

How We Stopped Airplanes Falling From The Sky

Solving the Windshear Problem

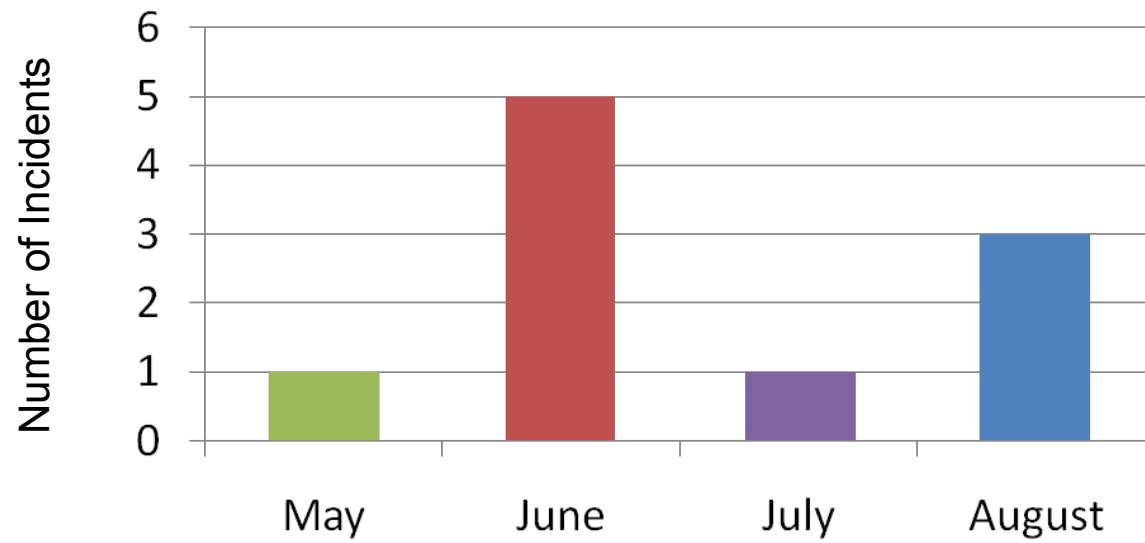


NCAR 50th Anniversary Presentation
Rita Roberts, Jim Wilson, Robert Marfuta

Changes in Wind Speed or Direction
Along Flight Path Can Be Catastrophic

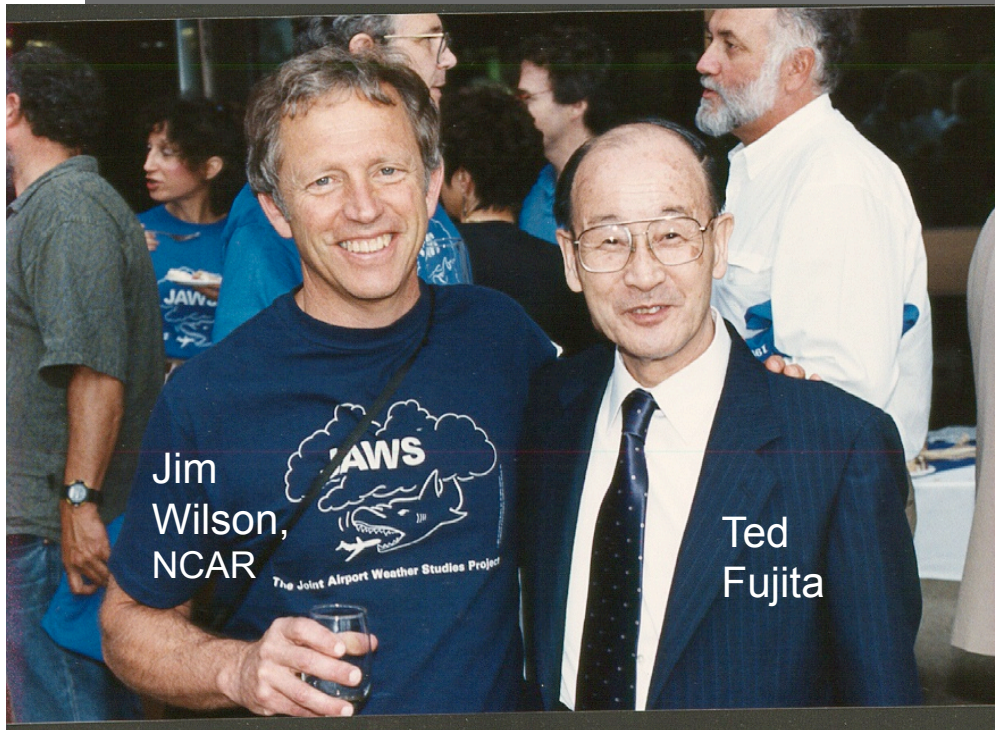


Frequency of Accidents Caused by Wind Shear (1975-1985)*



*Accidents occurred about every 18 months.

?? In the 1970s not much was known about Wind Shear.... ??



1975 Eastern Airlines Flight 66 crashed in New York

122 passengers and crew died in the crash

Dr. Theodore “Ted” Fujita at the University of Chicago was asked to investigate the mysterious winds that caused the crash.

Fujita had conducted detailed analyses of wind patterns following the bombing of Hiroshima, and later, for many tornadic events.



