Mitigating Near-Term Climate Change while Advancing Human Development

Drew Shindell

NASA GISS

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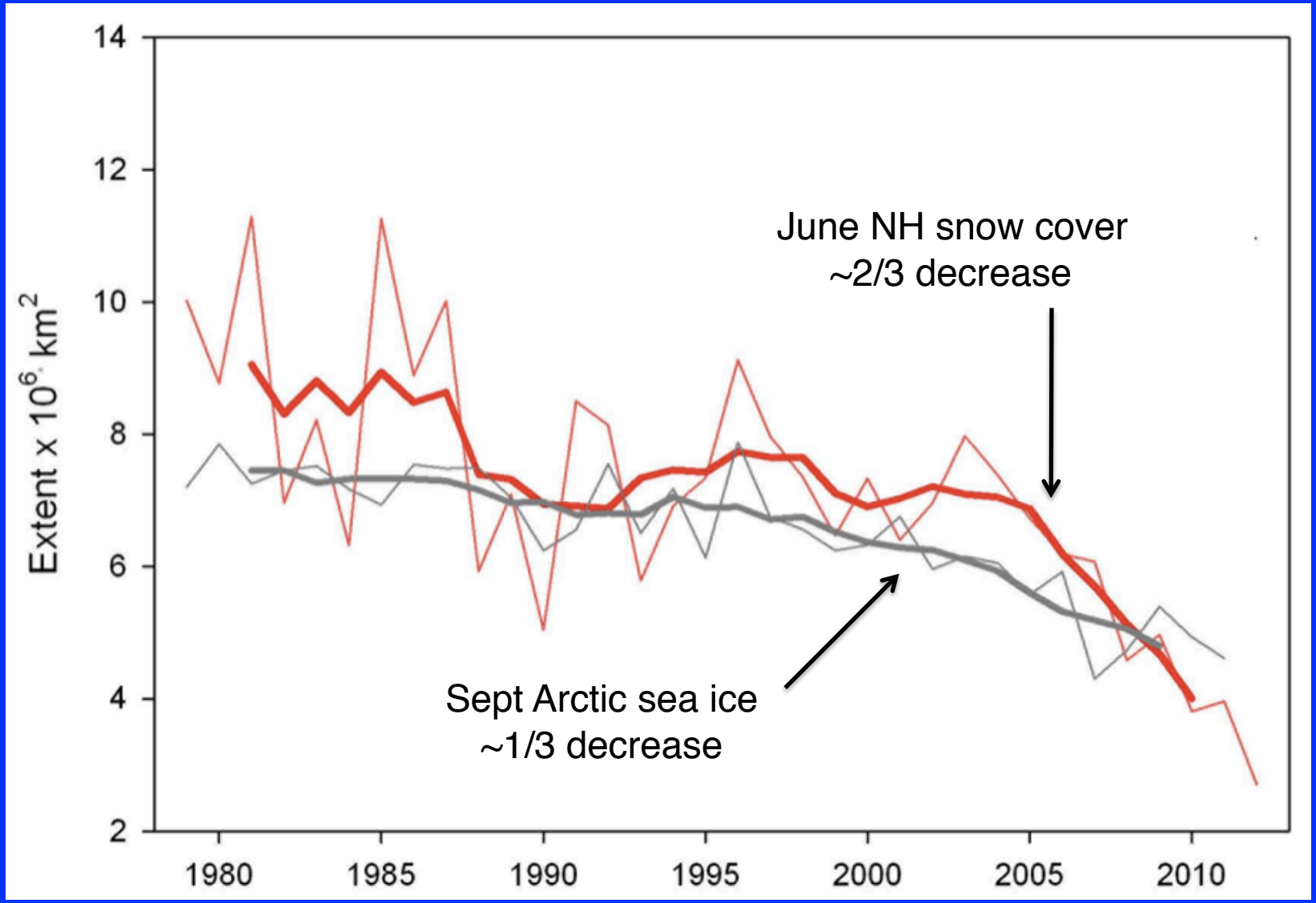
Climate change is not only a problem in 2100



Derksen & Brown, GRL, 2012

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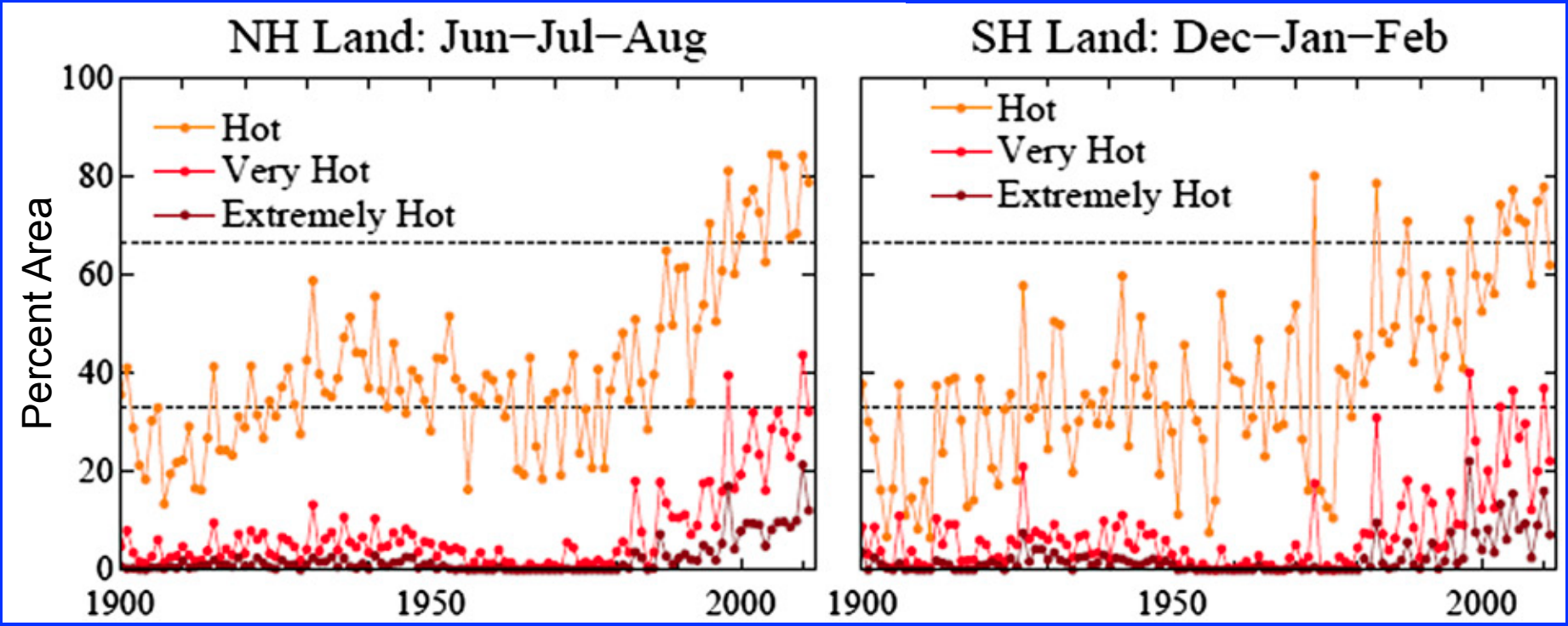

