Department of Atmospheric Sciences
Strategic Plan
2014 – 2019

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1 Vision

Our vision is to provide an educational and research environment in the field of atmospheric science where world-renowned faculty lead efforts to make new discoveries benefiting our educational program and our society. Advances the research frontiers in the core areas of atmospheric science, including meteorology, climate, and atmospheric chemistry, have important short-term and long-term socioeconomic applications, in areas ranging from emergency preparedness for extreme weather to economic policies for addressing climate change. We will strive to foster collaborations within geosciences as well as in other fields such as agriculture and life sciences to facilitate interdisciplinary research and outreach activities than can both advance our scientific knowledge and promote sustainable development. We will integrate our research activities with our undergraduate and graduate programs, to better prepare our students for the new challenges that lie ahead in their careers as atmospheric scientists and to better serve our society.

2 Mission

The Department of Atmospheric Sciences is dedicated to 1) advancing scientific understanding of the atmosphere and imparting that knowledge for the benefit of society, 2) preparing the next generation of atmospheric scientists to acquire and develop scientific knowledge, critical thinking skills, lifelong learning practices, and the potential to contribute to society, and 3) using our expertise to serve the broader scientific, government, and industry communities.

Our most fundamental mission is to educate students at all levels, from undergraduate to postdoctoral. We provide the opportunity for undergraduate students to major in meteorology and graduate students in atmospheric sciences. We also teach students in other disciplines through survey courses, which give students a better understanding of nature and of scientific methods, and through specialized courses for students requiring applied knowledge of meteorology.

Our research efforts serve two purposes: to expand the frontiers of fundamental and applied atmospheric science and to train students in how to conduct research. Research results are communicated through professional journals, books, and other media to scientists and the public.

As part of a public university, we have a duty to contribute to society through our educational and research activities. This includes administrative and educational efforts inside and outside the university, such as university governance and development of educational materials. We also serve the broader community by serving on committees of scientific societies, providing advice to state and federal governments, acting as reviewers and editors, organizing meetings, and consulting with industry.

3 Values

We believe first and foremost in integrity and quality in all that we do. We believe in service to the university community, the State of Texas, and to the society that sustains our activities. We believe in unselfish cooperation in research and teaching, and we strive to produce a diverse and equitable environment where everyone can develop and grow.

4 Environment

4.1 Overview of the department

People

Table 1 lists current faculty members and their areas of expertise. At this time we have 21 tenured (one as joint appointment) and tenure-track faculty, one instructional professor, and one research professor. We employ outside professional broadcast meteorologists as lecturers to teach an undergraduate course in broadcast meteorology. Many external faculty and scientists participate in joint research projects and on graduate student committees.

We have research strengths in four main areas:

- *Weather and Forecasting* (numerical weather prediction, data assimilation, synoptic meteo- rology, severe weather)
- *Dynamical Meteorology and Climate Dynamics* (geophysical fluid dynamics, climate predic- tion, climate change, radar meteorology, tropical meteorology)
- *Atmospheric Chemistry* (fundamental chemistry, air quality, aerosol physics, biogeochemical cycles)
- *Physical Meteorology* (radiative transfer, remote sensing, cloud physics, lightning)

The staff consists of four business staff members, one technical staff member, and one academic advisor who is responsible of academic advising for both the Department of Atmospheric Sciences and the Department of Oceanography.

Facilities and equipment

In the Eller Oceanography and Meteorology Building, the Department of Atmospheric Sciences occupies part of the 9th floor, all of the 10 and 11th floors, all of the 12th floor except for the Oceanography Department offices; and the 14th floor (in the building superstructure). This space includes offices for faculty, students, and staff; research laboratories; two computer teaching laboratories (with 20 and 25 seats); a combined radar operations room and broadcast studio; a weather center for real-time observations and forecasting; a seminar room; a small meeting room; and the department administrative offices. In the college server room (Eller B04), the Department occupies approximately one row of rack space for departmental and PI computers. The Department

