

Residential radon concentrations in the northern Bogotá region, Colombia

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Aim of the Study

Radon (²²²Rn) is a naturally occurring gas that has been causally related to lung cancer^[1]. Despite causing 226,057 deaths a year worldwide^[2] this is only the third study of residential ²²²Rn in Colombia and the first in Bogotá. This study aims to contribute to the bridging of the baseline information gap present in the country.

How it was done

Radon concentrations (RC) were measured in 30 houses using LR-115 Alpha track detectors over a period of 35 days. The samples were processed by the FINUAS laboratory of UPTC university (See ^[3] for details).

RC measured were introduced as the dependent variable to a log-linear regression model (Eq. 1) that was fitted using 7 predictors that consisted of geologic, meteorological and construction variables.

$$\log(RC) = \beta \cdot X + \xi \quad (1)$$

Where X represents a matrix containing the predictor values and β the coefficients fitted to the model by Ordinary Least Squares Method.

Findings

- The measured RC presented a geometric mean of 90.85 Bq/m³, which is above 58.33% of similar studies in Latin America and the Caribbean^[4]. The maximum value detected was 407 ± 10 Bq/m³.
- Strikingly, 56.66% of the residences exceeded the WHO's recommended level of 100 Bq/m³ (Fig. 1).

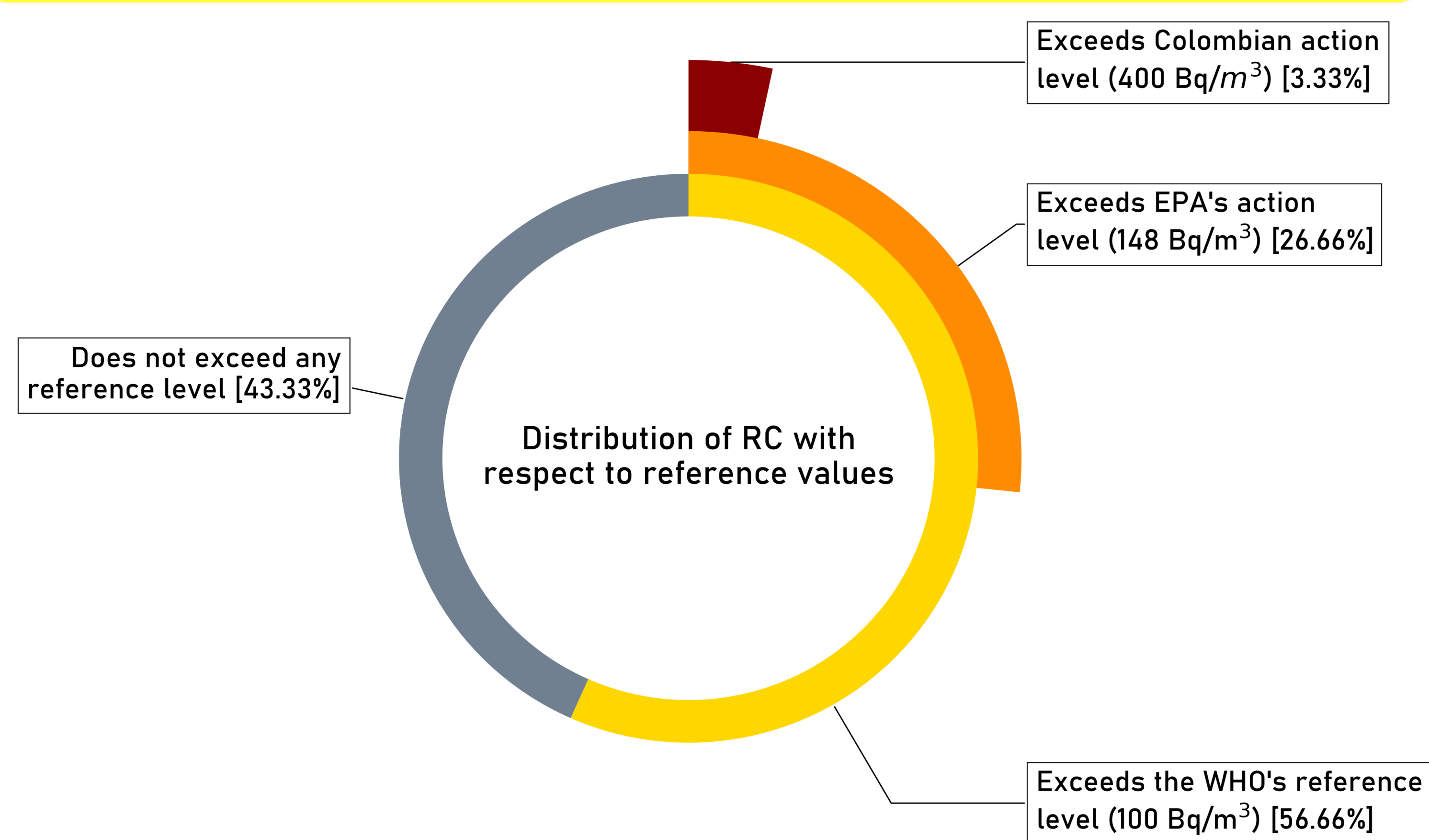


Figure 1. Pie chart with the percentage of the measurements exceeding the reference levels. The reference levels considered were retrieved from ^[5-7]

