

# INFLUENCES OF GRAVITY WAVES THROUGH PHOTOCHEMICAL HEATING IN THE MESOSPHERIC REGION

Vivekanand Yadav and R.S. Yadav

Department of Electronics and communication Engineering

J K Institute for Applied Physics and Technology

University of Allahabad, Allahabad – 211002

## ABSTRACT

*In this paper, the influence of gravity waves on photochemical heating in the mesospheric region has been studied. The loss of photochemical heating induced by gravity waves is determined by the amplitude of the perturbation, besides the background distributions of temperature and atomic oxygen. Two important results has been investigated, firstly; gravity wave cause a loss of photochemical heating in this region, secondly; as background temperature decreases, or as the background atomic oxygen density increases, the gravity wave induced loss of photochemical heating increases and the ratio between it and the background photochemical heating rate also increases.*

## I. INTRODUCTION

Atmospheric heating, cooling and energy transportation in the upper mesosphere and the lower thermosphere are very important. The photochemical heating is one of the major heating sources in this region. Gravity waves are one of the most common dynamical fluctuations in the middle atmosphere. The influence gravity waves on the large scale dynamical structure of the middle atmosphere has been thoroughly studied by Lindzen, Fritts, Holton, Tao and Gardner, Lubken, Hickey and Walterscheid, Vohn Zahn and Meyer ,Bresseur and Offermann, Schmidlin, Dickinson and Riese et al.

In this paper, a diabatic gravity wave model including photochemical diabatic processes has been developed. The effects of gravity waves on photochemical heating are analyzed using this model. The results show that gravity waves can cause a reduction in the photochemical heating rate in the mesospheric region. The variations in the reduction of the photochemical heating rate in the mesospheric region, induced by gravity waves with the changes in the background distribution and the atomic oxygen profile, are studied in detail. The accuracy of the results of this paper is obtained by the help of MATLAB Simulation setup.

(The paper has been divided into sections: Introduction, model and the calculation method of the effect of gravity waves on photochemical heating, the method for calculating the effect of gravity waves on photochemical heating, results of calculations, discussion and conclusions and future work).

## II. MODEL AND THE CALCULATION METHOD OF THE EFFECT OF GRAVITY WAVES ON PHOTOCHEMICAL HEATING

### 2.1 Model

Because the middle atmospheric is a system in which radiation, dynamic and chemical reactions are all coupled, the diabatic processes of photochemical heating and atmospheric cooling should be considered in the theory of gravity waves. The model equations for linear inertial internal gravity waves are as follows:

$$\frac{\partial \hat{u}}{\partial t} + \bar{u} \frac{\partial \hat{u}}{\partial x} + \bar{v} \frac{\partial \hat{u}}{\partial y} + \bar{w} \frac{\partial \hat{u}}{\partial z} - f \hat{v} + \frac{\partial \hat{\phi}}{\partial x} = 0 \quad (1)$$