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# COMPARISONS OF THE WEST PACIFIC SUBTROPICAL HIGH AND THE SOUTH ASIA HIGH BETWEEN NCEP/NCAR AND ECMWF REANALYSIS DATASETS

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**Abstract:** Comparisons of the west Pacific subtropical high with the South Asia High are made using the NCEP/NCAR and ECMWF 500 hPa and 100 hPa monthly boreal geopotential height fields for the period 1961 – 2000. Discrepancies are found for the time prior to 1980. The west Pacific subtropical high in the NCEP/NCAR data is less intense than in ECMWF data before 1980. The range and strength of the west Pacific subtropical high variation described by the NCEP/NCAR data are larger than those depicted by ECMWF data. The same situation appears in the 100-hPa geopotential field. These discoveries suggest that the interdecadal variation of the two systems as shown by the NCEP/NCAR data may not be true. Besides, the South Asia High center in the NCEP/NCAR data is obviously stronger than in the ECMWF data during the periods 1969, 1979 – 1991 and 1992 – 1995. Furthermore, the range is larger from 1992 to 1995.

**Key words:** reanalysis datasets; west Pacific subtropical high; South Asia High; comparisons

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## 1 INTRODUCTION

The west Pacific subtropical high and South Asia high are two important systems affecting the weather and climate in China [1-4]. Most of what has been studied up to now is based on the reanalysis data of NCEP / NCAR or ECMWF. At present, quite a number of meteorologists have conducted research on meteorological elements on different temporal and spatial scales using different datasets, with the results showing that the two data series are both similar to and yet very distinctive from each other [5-14]. In this study, the two reanalysis datasets are compared for their description of the west Pacific subtropical high and South Asia high in boreal summer.

## 2 DATA AND METHODS

The two monthly-averaged boreal data series in question cover a time from 1961 to 2000 for the levels of 500 hPa and 100 hPa. The interval is 2.5° × 2.5° for a longitude-latitude gridpoint, making a total of 144 × 37 gridpoints in the Northern Hemisphere. The mean field for June, July and August is used to represent the summer of a given year. Accumulative anomalies and an 11-year running mean are used to analyze the temporal tendency of the geopotential field. Tests are conducted for abrupt changes in its time series by means of the running *T*-test [15] and the Mann-Kendall method [16, 17].

## 3 COMPARISON OF THE WEST PACIFIC SUBTROPICAL HIGH IN BOREAL SUMMER

It is known from 500 hPa latitude – time cross section (Fig.1) that the subtropical high analyzed by the NCEP / NCAR reanalysis data prior to the year 1978 is much weaker than the one analyzed by the ECMWF reanalysis data; The latitudinal area covered by the 588 10-m isopotential line is also much smaller. It is found from comparisons of the mean square deviation of zonally-averaged geopotential height field (figure omitted) that the mean deviation of the 500 hPa geopotential height field for the middle and lower latitudes is smaller by the ECMWF reanalysis data

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than by the NCEP / NCAR reanalysis data. The opposite is true in the high latitudes.

Accumulative anomalies (Fig.2a) and running *T*-tests (Fig.2b) are separately applied to the time series of the geopotential field averaged over the area of 120°E – 180°E, 20°N – 30°N. In Fig.2a, the results achieved by the NCEP / NCAR reanalysis data prior to 1980 has a larger increase in intensity while being more consistent with those determined by the ECMWF reanalysis data afterwards. With the running *T*-test in which $t_{0.5}$=2.10, abrupt changes occur for the time from 1973 to 1981 by the NCEP / NCAR reanalysis data

