Report SDSMT/IAS/R-97/02 December 1997

ANNUAL PROGRESS REPORT ON ARMORED T-28 AIRCRAFT FACILITY COOPERATIVE AGREEMENT (ATM-9618569)

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ABSTRACT

This is the annual progress report required under the terms of Cooperative Agreement No. ATM-9618569 between the National Science Foundation (NSF) and the South Dakota School of Mines and Technology (SDSMT). The agreement provides base support for the operation of the SDSMT armored T-28 meteorological research aircraft as a national facility for investigations into cloud, thunderstorm, and hailstorm processes. Field deployments as allocated by the NSF Facilities Advisory Council to support research projects are funded through other sources, including the NSF Lower Atmospheric Research Facilities Deployment Pool. This report covers the period 16 September 1995 through 15 December 1997. During this period, the T-28 participated in the MOLAS project, an attempt to determine the propensity of propeller-driven aircraft to generate ice crystals in supercooled clouds, and a deployment to New Mexico intended to improve the calibration of the electric-field measuring system on the T-28. In addition, research results from prior projects supported by the T-28 were described in research papers in refereed journals and presented at national or international conferences; most included facility personnel as co-authors. Additional work in the area of instrumentation refurbishments and upgrades, aircraft systems improvements, and data analysis and interpretation was carried out.

1. INTRODUCTION

This annual progress report on T-28 research aircraft facility activities under Cooperative Agreement No. ATM-9618569 covers the period 16 September 1995 through 15 December 1997. This agreement became effective 15 March 1997; the extended interval covered in this report provides a bridge between the last report under a previous agreement (Detwiler and Smith 1995) and the present one. The T-28 research project support activity during this period included the MOLAS investigation of the potential for propeller-driven aircraft to generate aircraft-produced ice particles (APIPs). Attempts to carry out the MOLAS flights were made in the Mono Lake region of California/Nevada in the winter of 1995-96 and again in the Fargo, ND, vicinity in the winter of 1996-97. In neither case did the required supercooled cloud or fog conditions develop in the project area while project aircraft were available to fly the missions.

A more successful deployment was made to New Mexico in the summer of 1997. The purpose was to continue work on the calibration of the electric-field-measuring system on the T-28, and also to advance plans for an upgrade of that system. This work, carried out with cooperation from the New Mexico Institute of Mining and Technology, followed up an earlier deployment in 1990 during which the first full T-28 system calibration was accomplished.

Major facility upgrades completed during the period included conversion of the GPS navigation system to an IFR-certified category; acquisition of a new liquid-water probe to replace the obsolete Johnson-Williams unit; repair of the 2D-C optical array probe for sensing “cloud” particles; and acquisition of a video camera and recording system for the aircraft. Substantial work was done, with excellent cooperation from the National Center for Atmospheric Research (NCAR) Research Aviation Facility, to develop an upgraded data acquisition system for the T-28.

Subsequent sections present further details of these and related activities, along with plans for future facility activities.

2. PROGRESS DURING THE PERIOD

2.1 Project Support

2.1.1 MOLAS

The T-28 was allocated to support the MOLAS investigations of aircraft-produced ice particles (APIPs) during the winter of 1995-96 and again for 1996-97. The aircraft was deployed on a standby basis to Carson City, Nevada, during the months of December 1995 and January 1996. The objective was to fly the aircraft through supercooled fog over Mono Lake, California, using a variety of engine power and propeller speed settings to establish the envelope of operating conditions over which it may tend to generate APIPs. The deployment was requested by Dr. William Woodley of Woodley Weather Consultants, and funded by the NSF Lower Atmospheric Research Facilities deployment pool.

The actual observations of any APIPs were to be obtained by a separate cloud physics aircraft flying transects across the T-28 trail through the supercooled fog. The T-28 was not required to carry any research instrumentation, but did carry SF_6 dispensing apparatus (furnished by the University of Wyoming) to facilitate pinpointing the T-28 flight path. A radar altimeter was also added to the T-28 avionics to help insure safety in the low-level flights over Mono Lake.

