ENVIS NEWSLETTER

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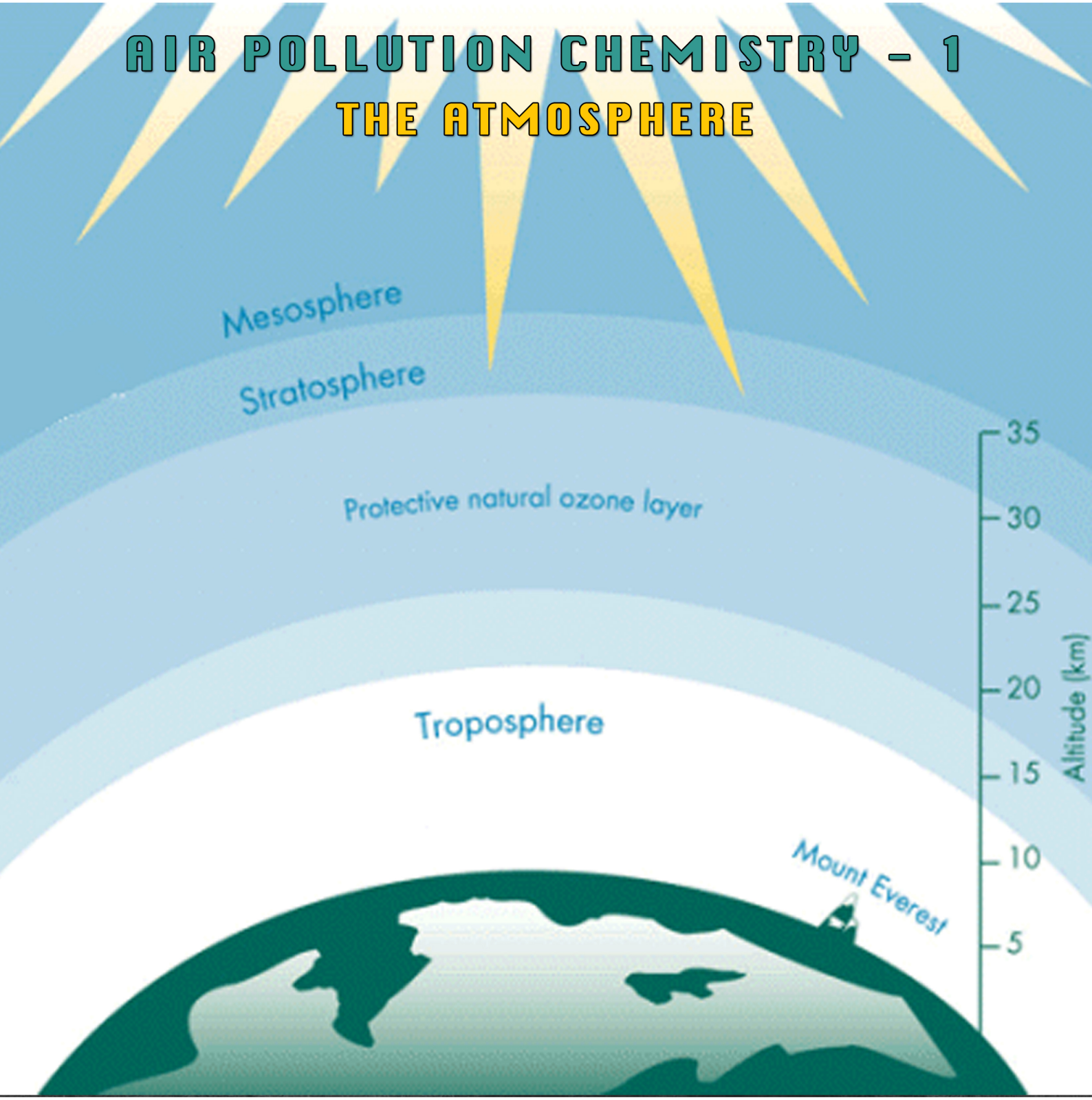
AIR POLLUTION CHEMISTRY – 1

