SUMMER 1988 TDWR MICROBURST ANALYSIS*

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ABSTRACT

The Terminal Doppler Weather Radar (TDWR) testbed system was operated during the months of July–August 1988 in a live operational demonstration providing microburst (and related weather hazard) protection to the Stapleton International Airport in Denver, CO. During this time period, the performance of the detection system was carefully monitored in an effort to determine the reliability of the system. Initial performance analysis indicates that the microburst detection component of TDWR satisfies the basic performance goals of 90% probability of detection and 10% probability of false alarm.

An in-depth study of the system performance, based on analysis of both dual-Doppler radar observations and surface mesonet measurements, is in progress to provide a detailed understanding of the observability of microbursts by the radar, the ability of the algorithms to detect microbursts observed by the radar, and the timeliness and accuracy of the microburst alarms provided to operational users.
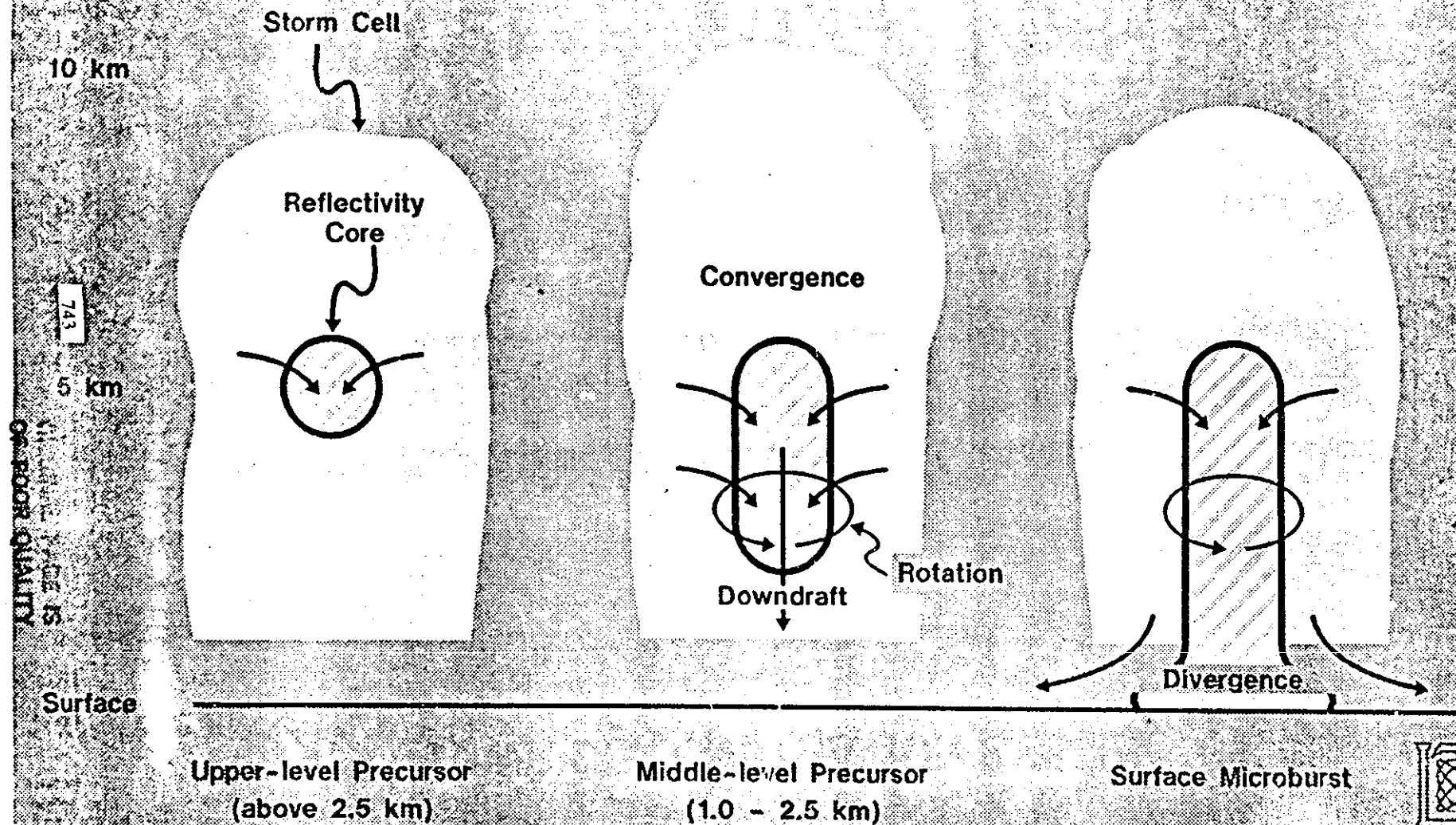

