CERTAIN ANALYSIS ON MESOSPHERE-THERMOSPHERE COUPLING

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ABSTRACT

In this paper, the process of growth wave has been studied. Saturation and interaction with mean flow as the waves propagate through the atmosphere have been developed. The internal atmospheric gravity have been generated mainly in the troposphere grow in amplitude as they propagate upward in the absence of any dissipation. The turbulent diffusion and mean flow acceleration accompanying the gravity wave saturation are to be explained.

Keyword - Growth Wave, Turbulent Diffusion, Means Flow Acceleration, Troposphere

I. INTRODUCTION

Mesosphere is the region of decreasing temperature with altitude and is the prone of turbulence. The transition level from mesosphere to thermosphere is called mesopause and coldest region of the earth atmosphere system. Atmospheric heating, cooling and energy transportation in the upper mesosphere and the lower thermosphere are very important. Atmospheric waves originating mainly in the troposphere grow in amplitude as they propagate into the thermosphere and carry momentum and energy into that region. The thermosphere waves are the important dynamics coupling agents between the lower and upper atmosphere. In above terms, the solar energy input to thermosphere is small compare to the input to the region below 90 km which is in and UV and visible wave length range of the solar radiation. For this reason, any small leakage of energy from the lower region to thermosphere would have profound effect on the thermosphere.

In the followings, the process growth wave, saturation and interaction with mean flow as the waves propagate through the atmosphere are obtained.

II. GRAVITY WAVE GROWTH AND SATURATION

The simplest theory, conceptually, of gravity waves saturation and breakdown is the linear saturation theory developed by Lindzen.The saturation mechanism though to be most important in the turbulent breakdown of convectively unstable regions due to the differential advections of more dense air by gravity wave motion. The resulting turbulent diffusion reduces the wave amplitude to that value that permits continued generation of turbulence. The internal atmospheric gravity waves generated mainly in the troposphere grow in amplitude as they propagate upward in the absence of any dissipation. As the wave propagates upwards, it propagates into regions of decreasing density.

III. MATHEMATICAL MODEL

Let us consider, in the absence of saturation [1], adiabatic inviscid gravity wave motion with intrinsic frequencies w such that

$f < w < N$

Where

f (Coriolis frequency) = $2\Omega \sin\emptyset$

Ω = Angular velocity of rotation of the earth

$\emptyset$ = latitude

N = Brunt- Vaisala frequency is given by

$N^2(z)=\frac{g}{T}(\frac{\partial T}{\partial x}+\frac{g}{c_p}) = \frac{g}{\theta}\frac{\partial\theta}{\partial z}$

Where

g = Acceleration due to gravity

$\bar{T}$ and $\bar{\theta}$ mean temperature and potential temperature, respectively

c_p = Specific heat at constant pressure

Z= Altitude

Then, to an approximation, inertial effect can be considered to be unimportant and motion to be two dimensional [5]. It can be assumed that the motions are in the x-z and that all field variables can be written as

$\psi(x,z,t) = \bar{\psi}(z) + \acute{\psi}(x,z,t)$

and $\bar{\psi}(z) = \frac{1}{\lambda_x}[\int_0^{\lambda_x} \psi(x)]$

It is further assumed that the product of perturbation quantities can be neglected and that and that $\acute{\psi}(x,z,t)$ can be as a single Fourier component.

$\acute{\psi}(x,z,t) = \bar{\psi}(z)e^{\frac{z}{2H}}e^{\gamma t+ikx}$

$Here\ k$ is Horizontal (x) wave number $(\lambda_x = 2\pi/k)\ and\ H\ is\ the$ atmospheric height. The factor $e^{\frac{z}{2H}}$ is required to compensate for the decrease of amplitude due to decrease of density of with altitude.

There are two broad categories of gravity wave generation in the troposphere, which are as follows.

(i) Mountain waves forced by flow over topography .The phase speeds associated with these waves are nearly zero. However, it need not be zero as the flow are unsteady and phase speed other than zero are likely.

(ii)Strong shears of wind are a potential source of gravity waves .when the shear region become unsteady, they can generate gravity waves with phase speed equal to the flow speeds [2].

IV. RESULT AND DISCUSSION

(i) Under the action of turbulent heat and moisture exchange, the air temperature changes and, as a result, the mass fraction of water vapour also changes.

(ii) It is realised that a zonal drag mechanism is required to reproduce the observed temperature and wind fields. Gravity wave saturation and breaking proving this mechanism and the models incorporating this feature of gravity wave drag are successful in reproducing the observed features of temperature and wind fields.

V. CONCLUSIONS

Gravity waves generated in the troposphere and propagating through the mesosphere to the thermosphere can cause change in the mean flow and the eddy diffusion in the upper mesosphere and lower thermosphere region [4]. The level of turbo pause depends upon the gravity wave/tidal activities. Librium and their concentration in the thermosphere are governed by the turbo pause level. The gravity waves generated in troposphere upward to attain saturation and wave breaking. Strong shears of wind are a potential source of gravity waves when the shear region become unsteady, they can generate gravity waves with phase speed equal to the flow speeds.

VI. FUTURE WORK

I. Many model calculations underestimate the ozone and atomic oxygen in the region of mesopause and lower thermosphere. This is open question at present for future work.

II. It will be interesting to deal with a disturbance whose characteristics height will be small compared to the height of the medium. The boundaries may be removed from the region of interest and their nature will be either very complicated or unknown to be studied in the future.

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