

A photograph of a busy, hazy city street. In the foreground, a man in a white tank top and blue shorts is sweeping the ground with a broom. The background is filled with cars, motorcycles, and a large bridge structure, all shrouded in a thick layer of smog or haze. The overall scene suggests a high level of air pollution, likely from diesel emissions.

Climate impacts of on-road diesel emissions

Anil Agarwal Dialogue 2015
Marianne T. Lund
CICERO

Global and regional climate impacts of black carbon and co-emitted species from the on-road diesel sector

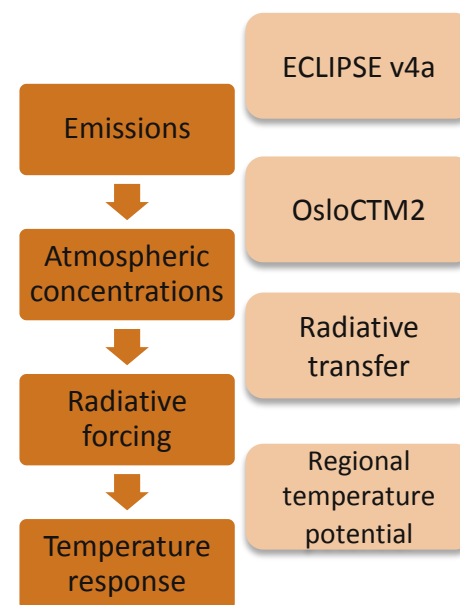
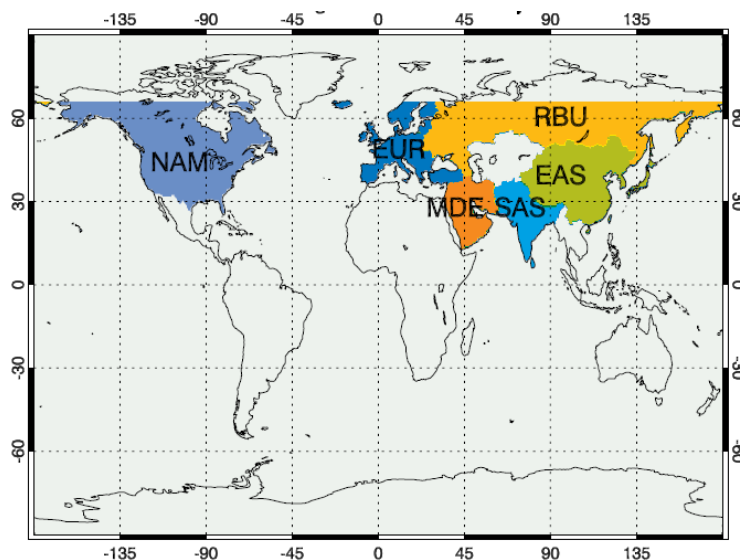


Marianne T. Lund ^{a,*}, Terje K. Berntsen ^{a,b}, Chris Heyes ^c, Zbigniew Klimont ^c,
Bjørn H. Samset ^a

^a CICERO – Center for International Climate and Environmental Research, Oslo 0318, Norway

^b Department of Geosciences, University of Oslo, Oslo, Norway

^c International Institute for Applied Systems Analysis, Laxenburg A-2361, Austria



Global and regional climate impacts of black carbon and co-emitted species from the on-road diesel sector

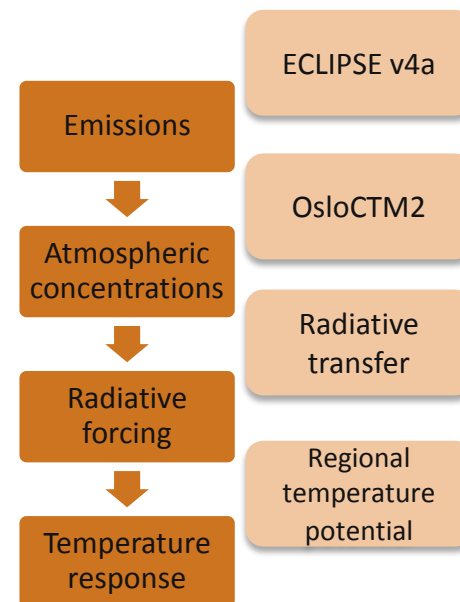
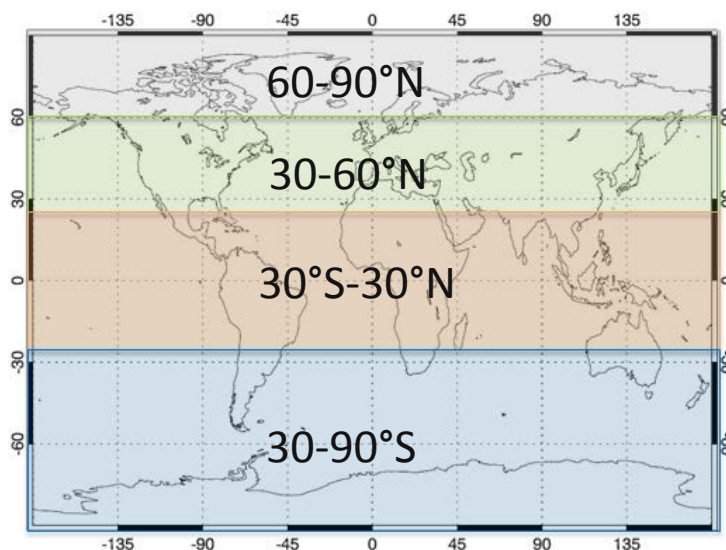


Marianne T. Lund ^{a,*}, Terje K. Berntsen ^{a,b}, Chris Heyes ^c, Zbigniew Klimont ^c,
Bjørn H. Samset ^a