Table 1: Current faculty - June 2014

Name	Title	Specialty	Notes
Kenneth P. Bowman	Prof.	Dynamics, climate dynamics	
Sarah D. Brooks	Assoc. Prof.	Aerosol physics	reinvestment
Ping Chang	Prof.	Climate variability, GFD	OCNG (joint)
Don Collins	Prof.	Aerosol physics	
Don Conlee	Inst. Prof.	Weather analysis, forecasting	
Andrew Dessler	Prof.	Climate change	reinvestment
Craig Epifanio	Assoc. Prof.	Mesoscale dynamics	
Robert Korty	Assoc. Prof.	Paleoclimate, dynamics	IODP
Mark T. Lemmon	Assoc. Prof.	Planetary atmospheres	reinvestment
Shaima L. Nasiri	Assoc. Prof.	Rad. trans., remote sensing	reinvestment
John W. Nielsen-Gammon	Prof.	Synoptic met., forecasting	
Christopher Nowotarski	Asst Prof.	Convective Storm Dynamics	
Gerald R. North	Dist. Prof.	Climate and statistics	joint w/ OCNG
Richard Orville	Prof.	Physical met., lightning	
Lee Panetta	Prof.	GFD, mathematics	joint w/ MATH
Anita Rapp	Asst Prof.	Cloud and Precipitation	
R. Saravanan	Prof.	Climate dynamics	reinvestment
Gunnar W. Schade	Assoc. Prof.	Biogeochemical cycles	reinvestment
Courtney Schumacher	Prof.	Trop. and radar met.	
Istvan Szunyogh	Prof.	Data assimilation, forecasting	
Thomas Wilheit	Res. Prof.	Rad. trans., remote sensing	
Ping Yang	Prof. & Dept Head	Rad. trans., remote sensing	Joint w/PHYS
Renyi Zhang	Dist. Prof.	Atmospheric chemistry	joint w/ CHEM

maintains the Aggie Doppler Radar (ADRAD) on the roof of the Eller Building and is part of a consortium that operates a mobile Doppler radar (SMART-R). Plans are underway to set up a surface meteorological observing site near the Eller Building for teaching and emergency management purposes. A number of individual professors deploy instruments in the field for research projects using trailers, fixed sites, and aircraft. This includes the Houston Lightning Detection and Ranging network. The Texas A&M Supercomputing Center is an important resource for a number of faculty members in the Department.

Teaching activities

The Department offers the B.S. in Meteorology and M.S. and Ph.D. degrees in Atmospheric Science. Tables 2 and 3 summarize basic enrollment numbers and characteristics of undergraduate majors and graduate students. Our primary service course for non-majors is ATMO 201/202, which serves approximately 600 students per year.

Table 2: Enrollment and gender diversity - Spring 2014

Classification	Female	Male	Total	M.S.	Ph.D.
Undergradate	57	70	127		
Graduate	15	37	52	22	30

Table 3: Student ethnic diversity – Spring 2014

Classification	White	Black	Hispanic	Asian	Am. Indian	International	Other
Undergradate	90	7	23	3		1	3
Graduate	26	2	2	2		22	

Research activities

The Department has a diverse and well-funded research program. Annual research expenditures are approximately $5M. The Department receives research grants from a number of federal and state agencies including NSF, NASA, NOAA, DOD, DOE, FAA, EPA, and TCEQ. Research grants expanded significantly during the last decade and the Department pays for one staff position from returned IDC to manage the administrative workload.

Within Texas A&M ATMO faculty have research collaborations with faculty in the Departments of Oceanography, Geography, Chemistry, Physics, Statistics, Aerospace Engineering, Nuclear Engineering, Ecosystem Science, Soil and Crop Science, Educational Psychology, and the Bush School. External research collaborations involve colleagues at more than 40 universities and government research laboratories.

The Department also contains the Office of the State Climatologist. The position of State Climatologist is appointed by the Governor of Texas and is currently held by Dr. John Nielsen-Gammon. The Office of the State Climatologist perpetually underfunded, which severely limits the services that the Office can provide to the State of Texas.

4.2 Evaluation

Strengths

- We are the only comprehensive undergraduate/graduate/research atmospheric sciences department in Texas, and one of the largest standalone departments in the country
- Student enrollment numbers are stable. Gender diversity in the undergraduate student body is good.
- A summer REU program in the department, which began in summer 2013, has begun to affect graduate student recruitment.
- A variety of high-impact learning opportunities (summer SOAP, Aggie Doppler Radar operation, weather balloon launches, green roof, research with faculty) available to undergraduates.
- Research strengths: the department has research strengths in four broad areas, namely, 1) weather and forecasting, 2) dynamical meteorology and climate dynamics, 3) atmospheric chemistry, and 4) physical meteorology. These strengths in four diverse areas establish a solid foundation for collaborative and interdisciplinary research.
- Diverse and well-funded research programs in the department
- Good facilities for teaching and research including a radar, a broadcast studio, a weather center, a lightning detection and ranging network, computer labs, high-performance computing, and lab space.

