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非对称型强飓风中的准平衡流特征分析Ⅱ:波动结构

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The diagnoses of quasi-balanced flows in asymmetric intense hurricane. PartⅡ: Wave stru

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摘要 利用非对称波分量分解和小波分析的方法,对准平衡动力模型下非对称强飓风内中尺度波动的空间结构和时间序列特征
结果表明,平衡流场中1波扰动占主要地位且具有涡旋Rossby波的典型结构特征,准平衡流各波数下扰动的空间分布反映了中
的混合性质;模式大气和准平衡垂直运动的全局功率谱中,超过信度检验的强波动信号中不仅包含分别表征重力波和涡旋Ros
频和低频波动信号,还存在表征具有物理性质不可分特性的混合涡旋Rossby-重力波的中频波动.混合波的出现建立了不同频
间的能量交换通道,其信号的变化对飓风系统的强弱变化具有一定的指示作用.非平衡垂直运动的波动强信号则主要集中在高
区域,反映了在飓风强度变化情况下,与高频重力波有关的快波调整过程所引起的垂直扰动的振荡和传播.强垂直风切变对飓风
波动的切向和径向传播具有重要影响,当环境垂直风切变很强时,准平衡1波扰动在径向和切向方向上均呈"驻波"形态,随着环
变的减弱,1波扰动以混合波波速逆基本气流传播.

关键词: 中尺度波动 准平衡流 PV-&omega 反演

Abstract: In this paper, the spatial structure and time series of mesoscale wave under the quasi-balan
model in an asymmetrical intense hurricane are investigated by using the method of asymmetric wave
decomposition and wavelet analysis. The results show that the wavenumber(WN)-1 component of balan
predominated and manifest the typical feature of vortex Rossby waves (VRWs), while the spatial distribu
every components reflect the mixed feature of mesoscale waves. The results from wavelet analysis indic
the strong wave signals of simulated and quasi-balanced vertical velocity, which exceed the significance
contain the high-frequency waves of inertial-gravity waves (IGWs), the low-frequency waves of VRWs,
middle-frequency waves of mesoscale mixed vortex Rossby-gravity waves (VRGWs). These mixed wave s
establish the path for exchanging the energy among different wavebands. The appearance and disappea
mixed VRGWs signals are related to the violence development and weakening of TC. The strong wave sig
unbalanced vertical velocity concentrate in the two regions with high and low frequency, reflecting that
forming and propagation of unbalanced vertical perturbation is the adjustment process relating to the hig
frequency gravity waves, which is influenced by the intensity change of TC. Environmental vertical wind
plays an important role in the propagation of waves. When the shear is strong, the WN-1 component in
balanced flows appears to be 'standing waves' both in tangential and radial direction. However, with the
decreasing of vertical shear, the WN-1 component propagates contrary to the basic flows at the phase
mixed waves.

Keywords: Mesoscale wave Quasi-balanced flows PV-ω inversion

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