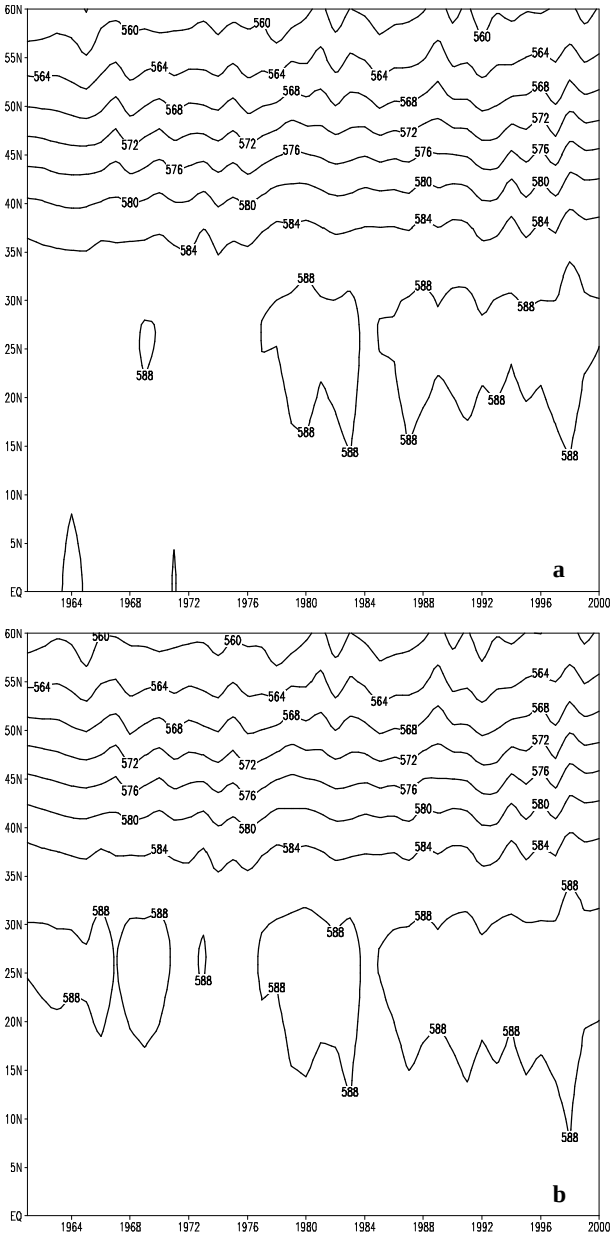


Fig.1 500 hPa latitude – time cross section of the zonally averaged geopotential field for the boreal summer from 1961 to 2000 by NCEP/NCAR (a) and ECMWF (b). Unit: gpdm

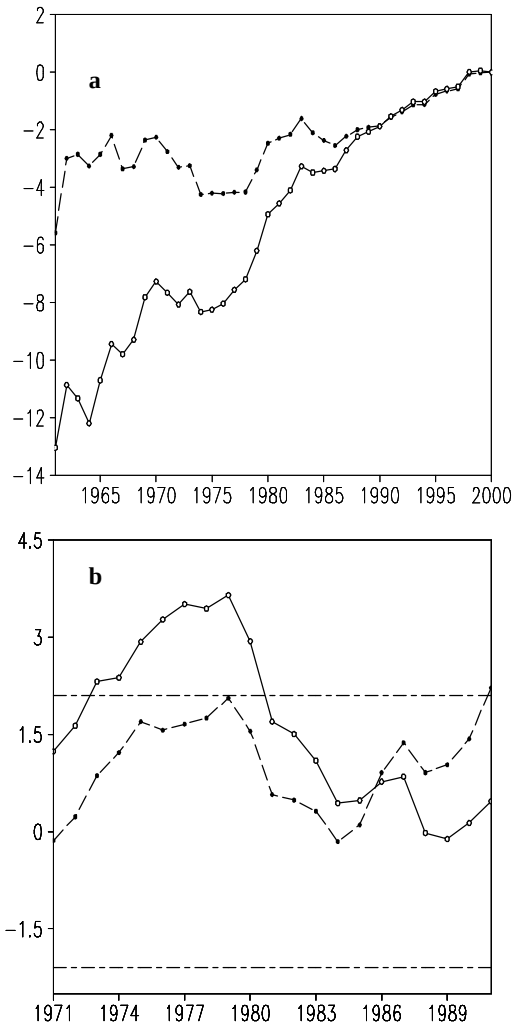


Fig.2 Accumulative anomalies (a) and running *T*-tests (b) of the regionally averaged 500-hPa geopotential height field ied determined by NCEP / NCAR reanalysis data (solid line) and ECMWF reanalysis data (dashed line).

