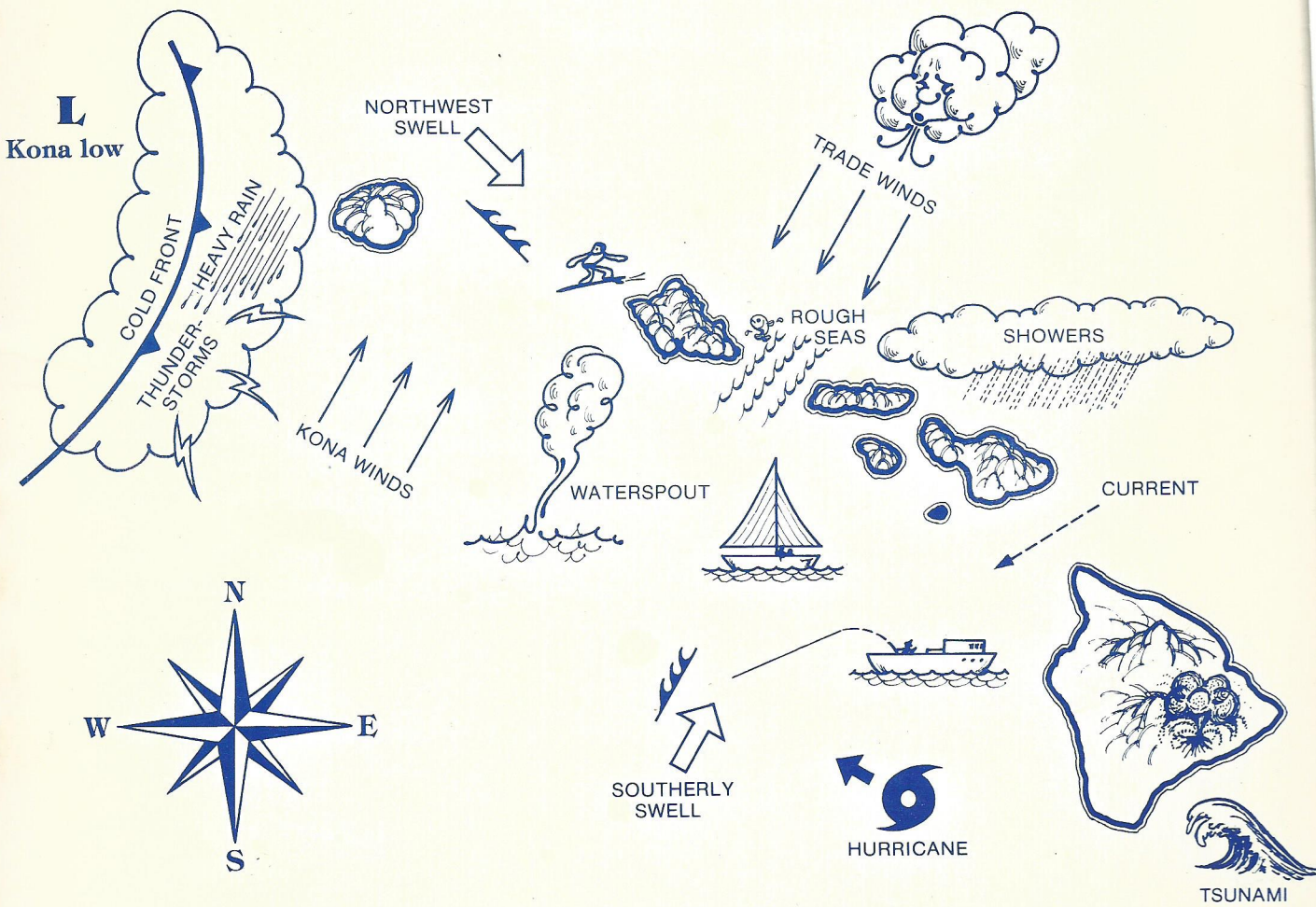


WEATHER IN HAWAIIAN WATERS



Paul Haraguchi

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PACIFIC WEATHER, INC.
HONOLULU, HAWAII

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Fortunately, these damaging Kona winds are not common in Hawaii, especially since 1970. Before 1970, these strong winds were more common occurring about once in two or three years during the "winter" months of November through April. Now, these winds are not as frequent - occurring only once since 1970. This is not to say that this infrequency of strong Kona winds will continue forever. Lighter non-damaging Kona winds are more common - occurring about two to five times almost every winter.

