4－1－5　Blocking Anticyclones or“ Cut-off High ”

The “blocking phenomenon” is observed often in the Aleutian Sea area in winter. It is a phenomenon by which a “cut-off high” [Note No.2] produced in the upper air is located at the front of the extra-tropical cyclone and blocks the eastward migration of the cyclone. If its migration is blocked, the cyclone may, however, maintain its intensity. This results in rough seas for a prolonged period. Therefore, one should pay attention to the “blocking phenomenon” when drawing up a navigation plan to such areas (Fig. 18).

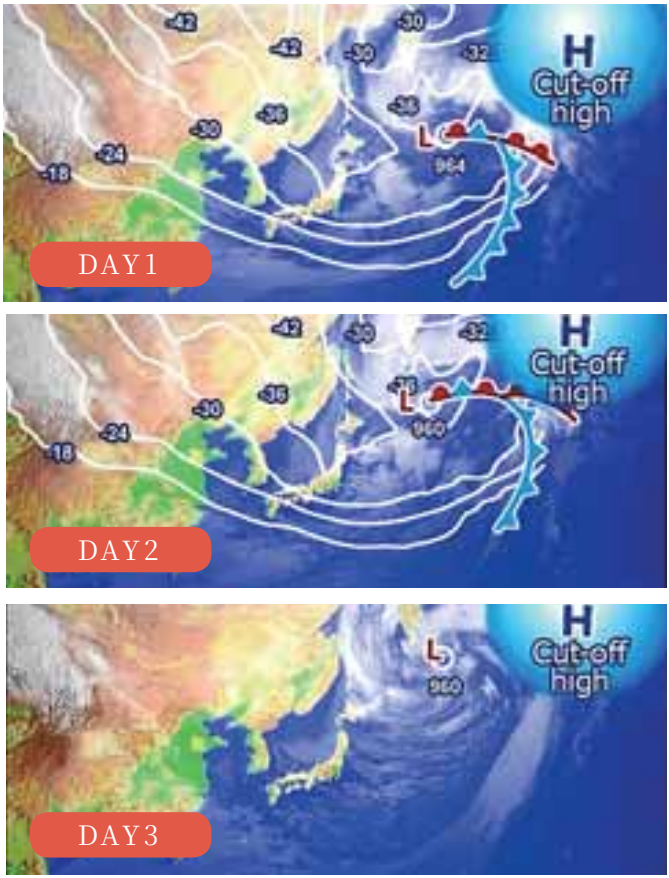

Fig. 18　Stationary low pressure, Japan Captains' Association, DVD

[Note No.2]

This is also referred to as " cut-off high " . A warm anticyclone in the upper air which is generated by the separation of the warm air at low latitudes and the high latitudes to the north, when the core located in the westerly belt of the upper air significantly moves south-northward. Normally, the blocking phenomenon occurs after a large stationary low pressure which seems to react with the ground, appears. The migration of the high or low pressure (as can be seen on a surface weather chart) normally moves to the east, carried by the westerlies. However, this phenomenon tends to detour south-north, accompanied by a back flow and so on, because the air is blocked at the west of the blocking anticyclone, and ascendant high pressure which penetrates the troposphere in the middle latitude stays in the area for a prolonged period. This is when cut-off high pressure most notably manifests in the upper-air (Fig. 19 From the Japan Meteorological Agency website).

