ROLE OF RESIDENTIAL RADON IN CHILDHOOD LEUKAEMIA: THE GEOCAP PROGRAM

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The GEOCAP program

Case/Control study

Recruitment 2002-2007

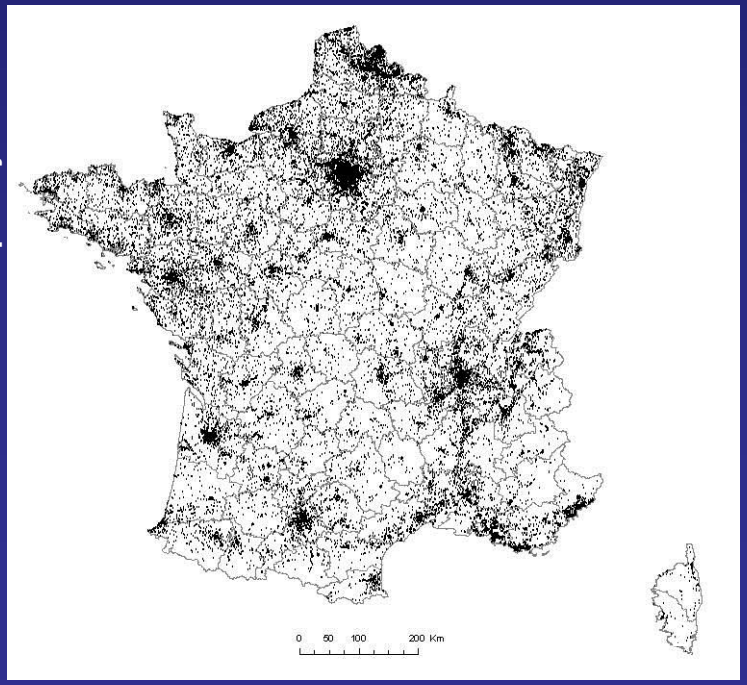
Leukaemia cases (470 per year)
National registry of childhood hematological malignancies (RNHE)
Children <15 years old living in mainland France

Population controls (30,000: 5,000 per year)
Sample of addresses representative of children <15 years old living in mainland France
Gathered by INSEE using income and council tax databases

Address and geolocalisation of the case's and control's homes

Automatic for well-referenced addresses
Manual for the other (town hall, maps, …)
Margin of error: 20 m for about 75% of addresses

Localisation of the Geocap subjects



The GEOCAP program

Environmental exposures

Several environmental exposures are studied in the GEOCAP program:

- **natural ionizing radiation**
- **proximity to nuclear sites**
- **traffic and air pollution**
- **power lines and ELF-MF**

The subjects' exposure will be estimated at the adress point.

Studying the statistical distribution of estimated exposure among the 30,000 GEOCAP controls will provide information on children's exposure in France.

The comparison of this distribution to that observed among the leukaemia cases will allow documenting further the association between these environmental exposures and leukaemia incidence among children.

Preliminary studies

Childhood leukaemia and exposure to radon

Radon = ionizing radiations exposure of natural origin

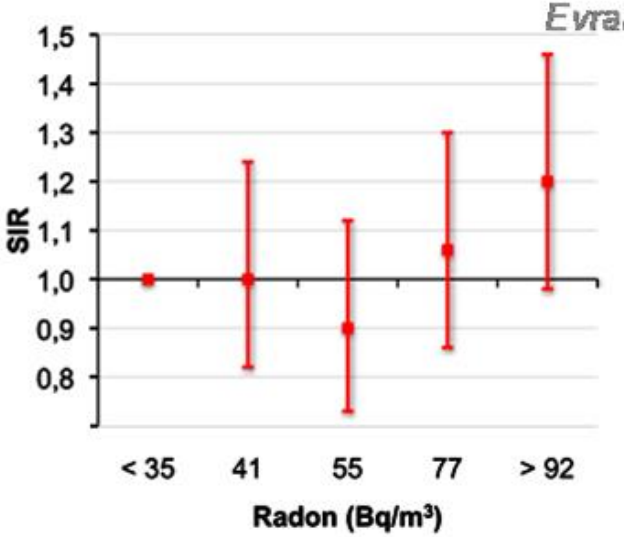
<u>Since 1980:</u> 20 studies have analysed the ecological association between leukaemia incidence and average concentrations in homes. Most of them concluded that there was a positive association

A <u>French</u> ecological study has shown a RR equal to 1.24 (acute myeloblastic leukaemia) in places with high exposure to radon

