# Strategic Plan 2021-25

**Department of Atmospheric Science**

**University of Wyoming**

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Note: this *Baseline Plan* is a fixed document. It will be revisited annually, early in the year, based on the previous year's accomplishments and events within the Department, the College, and the University. The annual updates and revisions will, in 2025, form the basis for the next Strategic Plan.

# 1. Introduction

This strategic plan builds on previous 5-year plans of the Department of Atmospheric Science (DAS). DAS has had a series of 5-year strategic plans going back to at least 1999. The previous strategic plan (2015-19) was written when the Department was very different, with 9 faculty (50% more than now), and a state budget that was about *twice* as large as today. Unlike previous plans, this strategic plan builds on an *external DAS Program Review*, conducted in April 2019 under the auspices of Academic Affairs. The report of that external review (date May 2019), and our formal response to Academic Affairs (June 2019), are available on this shared google drive. Specific recommendations from the DAS Program review are included herein. At this time, in late 2020, DAS is in a substantially different situation than any time in the last

several decades. With several retirements and resignations of full professors in the last 5 years, the DAS faculty corps is relatively young.

Another significant development that will affect the Department for the next 5 years and beyond is the development of *a new, more capable atmospheric research aircraft coming online in 2023*, funded through a $15.8M NSF Mid-scale Research Infrastructure (MSRI) grant (Oct '19 – Sept '24). With continued base support from NSF to operate this aircraft through the 8th Cooperative Agreement (over the same 5-year period), and with the new capabilities funded under the MSRI grant, the Department is poised to grow. With this long-term NSF support, we expect that UW will support growth in DAS faculty numbers, as soon as UW is in a condition to be able to afford growth again. In the last year, we have also increased our strength in computational research: with the recent addition of Prof. McCoy, *we are poised to grow our digital footprint*, esp. in the usage of the NWSC resources.

The present Strategic Plan is written at a time when UW is suffering financial hardship. This colors our stated goals and targets, but at the same time, this Strategic Plan serves as a vehicle for the Department to express its vision of growth, once the University is able to support that again.

# 2. Mission statement

In the context of the above-mentioned opportunities, our vision is to build expertise and recognition for the use of world-class observations and numerical simulations to address grand challenges in climate, high-impact weather, and air quality. Our mission on the UW campus, within the State of Wyoming, and on the national stage has four components:

1. We will grow our *recognized leadership in airborne atmospheric research*, in terms of diversified external funding, new technologies and capabilities, and new research areas, including those of high importance to the State and to federal funding agencies. As explained below, this, together with our air quality research, serves as strong examples of UW **President Seidel's "entrepreneurial" pillar.**
2. We will grow our *supercomputing resource use* in atmospheric research and education through increased collaborations both at UW and elsewhere as well as a more diverse research portfolio, thereby contributing to the **President's "digital" pillar**.
3. We will grow *our undergraduate engagement footprint on campus*, mainly through the offering of cross-listed courses and large-enrollment ATSC courses, and courses in support of non-ATSC degree programs, and through undergraduate research experiences. All these initiatives are highly **interdisciplinary**.
4. We will foster our *excellence in graduate education*, recruiting a student body drawn to Wyoming by our unique strengths in atmospheric measurements and supercomputer capabilities, as well as modifying our program to better prepare our students for different career pathways.

# 3. Core strengths

Our core strength and basis of national recognition remains the UW King Air (UWKA) and its instruments. While our UWKA-based research traditionally focused rather narrowly on cloud and aerosol physics, DAS has developed expertise in air quality and fugitive emissions, using both ground-based and airborne observations. Moreover, since 2014, we have built our expertise in weather and climate modeling using NWSC resources, often in joint projects linked to observations.

In a nutshell, DAS is exceptionally endowed with ready access to (a) world-class measurement capabilities and (b) world-class high-performance computing. The research of our faculty and graduate students is facilitated by a highly qualified team of engineers, scientists, and technicians, a team that is enabled by the UWKA facility. According to the 2019 DAS External Program Review Report, our main weakness regards the recent loss of faculty in these two key areas.

This strategic plan calls for DAS to overcome this weakness, in part through new faculty that can build on its core strengths.