Relative to 1951-1980 base period

Hot is >0.43 std dev
Very hot is >2 std dev
Extremely hot >3 std dev

Hansen et al, PNAS, 2012

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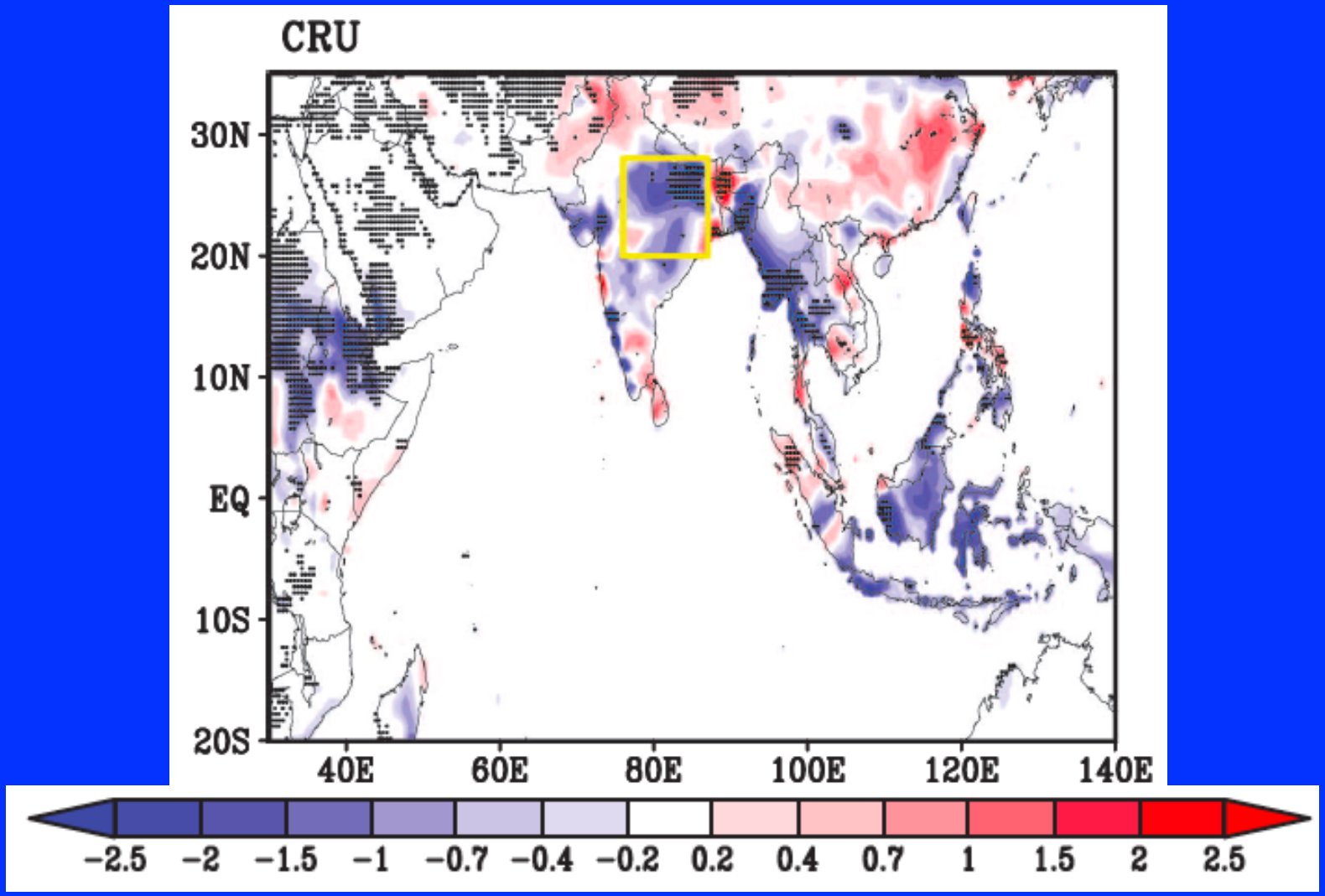
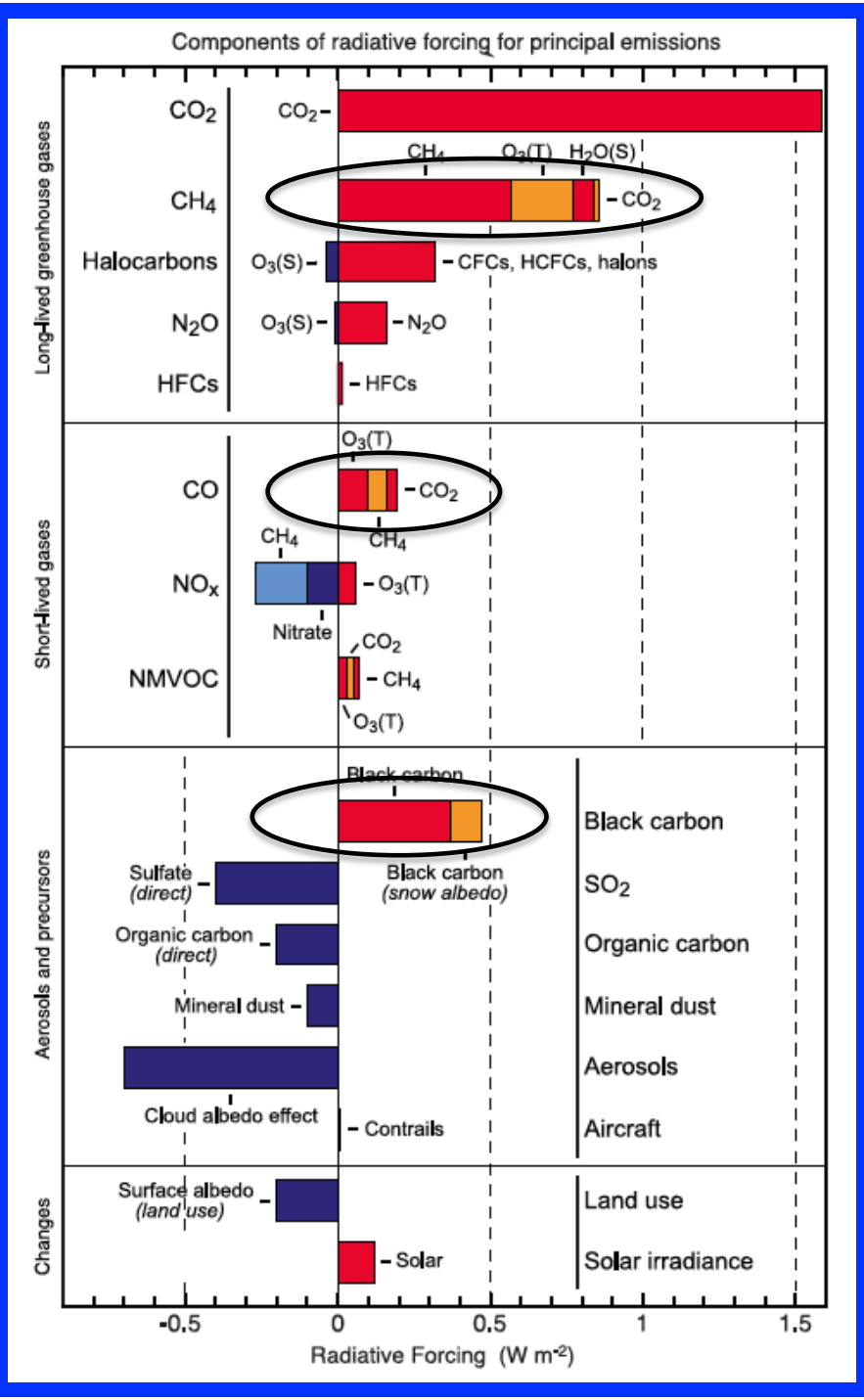