Leukaemia

Radon

Evrard et al, Eur J Cancer Prev 2005
Evrard et al, Health Physics, 2006



The GEOCAP program

Exposure to radon

Objectives

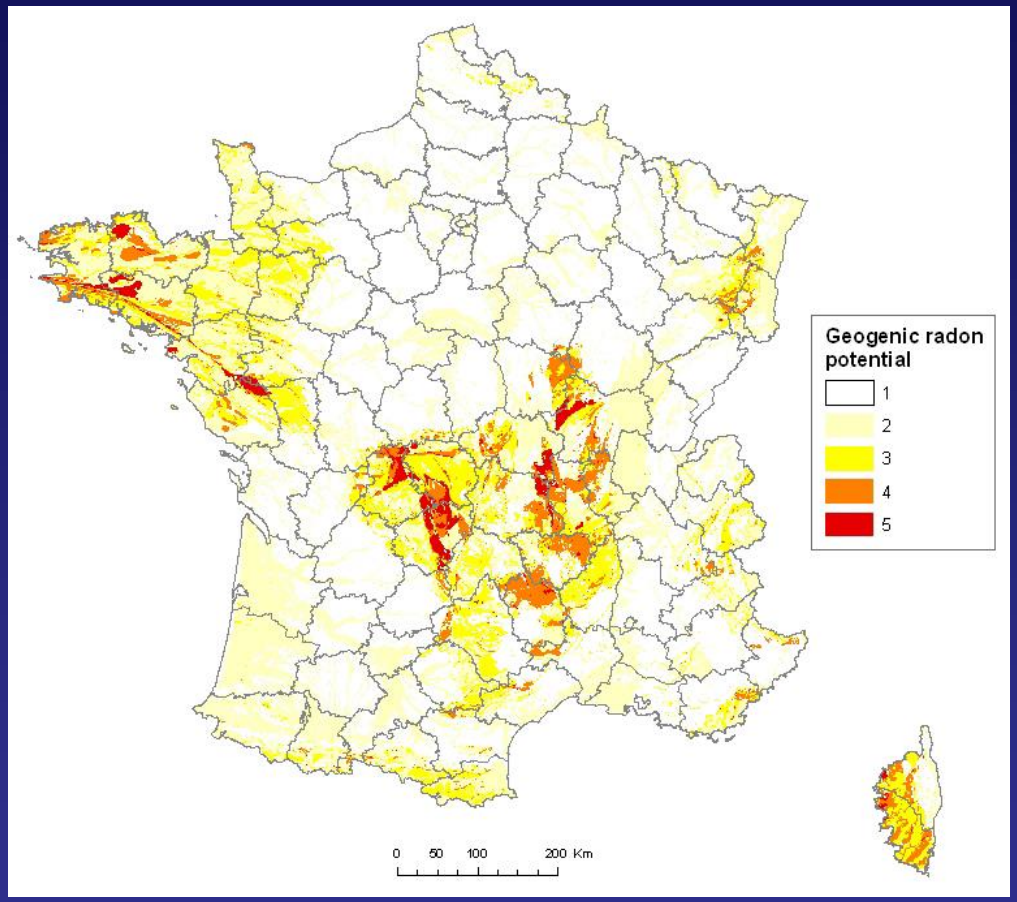
Two databases of IRSN are used to provide an estimate of radon exposure:
1. A geogenic radon potential map
2. A national sample of indoor radon concentration measurements with houses' characteristics

The objective is to assess the best estimation of the radon exposure in France by using these two databases.

Before estimating the residential radon exposure of the GEOCAP subjects, the relation between these two types of data is analysed.

Data

1) The geogenic radon potential



Objective:

Determining the capacity of the geological units to produce radon and to facilitate its transfer into the atmosphere.

- **Based on a classification of the geological units according to their uranium content.**
- **Improved by taking into account the main additional parameters which control the preferential pathways of radon through the ground**

Final map:

categorization of the whole French territory in five classes: from low to high geogenic radon potential (based on the geological map at scale 1 : 1 000 000) (with an accurate geographic resolution: 500 to 1,000 m)

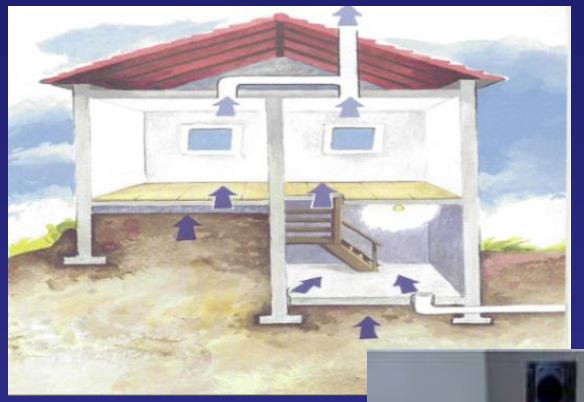
Data

2) National sample of indoor radon concentration measurements

IRSN conducted a national radon survey in collaboration with the French Ministry of Health (from 1982 until 2003, using track-etch detectors (LR 115)).

