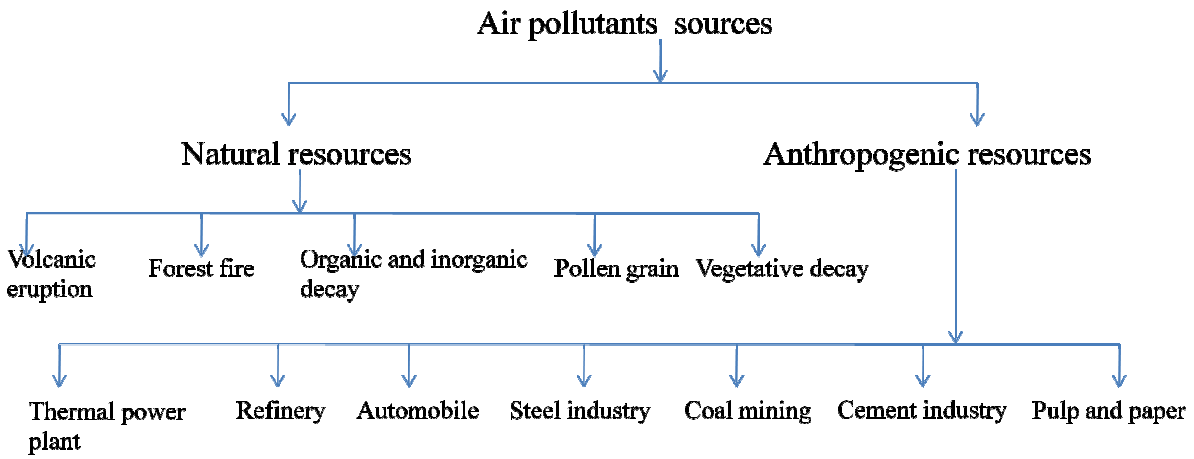
Air pollution Monitoring:

Air pollution is defined by the European Environmental Agency as "the presence of contaminant or pollutant substances in the air at a concentration that interferes with human health or welfare, or produces other harmful environmental effects". Air pollution can be understood as a deviation from baseline conditions of air composition unpolluted composition of air under the circumstances of no human intervention.

The classification of air pollutants is based mainly on the sources producing pollution



Aerosols: Aerosols refer to as fine particles of solid/liquid/mixed suspended particles in the air, which is natural originating (*i.e.* biogenic aerosol, sea spray, wind borne dust, volcanic debris) and/or anthropogenic activity (*i.e.* emissions of sulfates and nitrates from industries, combustion of fossil fuel, wind forced mineral dust mobilized in areas exploited for agricultural activities, and waste and burning of biomass). The fine particles of aerosols include both (i) Aitken nuclei, having a particle sizes mainly range from 5×10^{-3} to 5×10^{-2} μm, and (ii) accumulation particles of aerosols having a particle sizes range from 5×10^{-2} to about 2 μm. It is highly variable complex mixtures of chemicals, which is a single mineral species or contain dozens or even hundreds of distinct chemical compounds. For examples, particles of dust are generated by wind erosion of surface soils, agricultural activities, sea salt

and wave breaking over oceans. Other sources that generating particles through the chemical reactions in the atmosphere. For example, sulfate aerosols are generated by oxidation of sulfur dioxide in atmospheric moisture, the aerosols particles are generated in exhaust of automobile and incomplete combustion of fossil fuels in thermal power plants.

The role of atmospheric aerosols in the global climate:

In their most recent report, the Intergovernmental Panel on Climate Change (IPCC) concluded that emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate. For a while, it looked simple: greenhouse gases warm the Earth and sulphate aerosols cool it down. Because aerosol particles in the atmosphere scatter sunlight back into space, they reduce the amount of energy that the planet absorbs, keeping it cooler. But this simplistic view ignored the fact that aerosol particles in the real world may also lead to heating of the lower atmosphere if they contain light absorbers such as elemental carbon and mineral dust..

Scattering and absorbing the solar radiation is known as the “direct” effect of aerosols on the global climate, which can lead to either cooling orwarming of the atmosphere depending on the proportion of light scattered to that absorbed. Aerosols also have an “indirect” effect on climate by altering the properties of clouds, resulting in a change of their scattering properties and longevity. Indeed, if there were no aerosols in the atmosphere, clouds would be much less common.

. According to theory, as aerosol concentration increases within a cloud, the water in the cloud gets spread over many more droplets, each of which is correspondingly smaller. This has two consequences: clouds with smaller droplets reflect more sunlight, and such clouds last longer,

because it takes more time for small droplets to coalesce into droplets that are large enough to fall to the ground.

These changes in cloud droplets number concentration and size and their longevity are, respectively, known as the “first” and “second” indirect effects of aerosol on climate and they are both believed to increase the amount of sunlight that is reflected into space without reaching the Earth’s surface, resulting in a cooling effect.

Effects of atmospheric aerosols on human health: Cardiovascular diseases, respiratory disorders, atherosclerosis and mortality. Generally, respiratory and cardiovascular systems predominantly suffer adverse health effects of PM exposure. Studies also indicate that PM is associated with atherosclerosis, which results in adverse birth complications. In general, toxicity of particulate matter refers to the absorption and distribution of chemical components of the particle, which, in addition to carcinogenicity and mutagenicity can cause adverse health effects throughout the body .

Fine particulate pollution was associated with lung cancer and cardiopulmonary mortality. Each 10 μg m-3 elevation in fine particulate air pollution was associated with approximately a 6%, and 8% increased risk of cardiopulmonary and lung cancer mortality, respectively. On the other hand measures of coarse particle fraction and total suspended particles were not consistently associated with mortality.

Biological indicator of air pollution: The biological indicators refer to living organisms (*viz.* microorganisms, lichens, animals, or plants) that shows the information, either based on the environment.. The living organisms that can be examined without any difficulty and environmental conditions of their habitat can be regarded as indicator species. The bioindicators are used to assess the health of the environment and are also an important tool for detecting

changes in the environment, either positive or negative, and their subsequent effects on human society. Environment renders indicator species sensitive to its alterations, whereas detection of ecosystem by assessing an efficient incentive of a single population is believed to be more useful and cheaper.

i) **Lichens:** The lichens are strong symbiotic organisms, which consisting of a fungus and bacteria that can survive in various climatic conditions. The lichens considered the most reliable bio-monitors according to their specific characteristics of physiological, morphological, and anatomical act as early alarm systems. The lichens are one of the most notable biological components in monitoring and indicating environmental quality, especially air pollution. Lichens are likely to be used as indicators. Due to their sensitivity to different factors of environment, lichens are considered to be the most appropriate biomonitors of air quality during last 30 years

ii) **Bryophytes:** Bryophytes are used as reliable indicators of air pollution. Bryophyte sensitivity are sulfur dioxide ($S0_2$), hyclrogen fluoricle (HF), and ozone (0_3). They are exploited as bryometers instrument for measuring phytotoxic air pollution. carbon monoxide (CO), fluorides, hydrocarbons (HC), hydrogen sulphide (H_2S), nitrogen oxides (NO), Ozone (O_3), sulphur dioxide (SO_2), aldehydes, lead and automobile exhaust fumes. NO_X and NH_3 are primary gaseous pollutants which are strongly phototoxic.

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