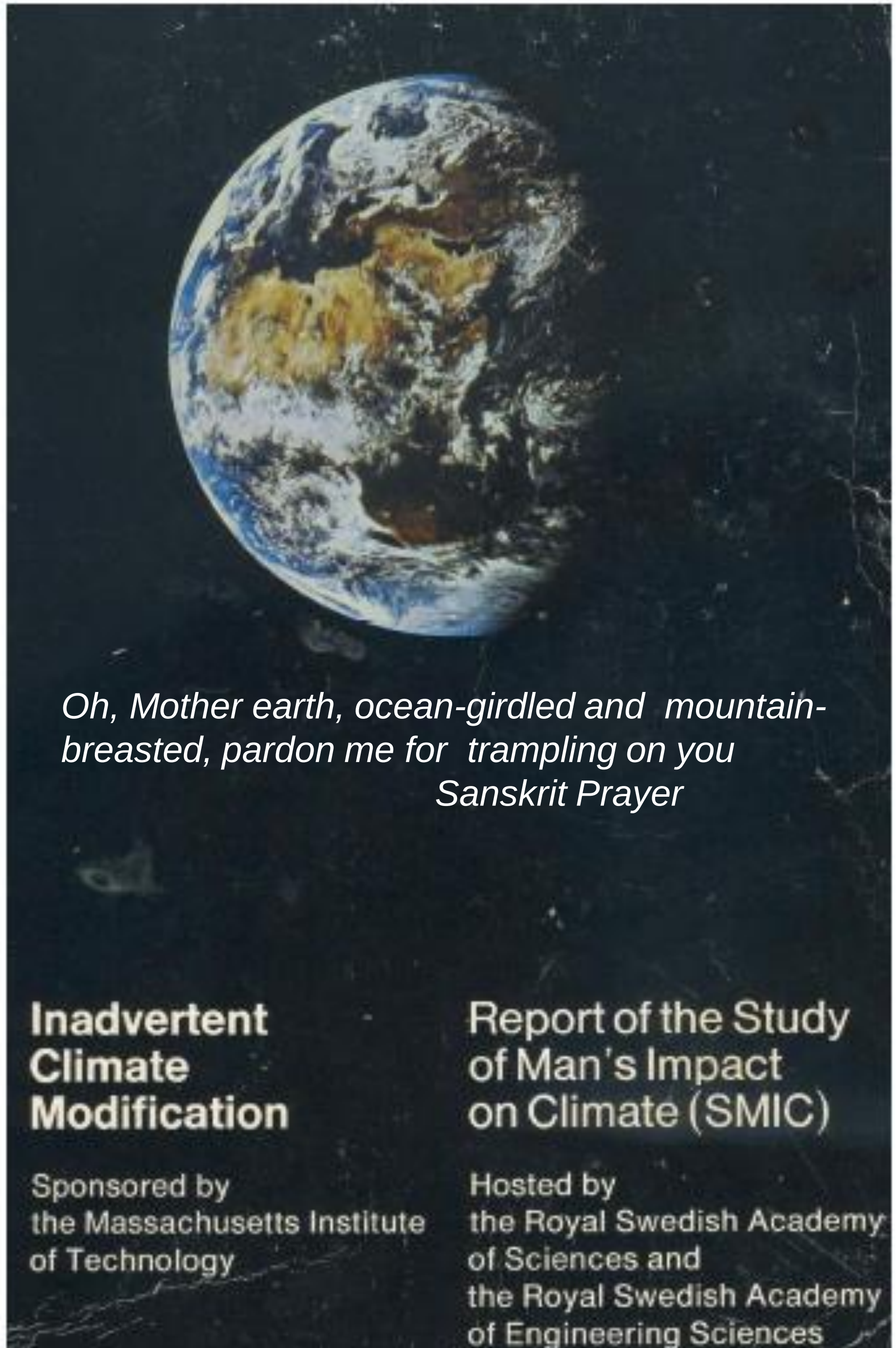
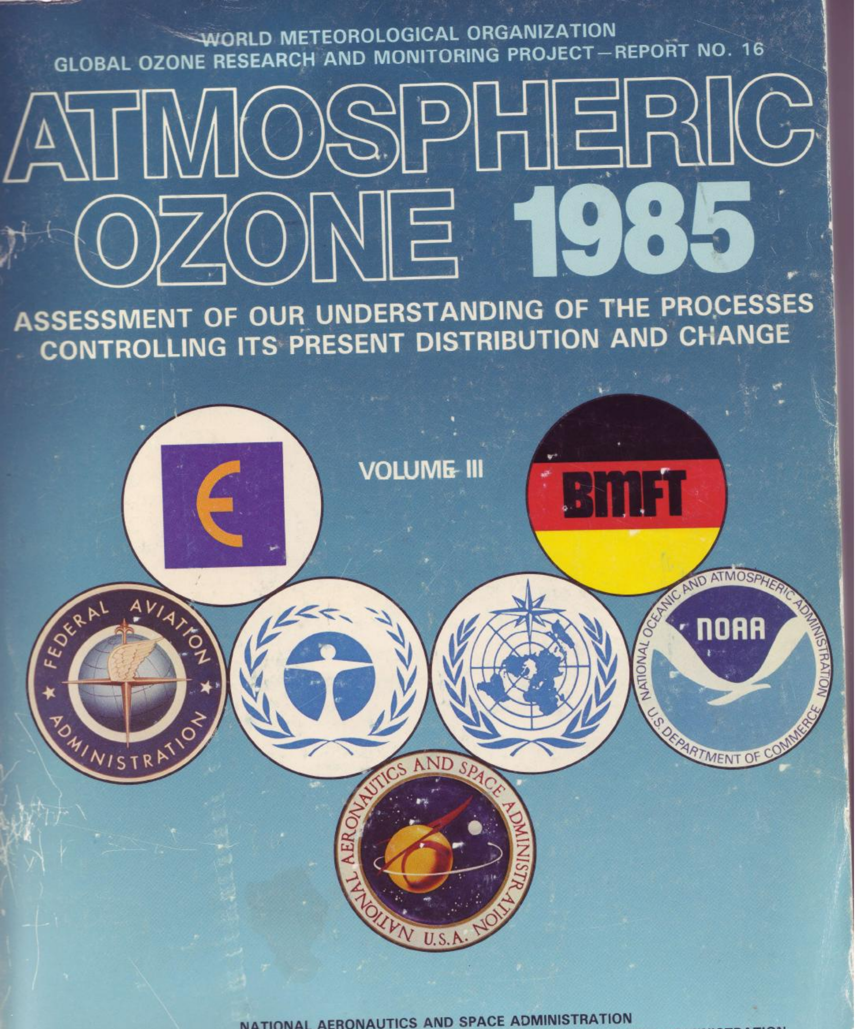
‘Scientific and Regional Aspects of Co-benefits Policies

