



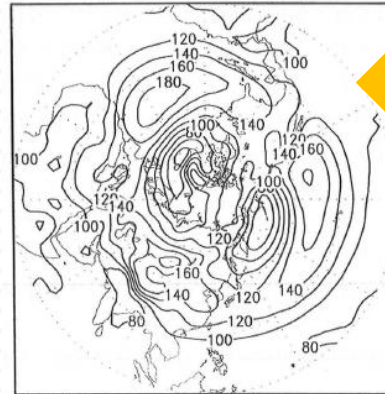
Introduction to Meteorology

29 High Pressure and Blocking (2)

Introduction



The area of relatively high atmospheric pressure is called high pressure (or high). In the weather chart, it appears as a series of isobars of almost circular or oval shape. The air descends from aloft to its center at the surface, and it becomes a circulation blowing out from the center. Compared to low pressure systems, in general, the high pressure systems move slower and are more sustainable. The high usually brings a slowly changing weather. Since highs and lows tend to be quasi-stationary, they are pronounced in a time-averaged weather map. There exist stationary highs and lows with large horizontal scale, such as the Siberian High and the Aleutian Low pressures observed during the winter, and the North Pacific High during the summer. On the other hand, there exist some migratory highs and lows propagating at considerable speed in the mid-latitude.



Isobar $\div 8$ = surface weather map
weather map

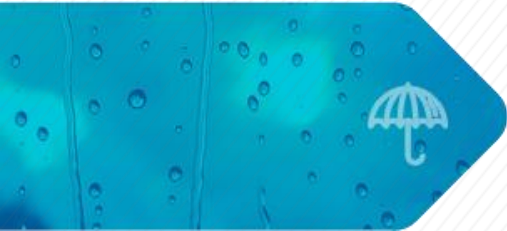
Stationary highs and lows

Some intensity changes are expected compared to those in the summer and winter.

〈Geopotential height at 1000 hPa averaged over 17 years〉

The proposed figure is the 17-year averaged geopotential height at 1000 hPa. Let's identify the stationary high and low mentioned above. Although the intensity of the pressure systems in summer would be differ from that in winter, it is still possible to locate stationary high and low pressure in Figure 1.

Contents



1. Blocking

Learning objectives

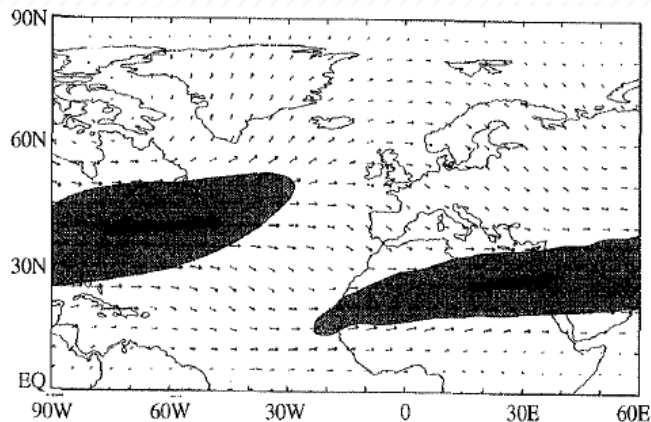


1. Describe the types and mechanism of blocking.

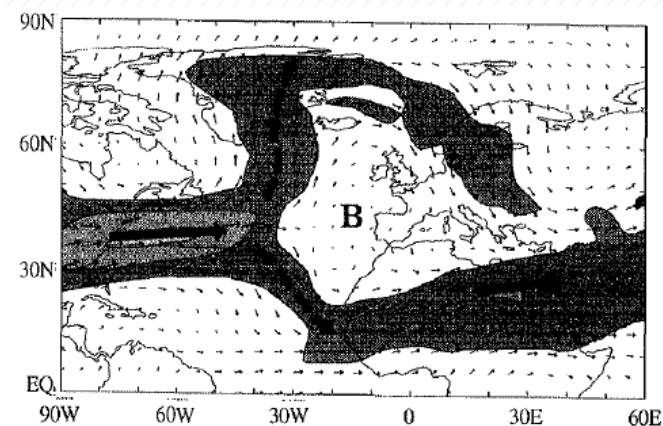
Learning Activities

1. Blocking

Blockings are quasi-stationary large-scale patterns in the atmospheric pressure field. They are also known as blocking highs. It has long-term variability. It was discovered for the first time in the early 1900s. Blocking, which tends to last more than a week, distorts the usual eastward progression of the mid-latitude system and causes a split in the westerly winds.