## 3.1 Airborne atmospheric research: the next-generation UW King Air

The DAS has operated aircraft for atmospheric research since its inception in the 1960s. The current UW King Air (tail ID N2UW) has been flown in support of projects funded by the State of Wyoming, the National Science Foundation (NSF), the Bureau of Land Management, the Department of Defense, NASA, NOAA, USGS, and several private companies, for instance, in 2020, for Airbus and DMT (Droplet Measurement Technologies). Critical to the viability of this facility is a cooperative agreement between UW and NSF for the operation of the UWKA as a facility that can be requested by the NSF funded community. We have been part of the NSF Lower Atmosphere Observing Facility (LAOF) pool since 1988. The most recent cooperative agreement (CA8) provides $12.5 M of base support over 5 years, through 2024, supporting staff and aircraft/equipment maintenance. The UWKA's remote sensing instruments, esp. the Wyoming Cloud Radar (WCR) and Wyoming Cloud Lidar (WCL), remain an important source of recognition and the basis for internal & external requests for the use of the UWKA.

The N2UW aircraft will be retired in 2022. UW recently purchased a lightly-used King Air 350i aircraft, which currently is being modified to enable a greater payload, longer endurance and more electrical power (compared to N2UW). The new aircraft (UWKA-2) will retain the same position in the NSF LAOF fleet, being relatively inexpensive to deploy compared to the two large atmospheric research aircraft operated by NCAR. The modified aircraft will be delivered to UW in 2022. An additional 12-18 months will be needed to transfer the instrument capabilities from N2UW to the new one, to test the new instrument configurations, and to complete a full FAA-certification of the new aircraft with its instrument payload. We expect that the new aircraft will become operational in 2023.

The new aircraft will not only meet the needs of DAS and the NSF-supported community, but will include new instruments and capabilities that are not currently available. The $15.8M NSF Mid-Scale Research Infrastructure (MSRI) grant that supports the modifications and certifications of the new aircraft also enables the advancement of airborne instrumentation, through the acquisition or development of new atmospheric chemistry probes, the next-generation profiling cloud radars (WCR-4 and KPR-2), the next-generation Raman lidar (MARLi-2), and an Airborne Doppler Lidar. It further will revolutionize ground-to-air communication to facilitate remote instrument access and more effective student participation. We will bring these new capabilities to a technical readiness level and a data accessibility level where they can be reliably deployed to study critical issues in atmospheric science. New capabilities (for instance, the combined deployment of MARLi-2 and WCR) are expected to result in an increased demand for the platform, and several scientists already submitted a letter of intent to request UWKA-2 deployment.

We expect UWKA-2 and its instrument suite to be one of two pillars of growth within DAS during the next 5 years and beyond, and the basis for future Cooperative Agreements with NSF to operate the aircraft in support of NSF-funded atmospheric research.

The 2019 External Program Review recommends the following: "*The committee strongly believes that maintaining the UW airborne research aircraft and reputation makes strategic sense. We note that airborne research has been the hallmark of the DAS's research productivity and are convinced that supporting a new cooperative agreement with the NSF is a highly positive strategic decision that will pay off and greatly enhance the national reputation for the DAS and University. The committee notes the significant research expenditures by the faculty associated with this area of research and the investments made in developing state-of-the-art remote systems. Hence, we urge that a commitment to a replacement be made and that the DAS develop a strategic vision that ensures that the faculty and staff maintain or increase their research productivity and national leadership in aircraft-based research*."

## 3.2 Weather and Climate modeling: the NCAR Wyoming Supercomputer Center

The second significant pillar to the Department is UW's privileged access to the NCAR Wyoming Supercomputer Center (NWSC). As part of its 20-year contract with NCAR and the State of Wyoming (2009-2028), UW remains obligated to continue to support the NWSC. This contract entitles Wyoming researchers to 1/7 of the supercomputer's core hours and data storage. In 2018-19, DAS used nearly 50% (65M core hours per year allocated) of this Wyoming allocation (150M core hours per year). Since the inception of the NWSC, Wyoming has underutilized its allocation. DAS faculty (esp. Profs. Lebo and McCoy) are increasing their HPC footprint, but they cannot instantaneously fill the void left behind through the departure (in 2019) of Prof. Liu's team.

The NWSC is heavily used by DAS faculty: Prof. Lebo's focus is on mesoscale and cloud-scale modeling, with an increasing interest in machine learning applications in ATSC. Prof. McCoy works with large datasets from models or satellites, as well as numerical simulations, to

understand extratropical cloud feedbacks and aerosol cloud interactions. Several other faculty work on HPC applications, mostly in collaboration with NCAR scientists.