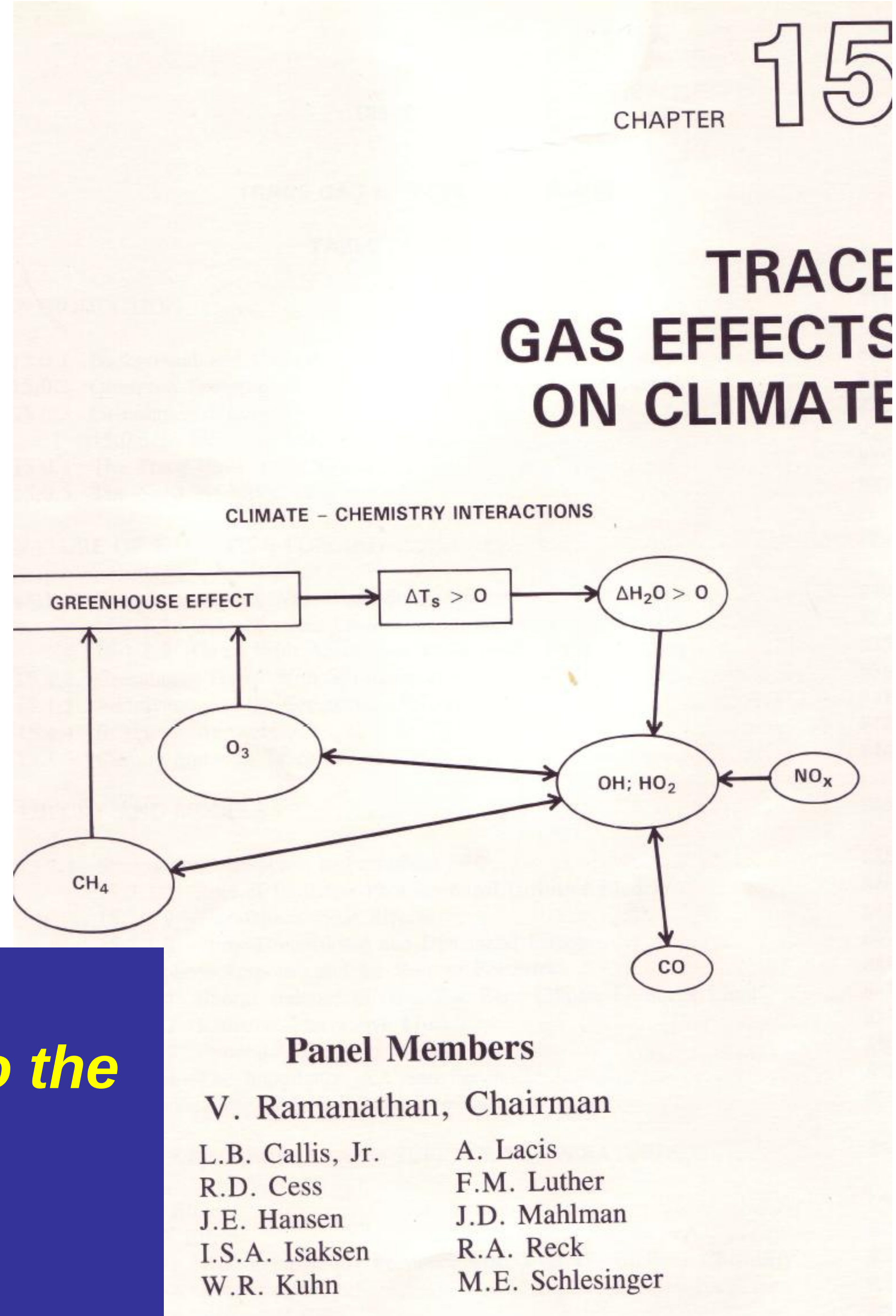
V. Ramanathan
Scripps Institution of Oceanography, UCSD

Air Pollution and Climate Change:
Developing a Framework for Integrated Co-benefits Strategies
17-19 September 2008
Royal Swedish Academy of Engineering Sciences
Stockholm, Sweden

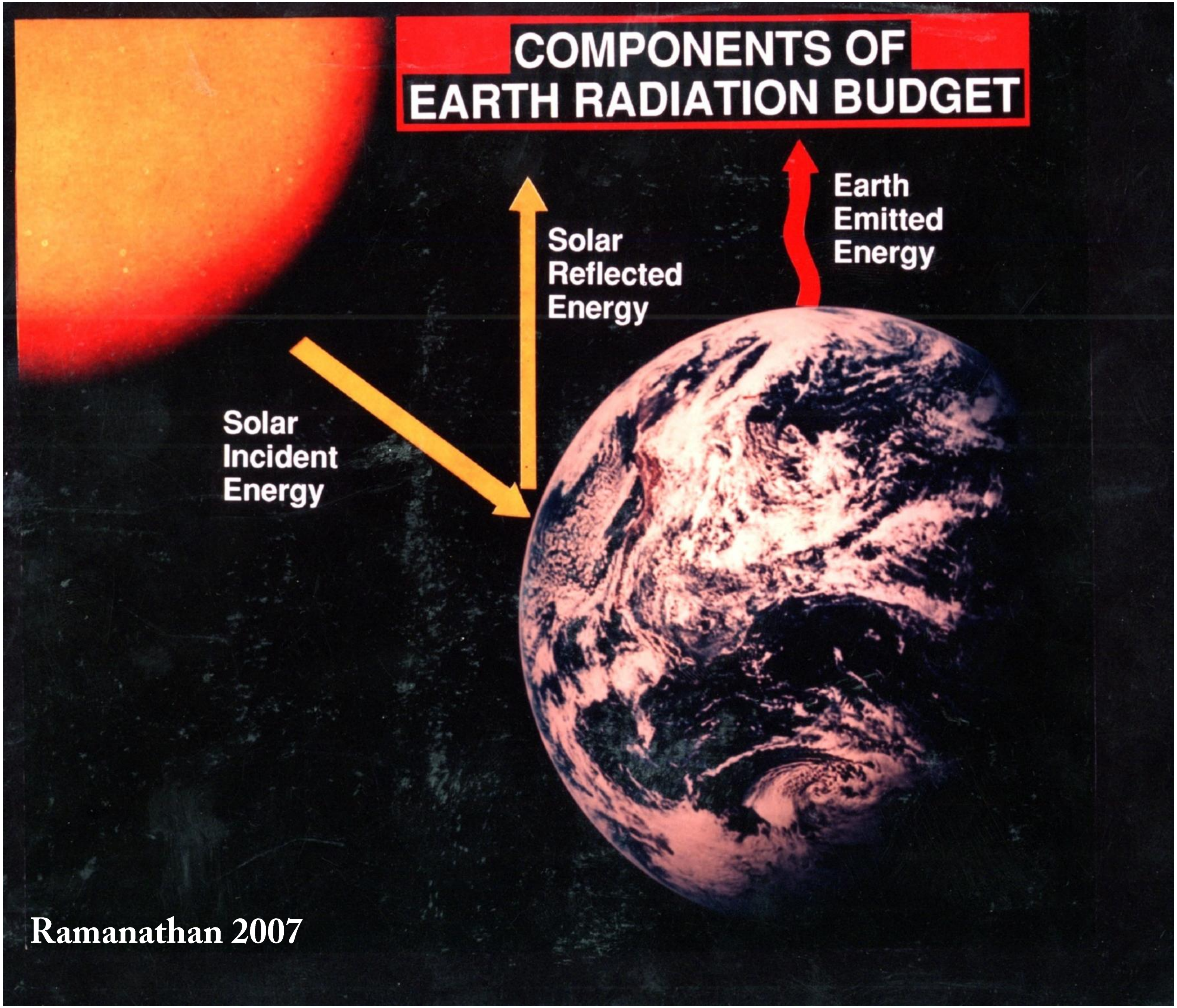
PUBLISHED 1971







The Non-CO2 trace gases contribute as much as CO2 to the <u>increase</u> in atmospheric Greenhouse effect: Ramanathan et al, JGR, 1983


COMPONENTS OF
EARTH RADIATION BUDGET
Solar Reflected Energy
Earth Emitted Energy
Solar Incident Energy
Ramanathan 2007

Early Edition: Sept 15 to 19. Proceedings of The National Academy of Sciences

On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead

V. Ramanathan* and Y. Feng

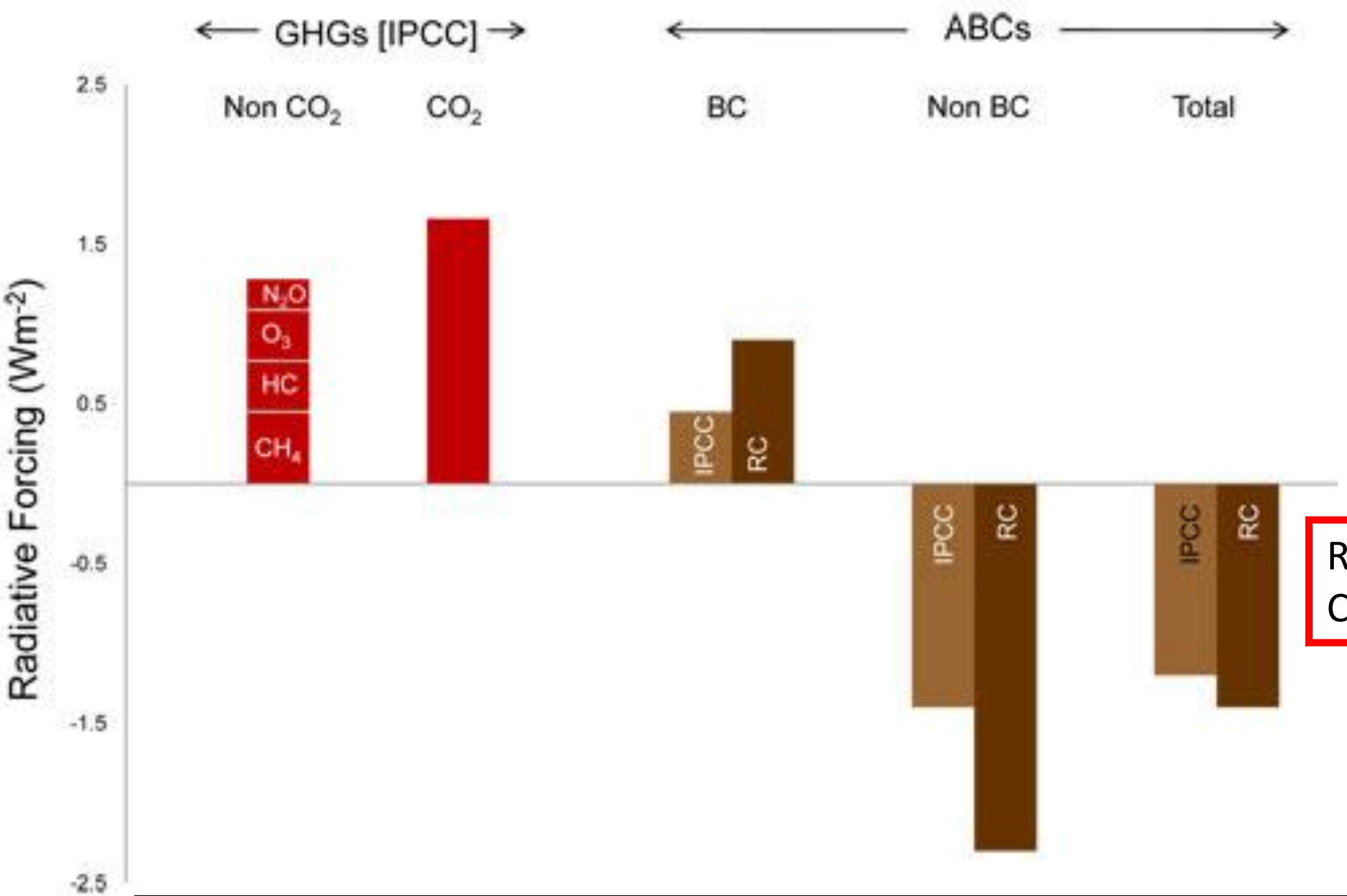
Scripps Institution of Oceanography, University of California at San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0221