1950-1999 June-Sep trends (mm per day)

Bollasina et al, Science, 2012



Climate change is driven by many agents

Historical methane + CO + BC approx. equal to CO_2

Degrade air quality

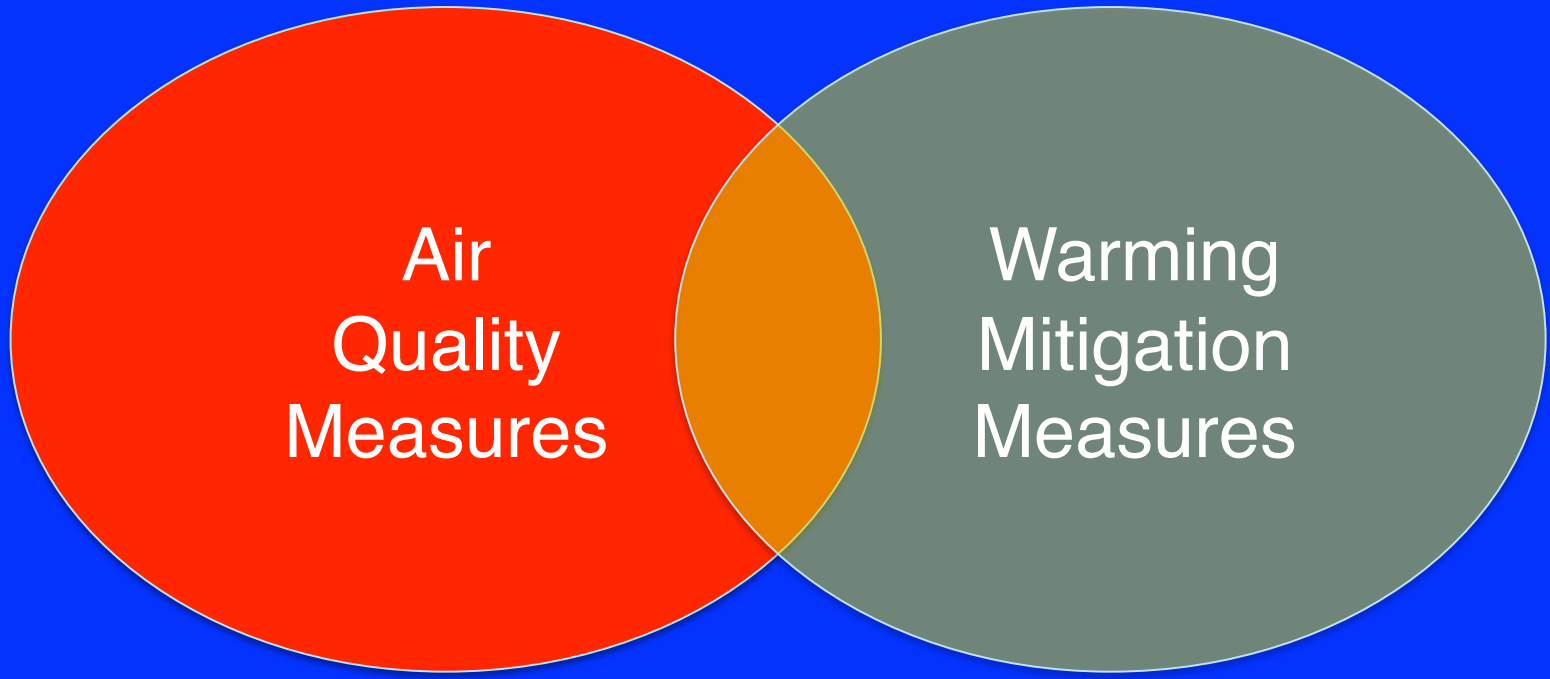
Relatively short-lived

IPCC AR4, 2007

Idealized removal of BC or ozone precursors would obviously be a ‘win-win’

Are there practical ways to achieve that?

UNEP/WMO agreed to try and find out



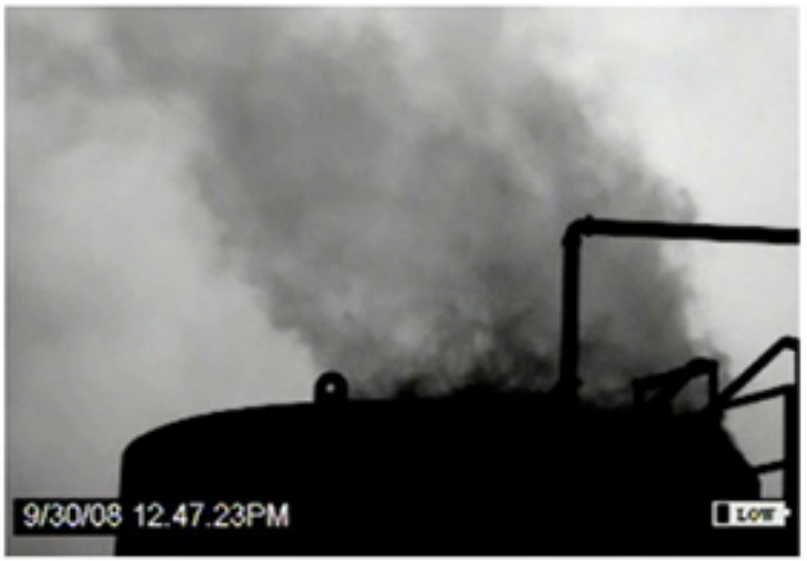
Screening of ~400 measures

Emission Control Measures in the Analysis

- Ranked by net GWP, picked the top measures

‘Methane measures’

– extraction and long-distance transport of fossil fuels
– waste management; municipal, landfills & wastewater
– agriculture; livestock manure & intermittent rice aeration



‘BC Measures’: reduce emissions of black carbon and co-emissions (e.g. OC, CO)

