Please note that this presentation was given during the United Nations Climate Change Conference (COP-15) in Copenhagen, December 7-18, 2009 for more information please visit http://www.cop15.state.gov/ .

BLACK CARBON

V. Ramanathan
Scripps Institution of Oceanography
University of California, San Diego

Partnership for Clean Indoor Air

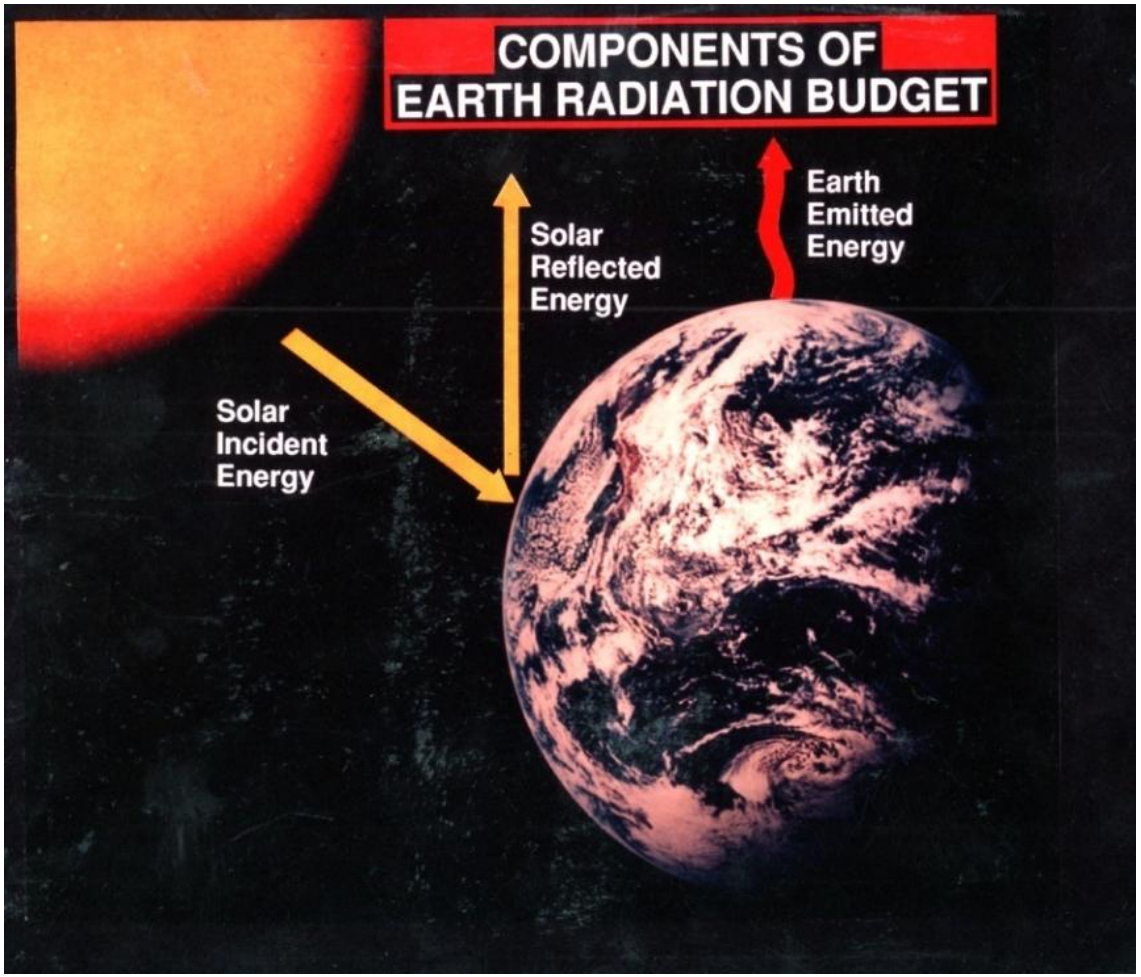
EPA-Side Event

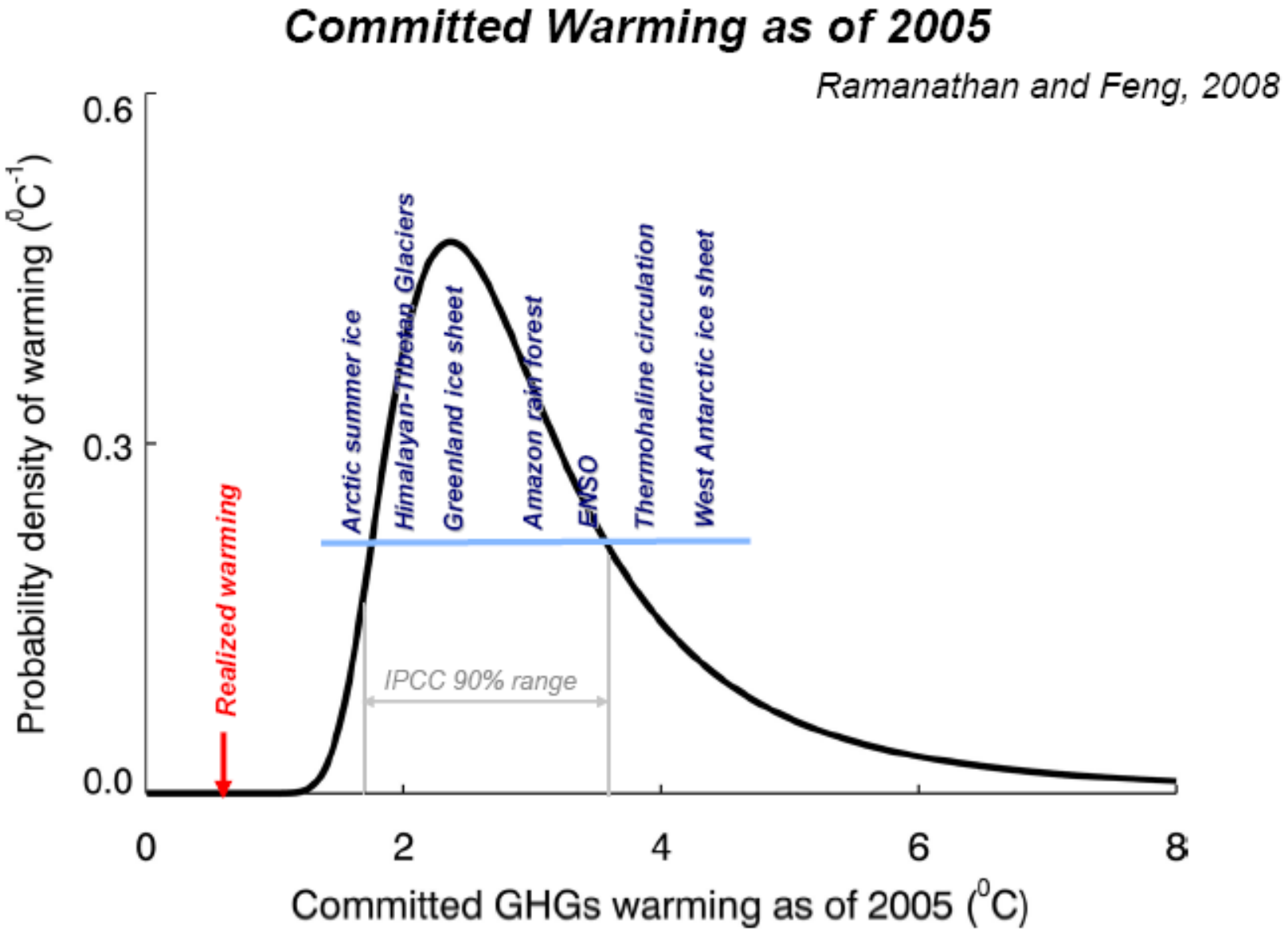
COP 15 Meeting at Copenhagen

Dec 09, 2009

US Pavilion

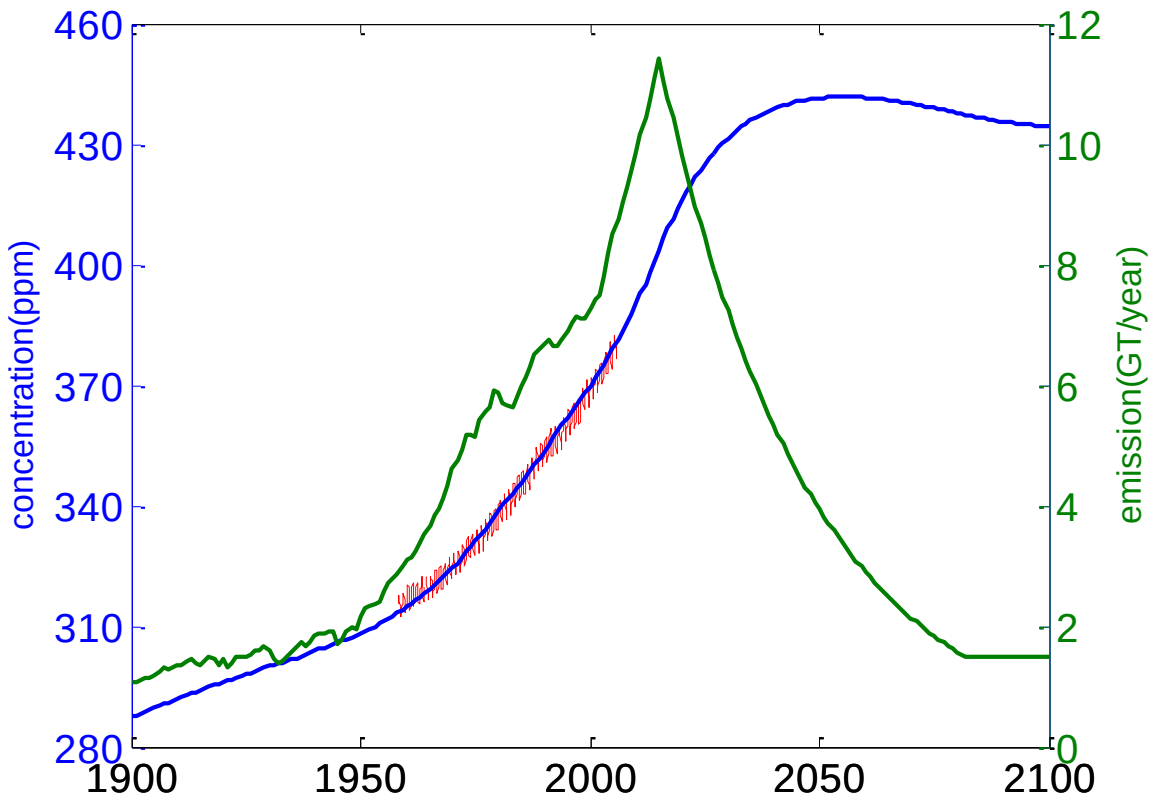
Manmade greenhouse gases surround the planet like a blanket and trap the infrared heat from the planet





Committed warming derived from IPCC Forcing & IPCC climate sensitivity

Even with 50% reductions by 2050, CO2 will Increase to 440 PPM; Commit another 1 C warming



CO2 reductions have to be complemented with Reductions in short-lived non-CO2 warming agents

Non-CO_2 climate warmers

Contribution to 2005 forcing relative to CO_2(1.66 Wm^{-2})

Greenhouse Gases

Ozone (troposphere)	**: 20%**
Methane	**: 30%**
Halocarbons	**: 20%**

Particles (Aerosols)

Black Carbon (soot/smoke)	**: 27% to 55%***
Total Non-CO_2	**: 97% to 125%**

All numbers except the red are IPCC values; Long lived N_2O not included

*** Ramanathan & Carmichael; 2008**

Global Black Carbon Emissions (8 Mtons/Yr)

Bond et al, 2004: Factor of 2 Uncertainty

Non-Residential (Fossil Fuels) **2600 (33%)**

Residential: Cooking and Heating **2050 (25%)**

Bio-Fuels (1480); Coal & Diesel (565)