Edited by William C. Clark, Harvard University, Cambridge, MA, and approved July 24, 2008 (received for review May 1, 2008)

PNAS **September 23, 2008 vol. 105 no. 38 14245–14250**

Global Radiative Forcing due to GHGs & ABCs

Ramanathan and Feng, 2008



RC: Ramanathan & Carmichael, 2008

For high BC heating, also see: Jacobson, 2001; Hansen and Nazarenko, 2004; Chung and Seinfeld, 2005

Ramanathan and Feng, 2008

IPCC-AR4 (2007) Concludes:

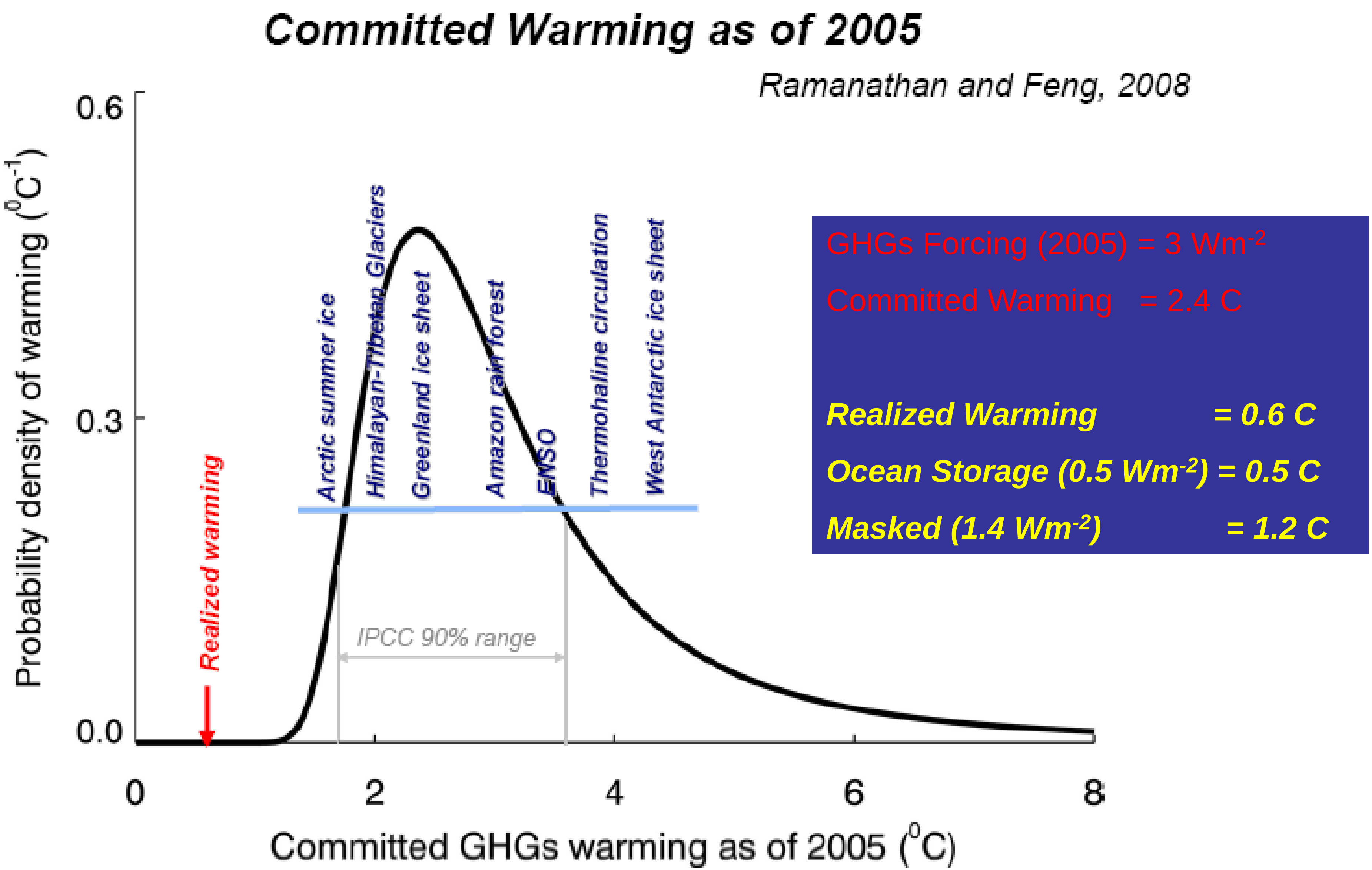
For a CO_2 doubling, the most likely climate sensitivity is 3 C warming with a 90% confidence interval of 2 to 4.5^0C