Table 1 summarizes the 1995-96 (and 1996-97) T-28 flight activity associated with MOLAS. The aircraft was ferried to Carson City in December 1995 to be ready for flights on short notice into the Mono Lake fog zone. Unfortunately, no suitable fog situations developed during the winter period of prime opportunity. The aircraft was therefore ferried back to Rapid City after the season for supercooled fog situations had passed.

The requesting scientist subsequently asked for another opportunity to try this experiment in the 1996-97 winter season, and the facility was allocated to support that work. This time the base of operations was shifted to Fargo, ND, due to the availability there of another aircraft for which APIPs characteristics were also desired. The SF_6-dispensing equipment was loaned to the facility by North American Weather Consultants of Salt Lake City, UT. The T-28 was ferried to Fargo in January 1996 to be ready for the MOLAS missions. Once again, however, the necessary supercooled cloud conditions failed to materialize during the project period. Therefore, the T-28 was returned again to Rapid City in February.

Table 1

T-28 Flights in Support of MOLAS - 1995/96/97

Date	Flight No.	Time (hours)	Purpose
(1995)			
15 Dec	673	2.3	Test
16 Dec	674	1.9	Ferry RAP → RKS
16 Dec	675	2.0	Ferry RKS → EKO
16 Dec	676	1.3	Ferry EKO → O04
(1996)			
18 Jan	677	1.8	Ferry O04 → EKO
18 Jan	678	1.0	Ferry EKO → RKS
18 Jan	679	1.8	Ferry RKS → RAP
(1997)			
6 Jan	682	2.1	Ferry RAP → FAR
5 Feb	683	2.4	Ferry FAR → RAP
	TOTAL	16.6	

Both the requesting scientist and the cognizant NSF program officers desire to see the MOLAS experiments carried out. The costs of standby deployments like those described above are minimal. Therefore, Dr. Woodley asked for a final opportunity to attempt the experiments in the winter of 1997-98, and the facility has been allocated to support that work. Current plans are to carry out the experiment in elevated supercooled stratus clouds along the northern Colorado Front Range in late January and February, 1998.

2.1.2 New Mexico 1997

A T-28 deployment to New Mexico for the purpose of resolving questions about the calibration of the electric-field measuring system on the T-28 was requested by Andrew Detwiler, T-28 Facility Scientist. An earlier deployment to New Mexico in 1990 had provided initial calibration data for this system. However, comparison of electric-field measurements by several of the aircraft participating in the 1991 CaPE project in Florida has revealed

discrepancies that can not be readily explained. In addition, problems with the field component along the flight axis of the aircraft, which cannot be accurately measured by the current T-28 system, and with the effects of charge emitted by the aircraft when it is highly charged, required further investigation.

The New Mexico Institute of Mining and Technology (NMIMT) SPTVAR aircraft is especially well-equipped for electric field measurements, and scientists at NMIMT have been in the forefront of developing techniques for calibrating aircraft field-measuring systems. The NMIMT aircraft and the T-28 still carry the same instrumentation used in the 1990 SPTVAR/T-28 intercomparisons. In addition, NMIMT has developed a new configuration for aircraft electric-field meters that seems to overcome most of the measurement difficulties caused by charge emitted from the engine, propeller, and airframe. That configuration has been implemented in a parallel installation on the SPTVAR, and upgrade plans for the T-28 include a similar installation in the near future. Thus the opportunity to fly the T-28 in conjunction with the SPTVAR would provide extremely valuable data on the calibration of the existing T-28 system, as well as an opportunity for evaluating the advantages of the new configuration. Consequently, deployment-pool funds were allocated to support this activity in August 1997.

Logistical requirements favored the use of Albuquerque, NM, as the base of operations for the T-28. The SPTVAR operated from its home base in Socorro. Table 2 lists the T-28 flight activity in conjunction with the New Mexico deployment.

