

# ***A New Approach to Slowing Down Climate Change, Sea Level Rise and Glacier Retreat in Our Life Time***

***Veerabhadran Ramanathan  
Chair, ABC-International  
Scripps Institution of Oceanography  
University of California at San Diego, CA 92037***

***High Summit 2013, Italy  
October 24, 2013***

***The Climate Problem is Still Solvable  
It Requires out of the box thinking  
It Requires Bottom-up-Approaches as well as the Top-Down  
approach***

## **My Forecast (Published in 2008 & 2010)**

**Without Actions to mitigate emissions of manmade greenhouse gases**

- **The planet is likely to warm  
(compared with pre-industrial times):**

**by 3.6 F (2 C) by mid- 21<sup>st</sup> century**

**by 7.2 F (4 C) by end of 21<sup>st</sup> century**

***It is still not too late to avert disastrous changes;  
But it requires a new way of thinking***

***We Must Recognize the Two Worlds We Inhabit***  
***Source: Ramanathan, 2013 (In Press)***

***T4B: The top 4 Billion  
who have unlimited Access  
to fossil fuels***



***B3B: The bottom 3  
billion who lack access  
to fossil fuels***





# SUSTAINABLE ENERGY FOR ALL

Energy powers opportunity. It transforms lives, economies, & our planet.

## LEADERSHIP THAT CATALYZES ACTION

The Sustainable Energy for All initiative brings together top-level leadership from all sectors of society, drawing on the global convening power of the United Nations and the World Bank. The initiative's Advisory Board, co-chaired by the Secretary-General and the World Bank Group President, includes distinguished global leaders from governments, business and civil society. They provide strategic guidance to the initiative and serve as its global ambassadors.



Saving our planet, lifting people out of poverty, advancing economic growth – these are one and the same fight.

United Nations Secretary-General  
Ban Ki-moon

***Decarbonization of the economy and reducing carbon footprint applies to T4B.***

***The T4B must help the B3B to gain access to clean energy to keep the overall Global warming to below manageable levels***

***IS THERE ANOTHER KNOB TO SLOW THE RATE OF WARMING?***

## ***The Short Lived Climate Pollutants***

**Methane; Black Carbon; Ozone (Lower Atmosphere); HFCs**

**Life times are about a decade or less**

***How Long Have We Known them and How Well do  
We Understand Their Climate Effects?***

## Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications

V. Ramanathan

**Abstract.** *The infrared bands of chlorofluorocarbons and chlorocarbons enhance the atmospheric greenhouse effect. This enhancement may lead to an appreciable increase in the global surface temperature if the atmospheric concentrations of these compounds reach values of the order of 2 parts per billion.*

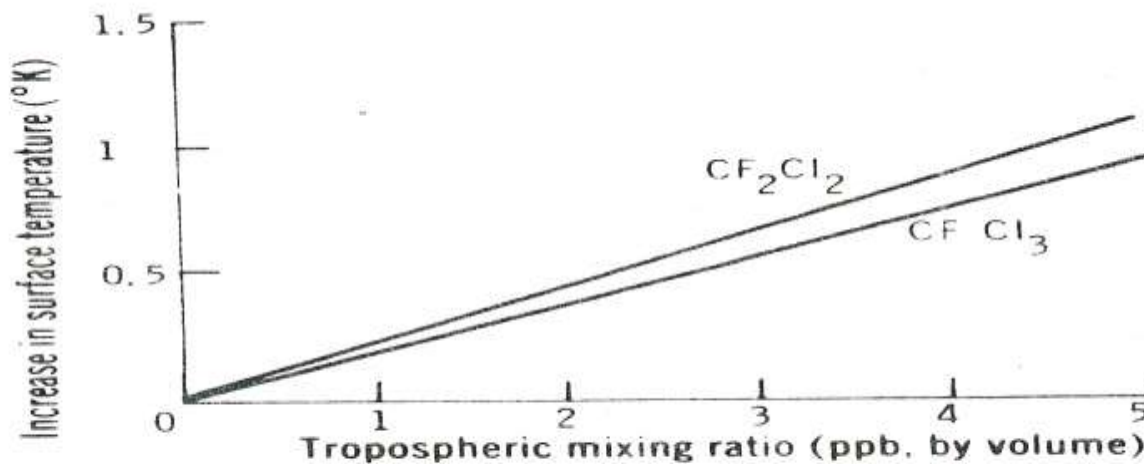


Fig. 1. Increase in global surface temperature is a function of the tropospheric concentrations of  $CF_2Cl_2$  and  $CFCl_3$ . Results are for globally averaged conditions with 50 percent cloud cover.