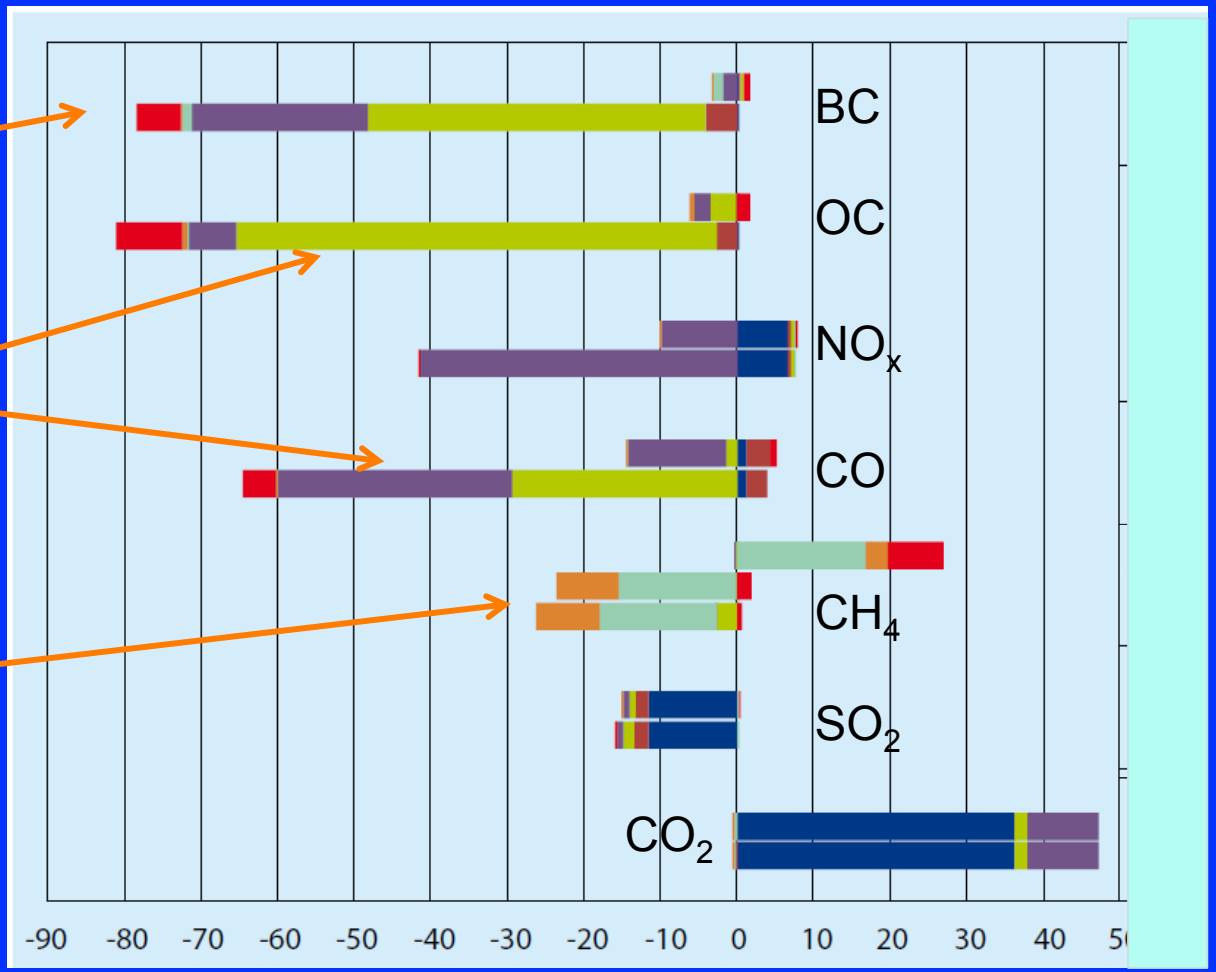
- Diesel vehicles (particle filters+)
- Replacing coal in residential stoves
- Replacing residential wood burning in Industrialized countries
- Clean-burning cookstoves in developing countries
- Modern brick kilns
- Modern coke ovens
- Ban of open burning of agricultural waste