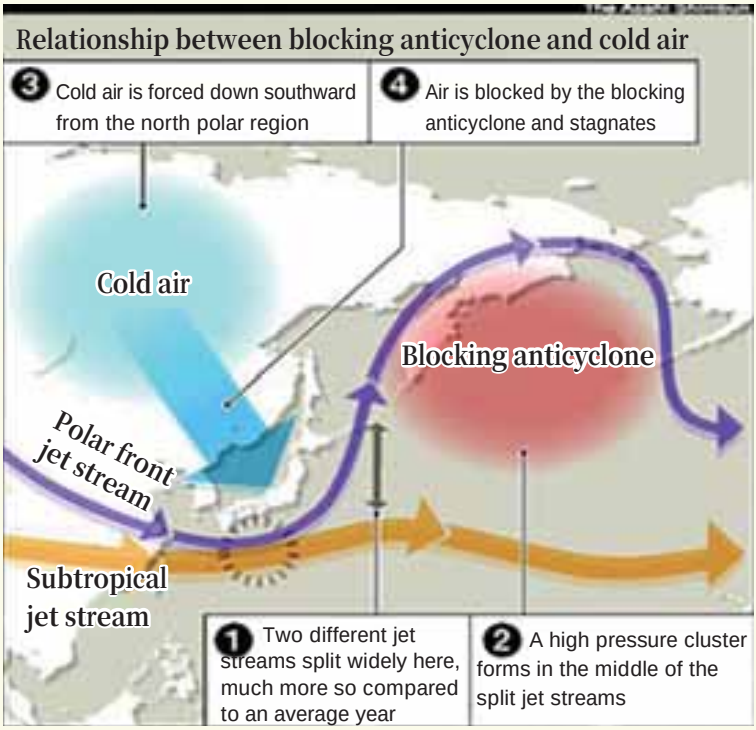

Fig. 19 Blocking Anticyclone From the Japan Meteorological Agency website

4−1−6 Low Pressure Rapidly Develops (Bomb Cyclone) (Figs. 20 and 21)

An extra-tropical cyclone which develops rapidly is referred to as a “bomb cyclone” in Japan. According to an encyclopaedia of meteorological science, the bomb cyclone is defined as “an extra-tropical cyclone that decreases its central pressure at more than 24hPa ×sin（φ）within 24 hours (Note: φ refers to latitudes)”. For instance, if the position is latitude 40° North, the air pressure will decrease more than 17.8hPa/24h per day.

Cyclones on the Japan Sea which have strong winds covering a wide area in early spring, have low pressures which rapidly develop close to Northern Japan along with other low pressures that rapidly develop in the east of Japan or off the coast near Chishima in winter, are known as bomb cyclones. Today, however, the Japan Meteorological Agency does not use the term, because the word “bomb” is not appropriate, thus it is replaced by “rapidly developing low pressure” instead.

