1977

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D O W N B U R S T

by

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Prepared for

30TH ANNUAL INTERNATIONAL AIR SAFETY SEMINAR

September 17-22, 1977, Ottawa, Canada

Downdrafts inside and beneath thunderstorms were conceptually described as early as 1884. A need for basic research on thunderstorm circulation arose as air traffic increased during the early 1940s. The Thunderstorm Project which operated in Florida and Ohio in 1946 and 1947, respectively, clarified the nature of downdrafts in clouds as well as in subcloud layers.

The three accidents which occurred at JFK, Denver, and Philadelphia International Airports in 1975 and 1976. have brought out the extreme hazard of intense downdrafts at approach and at climb-out levels in thunderstorms. Since then, I have made aerial surveys of trees and vegetation after the passage of severe thunderstorms in various parts of the United States. It was found that trees were often blown down outward from locations where downdrafts of extreme intensity descended all the way to the ground.

I have proposed that a downdraft be called a "downburst" if it induces damaging winds on the ground. If there are no damaging winds on the ground, the downdraft remains in the air and one does not know of its existence unless one flies through it. Likewise, a funnel cloud is harmless as long as it remains in the air away from aircraft. When the swirling motion reaches the ground, causing damaging winds, a funnel cloud is called a "tornado". Thus, downbursts and tornadoes can be compared on the basis of their damaging winds on the ground.

CHARACTERISTIC AIRFLOW (in and around storms)	HORIZONTAL WINDSPEEDS ON THE GROUND (less than 40 mph)	(more than 40 mph)
Divergent and outward without rotation	DOWNDRAFT	DOWNBURST
Convergent and inward with rotation	FUNNEL ALOFT	TORNADO

How strong can the intensity of downbursts be? So far, there is no theory by which the maximum intensity can be computed or estimated. In 1971 I devised the F-scale specifications of tornado damage shown in Figure 1. Since then one or two F5 tornadoes have been reported each year in the United States. Typical tree damage by a tornado is shown in Figure 2.

The Independence Day Downbursts of Northern Wisconsin, this year, have changed the expected intensity of a downburst from weak to intense. A downburst could be as strong as F2 (see Figure 3).

The estimated intensity of the JFK downburst is only F0. However, a downburst of F0 category might be the most dangerous one for air traffic, because most airports will be closed during F2 downbursts, such as in the case of the Northern Wisconsin storms.

Apparently, downbursts are occurring more often than one had expected. Now, experienced meteorologists are able to spot from low-flying aircraft the signatures in fields disturbed by a tornado (Figure 4) or by a downburst (Figure 5).

It is my desire to pursue research on both downbursts and tornadoes in an ultimate attempt to minimize accidents and damage related to severe local storms.

