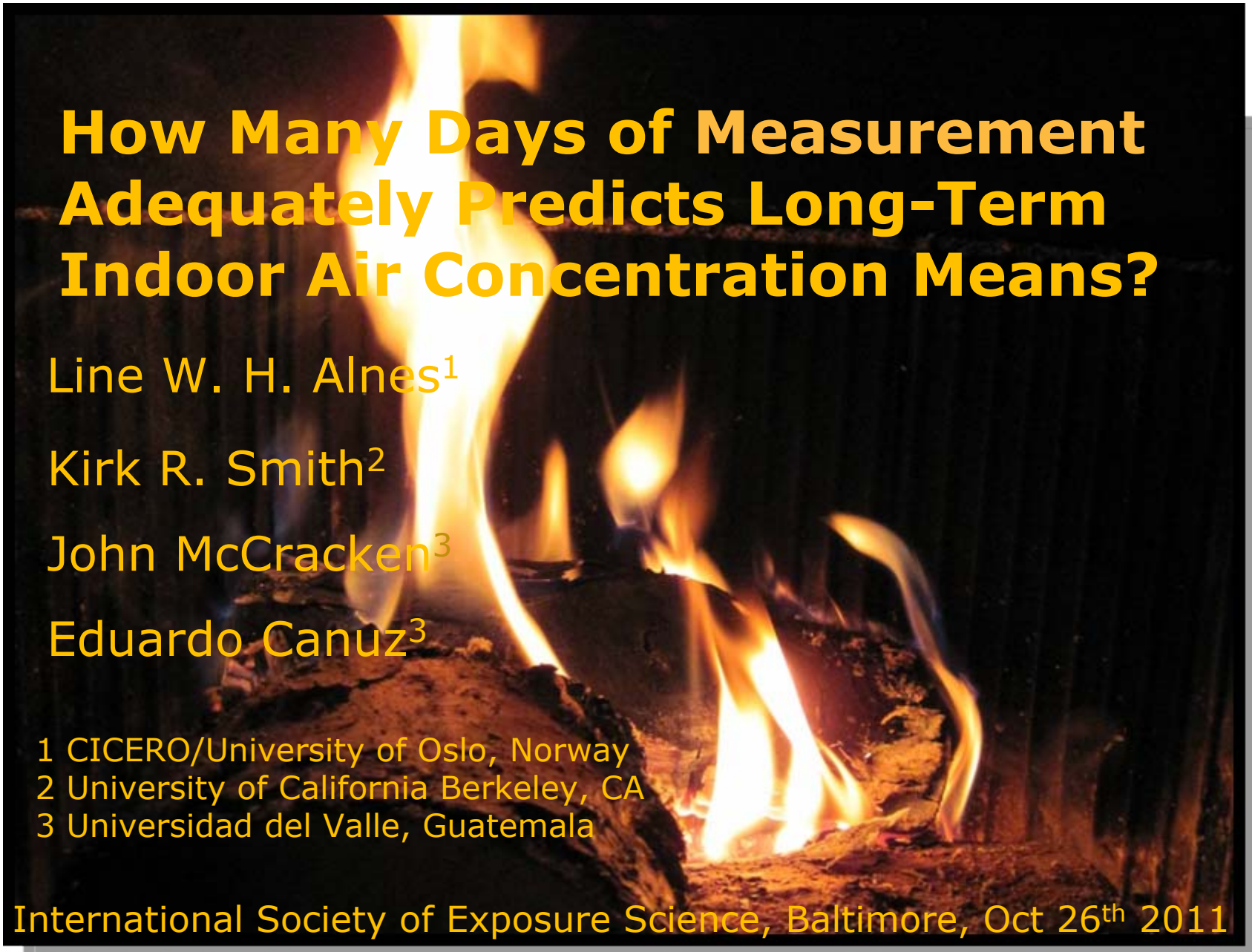


How Many Days of Measurement Adequately Predicts Long-Term Indoor Air Concentration Means?

Line W. H. Alnes[1]

Kirk R. Smith[2]

John McCracken[3]

Eduardo Canuz[3]

