



The Institute of Atmospheric Sciences at South Dakota School of Mines & Technology

Rapid City, South Dakota

Celebrating 50 years of success



A Very Special Thank You

***We wish to extend our grateful appreciation to
Dr. Arnett Dennis, Dr. Paul Smith, Dr. Briant Davis,
Dr. Harry Orville, Dr. Andrew Detwiler, and Mr. Dick Farley
for all their help in contributing to and editing this document.
Without their knowledge and direction, it would have been an
impossible task.***

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SPECIAL RESOLUTION NO. 30-1959

The Institute of Atmospheric Sciences was created by a special resolution of the Board of Regents of the State of South Dakota in 1959.

WHEREAS, the economy of South Dakota has much to gain from successful efforts in weather modification; and

WHEREAS, methods and practices in weather modification are handicapped by a lack of basic knowledge; and

WHEREAS the Congress, through appropriations to the National Science Foundation, has implemented its support of basic research in the atmospheric sciences; and

WHEREAS, it is reasonable and proper that South Dakota talent be mobilized to advance these researches insofar as it is practicable; and

WHEREAS, preliminary conversations reveal that an administrative headquarters, such as a department, is essential to expeditious and probable favorable consideration of research proposals,

NOW, THEREFORE, BE IT RESOLVED that an Institution of Atmospheric Sciences be created at the South Dakota School of Mines and Technology, and it is hereby created, to provide for and to conduct a program of basic and applied research in the several atmospheric sciences which research shall be calculated to expand the knowledge in the atmospheric sciences and to discover methods or procedures for the utilization of old and newly acquired knowledge in the art of weather modification; and

BE IT FURTHER RESOLVED that the Institute be authorized to receive grants, gifts, awards, and bequests of monies and/or equipment and to expend and/or use them in the prosecution of its objectives and to accept the loan of equipment from whatever source and to utilize it for these purposes all under the general control of the Board of Regents; and

BE IT FURTHER RESOLVED that such personnel as in its judgment shall be needed to prosecute the purposes of the Institute shall be appointed by the Board of Regents.

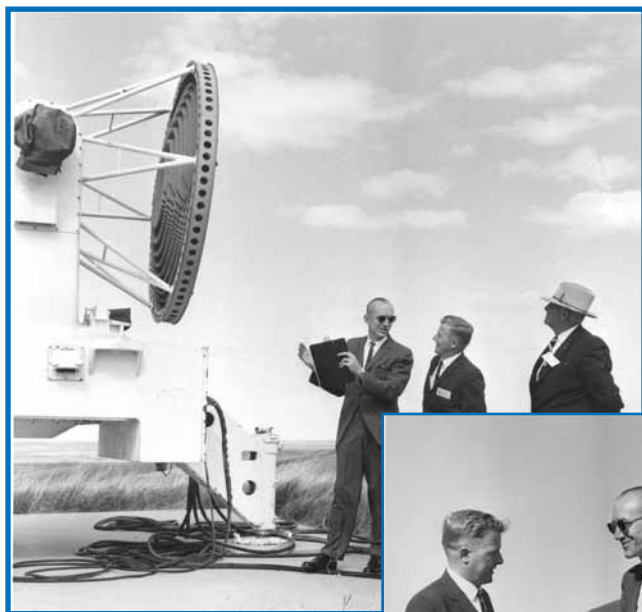
ATMOSPHERIC SCIENCES AT THE SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY

An Introduction

Note: The history of the Institute of Atmospheric Sciences (IAS) would be incomplete without mention of the Department of Atmospheric Sciences (in early years termed “Department of Meteorology”) so intertwined in this narrative will also be references to departmental activities. The research scientists at IAS also serve as faculty in the department.

The IAS was formally established in 1959 because of the great interest in weather modification developed during the 1950's. The Dean of Agriculture at South Dakota State University, A.M. Eberle, had been vice chairman of President Eisenhower's Advisory Committee on Weather Control, which had reported some favorable results regarding weather modification. Senator Francis Case had played a key role in the establishment of the Advisory Committee. The Institute was created in 1959 by Special Resolution No. 30-1959 of the Regents of Education of South Dakota “...to provide for and to conduct a program of basic and applied research in the several atmospheric sciences, which research shall be calculated to expand the knowledge in the atmospheric sciences and to discover methods or procedures for the utilization of old and newly acquired knowledge in the art of weather modification; ...”

This resolution took note that the U.S. Congress had implemented support of basic research in the atmospheric sciences and that it was reasonable and proper that South Dakota talent be mobilized to advance that research. During the next few years, a program of special studies and field experiments in weather modification got underway under a part-time appointment of Professor Joseph Cope (also the director of the School of Mines' Experiment Station at that time) as administrative officer. Cope and Professor Hoyt Hart were involved in the management, research, and educational program. Cope had come to Mines in 1950, Hart in 1964. An introductory course in meteorology was listed in the university catalog under the Physics Department in the early 1960's. One meteorologist was added to the Mines staff, but the IAS remained an almost empty shell for the first few years of its existence.



Richard Schleusener, above and directly right, discusses the new radar system with state officials.



Harry Orville discussing the new radar equipment with state officials.



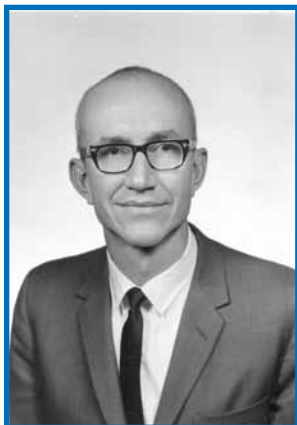
1960's

The Early Years of IAS – 1960's

Many members of Congress from western states became impatient with the slow pace of weather modification research in the various agencies of the Federal Government. They wanted applied research as well as the basic research being pursued by the National Science Foundation. In 1961 Congress charged the Bureau of Reclamation within the Department of Interior to develop and manage a program "to conduct research on increasing rainfall by cloud seeding" throughout the western states. The legislation included commitments for the establishment of new atmospheric science research programs in many of the so-called Reclamation states. This was a mechanism that brought many members of Congress on board as co-sponsors, and Sen. Karl Mundt and Rep. E.Y. Berry were enthusiastic supporters who made sure that South Dakota would get its share of the newly available funds.

The Reclamation program, named Project Skywater, was managed from the Bureau of Reclamation's Engineering and Research Center in Denver. Reclamation recruited Dr. Archie Kahan, a well-qualified scientist and administrator, to relocate from the University of Oklahoma to Denver to assume the overall management of the Skywater program. Kahan previously had worked for Irving P. Krick's weather modification operation, as well as for the Army Corps of Engineers and the Weather Bureau.

An NSF-sponsored conference on atmospheric science research was held in Rapid City in February 1962 and recommendations were made that provided an overall road map for the research and educational program which followed. The participants, one of whom was Dr. Vincent Schaefer, whose research on cloud seeding with dry ice had opened the era of modern weather modification activity in the United States, recognized the natural cloud laboratory that the Black Hills provide. Decisions were made to concentrate on studying the possibility of increasing rain and decreasing hail from convective-type clouds. Pursuant to those recommendations, limited field programs were carried out in the summers of 1963 and 1964.



Recruitment of Dr. Richard Schleusener

Senator Mundt was well aware that neither Mines nor any other college in South Dakota had staff members capable of running an extensive program of research into weather modification. A faculty member from

South Dakota State University, Dr. Emily Frisby, came out to Rapid City in 1962 to carry out a few exploratory cloud-seeding missions, but no systematic evaluation of seeding effects was made. A small Bureau of Reclamation contract with Mines achieved the same result in 1963 and 1964. Two scientists from Colorado State University, Prof. Lewis Grant and Dr. Richard Schleusener, served as consultants to Mines during this period. However, those efforts fell far short of what Mundt envisioned.

Cope contacted various scientists, including Dr. Schleusener and Dr. Arnett Dennis, to determine their possible interest in building a new research group at Mines. Schleusener agreed in 1964 to leave his post at Colorado State University to take over as the first full-time director of the IAS. Senator Mundt's verbal commitment that Reclamation's support for the IAS program would be on-going helped persuade Schleusener to make the move. It was an excellent choice. Schleusener's doctorate was in civil engineering, rather than meteorology, but he had served as a meteorologist for the U. S. Air Force, was still active in meteorology as an Air Force reservist, and had invented a device called the hailpad for measuring hail intensity. Most importantly, he had excellent management skills. He began work in the fall of 1964.

The year 1965: First Steps

With a \$300,000 contract from Reclamation in hand, Schleusener needed to move fast to recruit a staff. He asked Dr. Dennis to join the IAS as Associate Director. Dr. Dennis flew to Rapid City to meet with him and Pres. F. L. Partlo of Mines in November of 1964. On that trip he met several faculty members, and Schleusener gave him a tour of the offices being prepared for new IAS staff in the recently completed Mineral Industries building. A week or so later he agreed to accept Partlo's offer.

Dr. Dennis's first day of work at IAS was Monday, February 15, 1965. On his way into the Mineral Industries building that morning, he met one of Navy Capt. Howard T. Orville's sons, Dr. Harry Orville. (Capt. Orville had chaired the President's Advisory Committee on Weather Control, mentioned above.) It was Orville's first day, too. He had recently completed his doctoral work in meteorology at the University of Arizona, and was to head up IAS work in computer modeling of clouds.

As Dr. Dennis recalls: "*Upon arrival at Mines, I found myself in a strange situation. Research scientists normally spend a good fraction of their time writing research proposals to attract funds, and I had been doing that at Stanford Research Institute in California. But now the problem was reversed. We had the money; the question was how to spend it wisely. Our assigned task under Skywater was to study the convective clouds that bring showers to the Black Hills and surrounding areas during the spring and summer months. We sensed the urgency to get some limited field experiments going in the summer of 1965, and we began the job of writing work plans and hiring some contractor personnel to fill gaps in the IAS work force.*"

A rain gage network was set up around Rapid City, and we contracted with Snedigar's, a local firm, to provide a seeding aircraft and pilot. We called this effort the Rapid Project. It had no serious statistical design, and so could not answer questions about the effectiveness of cloud seeding. However, it was important, as IAS staff learned about the many problems involved in getting a project into the field. Another project, located in the northern part of the state, and called the Shadehill project, was operated totally by Atmospherics, Inc., a contracting firm based in Fresno, California.

An instrumented aircraft, a Piper Apache, was provided to support the Rapid Project by Dr. Ray Booker, who had developed it while a graduate student at Penn State. He joined us about May 1, and flew the aircraft himself during the summer. John Hirsch, a graduate of Penn State, joined our staff and acted as the observer aboard the Apache."

Personnel

Under Dr. Schleusener's leadership, the Institute grew rapidly. As just described, Dennis and Orville came on board in early 1965 and Hirsch later that year.

A more immediate need for the growing Institute was a meteorologist with some background in cloud seeding to take over the Rapid Project. For that position it was recommended to hire Alexander Koscielski, who was a graduate of the University of Texas. He had been hired in 1957 to run a seeding program in Oregon for the Weather Modification Co. In 1965 he was working in the Severe Local Storms office of the National Weather Service (NWS) in Kansas City, Missouri. However, his interest in cloud seeding was still alive. After he visited the IAS offices in November, Schleusener offered him a position, which he accepted. He began work with IAS in April, 1966.

Dr. Booker had decided to start his own firm, and so did not join the IAS. However, he leased the Apache to the IAS from his new firm for the summer of 1966, and hired Melvin Flanagan to fly it. Flanagan had been a pilot with the U.S. Marine Corps, and had retired with the rank of major. His resume included piloting Marine One, that being

the designation given to a Marine Corps aircraft with a sitting president of the United States on board. As Dr. Dennis recollected, Mr. Flanagan had ferried President Dwight Eisenhower from Andrews Air Force Base to the White House by helicopter on several occasions.