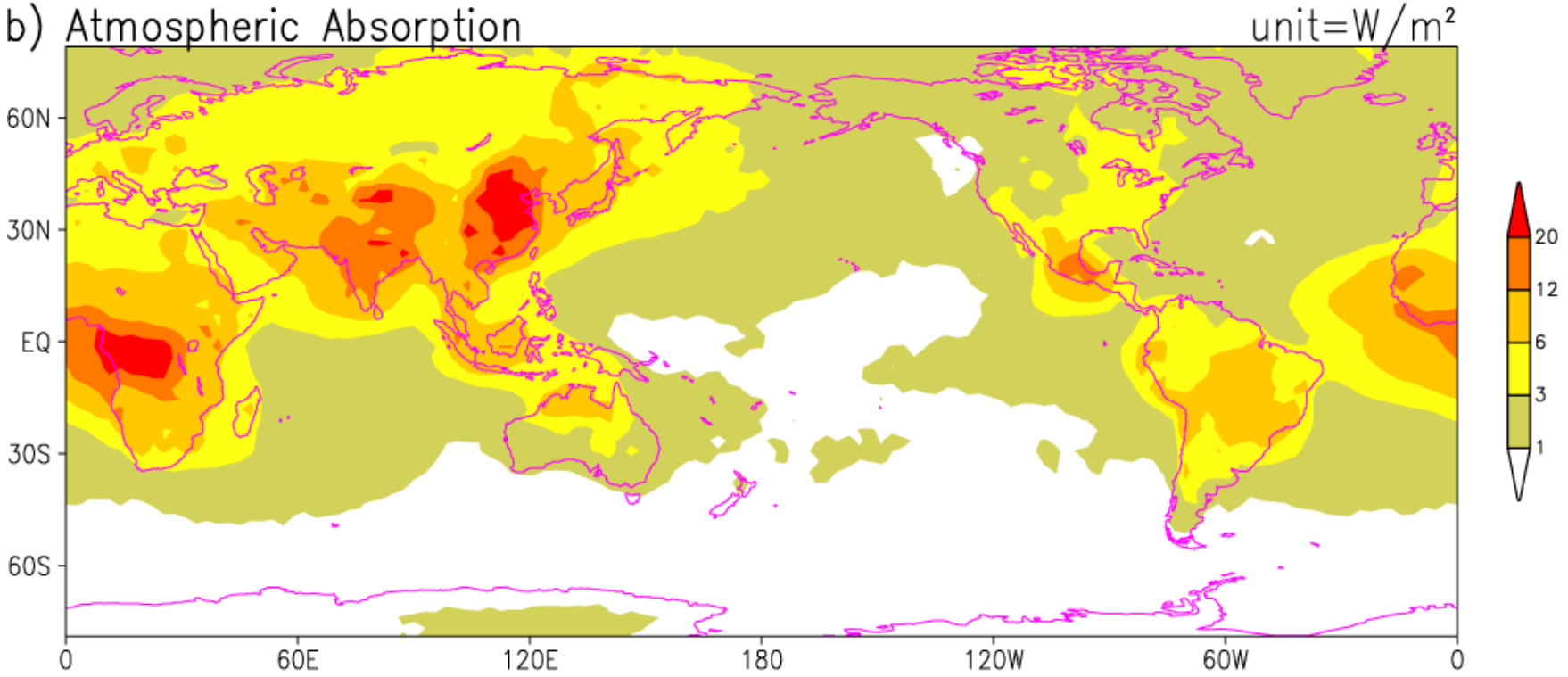
Open Burning: ..... **3325 (42%)**

Forest Fires (1240)
Savanna Burning (1720)
Crop Residues (325)

Removing 1 ton of fossil fuel Black Carbon can have the same effect as removing 1000 tons of CO2 over a 50-year period.

Black Carbon Emission is a Global Problem:

Heating of Blanket by BC



Chung, Ramanathan, Kim & Podgorny, 2005

Ramanathan & Carmichael, 2008

Pathway to limiting global warming to 2^0C

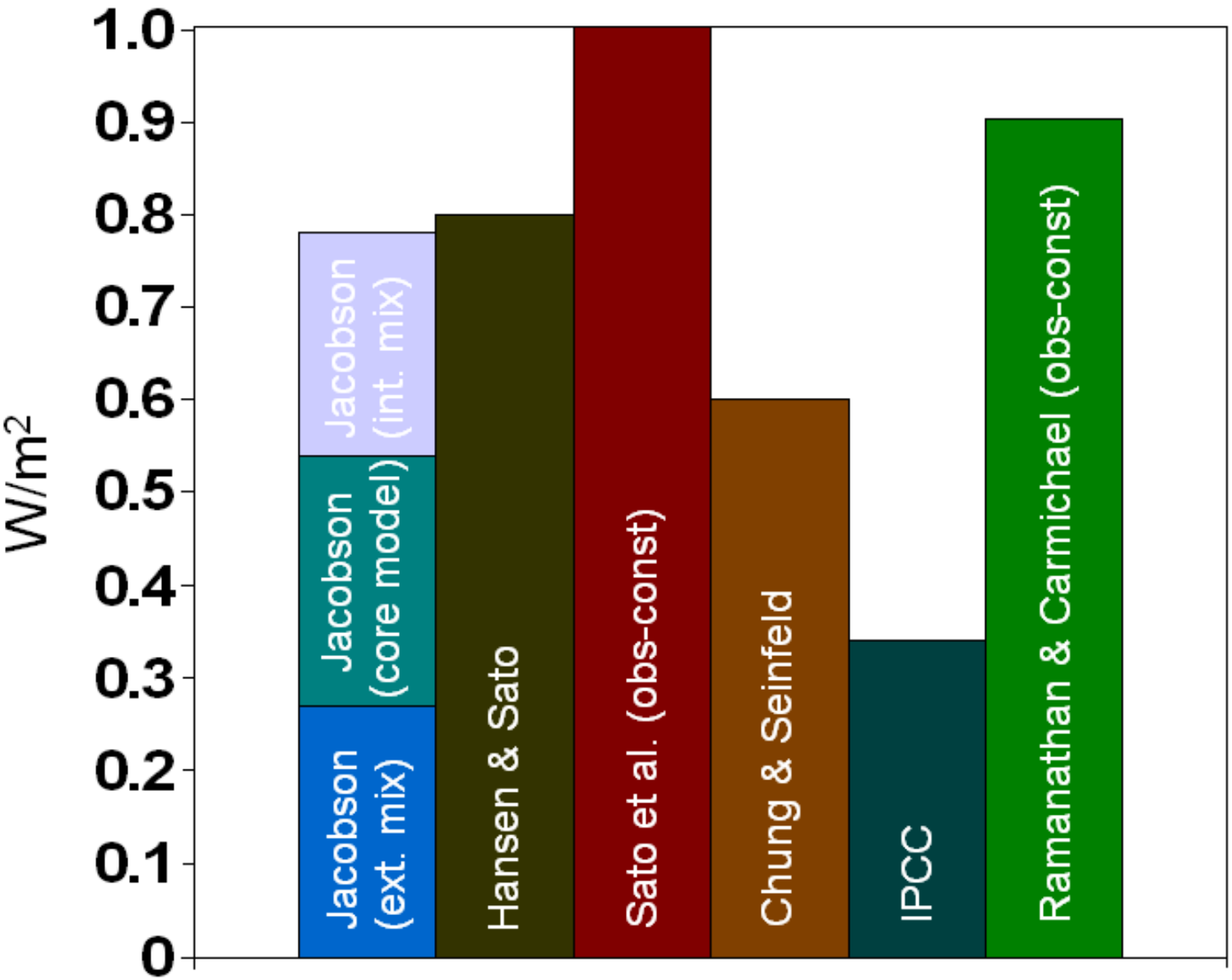
I. Reduce CO_2 by 50% before 2050

II. Reduce short lived warming agents: Roughly 30% in 30 Years

Black Carbon (<2 weeks);
Ozone (< 2 months);
Methane (<15 years)
HFCs & HCFCs (<15 years)

Buy about 30 years time: to develop transformational technologies for a massive thinning of the GHGs blanket: Zero emission of CO_2

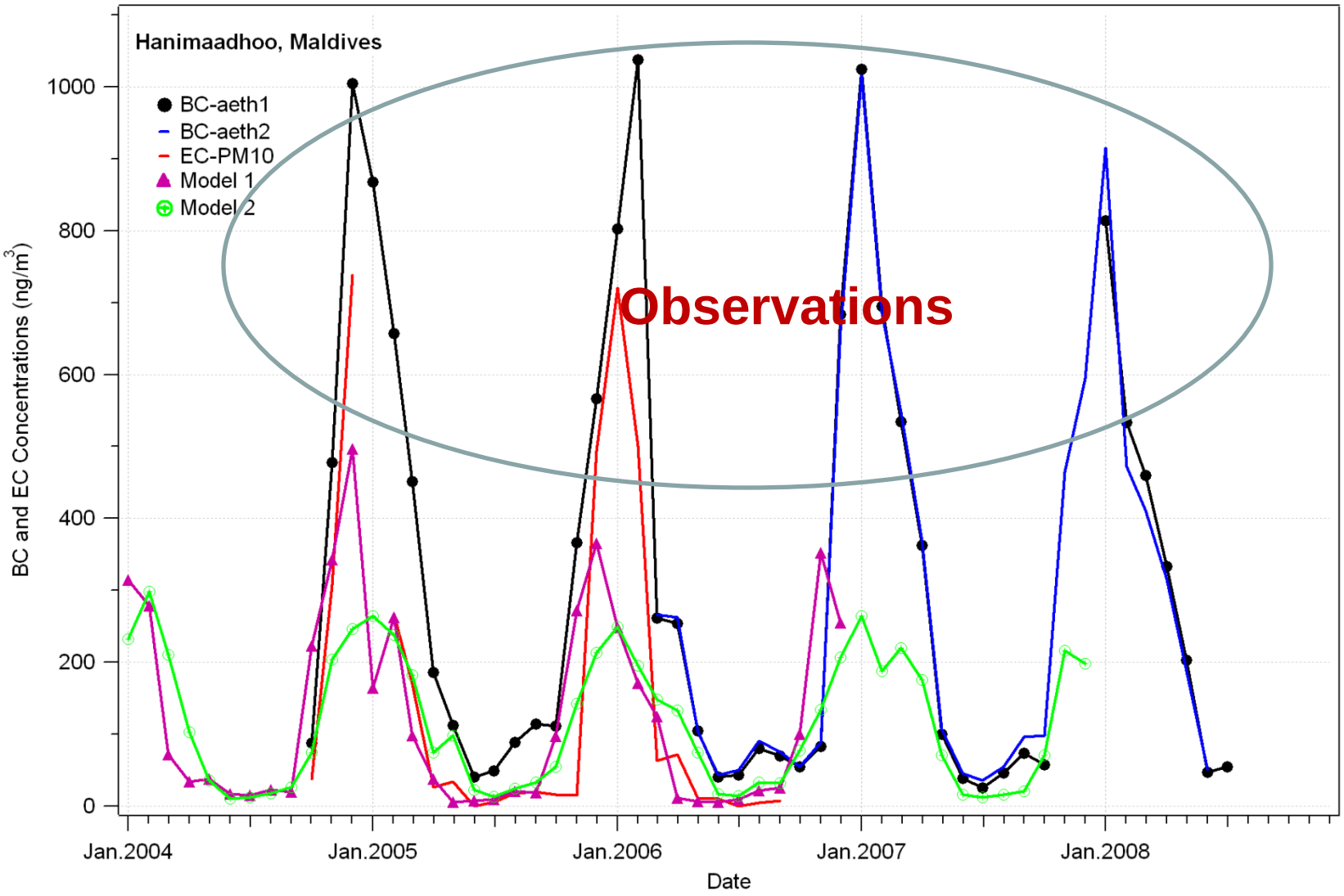
BC Radiative Forcing Estimates: Direct



Time Series of Black Carbon in Arabian Sea:

Models underestimate observed black carbon values

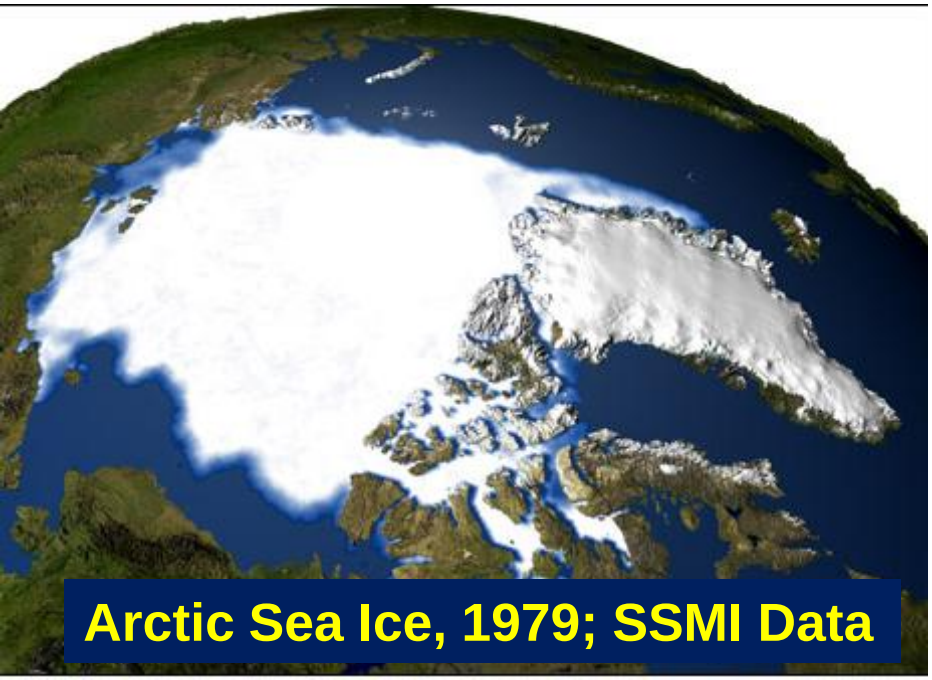
Data: Ramanathan et al, 2008

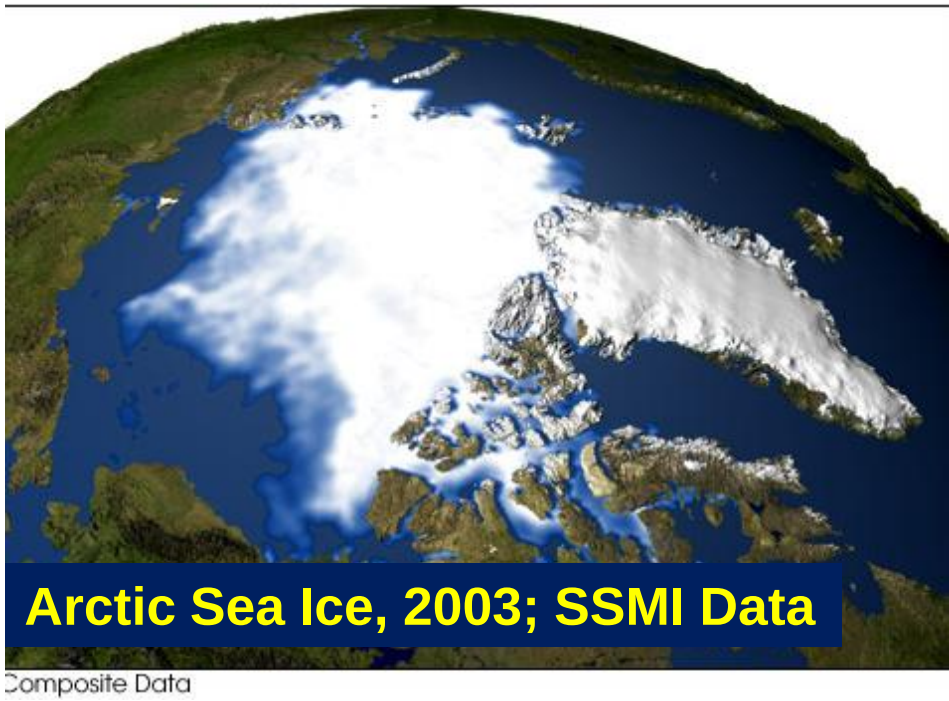


REGIONAL CO-BENEFITS:

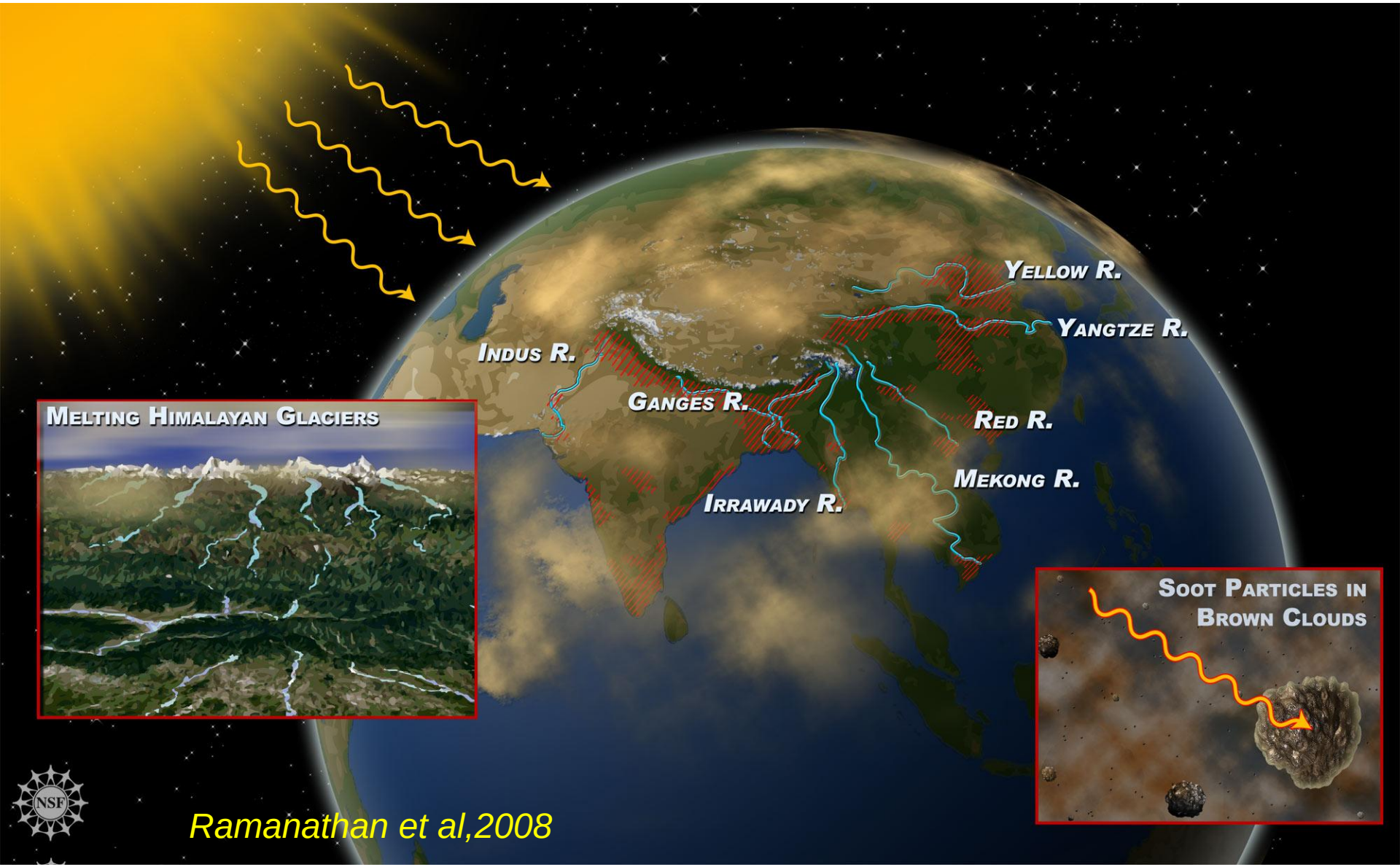
N American and European Emissions:

Black Carbon Heating of the arctic atmosphere and ice Contributes as much as 30% to 50% of the observed retreat: Hansen et al; Shindell et al and others.