THUNDERSTORM WINDS

A thunderstorm is a local storm produced by the further growth of a cumulonimbus cloud. It is exceptionally dense and vertically developed and appears as a cloud mountain. The thunderstorm is always accompanied by lightning and thunder. Lightning is the discharge produced when differences in ground and atmospheric charges are large enough. Usually, the more lightning observed in a thunderstorm, the more intense the storm. Thunder is the sound produced by expansion of air heated by the lightning stroke. The distance in miles to the lightning flash can be estimated by counting the number of seconds between lightning and thunder, and dividing by five. For example, the observer counts 10 seconds between the lightning flash and the sound of thunder. Then, the distance from the lightning to the observer is 10 divided by 5, or 2 miles away.

In addition to the lightning, heavy rains, strong downdraft winds and sometimes hail and waterspouts are the other weather hazards in a thunderstorm. Hail is precipitation in the form of lumps of ice, called hailstones. Because hail formation requires strong updrafts inside the cloud, the larger the hailstones, the more intense the storm.

Thunderstorms normally occur and move in straight or spiral lines. At any given time, over an area, the thunderstorms are at varying life-cycle stages. In the first stage of thunderstorm development, an updraft drives warm air up beyond the condensation level forming clouds. As the updraft continues, air flows in through the cloud's sides in a process called entrainment. The updraft is further aided by a chimney effect produced by high winds at the top of the cloud carrying away the ascending air. Vertical development of the cloud is further aided by heat energy released by condensing water vapor into liquid water in the rain-making process. Rain and snow begin to fall within the cloud in sufficient quantity against the updraft and a downdraft begins. The downdraft is strengthened by addition of entrained air and by evaporational cooling. The cold downdraft air rushing down and out of the thunderstorm signals the most violent phase. The thunderstorm unleashes its lightning, heavy rains, high downdraft winds, and sometimes hail or waterspouts. But even as the worst is occurring, the storm has begun to die. The downdraft cuts

off the life- created by the converging low-level winds and the thunderstorm loses its source of moisture and heat energy. Precipitation weakens and the downdraft stops - and the thunderstorm dies.

The life cycle of a thunderstorms is short - less than two hours, The single thunderstorm cell is only a few miles in diameter and usually travels with the prevailing wind flow.

Figure 17 depicts the mature thunderstorm.

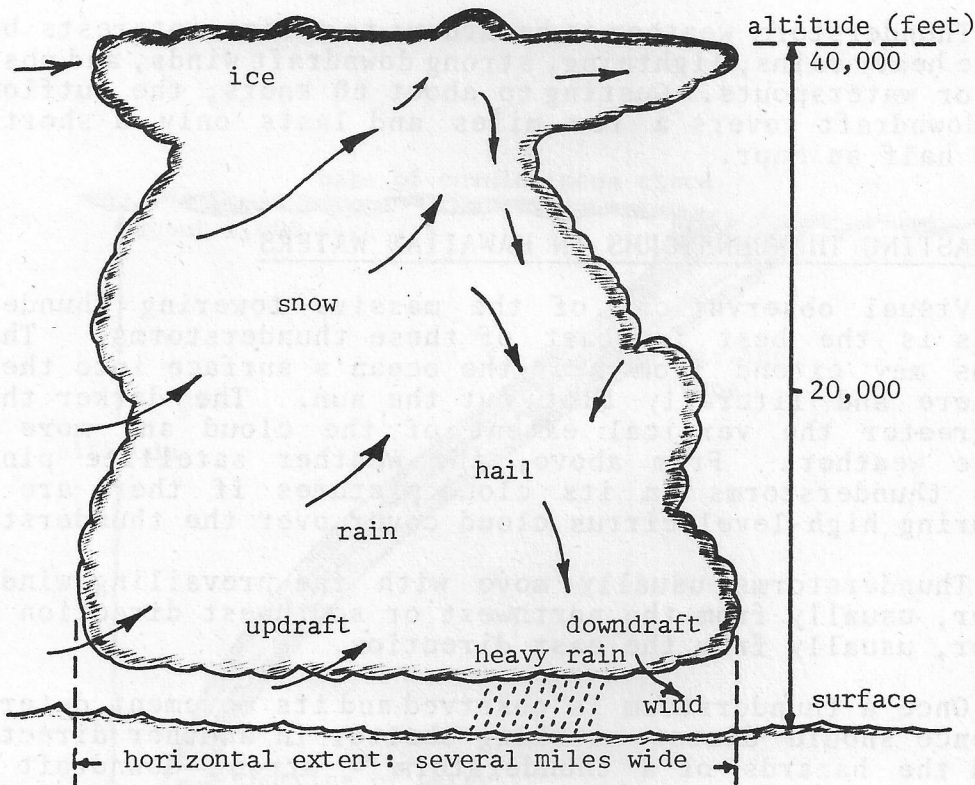


Figure 17. The mature thunderstorm. This is the most violent stage in the life cycle of the thunderstorm. Lightning, hail, heavy rain, high wind and possible waterspout are unleashed during this stage.

