

US EPA ARCHIVE DOCUMENT

*Confidence and key uncertainties in
black carbon emissions & radiative impacts
& measurements & co-emitted particles & gases &
optical properties & vertical distributions & future emissions &...*

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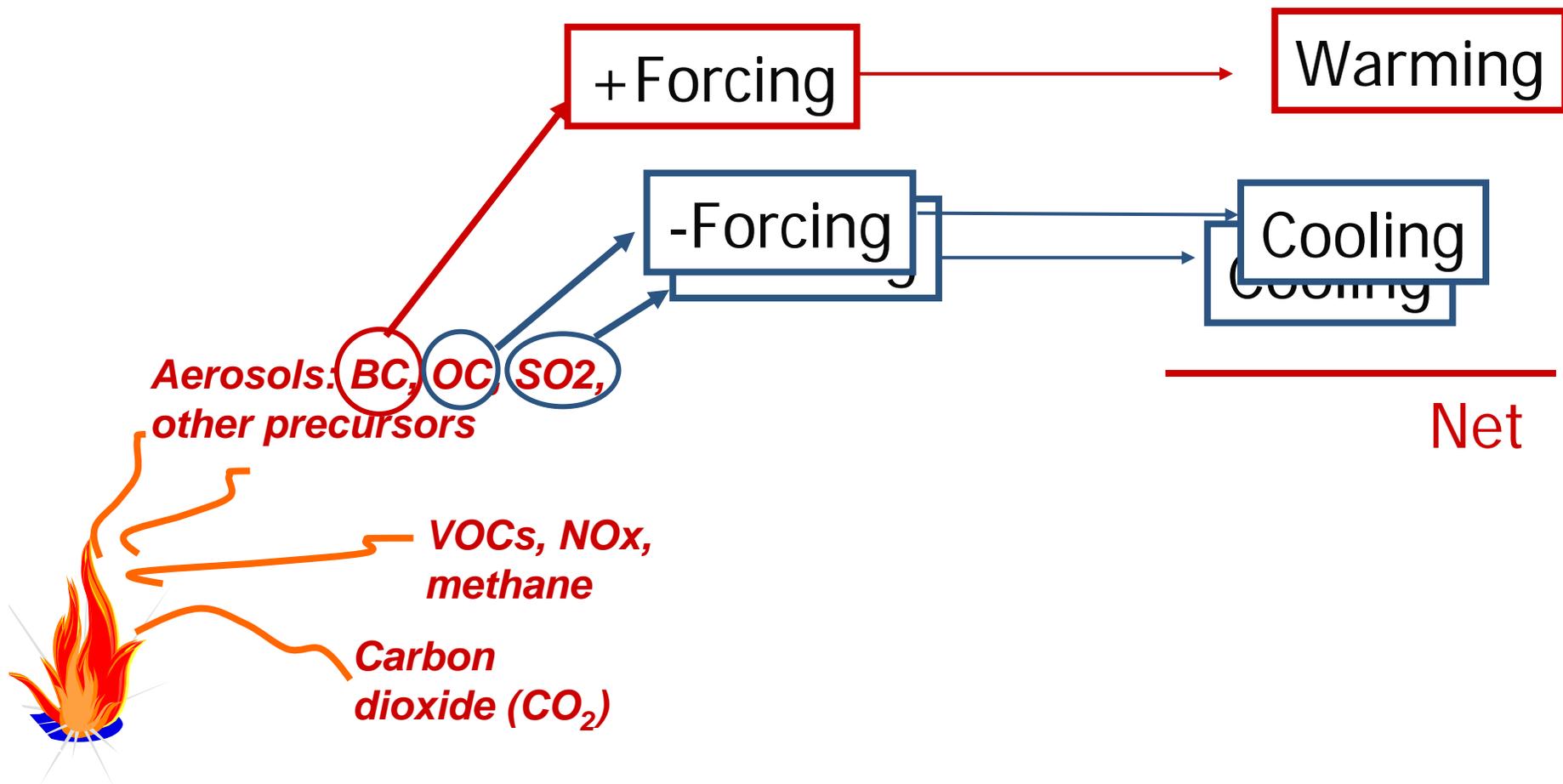
Climate