The Piper Apache from Ray Booker's company Aeromet.

Cope continued to serve on a part-time basis as the IAS administrative officer throughout 1965 and into 1966, but it soon became apparent that a full-time administrator was needed. Schleusener, while performing his reservist duty at Ellsworth Air Force Base, had been impressed by Lt. Col. James Simmons, the commander of the weather detachment at the base. Simmons had been in the service for over 20 years, and was ready to return to civilian life. Schleusener offered him the job, and he joined the IAS in 1966. He became the Assistant Director in 1971, and remained in that position until his final retirement in 1986. A relatively large workforce (perhaps as many as 50) was required during the era of numerous field projects and Simmons effectively managed this group.

It was obvious that the IAS needed a first-rate electrical engineer to take charge of the IAS radar equipment. The Air Force had turned over to the IAS the south Nike site of Ellsworth Air Force Base, complete with both S-band (10 cm) and X-band (3 cm) radar sets. The Nike site was on a ridge between the Rapid City Regional Airport and Ellsworth AFB, about 10 miles east of downtown Rapid City. The radar sets were originally built to detect enemy aircraft and missiles, and guide ground-to-air missiles to destroy them. Cope had already recruited three radar technicians, all veterans, to get the sets on the air.

When Schleusener asked for Dr. Dennis's advice on the matter, he told him about Dr. Paul Smith, whom he had met when Smith was on a post-doctoral appointment at McGill University in Montreal, Canada. His doctorate in electrical engineering was from the Carnegie Institute of Technology. Dr. Dennis recalls: "I had seen him in action at several AMS conferences on radar meteorology, and had been impressed with him as a person who did his homework. In 1965 he was working at the Midwest Research Institute in Kansas City, Missouri. He came to visit the Mines campus in the fall, and eventually agreed to join the IAS, which he did on April 1, 1966."

In addition to those already mentioned, by the late 1960's IAS staff included meteorologists Ed Boyd, Jack Donnan and K.R. Biswas, radar/electronics technicians Ed Galles, Clem Aadland, Wallace Amborn, Ken (Chuck) Jasper, John Callahan and Rudy Flohr, and pilots Bud Youngren, Bill Myers, Mel Flanagan, and Homer Merfeld. Don Blair, Garth Peterson, and Carol Myers contributed to efforts in other aspects of research, along with



Alex Koscielski and Richard Schleusener

Howard Elshire as administrative assistant and executive secretary Doris Knecht. Other office personnel during this period were Mona Young, Jean Alberts, Karen Brown, Helen Englebert, Carol (Lundy) Schock, Helen Smith, Joie Robinson, and Carol (Vande Bossche) Hirsch.

Research Projects

The sense of urgency at IAS increased when it was learned that the Federal budget for FY 1966 would include \$600,000 for work in South Dakota, as well as increases for other institutions that had contracted with Reclamation for work under Skywater.

The year 1965 also saw the beginnings of an IAS cloud physics laboratory. Dr. Briant Davis of the Mines Geology department was an expert in crystallography, and joined the group to study the structures of various crystalline forms of silver iodide.

One crucial decision that was made early on was to link a computer to a radar set. Early work with weather radar sets often involved time-lapse photography of radar scopes. By the mid-1960s some engineers had begun recording the radar data on magnetic tape for later analysis by computers. Hooking a computer directly to the radar set offered the intriguing possibilities of programming scanning routines and analyzing radar data in real time. The IAS bought an early model of minicomputer, a 12-bit PDP-8, for this purpose. The PDP-8 had to be programmed in machine language. James Boardman, a recent graduate of McGill University, developed the software that was needed, recognizing that it would be several years before this project would yield significant results.

Those were busy times for the IAS and the fledgling new Department of Meteorology. With support from Project Skywater, the NSF, and other sponsors, the IAS undertook several important field programs in weather modification, cloud physics, and radar meteorology. The field work conducted in South Dakota, North Dakota, and Nebraska involved cloud seeding by aircraft, radar coverage, and a series of rain gauge and hailpad networks. The Institute operated several of the aircraft, including an instrumented Piper Apache, and contracted for the others. At one time, 19 radar systems were in operation at five sites in the three states.



Early radars used by the team at IAS.

The numerical cloud modeling work involved many weekend trips to the National Center for Atmospheric Research (NCAR) computer lab in the era of punch-card decks and line-printer and microfilm output. The laboratory work involved cloud-chamber studies of nucleating agents for cloud seeding.

In the summer of 1966 a major field effort called Project Hailswath was hosted in Rapid City. Personnel from seventeen organizations from around the country and overseas converged on Rapid City and carried out hailstorm studies. At the same time and in the same area, the Rapid Project was being conducted to study cloud seeding effects on convective rain showers. The Rapid Project continued through 1968, to be supplanted by Project Cloud Catcher in 1969-72. Related projects were initiated in neighboring areas; in 1969, four field sites were operated simultaneously at Alliance, Nebraska; Watford City, North Dakota; and Lemmon and Rapid City, South Dakota. A fifth radar site was located at Berthold, North Dakota in 1971-72. Basic laboratory and numerical modeling studies were also undertaken during those years.

IAS research helped establish the extent to which cumulus clouds in the northern Great Plains can be modified to increase rainfall and suppress hail. Partly as a result of this research, the S.D. Legislature funded an operational cloud seeding program from 1972 until 1976.

The Rapid City flood occurred in June of 1972. Hygroscopic (salt) seeding experiments had been carried out earlier on the day of the flood. Studies determined that the seeding activity did not cause or contribute to the flood, but the public perception that the seeding was associated with the flooding was difficult to change. This led to a decline in cloud seeding activity around the Black Hills and the support from the Bureau of Reclamation. For a detailed account of the flood events from a scientific perspective, see Dr. Arnett Dennis's article posted at <http://www.ias.sdsmt.edu>.

Academic Connection

An important development for the IAS was the establishment of an M.S. program in meteorology at Mines in December of 1965. This allowed students to participate in state-of-the-art field experiments and work with novel radar data, cloud physics laboratory equipment, and cloud modeling codes. The curriculum in these early days is still recognizable in the coursework offered by the department today. It was also advantageous to IAS, as it provided graduate research associates to help with projects.

The start-up of new academic departments at small institutions in the Reclamation states did not win universal approval in the larger meteorological community. In the fall of 1965 Dr. Dennis attended a workshop on meteorological satellites in Boulder, Colorado, which drew attendees from some of the universities with long-established departments of meteorology. One of them, Prof. Hans Panofsky of Pennsylvania State University, told Dr. Dennis in a friendly way, in a conversation outside of the formal sessions, that diverting Federal funds to new

research groups, instead of increasing support to established researchers, was unwise.

Skywater colleagues at Mines, the University of Wyoming and elsewhere shrugged off such criticism. The resolve was to build a new research group that would be competitive with established departments at larger and more prestigious universities, and the IAS intended to recruit well-qualified staff to do that. The fact that the IAS ran mainly on "soft money" meant that none of its positions were tenured, so the persons joining IAS had to have a slightly more adventurous attitude than that of a typical university professor. Nevertheless, some well-qualified young scientists and engineers appreciated the opportunity to join a new and growing research group.

Dr. Schleusener assigned the job of preparing a syllabus and a budget for the new department to Drs. Orville and Dennis. In addition to graduate-level courses, they had to program some undergraduate courses, which incoming students from fields other than meteorology could take as prerequisites for the graduate level courses. The standard offerings at the beginning of the M.S. program were courses in general and synoptic meteorology, physical and dynamic meteorology and specialty courses in radar, fundamentals of nucleation, physics and dynamics of clouds, and precipitation physics and weather modification.

The graduate program in meteorology started out much smaller than the nationally-supported IAS research program. The first two M.S. degrees were awarded in 1968, to John Yu-Ming Liu and Martin Schock. Since that time over 200 degrees have been awarded. The students have generally been supported by graduate research assistantships. The IAS research sponsors provided this support and so most of the M.S. theses have been written on some area of IAS research. Results from roughly half of these have appeared in journal publications.

The faculty members of the Department also conducted research for the IAS, and the Department continued to grow. Martin Schock joined for a short stint after his graduation, but then moved on to lead the S.D. state program in operational weather modification. Air Force veterans Dennis Musil and James Miller also received M.S. degrees and stayed on to do research and teach in the Department. Curt Hartzell was employed as a Research

Meteorologist for a short time following his graduation in 1969. Two notable post-doctoral members of the Department were Marianne English and Philip Chang-Shin Chen. Dr. Chen later served for two years as an assistant professor.

The 1970's

The faculty and staff of the IAS in those early years had major involvement in a variety of meetings - those of the American Meteorological Society (AMS), Weather Modification Association (WMA), American Society of Civil Engineers, and a number of trade/business groups. A national AMS conference on weather modification was hosted in

Rapid City in 1972 (shortly after the flood) and one by the WMA in 1976. Numerous papers were published concerning the research efforts of the IAS, establishing their scientific reputation. A book on weather modification by cloud seeding, written by Arnett Dennis, was published in 1980.

The T-28 storm penetrating aircraft was acquired in 1969. Dr. Paul MacCready had championed this cause during Project Hailswath. After extensive modifications, including 700 lbs. of armor plating on all leading edges, a few test flights were conducted in the summer of 1970 in the Black Hills area and Colorado during the Northeast Colorado Hail Experiment. Bud Youngren piloted the T-28, under radar guidance by meteorologist Alex Koscielski. Wayne Sand was hired to pilot the T-28 in 1971, but engine problems prevented participation during the 1971 field season. After a new larger engine was installed, the first series of research flights were conducted during the 1972 National Hail Research Experiment in Northeast Colorado. The T-28 was serviced by aircraft technician Jon Leigh from 1972 to 1996. During the 1970's, the T-28 was piloted by Bud Youngren, Wayne Sand, Joe Killinger, and John Prodan.

The unique capabilities of the T-28 made it a fixture in a wide variety of field programs over the years. Although the instrument packages changed as the years went on and research objectives changed, the data collected by the T-28 have provided material for a large number of student theses and research papers extending into the 2000's. In addition, the T-28 served as an ambassador for the IAS wherever it went into the field.

The major research support by the Bureau of Reclamation ended in 1975, along with general cutbacks in federal research expenditures, so that weather modification field programs were no longer supported at Mines. With the end of this funding, many staff left employment at IAS.

Personnel

In 1974, Dr. Schleusener moved on to become Vice President and Dean of Engineering of the School (and soon thereafter its President). Dr. Dennis became Director of the Institute and Dr. Orville Head of the Department of Meteorology. Over the 1970's

1970's



The T-28 shortly after its arrival in Rapid City.

several additional faculty joined the Department and new areas of research and instruction were initiated. In 1974 Timothy Chiu joined the Department as a Post Doc (and later assistant professor) to pursue studies in atmospheric electricity. He accomplished pioneering work in modeling cloud electrification, until his (and his family's) tragic death by carbon monoxide poisoning in 1978. Dr. John Helsdon, Jr., joined the faculty in 1979 and continued and extended the atmospheric electricity effort.

Richard Farley, Fred Kopp, Gary Johnson, Ron Johnson, Doug Cain, and Jerry Halvorson were Tech graduates who joined IAS in the early 70's. Sheryl Hunter, Kathy Newkirk, and Pat Lemer also worked in the office between the mid-70's and early 80's.



