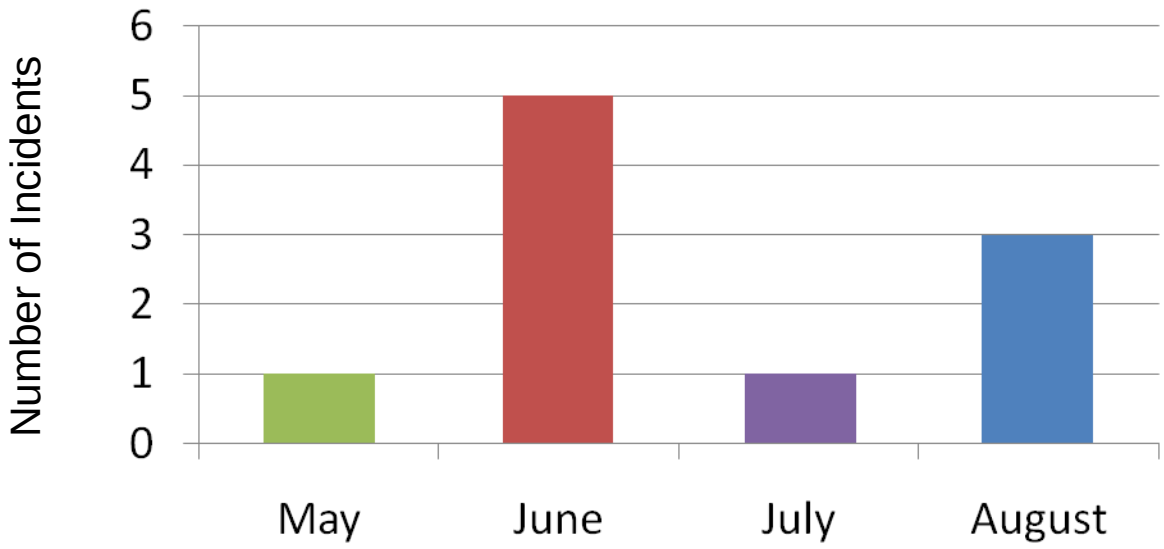
How We Stopped Airplanes Falling From The Sky

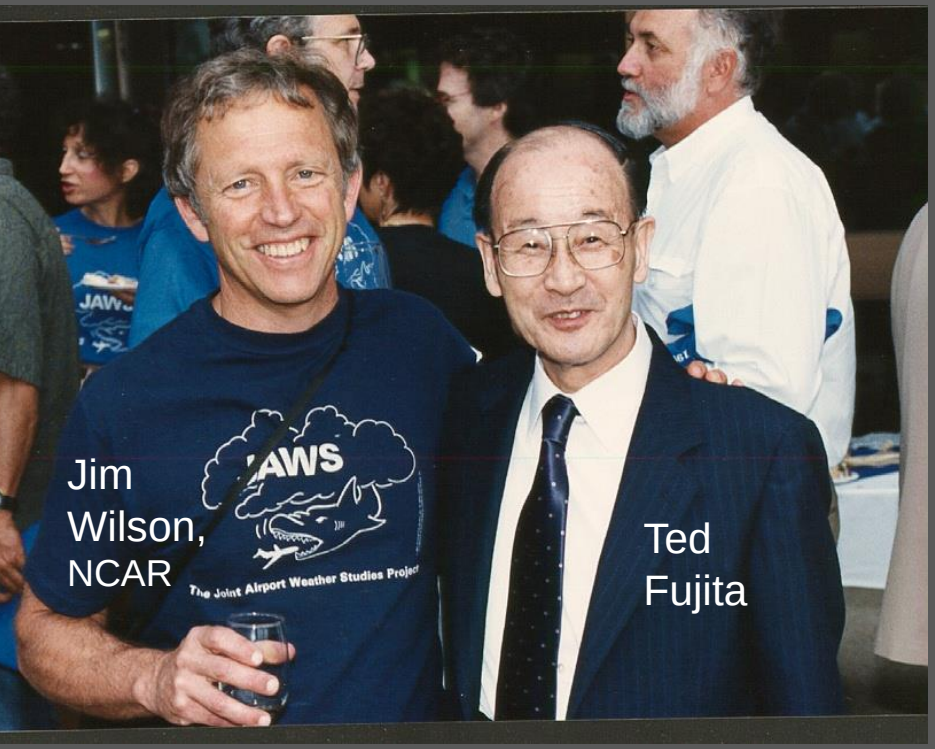
Changes in Wind Speed or Direction Along Flight Path Can Be Catastrophic

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



*Accidents occurred about every 18 months.

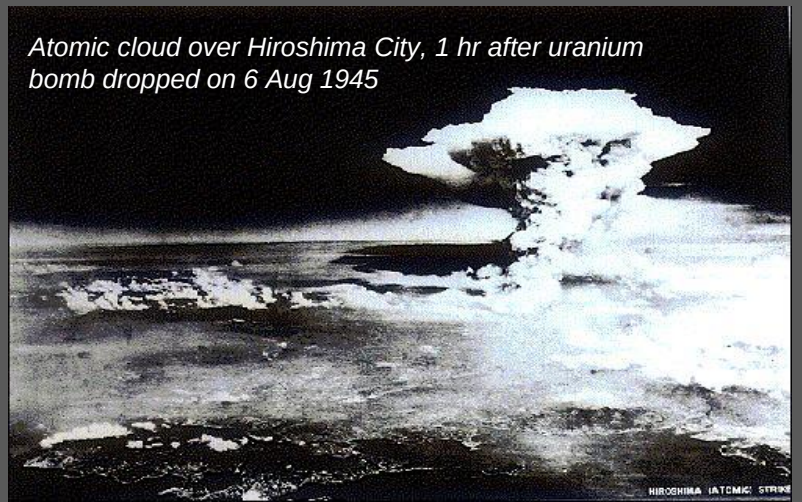
?? In the 1970s not much was known about Wind Shear…. ??



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.

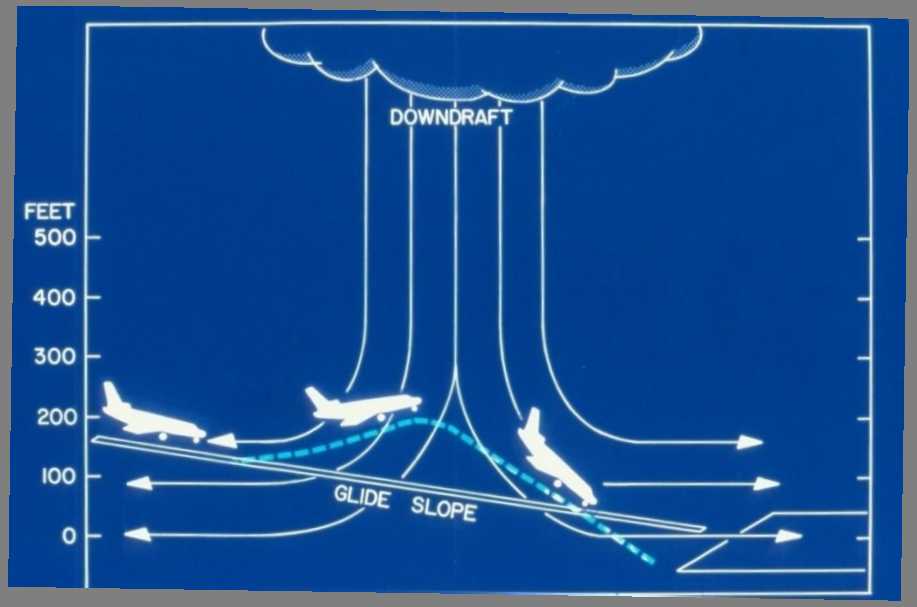
Fujita's Conclusion:

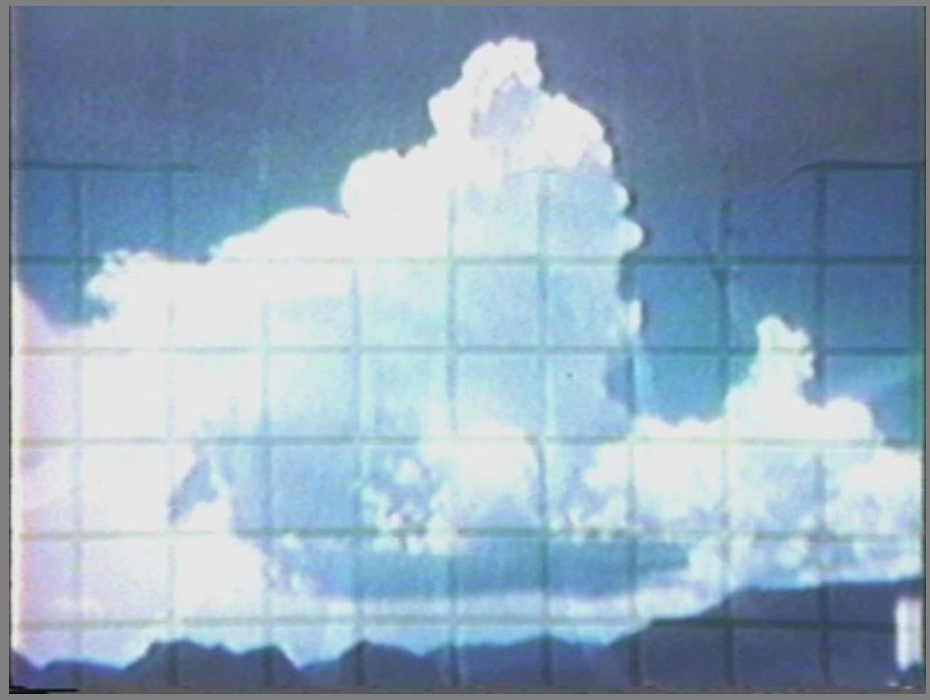
Eastern Flight 66 Crash was caused by strong wind shear.

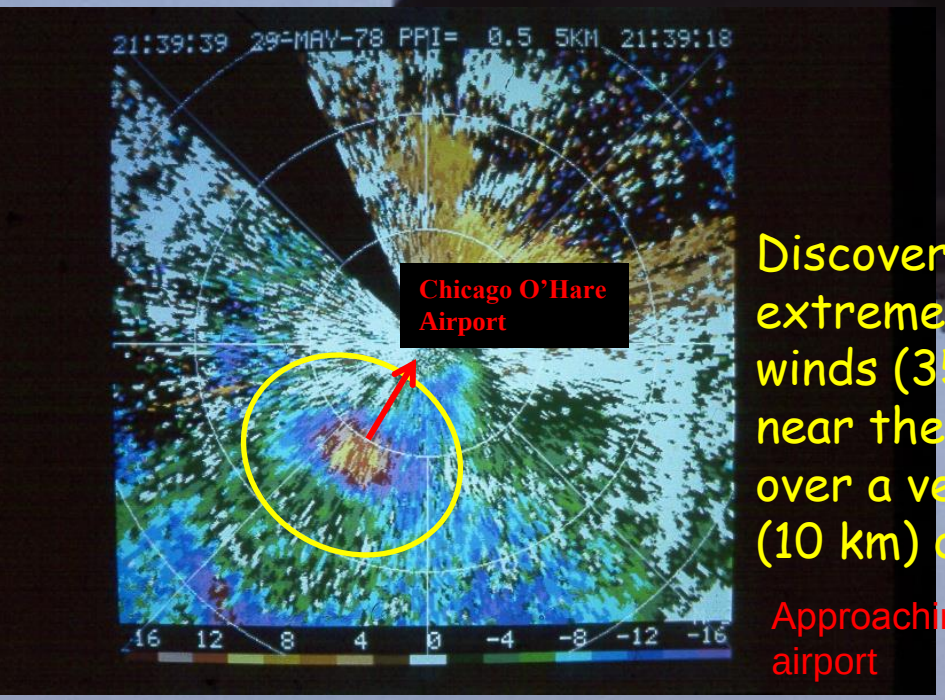
He called this type of wind shear a Downburst or Microburst.

WIND SHEAR:

SUDDEN CHANGE IN SPEED OR DIRECTION RELATIVE TO AN AIRCRAFT





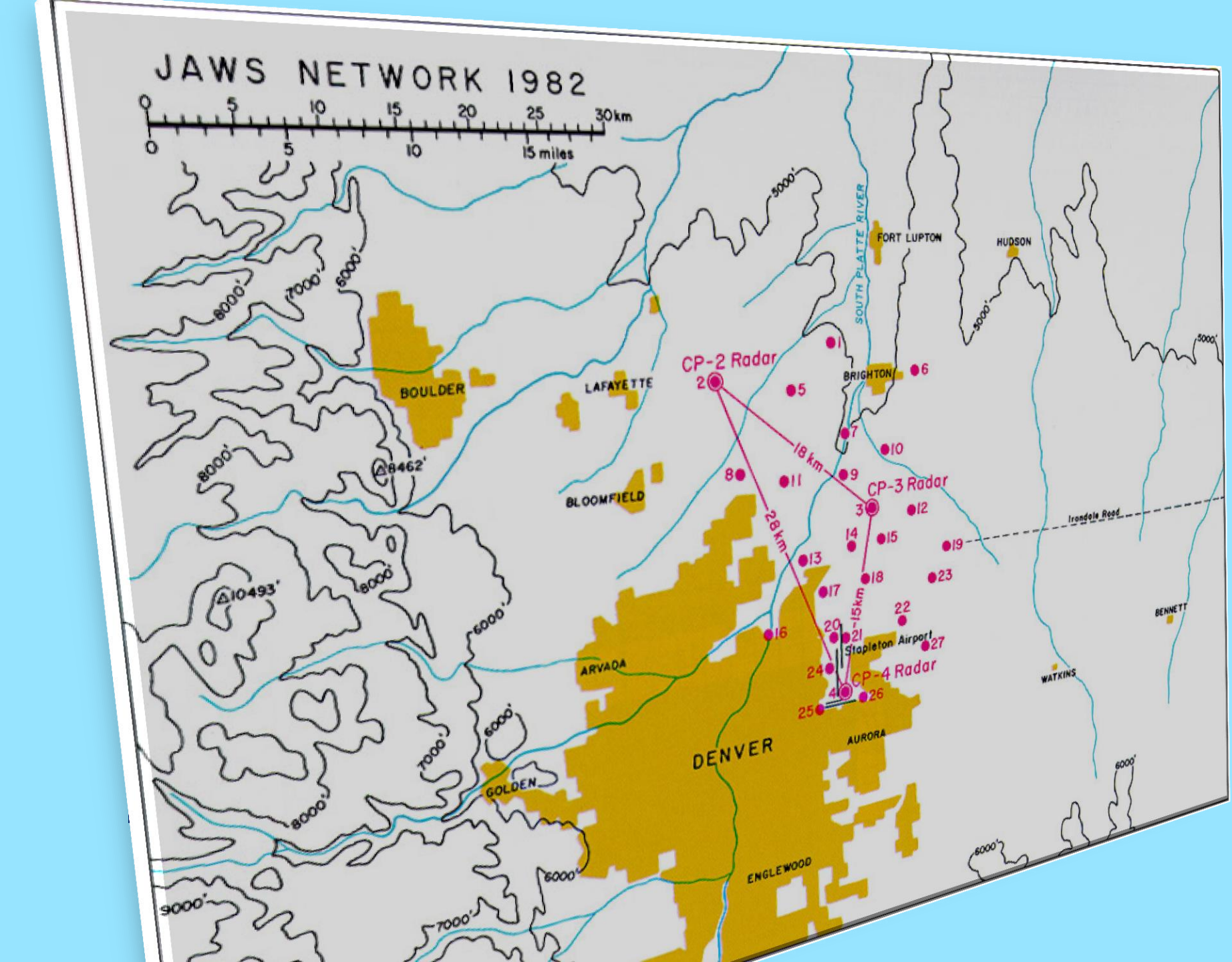


A few downbursts were detected by radar during NIMROD, but it was still considered a very rare event…..

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

Approaching O'Hare airport

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


JAWS NETWORK 1982
0 5 10 15 20 25 30km
0 5 10 15 miles
CP-2 Radar
CP-3 Radar
CP-4 Radar
18 km
28 km
15km
SOUTH PLATTE RIVER
FORT LUPTON
HUDSON
BRIGHTON
BOULDER
LAFAYETTE
BLOOMFIELD
ARVADA
DENVER
AURORA
GOLDEN
ENGLEWOOD
WATKINS
BENNETT
Stapleton Airport
Irondale Road
8462'
10493'
9000'
8000'
7000'
6000'
5000'

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

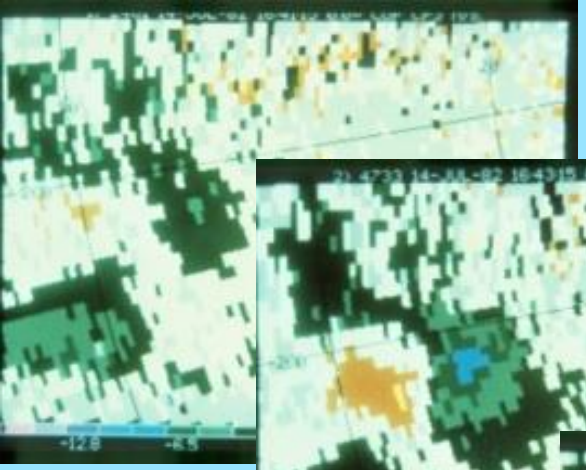
While on departure from New Orleans Airport

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

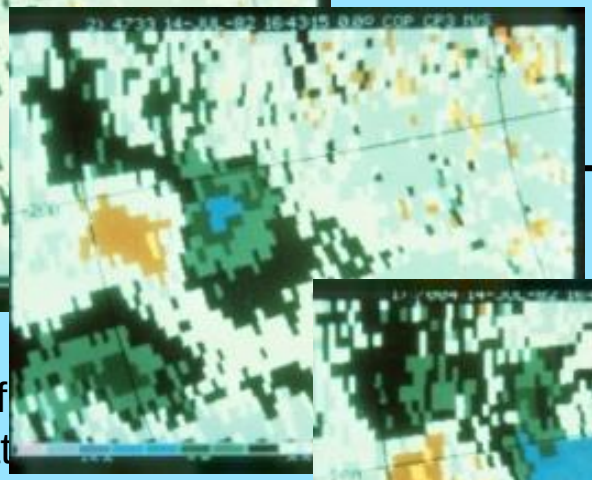
JAWS Experiment Continued in Earnest….

Data was collected on >150 microbursts!

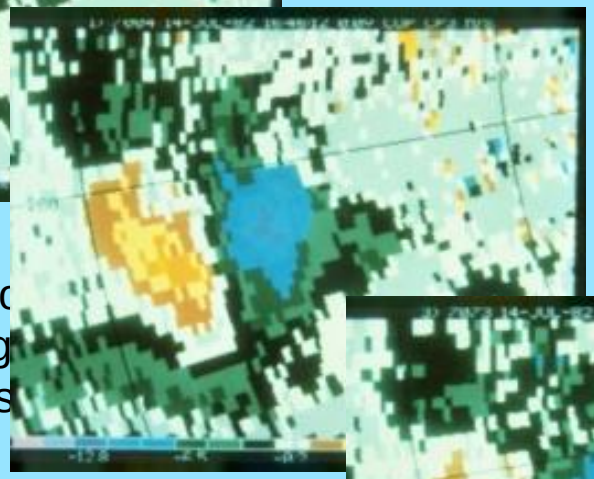
On radar, microbursts have these characteristic wind signatures and time evolution:



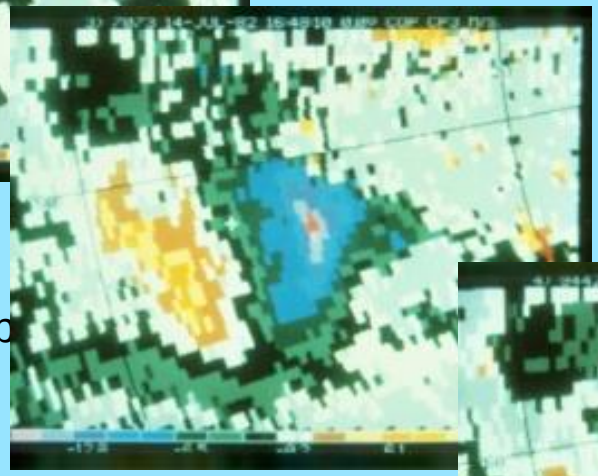
Time = 0
Only a hint of
downdraft hitt
surface



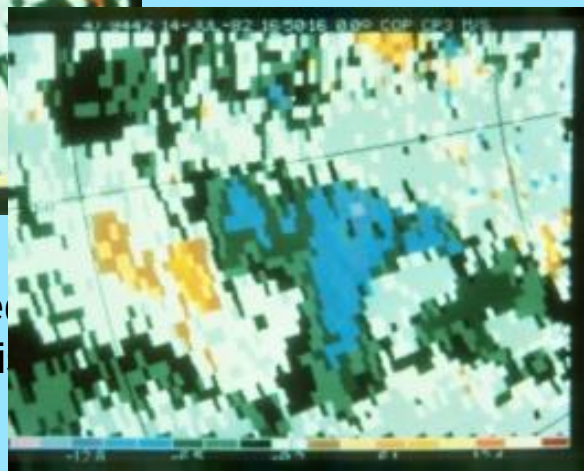
Time = 2 min
Downdraft and
spreading along
ground in oppos
directions