For doubling of CO2, TOA forcing is : 3.7 Wm^{-2}

So it takes about 1.25 Wm^{-2} (3.7/3) to warm the planet by 1^0C

The GHGs so far have added 3 Wm^{-2} forcing

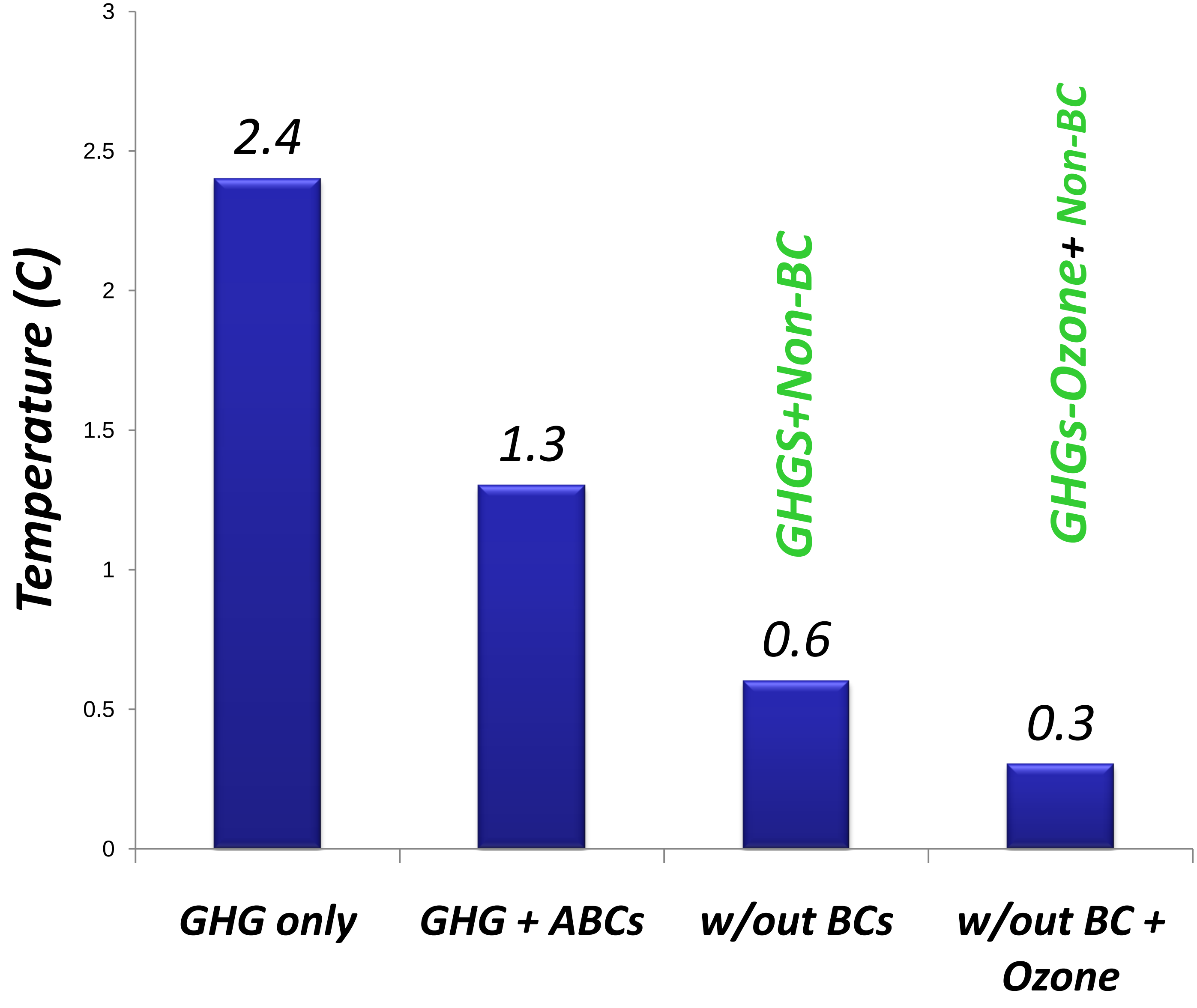
The committed (or the inevitable) warming is 2.4^0C



Committed warming derived from IPCC Forcing & IPCC climate sensitivity

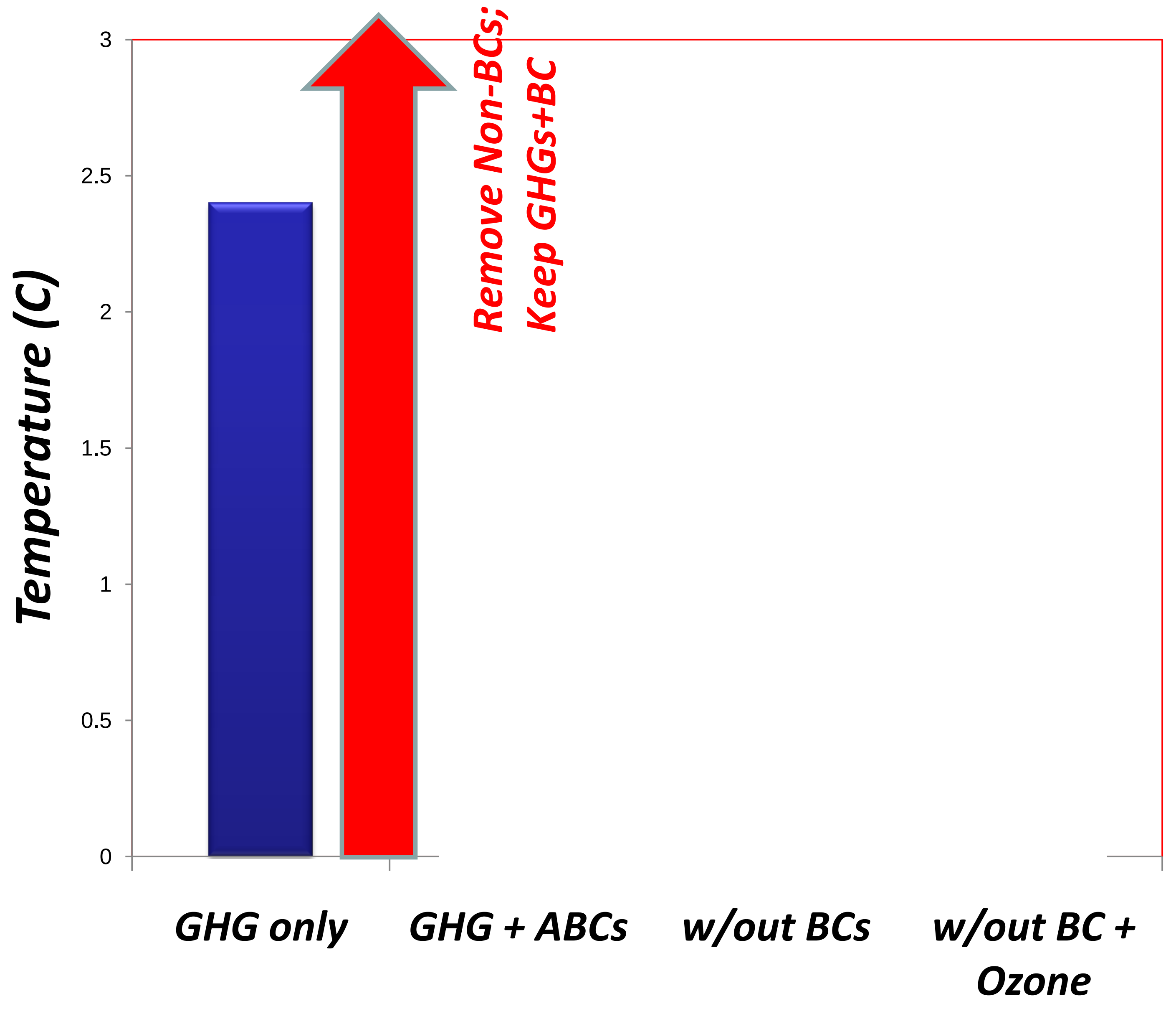
Leveraging with Short lived air pollutants

Ramanathan, 2008



The wrong way to go (what is happening in OECD nations)

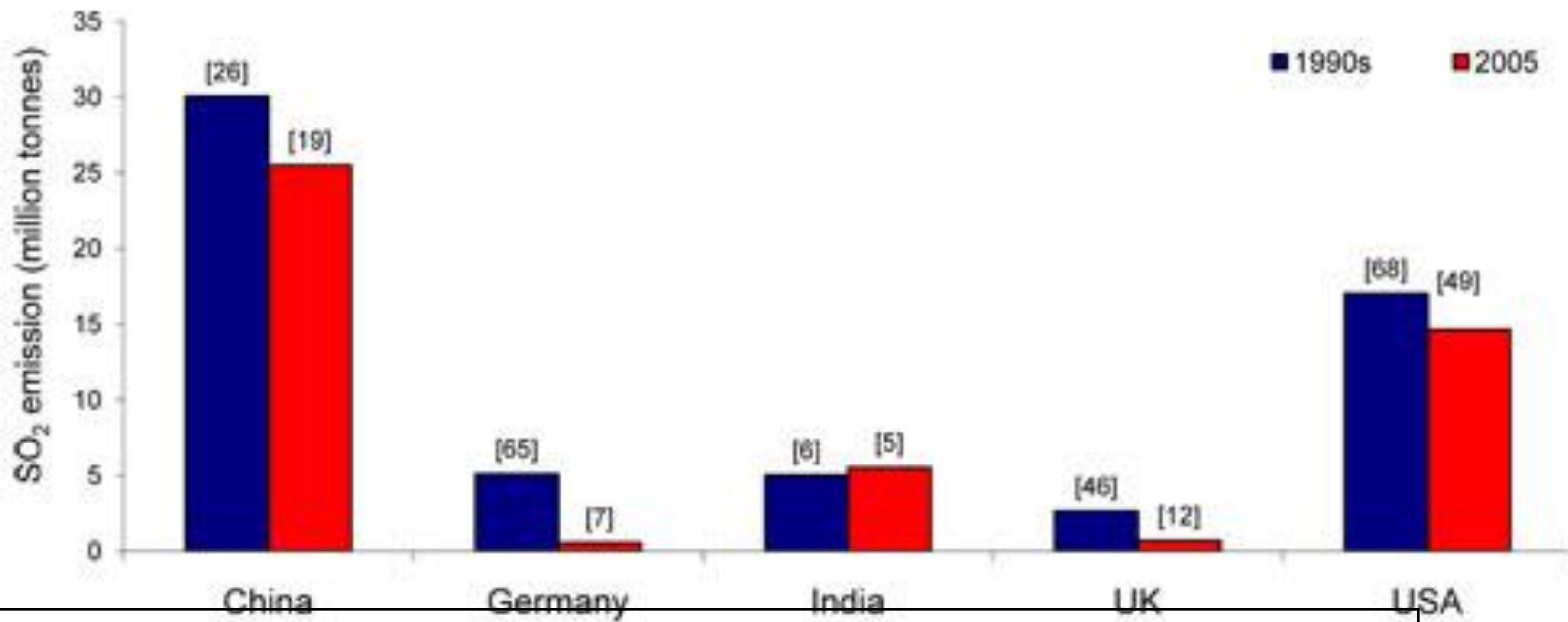
Ramanathan, 2008



How should We Unmask the ABC Effect ?

