Short-lived Climate Forcers

Takeshi Enoki

IPCC AR7 TFI Co-Chair, Japan

&

Robert Vautard

IPCC AR7 WGI Co-Chair, France

With contribution from Sophie Szopa, AR6 WGI Chapter 6 CLA

SEVENTH ASSESSMENT CYCLE

What are Short-Lived Climate Forcers?

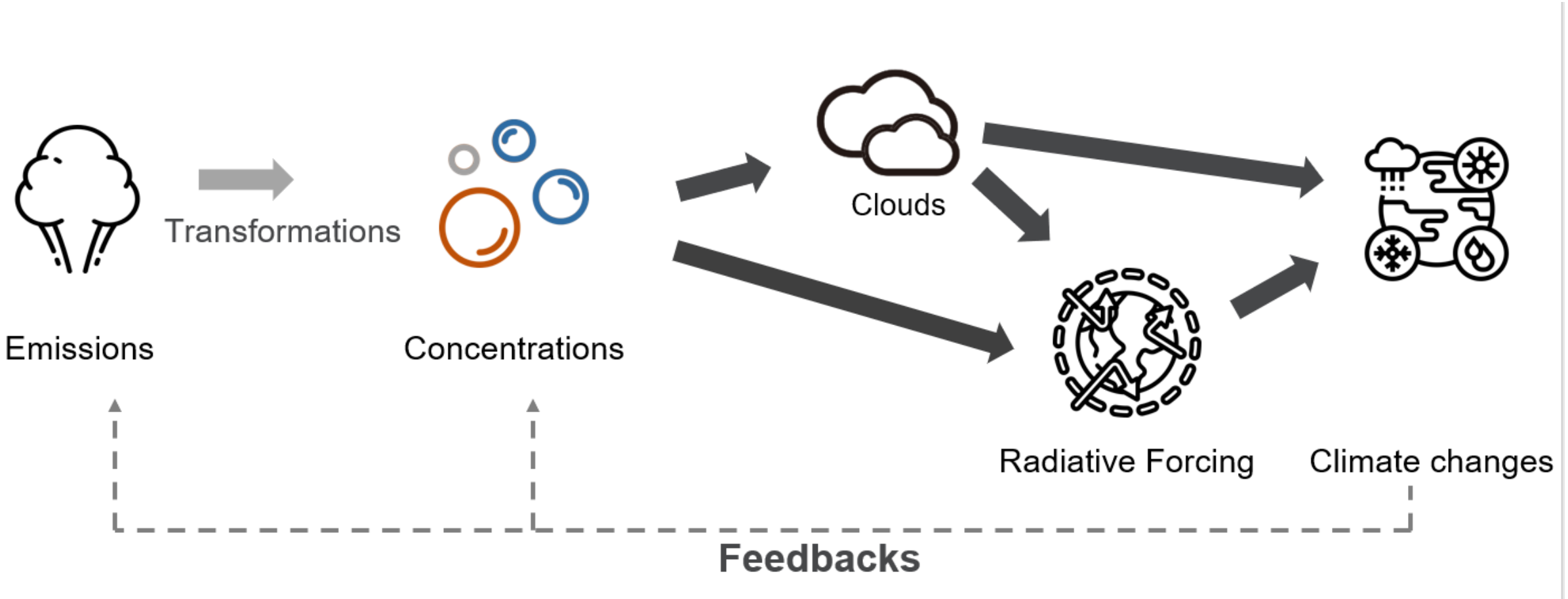
- A set of chemically reactive compounds with short (relative to *carbon dioxide (CO2)*) atmospheric lifetimes (from hours to about two decades) but characterised by different physiochemical properties and environmental effects.

- SLCFs are classified as direct or indirect, with direct SLCFs exerting climate effects through their *radiative forcing* and indirect SLCFs being the *precursors* of other direct climate forcers. Direct SLCFs include *methane (CH_4)*, *ozone (O_3)*, primary *aerosols* and some halogenated species. Indirect SLCFs are precursors of ozone or secondary aerosols.