^a CICERO – Center for International Climate and Environmental Research, Oslo 0318, Norway

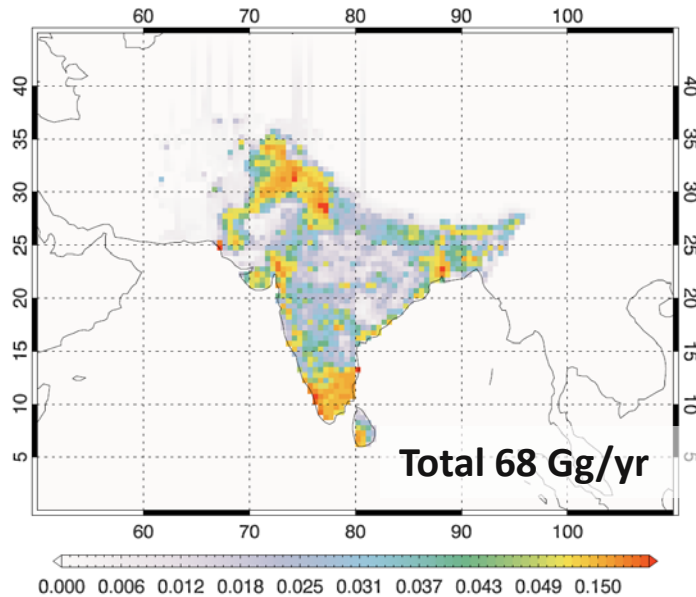
^b Department of Geosciences, University of Oslo, Oslo, Norway

^c International Institute for Applied Systems Analysis, Laxenburg A-2361, Austria



On-road diesel emissions [kt/yr]

BC, year 2010



Europe: 113

North America: 58

East Asia: 121

Co-emitted, year 2010

Sulfur dioxide (SO₂): 80 Gg

Nitrogen oxides (NO_x): 1740 Gg

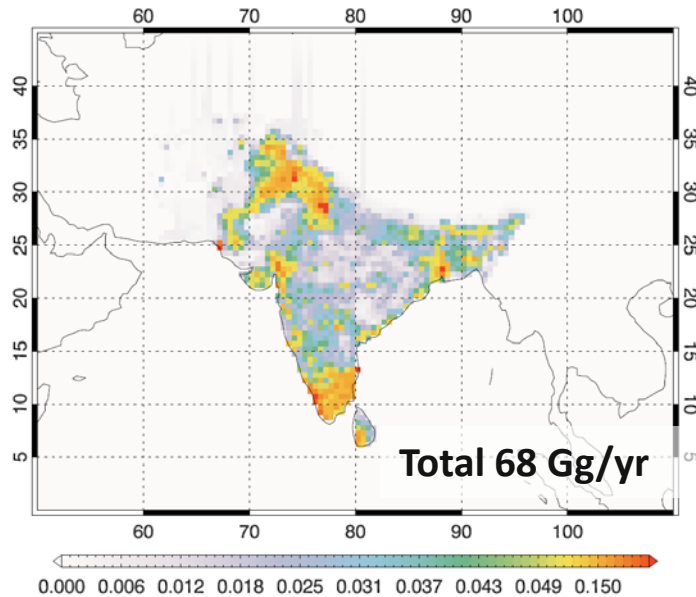
Carbon monoxide: 1620 Gg

VOCs: 150 Gg

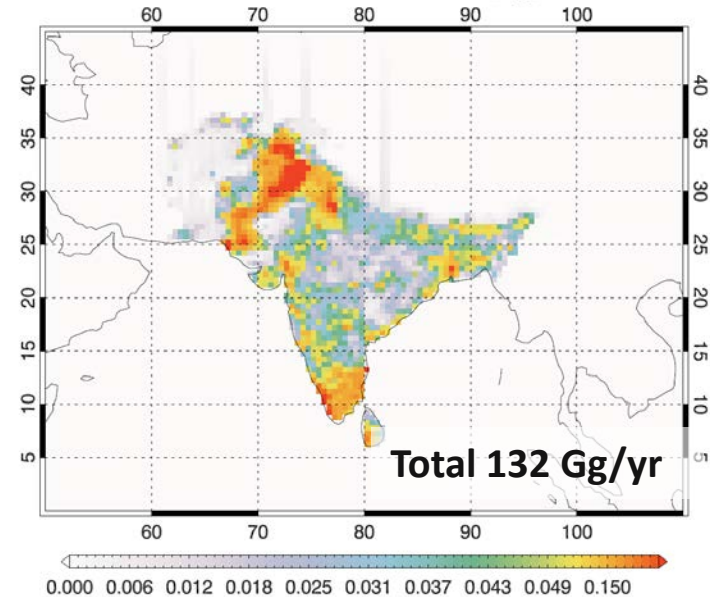
Organic carbon: 40 Gg

On-road diesel emissions [kt/yr]