THUNDERSTORMS IN HAWAIIAN WATERS

Thunderstorms are not common - usually associated with cold fronts, Kona lows or upper troughs during the "winter" months of October through May. Tropical systems, such as tropical cyclones or areas of enhanced cloudiness associated with "easterly waves" during the summer months may also have embedded thunderstorms in their westward moving clouds.

The frequency of "thunderstorm days" in Hawaiian waters is very low - on a monthly average - one to three days a month during the "winter" months and none to one day a month during the rest of the time. Thunderstorms during the winter season mainly occur in the waters north of Hawaii Island. In the opposite season, the reverse is true most of the time - thunderstorms affect the waters around Hawaii Island, especially off East Hawaii.

Thunderstorm weather is hazardous to marine interests because of the heavy rains, lightning, strong downdraft winds, and possibly, hail or waterspouts. Gusting to about 60 knots, the outflow from the downdraft covers a few miles and lasts only a short time - about half an hour.

FORECASTING THUNDERSTORMS IN HAWAIIAN WATERS

Visual observations of the massive towering thunderstorm clouds is the best forecast of these thunderstorms. Thunderstorms may extend from near the ocean's surface into the stratosphere and literally blot out the sun. The darker the sky, the greater the vertical extent of the cloud and more likely severe weather. From above, the weather satellite pinpoints these thunderstorms in its cloud pictures if there are little obscuring high-level cirrus cloud cover over the thunderstorms.

Thunderstorms usually move with the prevailing winds - in winter, usually from the northwest or southwest direction and in summer, usually from the east direction.

Once a thunderstorm is observed and its movement determined, prudence should dictate seeking shelter in another direction to avoid the hazards of a thunderstorm - strong downdraft winds, heavy rain, lightning and possibly hail or waterspouts.

WATERSPOUTS

Waterspouts are local storms of small diameter, formed of rotating winds, usually in a counter-clockwise direction, at very high speeds. A waterspout and a tornado are one of the same - only the name is different. The funnel is named a waterspout if it is over water and called a tornado if it is over land. In the case where a waterspout moves inland, it is called a waterspout-tornado. These short-duration severe storms develop from the base of heavy cumulonimbus or thunderstorms and extend downward toward the sea. As condensation occurs around the whirling vortex, the funnel of the waterspout become visible. (see figure 18.)

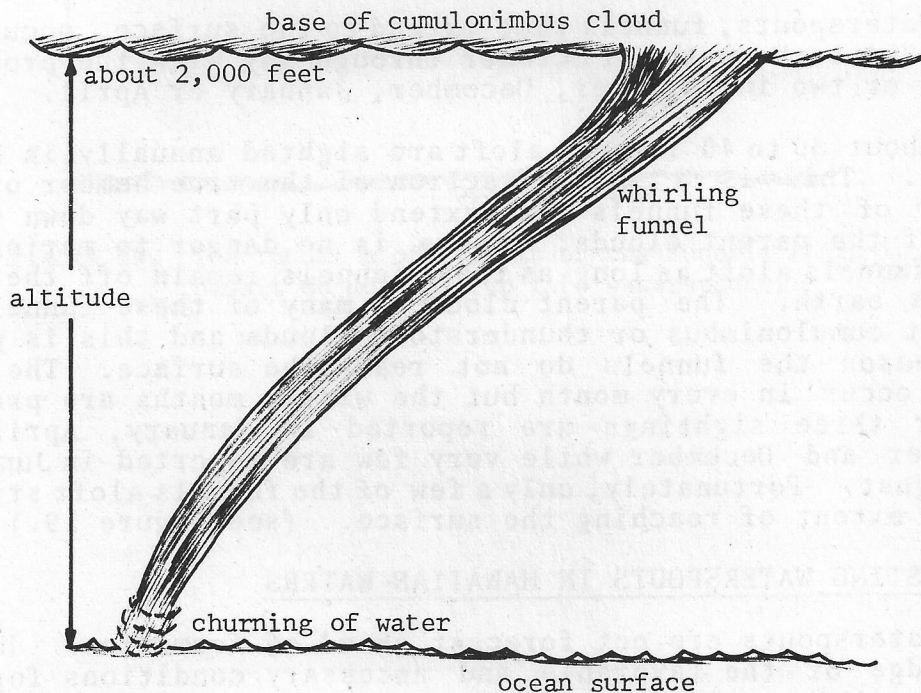


Figure 18. The mature waterspout. The whirling funnel extends down to the ocean surface from the cumulonimbus cloud.