⟨Westerly wind in normal condition⟩



⟨Westerly wind with blocking high⟩

Learning Activities

1. Blocking

A typical example is shown in the figure. The figure on the left illustrates the structure of the westerly wind during normal condition, and the figure on the right shows the state when blocking occurs. In most cases, blocking high interferes with the westerly winds, so the highs and lows change their paths significantly.

Because the blocking phenomenon is mainly due to the strong nonlinearity of the atmospheric motion, it is challenging to accurately predict the genesis and growth. Therefore, it is one of the major factors that make extended-range forecast difficult.

According to the analysis of observation data, various factors influence on the blocking mechanism: nonlinearity, orographic effect, thermal effect, baroclinic wave, for example.

Blocking occurs in the upper troposphere of the Pacific and Atlantic mostly in winter and spring. The duration of the blocking can vary widely from a week to about 20 days.

Learning Activities

1. Blocking

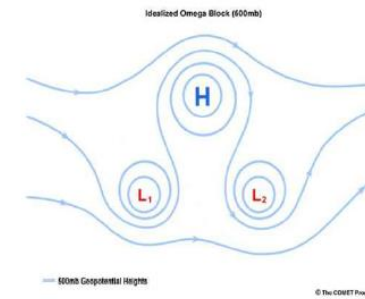
1) Structure of blocking

Although blocking is maintained by various factors, there are certain structures that appear frequently. Rex block is nearly symmetric to the north and south. Omega block resembles the Greek letter Omega and deflects the jet to northward.

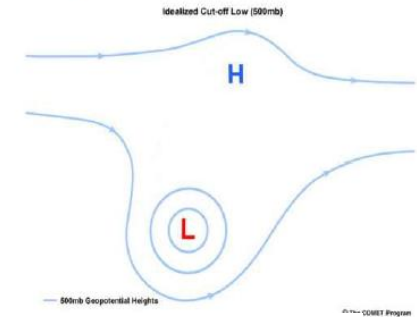
The figure shows various patterns of blocking. These patterns remain stationary for a long period in the upper-level.

As planetary waves gradually increase its amplitude by fluctuating north and south, they proceed with a cold low in the south and a warm high in the north as shown in the figure. These are called the cut-off lows and highs. As the amplitude of planetary waves increases, the propagation of shortwaves stops, so do the surface high and low pressure. This is called blocking.