Table 2
T-28 Flights for New Mexico Deployment - 1997

Date	Flight No.	Time (hours)	Purpose
12 June	688	1.1	Test
8 July	689	1.2	Test
31 July	690	1.2	Test and self-calibration
4 Aug	691	3.7	Ferry RAP → ABQ
6 Aug	692	2.3	Research
6 Aug	693	0.6	Ferry Socorro → ABQ
9 Aug	694	1.7	Research
10 Aug	695	1.8	Research
11 Aug	696	1.6	Research
13 Aug	697	1.8	Research
14 Aug	698	3.7	Ferry ABQ → RAP
TOTAL		20.7	

Test flights in Rapid City during June and July 1997 allowed us to verify good operation of the essential systems on the aircraft for the August deployment. Duties of facility ground personnel had shifted somewhat from previous years and they had to learn to perform some new tasks. The crew was well-prepared by the time of the deployment to New Mexico. The flights on 6 August were conducted in a shake-down mode, to give the pilots an opportunity to work out how to handle the required formation flying in the vicinity of thunderstorms. Extensive intercomparisons were carried out during formation flights on 9 and 10 August, with more than a dozen individual passes under and alongside of small thunderstorms. Figure 1 shows examples of some of the data recorded by the measurement systems on the two aircraft during one pass.

The T-28 attempted solo self-calibration maneuvers under the anvils from small thunderstorms in the vicinity of Socorro Airport on 11 August. However, the ambient fields were not constant over wide enough areas, and there was a problem in recording the T-28 heading data. The data obtained during some segments on this flight were useful in verifying the relative responses of the aircraft system to field components along the wing, and in the aircraft vertical. Relative response to the component along the fuselage axis has not as yet been as cleanly resolvable.

The flight on 13 August also involved some self-calibration maneuvers, as well as coordinated penetrations of a small thunderstorm with the SPTVAR and T-28 at different altitudes. Analysis of data from this flight is still in progress.

The deployment was successful in demonstrating that the calibration matrix for the T-28 electric-field measurement system is still the same as deduced from the 1990 intercomparisons. Comparisons between the old SPTVAR system, the T-28 system, and the new SPTVAR system show that a system like the new SPTVAR system on the T-28 would yield cleaner measurements than the current system. The new NMIMT-design system would provide a good estimate of the field component along the fuselage, the component that cannot be well-resolved by the present T-28 system. Finally, the intercomparison observations allow us to recognize more reliably artifacts in observations from the existing T-28 system, and the data it produced during major field projects in 1989, 1991, and 1993 through 1995.

(a)

(b)

(c)

Figure 1. (a) Example of a comparison of vertical component of electric field retrieved from the T-28 (E_z), the SPTVAR "old" fuselage system (E_{zo}) and the SPTVAR "new" wing pod system(E_{zn}). Abrupt changes are caused by lightning nearby as the aircraft flew in formation under a thunderstorm. Spikes due to telemetry dropouts are also present in the SPTVAR data. (b) The horizontal field component transverse to the aircraft direction of motion for the same period as in (a), as determined from the T-28 (E_y), and SPTVAR "old" (E_{yo}) and "new" (E_{yn}) systems. (c) The horizontal field component along the fuselage for the same period as in (a), as determined from the T-28 (E_x), and SPTVAR "old" (E_{xo}) and "new" (E_{xn}) systems.

2.2 Instrumentation Developments

The instrumentation refurbishments and upgrades planned under this Cooperative Agreement are well under way. Items already acquired and installed include:

- A new cloud liquid water sensor, to replace the obsolete Johnson-Williams unit.

- A video camera and recorder unit. As a fringe benefit, the recording unit provides continuous high-quality audio recordings for the cockpit voice channel and the windscreen hail microphone throughout the entire flight, a capability not available with the old audio recording system.

In addition, repair of the Particle Measuring Systems, Inc. (PMS), 2D-C “cloud” particle imaging probe has been completed and repair of the PMS FSSP cloud droplet spectrometer is soon to begin. With funds saved from the anticipated cost of the LWC sensor and the data system upgrade (see below), the FSSP repair work has been expanded to include replacement of the electronics as well as the optics with state-of-the-art components.