………With great care. Same care we give for decommissioning thermonuclear devices

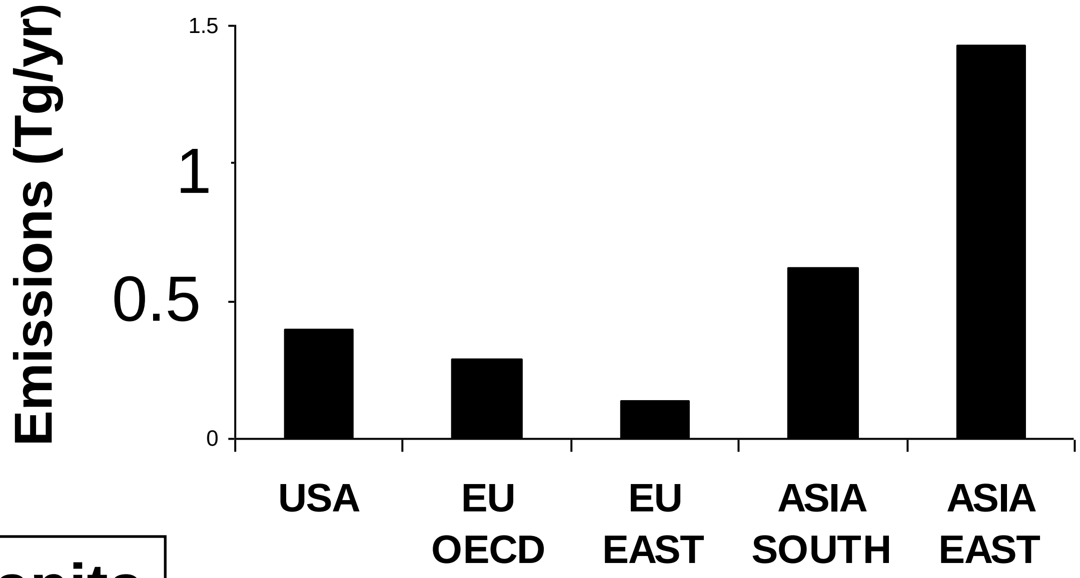
SO_2 *Emissions*



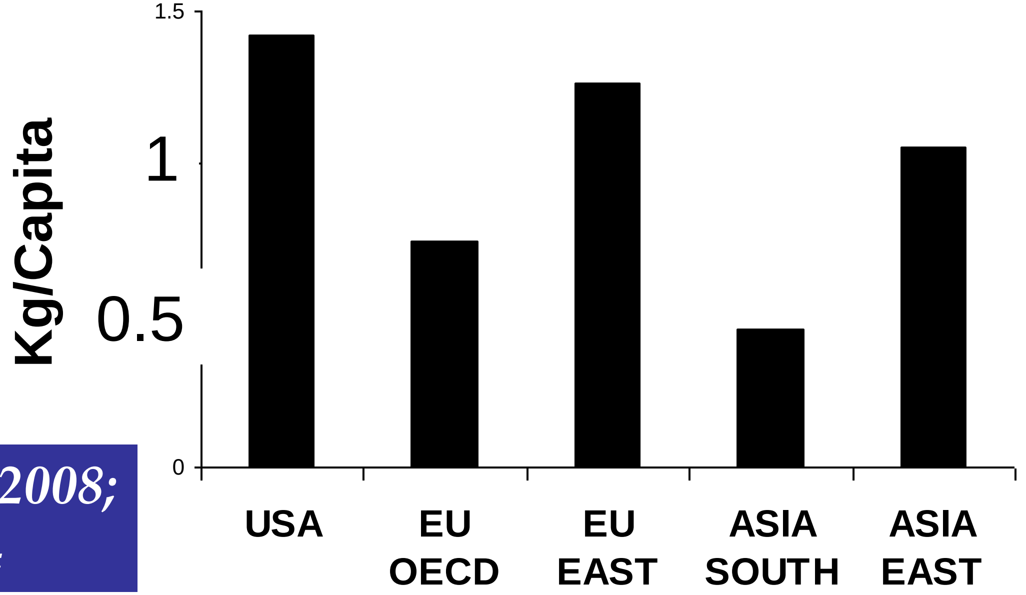
Research Funded by NSF; NOAA; California Energy Commission; Vetlesen Fndn

Ramanathan 2007

BC emission



BC Emission/Capita



Ref: Ramanathan and Feng, 2008; Data source: Bond et al 2004

Black carbon or brown carbon? The nature of light-absorbing carbonaceous aerosols

M. O. Andreae1 and A. Gelencs´er2
1Max Planck Institute for Chemistry, Biogeochemistry Department, P.O. Box 3060, 55020 Mainz, Germany
2Air Chemistry Group of the Hungarian Academy of Sciences, University of Veszpr´em, P.O. Box 158, H-8201 Veszpr´em,