Effect of measures on emissions projected in 2030 relative to 2005

9 BC measures reduce ~80% of BC

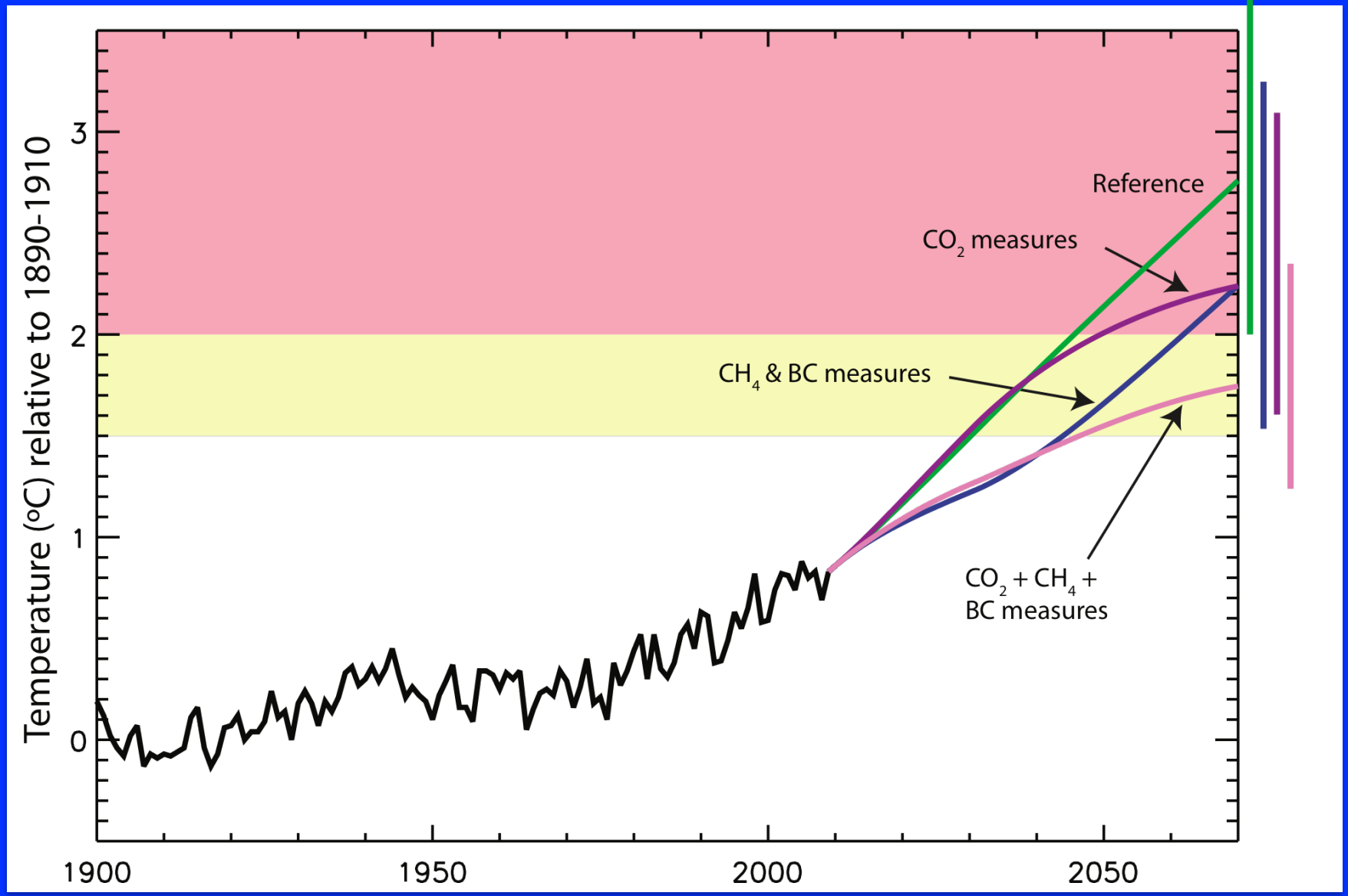
BC measures also reduce OC, CO

Reference: CH_4 increases
7 CH_4 measures reduce
~ 40% relative to 2030

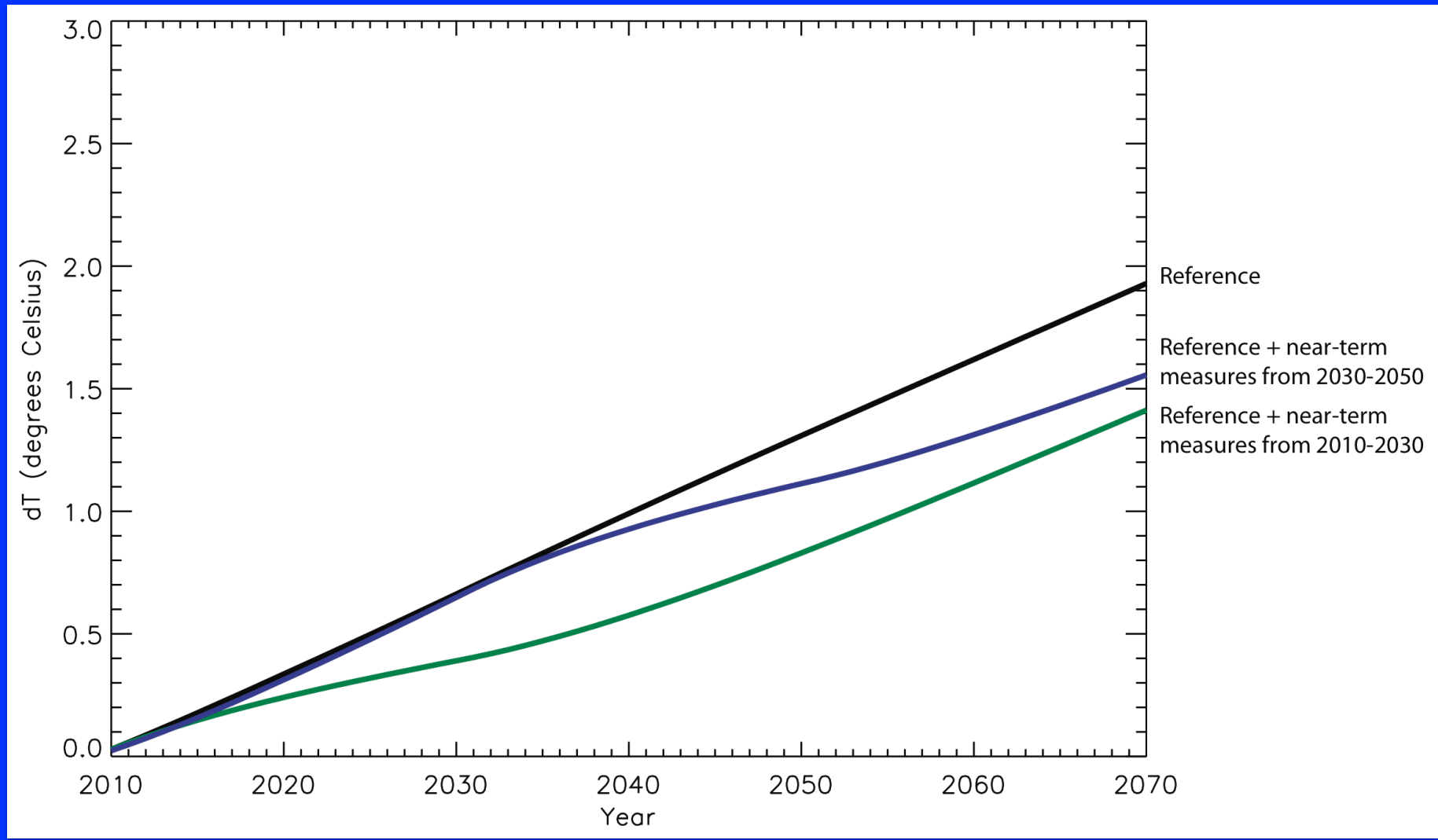


Change in emissions in 2030 compared to 2005 (%)