Health

Air Quality

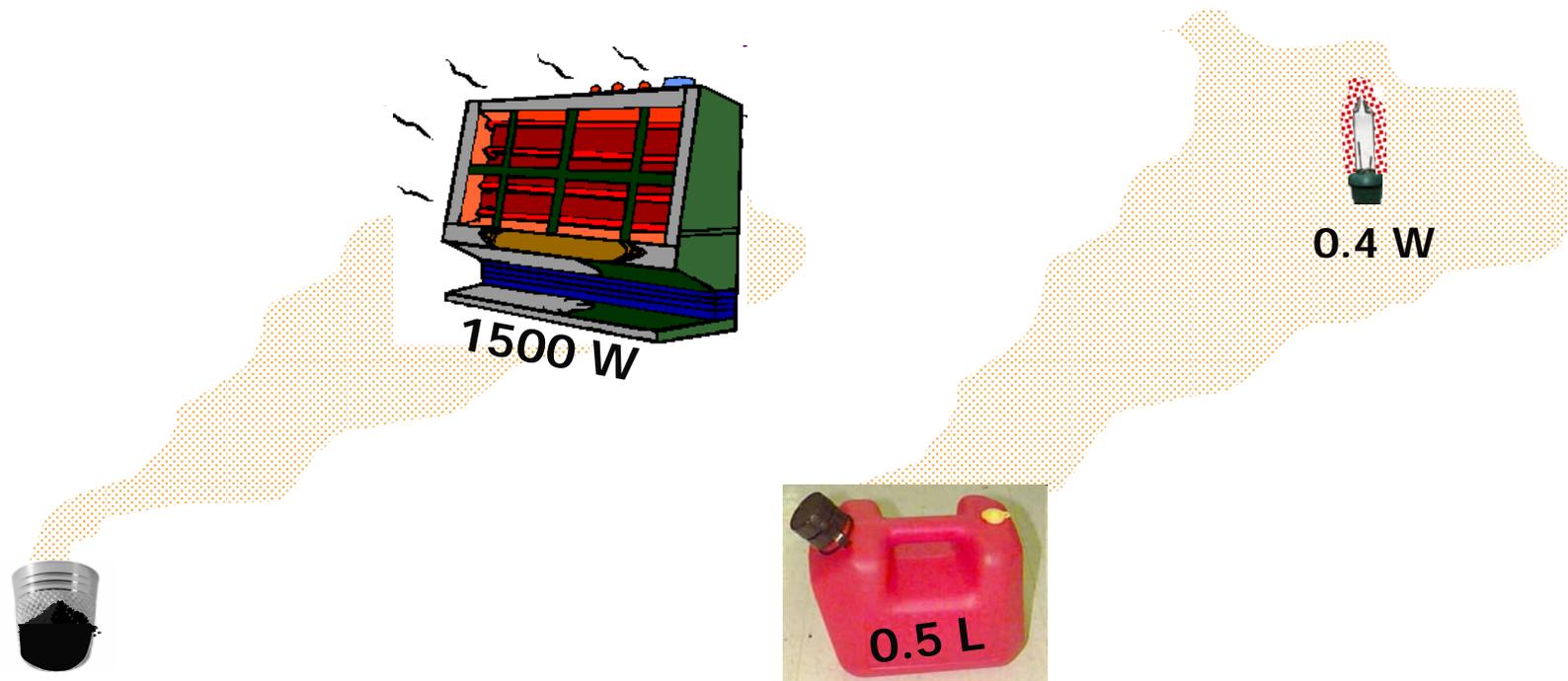


Source-to-Impact measures





Strong absorption of BC causes powerful, immediate warming.