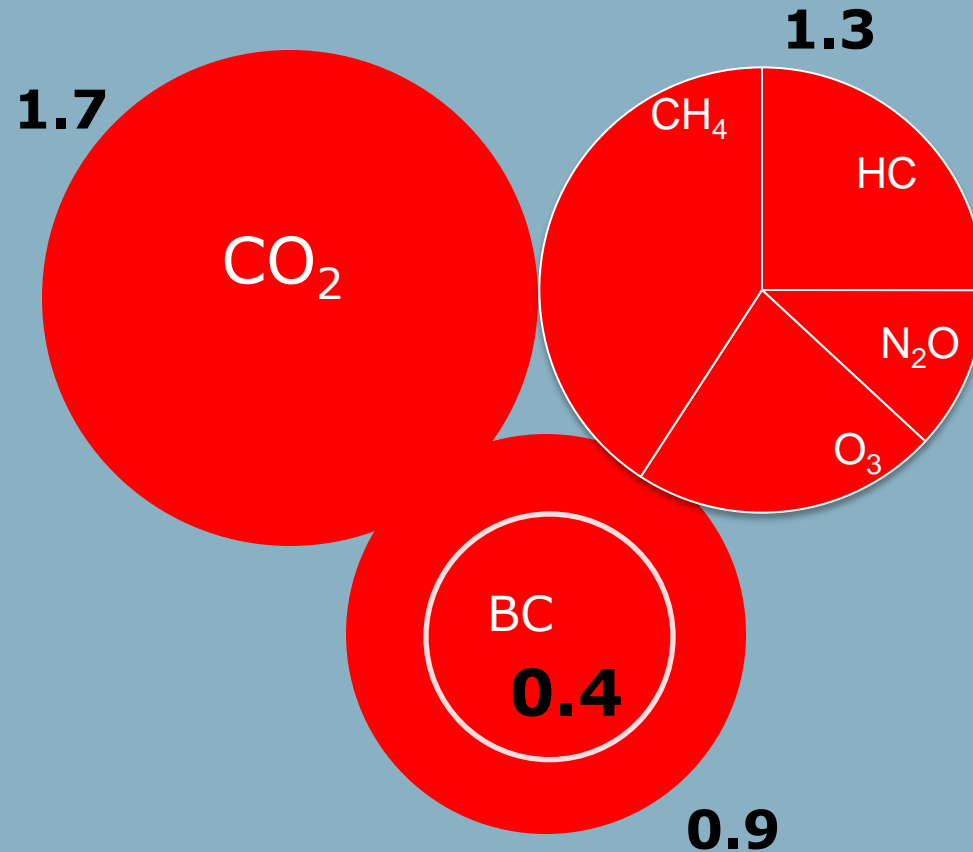


# Pollutants that lead to positive forcing

***GHGs Forcing from IPCC 2007;***

***BC Forcing (outer Circle): Ramanathan and Carmichael, 2008***

***BC Forcing (inner circle) : IPCC-AR4***



***The Greenhouse Gas Forcing- 2005  
= 3 Wm<sup>-2</sup> ( 25%)***

**Pathway for limiting global warming  
to 2 C (3.6 F)**

*Ramanathan and Xu, PNAS, 2010*

**I. Stabilize Carbon Dioxide Concentrations below  
440ppm (T4B problem)**

