



UNEP/WMO Integrated Assessment of Black Carbon and Tropospheric Ozone



Main Findings

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UNEP/WMO Integrated Assessment of Black Carbon and Tropospheric Ozone

- Black carbon, BC, and tropospheric ozone, O_3 , are **harmful air pollutants that also contribute to global and regional climate change**
- Scientific evidence and new analyses demonstrate that control of black carbon particles and tropospheric ozone through rapid implementation of proven emission reduction measures would have **immediate and multiple benefits for human well-being**
- Together with methane, an important precursor to ozone, these are termed '**Short-Lived Climate Forcers**' due to short residence time in atmosphere compared to CO_2

Black Carbon

- carbon-containing **particulate matter (PM)**
- absorbs light, affects health as PM
- results **from inefficient and incomplete combustion**
- emitted together with CO₂, CO, organic particulate matter (OC), other PM_{2.5}, SO₂, NO_x

~25%



~10%
of global
BC emissions

~7%



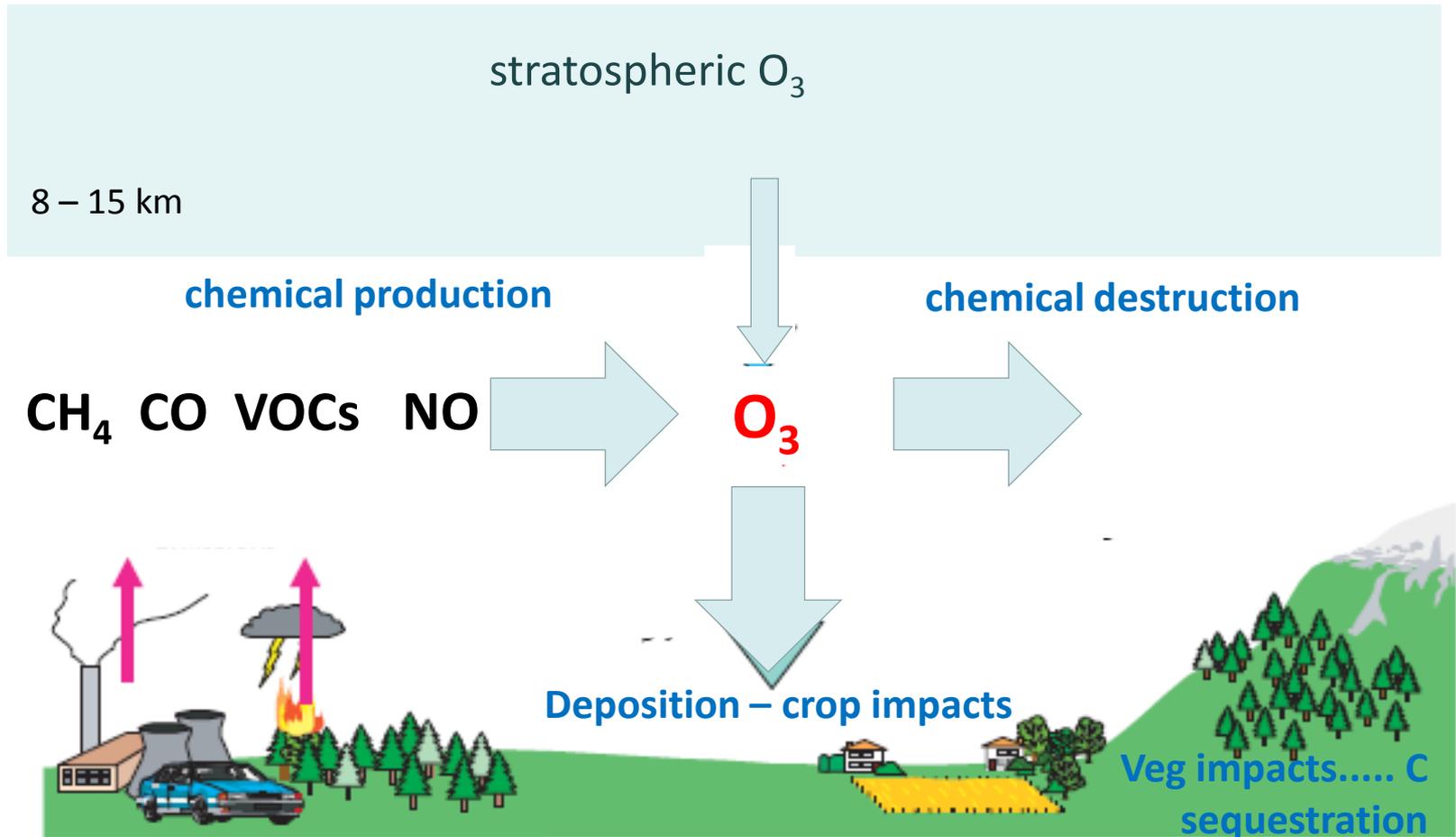
~50%

some 60% of the *total* BC emissions
is amenable to control

Tropospheric Ozone

stratosphere

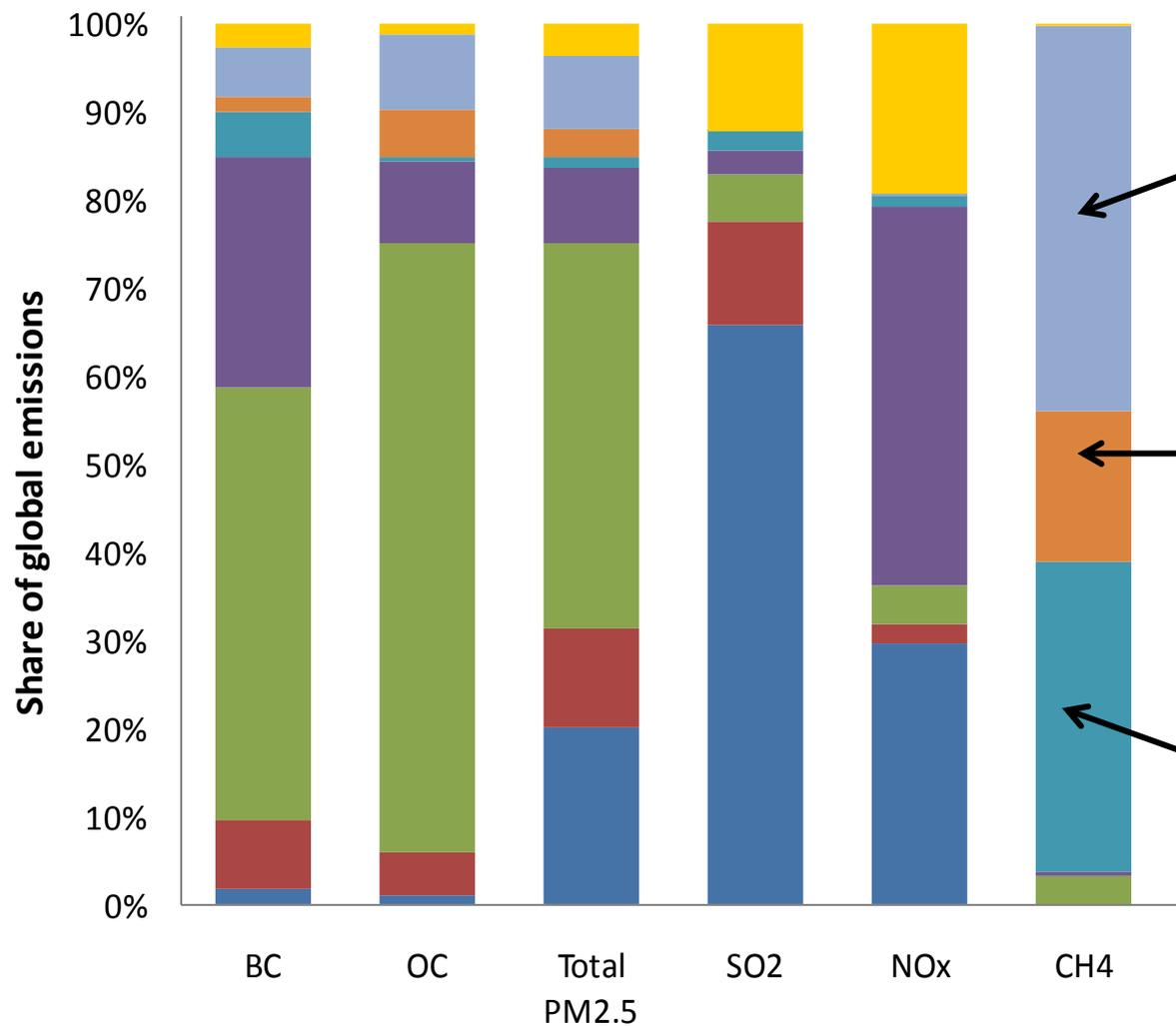
troposphere



cattle
gas leaks
mining
biofuels
fossil fuels

increase of precursor emissions by man has **more than doubled** the concentration of tropospheric ozone since pre-industrial times!

Sources of CH₄ emissions



- Large-scale combustion
- Industrial processes
- Residential-commercial combustion
- Transport
- Fossil fuel extraction and distribution
- Waste /landfill
- Agriculture
- Solvents
- International shipping and aviation

NCO-P web-cam images of Khumbu valley



evk2 - isac - cnr 2010-04-07 10:46:08

Morning conditions



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Afternoon conditions



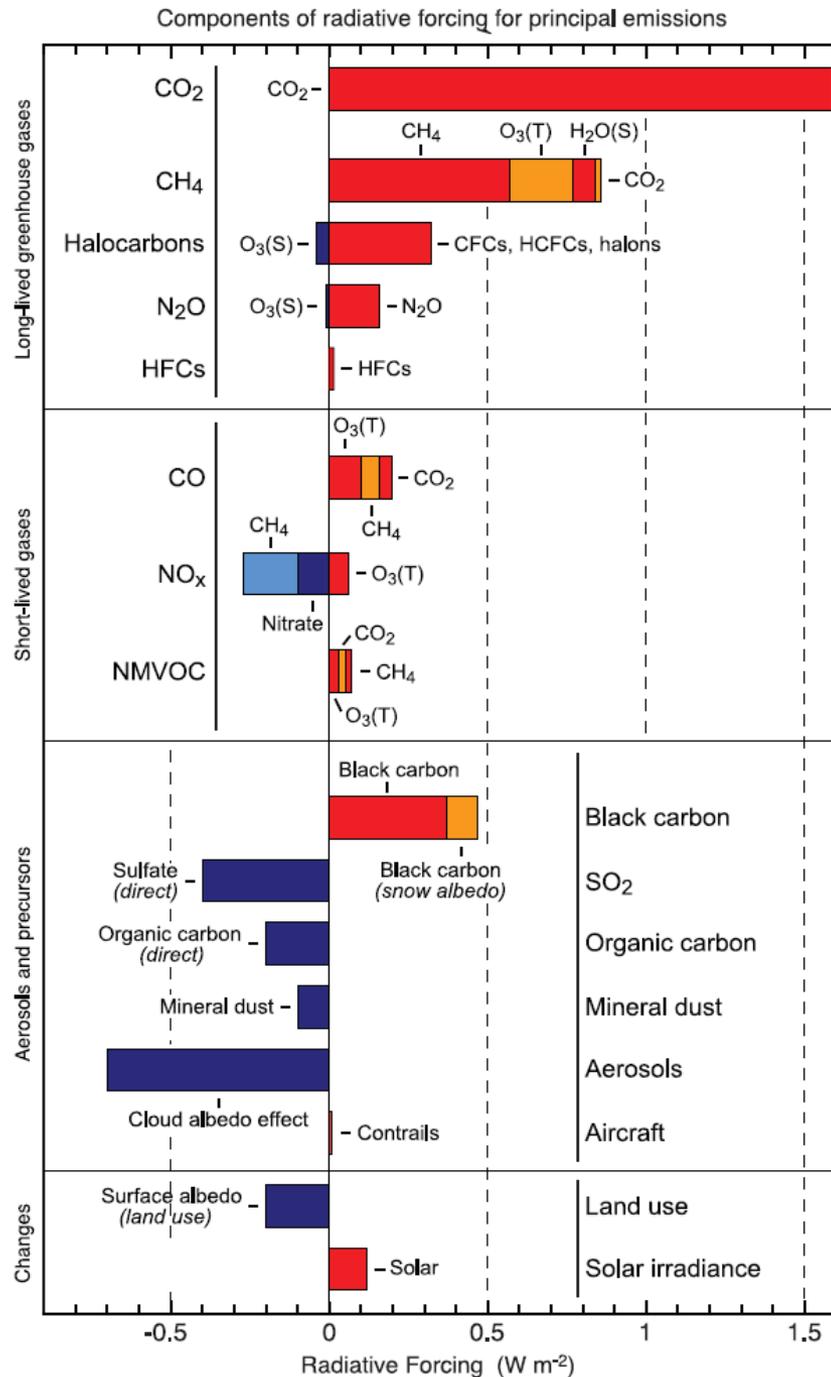
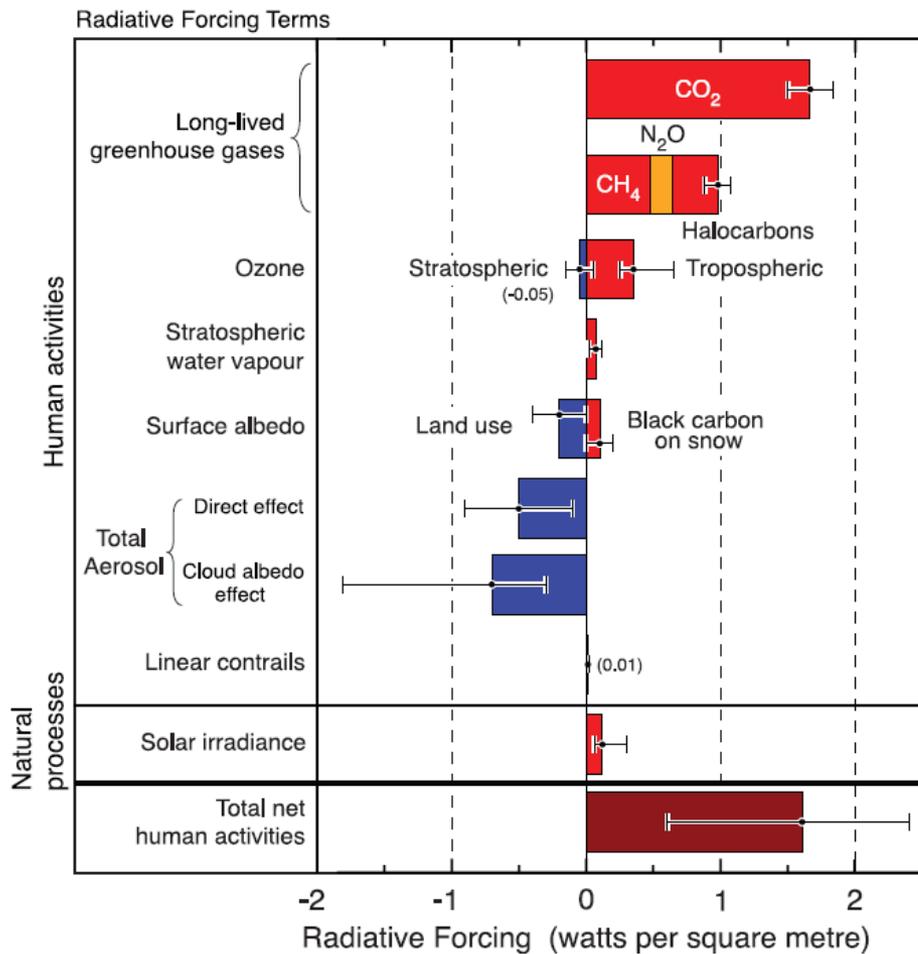
Source: CNR ISAC



