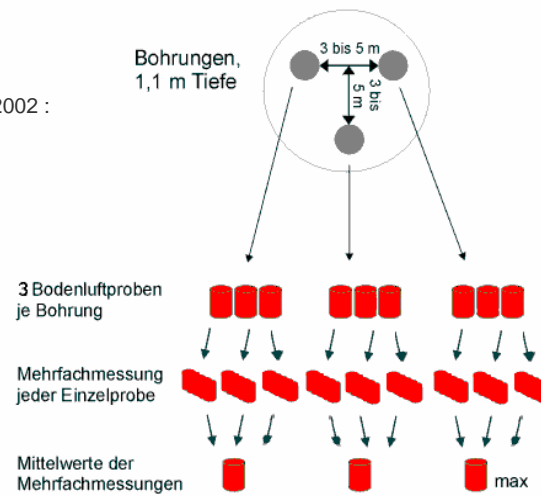
- **starting point:** Saxon part of the 2004 geogenic radon map of Germany
- ➔ 133 out of 544 municipalities with so far very uncertain prognosis were to be investigated at 3-8 sites each.



6 | 25. September 2010 | Dr. Werner Preuße

## Methods

- according to Kemski et al. 2002 :



7 | 25. September 2010 | Dr. Werner Preuße

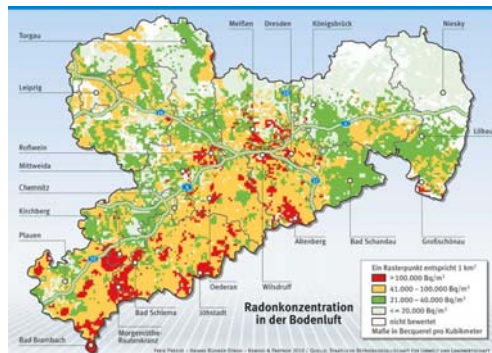
## Course of the measurement program

- coordination with local administrations for measurement on public areas
- started 2005, finished 2009
- since 2006 with drilling permissions from public utilities (electric lines etc.)
- 2006: pilot region middle Erzgebirge → effects on a regional map
- methodical investigations by students (types of probes, tube materials, spetal and temporal variability, representativeness, criteria for validation)
- 2009: preparation of computation of the new map,  
supplementary measurements in underrepresented regions

8 | 25. September 2010 | Dr. Werner Preuße

## ... and to the public

- 2010: computation of the new map by an external contractor
- 31 August 2010: presentation to the public by the Saxon minister for environment - front page of newspaper "Freie Presse" Chemnitz:

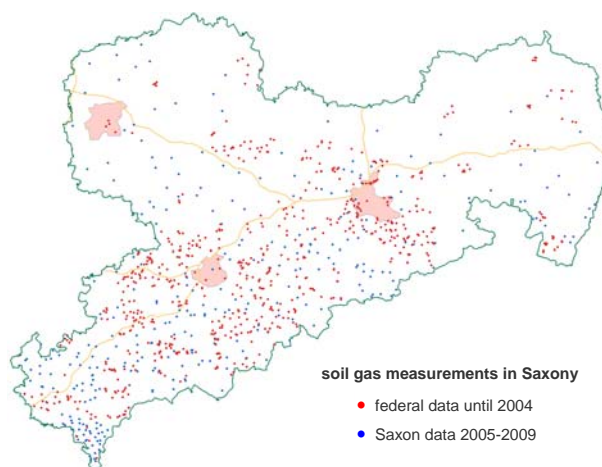


and on the website of the ministry.