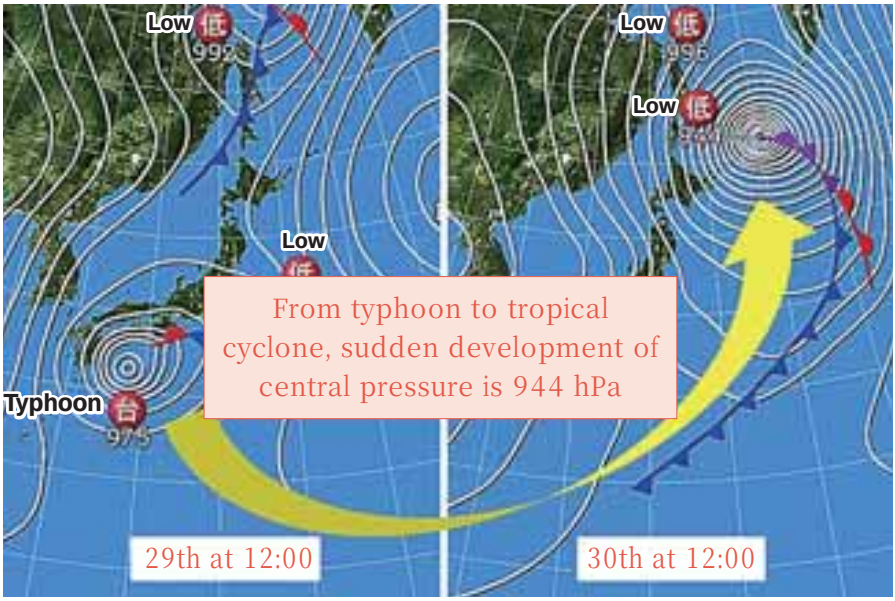

Fig. 20 From the Japan Weather Association

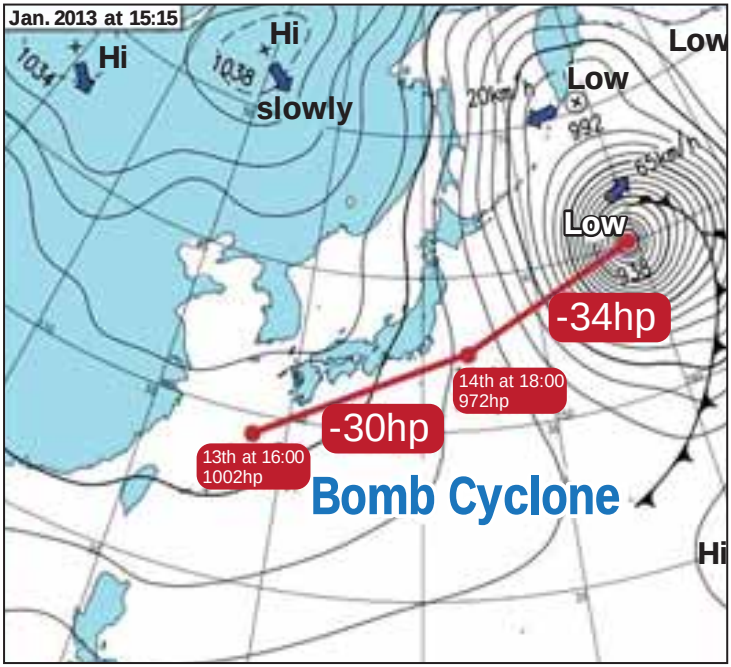

Fig. 21 From the Japan Meteorological Agency website

Regarding these types of cyclones, since they can cause rough weather and sea conditions to be worse than expected, in order to safeguard one's ship, close attention must be paid to them.

4－2　Tropical Cyclones and Typhoons

4－2－1　Classification and Naming of Extra-tropical Cyclones

Tropical cyclones refer to cyclones generated in tropical or subtropical waters, and the generation of which requires a continuous supply of water vapour energy. Therefore, tropical cyclones are formed in sea areas where sea surface temperatures exceed 26 degrees Celsius. Generally, this means tropical cyclones are formed in sea areas between 5 and 20 degrees latitude, excluding equatorial waters (Figs. 22 and 23).

