



## Gravity Wave Studies over a Tropical Location using Radio Occultation and Radiosonde Measurements

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### Abstract

Atmospheric gravity waves are excited in the lower atmosphere and transport energy and momentum while propagating to the upper atmosphere resulting in various exchange processes between different layers of the atmosphere. Intrusion of water vapor into the stratosphere has significant impact on the climate change. Previous studies revealed that during deep convection and cyclonic storms water vapor rich air from the upper troposphere enters to the lower stratosphere and ozone rich air from the lower stratosphere (LS) intrudes into upper troposphere (UT), the phenomenon being known as stratosphere-troposphere exchange (STE). Both upward and downward movement of energy occurs during deep convection. The effects of the cyclonic storm Aila in the lower stratosphere (18-25 km) over Kolkata (22°34' N, 88°29' E) has been studied. Important aspect of this location is that it is situated near the land ocean boundary in the tropical region and experiences heavy convective events in the pre-monsoon and monsoon period. The present study presents the seasonal analysis of gravity wave activity over Kolkata in the UT and LS and reveals the impact of the STE processes causing water vapour intrusion in the stratosphere during the cyclone Aila. Kinetic and potential energy have been estimated from radiosonde measurements obtained by the Indian Meteorological Department and available from the website of Wyoming University. The data of the radio occultation measurements, pertaining to a remote sensing technique, are utilized in the study to obtain the potential energy at lower stratosphere over the storm affected region. The present study reveals that convection is the main source of the gravity wave at a tropical location Kolkata. This convection causes the gravity wave to propagate upward up to lower stratosphere. The extent of upward propagation of energy has been examined by hodograph analysis that supports the said proposition. An investigation of gravity wave generation has been made during the cyclone Aila over the Indian region and Bay of Bengal using GPS RO data from the COSMIC constellation. Very low OLR values can be seen over the cyclone path which shows strong convective activities. This has a role in enhancement of the gravity wave energy in the lower stratospheric region as observed from the dry temperature profile of GPS RO measurements. The vertical direction of energy propagation is upward. The water vapour intrusion occurs simultaneously with the energy enhancement in the lower stratosphere indicating mass transfer by the deep convection during the cyclone.