BC, year 2010



BC, year 2050, CLE scenario



Europe: 113

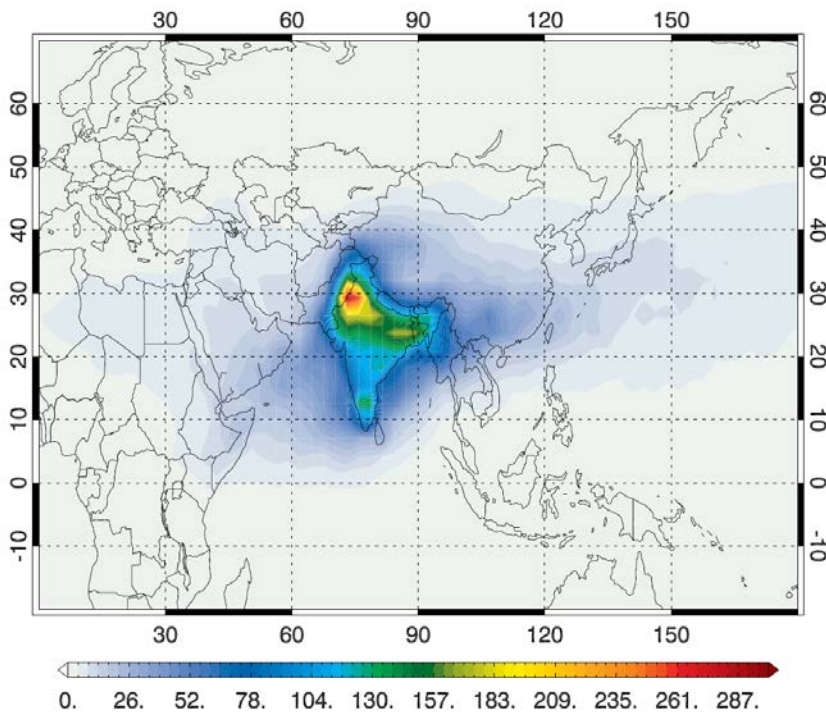
North America: 58

East Asia: 121

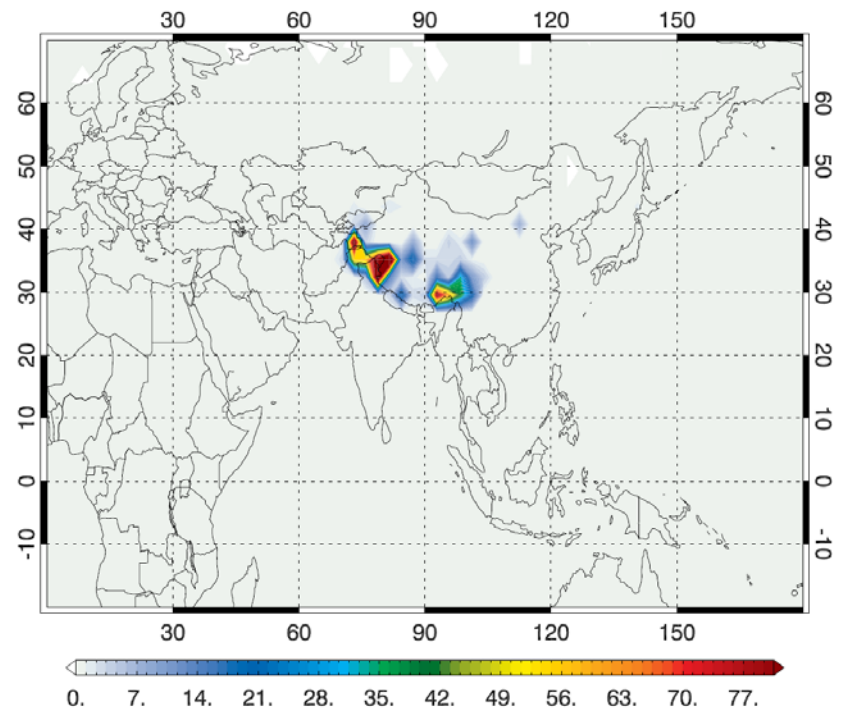
Radiative forcing of diesel BC

Global, annual mean RF 4 mW/m², snow RF 4% of total

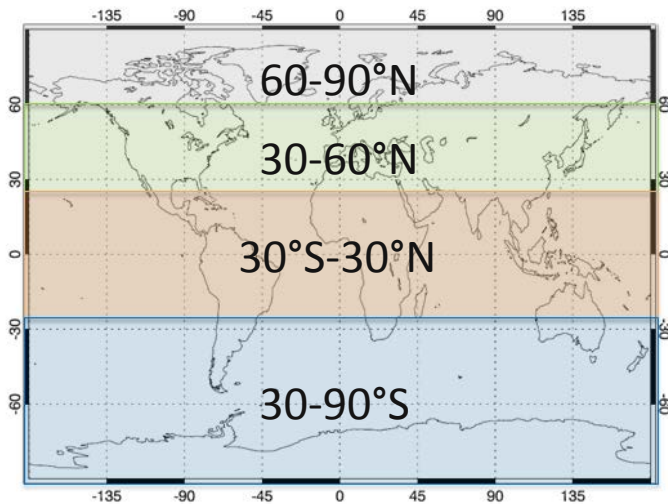
BC DRF annual mean [mW/m²]



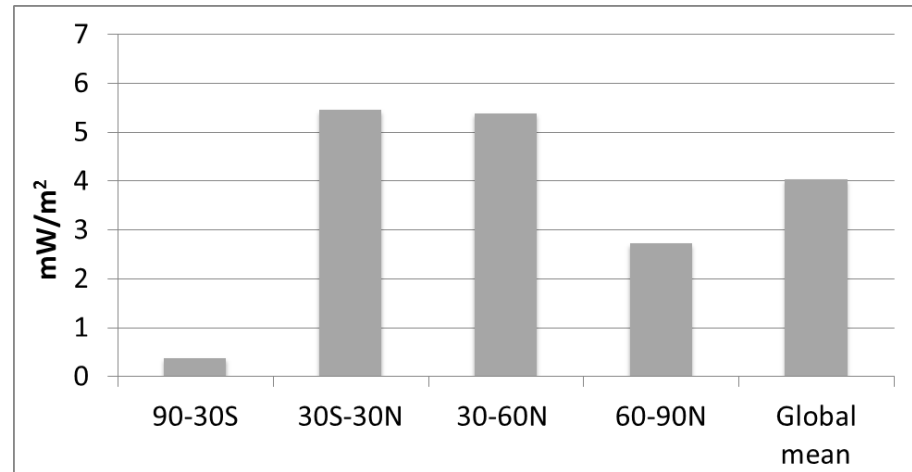
BC snow RF annual mean [mW/m²]