THE ATMOSPHERE



ENVIS NEWSLETTER

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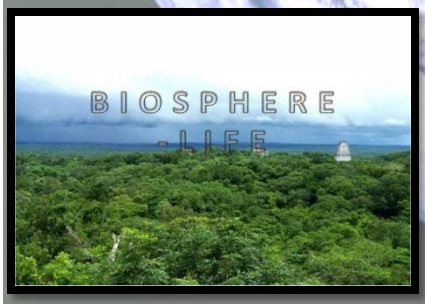
Editorial

Environment is the essential component of human life on which all living things depends for survival. There is a continuous interaction going on in each component of Earth system, change in one component affects the functioning of other either in positive or negative way and hence unsustainable use of natural resources during past few decades disturbs the functioning of Earth's ecosystem and alter the normal composition of Earth's atmosphere significantly. This result in the severe problems like acid rain, global warming, climate change, biodiversity loss, air pollution etc. and place the striking problems like food security, energy security, unpredictable weather in front of human race. To tackle these issues one need to know the present scenario of our atmosphere and how it changed over period of time; also the knowledge of major components which are responsible for this alteration is important. In view of these we are writing the series of ENVIS newsletters under the heading of "Air Pollution Chemistry" which will starts by giving you the basic information of our atmosphere, its normal composition, anthropogenic drivers of air pollution, climate change, and ends by conveying you there effects on our environment.

Present issue highlights the basic components of earths system, there interdependence, structure and composition of Earth's atmosphere, and the concept of air pollution. We hope our attempt to convey complicated scientific information in simple language will help to create awareness amongst the common public which is the first step towards safeguarding our environment.

Earth System



Earth is a comprehensive system of dynamic, interacting components, Air, Water, Soil and living things forming four overlapping, interconnected spheres Atmosphere, Hydrosphere, Lithosphere and biosphere.

Atmosphere:

The mixture of gas that's surrounds the entire planet.

Hydrosphere:

The combined mass of water found on, under, and over the surface of a planet. It also includes the crypto-sphere, which is made up of the world's ice sheets and sea ice.

Biosphere:

It includes all living things, from microbes to humans and everything in between.

Lithosphere:

It includes the rock material on the surface and in Earth's interior layers and soil

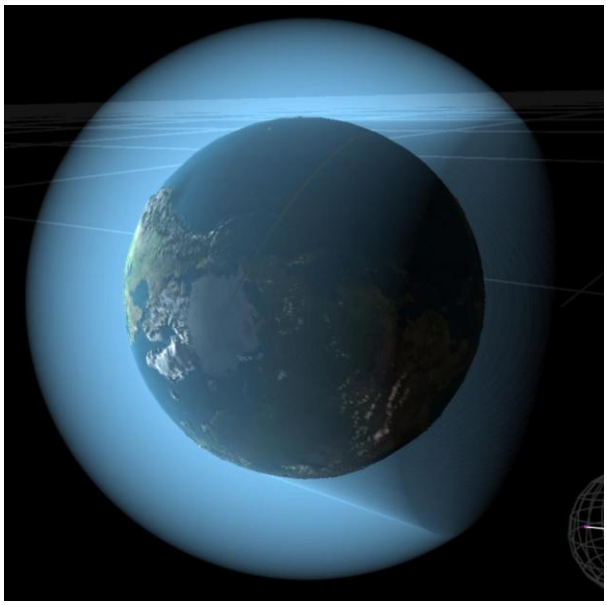
IS IT REALLY IMPORTANT TO KNOW?

All the components mentioned above are connected with one another. Change in the characteristic of one system affects the functioning of other either in positive or negative way.

Eg. Cutting of trees or deforestation reduce water holding capacity of soil, disturbs ground water balance, such conditions if exist for a longer period results in desertification of land, affects agricultural yield etc. The growing concern of food security is linked with the same. It also disturbs the natural habitat of animals and responsible for causing imbalance in the normal composition of earth's atmosphere. This is one of the reasons for increasing concentration of CO_2 in the atmosphere which is a potent green house gas which is considered to be responsible for global warming.

In this way each component is interlinked and if we disturb one we need to face there side effects.

