Extensive Evaluation of a Consumer-grade Temporal Radon Monitor

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Introduction & Motivation

* Background radiation monitoring essential for nonproliferation and public health
* Affordable, accurate, and robust temporal measurements best
* Extended evaluation to test devices under variable environmental conditions

Mission Relevance

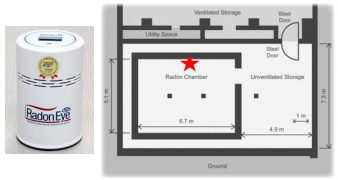
* Improved radionuclide detection over background radiation
* Discriminate underground tests & earthquakes
* Undergraduate research

Expected Impact

* Affordability expands research
* Increased background radiation knowledge
* High school collaboration

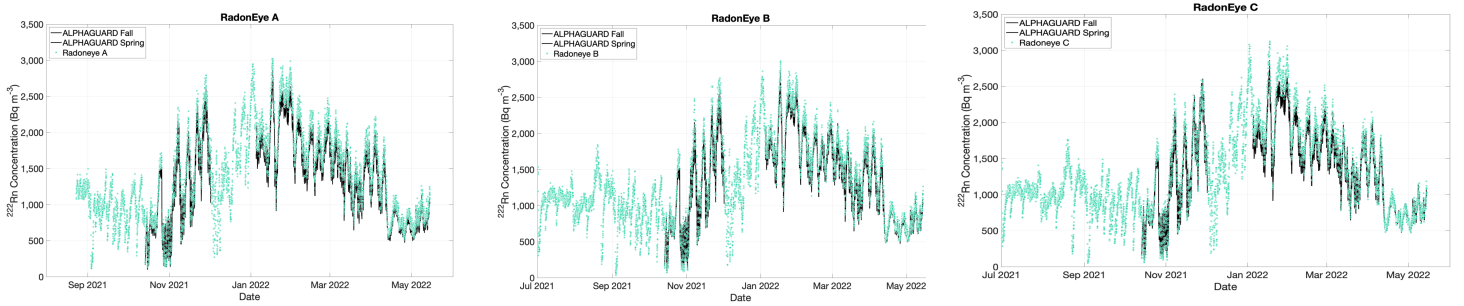
Technical Approach

* Six consumer-grade FTLab RadonEye
* Professional Saphymo ALPHAGUARD
* Natural Radon chamber
  19.8 ± 1.34 °C; 38.6 ± 6.7% humidity
* MathWorks MATLAB, Microsoft Excel
* 318 d data collection (Oct 2021 – May 2022)
* Linear interpolation to reconcile irregular sampling frequencies
* Normalized Root Mean Square Error to test AlphaGUARD-RadonEye agreement

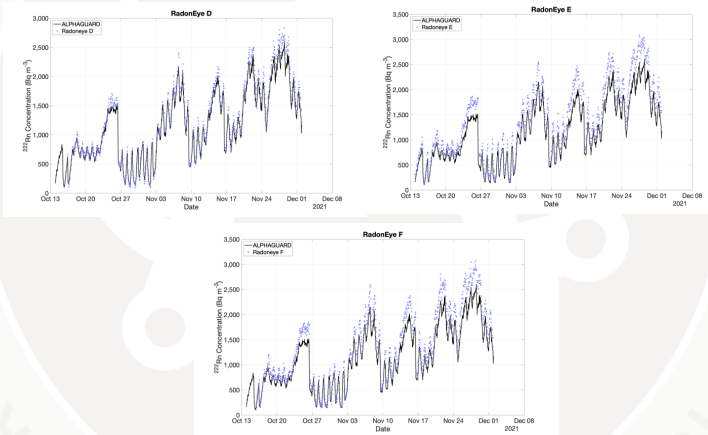


▲ *Fig 1. RadonEye and natural radon chamber*

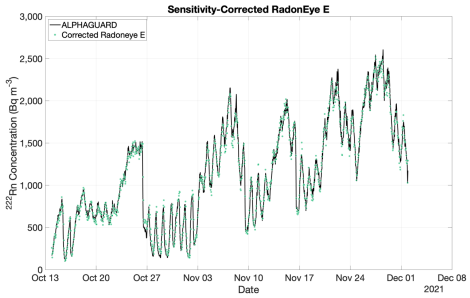
Results



▲ *Fig 2. ^{222}Rn using and AlphaGUARD and RadonEyes A, B, and C for 318 d experiment*



▲ *Fig 3. ^{222}Rn using AlphaGUARD and RadonEyes D, E, and F for 47 d experiment*



▲ *Fig 4. Sensitivity-normalized ^{222}Rn using AlphaGUARD and RadonEye E for 47 d experiment*

Table: Average relative sensitivity coefficients and normalized Root Mean Square Errors (NRMSE) of RadonEye compared to AlphaGUARD

RadonEye	Sensitivity Coefficient	NRMSE (Fall, Spring)
A	0.96	0.0021, 0.00027
B	0.94	0.0021, 0.0011
C	0.90	0.00047, 0.00058
D	0.97	0.00093
E	0.82	0.0012
F	0.87	0.00045

Conclusion

* RadonEye/AlphaGUARD agreement
* Notable environmental variations

Next Steps

* Test in controlled environment chamber
* Different statistical analysis modes
* Publish in Health Physics Journal

MTV Impact

* Students: Recruitment, research, academic credit, skills (calculus, MATLAB, statistics, exploratory data analysis)
* Professionals: Rn researchers, Rn professionals (testing/mitigation), public health officials

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