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论文

大气边界层湍流的动力非平稳性的验证

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摘要: 首次用验证时间序列中是否存在动力非平稳性的一种简单图示方法——space time index法来分析大气边界层湍流的动力平稳性特征.本文以取自淮河流域和威斯康星森林下垫面条件下的三维高精度风速和温度、湿度湍流脉动资料对大气边界层湍流的平稳性特征进行了分析.结果表明space time index方法能有效地检验大气边界层湍流信号中是否存在动力平稳性.另外,均匀下垫面条件(水稻田)及复杂下垫面条件(森林)下的大气边界层湍流信号中几乎都存在动力非平稳性,大气湍流动力学非平稳性可能是边界层湍流信号相当普遍具有的一种特性.大气边界层湍流中的间歇性和相干结构使得其非平稳性图形的特征不同于一般时间序列非平稳性图形的“V”型特征;森林下垫面条件下的湍流信号比相对均匀下垫面(水稻田)下的湍流信号更有组织性,相干结构更强.

关键词: Space time index 非平稳性 大气边界层湍流 间歇性 相干结构

A test of the dynamical nonstationarity in atmospheric boundary layer turbulence

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Abstract: A graphical method, named space time index plots for testing dynamical nonstationarity in general time series is addressed. In this method, the graph is V shaped due to nonstationarity. The method is used to test dynamical nonstationarity in atmospheric boundary layer turbulence. The high resolution temperature, humidity and three components of wind speed under various land surface obtained from HUBEX (Study of Energy and Water Cycle Over Huaihe River Basin) and PFRD (Park Falls Ranger District of the Chequamegon National Forest, about 15km east of Park Falls, Wisconsin, U.S.A.) are analyzed. The results show that the space time index plots method can test whether dynamical nonstationarity exists in atmospheric boundary layer turbulence signal. There is almost few dynamical stationarity in atmospheric boundary layer turbulence signal both under rice from HUBEX and under forest from PFRD. Dynamical nonstationarity is likely one common property of atmospheric boundary layer turbulence signal. The intermittency and coherent structures in atmospheric boundary layer turbulence lead to some differences in the nonstationarity graph shape between atmospheric boundary layer

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