SUMMER 1988 TDWR MICROBURST ANALYSIS

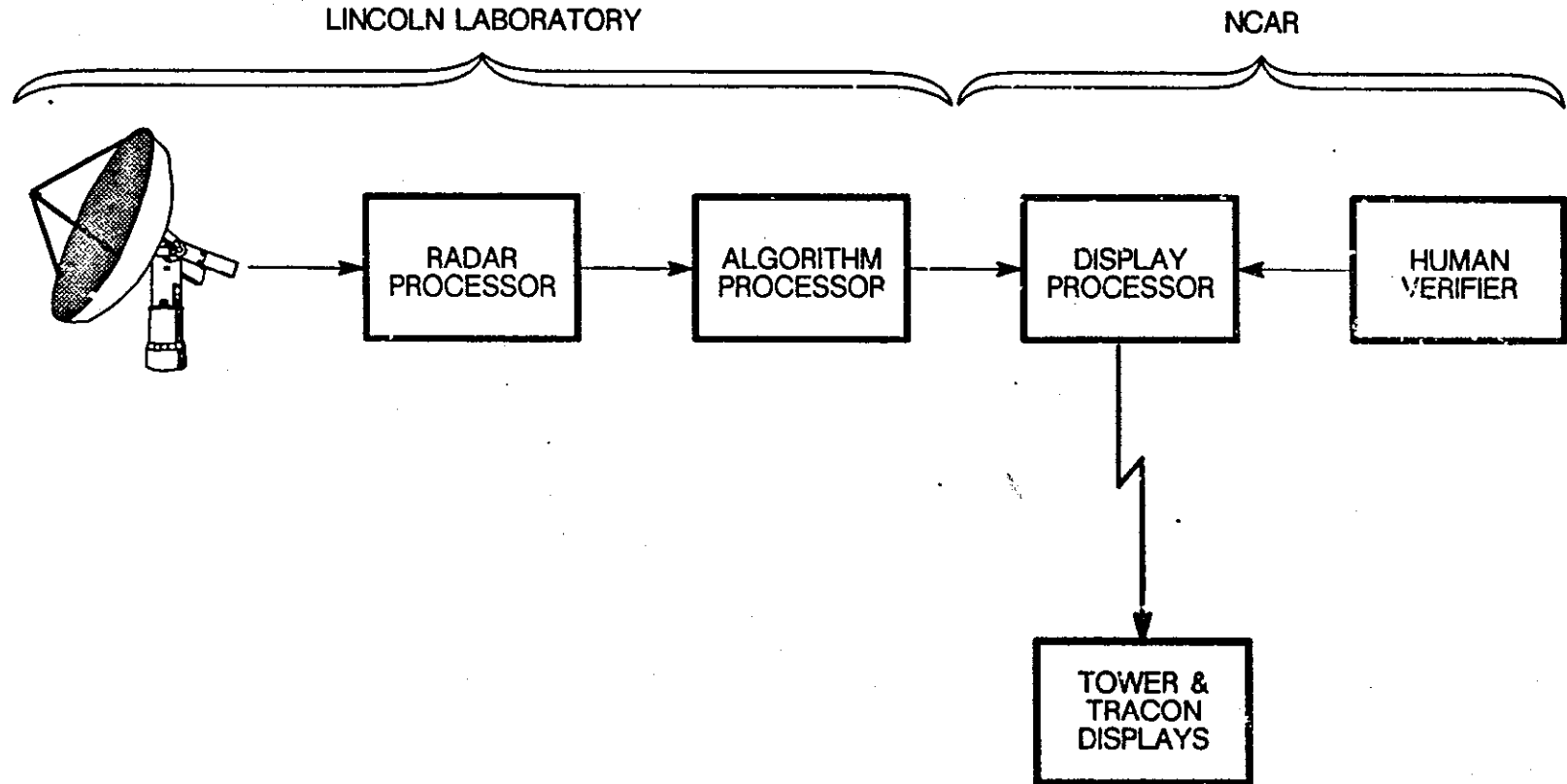## M.W. MERRITT
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- TDWR OPERATIONAL EVALUATION