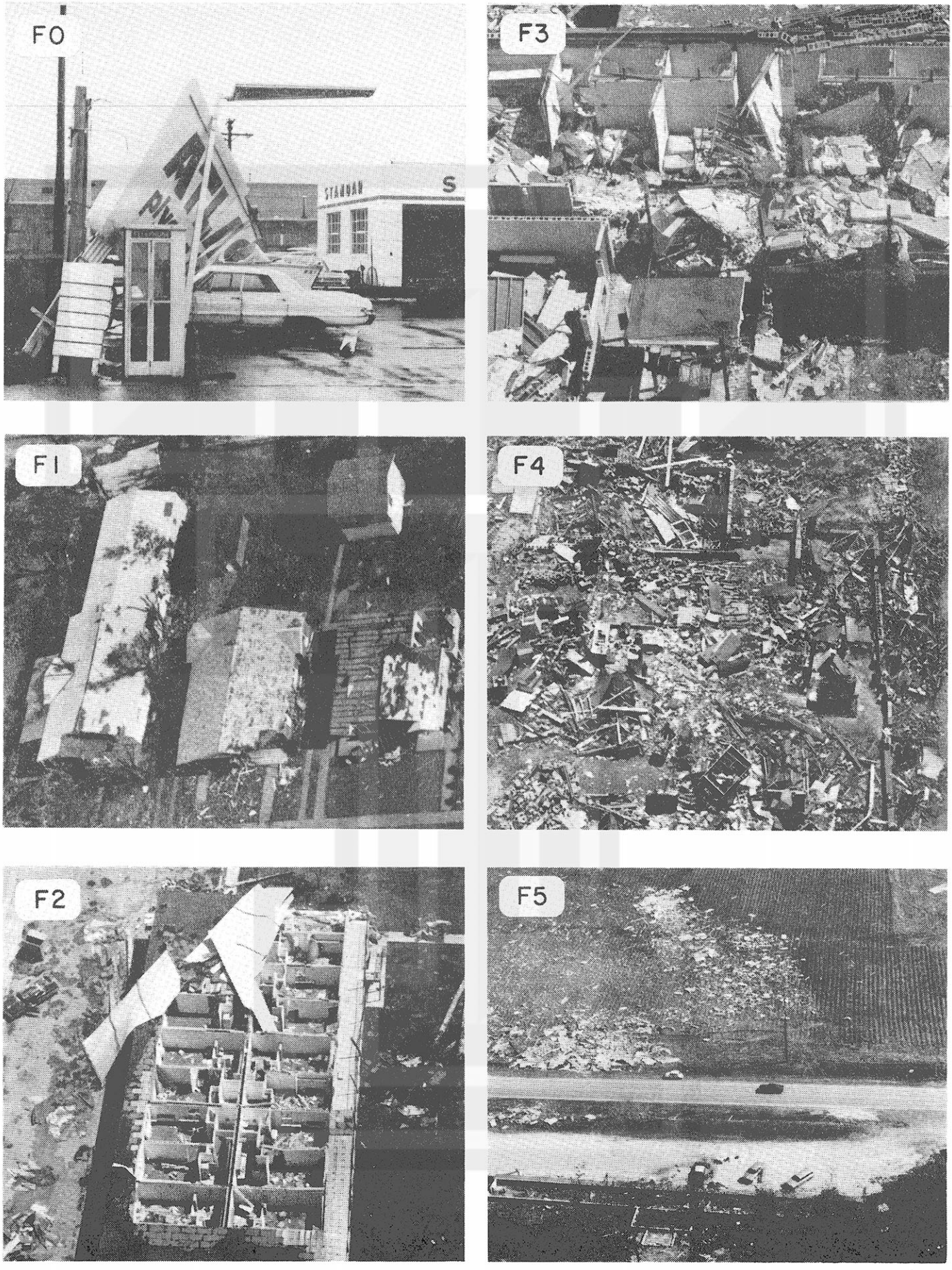

Figure 1. Fujita-scale damage specifications. F0 (40-73 mph), F1 (73-112), F2 (113-157), F3 (158-206), F4 (207-260), F5 (261-318), F12 (661 to Mach 1).