Weaknesses

- Student credit hours (SCHs) per faculty are realtively low, for example, in comparison with the counterparts of GEOG and GEPL.
- General interests amongst students outside the department have broadened from a traditional weather course to interests in both current climate issues and environmental quality. Our current course offerings do not fully satisfy these interests. We now teach some climate courses, and could offer more. We teach air quality and pollution but only to a select audience who meet the prerequisites.
- While improvements have been made, ethnic diversity amongst majors is low and the majority of majors come from within Texas.
- Our faculty and staff do not reflect the demographics of our students or our state and nation
- Some research strengths may be weakened due to possible faculty retirement in the next few years.
- The radar system is not a state-of-the-art facility for research. The facility is quite old and may stop functioning at any time.
- Lack of a co-located federal research lab makes it more difficult to compete with peer institutions.

Opportunities

- The addition of a new tenure-track assistant professor position through faculty retention efforts will help enhance the department's capacities in teaching, research, and service.
- Upcoming changes to the core curriculum science requirements and planned development of online classes (distance learning) provide opportunities to increase enrollment in ATMO 201 and GEOS 210.
- The undergraduate program can be strengthened through a broader incorporation of high-impact learning opportunities
- As the geosciences are inherently interdisciplinary, we are well prepared to participate in and lead new interdisciplinary research initiatives.
- Interdisciplinary opportunities within the college and broader university exist. A proposed new curriculum in high-performance computing could provide new opportunities for collaboration between disciplines, both within the college and in other science and engineering departments.

Threats

- We cannot predict how the changes in the core curriculum will impact student enrollment in our service courses. Loss of SCHs from decreased demand for ATMO 202 is likely.
- Flat to declining federal research budgets, increased competition from researchers at regional universities, and shifts towards interdisciplinary research priorities over disciplinary funding threatens growth in our research portfolio.
- The challenging funding situation may directly affect maintaining the scale of our graduate program.
- Other universities in Texas could develop atmospheric science programs that would compete with us for students and state funding.
- There are potential retirements of internationally prominent faculty, which will affect our stature and reputation.
- Faculty retention is a challenge. There is a risk of loss of our best faculty to 'better' institutions.

4.3 Peer and aspirant institutions

All are large public universities with excellent research reputations. These are arguably the best atmospheric sciences departments at public universities in the country. Our recent external program review committee included members from Penn State, U. Washington, and UCLA.

Penn State Probably most similar to Texas A&M. Large ATMO department. No co-located national lab. Attracts students regionally and nationally. Their department is better known nationally with a long-standing reputation in the field.

University of Washington A leading research department also known as a source for excellent undergraduate and graduate textbooks.

Colorado State University Leading research department. No undergraduate degree program.

UCLA Leading research department with a modest undergraduate program.

5 Strategy

5.1 Critical Issues

Research

- Maintaining (or even increasing) the current level of external funding support
- Diversifying the funding base
- Incentivizing interdisciplinary research

Education

- The top priority is to increase SCHs
- Systematically revisit the course designs, so as to ensure that courses and curricula meet current university learning outcomes.
- Maintaining high impact learning opportunities for students
- Conduct objective assessment to demonstrate that student learning is improving and meets expectations of university learning outcomes
- Develop an international component in the ATMO educational program to integrate teaching about a global science with global cultural competencies

Human Capital

- Maintaining an attractive, collegial, and rewarding overall environment and culture that value all aspects of the work of a faculty member and rewards true integration of teaching, research and engagement/service.
- As a faculty retention effort, establish recognition and allocate appropriate departmental resources to award truly distinctive, innovative, and effective teaching, research and service.
- Provide mentoring opportunities and career-development opportunities to "develop" faculty over a career.

