



SDM Mostly 'pipe-indirect' VI



EID Some 'pipe-direct & indirect' VI

# Retrospective interpretation of the representativeness of a limited number of regularly-scheduled short-term CVOC samples

Henry Schuver\*, Brian Schumacher, John Zimmerman, Chris Lutes, Chase Holton, & Robert Truesdale

**EPA VI Workshop at 2020 AEHS West-Coast Conference**

**San Diego, Calif., March 17**

\*USEPA – Office of Resource Conservation & Recovery (ORCR) Wash. DC (schuver.henry@epa.gov)

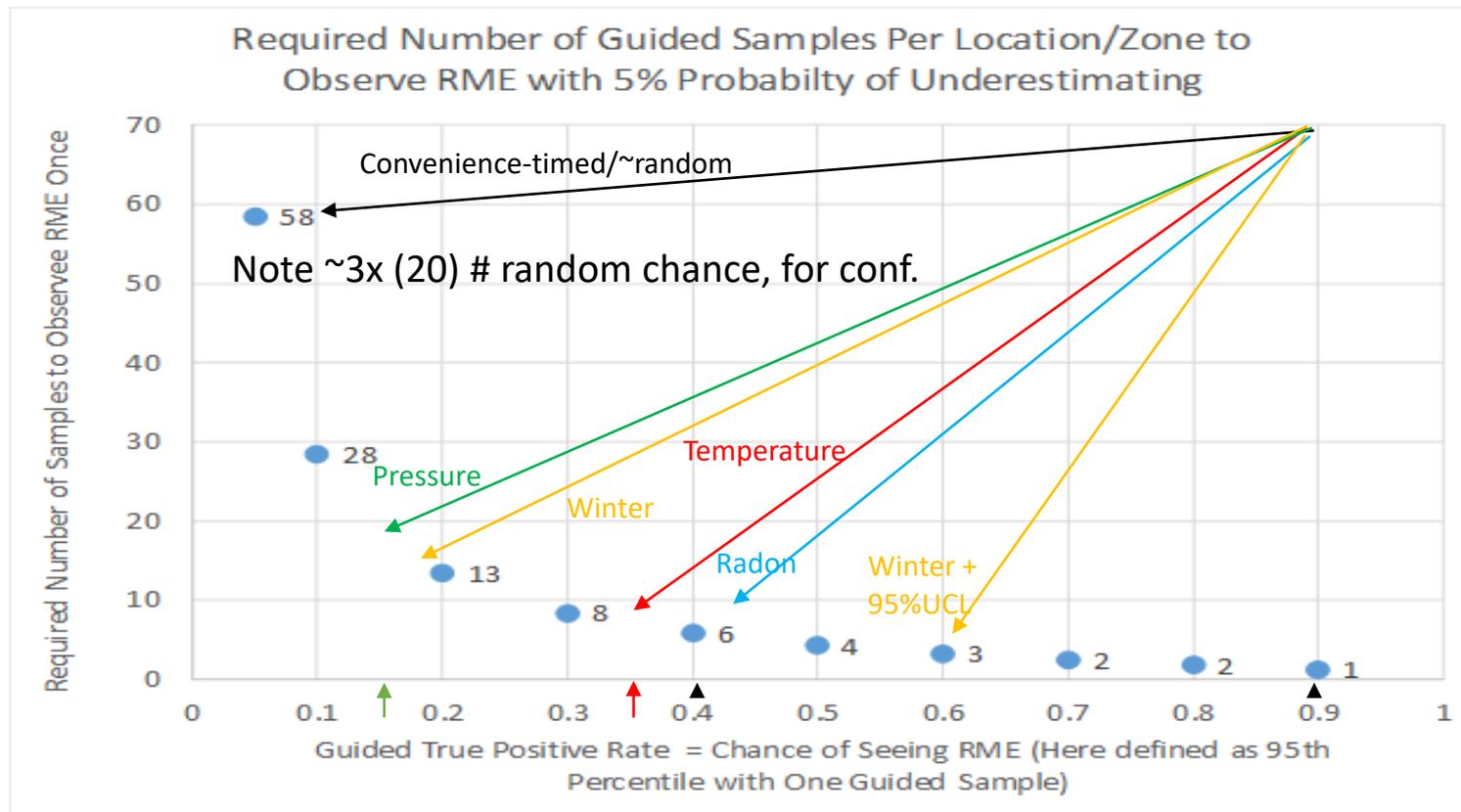
\* [Personal Perspective & Presentation – Does not represent Agency policy](#)

See: <http://epa.gov/oswer/vaporintrusion>

# If not the # 'random' Samples Needed to represent 95<sup>th</sup> percentile (RME)<sup>1</sup>

& Can't anticipate & collect ITS-Guided IAQ samples

What are you going to do?



