



# Long term radon monitoring in a completely refurbish residence : investigations in the framework of the french-swiss Interreg Jurad-Bat project



Haute école d'ingénierie et d'architecture Fribourg  
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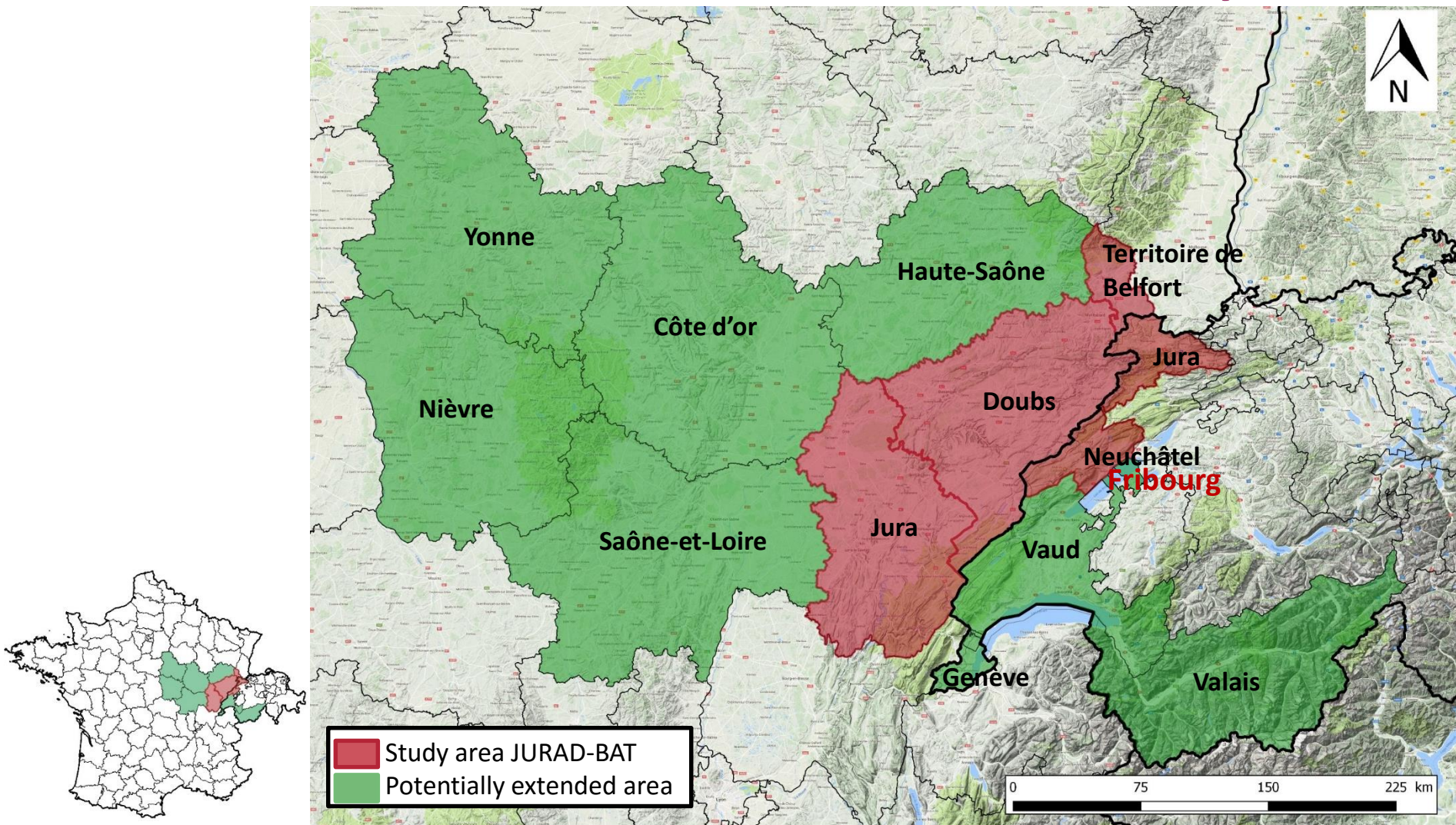


**Hes·SO**  
Haute Ecole Spécialisée  
de Suisse occidentale  
Fachhochschule Westschweiz

Céline de Potter Longchamp  
Joëlle Goyette Pernot  
Atmos'Fair, Lyon 2019

# What is «JURAD-BAT» project?

# Two countries, one territory





# Co-workers

## 2 leaders

University of Franche-Comté, France (UFC)  
School of Engineering and Architecture of  
Fribourg, Switzerland (HEIA-FR)

## 30 persons actively involved

23 interdisciplinary partnairs (energy, building,  
health, communication,... )