while the ECMWF reanalysis data fail to pass the test for the period from 1971 to 1990. Such abrupt changes might be caused by the inclusion of satellite data in the model, as reported in past relevant works. It is then suggested that the interdecadal variation of the subtropical high revealed by the NCEP / NCAR reanalysis data could be untrue.

## 4 COMPARISON OF THE SOUTH ASIAN HIGH

The same approach is used to study the 100-hPa geopotential height fields determined by the above two types of reanalysis data with the focus on the region

where the South Asia High is. According to the NCEP / NCAR reanalysis data, the 1864 10-m isopotential line is the enclosed, most outward contour around the South Asia High and crosses a longitudinal domain all the way eastward from 30°W to around 160°E and the 1860 10-m geopotential line is not enclosed. From what is depicted in the ECMWF reanalysis data, however, the 1860 10-m geopotenital line is the contour that is most outward as well as enclosed around the high covering an area eastward from 40°W to around 160°E (figure omitted). In addition, the variance is larger with the geopotential height field zonally averaged by the NCEP / NCAR reanalysis data than that by the ECMWF reanalysis data, while being relatively small in regions north of 70°N (figure omitted).

As shown in Fig.3, the center of the South Asia High is much stronger by the NCEP / NCAR reanalysis data than that by the ECMWF reanalysis data for 1969 and 1979 – 1991 and it is stronger and covers a wider area by the NCEP / NCAR reanalysis data than that by the ECMWF reanalysis data for 1992 – 1995.

A time series is determined by seeking regional mean of the 100 hPa geopotential height over the area of 60°E – 90°E, 25°N – 35°N. It is known from the accumulative anomalies (Fig.4) that both of the reanalysis data suggest a significant trend of decreasing for the time prior to 1965 and a moderate trend of increasing in the 1990s. If judged by the NCEP / NCAR reanalysis data alone, the South Asia high began an increasing trend in 1976. From comparisons of the running *T*-test applied to the time series of the geopotential height field (Fig.4b), it is noted that the time of abrupt change appears between 1975 and 1982 as shown by the NCEP / NCAR reanalysis data but in 1989 by the ECMWF reanalysis data.

See the Chinese edition of the journal for more details.