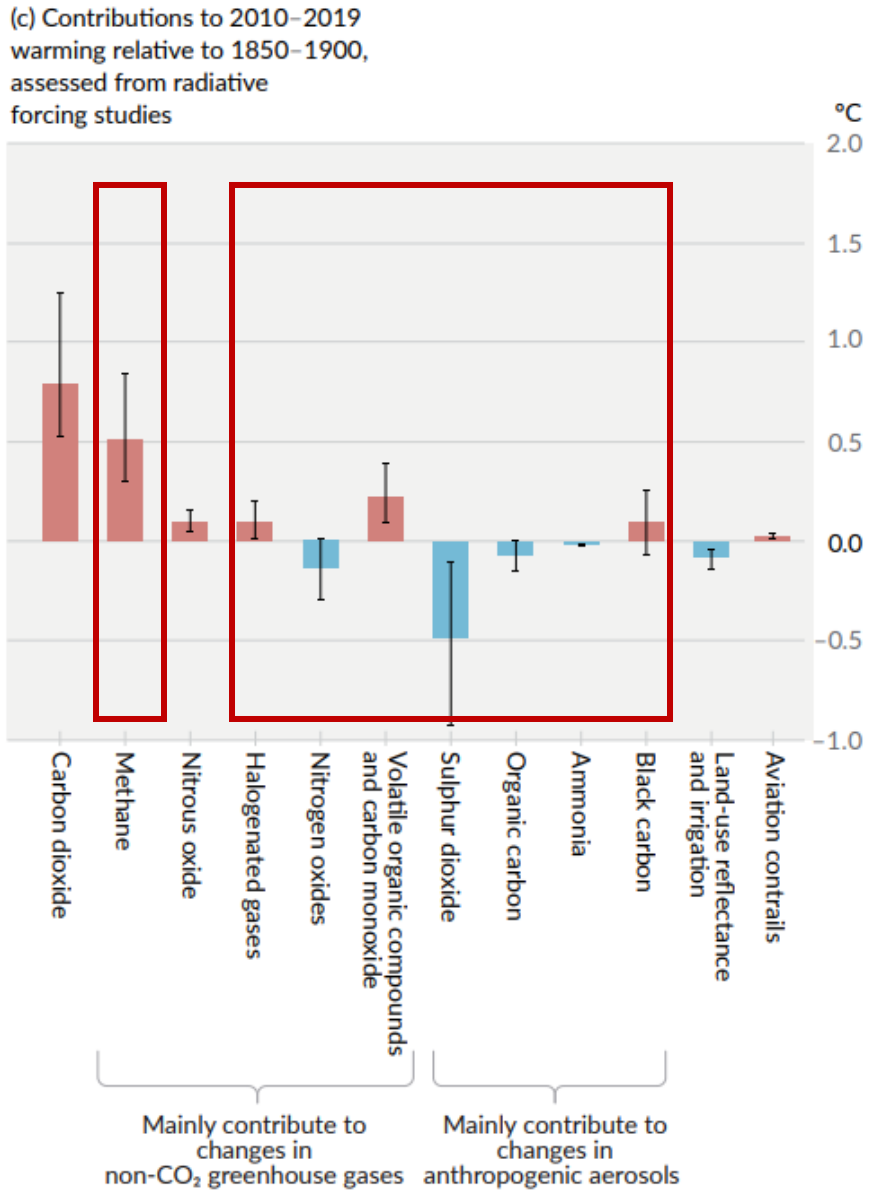
- Many SLCFs are also air pollutants.

Compounds	Lifetime
CH_4	-9 years -12 years perturbation time)
O_3	Hours to weeks
NO_x (= NO + NO_2)	Hours to days
CO	to 4 months
NMVOCs**	Hours to months
SO_2	Days (trop.) o weeks (strat.)
NH_3	Hours
HCFCs	Months to years
HFCs	Days to years
Halons and Methylbromide	Years
Very Short-lived Halogenated Species (VSLSs)	Less than 6 months
Sulphates	Minutes to weeks
Nitrates	Minutes to weeks
Carbonaceous Aerosols	Minutes to Weeks
Sea spray	Day to week
Mineral dust	Minutes to Weeks

What happens in the atmosphere?

