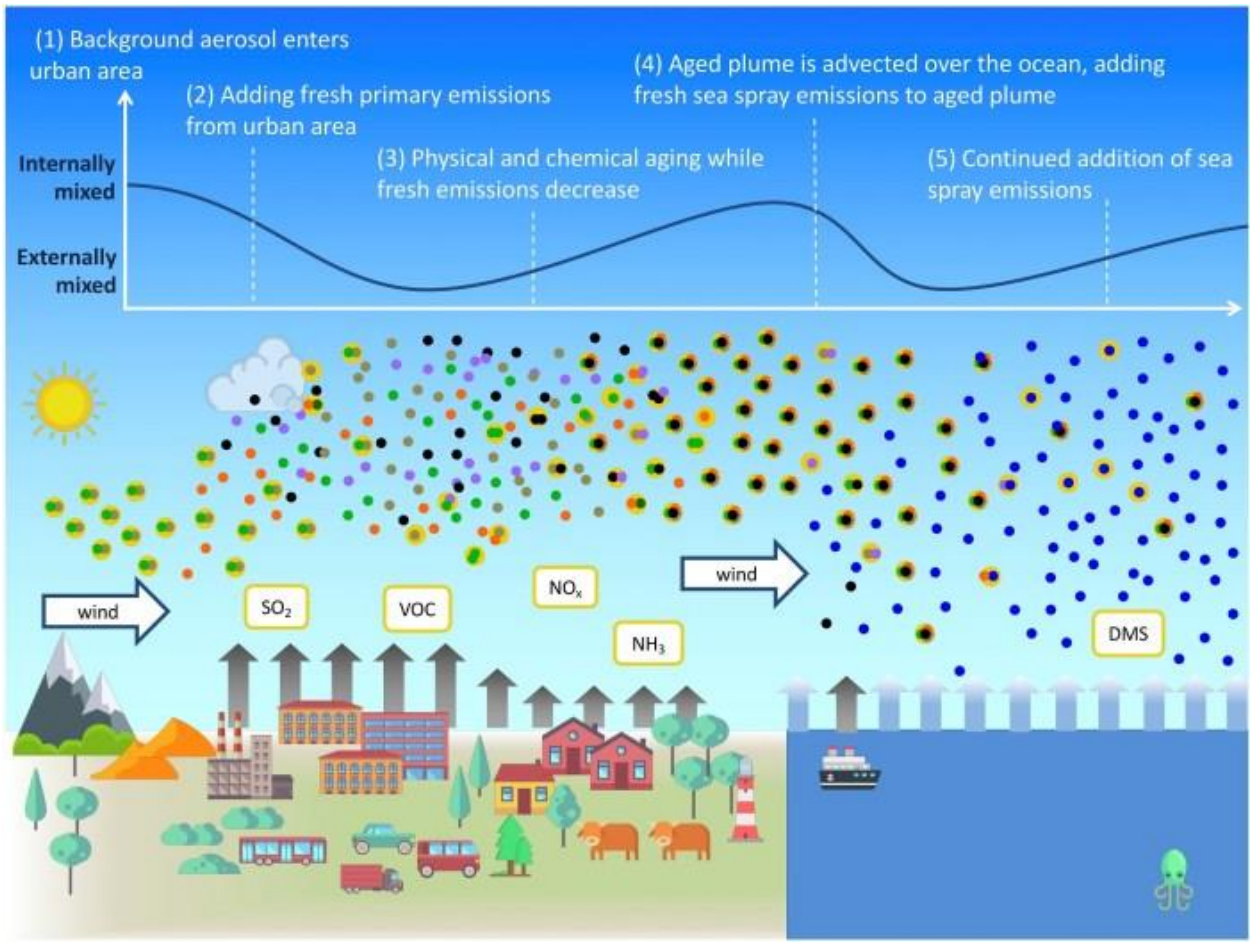
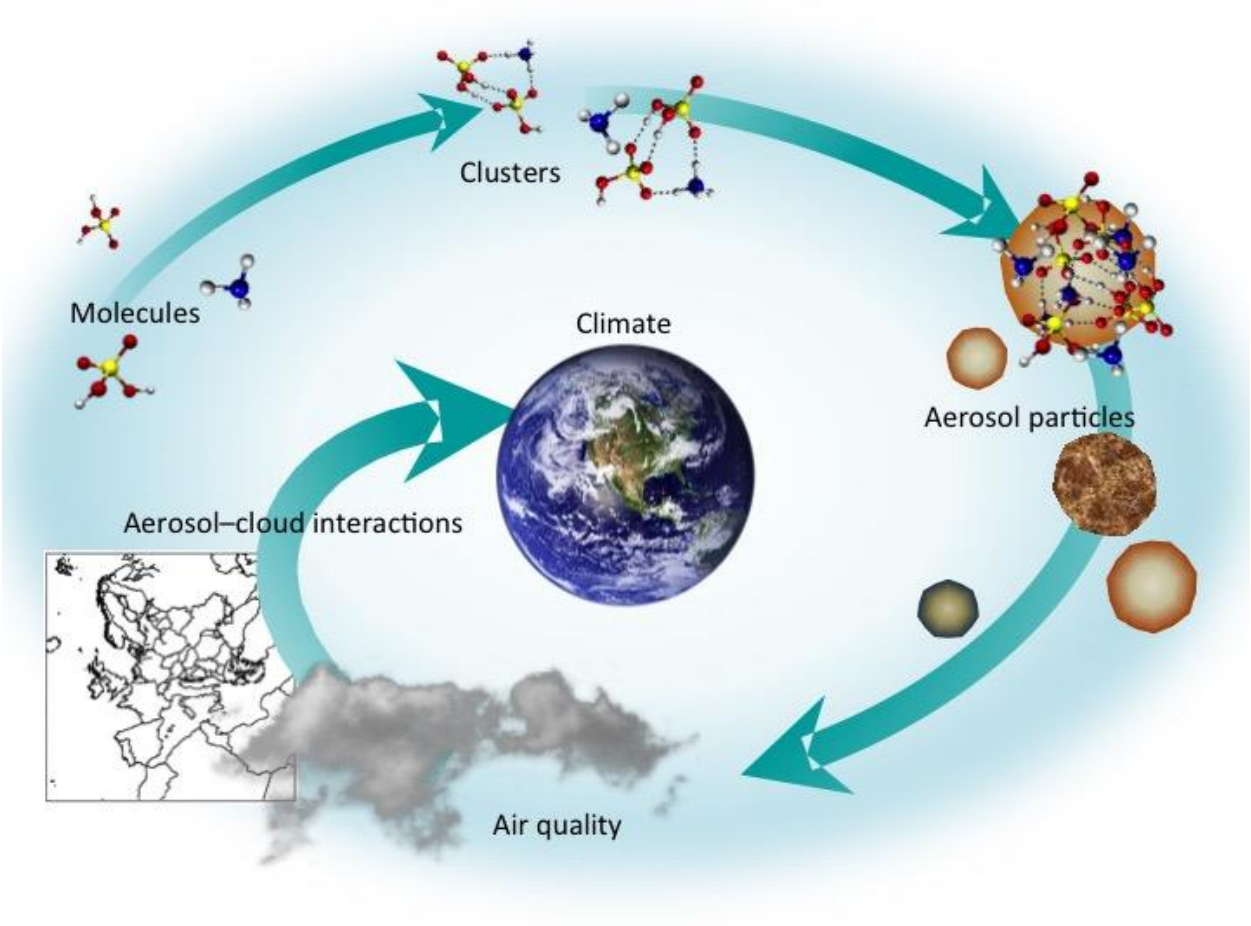
Atmospheric aerosols consist of small particles of solids, like dust, and liquids, like water, suspended in the atmosphere. Atmospheric aerosols can be either emitted directly into the atmosphere as a particle, like ash, or form when emitted gases undergo complex chemical reactions and condense as particles. Aerosols also have a wide range of sources and can be further classified as natural or anthropogenic, which originate from human-related activities. There are many different types of natural aerosols, including dust, sea-salt, smoke, and those from living sources, referred to as biogenic aerosols.

