KITCHEN 2.0: HOUSEHOLD AIR POLLUTION MODEL UTILIZING OPEN SOURCE SOFTWARE FOR APPLICATION IN DEVELOPING COUNTRIES

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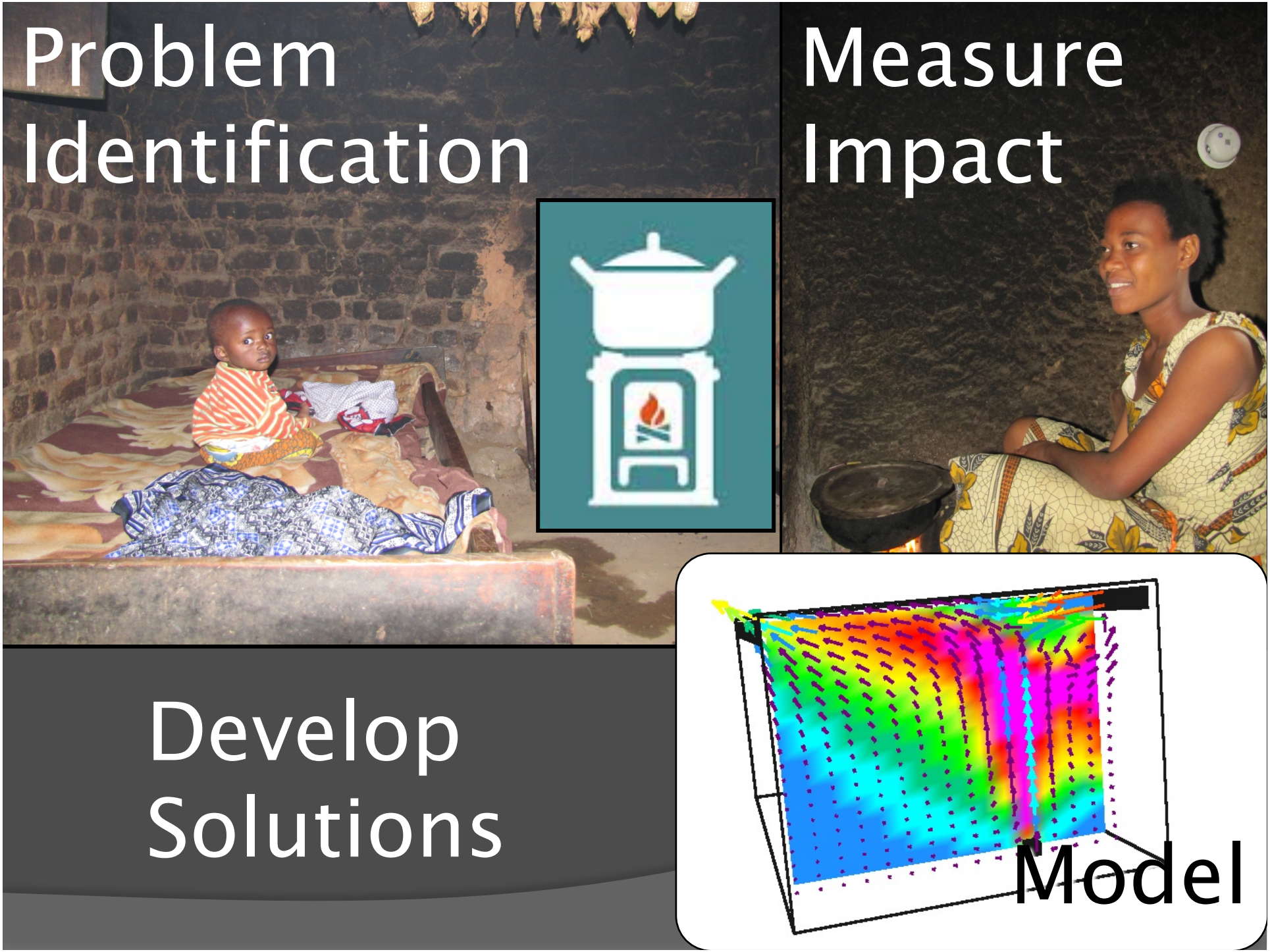
Overview

- Justification of Research
- Software and Methodology
- Calibration and Initial Findings
- Validation
- Conclusions and Next Steps

How can HAP modeling potentially help stove developers and policy makers?

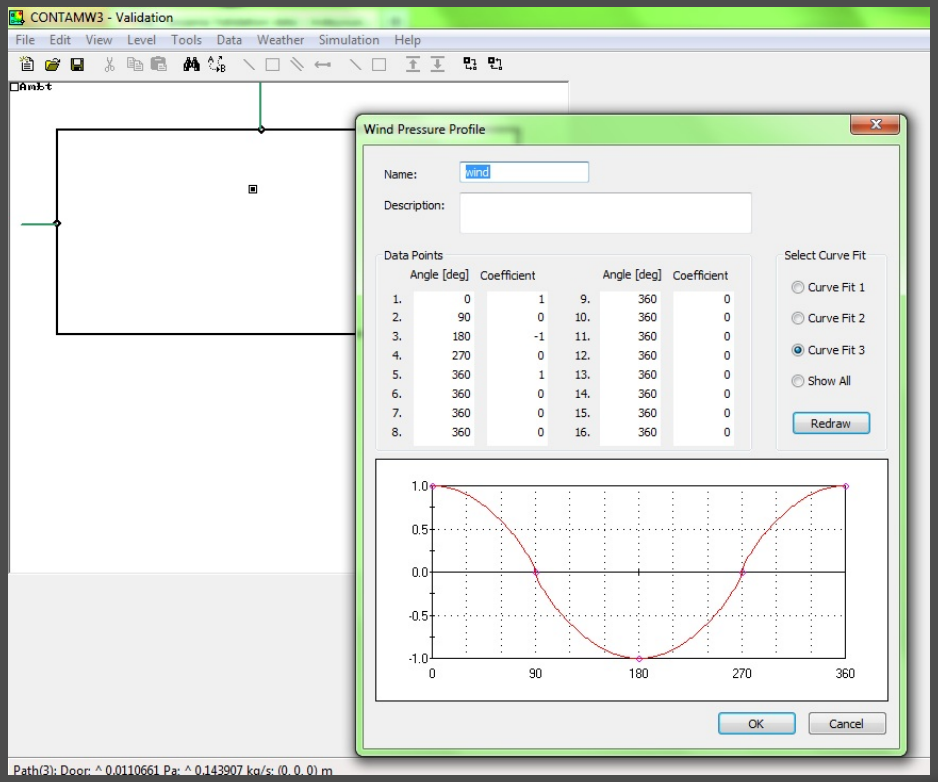
- A tool to predict deployment potential
- Help establish realistic benchmark standards
- Provide future projections and predictions
- Estimates impacts of individual and large-scale development interventions