Components of Radiative Forcing for emissions of principal gases, aerosols and aerosol precursors.

Values represent RF in 2005 due to emissions and changes since 1750.

Radiative forcing of climate between 1750 and 2005



Assessment Objectives

- To review the scientific literature on black carbon (BC), tropospheric ozone and its precursors and assess the state of knowledge of their influence on climate and impacts as air pollutants
- To assess the extent by which carefully identified measures using existing technology to address BC and ozone can help protect near-term global and regional climate change
- Determine the co-benefits of the selected measures on health and crops
- Identify how the selected measures can be widely implemented with reference to case studies



Emission Control Measures in the Analysis

IIASA ranked mitigation measures by the net GWP of their emission changes (considering CO, CH₄, BC, OC, SO₂, NO_x, nmVOCs, and CO₂), picked the top measures

‘Methane measures’

- extraction and long-distance transport of fossil fuels (~25%)
 - waste management; municipal, landfills & wastewater (~10%)
 - agriculture; livestock manure & intermittent rice aeration (~5%)
- (% reduction in 2030 relative to reference)



Black Carbon Measures

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

- Diesel vehicles (particle filters+)
- Eliminate high emitting vehicles
- Coal briquettes replacing coal in residential stoves
- Pellet stoves & boilers replacing residential wood burning in industrialized countries
- Clean-burning cookstoves in developing countries OR replace biomass with other fuel
- Modern brick kilns
- Modern coke ovens
- Ban of open burning of agricultural waste



Policy packages used in the assessment

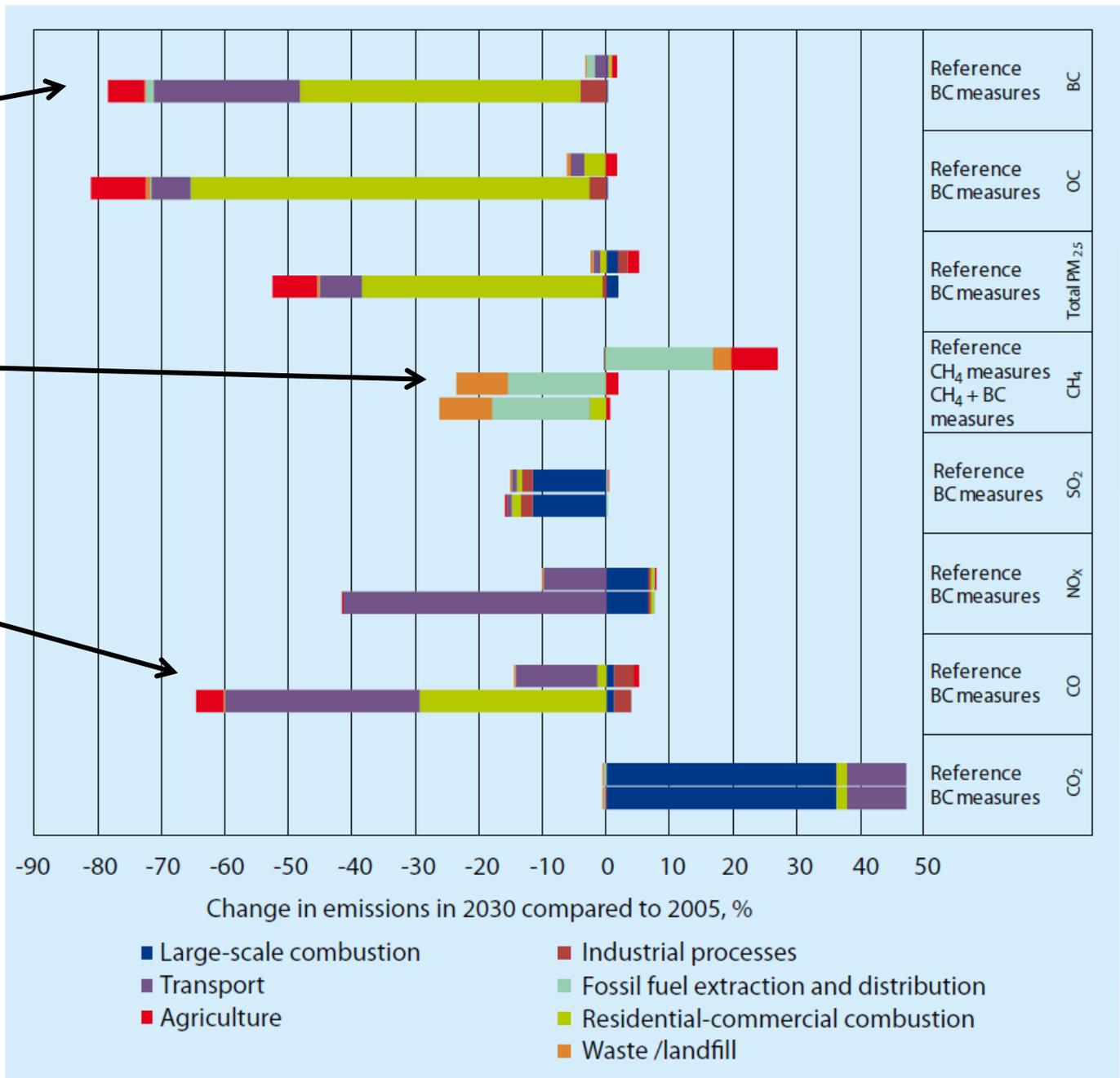
Scenario	Description
Reference	Based on energy and fuel projections of the (IEA) <i>World Energy Outlook 2009</i> and incorporating all presently agreed policies affecting emissions
CO ₂ Measures	Emissions modelled using the assumptions of the IEA 450ppm Scenario and the IIASA GAINS database. Includes CO ₂ measures only.
CH ₄ Measures	Reference scenario plus the CH ₄ measures
BC Measures	Reference scenario plus the BC measures (also affects other pollutants, especially BC, OC, and CO)