1 CICERO/University of Oslo, Norway
2 University of California Berkeley, CA
3 Universidad del Valle, Guatemala

International Society of Exposure Science, Baltimore, Oct 26th 2011

Outline

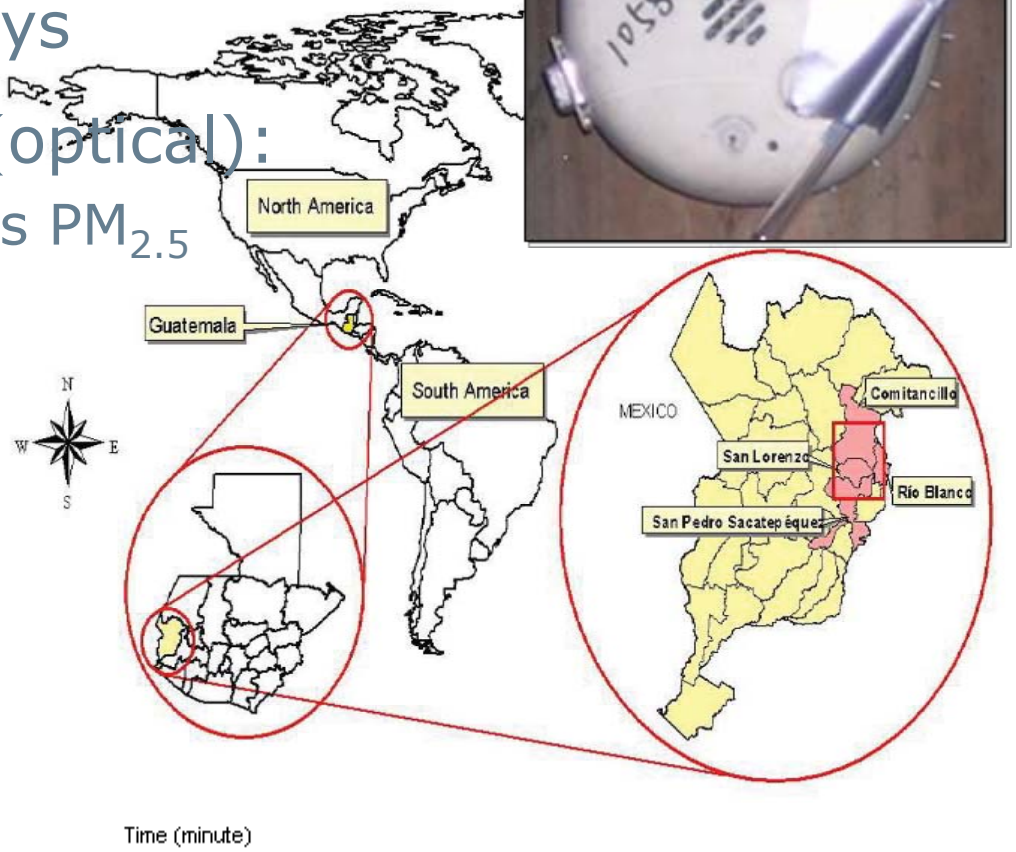
- Unique dataset with long-term measurements
- Aims: Determine
  - How accurate are sampling durations of 1 or 2 days, when the goal is to estimate long-term concentration levels?
  - What if measurement duration is increased?
- Key message: There was high temporal variability, and a few days of measurements was not sufficient to capture long term concentration levels

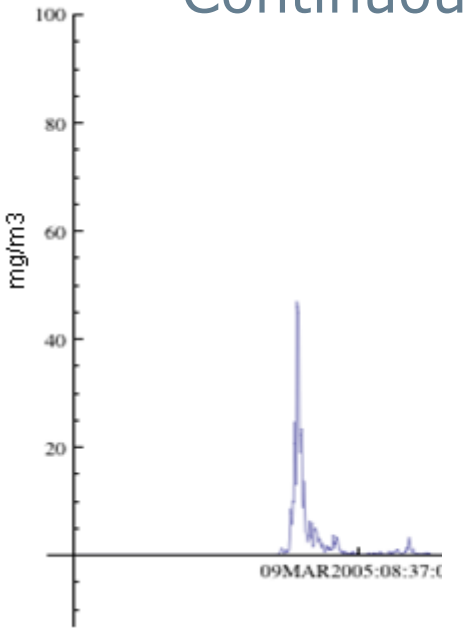
Motivation

- Half the world exposed to smoke from combustion of solid fuels for cooking/heating. -> Major contributor to global ill-health
- Need accurate exposure measurements to quantify dose-response relationships
- Most studies of household air pollution sample each home for 24 - 48 hours
- Assumed representative estimate of long term concentration levels
- **Unknown** how much concentration levels vary from day to day