Elemental Carbon

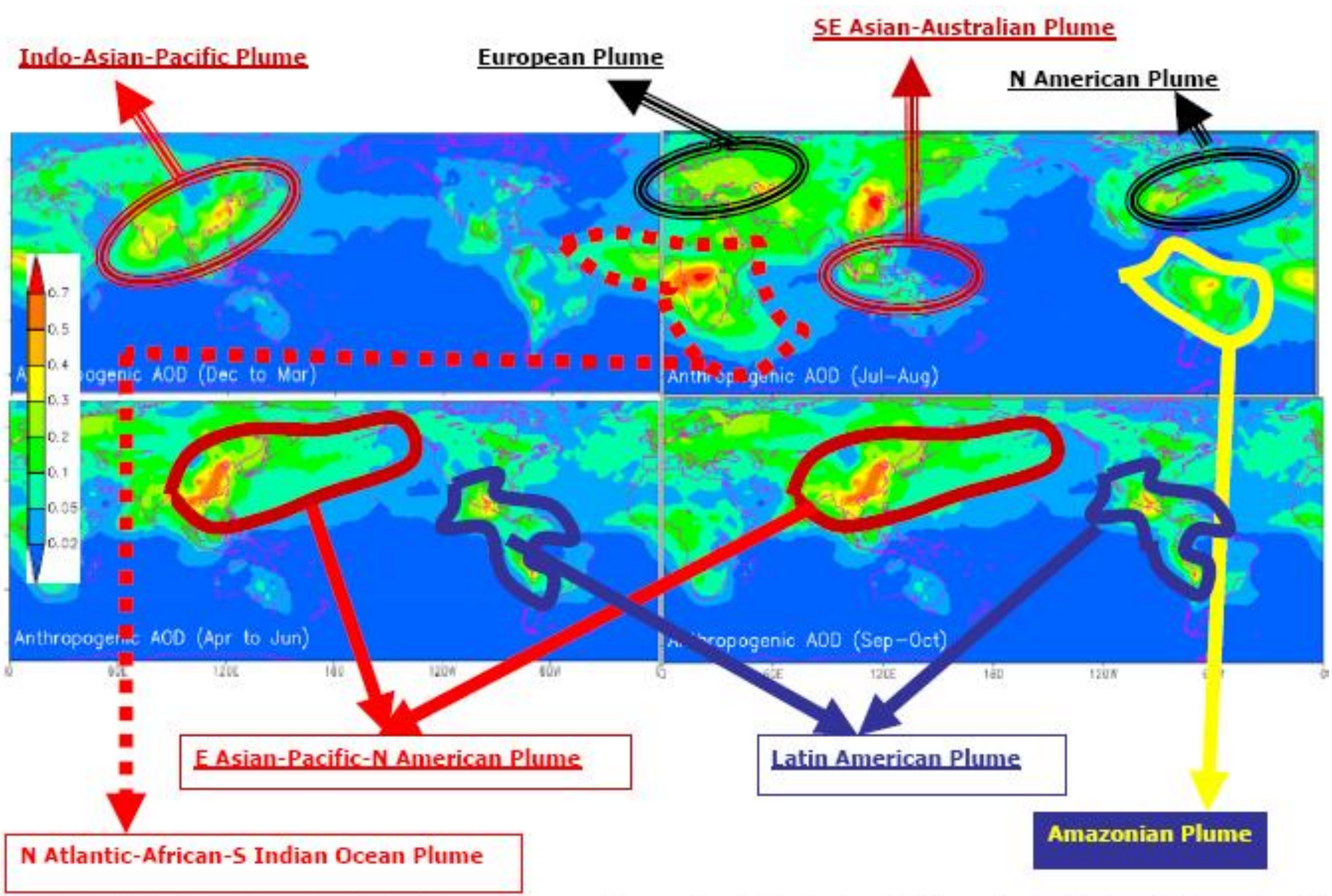
Black Carbon

Organics

HULIS

LAC

SEASONAL MEAN ANTHROPOGENIC AODs



RAMANATHAN ET AL, JGR, 2007

Link between Fuel Policies and Climate Change

Ramanathan, 2008

	1980	*2005*	*2030*	
Coal (Mton)	**2570** (1373)	**4154** (1615)	**7173** (1883)	**World** (OECD)
Oil (Mbarrels)	**65** (42)	**85** (47)	**116** (53)	
Gas *(B cub met)*	***1521*** *(959)*	***2854*** *(1465)*	***4780*** *(2000)*	

Coal	*SO2 (-)*		*indoor (BC+)*
Oil	*SO2 (-)*	*NOx (Ozone +)*	*Diesel (BC+)*
Gas			

But, switching to Natural Gas is important for reducing future warming commitment

Carbon (as CO_2) emission by the 3 fuels

Coal emits 25 Kg Carbon /Giga-Joules
Oil emits 20 Kg Carbon /Giga-joules
Natural Gas emits 15 Carbon /Giga-joules

Ramanathan, 2008

Europe-OECD

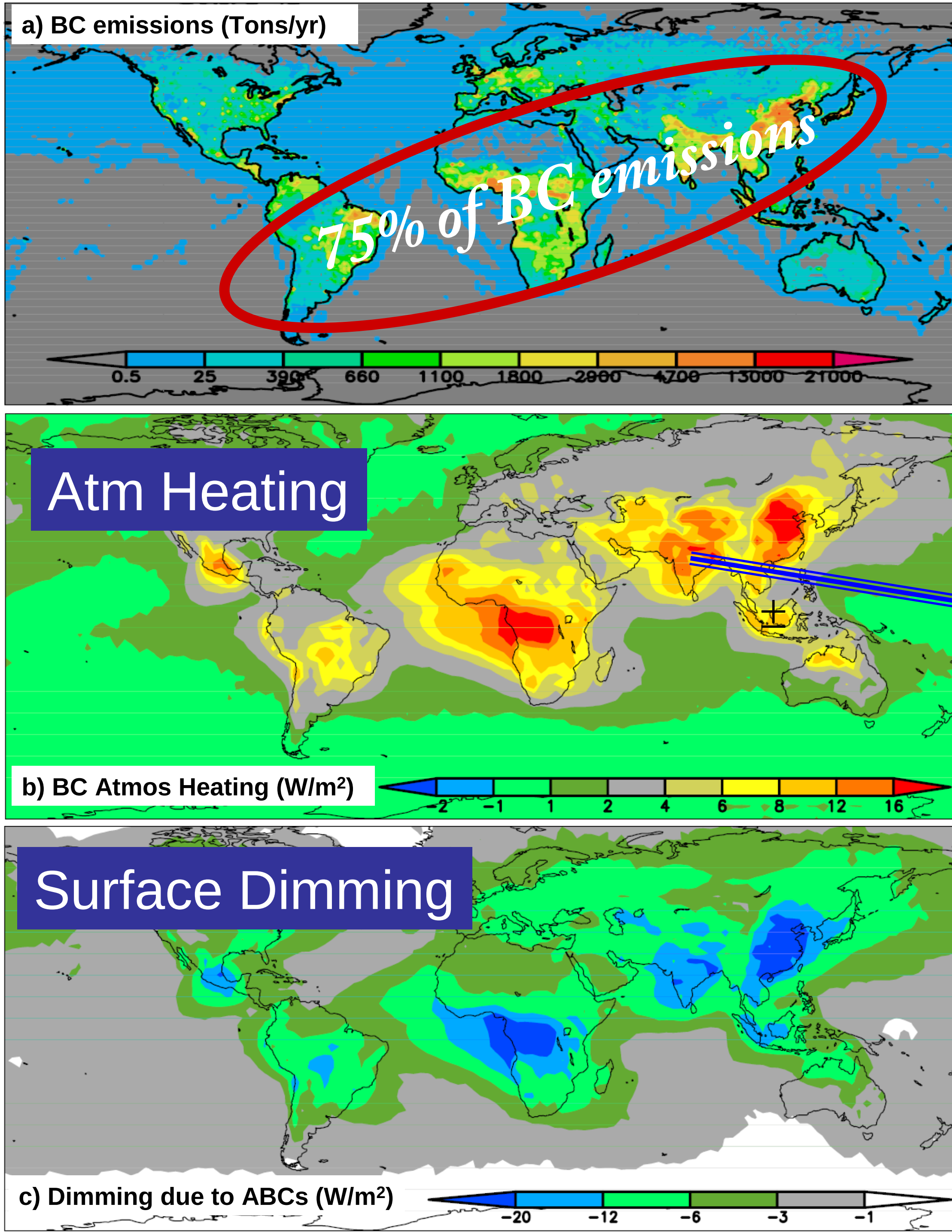
Warming since 80s more than 1^{0}C
Rapid decrease in Eurasian Snow Cover

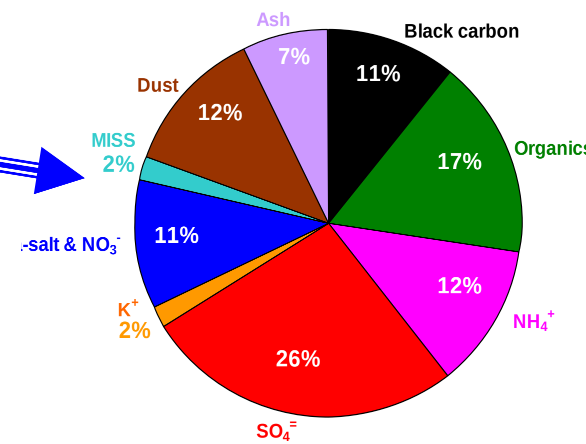
Gas Consumption: Impacts
Accelerates approach to committed warming
But
Decreases (compared with Coal and oil)
Commitment to future warming

