Geogenic radon potential mapping in Pest and Nógrád counties in Hungary

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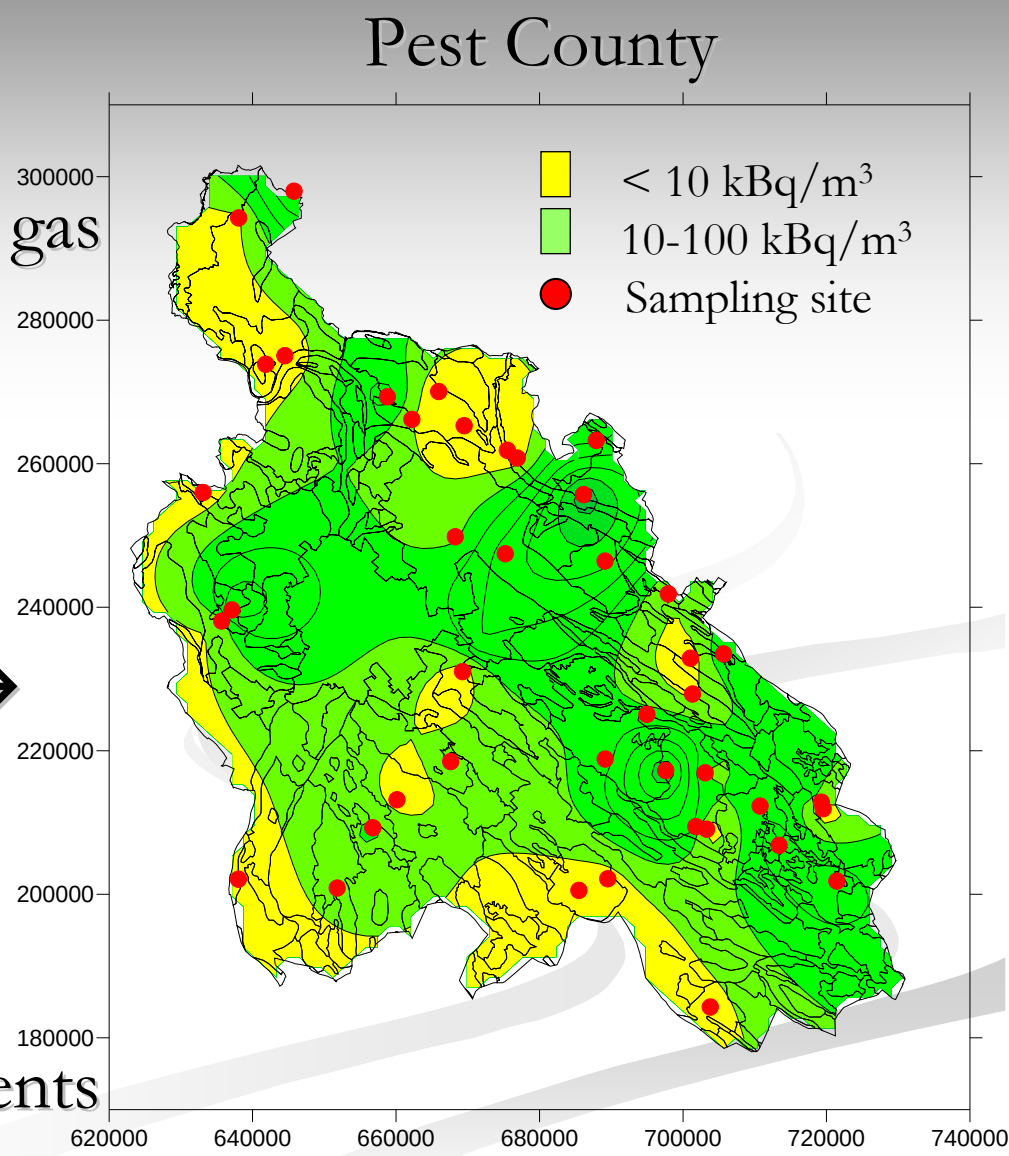
Introduction