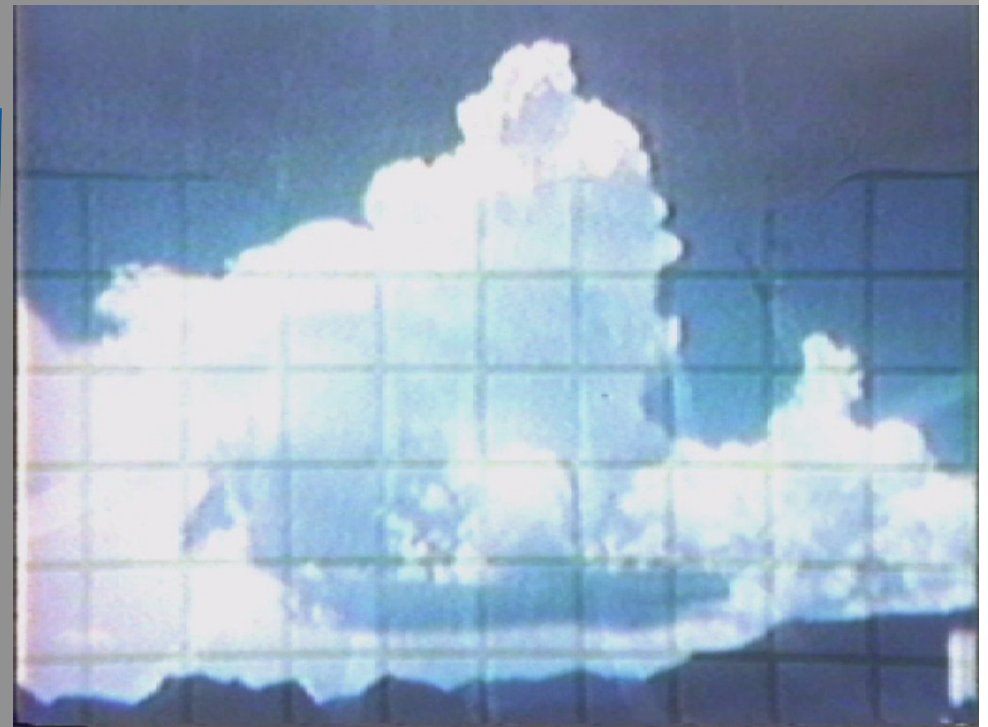
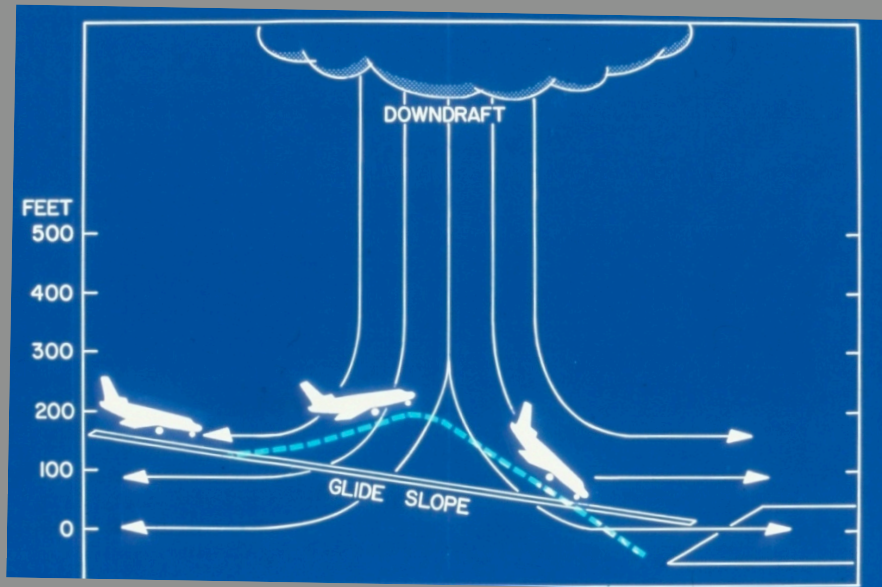
Fujita's Conclusion:

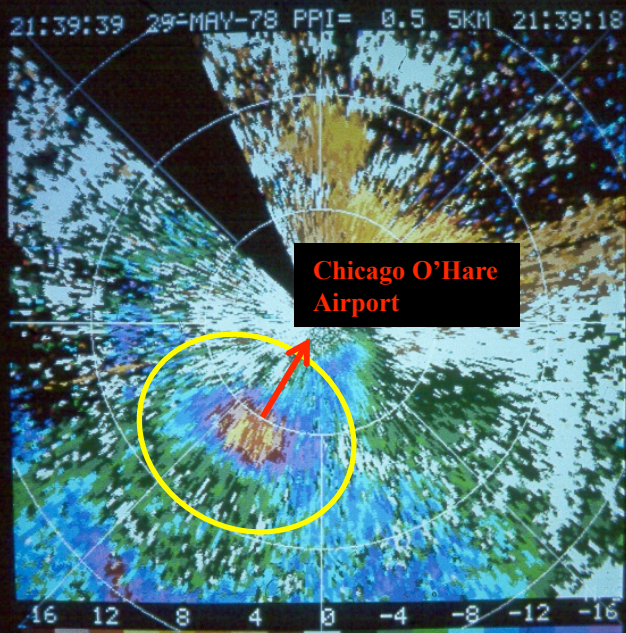
Eastern Flight 66 Crash was caused by strong **wind shear**.

He called this type of wind shear a **Downburst or Microburst.**

WIND SHEAR:

**SUDDEN CHANGE IN
SPEED OR DIRECTION
RELATIVE TO AN
AIRCRAFT**





Discovered extremely high winds (35 knots) near the ground over a very small (10 km) distance

Approaching O'Hare airport

A few downbursts were detected by radar during NIMROD, but it was still considered a very rare event....

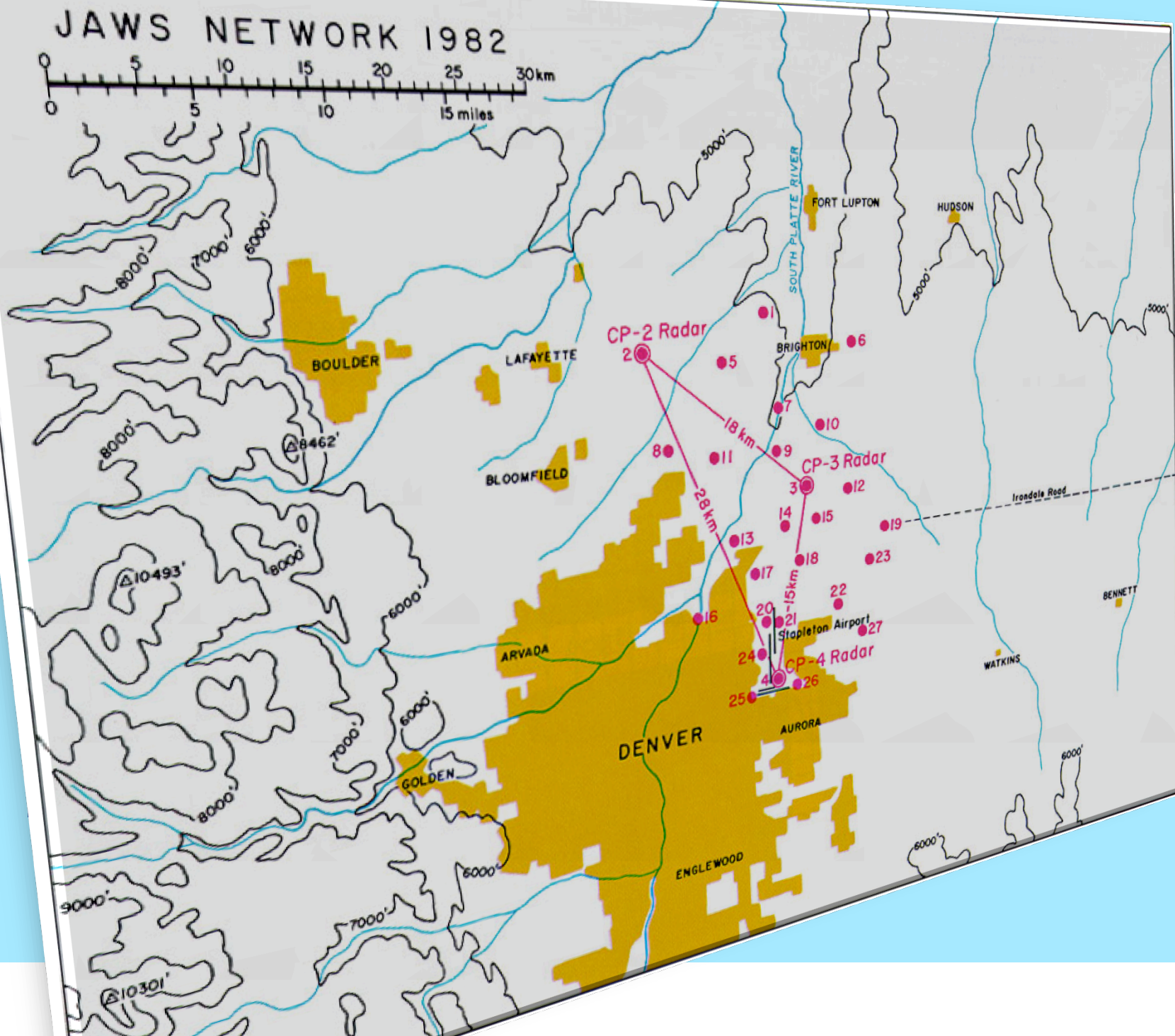
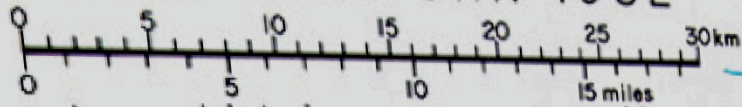




