Interaction Between Tropical Convection and Atmospheric Gravity Waves Over West Africa

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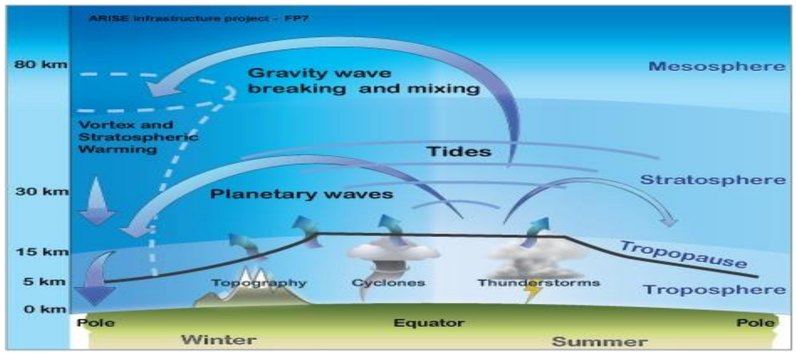
ABSTRACT

Gravity wave activity is an important feature transport energy and momentum from the lower atmosphere to the upper atmosphere causing convection in the atmosphere. Convection is a vital process which helps to redistribute energy away from hotter areas to cooler areas of the Earth aiding in temperature circulation and reducing sharp temperature differences.

We have extracted temperature perturbations that are signatures of Atmospheric Gravity Waves for evaluation of the models. These interactions as represented in the CORDEX regional climate models is assessed at the regional time scale. The regional distribution of Atmospheric Gravity Waves activity is determined.

MOTIVATION

Fig 1 Dynamics of the troposphere-stratosphere-mesosphere exchange



In this research, we study short period (20–100 min) AGWs over West Africa (13.64◦ N, 2.19◦ W) and their possible relation to the tropical convection in the troposphere using RegCM4

MODEL AND EXPERIMENTAL SETUP

For each of our simulations, we first run the model as a conventional RCM, that is without coupling to atmospheric gravity wave dynamics, for 30 days (referred to as the background integration). Coupling is then activated and the model is integrated for another 70 days. We also used averages for the background temperature and moisture profile for computing the perturbation temperature after coupling AGWs dynamics is activated.

We have implemented the above procedure in the Regional Climate Model (RCM) version 4.

RESULTS

Fig 2 a and b show temperature anomaly for 2006-2011 before and after coupling respectively.

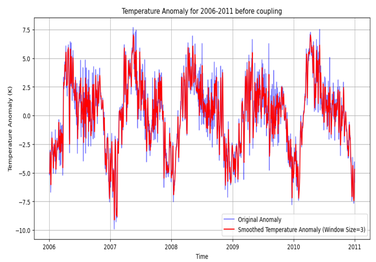


Fig 2a

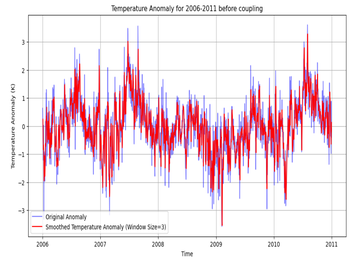


Fig 2b

Figure 3 a shows wavelet transform of AGWs (before coupling) with wavelengths of 5000, 6667, 16 024, 20 159, and 28 430 km).

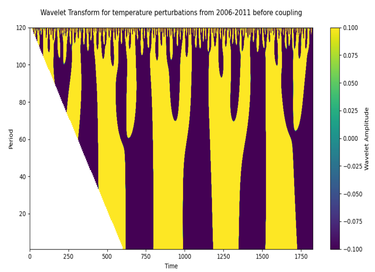


Fig 3a

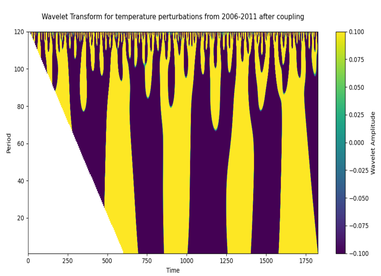
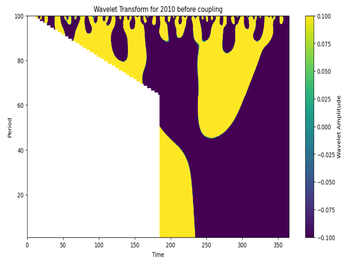
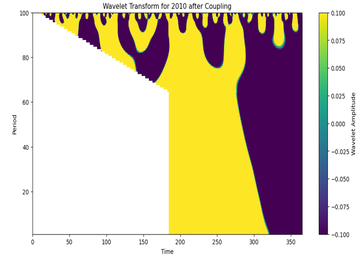


Fig 3b

Fig 4 a and b show wavelet transform for the year 2010 before and after coupling respectively.





DISCUSSIONS

After coupling is activated, AGWs activity extends over a longer time (from 275 – 260). As the wavelength increases beyond 10 000 km, it takes longer for the oscillation to grow to its equilibrated amplitude and the equilibrated amplitude also decreases.

CONCLUSIONS

We studied the diurnal variation of short period (20–100 min) AGW activity from January 2006 to January 2011 using CORDEX temperature profile over West Africa (13.64◦ N, 2.19◦ W)

Wavelet transform shows the presence of AGWs in the troposphere on convection day while the wave features are less pronounced in other normal days.

This result shows that gravity waves have an important role associated with convective structure at this level of the atmosphere.

Convection is the main source of AGWs generation in the tropics

Further study about convectively generated AGWs and their propagation using temperature and wind profiles from COSMIC-2 will be an added advantage for the present study.

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