

Short-Lived Climate-forcing Pollutants (SLCPs) in South Asia: Science, Impacts and Action

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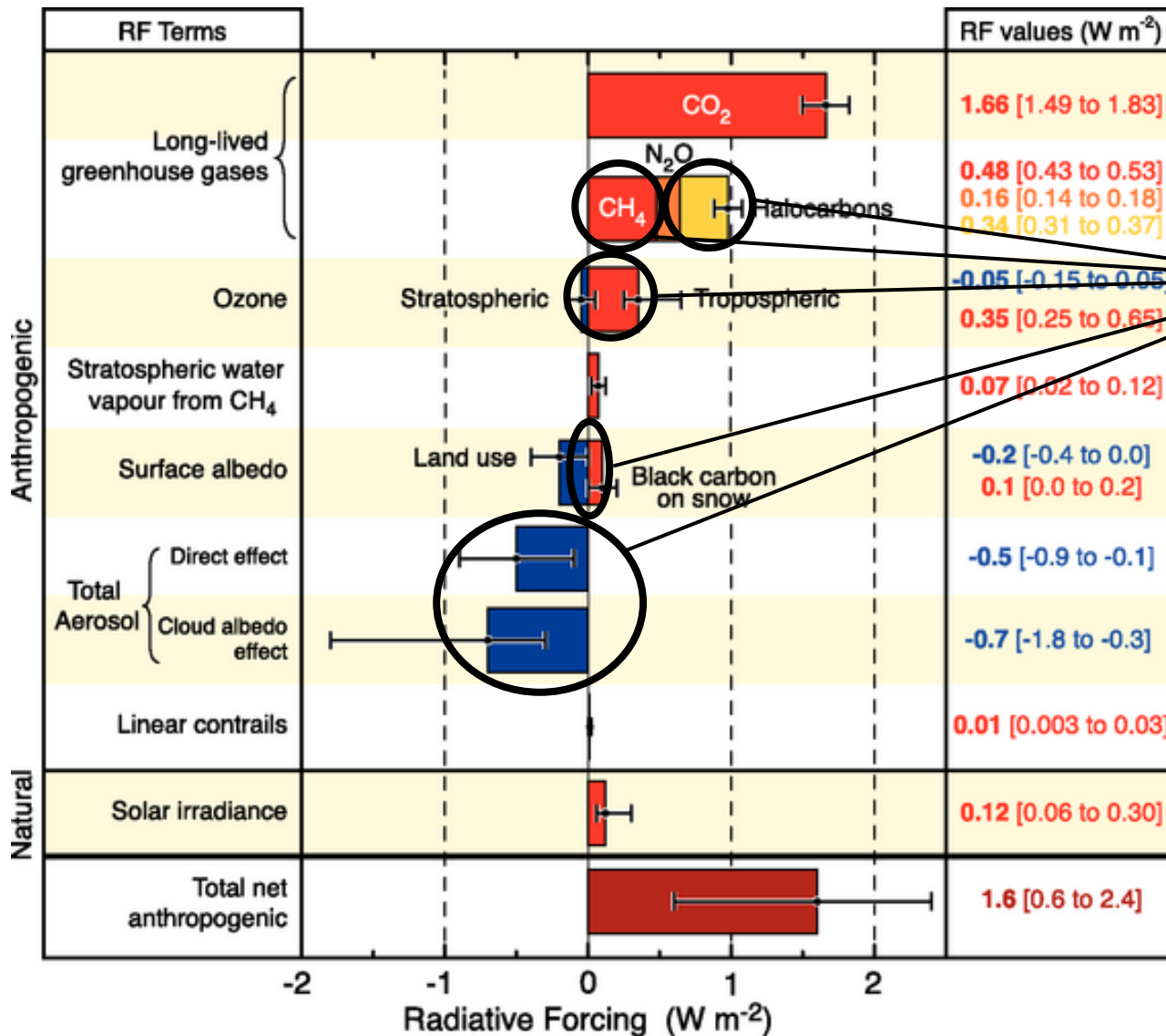
*Joint Side Event, UNFCCC COP-19
Warsaw, Poland, 18 November 2013*

- **Gases:**
 - Methane (CH₄)
 - Ozone (O₃)
 - Hydrofluorocarbons (HFCs)
 - Nitrogen Oxides (NO_x)
 - Carbon Monoxide (CO)
 - Volatile Organic Compounds (VOCs)
 - Sulfur Dioxide (SO₂)
- **Aerosol Particles:**
 - Soot (incl. Black Carbon (“BC”))
 - Organic Carbon
 - Sulfate (SO₄²⁻)
 - Nitrate (NO₃⁻)
 - Ammonium (NH₄⁺)

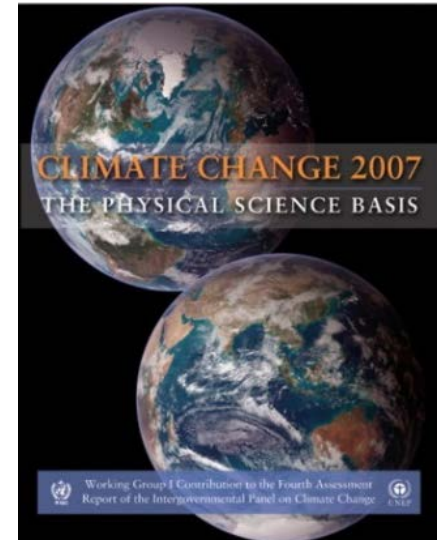
Roles

- Act as air **pollutants** or **pollutant precursors** (except HFCs)
- Responsible for significant **climate-forcing** (warming /cooling)
- Relatively **short-lived** in the atmosphere (days to decades)