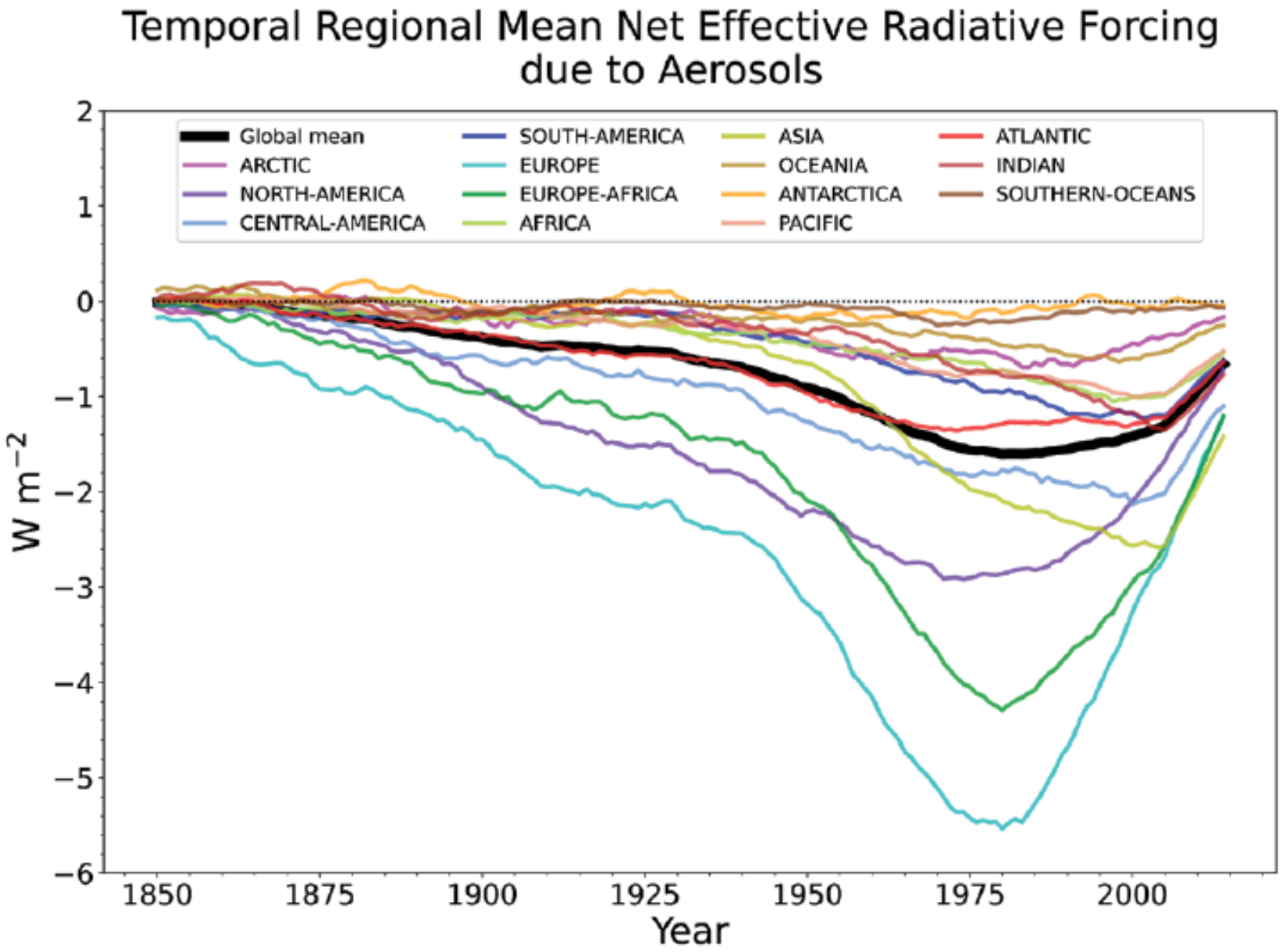


The importance of SLCFs

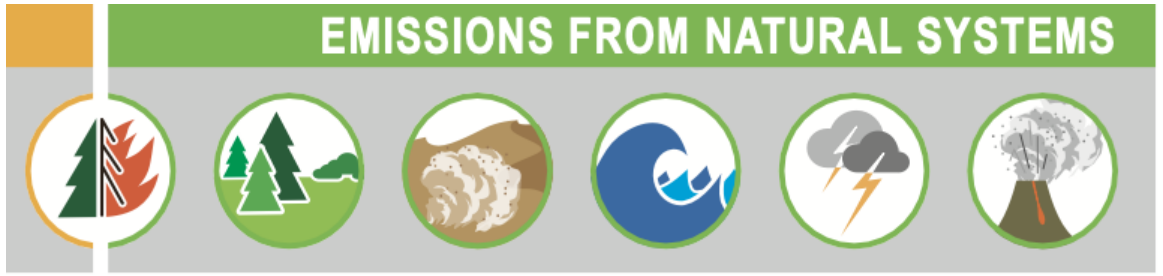


- SLCFs can be cooling or warming through interactions with radiation and clouds.
- Their emission or formation has a significant effect on radiative forcing over a period determined by their respective atmospheric *lifetimes*.
- Changes in their *emissions* can also induce long-term *climate* effects via, in particular, their interactions with some biogeochemical cycles.
- Over time scales of 10 to 20 years, the global temperature response to a year's worth of current emissions of SLCFs is at least as large as that due to a year's worth of CO2 emissions (*high confidence*).