Scientists from NCAR, NOAA, and several Universities participated in the experiment.



JAWS NETWORK 1982



Microburst Causes Pan American FLT 759 to Crash on July 9, 1982

While on departure from New Orleans Airport



Following this disaster, the FAA immediately provided NCAR funding for JAWS and for the ensuing years for research on wind shear.

JAWS Experiment Continued in Earnest....

Data was collected on >150 microbursts!

On radar, microbursts have these characteristic wind signatures and time evolution:

Time = 0

Only a hint of downdraft hitting surface

Time = 2 min

Downdraft and outflow spreading along ground in opposite directions

Time = 5 min

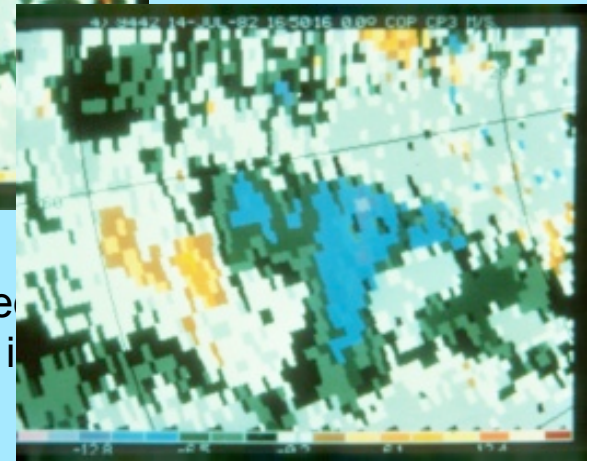
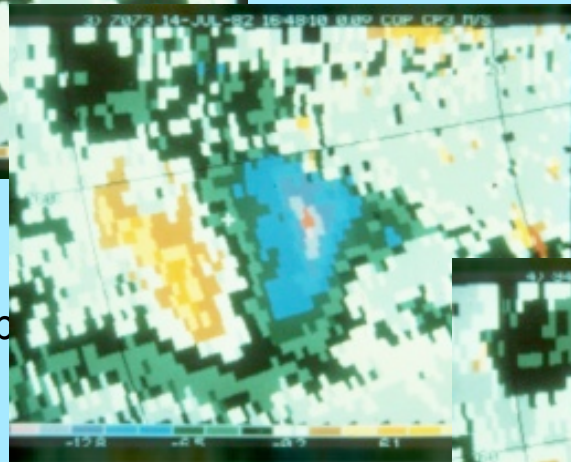
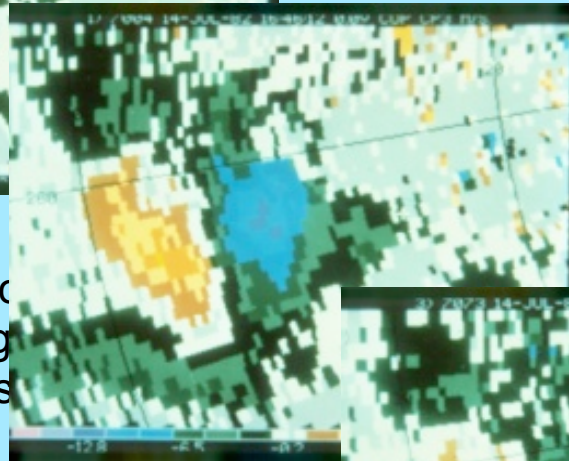
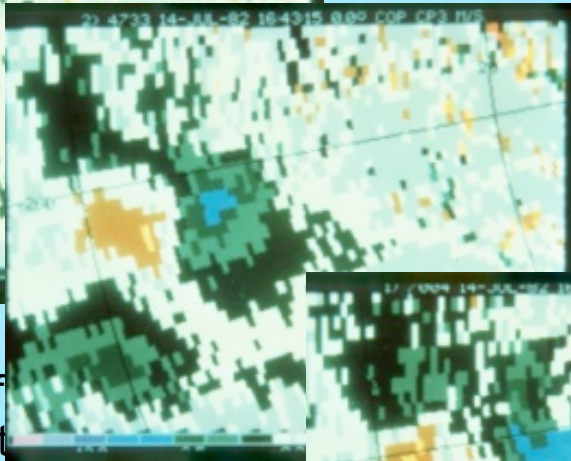
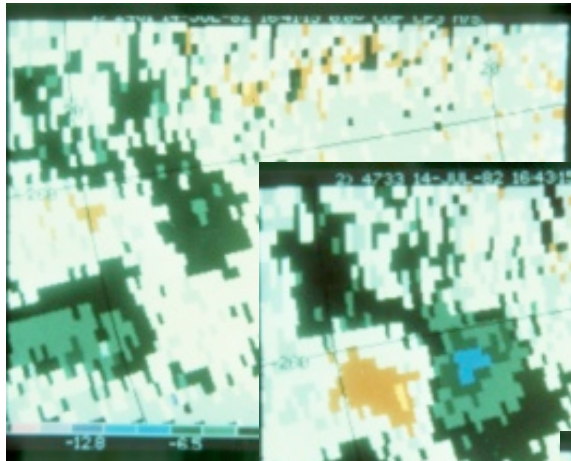
Wind speed is strengthening in both directions