The 2019 External Program Review recommends that "... *the DAS should strive to develop a strategic plan that takes greater advantage of the opportunities afforded by the NWSC including targeted future faculty hires*."

### 3.3 Air quality research facilities

In recent years the DAS has built its ground-based and airborne air quality and greenhouse gas measurement capabilities. We now are able to measure particulates, ozone, volatile organic compounds, and greenhouse gases thanks to a series of instruments for use onboard the UWKA and in the Mobile Air Quality Lab funded by the School of Energy Research (SER). As part of the MSRI grant, new instruments will be bought for high-rate (flux-capable) measurements of trace gases. We also operate the Wyoming Air Quality Aerosol Measurement Lab (WAQAML) facility, which monitors air quality year-round at several sites in Wyoming through a Cooperative Agreement with the Bureau of Land Management.

These capabilities are relevant for research, education, economic development, and public service needs of Wyoming and the nation. Currently these resources are contributing to multiple industry collaborations to reduce greenhouse gas emissions during natural gas production and they are being utilized to better understand emissions from wildfires and agriculture that impact local air quality. They have great potential for ongoing funding at the state and federal level.

The 2019 External Program Review recommends that "... *it is critical ... to maintain and broaden efforts in air quality research in the DAS. Air quality research and instrumentation development is also an area for collaboration with other programs at the UW.*

# 4. Research initiatives

It is our strategic vision to *advance UW's international recognition for the use of advanced observations [aircraft, mobile air quality labs] and high-performance computing to address grand challenges in climate, high-impact weather, water availability, and air quality*. We aim to further solidify research in our areas of strength and broaden our research portfolio. There is much interest amongst funding agencies in constraining weather and climate models through targeted observations, i.e., observationally driven weather/climate predictability improvement. We aim to be a leader in coupled observational and computational research.

### 4.1 Airborne atmospheric research

The new aircraft, its additional measurement capabilities, and its additional ports, power, and space, are expected to serve as an engine for new research endeavors in the Department in the next 5 years and beyond. The UW Administration and DAS faculty understand that leadership in airborne atmospheric research requires broad faculty involvement. The UW King Air serves not just the NSF-funded community but also DAS faculty and students. UW's

investment in a new aircraft carries the expectation of increased research productivity through the new capabilities enabled by the next-generation UWKA. The airborne capabilities enabled by UWKA-2 will be linked to those in other DAS labs. The main fields of growth we are targeting are remote sensing (radar and lidar), atmospheric chemistry, and aerosol/cloud/precipitation microphysics. This research will address critical problems facing Wyoming and the nation, including severe weather, water availability, wildfires, methane emissions, and wintertime ozone pollution.

The recognized strength of the UW King Air (compared to other atmospheric research aircraft, most of them managed by federal agencies such as NCAR, NASA, and NOAA) is in tropospheric remote sensing of clouds and aerosol, using profiling lidars and radars, in synergy with in situ data. We currently face a critical vulnerability of not having a remote sensing faculty on board. *We are committed to building faculty expertise in remote sensing*. In view of the increasing importance of air quality issues (such as wildfires) and issues relevant to climate change (such as sources/sinks of greenhouse gases), *we will be expanding the UWKA's capabilities in support of atmospheric chemistry studies*.

The MSRI-funded transition to the new aircraft, and the new measurement and communication capabilities, will require additional science support for the operation of the aircraft. Our radar scientist (Dr. Haimov) is planning to retire during this 5 year period. In addition, Dr. Oolman, who maintains the DAS linux cluster and weather web services, serves as UWKA project scientist, and supports many science projects (data mining etc), will be retiring during this 5 year period. All of this presents an opportunity to restructure the UWKA/DAS science support tasks. In the next few years, *the DAS must define and fill positions (through new hires and/or retraining of existing personnel) amongst the diverse, but linked tasks of IT support, science application programming, and embedded programming for the operation of in situ/remote sensing instruments*. This restructuring may involve science support for radars, lidars, and aerosol/trace gases, as well as the traditional UWKA project scientist tasks. The transition to new positions should involve bridging to the extent we can afford it, in order for effective transfer of know-how.

## 4.2 Numerical modeling

It is incumbent upon DAS to take advantage of UW-supported resources and to build faculty and student expertise in high-performance computing applied to societal challenges, such as severe weather, water availability, wildfires, and greenhouse gas emissions. We are committed to take advantage of the opportunities presented by the Wyoming allocation of the NWSC. Aside from traditional atmospheric science applications (which build on computational fluid dynamics), *we are planning to grow our expertise in machine learning and other artificial intelligence applications in the field*. A new course, ATSC 5009 Objective Analysis in Geosciences, dedicates a section to these topics as a component of growing DAS capability. We are keen to pursue a joint faculty position with Computer Science or Geographical Information Systems in this area.