Dwellings characteristics were collected in order to examine factors that might influence radon concentrations:

- **type of building,**
- **building materials,**
- **type of foundations,**
- **building period,**
- **level where the measurement was made**
- **type of room where the measurement was made,**
- **type of ventilation,**
- **air exchange frequency**



A correction factor has been applied to the results to take into account the seasonal variation.

10,843 indoor radon concentration measurements are used.

- ✓ **8,136 points whose complete address is available are geocoded at the address point**
- ✓ **others are located at the city hall point**

Distribution of the 10,843 indoor radon concentration measurements

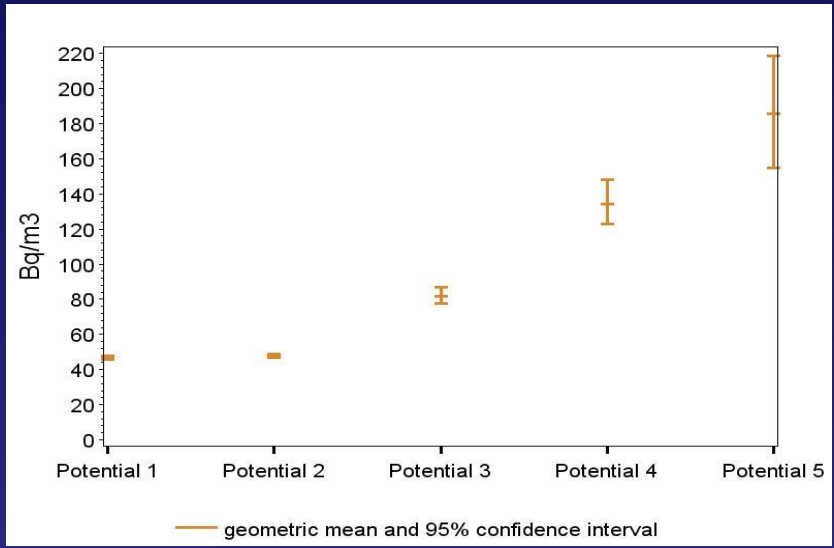
N	geometric mean [CI95%]	5%P (Bq/m^3)	median (Bq/m^3)	95%P (Bq/m^3)
10,843	53,0 [52,1;54,0]	13,1	49,4	272,3

Statistical analysis of data : preliminary results

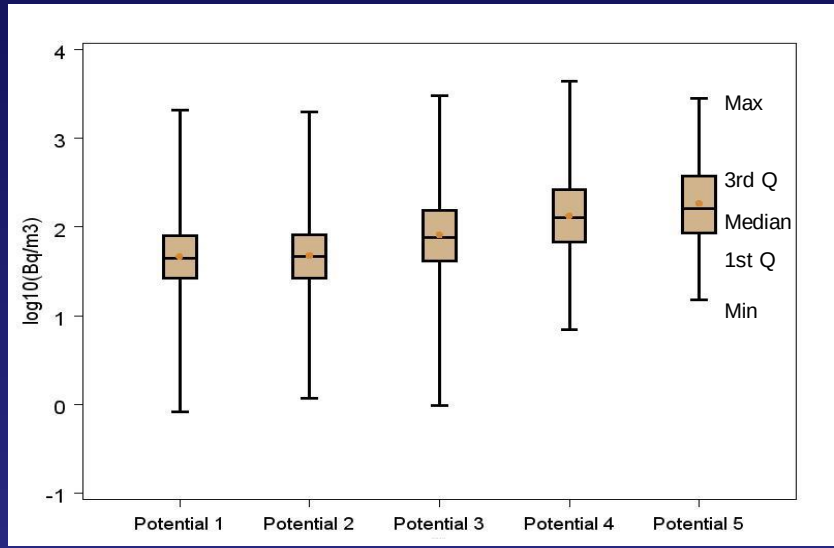
Indoor radon concentration measurements and geogenic radon potential

