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扰动位能与大气环流异常的耦合关系及机理研究

高丽¹, 李建平^{2*}

1. 中国气象局国家气象中心数值预报中心, 北京 100081;
2. 中科院大气物理研究所LASG, 北京 100029

Relationship and mechanism between perturbation potential energy and atmospheric general circulation anomalies

GAO Li¹, LI Jian-Ping^{2*}

1. Numerical Prediction Center, National Meteorological Center, China Meteorological Administration, Beijing 100081, China;
2. State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

摘要

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摘要 本文在前期局地扰动位能理论工作基础上,进一步着眼于扰动位能与大气环流异常的关系和机理问题,采用奇异值分解(SVD)方法分析了扰动位能与高、中、低层大气动能的耦合相关模式以及年际变率情况,同时考察它作为大气质量分布的海平面气压之间的相关关系,并从物理上初步探讨了扰动位能与大气动能以及质量的相关机理问题.结果表明,扰动位能自身变率的第一模式同时也是与大气环流异常场耦合变化的主要模式,与之相对应的大气动能和质量场的主模式也是其自身变率的支配模式,说明它们之间存在相互制约的物理机制.而且,热带外地区大气环流主模式特征的形成,与扰动位能兼具全球尺度纬向对称结构和局地尺度纬向非对称性密不可分.另外,冬季南北半球环状模指数与扰动位能的前两阶矩存在非常好的相关关系,而在夏季这种关系明显削弱,仅存在于南半球.

关键词 扰动位能, 大气环流异常, 动能, 环状模, 奇异值分解

Abstract: Based on previous theoretical studies for local perturbed potential energy (PPE), in this study, we further focus on the relationship and mechanism between the PPE and atmospheric general circulation (AGC) anomalies, and analyze the coupled correlation modes between the PPE and upper, middle and lower-level atmospheric kinetic energy (AKE) and their interannual variability. Meanwhile, we also examine the relationships between the PPE and sea surface pressure as the measure of atmospheric mass and further discuss physical mechanisms involved in the relationships between the PPE and the AKE as well as mass. Analysis results show that the first mode in the variability of the PPE is also the leading mode in the coupled variation of the PPE and AGC anomalies, and the corresponding primary modes in the AKE and mass fields are also the dominant modes in their own variability, which indicates a possible interrelated physical mechanism between them. Furthermore, it is demonstrated that the formation of the prevailing mode of the extratropical AGC is closely associated with the feature that the PPE has both zonal symmetry at global scale and zonal asymmetry at local scale. Moreover, there is a significant correlation between the first two orders of moments of the PPE and the southern/northern annular mode indices in the wintertime, but such a relationship is apparently weakened in the summertime and exists in the southern hemisphere only.

Keywords [Perturbation potential energy](#), [Atmospheric general circulation anomaly](#), [Kinetic energy](#), [Annular mode](#), [SVD](#)

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About author: 高丽,女,理学博士,高级工程师,主要从事大气动力学和数值天气预报研究.E-mail: gaol@cma.gov.cn

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