Time = 5 min
Wind speed is
strengthening in b
directions

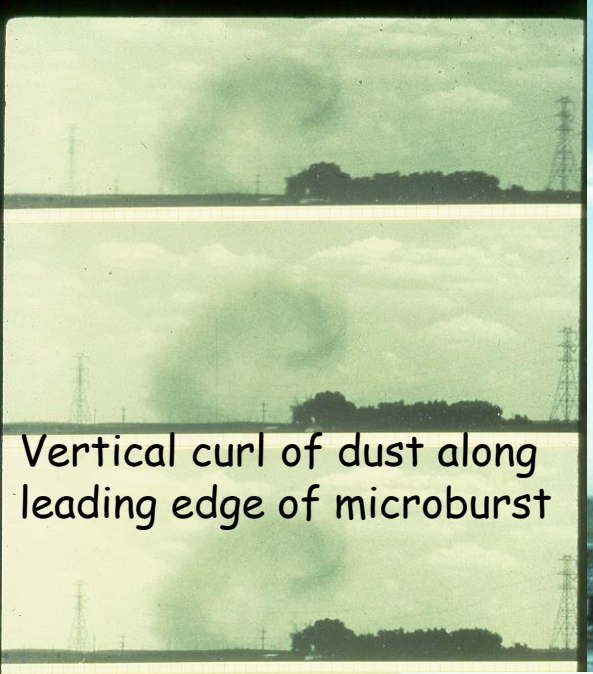


Time = 7 min
Wind change associate
with spreading outflow i
greatest at this time