Effect of measures on emissions projected in 2030 relative to 2005

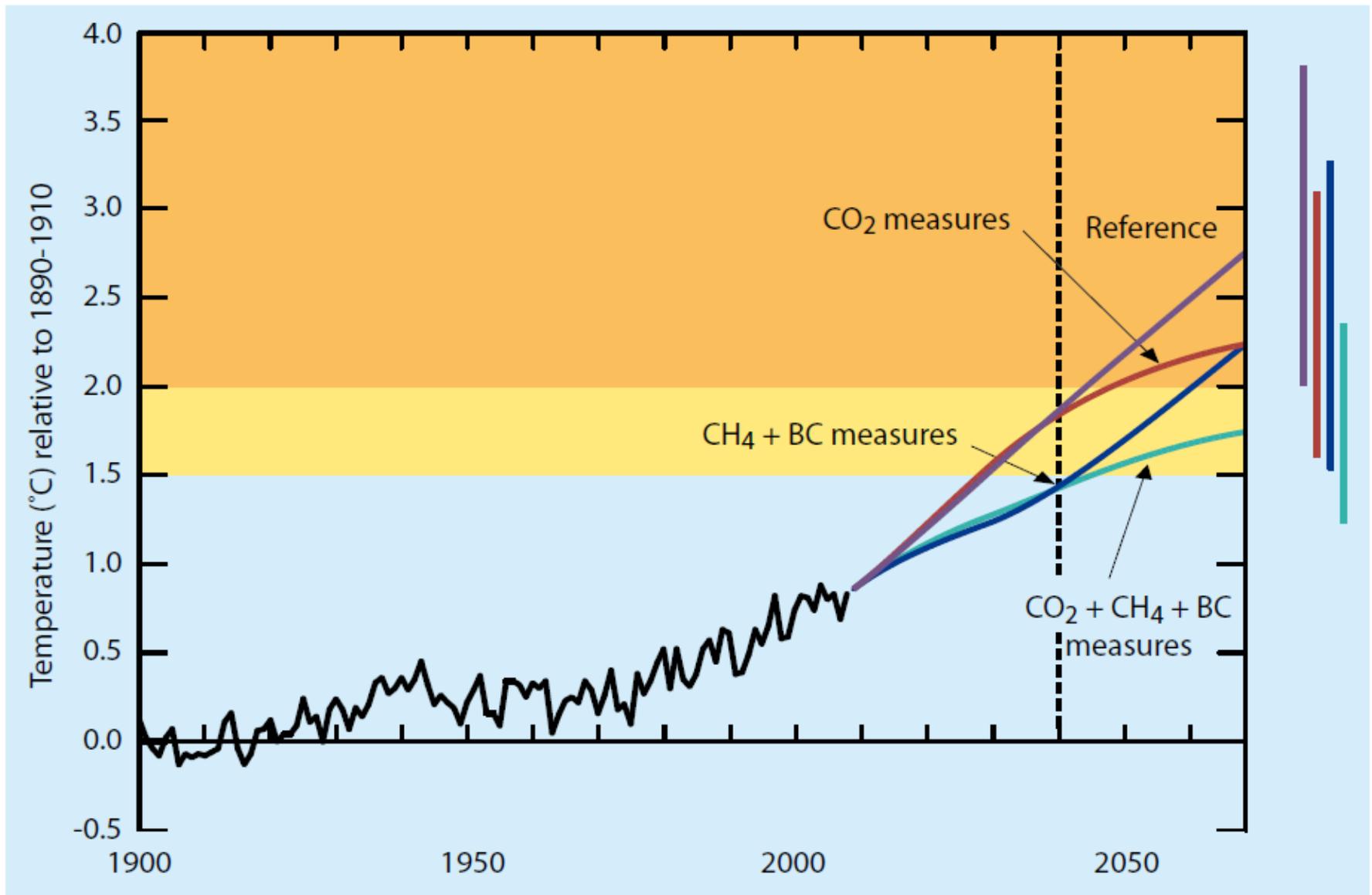
9 BC measures reduce ~80% of BC

Reference: CH₄ increases 7 CH₄ measures reduce ~25% of CH₄ (2005); or ~40% relative to 2030

