



EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Joint Research Centre

Tackling Air Pollution and Climate Change looking for win-win air pollution policies

Frank Raes

Rita Van Dingenen

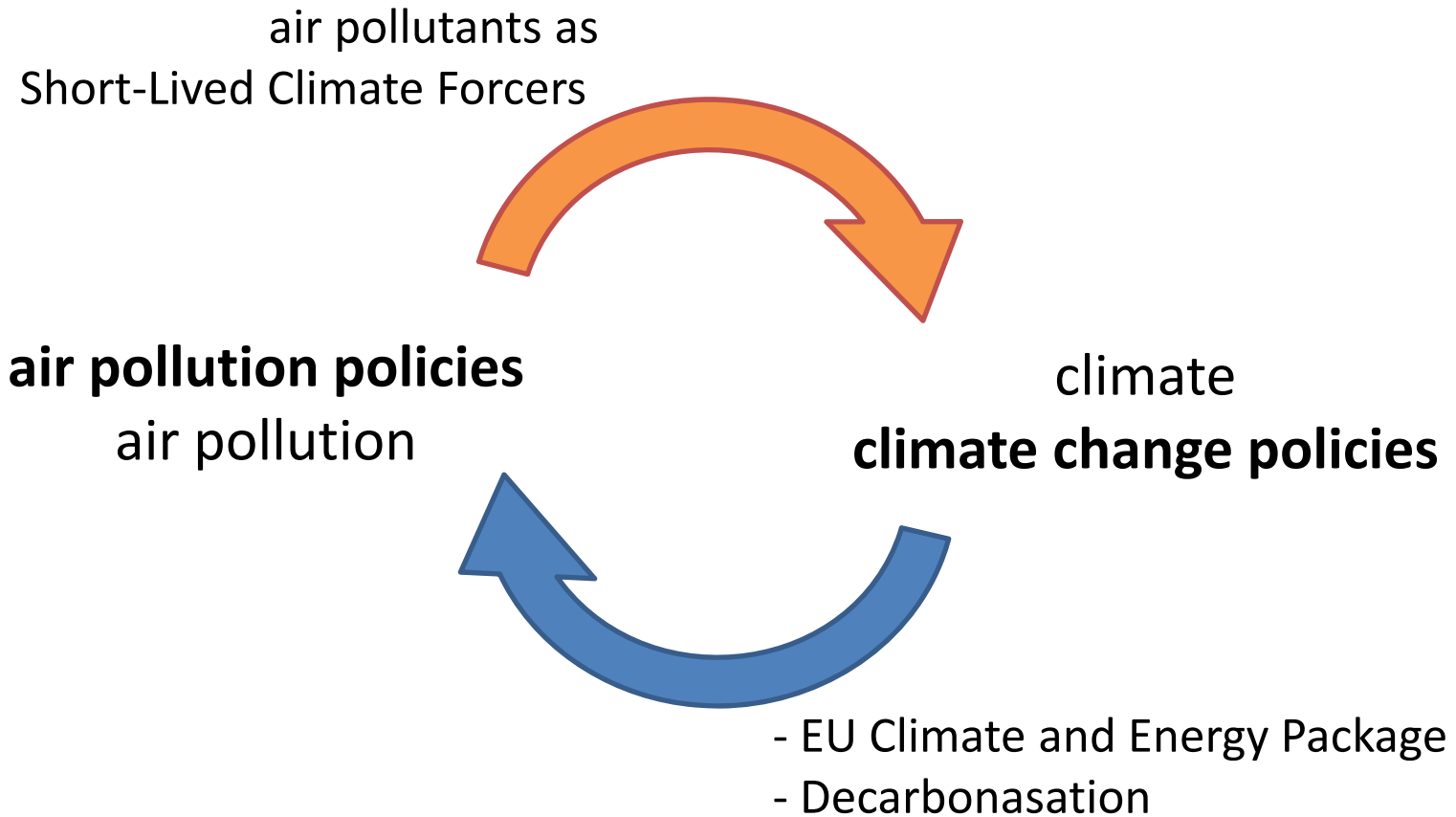
Frank Dentener

Elisabetta Vignatti

Greet Maenhout

+

UNEP

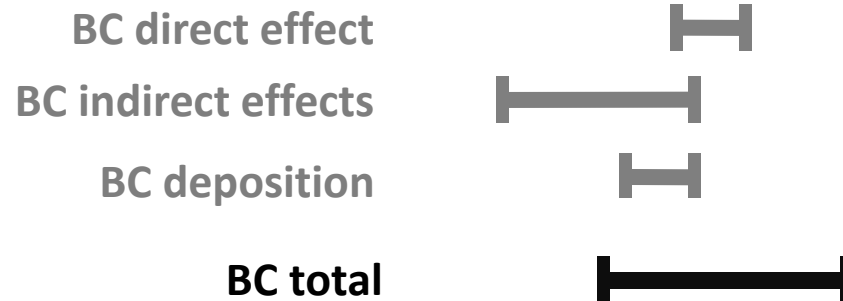
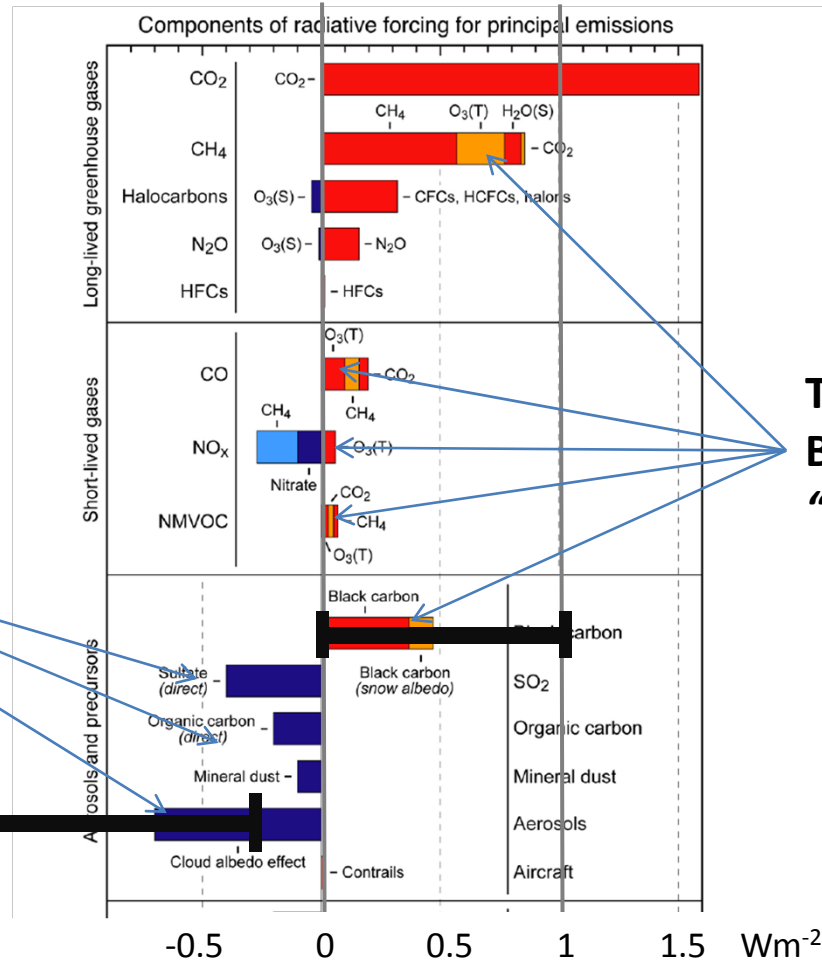




Global radiative forcing of past emissions

Inorganic Aerosols
Organic Carbon Aerosols
"Good" SLFCs

Tropospheric O₃
Black Carbon:
"Bad" SLFCs





On global climate

Changes in their burdens over the 20th Century has resulted in a global warming that is *potentially* similar to that of CO₂

On regional climate

Atmospheric heating by BC disturbs tropical rainfall and regional circulation patterns such as the Asian monsoon.

Black carbon deposition on snow, along with atmospheric heating, leads to faster melting of a.o. the Arctic, the Himalayan and Alpine glaciers.



