Generalised geological units as a background for European Geogenic Radon Potential Map – an example from the Czech Republic

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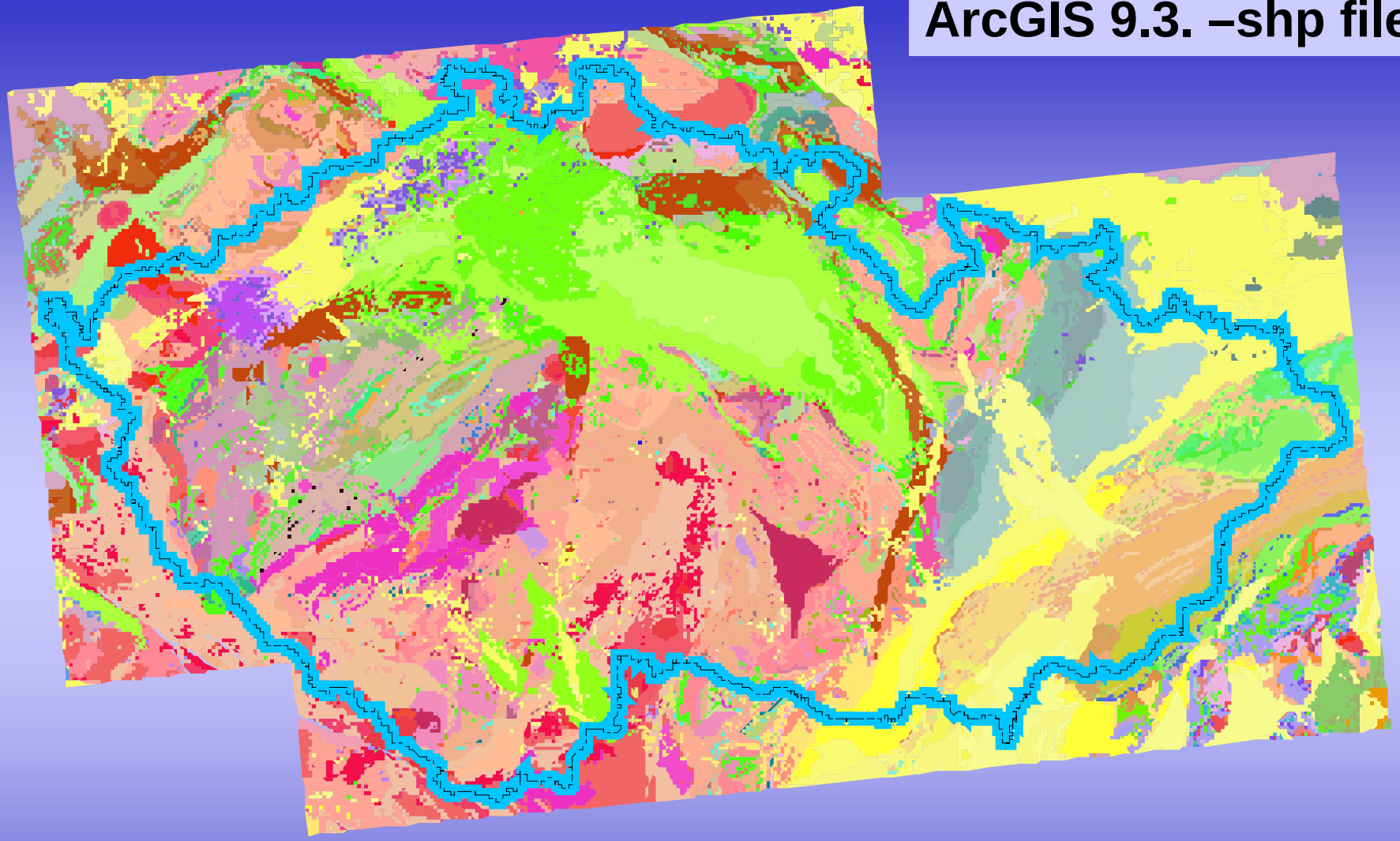
ArcGIS 9.3. –shp file

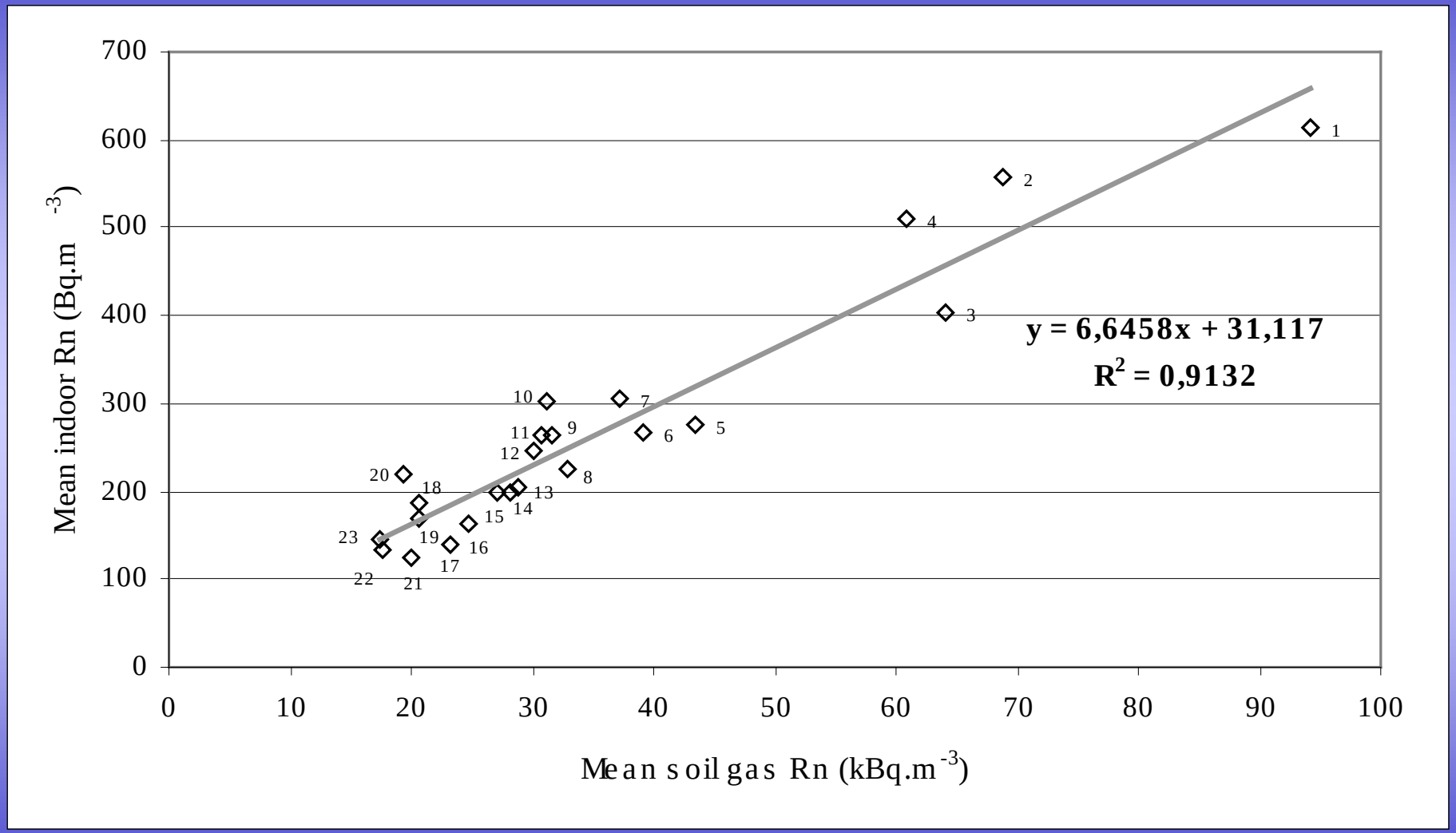


Geological map 1 : 500 000 – 530 different items in legend
8544 soil gas Rn (CGS), 92 276 indoor Rn (NRPI)