**II. Reduce Short Lived Climate Pollutants  
(T4B and B3B problem)  
( contributes 40% of current Global warming):**

**Black Carbon (<2 weeks);**

**Ozone (< 2 months);**

**Methane (<15 years)**

**HFCs & HCFCs (<15 years)**

**25 to 4000 times more effective than CO<sub>2</sub> on 50-100 years scale**



# Role of CO2 and SLCPs Mitigation in future Warming & Sea Level Rise

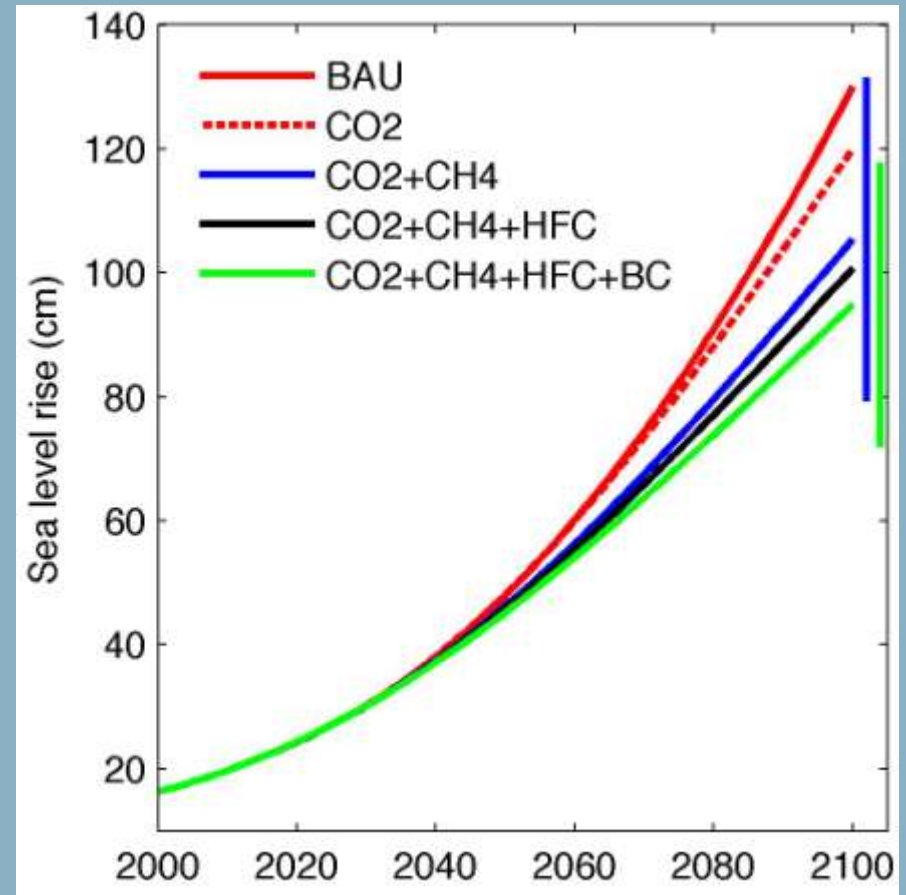
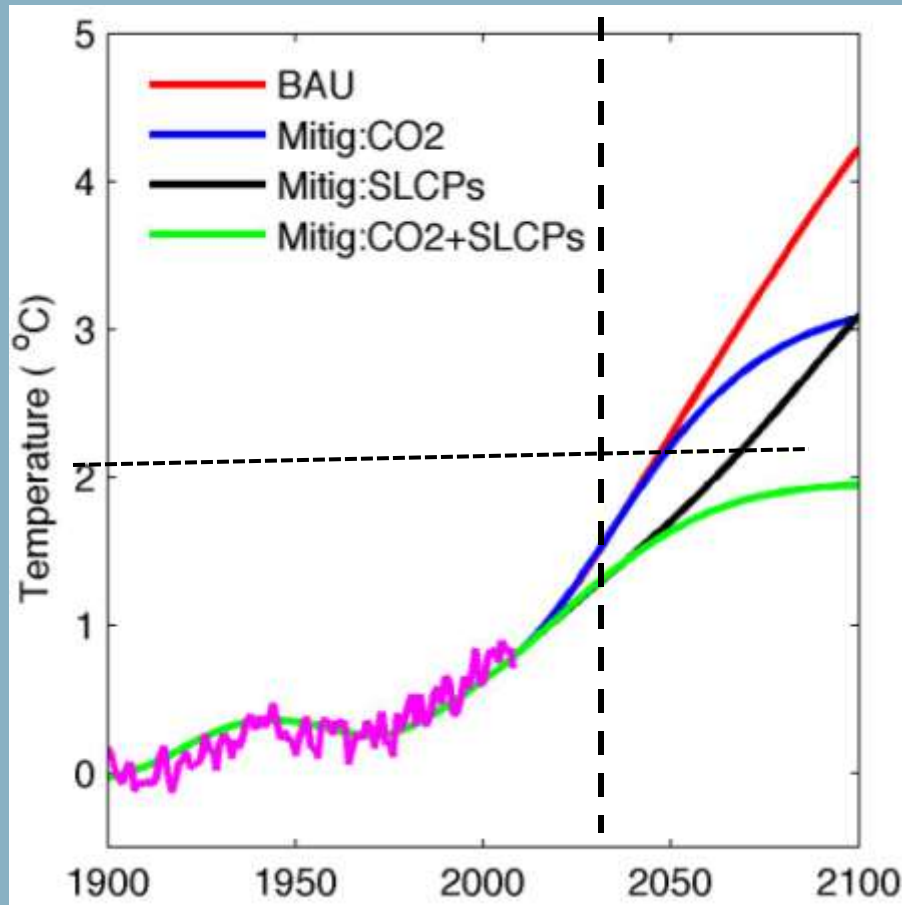
## SLCPs: BC+Methane+ Ozone+HFCs