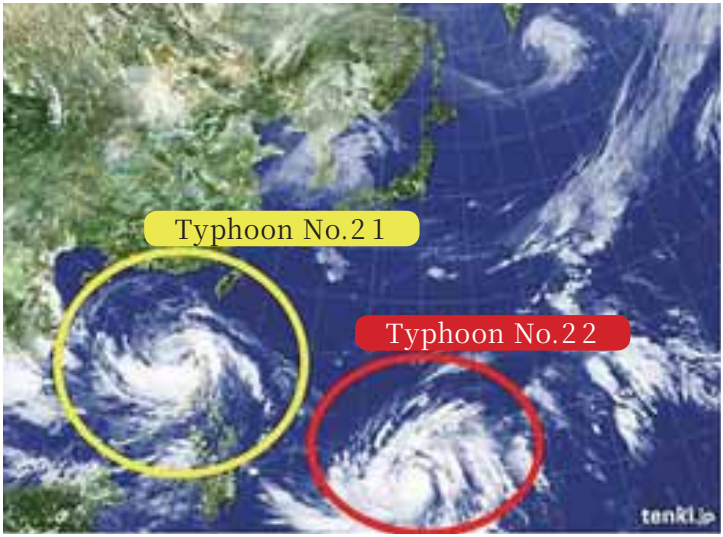

Fig. 22　From the Japan Weather Association

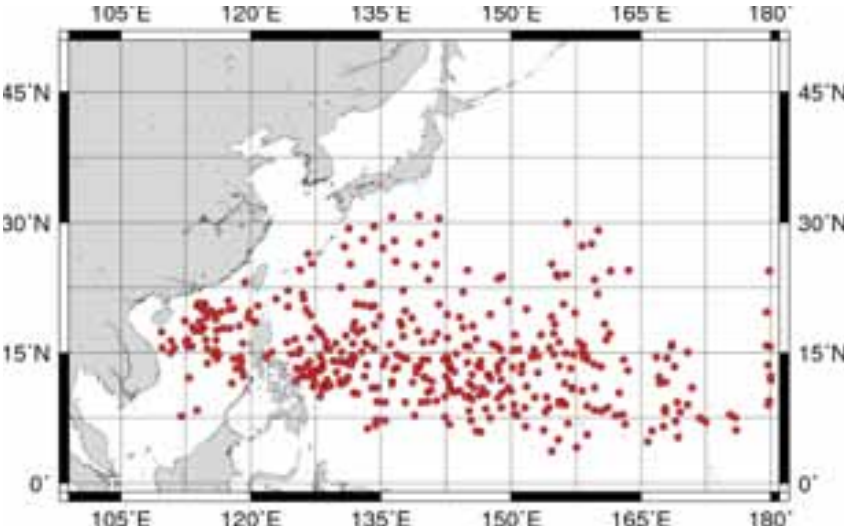

Fig. 23　From the Japan Meteorological Agency website

Extra-tropical cyclones are internationally classified into four categories according to the maximum wind speed as shown in Fig. 24.

International Tropical Storm Classification

Symbol		TD	TS	STS	T
Classification		Tropical Depression	Tropicl Storm	Severe Tropical Storm	Typhoon
Max Eind (m/sec)	(m/sec)	～17.1	17.2～24.4	24.5～32.8	32.7～
	Knots	～33	34～47	48～63	64～
Beaufort Scale (Wind Speed)		～7	8～9	10～11	12～
East Pacific Ocean and Caribbean Sea		Tropical Depression	Tropicl Storm	Severe Tropical Storm	Hurricane
Japan (Japan Meteorological Agency)		Extra-tropical Cyclone	Taifu ＊(Typhoon)		
Indian Ocean and South Pacific Ocean		Tropical Depression	Cyclone		

Fig. 24　Classification of Extra-tropical Cyclones

As can be seen in the chart, those that have the maximum wind speed of more than 64kts (32.7m/sec) and can be found in the western part of the North Pacific Ocean are called Typhoons, while those that exist in the eastern part of the North Pacific Ocean in the vicinity of the Caribbean Sea are referred to as Hurricanes.

*In Japan, those that have a maximum wind speed of more than 34kts (17.2m/sec) are called Taifu (Typhoon). In the Indian Ocean and the western South Pacific, they are referred to as “cyclones”. In general, they are called tropical cyclones (Fig.25).

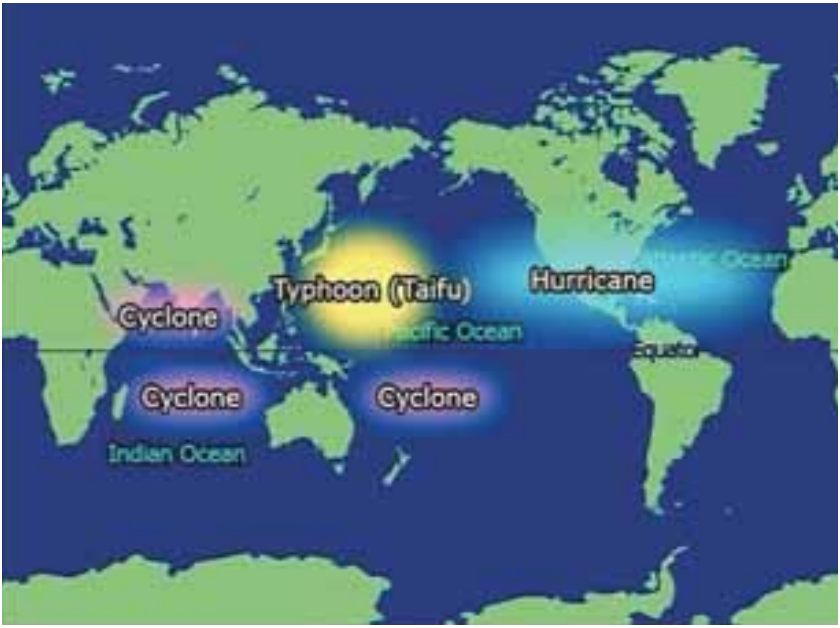

Fig. 25 The Naming of Extra-tropical Cyclones Japan Captains' Association,

4—2—2 The Generation Mechanism of Extra-tropical Cyclones

Northeast and southeast trade winds in the northern and southern hemispheres blow into the equatorial area and form a trough (Figs. 26 and 27).