Global Temperature Change



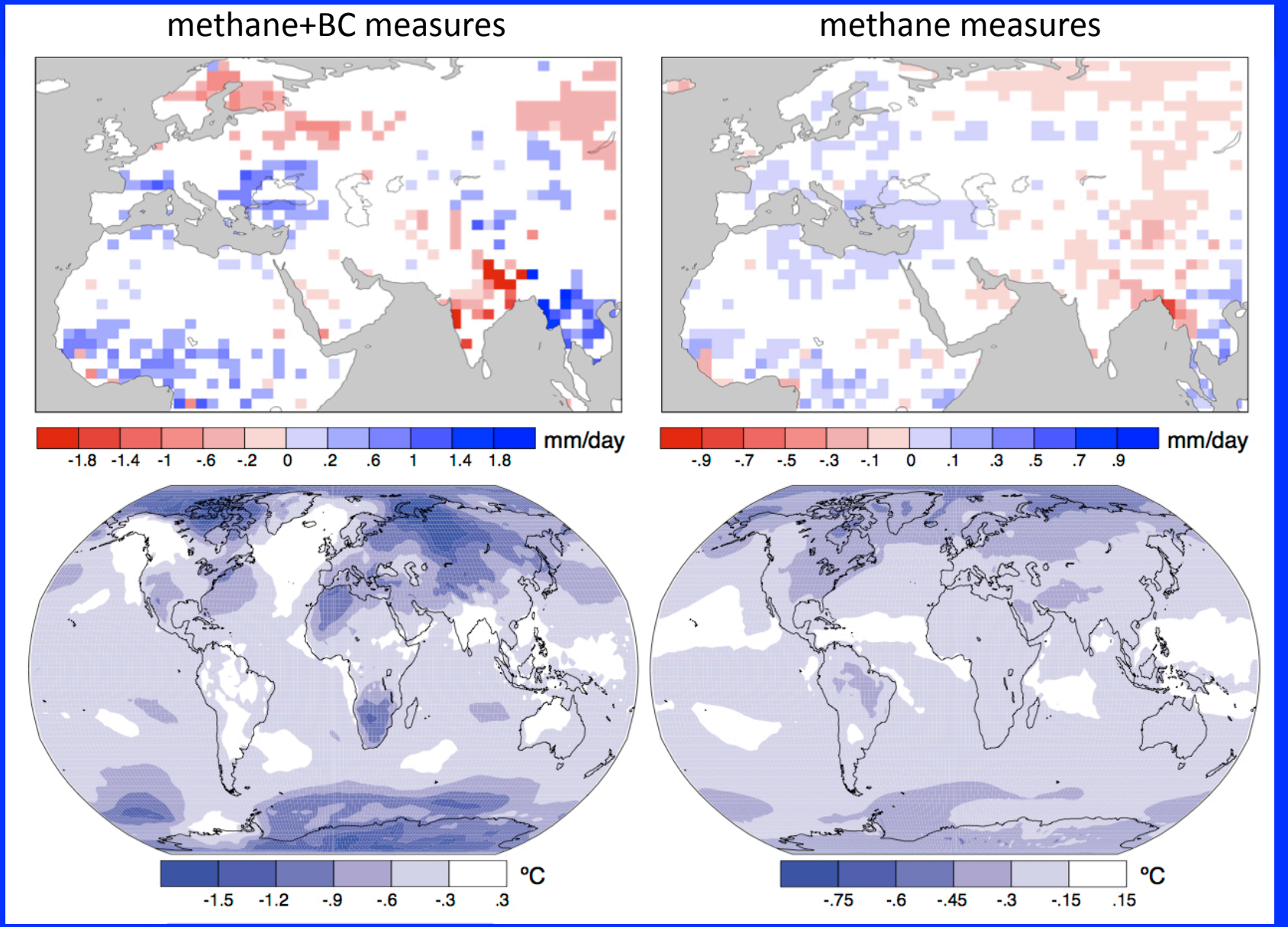
Shindell et al, Science, 2012



Phasing in measures early gives strong near-term benefit

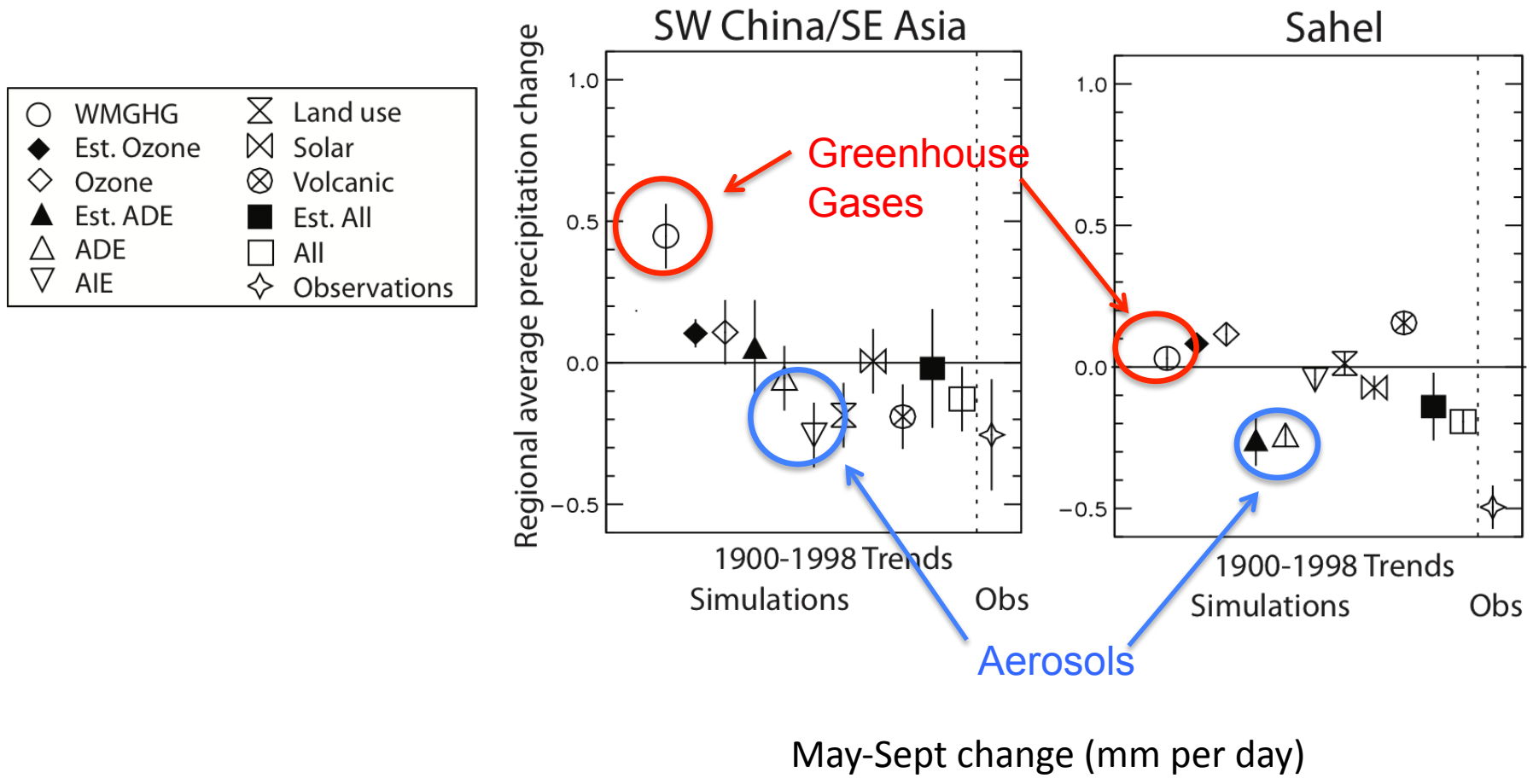
Early action relative to late has little long-term impact