### CHEFS DE FILE



### PARTENAIRES



### CONTRIBUTEURS



Ce projet est soutenu par Interreg V-A  
France-Suisse et le soutien financier  
de l'Union Européenne via le FEDER

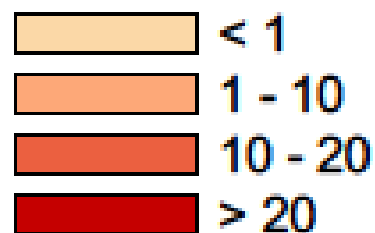


# One goal...

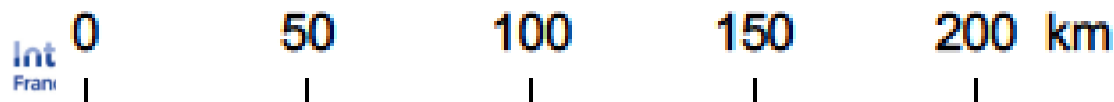
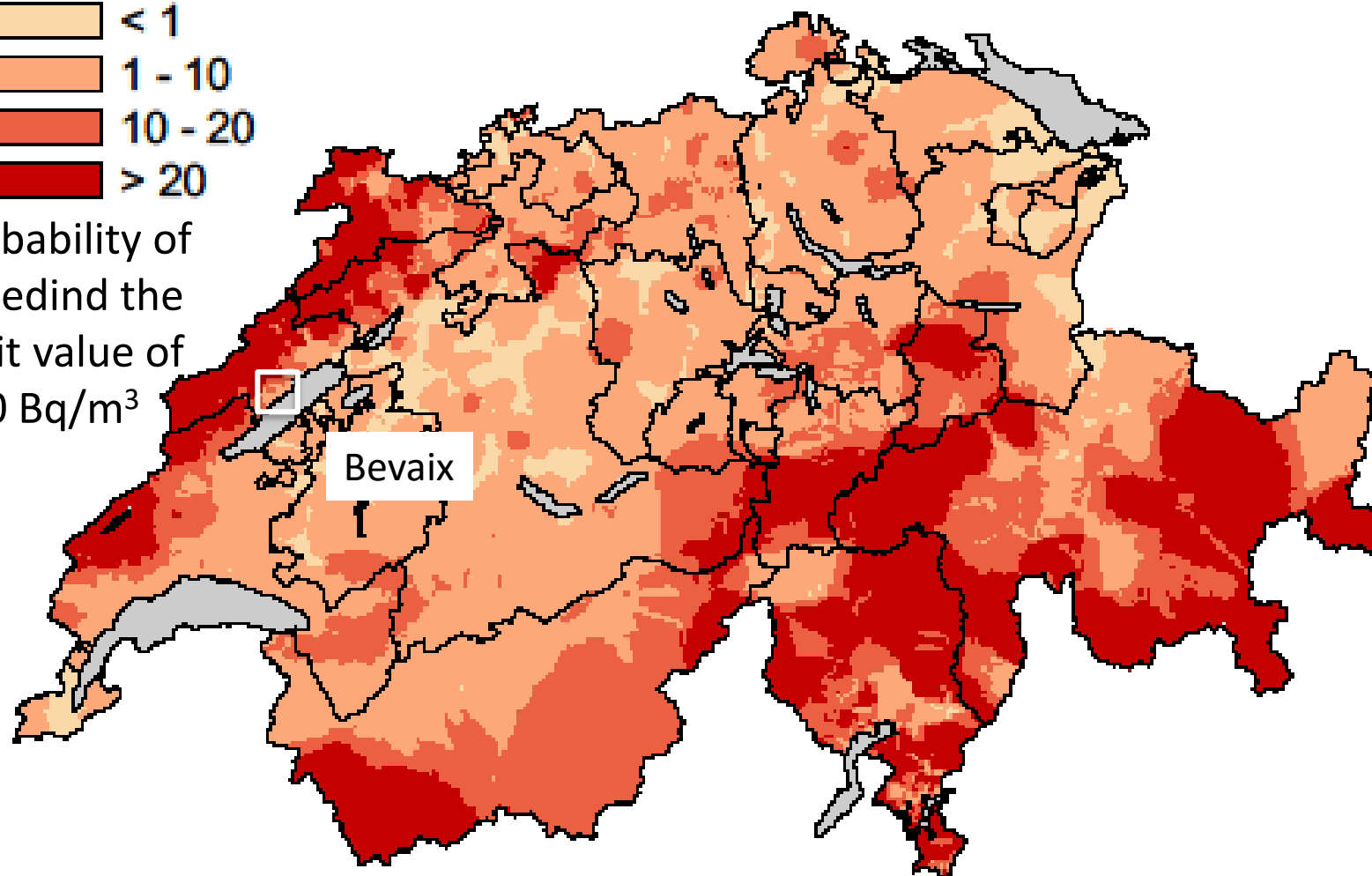
**Improve knowledge of the radon risks in buildings of the Jura Mountains and communication between different actors.**