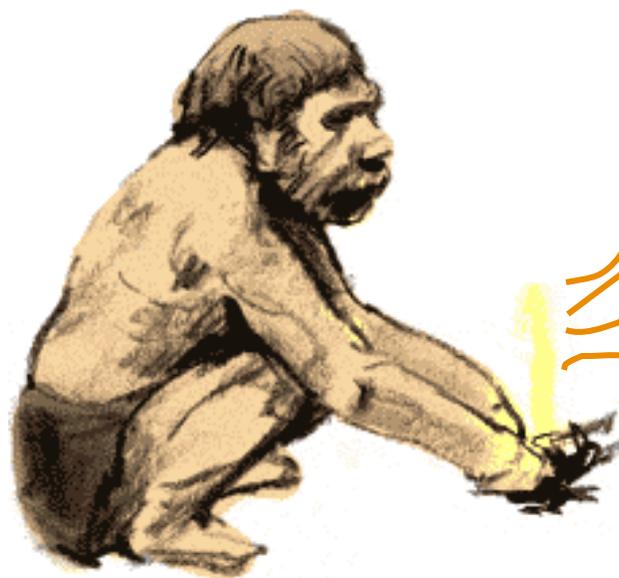


1 gram BC emitted =
small heater in atmosphere for 1 week
1 kg CO₂ emitted =
1 small bulb for 100 years

Black Carbon Sources