Distribution of the 10,843 indoor radon concentration measurements according to the 5 geogenic radon potential classes

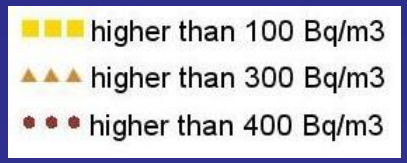
1. Geometric means

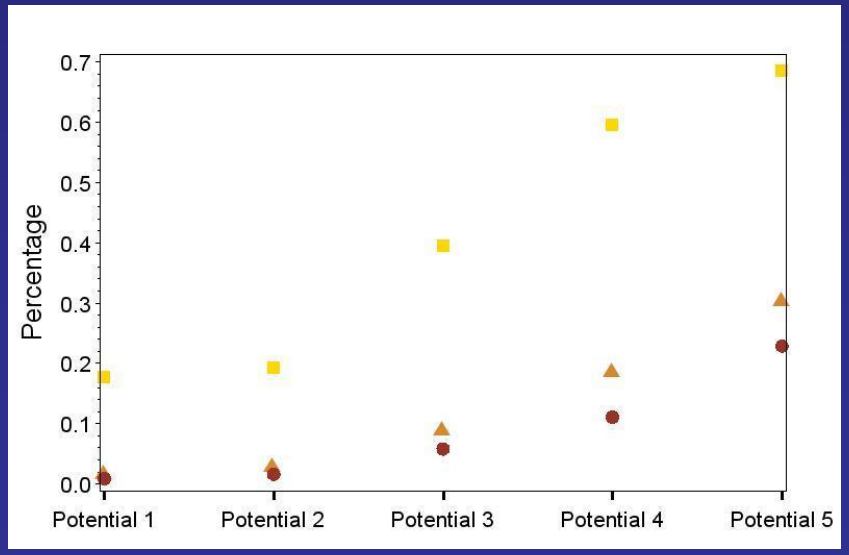


2. Boxplots



3. Percentage of measurements higher than thresholds





Statistical analysis of data : preliminary results

Indoor radon concentration measurements, geogenic radon potential and home characteristics

Geogenic radon potential and houses characteristics significantly associated with indoor radon concentration measurements

Geometric mean [CI95%] adjusted for other characteristics	
1. Geogenic radon potential	
Potential 1	**40,2** [37,8; 42,8]
Potential 2	**43,4** [40,8; 46,2]
Potential 3	**65,5** [60,6; 70,7]
Potential 4	**96,5** [87,7; 106,3]
Potential 5	**130,9** [112,7; 152,0]
2. Type of building	
apartment building	**54,1** [49,6; 59,0]
house	**83,4** [77,6; 89,6]
3. Building materials	
brick	**53,2** [49,4; 57,3]
concrete	**59,7** [54,8; 65,1]
stone	**75,4** [70,0; 81,2]
granite	**124,1** [111,6; 137,9]
4. Construction period	
After 1945/1948	**61,3** [57,1; 65,9]
Before 1945/1948	**74,2** [69,0; 79,8]

Geometric mean [CI95%] adjusted for other characteristics	
5. Level	
floor	**61,1** [56,8; 65,6]
ground floor	**69,9** [65,3; 74,7]
6. Type of foundations	
basement, cellar	**63,4** [59,0; 68,0]
slab	**71,4** [66,4; 76,8]
7. Type of ventilation	
natural	**63,7** [59,3; 68,4]
mechanical and collective	**68,1** [59,6; 77,8]
mechanical and individual	**69,9** [64,5; 75,8]
none	**70,1** [65,5; 75,1]
8. Air exchange frequency	
low	**69,3** [62,4; 77,0]
medium	**74,2** [69,3; 79,4]
high	**71,0** [66,2; 76,2]

Current studies

1. **Estimation of the radon exposure:**
   - ✓ **Consideration of the contextual information on geogenic radon potential surrounding measurement points rather than using punctual geogenic radon potential alone.**
   - ✓ **Kriging map of the radon concentration (ongoing work in IRSN)**

2. **Relation between childhood leukaemia and radon:**
   - ✓ **Incidence study at the municipality scale for the period 1990/2007**
   - ✓ **Case-control study for the period 2002/2007**
   - ✓ **Risk assessment of the potential impacts of radon, terrestrial gamma and cosmic rays on childhood leukemia in France *(oral presentation TS1c.2, May 15th)***

Thank you for your attention