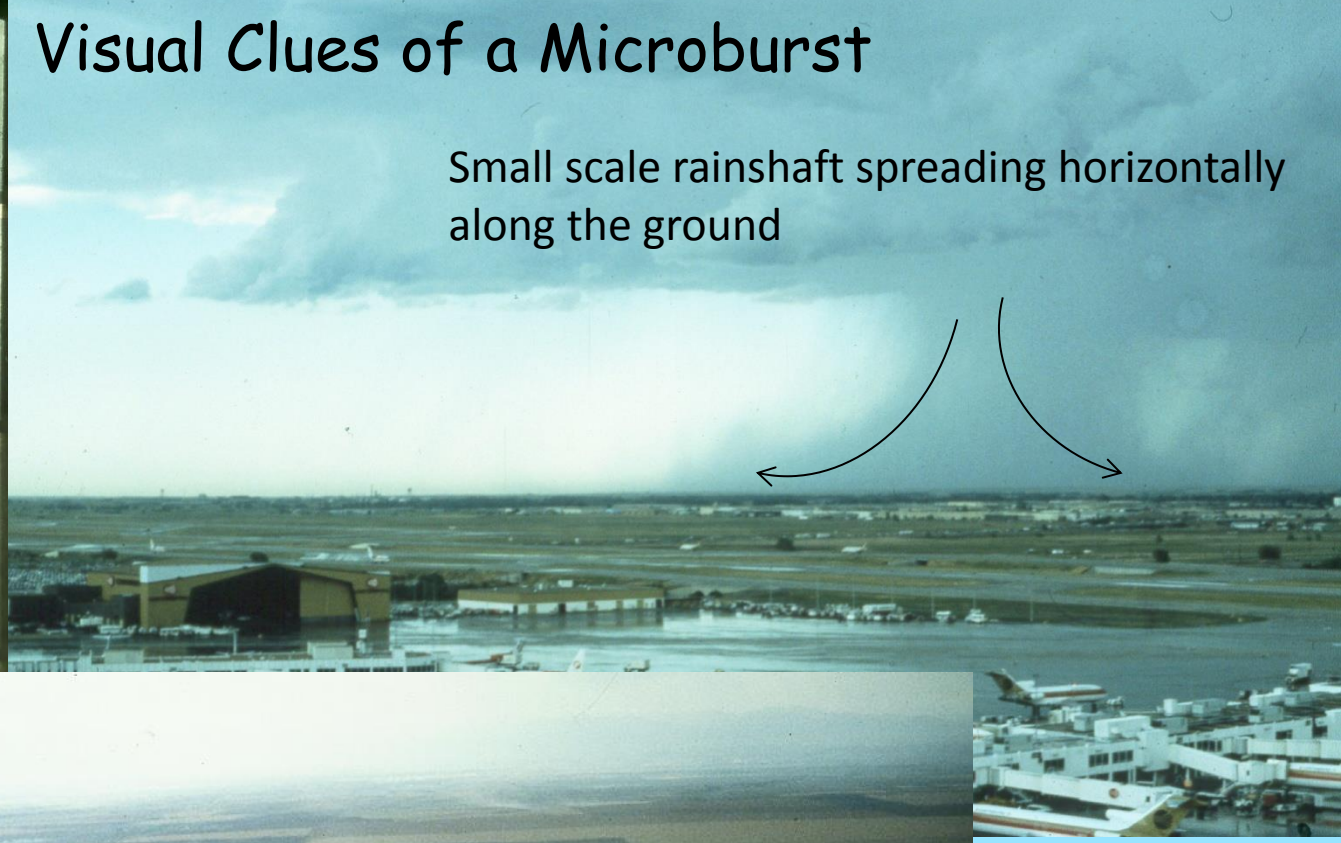
Time = 9 min
Wind speeds are
decreasing

Visual Clues of a Microburst



Vertical curl of dust along leading edge of microburst

Small scale rainshaft spreading horizontally along the ground

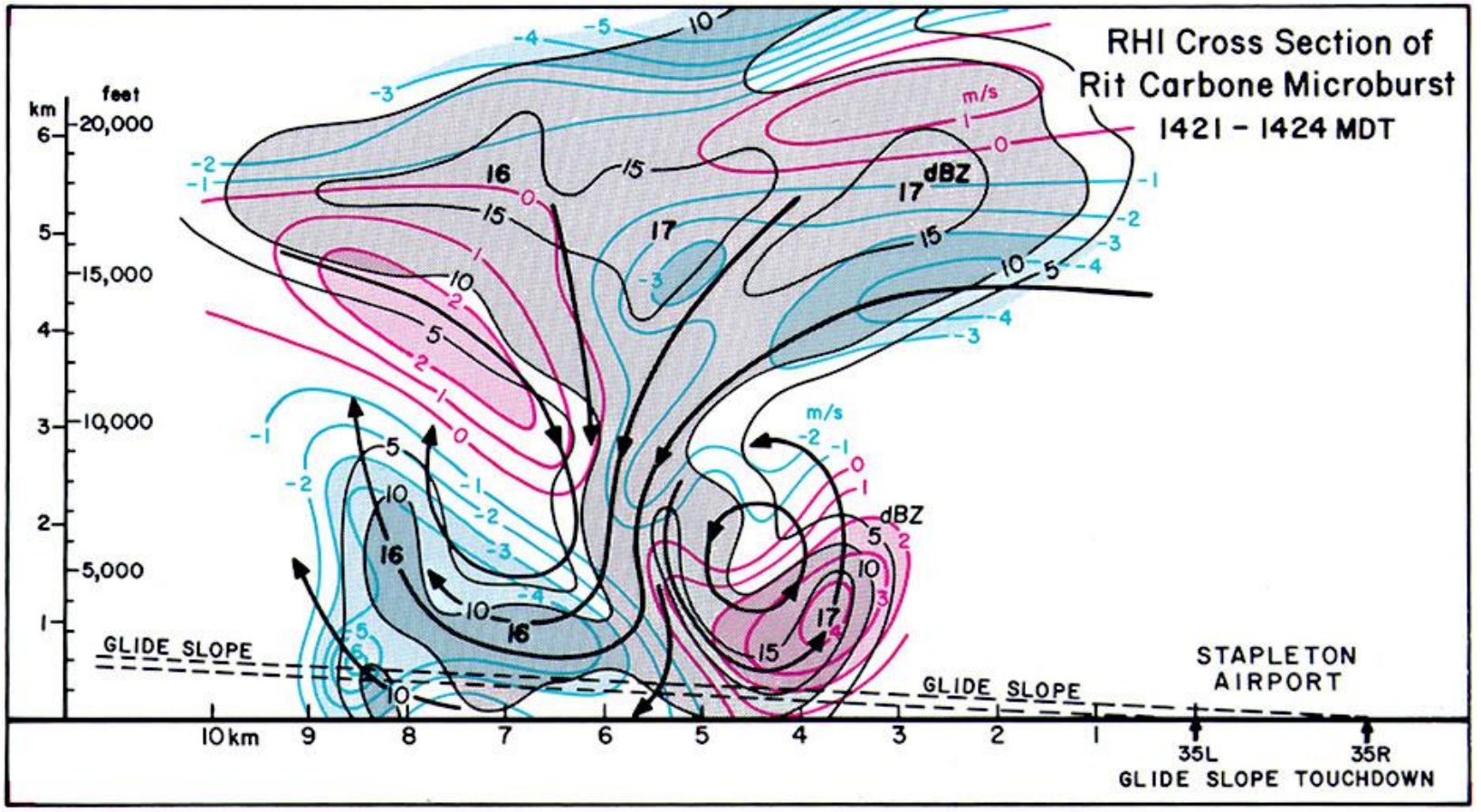


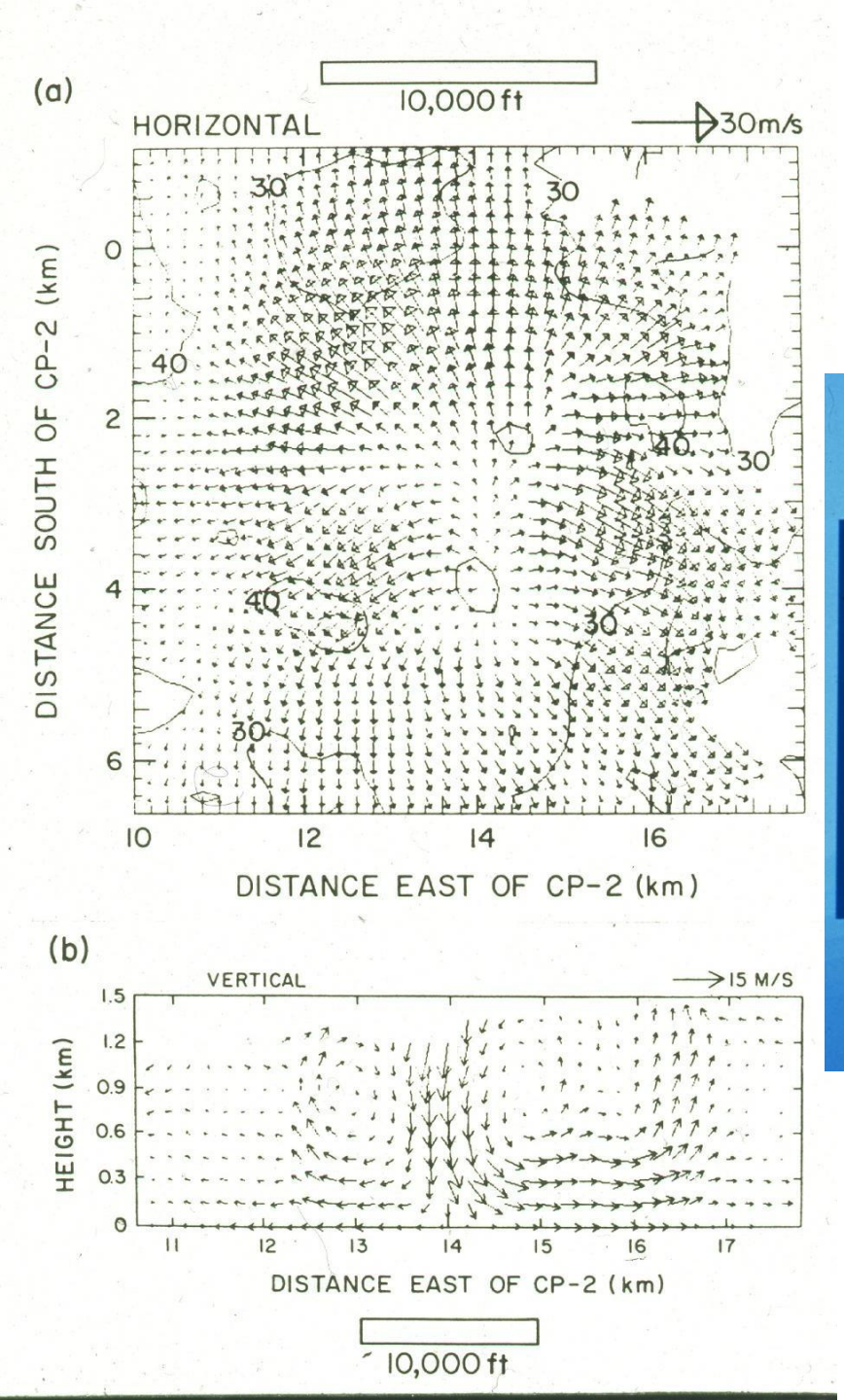
Circular Ring of Blowing

During JAWS……

A Very Close Call at Denver Stapleton Airport…….

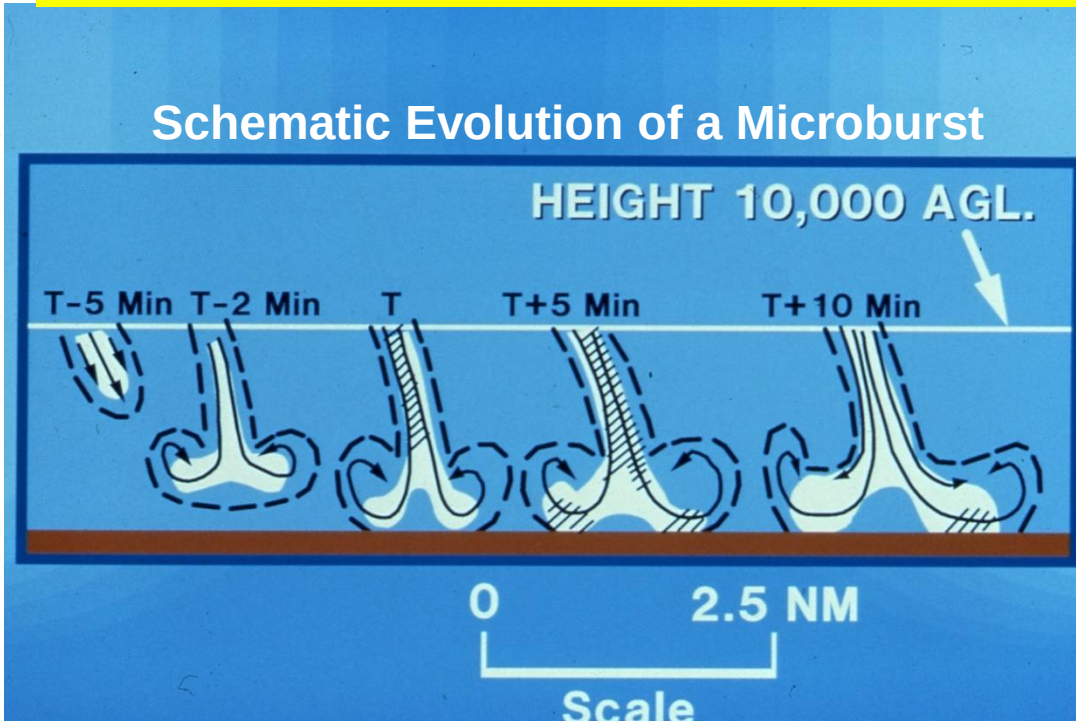
NCAR Senior Scientist, Rit Carbone was on the airline flight coming in to land that encountered this strong wind shear event !