Number of samples needed to 'know' you have one sample > target TCE conc. of 95<sup>th</sup> percentile (1.5 ug/m<sup>3</sup>)

[Guided sample # from evidence **at a house, Sun Devil Manor** – VI research house (formerly ASU), **Layton, UT**]

# What can you do, with what you can get (now)?

- For Temporal variability
- 0 – Collect 58 randomly-timed samples (per building) – to get 1 in RME
- 1 – **Try to** Schedule CVOC sampling during high-VI (Rn) conditions
- 2 – Collect **regularly-scheduled** CVOC samples with ITS (e.g., Rn)
  - Compare to Rn conc. during CVOC sampling to previous time periods (%iles)
    - ONLY **if** ITS (e.g., Rn conc.) were measured prior to, during & after CVOC sampling
- 3 – Use Rn-sensor & **auto-triggering** device to collect CVOC sample when Rn conc. are 'elevated (e.g., >95<sup>th</sup> %ile)

# #1 Trying to anticipate high-VI conditions and time CVOOC sample collection then – is difficult

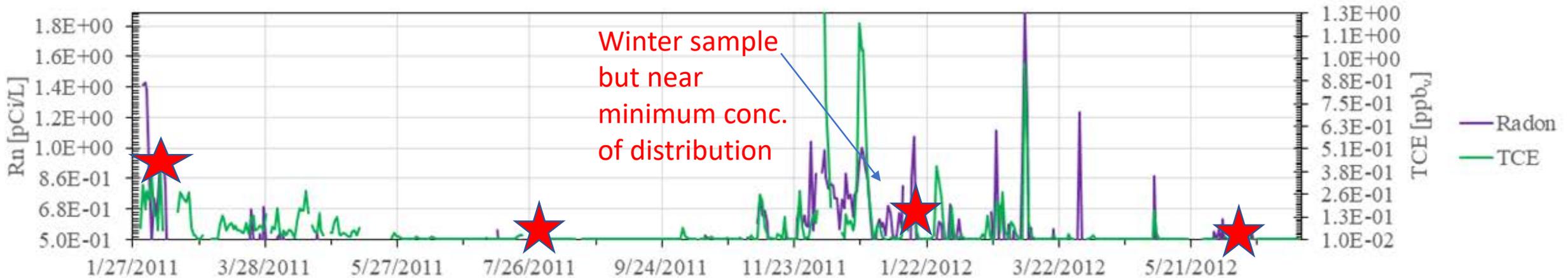
- And #3 ITS-sensor-triggering samples are not possible – today ...
- However, even ITS measurements only taken (briefly before)<sup>1</sup> during and after CVOOC samples can be used to document the building-specific VI-behavior/distribution over time and that establishes the context for possible value by retrospective interpretation of typical regularly-scheduled samples – post CVOOC sample collection
- For example, even a short period of ITS measurements before CVOOC sample helps to identify the VI conditions during the first CVOOC sampling event, and this is apparent relatively shortly after the CVOOC sample was collected
- ITS measurements between a ‘few’ later CVOOC samples would allow a much fuller understanding of the relative VI – On, On-High, Low, or Not On conditions at the time of the first and later CVOOC samples.