Time = 7 min

Wind change associated with spreading outflow is greatest at this time

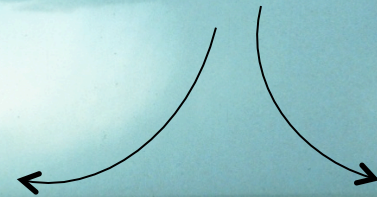
Time = 9 min

Wind speeds are decreasing



Visual Clues of a Microburst

Small scale rainshaft spreading horizontally along the ground



Vertical curl of dust along leading edge of microburst



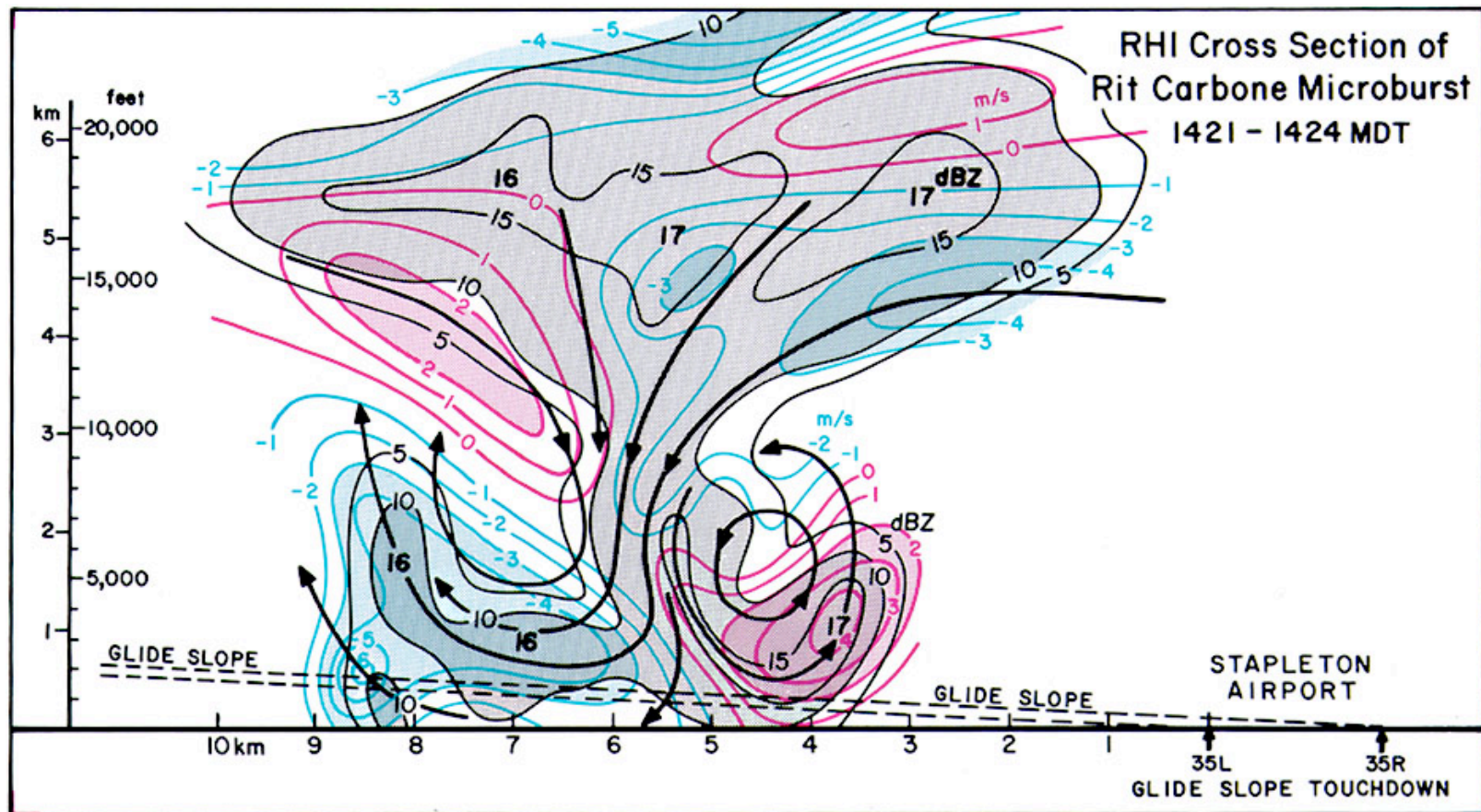
Circular Ring of Blowing



During JAWS.....