Work on the new data acquisition system has progressed well, thanks largely to excellent cooperation from the NCAR Research Aviation Facility (RAF). The T-28 facility engineer and programmer visited the RAF in Boulder and the University of Wyoming King Air facility in Laramie to review their current approaches to data acquisition and processing. The plan decided upon is to essentially duplicate the relevant features of the system currently used on RAF aircraft, and employ as many physical components from the system currently in the NCAR sailplane as possible. There are no current plans for use of the sailplane, but elements that would be hard to transfer from one platform to the other are being replicated for the T-28 system. This will facilitate deployment of the sailplane when it is next needed in the field.

Remaining major acquisitions include a High Volume Particle Sampler (HVPS) for imaging precipitation particles and a set of new electric-field meters like those on the SPTVAR. Plans had been made to borrow these instruments from NMIMT for testing on the T-28 during the RACES project in 1998, before proceeding with a procurement action. Since RACES will not go forward as planned (see Sec. 3.1), that situation is currently being re-evaluated.

2.3 Aircraft and Avionics Developments

A telemetry ground station and computer display system to facilitate T-28 system test activities was established and demonstrated at the Rapid City National Weather Service Forecast Office, collocated on the SDSM&T campus. Several test flights have shown that this system can be used reliably at ranges up to approximately 120 km from Rapid City. The ground equipment is the same as that used in field projects supported by the T-28, so it is not permanently located at the NWS office. However, the antennas and cabling were left in place so that setup time would be minimal for any future Rapid City activities.

The required 5-year propeller inspection was completed in March 1997. We were able to save sufficient funds from several cost categories to have the T-28 GPS navigation unit upgraded and certified for IFR flight.

2.4 Administrative and Scientific Meetings

The T-28 facility was represented at the April 1997 meeting of the NSF Observing Facilities Advisory Panel by the Facility Scientist, and at the October 1997 Panel meeting by the Facility Manager. The Facility Scientist attended the 1997 Fall Meeting of the American Geophysical Union to present a paper on the T-28 electric-field measurements and discuss with colleagues future plans for RACES (see Sec. 3.1) and other field projects.

2.5 Educational and Informational Activities

An article about the T-28 New Mexico deployment appeared in the 1 September 1997 issue of *The Dallas Morning News*, and elsewhere. A sidebar describing the T-28 appeared in the October/November 1997 *Weatherwise* article “Riders on the Storm”. A local Rapid City TV station produced a short video item concerning the T-28 facility operation. The facility scientist made roughly a dozen presentations during the reporting period describing facility research activities to school groups and community organizations in the region.

A T-28 web page was established at http://thunder.ias.sdsmt.edu/t28/ to make information about the facility and its capabilities readily accessible. A web-based request form will be implemented in the near future.

3. PLANS FOR NEXT FUNDING YEAR

3.1 Projects to be Supported

At this time the T-28 has been allocated to support the MOLAS project during the winter of 1997-98. This is a repeat of the earlier attempts (see Sec. 2.1.1) to obtain information about production of APIPS by the aircraft. The procedure to be followed will be the same as that intended for those attempts, with a fervent hope for suitable supercooled fog or cloud situations. The region of operations will be the Colorado Front Range from Colorado Springs north to Cheyenne.

A request for T-28 support of the RACES project in the summer of 1998 was reviewed by the NSF Observing Facilities Advisory Panel (OFAP) at its October 1997 meeting. The OFAP evaluation of the T-28 contribution to RACES was quite favorable, and the Panel recommended allocation of the facility for that purpose. A RACES deployment would have made good use of the evolving T-28 electric-field measurement capabilities. Unfortunately, numerous technical and other difficulties with the RACES program plans led NSF to decline the RACES science proposals, obviating the need for T-28 support. It is anticipated that efforts will be made to overcome the deficiencies, with a revised request for RACES support by the T-28 and other facilities to come later.