530 rock types generalised into 23

Rock type	Num in graph	Mean indoor Rn ($Bq.m^{-3}$)	Median indoor Rn ($Bq.m^{-3}$)	Indoor Rn num	Mean soil gas Rn ($kBq.m^{-3}$)	Median soil gas Rn ($kBq.m^{-3}$)	Mean Rn index	Soil gas Rn num
Durbachites	1	612,8	456	5730	94,3	64,6	2,61	166
Teplice rhyolite	2	556,7	294	65	68,8	61,3	2,71	7
Variscan granites	3	404,2	272	11873	64,1	44,9	2,42	555
Variscan granodiorites	4	509	414	3645	60,9	51,3	2,47	100
Precambrian -Palaeozoic phyllites	5	275,3	166	830	43,5	27,1	1,89	57
Orthogneisses+migmatites	6	265,7	188	6826	39,1	26,3	1,97	505
Trondhjemites	7	306,2	267	124	37,1	18	2	18
Tertiary BM	8	225,1	156	1566	33	23	1,84	247
Mica schists	9	262,9	142	1429	31,6	22,6	1,75	147
Neoproterozoic	10	303,1	212	2676	31,1	21	1,85	472
Palaeovolcanites	11	265,3	172	1930	30,8	20	1,71	253
Variscan diorites	12	244,8	188	1759	30,1	23,6	1,93	72
Palaeozoic Czech Rep.	13	204,5	138	12288	28,8	20,4	1,74	1234
Tertiary terrestrial	14	198,6	160	1561	28,2	24,1	1,66	153
Moldanubian paragneisses	15	199,4	152	10363	27,2	21	1,78	468
Granulites	16	162,6	126	284	24,8	19,3	1,65	64
Prevariscan diorites	17	138	122	149	23,2	16,1	1,73	12
Variegated intercalations	18	169,7	122	639	20,7	16	1,57	65
Prevariscan granitoids	19	188,2	148	1392	20,7	15,2	1,71	167
Neovolcanites	20	125,4	94	482	19,9	13	1,51	69
Gabros	21	218,6	178	268	19,3	11,5	1,6	15
Mesozoic sediments	22	132,8	102	17223	17,6	14,3	1,43	2029
Tertiary Marine Carp.	23	144,5	122	2720	17,4	15,6	1,32	529

Mean soil gas Rn – mean indoor Rn



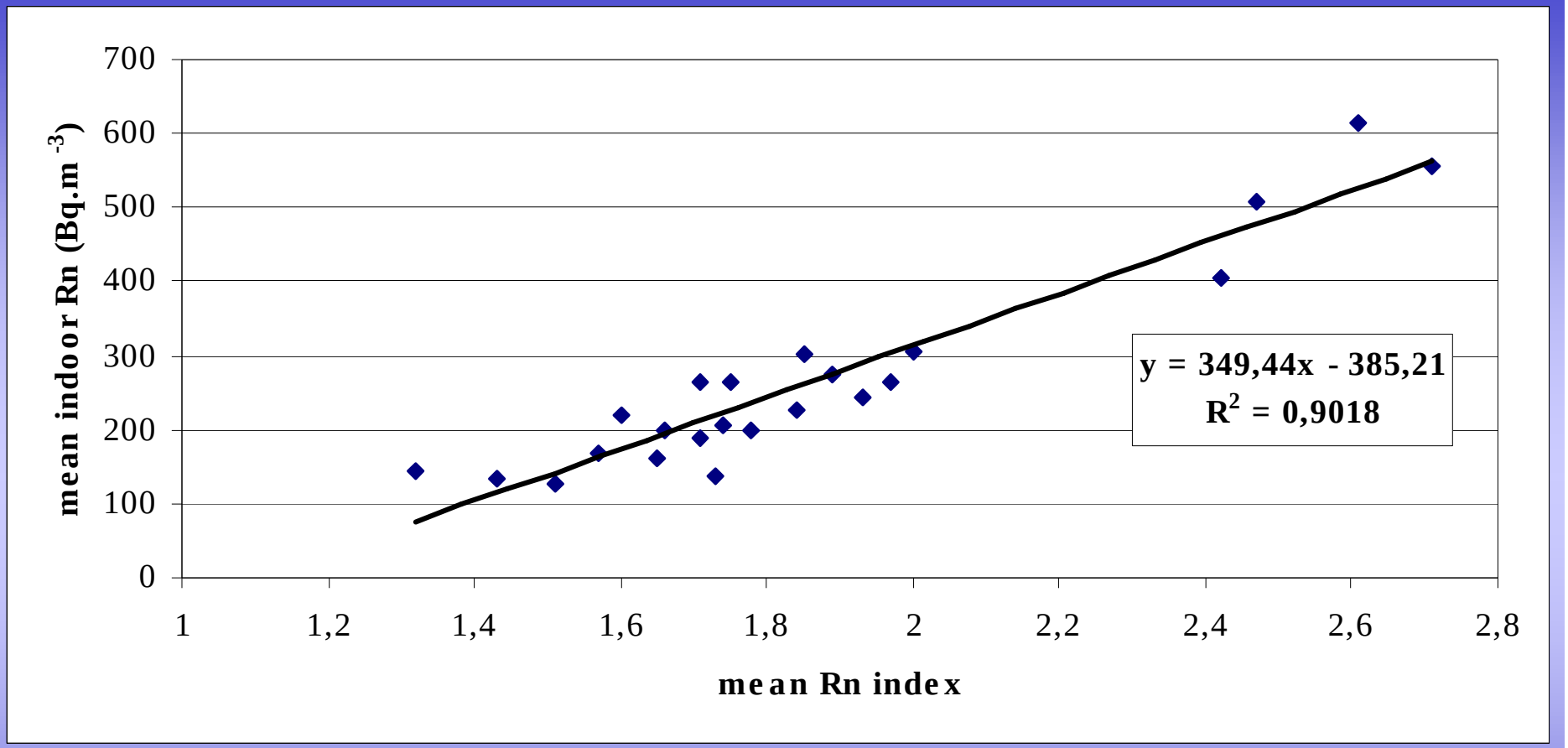
Calculated for 23 generalised rock units

Categories of radon index of bedrock

Radon index	^{222}Rn concentration (kBq.m^{-3})		
	Low permeability	Medium permeability	High permeability
low	< 30	< 20	< 10
medium	30-100	20-70	10-30
high	> 100	> 70	> 30