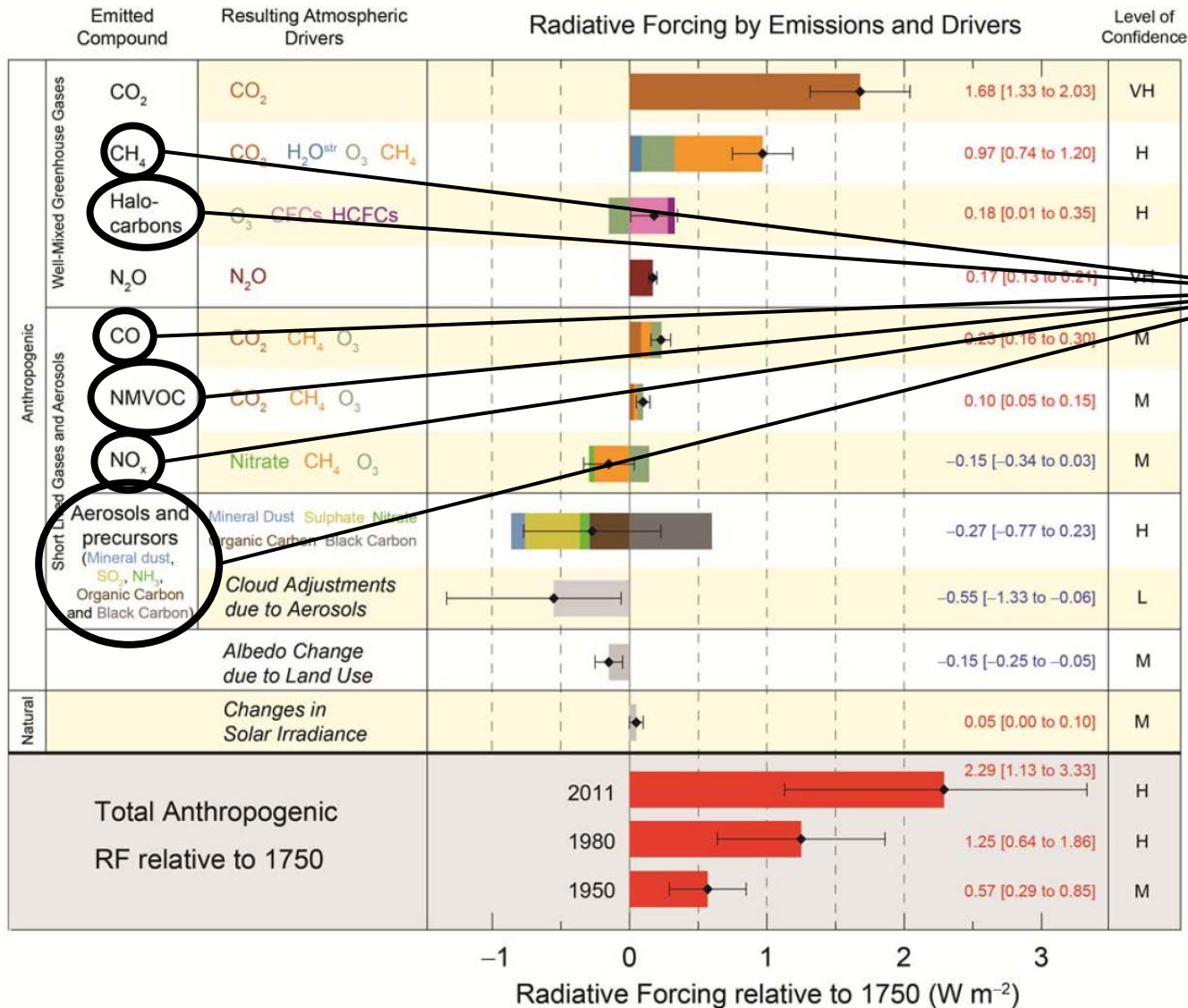
Global Mean Radiative Forcing, 1750 to 2005



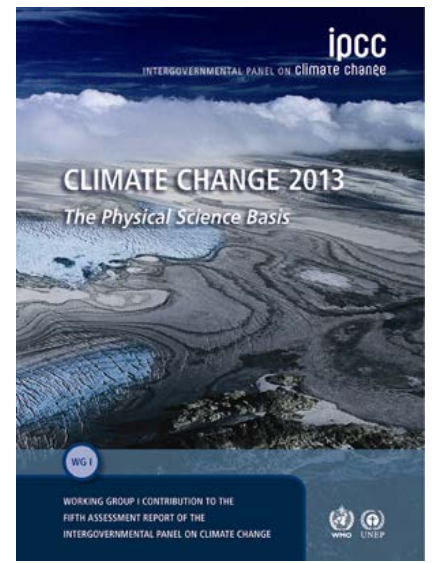
SLCPs!



Global Mean Radiative Forcing, 1750 to 2005



SLCPs!



Health Impacts?



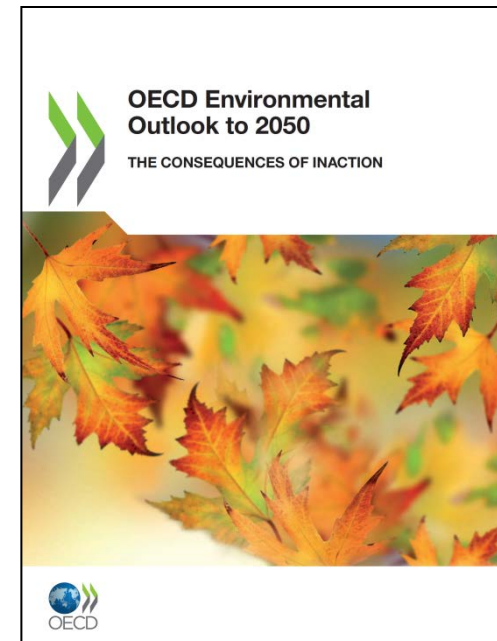
**Filter after one day of sampling at
the SusKat-ABC Bode Supersite**

Global Air Pollution Impacts on Health

Global premature deaths from selected environmental risks: Baseline, 2010 to 2050



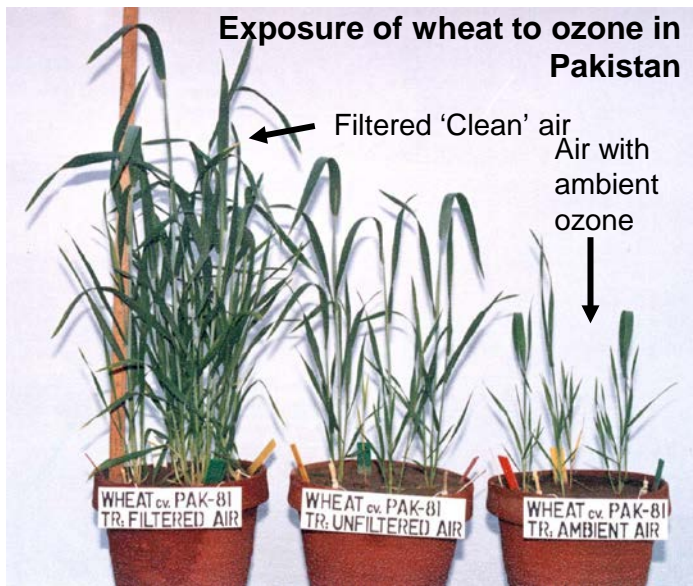
→ Outdoor air pollution in 2050: top environmental cause of mortality worldwide, ahead of dirty water and lack of sanitation