Mitigation of Regional Climate Changes



Response to BC much larger than response to equivalent global mean GHG forcing

Mitigation of Regional Climate Changes

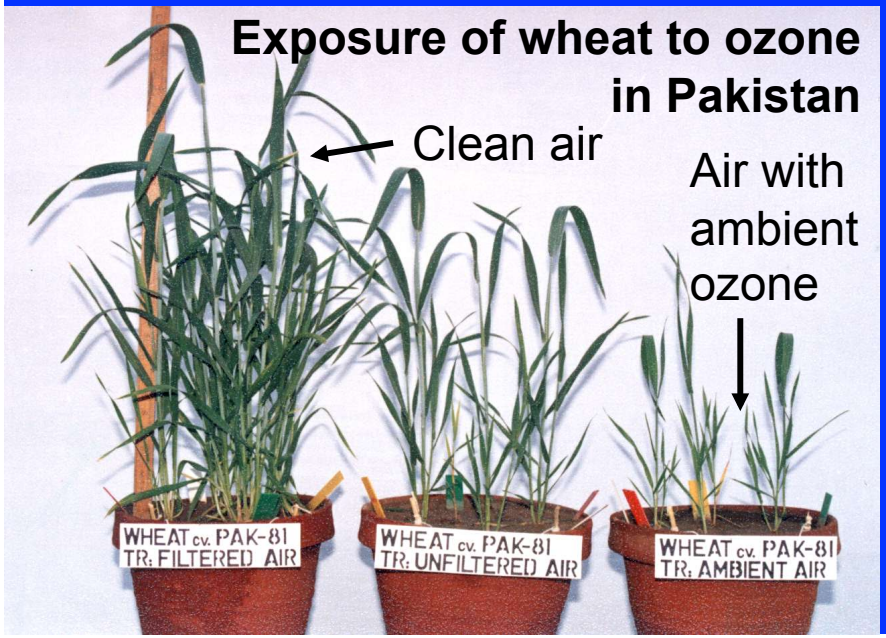


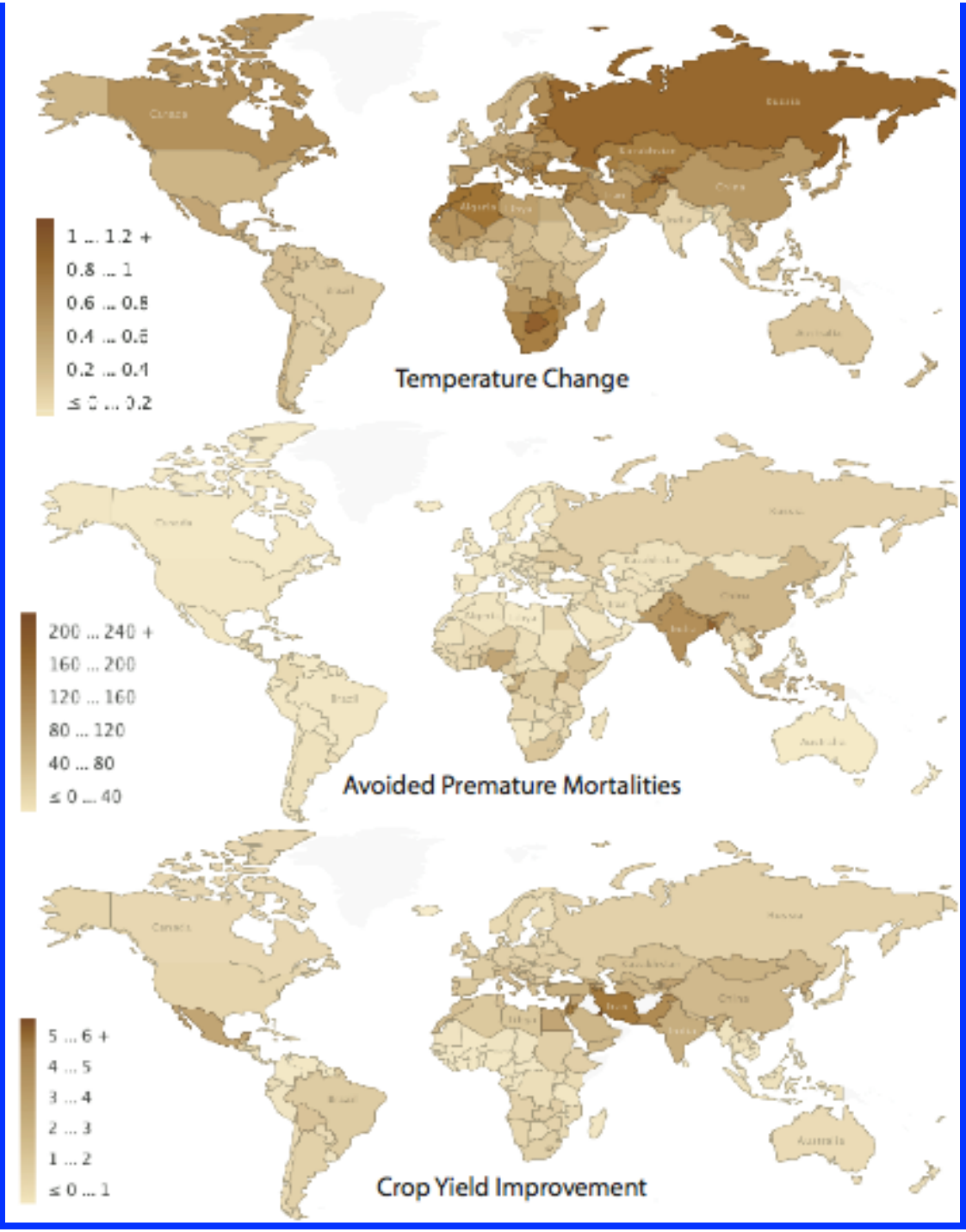
GFDL NE India trends: -0.95 observed, -0.39 aerosols, +0.55 WMGHG/Ozone
Bollasina et al., Science, 2011

Shindell et al., ACP, 2012

Impact of the Measures on Health and Crop yields

- Models give **$PM_{2.5}$ and ozone concentrations** for health and crop yield impact assessment
- Concentration-response relationships from literature used to evaluate global impacts