Black carbon is created ~~only~~^{99.99%} in flame



Soot Particle Size Spectra

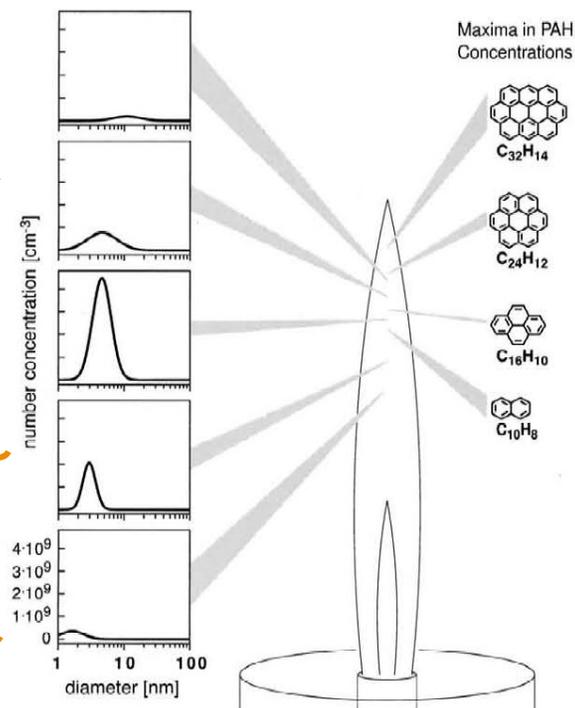
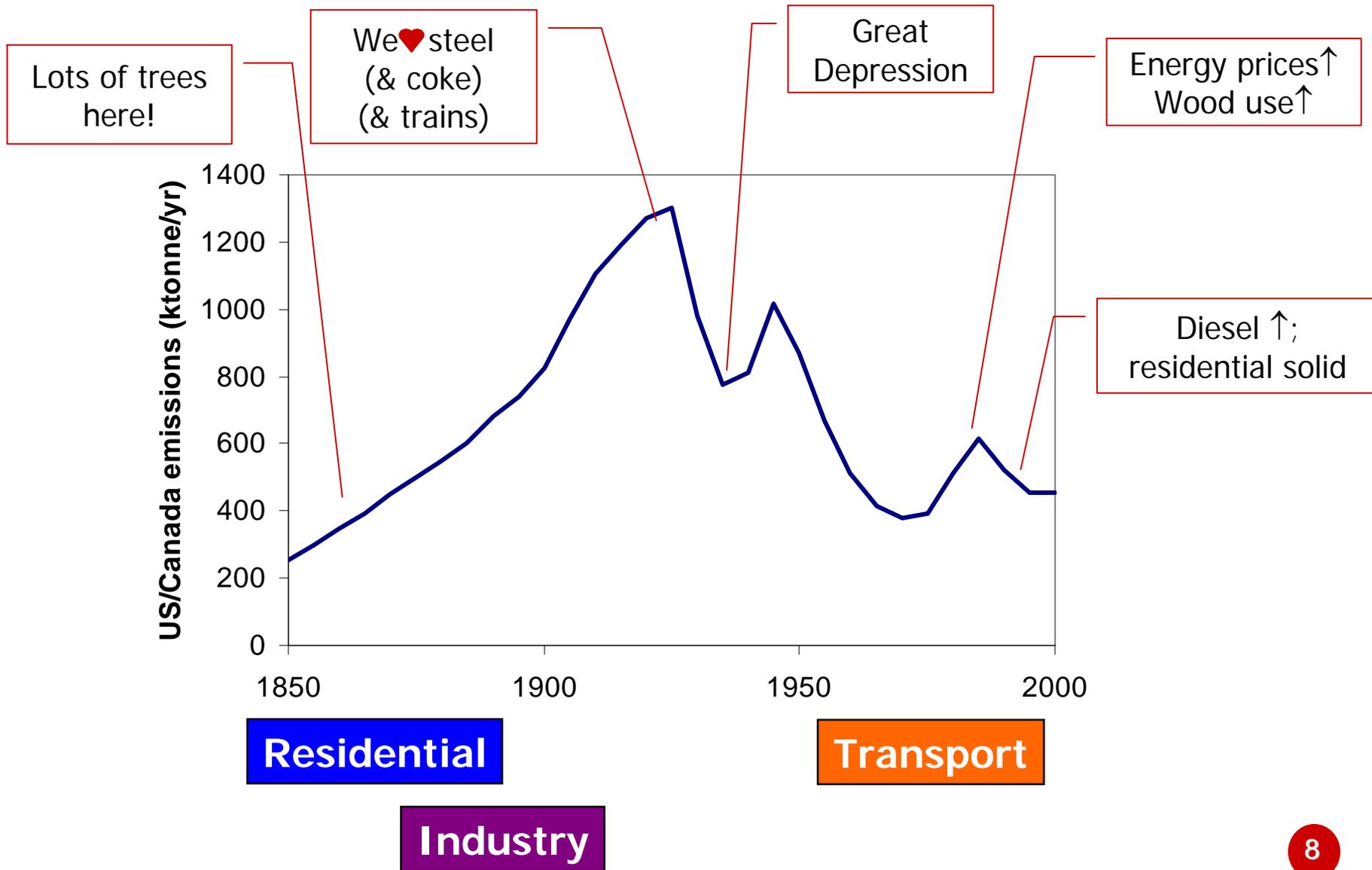