Arctic haze layer over Svalbard, Spitsbergen



Source: Alfred-Wegener Institute



NCO-P web-cam images of Khumbu valley

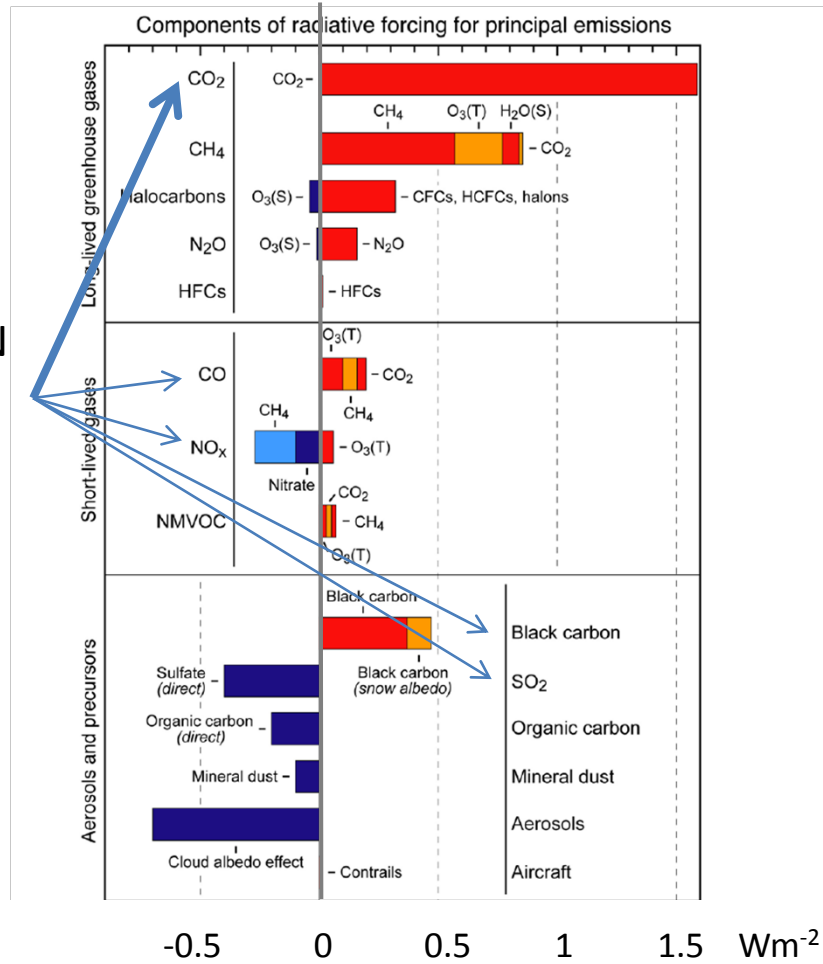


Source: CNR ISAC



Global radiative forcing of past emissions

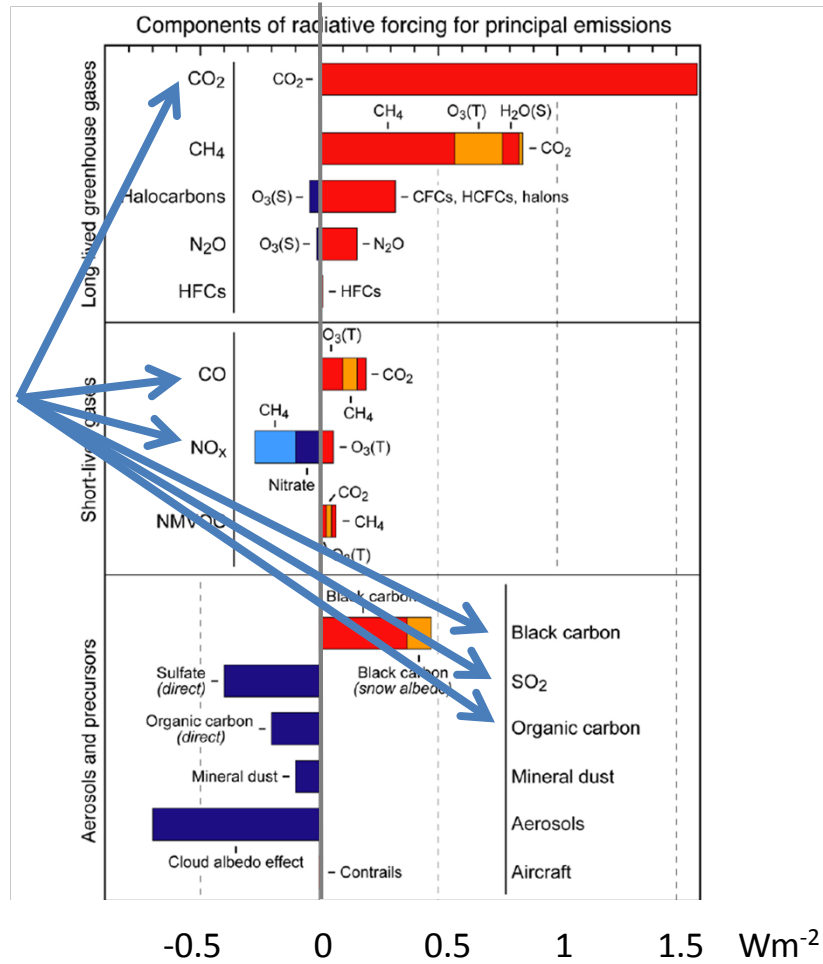
Clean ENERGY PRODUCTION
 - efficient combustion
 - AP emission control





Global radiative forcing of past emissions

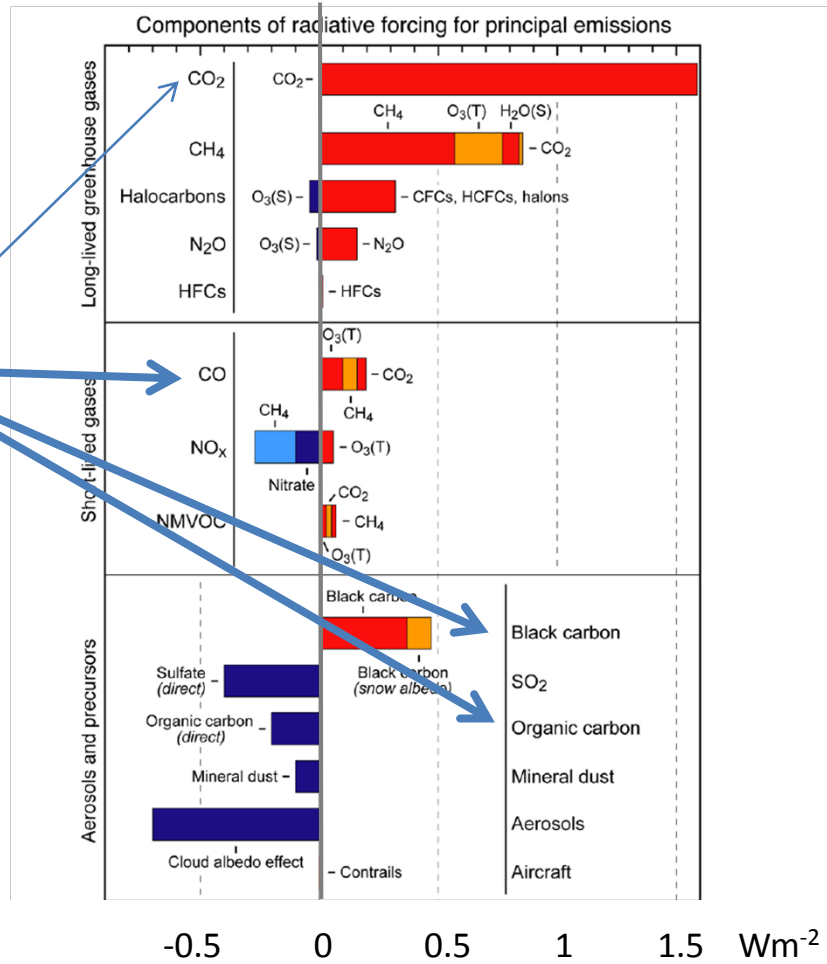
Dirty ENERGY PRODUCTION
 - inefficient combustion
 - little AP emission control