Problem Identification
Measure Impact
Develop Solutions
Model

CONTAM

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

Multizone IAQ and ventilation analysis software developed by NIST

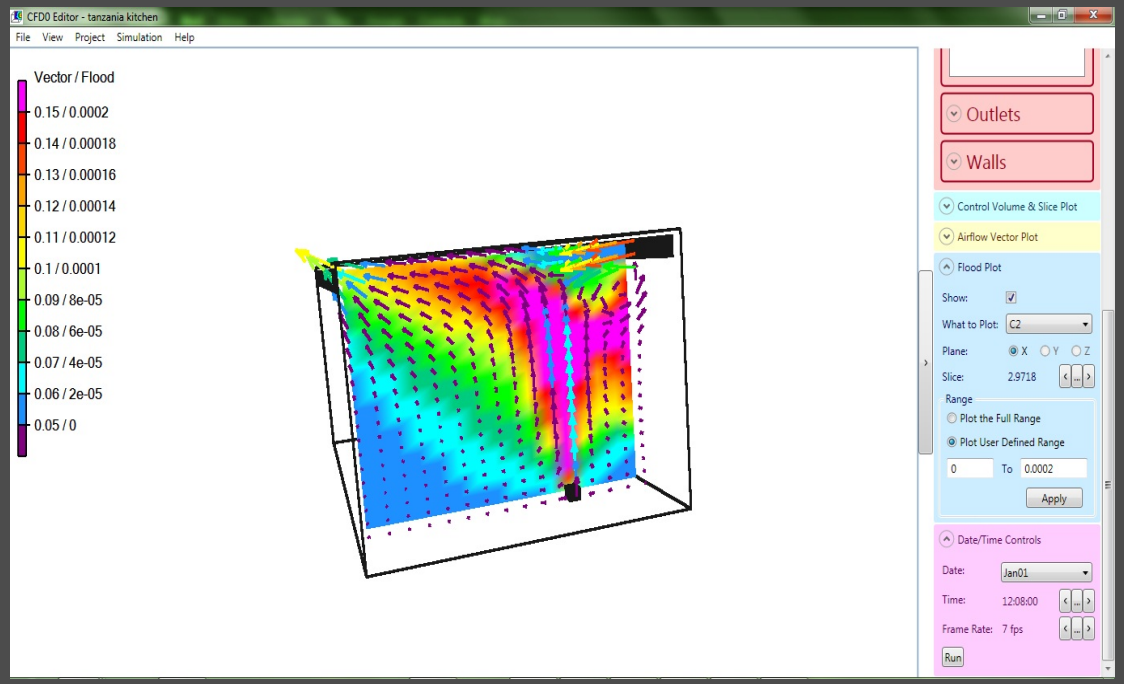


- Open Source
- Concentrations profiles
- Deposition and resuspension
- Personal Exposure