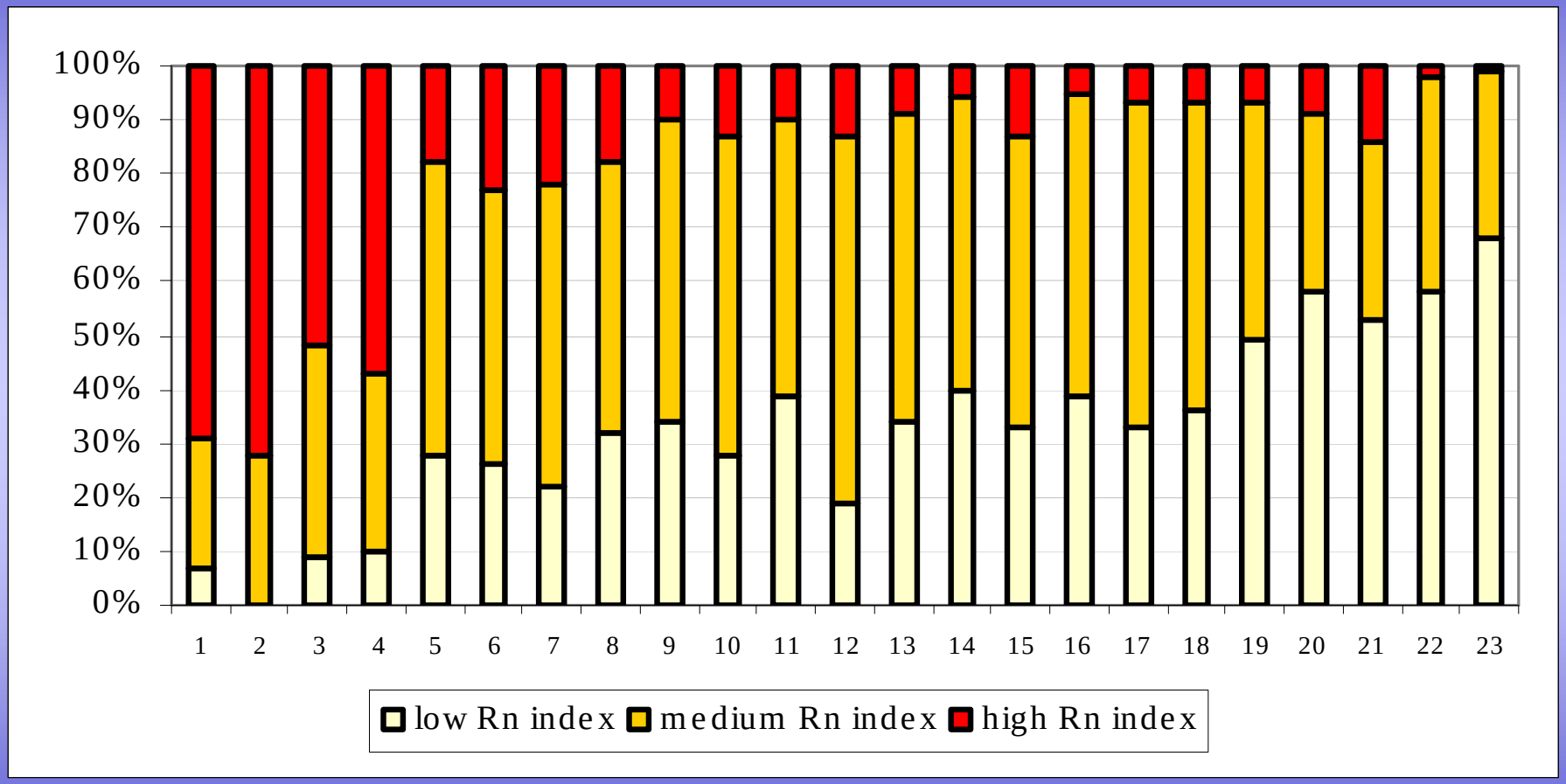
Uniform method for soil gas radon measurements in CZ since 1994
3rd quartile of the 15 points data set and permeability characterises the test site

Mean Rn index – mean indoor Rn



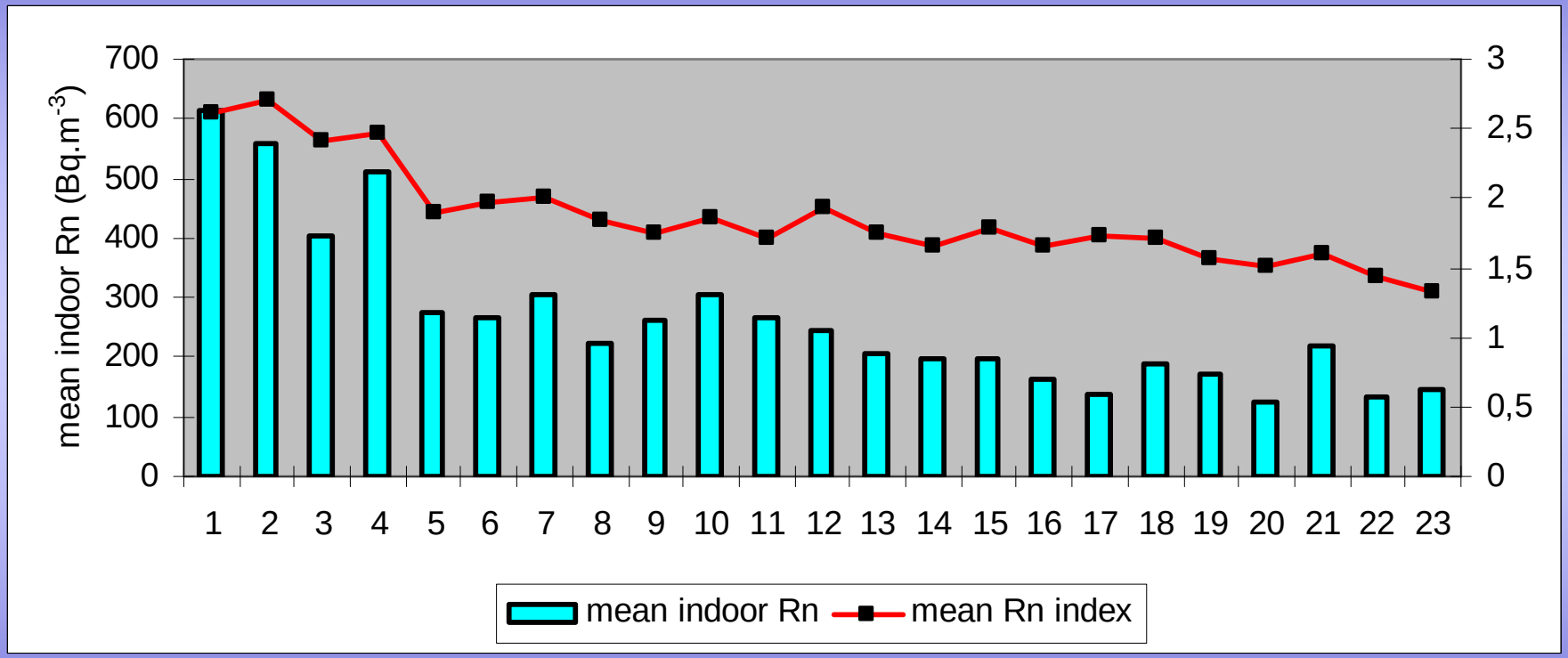
Calculated for 23 generalised rock units, 1=low, 2=medium 3=high radon index

Percentage of low, medium and high Rn index in 23 generalised units



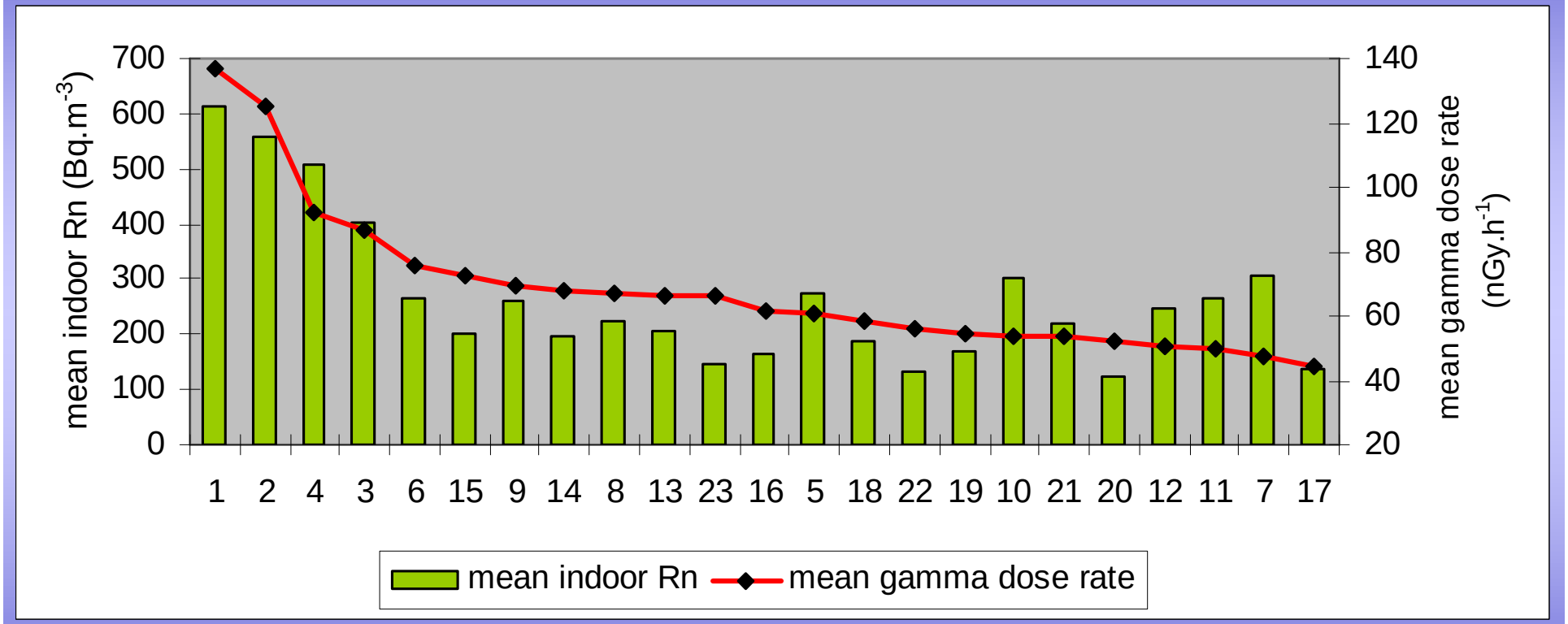
Rock units are sorted according to mean soil gas Rn