9 | 25. September 2010 | Dr. Werner Preuße

## Measurement sites (I)

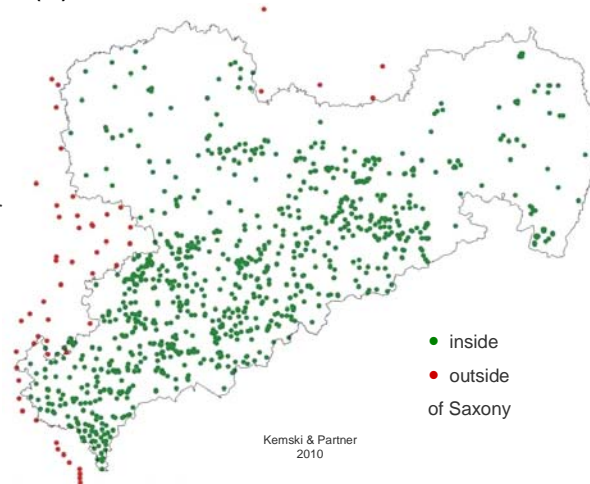
- 320 sites from the mapping of Germany until 2004
- 608 sites of the Saxon measurement program 2005-2009
- 89 selected sites from measurements of the Saxon radon information centre (measurements with radon monitor)



10 | 25. September 2010 | Dr. Werner Preuße

## Measurement sites (II)

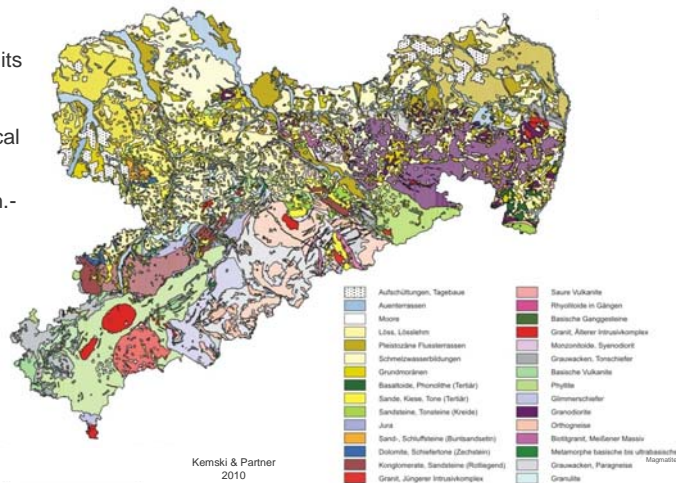
- + 53 sites outside of Saxony (max. 10 km distance from the border) from Germany mapping
- altogether 981 sites (after tests for outliers) for the computation of the new map



11 | 25. September 2010 | Dr. Werner Preußé

## Geological classification (I)

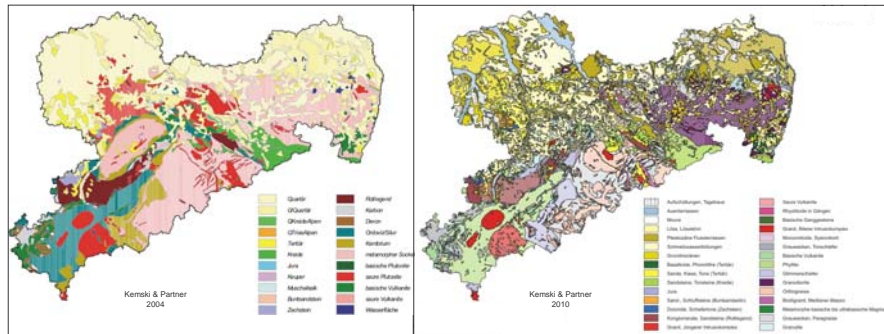
- combination of **90** units from the 1:200000 geological map of Saxony (stratigraphical & petrographical)
- ➔ **30** mainly petrograph.-geochemical characterised units
- "slope loam" (8,4% of the Saxon area) substituted by the underlying pre-quaternary geology