https://www.bfrl.nist.gov/IAQanalysis/CONTAM

CFDo

Computational Fluid Dynamics program algorithmically coupled with CONTAM

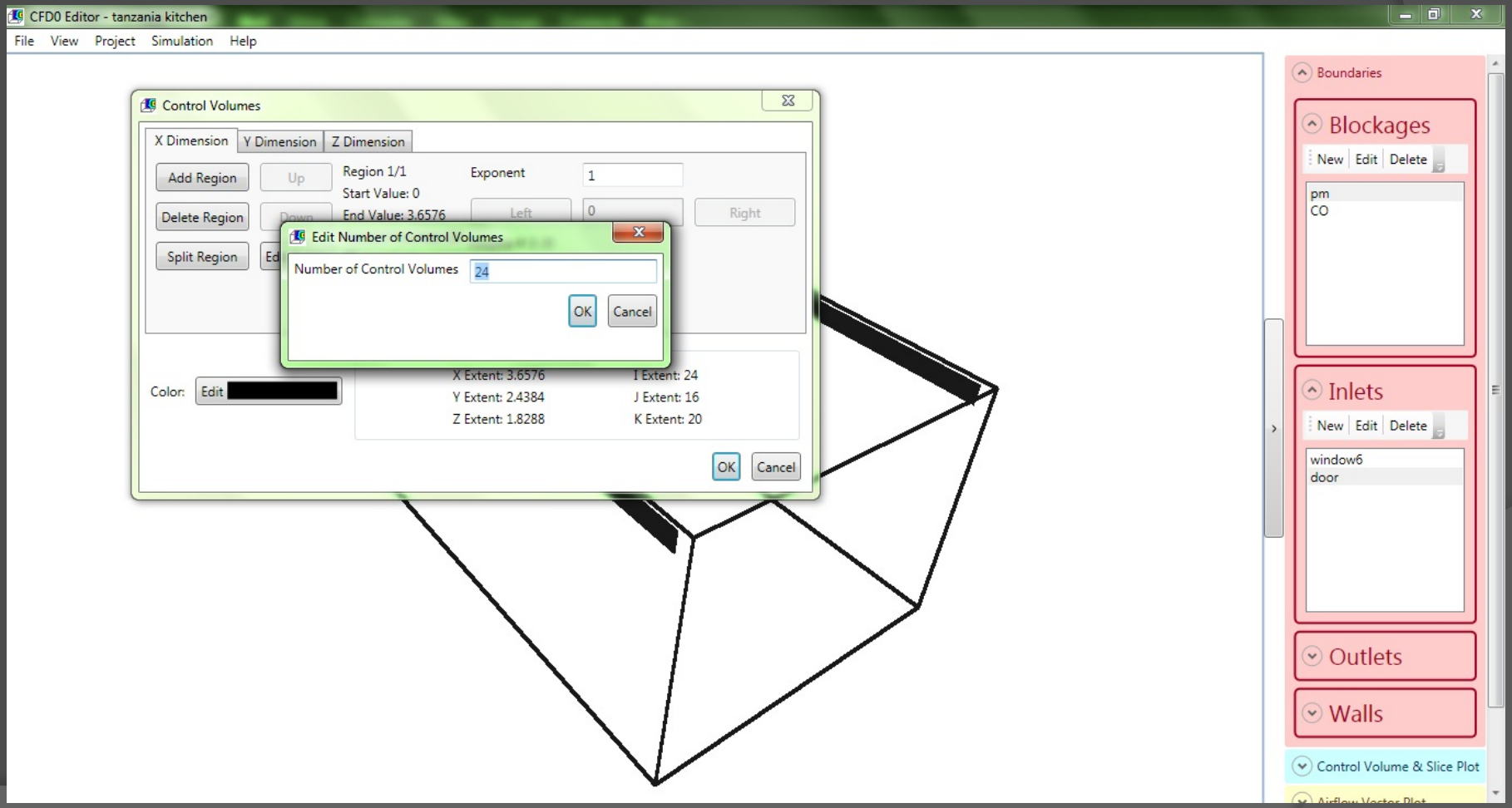


- Open Source
- Airflow and turbulence
- Thermal Advection
- Improves predictive accuracy