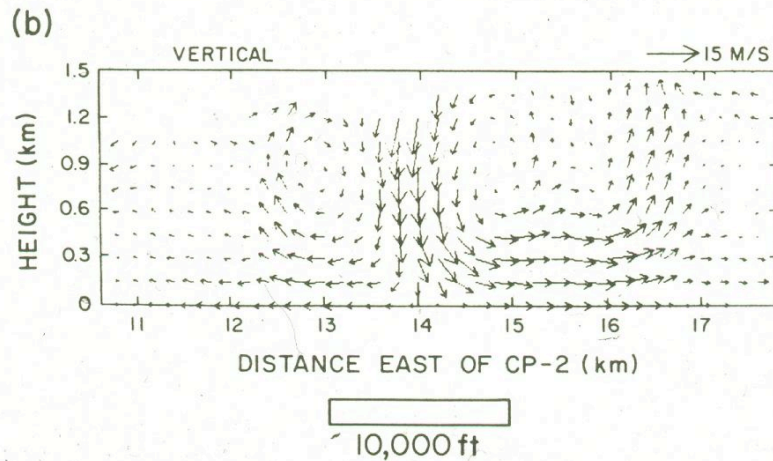
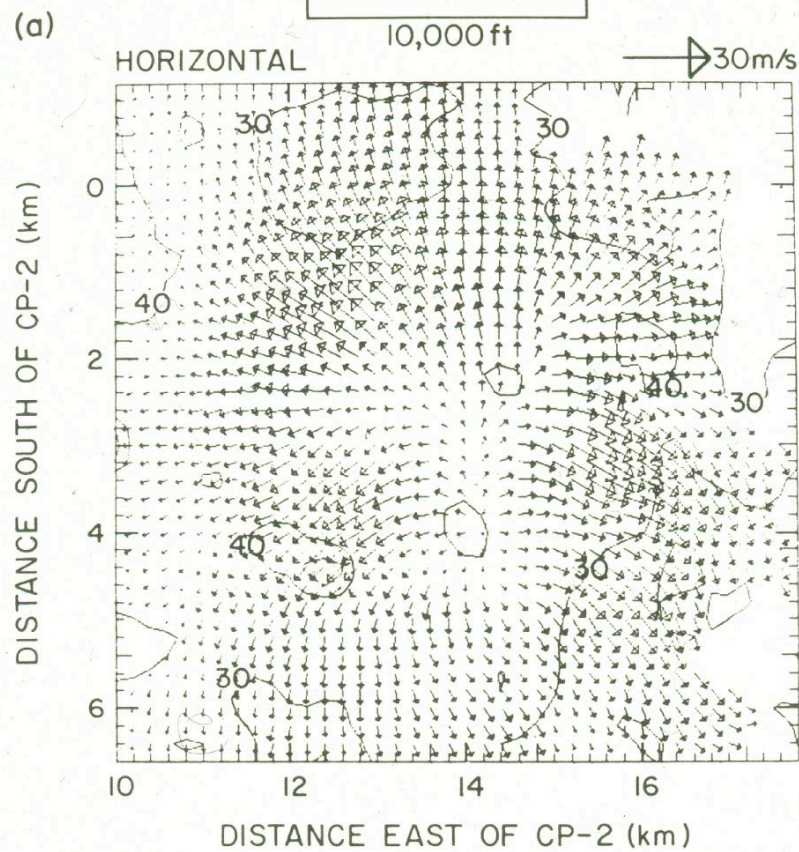
A Very Close Call at Denver Stapleton Airport.....

NCAR Senior Scientist, Rit Carbone was on the airline flight coming in to land that encountered this strong wind shear event !



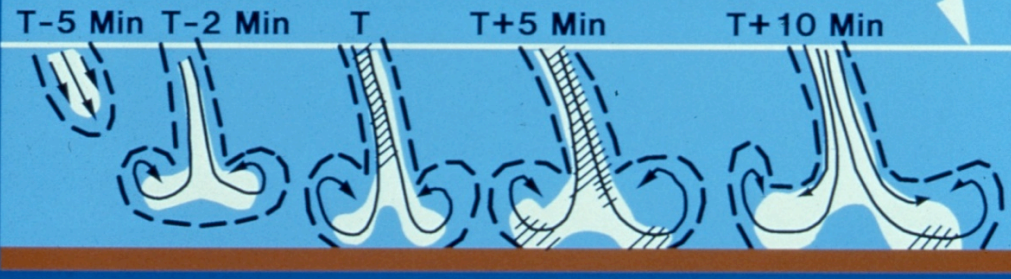
NCAR scientists conducted detailed research on microbursts:

- To understand how they form
- When they are likely to occur
- To train pilots to avoid them



Schematic Evolution of a Microburst

HEIGHT 10,000 AGL.



0 2.5 NM

Scale

*J. W. Wilson, R. D. Roberts, C. K. Kessinger, and J. McCarthy,
1984, Journal of Applied Meteorology*

THE MICROBURST



In 1984, 2 years after JAWS... NCAR Conducted..

CLAWS

Classify, Locate and Avoid Wind Shear



The experiment was run at the Denver Stapleton Airport with scientists present at the Air Traffic Control Tower and at research radar sites

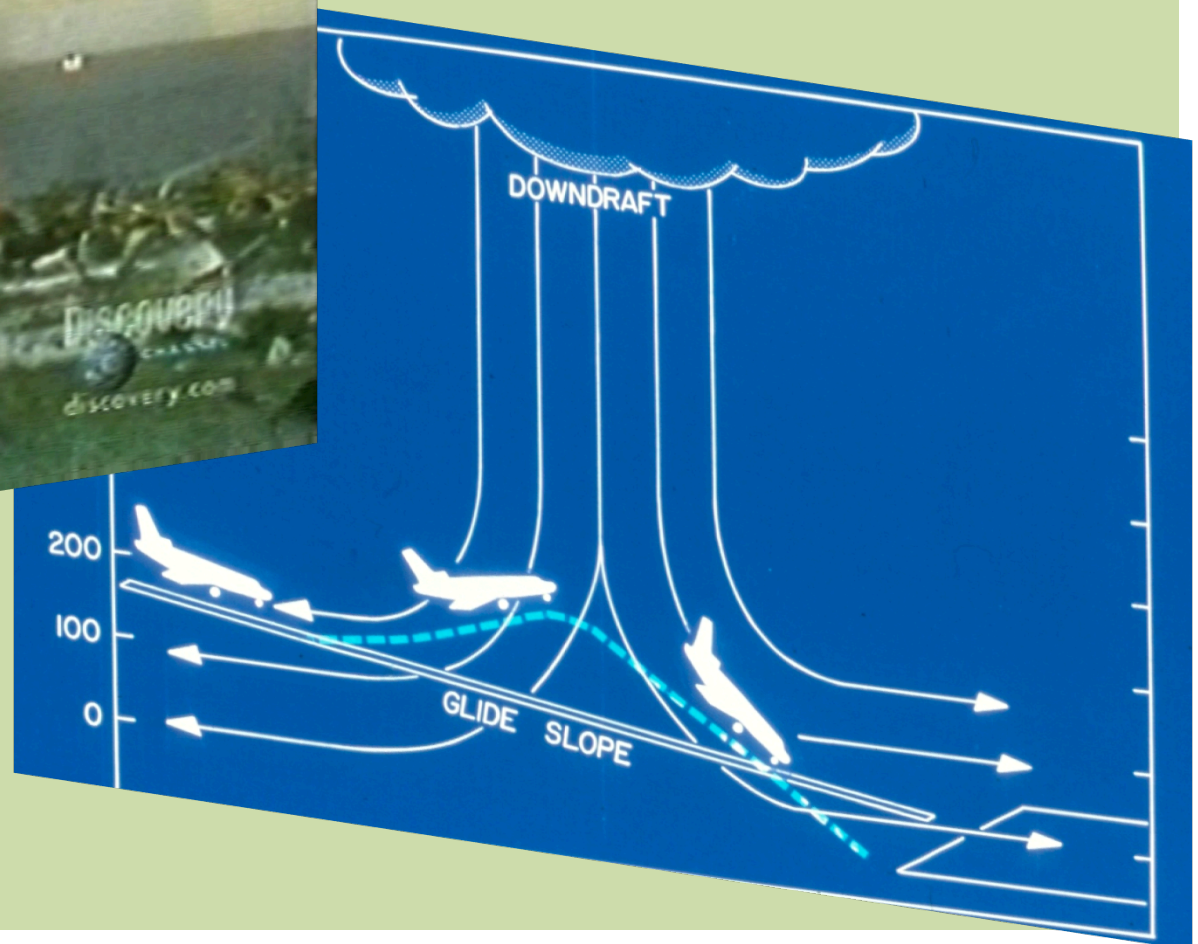
Objectives:

- ❖ Transfer our knowledge of microbursts to the aviation community
- ❖ Test how to make this information operationally useful to pilots and Air Traffic controllers
- ❖ Provide information on dangerous microbursts and wind shear to pilots and Air Traffic controllers

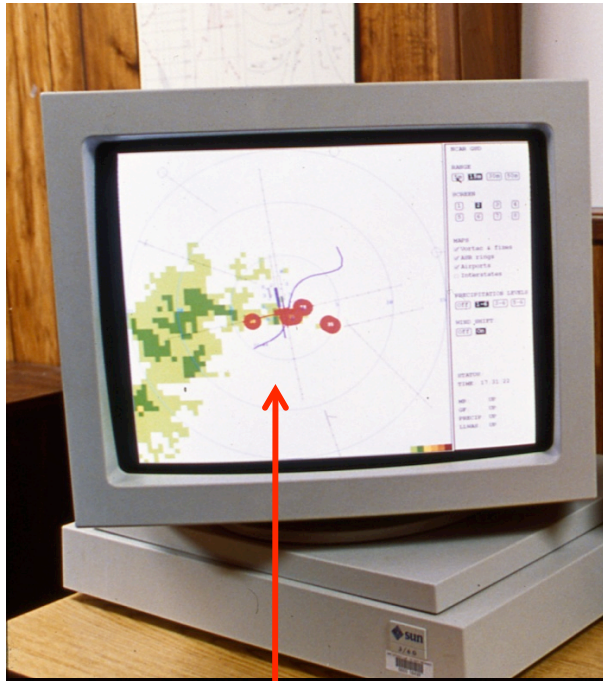
Delta 191 crashes on arrival to Dallas/Ft. Worth Airport on 2 August 1985

Pilot attempts a go-around after encountering a 50 knot tailwind of a microburst...

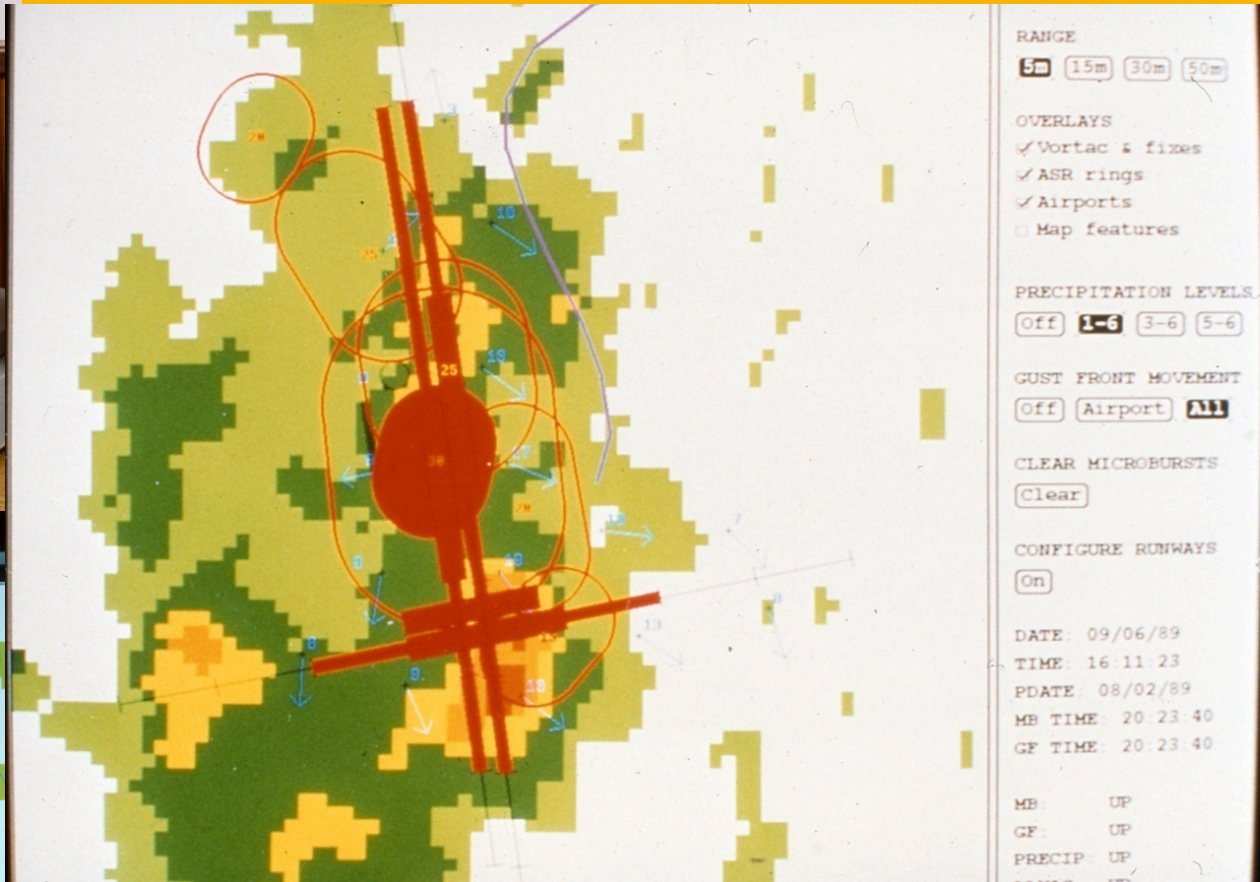
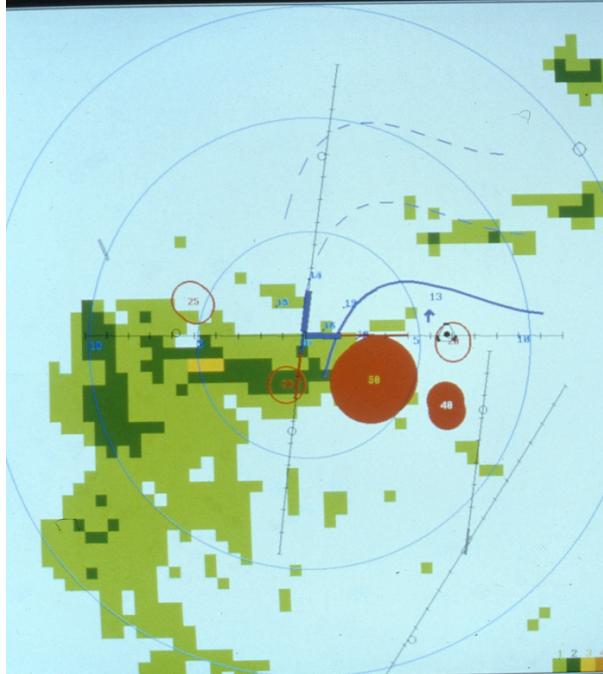
....but the maneuver was too late...