- "QUICK-LOOK" PERFORMANCE RESULTS

- ANALYSES IN PROGRESS

MICROBURST FEATURES ALOFT

Storm Cell

Reflectivity Core

Convergence

10 km

743

5 km

Rotation

Downdraft

Surface

Divergence

Upper-level Precursor
(above 2.5 km)

Middle-level Precursor
(1.0 - 2.5 km)

Surface Microburst

42-2301

TDWR DEMONSTRATION SYSTEM

LINCOLN LABORATORY   NCAR

| RADAR PROCESSOR | → | ALGORITHM PROCESSOR | → | DISPLAY PROCESSOR | ← | HUMAN VERIFIER |

TOWER & TRACON DISPLAYS

744

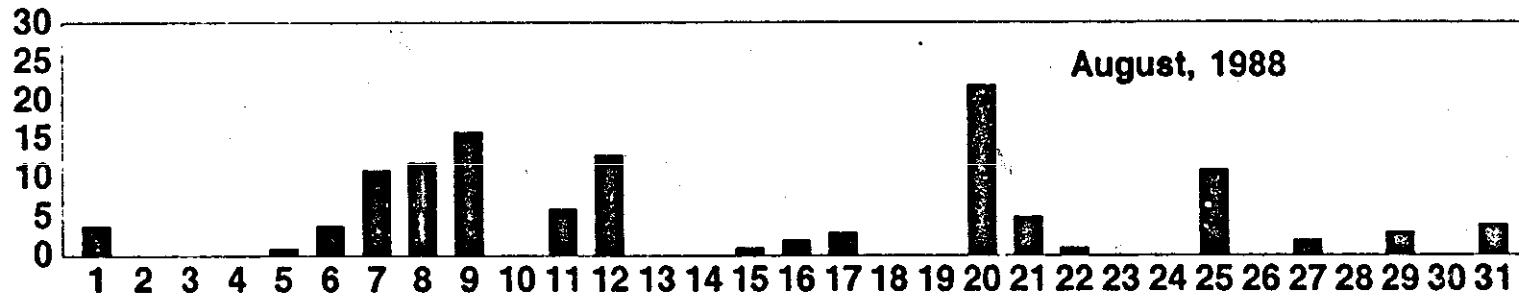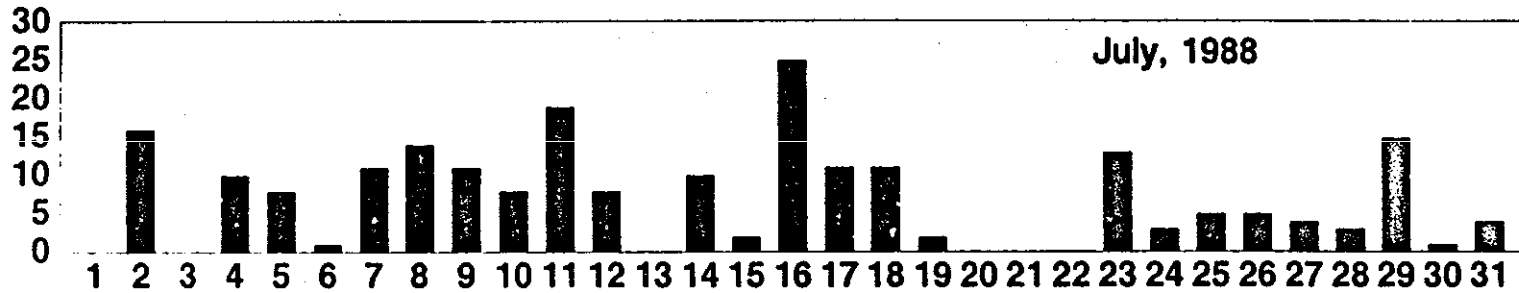12 Oct 88