Wang et al. 2010

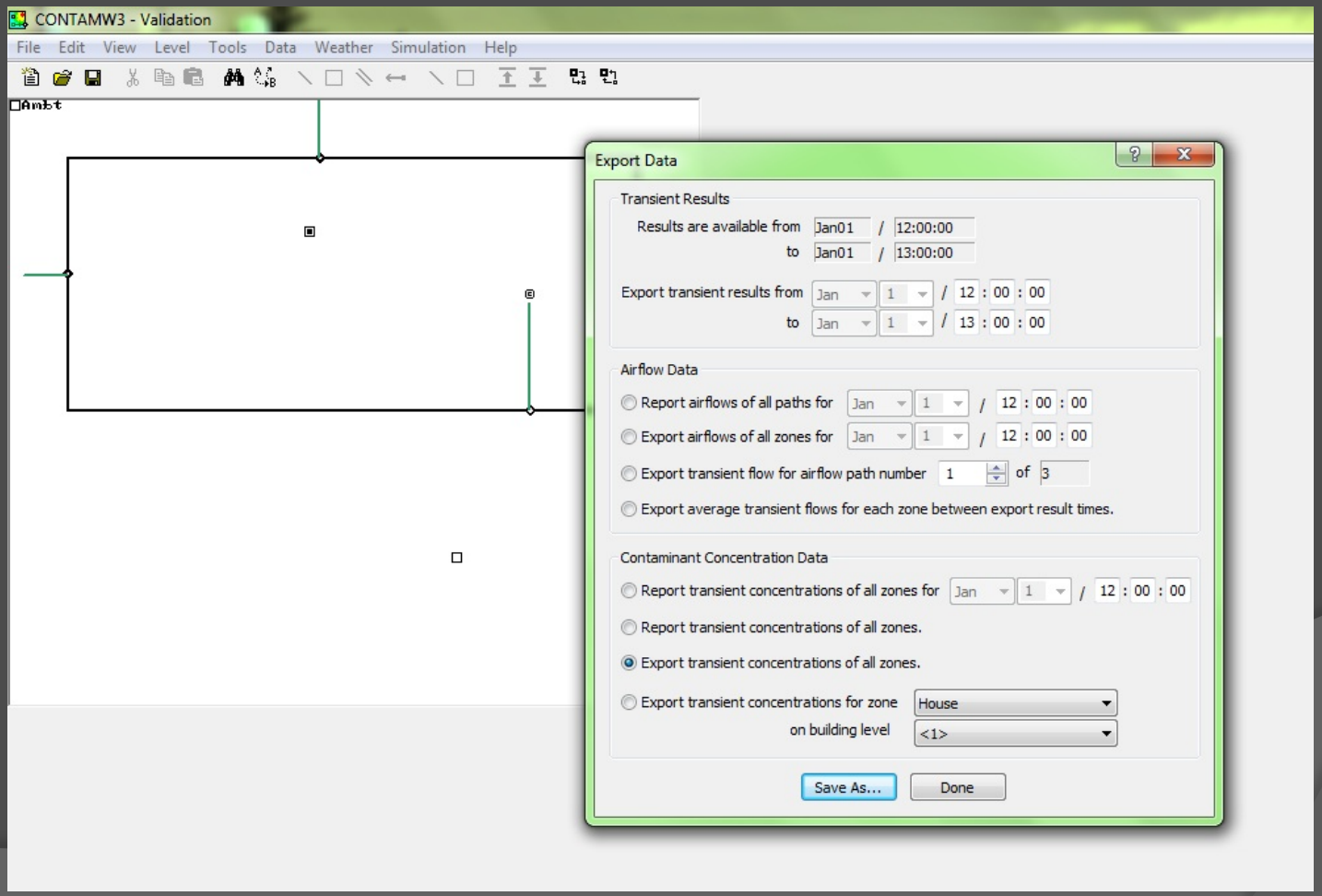
Creating the model

Step 1: Building Idealization



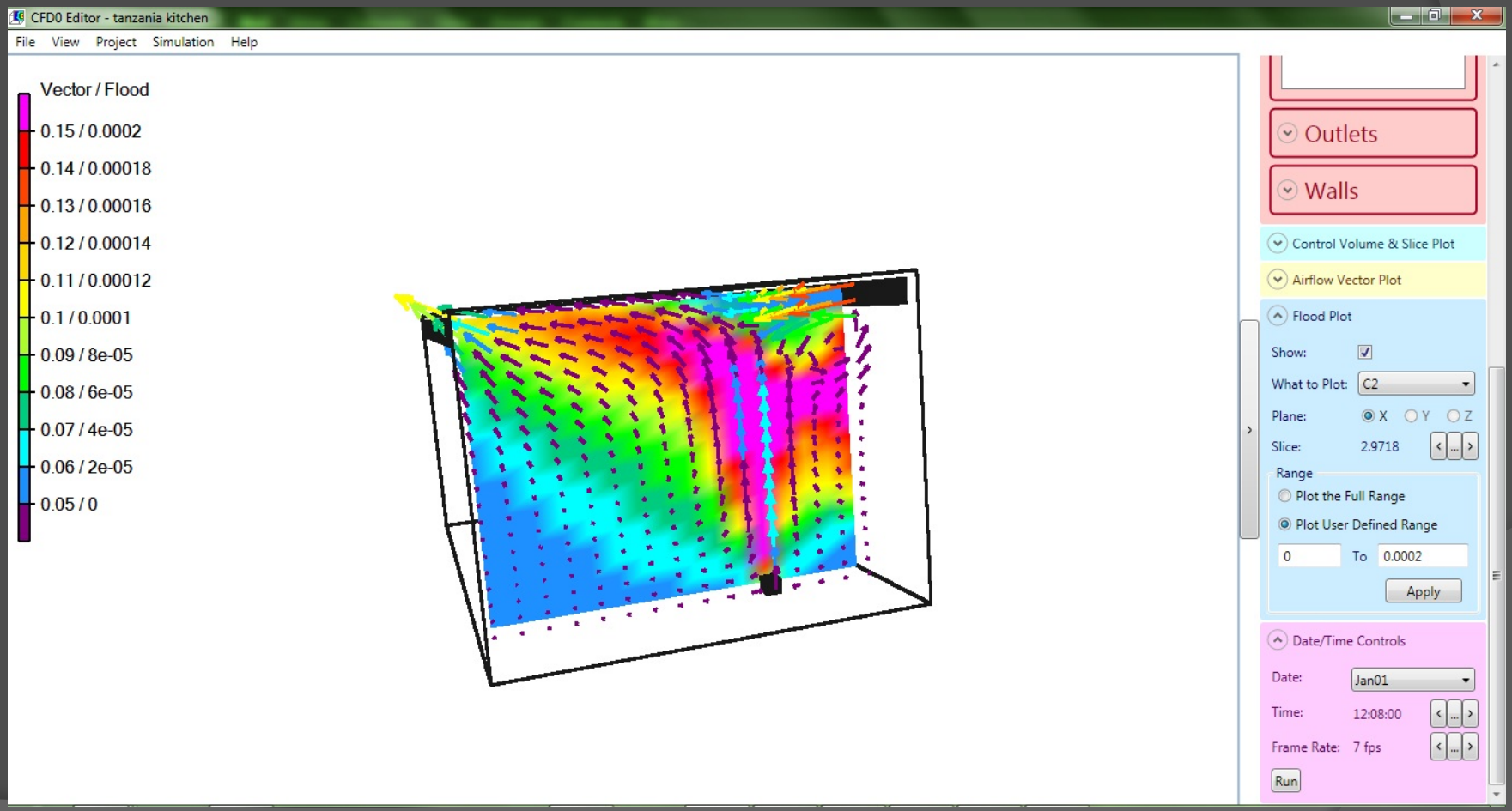
Creating the model

Step 2: Data input (sources, sinks, ventilation, windows, doors, wind, pressure, temperature)