Dr. André Doneaud emigrated from Romania in 1977. He was an eminent dynamic meteorologist in his country, having written many articles and books on meteorological topics. He came to IAS in 1978, initially as a Visiting Scientist, then as a Research Scientist and Professor, and took up studies of radar meteorology, broadening

into mesoscale meteorology. Although he knew very little English when he came to this country, André learned the language, published scientific papers, obtained grants and led the IAS efforts in mesoscale meteorology and the Department's teaching efforts in this newly developing field.

Academic Connection

The 1970's was an era of diversification in the IAS and a period of new course offerings began in the Department. Air pollution became part of the curriculum in 1974, and several of the staff of IAS conducted research on air quality and the relationship between our air quality and the energy developments in Wyoming and Montana. The Department faculty had been interested in starting a Ph.D. program and had employed a consultant in 1969 to assess the possibilities. The conclusion was that the program was too narrow at that time to support Ph.D. work, although research monies were certainly sufficient. In the mid-1970's discussions were held with Colorado State University and a Co-operative Ph.D. program was established in 1977. R.A. Sarma was the first student to complete the cooperative program, finishing in 1987. He had previously received an M.S. degree from SDSM&T.

In order to broaden the appeal of meteorology on campus, a minor program at the undergraduate level was started in 1978. This program allows undergraduate students to obtain 18 or more semester credit hours in meteorology and satisfy the National Weather Service requirement for employment as a meteorologist.

In 1977 the IAS and the Department moved

from the Mineral Industries building to the McLaurry building. The Engineering Group, which had been temporarily housed in the lower level of a dormitory building, was there reunited with the rest of the staff.

Research

Much of the air pollution work was accomplished using a specially-equipped motorhome obtained with funding from the Department of Energy in 1976. Dr. Paul Yue joined IAS in 1974 to assist Dr. Briant Davis and Ron Johnson in the air pollution effort, which involved a variety of air quality related measurements over a circuit involving the five states of South Dakota, North Dakota, and Nebraska, in addition to Montana and Wyoming. The air quality group went on to perform studies related to the fugitive dust problem in the Rapid City area in the late 1980's and early 1990's.

Early in 1978 the IAS was awarded the contract for the design and evaluation of the HiPLEX project. HiPLEX was a rain enhancement project for the High Plains run by the Bureau of Reclamation; exploratory phases of this project had started a few years earlier with sites in three states (Montana, Kansas, and Texas), which focused on the HiPLEX-1 experiment carried out in southeastern Montana. Most of the IAS staff were involved in this effort. Ms. Barbara Brown and Dr. Sumedha Sengupta (part-time) joined the IAS to assist Drs. Paul Mielke and Ken Berry of Colorado State University with statistical aspects of the study.

IAS scientists participated in the following projects during the 1970's:

- THEMIS, a laboratory project involving Briant Davis and associates, in association with faculty from other Mines departments;
- National Hail Research Experiment (NHRE), which ran from 1972-1976 in northeastern Colorado to investigate hail formation and methods to modify it. The T-28 was a key facility in this project, with Wayne Sand as the pilot (a follow-on project took place in the same area in 1978, with John Prodan as the pilot);
- Thunderstorm Research International Program (TRIP'78), an investigation of thunderstorm electrical processes, held in the Cape Canaveral area in 1978. John Prodan was also the pilot of the T-28 for this project;
- Severe Environmental Storms and Mesoscale Experiment (SESAME '79) to investigate the links between storm-scale and mesoscale circulations, conducted in the Norman, Oklahoma area with John Prodan as T-28 pilot.

The modeling group developed and applied a variety of cloud models in support of many of these field projects, especially NHRE and HIPLEX. Most of these studies concentrated on precipitation physics and possible effects of cloud seeding. Although much of the computational work was still performed using facilities at NCAR, trips to Boulder became

less necessary due to remote access to NCAR's computers via terminals and telephone modems in the late 70's.

1980's

The 1980's

Personnel

Leadership of the IAS changed in 1981 when Dr. Dennis left to become a research administrator at the Bureau of Reclamation in Denver. Dr. Paul Smith assumed the position of Director of the IAS, and Dr. Orville continued to serve as Meteorology Department Head. James Simmons retired in 1986 after serving 20 years with the Department and the IAS as Associate Professor and Assistant Director, respectively, and became the Department's first emeritus professor. James Miller succeeded Simmons as Assistant Director of the IAS. Dennis Musil retired as an associate professor in 1990, but continued to work on various T-28 projects on a part-time basis until 1995. Dr. Schleusener continued as President of the School until his retirement in 1987. After Dr. Doneaud's untimely death in December 1987, Dr. Mark Hjelmfelt (an SDSM&T M.S. recipient in 1975) joined the staff in 1988 to advance mesoscale research efforts.

A new addition to the IAS and department faculty was Dr. Ronald Welch, who joined the IAS in 1982. He performed studies in remote sensing and satellite meteorology and developed radiative transfer and satellite meteorology courses in the Department. Welch later assembled a remote sensing group (see 1990's).

Other staff members during this time included: Linda Allen, Bob Thompson, Jonathon Lee, Alan Pretre, Art DeGaetano, Dave Priegnitz, Ken Hartmann, Saskia Willemse, Tracy Schilling, Tongli Shen, and seven secretarial staff: Joie Robinson, Carol Hirsch, Sandi Palmer, Tom Lowther, Margaret Nickeson, Pat Peterson, and Mary Holter. Joie and Carol began with the Department/IAS in the early 1970's.

Research

The HiPLEX project continued through 1980, and the facilities at Miles City, Montana served as the base of operations for the 1981 CCOPE project, a large field study of convective storms. The T-28 participated in CCOPE, where it encountered the strongest storm updraft in its history.

The T-28 made its first international ventures with a trip to Switzerland in 1982 and 1983 to participate in the Grossversuch IV project, and in 1985 to Alberta, Canada. These were hail suppression projects. Dave Priegnitz built the data acquisition software for the microNova computer on the T-28, first used in the Grossversuch project and later in the MayPole and Canadian projects. In 1987, the T-28 entered into a formal NSF facility mode of operation, with an increment of state funds for cost sharing. Dr. Andrew Detwiler was hired as facility

scientist for the T-28 in 1987, and Dr. Paul Smith was named as the facility manager. Norm Vine and Dan Custis shared piloting duties during the 1980's.



Dr. Paul Smith, Mr. John Hirsch, and Dr. William Hughes discussing the North Dakota Thunderstorm field project in Bismarck in 1989.



Various radar equipment and on-site labs were used during the North Dakota Thunderstorm Project (NDTP).



The T-28 in Switzerland in 1982 for the Grossversuch Project. Swiss officials greet the crew.



Jon Leigh stands in the cockpit as the plane is towed to its hangar during the Grossversuch project in Switzerland.

A major North Dakota field project with the T-28 took place in 1989 (the North Dakota Thunderstorm Project). This decade saw the end of air quality laboratory work and Dr. Davis left IAS to become Director of the Mining and Experiment Station on campus in 1990.

The 1980's also saw the end of significant involvement of Reclamation in weather modification research. The National Oceanic and Atmospheric Administration (NOAA) entered the picture with its Federal-State Cooperative Program in 1980. Projects conducted under this program included:

- North Dakota Cloud Modification Project (1987),
- Precipitation Augmentation for Crops Experiment (PACE) (1989) in Illinois,
- North Dakota Thunderstorm Project (1989).

The T-28 was involved in those projects and also was a key platform in the Cooperative Huntsville Meteorological Experiment (COHMEX) in Alabama in 1986. The IAS cloud modeling group performed a variety of studies in association with these field projects, addressing topics such as hail, microbursts, cloud electrification and cloud seeding, and was contracted to provide modeling support for the internationally-sponsored Precipitation Enhancement Program (PEP) in the Duero River Basin in Spain. The internet replaced telephone modems as the primary connection to the computing facilities at NCAR.

In 1989, Dave Priegnitz developed an IRAS software package used by NEXRAD level2 data users and COMET. Part of this IRAS software became a part of the Human Computer Interface for the NEXRAD Open Radar Product Generator and is still used at WSR-88D sites around the world.

Academic Connection

In 1989, a Bachelor of Science in Interdisciplinary Science was initiated at Mines. Through this program a student may obtain a degree equivalent to a B.S. in Meteorology. In the 1990's, John Salmen, Jason Goehring, Shane Hansen, and Kyle Brehe completed this program and later went on to graduate work in meteorology. Matt Bunkers, another B.S.I.S. graduate who continued with our program, obtained an M.S. degree in 1993 and a Ph.D. in 2005. Matt was a full-time employee of the National Weather Service in Rapid City while pursuing his doctorate, and now is a Science Operations Officer (SOO) at the Rapid City station.

Weather Service moved from the Rapid City Regional Airport to the hill above campus east of the Star Village complex as part of the national move to modernize the NWS and co-locate National Weather Service offices with universities when possible. The T-28 continued to participate in a regular series of research experiments.

Dr. Ron Welch was the recipient in 1992 of the largest contract ever awarded at that time to a SDSM&T faculty member: \$15,000,000 for research in several NASA/EOS programs which were expected to last through the year 2002.

Personnel

Dr. Welch assembled a remote sensing group consisting of Dr. Qingyuan Han (hired in 1992), Tech grads Todd (1991) and Denise (1993) Berendes, Hui-Yun "Joyce" Chou (1993), Rand Feind (1992), and Donna (Vulcan) Kliche (1993), and CSU/SDSMT Coop Ph.D. grads Sundar Christopher and Kwo-Sen Kuo (both in 1994) and Visiting Scientist Dr. Oleg Vassiliev (1992). However, Dr. Welch and most of his remote sensing group left SDSM&T in 1997 to continue their work at the University of Alabama-Huntsville. Rand Feind and Donna Kliche remained with IAS.

The mid- to late-1990's also saw some major changes for the meteorology department. Dr. Orville stepped down as Department Head in 1994, when Department Heads were replaced by non-supported rotating chair positions campus-wide. Dr. Orville continued his research work, and Dr. John Helsdon became the Department's first chair and was succeeded by Dr. Hjelmfelt in 1997. In 1996, John Hirsch and Paul Smith retired; Dr. Smith chose retirement to spend time with his terminally ill wife. Dr. Sherry Farwell, who had come to Mines in 1995 as Dean of Graduate Education and Research, assumed the role of Acting Director of IAS. Karl Lalonde was hired in 1999 as computer systems administrator, to succeed Kathy Fryberger, who had become systems manager shortly before Dr. Welch's group moved to Alabama. Jim Miller retired at the end of 1997; Carol Hirsch took over his research administration duties.

For T-28 research, Dave Priegnitz, Ken Hartman, Donna Kliche and Rand Feind performed



The National Weather Service is co-located on the SD Mines campus (on the hill on the west side of campus). The white-domed building is where the weather balloons (radiosondes) are released every day for data-gathering.

1990's

The 1990's

The South Dakota Space Grant Consortium came into being in the early 1990's, and local activities were managed by IAS for the first few years before being transferred to the Office of Graduate Education. The Federal-State Cooperative Program ended in 1995. Also in 1995 the local National

data processing and analysis and Drs. Richard Kelley (1992) and Qixu Mo (1998) served as post-doc research scientists. Charlie Summers, Tom Root, and Tom Warner each spent time piloting the T-28 during the decade of the 1990's.