SUMMARY OF MICROBURST EVENTS

Number of microbursts per day (from daily logs)

745

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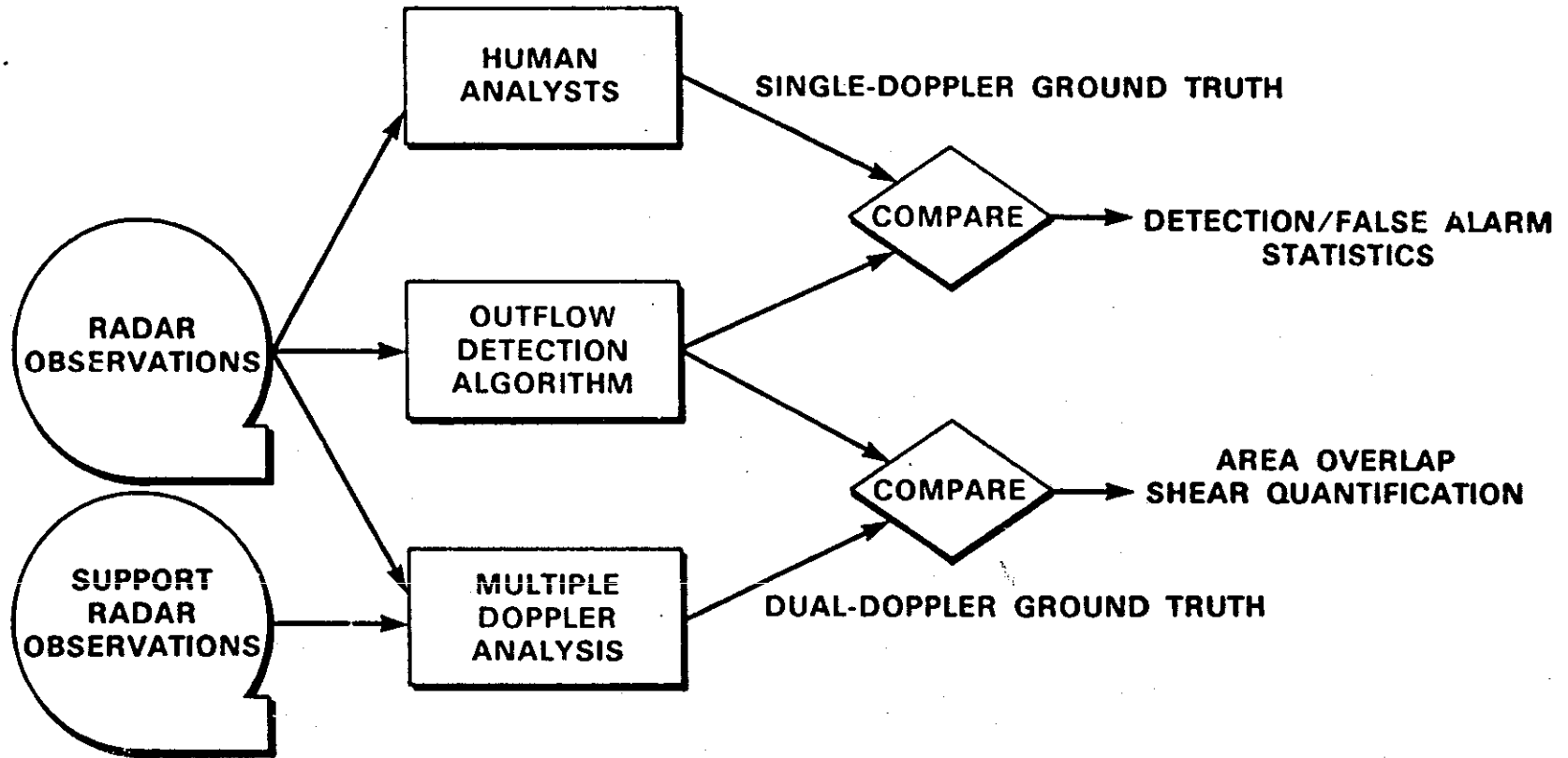# FAA GOALS FOR TDWR
MICROBURST DETECTION PERFORMANCE

