20TH CONFERENCE ON RADAR METEOROLOGY

PREPRINTS

November 30-December 3, 1981

AMERICAN METEOROLOGICAL SOCIETY

20th CONFERENCE

ON

RADAR METEOROLOGY

Sponsored by the
AMERICAN METEOROLOGICAL SOCIETY

November 30-December 3, 1981

Boston, Mass.

Cover: A SOUTH-EAST VIEW OF THE CITY OF BOSTON IN NORTH AMERICA (ca. 1723-30), reproduced from a color engraving by I. Carwitham from Antique Views of Boston by James Henry Stark. Design by Polly Doyle, Etchings & Paintings, 26 Chestnut St., Brookline, Mass. (wife of Aaron Fleisher).

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AMERICAN METEOROLOGICAL SOCIETY
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U.S.A.

FOREWORD

Nearly thirty-five years ago the first Weather Radar Conference, as it was called in those early days, was held in Boston. Others followed, usually at intervals of eighteen months to two years and, beginning with the 12th, they became Conferences on Radar Meteorology. We now return to Boston for the 20th of this longest-running series of conferences of the American Meteorological Society.

As this is a rather historic occasion, we on the Program Committee felt that it would be especially fitting to enlist our "classicists" as session chairmen. We are pleased that so many have agreed to serve, and feel sure that they will contribute notably to a successful and enjoyable Conference.

As a result of our experience at the last few Conferences, where there has not been adequate time for either presentation or discussion of the papers, we have decided to try a new format. Each morning, there will be two sets of triple parallel sessions separated by the coffee break. In the afternoons, there will be two plenary sessions at which the morning sessions are summarized by Session Reviewers and papers are open to general discussion. In this conference format the role of the Session Reviewers is a particularly vital one and we are most pleased that those asked have agreed to take on this very important task.

SPIROS G. GEOTIS
Program Chairman

AMS RADAR METEOROLOGY CONFERENCES

March 1947	Boston, (Cambridge) MA
October 1951	Urbana, IL
September 1952	Montreal, CN
November 1953	Austin, TX
September 1955	Asbury Park, NJ
March 1957	Boston, (Cambridge), MA
November 1958	Miami Beach, FL
April 1960	San Fransisco, CA
October 1961	Kansas City, MO
April 1963	Washington, D.C.
September 1964	Boulder, CO
October 1966	Norman, OK
August 1968	Montreal, CN
November 1970	Tucson, AZ
October 1972	Champaign-Urbana, IL
April 1975	Houston, TX
October 1976	Seattle, WA
March 1978	Atlanta, GA
April 1980	Miami Beach, FL
November 1981	Boston, MA

Ode to the 20th Radar Conference

'Tis Radar Conference twenty
Perhaps that ought to be plenty
I remember those of years past
Each was thought to be the last
There was one on Donaldson's nose
Perhaps the knee but not the toes
And many a Z-R relation
And rainfall by attenuation.

There were barbed remarks by Marshall
Which were very impartial;
Atlas' ideas were relevant
To those of a white elephant
He included talks by Kessler
Especially those of Wexler
And was particularly mean
About the perils of Pauline.

There were some moments of glory
Bemis and a down-Maine story
One that was even nicer
The fake paper by Fleisher
That poem about more data
Everywhere now and later
This meeting will not be gratis
We can blame that on Geotis.

Ray Wexler

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Session 1C: Particle Size Distributions and Z-R Relations

Chairman: E. A. Mueller, Illinois State Water Survey, Champaign, Ill.

Session Reviewer: A. Waldvogel, Atmospheric Physics ETH, Zurich, Switzerland.

Session 2A: UHF/VHF Observations

Chairman: K. R. Hardy, ERT, Concord, Mass.

Session Reviewer: R. K. Crane, ERT, Concord, Mass.

Session 2B: Convective Storms--II

Session 2C: Precipitation Measurements--I

Plenary Review Session 1

Plenary Review Session 2

Session 4A: Signal Processing

Chairman: R. M. Lhermitte, Univ. of Miami, Fla.

Session Reviewer: D. S. Zrnic', NSSL/NOAA, Norman, Okla.

Session 4B: Convective Storms--IV

Chairman: R. Cunningham, Lincoln, Mass.

Session Reviewer: J. C. Fankhauser, NCAR, Boulder, Colo.

* Manuscript not available; if received in time, it will appear in back of book.

Session 6B: Boundary Layer

Chairman: E. Kessler, NSSL/NOAA, Norman, Okla.

Session Reviewer: P. H. Hildebrand, NCAR, Boulder, Colo.

Session 6C: Polarization and Multiple Wavelength Techniques--I

Chairman: R. E. Newell, MIT, Cambridge, Mass.

Session Reviewer: J. I. Metcalf, Georgia Institute of Technology, Atlanta, Ga.

* Manuscript not available; if received in time, it will appear in back of book.

Session 7C: Polarization and Multiple Wavelength Techniques--II

Chairman: M. Brook, New Mexico Institute of Mining and Technology, Socorro, N.Mex.

