

2020/2021年冬季東亞冬季風次季節變化的水平和垂直特徵

Horizontal and Vertical Features of the East Asian Winter Monsoon Subseasonal Variations during 2020/2021 Winter

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摘要

本研究將以2020/2021年冬季的東亞冬季風特徵為聚焦比較中央氣象局全球預報系統同化FOMOSAT-7/COSMIC GPS-RO產出的分析資料和歐洲展期天氣預報中心再分析資料ERA-5 在季風次季節變化的水平和垂直特徵展現的異同。東亞冬季季風氣候背景是根據30年(1990/1991~2019/2020) ERA-5 資料統計的氣候平均場及變異量判斷冬季季風的主要高低壓中心位置以及年際變化的敏感區域。結果顯示東亞冬季季風在低層以蒙古高壓與阿留申低壓為焦點，高層則以在鄂霍次克海上方的東亞主槽與在歐亞大陸上的高壓脊為主的大尺度滯波作為定位中心。東亞主槽是極渦(polar vortex)的一部分，低壓中心在西伯利亞北方的北極海上空，往東南延伸至鄂霍次克海上空。在2020/2021年冬季，低層的蒙古高壓與阿留申低壓中心往西偏移，而高層大氣極渦偏弱，東亞主槽中心位置偏東並且季內擾動並非極渦低壓的延伸反呈切斷現象。明顯的季內尺度變異出現在2020年12月中下旬，始於北極巴倫支海上空阻塞高壓增強並在12月22-26日向東擴展至北極喀拉海，繼而往南擴展至蒙古北方，之後10天隨著蒙古高壓的增強冷空氣往南移動直到2021年1月中旬才結束了這個季內尺度的寒流事件。本文將比較ERA-5和CWBGFS分析場對這個事件的表現，未來將進一步分析預報資料。

關鍵字：東亞冬季風，蒙古高壓，阿留申低壓，東亞主槽，阻塞高壓

Abstract

In this study we will analyze the East Asian winter monsoon (EAWM) and its variations during the 2020/2021 winter (December 2020-February 2021) using the ECMWF Reanalysis v.5 (ERA-5) data and compare the horizontal and vertical structures of the subseasonal cold wave event with the findings based on CWBGFS analysis that assimilated the FOMOSAT-7/COSMIC GPS radio occultation (GPS-RO) data. Thirty winters (1990/1991 ~ 2019/2020) of ERA-5 data are analyzed to provide the climatological background information such as the climatological seasonal means and standard deviations that reflect the sensitive centers of the interannual variability is large. The analyzed variables include the surface-level mean sea level pressure (MSLP), 2-meter air temperature (T2m) over land region and sea surface temperatures (SSTs) over the oceans, and 10-meter winds. The upper-level variables include the geopotential height, temperature, and winds. We found that EAWM is associated with high MSLP over the Eurasian continent with the center in Mongolia (Mongolian High) and low MSLP over North Pacific Ocean with the center in Bering Strait (Aleutian Low). In upper level, it is characterized by the East Asian major trough centers in the Sea of Okhotsk and a ridge in Eurasian continent. The East Asian major trough was found as an extension of the polar vortex that shows a low pressure center over the Arctic ocean to the north of Siberia with a southeastward oriented trough extended to far east Siberia and the Sea of Okhotsk. During the 2020/2021 winter the Mongolian High and Aleutian low centers were shifted to the west of the climatological mean locations. In upper level, the polar vortex was weaker than normal and

the jet stream shifted southward with East Asian trough tilted to the east. A significant cold surge event was identified with the southward movement of the Mongolia-Siberia cold air mass initiated by the strengthening of a blocking high centered over the Arctic Barents Sea during 17-21 December 2021. The blocking first expanded eastward to the Kara Sea during 22-26 December then moved southeast and reached the northern Mongolia in five days. The anomalous high-pressure center was over central Russia and extended across Mongolian and reached south China in early January 2021. A comparison of the 2020/2021 EAWM features represented in ERA-5 and CWBGFS analysis will be discussed in the paper. The forecast data will be analyzed later.

Key words: East Asian winter monsoon, Mongolian High, Aleutian Low, East Asian major trough, blocking high