**SLCPs can reduce near term (2000-2050) warming by as much as 50%**

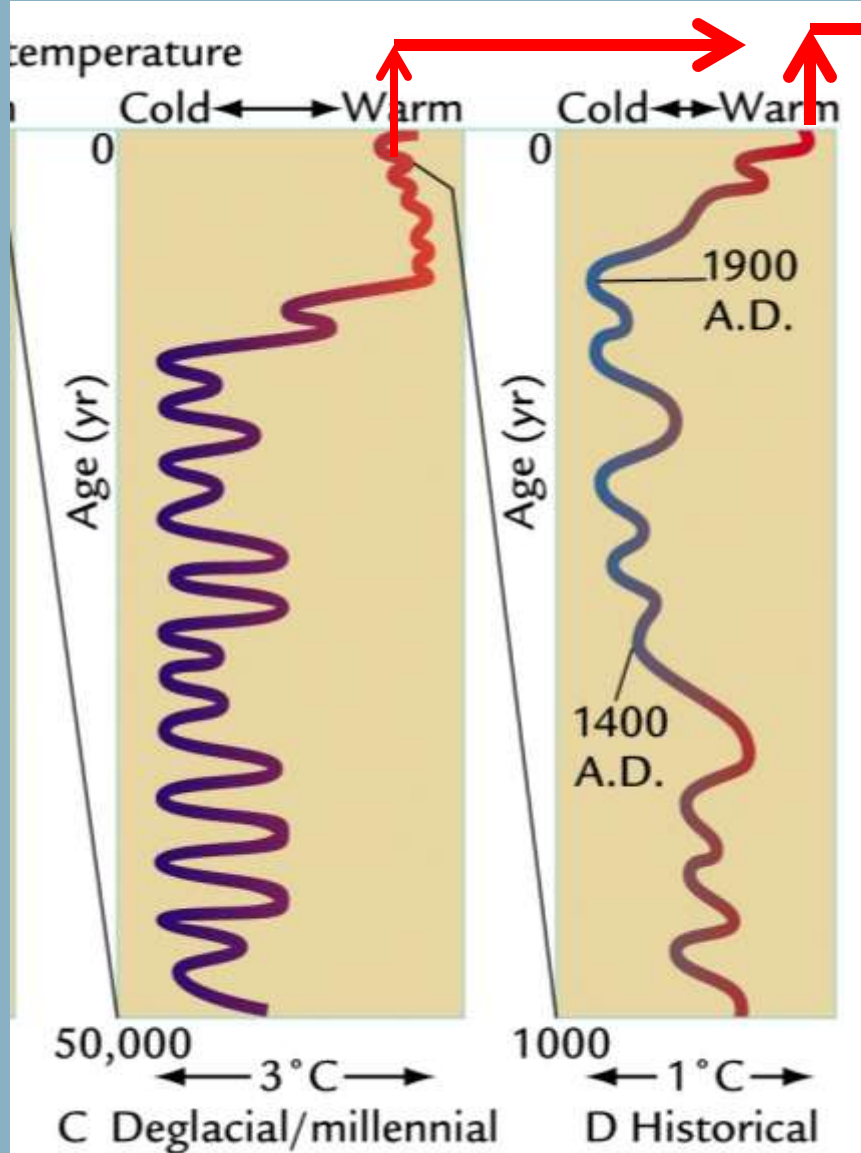
**SLCPs can reduce end of century sea level rise by about 25%**

