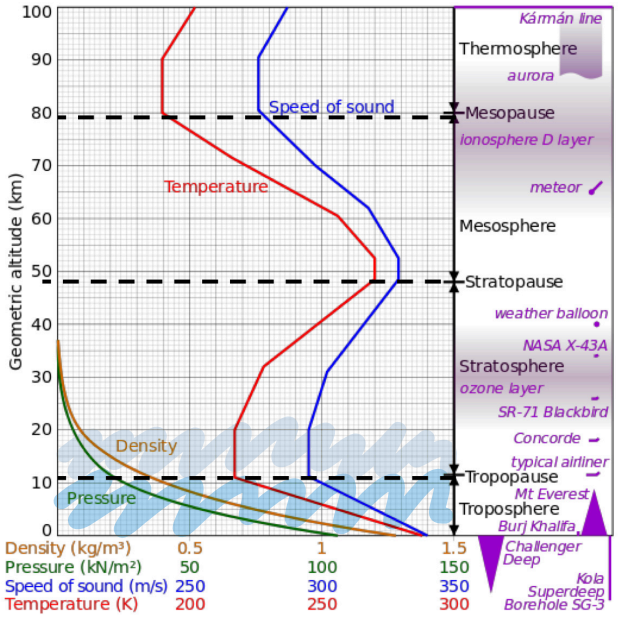
The Atmosphere :



In troposphere (0-11km) temp ↓ as alt. ↑

Tropopause is the seperating boundary between

In lower stratosphere (11-20 km), isothermal

most aircrafts with air-breathing engines operate <20 km

International Standard Atmosphere :

Represents atmospheric conditions in NA & EU and assumes :

- air is a perfect gas
- air is dry
- g does not vary with altitude
- hydrostatic equilibrium exists

ISA Values : often stated as ratios of sea level values,

Absolute temp. ratio $\theta = \frac{T}{T_{SL}}$

Static Pressure Ratio $\delta = \frac{p}{p_{SL}}$

Density Ratio $\sigma = \frac{\rho}{\rho_{SL}}$

using equation of state $p = \rho R T$

$$\delta = \sigma\theta$$

ISA Temperature :

Above tropopause : $T = 216.65\ K$

Below tropopause : $T = 288.15 - 6.5 \times 10^{-3} h$ ← altitude in m

ISA Pressure :

Determined using hydrostatic equation $\frac{dp}{dh} = -\rho g$

Above tropopause : $\delta = 0.22\ldots e^{(1.7346 - 1.5769 \times 10^{-4} h)}$

Below tropopause $\delta = (1 - 2.2558 \times 10^{-5} h)^{5.25588}$

ISA Density :

Determined using $\rho = \frac{p}{RT}$

approximated as $\sigma = \frac{20 - H}{20 + H}$ ← altitude in km

ISA Speed of Sound :

$$a = \sqrt{\gamma RT}$$

γ ← ratio of specific heats for air = 1.4

a also calculated in terms of temp. ratio :

$$a = a_{SL} \theta^{0.5}$$