

GOVERNMENT DEGREE COLLEGE
ARMOOR, DIST: NIZAMABAD

DEPARTMENT OF PHYSICS

STUDENT STUDY PROJECT

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TITLE: “IONOSPHERIC CHANGES OVER INDIAN LOW LATITUDES”

➤ HYPOTHESIS :

Ionosphere is being used by many communication systems to reflect radio signals over long distances. The critical frequency (foF2) is the preventive frequency at or lower which a radio wave is reflected by ionosphere in HF radio propagation.

Now our hypothesis is that the equatorial /low-latitude ionosphere is highly variable both spatially (both along longitude and latitude) and temporally, and with solar and geomagnetic activity.

➤ Introduction:

The ionosphere is that layer of the Earth's atmosphere which extends from 80 to 1000 Km. It affects the propagation of radio waves significantly. Ionosphere is being used by loads of communication systems to reflect radio signals over lengthy distances. The ionosphere can reflect waves of frequencies below about 30 MHz, allowing (HF) radio communication to distances of many thousands of kilometres. The critical frequency (foF2) is the limiting frequency at or below which a radio wave is reflected by ionosphere in HF radio propagation. If the frequency is higher than this value the wave penetrates through an ionosphere F-layer. For long distance high frequency communication F2-region plays important role in the ionosphere because of its thickness and negligible reduction for penetrating radio waves.

➤ AIMS AND OBJECTIVES OF THE STUDY:

Aim of our study is to study the Ionospheric changes over Indian low latitudes

➤ REVIEW OF LITERATURE:

Variations in the critical frequency afford intimations on the occurrences within the F2-layer. Surveillances show that after sunrise foF2 rises, reaches to its greatest value in the early afternoon, and there is a quick fall shortly after sunset. This layer of the ionosphere is

affected by numerous influences such as solar wind, solar ionizing radiation, neutral atmosphere, geomagnetic activity and electrodynamics effects. (Rishbeth and Mendillo, 2001) Various authors have examined ionospheric variability. Number of studies has been done for investigating the variability of the ionosphere

➤ **METHODOLOGY:**

The present study is undertaken by the B.Sc student of Government degree college Armoor under the departmental activities of the college. The entire study is based only on the secondary data. Purposively the study has taken relating to the Ionospheric changes over Indian low latitudes.

Data source: The study has adopted entirely on secondary data from the various sources like Ph.D thesis, Reports IRM model and International Journals and books related to Ionospheric changes web-sites considered.

➤ **VERTICAL STRUCTURE OF THE ATMOSPHERE**

The atmosphere can be divided vertically into zones based on changes that occur with altitude.