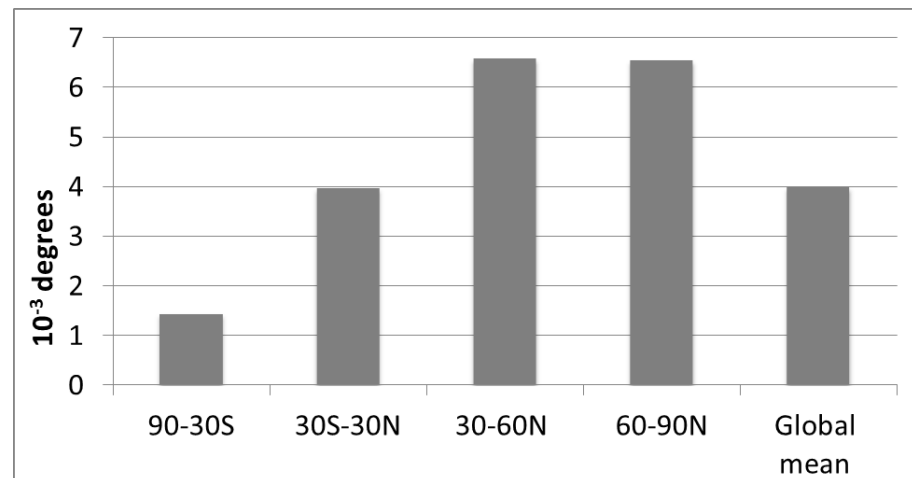
From radiative forcing to temperature response



Regional BC DRF annual mean [mW/m^2]

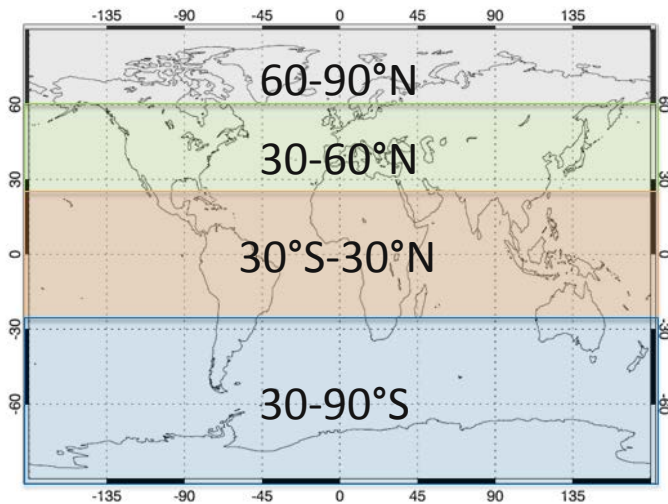
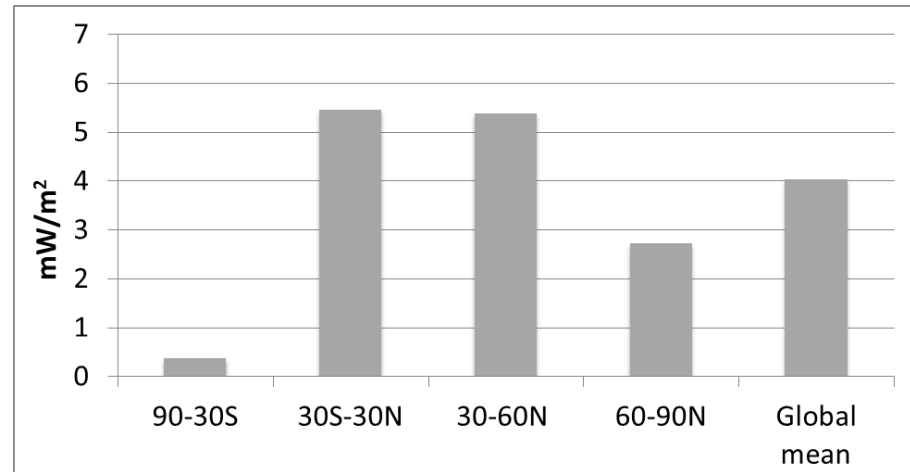


Regional temperature response [10^{-3} degrees]