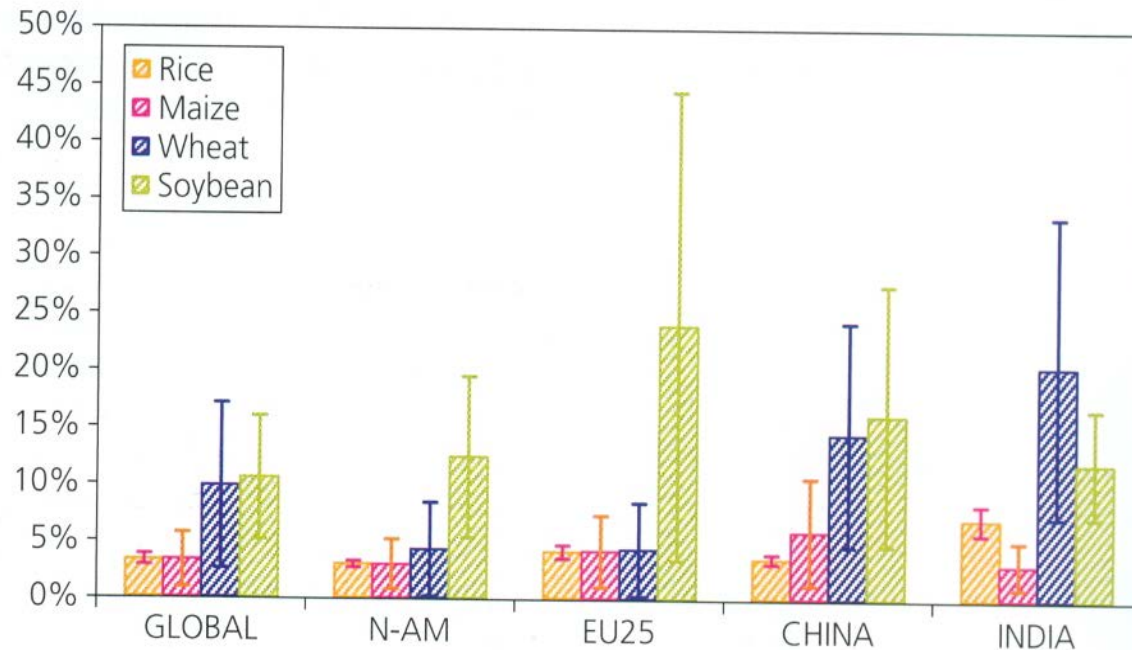
Air Pollution Impacts on Agriculture



Ozone injury to grapevine leaves

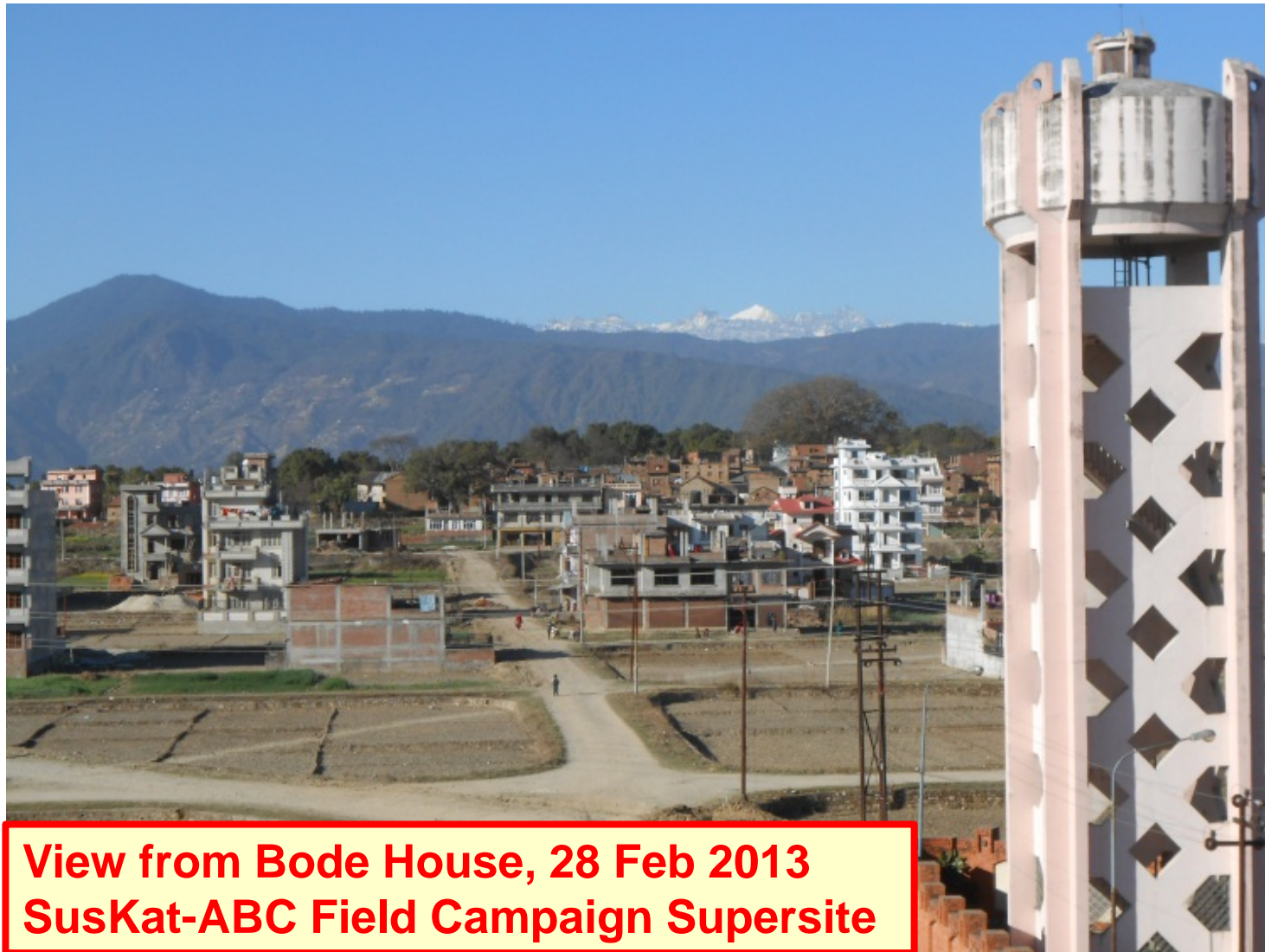


→ Increasing ground level ozone can result in significant crop loss.



The Royal Society 2008

Reduced Visibility



**View from Bode House, 28 Feb 2013
SusKat-ABC Field Campaign Supersite**

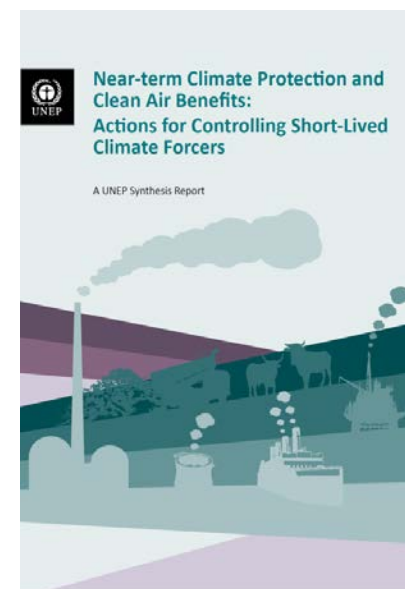
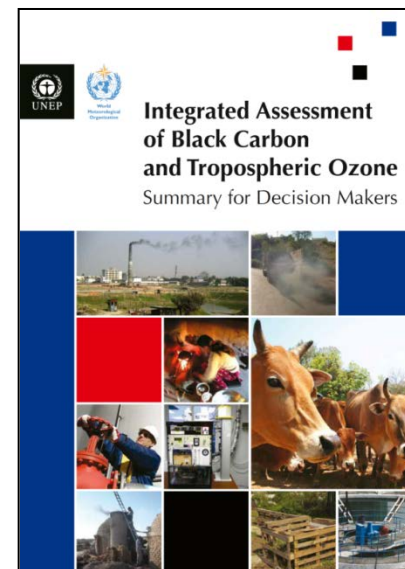
Reduced Visibility



Mitigation Possibilities?

