Indian Institute of Tropical Meteorology (IITM), Pune

Press Release

New study shows that ocean-emitted natural compounds cool climate

Highlights from the study:

- Cooling effects on climate due to natural short-lived halogens emitted by the ocean.
- Since 1750, this cooling effect has been increased, which is driven by the anthropogenic amplification of these natural oceanic emissions of halogens.
- The study used a state-of-the-art Earth-system model to quantify the contribution of SLH to the global energy balance across pre-industrial, present-day and future climates.
- This cooling effect mitigates some of the global warming but is unable to compensate for all warming caused by anthropogenic emissions.
- IITM as collaborative partner for this international study, led by of Physical Chemistry Rocasolano, CSIC, Spain

IITM Pune; 28.6.2023: **A new study published in *Nature* resulting from an international collaboration including a scientist from the Indian Institute of Tropical Meteorology (IITM), Pune, shows that natural short-lived halogens emitted by the ocean exert a substantial indirect cooling effect on climate. According to the study, this cooling effect arises from the halogen-caused changes to ozone, methane, aerosols and stratospheric water vapour. In addition, this cooling effect has increased since 1750, driven by the anthropogenic amplification of these natural oceanic emissions of halogens.**

The climate significance of ocean-atmosphere gas exchange has primarily focused on the exchange of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less attention has been paid to ocean emissions of reactive gases to the atmosphere, where they initiate chemical reactions that have the potential to impact the Earth's radiative balance and climate indirectly. One such group of reactive gases is the so-called short-lived halogens compounds (SLH, chlorine, bromine and iodine compounds with a lifetime of less than six months in the atmosphere). These species are naturally emitted from the oceans, polar ice and the biosphere, and for the past two decades measurements made around the world have demonstrated their ubiquitous presence in the global atmosphere. Despite this observational evidence, climate models used in international climate assessments, such as the Intergovernmental Panel on Climate Change (IPCC), have not included the sources and chemistry of SLH.

The study used a state-of-the-art Earth-system model to quantify the contribution of SLH to the global energy balance across pre-industrial, present-day and future climates. "Our results show that ocean-emitted halogen compounds cool the climate system, and this natural cooling effect has been amplified since the beginning of the

Industrial Era due to anthropogenic activities" explains Anoop Mahajan, IITM. The work highlights that the net indirect cooling effect caused by SLH is the result of a trade-off between the spatially variable effects of halogens, mainly on ozone (both tropospheric and stratospheric) and methane, with a minor contribution from aerosols and stratospheric water vapour. The study demonstrates that ocean-initiated atmospheric chemistry plays a critical role in mitigating some anthropogenic warming. This hitherto unrecognized interplay between SLH and the Earth´s radiative balance is non-linear across past, present and future climates, and is determined by a combination of natural and anthropogenic emissions, climate variability and atmospheric chemistry.

Reference to the article

Saiz-Lopez et al., **Natural short-lived halogens exert an indirect cooling effect on climate**. *Nature*, DOI: 10.1038/s41586-023-06119-z

Institutions involved:

Indian Institute of Tropical Meteorology, Ministry of Earth Sciences, India
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Institute for Interdisciplinary Science , National Research Council, Argentina
Institute of Environment and Ecology, Tsinghua University, China
National Center for Atmospheric Research, USA
Instituto de Astrofísica de Andalucía, Spain
Institut für Physik der Atmosphäre, Germany
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Embargo ends **28 June 2023 at 21:30 IST.**

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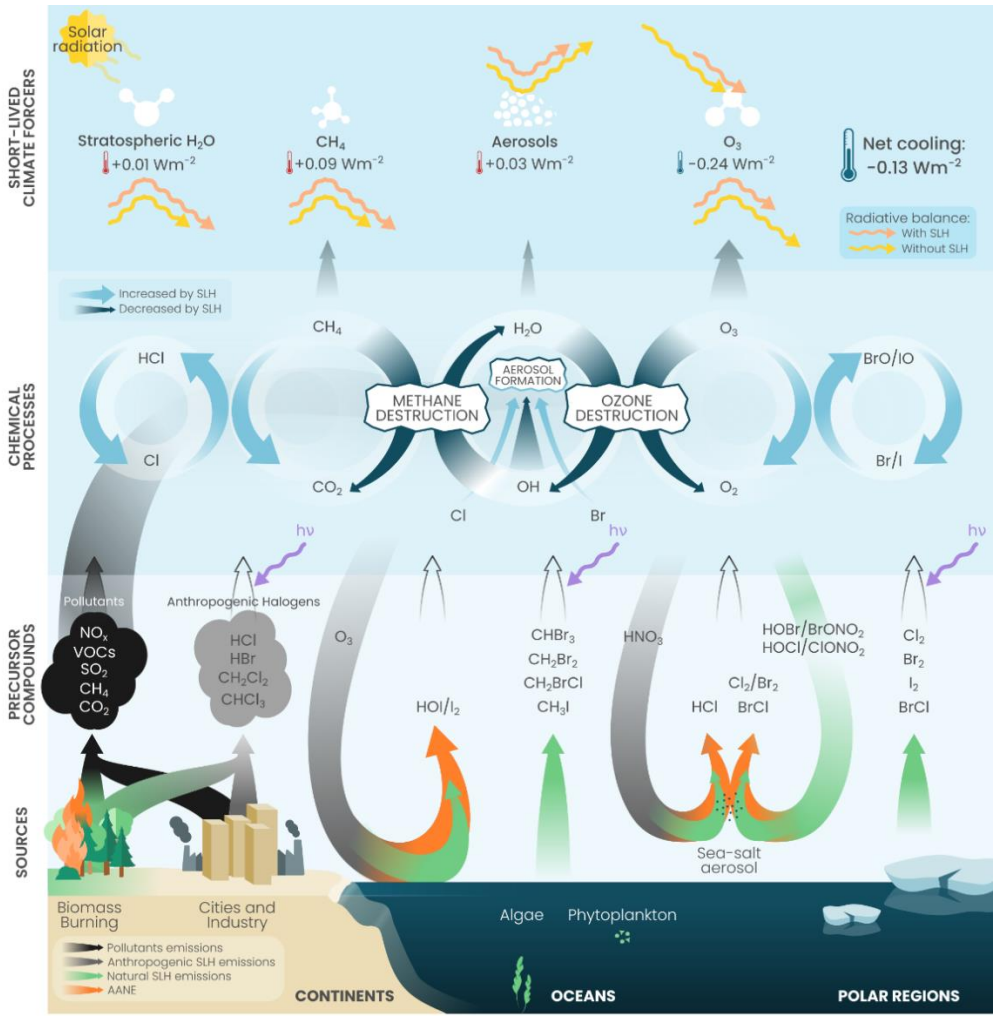

Figure: Conceptual representation of the SLH influence on atmospheric composition and radiative feedbacks within the climate system. *Ocean emitted halogens influence the climate system through changes in ozone (O_3), methane (CH_4), aerosols and stratospheric water vapour (H_2O). The individual warming and cooling effect, as well as the net SLH-driven cooling radiative effect, are synthesized as colored thermometers.*