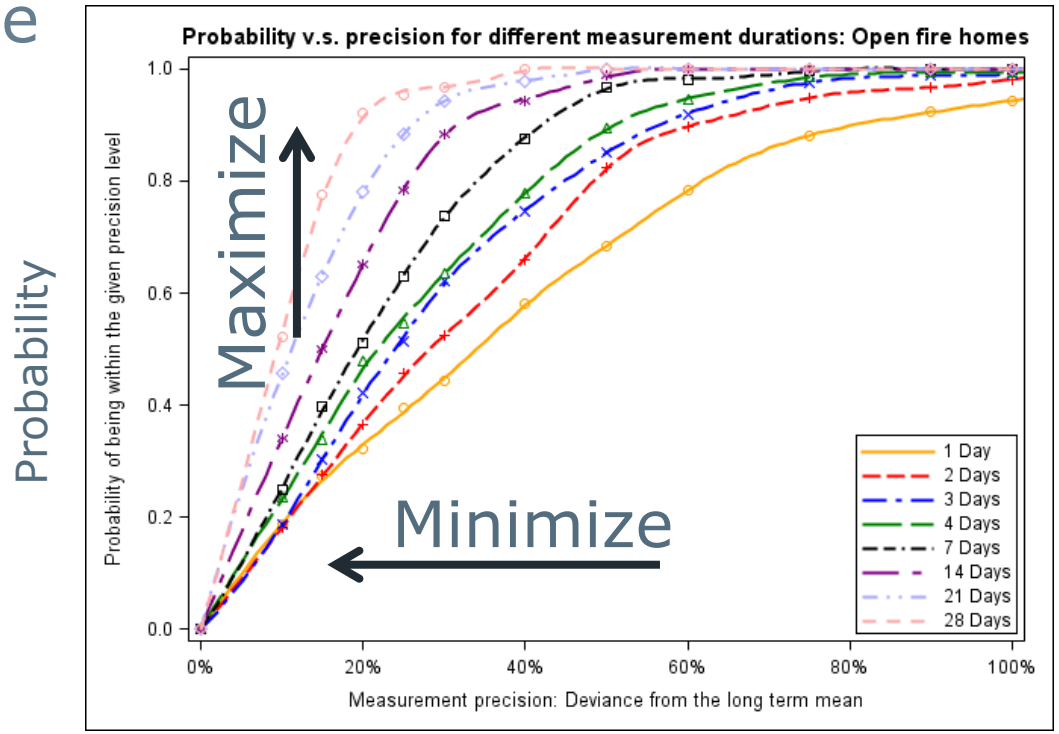
Methods

- 8 homes
  - RESPIRE, San Lorenzo
  - 4 open fire, 4 chimney
- 120-333 days
- UCB-PATS (optical):
  - Continuous $PM_{2.5}$





- Overall mean concentration in each home over the entire measurement duration was defined as the "target"
- Compared samples of different duration to see how often the results were close to the target value



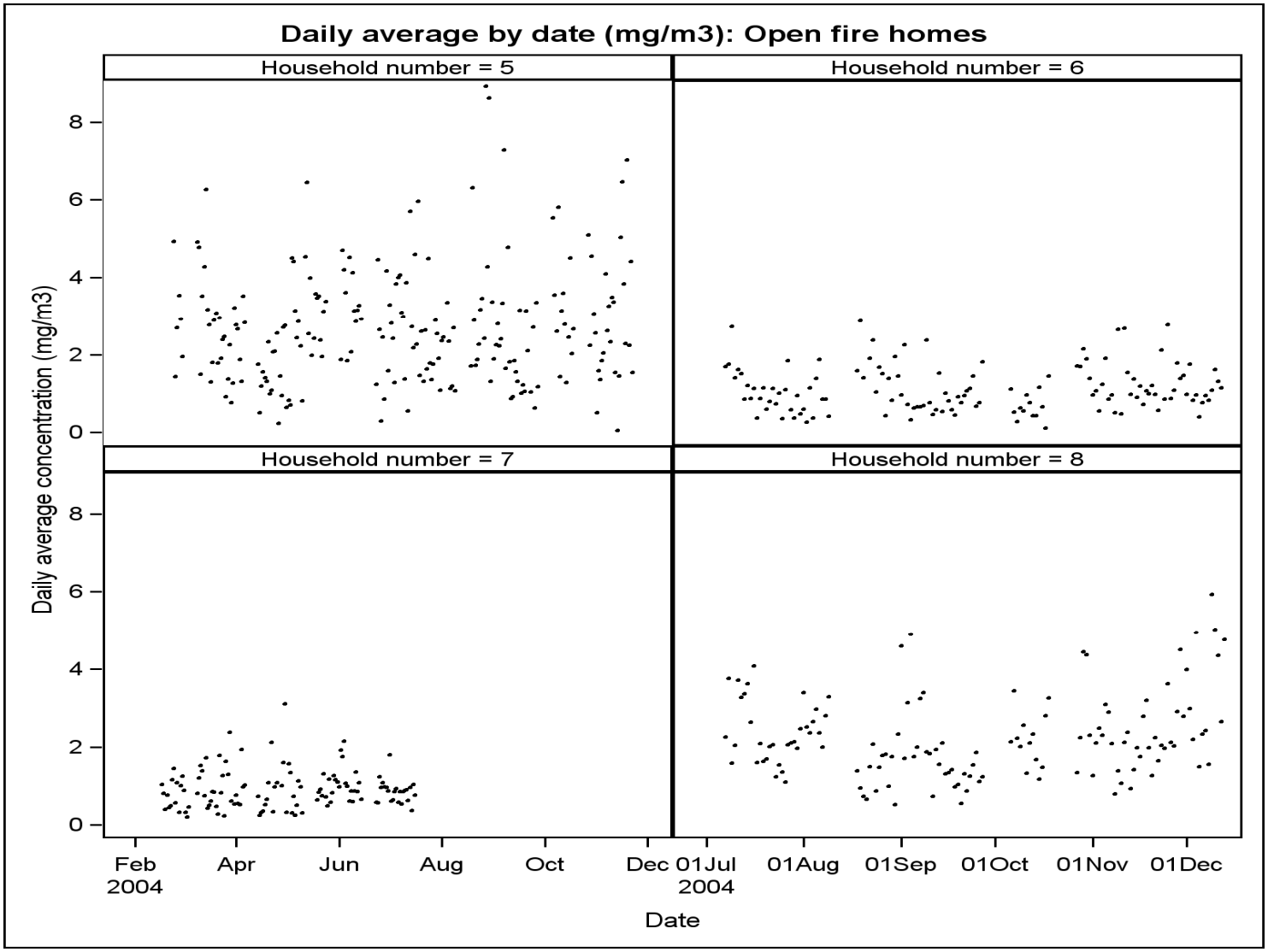
Probability

Deviance from target (+/- %)

