

论文

大气流场的拓扑结构

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摘要: 用简化的大气运动方程, 定性分析了大气中几种常见天气系统流场的拓扑结构. 研究表明, 气旋反气旋流场与中心点附近的流形相对应; 长波演化形成阻塞高压流场, 与鞍点和中心点从合并到分离的流形相对应; 台风和龙卷风的流场与三维空间中鞍-焦点附近的流形相对应. 研究大气流场的拓扑结构, 可以直观清晰地揭示大气运动的形态和形成机理, 有助于认识大气运动的规律. 文中讨论基于一定假设, 结果与实际大气有差异, 因而具有局限性.

关键词: 大气流场 流函数 拓扑结构 平衡点 鞍-焦点

Topological structures of the atmospheric flow fields

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Abstract: We study qualitatively topological structures of some common flow fields in the atmosphere based on different simplifications and assumptions of fundamental equations. Results show that the streamlines of cyclones and anticyclones on the 2-D isobaric surface are similar to the manifold of a centric point (or elliptic point), The flow fields of typhoon and tornado are similar to the manifolds of saddle focus points in 3-D space. When the atmospheric long wave evolves and blocking high appears, the manifold corresponds to the case while a saddle and a center point changes from coalescence to separation. The topological analyses of these flow fields are clearly intuitive and do help understand the patterns formation of atmospheric motion and the underlying mechanisms. Differences between the theoretical results and the real behavior of the atmospheric flow are due to the simplifications and assumptions we made, so our results have some Limitations.

Keywords: Atmospheric flow field Stream function Topological structure Equilibrium point Saddle focus point.

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