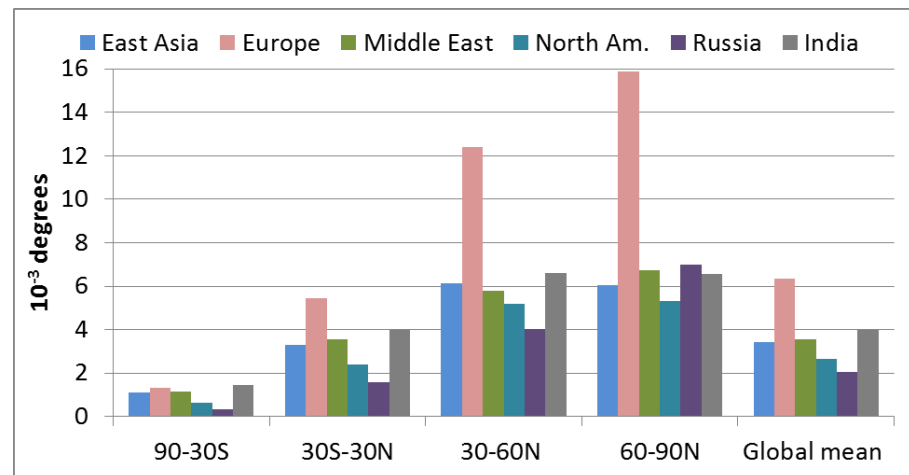


From radiative forcing to temperature response

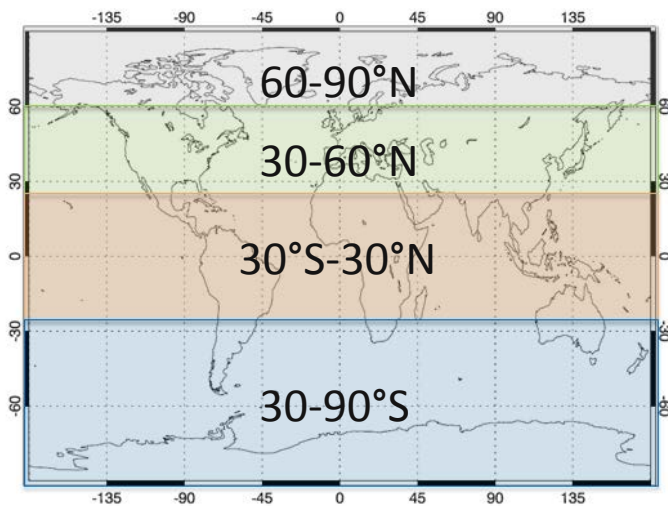
Regional BC DRF annual mean [mW/m^2]



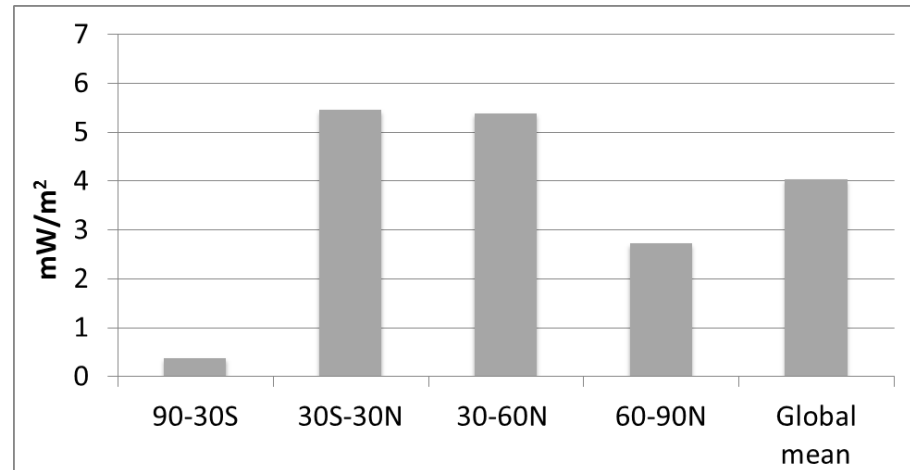
Regional temperature response [10^{-3} degrees]



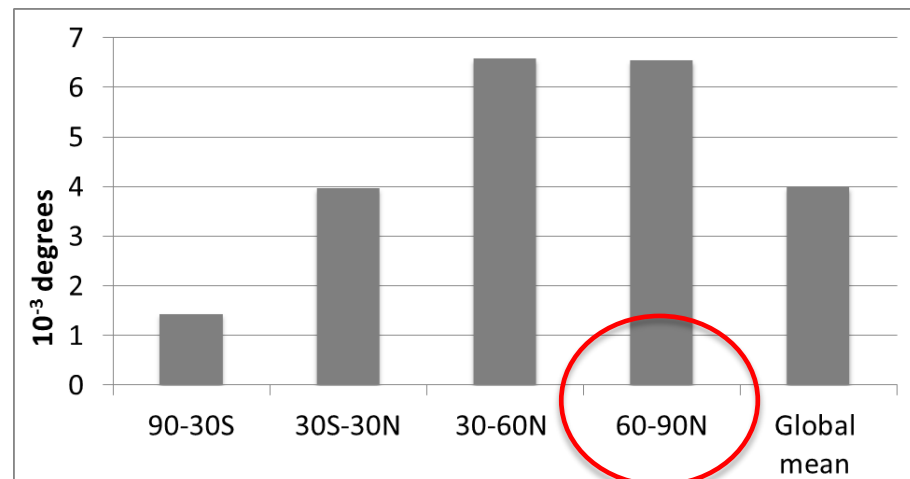
From radiative forcing to temperature response



Regional BC DRF annual mean [mW/m^2]



Regional temperature response [10^{-3} degrees]



Diesel BC impacts on Arctic climate

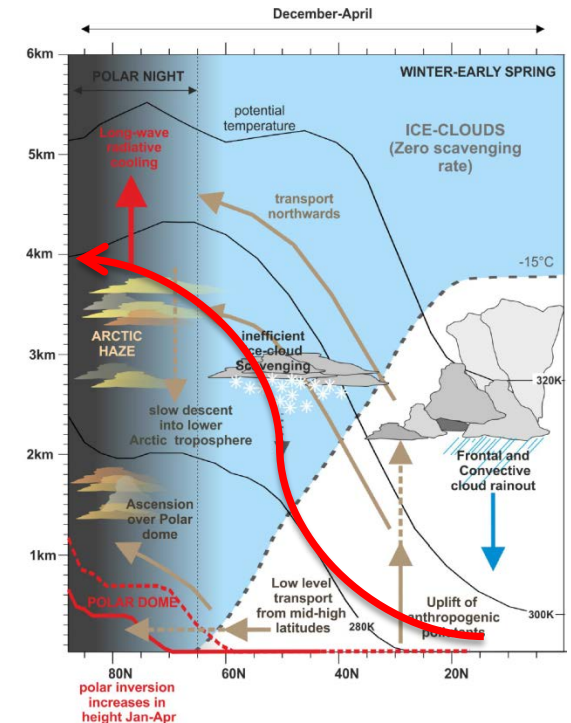
Can BC emissions in India impact Arctic climate?