To enhance utilization of the UW NWSC allocation, DAS faculty have applied for proposals focussed on using NWSC facilities to conduct research that cannot be done easily at other institutions with smaller supercomputing allocations. For example, DAS faculty have submitted proposals that will run numerous global model simulations simultaneously to explore parameter sensitivity. This sort of research is typically done by national labs or other federal facilities (NASA/NCAR), but the NWSC access allows DAS to perform similar research. Other examples of the use of the NWSC for processing large quantities of observational data (e.g. satellite remote sensing), applying machine learning algorithms to create new datasets, and performing very-high-resolution simulations of high-impact weather events. DAS will work with the University to set up a pre-approval process for NWSC allocations that can be attached equivalent to letters of commitment to non-NSF proposals, to strengthen these proposals.

# 5. Educational initiatives

While the DAS traditionally has operated as a research and graduate education center, our undergraduate student credit hour teaching has increased dramatically in the last 5 years. It is imperative that this trend be continued and we integrate further in the central mission of the university, *through deeper engagement with interdisciplinary undergraduate education*.

## 5.1 Graduate education

### 5.1.1 Graduate Curriculum

*We aim to improve graduate student research and career development experiences*. This includes an Individual Development Plan that incoming students start upon their arrival and maintain throughout their graduate curriculum, as well as an annual student-led assessment of the graduate school experience. Details of this plan will be shared with the AVP for Graduate Education.

We further plan to grow our graduate program with a more active, targeted recruitment of U.S. and international students. To attract top-level PhD students, we will emphasize the access to world-class computational and observational resources. Promotional materials will be circulated to undergraduate departments that have a history of producing DAS applicants. We will continue to recruit at American Geophysical Union and at the American Meteorological Society Career Fair.

As we attract more graduate students, we also need to be able to provide them with an up-to-date graduate curriculum that reflects the current need of future atmospheric scientists in a variety of careers, including air quality analysts, weather forecasters for the NWS or transportation services, and weather / climate researchers. Two vulnerabilities currently exist: first, we lack expertise in the offering of certain elective graduate courses, in particular Cloud and Precipitation Systems and Satellite Remote Sensing. Second, while three of the four core courses currently have at least one alternate faculty (alternate to the primary instructor), one course (Synoptic Meteorology) does not.

We plan to offer *at least two ATSC graduate electives per semester*, and maintain a rotating list of upcoming graduate electives that looks forward to 3 years ahead. In AY21-22, *we plan to revise the ATSC graduate curriculum*, to become effective in Fall '22. This curriculum will be comprehensive, forward-looking, and will reflect the expertise of the faculty corps.

### 5.1.2 PhD and MSc Degree Programs

We plan to *increase the number of graduate assistant (G/A) students in the MSc and PhD programs through increased external funding, and through international joint MS programs*.

We currently participate in two international MSc dual-degree programs, and we are working with the UW Graduate Council to define the expectations and processes for joint degree programs.

Firstly, the InMAS program with University Clermont Auvergne (Clermont-Ferrand, France) and the Johannes Goteborg University (Mainz, Germany) is an exchange program. Essential to the viability of InMAS is that the number of incoming and outgoing students is balanced, over time. The InMAS program faces two challenges: one is that it has proven difficult to produce outgoing students, (a) because it is difficult to recruit fee-paying domestic MS students into this program, and (b) few advisors are willing send their G/As out in their Year 2. The other challenge is that incoming students are expected to complete a MS degree in 12 months (at UW, in their 2$^{nd}$ year) with little or no research preparation in their first year (at their home university). The former challenge can be addressed through active recruitment, and the building of material collaborations, including joint proposals. The latter can be managed: currently, incoming InMAS MS students pursue Plan A (with thesis), but we may consider offering a Plan B degree (no thesis).

Secondly, the ChUW program with Chengdu University of Information Technology is one-way, tuition & fee-paying. It started in Fall 2019 as well. The main questions are whether there is sufficient demand, and whether the students are sufficiently prepared. Recruitment is essential, and we plan to visit frequently, remotely and/or in-person, with prospective students. To increase demand, we could offer select incoming ChUW students a G/A position (tuition, fees, and stipend), although UW sees these joint-degree programs mainly as tuition-revenue-generating.