Areas of interest to the evolving multi-agency National Aviation Weather Program include Convective Hazards and Turbulence. The T-28 facility is ideally suited for work in the former, and has been involved in studies of turbulence in connection with past weather modification research projects (e.g. Sand *et al.* 1976). A test flight carried out on 15 May 1996 using the NWS ground station (see Sec. 2.3) included acquisition of some turbulence data with flight guidance provided using the Rapid City NEXRAD radar. The results showed a capability to generate turbulence data and relate them to the radar observations. This capability could be useful to the Turbulence component of the National Program, and example results were forwarded to NCAR scientists organizing FAA-sponsored turbulence investigations. Other potential uses of the T-28 in the National Program will be explored during the coming year.

Faculty personnel are currently exploring other potential uses of the T-28 in future field projects. These might involve: 1) monitoring precipitation development in clouds treated with hygroscopic nuclei, 2) monitoring transport of boundary-layer gases upward to the upper troposphere by thunderstorms, 3) observing the link between microphysics and electrification in

thunderstorms, and 4) providing *in situ* measurements to assist in the interpretation of multiparameter radar signatures.

3.2 Facility Refurbishments and Upgrades

We anticipate completing the instrumentation refurbishments and upgrades (see Sec. 2.2) during the coming year. Completion of the new data sys-

tem, with important assistance from the NCAR RAF, is expected in the spring of 1997. A requested supplement (funding for which is eagerly anticipated) will provide a Post-Doctoral scientist who will help fabricate and mount new electric-field meters for the T-28 according to the NMIMT design. A decision about the best way to proceed with the HVPS acquisition will be made in the spring.

A major spring activity, not anticipated at the time the Cooperative Agreement was established, will be having the T-28 repainted. Skin corrosion discovered during the regular annual inspection cycle following the New Mexico 1997 deployment makes this repainting mandatory. Initial plans to have that done in the Fall of 1997 had to be postponed because the shop submitting the low bid could not accommodate the T-28 until the spring of 1998.

3.3 Data Analysis Efforts

The T-28 facility staff will continue with data analysis and publication work as time and resources permit. Primary emphasis will be placed on completing analysis of data from CaPE and organizing the results of the New Mexico flights into a comprehensive calibration of the field-measuring system. A report, and possibly a brief journal manuscript, summarizing the results of both the 1990 and 1997 SPTVAR/T-28 calibration work is planned. Work on a synthesis of aircraft data from the 1993 North Dakota Tracer Experiment (NDTE) and the 1989 North Dakota Thunderstorm Project, in collaboration with the University of North Dakota, will continue.

4. PERSONNEL

The key personnel indicated in Section I.10 of the Agreement as amended remain committed to the project at the levels indicated.

5. PUBLICATION ACTIVITY

Published in Refereed Journals

Ramachandran, R.G., A. G. Detwiler, J. H. Helsdon, P. L. Smith and V. N. Bringi, 1996: Precipitation development and electrification in Florida thunderstorm cells during CaPE. *J. Geophys. Res*., **101,** No. D1, 1599-1619.

French, J. R., J. H. Helsdon, A. G. Detwiler and P. L. Smith, 1996: Microphysical and electrical evolution of a Florida thunderstorm. Part I: Observations. *J. Geophys. Res.,* **101**, No. D14, 18,961-18,977.

Bloomer, M.C. and A.G. Detwiler, 1996: Implications from the North Dakota Tracer Experiment of 1993 for the glaciogenic seeding of supercooled convective clouds to suppress hail. *J. Weather Modification,* **28,** 86-91.

Submitted to Refereed Journals

Smith, P.L., D.J. Musil, A.G. Detwiler, and R. Ramachandran, 1998: Observations of mixed-phase precipitation within a CaPE Thunderstorm. (Submitted to *J. Appl. Meteor.,* 1997)

Detwiler, A.G. and H. Norment, 1998: The M-Meter: A simple airborne hydrometeor measurement instrument. (Submitted to *Journal of Atmospheric and Oceanic Technology*, 1997)

Presented at Conferences

Chang, W-Y, A. G. Detwiler, M. R. Hjelmfelt, and P. L. Smith, 1995: Radar and in-situ microphysical observations in a high plains squall line. Preprints, *27th Conf. Radar Meteor.,* Vail, CO, Amer. Meteor. Soc., 559-561.