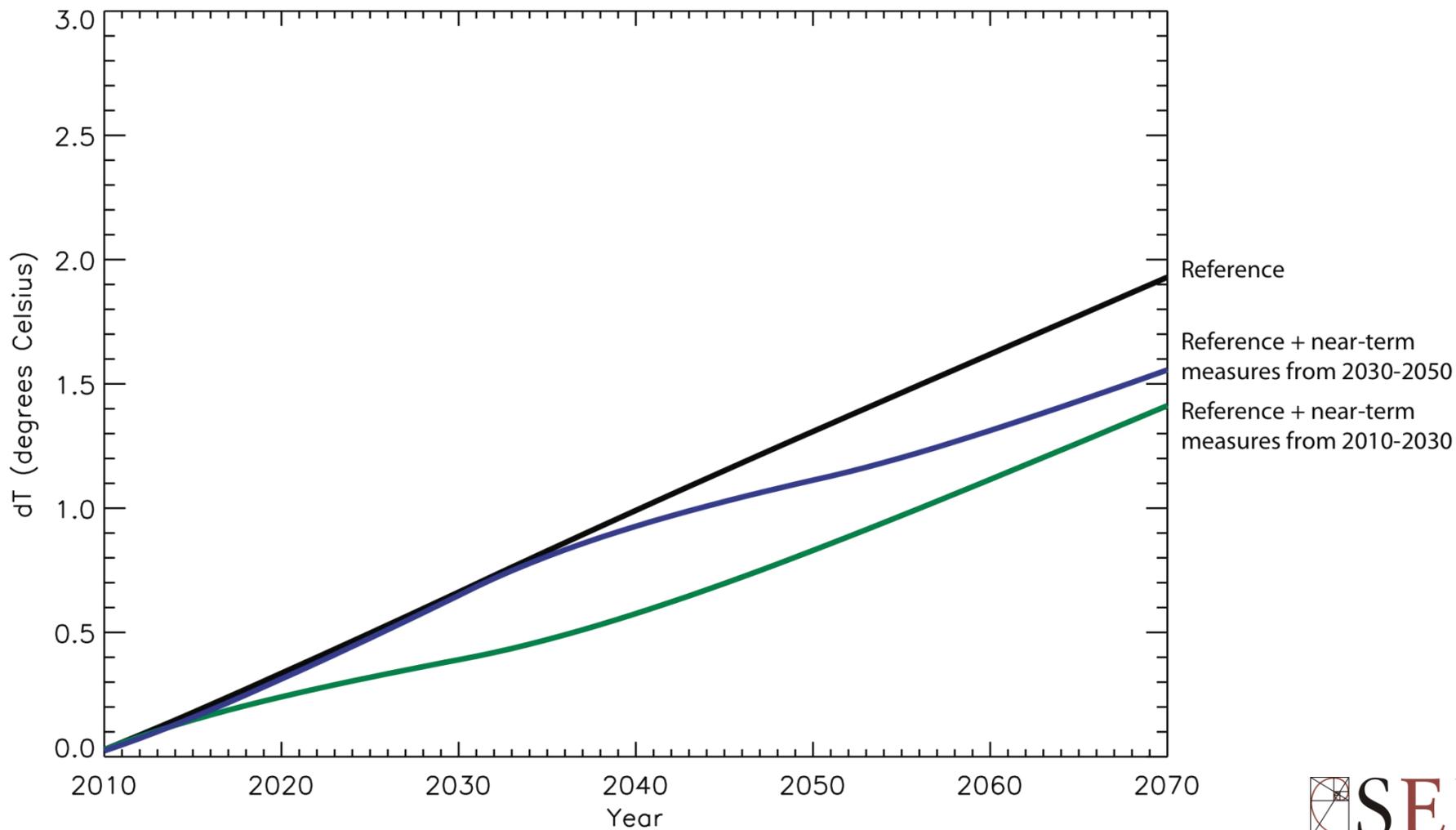
BC measures reduce CO



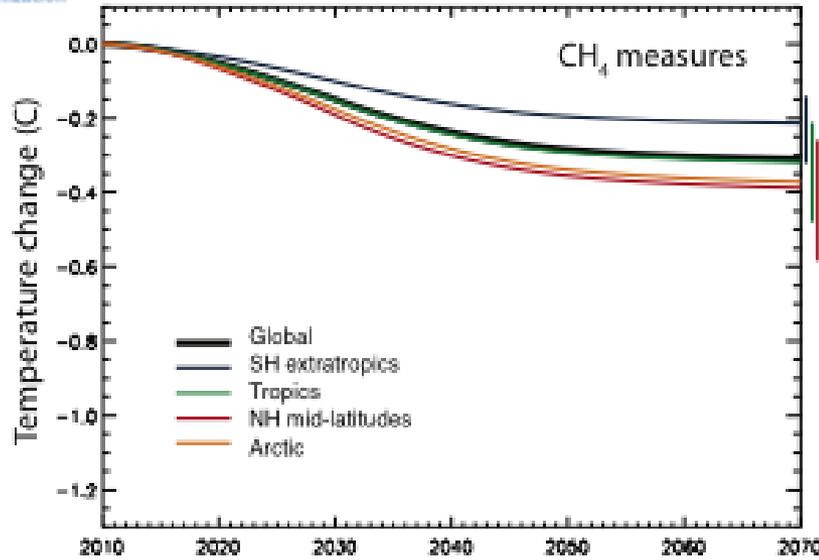
Result for Global Temperature Change: CO₂ and SLCF measures are complementary strategies



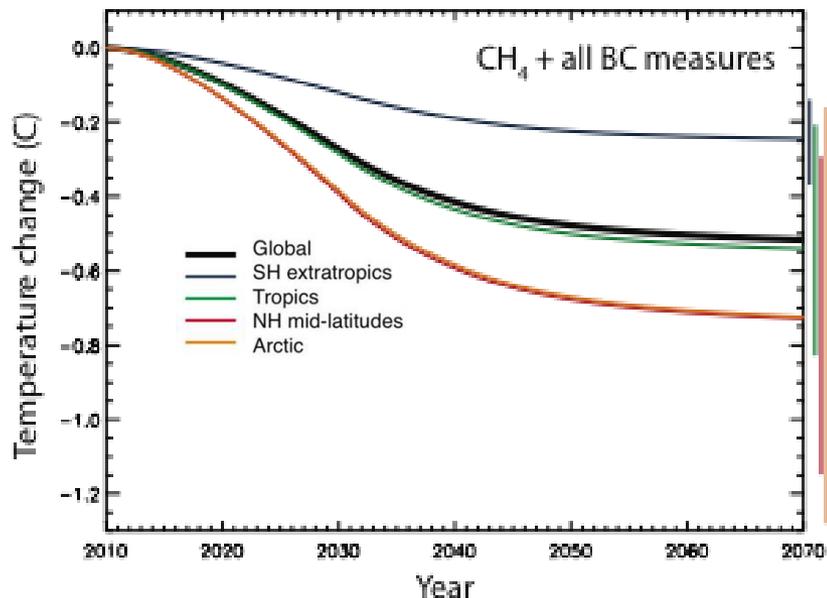
Climate Impact of Measures: Starting Now vs Delayed



Global and Regional Temperature Change Relative to the Reference Scenario (hybrid modelling of GISS, ECHAM informed by the literature)



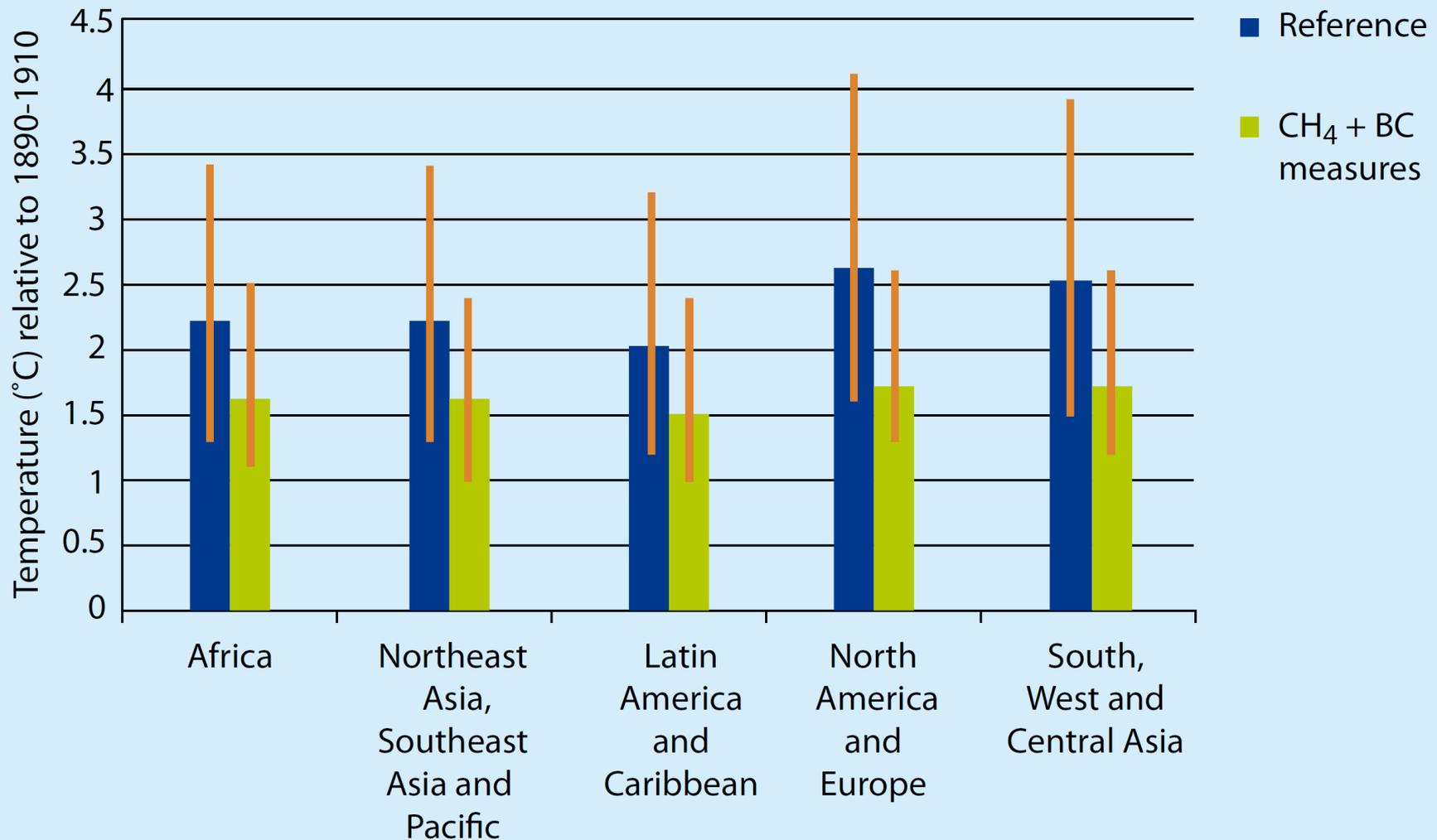
Methane measures:
Relatively uniform benefits,
low uncertainty