12 | 25. September 2010 | Dr. Werner Preußé

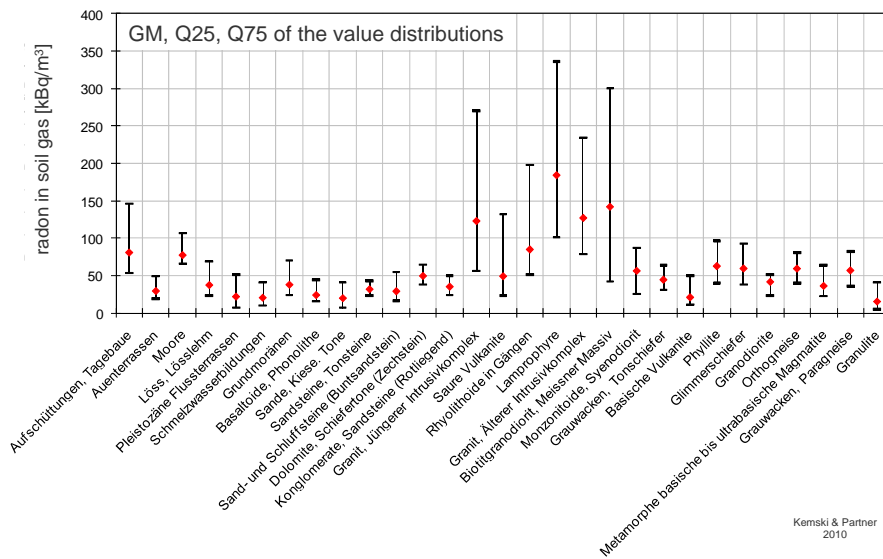
## Geological classification (II)

- new classification with **30** units much more differentiated as for the Germany map (that with geology according BGR 1 : 1 000 000 → **16** generalised units in Saxony) and more determined by the radon relevant petrography/geochemistry



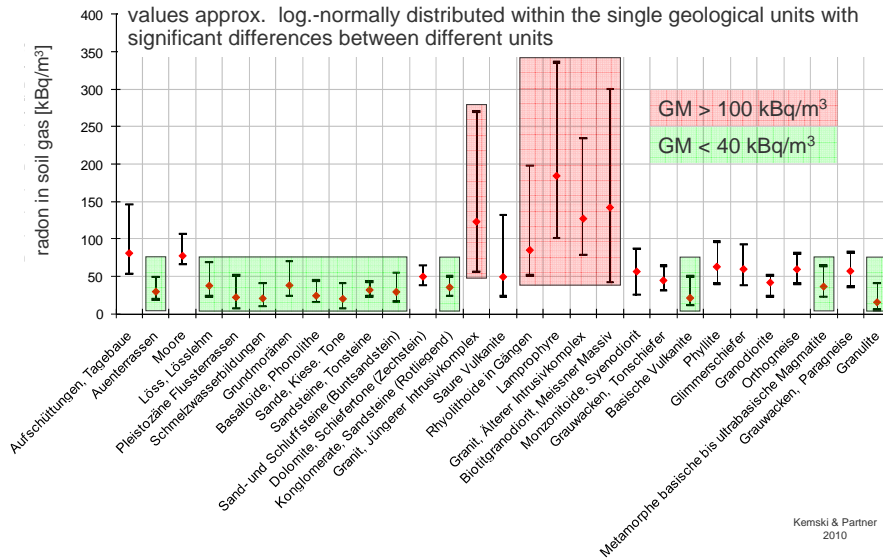
13 | 25. September 2010 | Dr. Werner Preuße

## Measured values (I)



14 | 25. September 2010 | Dr. Werner Preuße

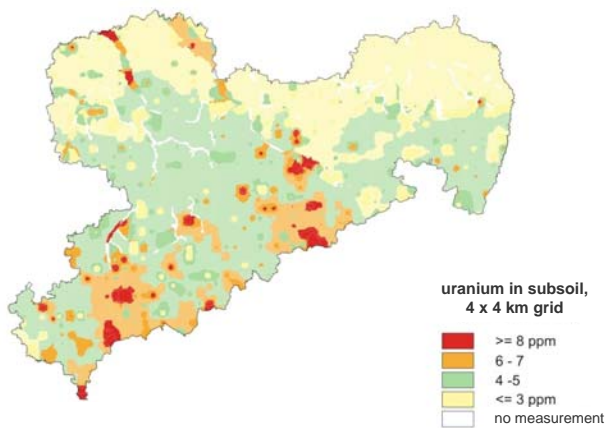
## Measured values (II)