Hjelmfelt, M.R., L.R. Johnson, A.G. Detwiler, D.L. Priegnitz, P.L. Smith, B.A. Boe and R.F. Reinking, 1995: Radar analysis of the 15 July 1993 North Dakota record rainstorm. Preprints, *27th Conf. Radar Meteor.*, Vail, CO, Amer. Meteor. Soc., 571-573.

Smith, P.L. and A.G. Detwiler, 1996: Aircraft observations within thunderstorms for validation of microphysical inferences from multiparameter radar data. *Proc., Second International Airborne Remote Sensing Conference and Exhibition*, San Francisco, CA, ERIM, II-507-516.

Detwiler, A.G., P.L. Smith, and J.L. Stith, 1996: Studies of thunderstorm transport processes with aircraft using tracer techniques. *Proc., Second International Airborne Remote Sensing Conference and Exhibition*, San Francisco, CA, ERIM, I-3-10.

Smith, P.L., T.E. Bowen, A.G. Detwiler, J.L. Stith, B.A. Baum, and R.F. Reinking, 1996: Summary of some cloud transport and dispersion experiments using a gaseous tracer and radar chaff. *Proc., 12th Int. Conf. on Clouds and Precipitation,* Zurich, 514-517.

Stith, J.L., R.J. Zerr, A.G. Detwiler, and P.L. Smith, 1996: A comparison of the microphysical characteristics of convective clouds during a wet summer and a dry summer. *Proc., 12th Int'l. Conf. Clouds and Precip.,* Zurich, 179-182.

Project Summary Reports

Detwiler, A.G., K.R. Hartman, and P.L. Smith, 1996: Summary of T-28 participation in VORTEX/MIGHT, 1994-1995. Report 96-1, Institute of Atmospheric

Sciences, South Dakota School of Mines and Technology, Rapid City, SD 57701, 108 pp.

Other Items

Jin, Q., 1996: Analysis of a Florida thunderstorm during the Convection and Precipitation/Electrification Project: The case of 13 August 1991. M.S. Thesis, Department of Meteorology, South Dakota School of Mines and Technology, Rapid City, SD. 77 pp.

Krcil, K.L., 1996: Multi-dimensional modeling case study of the 1 July 1993 North Dakota Tracer Experiment hailstorm. M.S. Thesis, Department of Meteorology, South Dakota School of Mines and Technology, Rapid City, SD. 133 pp.

Schimelfenig, T.T., 1996: Three-dimensional numerical simulation of an extratropical squall line: North Dakota Thunderstorm Project, 17 July 1989. M.S. Thesis, Department of Meteorology, South Dakota School of Mines and Technology, Rapid City, SD. 115 pp.

Zhang, Y., 1996: A modeling study of the 24 June 1992 thunderstorm in Colorado. M.S. Thesis, Department of Meteorology, South Dakota School of Mines and Technology, Rapid City, SD. 116 pp.

Detwiler, A.G., and J.H. Helsdon, 1997: Scientific Overview of Radar and Aircraft Cloud Electrification Studies (RACES), 1998. Bulletin 97-1, Institute of Atmospheric Sciences, South Dakota School of Mines and Technology, Rapid City, SD, 26 pp.

Papers by Other Authors Using T-28 Data

Brandes, E.A., J. Vivekanandan, J.D. Tuttle, and C.J. Kessinger, 1995: A study of thunderstorm microphysics with multiparameter radar and aircraft observations. *Mon. Wea. Rev.*, **123**, 3129-3143.

Bloomer, M.C., M.R. Hjelmfelt, A.G. Detwiler, and P.L. Smith, 1995: Circulations and microphysical developments in convective cloud complexes observed with radar and aircraft. *Preprints, 27th Conf. on Radar Meteorology*, Vail, CO, Amer. Meteor. Soc., 386-388.

Stith, J.L., J. Scala, R. F. Reinking and B. E. Martner, 1996: Combined use of three techniques for stuyding transport and dispersion in cumuli. *J. Appl. Meteor.,* **35**, 1387-1401.