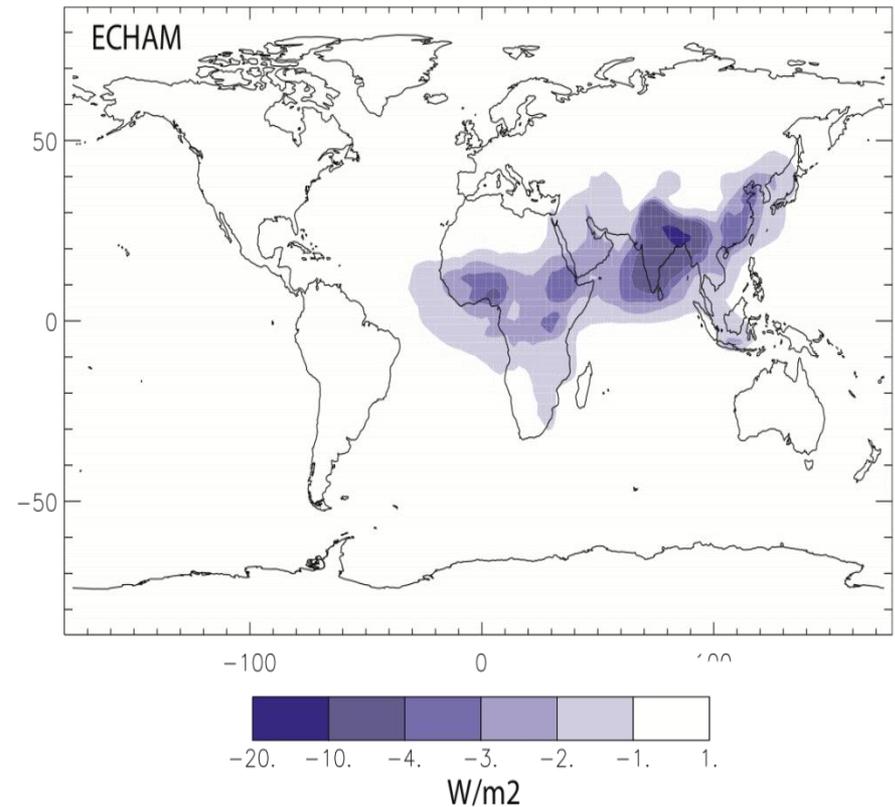
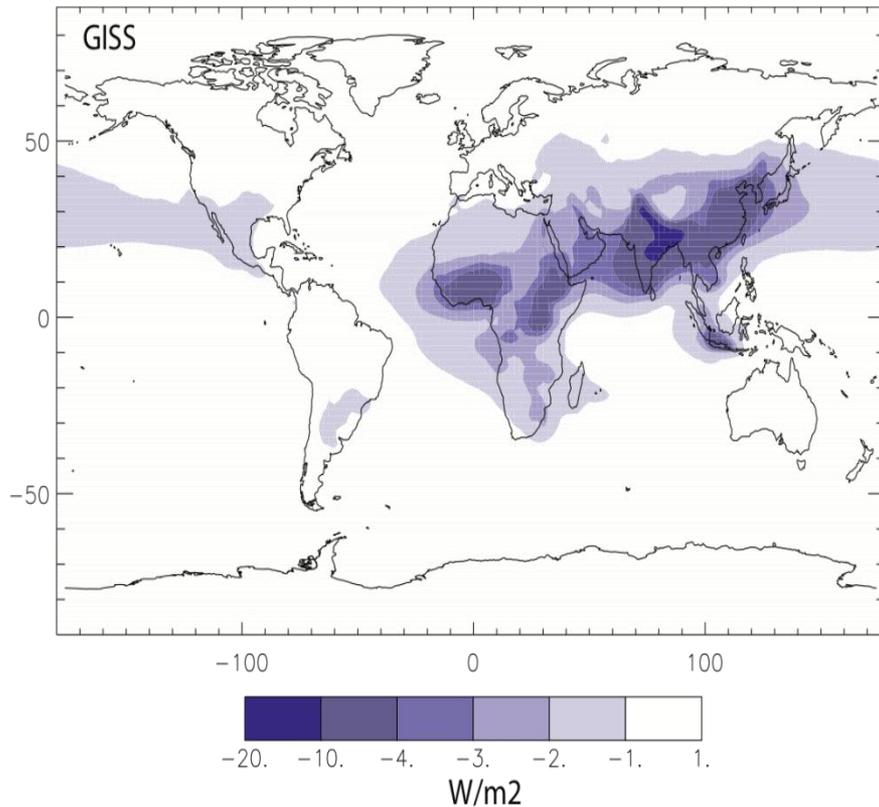
BC measures:
Larger benefits in North, greater
uncertainty for temperature (large
regional precipitation & glacial melting
benefits)

Reduced Arctic warming by 0.7°C by 2040 compared to the reference Scenario, with measures taken 2010---2030. **Mitigating ~2/3 of projected 1.2°C warming**

Regional Climate Changes: Comparison of regional mean warming over land (°C) showing the change in 2070 compared with 2005 for the reference scenario (Table 2) and the CH₄ + BC measures scenario. The lines on each bar show the range of estimates



