

Mesosphere

The **mesosphere** (/ˈmɛsoʊsfiər/; from Greek *mesos* "middle" and *sphaira* "sphere") is the layer of the Earth's atmosphere that is directly above the stratosphere and directly below the mesopause. In the mesosphere, temperature decreases as the altitude increases. The upper boundary of the mesosphere is the mesopause, which can be the coldest naturally occurring place on Earth with temperatures below −143 °C (−225 °F; 130 K). The exact upper and lower boundaries of the mesosphere vary with latitude and with season, but the lower boundary of the mesosphere is usually located at heights of about 50 kilometres (160,000 ft; 31 mi) above the Earth's surface and the mesopause is usually at heights near 100 kilometres (62 mi), except at middle and high latitudes in summer where it descends to heights of about 85 kilometres (53 mi; 279,000 ft).



Space Shuttle *Endeavour* appears to straddle the stratosphere and **mesosphere** in this photo. The troposphere, which contains clouds appears orange in this photo^[1]

Contents

Mesosphere, Middle Atmosphere, and Near Space

Temperature

Dynamic features

Exploration and Uses

High-altitude balloons

Phenomena in mesosphere and near space

See also

References

External links

Mesosphere, Middle Atmosphere, and Near Space

The stratosphere, mesosphere and lowest part of the thermosphere are collectively referred to as the "middle atmosphere", which spans heights from approximately 10 kilometres (33,000 ft; 6.2 mi) to 100 kilometres (62 mi; 330,000 ft). The mesopause, at an altitude of 80–90 km (50–56 mi), separates the mesosphere from the thermosphere—the second-outermost layer of the Earth's atmosphere. This is also around the same altitude as the turbopause, below which different chemical species are well mixed due to turbulent eddies. Above this level the atmosphere becomes non-uniform; the scale heights of different chemical species differ by their molecular masses

The term **near space** is also sometimes used. This term does not have a technical definition, but typically refers the region of the atmosphere up to 100 km (65,000 and 328,000 feet), roughly between the Armstrong limit (above which humans need a pressure suit to survive) up to the Kármán line where astrodynamics must take over from aerodynamics in order to achieve flight. The definition of near space can vary depending on the source, but in general near space comprises the altitudes above where commercial airliners fly but below orbiting satellites. Some sources distinguish between the terms "near space" and "upper atmosphere," so that only the layers closest to the Karman line are called near space.

Temperature

Within the mesosphere, temperature, decreases with increasing height, due to decreasing solar heating and increasing cooling by CO₂ radiative emission. The top of the mesosphere, called the mesopause, is the coldest part of Earth's atmosphere.^[2] Temperatures in the upper mesosphere fall as low as −101 °C (172 K; −150 °F),^[3] varying according to latitude and season.

Dynamic features

The main dynamic features in this region are strong zonal (East-West) winds, atmospheric tides, internal atmospheric gravity waves (commonly called "gravity waves"), and planetary waves. Most of these tides and waves start in the troposphere and lower stratosphere, and propagate to the mesosphere. In the mesosphere, gravity-wave amplitudes can become so large that the waves become unstable and dissipate. This dissipation deposits momentum into the mesosphere and largely drives global circulation.

Noctilucent clouds are located in the mesosphere. The upper mesosphere is also the region of the ionosphere known as the *D layer*. The D layer is only present during the day when some ionization occurs with nitric oxide being ionized by Lyman series-alpha hydrogen radiation. The ionization is so weak that when night falls, and the source of ionization is removed, the free electron and ion form back into a neutral molecule. The mesosphere has been called the "ignorosphere" because it is poorly studied relative to the stratosphere (which can be accessed with high-altitude balloons) and the thermosphere (in which satellites can orbit).^[4]