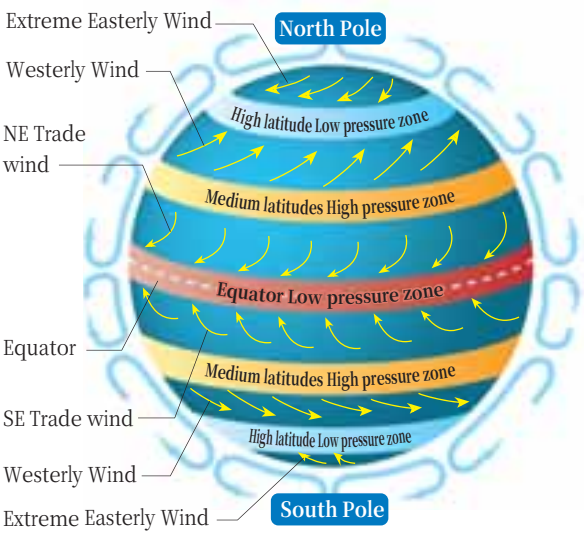

Fig. 26

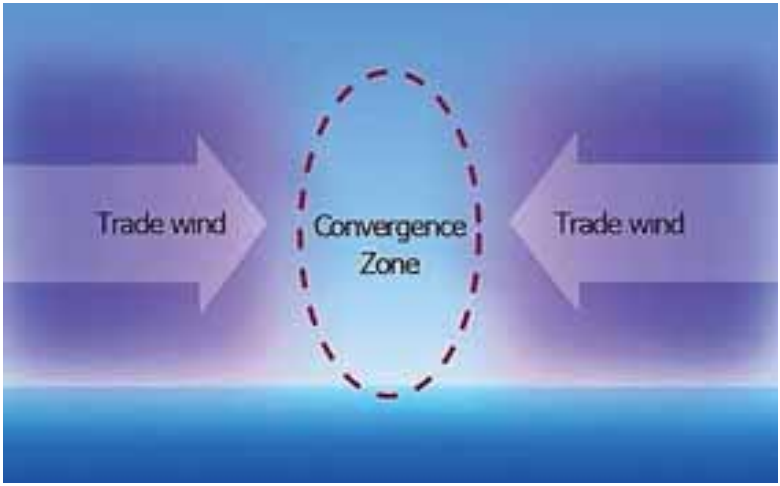

Fig. 27 Japan Captains' Association, DVD

This trough is known as an "equatorial trough" or "Intertropical Convergence Zone" (ITCZ). This TCZ usually migrates westward while undulating north to south. When this undulation becomes unstable and increases, it forms an eddy that generates a tropical cyclone (Fig. 28).

Fig. 28 Japan Captains' Association, DVD

The potential energy of extra-tropical cyclones can be generated by the difference between the temperatures of those air masses. This energy source for a tropical cyclone is the latent heat from a continuous supply of water vapour that is discharged when humid air rises, is cooled, and then condensed into droplets. (See Note:1 on P.7)

In other words, when humid air near a sea happens to start rising (Fig. 29), especially because it tends to become an updraft as the cyclone converges in the ITCZ, once the water vapours start condensing, cumulus and cumulonimbus clouds are produced (Fig. 30).

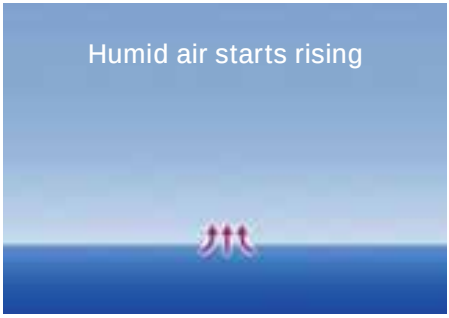

Fig. 29 Japan Captains' Association, DVD

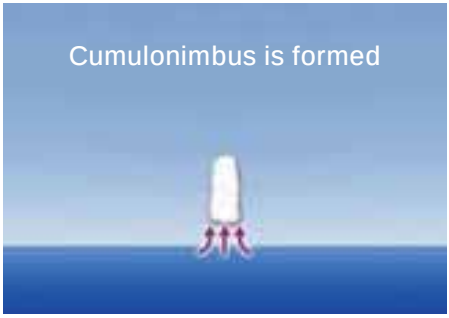

Fig. 30 Japan Captains' Association, DVD

Because of the emission of latent heat, the temperature increases, compared with the region without clouds. Then, the rising warm air becomes less dense than the surrounding atmosphere, as it continues to rise. This lowers the central atmospheric pressure of the tropical cyclone and keeps the cyclone developing. In these unstable atmospheric conditions, several cumulonimbus clouds of approximately 10 km in scale form horizontally (Fig. 31) and these effects produce tropical cyclones exceeding approximately 100 km in scale horizontally (Fig. 32).