Variations of aerosols across time and regions



Uncertainties in emissions



Since AR5, improvement of activity and emission-factor data, spatial allocation
+ independent satellite-derived observations, raising confidence in methods to derive emissions

until the year 2000 : *High confidence* in the **sign of global trends** of SLCF emissions
since 2000 : only *medium confidence* for the **rate of change**, owing primarily to uncertainties in the actual application of reduction technologies in fast-growing economies of Asia

For most SLCF species, there is *high confidence* in trends and magnitudes for affluent countries from the OECD but *medium confidence* for regional emissions of NH3, methane and NMVOC

Mitigation

- From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO2 emissions, reaching at least net zero CO2 emissions, along with strong reductions in other greenhouse gas emissions. **Strong, rapid and sustained reductions in CH4 emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.**

- Sectors producing the largest SLCF-induced warming are those dominated by methane emissions: fossil fuel production and distribution, agriculture and waste management (high confidence).

- **Health co-benefits in mitigation from climate change and air pollution**

SLCFs and scope of the GHG Inventory

Gases included in IPCC Guidelines tables	Gases under the Paris Agreement	Guidance provided in IPCC Guidelines	Identified as SLCF	Additional guidance needed?
CO_2	✔	✔		
CH_4	✔	✔	✔	?
N_2O	✔	✔		
HFCs	✔	✔	✔	?
PFCs	✔	✔		
SF_6	✔	✔		
NF_3	✔	✔		
NO_X		Limited	✔	✔
CO		Limited	✔	✔
NMVOCs		Limited	✔	✔
SO_2		Limited	✔	✔

New guidance needed?
O_3
NH_3
HCFCs
Sulphates
Carbonaceous aerosols
Sea spray
Mineral dust
Etc.

Mandate to produce a Methodology Report on SLCFs

IPCC49 (2019) decided that IPCC TFI should develop a Methodology Report on SLCFs during AR7 cycle with a preparatory work during AR6 cycle:

- Approach
  - The preparatory work for the Methodology Report start in the AR6 cycle.
  - Followed by further methodological development in the AR7 cycle
- Output and Timeline
  - Expert meetings will produce a series of supporting materials
  - These will be used to inform the Scoping of methodological work on SLCF
  - The Scoping Meeting take into consideration the work on SLCF in the AR6 reports
  - Outline to be presented for approval to the Panel after the Scoping Meeting
- Required Activities
  - Technical analysis work by TFI TSU with other experts
  - 3-4 Expert meetings
  - Scoping Meeting
  - Approval of outline by the Panel

Due to the pandemic, the Scoping Meeting was postponed to AR7

Preparatory work in AR6

TFI TSU carried out a technical analysis of existing methodological frameworks on SLCF categories and emissions.

Joint 1st and 2nd Expert Meeting was held in October 2021 (online)

- Expert Meeting developed the following:
  - A list of SLCF categories and associated SLCF species for all sectors of the inventory
  - List of knowledge gaps in all sectors

The 3rd Expert Meeting was held in April 2022 (online)

- Participants further considered knowledge gaps and discussed cross-cutting issues
- The discussion was focused on three main topics:
  - Definitions of SLCF species and methods of their identification/quantification
  - General inventory issues
  - Refined Category and Gaps' lists

Scoping Meeting and Beyond

- Scoping Meeting on SLCF held in February 2024 (Brisbane, Australia).
- Outcomes:
  - Recommendation on the title and format of the Methodology Report
  - Draft Terms of Reference (TOR)
  - Draft Table of Contents (TOC)
  - Draft Instructions to Experts and Authors

- These outputs will be the core elements of the proposal by TFI Bureau to the IPCC 61 (Jul. 2024) for its consideration.
- Call for nominations of authors/review editors after IPCC 61.
- Methodology Report to be completed by the end of 2027.

SEVENTH ASSESSMENT CYCLE

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UN environment programme

THANK YOU
FOR YOUR ATTENTION

STAY IN TOUCH

ipcc.ch

ipcc-sec@wmo.int

ipcc-media@wmo.int

STAY CONNECTED

ipcc_ch

ipcc

@ipcc

ipcc