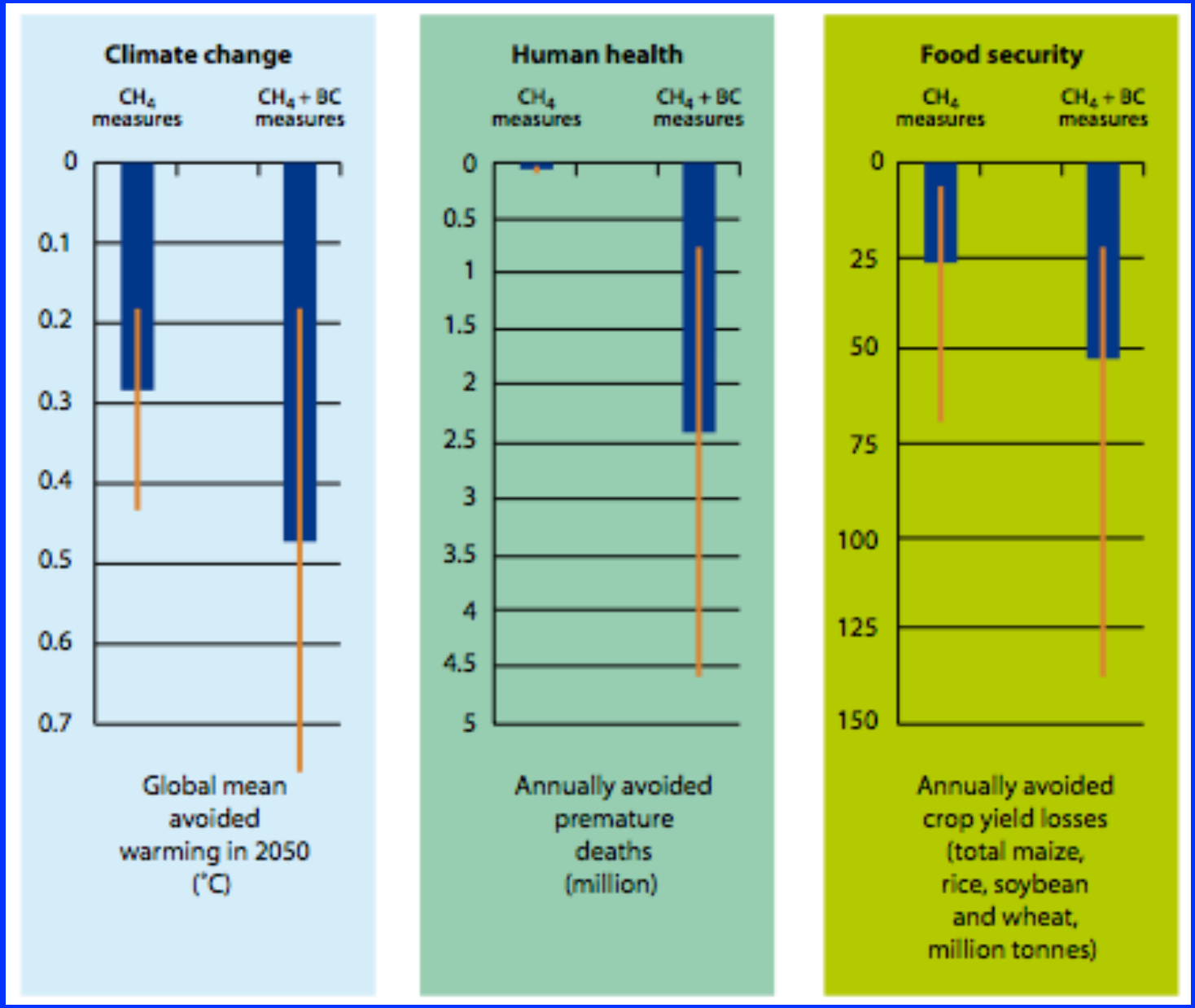




Projected 2010-2050 warming cut by half

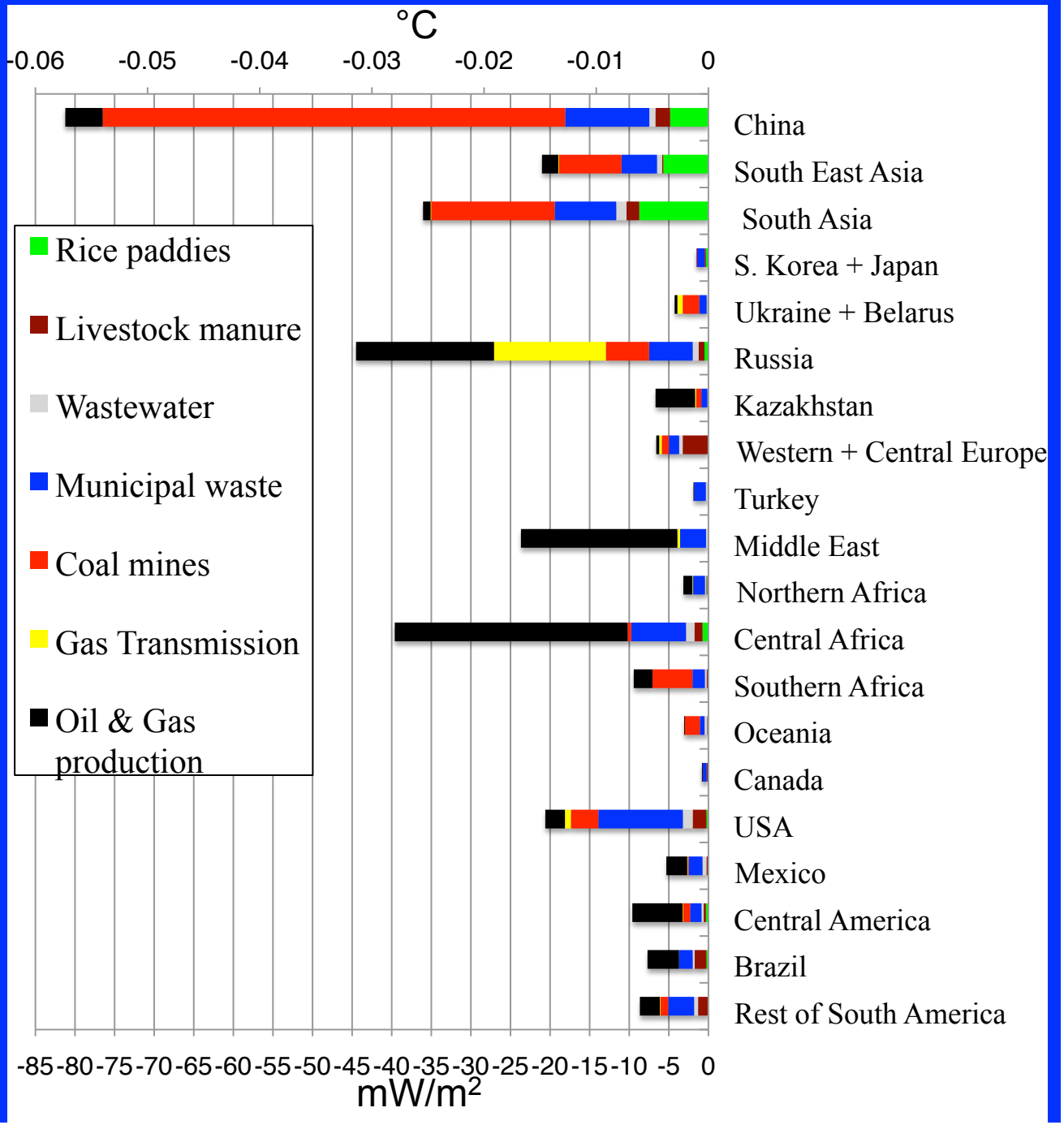
More than 3 million premature deaths prevented every year

More than 50 million tons of crop yield increases every year



Air quality benefits for 2030 and beyond.
Health & crop benefits greatest in regions that reduce emissions.

Methane's impact can be easily broken down by sector and region



Shindell et al., Science, 2012

Benefits and Costs

Methane measures (billions $US):

~$330 climate, ~4 crops, ~150 health

~$3500 benefits per ton

Most methane abatement measures cost less than $250/ton.

BC measures (billion $US):

~200 climate, ~4 crops, ~5000 health

~50% of BC measures have net cost savings, another 25% (ag waste burning, high-emitting vehicles) largely regulatory

Associated Development Benefits

- Biomass stoves
  - Time
  - Reduced deforestation

- Efficient kilns/coke ovens
  - Time & fuel (50%)

- Methane capture
  - Increased energy security

Policies to Implement the Measures

- All in use in different regions
- Much wider and more rapid implementation is required
- Initial capital investment can be problematic

CDM funded coal mine methane project in China

Loans for efficient charcoal stoves in Ghana

Policy Implications

- Methane - part of UNFCCC negotiations
  - *'exchange rate' only takes into account 100-yr climate impact*
- BC measures - distinct differences with respect to WMGHG policies
  - *Localized benefits*
  - *Health benefits*
- WMGHGs a 'common good' - incentivizes doing less and encouraging others to do more
- 'Local good' much easier to get cooperation
- Health important issue everywhere (unlike climate change)

Policy Implications

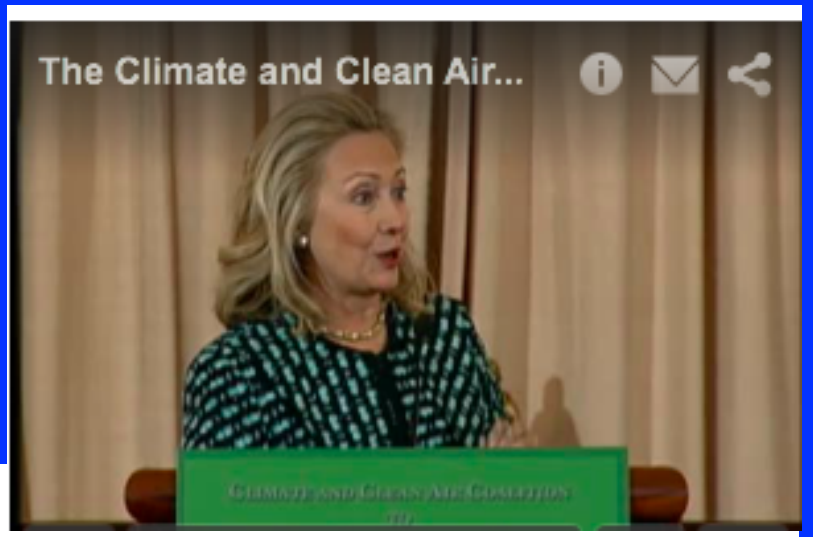
- CO_2 and CH_4/BC: different sources, different impacts

- Argues for two pronged strategy
  - Long-term climate stabilization (mostly CO_2)
  - Near-term climate change mitigation and human development

- Reducing near-term warming rate important to:
  - those already suffering from the impacts of climate change
  - preventing biodiversity loss
  - providing additional time for adaptation
  - realize the health and agricultural benefits

International Response

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



The New York Times

“A Second Front in the Climate War”

hindustantimes

“Simple measures could reduce global warming, save lives”

The south Asian countries of India, Bangladesh and Nepal would see the biggest reductions in premature deaths.

Reducing both SLCPs and CO_2 important!

Distinct societal goals

More multi-impact perspective can potentially lead to progress in reducing CO_2 as well

Near-term for our children's generation

Long-term for our great-grandchildren's generation