Liao, L., R. Meneghini, T. Iguchi and A. Detwiler, 1997: Estimation of snow parameters from dual-wavelength airborne radar. *Preprints, 28th Conf. Radar Meteorology,* Austin, TX, Amer. Meteor. Soc., 510-511.

6. Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Andrew G. Detwiler

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Further Investigation of Microphysical, Kinematic, and Electrical Characteristics of CaPE Thunderstorms

Source of Support: National Science Foundation

Total Award Amount: $90,000/yr. Total Award Period Covered: 1 Dec 1995-30 Nov 1998

Location of Project: Rapid City, SD

Person-Months Per Year Committed to the Project. Cal: 1.6 mo. Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Armored T-28 Aircraft Facility for Research Requiring Thunderstorm Penetrations

Source of Support: National Science Foundation

Total Award Amount: $701,300 Total Award Period Covered: 15 Mar 1997-29 Feb 2000

Location of Project:

Person-Months Per Year Committed to the Project. Cal: 6 mo.* Acad: Sumr: * cost-sharing

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Analysis & Intepretation of Contrail Formation Theory & Observations

Source of Support: AFOSR

Total Award Amount: $25,000 Total Award Period Covered: 15 Jan 1997-31 Mar 1998

Location of Project: Rapid City, SD

Person-Months Per Year Committed to the Project. Cal: 2.4 mo. Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Paul L. Smith

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Further Investigation of Microphysical, Kinematic, and Electrical Characteristics of CaPE Thunderstorms
Source of Support: National Science Foundation
Total Award Amount: $90,000/yr. Total Award Period Covered: 1 Dec 1995-30 Nov 1998
Location of Project: Rapid City, SD
Person-Months Per Year Committed to the Project. Cal: 1.8 mo. Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Armored T-28 Aircraft Facility for Research Requiring Thunderstorm Penetrations
Source of Support: National Science Foundation
Total Award Amount: $701,300 Total Award Period Covered: 15 Mar 1997-29 Feb 2000
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 1.5 mo. Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Adaptive Threshold Approaches for Determining ATI from Satellite Data to Estimate Rain Volumes
Source of Support: NASA
Total Award Amount: $60,000/yr. Total Award Period Covered: 1 May 1995-30 April 1998
Location of Project: Rapid City, SD
Person-Months Per Year Committed to the Project. Cal: 0.5 mo. Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Upper Missouri River Basin Project
Source of Support: NASA
Total Award Amount: $800,000 Total Award Period Covered: 1 Feb 1998-31 Jan 2000
Location of Project: Rapid City, SD
Person-Months Per Year Committed to the Project. Cal: 1.8 mo. Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Source of Support:
Total Award Amount: Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

7. COST SHARING FUNDS

As of 1 December 1997, SDSM&T has provided $39,100 in cost-sharing expenditures in support of this Cooperative Agreement. We anticipate providing another $20,000 by 28 February 1998.

8. RESIDUAL FUNDS

As of 30 November 1997 a balance of $65,690 remains in the Permanent Equipment category. These funds are intended for completion of the system refurbishment/upgrade as discussed in Secs. 2.2 and 3.2 of this report as well as Sec. 2.5 of the original proposal. Major acquisitions to be completed include the new data acquisition system, the improved electric-field meters and the HVPS precipitation-particle sensor. Expenditures for these items may be encumbered by 28 February, but at this time we are not certain of that.

We anticipate a residual balance at 28 February 1998 of about $20,000 in the Salaries and Benefits category, including the associated indirect costs. Another $6,000 is estimated in the Other Direct Costs category, though part of that amount will be needed for “non-permanent-equipment” components of the data acquisition system.

There is a current residual balance of almost $6500 in the account for the New Mexico 1997 deployment. A few charges remain outstanding, including the production of the project summary report. The MOLAS deployment will not occur until early 1998, so we have no basis for forecasting any residual funds from that deployment.

9. COST RECOVERY FUNDS

No cost recovery funds were generated during the period covered by this report. At this time we anticipate no cost-recovery activity during the next funding year.

10. REFERENCES

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