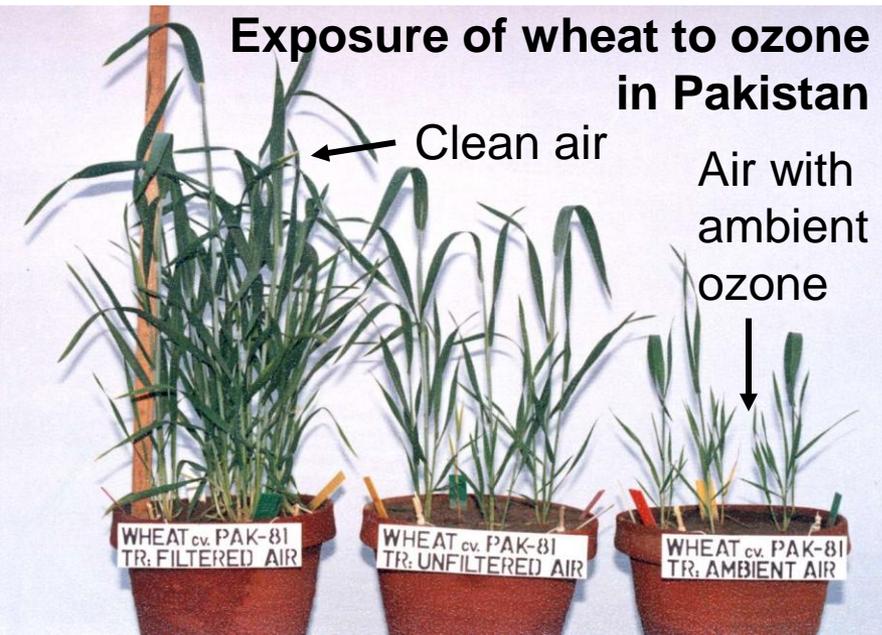
Regional Climate Changes: Change in atmospheric forcing at 2030 relative to the reference case in the two models.



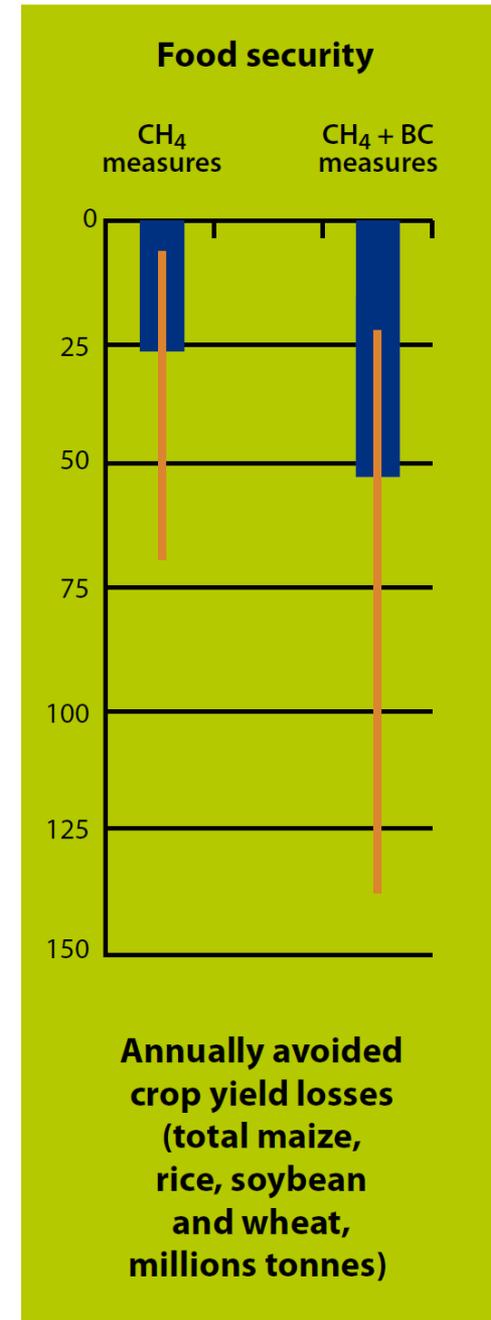
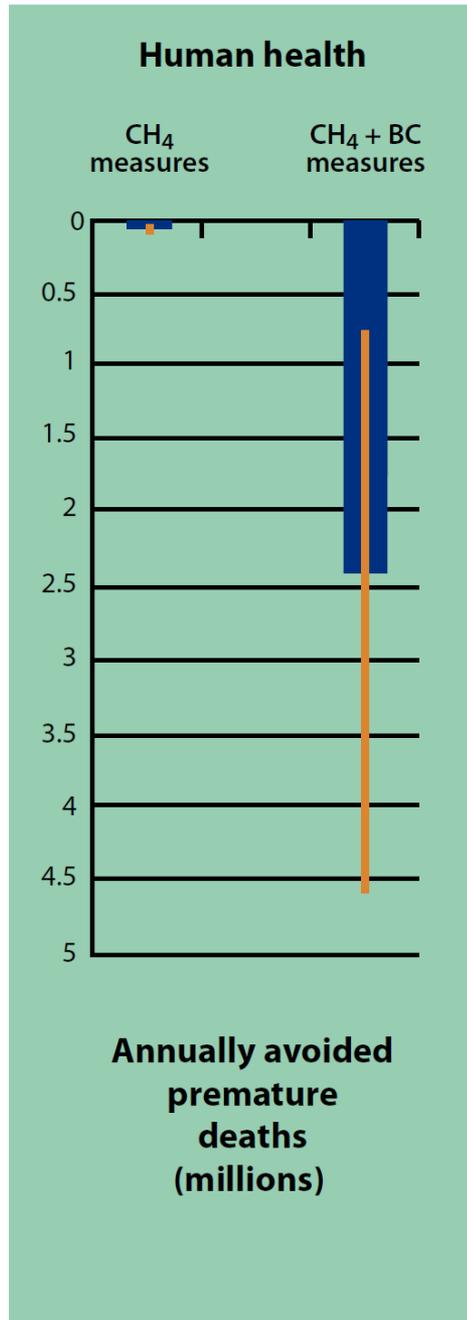
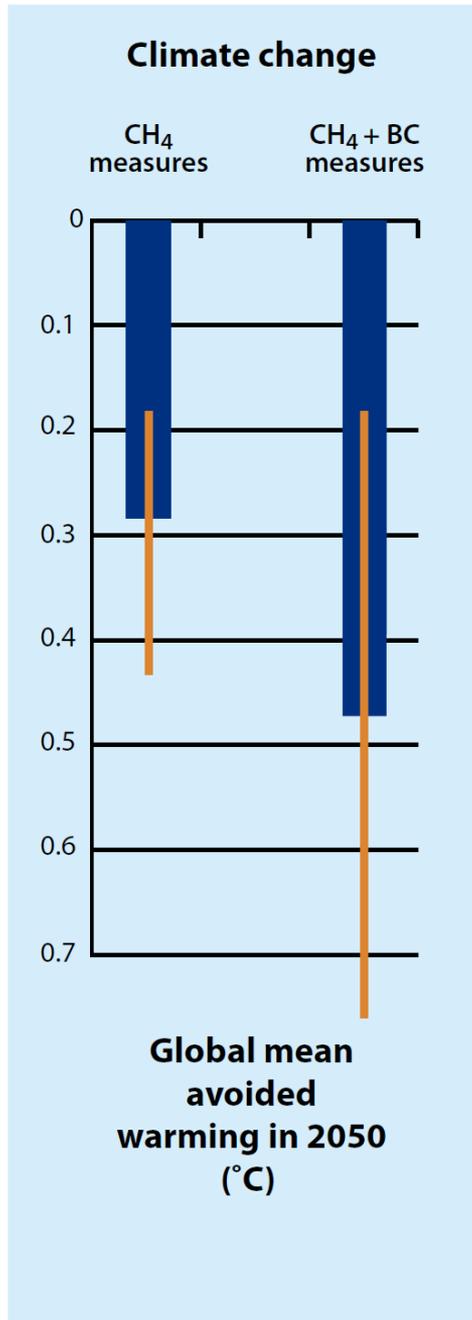
- Dark areas: where the biggest energy change to the atmosphere occurs
- This drives regional weather pattern changes