NCAR scientists conducted detailed research on microbursts:

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



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

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

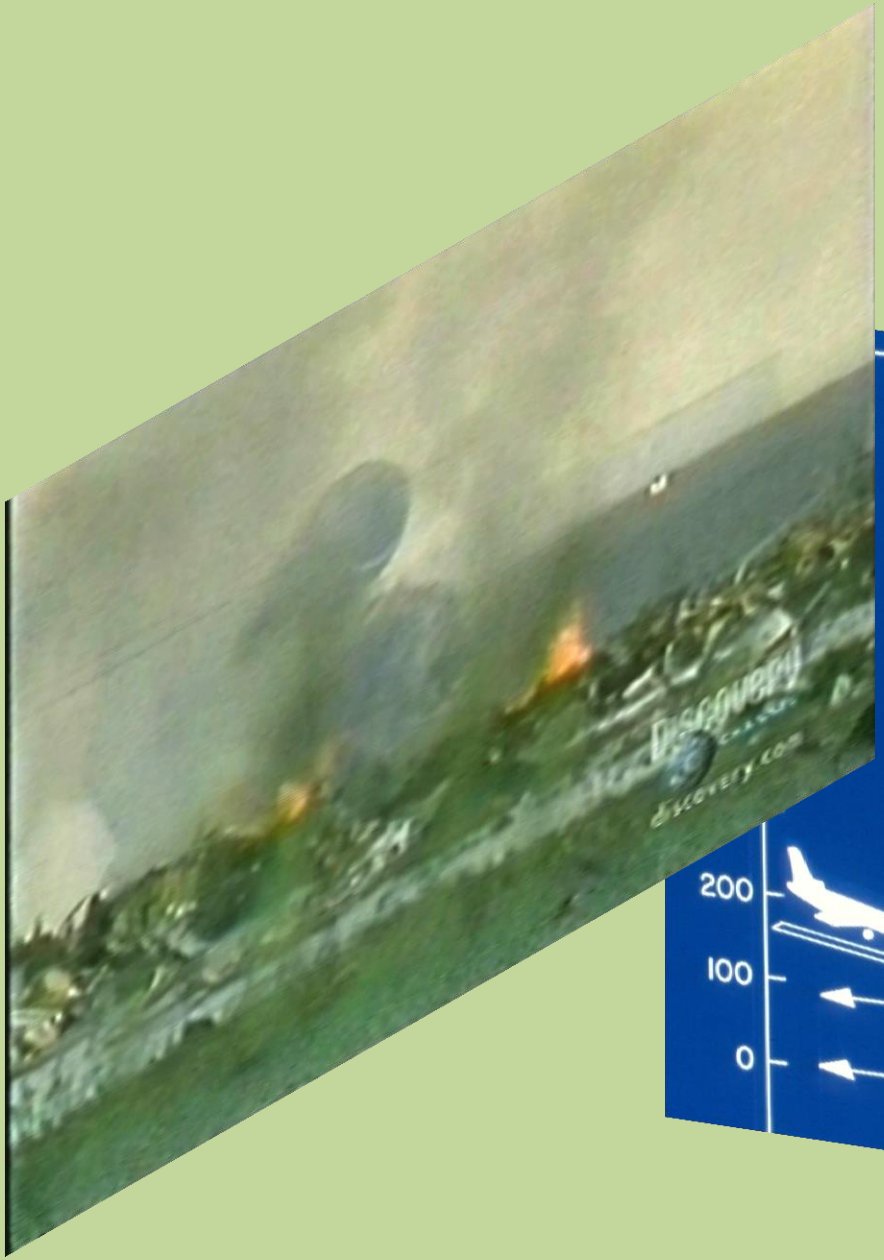
❖Test how to make this information operationally useful to pilots and Air Traffic controllers

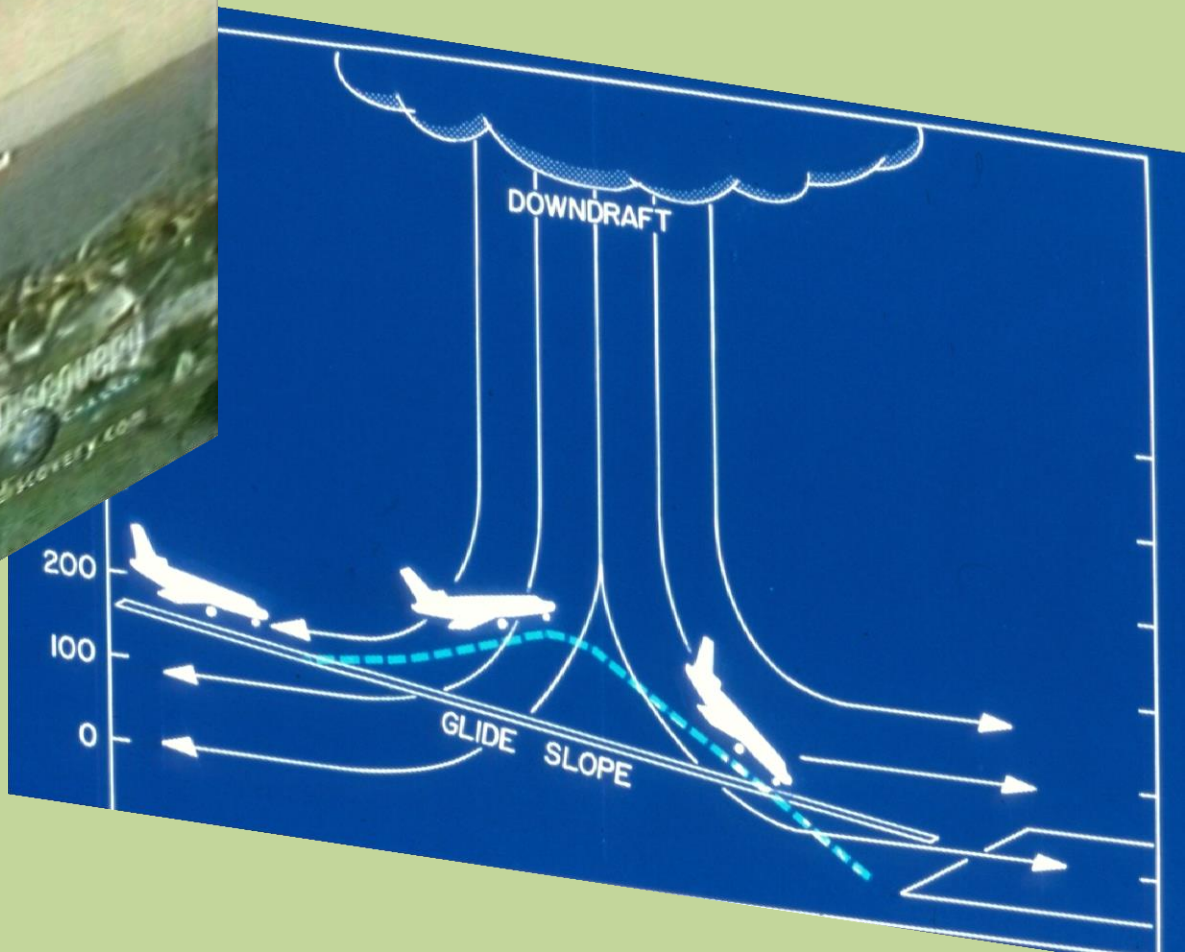
❖Provide information on dangerous microbursts and wind shear to pilots and Air Traffic controllers

