

Short lived climate pollutants

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Species in relation to climate change

Long-lived climate forcers

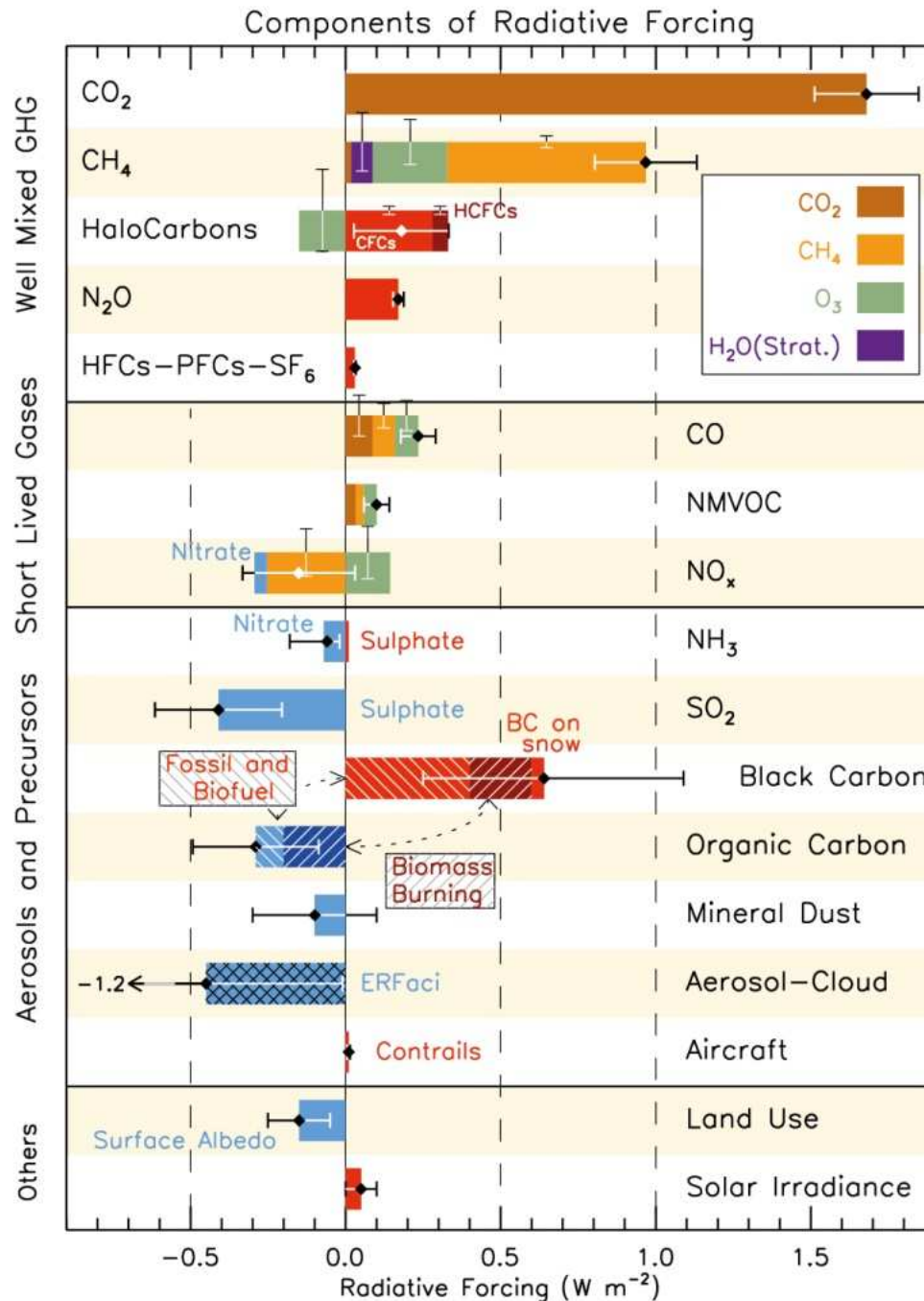
Well-mixed greenhouse gases

Short-lived climate forcers (SLCF)

- SLCF species are gases and particles that affect the climate.
- They have lifetimes in the atmosphere of a few days to a decade.
- The impacts of SLCF species on climate are complex; some of the species warm and others cool the climate

Short-lived climate pollutants (SLCP)

Many of the SLCF are also air pollutants.