Atmospheric aerosols range in size from a few nanometers—the size of a DNA molecule—to tens of microns—the width of a human hair—in diameter. The size of a particle alters its behavior, including how long it remains suspended in the air. Aerosol systems are complex, undergoing chemical reactions that can cause the aerosols to evaporate and recondense. This complexity makes it challenging to predict and model aerosol properties.

Atmospheric aerosols play a significant role in Earth's climate. Depending on their composition, they may either absorb or reflect heat and sunlight. They also form necessary seeds for cloud formation. In many climate models, the uncertainty around atmospheric aerosols and their interaction with clouds remains one of the largest overall sources of uncertainty in climate projections.

Atmospheric aerosols affect air quality and have consequences for human health. Directly measuring the amount and type of aerosols in a specific region can provide insight into how factors like pollution and wildfires influence air quality. Measurements of aerosol types can help researchers identify the sources of unknown aerosols and determine how they form.


(1) Background aerosol enters urban area
(2) Adding fresh primary emissions from urban area
(3) Physical and chemical aging while fresh emissions decrease
(4) Aged plume is advected over the ocean, adding fresh sea spray emissions to aged plume
(5) Continued addition of sea spray emissions
Internally mixed
Externally mixed
wind
wind
SO_2
VOC
NO_x
NH_3
DMS



Sources of aerosols

Major sources of aerosols include **urban/industrial emissions, smoke from biomass burning, and secondary formation from gaseous aerosol precursors, sea salt and dust.**

Aerosol particles are either emitted directly to the atmosphere (primary aerosols) or produced in the atmosphere from precursor gases (secondary aerosols). Primary aerosols consist of both inorganic and organic components.

“Primary” aerosols, like **dust, soot, or sea salt**, come directly from the planet's surface. They get lifted into the atmosphere by gusty winds, shot high into the air by exploding volcanoes, or they waft away from smokestacks or flames.

Secondary aerosols include sulphates from the oxidation of sulphur-containing gases during the burning of fossil fuels, nitrates from gaseous nitrogen species, and products from the oxidation of volatile organic compounds (VOCs).

Abatement strategies for particulate emissions

We can reduce particulate matter by **reducing usage of particulate mater forming appliances, Avoid burning, quit indoor smoking, walk instead of vehicle, using solar energy, regular maintaining vehicle** etc.

Pollution prevention approaches to reduce, eliminate, or prevent pollution at its source, should be considered. Examples are to **use less toxic raw materials or fuels, use a less-polluting industrial process, and to improve the efficiency of the process**.

In summary, **source elimination** is the most effective and often the least expensive method for PM control. More than 90% dust removal efficiency was observed within the indoor environments.

Particulate matter (PM) is one of the most harmful inhaled pollutants. When PM is emitted into the atmosphere, the only possible method for cleaning ambient air is through **vegetation acting as biological filters for pollutants**.

Aerosols Impacts

Aerosols can directly affect human health and the climate on their own. They are associated with negative health impacts when inhaled and can affect the climate by **influencing temperature, precipitation patterns, and how much sunlight reaches the Earth's surface**.

Light-absorbing aerosols such as black carbon particles can impact **climate, agriculture, satellite remote sensing and public health**. They can alter cloud

properties and precipitation patterns affecting the hydrological balance of the Earth-atmosphere system.

Aerosol particles can penetrate the human lungs deep into the smallest respiratory tracts and parts of the lungs during inhalation. The effects, caused by inhaled particles, depend on the site at which they deposit within the respiratory system.