Seasonal variability of gravity wave momentum flux in the MLT over Sao Joao do Cariri (7°S; 36°W)

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In the present work we have used Hocking's (2005) technique to infer the monthly mean gravity wave (GW) momentum fluxes and their seasonal variability over Sao Joao do Cariri (7°S; 36°W). We also have used numerical simulations to test the ability of Skyimet meteor radars to measure GW momentum fluxes. From theses tests we can conclude that, provided allowance is made for contamination by tides, we can measure GW momentum fluxes with reasonable accuracy on a monthly basis, at least at altitudes at which meteor counts are relatively high, typically from 87 to 94.5 km, with greater better accuracies near the meteor peak of the meteor distribution in altitude. We have analyzed the data from June 2004 to December 2008 and the results are encouraging. We observed mainly annual variability in the component, being positive from March to August. On the other hand, we observe mainly a 4 month oscillation in the component, being positive from February to April, July to August, and October to November. Com; Nað dá para entender, é anual ou 4 meses?

INTRODUCTION

The deposition of energy and momentum by breaking gravity waves is generally believed to play a crucial role in the dynamics and energy balance of the MLT region (Clemesha et al. 2008). The Hocking technique has helped in making available plenty of data sites around of the world, and also in the context of a full understanding of global momentum flux morphology due to gravity waves. This is because this technique provides the values of the components for momentum flux and wind variances from SKiMET meteor radar data and, according to Hocking 2005, at that time there were almost 30 such radars distributed world-wide. In the present work we study the behavior of vertical momentum flux and the horizontal variances from a SKiMET meteor radars located at Sao Joao do Cariri (7.3ºS, 36.4ºW).

Momentum Flux Determination Using SKiYMET Meteor Radar

For the present study, meteors detected in the zenith angle range from 15º to 50º are chosen. Only unambiguous meteors are used for the study. The averaging time bins cover 120 min, with an overlap of 30 min before and 30 min after, and a 3-km height bin is are used. With these scattering volume and averaging intervals, the present study thus focuses on gravity waves of period less than 2–3 h with horizontal and vertical wavelengths of less than 180 km and 5–10 km respectively. The choice of scattering volume and the averaging period is discussed in detail by Hocking [2005].

We also have made several tests based on Fritts et al. 2010, do not shown here, that have demonstrated we can measure GW momentum fluxes with reasonable accuracy on a monthly basis, at least at altitudes at which meteor counts are relatively high, typically from 87 to 94.5 km, with greater accuracies near the peak of the meteor distribution in altitude.