WATERSPOUTS IN HAWAIIAN WATERS

The Hawaiian variety of waterspouts is usually a milder version of the severe tornado of the midwest United States where it is feared for its devastating winds. Most of the waterspouts in Hawaiian waters do not pack the devastating winds over a long path. But a few of the waterspout-tornados have had very strong winds that caused severe damage to property. The few waterspout or tornado damages studied indicate destructive wind speeds of over 100 mph. Every waterspout has to be treated as though it will be severe, although most waterspouts in Hawaiian waters spin away harmlessly over the open water and cause no damage to property.

The course of the waterspout is a straight line in the same direction as the prevailing wind flow. The favorite formation of the destructive waterspout is from the cumulonimbus or thunderstorm cloud in the convergence of the Kona wind. Its movement would then be towards the northeast in the flow of the Kona wind. The path of destruction is narrow - 50 to 300 feet wide and usually less than a mile long. Its speed of travel is faster than a boat. Severe weather of a thunderstorm occurs together with a waterspout.

Waterspouts, funnels that extend to the surface, occur mainly in the "winter" months of October through May with the probability of one or two in November, December, January or April.

About 30 to 40 funnels aloft are sighted annually in Hawaiian waters. This is a small fraction of the true number of occurrences of these funnels that extend only part way down from the base of the parent clouds. There is no danger to mariners from these funnels aloft as long as these funnels remain off the surface of the earth. The parent cloud of many of these funnels aloft are not cumulonimbus or thunderstorm clouds and this is possibly the reason the funnels do not reach the surface. The funnels aloft occur in every month but the winter months are preferred. Two or three sightings are reported in January, April, May, November and December while very few are reported in June, July, and August. Fortunately, only a few of the funnels aloft strengthen to the extent of reaching the surface. (see figure 19.)

FORECASTING WATERSPOUTS IN HAWAIIAN WATERS

Waterspouts are not forecast ahead of formation. However, knowledge of the favorable and necessary conditions for severe waterspout formation can ensure avoidance of these local storms. Severe waterspouts do not form in a clear sky or from fair clouds. Development from the base of a cumulonimbus or thunderstorm cloud is necessary. These parent clouds mainly develop in the convergence in the basic southwesterly wind flow ahead of a cold front or in the southwest wind flow of a Kona low or an upper level trough. The safety rule is simple - avoid bad weather cumulonimbus or thunderstorm clouds and waterspouts can also be avoided.

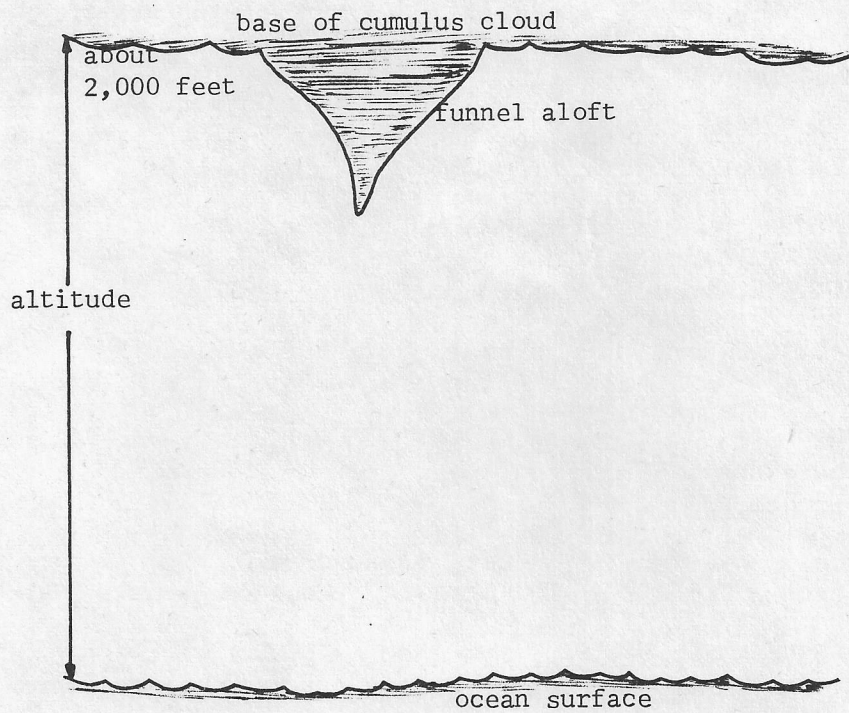


Figure 19. The funnel aloft. Most of the funnels aloft in Hawaii do not develop into waterspouts.