- Our former work → soil gas radon from laboratory measurements of soil samples
- Radon exhalation of soil samples + soil porosity → soil gas radon activity concentration
- Indoor radon measurements (RADLabor, NRIRR)

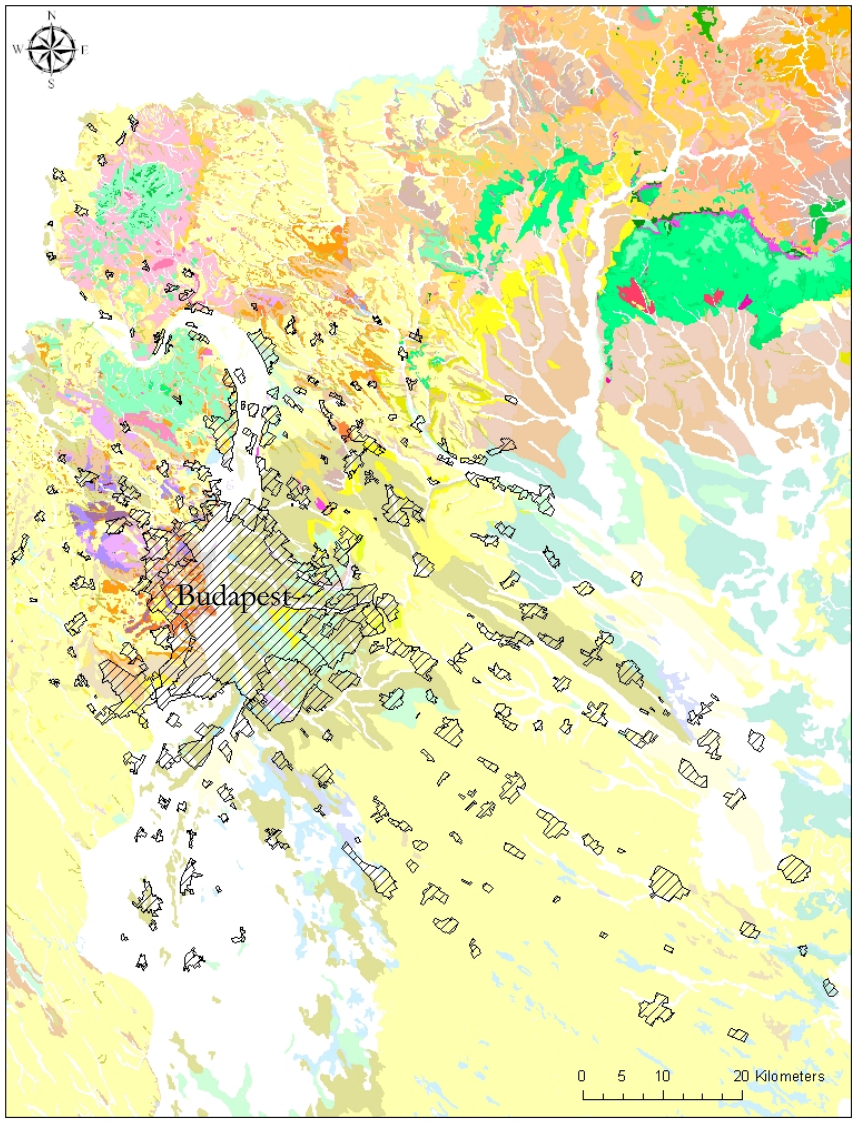


Aims

- Take the first step to mapping the geogenic radon potential in Hungary
- Categorize the geological formations into radon potential categories
- Determine the daily, weekly, monthly and annual variation of soil gas radon concentration and the meteorological influences on it
- Create radon potential map for the studied area based on geological background

Geogenic radon mapping in Hungary

- Diverse geology of the studied area
  - Mesozoic sedimentary rocks (limestone and dolomite)
  - Tertiary volcanic rocks (andesite, dacite and rhyolite)
  - Tertiary sedimentary rocks (marl, clay and sandstone)
  - Quaternary sediments (loess, sand, gravel and clay)
- Soil gas radon activity concentration
- Gas permeability of soil



Geological map of Central Region of Hungary, *Gyalog L., 2005*: Geological map of Hungary 1:100 000 (Budapest),©Geological Institute of Hungary