Both programs are considered probationary, and will run until Summer 2022, at which point UW is expected to re-examine the underlying MOUs. *We plan to ensure long-term viability of both international dual-MS programs, and hope to see 1-4 students in each program per year*.

UW faculty from various disciplines (ATSC, Ecosystem Resource Management, Geology / Geophysics, Hydrology, and Biology) are discussing an interdisciplinary Earth System Science graduate degree program, as part of the UW Crossing Divides and NSF EPSCoR Track 1 initiatives. Should this effort materialize, then the DAS will be an active participant.

We have discussed the possibility of a QuickStart (4+1) MSc degree program in collaboration with such undergraduate degrees as physics, chemistry, and civil engineering. Quickstarts have become popular on the UW campus, although they are offered only within disciplines. There are

many challenges in a Quickstart program that adds a MS in Atmospheric Science (or Air Quality, or Meteorology …) to a BS in a different field, including the lack of course credits that can be counted towards both degrees. For now, *we plan not to actively pursue the Quickstart option with a MS in Atmospheric Science.*

### 5.2 Undergraduate engagement

We have tripled our undergraduate footprint over the last 5 years, and now teach about 900 new undergraduate student credit hours. We plan to continue to offer our very popular USP courses on Climate Change (ATSC 2100) and Severe and Unusual Weather (ATSC 2200), which draw ~100 students per class. We may develop asynchronous, online versions of both courses. We may also offer a Honors-only version of these courses. We will also continue to offer a First Year Seminar (ATSC1101: Weather, Climate, and Global Change), with limited enrollment, but always filling up rapidly to capacity.

We will broaden our undergraduate footprint also through new or existing interdisciplinary courses in support of non-ATSC degree programs in the College (e.g., Chemical Engineering, Computer Science, Hydrology) or elsewhere (e.g., ENR, SER, Geology/Geophysics …). The 2019 External Program Review argues that such broadening of our undergraduate education footprint may require additional resources, such as an APL position dedicated to undergraduate teaching, something we will pursue when UW is financially stronger.

We plan to offer *cross-disciplinary undergraduate research opportunities*, through our unique access to facilities mentioned above, including for the class of honors students in the College of Engineering and Applied Sciences. We plan to make available some of our soft-money personnel for this (engineers and research scientists). This effort will be coordinated with other undergraduate research efforts on campus, especially through the UW Science Initiative. The long term success of such program will hinge on the availability of a part-time research coordinator, as well as a few graduate assistant (GA) students with teaching duties focusing on mentoring teams of undergraduate researchers. The coordinator's responsibility is significant and must be recognized in their job description.

# 6. Relevance to President Seidel's four pillars of academic success

In Section 7 below, we list the Department's goals. Here, we highlight how these goals align with UW *President Seidel's pillars of academic success*:

1. ***Digital:*** We will compete for an even larger fraction of the WY allocation of the supercomputer resources at the NWSC, and offer such graduate courses as Objective Analysis and Numerical Modeling. Several undergraduate-level initiatives will introduce students to HPC and AI applications.

2. ***Entrepreneurial*:** The DAS is largely externally funded, and with ~15 soft-money personnel, we will continue to operate as a small business in Laramie. Several of our PhD graduates have become CEOs of successful companies, and we will continue to foster such opportunities. We will grow industry collaborations, e.g. deploying the research aircraft for commercial purposes and working with industry to reduce greenhouse gas emissions during natural gas production.

3. ***Interdisciplinary:*** Our undergraduate courses draw an interdisciplinary audience, and new courses will be cross-listed across disciplines. Our atmospheric research will become more interdisciplinary, addressing the Earth system (biosphere-air-land-ocean interactions), using some tools developed for other disciplines (e.g., AI).

# 7. List of Dept. of Atmospheric Science goals in the next 5 years

## ATSC Goal 1: Foster, create, and communicate atmospheric research that addresses some of the most pressing issues facing society today, including global warming, severe weather, wildfires, and water shortages.