Mesoscale modeling efforts were bolstered by the addition of Dr. Russell Derickson in 1996 and Dr. William Capehart in 1997. Dr. Patrick Zimmerman became the Director of IAS in 1997, and, as noted earlier, most of the Remote Sensing Group relocated to Alabama. Dr. Zimmerman sought to broaden the Institute and departmental focus to an Earth Systems approach, with new emphasis on atmosphere-biosphere interactions, global change, and earth systems. He brought on board some very energetic and capable young faculty. The first of the new faculty hired by Dr. Zimmerman was Dr. Lee Vierling, a biologist specializing in biosphere-atmosphere interactions and remote sensing, who came on board in Fall, 1999. Joie Robinson retired the position of Publications Production Specialist in 1996; Connie Crandall filled that position.

Research

During this decade, the scientists at IAS participated in a number of field projects, most of which involved the T-28 aircraft:

- Small-scale instrument test projects involving the T-28 and the atmospheric electricity research group at the New Mexico Institute of Mining and Technology;
- Cooperative Oklahoma Profiler Studies (COPS-91), conducted in the Norman, OK area;

- Convection and Precipitation/Electrification Experiment (CaPE), conducted in the Cape Canaveral area in 1991;
- Real-Time Analysis and Prediction of Storms (RAPS) in Greeley, CO in 1992;
- North Dakota Tracer Experiment (NDTE) in Bismarck, ND in 1993;
- Texas Experiment in Augmenting Rainfall through Cloud Seeding (TEXARC) in Big Spring, TX in August 1994 and sponsored by the NOAA Federal-State Cooperative Program;
- Verification of Rotation in Tornadoes Experiment (VORTEX and VORTEX 95) which ran for two springs, 1994 and 1995, in the Norman, OK region; and the
- Convective Turbulence Data Collection Program in northeast Colorado in 1999.

Numerical modeling efforts during this period continued in the traditional areas of cloud seeding and precipitation processes for various field projects but broadened to include studies of convective initiation, marine boundary layer clouds, and cold-season precipitation over the Black Hills region. Atmospheric electricity modeling expanded to a 3D framework and included simulated lightning discharges. Department computers took on much of the computational work previously done at NCAR and externally-developed models replaced in-house programs, especially for mesoscale modeling studies.

The first major Institute-wide project under Dr. Zimmerman was the Upper Missouri River Basin Pilot Project (UMRBPP), which was undertaken to better establish and understand the water budget for the region. This collaborative research project,



One of the larger classes of ATM students (circa 1995) and staff, taken on the occasion of Dr. Orville's last dynamics class. This is also just prior to Dr. Ron Welch and his group departing for the University of Alabama at Huntsville. Pictured, standing, left to right: Steve Trimarchi, Anthony Stender, Z. Li, Donald Sedlacek, Dale Hjermstad, Chengshu Wang, Trace Bowen, an unidentified student behind Dr. Orville, Harry Orville, Kevin Krcil, Ron Johnson, John Hirsch, Kuo Sen-Kwo, Donna Kliche, Denise and Todd Berendes, Rand Feind, Fred Kopp, Andy Detwiler, and another unknown student. Seated, front: Allison (Wozniak) Scheier, Kristine Barbieri, X. Zhang, Q. Jin; back: Spencer Caldwell, Chris Waits, and Joyce Chou.

involving various universities and federal agencies, was funded by NASA as part of the Global Energy and Water-cycle Experiment (GEWEX) Continental-scale International Project (GCIP). Sen. Larry Pressler was a strong proponent of water budget studies within the Upper Missouri River Basin, and was influential in seeing that funding was provided. Early preparatory work for this project was initiated under Drs. Smith and Farwell and was supported by NSF-EPSCoR. An intensive observing period for UMRBPP was centered over the Black Hills region in spring 1999.

Academic Connection

The department name was changed to the Department of Atmospheric Sciences in the fall of 1997, and somewhat later two M.S. tracks were established, one in Meteorology and one in Earth Systems. The Earth Systems track is less mathematics-intensive, but requires more chemistry, biology, and instrumentation.

In 1994 the South Dakota Board of Regents approved a joint Ph.D. program in Atmospheric, Environmental and Water Resources between Mines and South Dakota State University. Students were required to take courses in all three areas, atmosphere, environment, and water resources. Coursework taken over South Dakota's Rural Development Telecommunications Network (RDTN) allowed students to reside at one university and take required courses from the other university. Interdisciplinary research was emphasized in the program. The first atmospheric sciences graduate of the AEWB Ph.D. program was Xingjun Zhang in 2002.

2000's

A New Century

By the middle of the year 2000, the earth systems emphasis shifted to a much stronger emphasis on the carbon cycle and carbon sequestration. The IAS and the Department moved back to the Mineral Industries building in January 2001, due to a growing need by the Math and Computer Sci-

ences department for more space in the McLaury Building. Although the T-28 laboratory remained in McLaury for a while, the T-28 was retired from service after 2004 and all inventory was moved completely to the MI building by 2007.

Personnel

Dr. Vierling was followed in 2000 by Dr. Bradley Baker, whose specialty was analytical atmospheric chemistry. Dr. Zimmerman was able to convince Gov. William Janklow of the need for additional state-supported positions within IAS. Two additional positions were instituted through the Governor's office: a State Carbon Scientist and a State Wildfire Meteorologist.

The State Carbon Scientist works on issues involving agriculture, climate change, and the earth-

atmosphere carbon cycle. This position was filled by four individuals in the first five years: Dr. Ann West for part of 2001, Dr. Changui Peng from late 2001 to 2003, and Dr. Quinlai Zhang from 2004 to 2005. Dr. P.V. Sundareshwar, who was hired in 2003, currently holds the position.

The fire meteorologist position had been created due to the growing number of large fires created by drought conditions across the state, and in particular in the heavily-forested areas of the Black Hills. In addition to being on duty during wildfires, the fire meteorologist also serves as an instructor in the Atmospheric Sciences department. He works closely with the state wildland fire suppression team, currently housed at the Rapid City airport.

The State Wildfire Meteorologist position was filled by Dr. Randall Benson in October, 2002, and by Darren Clabo in 2009 after Dr. Benson left to take a position in private industry. Dr. Benson earned his Ph.D. in the AEWB program while serving in this position. Darren Clabo is a 2009 M.S. graduate of our program.

Dr. Smith returned to IAS on a part-time basis following his wife's passing in the year 2000. He continued to serve as the Facility Manager for the T-28 until its retirement in 2004. Ms. Elaine (Foy) Baker was hired as Assistant Director following Carol Hirsch's retirement in 2001. Dr. Kata McCaville succeeded Elaine in the upgraded position of Associate Director in 2003 and continued until 2005, after which the position was discontinued.

Other retirements during this time were Ron Johnson in 2000, Dr. Orville and Fred Kopp in 2003, and Dr. Smith and Gary Johnson from their part-time positions in 2004. Orville, Smith, Miller and Ron Johnson were all granted emeritus status. Dr. Karen Updegraff, a post-doctorate scientist, was hired to assist with policy issues for the carbon sequestration research in 2003 and served until 2009, and Nancy Kuster served as secretary in 2003 and 2004. Pam Cox currently holds that position, which was updated to Program Assistant I in 2011.

Dr. Zimmerman took a rotation as Department Chair in 2000, with Dr. Detwiler assuming the position in 2003. Dr. Hjelmfelt began his second term as Department Chair in 2006. Dr. Zimmerman resigned in 2007 to concentrate on carbon sequestration efforts in private industry. Karl Lalonde, who earned his PhD while at IAS, left employment with the IAS to join Dr. Zimmerman in his newly-formed C-Lock corporation. Dr. John Helsdon served as Acting Director after Dr. Zimmerman's departure, and in 2008 he also assumed the half-time role of Dean of Graduate Education. After John's retirement in August of 2010, Dr. Paul Smith agreed to work on a part-time basis as interim director until June of 2011, at which time Dr. Andy Detwiler took over as interim dean. In spring 2012 an external search for a permanent head came up empty and Andy Detwiler was named to the position. Dr. Smith continues to work in a voluntary capacity on research projects, writing papers and mentoring students, as well as serving as a consultant and committee member throughout the radar community.

Research

The focus of Dr. Sundareshwar's biogeochemistry research work is on coupled biogeochemical cycles of carbon, nitrogen, phosphorus and sulfur in aquatic and terrestrial ecosystems, ecosystem dynamics and microbial ecology, ecosystem structure and function, wetland ecology, water quality issues, and the dynamics of coupled natural and human systems. In 2005, he obtained a major equipment grant through the National Science Foundation. With this money, the Biogeochemistry Core Facility (BCF) was established and projects utilizing the equipment and supporting several graduate and undergraduate students are underway.

Dr. Sundareshwar also conceived of the idea of developing a center to study the influence of airborne particulates on human health. Funding to support this effort was obtained through Senator Tim Johnson's office and administered by NOAA. The Great Plains Center for Atmosphere and Human Health was a partnership of two private enterprises, the Western Research Alliance Foundation and the Black Hills Center for American Indian Health, and two public universities, SDSM&T (IAS) and Black Hills State University (Center for the Conservation of Biological Resources). During the 24-month life of this project, considerable effort was devoted to infrastructure development (assembling the research team and developing required tools and techniques). A preliminary assessment of health and atmospheric data was conducted based on hospitalization records for cardiovascular and respiratory ailments at Rapid City Regional Hospital for the period 2000 through 2006 and particulate matter measurements and associated meteorological data for the same period, with particular emphasis given to periods of relatively large wildfires. Due to inadequate sample size and other problems with the data, statistical tests were unable to detect significant correlations and funding was not continued.

Dr. Pat Zimmerman led an effort to erect a 22-meter walk-up tower in the Black Hills National Forest that was instrumented by NOAA and became a part of the Ameriflux network. This tower system operated from 2001-2009. In 2004, Drs. Zimmerman, Vierling, and Baker collaborated to



The Biogeochemistry Core Facility Lab is a second home to students conducting their Masters and PhD thesis research. The lab is used by several departments on campus. Pictured above are Richard Lebeau, Mebratu Abessa, Shawn Honomichl, and Sikhya Upadhayay, M.S. degree students in 2010.

erect a second flux tower, a 7-meter tower, at the Cottonwood agricultural experiment station. It was instrumented and operated by the IAS from 2004-2008, then taken over by NOAA and became part of the Ameriflux program. It was retired in 2010.

The IAS has a number of numerical models and remote sensing techniques to simulate and monitor local and regional hydrologic processes. On the cloud scale, the Storm Electrification Model (SEM) has been extended to include nitrous oxide (NO_x) chemistry associated with lightning discharges. Various mesoscale models have been applied to water budget studies for UMRBPP, lake-effect snow storms, and regional climate studies. IAS also is developing tools applicable toward mitigating sediment from agricultural practices and examining regional water resource issues. Remote sensing is used for determining fire danger and burn severity, the hydrology of the post-fire environment, the vegetation stress, and for modeling of water deficiencies. Current and future emphasis is to establish the Black Hills as a laboratory to study fire weather processes and behavior.

With the retirement of the T-28 also came the need for an archive of the airborne *in situ* observations obtained during the T-28 history of summer thunderstorm field projects. All available data and reports from T-28 activity are being housed in a central location at the Earth Observing Laboratory at NCAR in Boulder, Colorado.

Although the plane was retired from active duty in 2005, a replacement was sought in the A-10 "Warthog". A proposal was submitted successfully to the National Science Foundation for a new plane. Transfer of an A-10 "Warthog" from the Air Force to the Navy has been approved. The Institute is currently collaborating with the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) at the U.S. Naval Postgraduate School in Monterey, California in the development and eventual operation of the "SPA-10".