Fig. 2. A representation of the methane flame with PAH-maxima and soot particle size distributions, assigned to the respective height in the flame.

K. Siegmann, K. Sattler, and H. C. Siegmann, J. Electron Spectrosc. Rel. Phenom. 126, 191-202, 2002



Historical BC lessons

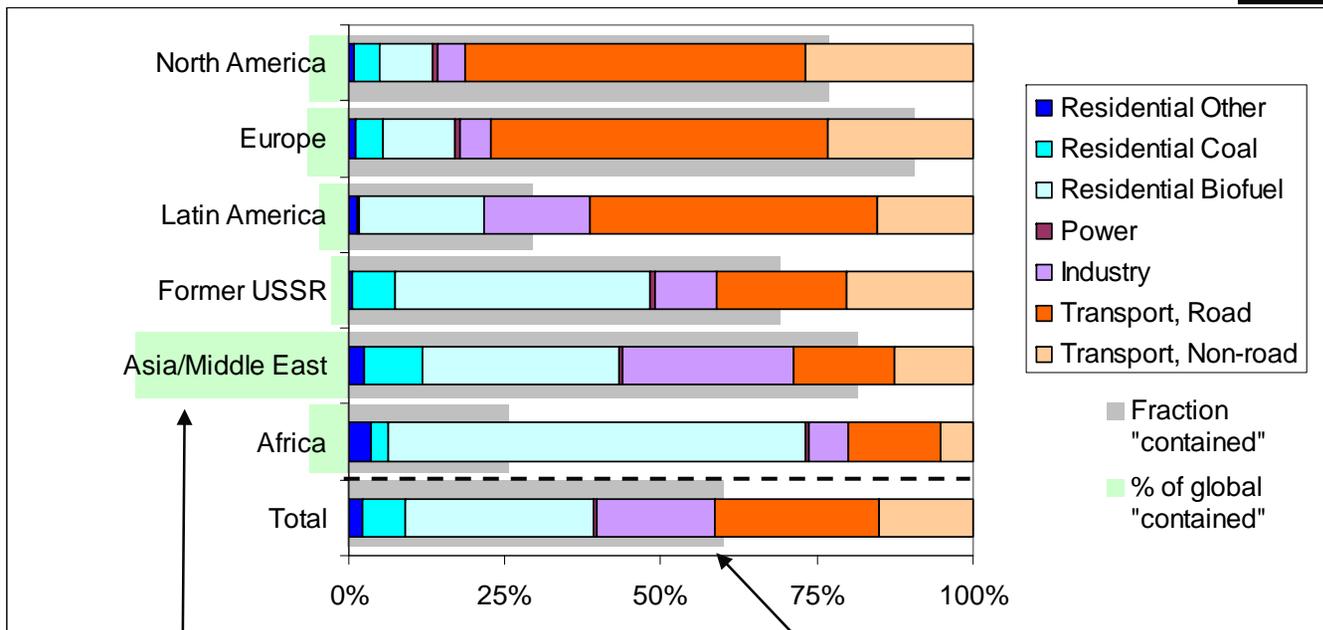




Source mix differs by region



Colored bars indicate relative contribution to global total.



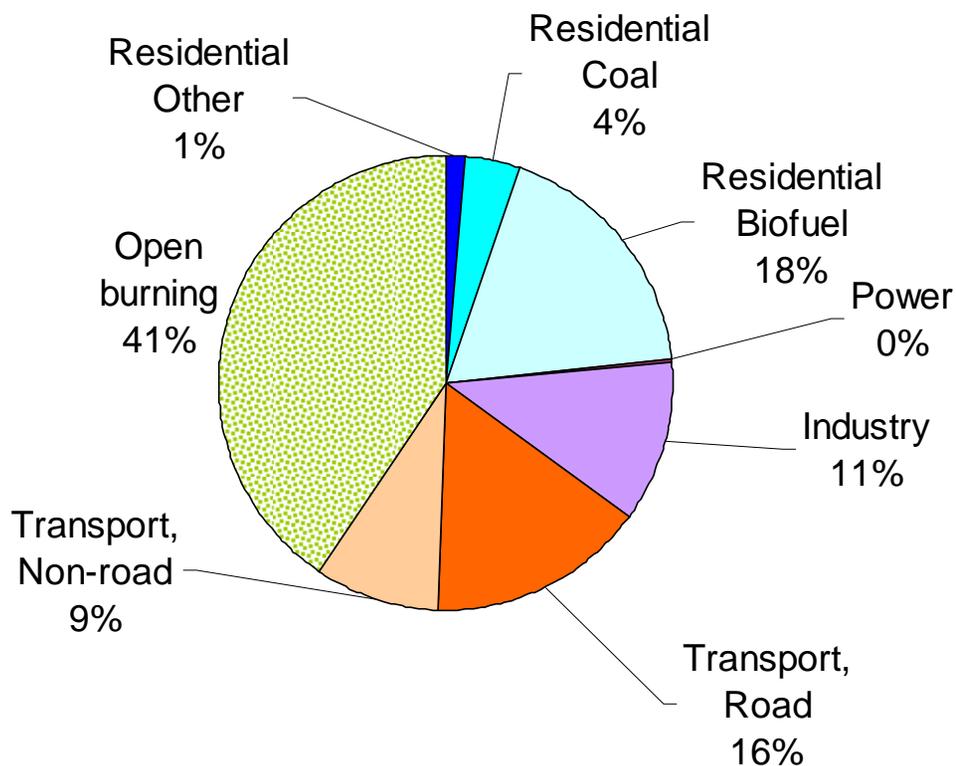
Green bars indicate relative contribution to global total.