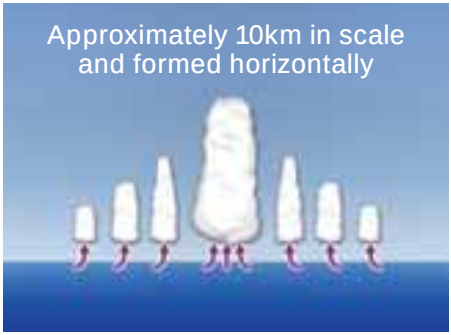

Fig. 31 Japan Captains' Association, DVD

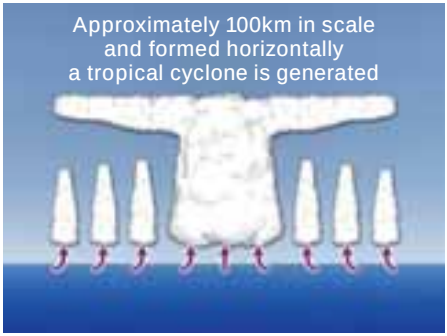

Fig. 32 Japan Captains' Association, DVD

Tropical cyclones produced in tropical waters can develop into typhoons (shown in Table 24), if the maximum wind speed within the area develops to exceed 34 kts (17.2m/sec) under the Japanese classification. As to what kinds of cloud mass can develop into typhoons is still yet to be revealed. However, since it is understood that the energy source of a typhoon comes from sea water surface vapour, it follows that the higher the temperature at an area where the typhoon begins, the stronger the typhoon will be. In addition, for a strong typhoon to develop, it needs to pass an area of sea where the seawater temperature is more than 28 degrees centigrade.

On the contrary, if a typhoon reaches an area of sea that is less than 28℃ (or less than 26℃ to be exact) or ends up on land, it will start to weaken because of the typhoon's energy excretion. Later, it attenuates and the extra-tropical cyclone finally decays.

Fig. 33 Photograph Image (not Typhoon generated)

4－2－3 Structure of Extra-tropical Cyclones

Typhoons are huge atmospheric eddies with diameters ranging between hundreds to thousands of kilometres. Inside the eddy, strong updrafts form cumulonimbus. The "eye of a typhoon" is formed by a downdraft at the centre of the typhoon, and the heaviest rain and strongest wind occur below the "eye wall." On the other hand, in the vicinity of the tropo-pause above the eye of the typhoon, an eddy of cirrus clouds is formed that flows outward clockwise due to the Coriolis' force which is formed as a result of the earth's rotation (Figs. 34 and 35) .