➔ 16 Key Global Measures for CH₄ and BC

Measure ¹	Sector
CH₄ measures	
Extended pre-mine degasification and recovery and oxidation of CH ₄ from ventilation air from coal mines	Extraction and transport of fossil fuel
Extended recovery and utilization, rather than venting, of associated gas and improved control of unintended fugitive emissions from the production of oil and natural gas	
Reduced gas leakage from long-distance transmission pipelines	
Separation and treatment of biodegradable municipal waste through recycling, composting and anaerobic digestion as well as landfill gas collection with combustion/utilization	Waste management
Upgrading primary wastewater treatment to secondary/tertiary treatment with gas recovery and overflow control	Agriculture
Control of CH ₄ emissions from livestock, mainly through farm-scale anaerobic digestion of manure from cattle and pigs	
Intermittent aeration of continuously flooded rice paddies	
BC measures (affecting BC and other co-emitted compounds)	
Diesel particle filters as part of a Euro VI package for road and off-road diesel vehicles	Transport
Elimination of high-emitting vehicles in road and off-road transport	
Replacing coal by coal briquettes in cooking and heating stoves	Residential
Pellet stoves and boilers, using fuel made from recycled wood waste or sawdust, to replace current wood-burning technologies in the residential sector in industrialized countries	
Introduction of clean-burning biomass stoves for cooking and heating in developing countries ^{2,3}	
Substitution of clean-burning cookstoves using modern fuels for traditional biomass cookstoves in developing countries ^{2,3}	
Replacing traditional brick kilns with vertical shaft kilns and Hoffman kilns	Industry
Replacing traditional coke ovens with modern recovery ovens, including the improvement of end-of-pipe abatement measures in developing countries	
Ban of open field burning of agricultural waste ²	Agriculture



9 Key Global Measures for Reducing BC Emissions

→ Many are typical for southern Asia!