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…

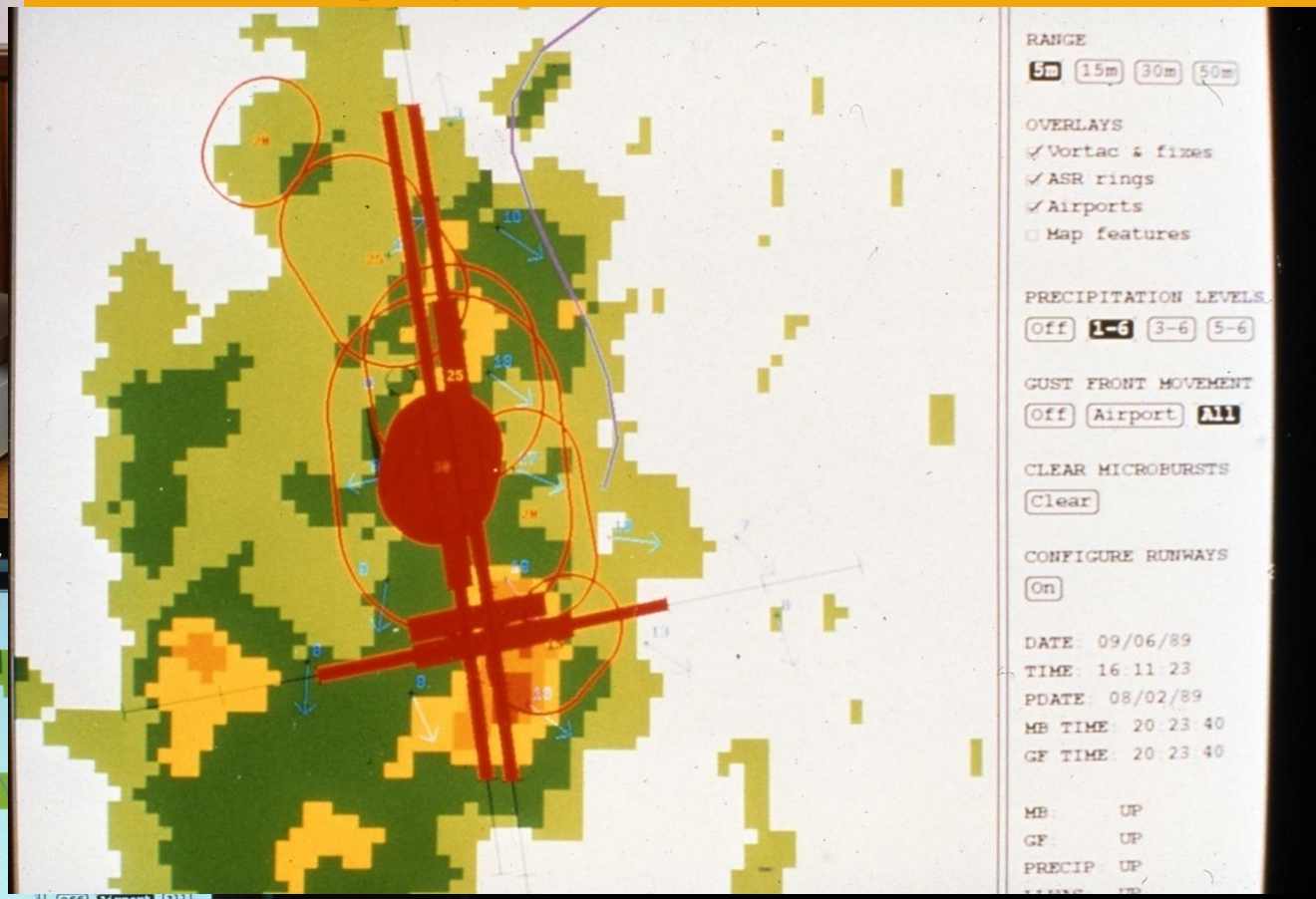
….but the manuever was too late…

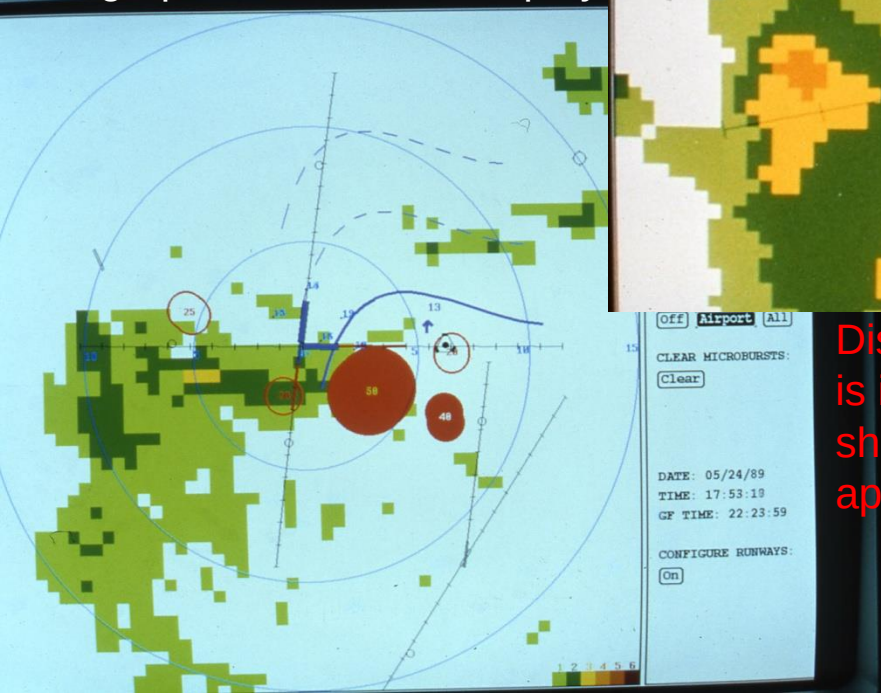




Late in 1980's, NCAR built a new Wind Shear Display for Air Traffic Controllers

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.