15 | 25. September 2010 | Dr. Werner Preuß

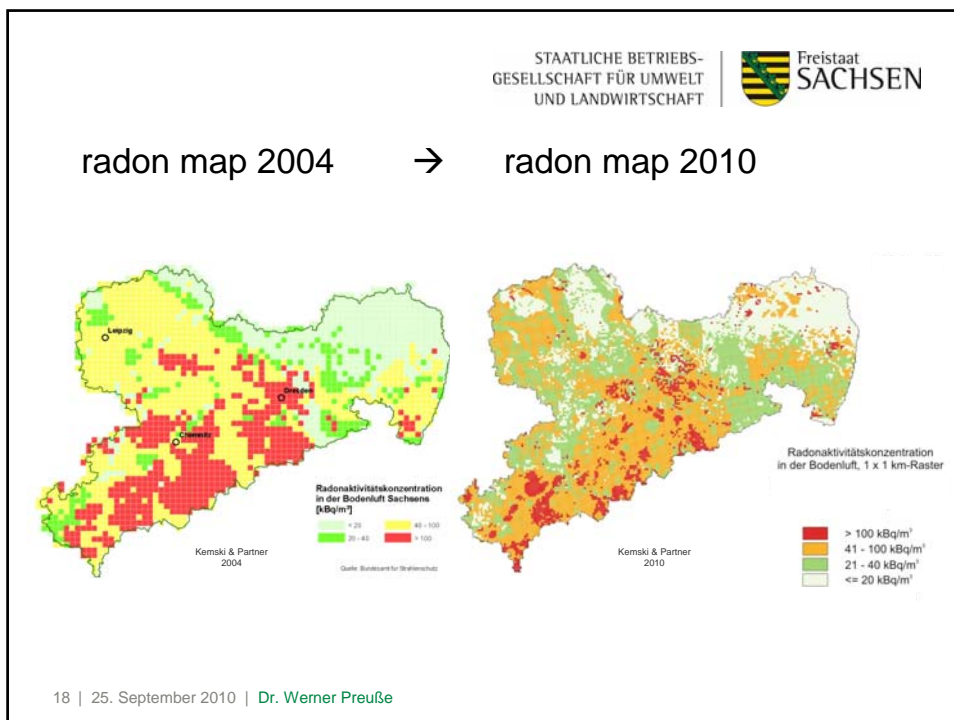
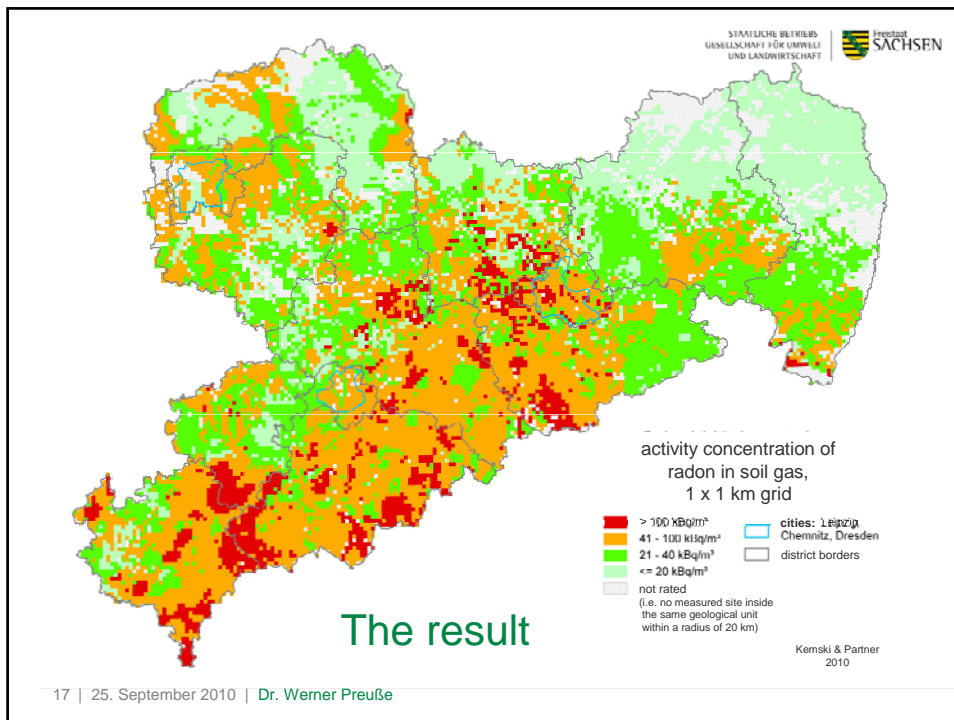
## Geochemistry - uranium