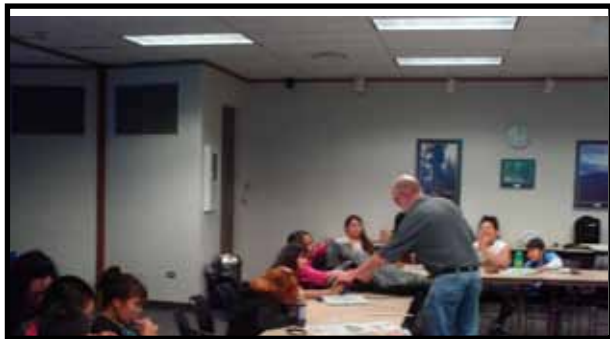
IAS has been the driving force in high-end computer and visualization use at the School of Mines. Current capabilities at IAS include: an SGI Onyx 16 processor, various immersive software, UNIX and Linux workstations, and a 17-node (34 processor) dual-Athlon computational cluster.



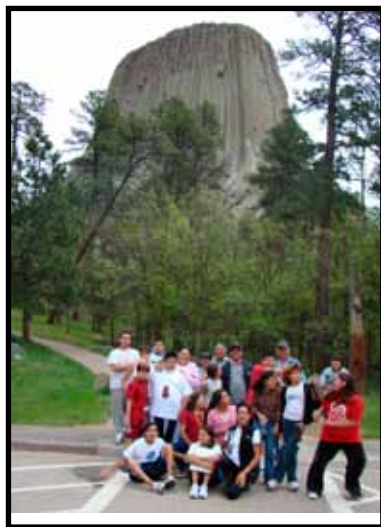
The A-10 "Warthog" - the next generation storm penetrating aircraft.

Various forms of interactive, immersive visualization were used to teach and understand model results. The visualization equipment moved from the MI Building to the new Computational Mechanics Laboratory wing of the Civil/Mechanical building in 2007, but closed in 2010 due to an increasing need for the space.

An NSF project entitled He Sapa Bloketu Woe-cun paired science with Native American culture through the exploration of special places in the Black Hills and surrounding area. Groups of Native American middle and high school students, along with a family member, participated in week-long summer camps in 2007 and 2008. They visited sites of cultural interest such as the Vore Buffalo Jump and Devil's Tower in Wyoming, and the Badlands, Mt. Rushmore, Crazy Horse, and Bear Butte in South Dakota. During these summer camps, students attended several presentations of scientific principles and also learned the scientific background of these important cultural sites. During the fall of 2008, Dr. Donna Kliche worked with several of the camp participants in preparing entries for the High Plains Regional Science Fair the following spring. A second grant has been awarded which allows Dr. Kliche to prepare students for such science fair activities by participating in a week-long camp at SD Mines in 2012.



The He Sapa Oyate Summer Camp program held in 2008 allowed students the opportunity to study their Native American culture in combination with learning science. Not only did the students visit many places significant to their heritage, but they also had hands-on learning experiences on the SD Mines campus.



Students of the He Sapa Oyate Summer Camp program hike to Devil's Tower near Sundance, Wyoming.

Since 2005, Dr. Mark Hjelmfelt and Dr. Bill Capehart have been working on a project supported by the U.S. Army. This research has focused on improvements to low-level numerical wind forecasts in complex terrain, better use of local observations in numerical weather prediction, and estimation of confidence level for numerical predictions. Dr. Capehart and Dr. Hjelmfelt received certificates of appreciation from NATO for their work on the project. Assisting on the project are Dr. Donna Kliche and Mr. Dick Farley.

In 2009, Dr. P.V. Sundareshwar began research on an invasive diatom, *Didymosphenia geminata*, which has started to invade Rapid Creek. He has also done research on this same diatom in the rivers of Chile, and attended a workshop in Chile in 2010 by special invitation of the Senate of Chile. Dr. Sundareshwar received the highest honor awarded a civilian by the Chilean Senate in 2010, the Congreso Nacional Senado medal by Republica de Chile, for his work regarding the *didymo* and its effects on the rivers and streams in Chile.

Academic Connection

T. M. (Bull) Bennett was the first Native American to earn a Ph.D. from Mines, graduating in 2005 from the AEWB program. By 2005, the AEWB program underwent reorganization, resulting in the change to Atmospheric and Environmental Sciences, and separate from an AES program at SDSU. The program is interdepartmental on the campus of the School of Mines, including Geology and Geological Engineering, Civil and Environmental Engineering, as well as Atmospheric Sciences.



Dr. Sherry Farwell (acting Department Head at the time, and Dr. T.M. (Bull) Bennett, 2005.

Service to the professional field of atmospheric science

The IAS and Department faculty and staff contributed much service to several meteorological professional societies, primarily the American Meteorological Society (AMS), the Weather Modification Association (WMA), and the World Meteorological Organization (WMO). Many of our staff, students, and alumni are members of the Black Hills Chapter of the American Meteorological Society. Drs. Schleusener and Dennis served terms as president of the WMA. Dr. Orville was elected a councilor of the American Meteorological Society (AMS) and served as a STAC Commissioner. Drs. Smith, Dennis, and Orville served or chaired various committees of the WMO and helped organize international cloud physics and numerical modeling workshops. Many of the faculty and staff members chaired or served on committees of the AMS, helping organize and sponsor scientific meetings concerning meteorological radar, cloud physics, weather modification, and atmospheric electricity.

The faculty members of the Department have also achieved distinction, several of them having been with the Department for periods ranging more than 30 years. They serve on national and international committees, help plan national programs in meteorology, contribute to field programs and publish many scientific papers every year.

In addition to these services, staff members served on or chaired committees for the National Academy of Sciences, the National Science Foundation, the National Center for Atmospheric Research, the Bureau of Reclamation, and the National Oceanic and Atmospheric Administration, among others. They have also participated as reviewers for many scientific journals, and served on review panels for NSF and other research proposals.

The faculty and staff have also helped edit some of the AMS scientific journals. IAS took over production of the *Journal of Weather Modification*, a publication of the Weather Modification Association (WMA), in 1993. Jim Miller served as Editor from 1993 through 2001, assisted initially by Joie Robinson, and then by Connie Crandall following Joie's retirement. Production of this journal was transferred to Desert Research Institute in 2002. IAS again resumed production of this journal from 2006 through 2011; Dr. Detwiler served as Editor, with assistance from Connie Crandall.

In April 2003, the WMA held its annual meeting in Rapid City. The day preceding the conference was devoted to the Orville Symposium, an event honoring 40 years of cloud modeling work by Dr. Orville; various presentations were given by colleagues and former students.

Dr. Andy Detwiler served full-time as a program director in the Physical and Dynamical Meteorology program at NSF for 2006-2007, and part-time for 2009-2010.

Dr. Orville took sabbaticals with the National Oceanic and Atmospheric Administration (NOAA) and the World Meteorological Organization (WMO), travelling extensively around the world. Dr. Arnett Dennis also spent time at NOAA.

Honors and awards

Dr. Orville received the Charles Franklin Brooks Award, for outstanding and sustained contributions to the advancement of AMS publications and educational goals.

In 2006, Dr. Paul Smith received the AMS Remote Sensing Lecturer Award for his work in advancing the quantitative use of radar in cloud and precipitation physics. He was invited to give the keynote speech at the AMS International 33rd Conference on Radar Meteorology in Australia in 2007. Dr. Smith continues to serve on a consulting basis throughout the radar community, serving on many committees.

John Helsdon and Andrew Detwiler received Editors' Citations for Excellence in Refereeing by the American Geophysical Union for their work in reviewing submissions to JGR-Atmospheres.

Dr. Donna Kliche was invited to present a paper at the American Meteorological Society's 33rd Conf. on Radar Meteorology, Cairns, Australia in 2007.

Through the 1990s, the IAS consistently ranked in the top 10 - 15 percent of those organizations receiving funds from the National Science Foundation in atmospheric science. Total research funds for the IAS have been as high as \$2.5 million per year. The faculty and staff have taken sabbaticals or short term work assignments to McGill University, University of Helsinki, University of California, Berkeley, Brigham Young University, NASA Langley Research Center, Jet Propulsion Laboratory and the Navy Postgraduate School, National Center for Atmospheric Research, the World Meteorological Organization, NOAA, USAF Air Weather Service, Air Force Geophysics Lab, and the Alberta Research Council. Drs. Dennis, Orville, and Smith have all been honored as Fellows of the AMS. All of the IAS and Department members have contributed significantly to education and research in meteorology.

Drs. Richard Schleusener, Arnett Dennis, Harry Orville, Andy Detwiler and Paul Smith have all received the Weather Modification Association's prestigious Thunderbird Award.

A note about our students

The M.S. in Meteorology/Atmospheric Sciences graduates have been very successful. More than a third of them have gone on to earn doctoral degrees at universities such as Penn State, Colorado State, Illinois, Chicago, Wyoming, Utah State, Denver, Yale, Princeton, and Iowa State. Some of the graduates have gone into state government, led weather modification programs, or entered into private industry or the federal government. Several went back

to their own countries and are leading very important programs. Notable among these graduates are a group of Moroccan students and another group of Thai students who were sent to the U.S. in the mid-1980's, supported by the U.S. Agency for International Development, to study cloud physics and weather modification at Mines.

Our graduate student population has been quite diverse. Nearly 40% of the graduates of our programs are from foreign countries. Taiwan has provided the greatest share of these (32), being a major source of foreign students up to 1990. The People's Republic of China has provided the second largest contingent of foreign students (23); most of these have been post-1990. These are followed by India (10), Morocco (6), Romania and Thailand (3 each), Korea, Belize, and Nepal (2 each), and one each from Bangladesh, Germany, Jordan, Russia, Ukraine, Vietnam, Ethiopia, and Zimbabwe. The USAID program funded most of the students from Morocco and Thailand. Foreign student numbers dropped dramatically following restrictions put in place as a result of security concerns in the wake of the events of 9/11/2001.

Most states are represented among our American students. The largest contingent of these is from South Dakota, with strong representation from neighboring states and the upper Midwest. New York and Pennsylvania have provided the majority of students from eastern states. Several of our graduates came into our programs as a result of being stationed at Ellsworth Air Force Base; most of these were during the 1970s.

Collaborations and partnerships

The Institute of Atmospheric Sciences partners with many other agencies in research work, some of which include the National Weather Service, the North Dakota Atmospheric Resource Board, EROS Data Center and US Geological Survey, Satellite Data and Water Resources, SD DENR and US Bureau of Reclamation, South Dakota State University, MESONET, Forest and Wetlands Ecology Lab, and the newly-designated DUSEL underground laboratory.

IAS LEADERSHIP

The Institute has had at its helm several distinguished scientists since its inception in 1959. Although the Institute started in 1959, the first official director was appointed in 1965.



Dr. Richard Schleusener
1965-1974



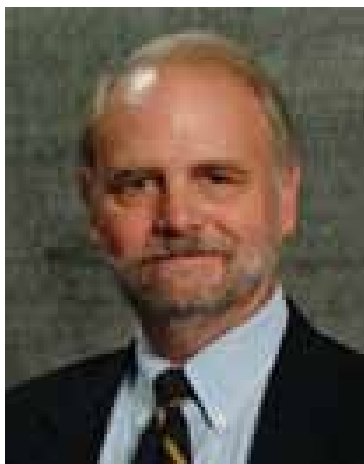
Dr. Arnett Dennis
1974-1981



Dr. Paul Smith
1981-1996; 2010-2011



Dr. Pat Zimmerman
1997-2005



Dr. John Helsdon
2005-2010



Dr. Andrew Detwiler
2011-current

In 2011, a transition began to change our faculty from non-tenure track positions to tenure-track and to create an official “Atmospheric Sciences Department” at the Mines. Dr. Andy Detwiler is currently serving as the Department Head.