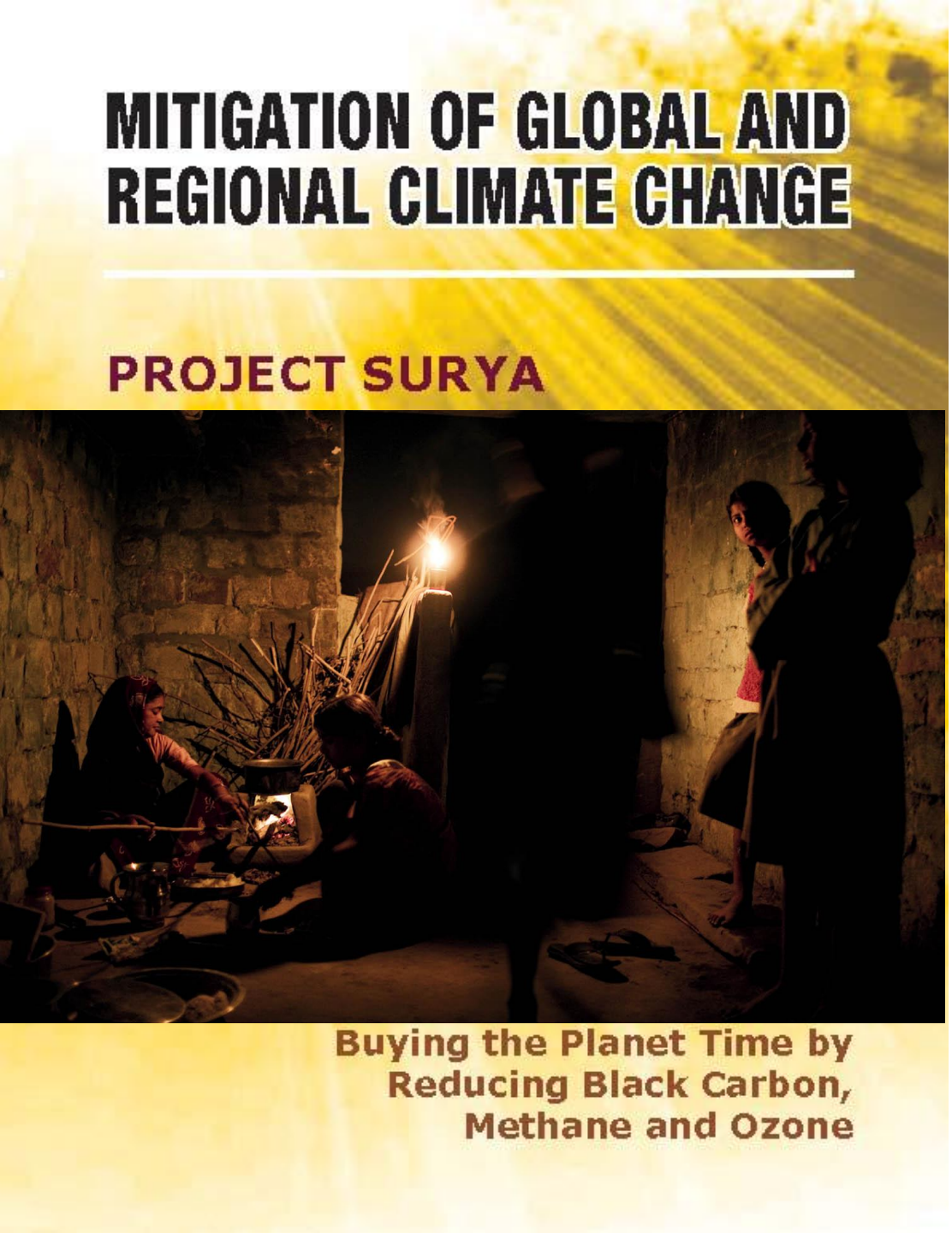




Hindu Kush-Himalayan-Tibetan Glaciers:
Water Fountain of Asia



Ramanathan et al,2008



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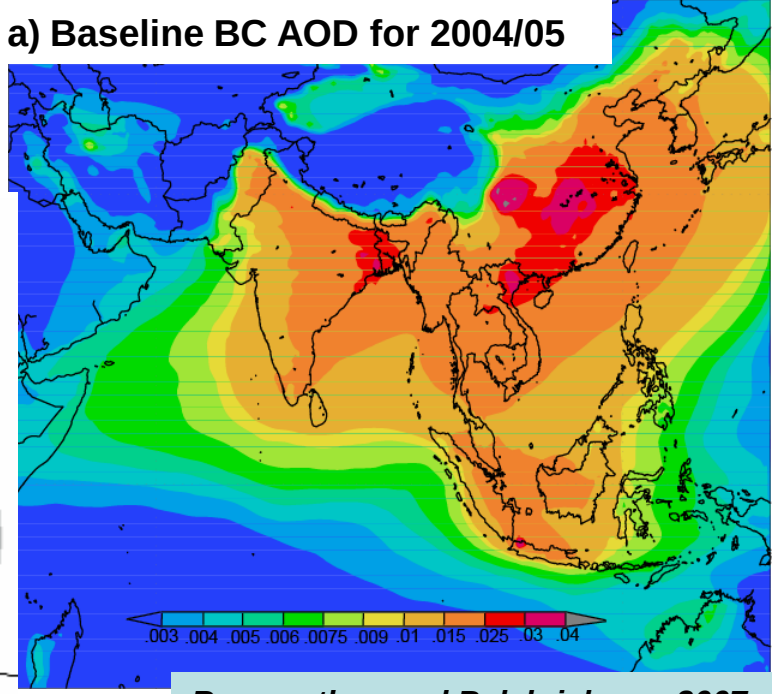
CENS, UCLA

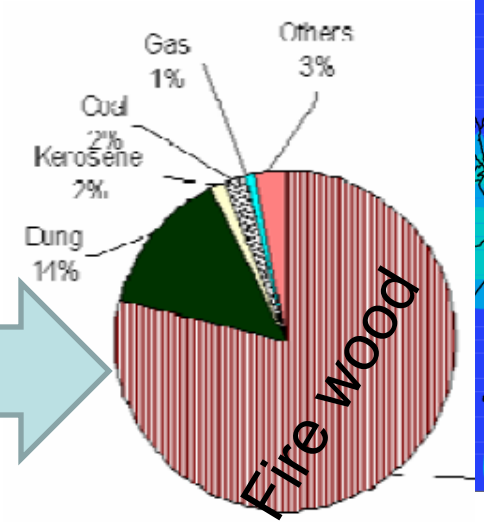
Sri Ramachandra Univ; Chennai, India

Target mitigation (Surya)

a) Baseline BC AOD for 2004/05

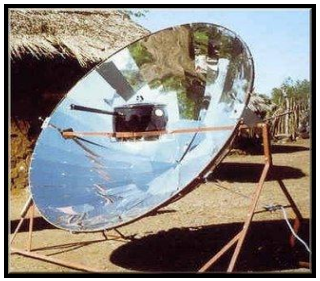


Rural Cooking



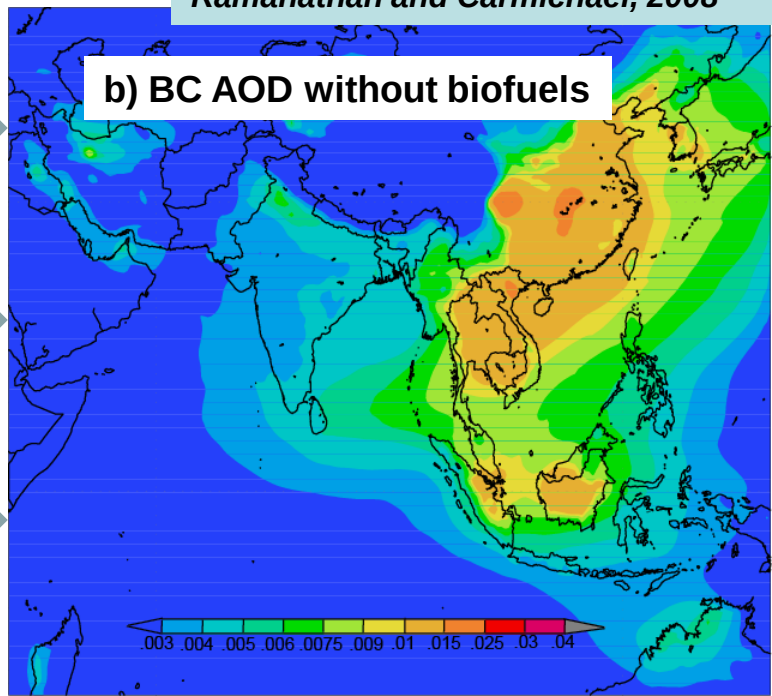
Ramanathan and Balakrishnan, 2007
Ramanathan and Carmichael, 2008

