ABSTRACT

The paper introduces an exposure model for individuals (EMI) to evaluate indoor air quality for particulate matter (PM2.5) in health studies. The model predicts personal exposures from ambient concentrations and questionnaire information such as indoor sources and time-activity patterns.

EXPOSURE MODEL FOR INDIVIDUALS (EMI) IN HEALTH STUDIES

Steady-State Mass Balance Equation

\[
PM_{2.5, in} = PM_{2.5, out} - \left( k_s + k_d \right) \cdot PM_{2.5, in}
\]

where:

- \( k_s \): stack coefficient (m²/oC-h²)
- \( k_d \): wind coefficient (dimensionless)
- \( T_{in} \): indoor temperature (ºC)
- \( T_{out} \): outdoor temperature (ºC)
- \( U \): wind speed (m/h)

Model Evaluation Metric

\[
\text{Meas. Error} = \left\{ \frac{|C_{PM2.5, in, meas} - C_{PM2.5, in, model}|}{C_{PM2.5, in, meas}} \times 100 \right\}
\]

Sensitivity Analysis

\[
\frac{\partial C_{PM2.5, in}}{\partial k_s} = \frac{1}{C_{PM2.5, in}} \left( k_s + k_d \right)
\]

CONCLUSION

- Median \( k_s \) increased by 3-4% when using central-site, instead of residential, outdoor PM2.5 measurements.
- Median \( k_s \) increased by 6-7% when using model-predicted, instead of measured, air exchange rates.
- Indoor air quality model could be useful to develop exposure metrics for individuals in health studies.

REFERENCES

ASHRAE Handbook of Fundamentals, Chapter 16, 2009.