

冬季太阳11年周期活动对大气环流的影响

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The influence of the 11-year sunspot cycle on the atmospheric circulation during winter

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摘要

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摘要

利用气象场的再分析资料和太阳辐射活动资料, 对太阳11年周期活动影响北半球冬季(11月~3月)大气环流的过程进行了统计分析和动力学诊断. 根据赤道平流层纬向风准两年振荡(QBO)的东、西风状态对太阳活动效应进行了分类讨论, 结果表明: 东风态QBO时, 太阳活动效应主要集中在赤道平流层中、高层和南半球平流层, 强太阳活动时增强的紫外辐射加热了赤道地区的臭氧层, 造成平流层低纬明显增温, 同时加强了南半球的Brewer-Dobson(B-D)环流, 引起南极高纬平流层温度增加; 而北半球中高纬的环流主要受行星波的影响, 太阳活动影响很小. 西风态QBO时, 太阳活动效应在北半球更为重要, 初冬时强太阳活动除了加热赤道地区臭氧层外, 还抑制了北半球的B-D环流, 造成赤道平流层温度增加和纬向风梯度在垂直方向的变化, 从而改变了对流层两支行星波波导的强度; 冬末时在太阳活动调制下, 行星波向极波导增强, B-D环流逐渐恢复, 造成北半球极地平流层明显增温, 同时伴随着赤道区域温度的下降.

关键词: [太阳活动](#) [准两年振荡](#) [Brewer-Dobson环流](#) [行星波](#) [平均剩余环流](#)

Abstract:

Based on reanalysis monthly data and sunspot cycle index, the influences of the 11-year sunspot cycle (SSC) in stratospheric and tropospheric circulation are investigated by using statistical analysis and dynamical diagnosis during northern winter (November to March). According to the east or west phase of stratospheric equatorial zonal wind quasi biennial oscillation (QBO), we've analyzed the solar effects in different situations. In east QBO phases, the solar effects focus on the equatorial upper stratosphere and south hemispheric stratosphere, where enhanced solar ultraviolet radiations heat up the stratospheric ozone layer, leading to the temperature increase apparently; the solar maxima events reinforce the south stratospheric Brewer-Dobson circulation, and result in the south polar areas warming; planetary wave plays a significant role in north high latitudes regions, hence the solar cycle signals could be nearly neglected. In west QBO phases, solar effects are more important in north hemisphere. In early winter, solar maxima effects are not only warming the equatorial stratospheric ozone, but also restraining the northern atmospheric B-D circulation, leading to the equatorial stratospheric temperature increase and zonal wind gradient change, hence the two waveguides of planetary wave are altered after those processes. In late winter, the polar waveguide of planetary wave is enhanced by solar effects and the B-D circulation is recovered gradually. After these procedures the temperature of northern polar stratosphere starts to increase conspicuously, accompanying by the decrease of equatorial zonal temperature.

Keywords: [Sunspot cycle](#) [Quasi biennial oscillations](#) [Brewer-Dobson circulation](#) [Planetary wave](#) [Mean residual circulation](#)

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