It is our strategic vision to *advance UW's international recognition for the use of advanced observations [aircraft, mobile air quality labs] and high-performance computing to address grand challenges in climate, high-impact weather, water availability, and air quality*. We aim to further solidify research in our areas of strength and broaden our research portfolio. There is much interest amongst funding agencies in the constraining of weather and climate models through targeted observations, i.e., observationally driven weather/climate predictability improvement. We aim to be a leader in coupled observational and computational research.

| No. | Performance Goals and Indicators | 2019 | 2020 | 2021 | Longer-term baseline targets | Longer-term aspirational targets |
|---|---|---|---|---|---|---|
| 1.1 | Build UW's international recognition for the use of advanced observations [aircraft, mobile air quality labs] and high-performance computing to address grand challenges in climate, high-impact weather, water availability, and air quality | External review performed | Strategic Planning 21-25 initiative | Implement Strategic Plan (SP)<br><br>Complete DAS review for UW | Use the SP annual review process as roadmap for building DAS' standing in the research community | same |
| 1.2a | Retain and grow the King Air facility as a national, NSF-funded facility.<br>(a) Build faculty expertise in airborne remote sensing | Recommended by the External Program Review | | | Hire a faculty in (airborne) remote sensing | same |
| 1.2b | Retain and grow the King Air facility as a national, NSF-funded facility.<br>(b) Build an instrument, science, project management, and computer support system that minimizes vulnerability and maximizes research performance, through new hiring and/or retraining. Support and recognize skills base enhancement efforts. | | Sub-committee formed | Hire radar scientist. Start to budget for training opportunities for all support staff | Integrated personnel strategy implemented that provides a clear management structure and mission for the group, including the hiring of new expertise (science application programmer, embedded programmer, and aerosol scientist), bridging with retiring personnel, and the retraining of current personnel as needed. | same |
| 1.3 | Grow our **digital** footprint, esp. by increased usage of the NWSC resources, development of | Recommended by the | TDB core hours used | Add a section on AI | DAS to use 50M core hours per year on Cheyenne or equivalent | 100M core hours |

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|---|---|---|---|---|---|---|
| | expertise in artificial intelligence applications in ATSC, and participation in computational initiatives within the College (CEAS) and the University | External Program Review<br><br>56M core hours | | apps in *Objective Analysis in Geoscience* (ATSC5009) | | Hire a faculty in AI applications in atmospheric/ Earth System science, jointly with COSC |
| 1.4 | Grow our **interdisciplinary** presence on campus (e.g., collaborative proposals with faculty in other UW Departments, joint teaching) | Recommended by the External Program Review | Participation in Crossing Divides / Grand Challenges initiatives | Same as longer-term | Target of 1 intra-UW interdisciplinary proposal with DAS participation per year, e.g. NSF EPSCoR Track 1 and Track 2, interdisciplinary Air Quality research.<br><br>Collaborative teaching, e.g. Ethics (ATSC5018) and Objective Analysis (ATSC5009) offered to more non-ATSC students, joint seminars. | 2 such proposals |
| 1.5 | Grow our air quality and climate research area | Recommended by the External Program Review | | | Enhancement with existing personnel and resources | Hire a faculty in climate or air quality modeling (possibly through NSF EPSCoR Track 1) |
| 1.6 | Grow the number of peer-reviewed publications with DAS (co-)authorship, esp. in high-impact journals | 39 | 24 | 3 per faculty per year | 3 per faculty per year | 4 per faculty per year |
| 1.7 | Give credit to and Increase recognition of publicly shared observational/numerical datasets and code | | | | Encourage DOI generation, and the posting of code on github or other digital commons | same |
| 1.8 | Facilitate wider communication of new research through professional oral and poster conference presentations | 24 delivered at 8 conferences | 27 delivered at 9 conferences | | 5 lead or co-authored per faculty per year | 7 per faculty per year |
| 1.9 | Encourage faculty and student participation in (inter)national research workshops | Review of existing footprint | | | 2 per faculty per year | 3 per faculty per year |
| 1.10 | Maintain and enhance the quality of the ATSC seminar series | | | | Create a named, annual seminar | |

## ATSC Goal 2: Generate external funding through research grants and cooperative agreements and support economic development in Wyoming