Methods

Soil gas radon

- RAD7 radon monitor (solid state, ion-implanted, planar silicon alpha detector) coupled with soil gas probe
- Sampling depth: 70-80 cm generally
- Mapping: GRAB protocol
- Radon annual variation: SNIFF protocol

Methods

Gas permeability of soil

- RADON - JOK portable permeameter
- at the same depth (70-80 cm)

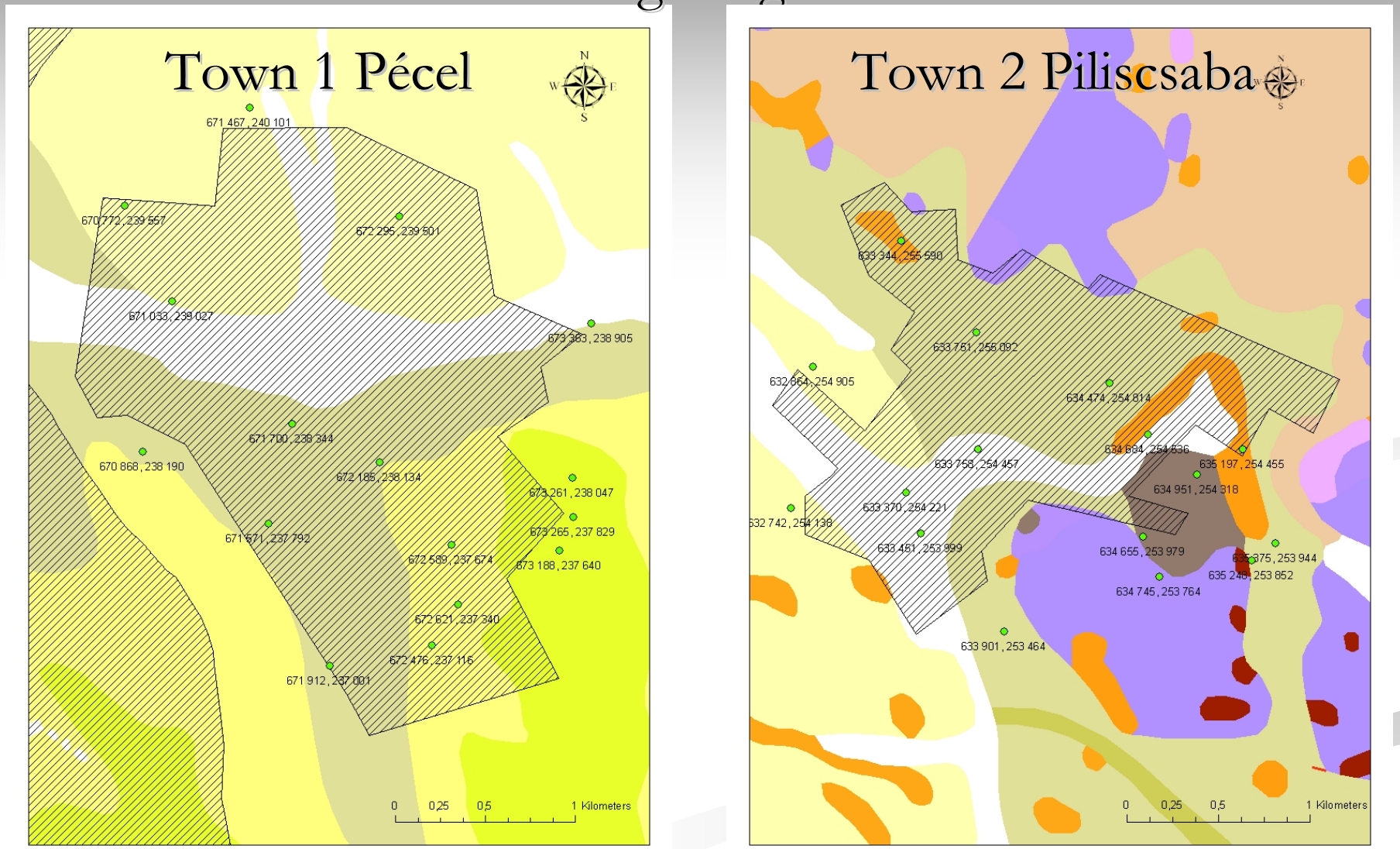
Methods

Categorization of geological formations into radon potential

- Soil gas radon activity concentration
  - 0-10 kBq/m^3 → LOW
  - 10-100 kBq/m^3 → MEDIUM
  - 100-500 kBq/m^3 → INCREASED
  - >500 kBq/m^3 → HIGH
  - after Kemski et al. (2001)
- Gas permeability of soil