Photograph courtesy of Energy project

Improved biomass stoves



Modern coke ovens



UNEP Photo

Remove mega-emitters / DPF



Cooking with clean fuel



Pellet biomass heating stoves



Improved brick kilns



Coal briquettes replacing coal



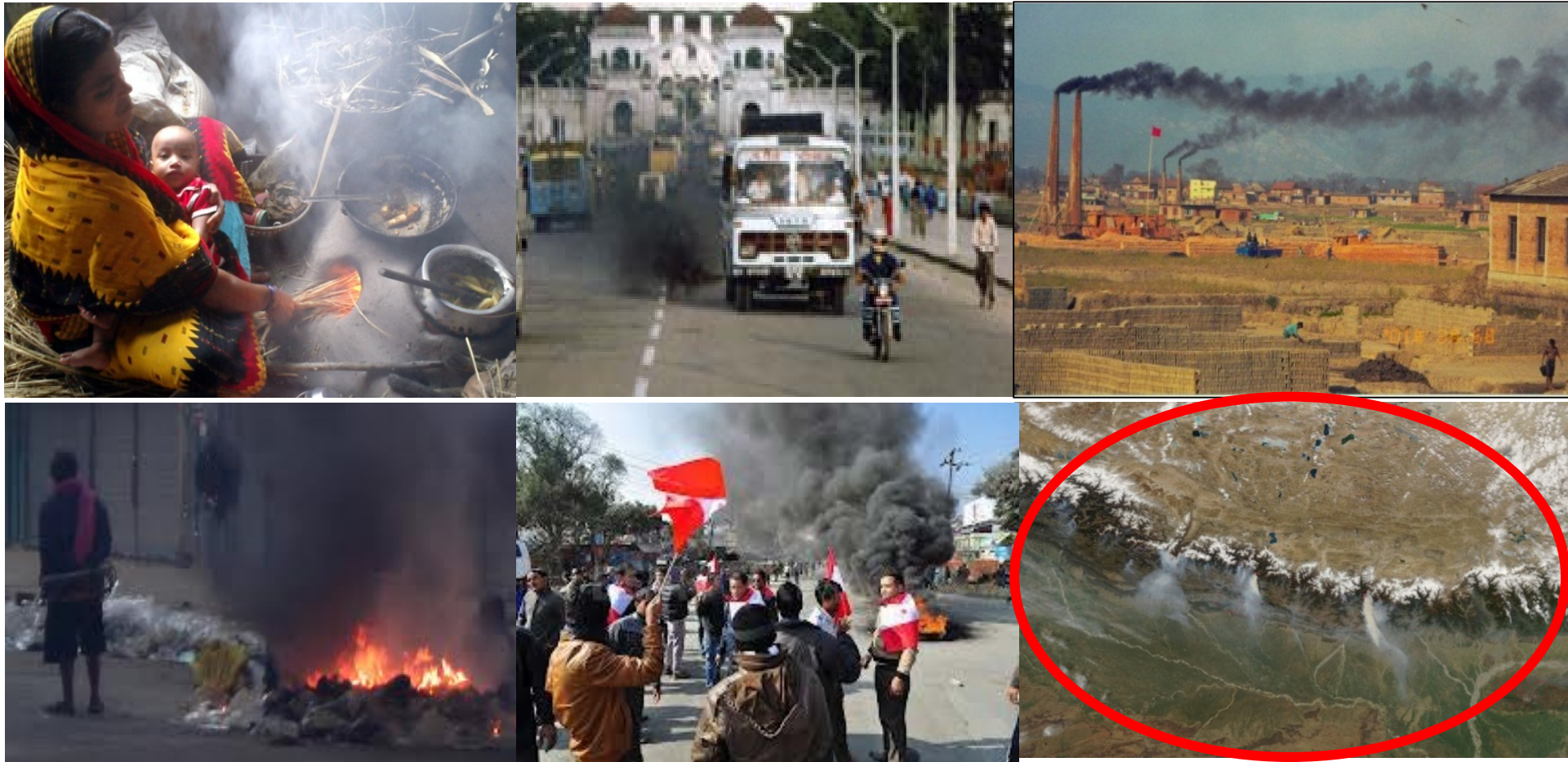
Reduce agricultural burning



UNEP Photo

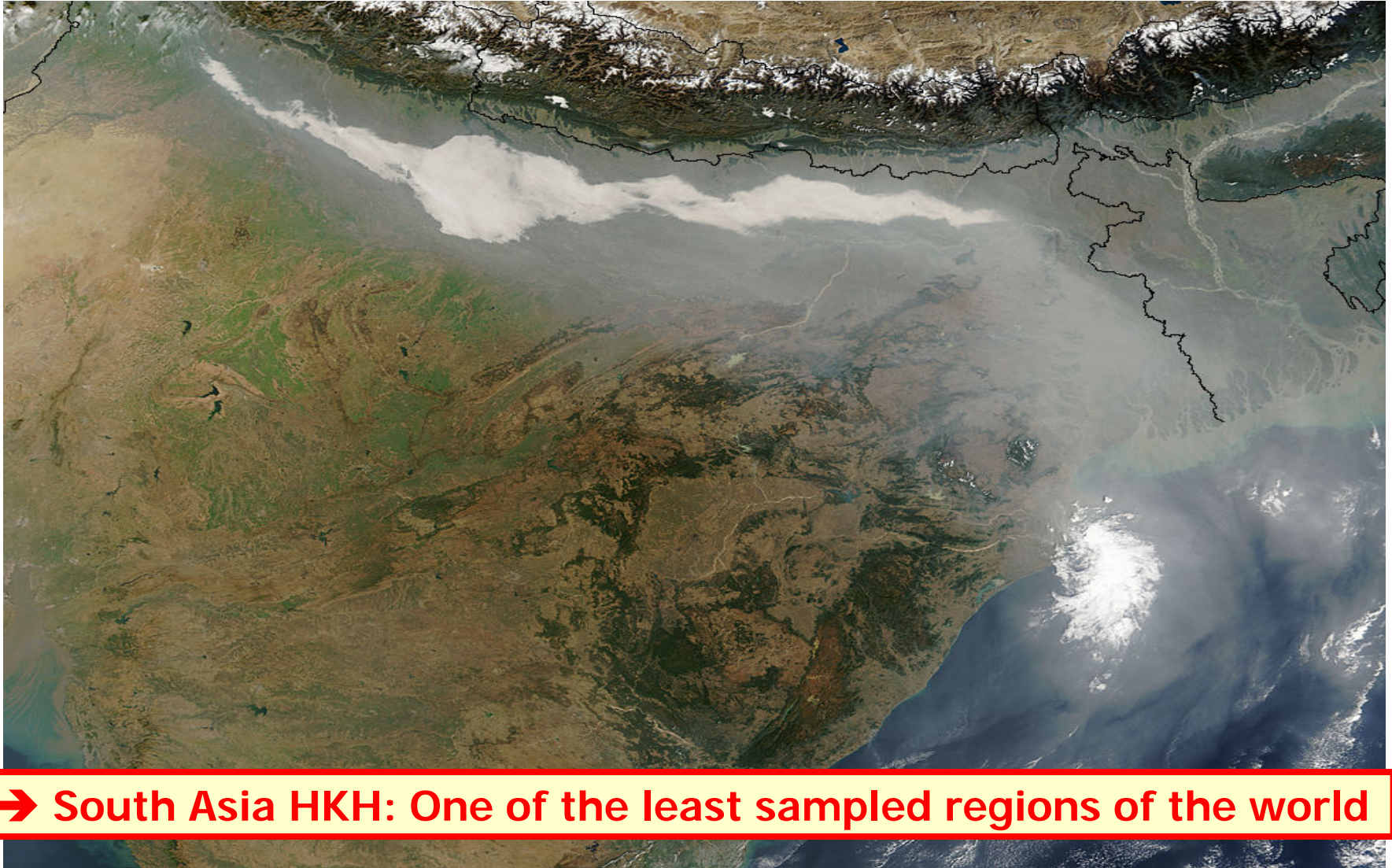
Reduce flaring

Southern Asia: Major Difficulties with SLCPs



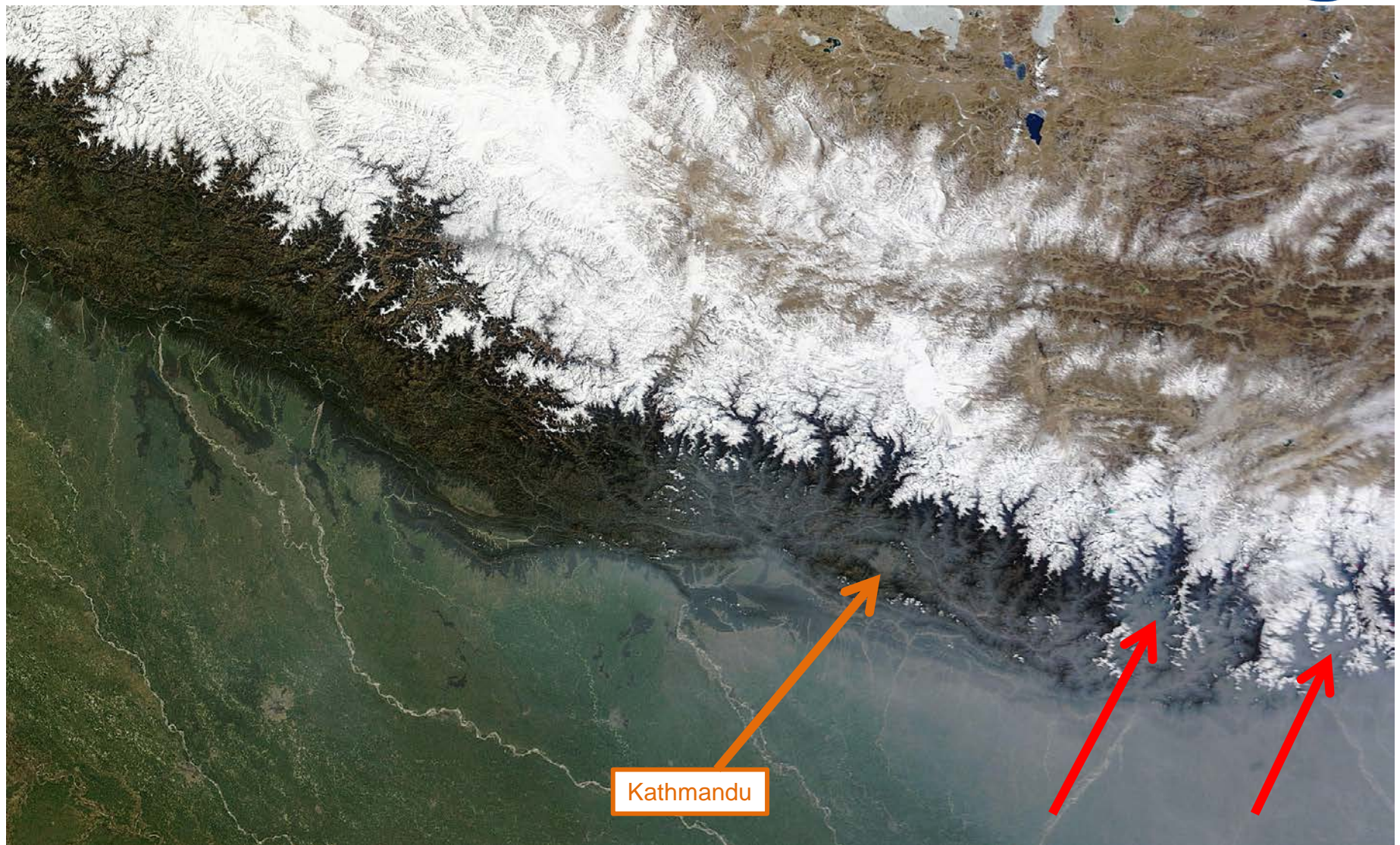
“River of Pollution”