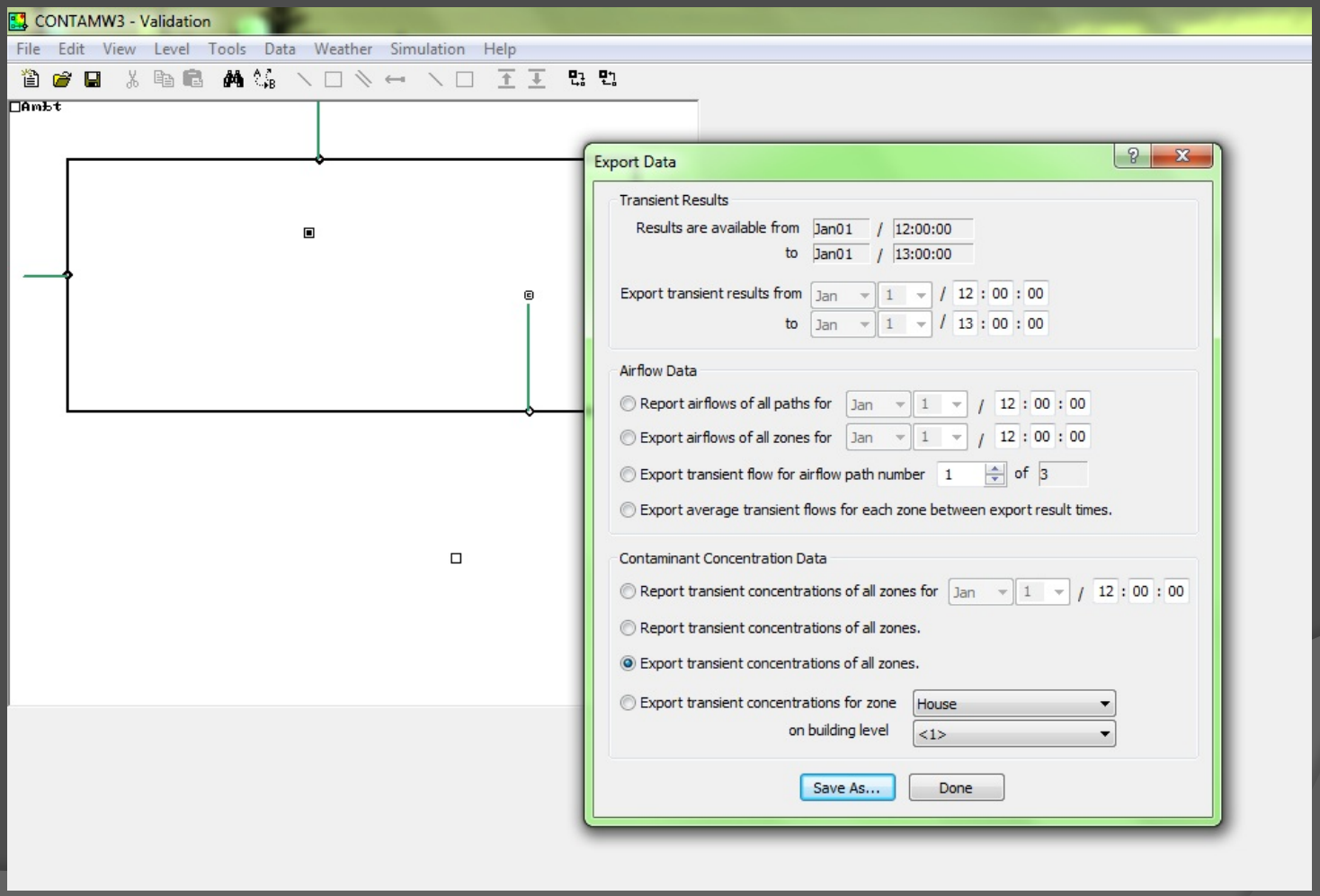
Creating the model

Step 3: Simulation and CFDo coupling

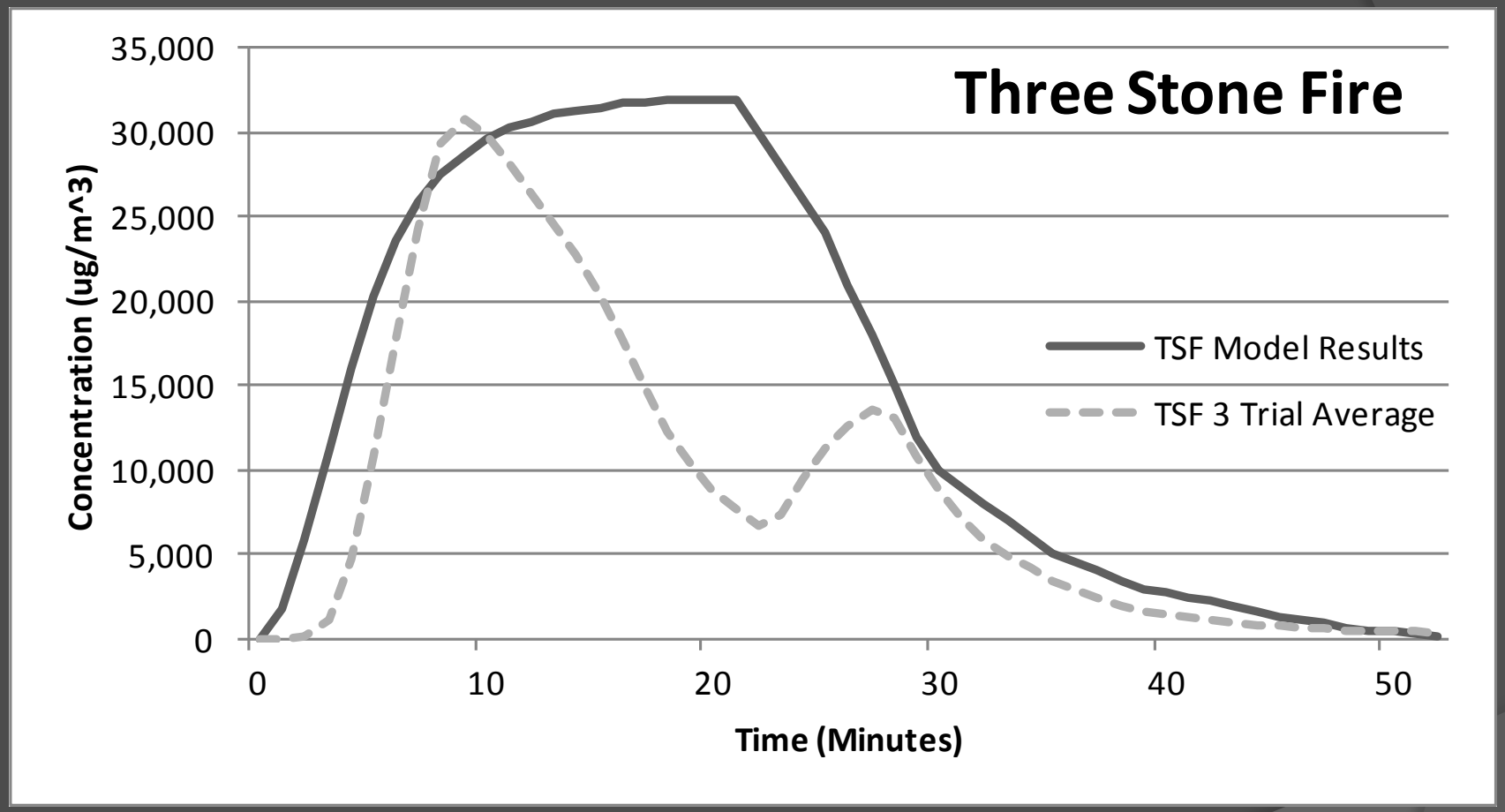


Creating the model

Step 4: Export record and review results

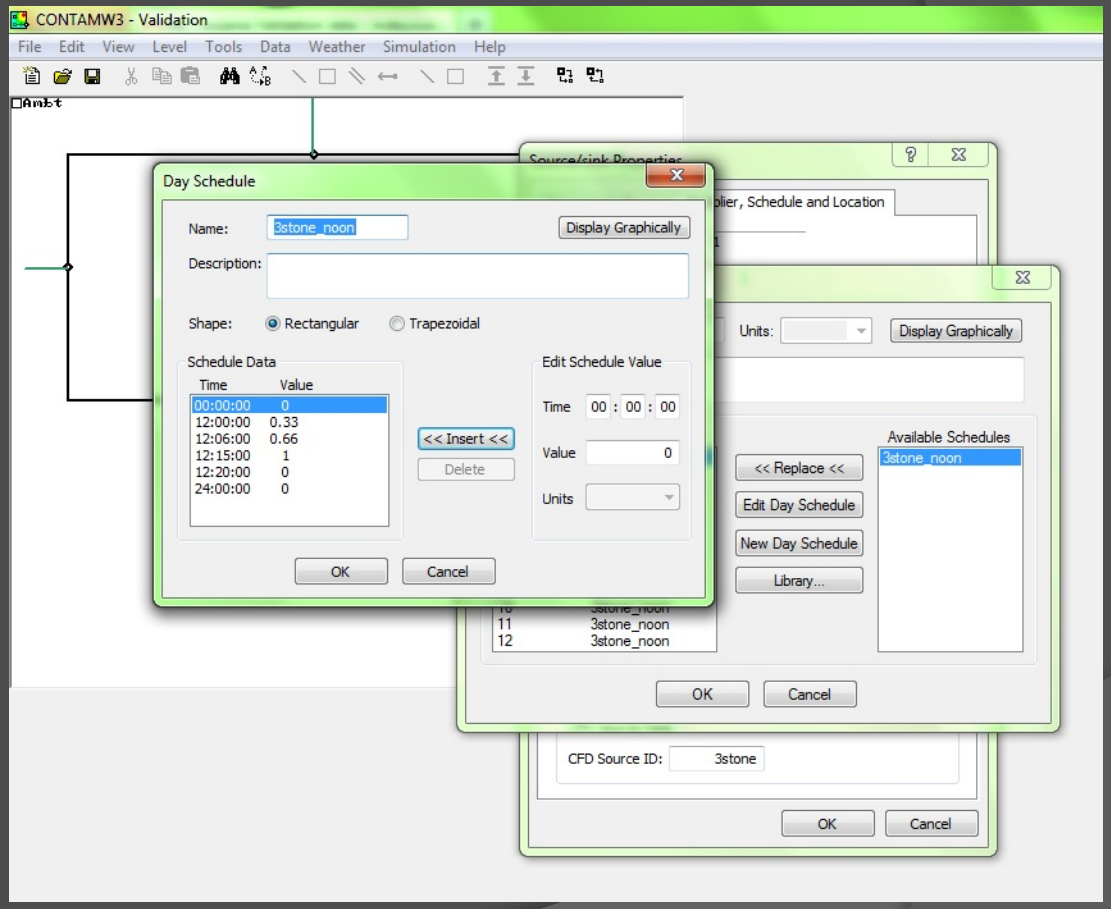


Initial Model Results



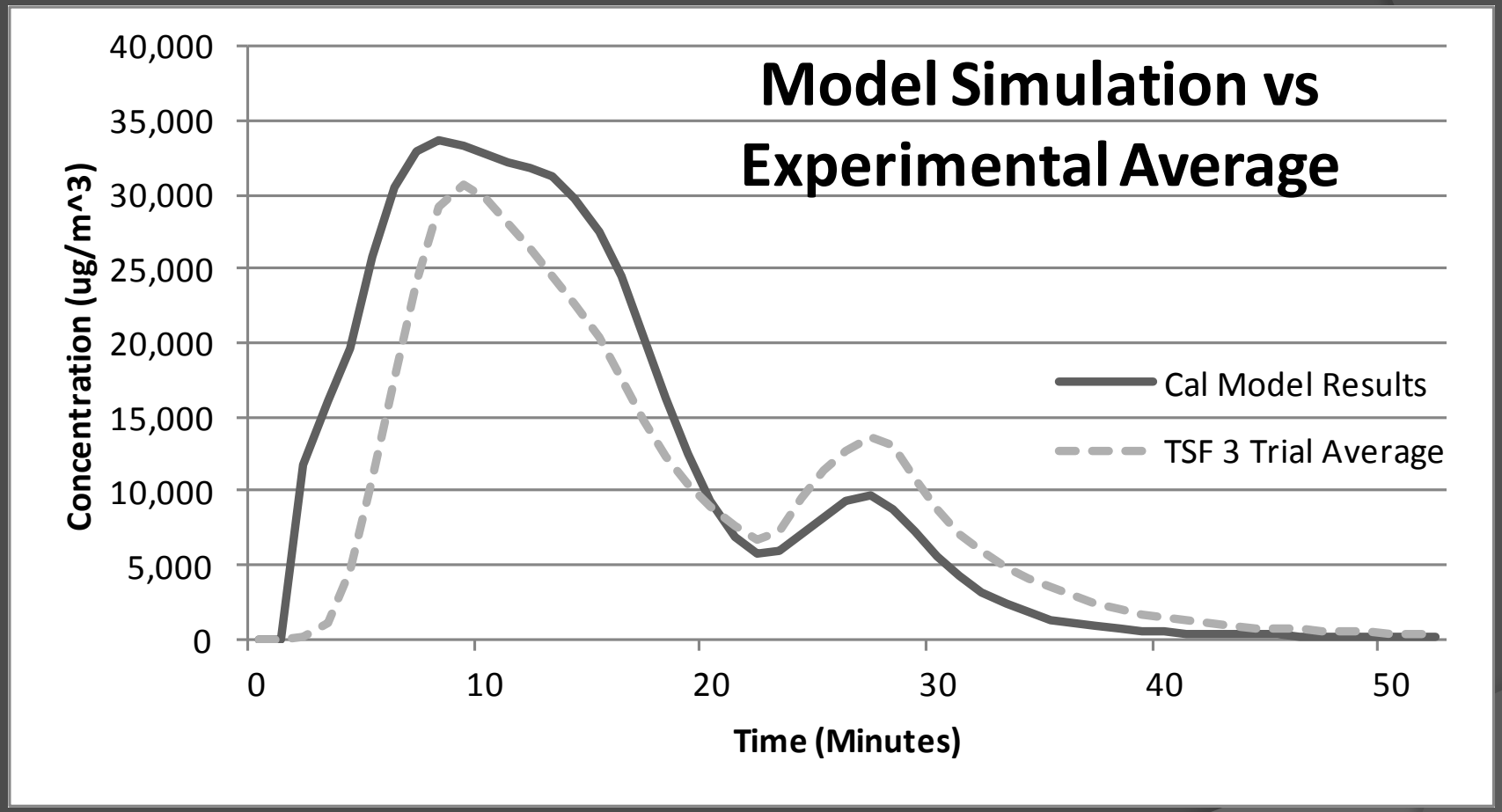
Controlled Cooking Test Simulation
MaCarty et al 2010 – Generation Rate
2 Minute Running Average

Model Calibration



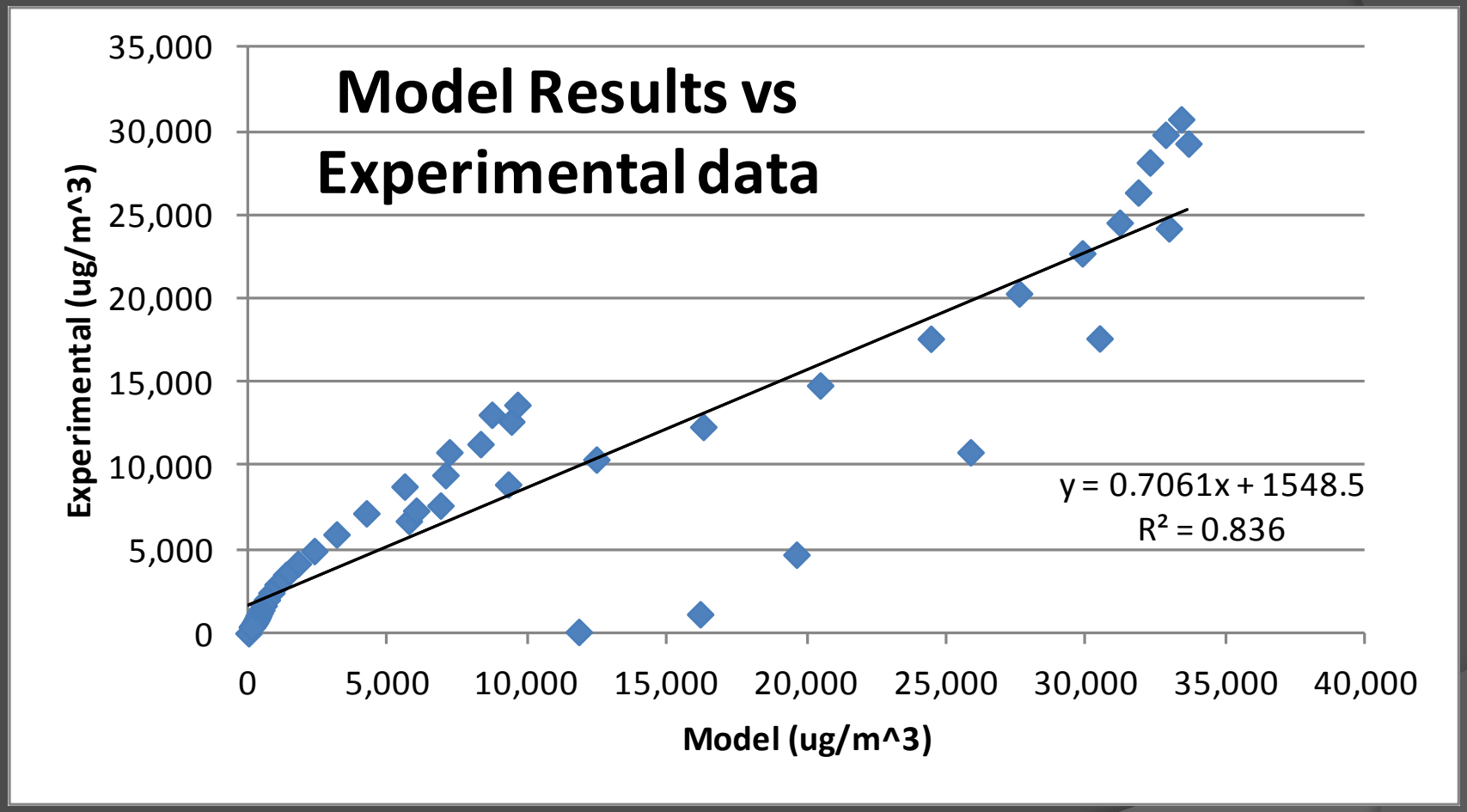
Realistic Schedule

Model Calibration Results



Overestimate in beginning – 17%
Underestimate in the end – 12%

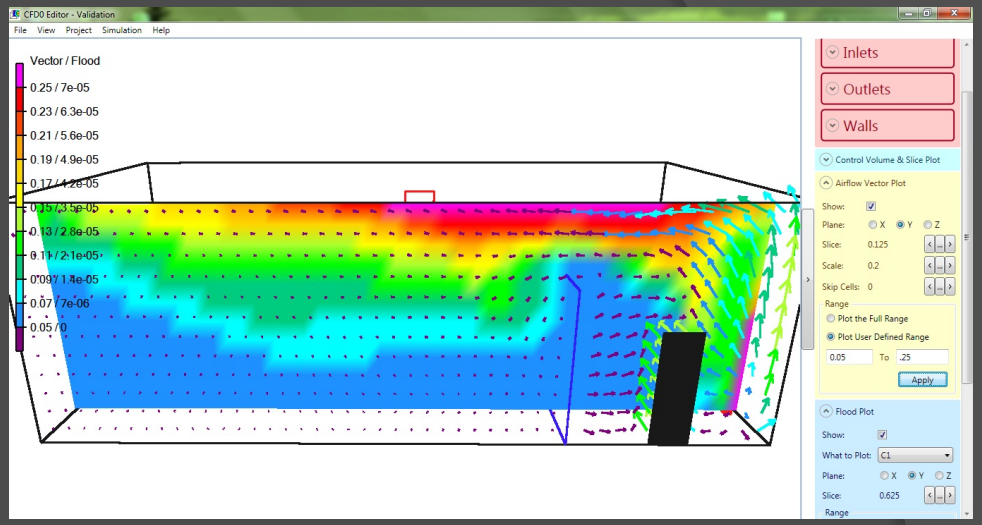
Model Calibration Results

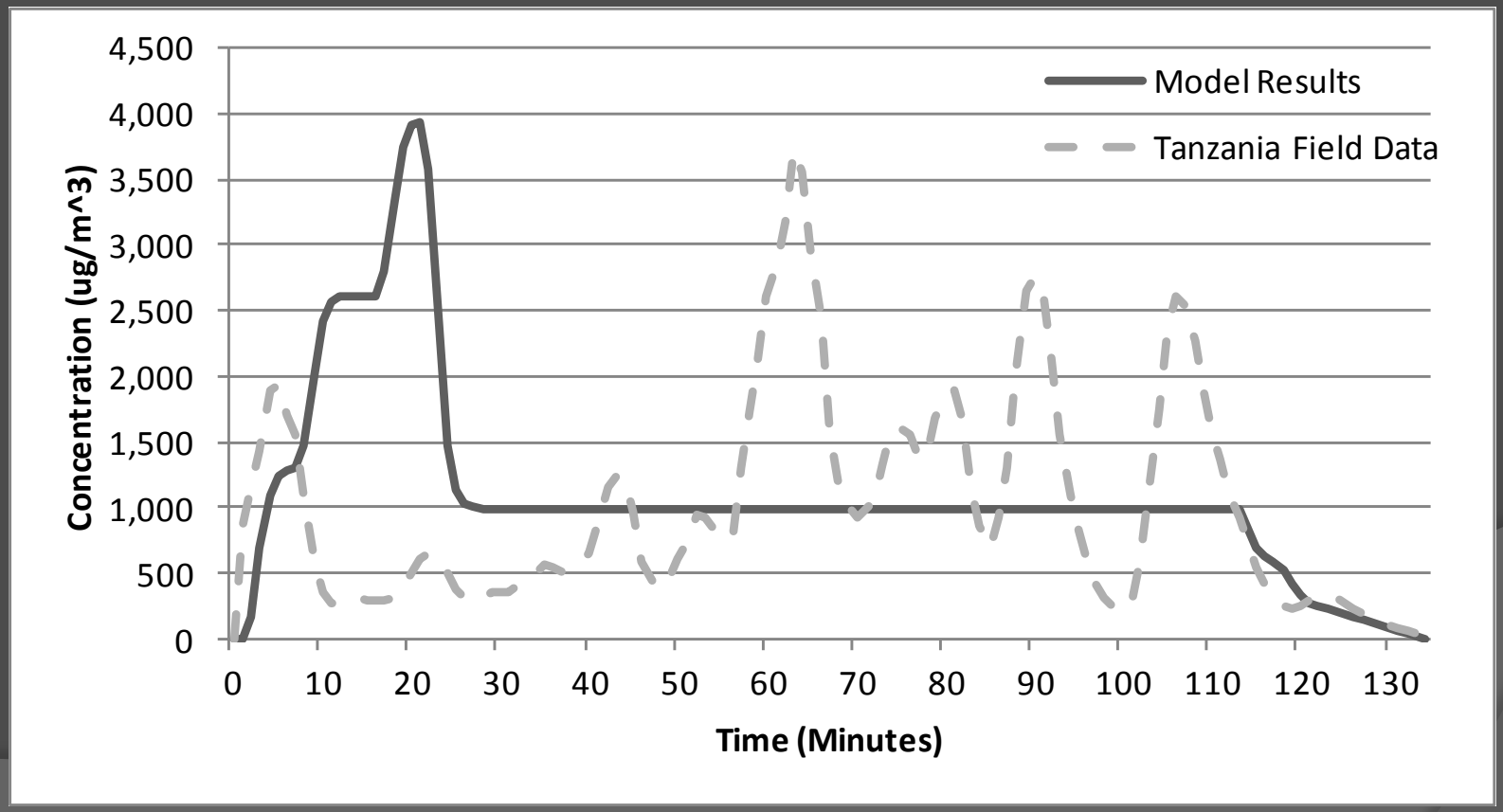


Validation

Model Validation

8.5%





Conclusions and next steps

- Predicting stove performance in the field is hard
- Initial model results look good and may be used by stove implementers
- House design and ventilation is important!

Call to Action

Acknowledgements

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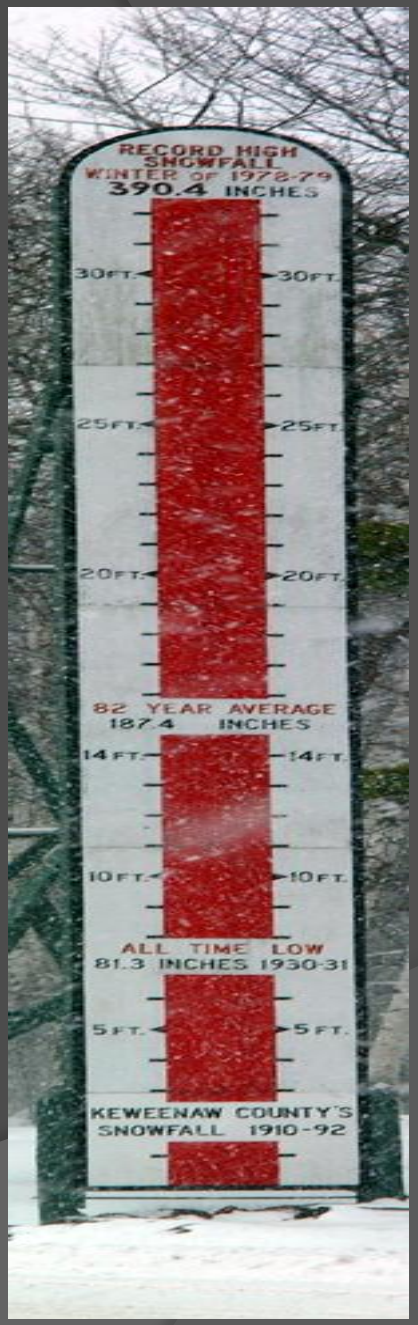

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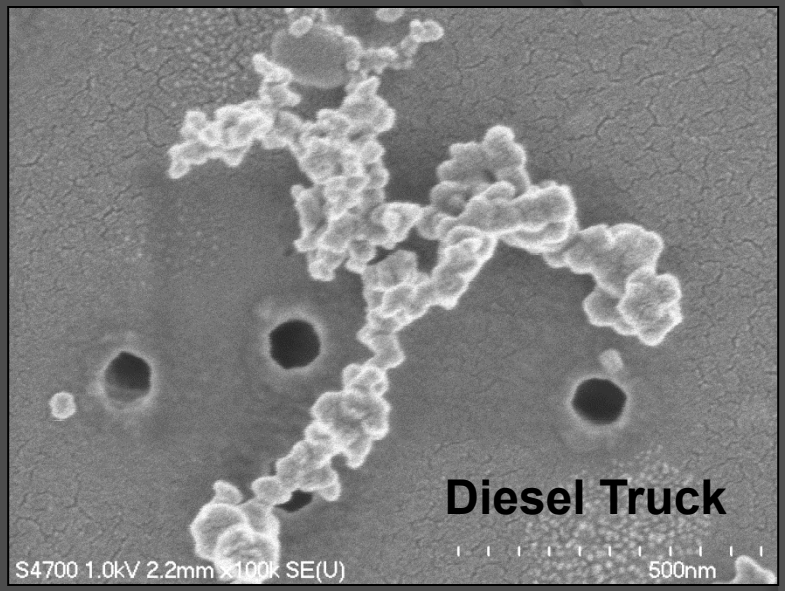
Questions???


Diesel Truck
S4700 1.0kV 2.2mm x100k SE(U)
500nm

3 Stone Fire
S4700 1.0kV 2.1mm x100k SE(U)
500nm

Finite Volume Method

Navier-Stokes General Equation (CFD)

$$\rho\left(\frac{\partial v}{\partial t} + v \bullet \nabla v\right) = -\nabla p + \nabla \bullet T + f$$