Mean indoor Rn – mean Rn index



Rock units are sorted according to mean soil gas Rn

Mean indoor Rn – mean gamma dose rate

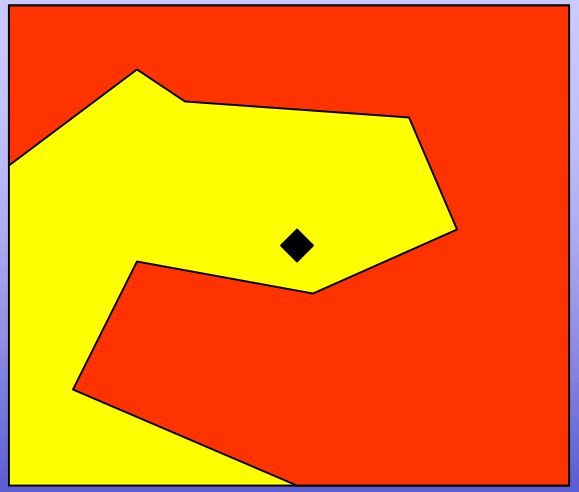


Rock units are sorted according to mean gamma dose rate

Conversion of vectorised geological units

grid net for EU countries 10 x 10 km - see:
http://eusoils.jrc.ec.europa.eu/library/reference_grids/reference_grids.cfm

Can be made by computer, but geological knowledge is necessary

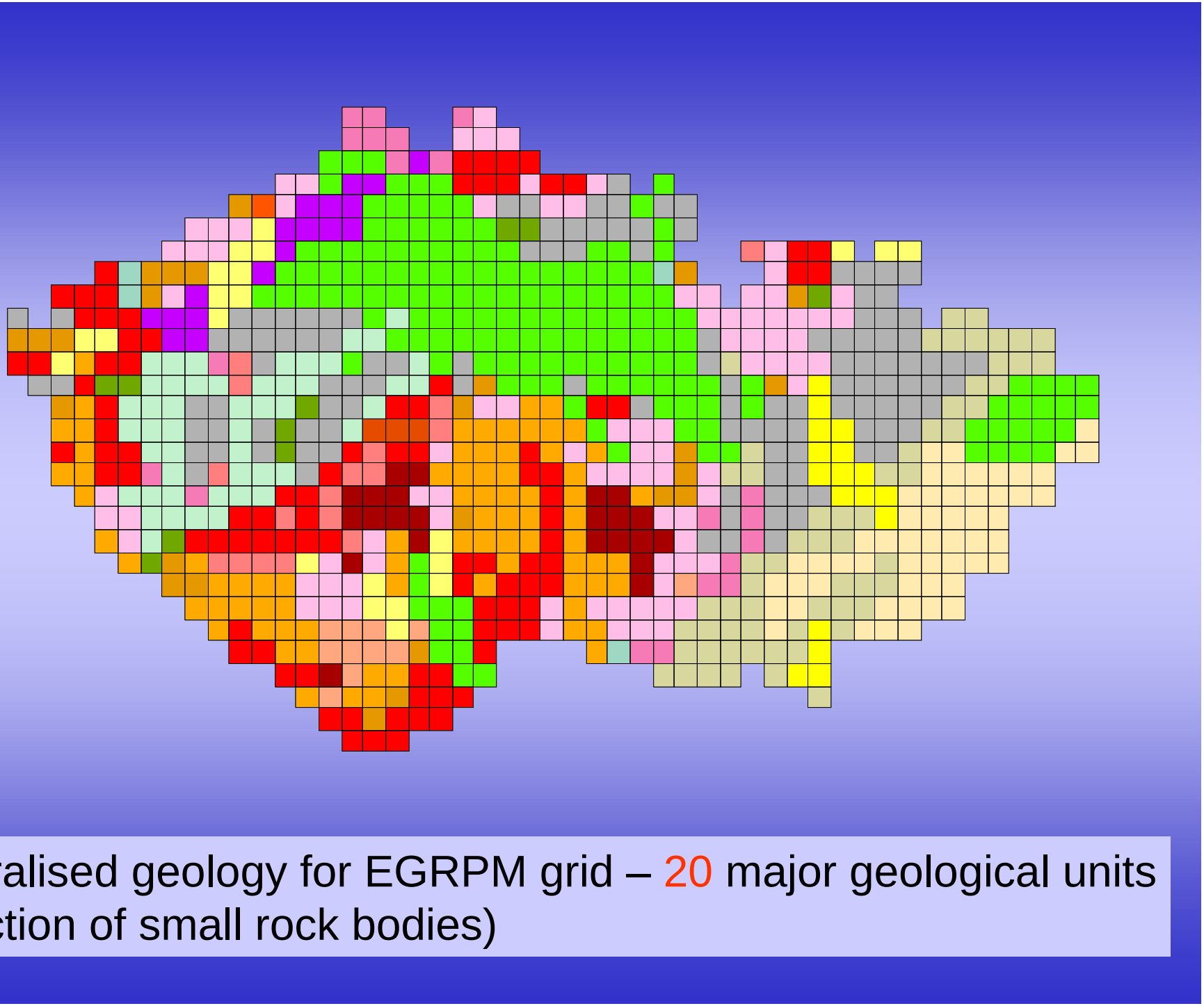


- Border areas of geol. units
- Areally prevailing geology
- Centroids for homogeneous geology
- Higher RP should be respected
- This example = result „granite“