  - $<4.0\times10^{-13}$ m^2 → LOW
  - 4.0×10^{-12} - 4.0×10^{-13} m^2 → MEDIUM
  - $>4.0\times10^{-12}$ m^2 → HIGH
  - after RADON-JOK MANUAL

Methods

Sampling soil gas radon derived different geological formations

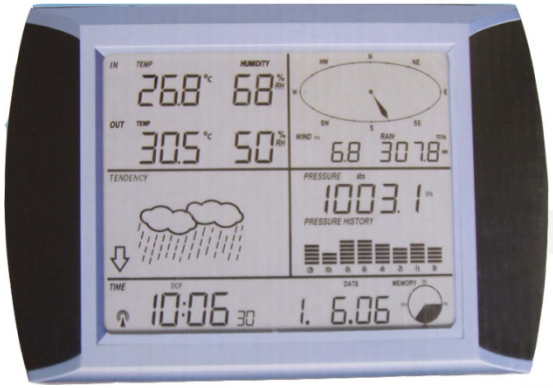


Geological map of Pécel and Piliscsaba, *Gyalog L., 2005*: Geological map of Hungary 1:100 000 (Budapest),©Geological Institute of Hungary

Methods

Meteorological parameters

- Easy Weather station
  - humidity
  - temperature
  - pressure
  - wind
  - rain



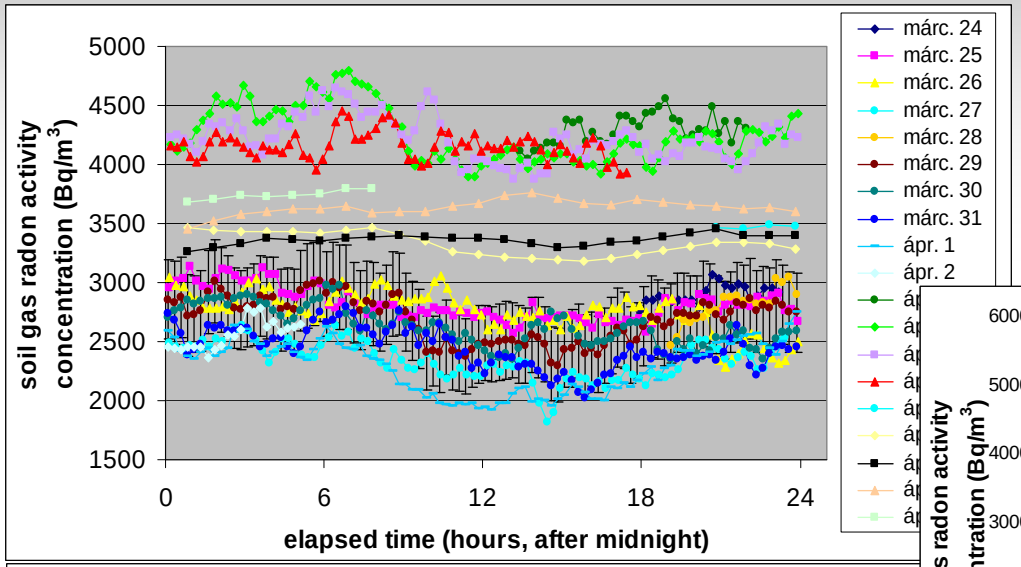
Results

Soil gas radon activity concentration of soils derived different geological formation