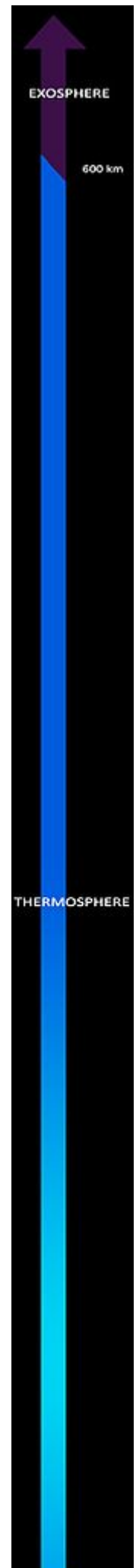
A 5 km (3.1 mi; 16,000 ft) deep sodium layer is located between 80–105 km (50–65 mi; 262,000–344,000 ft). Made of unbound, non-ionized atoms of sodium, the sodium layer radiates weakly to contribute to the airglow. The sodium has an average concentration of 400,000 atoms per cubic centimetre. This band is regularly replenished by sodium sublimating from incoming meteors. Astronomers have begun utilizing this sodium band to create "guide stars" as part of the adaptive optical correction process used to produce ultra-sharp ground-based observations.^[5] Other metal layers, e.g. iron and potassium, exist in the upper mesosphere/lower thermosphere region as well.

Millions of meteors enter the Earth's atmosphere, averaging 40 tons per year.^[6] The ablated material, called meteoric smoke, is thought to serve as condensation nuclei for noctilucent clouds.

Exploration and Uses

The mesosphere lies above altitude records for aircraft,^[7] while only the lowest few kilometers are accessible to balloons, for which the altitude record is 53.0 km.^[8] Meanwhile, the mesosphere is below the minimum altitude for orbital spacecraft due to high atmospheric drag.^{[9][10][11]} It has only been accessed through the use of sounding rockets which are only capable of taking mesospheric measurements for a few minutes per mission.^[12] As a result, it is the least-understood part of the atmosphere, resulting in the humorous moniker *ignorosphere*.^[13] The presence of red sprites and blue jets (electrical discharges or lightning within the lower mesosphere), noctilucent clouds and density shears within this poorly understood layer are of current scientific interest.

Near space was first explored in the 1930s. The early flights flew to the edge of space without computers, spacesuits, and with only crude life support systems. Notable people who flew in near space were Jean Piccard and his wife Jeannette, on the nearcraft The Century of Progress. Later exploration was mainly carried out by unmanned craft, although there have been skydiving attempts made from high-altitude balloons.



The area is of interest for military surveillance purposes, scientific study, as well as to commercial interests for communications, and tourism. Craft that fly in near space include high-altitude balloons, non-rigid airships, rockoons, sounding rockets, and the Lockheed U-2 aircraft. The region has been of interest to space travel. Early attempts used a craft known as a rockoon to reach extreme altitudes and orbit. These are still used today for sounding rockets.

High-altitude platform stations have been proposed for applications such as communications relays. There has been a resurgence of interest in near space to launch manned spacecraft by man. Groups like ARCASPACE, as well as the da Vinci Project are planning on launching manned suborbital space vehicles from high-altitude balloons. JP Aerospace has a proposal for a spaceport in near space, as part of their Airship to Orbit program.

High-altitude balloons

Near space has long been used for scientific ballooning, for applications such as submillimetre astronomy. High-altitude balloons are often flown by students and by amateur groups to altitudes on the order of 100,000 ft (30,000 m), for both scientific and educational purposes.^{[14][15][16]}

Phenomena in mesosphere and near space

- Polar aurora
- Airglow
- Noctilucent cloud
- Meteors
- Upper atmospheric lightning.k.a. Transient luminous event
- Nacreous clouds
- Ozone layer
- Atmospheric tides
- Ionosphere

See also

- High altitude
- Amateur radio high-altitude ballooning

References

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Diagram showing the five primary layers of the Earth's atmosphere: exosphere, thermosphere, mesosphere, stratosphere, and troposphere. The layers are to scale. From Earth's surface to the top of the stratosphere (50km) is just under 1% of Earth's radius.



The Earth from approximately 100,000 ft (30,000 m) above Oregon, United States.

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External links

- [Description with links to other atmospheric topics](#)
- [Students And Teachers In Near Space](#)
- [Near Space Systems](#)
- [Space Data Corporation](#)

- The B.H.A.L.D.I. Project
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