- important (existing) additional information
- significant correlation with radon in the chosen geological units
- ➔ confirms the geological classification as "radon relevant"



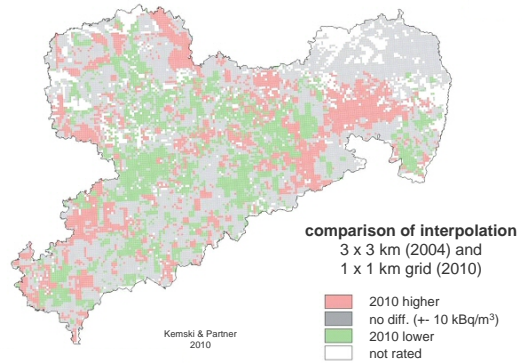
16 | 25. September 2010 | Dr. Werner Preuß





## Comparison 2004 - 2010

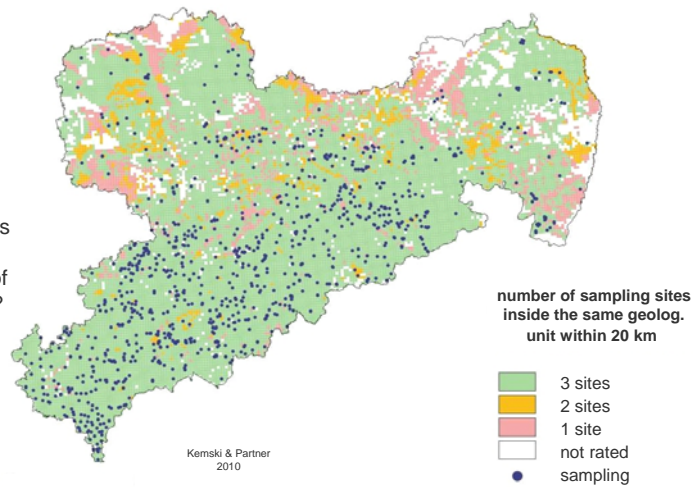
radon concentration	area parts [%]		
	2004	2010	
		without 20 km criterion	with 20 km criterion
< 20 kBq/m <sup>3</sup>	24.0	22.4	21.4
20 - 40 kBq/m <sup>3</sup>	10.9	30.1	27.1
40 - 100 kBq/m <sup>3</sup>	42.1	38.7	34.3
> 100 kBq/m <sup>3</sup>	23.0	8.8	7.5
not rated			9.7



19 | 25. September 2010 | Dr. Werner Preuße

## Uncertainties ?

- I density of sampling points vs. homogeneity within geological units
- I other approaches for estimation of the uncertainty of local prognosis ?



20 | 25. September 2010 | Dr. Werner Preuße

## A map for ...

- Motivation -  
indicate the most concerned regions in Saxony on municipal level to meet the need for information of residents, economy and administration.
- Estimation of expenses  
to reach reference values in buildings is possible now on a better founded basis.
- Instrument  
for cost-effectiveness analysis of different strategies for radon control (more detailed prognosis for existing administrative units).
- Support  
for house builders in order to evaluate the situation in their municipality.

21 | 25. September 2010 | Dr. Werner Preuße

## ... but not for ...

- „Map of expected values of radon concentration in soil gas“  
→ i.e. not the radon concentration in soil gas that is solely true for a certain site.
- An important result:  
“The distribution of the radon concentration is the essential indicator for the geogenic radon potential of an area – a single measured value is not sufficient”.
- Not a prediction  
for single values that might be measured and will often differ from the expected value in a 1 x 1 km cell.

**Thank you for your attention !**

22 | 25. September 2010 | Dr. Werner Preuße