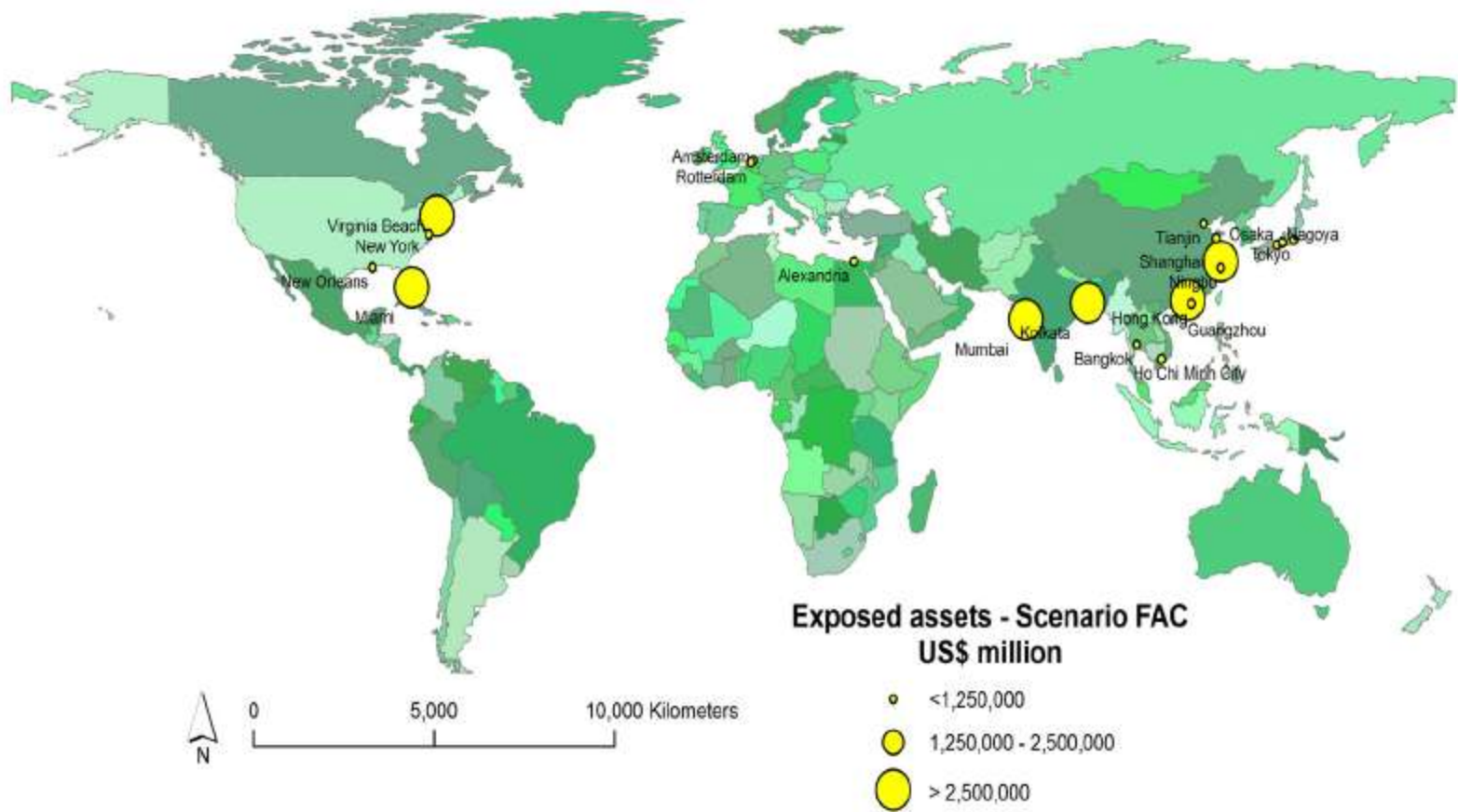
**Simultaneous CO2 mitigation is crucial for limiting end of century warming below 2°C**

*Source: Ramanathan and Xu.2010 & HU et al, 2013*



# *Climate has Changed in the Past..... But*





*Figure 3: Map showing the top 20 cities for exposed assets under the future climate change and socioeconomic change scenario*

# CCAC

CLIMATE AND CLEAN AIR COALITION  
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS



**Feb 16, 2012**

***Now 30 nations have joined. European Union and World Bank; Many Major NGOs have joined in this Second Front Against Climate Change***

***Reasons for Rapid Response from Policy Makers: Public Health; Food Security; Benefits will materialize in our life times; Regionally Concentrated; Practical Measures available; Intersects With development issues***

**Black Carbon: Product of Incomplete Combustion:**  
***Strongest absorber (per unit mass) of sunlight;***  
***Directly heats the air and the glaciers/Sea Ice when it is deposited.***  
***The Second Largest Contributor to Global Warming***



***The B3B World***

***Residential solid biomass burning is the second largest source of BC***

***Mukteshwar, Cetntral Himalayas, India***



Photo:Ramanathan, 2009

# Why should S. Asia be interested in SLCPs?

**November 14 2006**

**500,000 deaths from indoor Pollution**

**Outdoor impacts comparabile**

**Millions of Tons of crop damages**

**NASA-MODIS**

**December 21 2001**

Deposition of BC on Snow  
Melting of Glaciers

Intense Atmospheric Solar Heating:  
Melting of Glaciers;  
Disruption of Monsoon