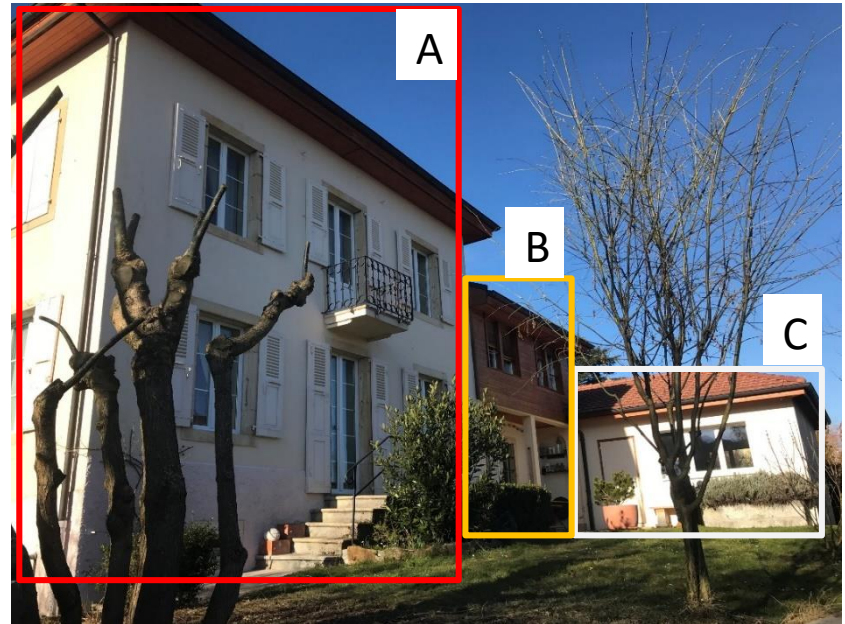
- To design a cross-country web-plateform : share experiment, propose trainings, creat tools for communications, ...
- Increase radon and IAQ measurements in buildings (100 in Switzerland, 100 in France)
- Increase our knowledge of radon propagation (link between radon concentration and geology and meteorology)

# Studied area



Probability of  
exceeding the  
limit value of  
300 Bq/m<sup>3</sup>





1895 building, totally renovated in 2010  
 A – Main part, partially excavated, filled crawl space