Late in 1980's, NCAR built a new Wind Shear Display for Air Traffic Controllers

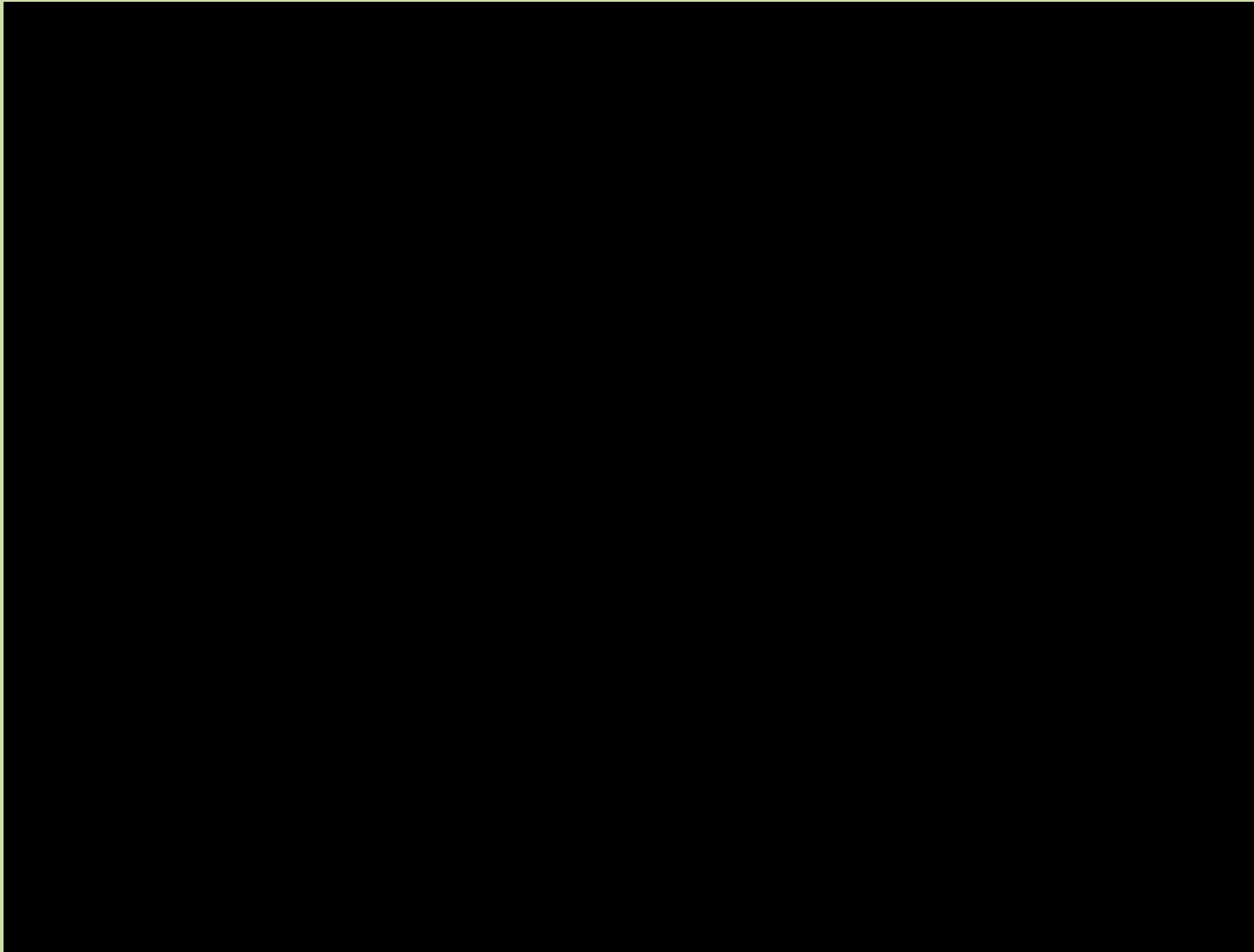


Geographical Situation Display



Display lets controllers know when a microburst is impacting the runways and the intensity of the wind shear (here: 38 knots). Controllers alert pilots on approach and departure.