Global radiative forcing of past emissions

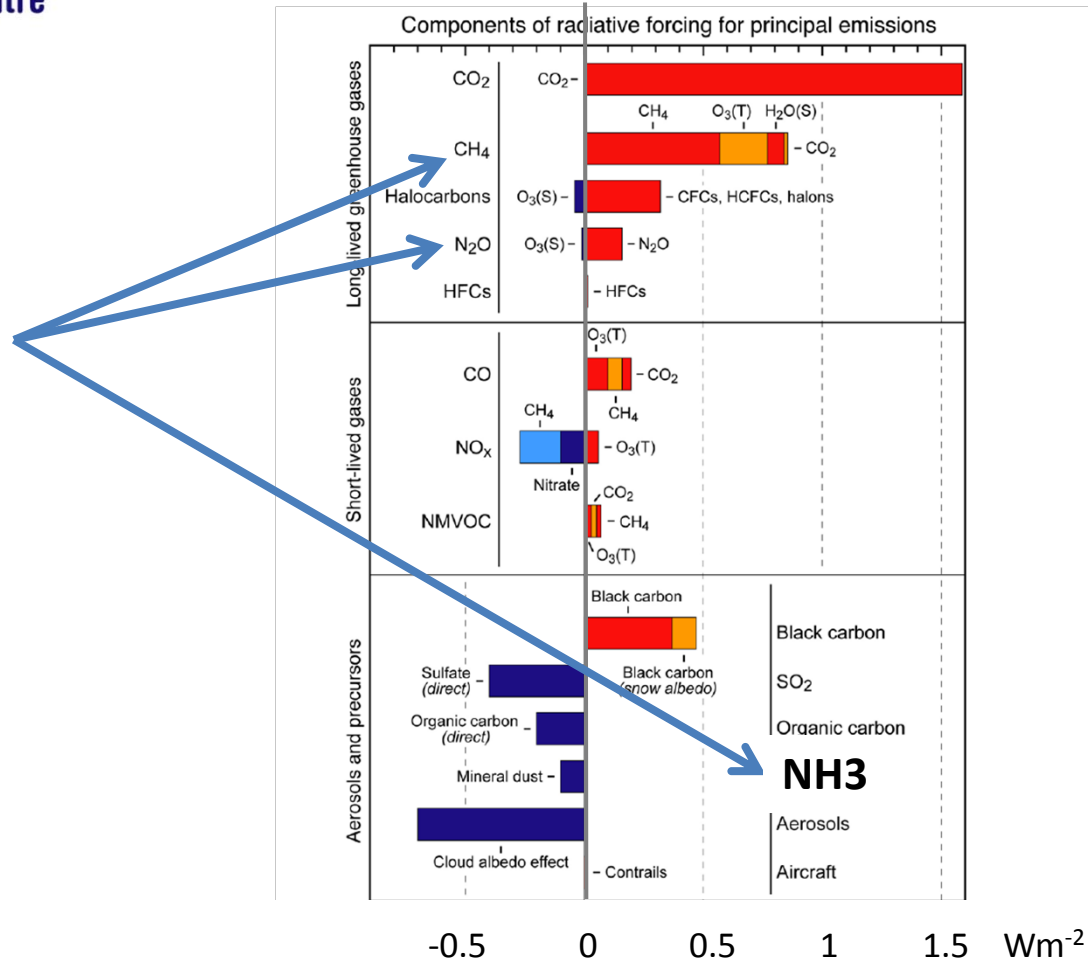
DOMESTIC BURNING
- e.g. wood burning





Global radiative forcing of past emissions

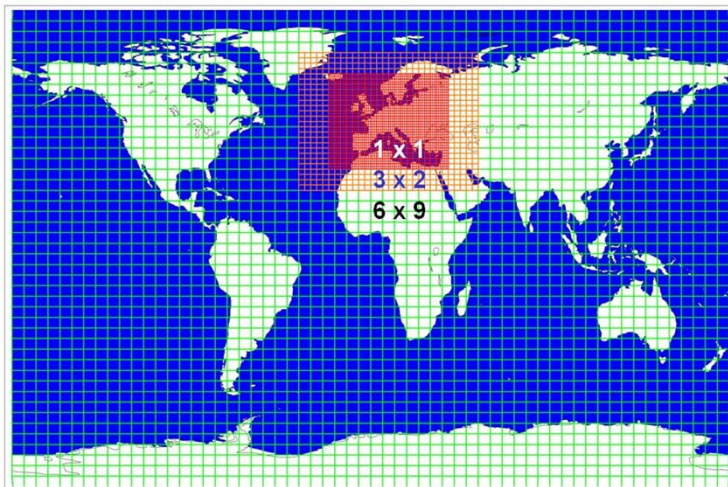
AGRICULTURE





the FAsT Scenario Screening Tool TM5-FASST

Based on global source receptor relationships (SRs) calculated with TM5



Calculates the effect of an emission reduction in one grid cell, on various impacts in all other grid cells. Aggregation to SRs between 56 world regions (a.o. WEUR, CEUR)

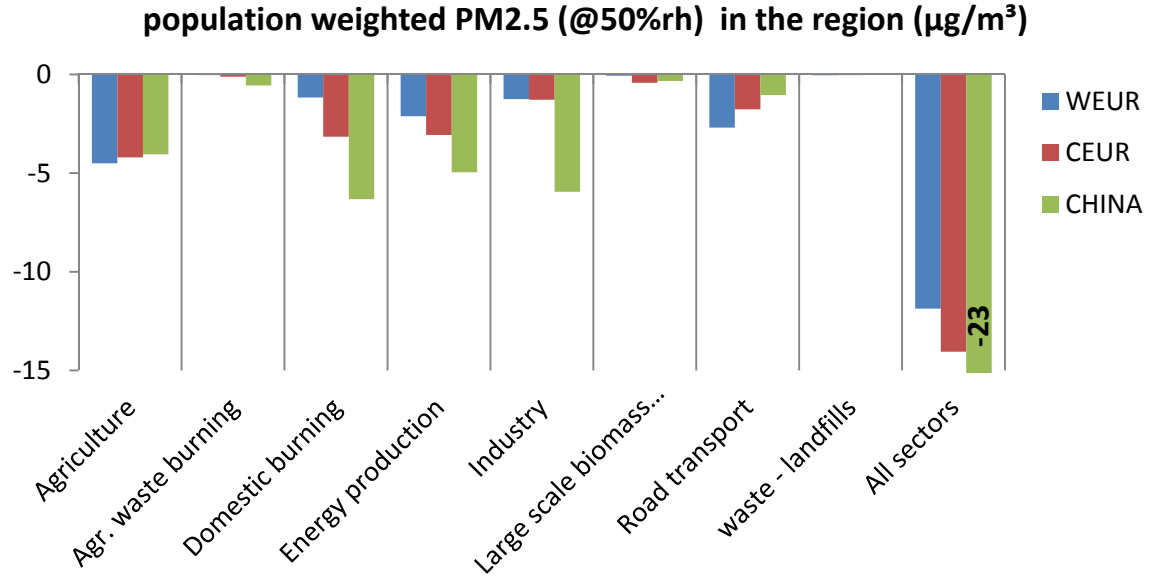
Emissions considered: SO₂, NO_x, NH₃, Black Carbon, Primary Organic Matter, CH₄

Impacts considered:

- PM_{2.5} impacts on human health,
- O₃, impacts on agriculture
- Radiative forcing
- Absolute global warming potential

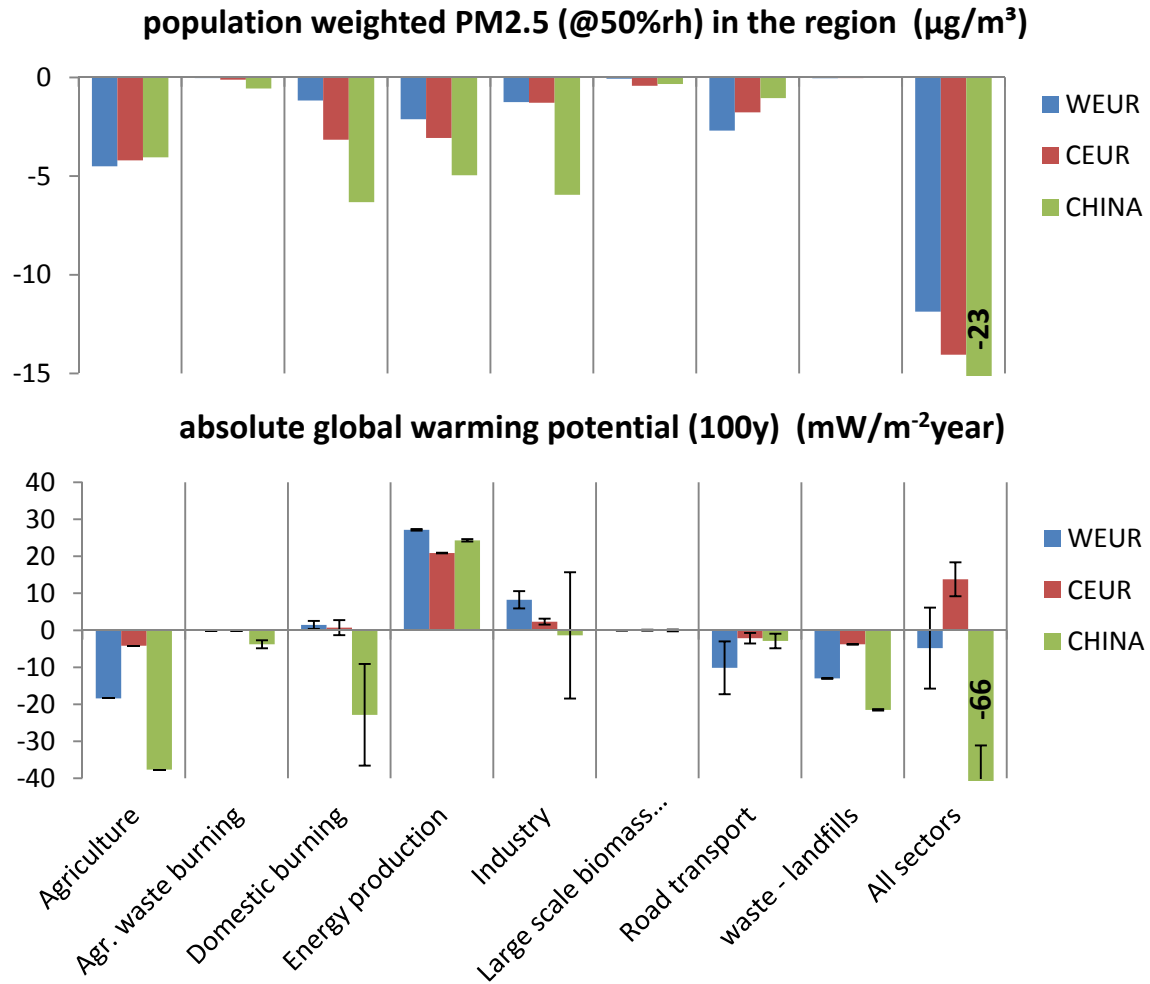


Effect of
 100% reduction
 of man-made emissions
 of CH4 & air pollutants
 in individual sectors
 and in
 individual regions
 on:



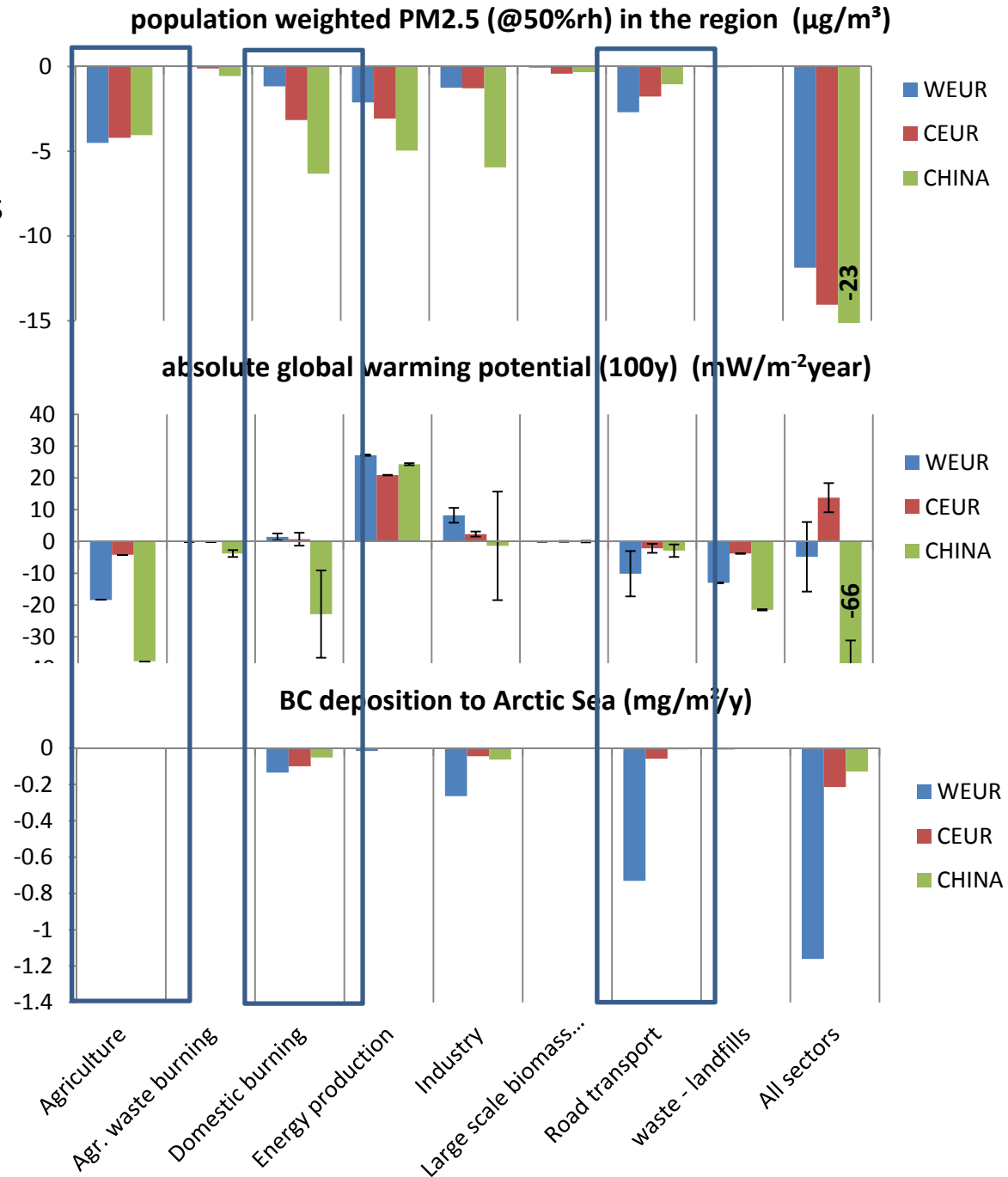


Effect of
 100% reduction
 of man-made emissions
 of CH₄ & air pollutants
 in individual sectors
 and in
 Individual regions
 on:





Effect of
100% reduction
of man-made emissions
of CH₄ & air pollutants
in individual sectors
and in
individual regions
on:





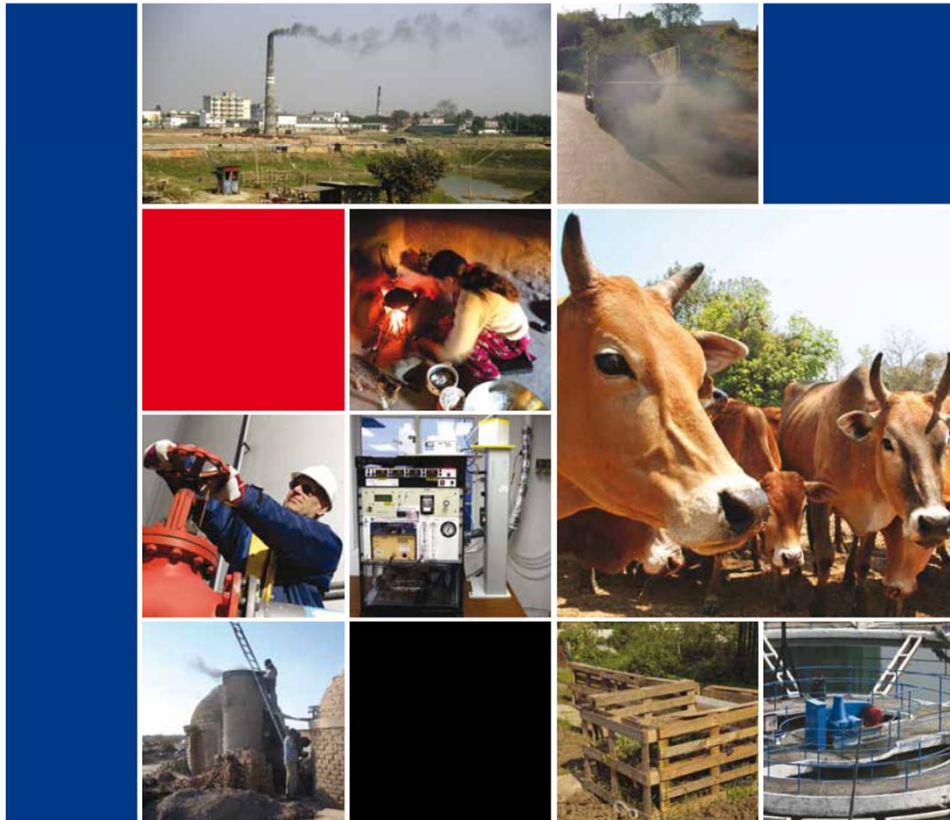
EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Joint Research Centre



Integrated Assessment of Black Carbon and Tropospheric Ozone

Summary for Decision Makers



UNEP, 2011

Three groups of promising measures (UNEP, 2011)

“CH₄” measures

1. Recovery of coal mine gas
2. Production of crude oil and natural gas
3. Gas leakages at pipelines and distribution nets
4. Waste recycling
5. Wastewater treatment
6. Farm-scale anaerobic digestion
7. Aeration of rice paddies

Technical “BC” measures

1. Modern coke ovens
2. Modern brick kilns
3. Diesel particle filters
4. Briquettes instead of coal for heating
5. Improved biomass cook stoves
6. Pellets stoves and boilers (in industrialized countries)

