

一次冰雹过程的惯性重力波观测及数值模拟

覃卫坚^{1, 2}, 寿绍文², 高守亭³, 李启泰^{4*}

1 广西区气候中心, 南宁 530022

2 南京信息工程大学江苏省气象灾害重点实验室, 大气科学学院, 南京 210044

3 中国科学院大气物理研究所, 北京 100029

4 贵州省环境科学院, 贵阳 550002

Numerical study of the dynamical mechanism of inertial gravity waves in hail storm process

TAN Wei-Jian^{1, 2}, SHOU Chao-Wen², GAO Shou-Ting³, LI Qi-Tai^{4*}

1 Guangxi Climate Center, Nanning 530022, China

2 Nanjing University of Information Science & Technology, Jiangsu Key Lab of Disaster Weather, College of Atmospheric Science, Nanjing 210044, China

3 Institute of Atmospheric Science, Chinese Academy of Sciences, Beijing 100029, China

4 Guizhou Institute of Environmental Science, Guiyang 550002, China

摘要

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摘要

使用高灵敏度的电容式微压波传感器对1998年4月11日16时发生在贵州省普定县的一次降冰雹过程的重力波进行观测, 利用WRF (Weather Research and Forecast) 中尺度模式对这一过程进行数值模拟, 使用Morlet小波方法对模拟结果进行分析, 得出这一过程中惯性重力波的分布和变化规律, 并分析急流、地形及切变线对惯性重力波的影响. 观测发现: 在降冰雹前, 每隔1~4小时出现一次短周期重力波阵性增强的现象. 数值模拟结果显示: 在低空降冰雹前几个小时有强的短周期重力波出现, 其中周期较长的出现早、存在时间长, 周期较短的出现晚、存在时间短; 强的低空急流和风速垂直切变触发对流或湍流的发生和加强, 对流或湍流又激发了80~200 min的短周期重力波; 短周期重力波更容易向垂直方向传播, 而长周期重力波倾向于水平方向传播. 长周期重力波在降冰雹后周期有明显变短现象, 随高度越加明显. 由地形形成的重力波在最高山峰上空振幅最大.

关键词: 惯性重力波 重力波观测 数值模拟 小波分析

Abstract:

Gravity waves were observed in a hail storm process on 11 April 1998 in Puding County of Guizhou Province by using very sensitive microbarovariograph. And this process is simulated by using the mesoscale numerical model of WRF and the results of the simulation are analyzed by using Morlet wavelet method. The result shows the characteristics of the spatial-temporal distribution of Inertial Gravity Waves (IGWs). In addition, the factors influencing IGWs and weather system, and the dynamic mechanism of IGWs are studied in this paper. The IGWs with short period are strengthened in each 1~4 hour before the hail storm. The results of the simulation show that some IGWs with short period are generated before near the hail storm below the 3 km altitude. In them the long ones are generated early and last longer, and the others are later and last shorter. At the low altitude, the turbulent convection is generated and strengthened by the strong low jets and shears, and the new IGWs with 80~200 min period are excited by the turbulent convection. The IGWs with short period are easier to propagate vertically, while the long ones tend to propagate horizontally. The period of IGWs with long period is obviously shortened after the hail storm and the IGWs are strengthened along with the altitude. The IGWs over the highest mountain usually are the strongest.

Keywords: IGWs Observation of IGWs Numerical simulation Wavelet analysis

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Corresponding Authors: 覃卫坚 Email: qinweijian2008@126.com

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