**Another Microburst-Related Crash on July 9, 1994
Charlotte International Airport**



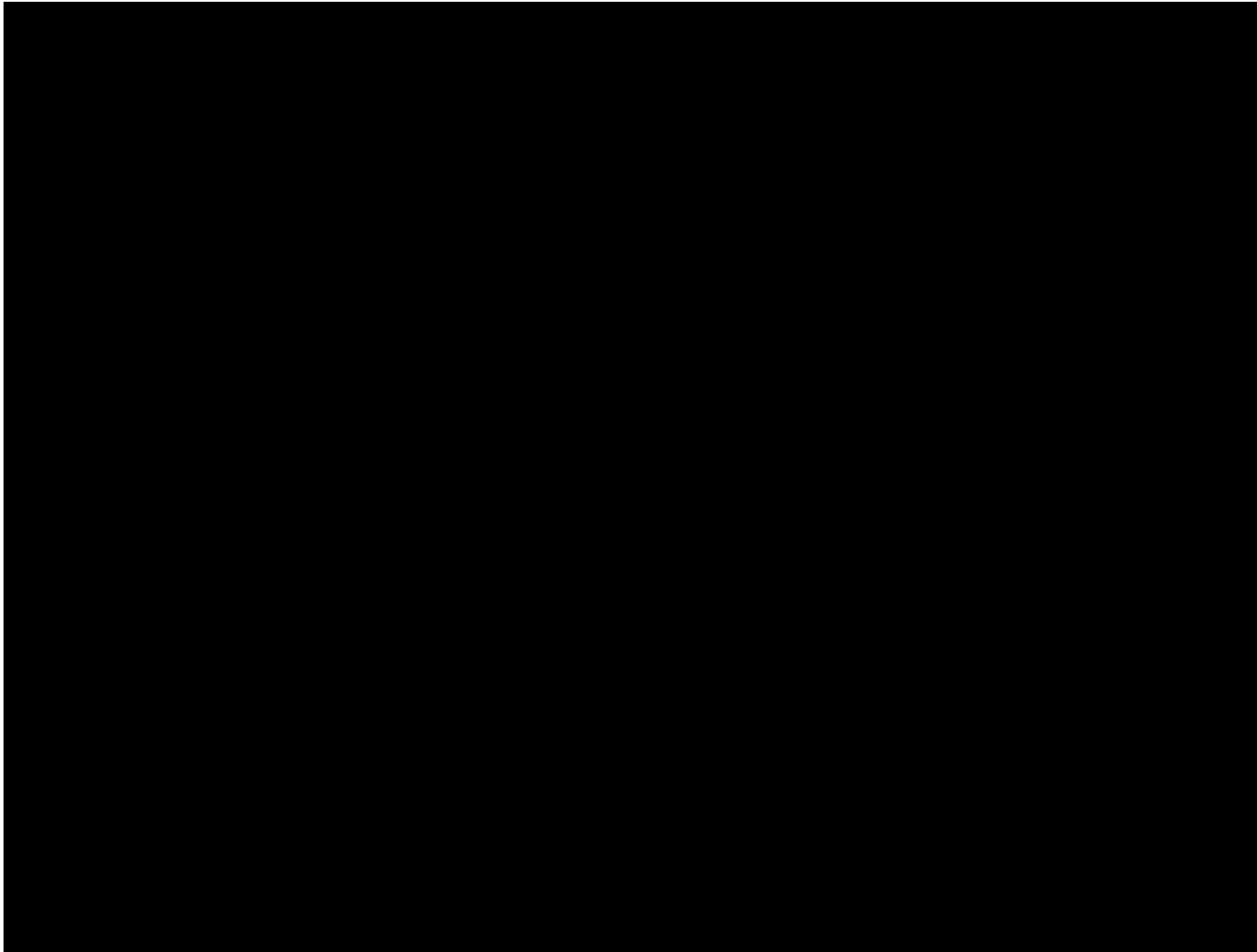
Federal Aviation Administration (FAA) Response



Terminal Doppler Weather Radar

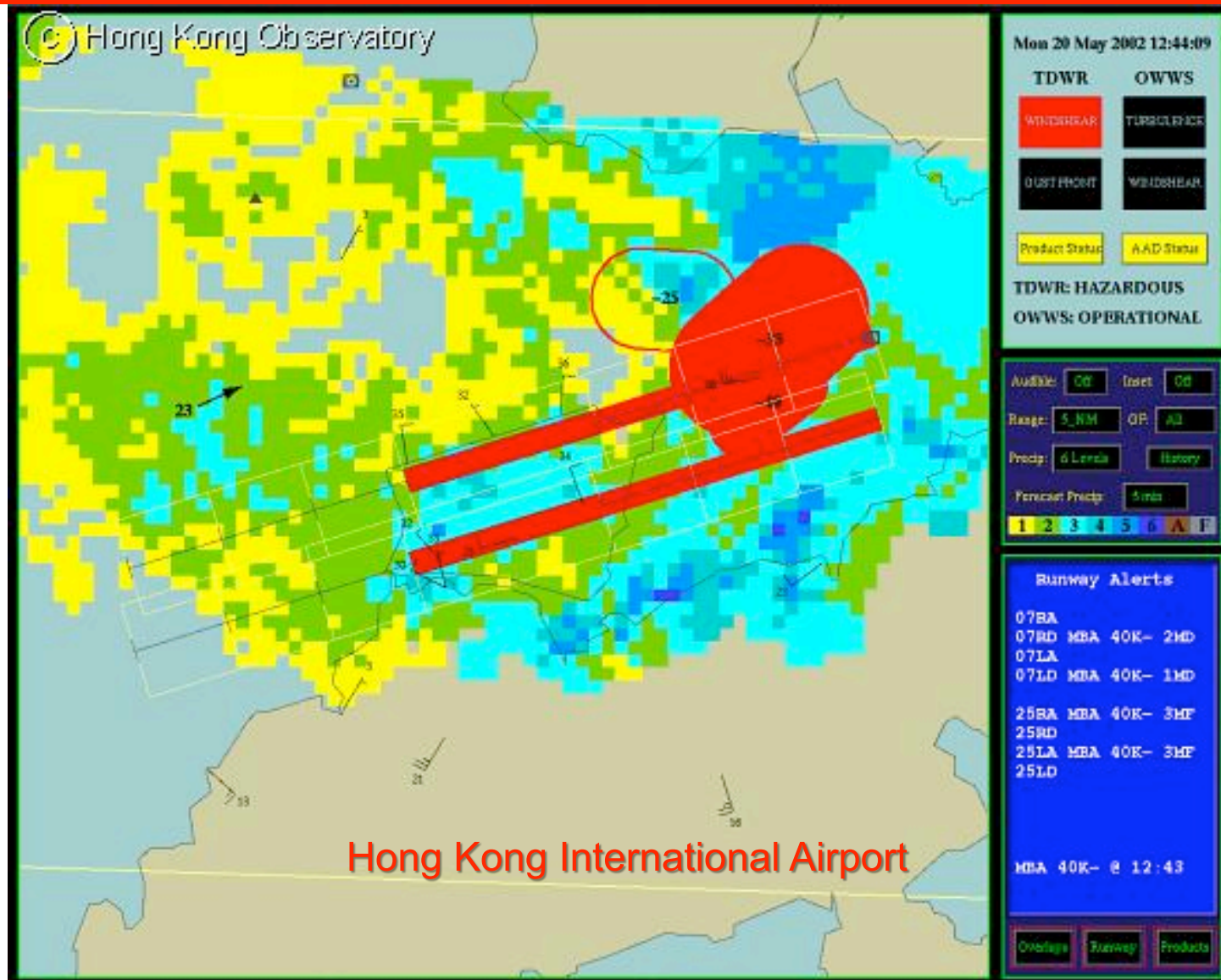
- Approved and funded the installation of Doppler radars within 15 km of all major airports in the U.S.
- These radars are called TDWR for “Terminal Doppler Weather Radar(s)”
- The radars run continuously to detect microburst storms and measure wind shear intensity

A Rewarding Scientific Experience



And it's a Never Ending Story

as TDWR systems are now being installed around the world



We **Can Keep** Airplanes From Falling From The Sky



A Success Story: One of the Best Aviation Safety Fixes