Dimming of Surface:  
Decreasing evaporation;  
Decreasing Monsoon Rainfall

*Ramanathan et al, 2007 & 2008*

# Health Impacts of indoor and outdoor Air pollution

## **A Major New Study was released two weeks ago:**

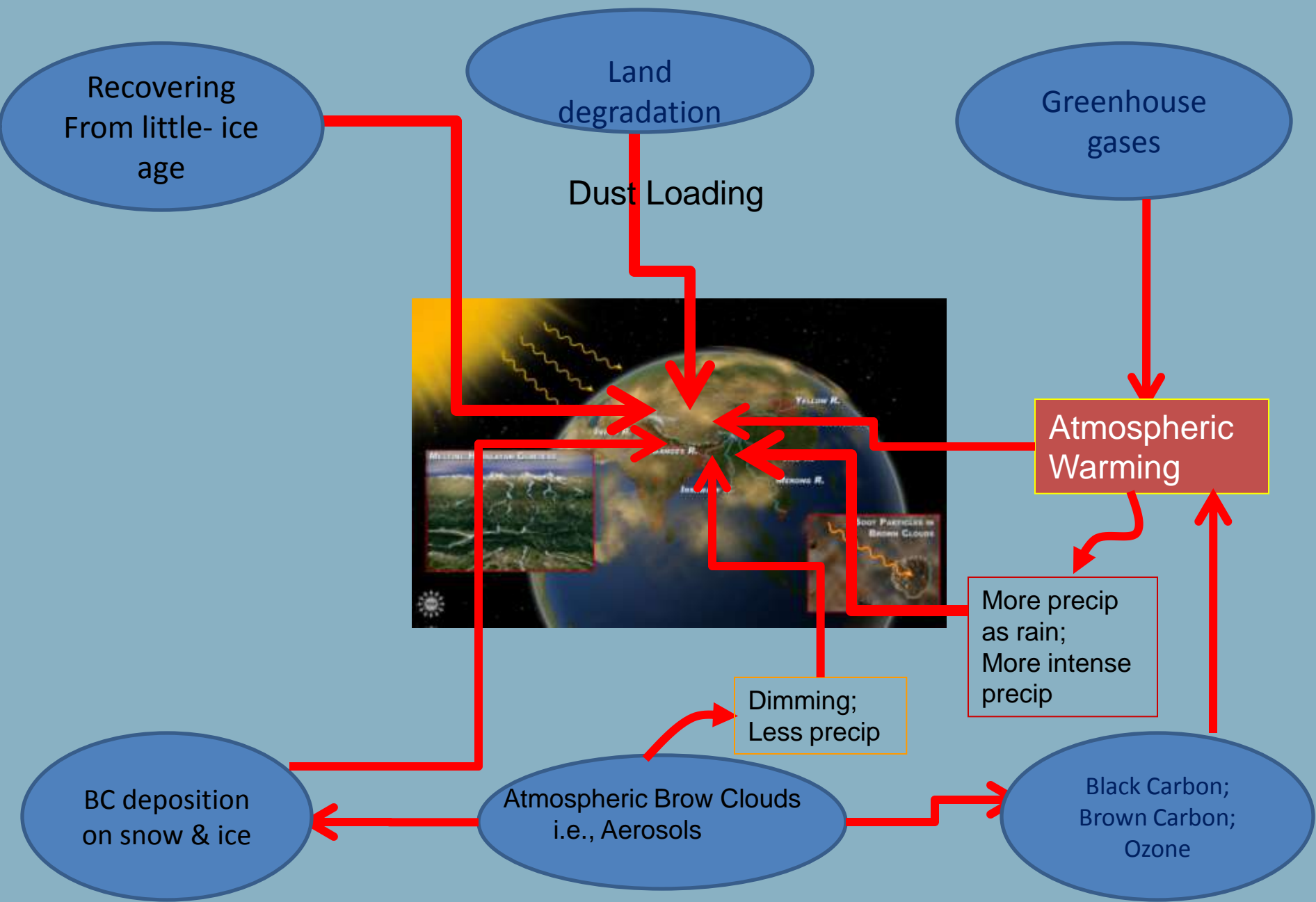
A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010: *Lin et al, LANCET, 2013*

***Household air pollution from solid fuels accounted for 3.5 million (2.7 million to 4.4 million) deaths.***

***Ambient particulate matter pollution accounted for 3.1 million (2.7 million to 3.5 million) deaths***

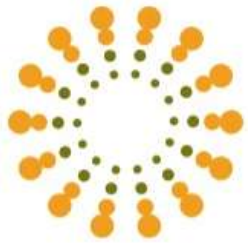


# Multiple Stressors on Glaciers and snowpacks



***One of the major highlights of the ABC program is the establishment of The EV-K2-CNR Pyramid Observatory by the Italian Government and scientists***

***It is likely the Himalayan Glaciers is one of the Tipping Points of Climate Change and We still Have the Chance to prevent it***