Yes

- BC transported northwards at high altitudes
- Arctic climate is sensitive to BC forcing exerted outside the Arctic

Implication:

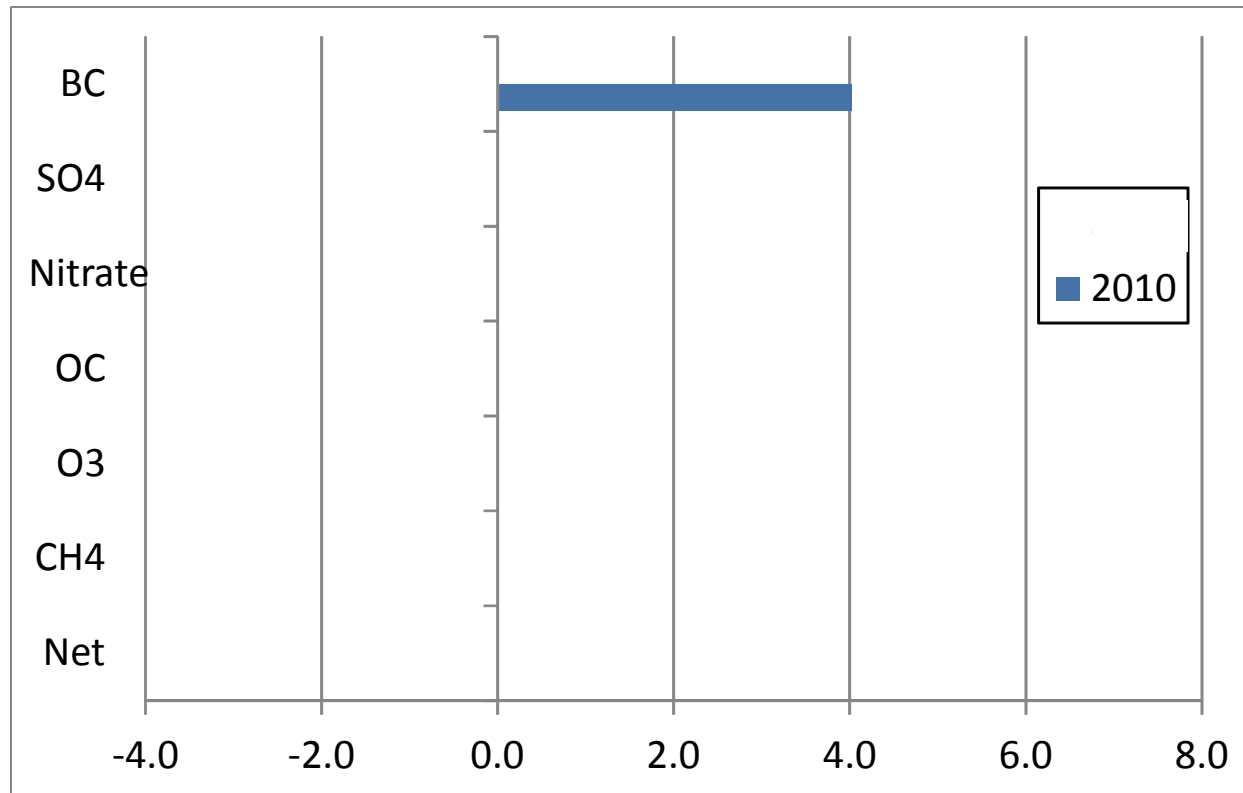
Reduce emissions also in regions which contribute little to local Arctic BC