Gray bars show how much comes from energy-related combustion.

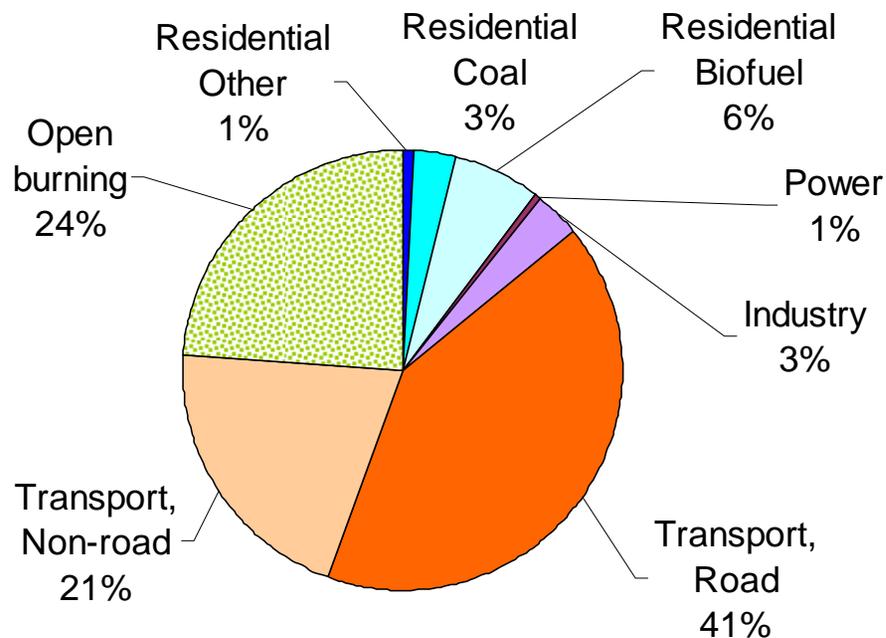
(Bond et al. 2004 JGR)



Global & N American sources of BC



Global



North America

Year 2000 estimates (Bond et al., GBC 2007 + van der Werf, 2006 + updates for IPCC AR5)



Bottom-up inventory needs & major uncertainties

- ✦ Open biomass (forest+savanna) will *always* be uncertain

Gaps: Small fractions or small sources (stats please!)

- ✦ Activity: Vehicle superemitters
- ✦ Activity & Profiles: Residential wood
- ✦ A&P: Small industrial sources
- ✦ A&P: Crop burning, esp near ice
- ✦ A&P: Flaring