The distinction of IAS as a research institute is also in transition, as there is a proposal to create four research institutes on campus, into which IAS would be absorbed.

The Harold D. Orville Symposium

Forty Years' of Modeling Clouds and Weather Modification

The Harold D. Orville Symposium was held on Saturday, April 26, 2003, to celebrate Dr. Harold Orville's more than 40 years of contributions to atmospheric sciences. A special banquet attended by over 130 of Dr. Orville's colleagues, former students, family and friends provided a time for celebration and reminiscences. Dr. Orville hosted a golf tournament and brunch the next day at Arrowhead Country Club.



Front row, seated, left to right:

James Miller, Dick Schleusener, Rick Anthes, Bill Cotton, Paul Smith, Harry Orville, Laura Orville, Nancy Knight, Arnett Dennis, Dick Orville, Barbara Orville, and Ed Boyd.

Second row, left to right:

Katy (Fitzpatrick) Branham, Tom Henderson, Bill Capehart, Steve Chai, George Farazoulis, Chin Ho Moeng, Y. Lin, Mike Yeh, Donna Kliche, Elaine (Foy) Baker, Madeline Dessens.

Back rows, left to right, but staggered ordered front to back as they are standing:

Erin Landguth, Patrick Zimmerman, L. Ron Johnson, R.A. Sarma, Shane Hansen, Tom Henderson, Andrey Sinkevich, Larry Hjermstad, Johnny Medina, Chandan Das, Mark Hjelmfelt, Joe Dreher, Fred Kopp, Fanthune Moeng, Brad Ferrier, Jason Goehring, Charlie Knight, Jim Renick, Jim Heimbach, Gary Riley, Roger Reinking, Aaron Gilstad, Maury Roos, Don Griffith, Joe Golden, Jeff French, Andy Detwiler, Bruce Boe, John Helsdon, Laron L. Smith, Matt Bunkers, Bob Riggio, Dick Farley, Curt Hartzell, Jean Dessens, John Eylander, Simon Chang, unknown, Bill Kuo, Duncan Axisa.



Dr. Harold Orville



Dr. Harold "Harry" Orville, 79, Distinguished Professor Emeritus of Atmospheric Sciences at the South Dakota School of Mines and Technology, died 6 June 2011 at a Rapid City nursing home. Over a long and distinguished career he contributed much to the science of weather modification and the use of numerical cloud models in support of weather modification research. Harry was a long-time member of the WMA and received its Schaefer, Thunderbird and International awards (the only WMA member to hold all three).

Harry was born 23 January 1932 in Baltimore, MD to Capt. Howard and Lillian Orville. He grew up in Arlington, VA, graduating from high school in 1950. He received a degree in political science from the University of Virginia in 1954, along with a commission in the U.S. Army, and married Laura Milster the same year. In his senior year he gave a speech in speech class on the newly developing field of weather modification by cloud seeding. In those days Harry's father chaired President Eisenhower's Committee on Weather Control. Harry, now following in his father's footsteps, served as a Signal Corps meteorologist at Ft. Huachuca, AZ, and was honorably discharged in 1956 as a 1st Lieutenant. He subsequently received his M. S. degree in meteorology from Florida State University and his Ph.D. from the University of Arizona in 1965.

Harry was born 23 January 1932 in Baltimore, MD to Capt. Howard and Lillian Orville. He grew up in Arlington, VA, graduating from high school in 1950. He received a degree in political science from the University of Virginia in 1954, along with a commission in the U.S. Army, and married Laura Milster the same year. In his senior year he gave a speech in speech class on the newly developing field of weather modification by cloud seeding. In those days Harry's father chaired President Eisenhower's Committee on Weather Control. Harry, now following in his father's footsteps, served as a Signal Corps meteorologist at Ft. Huachuca, AZ, and was honorably discharged in 1956 as a 1st Lieutenant. He subsequently received his M. S. degree in meteorology from Florida State University and his Ph.D. from the University of Arizona in 1965.

In February 1965 Dr. Orville came with his family to the Black Hills to join Dr. Richard Schlesener, Dr. Arnett Dennis and other colleagues at the Institute of Atmospheric Sciences at the South Dakota School of Mines and Technology. His main activity was developing numerical cloud models as a major component of the Institute's weather modification research program, being carried out under what came to be known as the Bureau of Reclamation "Skywater" program. His Ph.D. research involving cloud photogrammetry led him into cloud physics, and Harry and his students and colleagues were careful to include cloud microphysics as well as dynamics in their models. They developed microphysical parameterization schemes to represent the generation, growth and interactions of different classes of cloud and precipitation particles. As computer capabilities advanced, these schemes became more complicated and sophisticated and the models moved from clouds containing only liquid particles (cloud droplets and raindrops) to incorporate various forms of ice including cloud ice crystals, snow, graupel and hail. Furthermore, Harry always paid close attention to comparisons between the model simulations and corresponding observations.

Often the focus of the modeling work was on understanding and properly simulating basic physical processes, but as the capabilities improved it became possible to simulate effects of cloud seeding in the models as well. The first journal publication dealing with glaciogenic cloud seeding appeared in 1980, and many followed. Harry understood that models offer a unique capability to compare the behavior of the same cloud with and without the application of seeding treatments. He thus became an international leader in the application of numerical cloud modeling to the simulation of cloud seeding processes. Work expanded to cover seeding for precipitation enhancement from both summer convection and winter orographic storms, for hail suppression, and even for trying to enhance convection through widespread dispersal of carbon black dust. More recent years saw the addition of hygroscopic seeding simulations (though some simulations of salt seeding had been carried out in the 1970s). In 1990 and 1996 he published important surveys of the role of numerical cloud modeling in weather modification research and operations.

Harry helped set up the Department of Meteorology (now the Department of Atmospheric Sciences) – the academic arm of the Institute – in 1966, became department head in 1974, and served for over twenty years in that position. He also served as interim vice president at SDSM&T in 1987 and 1993, and as acting director of IAS. Upon retiring from fulltime teaching in 1996, Orville was named a distinguished professor emeritus.

He successfully advocated for cloud seeding trials, sponsored by the West Dakota Water Development District and the City of Rapid City, to enhance reservoir levels in the Black Hills during 1989. He organized a local workshop with invited national speakers, spoke at council meetings, and participated in on-air call-in shows on the topic. In the early 1990's he conducted local research involving microwave radiometer measurements of the vapor flux over the Black Hills region and, in collaboration with Richard Farley and several students, simulated Black Hills spring storm cases to explore the potential enhancement due to seeding of these storms.

Dr. Orville and Nancy Knight collaborated on two NSF-sponsored Research Experiences for Undergraduates projects associated with major convective-storm field projects conducted in Bismarck, ND, in 1989 and 1993 to study potential for hail damage mitigation using cloud seeding. He helped organize a program development workshop for the Board on Atmospheric Sciences and Climate of the National Academies of Science in November 2000, to assess whether a new study of the scientific underpinnings of weather modification was needed. It led to a study that resulted in the National Research Council report on *Critical Issues in Weather Modification Research*, issued in 2003.

Dr. Orville was a Fellow of the American Meteorological Society and in 1993 was awarded the Charles Franklin Brooks Award, the highest AMS award for service. He served the AMS in many capacities, including AMS councilor and member of

the Executive Committee from 1983-1986, and Scientific and Technical Activities Commissioner from 1989-1996. In addition, he chaired the AMS Committee on Weather Modification on two different occasions and also served on the Committees on Cloud Physics and on Severe Local Storms. He was a member of the International Commission on Cloud Physics from 1971 to 1980, spent the academic year 1972-73 working with the NOAA Office of Environmental Modification (dealing with their weather modification programs), and spent a 1982 sabbatical in the Weather Modification Office at the World Meteorological Organization headquarters in Geneva. He later chaired the WMO Executive Council Panel of Experts/Committee on Atmospheric Sciences Working Group on the Physics and Chemistry of Clouds and Weather Modification Research from 1991-1997. He chaired the organizing committees for WMO scientific conferences on weather modification in Italy (1994) and Thailand (1999), and was instrumental in initiating the series of International Cloud Modeling Workshops conducted under WMO auspices.

Harry had a lifelong interest in sports and ath-

letics, including being a boxer in college. In 1965 he became the manager of Harney Little League teams, and was also active in the Boy Scouts of America and served as PTA President. He was an avid golfer, becoming a member of the Hole in One Club in 1998, and initiated the annual South Dakota School of Mines and Community Golf Tournament (which has raised tens of thousands of dollars for scholarships). The seventh annual event took place on the day that Dr. Orville passed away. Survivors include his wife, Laura Orville, Rapid City; their golden retriever, "Breezy;" four children, six grandchildren, and three great grandchildren; and two brothers, of whom Richard Orville of Texas A&M University will be familiar to many WMA members. Memorials will be placed towards the Harold and Laura Orville Graduate Fellowship or to the South Dakota School of Mines and Community Golf Tournament through the SDSM&T Foundation.

---Dr. Paul L. Smith

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A Tree is Planted in His Memory

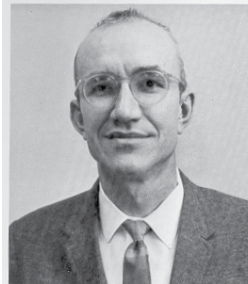


On July 31, 2011, a honey locust tree was planted in front of the Mineral Industries building on the campus of SDSM&T in memory of Dr. Harry Orville. Dr. Orville, who passed away in June, was a distinguished professor emeritus of the atmospheric sciences department and was also a generous benefactor to the department and the School of Mines. In addition to being a favorite professor of the students, he also conducted research work, served as department chair, and served as an interim vice president of the university. He was a strong supporter of sports activities, both in the community and on campus.

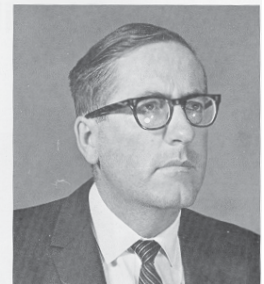
Photos



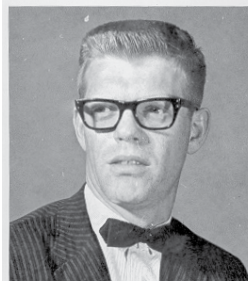
Institute of Atmospheric Sciences receives substantial government commitment.



R. A. Schleusener
Director & Prof. of
Meteor.



Arnett S. Dennis
Assoc. Dir. & Prof. of
Meteor.

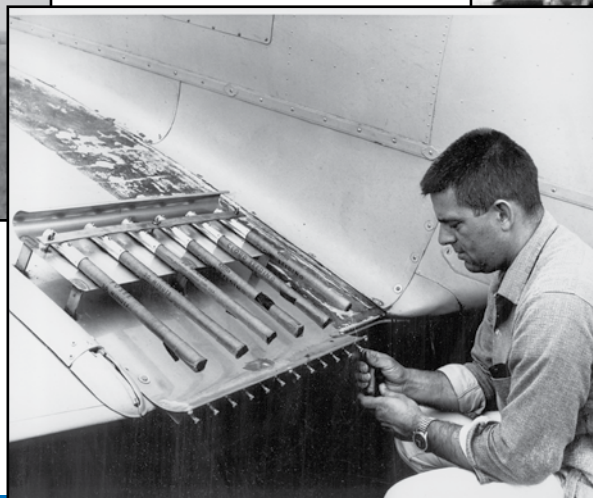


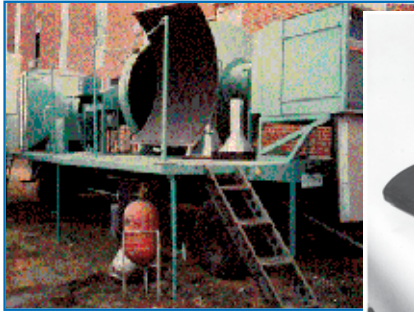
John Hirsch
Asst. Prof.