need to consider air pollution and global warming under One framework

ABCs: Emission & Global Forcing

Ramanathan and Carmichael, Nature_Geoscience 2008

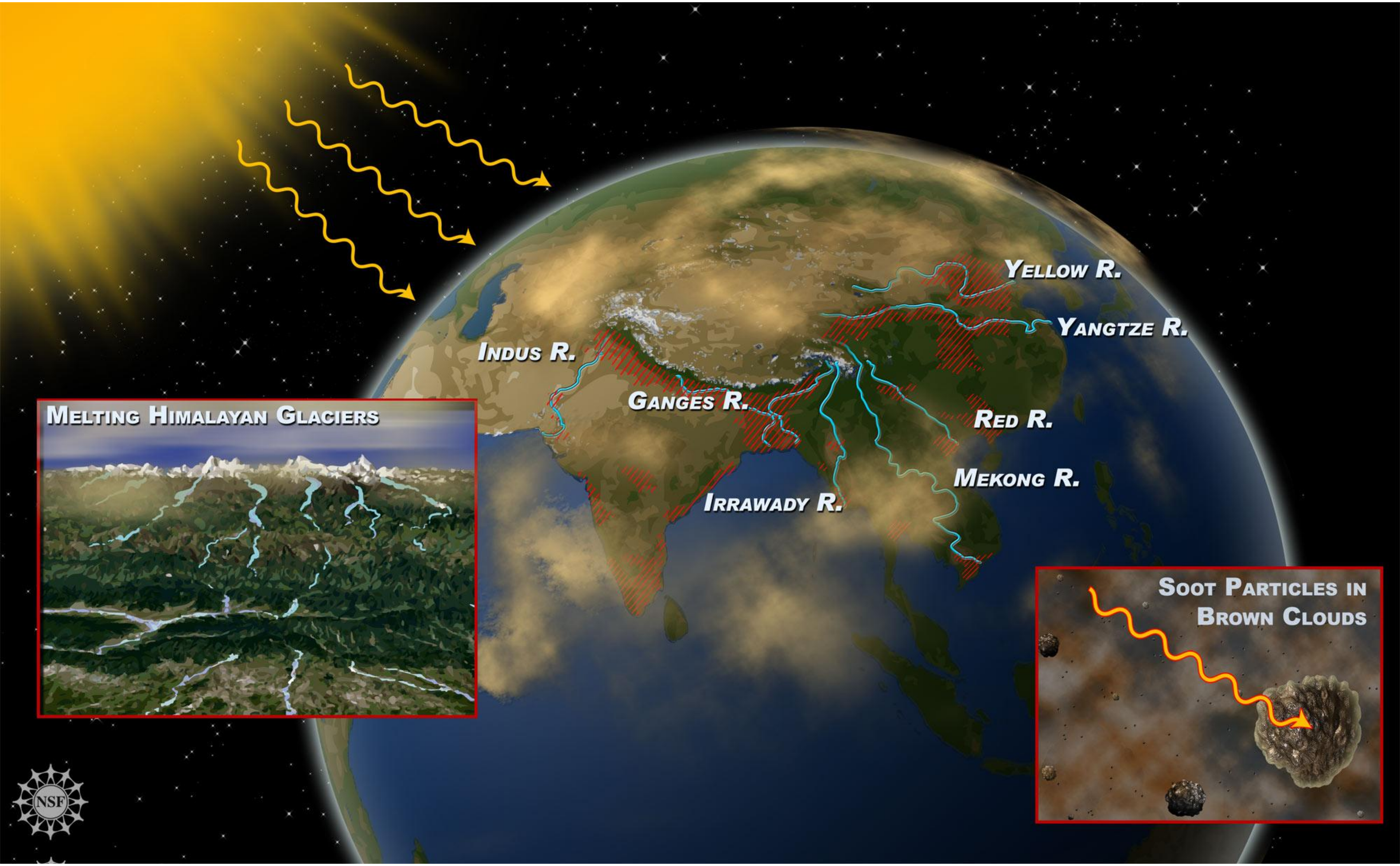




Ramanathan et al, 2001

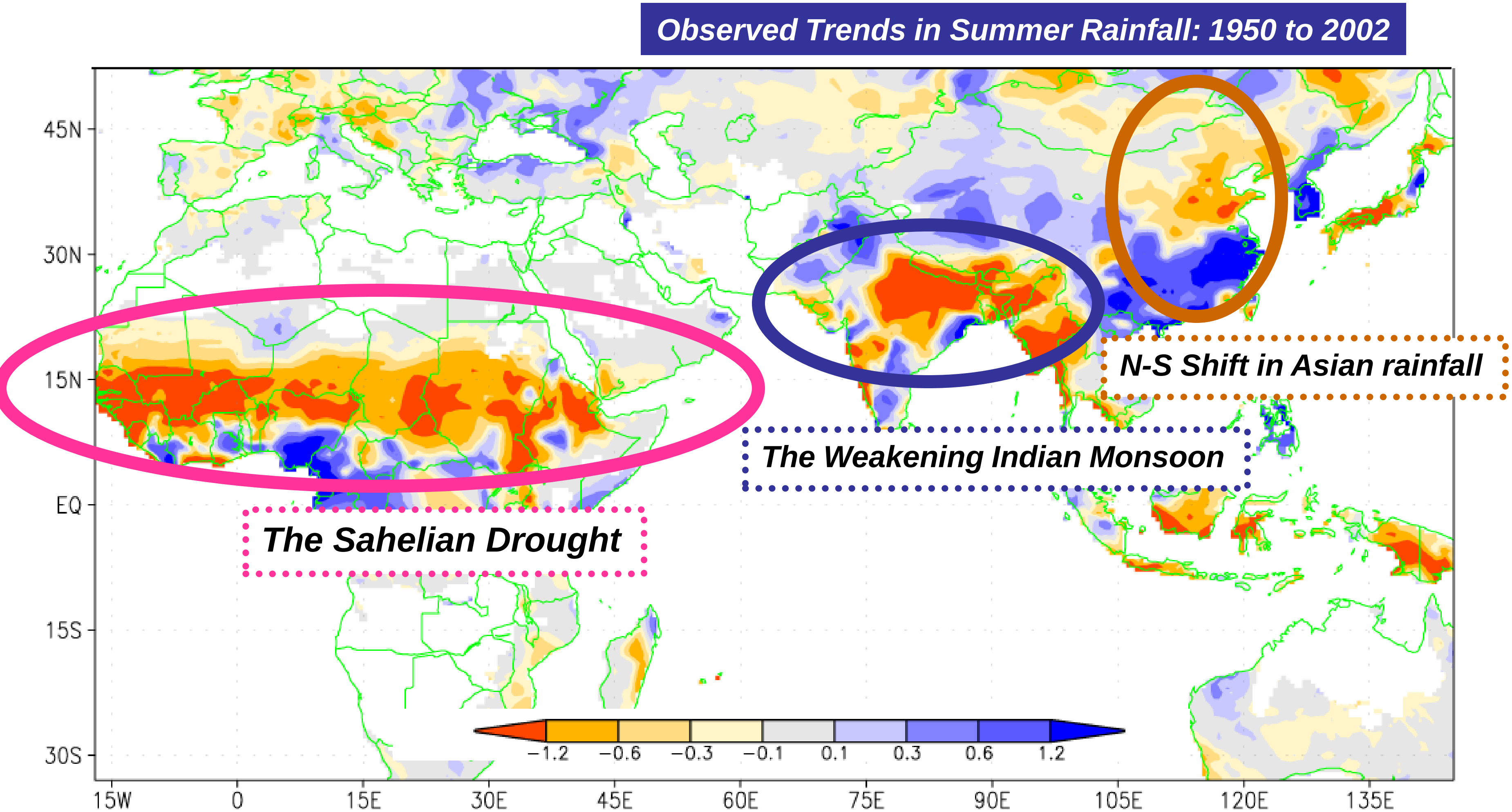
Hindu Kush-Himalayan-Tibetan Glaciers:

Water Fountain of Asia



Major Rainfall Shifts during the last 50 Years

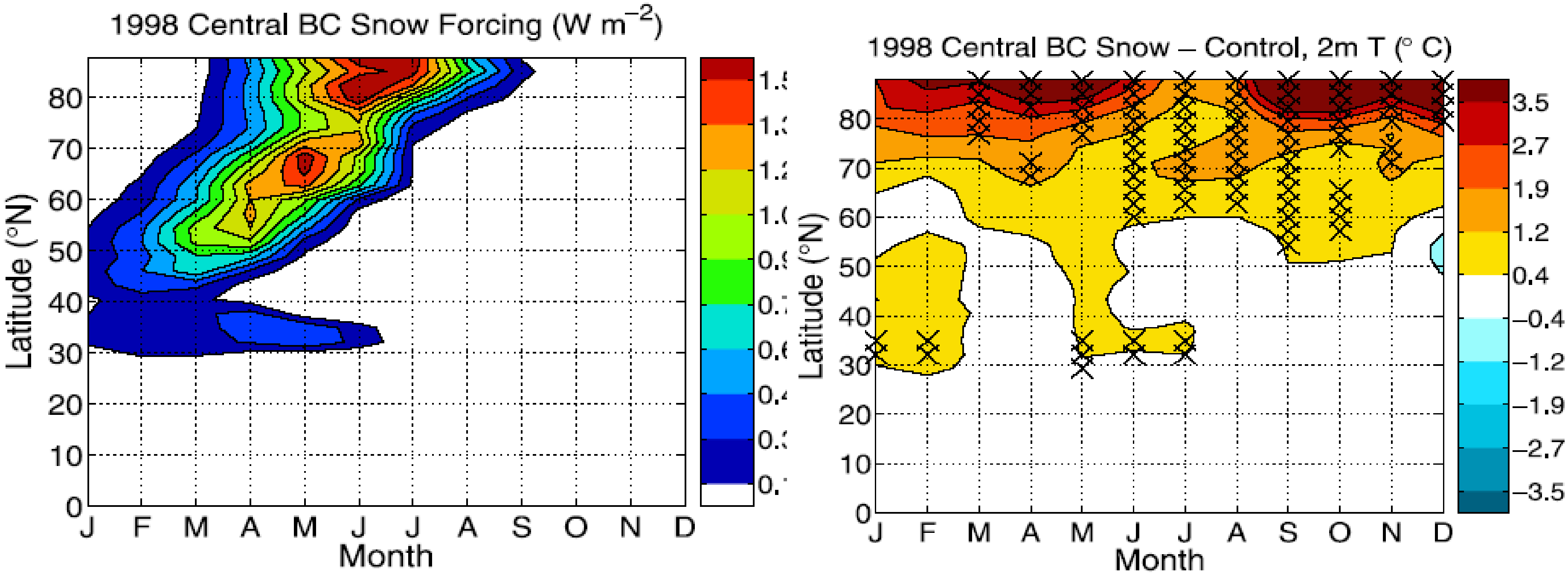
Chung and Ramanathan 2006



Black Carbon deposition on Snow is a major source for arctic sea Ice retreat

Present-day climate forcing and response from black carbon in snow

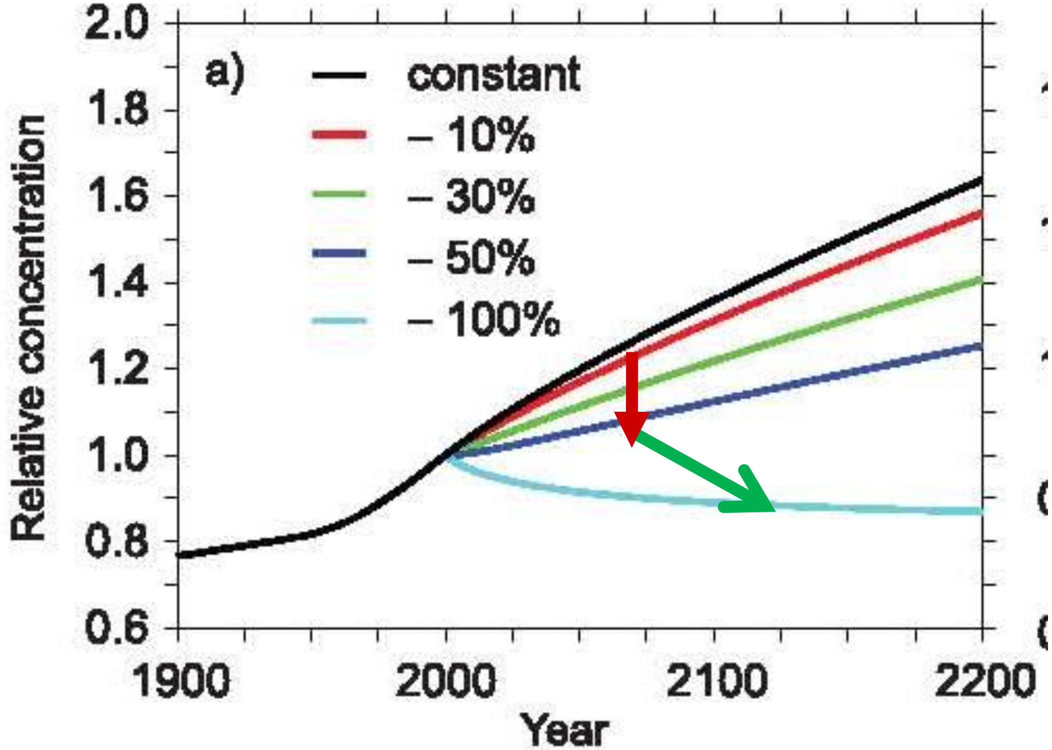
Mark G. Flanner,[1] Charles S. Zender,[1] James T. Randerson,[1] and Philip J. Rasch[2]



JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 112, D11202, doi:10.1029/2006JD008003, 2007

1. Reducing short-lived warming agents is the only realistic way to reduce Committed warming: Ozone and Black Carbon. Buy the planet some time (decade or two) to fully implement CO2 reduction technologies in the Market

CO_2: Emission reduction and Atm Concentrations : IPCC-AR4; Chapt 10.



2. But you have to start CO2 reduction now to avoid future commitment

Ramanathan 2008


सूर्य PROJECT SURYA
Reduction of Air Pollution and Global Warming by Cooking with Renewable Sources
A nexus between mitigation of climate change, alleviation of poverty and improvement of public health, water and food security of Asia
V. Ramanathan, Surya PI
A pilot program of the United Nations Environment Programme
UNEP

PROJECT SURYA

The Surya Approach

- Project Surya is an interdisciplinary initiative to mitigate climate change and improve living standards of the rural poor in India by sustainably reducing soot emissions that result from traditional fire-based cooking.
- Project Surya will replace traditional fire cooking with clean-cooking technologies, and will innovatively use mobile phones to gather data and track outcomes.
- We will use the above data to promote and guide policy actions in India, and we believe, eventually in the entire sub-continent. The project can also be replicated in other major soot-emitting regions such as China and Africa.
- Project Surya is not the first effort to distribute non-fire cooking methods in the developing world. What distinguishes Project Surya from the numerous other cleaner-cooking projects is the scope and method of evaluation of outcomes.

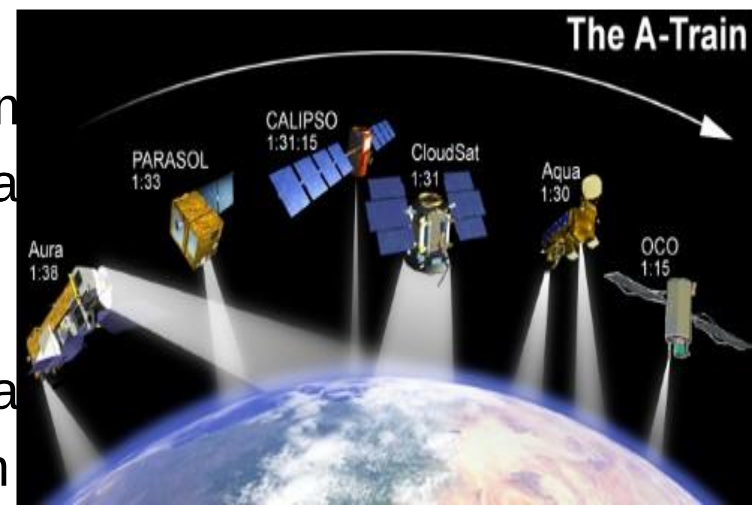
Evaluating Climate Impacts

Project Surya will undertake the most comprehensive and rigorous scientific evaluation of the impact of such a project to date. Climate scientists at C4 will use this data to evaluate Project Surya's impacts on global warming and local climate.

- We will install 4 climate observatories at the boundaries of the selected region to document the concentrations of particulates and soot content and solar radiation at the surface.

- A van fitted with mobile instrun will sample indoor pollution in a homes at random each day.

- Air pollution in the region will a monitored using NASA A-Train



Evaluating Health Outcomes

Our team is implementing a cell-phone tool to collect data on the health risks associated with villagers' exposure to indoor air pollution. Epidemiologists at SRU will use this data to evaluate Project Surya's impacts on the health of villagers.

- Cell-phones carried by participants will collect GPS and accelerometer data to infer their time-location-activity budgets at unprecedented detail.

- Cell-phones will report indoor soot levels. We will install inexpensive and miniaturized filters to monitor soot levels in selected homes. Villagers will use the cell phone camera to take a picture of the filter and upload it to a server.

- Machine learning algorithms can analyze the images and automatically extract indoor soot levels.

Technology Adoption and Deployment

Project Surya's success on the ground depends on adoption of cleaner-cooking technology by the residents of the target villages. Leveraging its strong presence in the target village of Mukteshwar, TERI will lead deployment efforts in the following areas:

- Survey local cooking practices, and select the most appropriate clean-cooking technology.
- Characterize all potential cookers with regards to their environmental impact, overall cost, and ease of use.
- Pilot the cookers in several hundred households and collect feedback from women before undertaking the full deployment.
- Handle all of the public education and interface design issues related to the adoption of the cooking and measurement technology.

PROJECT SURYA

The Surya Team

Project Surya will be implemented by a team of leading climate scientists, epidemiologists, community experts, economists, computer scientists, and development experts.

The team includes:

- The United Nations Environment Program (UNEP)

* Sri Ramchandra Medical College

- The Center for Clouds, Chemistry and Climate (C4), UCSD
- The Center for Embedded Networked Sensing, UCLA (CENS)
- The Energy and Resources Institute, In dia (TERI)
- Centre for Development Finance, India

Funded by NSF; NOAA and UNEP

Fundamental Deductions

Ramanathan, 2008

We must reduce air pollution to mitigate Impacts on Human Health; Water Budget &Agriculture

But reducing air pollution increases the urgency to reduce CO2 emission

A LARGE REDUCTION IN AIRPOLLUTION WITHOUT A COMPARABLE REDUCTION IN CO_2 EMISSION WILL LIKELY PUSH THE SYSTEM RAPIDLY PAST THE CLIMATE TIPPING ELEMENTS.