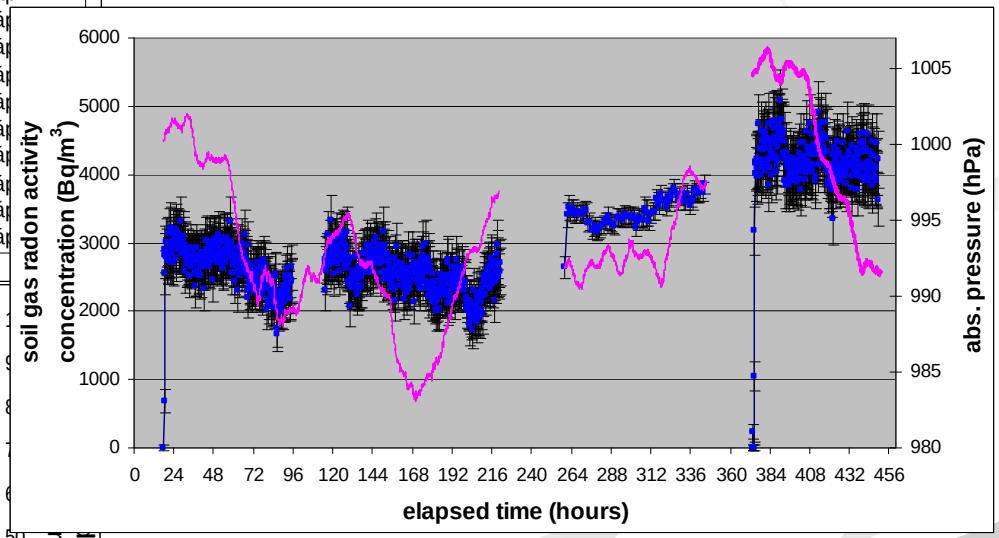
Geological formations	number of sampling sites	range (kBq/m^3)	median (kBq/m^3)	average (kBq/m^3)
Mesozoic sedimentary rocks (limestone and dolomite)	4	2,9-10,2	4,7	5,6
Tertiary sedimentary rocks (marl, clay and sandstone)	7	1,4-9,3	2,8	3,8
Quaternary sediments (loess, sand, gravel and clay)	36	0,7-10,3	4,4	4,9

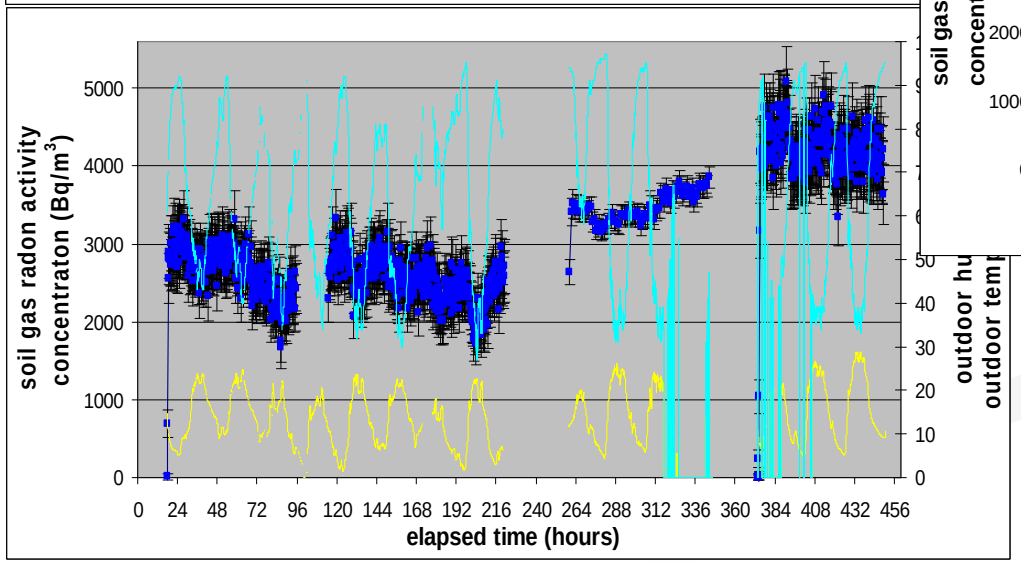
Results

Daily and monthly variation of soil gas radon activity concentration and the meteorological influences