Our Atmosphere



It's a mixture of gases surrounding the planet Earth having a mass of about 5 x 10^{18}. Based on the temperature and composition atmosphere is divided in to following distinct layers.

- **Troposphere**
- **Stratosphere**
- **Mesosphere**
- **Thermosphere**
- **Exosphere**

Troposphere:

Begins at the surface of Earth and extends to between 9 km at the poles and 17 km at the equator. As it's **heated by transfer of energy from the Earth's surface** on an average its lowest part is warmest and temperature decreases with altitude. It contains 80% of the mass of the atmosphere

Stratosphere:

It's a Layer above tropopause extending up to 50-55km. This thick layer marked by increase of temperature with altitude. Increase of temperature occurs because of absorption of solar radiation by ozone which is present in this layer. Ozone layer exists in the lower portion of the stratosphere from approximately 20-30km above Earth. It absorbs 97-99% of the sun's biologically harmful medium frequency Ultraviolet Light (200nm to 315nm wavelength)

Mesosphere:

It extends from the stratopause to about 80-85km. In Mesosphere temperature decreases with height. In this layer most meteors burn up upon entering the atmosphere. Mesopause is the coldest place on Earth (Avg. Temperature -85^{o}C)

Thermosphere:

It extends from Mesopause. Top of the thermosphere is called as exobase, its height varies from about 350-800km with solar activity. The density of air in this

layer is extremely low and the temperature observed merely represents the velocity of the fast moving atoms. The International Space Station orbits in this layer, between 320 and 380 km.

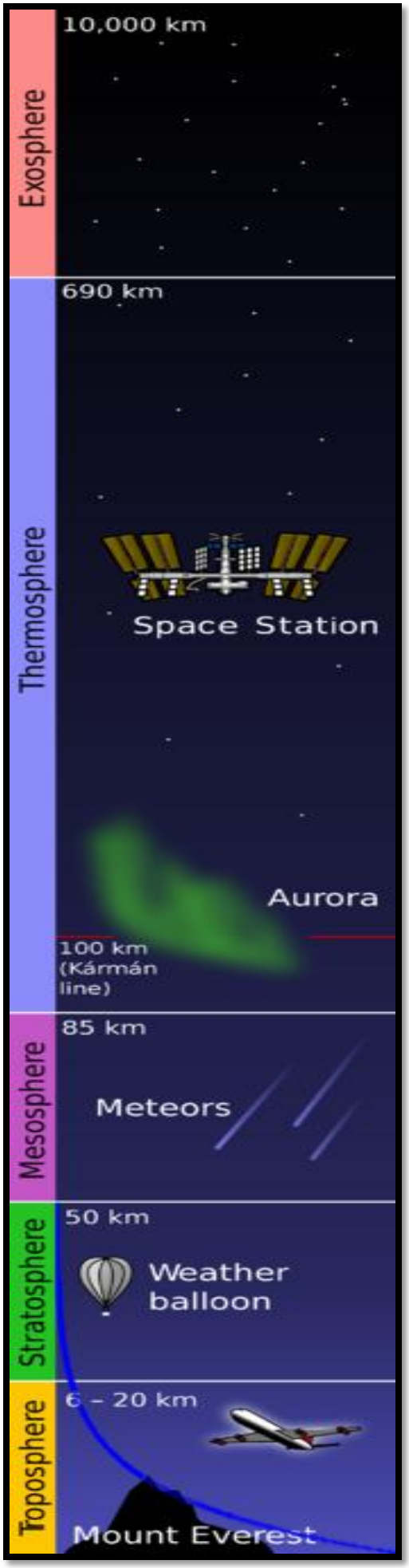
Exosphere:

The outermost layer of Earth's atmosphere extends from the exobase upward. It is mainly composed of hydrogen and helium.

The narrow isothermal layer at the top of troposphere, stratosphere, mesosphere, and thermosphere is known as tropopause, stratopause, mesopause and thermopause respectively.