RESULTS

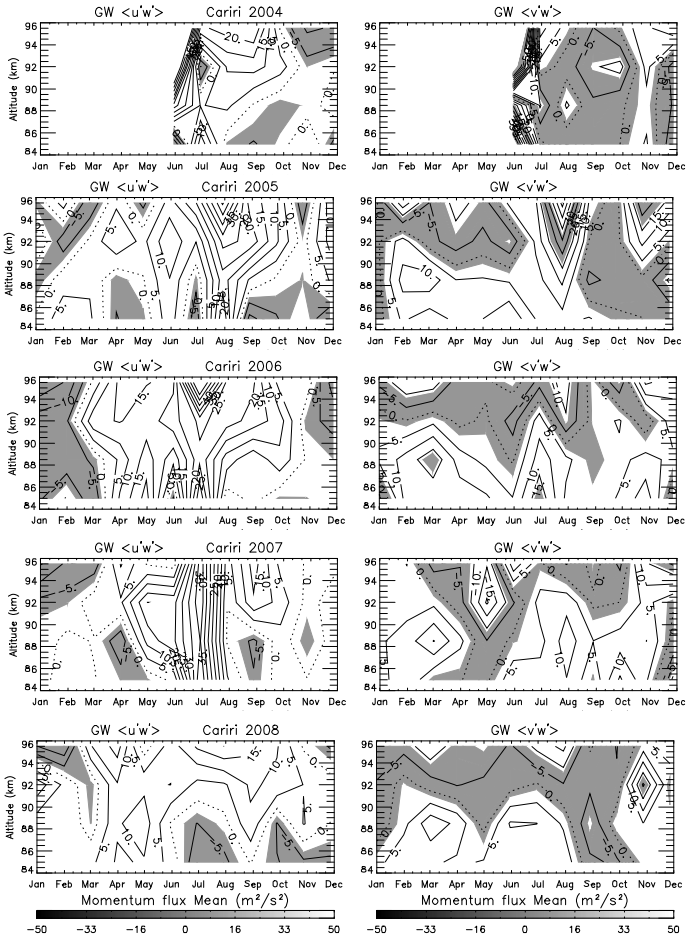

Figure 1: Monthly mean of the vertical flux of horizonal momentum for São Joao do Cariri, from 2004 to 2008.

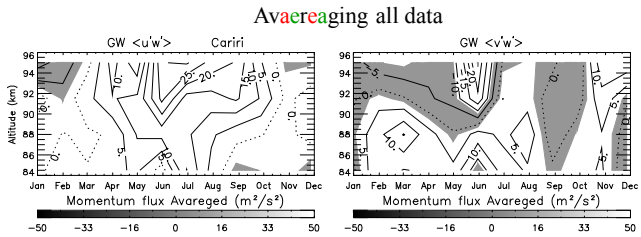

Figure 2: An average of vertical flux of the horizontal momentum.

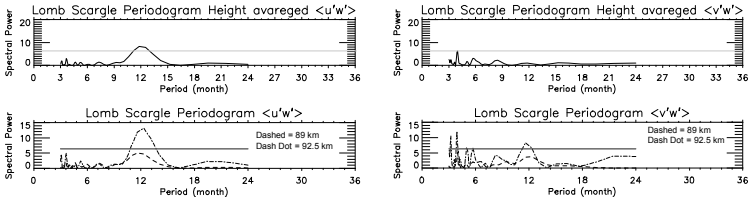

Figure 3: Lomb Scargle Periodograms for zonal (left) and meridional (right) components of the vertical momentum flux. On top is the height averaged only in the altitudes where we have more confidence (87 to 94.5 km) ; at two chosen hights (89 and 92.5 km), shown on the bottom.

SUMMARY AND COMENTS

We have analyzed the gravity waves momentum fluxes data from June 2004 to December 2008 for São João do Cariri, low latitude, and the results are encouraging. From this study we have observed the following:

- The Lomb Scargle Periodograms have shown mainly annual variability in the <u'w'> component, and mainly a 4 month oscillation in the <v'w'> component;
- Averaging through all data we can see that the vertical flux of the zonal momentum is positive from March to August. On the other hand, the meridional one is positive from February to April, July to August, and October to November.
- Clemesha et al. (2009) have observed semiannual oscillation in the fluctuating velocity of the wind at the same station.

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REFERENCES

CLEMESHA, B. R. ; Batista, P. P. ; Buriti da Costa, R. A. ; Schuch, N. . Seasonal variations in gravity wave activity at three locations in Brazil. Annales Geophysicae, v. 27, p. 1059-1065, 2009. DOI: 10.5194/angeo-27-1059-2009

FRITTS, D. C., D. Janches, and W. K. Hocking, 2010: Southern Argentina Agile Meteor Radar: Initial assessment of gravity wave momentum fluxes. Journal of Geophysical Research, 115, D19123, doi:10.1029/2010JD013891.

HOCKING, W. K. (2005). A new approach to momentum flux determinations using SKiYMET meteor radars, Annales Geophysicae doi:10.5194/angeo-23-2433-2005

VINCENT, R. A., and Reid, I. M. (1983). HF Doppler measurements of mesospheric gravity wave momentum fluxes. *J. Atmos. Sciences* 40, 1321-1333.

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