Budapest 1 - Kispest

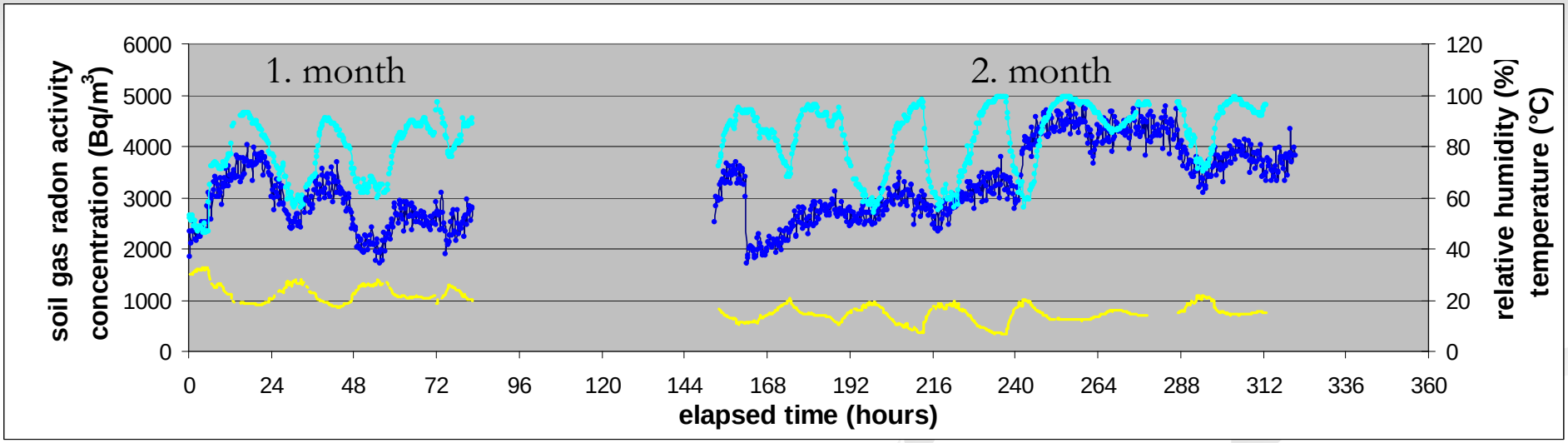


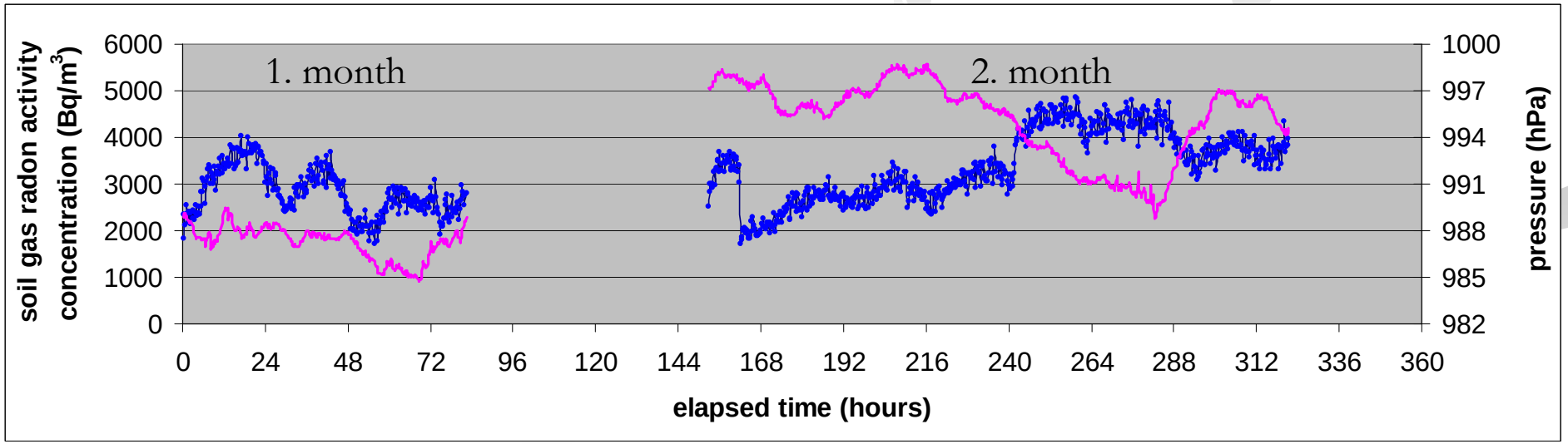


Results

Monthly changes of soil gas radon activity concentration and the meteorological influences