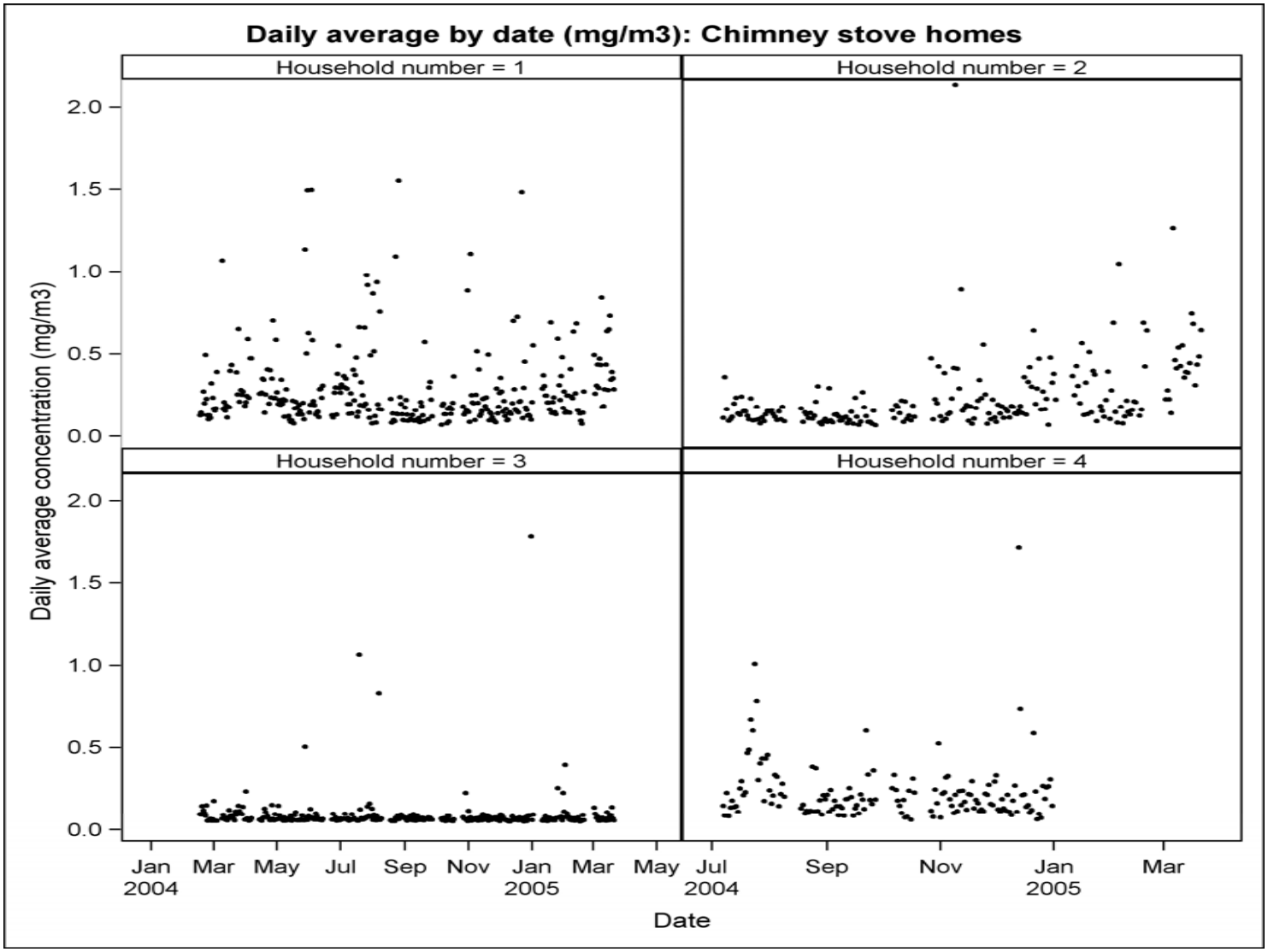
Data by household

ID #	Stove type	Start date	End date	N days	Mean µg/m³	St.d.	Med.	Min	Max
1	Chimney	Feb-04	Mar-05	327	**279**	23 8	204	68	1550
2		Jul-04	Mar-05	215	**233**	220	156	65	2134
3		Feb-04	Mar-05	333	**86**	122	66	50	1784
4		Jul-04	Dec-04	154	**228**	189	183	62	1713
5	Open fire	Feb-04	Nov-04	215	**2690**	1498	2452	52	8927
6		Jul-04	Dec-04	134	**1107**	586	972	101	2874
7		Feb-04	Jul-04	120	**914**	489	854	192	3104
8		Jul-04	Dec-04	136	**2233**	1058	2055	522	5927