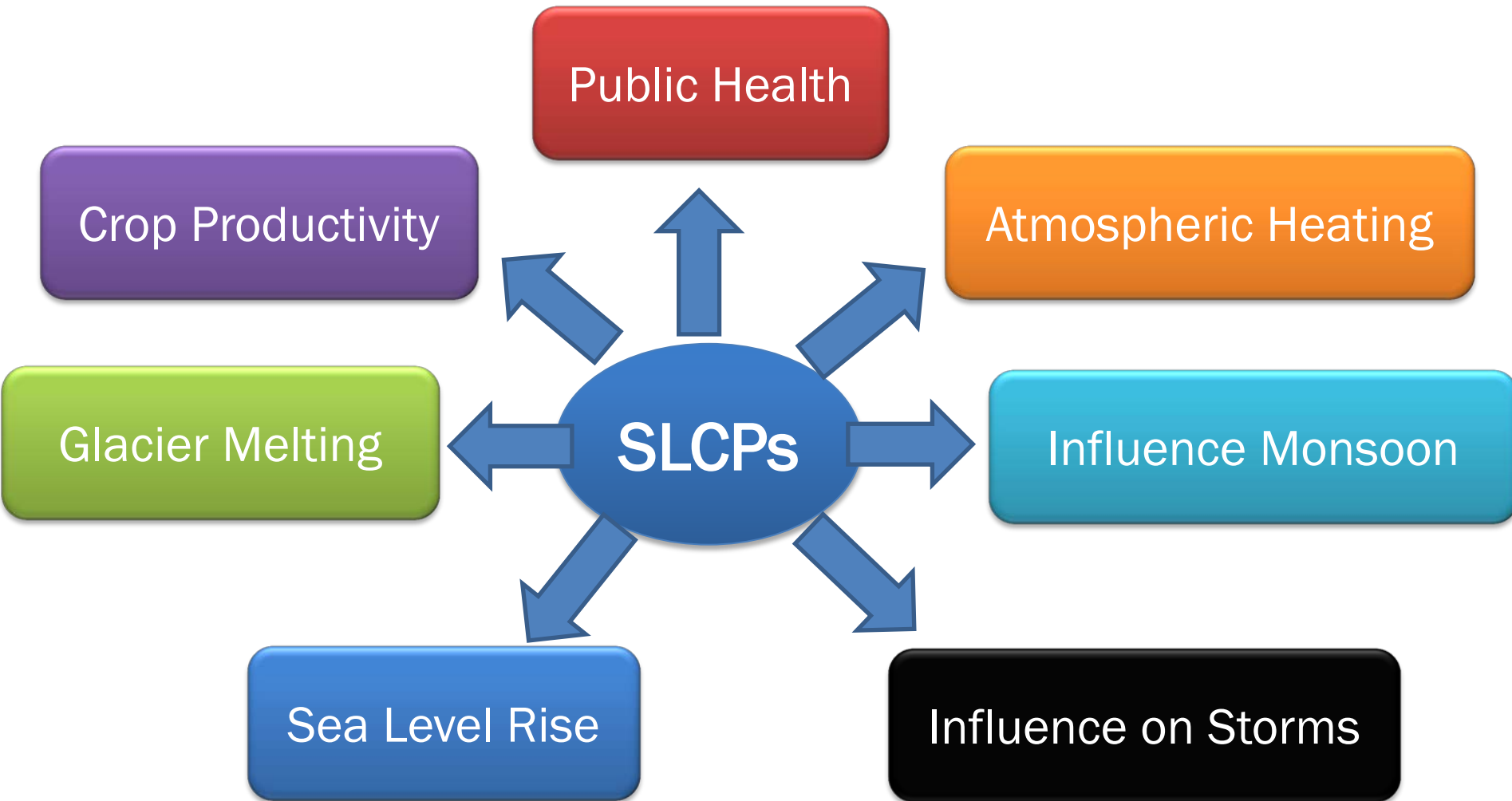
Regional pollution haze in the HKH Region (20 March 2013)



→ South Asia HKH: One of the least sampled regions of the world

Regional Air Pollution Intruding into the Himalayas

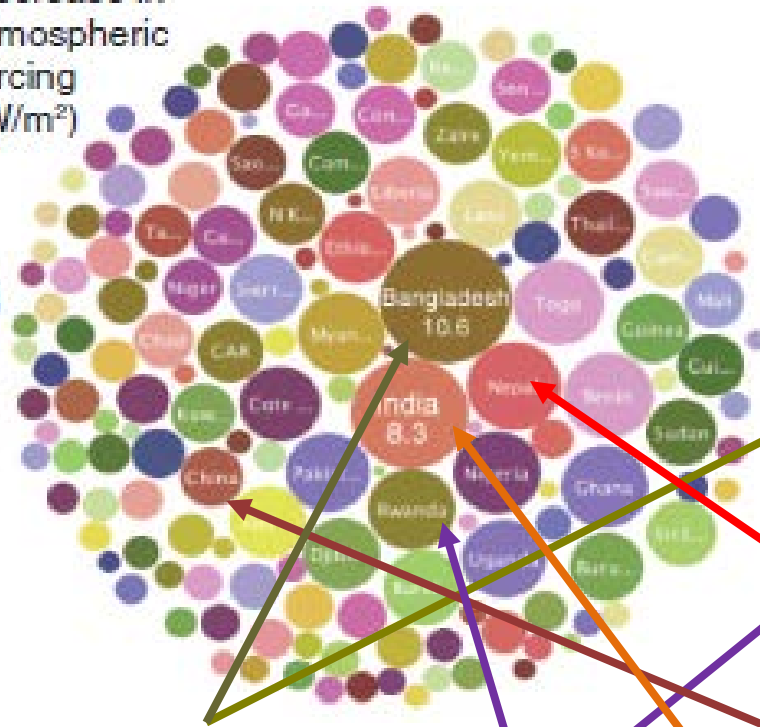




Extensive Benefits for (Southern) Asian Countries from Air Pollution Control

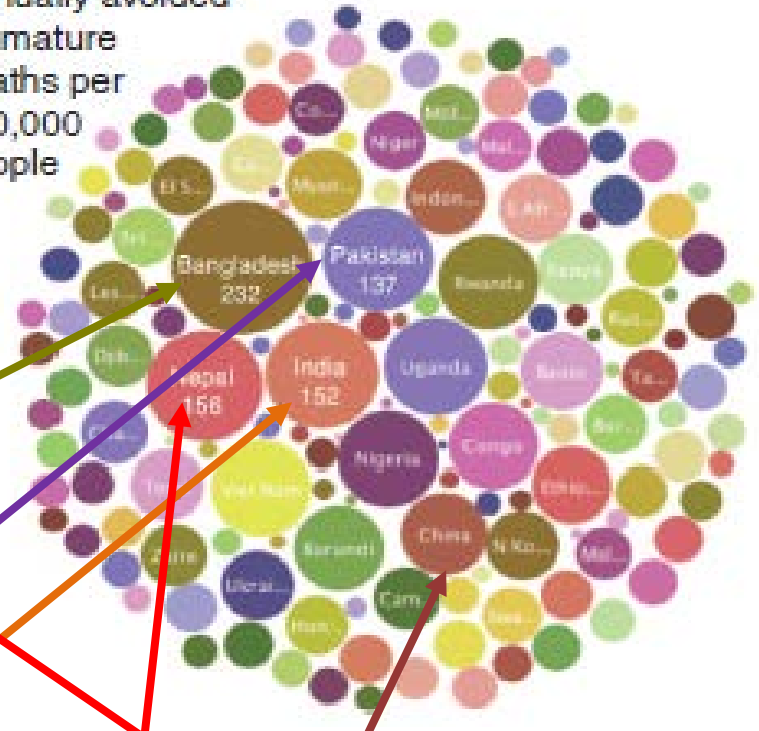
Decrease in atmospheric forcing (W/m^2)