1. TROPOSPHERE
2. STRATOSPHERE
3. MESOSPHERE
4. IONOSPHERE
5. THERMOSPHERE

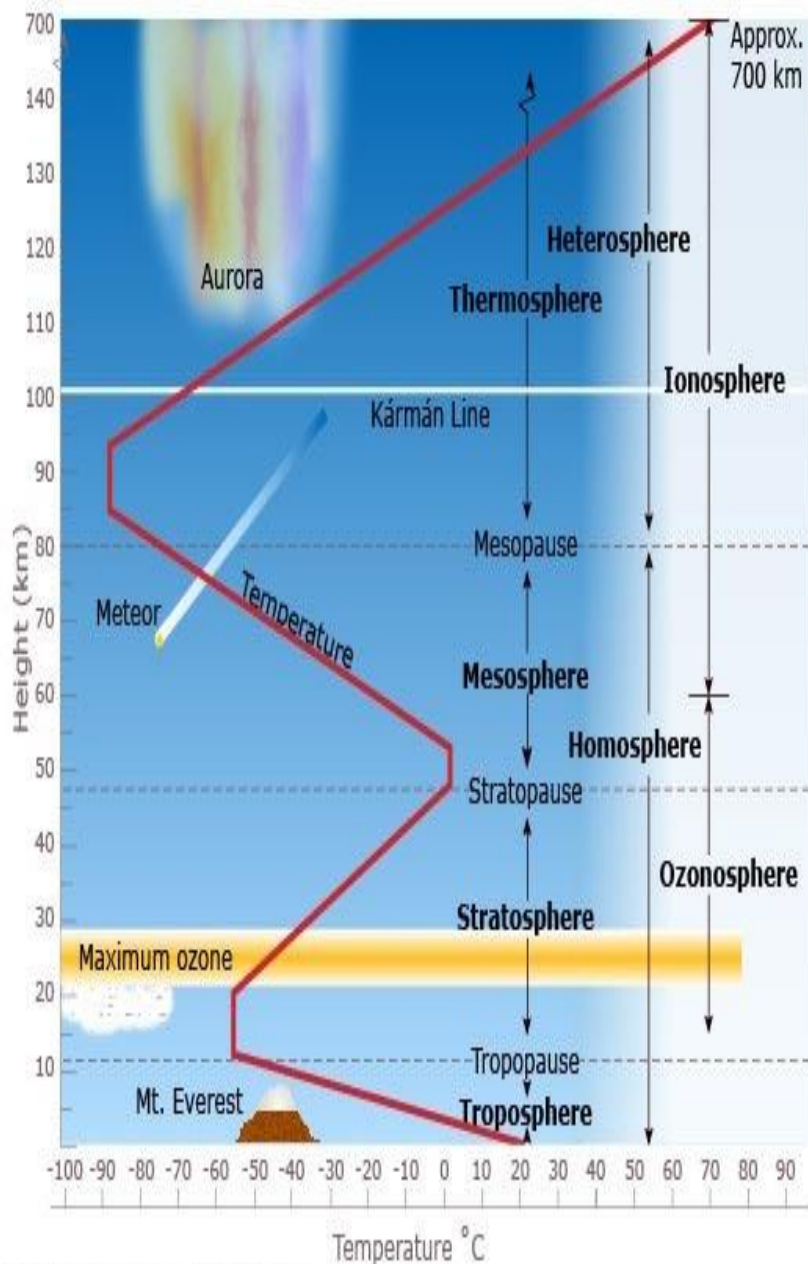


Figure 1: Structure of Atmosphere

➤ 1. TROPOSPHERE

The lowest part of the atmosphere known as the troposphere forms a natural lid on the lower atmosphere in which the temperature decreases with altitude. A distinct boundary layer known as the tropopause marks the upper reaches of the troposphere and the upper limit of most turbulent mixing started from the surface. At the equator the tropopause is at a height of 16-17 km.

➤ 2. STRATOSPHERE

Above the tropopause is the stratosphere, which is named for the layered nature of the air at these levels. The stratosphere is relatively stable, dry and has little vertical motion. Some high velocity winds occur just above the tropopause; otherwise winds are noticeably absent. Upper boundary layer of the stratosphere is the stratopause.

➤ 3. MESOSPHERE

Above the stratopause is a layer identified by a temperature decrease with altitude (mesosphere). Beginning at an elevation of about 48 km, the decline in temperature continues outward to the mesopause near 80 km. Up to the mesopause, the mixture of gases is about the same as at the surface. For this reason, the lower 80 km of the atmosphere is termed the homosphere. Beyond 80 km altitude, the composition of the air begins to change. Above the homospheric atmosphere, gases tend to stratify on the basis of their molecular weight. This layer is termed the heterosphere. To a height of 220 km, molecules of nitrogen largely make up the atmosphere. Layers of oxygen, helium and hydrogen exist beyond this height.

➤ 4. IONOSPHERE

The mesosphere merges with a zone called the ionosphere. The incoming solar radiation is able to ionize the neutral particles, so that a region of free electrons, ions and neutral particles exists in the atmosphere. It consists of three major regions: D-region at heights of 60-90 km, E-region from 90-150 km and F-region approximately at 140-230 km in altitude. The height/altitude varies by means of solar activity, season and geomagnetic activity. During day time, the F-region splits up into F1 and F2 regions and merges during night time. By model simulations an additional layer that occurs above the F2 peak namely the F3 layer was predicted. Its occurrence and variability over Brazilian region was studied.

➤ 5. THERMOSPHERE

Above 80-85 km (menopauses) is the thermosphere where the neutral gas temperature increases to an altitude of 200 km and then remains constant to heights exceeding 103 km. The other mal-behavior of the upper thermosphere arises because its thermal conductivity is high and most of the energy absorbed by the gas is removed downwards. During periods of very high solar activity, the Sun emits large amount so ultra-violet radiation and the thermosphere temperature reaches 2200K. But at the minima of solar activity, no part of the atmosphere exceeds 750K.

In the lower thermosphere, i.e. below 130 km, heat is transported down to the mesopause by convection. In the upper thermosphere (130-180 km) heat is transported down to lower levels by conduction resulting in an isothermal region beyond about 500 km. The thermopause is the point of transition to a more or fewer isothermal summary. The region above 500 km is known as exosphere.

➤ **ANALYSIS OF DATA:**

IONOSPHERIC VARIATIONS OVER INDIAN LOW LATITUDES

The Earth's ionosphere demonstrates complex variabilities with varying spatial and temporal scales. The influencing factors for the ionospheric variabilities are (a) solar ionizing flux, (b) neutral dynamics and electrodynamics, and (c) solar wind conditions. The solar flux, which varies with the 11-year solar cycle, quasi 27-day rotation of the sun, day-to-day and even shorter timescales, has direct control on the plasma density in the ionosphere. The ionosphere is too controlled by the solar zenith angle, manifesting diurnal, annual and semiannual variations. Solar flux induced spatial and temporal variations in the neutral atmosphere lead to the thermospheric wind and electric field. In the low latitudes, the thermospheric wind and electric field, in conjunction with Earth's magnetic field, play an important role in the redistribution of plasma. In the recent past, it has also been recognized that significant variations in ionospheric parameters are governed by lower-atmospheric processes through complex coupling processes in the middle atmosphere.

With regard to the low-latitude ionosphere, variabilities in the F- region have been given special attention due to their direct effects on communication / navigation systems. A large number of observational and modeling studies have been made to understand F region parameters, such as the critical frequency of the F2 layer, foF2 and the corresponding height, hmF2, in terms of variabilities in solar flux, magnetic field, neutral dynamical / electro dynamical parameters. These studies have provided important inputs to the development of the International Reference Ionosphere (IRI) model, which is widely used by the autonomy community across the world.

➤ **FINDINGS & CONCLUSION:**

Many issues concerning the evolution of solar activity and its impact on Martian volatiles have been answered successfully in the past decade and given the fact that the equatorial/low-latitude ionosphere is highly variable both spatially (both along longitude and latitude) and

temporally, and with solar and geomagnetic activity, observations have revealed significant departure from the IRI model. With regard to the Indian sector, although some interesting studies addressing local time, seasonal and solar activity dependence of FoF2 and hmF2 have been made based on observations made from the magnetic equator and from locations close to or beyond the equatorial ionization anomaly crest

➤ **References:**

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