B – Annexe office and bedroom, non-excavated

C – Annexe workshop, non-excavated

- Water table subcropping

- Moraine and fluvio-lacustrine deposits



# Instrumentation

# Radonmapper (Tecnavia)

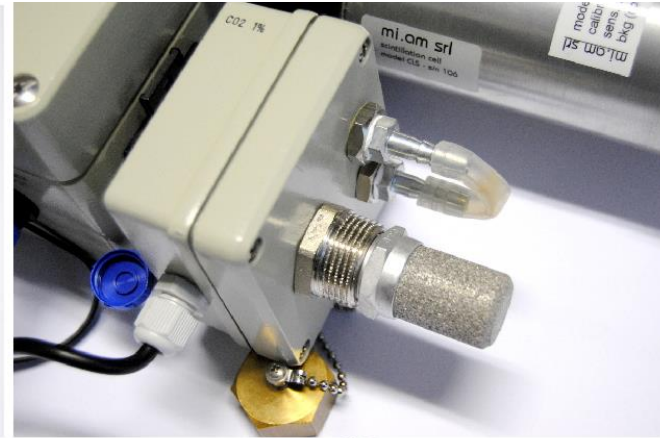
Radon detector Lucas scintillation cell

Measure at the same time : radon, temperature, atmospheric pressure

Passive  
measurement



CO<sub>2</sub>  
sensor



Active  
measurement

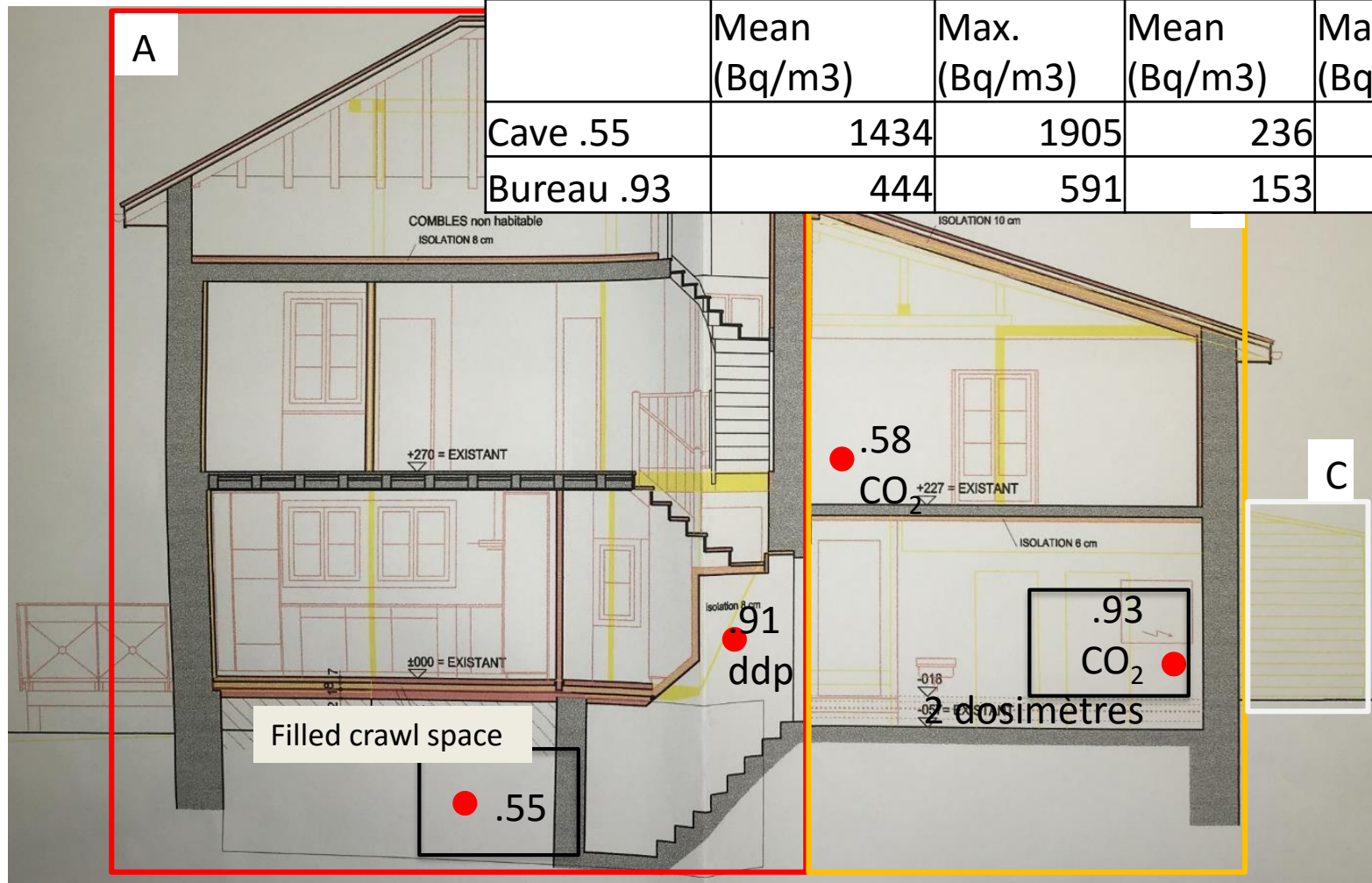


Pressure  