Long-lived climate forcers (gases)

Short-lived climate forcers (gases)

Short-lived climate forcers (aerosols and precursors)

Radiative forcing of climate change by emitted species

SLCF with warming effect on the climate

SUBSTANCE	 ANTHROPOGENIC SOURCES	LIFETIME IN ATMOSPHERE	 IMPACTS/MITIGATION
BLACK CARBON (BC)		4-12 DAYS	
METHANE (CH ₄)		12 YEARS	
TROPOSPHERIC OZONE (O ₃)		WEEKS	
HYDROFLUORO-CARBONS (HFCs)		15 YEARS (WEIGHTED BY USAGE)	

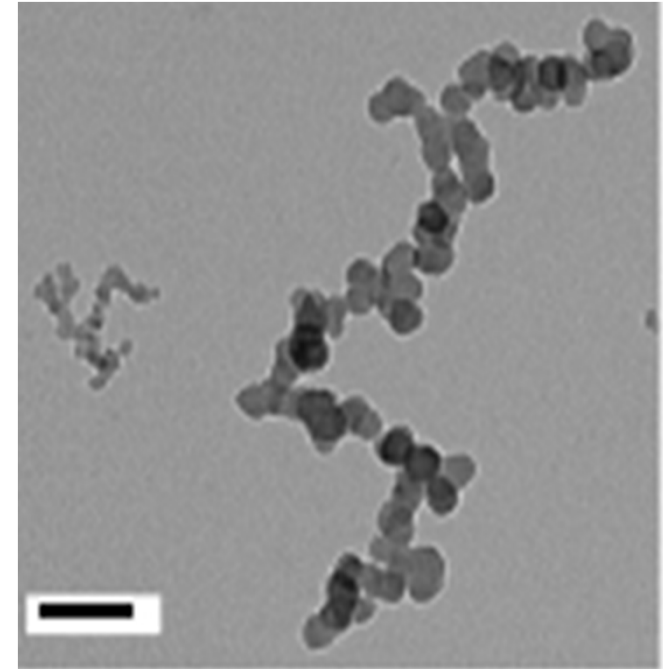
Black carbon particles

- Emitted only by combustion
- Fraction of $PM_{2.5}$, aggregate of small carbon spheres (10-50 nm)
- Refractory \rightarrow vaporization $T \sim 4000$ K
- Water insoluble

CLIMATE: Strong absorption of VIS radiation, with warming impact of 460-1,500 times stronger than CO_2 per unit of mass

HEALTH:

- BC particles can reach the alveolar region.
- They can also carry toxic chemical species (PAH) deposited onto their porous surface



Source: Steven Rogak (UBC-Canada)

BC is a good tracer of vehicle exhausts

BC emission= 6.6 million tonnes

BLACK CARBON EMISSION TRENDS

2015 Black carbon emissions from main anthropogenic sources (in million tonnes) by region, historical trends and 2030 projections under BAU and full SLCP mitigation scenario

LATIN AMERICA & CARIBBEAN



11% -4% -56%

N. AMERICA & EUROPE



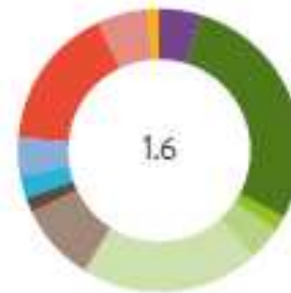
-24% -26% -73%

AFRICA



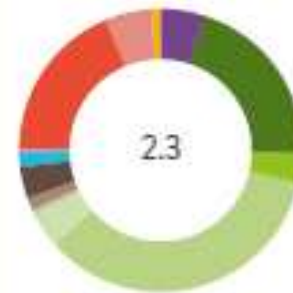
22% 11% -68%

SOUTH, WEST & CENTRAL ASIA



12% 5% -65%

EAST ASIA, SE ASIA & PACIFIC



-2% -19% -62%

● % of change from 2000 to 2015 ○ Projected % change from 2015 to 2030 under BAU ○ Projected % change from 2015 to 2030 under mitigation scenario

HOUSEHOLD
58% of 2015
global emissions

- Biomass cookstoves
- Biomass heating stoves
- Coal stoves
- Other residential combustion, incl. kerosene lamps

TRANSPORT
24% of 2015
global emissions

- Transport
- Transport high emitters

INDUSTRIAL
PRODUCTION
6% of 2015
global emissions

- Brick production
- Coke production
- Other

AGRICULTURE
5% of 2015
global emissions

- Open burning

FOSSIL FUELS
3% of 2015
global emissions

- Long distance gas transmission
- Oil and gas production incl. flaring

LARGE SCALE
COMBUSTION
2% of 2015
global emissions

- Large scale combustion including boilers and furnaces in power plants and industry

WASTE
1% of 2015
global emissions

- Open burning of municipal waste

Challenges related to SLCF reduction

- BC is an interesting SLCF because it is regionally important and offers some synergy between air quality and climate policies.
- BC is the only particulate with warming effects, mitigation is not so easy since other species are often co-emitted. Therefore, uniform elimination of all emissions from black-carbon-rich sources could lead to no change in climate warming.
- There is still a large uncertainty in the radiative and climate effects by SLCF, including BC.
- **Monitoring of SLCFs is needed as well as the evolution of their emissions** to progress towards the goals of the Paris Agreement.

THANK YOU!



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