Harold D. Orville
Asst. Prof.



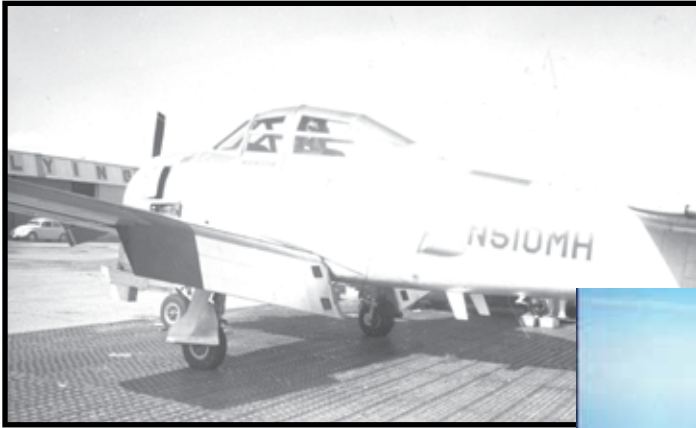




Equipment through the years has varied, from the Cloud Chamber top left to the lab equipment bottom right.



The T-28 Armored Research Aircraft



1969

1989



2000

*The "SPA-10":
Our Next Generation
Storm Penetrating
Aircraft*





Left: Dr. Richard Schleusener, Dr. Paul MacCready, and Dr. Paul Smith on the wing of the T-28 in the Rapid City hangar (2005).

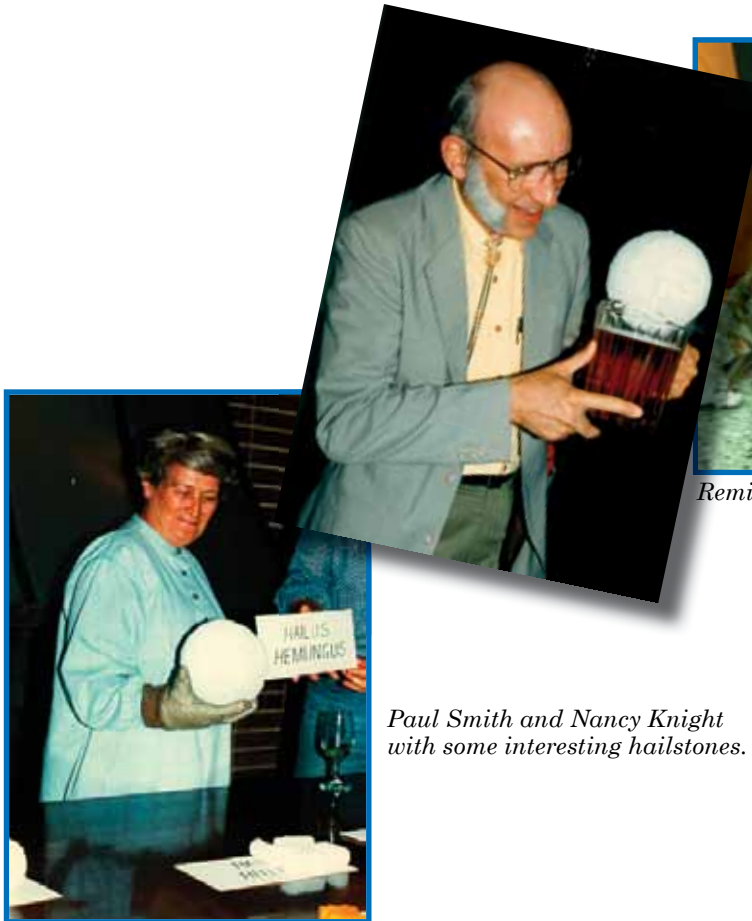


T-28 pilots: Norm Vine, Dan Custis, Charlie Summers, Charlie Summers and Tom Root, and Tom Warner

Below left: 1972 crew and Right: 2004 crew & staff



On the lighter side...



*Paul Smith and Nancy Knight
with some interesting hailstones.*



Remind you of anyone?

Oops!



*Gary Johnson - feeling all boxed in (bottom left),
and auditioning for the part of T-28 pilot (below).*





*Getting older
at IAS...*



*you never
know what
may show up
in your office*



Pam cooked up a special treat - homemade ice cream - but the students had to make it themselves by tossing the bags back and forth!



It's a ghoulish good time in 2008 with the students at IAS!

No, it's not a student gone mad... it's just Kelly Malone (ATM 2009), getting a really good view of the radar tower at New Underwood. Dr. Hjelmfelt often treated the students in his radar meteorology class to a field trip to view the inner workings of the tower.



SDSM&T holds an annual "Parade of Trees" and IAS has been notorious for presenting the "most unique" tree as its entry. The 2010 model depicts various storm events through the decades on empty bottles attached to a welded tree, and was completed with the help of the blacksmithing group on campus.



ATMOSPHERIC SCIENCE GRADUATES **1968-PRESENT**

1968

Liu, John M.S.
Schock, Martin M.S.

1969

Hartzell, Curtis M.S.
Huang, Yi-Hui M.S.
Musil, Dennis M.S.

1970

Chang, Chai-Bo M.S.
Lai, Han-Wei M.S.
Petersen, Ronald M.S.
Wisner, Chester M.S.

1971

Chen, Y-Hsiung M.S.
Miller, James M.S.

1972

Chang, Simon M.S.
Gelhaus, James M.S.

1973

Chong, Shu-Lin M.S.
Farley, Richard M.S.
Hubbard, Kenneth M.S.
Riggio, Robert M.S.
Schroeder, Melvin M.S.

1974

Lee, Rueen-Yuh M.S.
Leichter, Irving M.S.
May, Edwin M.S.
Moeng, Fanthune M.S.
Sand, Wayne M.S.
Shaw, William M.S.

1975

Hjelmfelt, Mark M.S.
Lin, Chin-Hoh M.S.
Pellett, Jackson M.S.
Wilhelm, Dale M.S.

1976

Chang, Lang-Ping M.S.
Chen, Ching-Sen M.S.
Cho, Nam-Kun M.S.
Haggard, Steven M.S.
May, Laurence M.S.
Spahn, John M.S.
Wang, Sue-Lee M.S.
Weber, Steven M.S.
Yeh, Hwa-Young M.S.

1977

Birkenheuer, Daniel M.S.
Bradley, Michael M.S.
Chang, Chen-Hung M.S.

1978

Biltoft, Christopher M.S.
Chen, Chaing-Heins M.S.
Eckhoff, Peter M.S.
Ekern, Michael M.S.
Hsie, Eirh-Yu M.S.
Laco, Carlton M.S.
Sarma, R. Ananthakrishna M.S.

1979

Chen, Wen-Dar M.S.
Dixon, Robert M.S.
Hwang, Chang-Sik M.S.
Jameson, Terry M.S.
Malo, Jane M.S.
Peak, James M.S.
Santhanam, Suresh M.S.

1980

Kuo, Ying-Hwa M.S.
Lin, Yuh-Lang M.S.

1981

Chen, Jeng-Ming M.S.
Hsiao, Hui-I M.S.
Jansen, Douglas M.S.

1982

Arnesen, Keith M.S.
Chen, Wen-Tsann M.S.
Liu, Henry F.C. M.S.
Melita, David M.S.
Viswanath, Lakshmana M.S.

1983

Day, Robert M.S.
Ewald, Rick M.S.
Ionescu-Niscov, Stefano M.S.
Lai, Li-Jane M.S.

1984

Kuo, Shu-Ling M.S.

1985

Fakhruzzaman, Khan M.S.
Krause, Todd M.S.
Parker, Lindsay M.S.
Tyler, Kelly M.S.
Wu, Ling May M.S.

1986

Bachmeier, A. Scott M.S.
Deola, Regina M.S.
Johnson, Bryan M.S.
Kubesh, Rodney M.S.
Price, Pamela M.S.
Rajan, Sudhir M.S.
Sarma, R. Ananthakrishna PhD (Coop)

1987

Chen, Jen Ping M.S.
Fuhs, Michael M.S.
Loukah, El Bachir M.S.

Makarau, Amos	M.S.		
Wu, Gang	M.S.		
1988			
Blackmore, William	M.S.		
El Mokhtari, Mohammed	M.S.		
Hammer, Robert	M.S.		
Kuo, Kwo-Sen	M.S.		
Tao, Ningsheng	M.S.		
Yan, Wei	M.S.		
Zebic, Dawn	M.S.		
1989			
El Majdoub, Ali	M.S.		
Jung, James	M.S.		
Peterson, Bret	M.S.		
1990			
Abidi, Azzouz	M.S.		
Addison, Roy	M.S.		
Anantharaj, Valentine	M.S.		
Anderson, Darcy	M.S.		
Chi, Yue-Chen	M.S.		
Christopher, Sundar	M.S.		
Hoffmanm, Randall	M.S.		
Huston, Michael	M.S.		
Todey, Dennis	M.S.		
Vulcan, Donna Veturia	M.S.		
Wang, Shaohua	M.S.		
1991			
Berendes, Todd	M.S.		
El Hilali, Mohammed	M.S.		
Lee, Bruce	M.S.		
Liu, Zhong	M.S.		
Murtha, Debra	M.S.		
Zhang, Shengyu	M.S.		
1992			
Chou, Hui-Yun	M.S.		
Khantiyanan, Warawut	M.S.		
Mayer, Kurt	M.S.		
Ross, Craig	M.S.		
Searles, Jay	M.S.		
Sukarnjanaset, Wathana	M.S.		
Nair, Udaysankar	PhD (Coop)		
1993			
Feind, Rand	M.S.		
Stoppkotte, John	M.S.		
Viswanathan, Krishnaswamy	M.S.		
Zhu, Tianri	M.S.		
1994			
Bunkers, Matthew	M.S.		
Chen, Liqiang	M.S.		
Huang, Nu-Ling	M.S.		
Nguyen, Phuong	M.S.		
Ramachandran, Rahul	M.S.		
Wu, Ting	M.S.		
1995			
Kondrasuk, Gregory	M.S.		
Rife, Daran	M.S.		
Chang, Wen-Yu	M.S.		
French, Jeff	M.S.		
Larsen, Scott	M.S.		
Li, Xiang	M.S.		
McGrath, Kevin	M.S.		
Wojcik, William	M.S.		
1996			
Bloomer, Mark	M.S.		
Chen, Hui	M.S.		
Hjermstad, Dale	M.S.		
Isakov, Vladilen	M.S.		
Kraaijenbrink, Gerald	M.S.		
Krcil, Kevin	M.S.		
Stender, Anthony	M.S.		
VanderVorste, Michael	M.S.		
Zhang, Yong	M.S.		
Christopher, Sundar	PhD (Coop)		
Kuo, Kwo-Sen	PhD (Coop)		
1997			
Barbieri, Kristine	M.S.		
Jin, Qiaolin	M.S.		
Li, Zhen	M.S.		
Schimelfenig, Todd	M.S.		
Waits, Charles	M.S.		
Wozniak, Allison	M.S.		
1998			
Cooper, Kevin	M.S.		
Grimaldi, Richard	M.S.		
Salmen, John	M.S.		
Trimarchi, Stephen	M.S.		
1999			
Covert, Josiah	M.S.		
Cruickshank, Tyler	M.S.		
Gattaleeradapan, Sirin	M.S.		
Salmen, John	M.S.		
2000			
Meng, Fanguang	M.S.		
2001			
Connelly, Michael	M.S.		
Eylander, John	M.S.		
Gonguez, Dennis	M.S.		
Rudge, Scott	M.S.		
Sus, Inna	M.S.		
2002			
Dykstra, Denise	M.S.		
Tao, Jin	M.S.		
Wang, Jianzhong	PhD		
Zhang, Xingjun	PhD		