- \> 90% PROBABILITY OF DETECTION

- < 10% PROBABILITY OF FALSE ALARM

- ONE MINUTE ADVANCE WARNING

- +/– 5 KNOTS (OR 20%) ACCURACY ON STRENGTH

746

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ALGORITHM SCORING PROCEDURE

RADAR OBSERVATIONS → **HUMAN ANALYSTS** → SINGLE-DOPPLER GROUND TRUTH → COMPARE → **DETECTION/FALSE ALARM STATISTICS**

RADAR OBSERVATIONS → **OUTFLOW DETECTION ALGORITHM** → COMPARE

SUPPORT RADAR OBSERVATIONS → **MULTIPLE DOPPLER ANALYSIS** → DUAL-DOPPLER GROUND TRUTH → COMPARE → **AREA OVERLAP SHEAR QUANTIFICATION**

79242-3

MICROBURST PERFORMANCE ANALYSIS
(SINGLE DOPPLER GROUND TRUTH)

Date	TRUE EVENTS		Detected Events	
	>15 m/s	≤15 m/s	>15 m/s	≤15 m/s
10 June 88	59	37	56	28
21 June 88	45	36	44	32
25 June 88	70	19	69	16
7 July 88	46	48	43	32
17 July 88	39	1	38	1
Totals	259	141	250	109

Probability of Detection (>15 m/s)	=	250/259	=	97%
Probability of Detection (≤15 m/s)	=	109/141	=	77%
Probability of Detection (overall)	=	359/400	=	90%
Probability of False Alarm	=	21/417	=	5%

748

12 Oct 88

PERFORMANCE OF
1-DIMENSIONAL SHEAR LOCATION ALGORITHM

RADIAL VELOCITY → SHEAR SEGMENT SEARCH → AZIMUTHAL ASSOCIATION → DIVERGENCE REGIONS

DISTRIBUTION OF SEGMENT LENGTHS

false (% false)

false (% total)

true (% true)

true (% total)

Cumulative Probability

Length (km)

R.O.C.