difference

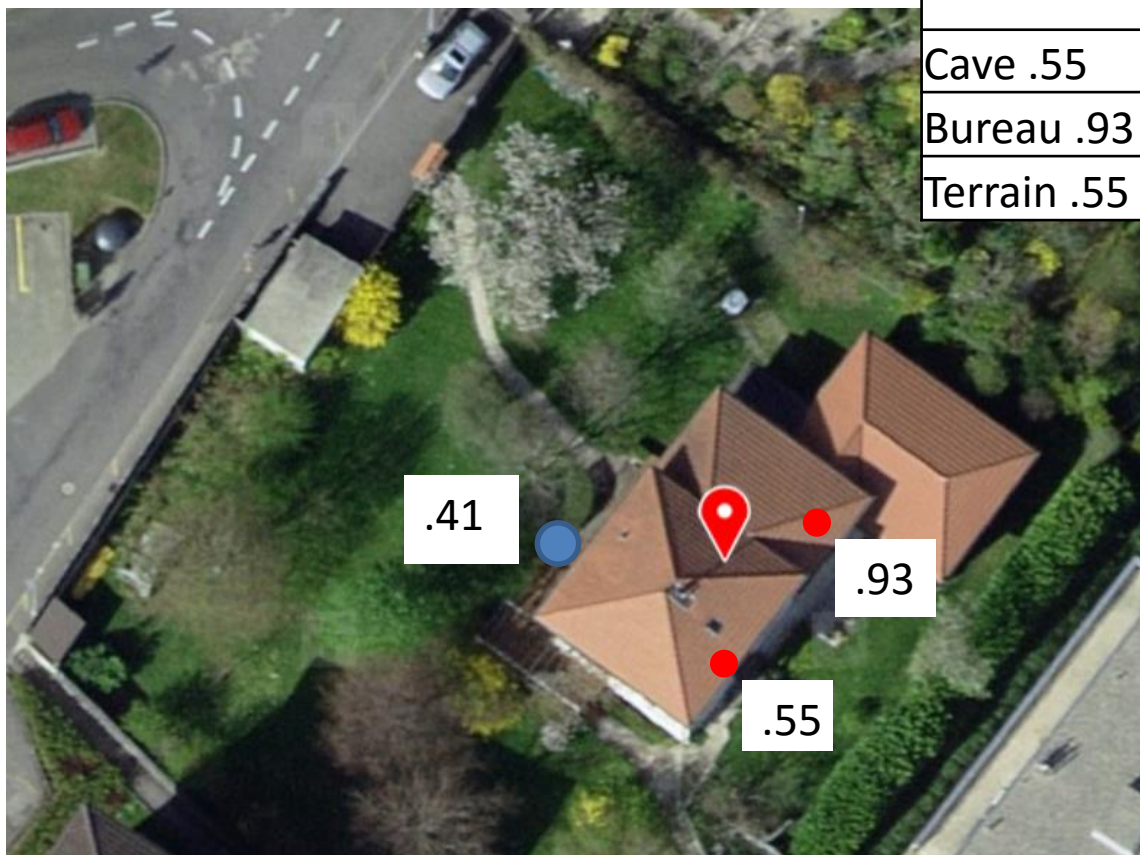


(pictures : <http://www.econs.ch>)

	01 Feb.–31 March 2018		16 May – 06 Jul. 2018	
	Mean (Bq/m <sup>3</sup> )	Max. (Bq/m <sup>3</sup> )	Mean (Bq/m <sup>3</sup> )	Max. (Bq/m <sup>3</sup> )
Cave .55	1434	1905	236	560
Bureau .93	444	591	153	488



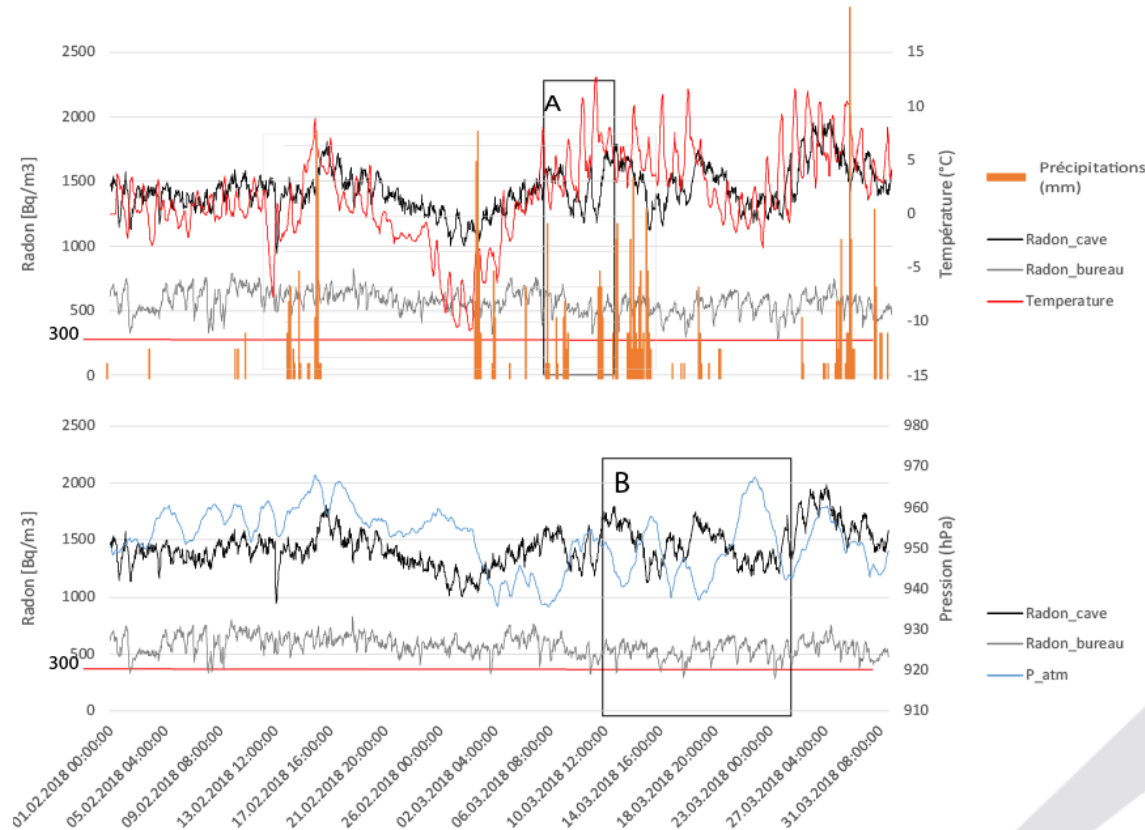
	24 Aug.-21 Sep. 2018	
	Mean (Bq/m <sup>3</sup> )	Max. (Bq/m <sup>3</sup> )
Cave .55	316	563
Bureau .93	271	638
Terrain .55	6397	10'322