2003		
Tao, Jin	M.S.	
Grimaldi, Richard	PhD	
2004		
Dreher, Joseph	M.S.	
Fersdahl, Mark	M.S.	
Fitzpatrick, Katy	M.S.	
Jardine, Kolby	M.S.	
Landguth, Erin	M.S.	
Toomey, Michael	M.S.	
Warner, Tom	M.S.	
Song, Xianzhi	PhD	
2005		
Nelson, Kurtis	M.S.	
Rowell, Eric	M.S.	
Bennett, T.M. Bull	PhD	
Chen, Xuexia	PhD	
Das, Chandan	PhD	
2006		
Elsen, Jessica	BSIS-ATM	
Preiss, Brian	BSIS-ATM	
Sadler, Stacey	BSIS-ATM	
Franks, Chris	M.S.	
Goehring, Jason	M.S.	
Hansen, Shane	M.S.	
Holm, Meagan	M.S.	
Poeppel, Kurt	M.S.	
Benson, Randall	PhD	
Bunkers, Matthew	PhD	
Lalonde, Karl	PhD	
2007		
Richards, Lance	BSIS-ATM	
Beals, Matt	M.S.	
Brehe, Kyle	M.S.	
Clawges, Rick	M.S.	
Cousins, Dave	M.S.	
Franks, Chris	M.S.	
Hulka, James	M.S.	
Feind, Rand	PhD	
Kliche, Donna	PhD	
2008		
Hertz, Terri	BSIS-ATM	
Jorde, Sarah	BSIS-ATM	
Pellatz, Doug	BSIS-ATM	
Tate, Andrew	BSIS-ATM	

Axford, Timothy	M.S.
George, Joanna	M.S.
Harrelson (Nelson), Sarah	M.S.
Liske, Edward	M.S.
Ott, Jeremy	M.S.
Wetenkamp, John	M.S.
Zimmerman, Andrew	M.S.
2009	
Honomichl, Shawn	BSIS-ATM
Lynch, Ryan	BSIS-ATM
Clabo, Darren	M.S.
Jacobs, Shawn	M.S.
Verwolf, Adrian	PhD
2010	
Berg, Gretchen	BSIS-ATM
Cowing, Tyler	BSIS-ATM
Ewy, Katie	BSIS-ATM
Hammrich, Christopher	BSIS-ATM
Konold, Amanda	BSIS-ATM
Luze, Jason	BSIS-ATM
Carroll, Kathleen	M.S.
Meyer, Jonathan	M.S.
Mohn, Cory	M.S.
Phillips, Lisa	M.S.
Stauffer, Phillip	M.S.
2011	
Honomichl, Shawn	M.S.
Upadhayay, Sikchya	M.S.
2012	
Aguilar, Theresa	M.S.
Berg, Gretchen	M.S.
Brewer, Joshua	M.S.
Caye, Heather	M.S.
D'Amico, Dan	M.S.
French, Emily	M.S.
McKemy, Dan	M.S.
Sewell, Frances	M.S.

**HISTORY OF THE INSTITUTE OF ATMOSPHERIC SCIENCES
AND THE DEPARTMENT OF METEOROLOGY (ATMOSPHERIC SCIENCES)
A BRIEF TIMELINE OF EVENTS**

1959	IAS was established in 1959 by Special Resolution No. 30-1959 of the SD Board of Regents.
1962	An NSF-sponsored conference outlined recommendations for the research and educational program.
1963-64	Limited field programs were carried out in the summers of these two years.
1964	Dr. Richard Schleusener was hired to head the IAS as its first full-time director.
1965	S.D. Board of Regents approved the M.S. degree in Meteorology at SDSM&T; Dr. Schleusener became Department Head in addition to being the Director of IAS.
1966	<p>Project Hailswath was hosted in Rapid City. Personnel from 17 organizations from around the country converged in Rapid City to carry out hailstorm studies.</p> <p>Rapid Project was conducted at this same time to study cloud seeding effects on convective rain showers. This project continued through 1968.</p>
1968	John Yu-Ming Liu and Martin Schock received the first M.S. degrees in Meteorology.
1969	Rapid Project was supplanted by Project Cloud Catcher in 1969-1972. Four field sites were operated simultaneously in Alliance, Nebraska; Watford City, ND; and Lemmon and Rapid City, SD.
1970	IAS received the T-28 aircraft in January. Additional modifications were made to the plane during the spring and summer. In July/August, the T-28 was part of the Joint Hail Research Project (JHRP) in Greeley, CO. It flew 16 flights and logged 25.6 hours.
1972	<p>The Flood of '72 occurred on June 9th; cloud seeding activity was curtailed due to controversy over cloud seeding activities that were carried out at that time.</p> <p>National AMS Conference on Weather Modification was hosted in Rapid City.</p> <p>The T-28 participated in the second year of the National Hail Research Experiment (NHRE) from Cheyenne, Wyoming. Although scheduled to participate in the first year's work, mechanical problems caused the T-28 to be grounded for the field season in 1971.</p>
1974	<p>General cutbacks in federal research expenditures ended the support of weather modification field programs. Dr. Schleusener became VP and Dean of Engineering of Mines (and later President of the university); Dr. Arnett Dennis became Director of the Institute and Dr. Harold Orville became Head of the Department of Meteorology.</p> <p>The T-28 participated in the third year of the NHRE.</p> <p>Support for the Institute was provided by the Bureau of Reclamation.</p>
1975	The major research support by the Bureau of Reclamation ended.
1976	The Weather Modification Association held its annual meeting in Rapid City. The T-28 participated again in the NHRE.

1977	<p>The Cooperative PhD project with Colorado State University was established.</p> <p>The Institute/Department of Atmospheric Sciences was moved from the Mineral Industries building to offices in the McLaury Building.</p>
1978	The Minor in ATM was established.
1981	Dr. Dennis resigned as Director to join the Bureau of Reclamation as a research administrator. Dr. Paul Smith succeeded him as Director.
1987	IAS officially became the NSF national facility for the T-28 Storm Penetrating Aircraft, with Dr. Smith as the facility manager.
1989	A BSIS degree was initiated at SDSM&T, allowing a degree equivalent to a B.S. in Meteorology (now Atmospheric Sciences).
1994	<p>The PhD program in Atmospheric, Environmental and Water Resources was established jointly with SDSU.</p> <p>Dr. Orville retired from active research and teaching, although he remained a steady support and presence for the Institute and especially the Department.</p> <p>Dr. Mark Hjelmfelt is Chair of the Atmospheric Sciences Department.</p>
1996	Dr. Paul Smith retired; Dr. Sherry Farwell became Acting Director.
1997	Dr. Patrick Zimmerman was chosen to become the new director of IAS; Dr. John Helsdon is Department Chair.
1998	The Remote Sensing group left IAS to take positions at the University of Alabama-Huntsville.
2000	IAS moved from the McLaury Building back to the Mineral Industries building, where it had its start.
2004	Timothy "Bull" Bennett was the first Native American to graduate with a PhD degree from Mines. He received his PhD in the AEWWR program.
2005	<p>Dr. Zimmerman left IAS after forming his own company (C-Lock Technologies).</p> <p>Dr. John Helsdon was named as Interim Director for the Institute.</p> <p>The T-28 was retired from active duty.</p>
2007	Dr. P.V. Sundareshwar was recognized by <i>Seed</i> magazine as one of the world's Revolutionary Minds.
2009	IAS is officially 50 years old.
2011	Dr. Harry Orville passed away after a lengthy illness.
2012	Dr. Andrew Detwiler named Department Chair.

RESEARCH PROJECT LIST

1965-68	Shadehill Project	Lemmon, SD
1965-68	Rapid Project	Black Hills area
1966	Project Hailswath	Black Hills area
1967-70	Western Nebraska Project	Hemingford and Alliance, NE
1967	East River Project	Huron, SD
1967-74	Project Skywater	Black Hills
1967-69	Hailstorm Models Project	Black Hills area
1970	Grand River Project	Northwestern SD
1969-72	North Dakota Pilot Project (NDPP)	Western ND
1972	THEMIS	School of Mines
1972-76	National Hail Research Experiment (NHRE) (T-28)	Northeast CO
1977-81	HiPLEX	Southeastern MT
1978	TRIP '78	Cape Canaveral, FL
1979	SESAME '79 (T-28)	Central Oklahoma
1980	Norman, OK (T-28)	
1981	Modeling project from Spain	Duero River Basin
1981	CCOPE Project (T-28)	Miles City, MT
1980-95	North Dakota Cloud Modification Project	Western ND
1982-83	Grossversuch IV (T-28)	Switzerland
1985	Alberta Hail Project (T-28)	Red Deer, Canada area
1986	COHMEX (T-28)	Huntsville, AL
1987	North Dakota Federal/State Weather Modification Project (T-28)	Dickinson, ND
1989	Precipitation Augmentation for Crops Experiment (PACE) (T-28)	Champaign, IL
1989	North Dakota Thunderstorm Project (NDTP) (T-28)	Bismarck, ND
1989-98	MOLAS (Mono Lake AIPs) (T-28)	Mono Lake, CA
1990	NMEX (T-28)	Socorro, NM
1991	Cooperative Oklahoma Profiler Studies (COPS-91) (T-28)	Norman, OK
1991	Convection & Precipitation/Electrification (CaPE) (T-28)	Melbourne, FL
1992	RAPS (T-28)	Greeley, CO
1993	North Dakota Tracer Experiment (NDTE) (T-28)	Bismarck, ND
1994	Texas Experiment in Augmenting Rainfall through Cloud Seeding (TEXARC) (T-28)	Big Spring, TX
1994	VORTEX (T-28)	Norman, OK
1995	Verification of Rotation in Tornadoes Experiment (VORTEX 95) (T-28)	Norman, OK Ft. Collins, CO
1997	NMEX 97 (T-28)	Socorro, NM
1999	Convective Turbulence Data Collection Program (T-28)	Northeast, CO
	COMET project	
1999	Upper Missouri River Basin Project (UMRB)	Black Hills area

2000	Severe Thunderstorm Electrification and Precipitation Studies (STEPS) Project (T-28)	Goodland, KS
2001-2009	Ameriflux Tower Network	Black Hills area
2003	NDARB WEATH Damage Report	
2003	Last actual flights of T-28 for projects	Norman, OK Greeley, CO (T-28)
2004-2010	Cottonwood Tower project	Cottonwood, SD
2005	Biogeochemistry Core Facility established	School of Mines
2005-current	ARDEC Department of Defense	School of Mines
2007-2008	He Sapa Bloketu Woecun Project	Black Hills Area
2007-2008	NOAA-WRAF Atmosphere and Human Health	Black Hills Area
2008	T-28 Data Archive Project	School of Mines and Boulder, CO
	LAKE-Ice Project	Michigan
2008-current	USGS Pothole Project	South Dakota
2009	He Sapa Oyate Embracing Science Project	Black Hills area
2009-2011	<i>Didymo</i> Project	Rapid Creek and in Chile, South America
2011-2012	He Sapa Oyate Field to the Fair Project	Black Hills area
2012-2014	Lightning Studies (UPLIGHTS)	Black Hills area
2012-2014	SPA-10 Project	