Connections: Inventory links from state-national-global levels

- ✦ Must retain flexibility & research nature



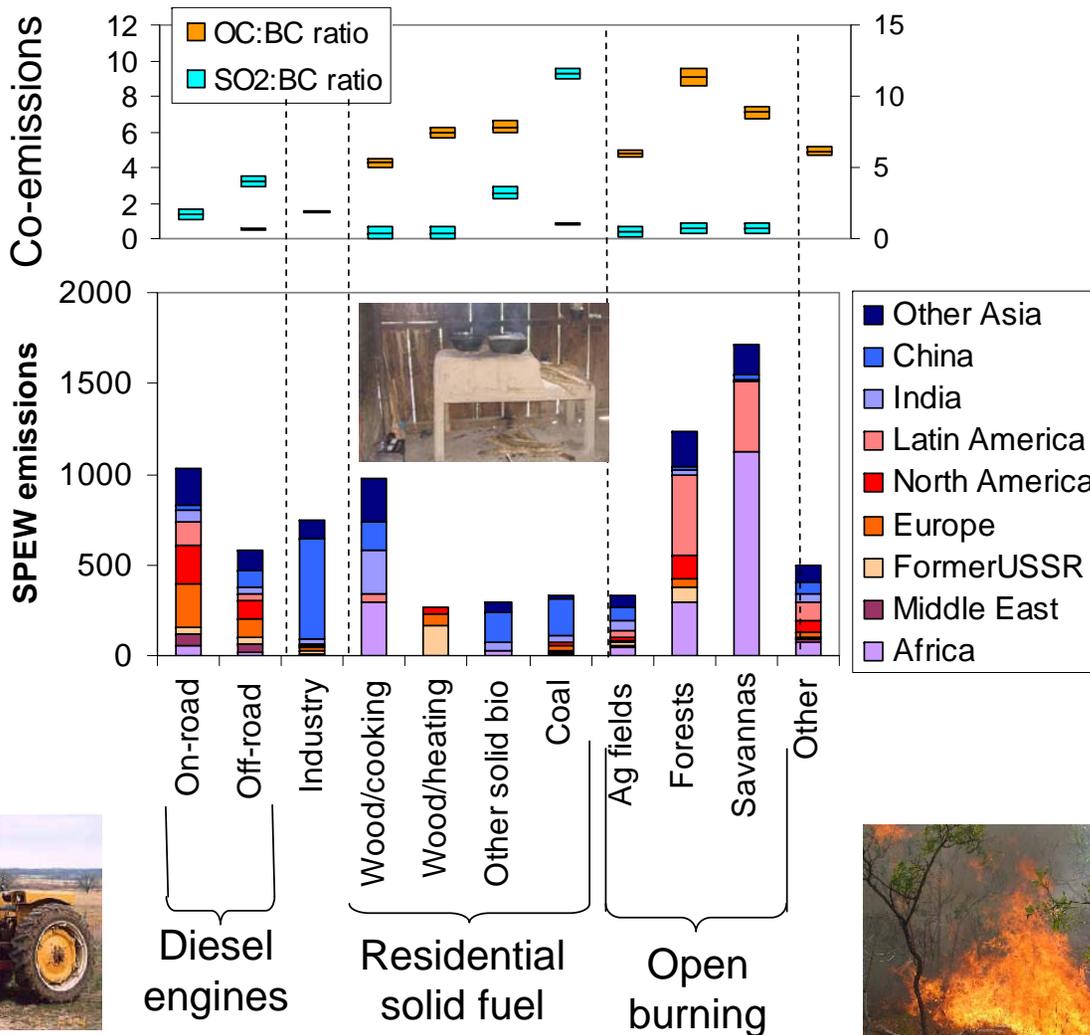
Straight talk about uncertainties

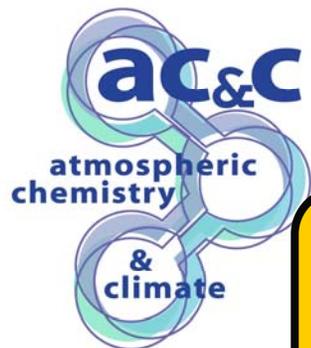
- ✦ Bottom-up inventory uncertainty = x2
 - Some sectors x5
 - If activity uncertain → Sign is known, magnitude isn't
 - If profile uncertain → Δ Climate forcing may be wrong
 - Measurements contribute (BC/OC division)
- ✦ Global model analysis (*Koch et al.*, ACP, 2009)
 - Surface predictions *close* to models
 - ⇒ But only available in certain regions (US-Europe)
 - Column absorption *higher* than models
 - ⇒ Probably affected by aerosol mixing = absorption ↑
 - Large underpredictions in *open biomass burning regions*