**project surya**  
Fighting Climate Change Now

***Providing Clean Cooking and Lighting Technologies & documenting their impacts on Air pollution, Climate Forcing, Health Exposure Indoors and outdoors***

***PIs: V. Ramanathan, I.H. Rehman and N. Ramanathan***

### **CORE INSTITUTIONS**

University of California at San Diego, USA  
The Energy Resources Institute, Delhi, India  
Nexleaf Analytics, Los Angeles, USA

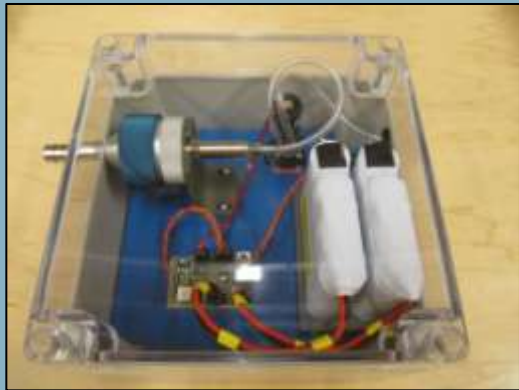
### **Collaborating Institutions**

U. Iowa, USA  
Jawaharlal Nehru University, Delhi, India  
Duke University, USA  
Carbonomics, USA  
Environmental Financial products LLC, USA  
U. Of Southern California, USA

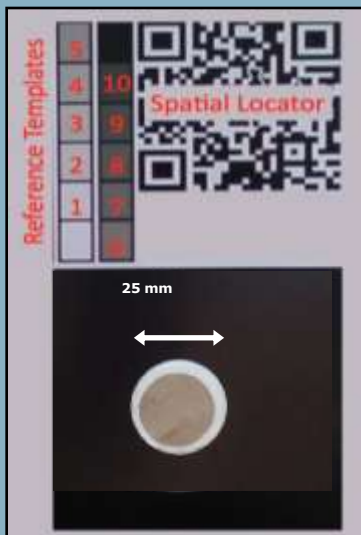
University of Nairobi (Kenya)  
African Center for Technology Studies (Kenya)  
Appropriate Solar and Wood Energy Network (Kenya)  
Department of Environment (Bangladesh)  
Dhaka University (Bangladesh)  
Alternative Energy Promotion Center (Nepal)  
National Environment Commission (Bhutan)

# Monitoring Stove BC Emissions Using Mobile Phones: Nithya Ramanathan et al, 2011

Micro-Pump and Filter



Filter, placed on  
reference template



## Innovations

- \$500 per unit, ultra low power.
- Low-tech: works with **any** camera cellphone.
- Real-time reporting.

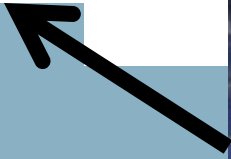
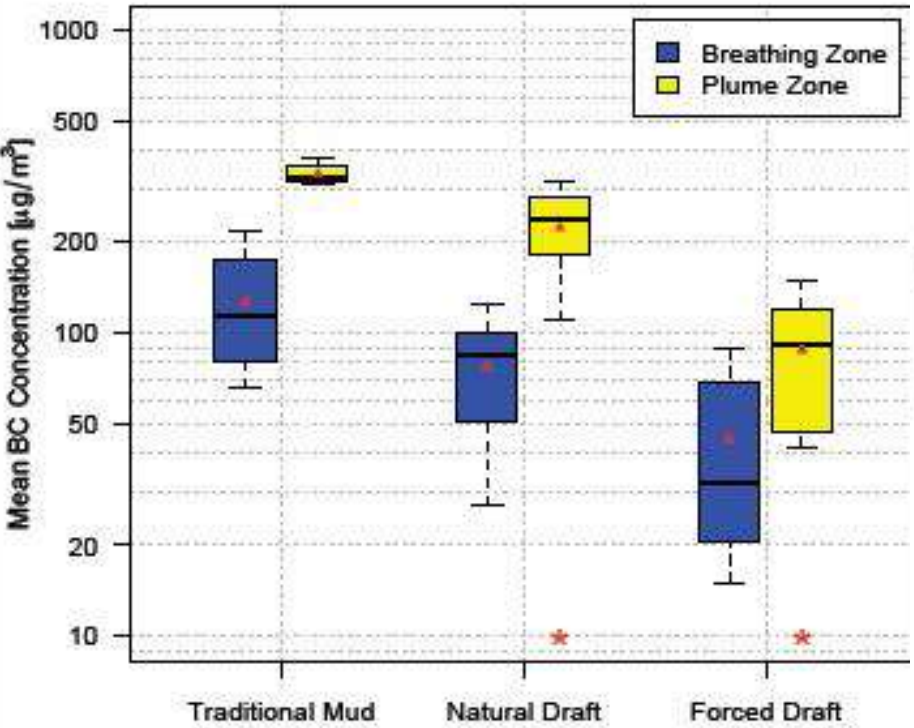
Picture sent  
to server