5.2 Goals

- Increase student credit hours through increasing combined enrollment in ATMO 201 and GEOS 210 to approximately 900 students per academic year within the next 4 to 5 years.
- Increase the national stature of our undergraduate meteorology program so that we attract undergraduate students from around the country. This will address dual goals of increasing undergraduate student numbers and quality.
- Increase our current scholarship endowment to be able to provide new scholarships, and offer three new $1,000 four-year scholarships each year (on an ongoing basis) at both the undergraduate and graduate levels.
- Increase the national stature of our graduate program in Atmospheric Sciences so that we can compete successfully for graduate students with leading public and private

graduate programs in atmospheric science.

- Attract and retain high-quality faculty.
- Maintain a broad, well-funded research program with strengths across the atmospheric sciences. This depends fundamentally on high-quality research proposals developed by individual faculty and groups of faculty.
- Increase research funding, and facilitate interdisciplinary research involving other departments/colleges to take advantage of new funding opportunities for integrative research

5.3 Action Plan

Definitions of milestones

Short range: by December 2014

Medium Range: By the end of the summer of 2015

Long range: After three years, that is, by the end of the summer of 2017

Increase SCHs through increasing enrollment in undergraduate service courses

- We are working on increasing enrollment in ATMO 201 through changes to departmental resource prioritization, better advertising of the course, developing distance learning options, and increasing course consistency from semester to semester. – *medium range*
- The title of ATMO 201 will be updated to a more descriptive and appealing name (e.g., replace "Introduction to Atmospheric Sciences" with "Weather and Climate"). – *short range*
- We will improve visibility and marketing for the course through direct contacts with academic advisors outside of the College. – *short range*
- We will survey the syllabi of successful similar courses at peer institutions to get insights into appropriate course content. – *short range & medium range*
- To the extent possible, we will schedule popular instructors to teach ATMO 201 to ensure continuity of content and build the reputation of the course. – *long range*
- To address the difficulty in getting large classroom space, we will test the effectiveness of a flipped classroom model that will allow us to better utilize space while maintaining intellectual rigor. An increased online presence could provide another alternative. – *medium range*
- We will increase the number of ATMO faculty who regularly teach GEOS 210 and take advantage of the reorganization of the course to 1) teach larger sections and 2) offer the course more often. – *medium range*
- We will work with the Environmental Programs to capitalize on changes in the core curriculum and increase enrollment in GEOS 210. – *medium range*

Increase national stature of undergraduate meteorology major and develop signature undergraduate programs

- Maintain a high-quality undergraduate program to prepare students for careers in weather forecasting, air quality, and other technical areas, as well as for graduate or professional education. – *long range*
- Improve recruitment of students from within Texas to attract more high performing students and continue to increase diversity. We will work with the new College of Geosciences Director of Recruitment to develop a recruitment strategy. – *medium range*
- Develop a national recruitment strategy to attract high performing students from across the country. This will involve collaboration with the College of Geosciences Director of Recruitment. – *medium range*
- Revise the undergraduate curriculum as needed to meet university learning outcomes and incorporate the results of ongoing assessment programs, as well as tracking of our graduates. – *medium range*
- Build upon and improve existing high-impact learning opportunities for undergraduates such as our unique student-operated S-band Doppler weather radar, the summer SOAP program, and the upper-air observation facilities, as well as developing additional high-impact learning opportunities for our students. – *medium range*
- Advertise and offer four-year incentive scholarships of at least $1000 per year to outstanding prospective undergraduates. (Requires that we increase our scholarship endowment, see below.) – *long range*
- Work with the College Communications office to develop a strategy for advertising our program and departmental accomplishments through the web and other venues. - *short range*
- Maintain the recently funded NSF Research Experiences for Undergraduates site grant. – *medium range*

Expand undergraduate scholarship and graduate fellowship funds

- Work with the College Development Officer to develop a plan to quadruple our scholarship endowment. Our current scholarship endowment is less than $200,000 and funds are divided among many small scholarships. – *short range & medium range*
- Create scholarships that can assist in undergraduate and graduate recruitment. – *long range*