The composition of air from troposphere to mesosphere is fairly constant above a certain point air is poorly mixed and becomes compositionally stratified. The point dividing these two regions is known as the **turbopause.**

The region below the turbopause is known as the **homosphere** where the chemical composition of the atmosphere remains constant for chemical species which have long mean residence times while the region above turbopause is known as **heterosphere** where molecular diffuse dominates ad the chemical composition of the atmosphere varies according to chemical species.



AIR WE BREATH

Atmosphere which is used for breathing and photosynthesis is known as Air. Air suitable for the survival of terrestrial plants and terrestrial animals is found only in Earth's troposphere.

Composition of Dry unpolluted air

Sr.No.	Gas	Volume
1	Nitrogen (N2)	78.08%
2	Oxygen (O2)	20.95%
3	Argon (Ar)	0.93%
4	Carbon dioxide (CO2)	0.04%
5	Neon (Ne)	0.001818%
6	Helium (He)	0.000524%
7	Methane (CH4)	0.000179%
8	Krypton (Kr)	0.000114%
9	Hydrogen (H2)	0.000055%
10	Nitrous oxide (N2O)	0.000033%
11	Carbon monoxide (CO)	0.000010%
12	Xenon (Xe)	0.000009%
13	Ozone (O3)	0 to 7×10^{-6}%
14	Nitrogen dioxide (NO2)	0.000002%
15	Iodine (I2)	0.000001%
16	Ammonia (NH3)	trace

Air also contains the variable amount of water, which is not included in dry atmosphere. On average around 0.40% over full atmosphere, typically 1%-4% at surface.

Each day we inhale around 14,000 litres (14 m^3) of air as we take about 26,000 breaths.

If this air contains pollutants, we inhale them into our bodies and they can affect our health. So to protect people's health and the environment, we need to keep the air clean and free from pollution.

Air Pollution

Chemicals and particles that have the potential to affect our health and the environment are called **contaminants or pollutants**. As composition of the gases in the air remains almost constant, any rise in its components can be considered as a kind of air pollution which may have widespread ecological implications on global scale.

SOURCES: Natural & Anthropogenic

The quality of the atmosphere, on which all terrestrial forms of life are dependent, has been found to be changing. There are various types of **natural processes** like volcano, earthquake, decomposition of organic matter, dust storms and salt sprays that led to the change in the global atmospheric composition in addition to these, various records reveal that during past few decades **human activities** have changed the chemical composition of the global atmosphere considerably. This results in serious problem of air pollution.

Air pollution becomes severe during the industrial revolution because of the extensive use of fossil fuel for the energy generation in different industrial processes and its concern was further increased in the 20th century with the development of transportation system which results in the large scale use of petrol & diesel. Today it is the well known fact that the combustion of fuels is one of the most significant sources of air pollutants.

Today in most of the urban areas air pollution related health and environmental problems are more common and their increasing number is of great concern. As a result urgent need of air quality management (AQM) is felt to improve the ambient air quality within a city or state or country.



Air Pollutants

The combustion of fossil fuel- Coal & petroleum products for energy generation, uncontrolled growth in population, urbanization etc. results in the release of major green house gases like CO2, CH4 & air pollutants including CO_2, NO_X, CO, SO_2, particulate matter (PM10, PM2.5) etc. in to the atmosphere. When the local concentrations of these substances exceed certain threshold limit they have adverse effect on plants, animals, human health & cause discomfort to life. The six commonly found air pollutants in the atmosphere are particulate matter (PM), ground-level ozone (O_3), carbon monoxide (CO), nitrous oxides (NO_X) & lead (Pb). Environment Protection Agency (EPA) identified these pollutants as **"criteria"** air pollutants i.e. the pollutants that can harm health and the environment, and cause property damage and hence National Ambient Air Quality Standards (NAAQS) have been established for these six air pollutants.

DO YOU KNOW?

Air as a mixture of gases, was not really understood until the late 1700's. It took a few scientists to discover the composition of air. Antoine Lavoisier is one of the first chemists who suggest that air was composed of different gases.

In the mid 1700's Joseph Black discovered "fixed air" which is now known as Carbon dioxide (CO2).

In 1774 Joseph Priestly discovered the Oxygen (O2) some people use to refer it as "fire air" because it could burn.

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