Non-technical “BC” meas

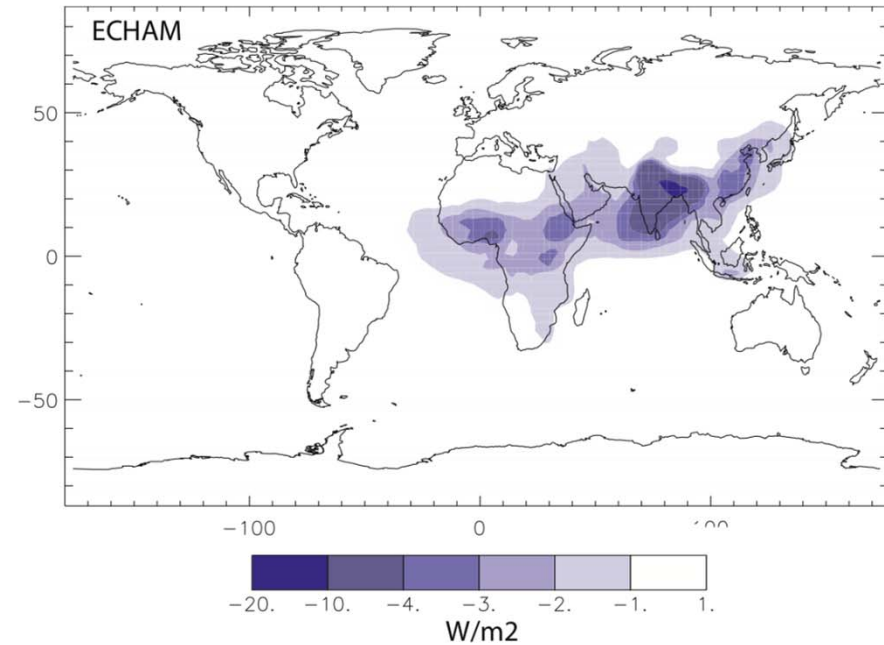
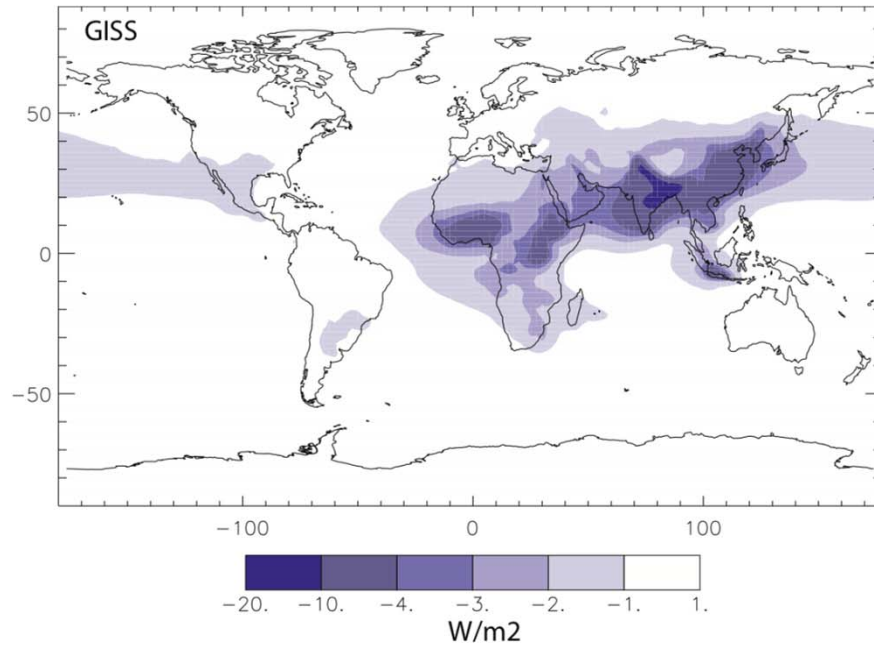
1. Ban of high-emitting vehicles
2. Ban of open burning of agricultural waste
3. Elimination of biomass cook stoves



UNEP, 2011

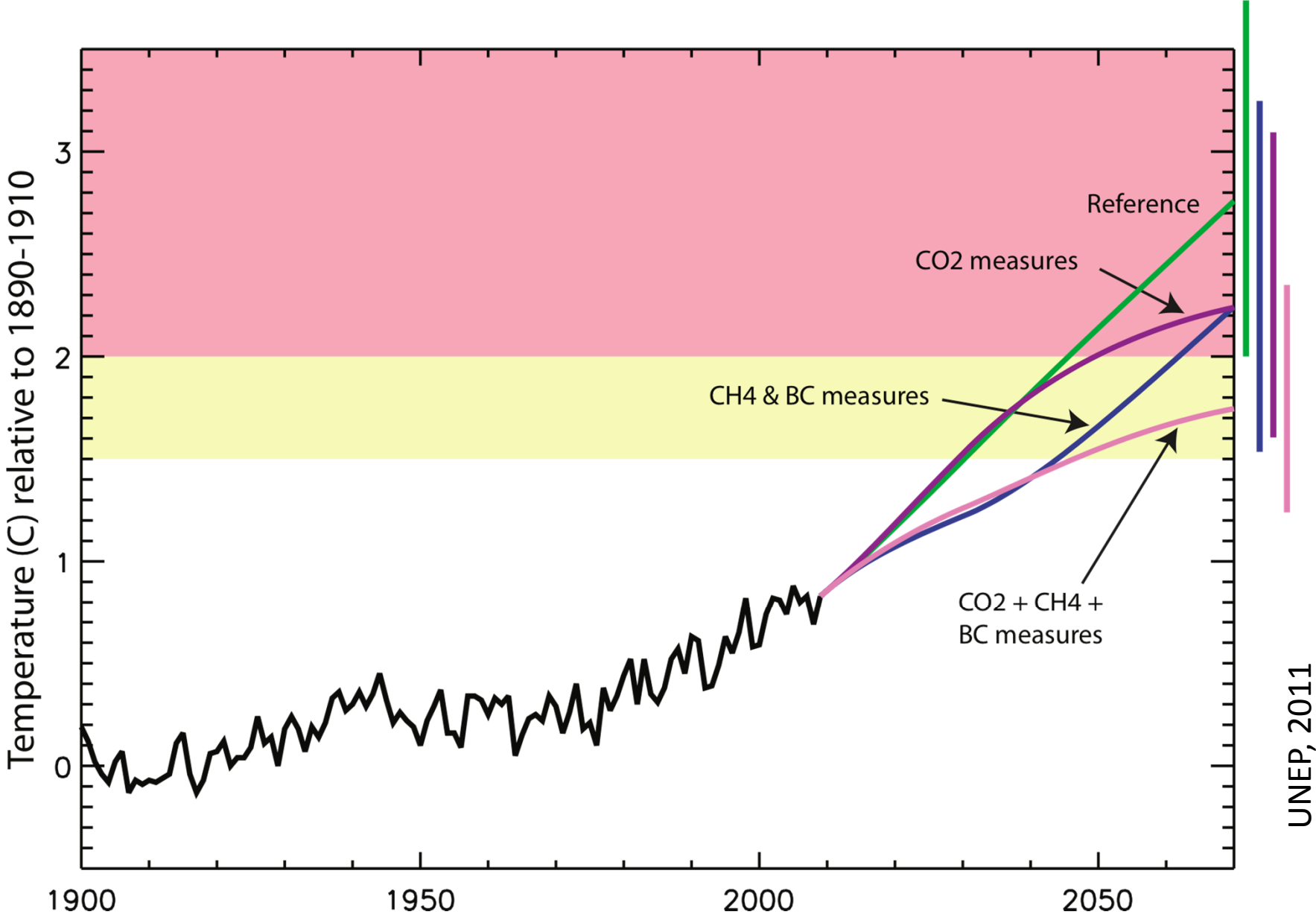


Regional Climate Changes: Change in atmospheric forcing at 2030 relative to the reference case in the two models.



This is where the biggest energy change to the atmosphere occurs and this is what drives weather patterns – relative distribution of energy.

Result for Global Temperature Change (hybrid of results from GISS and ECHAM models and assessment of literature) added to the historical record





Reducing emissions of air pollutants will have a fast impact on global mean temperature (GMT) : (80% of expected GMT within 20 yrs)

Favoring reductions in specific sectors or through specific measures (e.g. because of cost) might either lead to a win or a lose for global climate, but will all be beneficial for air quality and “saving the Arctic”.
Optimization needed.

A multi-species Mult-effect approach makes policy measures more robust

Known climate friendly PM measures in EU (wood pellets, diesel particulate filter, coal bricks) constitute only 10-20% of PM reduction potential in EU.

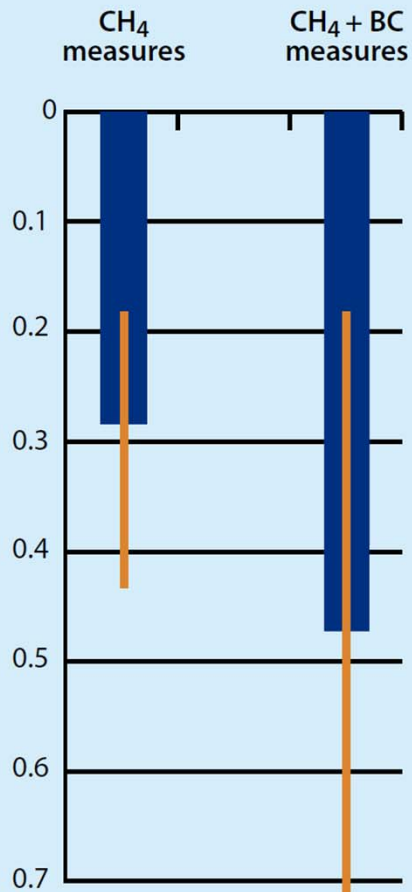
Ozone reduction measures, especially through CH₄, are an absolute no-regret policy for air pollution and climate

More information on the chemical fingerprint of individual control measures would be helpful to evaluate more accurately their climate impacts !