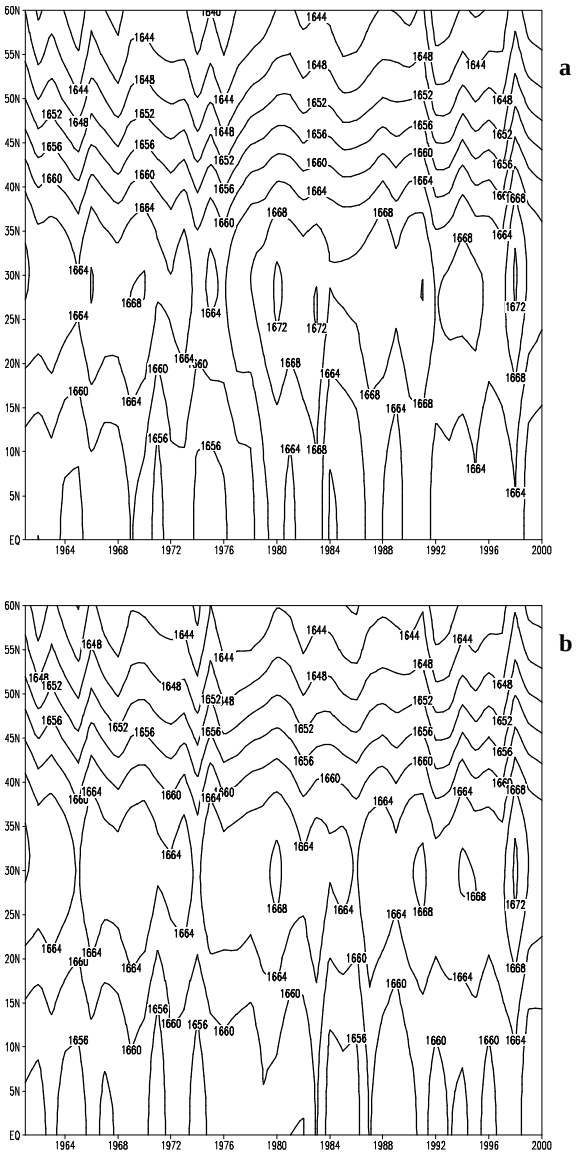


Fig.3 Same as Fig.1 except for 100 hPa

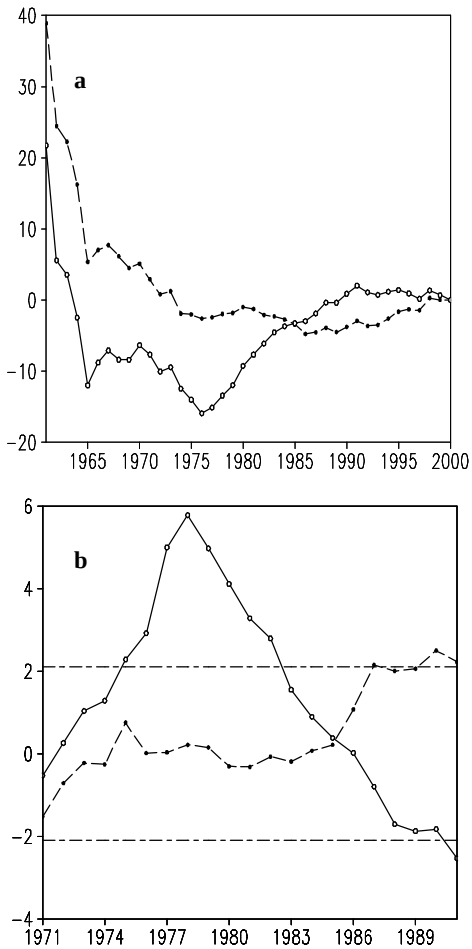


Fig.4 Same as Fig.2 but for 100 hPa.

## 5 CONCLUSIONS

In summary, this study has concluded as follows.

(1) For the time prior to 1980, the two reanalysis datasets differ much from each other and the NCEP / NCAR reanalysis data suggest a much weaker subtropical high.

(2) The variation of the subtropical high as shown by the NCEP / NCAR reanalysis data is larger in both the magnitude and intensity than that determined by the ECMWF reanalysis data.

(3) The interdecadal variation as suggested by the NCEP / NCAR reanalysis data may not be true.

The differences existing in the models employed by NCEP / NCAR and ECMWF for reanalysis are causing the differences in the reanalysis data. Using the technique of 3-dimensional variational assimilation (3DVAR), the $T_{159}$ spectral model used at ECMWF is divided into 60 layers from the ground surface to the 0.1 hPa level with 13 levels in the boundary layer. Also based on the spectral model and the 3DVAR technique, the NCEP / NCAR reanalysis data have lower horizontal and vertical resolution because the $T_{62}$ is used instead. It is made up of 18 levels from the ground surface to the 3-hPa level with only five levels within the boundary layer. Apart from the difference in spatial resolutions, the two models also differ in the schemes of physical parameterization, such as the boundary layer, soil, surface fluxes and radiation processes. Besides, they are also different in the assimilated data. More needs to be done to look into the causes for these differences.

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