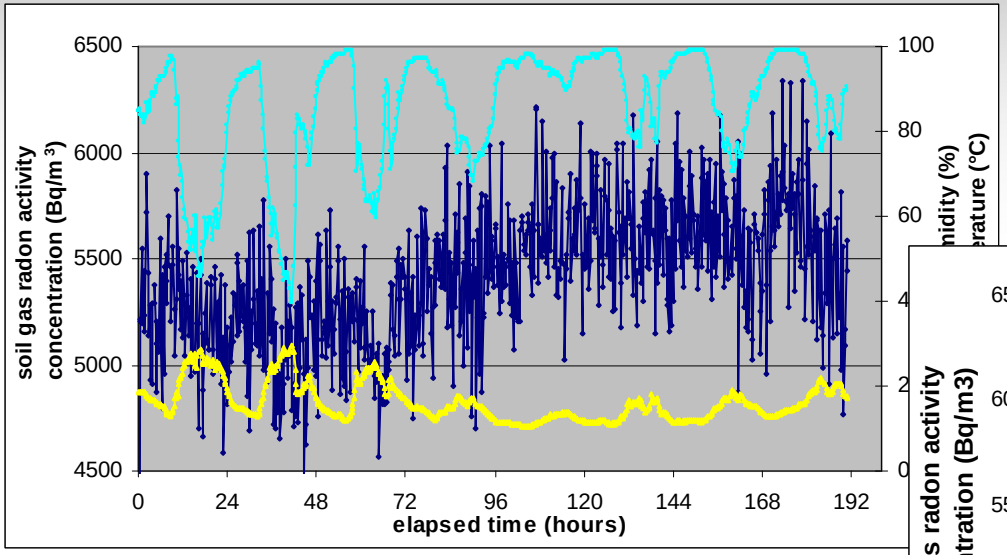
Budapest 2 - Gilice tér



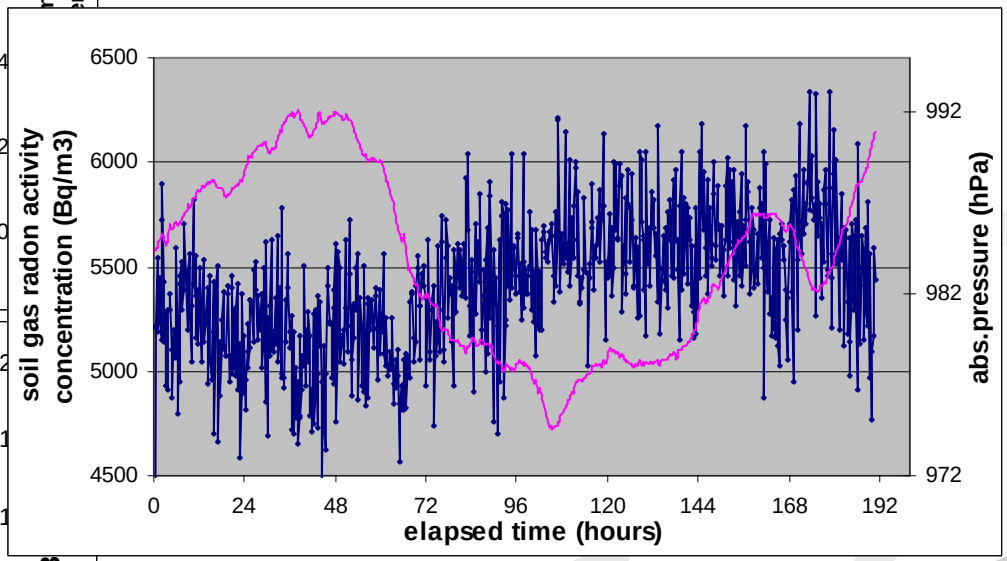


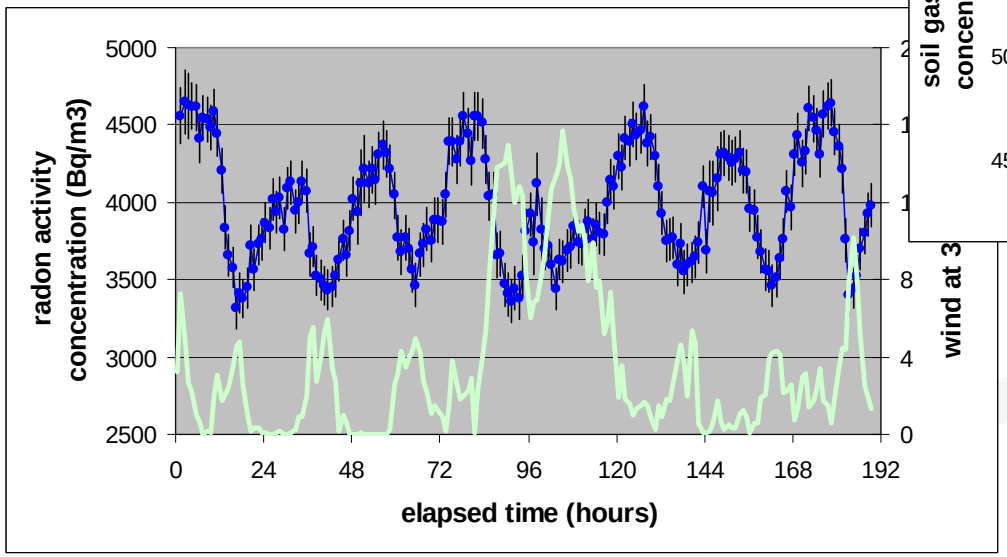
Results

Weekly variation of soil gas radon activity concentration and the meteorological influences



Nagytarcsa





Results

Linear correlation between soil gas radon and meteorological parameters in 1 week periods

Soil gas radon	Outdoor humidity	Outdoor temperature	Pressure	Wind
Budapest 1 - Kispest	0,06 -0,36 -0,31	-0,04 0,13 0,22	0,47 0,59 0,19	-0,02 0,19 0,19
Budapest 2 - Gilice tér	0,47 0,37	-0,6 -0,03	0,43 **-0,75**	0,1 0,14
Nagytarcsa	0,58 0,40	-0,42 -0,46	-0,06 -0,45	-0,46 -0,09

Results

Variability of soil gas radon activity concentration time series 1 week periods

Soil gas radon	average (Bq/m^3)	standard deviation (Bq/m^3)	relative deviation %
Budapest 1 - Kispest	2580	290	11%
	3460	200	6%
	4220	250	6%
Budapest 2 - Gilice tér	2810	510	18%
	3400	750	22%
Nagytarcsa	3970	360	9%
	5420	330	6%

Summary

- Soil gas radon activity concentration derived different geological formations
  - Mesozoic sedimentary rocks – LOW
  - Tertiary sedimentary rocks - LOW
  - Quaternary sediments – LOW

- Higher soil gas radon activity concentration than 10 kBq/m^3 (with higher than 15% probability)
  - Quaternary sediments 1 site
  - Mesozoic sedimentary rocks 1 site

Summary

- Soil gas radon
  - daily variation is 7,5 ± 1%
  - weekly variation is 6-9%, 6-11%, 18-22%
  - monthly variation is 25%

- Correlation between soil gas radon and meteorological parameters from 7 one week measurements
  - outdoor humidity: 6 moderate correlation
  - outdoor temperature: 2 moderate and 1 strong correlation
  - pressure: 4 moderate and 1 high correlation
  - wind: 1 moderate correlation

THANK YOU FOR YOUR ATTENTION!