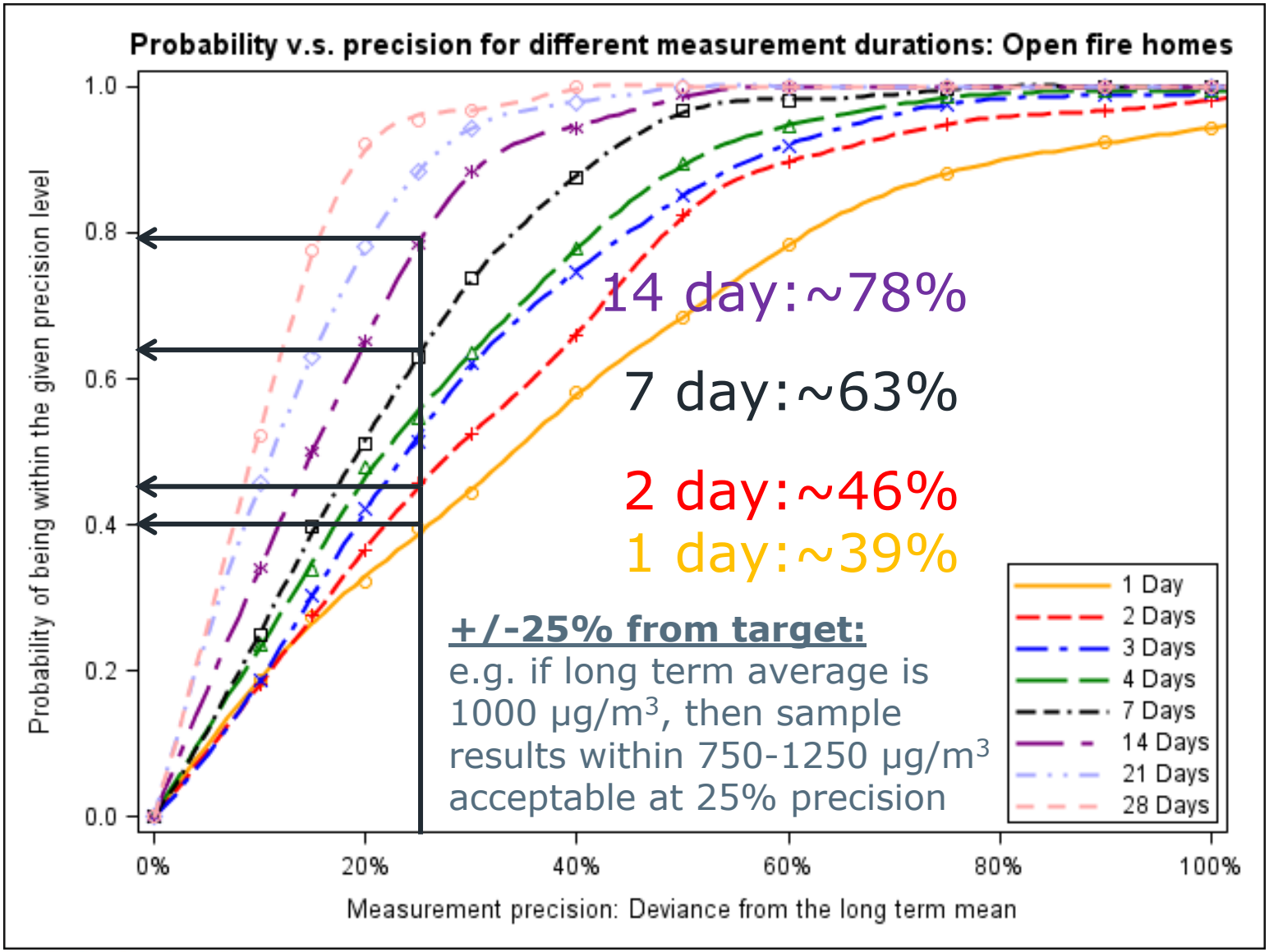
Concentration by Date: Open Fire



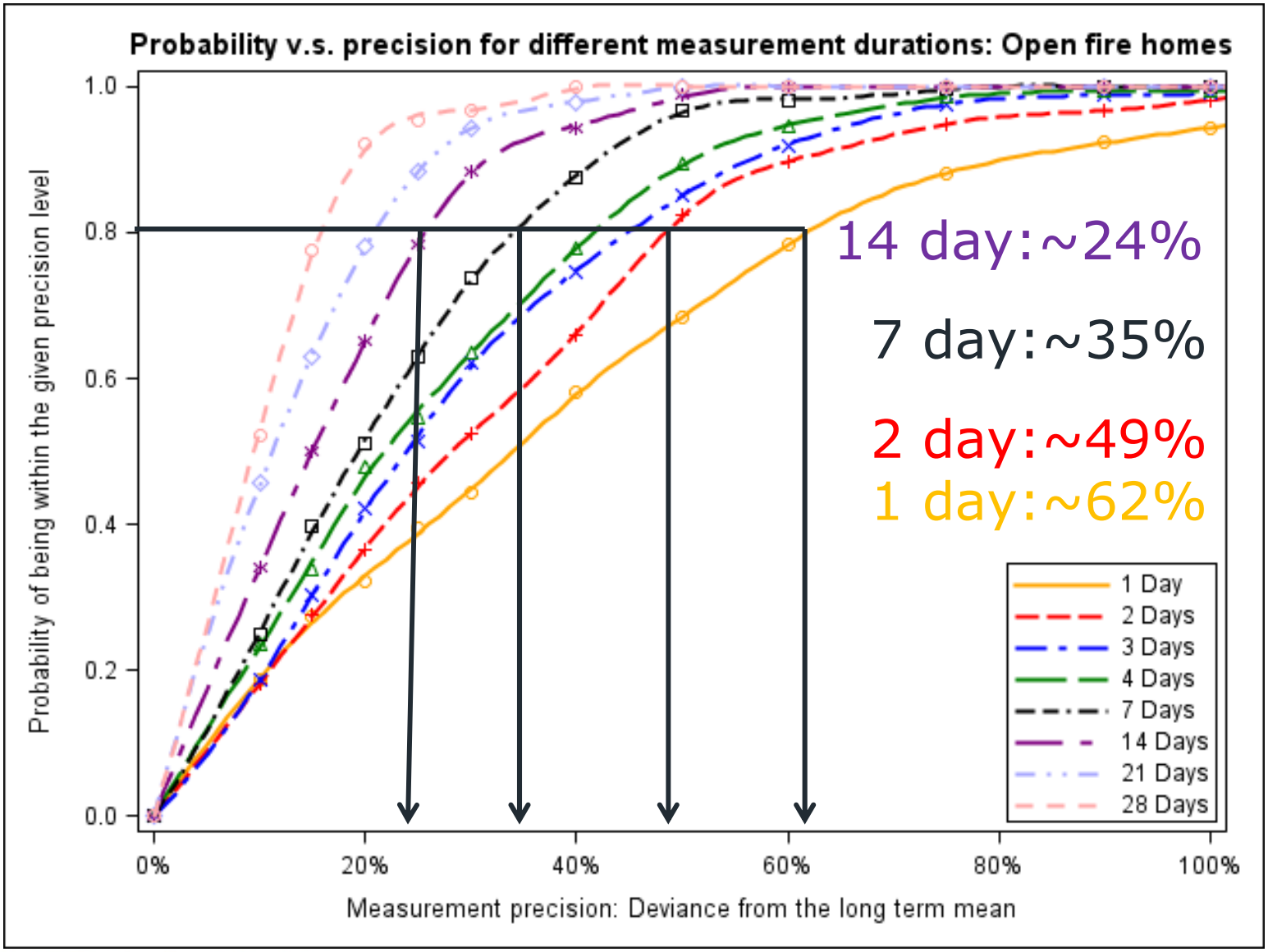
Concentration by Date : Chimney



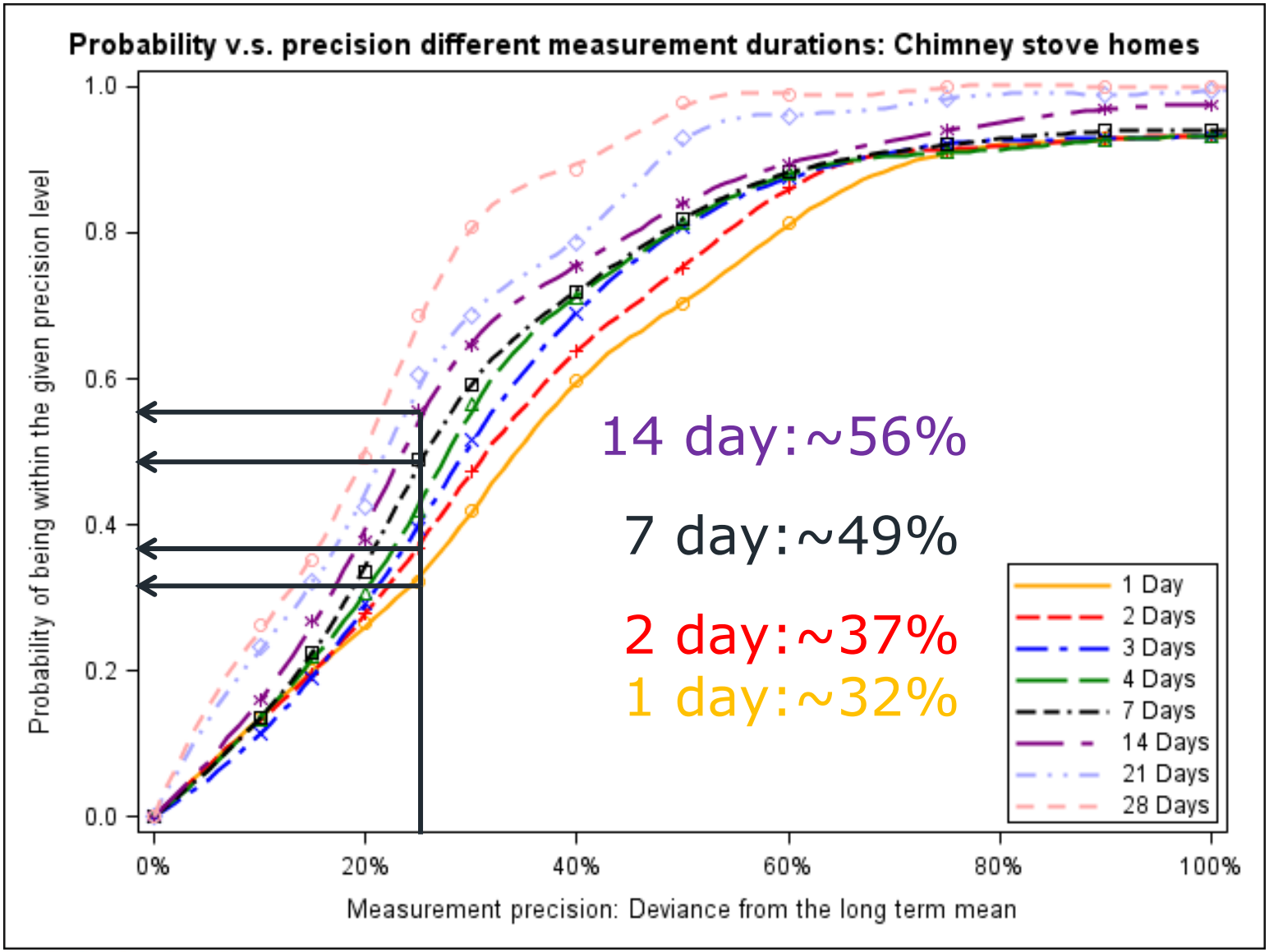
Results: Open fire homes



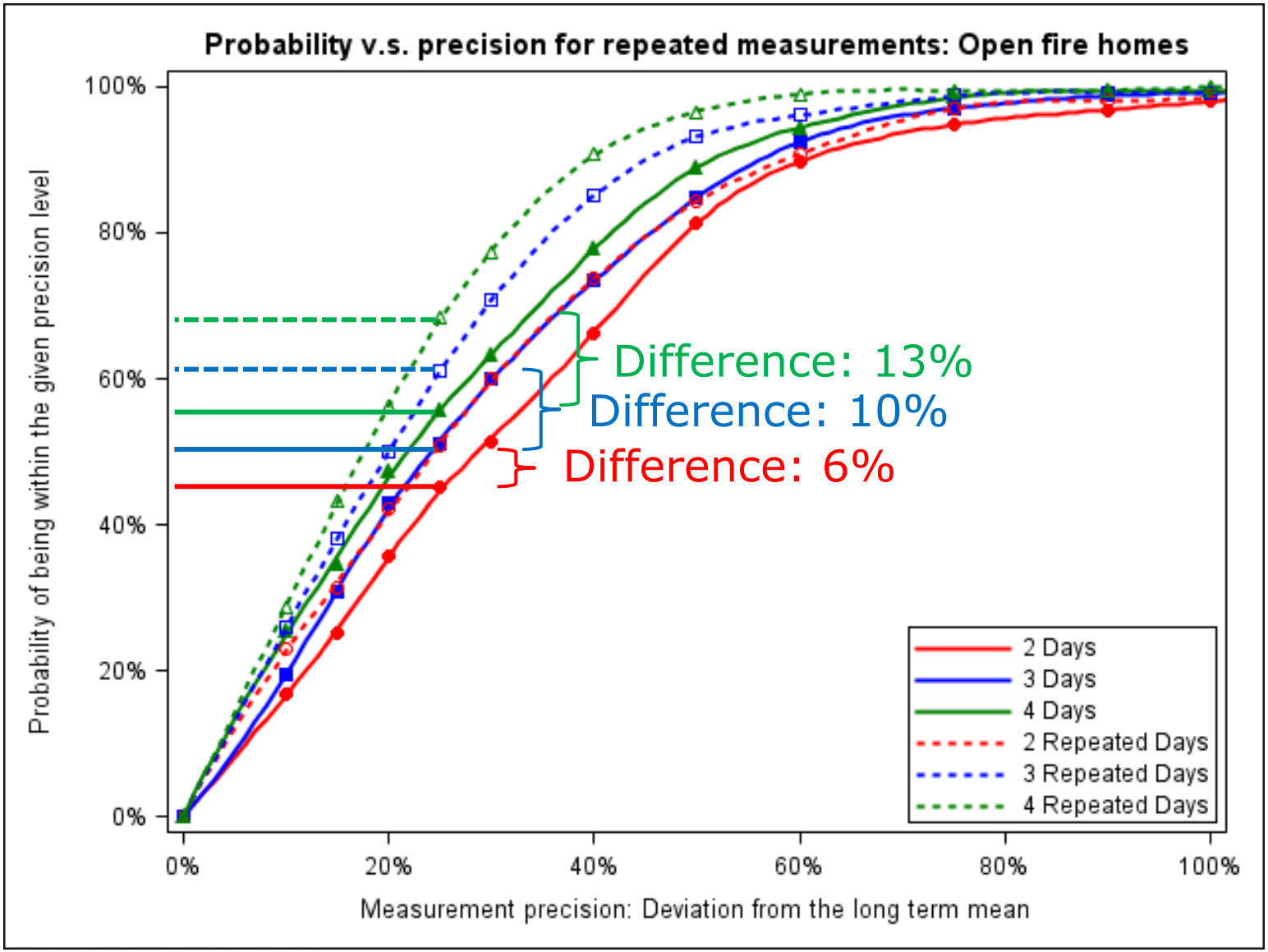
Results: Open fire homes



Results: Chimney homes



Repeated measurements: Open fire



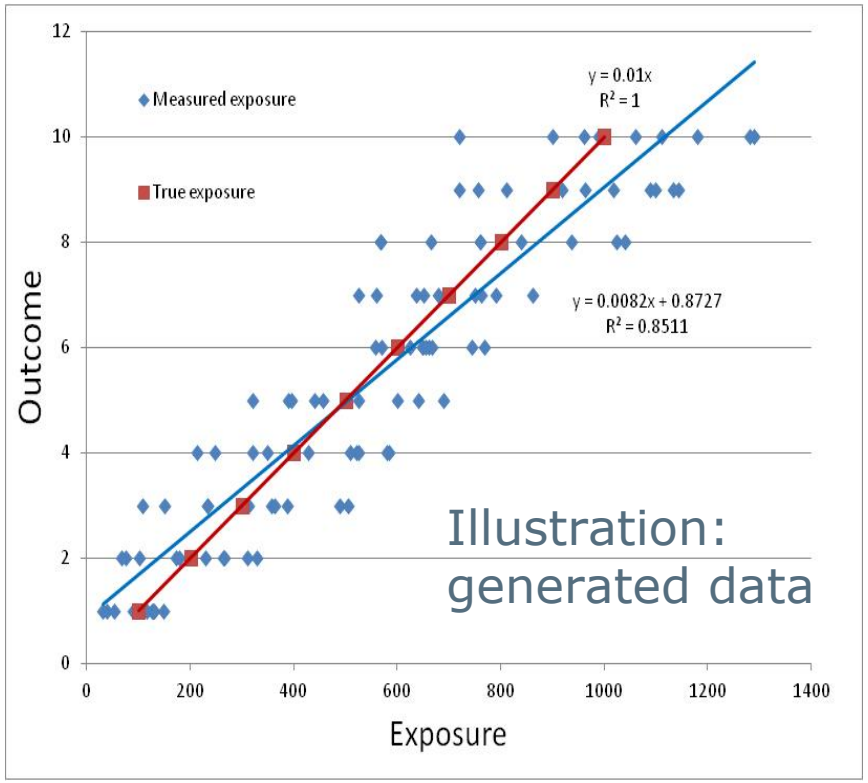
Attenuation Bias:

Random error in exposure estimate will underestimate true dose-response relationship