*We will build on our core strength of a nationally recognized, externally funded research program facilitated by a highly qualified team of engineers, scientists, programmers, and technicians. We will operate both as a Tier 1 academic Department, and a small, high-tech business.*

| No. | Performance Goals and Indicators | 2019 | 2020 | 2021 | Longer-term baseline targets | Longer-term aspirational targets |
|---|---|---|---|---|---|---|
| 2.1 | Increase the number of external research proposals *submitted* | 10 | TBD | | 3 proposals per faculty per year | 4 proposals |
| 2.2 | Increase the dollar amount of external research proposals *submitted* * | $617K per faculty | TBD | | ~$800K per faculty per year | ~$1,200K |
| 2.3 | Increase the dollar amount of external funding (actual research expenditures, excluding indirect cost, including CA and MSRI-1) | FY19: $561K per faculty | FY20: $1,279K per faculty | | $800K per faculty per year | $900K |
| 2.4 | Increase the amount of monetary support through gifts awarded through the Office of Foundations | ~ $3K to DAS | m | Develop a plan | $5K/year through engagement with alumni and other possible donors. Maintain the Laramie High Tidings as a way to connect regularly with alumni | $50K/year |
| 2.5 | Maintain and grow the Cooperative Agreement with NSF to operate the UWKA-2 and instruments. Pursue other cooperative agreements or contracts. | ~$2,200K for CA8<br>~$170K for CA with BLM for AQ monitoring | | Add CA to operate WRDS | Inflationary growth, scope maintained | Increase in scope |
| 2.6 | Successfully complete the development of the Next-Generation UWKA, including instruments and communication systems funded under MSRI-1 grant | | New aircraft purchase | Aircraft UWKA-2 modified for research | Successful modification, instrument integration, and certification of new research King Air<br><br>UWKA-2 deployment-ready in 2023 | New external funding enabled by new capabilities |

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| | | | | | Instruments and communication systems funded under MSRI grant becoming deployable through 2023 and y 2024 | |
| 2.7 | Increase the number of (a) requests for the UWKA/WCR/WCL, (b) deployments of the UWKA/WCR/WCL, and (c) UWKA flight hours by working closely with outside research groups to encourage use and advertise capabilities of the facility | | Strategic Planning 21-25 initiative | | 6 UWKA/WCR/WCL requests per year **<br>3 UWKA/WCR/WCL deployments **<br>250 UWKA flight hours ** | 20-30% more |
| 2.8 | Maintain and support ground based research platforms including Atmospheric Mobile Research Laboratory and Wyoming Air Quality Assessment Monitoring Laboratory | | Strategic Planning 21-25 initiative | Perform annual review of needs | maintain | expand |
| 2.9 | Maintain and encourage the number of research projects and industry collaborations performed in Wyoming, in support of its citizens, government, and commerce | All projects listed as targets started in 2019 or earlier | | | Further growth in:<br>Reduction of the *climate and air quality impacts* of natural gas and oil production.<br>Research in cloud seeding and related research that may impact *water availability.*<br>Improvements of predictability of cold-season *hazardous road conditions* | Further expand these and related efforts |

* These figures exclude the $15.8M NSF MSRI-1 grant for UWKA-2, and the $12.5M NSF Cooperative Agreement to operate the research aircraft.

** These figures will vary significantly from year to year, and are largely controlled by NSF. Included here are non-NSF requests/deployments.

## ATSC Goal 3: Take initiatives that support and broaden the highest quality education for graduate and undergraduate students in atmospheric and earth system science

While the DAS traditionally has operated as a research and graduate education center, our undergraduate student credit hour teaching has increased dramatically in the last 5 years. *It is imperative that this trend be continued and we integrate further in the central mission of the university, through deeper engagement with undergraduate education*.

| No. | Performance Goals and Indicators | 2019 | 2020 | 2021 | Longer-term baseline targets | Longer-term aspirational targets |
|---|---|---|---|---|---|---|
| ***Graduate level*** | | | | | | |

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|---|---|---|---|---|---|---|
| 3.1 | Offer a graduate course curriculum that delivers the knowledge, skills, and competencies needed to meet future workforce needs | Recommended by the External Program Review | Strategic Planning 21-25 initiative | Internal review of graduate curriculum, possibly leading to a revision of the suite of core courses | Regular review of knowledge and skills taught in the core courses, in the context of employer expectations (e.g., AMS, NWS)<br><br>Regular assessment of MS and PhD degrees, in the context of student input received and career paths chosen<br><br>Maintain an online repository for graduate course materials to allow better coordination between classes and between instructors | same |
| 3.2 | Offer at least 2 elective graduate ATSC classes per semester, to enable M.S. graduation within 2 years, and PhD degrees in 3 years. | | Develop long term plan for delivery of elective courses | a.<br>Review of existing curriculum<br><br>b.<br>Implement long term plan of elective courses | 3 electives (consistent with the larger graduate population) | same |
| 3.3 | Increase the number of students in the ATSC MSc or PhD programs, mainly through the hiring of new faculty. | 25 | 25 | 25-30 | 25-30 | 30-35 |
| 3.4 | Sustain the international dual-MS-degree program with universities in China (Chengdu: ChUW) | | 2 InMAS and 1 ChUW degrees awarded | | Maintain regular contact with CUIT, through visits and in-person or remote presentations to prospective students.<br><br>A faculty member should be responsible for the management of these programs. | Expand the ChUW model to include other universities abroad. |
| 3.5 | Increase the number of MS and PhD degrees awarded in ATSC | 5-year average through AY ‘19-20: 6.6 MS, 2.2 PhDs/year | | | ~10% higher | ~20% higher |
| 3.6 | Actively recruit top-level graduate students | | | | Terminal degree for a majority of new recruits is a PhD | same |

