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夏季亚洲季风区对流层-平流层不可逆质量交换特征分析

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Irreversible stratosphere-troposphere mass exchange charact summer monsoon region

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摘要

基于2005年NCEP/GFS分析资料和拉格朗日粒子扩散模式的“Domain Filling”技术，以气块穿越对流层顶后的滞留时间断分析了夏季亚洲季风区对流层-平流层质量交换，重点讨论了对平流层大气成分收支具有实际意义的不可逆双向质量交换用前向（后向）轨迹追踪方法，分析了其4天的“源（汇）”特征.研究结果表明：(1)对流层-平流层质量交换(Troposphe Stratosphere mass Exchange，STE)的计算对滞留时间阈值的选择具有较强敏感性，大多数的气块在1～2天内可频繁层顶.这些瞬时交换事件的考虑与否对穿越对流层顶的质量交换计算的准确性具有重要影响，尤其在中纬度的风暴轴区域.(2风区对流层-平流层质量净交换纬向平均上看，45°N以南的区域为对流层向平流层的质量输送(Troposphere to Str mass Transport，TST)，副热带地区为最强的上升支，而在45°N~55°N的中纬度地区是平流层向对流（Stratosphere to Troposphere mass Transport，STT）.地理分布上，STT主要分布在青藏高原以北的东亚地区，区夏季大尺度的槽区相对应.夏季整个亚洲季风区都是TST发生的区域，最大值位于青藏高原东南侧及其附近区域，该区域区不可逆TST夏季平均总量的46%.(3)对流层-平流层质量交换的“源汇”特征分析表明，STT主要源于100°E以西、50°纬地区，向下可以输送到中国东北部及朝鲜半岛北部等中纬度区域.而TST主要来源于中纬度和副热带地区的大气输送，向层顶高度以后，可分别向高纬的极地和热带地区输送，这意味着亚洲季风区夏季的TST水汽输送可能进入“热带管”中，对全球平流层水汽平衡产生重要影响.

关键词： 亚洲季风区 对流层-平流层 不可逆质量交换 源汇特征

Abstract:

A particle dispersion model combined with “domain filling” technique is applied to the analyzed data fr Forecast System of National Centers for Environmental Prediction (NCEP/GFS) to study the tropos stratosphere mass transport (TST) and the stratosphere-to-troposphere mass transport (STT) over monsoon region for the period from June to August in 2005. A residence time criterion serves to between transient (reversible) exchange and irreversible exchange, and special emphasis is paid to the exchange, which has great impact on the budget of chemical constitutes in both the stratosp troposphere. The source and sink features in the irreversible exchange are also analyzed by trajec method. The main conclusions can be summarized as follows:（1）The results show that the sensitiv Troposphere-Stratosphere mass Exchange (STE) distributions to the threshold residence time is pronou latitudes. The major part of exchange air parcels return rapidly (within less than 1~2 days) to the sphere”. The quantitative STT and TST mass flux estimates are strongly dependent upon whether these events are considered or not.（2） In general, the overall analysis of STT, TST and net mass exchan that upward and downward transport of mass at the middle and high latitude accompany with each meridional distribution of the net flux reveals an upward branch in the subtropics, pronounced downward in the midlatitudes from 45°N to 55°N latitude and weak upward fluxes in high latitude region geographical distributions show strong downward cross tropopause mass flux mainly in the north Plateau, which corresponds to the large scale troughs in summer. The results also show that the wh

monsoon region is the region of upward cross tropopause mass flux. Tibetan Plateau and its adjoint re
the main channels of the upward mass flux into the stratosphere, which makes a fraction contributior
（3）The four days source and sink characteristics of the irreversible mass exchange also reveal tha
mainly come from the high latitude regions of west of 100°E and north of 50°N, and transport to t
latitude areas, such as the northeast of China and north Korea. But the source and sink characterist
reveal that the upward mass from the troposphere into the lowermost stratosphere can be transport
high latitude and low latitude torpocical regions respectively, which indicate that the TST of Asian mons
an enhanced potential for water vapor transportation into the stratosphere tropical pipe and play an
role in the global stratosphere water budget.

Keywords： Asian monsoon region Troposphere-Stratosphere Irreversible mass process Source and

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灾害天气国家重点实验室自主研究项目(2008LASWZI04、2009LASWZF02)和科技部国家重点基础研究发展计划