- According to the log-linear model, RC measured in houses built before 1980 would be 77.3% higher (Fig. 2).
- The positive association of house age with RC is explained by the increase of cracks and the lack of continuity of construction materials, enhancing ²²²Rn migration^[8]
- In Bogotá, these phenomena could be exacerbated by subsidence of up to 6 cm a year in the city^[9].

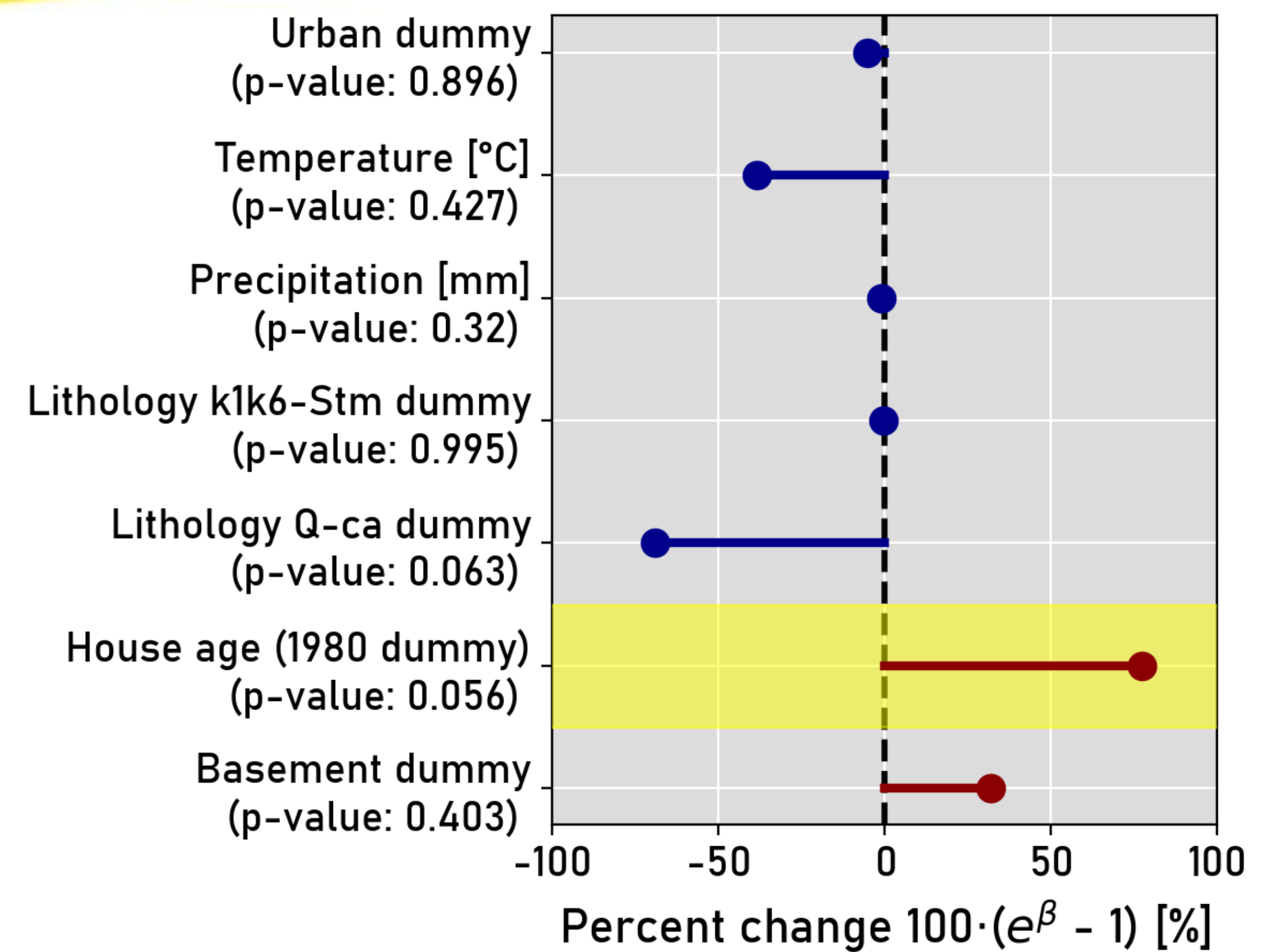


Figure 2. Percent change in ²²²Rn concentrations due to a change in a unit of each independent variable included in the log-linear regression model.