Results sent  
back via SMS



# Have Identified the Technology that reduces BC emissions

Kar et al, 2011



# Scaling Up Sustainably

***Improved Stoves are expensive: \$70....  
A month of their take home pay***

***•Economies of Scale... \$50 in mass and  
local manufacture (Total: \$30 Billion)***

***• Get Financial Rewards directly to  
Women by linking them with carbon  
credit markets***



# Carbon Credit Pilot Project (C2P2)



**\$70**



**\$25**

**<<http://www.projectsurya.org/>> for information**

# Inaugurating an Energy Entrepreneur in UP April 1, 2013





# Sealing the deal with the Chairman of a large Rural GOI Bank, Varanasi May 12, 2013

## इस्तेमाल से बचेगा 70 फीसद ईंधन

वाराणसी (एसएनबी)। ग्रामीण महिलाओं की समस्याओं को देखते हुए टेरी ने मातृ दिवस पर ऐसा चूल्हा बाजार में उतारा है जिस पर खाना बनाने समय माता, बहनों व बहूओं को कोई दिक्कत नहीं होगी। बिना फूँके, आख खराब किये उन्मत्शील चूल्हे पर खाना बना सकता है। यह जानकारी काशी गोमती संयुक्त ग्रामीण बैंक के चेयरमैन एसएन त्रिपाठी, कैलीफोर्निया विवि के सेन डियागो, अमेरिका के प्रोफेसर वी. रामनाथन, टेरी नई दिल्ली के निदेशक एच रहमान ने फातमान रोड स्थित केबीएसजी बैंक के कार्यालय में रविवार को आयोजित संयुक्त पत्रकार वार्ता में दी।

उन्होंने बताया कि ग्रामीण क्षेत्रों में जलाये जाने वाले चूल्हों से अधिक मात्रा से कार्बन और कार्बन डाईऑक्साइड निकलता है, जबकि उन्मत्शील चूल्हा इस्तेमाल करने से

ने बताया कि सोमवार को आजमगढ़ स्थित मुबारकपुर में बैंक के ऋण मेले में ग्रामीण क्षेत्र की 100 महिलाओं को उन्मत्शील चूल्हा दिया जाएगा। इसके अलावा



► मुबारकपुर क्षेत्र में आज

ऋण दिया जाएगा। इसमें 165 रुपए प्रति माह किस्त देना होगा। इस योजना में तीन लोग साझेदार हैं। द एनर्जी एंड

### खासियत

10 करोड़ ऋण वितरण किया जाएगा। मेले में किसानों को 500 किसान क्रेडिट कार्ड दिया जाएगा। उन्होंने बताया कि एकीकृत धरेलू सौर ऊर्जा प्रणाली भारत सरकार की महत्वपूर्ण योजना है। इसमें एक सौर पैनल, दो बल्ब, एक चूल्हा एक बैटरी, एक चार्ज कंट्रोलर उपलब्ध होगा। इसकी कुल लागत 8500 रुपए है। इसमें ग्रामीण क्षेत्र के लोगों को 15 सौ रुपए लगाना और शेष रुपए 7 हज़ार बैंक द्वारा ऋण के रूप में दिया जाएगा। पांच साल के लिए

- सामान्य चूल्हे के मुकाबले ईंधन की मात्रा 70 प्रतिशत कम लगेगी
- न तो धुआं निकलेगा न ही प्रदूषण होगा
- चूल्हे की बाडी स्टेनलेस स्टील की है
- जिसको छूने पर हाथ भी नहीं जलेंगे

# The Co-Dependence of T4B and the B3B World

- *Carbon footprint of Top 4 Billion is the Biggest Threat to Sustainability*
- *During this Century, the Bottom 3 Billion (B3B)*
- *Will morph into the Bottom 5 Billion (B5B)*
- *If the B3B follows T4B, the Carbon foot print will increase From 0.5 tonnes/year to 4.5 tonnes/Year for 3 billion now and additional 2 billion by 2050.*

• **T4B must help B3B on a sustainable energy pathway for meeting basic needs: Cooking/Heating/Lighting/Farming to avoid catastrophic climate changes**

**THANK YOU**

*STUDENTS, POSTDOCS IN MY LAB AND  
COLLEAGUES FROM AROUND THE WORLD*