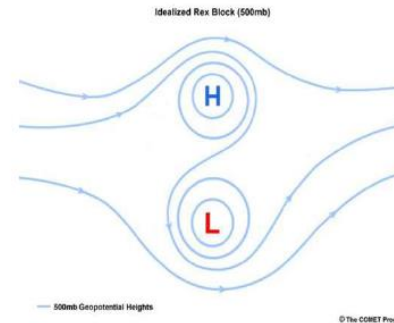
Omega Block



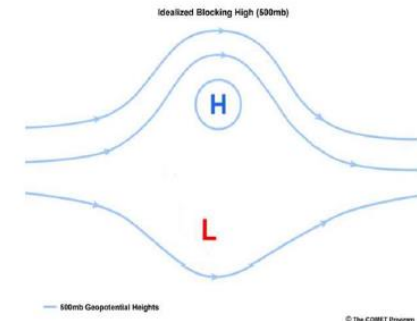
Cut-off Low



Rex Block

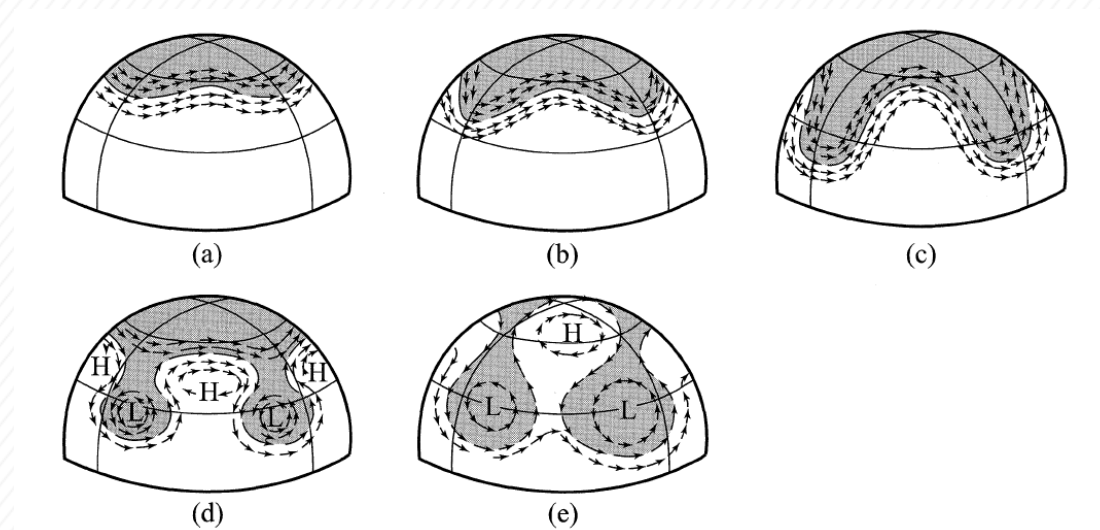


Cut-off high



Learning Activities

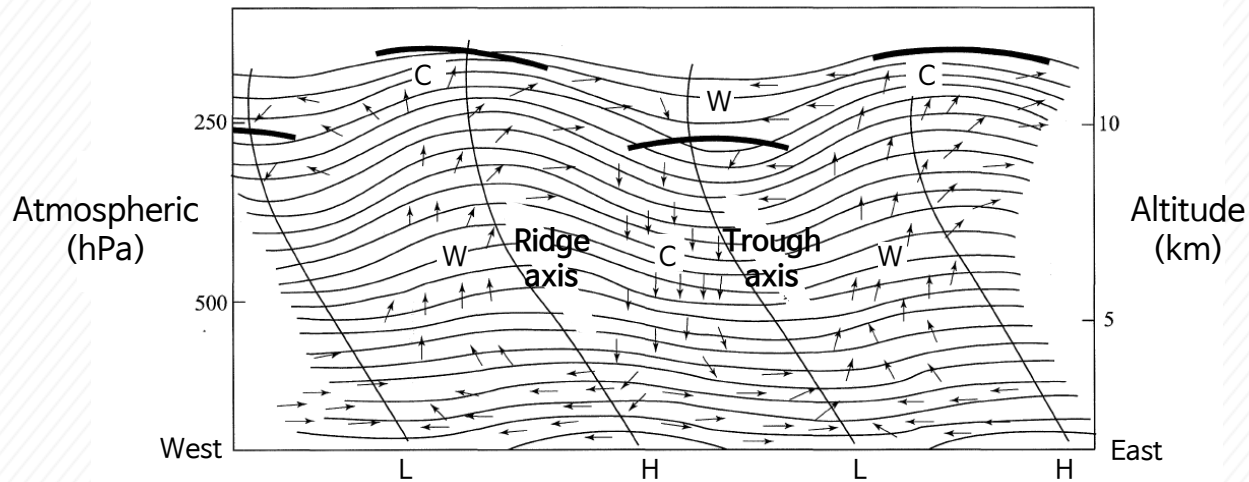
1. Blocking



Cold (heat) wave persists in the area corresponding to the trough (ridge) of the planetary wave. A widespread abnormal weather is caused by blocking. Cold low pressure on the low-latitude side becomes warm, and warm high-pressure on the high-latitude side becomes cold, and the westerly returns to its normal state. In other words, blocking is a form of heat exchange.

Learning Activities

1. Blocking



〈Idealized vertical cross-section of westerly〉

※ East-west vertical cross section for a developing synoptic disturbance with isobar (thin solid line), tropopause (thick solid line), and wind vectors (vector) (Ogura Yoshimitsu, 1984)

Upward (downward) motion can be found to the east (west) of the trough axis. Therefore, when the upper trough is approaching, the weather gets cloudy and rainy. The structure is westward tilted to satisfy the hydrostatic balance.

Summary

1. Blocking

- Blocking is a quasi-stationary large-scale pattern in the atmospheric pressure field. It has long-term variability.
- It tends to last more than a week, distorts the usual eastward progression of the mid-latitude system and causes a split in the westerly winds.
- Types of blocking are the Omega block, the cut-off highs and lows, and Rex blocks.