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



Impact of the Measures on Health, Crop yields and Climate



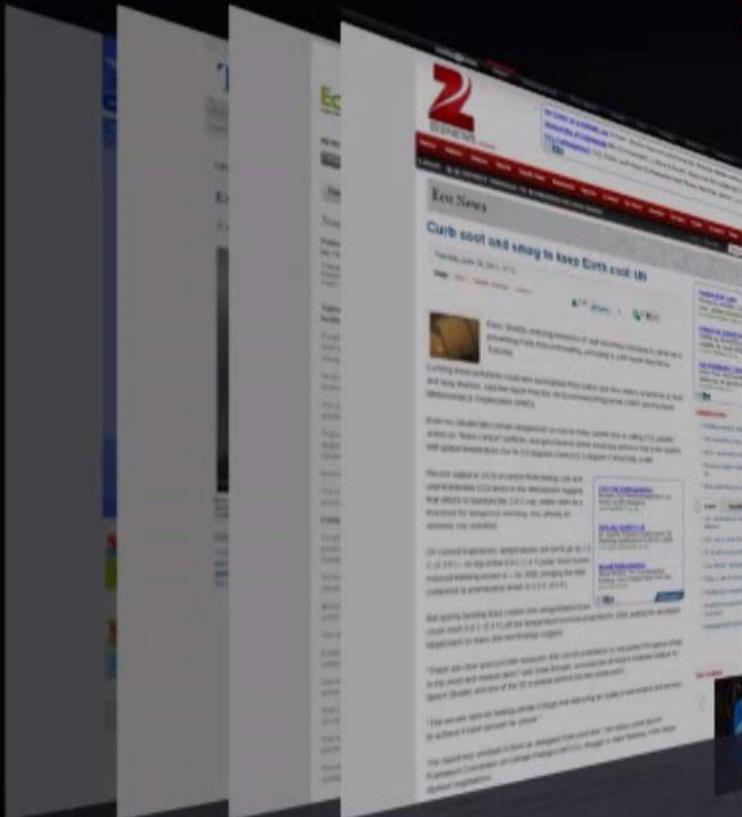
Impact of the Measures on Health: indoor air pollution impacts on health not included in quantitative analysis



Main Findings of the Assessment

- 16 identified measures, implemented by 2030, would **reduce global warming by 0.5°C** (0.2-0.7°C) in 2050 – half the warming projected by the Reference Scenario
- Near-term measures would **improve the chance of not exceeding 2°C target**, but only if CO₂ is also addressed, starting now (**complementary strategies; not alternatives**)
- Substantial regional climate benefits: e.g. in the **Arctic reduce warming by 0.7 °C** (range 0.2-1.3°C by 2040), for Himalayas and South Asian monsoon
- Health and crop benefits are substantial – could **avoid 2.4 million premature deaths** (0.7-4.6 million) and **loss of 52 million tonnes** (30-140 million) of maize, rice, wheat and soybean, each year (plus indoor air pollution – chronic health)
- The identified **measures are all currently in use** in different regions around the world; much wider and more rapid implementation is required to achieve the full benefits
- Many **measures achieve cost savings** over time. However, initial capital investment could be problematic, necessitating additional strategic support and investment.

Considerable global media attention to the issue



Alaska Business MAGAZINE

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Government News

Complementary Action to Earth Treaties and Strong Pollution Could Help Limit Global Temperature Rise to 2 Degrees or Less

Multiple Benefits Include Improved Air Quality and Human Health, Higher Crop Yields, Reduced Rate of Climate Change in the Near Term and a Chance to Slow Serious Warming of the Arctic

Geneva, June 14 June 2012 Fast action on pollution such as black carbon, ground level ozone and sulfates may help limit near-term global temperature rise and significantly increase the chances of keeping temperature rise below 2 degrees C, and perhaps even 1.5 degrees C, unless assessment says.

Restricting the near-term climate to control the significantly cutting the risk of "worsened global climate change" linked with rapid and extensive loss of Arctic ice on both the land and at sea.

Fast action might also reduce losses of mountain glaciers linked to sea level rise with black carbon deposits while reducing projected warming in the Arctic over the coming decades by two-thirds.

The scientists behind the assessment, coordinated by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), also point to numerous health, wealth and food security opportunities above and beyond those linked with halting climate change.

By curbing emissions of black carbon will improve respiratory health, reduce hospital admissions and deaths at work due to asthma, save the government where temperature provided by the Stockholm Environment Institute. Indeed close to 15 million premature deaths from outdoor air pollution could on average be avoided annually world-wide by 2020 with many of those lives saved being in Asia, it is estimated.

By curbing ground level ozone could also contribute to reduced crop damage equal to between one to five per cent of the annual global wheat, rice, soybean and wheat production.

Cutting these so-called "short lived climate forcers" can have immediate climate, health and agricultural benefits, the report concludes. Thus, because unlike carbon dioxide (CO2) which can remain in the atmosphere for centuries black carbon for example only persists for days or weeks.

The researchers also establish the fact that while fast action on black carbon and ground level ozone could give a key role in limiting near-term climate, immediate and sustained action to cut back CO2 is crucial if temperature rise are to be limited over the long term.

In the combination of action on short lived climate forcers and long lived greenhouse gases which improve the chances of keeping below the 2 degree target through the 21st Century.

The findings, released today in Geneva, Germany during a meeting of the UN Framework Convention on Climate Change (UNFCCC) have been compiled by an international team of more than 10 researchers chaired by Drew Shindler of the National Aeronautics and Space Administration (NASA).

Julian Dore, UN Under-Secretary General and UNEP Executive Director, said "There are now clear, powerful, abundant and compelling scientific evidence to reduce levels of pollutants such as black carbon and atmospheric ozone along with methane their growing contribution to climate change being just one of them".

(no title)

<http://www.akbizmag.com/more/12278-new-unep-wmo-assessment-complements-urgent-action-needed-to-cut-co2-emissions-under-un-climate-treaty.html>

Today



'An Integrated Assessment of Black Carbon and Tropospheric Ozone'

http://www.unep.org/dewa/Portals/67/pdf/BlackCarbon_SDM.pdf