Major BC sources of interest

AKA: bands with a loud frontman





Bounding-BC

tease

“Bounding the Role of Black Carbon in Climate”
Conceived Jan 2009
Due Jun 2010



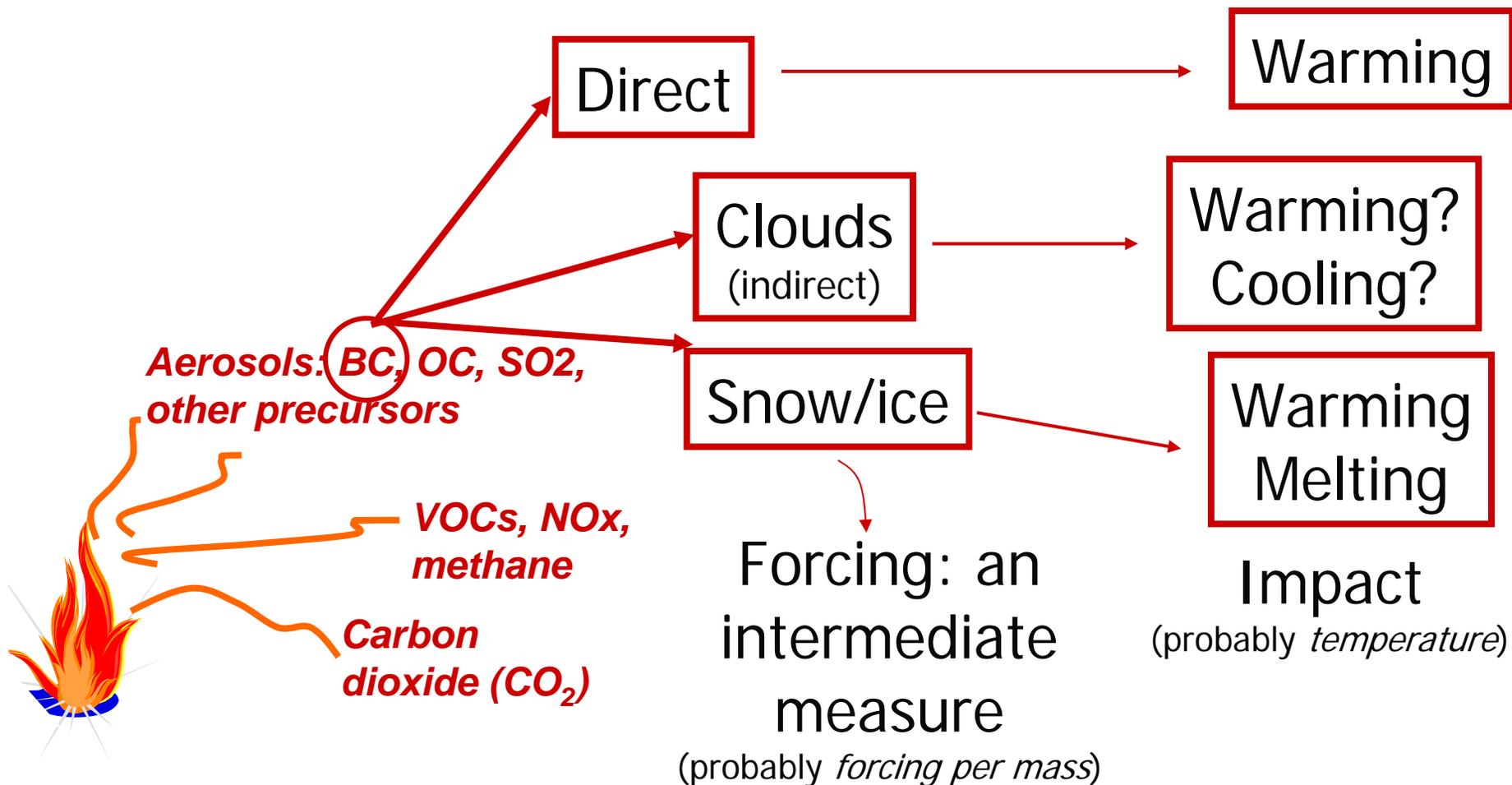


Bounding-BC major goals

- ✦ Provide **best current estimate** for radiative forcing by black carbon
 - identify causes of disagreement
- ✦ Connect **individual sources** to climate impacts
 - account for co-emitted short-lived pollutants



Bounding-BC Source-to-Impact measures



Bounding-BC: BC + OC + SO₂
 Someday: All emitted species



THANK YOU!!

Questions?

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