thanks

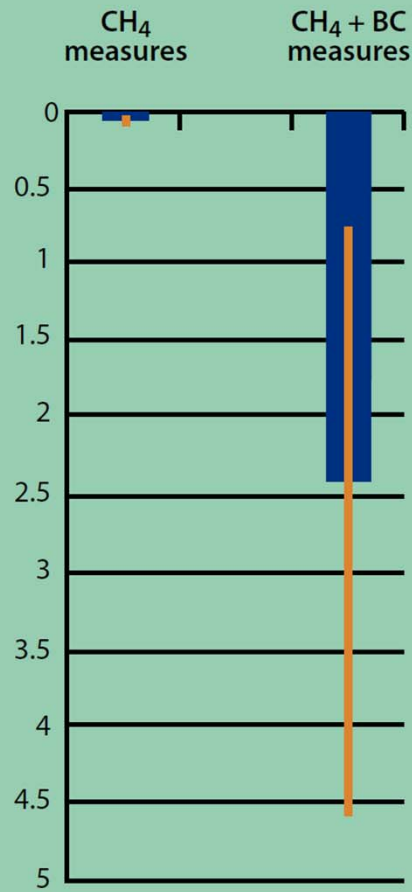


Climate change



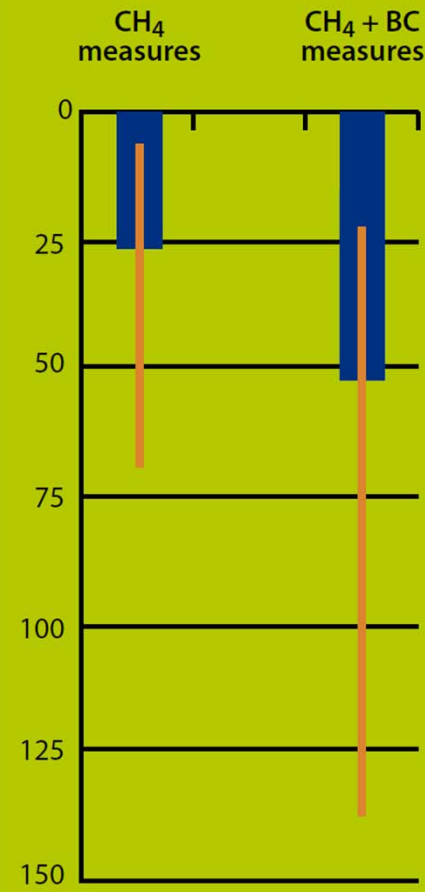
Global mean avoided warming in 2050 (°C)

Human health



Annually avoided premature deaths (millions)

Food security



Annually avoided crop yield losses (total maize, rice, soybean and wheat, millions tonnes)

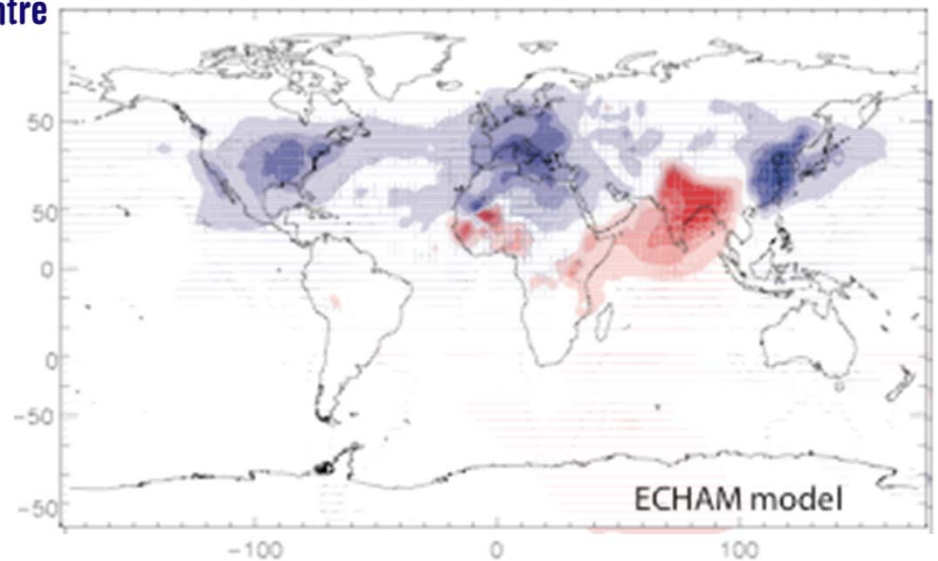
Radiative forcing of GHGs and air pollutants

Literature ranges of GWP100

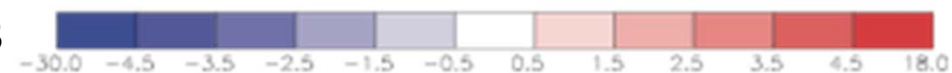
	<i>Mean value</i>		<i>Range</i>	<i>Reference</i>
CO ₂	1	IPCC, AR4		
CH ₄	25	IPCC, AR4	16 - 34	IPCC AR4
CO	1.9	IPCC, AR4	1 - 3	Range from AR3, cited in AR4
VOC	3.4	IPCC, AR4	2 - 7	IPCC AR4, ref. to Collins et al. 2002
BC	680	Bond & Sun, 2006	210 - 1500	Bond & Sun, 2006
SO ₂	-40	Fuglestvedt et al., 2009	-24 - -56	Schulz et al. 2006, (±40%)
OC	-69	Schulz et al., 2007	-25 - -129	Bond et al. (2011)
NO _x	~0			

UNEP, 2011

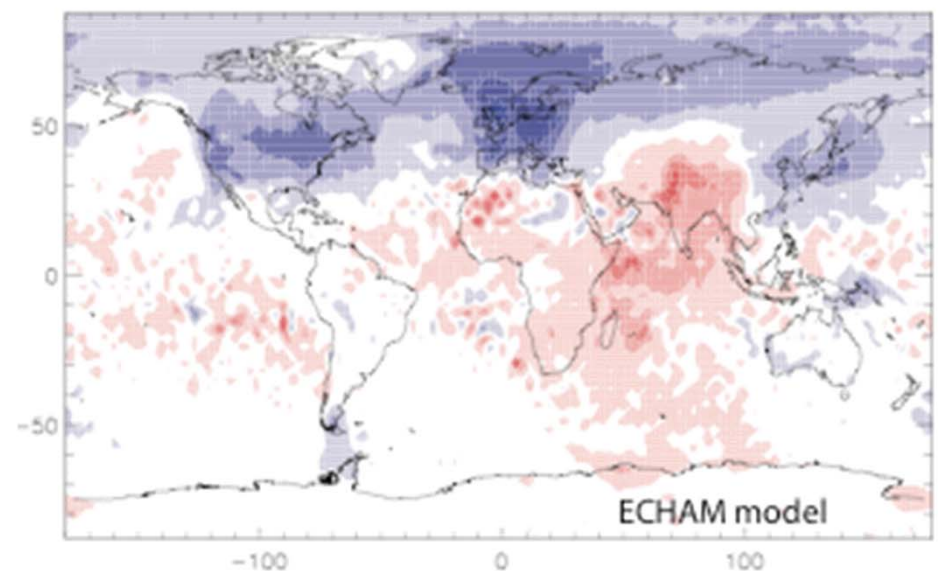
UNEP, 2011



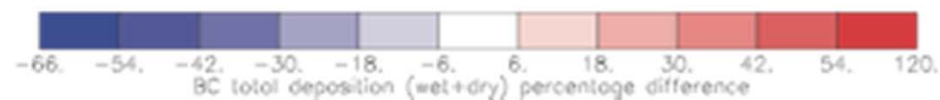
$\mu\text{g}/\text{m}^3$



UNEP, 2011



%



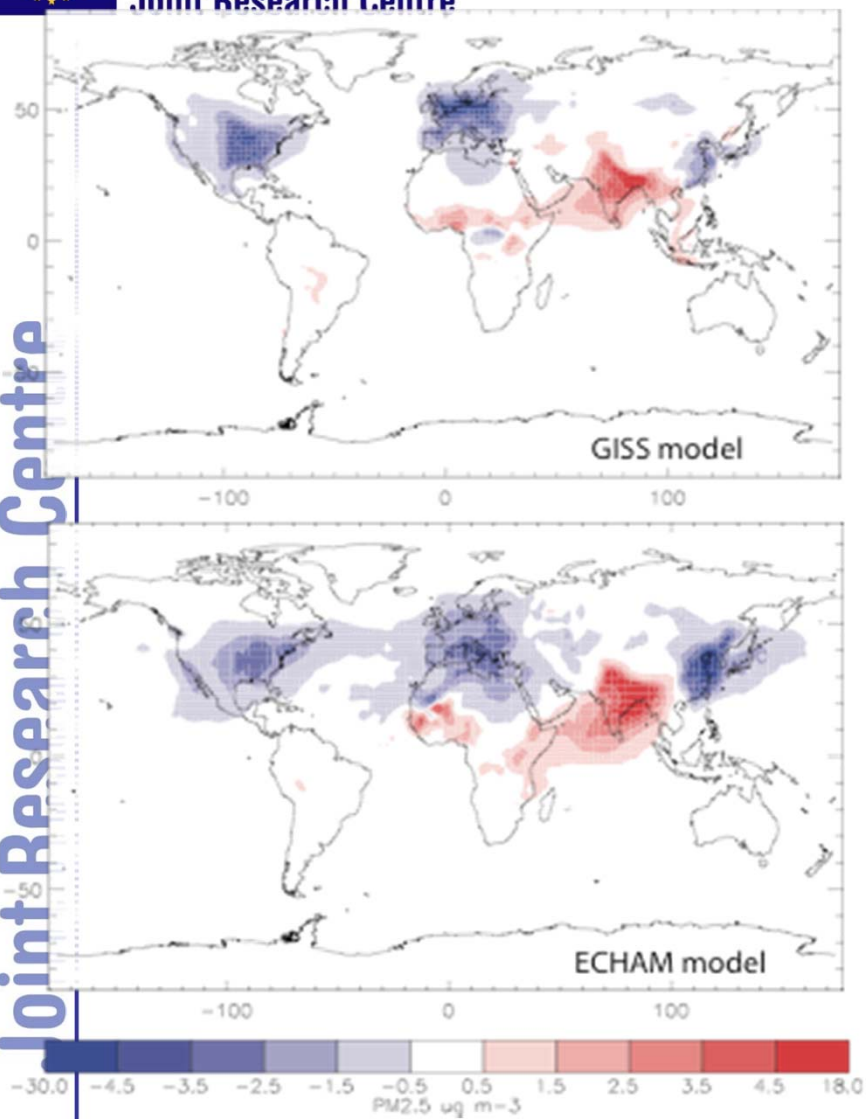
change in PM_{2.5}:
2005 to 2030
reference scenario