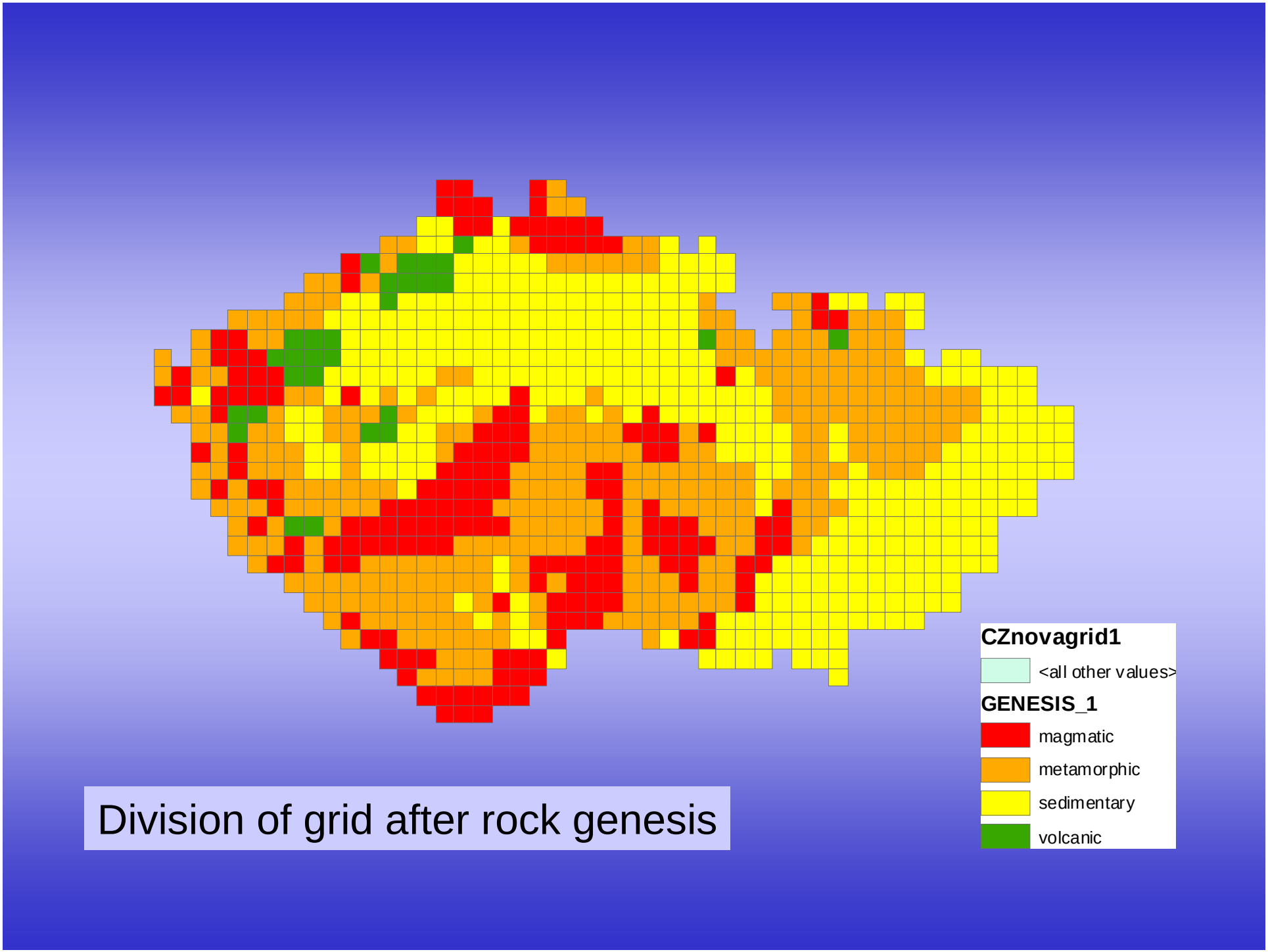
Data for one grid cell (as settled on in ISPRA 2009 working group meeting):

- Geological unit
- Lithology
- Genesis
- Tectonic
- Special features (karst, undermining)
- Soil gas Rn data – default for rock type or measured or measured in grid cell
- Gamma dose rate data
- U data (gammaspectrometric or analytical)

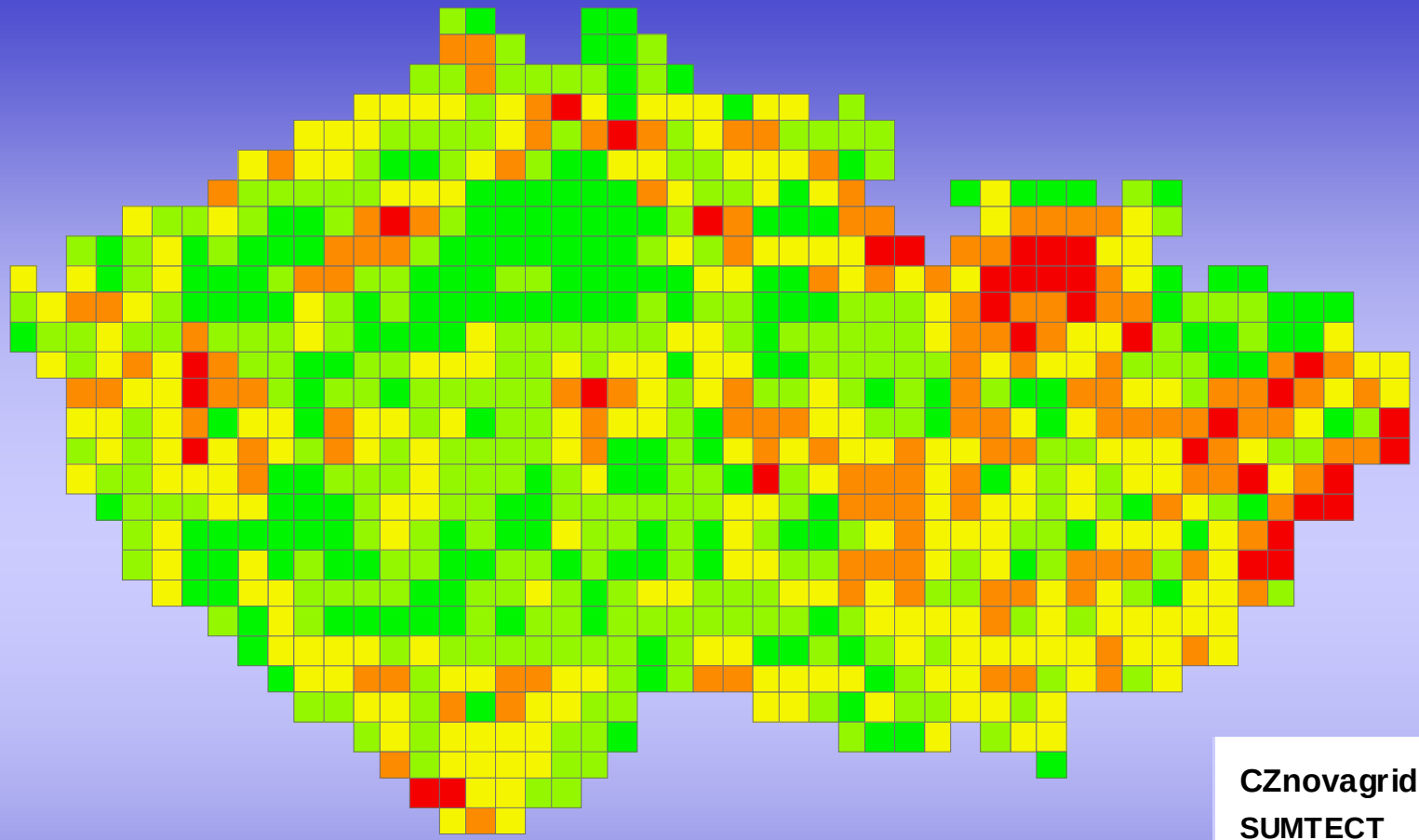
Practical examples from the Czech Republic follow:



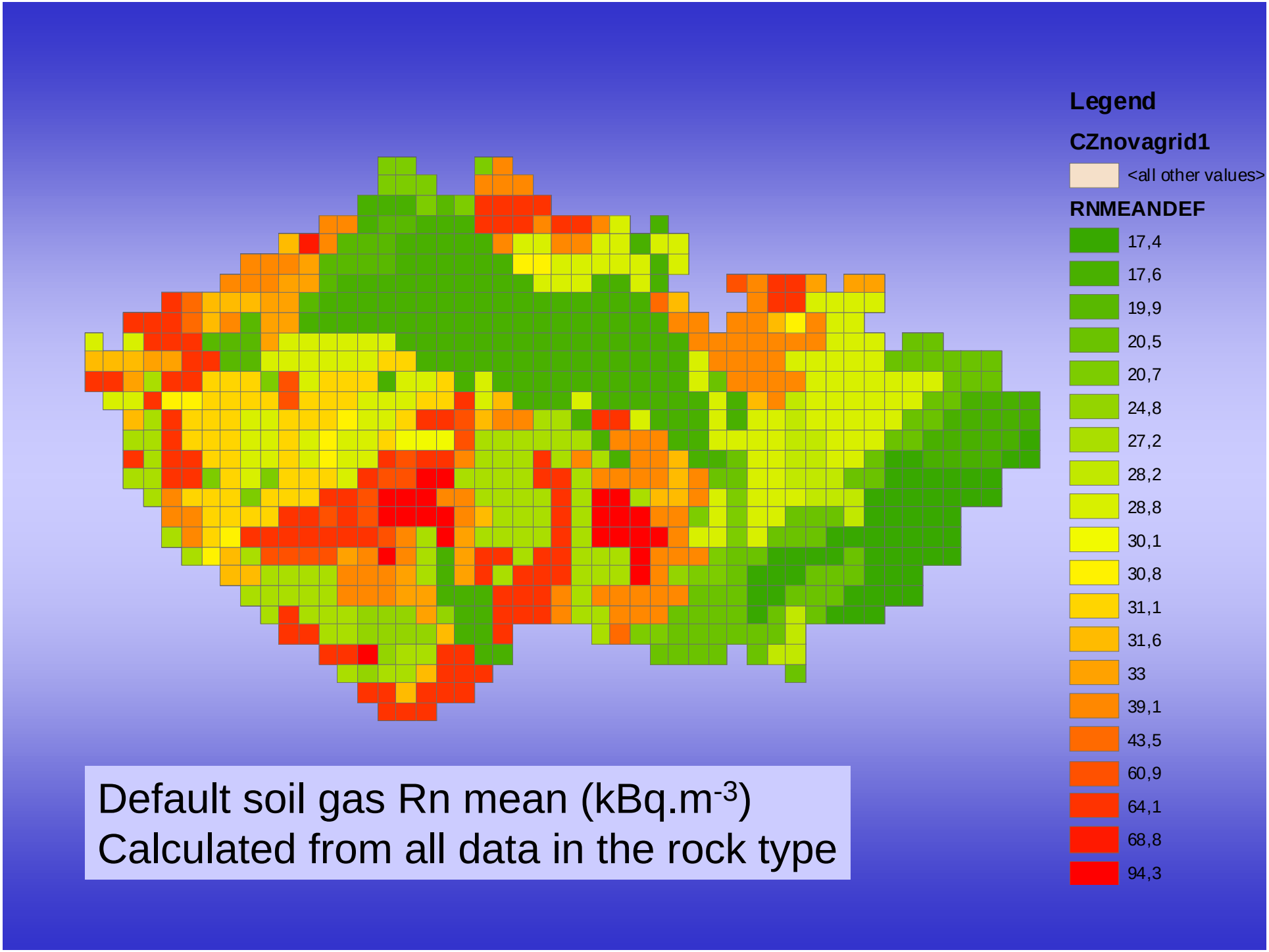
Generalised geology for EGRPM grid – 20 major geological units (reduction of small rock bodies)