# Results

# Winter : February – March 2018

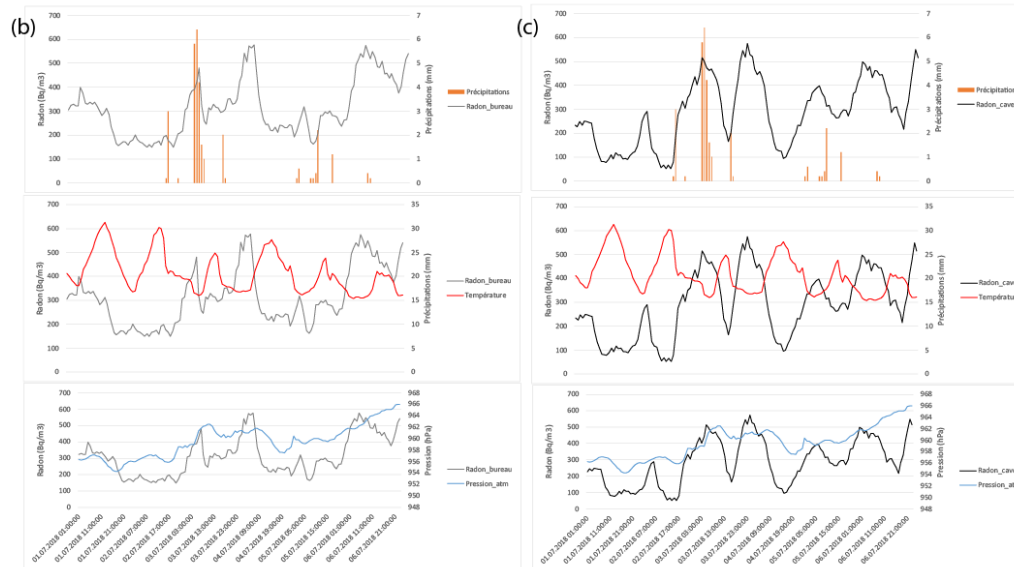
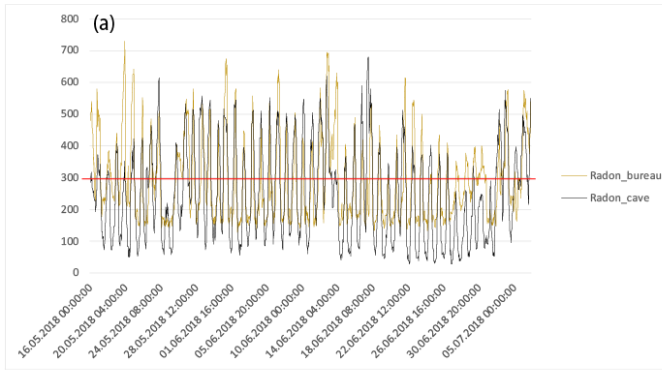


- Basement windows are closed
- No correlation for the 2 months period
- A : one week measurements , inverse correlation between temperature and radon concentration in basement ( $K=-0.68$ ) and office ( $K=-0.59$ )

When the outside temperature decrease,  $\Delta T$  increases  $\rightarrow$  chimney effect is more important

- B : inverse correlation between radon concentration in basement and atmospheric pressure ( $K=-0.64$ )

