The Earth's Ionosphere from the Space

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Abstract

Recent has been published the spectacular photos taken by astronauts on the ISS International Space Station (Ref. Science Image NASA Johnson Space Center. From these images it is possible to observe the Earth's ionosphere as a thin green line at a height of about 85 km (D region). This view is possible because of the ionized particles from the solar wind. This is a phenomenon similar to the Aurora (1) . The most commonly observed color of aurora is green, caused by photons (light) emitted by excited oxygen atoms at wavelengths centered at 0.558 micrometers. Red aurora are generated from the light emitted at a wavelength longer (0.630 micrometers), and other colors like purple or brown are also sometimes observed - the colors depends on the energy of geomagnetic storms, and how high in the atmosphere the impact of oxygen and nitrogen atoms occur.

The Height

We calculated the height of the green light emission that it is at about 85-95 km. (located approximately in the Ionospheric D region) below those heights the atoms and molecules are more concentrated and collide more readily, releasing their energy sooner, and above that altitude the density of the atoms is too low to do much colliding at all. By summarizing: the region that glows visibly is constrained to a region 85-95km up in a band about 6-10km wide. (This Phenomenon is know also as Airglow).

Fig.1 Green light emission localized in the polar regions (greater intensity, Aurora) and extending to the rest of the earth (ionosphere)

Description (reference: Wikipedia)

Airglow is caused by various processes in the upper atmosphere, such as the recombination of ions which were photoionized by the sun during the day, luminescence caused by cosmic rays striking the upper atmosphere, and chemiluminescence caused mainly by oxygen and nitrogen reacting with hydroxyl ions at heights of a few hundred kilometers. It is not noticeable during the daytime because of the scattered light from the Sun. Even at the best ground-based observatories, airglow limits the sensitivity of telescopes at visible wavelengths. Partly for this reason, space-based telescopes such as the Hubble Space Telescope can observe much fainter objects than current ground-based telescopes at visible wavelengths. The airglow at night may be bright enough to be noticed by an observer, and is generally bluish in color. Although airglow emission is fairly uniform across the atmosphere, to an observer on the ground it appears brightest at about 10 degrees above the horizon, because the lower one looks the greater the depth of atmosphere one is looking through. Very low down, however, atmospheric extinction reduces the apparent brightness of the airglow.The mechanism is when an atom of nitrogen combines with an atom of oxygen to form a molecule of nitric oxide (NO). In the process a photon is emitted. This photon may have any of several different wavelengths characteristic of nitric oxide molecules. The free atoms are available for this process because molecules of nitrogen (N2) and oxygen (O2) are dissociated by solar energy in the upper reaches of the atmosphere, and may encounter each other to form NO. Other species that can create air glow in the atmosphere are hydroxyl (OH) molecular oxygen (O), sodium (Na) and lithium (Li). See Sodium layer. The sky brightness is typically quoted in units of astronomical magnitudes per square arcsecond of sky.

Fig.2 Picture of Central Europe with the Alps and the Po valley in the foreground.

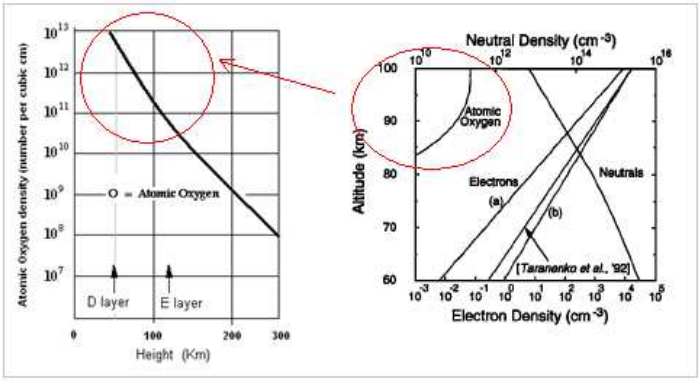

Fig.3 The concentrations of atomic oxygen, [O], at heights from 60 to 140 km. The maximum value of [O] was found to occur near 95 km, and its value was usually in the range 1-3 x 1012 cm-3, During the night, when the dissociative agent is absent, the concentration of oxygen atoms undergoes small changes.

Notes:

(1) The Aurora is bright due to the emission of excited atoms. As we know occurs in the polar regions because the magnetic field lines convey a large amount of energy toward the poles. The charged particles that originate in the Magnetosphere and solar wind and, on Earth, are directed by the Earth's magnetic field into the atmosphere. Aurora is classified as diffuse or discrete aurora. Most aurorae Occur in a band known as the auroral zones

References:

Discovery Channel News
NASA
Wikipedia, the free encyclopedia

Image credit: NASA

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