- The ²²²Rn prediction map showed higher concentrations in localities downtown (Fig. 3b). These localities are characterized by the presence of older houses.
- The log-linear model estimates that 418,549 citizens of Bogotá could have concentrations above the WHO's recommended level in their houses.

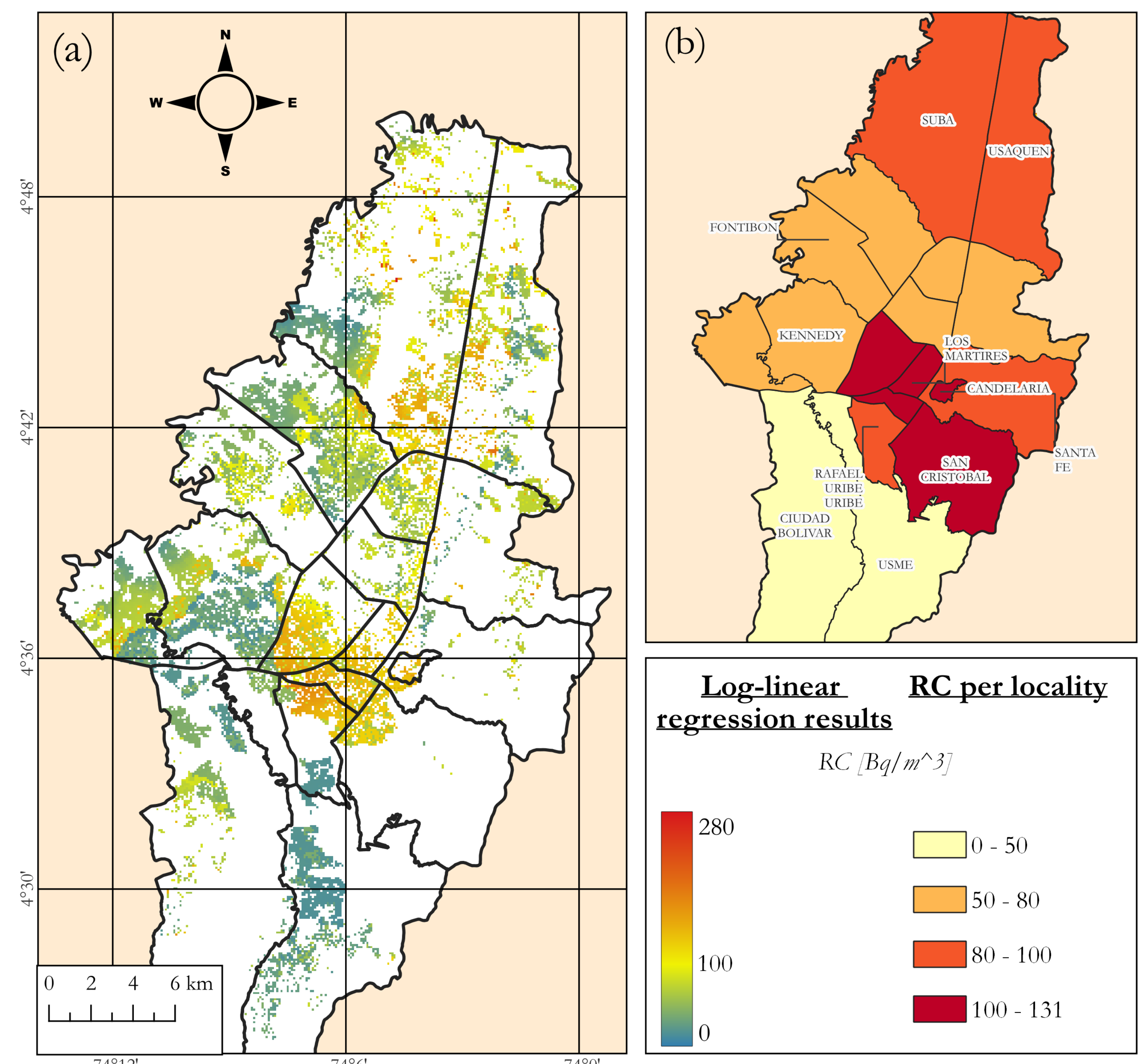


Figure 3. Application of linear regression model to houses of Bogotá's cadaster. (a) ²²²Rn concentrations predicted using a log linear regression model. Orange and red pixels exceed WHO's recommended level and green and blue values are below (b) Mean ²²²Rn concentrations predicted on each locality of Bogotá. The highest values are reported in dark red. Base map source: ^[10]

Conclusions

- 56.66 % of residences in Bogotá exceeded the WHO's limits and high RC could affect 418,549 citizens in Bogotá.
- House age showed a marginal significant association with high RC.
- The study highlights the importance of expanding Rn studies and updating public policies in Colombia.
- Our prediction maps cannot replace RC measurements.

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With the collaboration of:

