A Global Map of Feasible Residential Solutions, Emphasizing Stoves with Space Heating Uses

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Participants – Data generation

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Alaska:

Craig Moore (Tlingit-Haida Regional Housing Authority)

Paul Francisco, Zach Merrin (Indoor Climate Research and Training, U Illinois)

Nepal:

Basudev Upadhyay (Centre for Rural Technology/Nepal)

Mongolia:

Rufus Edwards (UC Irvine)

Inner Mongolia, China:

Jill Baumgartner (McGill University)

Survey development:

Michael Johnson and Kirstie Jagoe (Berkeley Air)

Participants – Modeling

Bond group:

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Woodfuel balance:

Omar Masera and Adrian Ghilardi (GIRA, Mexico)

Surveys across China:

Qiang Zhang (Tsinghua University, China)

Indoor-outdoor exchange and heating demand:

Paul Francisco, Zach Merrin (Indoor Climate Research and Training, U Illinois)

Neighborhood effect:

Marko Princevac (UC Riverside)

Global transport and climate:

Susanne Bauer (NASA-GISS)

The "cookstove problem"

We don't have a cookstove problem.

We have a household energy* problem

* actually I'd say it's a household *services* problem, but that's for another day: energy, WASH, shelter, nutrition

To begin: Acknowledge that the home is a system

Understand the end-use demand: cooking-heating-lighting-"other", available resources, consumer preference and practice, home tightness

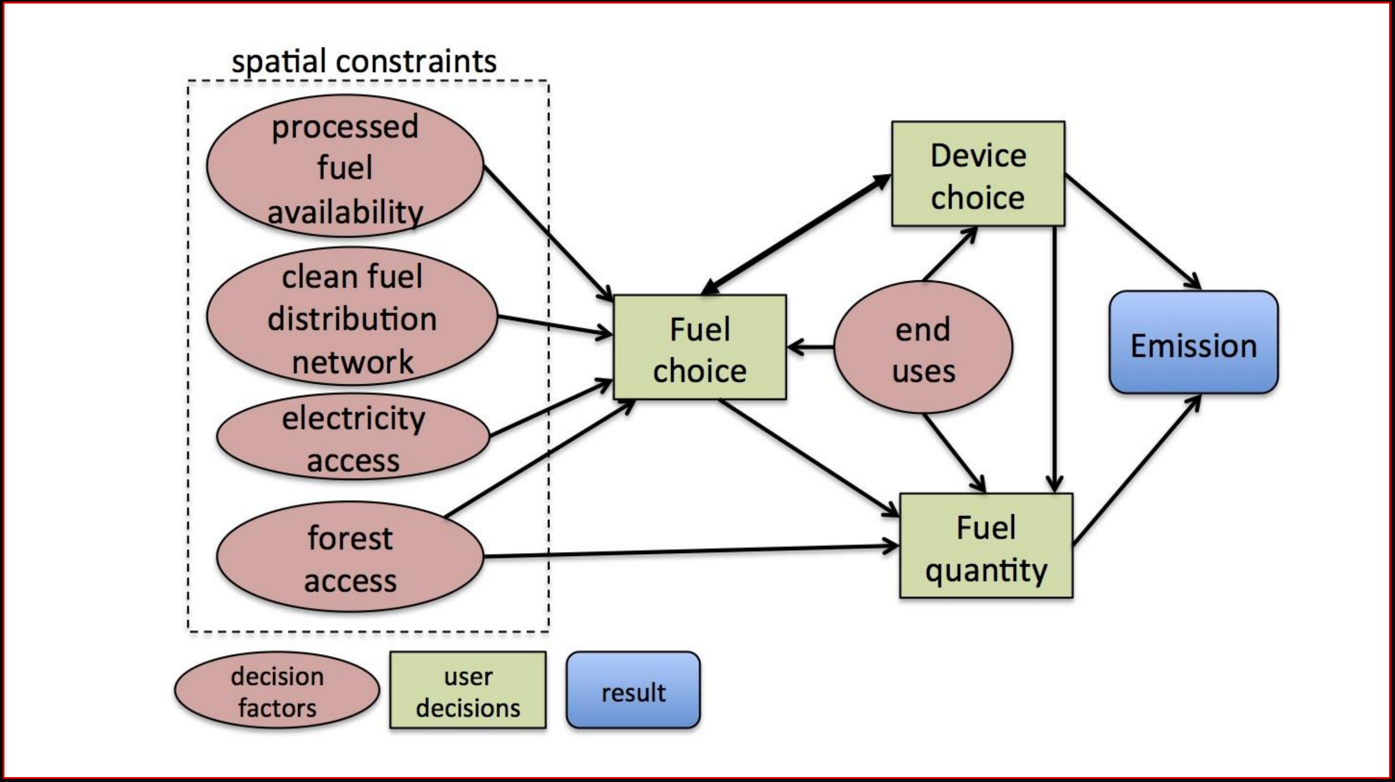
The “climate problem”

We don’t have a climate problem.
We have an adaptive capacity* problem.

* adaptive capacity = you can look ahead and choose to avoid a problem, or you can adapt to a problem if it comes

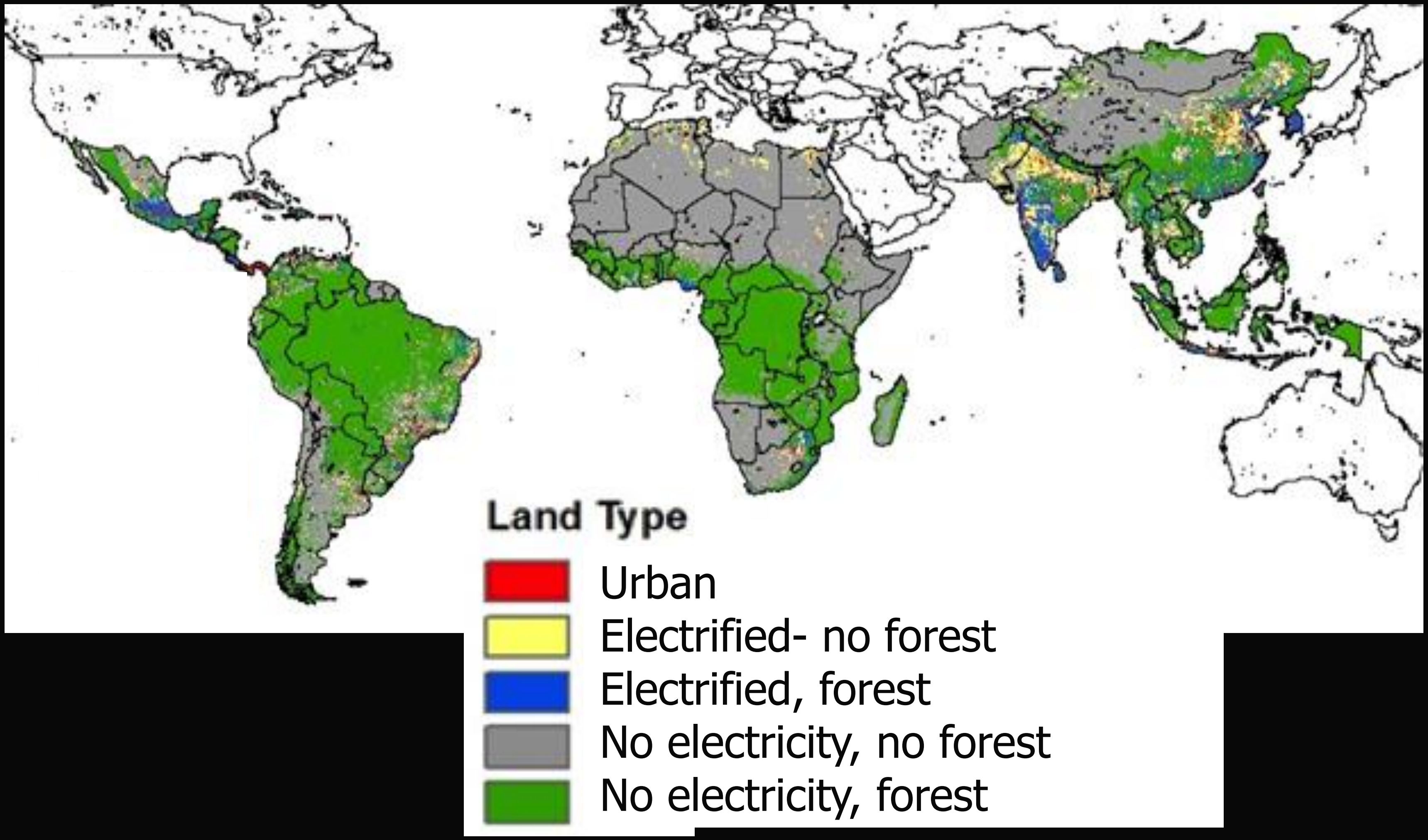
To begin: Use “good-enough models” to identify worst vulnerabilities and best mitigation
Estimate: impact on indoor AQ and exposure; neighborhood AQ; climate

Objective 1.
Produce a global resource-driven map of current emissions and plausible interventions for all residential uses of solid fuel.



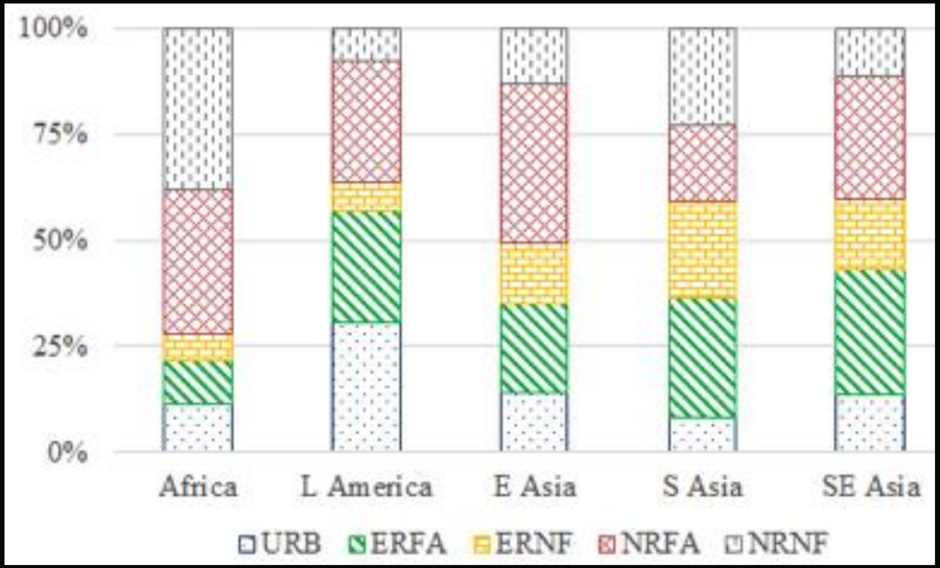
Step 1: classify land types

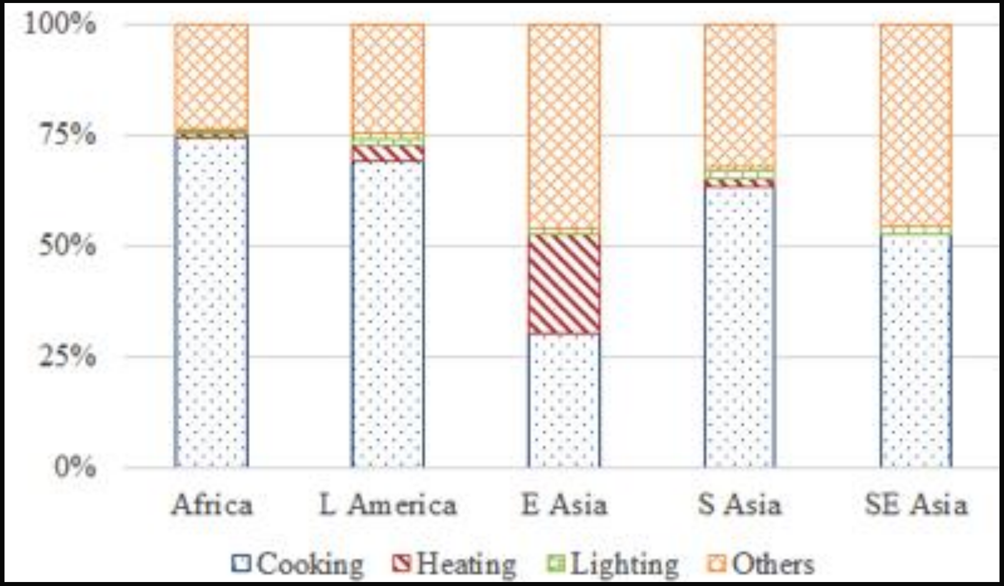
GIS: population, forest maps, nightlights



Winijkul, Bond and Fierce (perpetually in prep)

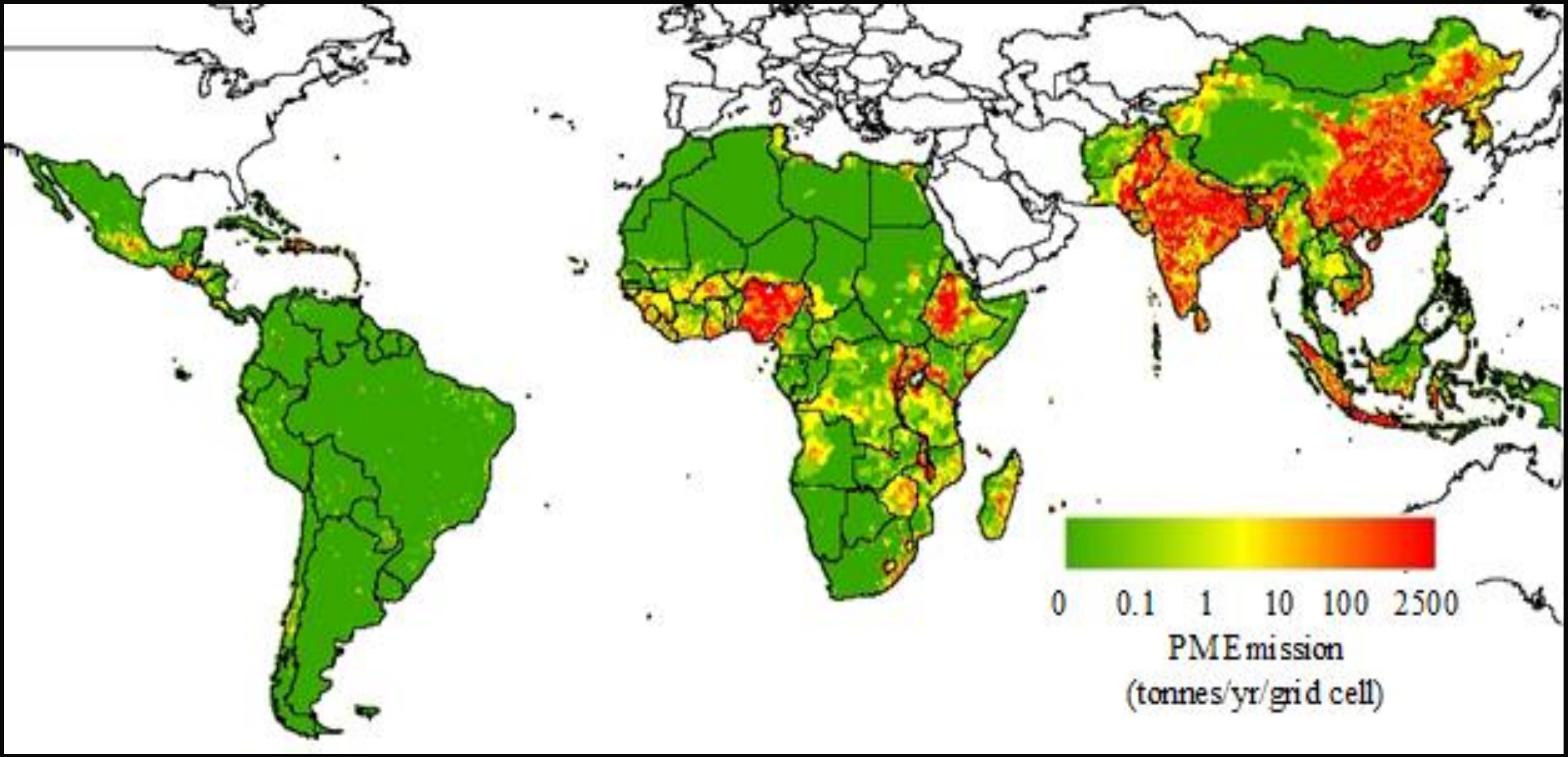
Step 2+3: distribute fuel consumption; estimate end use





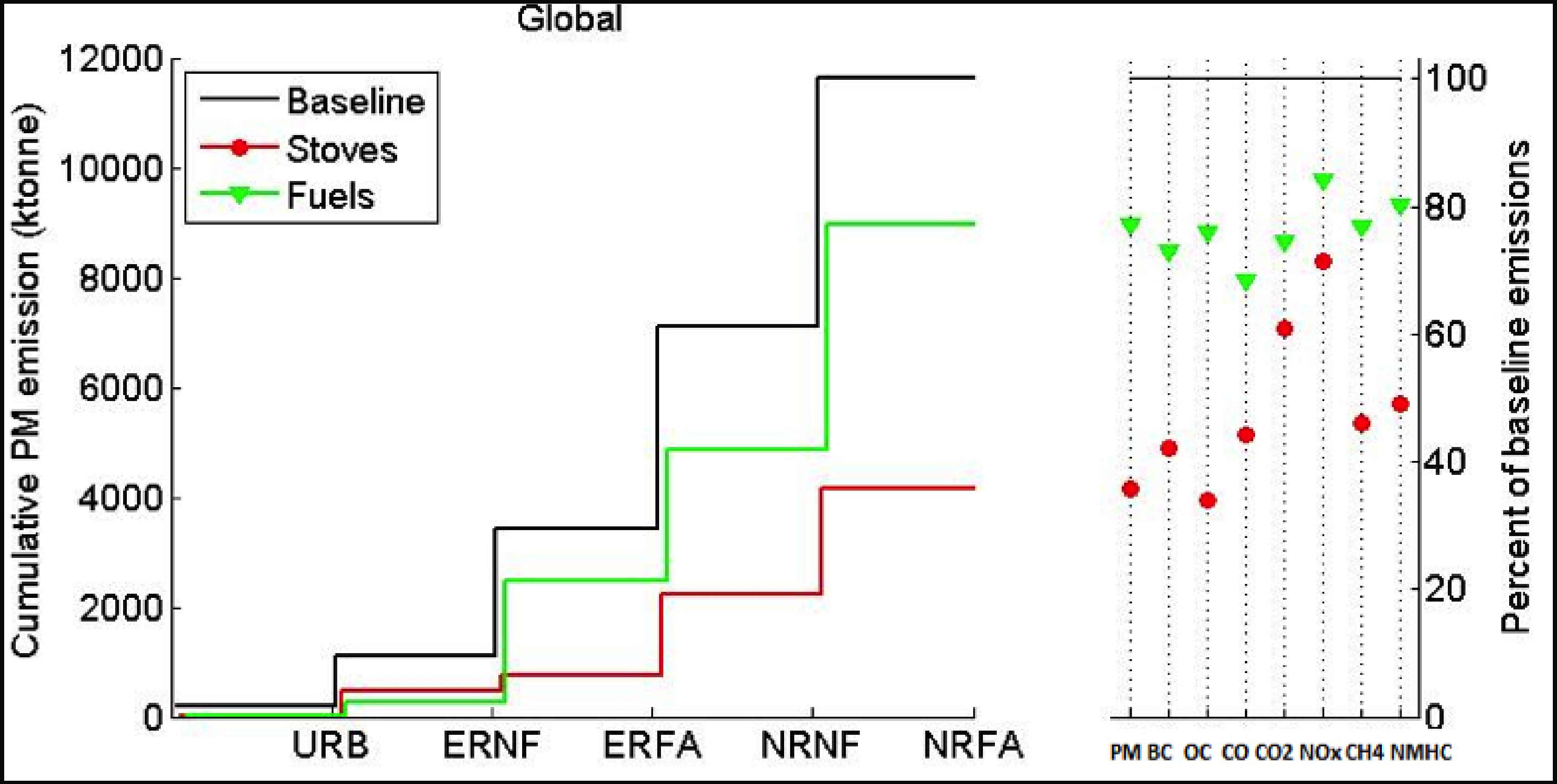
Winijkul, Bond and Fierce (in prep)

Step 4+5: assign devices, calculate emissions



Winijkul, Bond and Fierce (in prep)

Finally, calculate plausible emissions under scenarios

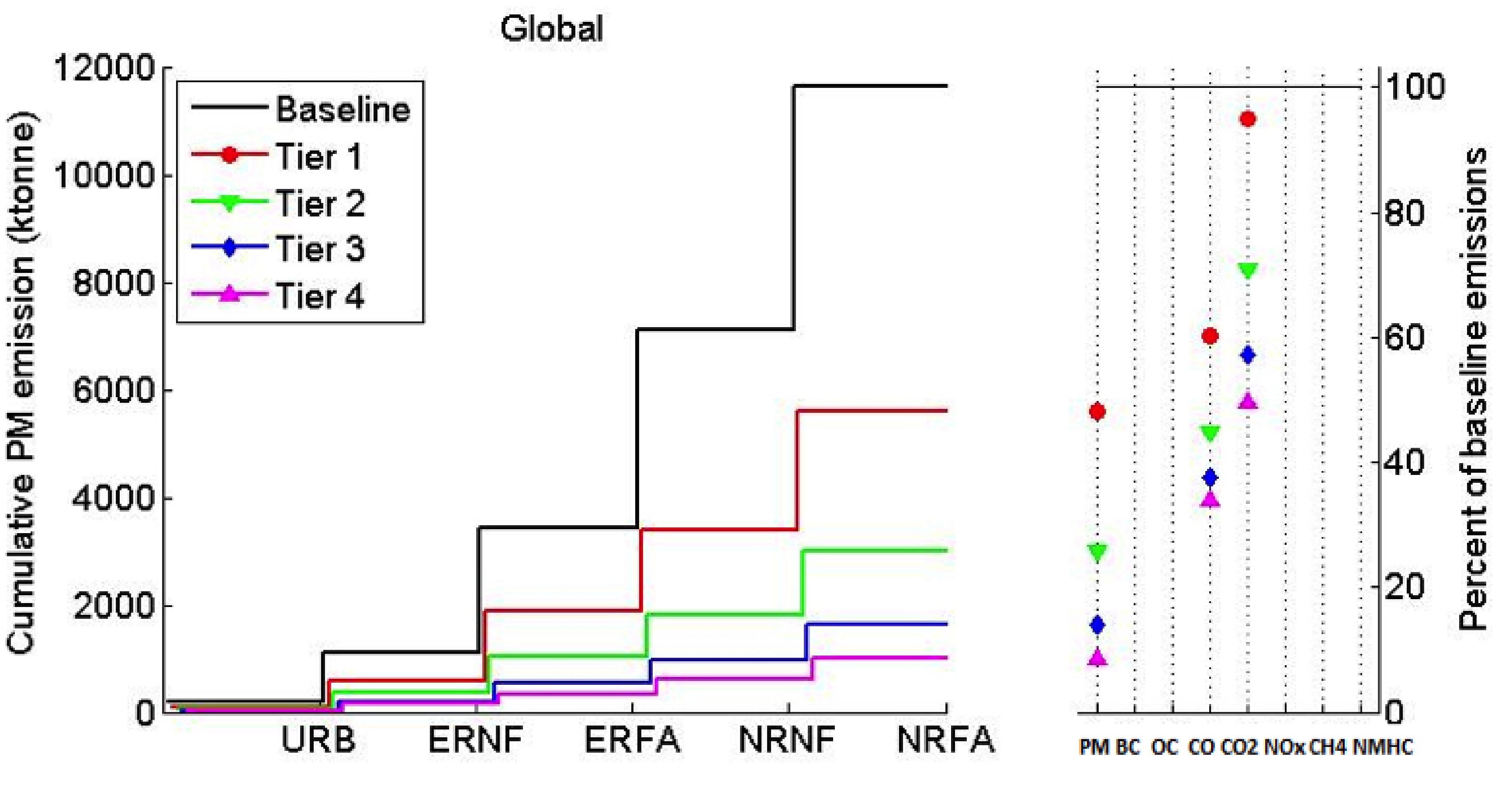


Stoves: Cleanest plausible stove, no fuel switch

Fuels: Switch to clean fuels, but not in forest access areas

Winijkul and Bond (paper II– also in prep)

Finally, calculate plausible emissions under scenarios



Stoves: Cleanest plausible stove, no fuel switch

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Winijkul and Bond (paper II– also in prep)

Objective 2.
Improve understanding of emission rates and emissions attributable to space heating by adding measurements to four existing residential-energy projects.

Why space heating?

-Different stoves (cooking efficiency doesn't matter)

-Definitely burned indoors– potentially high exposures

-Near snow fields

-Similarities among very different areas!

Seasonal "Kitchen Performance Test" to evaluate heating use

Objective 2.
Improve understanding of REAL emission rates and emissions attributable to space heating by adding measurements to four existing residential-energy projects.

It has not been demonstrated that laboratory performance is predictive of in-use performance. (And there is some evidence that it isn't… Especially for PM emissions.)

This includes:
- *relative performance of "improved" vs "traditional" stoves*
- *black carbon fraction of PM emissions.*

Field measurements: The “Fumitron”

Real-time CO, CO_2, scattering (for PM); can have absorption (for BC)

Filters for PM and EC/OC

Yields: emission factors

Hard work on: flows & dilution; datalogging (SD card)

Kake, Alaska

- Population 546
- Cash economy
- In wooded area
- Also have access to fuel oil
- Most homes also have oil boiler, many have Toyo oil heaters
- Oil boilers used for domestic hot water

- Oil: $5.65/gallon
- Electricity: $0.65/kWh

Not technology limited

Transport limitations

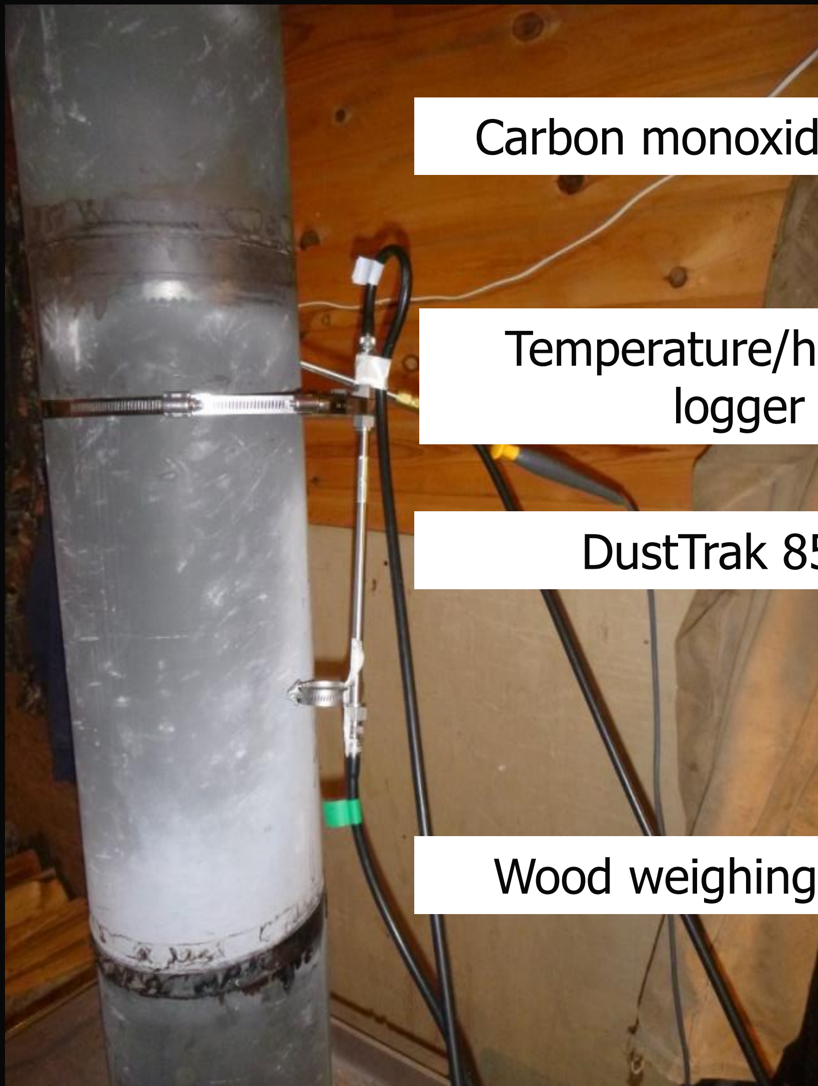
- No roads to other locations
- Supplies (travel) by:
  - Small plane – small supplies
  - Ferry – larger supplies, takes about a day
  - Barge – large supplies, large quantities

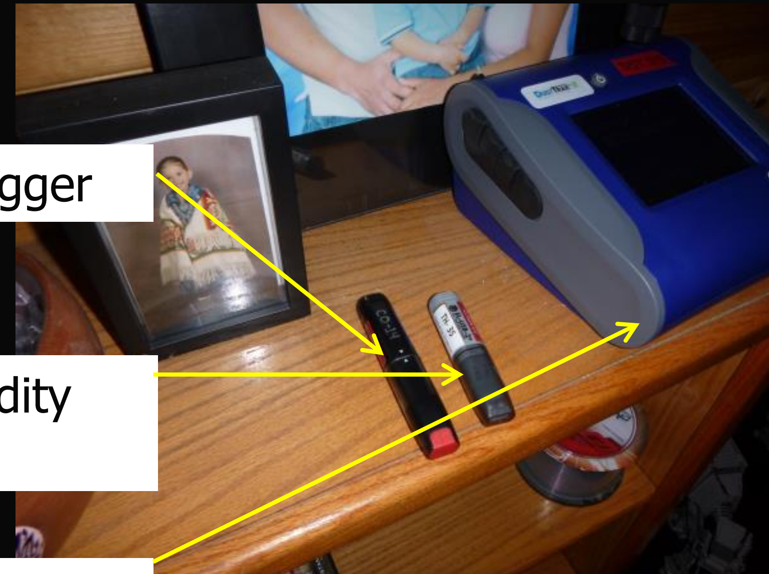
The palette scale goes by ferry.

Kake, AK
Juneau
Chichagof Island
Admiralty Island
Kruzof Island
Sitka
Baranof Island
Kupreanof Island
The Tongass


Pots on stove to humidify
Door open to allow more air in during start-up

Emission and indoor measurements





Carbon monoxide logger

Temperature/humidity logger

DustTrak 8530

Wood weighing station

Varying success in trying
to keep wood dry

Most homes have decent ceiling penetrations

Some don't

Measuring building envelope tightness

THRHA personnel are being trained in *all* measurements

Particulate matter is yellow, brown, black

Objective 3.
Incubate a Regional Testing and Knowledge Center with community presence and demonstrate successive improvement in interventions.

Why? – Because we can't do it ourselves*

* We = the academic/research community. We are too distant and too expensive

Example of activities

- Providing and training on field testing equipment
- Jointly designing surveys
- Joint data analysis and partner-led publication

- Participating in regional knowledge-sharing workshops
- Assisting with proposals for Regional Testing and Knowledge Center (funded)
- Setting up quality control procedures

Objective 4.

Model the effects of current emissions, future emissions, and plausible interventions on local outdoor concentrations, and global radiative forcing.