Browse et al. 2012

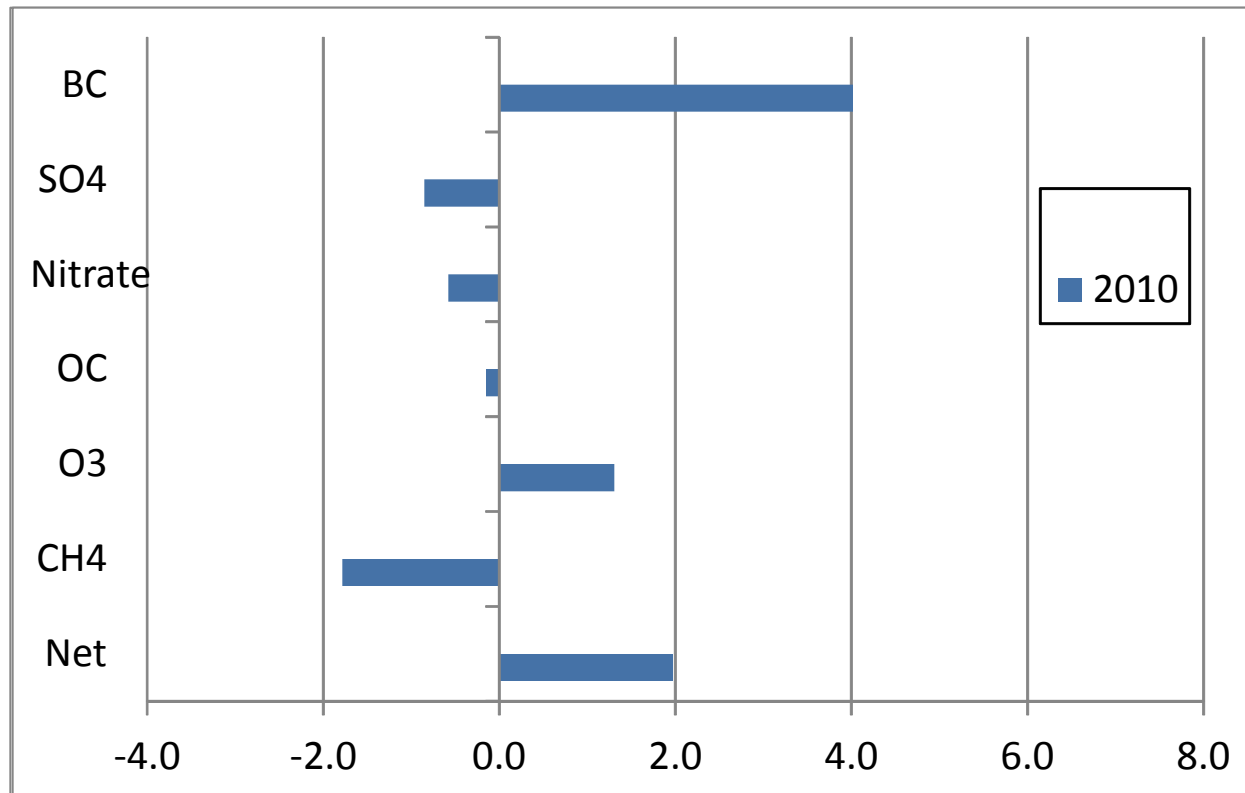
Accounting for co-emitted species

Global, annual mean RF [mW/m^2]



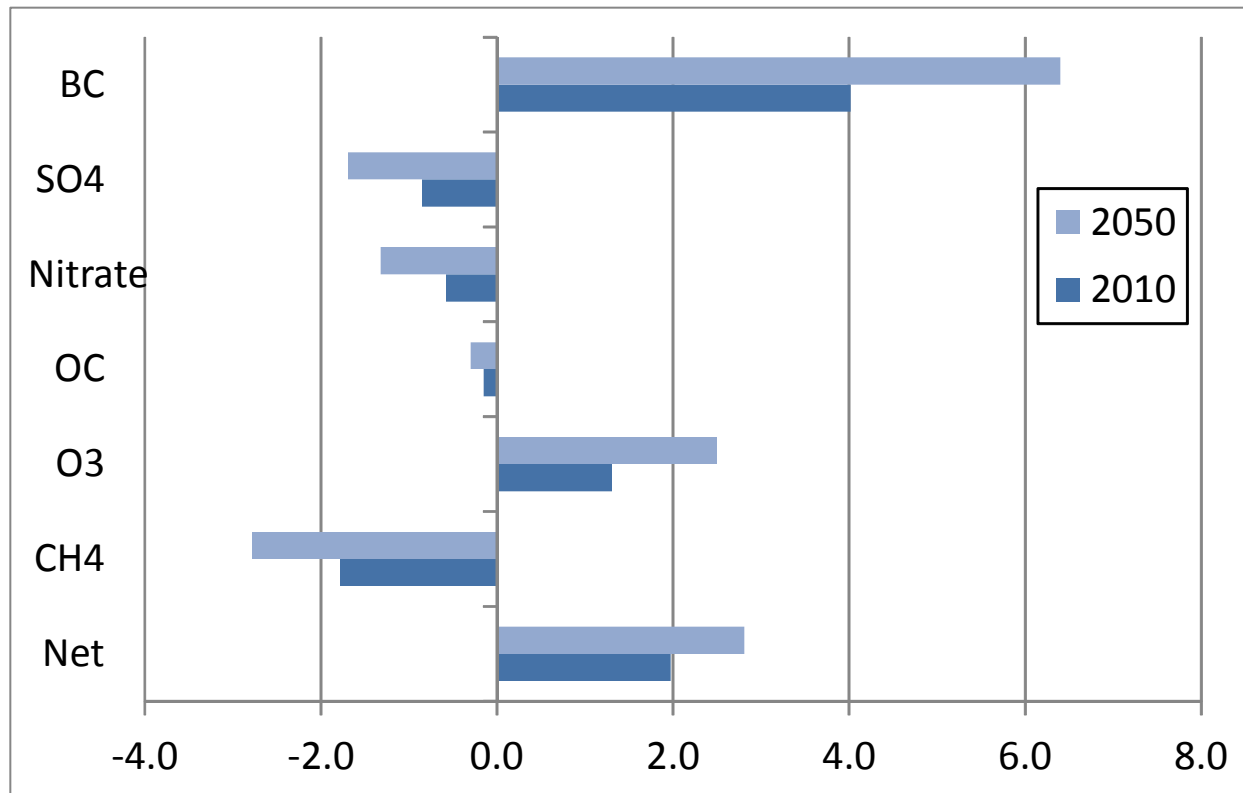
Accounting for co-emitted species

Global, annual mean RF [mW/m^2]



Accounting for co-emitted species

Global, annual mean RF [mW/m^2]



Net warming
impact of on-
road diesel
emissions

*Caveat;
indirect effects
not included.*

Summary

Reducing the climate impact of the on-road sector requires comprehensive strategy including CO₂