B



Annually avoided premature deaths per 100,000 people

D



Bangladesh

Pakistan

India

Nepal

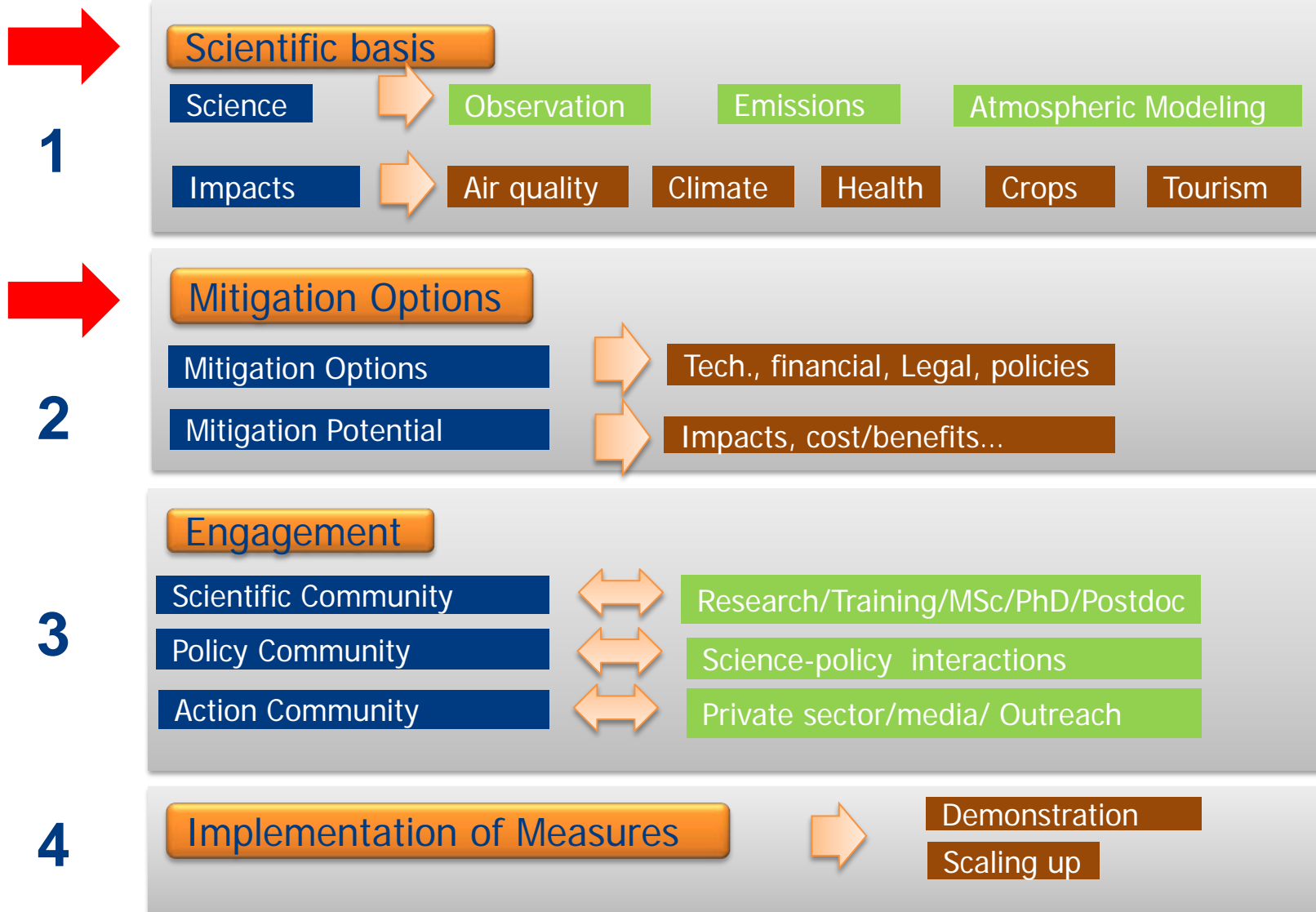
China

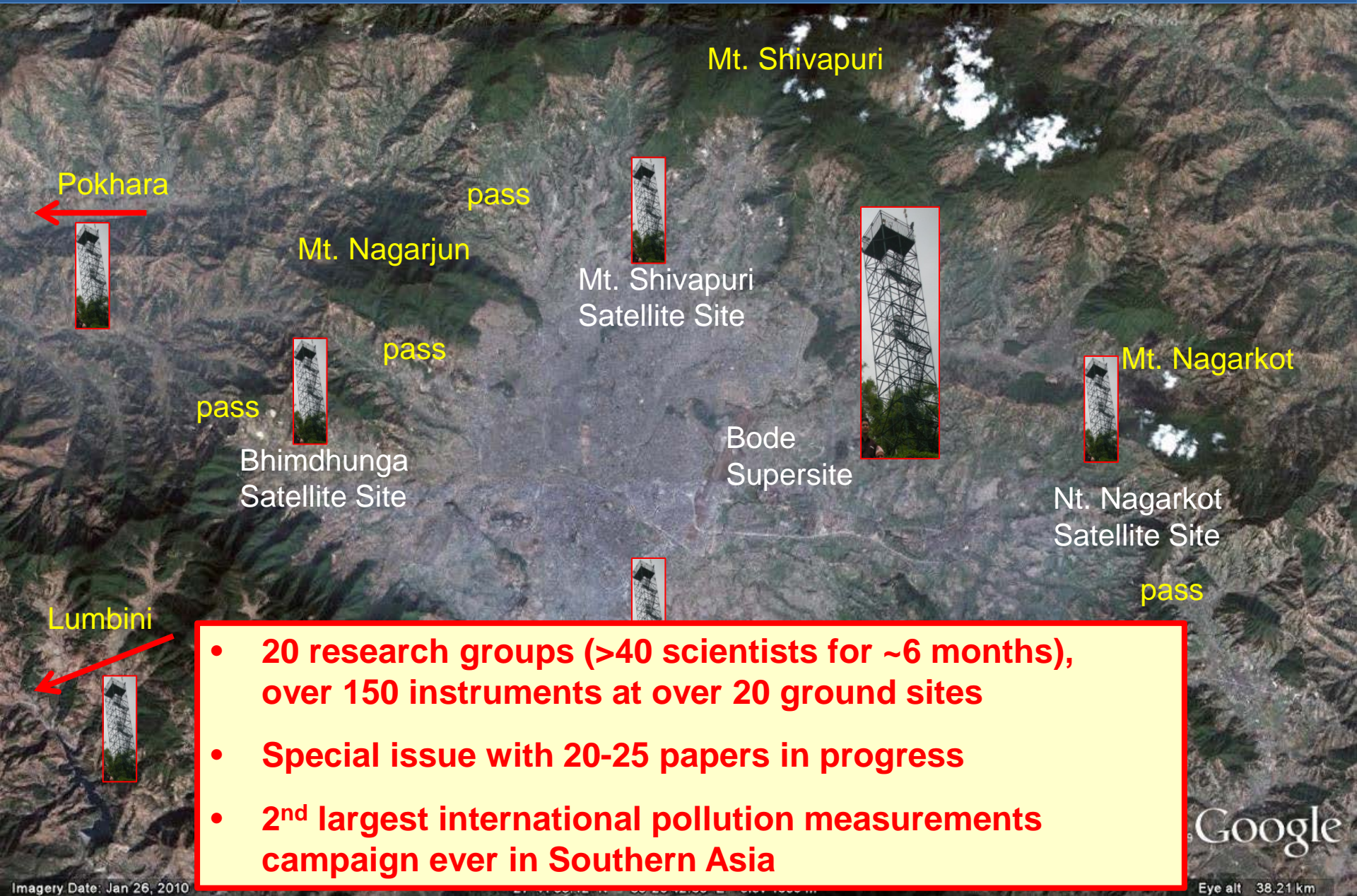
- clean-solutions
- grounded in sound science
- tailored to local context

→ One Response: *Pilot Studies (our example: Nepal)*

- Significant levels of pollution
- Yet manageable size for potential interventions
 - *Collaboration with ICIMOD and over 20 other research institutions*