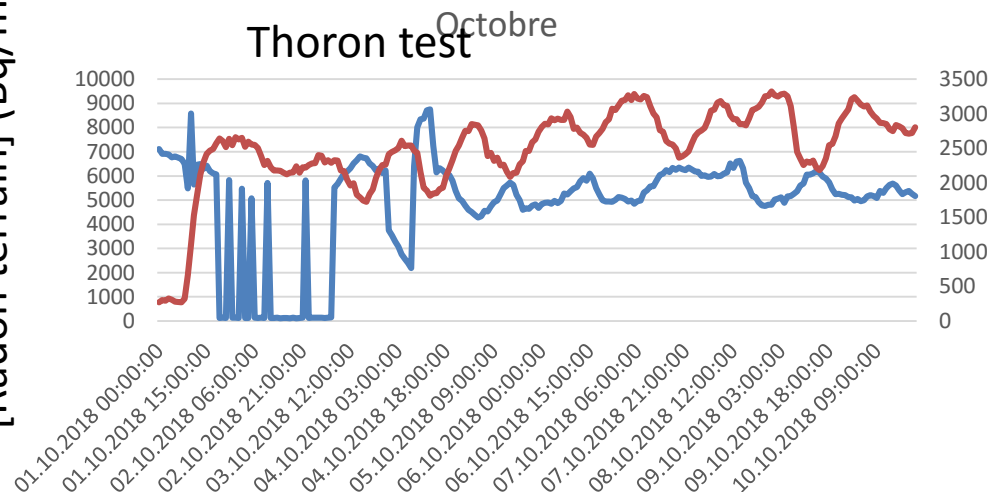
# Summer : 16 of May – 06 of July 2018



- Basement windows are open
- Little inverse correlation between basement radon concentration and temperature ( $K=-0.58$ ) for the 2 months period
- July measurements : strong inverse correlation between basement radon concentration and temperature ( $K=-0.83$ ).

# October:field and basement

[Radon terrain] (Bq/m<sup>3</sup>)

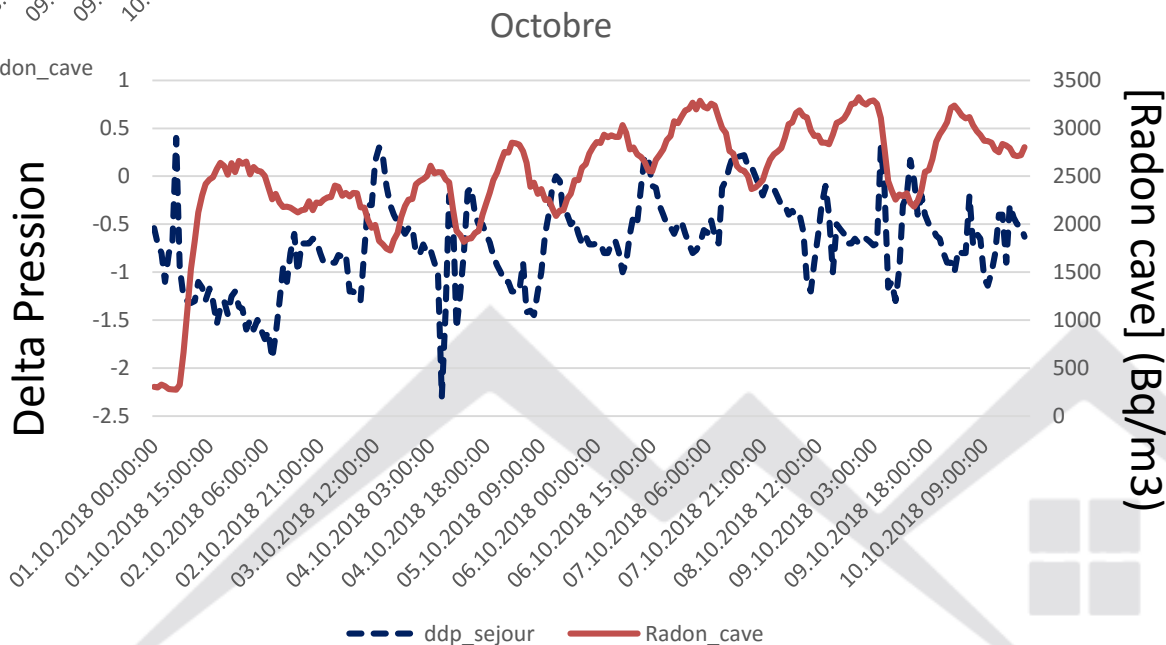


[Radon cave] (Bq/m<sup>3</sup>)

Inverse correlation between radon concentration in the field and the one in the basement.

Inverse correlation between radon concentration in the baesement and the difference of pressure.

- Overpressure inside → radon increases in the field
- Overpressure outside → radon increase inside