change in
BC deposition
2005 to 2030
reference scenario



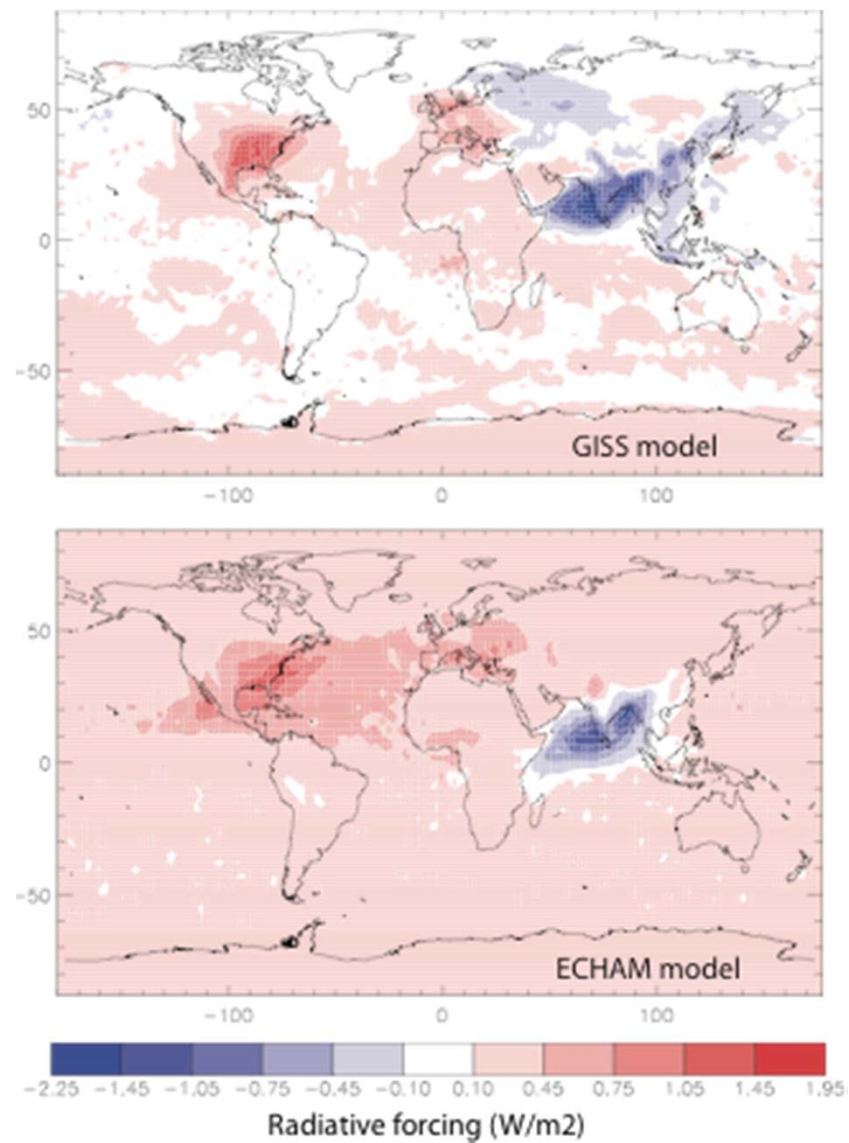
PM2.5 ($\mu\text{g}/\text{m}^3$) 2030 - 2005

Joint Research Centre



Change in annual average PM2.5 ($\mu\text{g}/\text{m}^3$), Reference scenario.

TOA RadFor (W/m^2) 2030 - 2005



TOA radiative forcing (W/m^2) due to methane, ozone, and the direct effects of aerosols. Reference scenario.

Black carbon is the 2nd biggest contributor to global warming.

An EU black carbon strategy today means a cooler planet tomorrow.

THE PARLIAMENT
PROTECTS PEOPLE AND PEOPLE

Come and join a panel debate on this issue.
Paul Henri Spaak Building, European Parliament, June 22nd, 11h30-13h00.
For more information go to www.theparliament.com/blackcarbon





On air quality

BC is a part of Particulate Matter, which reduces peoples lifetime worldwide. Tropospheric Ozone leads to reduction of crop yields

On global climate

BC and TO are Short-Lived Climate Forcers(SLCF) and the change in their atmospheric burdens over the 20th Century has resulted in a global warming that is *potentially* similar to that of CO₂

On regional climate

Atmospheric heating by BC disturbs tropical rainfall and regional circulation patterns such as the Asian monsoon.

Black carbon deposition on snow, along with atmospheric heating, leads to faster melting of a.o. the Arctic, the Himalayan and Alpine glaciers.



EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Joint Research Centre

Tackling Black Carbon Emissions within a Multi-Pollutant Multi-Effect Framework

Frank Raes,
Rita Van Dingenen,
Frank Dentener,
Elisabetta Vignati,
Greet Maenhout

a focus on solutions

- sectors and measures
- emissions rather than concentration levels

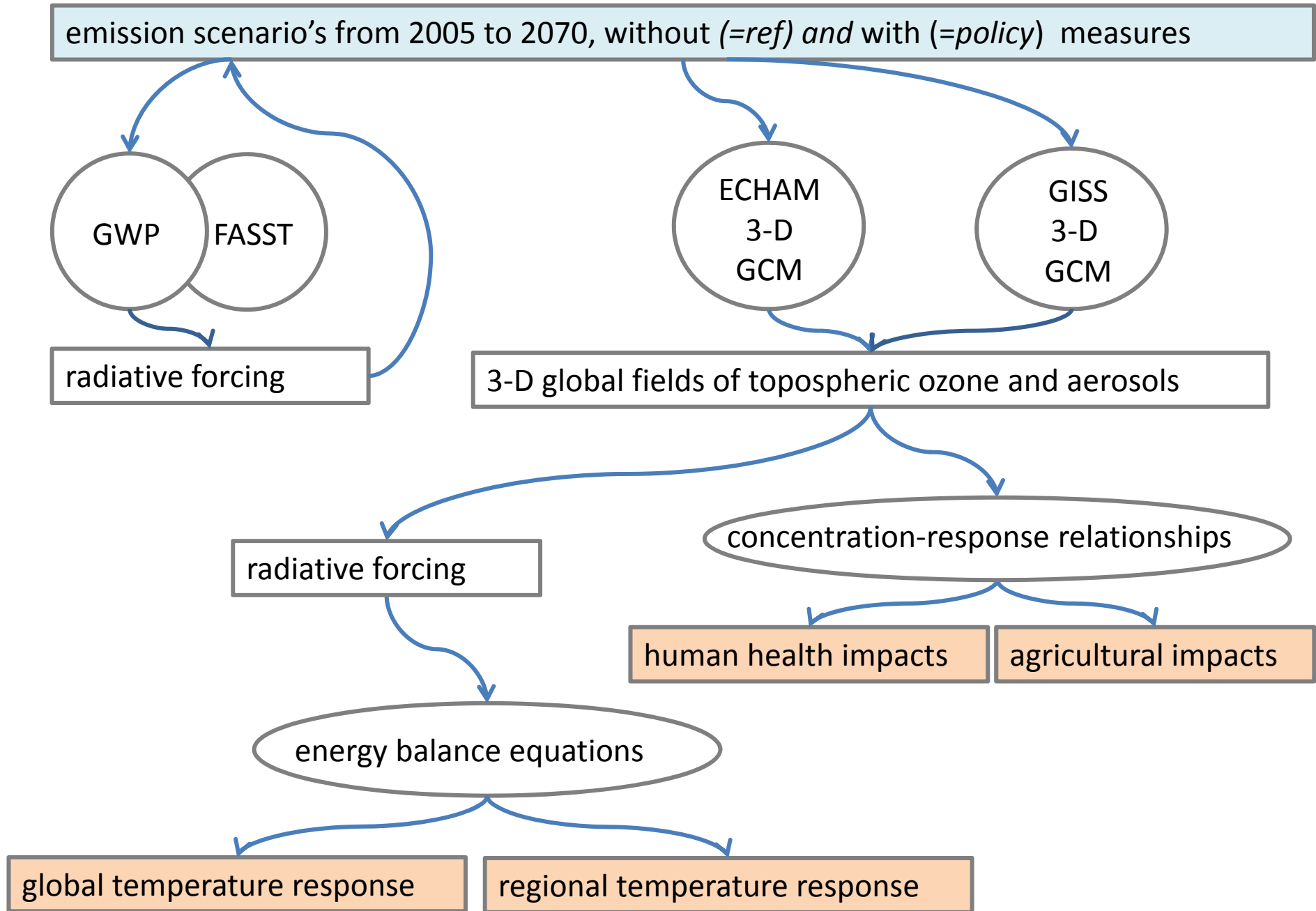
handling uncertainties through a *multi-species* approach