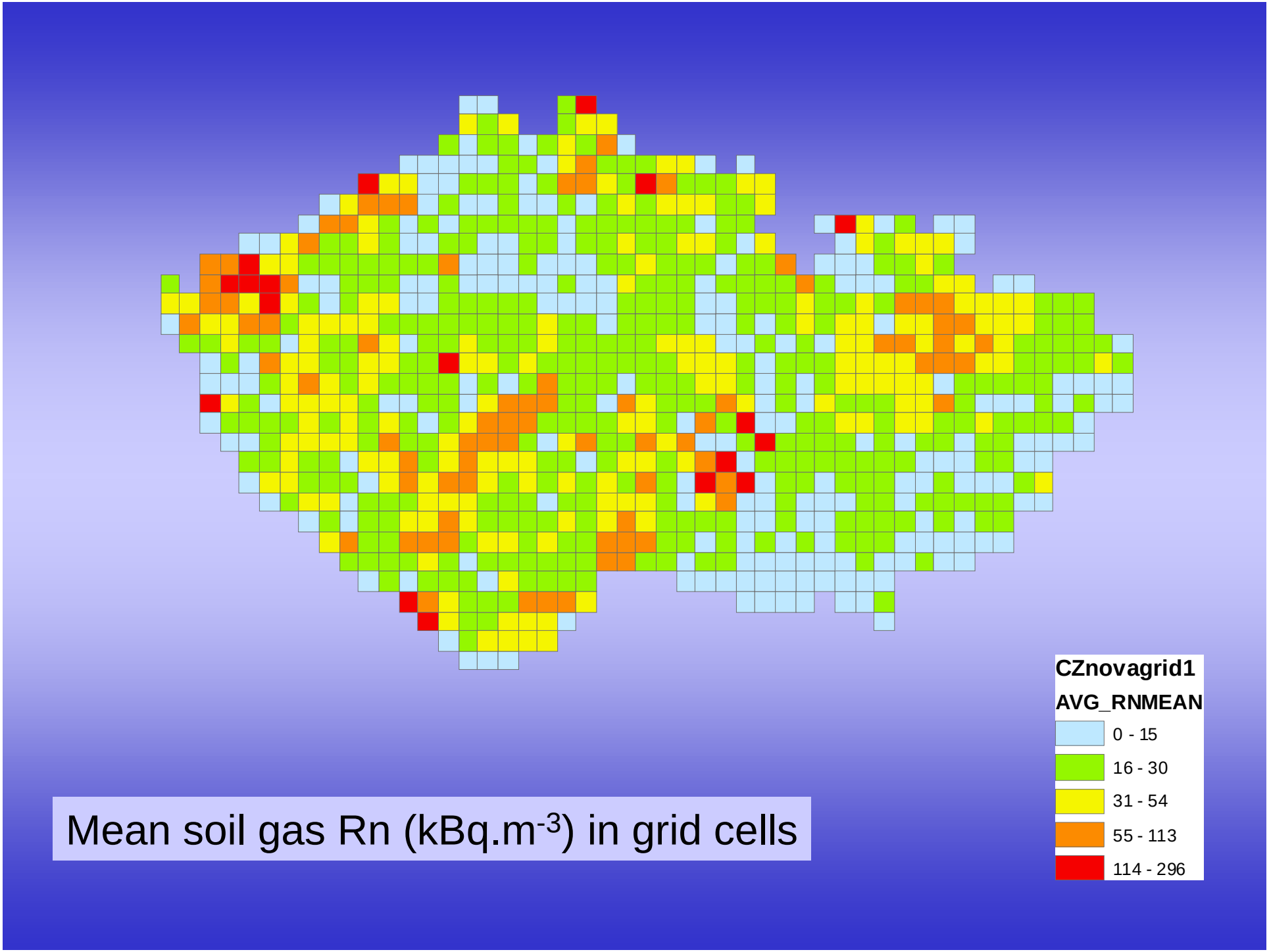
Division of grid after rock genesis



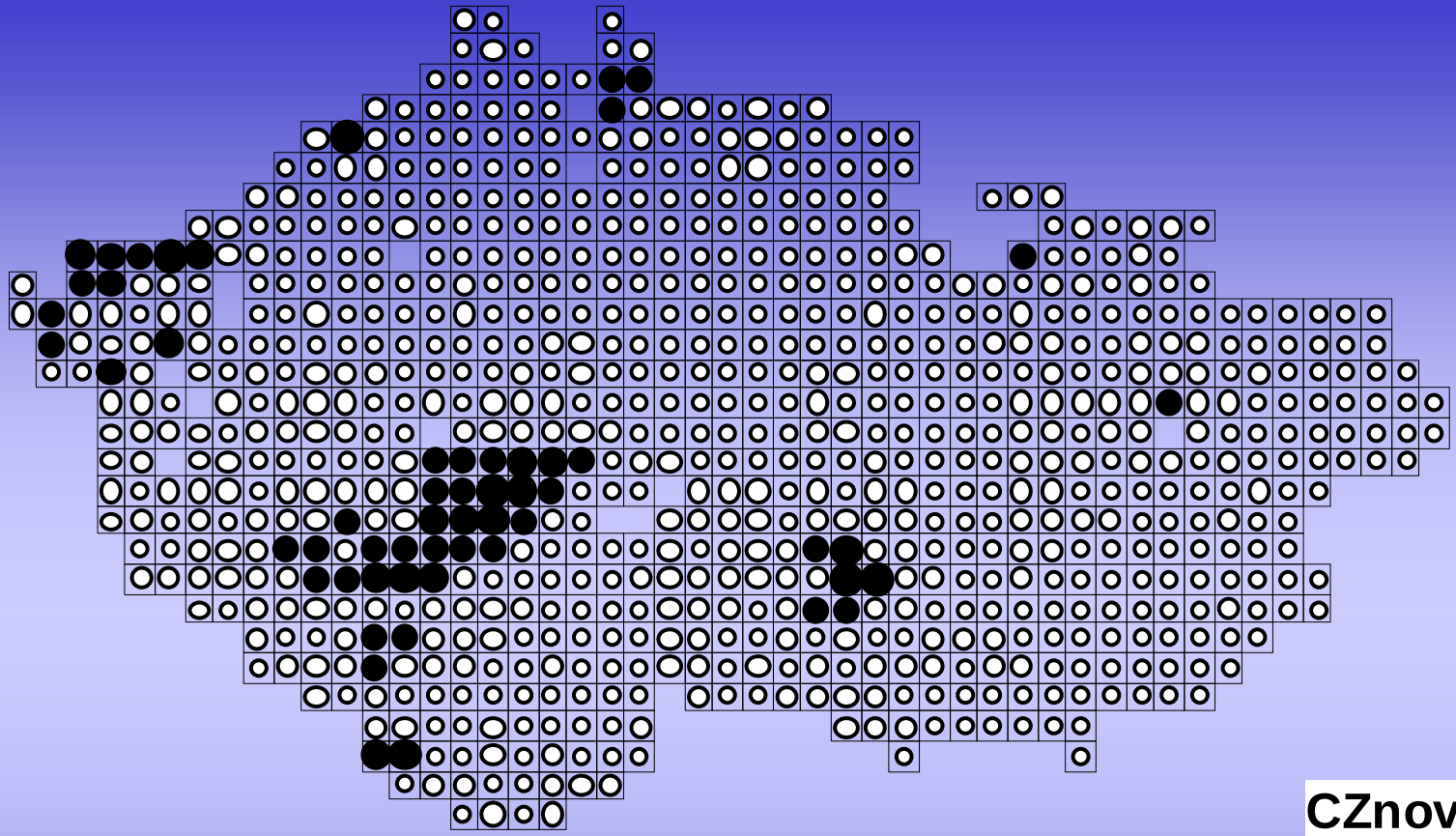
Tectonic disturbance – sum of tectonic lines in grid cells (meters)



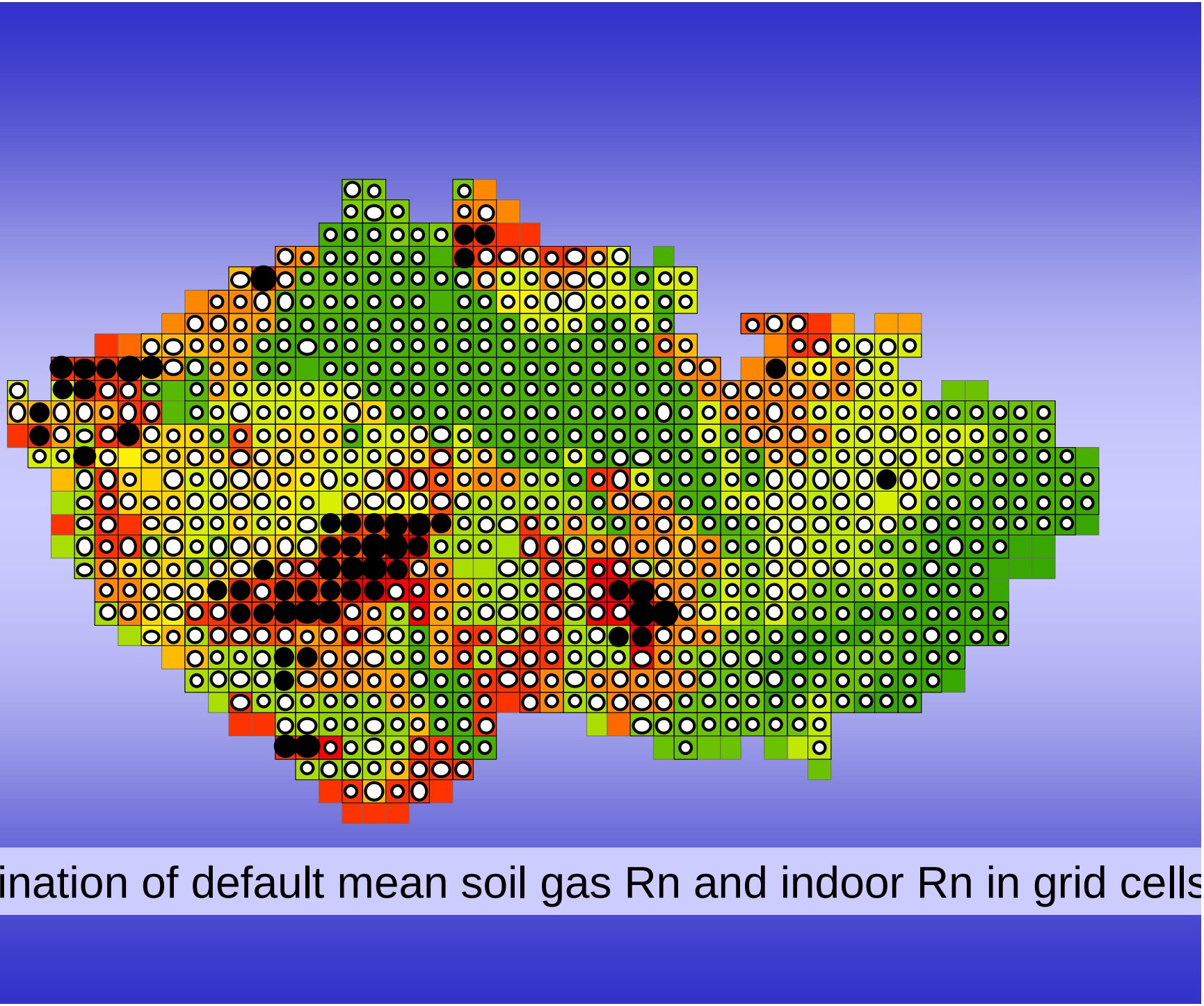
Default soil gas Rn mean (kBq.m^{-3})
Calculated from all data in the rock type