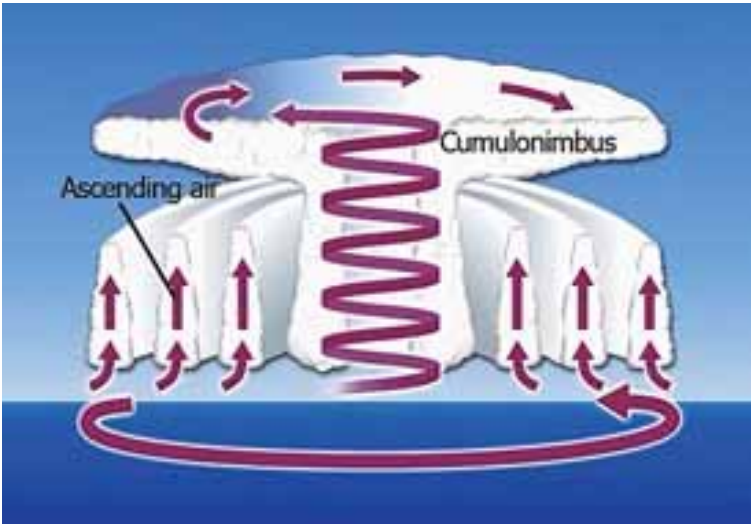

Fig. 34 Japan Captains' Association, DVD

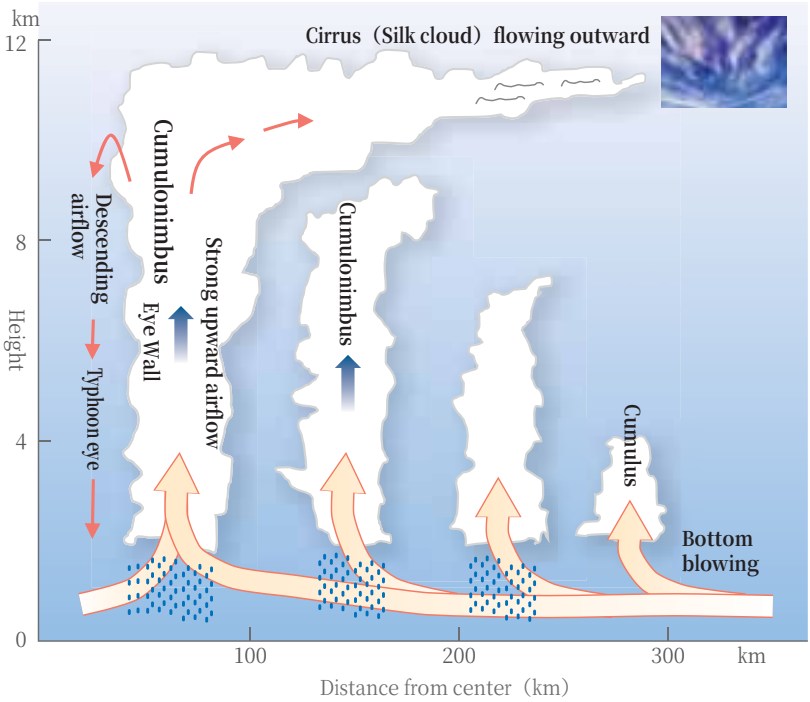

Fig. 35 Cross-sectional diagram of a typhoon

"The spiral cumulonimbus band" extending from the centre of a typhoon is known as the spiral band. Within the spiral band, strong wind and heavy rain are generated by the strong general air flow of the typhoon and strong downdrafts derived from huge cumulonimbus. Attention should be paid to this weather condition and poor visibility (Figs. 36 and 37).

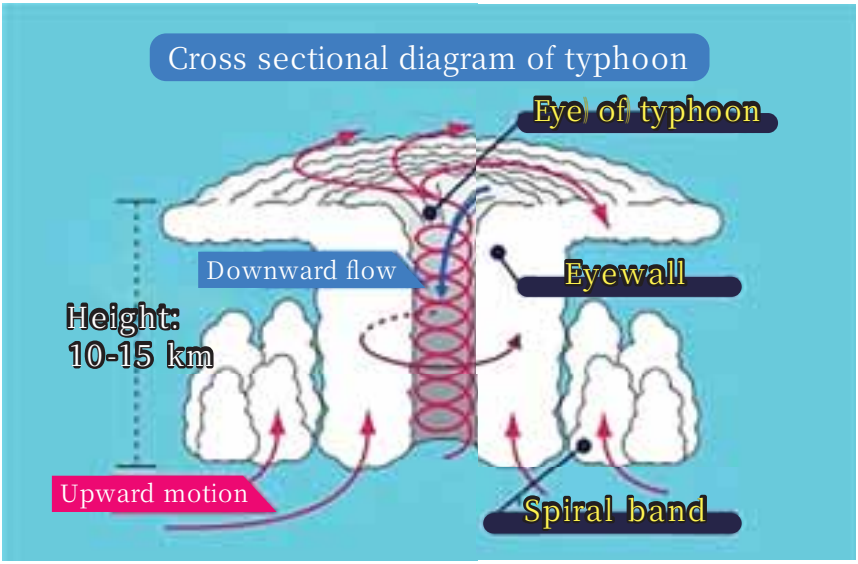

Fig. 36 From the Japan Meteorological Agency website

Fig. 37 Japan Captains' Association, DVD