Probability of False Alarm

Probability of Detection

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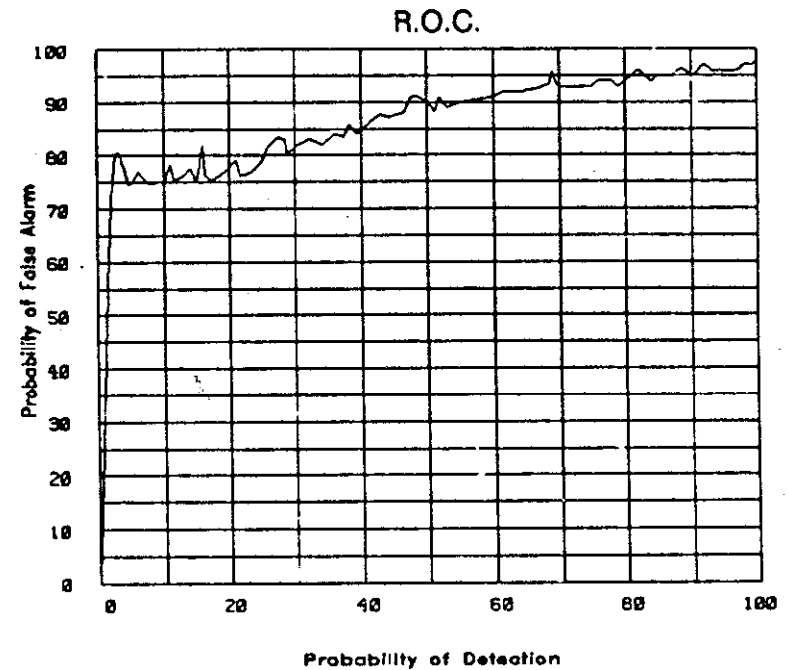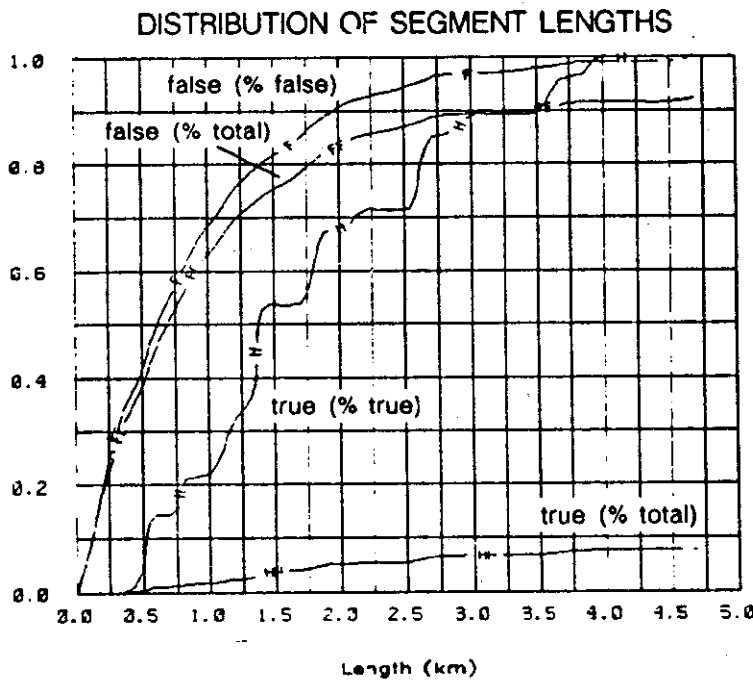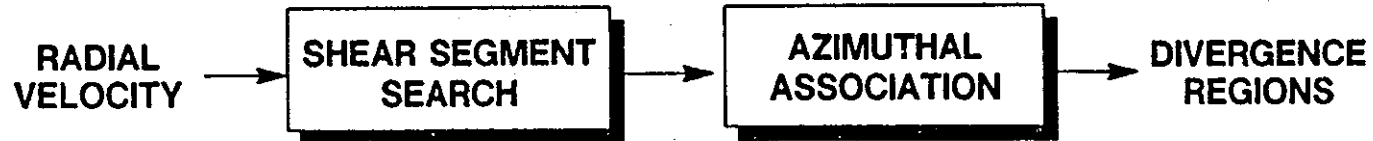
TIMELINESS OF MICROBURST DETECTIONS

HOW MUCH ADVANCE WARNING CAN BE PROVIDED TO PILOTS BY A GROUND-BASED RADAR SYSTEM?

DATE	SURFACE ONLY	3-D ALGORITHM	IMPROVEMENT	PRECURSOR WARNING
7 JUNE 1986	0.0	+1.3	+1.3	+10.1
25 JULY 1986	−1.8	−0.8	+1.0	+6.0
31 JULY 1986	−0.9	0.0	+0.9	+5.7
23 MAY 1987(a)	−3.4	−2.5	+0.9	+6.3
23 MAY 1987(b)	0.0	+2.6	+2.6	+4.7
23 MAY 1987(c)	0.0	0.0	0.0	+4.8
23 MAY 1987(d)	0.0	+2.3	+2.3	+5.9
AVERAGE	−0.9	+0.4	+1.3	+6.2

(MINUTES PRECEEDING START OF EVENT)

12 Oct 88

RADAR OBSERVABILITY OF MICROBURST OUTFLOWS
DENVER, 1988

- COMPARE RADAR OBSERVATIONS WITH SURFACE MESONET

- TIME PERIOD: 1 JULY – 31 AUGUST 1988

- SUMMARY RESULTS:

	RADAR	
	HIT	**MISS**
MESONET — HIT	66 (94.3%)	2 (2.9%)
MESONET — MISS	2 (2.9%)	?

12 Oct 88