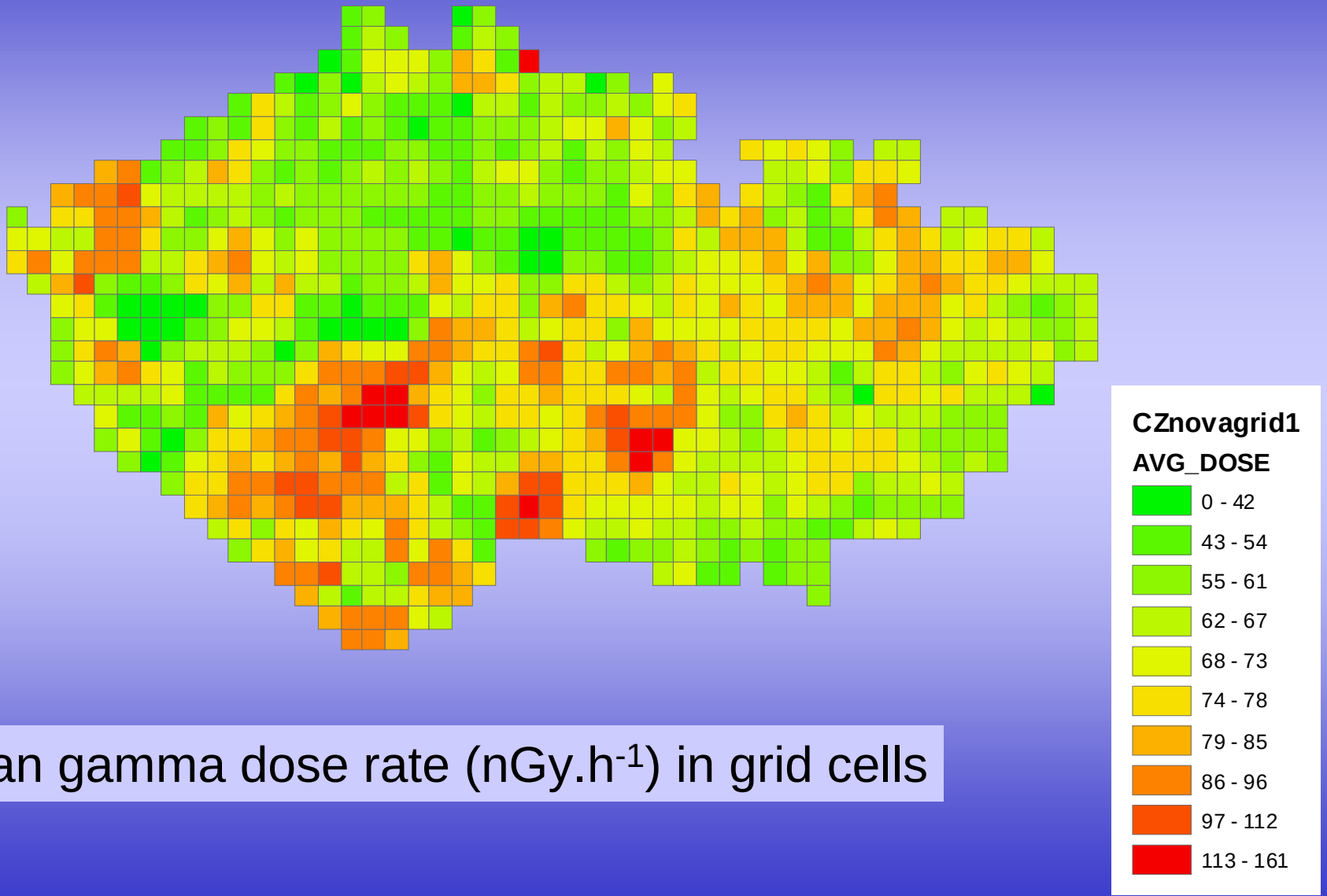
Mean soil gas Rn (kBq.m^{-3}) in grid cells



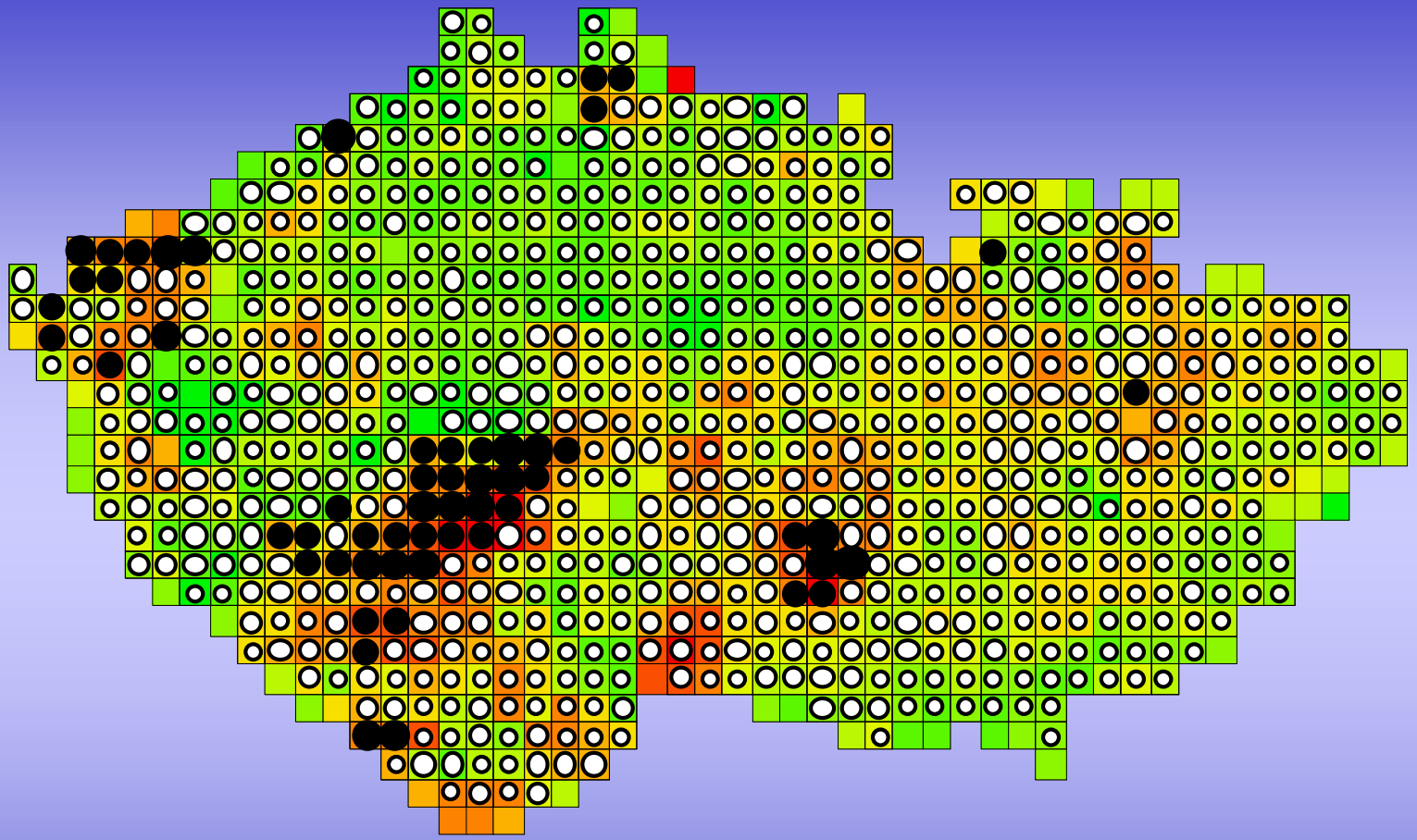
Mean indoor Rn ($Bq.m^{-3}$)
Calculated for grid cells, primary data of NRPI



Combination of default mean soil gas Rn and indoor Rn in grid cells



Mean gamma dose rate (nGy.h^{-1}) in grid cells



Combination of mean gamma dose rate and mean indoor Rn in grid cells

Conclusions:

- **Practical test on CZ data shows the possibility to construct the EGRPM**
- **Even complicated geological vectorised maps can be converted into grid net**
- **Rn or radiometric data in one grid cell can be expressed in the default (for rock unit) or calculated form (from measured values for grid cell)**

? Which resulting parameter will be expressed in one grid cell in EGRPM ?

References:

Bedřich Smetana (1874-1879): Symphonic Poems My Country:

Vyšehrad – Ordovician (medium Rn index)
Vltava – Paragneisses + granites (medium and high Rn index)
Šárka – Proterozoic silicites (medium Rn index)
Z českých luhů a hájů – Cretaceous sediments (low Rn index)
Tábor – Durbachites + husite movement – most dangerous
Blaník – Orthogneisses (medium Rn index)