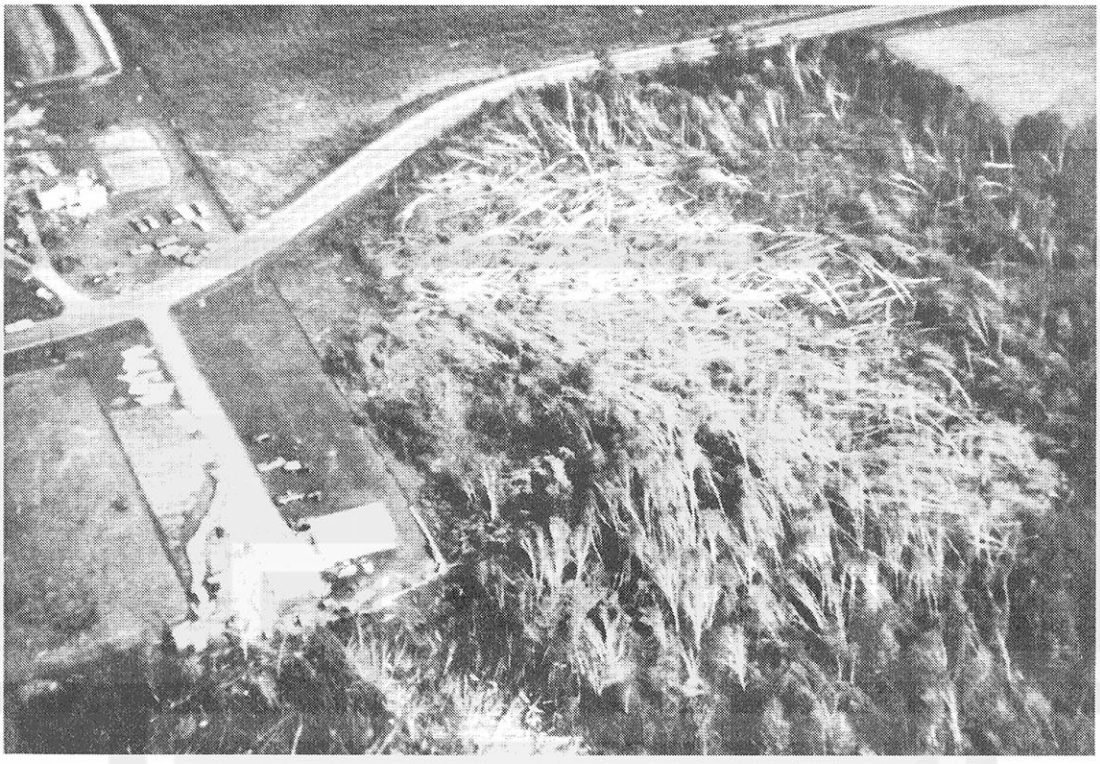

Figure 2. Trees blown down by a tornado (F 2). Photo by Stiegler.

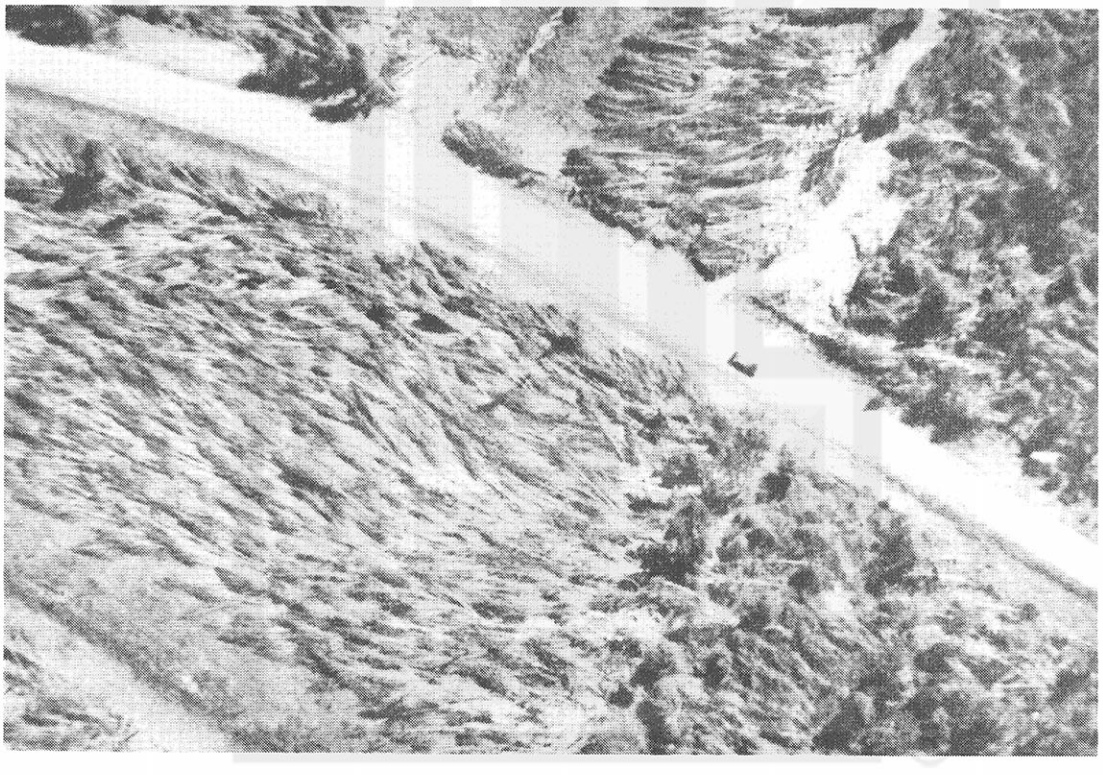

Figure 3. Trees blown down by a downburst (F 2). Photo by Fujita.

Figure 4. Swirling patterns in a cornfield left behind by a tornado. Photo by Fujita.

Figure 5. Diverging patterns in a cornfield left behind by a downburst. Photo by Wakimoto and Forbes.