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Parameters of sudden stratospheric warmings from the reanalysis database jra-55

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The purpose of the study and classify parameters of sudden stratospheric warmings (SSW) using an automated method for determining the characteristics of SSW for the period from 1958 to 2017 according to Japanese reanalysis of meteorological information JRA-55. The times of start and end of the SSW are determined using the moments of the maximum rate of temperature change and the average zonal speed at an altitude of 30 km and latitudes above 60º N. Algorithms and programs have been developed in [1,2] to search for zero values of the second derivative of temperature and zonal velocity with respect to time, which corresponds to extreme values of the rate of change of these parameters. In this study, this method is used to search and determine the characteristics of SSW at an altitude of 30 km for the period from 1958 to 2017 using the JRA-55 database of the Japanese meteorological reanalysis. Based on the data from an automated search for SSW dates, an attempt was made to modify the generally accepted classification of SSW events based on the presence or absence of a reversal of the mean zonal wind and the magnitude of the temperature increment relative to its median at an altitude of 30 km. A search for early-winter, mid-winter and final stratospheric warmings was performed. A total of 148 winter-average SSW were detected, with an average of 2.5 events per year. The moments of maximum rates of change in temperature and zonal wind differ by no more than two days. Criteria for determining strong and moderate SSW, which can be considered as analogues of major and minor warming in the international classification of SSW, are described. The proposed method is highly sensitive and has made it possible to identify an additional class of weak SSWs. Early winter stratospheric warming occurring in late autumn or early winter (November-December) is considered separately. The final warming is also analyzed, for which there is no return of the average zonal wind to the west within 30 days after its reversal to the east, which occurs during the spring restructuring of the circulation of the middle atmosphere. A total of 63 strong warmings were detected at an altitude of 30 km. On average, strong warming occurs once a year. Most of them occur in the month of January. On average, the number of moderate warming events is 0.6 – 0.7 events per year. In addition, 44 moderate warming events have been found. On average, this type of warming occurs 0.75 times a year. The greatest number of SSWs occurs in the month of February. Number of detected weak SSW events is 44. On average, there is also more warming in the month of January. Final warming and early winter warming were considered separately. Total 18 early winter warmings were detected. They were also subdivided into strong, moderate and weak SSWs. Their average duration is 7-9 days. A total of 18 final warmings were detected. All of them began in March. It has been confirmed that the development of SSW is always preceded by an increase in the meridional heat flux directed towards the North Pole. These flows can contribute to the heating of the polar stratosphere and the development of SSW.

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References.

[1]. Gavrilov N. M., Efimov M. M., Automated determination of the dates of sudden stratospheric warming, Proc. SPIE 11916, 27th International Symposium on Atmospheric and Ocean Optics, Atmospheric Physics, 119167T, 2021.

[2]. Efimov M. M., Nikolai M. Gavrilov N. M. Determination of sudden stratospheric warming dates and their classification according to the JRA-55 reanalysis data. Proc. SPIE 12780, 29th International Symposium on Atmospheric and Ocean Optics: Atmospheric Physics, 127807B, 2023, doi: 10.1117/12.2690514