X= true exposure

Z= observed exposure

- Dose response:
  - D= $a^* + b^* \cdot X$ (true)
  - D= $a + b_{obs} \cdot Z$ (obs)
- Correction factor $1/\lambda$:
- Regress
  - $X_{true} = a + \boldsymbol{\lambda} \cdot Z_{obs}$
- Corrected dose-response estimate:
  $b^* = b_{obs} \cdot \mathbf{1/\lambda}$



Regression dilution: correction

Sampling duration in days	Correction factor: 1/λ (std.dev)
1	1.52 (0.04)
2	1.30 (0.03)
3	1.24 (0.02)
4	1.19 (0.02)
7	1.13 (0.02)
14	1.06 (0.01)
21	1.03 (0.01)
28	1.01 (0.01)
2 *1	1.25 (0.02)
3 *1	1.13 (0.02)
4 *1	1.08 (0.01)

Discussion

- Individual households v.s. group level
- Long term mean - meaningful target? Assuming outcomes are related to overall mean exposure (not median or peak events)
- Limitations: generalizability?
  - Only 8 households
  - Only in Guatemala
- Strengths: >1600(!) days
  - First study with long-term data

Summary

- High temporal variability
- Attenuation bias likely when using only 1 or 2 day measurements as surrogate for long term exposure
- Implications for interpretation of exposure-response estimates, and for future measurement strategies
- More measurements are needed to verify results in other settings

Acknowledgements

- Guatemalan field team and the participants!
- EHS group at UC Berkeley

- Funding
  - NIEHS, RESPIRE Project
  - Fulbright Foundation for Educational Exchange

»Thank you!