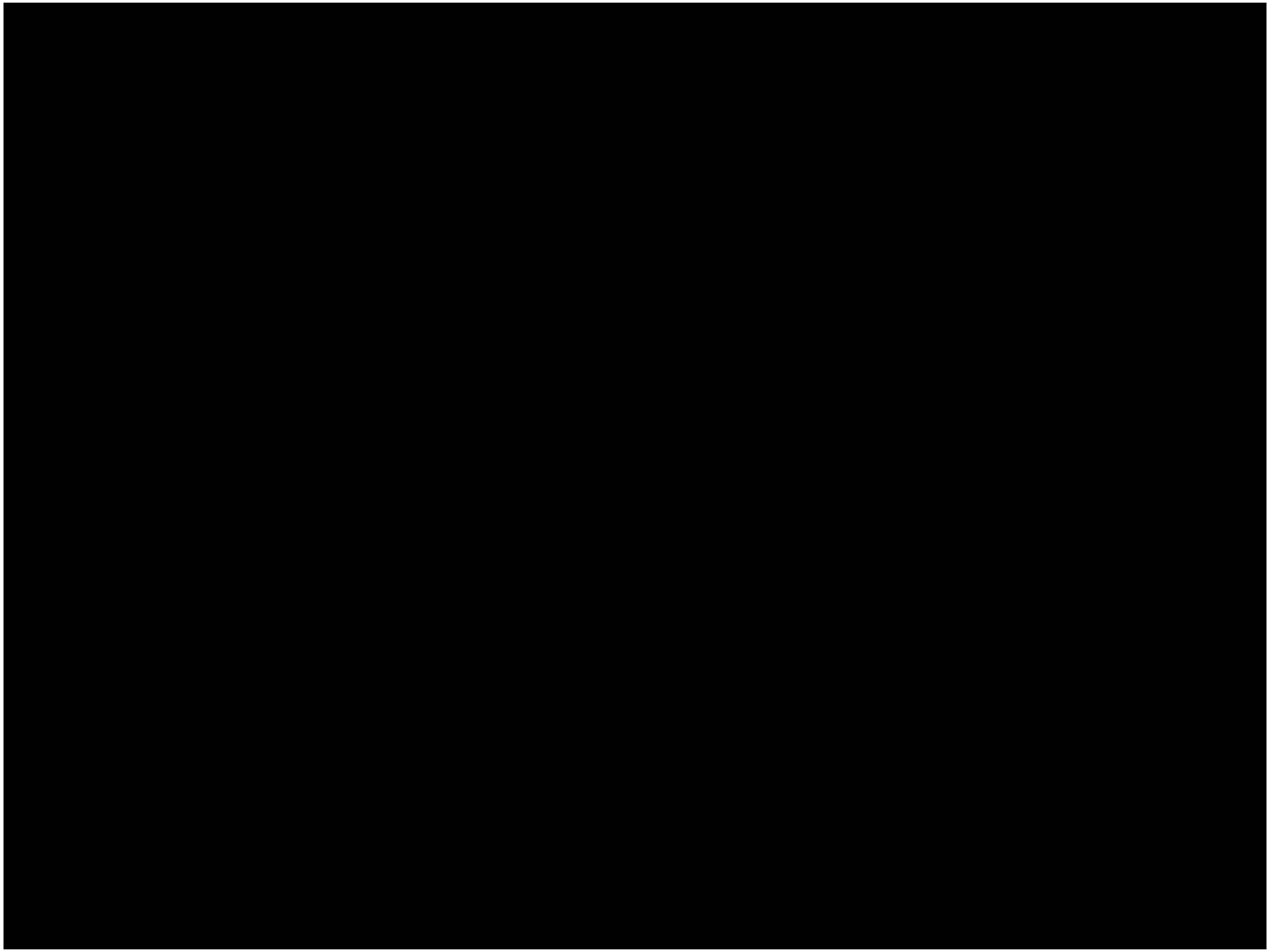
Another Microburst-Related Crash on July 9, 1994
Charlotte International Airport

Federal Aviation Administration (FAA) Response

Terminal Doppler Weather Radar

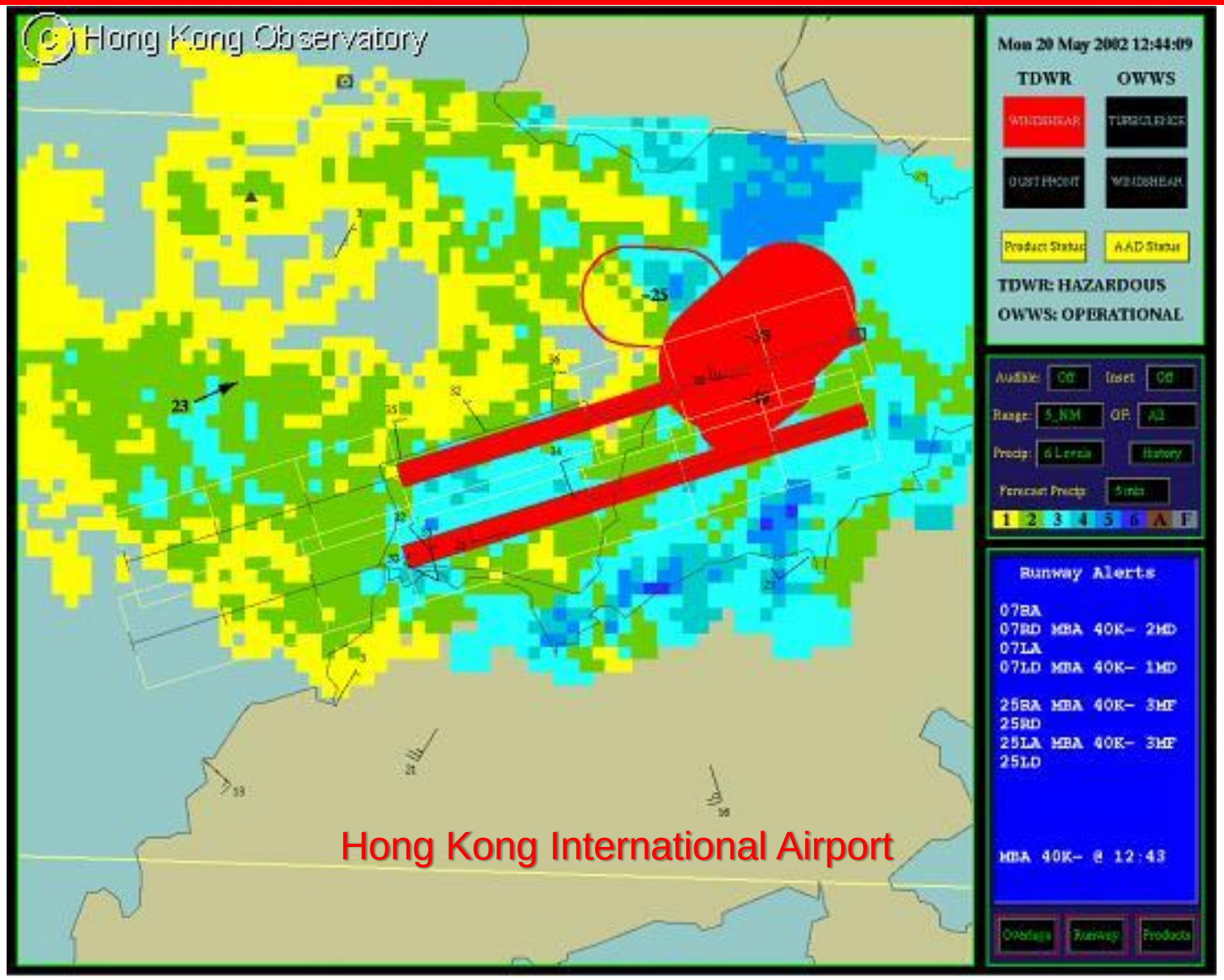
- Approved and funded the installation of Doppler radars within 15 km of all major airports in the U.S.
- These radars are called TDWR for “Terminal Doppler Weather Radar(s)”
- The radars run continuously to detect microburst storms and measure wind shear intensity

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