SusKat: A Sustainable Atmosphere for the Kathmandu Valley





Pokhara

Mt. Shivapuri

pass

Mt. Nagarjun

Mt. Shivapuri
Satellite Site

pass

pass

Bhimdhunga
Satellite Site

Bode
Supersite

Mt. Nagarkot

Nt. Nagarkot
Satellite Site

pass

Lumbini

- 20 research groups (>40 scientists for ~6 months), over 150 instruments at over 20 ground sites
- Special issue with 20-25 papers in progress
- 2nd largest international pollution measurements campaign ever in Southern Asia

Collaborators



- **IASS:** M. Lawrence, [M. Rupakheti](#), J. Schmale, [K. Mahata](#), A. Lauer, A. Mues, P.S. Praveen ...
- **U. Mainz:** P. Hoor, H. Bozem,
- **KIT:** W. Junkermann



- **NASA:** B. Holben
- **UVA:** [A. Panday](#), [S. Dhungel](#)
- **U. Masstt.:** R. Peltier, [K. Shakya](#)



- **ICIMOD:** [A. Panday](#), [B. Banmali](#),
- **IOE TU:** [B. Sapkota](#), [Ram K. Sharma](#), [M. Thapa](#)
- **CDP TU:** [Ram P. Regmi](#) & Students



- **SNU:** S.C. Yoon, S.W. Kim, J.H. Kim ...
- **NIER:** J.S. Park,



- **ITP CAS :** S. C. Kang, Q.G. Zhang, Z. Luthi, [D. Rupakheti](#) ...



- **SU:** O. Gustafsson (SU), C. Bosch, A. Anderson



- **IISER-Mohali:** V. Sinha, C. Sarkar,
- **ARIES-Nainital:** M. Naja, P. Bhardwaj
- **PRL:** S. Lal
- **NARL:** A. Jayaraman, A. K. Pandit



- **Ev-K2-CNR:** P. Bonasoni, E. Vuilermoz, A. Marinoni, P. Cristofelli, [B. Adhikary](#), ...

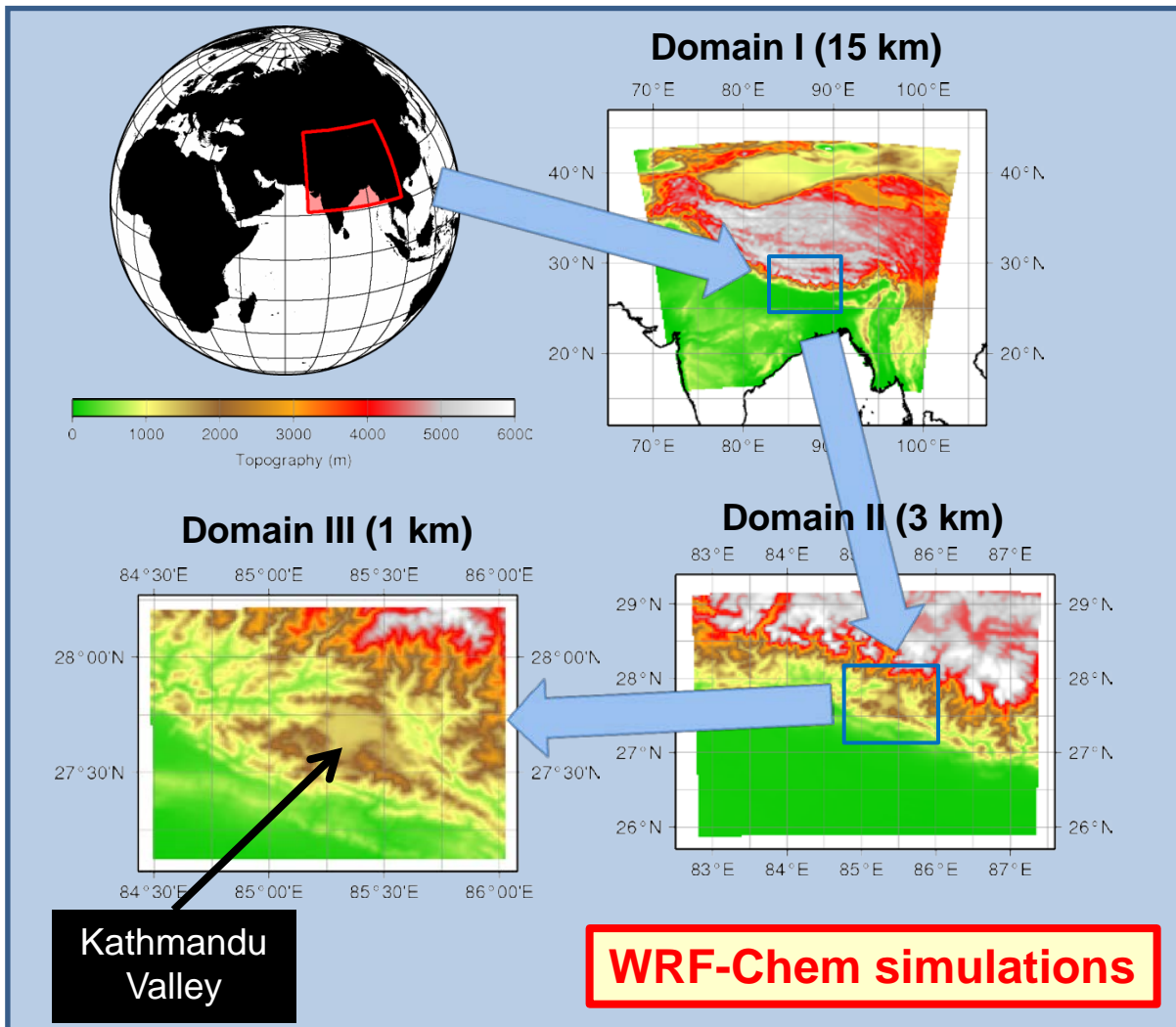
SusKat-ABC data workshop, 27-29 Aug 2013, Kathmandu



→ Next Steps:

- Data Analysis, Source Characterization
- Modelling (incl. Mitigation Scenarios)
- Impact Studies (esp. Health)

Sources, Impacts, and Mitigation Options



→ Health impacts intensive (traffic police) planned for Jan. 2014



Photos: Mark Lawrence

SusKat: An end-to-end project:

1

Scientific basis

Science



Observation

Emissions

Atmospheric Modeling

Impacts



Air quality

Climate

Health

Crops

Tourism

2

Mitigation Options

Mitigation Options



Tech., financial, Legal, policies

Mitigation Potential



Impacts, cost/benefits...



Engagement

Scientific Community



Research/Training/MSc/PhD/Postdoc

Policy Community



Science-policy interactions

Action Community



Private sector/media/ Outreach

4

Implementation of Measures



Demonstration

Scaling up

Engagement Example

Science-Policy Seminar on SLCPs, 22 Nov 2012, Kathmandu



Involvement of a Broad Range of Stakeholders



Government: Joint Secretary-MoEST



Politicians: Former Minister-MoEST



Experts: Scientists



Students and Fellows: Capacity building

Involvement of a Broad Range of Stakeholders



Movie Actors



Media

Civil Society:
Spiritual Leaders



Private Sector: Brick Manufacturers Assoc.

- Science has made a strong case that cannot be ignored: SLCPs are a significant threat to development in South Asia
- Need to continue advancing SLCP science in the region
- Connect to local policy makers and other key stakeholders: Benefits are greatest near where emissions are cut, and extend to other regions through climatic and economic benefits.

For more information:

<http://www.iass-potsdam.de/regional-focus-sustainable-atmosphere-kathmandu-valley>

<http://www.unep.org/ccac/>