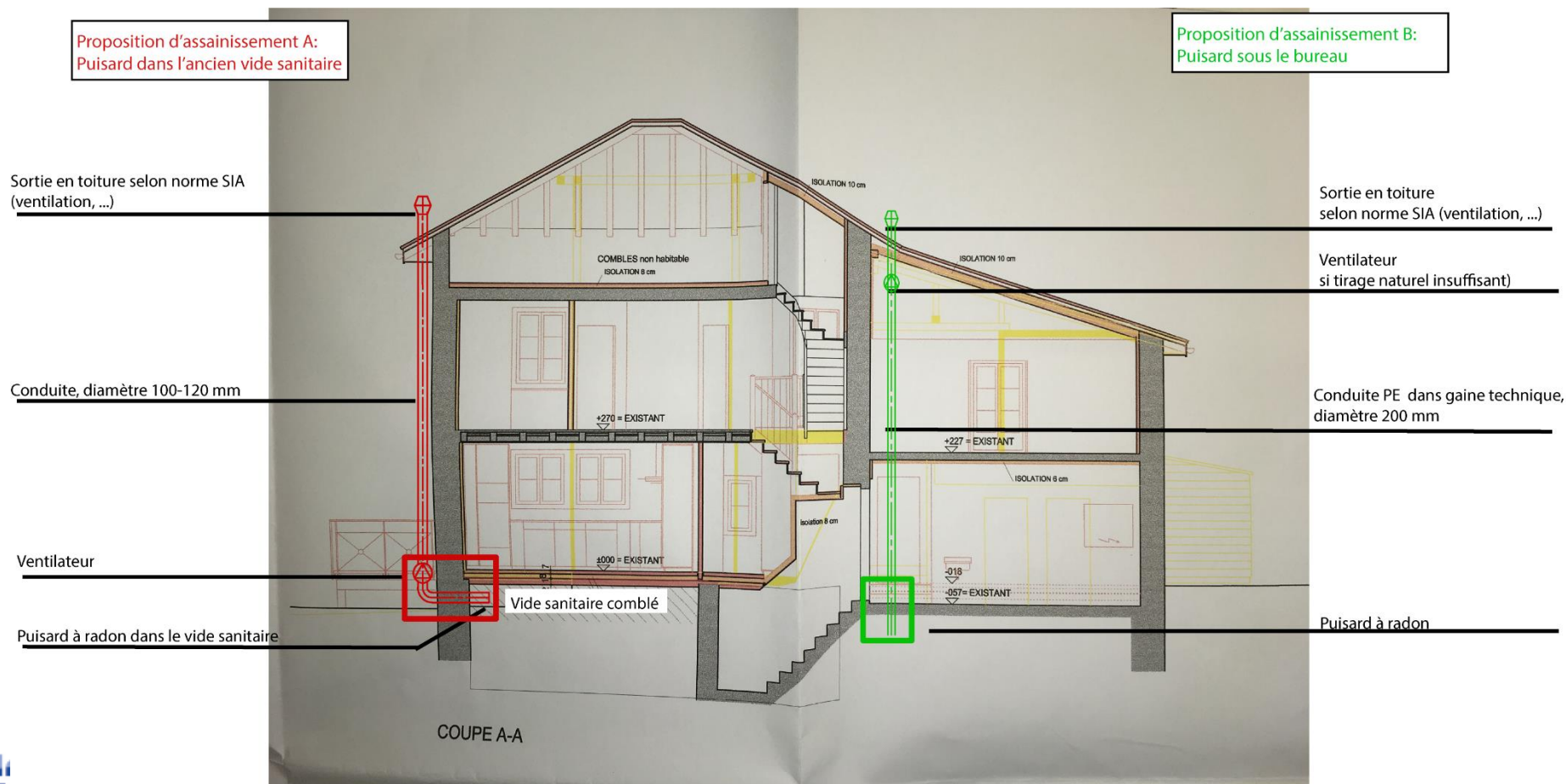


# Remediation

# Two possibilities

1st : Sump in the old crawl space

Sump under the office



Détail du

Saut de loup

Vue façade

Test of ventilation  
of the old crawl  
place

No

Yes

Radon concentration  
< 300 Bq/m<sup>3</sup>

Sump under the  
office

Final installation  
of a sump and  
chimney on the  
roof

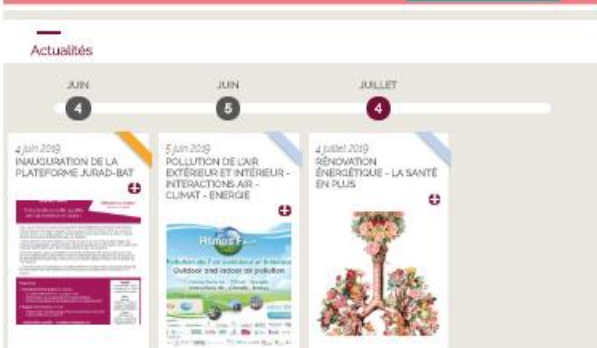
Costs : **7500**  
**CHF**

Costs : **5600**  
**CHF**

# Conclusions



- In winter : higher concentrations, windows in basement are close → accumulation.
- Influence of the variation of temperature between inside and outside → chimney effect
- Influence of the difference of pressure between inside and outside
- 2 remediation propositions for this case :
  - 1: Sump in the crawl space.
  - 2: if 1 not efficient, sump under the office



3 public cibles:

- Le grand public
- Les professionnels
- Les autorités locales

Boîte à outil:

- Ressources, documentation
- Auto-évaluation du bâtiment
- Fiches techniques
- ...

Cartographie interactive

Quiz (questions interactives et bonnes pratiques)

Actualités

Thank you for  
your attention

For further  
information about  
radon and indoor air  
quality

[www.jurad-bat.net](http://www.jurad-bat.net)