

Three dimensional structure of the Arctic cyclones

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Arctic cyclones are unique low pressure systems appearing in the Arctic, which are different from the tropical cyclones and the mid-latitude cyclones. Previous studies provided a new insight that the surface Arctic cyclone connects to an upper polar vortex producing a deep barotropic vortex. The previous studies also noted that the characteristic thermal and the vortical structures are maintained throughout a life cycle. But, the three dimensional stereoscopic structure of the Arctic cyclones was not investigated by the previous studies.

To investigate the three dimensional structure of the Arctic cyclones, we converted the meteorological data from a latitude/longitude coordinate system into the cylindrical coordinate system around the Arctic cyclone center. The original data used in this study are the reanalysis data of JRA-25 (Japanese 25year Reanalysis) and JRA-55 (Japanese 55year Reanalysis).

The Arctic cyclone has a deep barotropic cyclonic circulation, a secondary circulation in the troposphere, a downdraft at the lower stratosphere, a coupling of a warm core at the lower stratosphere and a cold core in the troposphere, and a deep tropopause folding over the cyclone center.

For the Arctic cyclone, the positive relative vorticity related to the deep axisymmetric cyclonic circulation stretches up to the stratosphere of 50 hPa level from the surface indicating a connection with the stratospheric polar vortex. The upper vortex of the well-developed occluded cyclone is not the polar vortex in the stratosphere. The Arctic cyclone at the surface is characterized by the deep stratospheric polar vortex, which is different from the occluded cyclone in terms of the vertical scale.

Although additional studies are needed, a schematic diagram of the Arctic cyclone is proposed in this study.

Keywords: Primary circulation, thermal structure, polar vortex