# A few indoor chemical air samples is ~typical

But with 'continuous' I&T the representativeness of 'high-end' is **apparent**

- Even without calculated percentiles it possible to see how well the samples represent the high-end exposures (within the period illustrated by ITS measurements)

With *only* the **red stars** We have no context for *seeing* how representative they are



With more frequent/continuous quantitative data **Occupants Can See** protective samples

# Categorical Statistical correlations (of Conc.) (2x2 graph) showed:

- If Rn intrusion is not 'elevated/High'
- CVOC intrusion will 'not-often'<sup>1</sup> be High
- If soil-gas/Rn intrusion is 'High'
- There is an increased probability that CVOC intrusion can also be high
- When indoor air has a high %-conc. of soil-gas it mean VI is ON High
  - When/where Rn conc. is a surrogate for soil-gas %-conc.
  - High Rn %iles means VI On High conditions – & CVI can\* also be On High

# Probability statistics from ITS distribution of conc. presented + some percentile (%ile) cut-points

- Evidence from two residences in Building Zone 5 (SDM & EID) show:
  - & If new bldgs. 'match' this well-studied building-setting-scenario; &
- If indoor, e.g., **Rn** conc. is '**low**' (<90<sup>th</sup>%ile) on the day of CVOC sampling, then:
- There is a:
  - 99% probability that **chemical** VI sample conc. will also be '**low**' (<95<sup>th</sup>%ile)
  - &
- If indoor **Rn** conc. is '**high**' (>90<sup>th</sup>%ile) on the day of CVOC sampling, then:
- There is a:
  - 40% probability that the **chemical** VI sample conc. will also be '**high**' (>95<sup>th</sup>%ile)
    - i.e., 8x higher than random probability

Note: Only 3 Options: Have 1) Low or 2) High Rn; Or 3) No understanding of soil gas/Rn intrusion levels

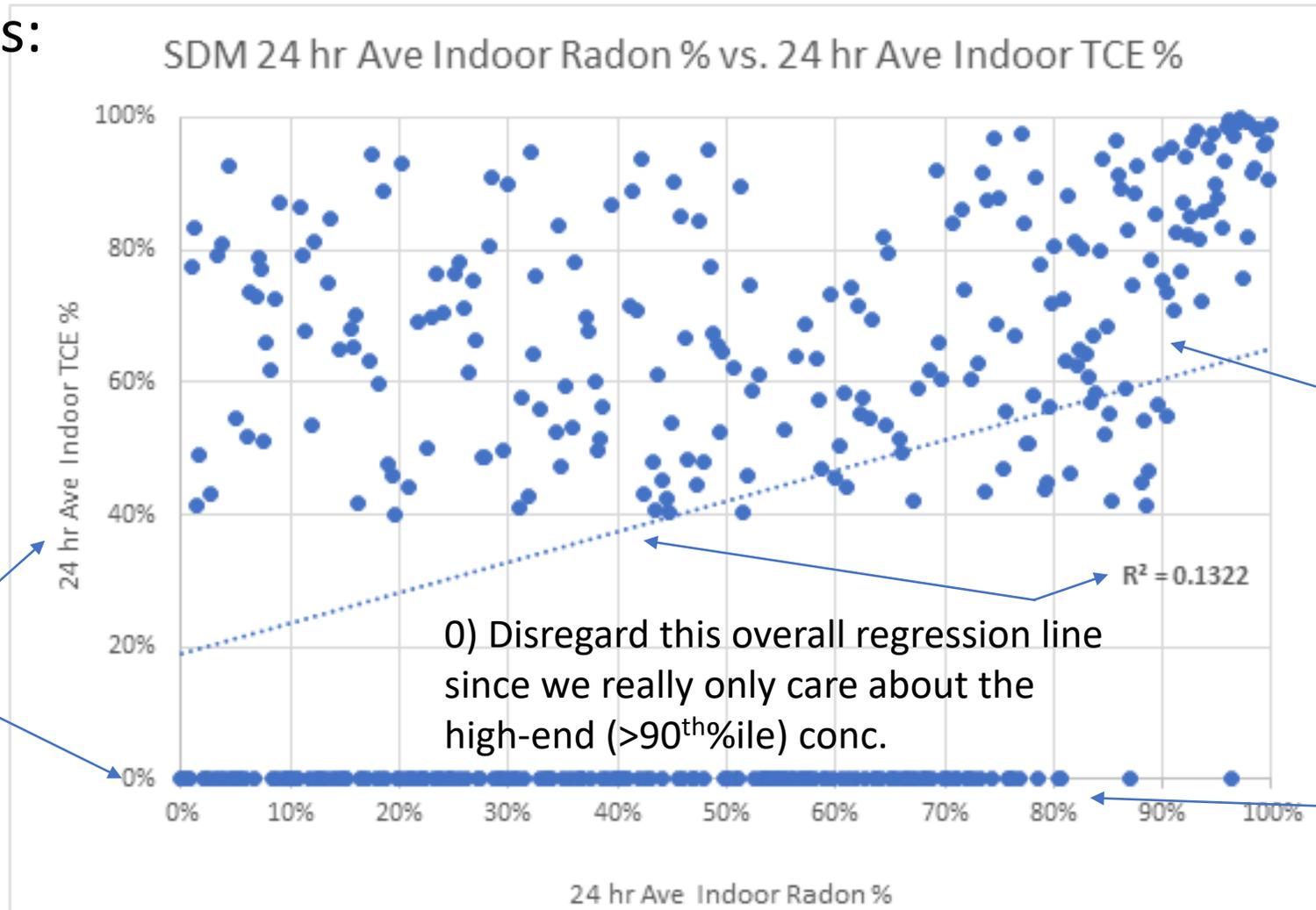
# Radon & TCE data presented in units of Percentiles\* of their distributions (not conc.) shows:

Calculated Percentiles (%iles), including No-Detected (ND) values

1) ~ 40% of the TCE levels are Non-Detected w/ Rn <80<sup>th</sup>ile = **CVI Not ON**

Sampling for TCE when the Rn level is <80<sup>th</sup>ile gives a >40% probability (~1/2) of finding a ND TCE value!

You need to know the building's %ile of Radon conc. when chem. sample is collected to understand what chemical conc. found represents. When sampling when Rn was > 80<sup>th</sup>%, or even better >90<sup>th</sup>%, you could find much higher TCE levels.



\* but still w/o regard to sequence

3) When >90<sup>th</sup>ile Rn, almost all TCE levels >70<sup>th</sup>ile & up to 100<sup>th</sup>ile (Highest TCE levels) = **CVI On High**

2) At >80<sup>th</sup>ile Rn only a very few ND levels; = **CVI On**

# Apparent Probability statistics for ITS distribution of conc. converted to & direct percentiles (%ile)

- Evidence from two residences in Building Zone 5 (SDM & EID) show:
  - & If new bldgs. 'match' this well-studied building-setting-scenario; &
- If indoor, e.g., **Rn** conc. is '**low**' (<80<sup>th</sup>%ile) at the day of sampling, then:
- There is a:
  - ~40% probability that **chemical** VI sample conc. will be '**ND**' (not just 'low' <RME)
  - &
- If indoor **Rn** conc. is '**high**' (>90<sup>th</sup>%ile) at the day of sampling, then:
- There is a:
  - 40% probability that the **chemical** VI sample conc. will also be '**high**' (>95<sup>th</sup>%ile)
    - i.e., 8x higher than random probability

Note: Only 3 Options: Have 1) Low or 2) High Rn; Or 3) No understanding of soil gas/Rn intrusion levels

# Total probability from multiple regularly-scheduled CVOC samples

- With a baseline for VI from having measured continuous ITS distribution(s),
- & calculated the percentiles (%iles) the ITS conc. represent
- You can use each of your regularly-scheduled DVOC samples to calculate your total probability for representing an 'elevated' CVOC conc.

# Measured Rn %ile can document\* Total Probability of finding TCE in levels of interest – Individual & Multiple samples

e.g.,

Rn %ile	Prob TCE > 95%ile	~# Samples Needed**
50th %	10%	28
75th %	19%	13
90th %	41%	6
95th %	55%	4

<b>Total Probability for all four samples</b>	<b>81% Prob. TCE &gt;95<sup>th</sup>%ile</b>
---	--

Note – 4 ~ typical samples could provide 81% confidence of having one in >95<sup>th</sup>%ile

Having Rn percentiles can allow probability of multiple samples to be combined for a (higher) total probability of having one or more samples from within the Exposure Levels of Interest – for regulatory decision making

\* And guide/help samplers decision to manage analyze chemical samples (or not) or extend time

\*\*If all samples have the same probability of finding a sample w/ TCE above the given target %ile (w/ 95% conf.)

# In Summary – ITS measurements can:

- Be relatively-easily added to typical regularly-scheduled CVOC sampling efforts, &
- Add significant context and meaning to these short-time CVOC indoor air samples
- With longer ‘baseline’ adds improving Retrospective interpretation of the meaning of CVOC conc. collected earlier

Thank You