Session Reviewer: B. L. Barge, Alberta Research Council, Edmonton, Alta., Canada.

Session 8A: Data Processing Techniques

Chairman: K. E. Wilk, NSSL/NOAA, Norman, Okla.

Session Reviewer: R. G. Humphries, Alberta Research Council, Edmonton, Alta., Canada.

Session 8B: Hurricanes

Chairman: H. W. Hiser, Univ. of Miami, Fla.

Session Reviewer: R. A. Houze, Jr., Univ. of Washington, Seattle, Wash.

* Manuscript not available; if received in time, it will appear in back of book.

THE POKER FLAT MST RADAR SYSTEM: CURRENT STATUS AND CAPABILITIES

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1. INTRODUCTION

The MST (mesosphere-stratosphere-troposphere) radar nearing completion at Poker Flat, Alaska, is a prototype system designed to continuously observe the atmosphere between 1-100 km. The MST technique, which has been used by a number of existing radars in the VHF-UHF (30-300 MHz) range, affords the possibility of continuously monitoring winds, waves, turbulence and atmospheric stability within this height range (for a discussion of MST capabilities, see Gage and Balsley, 1978; Green et al., 1979; and Balsley and Gage, 1980). The Poker Flat radar was designed to explore the capabilities of the new technique in detail. It has also been designed to operate as an unattended system. The system will operate in conjunction with a variety of other atmospheric-ionospheric research facilities, which are, or soon will be, located nearby. For example, the nearby Poker Flat research range has the capability of launching large experimental rockets designed for mesospheric investigations. Doppler-tracked balloon measurements of wind profiles up to about 30 km are also possible. Additional radar facilities include the Chatanika Incoherent Scatter Radar (to be moved to Greenland in Spring 1982), and NOAA's HF Sounder for mesospheric investigations. Thus the variety of complementary observations made possible by this complex should afford an ideal opportunity to study the atmosphere in detail.

2. SYSTEM DESCRIPTION

As indicated in the artist's sketch shown in Fig. 1, the completed system will consist of two independent, coherent, pulsed, monostatic, VHF radars that operate on an essentially continuous basis. One radar uses one polarization of a phased array antenna directed to a fixed zenith angle and azimuth; the other radar uses a superimposed, orthogonal array directed to the same zenith angle but at a complementary azimuth. The final system will also have a vertical beam, either by phasing one-quarter of one of the oblique arrays or by constructing an additional one-quarter array. Each polarization is fed at 32 points by 32 separate 100 kW peak pulse power transmitters.

The current system is configured somewhat differently, in order to take advantage of the modular design during the construction phase. The present configuration consists of a fully implemented single quarter phased to look in the same oblique directions as the final system (but with a 2° beamwidth). A second quarter with only one transmitter is directed to look vertically. Parameters for both the present and final system are given in Table 1.

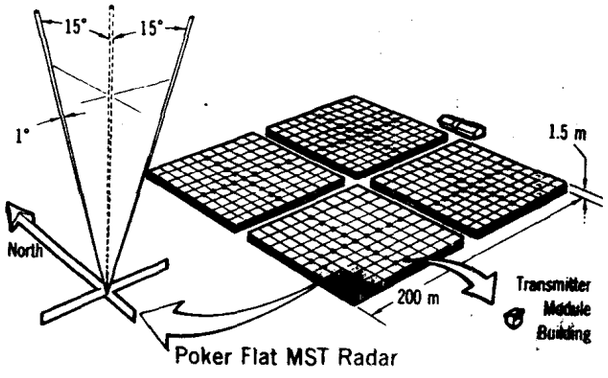

Fig. 1. Artist's sketch of the Poker Flat system.

A photograph of the Poker Flat MST site taken in September 1980 looking approximately northwest is shown in Fig. 2. This view shows the fully-completed antenna array and the 64 transmitter "houses". The current oblique-directed quarter appears in the upper right in the picture, while the vertically-directed quarter is in the upper left. The laboratory is located on the bottom of the picture, to the left of the garage/storage building.

3. DATA ANALYSIS

The on-line data analysis system is comprised of the digital processor, CRT display, hard copy device, and magnetic tape unit. Analog data are acquired from the qdadrature outputs of the three (one vertical and two oblique) receivers. The receiver outputs are sampled following each transmitter pulse at preset height intervals and then digitized at the computer interface. After coherently averaging (i.e., averaging the digital signals at each height interval over a predetermined number of consecutive transmitter pulses), the computer calculates an asymmetric power spectrum at each height for each receiver. A selected number of these Doppler spectra, amounting to about a four minute sample, are then averaged and are written onto magnetic tape and also displayed on a CRT terminal. At the same time the computer

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performs a preliminary analysis of the averaged spectra by computing noise and signal power levels, mean Doppler shifts, and spectral widths. These values are also written on the tape along with "housekeeping" details (transmitter power, phase, line voltage fluctuations, etc.). Further analysis of the tape-recorded data is accomplished using an off-site computer system.