Increase the national stature of our graduate program

- Continue to increase the fraction of students with Ph.D. as the terminal degree relative to the number of students who leave the program with M.S. degrees. – *medium range*
- Increase the number of graduate students per faculty by 15% compared to the five-year period that ends with the 2012/2013 academic year. – *medium/long range*
- Produce Ph.D. graduates capable of becoming faculty at leading research universities, researchers at national labs, and employees in major industries. - *long range*
- Develop courses and workshops to improve our graduate students' oral and written communication skills to enhance their career opportunities. This includes preparing and presenting research talks, how to apply for fellowships and grants, and professional

ethics and responsibility - *medium range*

- Continue to expand graduate course offerings that allow students to capitalize on the research breadth of our faculty. – *medium range*
- Participate in college-wide discussions for a proposed graduate High-Performance Computing curriculum. – *short range*
- Work with the College to develop a communications and recruitment strategy that addresses the challenge of recruiting a diverse graduate student population. – *short range*

Research initiatives: Over the next five years there is also the possibility of retirements in climate dynamics and physical meteorology (lightning). In order to maintain research strength in critical areas, we have identified the following research initiatives and faculty hiring priorities.

- *Hurricane research* – Texas is highly vulnerable to hurricane damage, but no focused research effort in this area exists within the state. Hurricanes pose exciting scientific research problems, including improvement of intensity and track forecasts, response of hurricanes to a changing climate, and the impacts of hurricanes on the natural land- scape and human society. Hurricane research has high priority in the national atmospheric research plan. We propose to hire a leading expert in hurricane simulation and forecasting. Improvements in hurricane forecasts will have a direct benefit to the citizens of Texas. A high visibility research program will attract research funding as well as undergraduate and graduate students. This hire will have excellent opportunities for collaborative research with Geography, Geology & Geophysics, Oceanography, and Civil & Environmental Engineering.
- *Air quality and global atmospheric chemistry modeling* – Air quality is a pressing environmental issue for Texas that is related to outstanding scientific problems in atmospheric chemistry. We have a strong research program in the areas of air quality chemistry and meteorology, but lack an air quality modeler to provide a central focus for many research funding opportunities.
- *Regional climate modeling and prediction* – Climate change remains one of the great research challenges in atmospheric science and a critical issue for Texas. In combination with Oceanography, we have considerable strengths in this area. We believe that the time is ripe to develop a regional climate modeling and prediction center in collaboration with the Jackson School of Geophysics at the University of Texas. This initiative has the possibility of bringing substantial research funds into the College, developing a very strong multi-institutional graduate education program in climate, and making Texas A&M a highly visible leader in climate research.
- *Data assimilation* – Data assimilation is the process of obtaining an estimate of a complex, partially observed system such as the atmosphere, ocean, or the entire climate system based on observations. These observations may include both in situ and remotely-sensed data. The department has an active data assimilation research program that opens up a wide range of opportunities for collaborative research with other disciplines of geosciences, statistics, nonlinear dynamics, planetary sciences, and different areas of engineering. In particular, opportunities may arise for pursuing data assimilation initiatives jointly with the

Oceanography department, taking advantage of their unique observational capabilities in the Gulf of Mexico region.

- *Physical meteorology - lightning* – The Department has unique capabilities in the area of lightning research. The Houston Lightning Mapping Array is the only facility of its kind in a large metropolitan area. We plan to build upon this strength over the coming years, but it may require a replacement faculty position in this area of research.
- *Technical support staff* – Because the Department has a large teaching commitment with the Aggie Doppler Radar (ADRAD), it is essential to have partial support for a radar and facilities engineer to maintain the mechanical, electrical, electronic, and software infrastructure of the radar. Additional support can come from faculty with laboratory and field research programs.

Research center (*long rang and beyond***):** The main weakness identified in the analysis of department's research performance is the low number research dollars per grant, relative to peer departments. This is tied directly to the lack of a large research center associated with the department. Over the next 5 years, we plan to leverage our strengths in the area of air quality research, remote sensing and climate modeling to explore opportunities for a research center supported by agencies such as EPA, NOAA, or DOE.

Research funding (*medium rang and long rang***):** To increase external research funding, more high-quality proposals should be submitted. Strategically, we will encourage faculty to submit additional proposals each year, with a target of 2 proposals per year per faculty member with requested funding support of $2M. The goal for research expenditures (direct plus indirect funds) will be $0.5M per faculty per year. We will also encourage faculty to submit collaborative and interdisciplinary research proposals requesting significant amounts of funding support (> $5M per proposal).