Reducing on-road emissions will likely give reduce climate warming impact

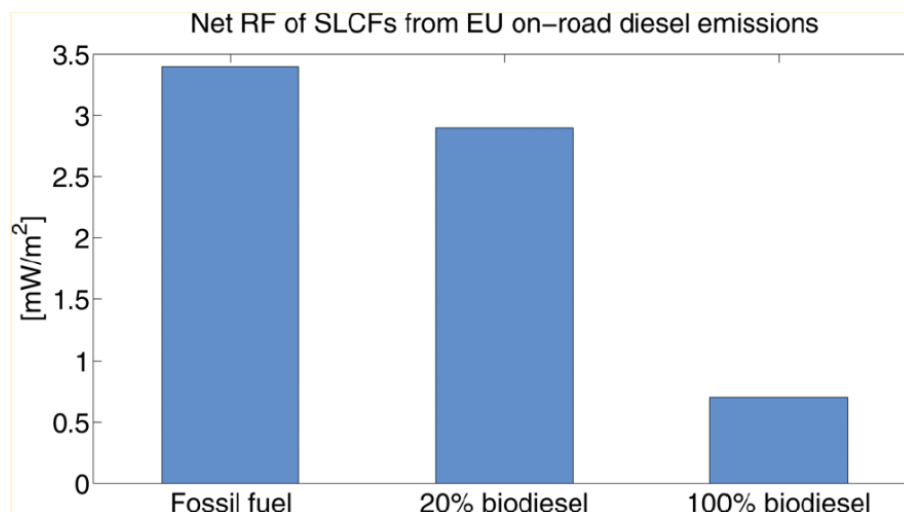
For reduction of Arctic warming; not sufficient to target emissions in the region

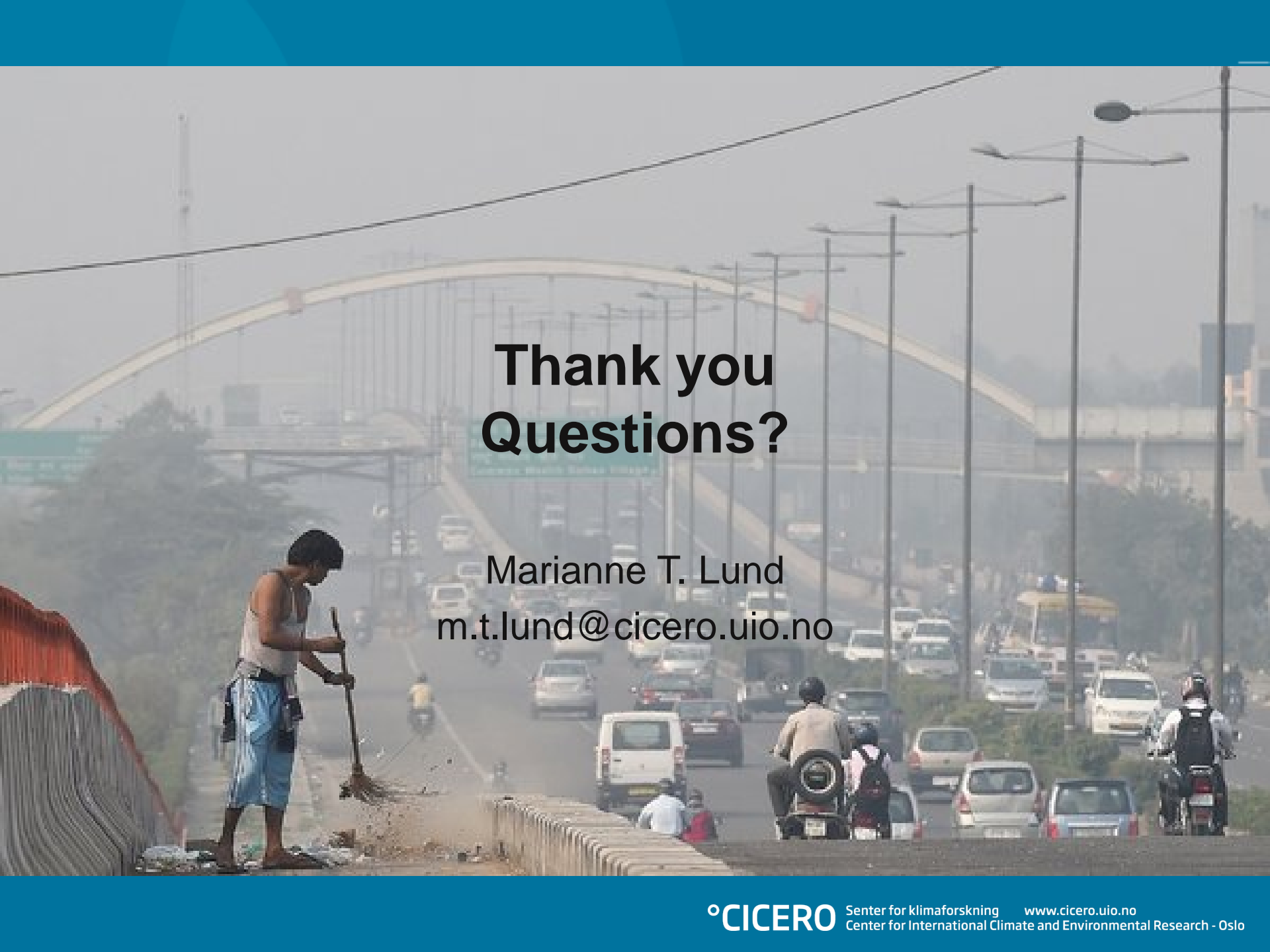
Under current legislation South Asia (India) plays a relatively much more important role by 2050

Emission reductions from a switch to biodiesel

Climate Impacts of Short-Lived Climate Forcers versus CO₂ from Biodiesel: A Case of the EU on-Road Sector

Marianne T. Lund,^{*,†} Terje K. Berntsen,^{†,‡} and Jan S. Fuglestad[†]





Thank you Questions?

Marianne T. Lund
m.t.lund@cicero.uio.no