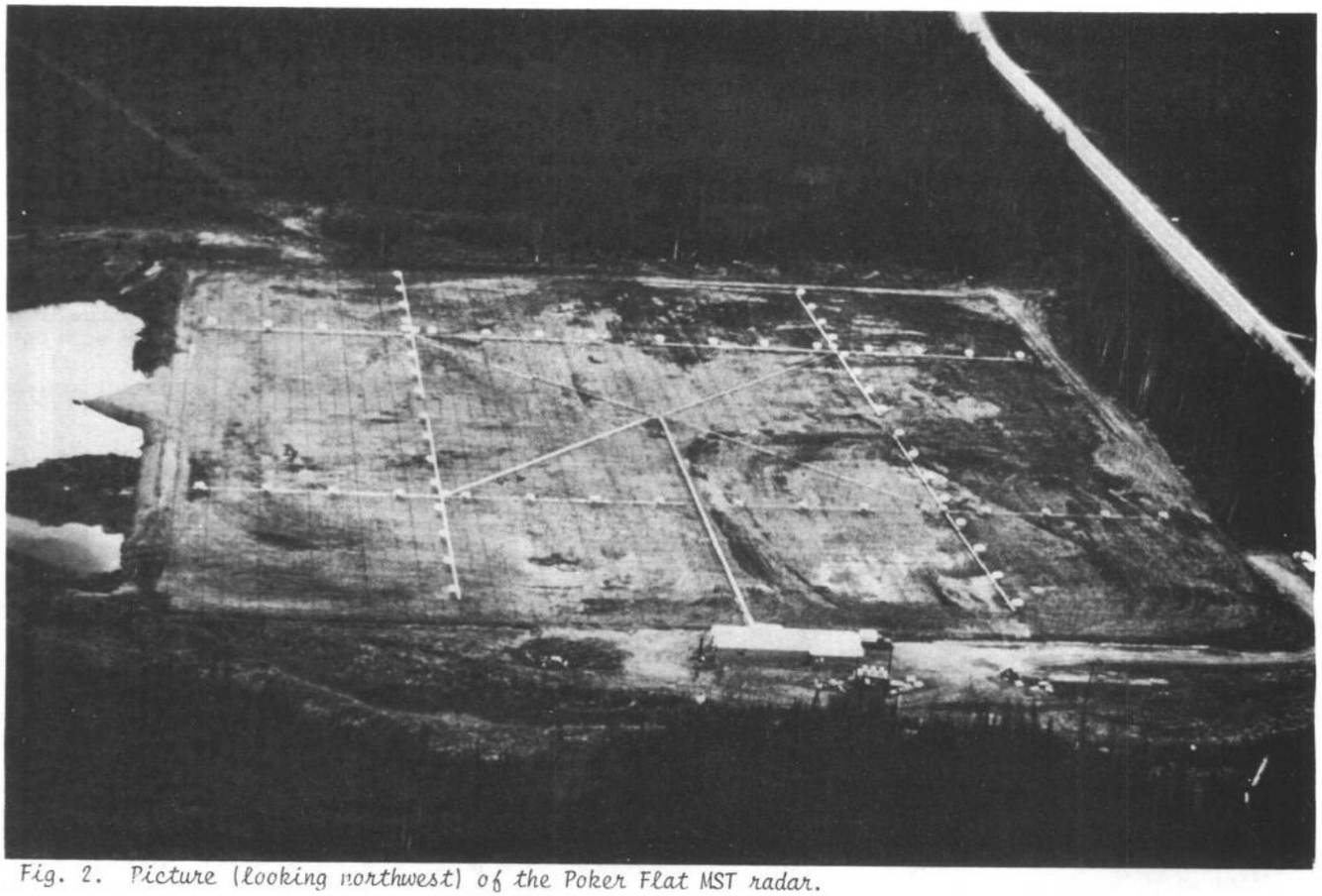

Fig. 2. Picture (looking northwest) of the Poker Flat MST radar.

TABLE 1. POKER FLAT MST RADAR* PARAMETERS

		CURRENT (JUNE 1981)	FINAL
Transmitter	Frequency	49.920 MHz	49.920 MHz
	Peak pulse power	0.5 MWatts/polarization	3.2 MWatts/polarization
	Average power	2 kW/polarization	64 kW/polarization
	Pulse width	16 μsec	2-16 μsec (coded)
	Pulse rate	≃250 Hz	1.25 kHz
Receiver	Noise figure	≃3 dB	≃3 dB
	Bandwidth	Matched to pulse width	Matched to pulse width
	Filtering	Bessel	Bessel
Antenna	Area	10^4 m^2	4×10^4 m^2
	Beamwidth (two-way)	≃2°	≃1°
	Direction	Oblique/vertical	Oblique/vertical
Processing	Coherent averaging	8-10 pulses	40-50 pulses
	Spectral resolution	32 points	64 points

*Location 65° 07' 58" N, 147°

The Poker Flat system has been in almost continuous operation (although at a reduced sensitivity relative to the final system) since February 1979. The extent of this data base has enabled a number of preliminary studies to be made of a variety of atmospheric phenomena. Results from these studies are outlined below.