Biogas plants converts organic waste into gas

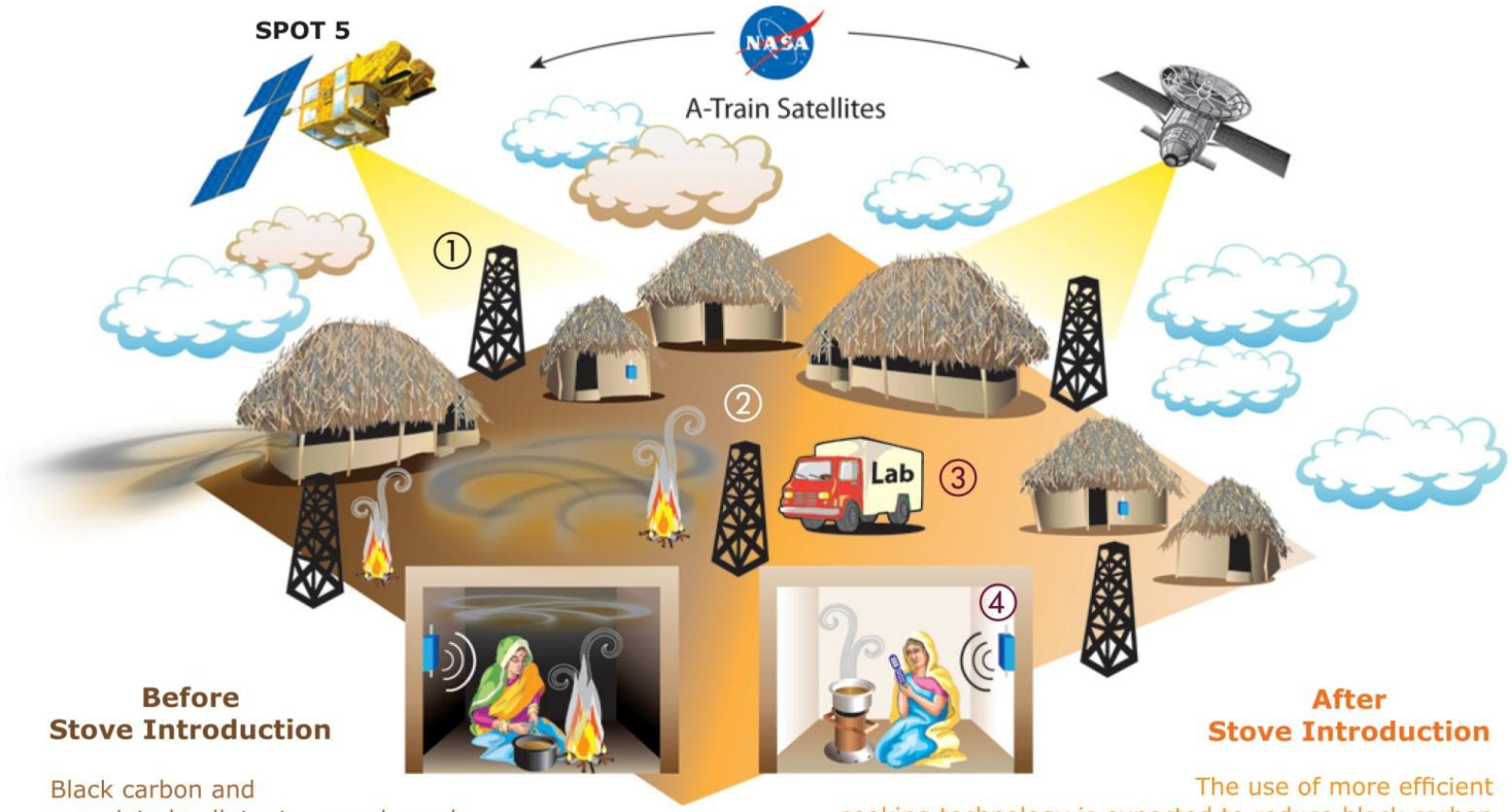


Parabolic solar cooker

b) BC AOD without biofuels



Technology: Documenting the Mitigation



A Sustainable Future for Everyone?

The three billion people who live on less than $2 per day.

CAN WE STEER THEM INTO A SUSTAINABLE NON-FOSSIL FUEL PATHWAY AND ENABLE THEM TO CLIMB UP THE ENERGY PYRAMID?

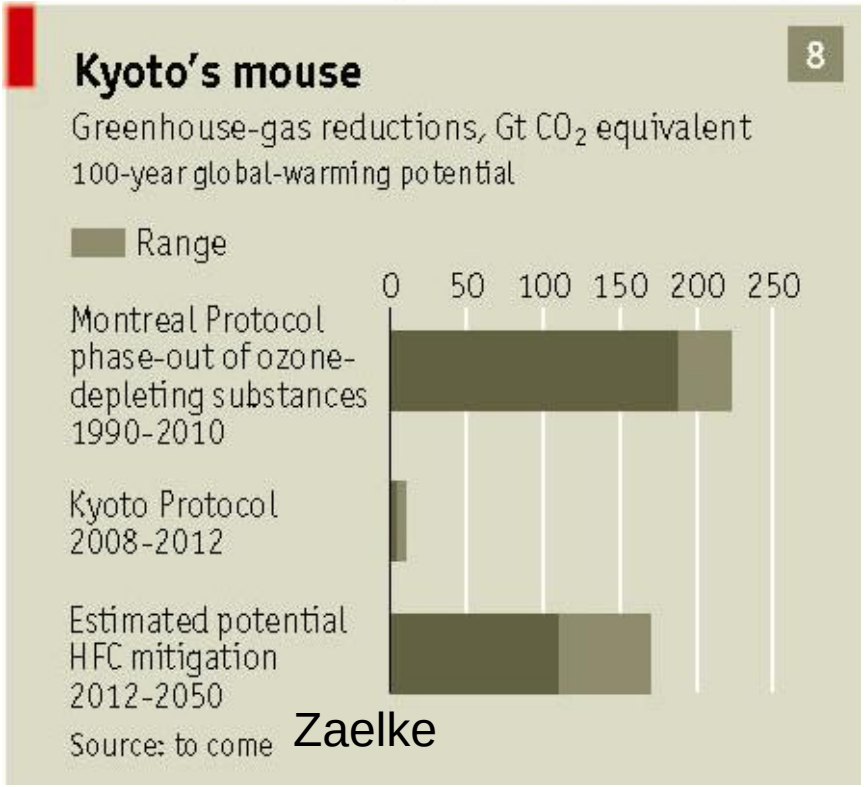
Reprinted from
3 October 1975, Volume 190, pp. 50-52

SCIENCE

1975

Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications

V. Ramanathan



Economist, Dec 12 2009