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| 3.8 | At least maintain the number of graduate student credit hours delivered to meet program needs | 219/year | | | 290/year | 340/year |
| ***Undergraduate level*** | | | | | | |
| 3.9 | Expand service teaching of large-enrollment USP courses in ATSC topics | Recommended by the External Program Review | | | Maintain ATSC 1101, 2100, and 2200<br>Develop another undergraduate course | same |
| 3.10 | Increase the number of undergraduate interdisciplinary non-ATSC classes delivered by DAS personnel, in support of College and University needs | 4/year | | | 5/year | same |
| 3.11 | Increase the number of undergraduate student credit hours delivered by DAS personnel | 1,566 | TBD | TBD | 2,000 | 2,500 |
| 3.12 | Encourage faculty to hone teaching skills | | | | Regular DAS participation in internal/external seminars or workshops focused on pedagogical or technical aspects of teaching | same |

## ATSC Goal 4: Facilitate graduate and undergraduate student participation in research and leadership and provide mentoring for communication of research outcomes to enhance future career progression

*We aim to improve graduate student research and career development experiences and engage more undergraduate students in research.*

| No. | Performance Goals and Indicators | 2019 | 2020 | 2021 | Longer-term baseline targets | Longer-term aspirational targets |
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| ***Graduate level*** | | | | | | |
| 4.1 | Include graduate student representation in departmental bodies | Recommended by the External Program Review | AY '19-20: two graduate students @ Faculty Plus meetings | | Inclusion of graduate students in ad hoc committees, such as faculty/staff search committees | same |
| 4.4 | Improve the graduate student research and career development experience, e.g. through Individual Development Plans (IDPs) | External Program Review recommendation | Most students have a current IDP | | All students are encouraged to maintain a current IDP.<br><br>Discuss IDPs at annual graduate orientation.<br><br>Track careers of alumni and make data part of the MS and PhD degree program assessment | All students maintain a current IDP. |
| 4.5 | Assess the experience of graduating students | Exit interviews | | | Periodically assess graduate degree programs.<br>Respond to recommendations in exit interviews. | same |
| 4.6 | Increase the number of peer-reviewed papers with graduate student co-authorship | 60% | | | ~80% | same |
| 4.7 | Provide a thorough assessment of theses and dissertations at the graduate committee level | Started the use of assessment forms in AY 2015-16 | | | Review process similar to that in the peer-reviewed literature: candidates to respond in writing to committee comments.<br><br>Retain the committee assessments and periodically evaluate the process | same |
| 4.8 | Increase graduate student opportunities to network and present their science to a range of audiences, through the DAS seminars, oral or poster presentations at regional or national conferences and workshops, etc. | Recommended by the External Program Review | Started DAS support for AMS/AGU travel in 2018 | | Encourage graduate students to participate in the annual AMS Student Conference, the Front Range Young Scientist Symposium on Atmospheric Research (YSSAR), AGU, and others. Enable financially through fundraising initiatives. | same |
| 4.9 | As part of the ATSC seminar series, host non-academic or "soft skill" seminars on topics related to career opportunities, leadership, diversity, professionalism. | | Matthias Steiner, NCAR | | One per year, possibly in collaboration with other Departments | Two per year |

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| ***Undergraduate level*** | | | | | | |
| 4.10 | Increase **interdisciplinary** undergraduate research opportunities within DAS, and advertise these opportunities more widely. | Recommended by the External Program Review | 5 students advised or employed | Develop a plan with ORED and WRSP | DAS faculty and graduate students mentor undergraduate student research in both observational and computational areas, e.g., Honors projects (research for credit), research for pay, McNair scholars program, Wyoming Scholars Research Program. | same |