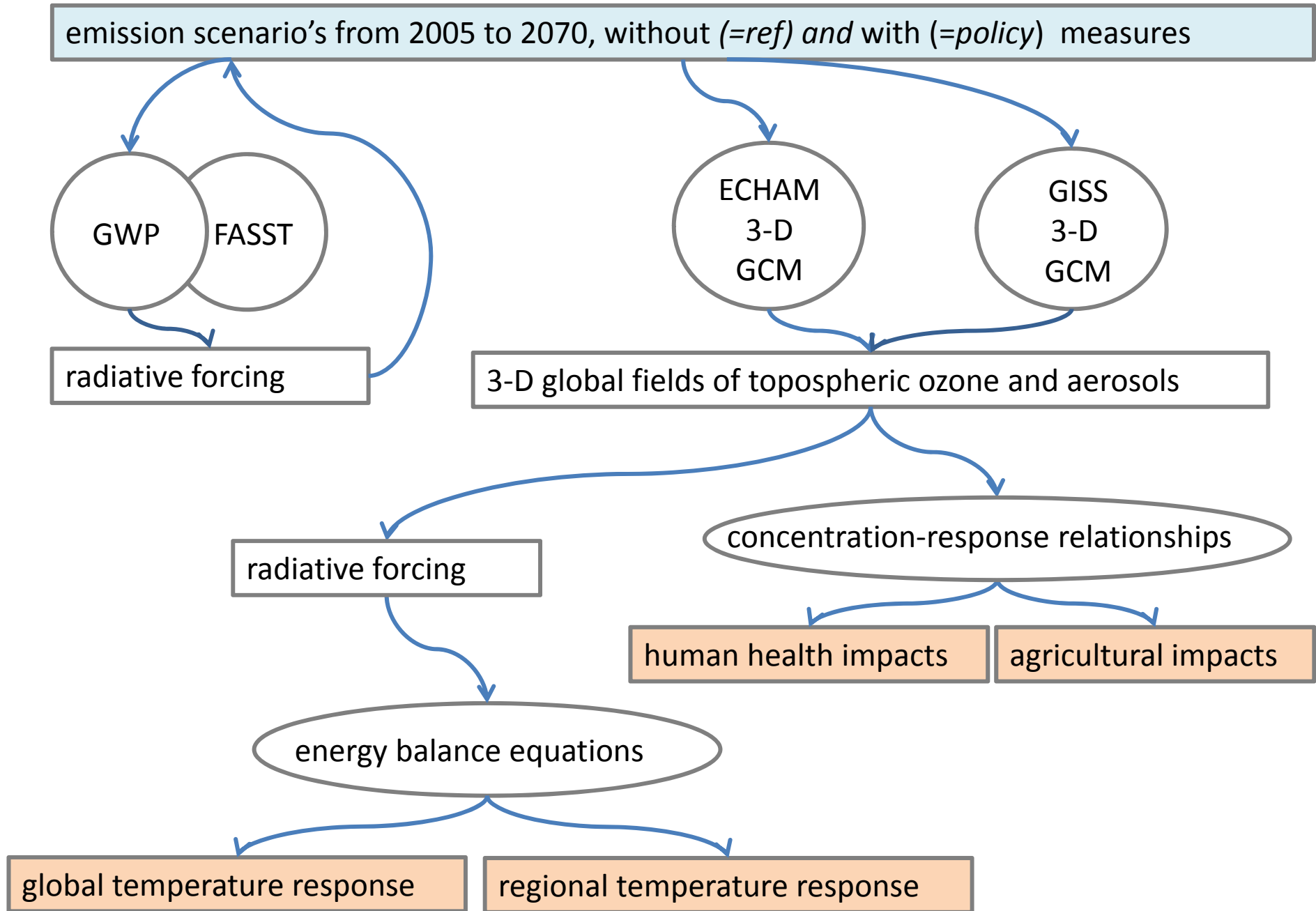
- PM *and* ozone *and* methane (*and* CO₂)

handling uncertainties through a *multi-effect* approach

- focus also on regional rather than just global climate impacts
- put them aside impacts on human health and ecosystems

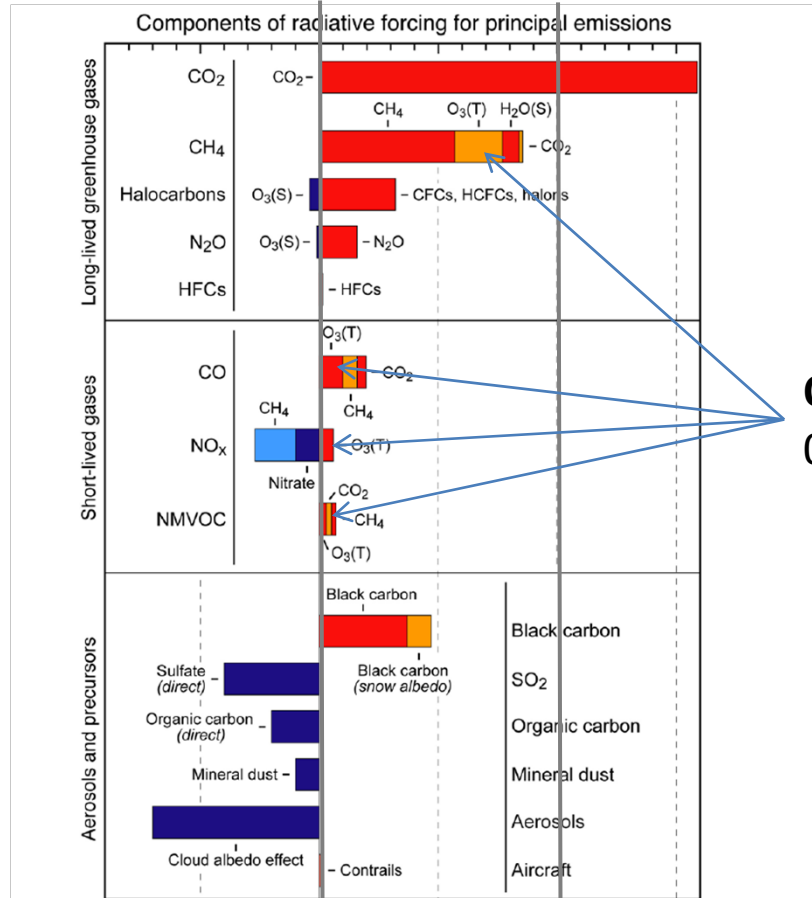
“killing several birds with just 17 stones”







Global radiative forcing of past emissions



O₃, troposphere
 0.25 - 0.45 Wm⁻²

BC direct effect
 BC indirect effects
 BC deposition
BC total

0.0 - 1.0 Wm⁻²



Measures to Limit Near-Term Climate Change & Improve Air Quality



- Chair:** **Drew Shindell:** NASA Goddard Institute for Space Studies, USA
- Vice Chairs:** **Frank Raes:** EC Joint Research Centre, Ispra, Italy
V. Ramanathan: Scripps Institute, Univ. of California, USA
Kim Oanh: Asian Institute of Technology (AIT), Thailand
Luis Cifuentes: Pontificia Universidad Católica, Chile
- Sci. Secretariat:** **Johan Kuylenstierna, Kevin Hicks,** SEI, York, UK
- UNEP Coordinator:** **Volodymyr Demkine,** UNEP DEWA, Nairobi, Kenya
- Lead Authors:** Emissions: **David Streets:** Argonne National Labs. USA
Atmospheric processes: **David Fowler:** CEH, UK
Impacts: **Lisa Emberson:** SEI, UK
Policy Measures: **Martin Williams:** Kings College. UK
- Lead Modelers:** Emissions: **Markus Amann:** IIASA **Greet Maenhout:** JRC/EC
Climate: **Drew Shindell:** GISS. **Elisabetta Vignati** – ECHAM at JRC
Health: **Susan Anenberg:** US EPA
Crops: **Rita van Dingenen:** JRC
Economic Valuation: **Nicholas Muller** Middlebury College



On global climate

Changes in their burdens over the 20th Century has resulted in a global warming that is *potentially* similar to that of CO₂

On regional climate

Atmospheric heating by BC disturbs tropical rainfall and regional circulation patterns such as the Asian monsoon.

Black carbon deposition on snow, along with atmospheric heating, leads to faster melting of a.o. the Arctic, the Himalayan and Alpine glaciers.

3 groups of measures



‘Methane only’: Measures that affect emissions of methane

- Extraction and transport of fossil fuel, waste management and agriculture
- to be implemented centrally by large multi-national and national energy companies, municipalities and through modified agricultural practices





BC Measures to eliminate the most polluting activities

- Transport (high-emitters), cookstove substitution, agricultural waste burning
- Through improved enforcement of legislation or economic and technical assistance to the poorest; biggest BC reduction is from cookstoves



BC, OC and CO reduced by 50-80%, methane by ~40%



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

- Transport, residential, & industry
- mainly at small stationary and mobile sources;
- biggest BC reduction is from diesel particulate filters

