

# **Diversity, Education & Outreach Needs** **Assessment of NCAR Partner Institutions**

February 5, 2016

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## **PURPOSE**

In preparation for developing a Diversity, Education & Outreach (DEO) Strategic Plan, the NCAR Office of DEO has, in collaboration with UCAR, carried out needs assessments of the university community and potential informal education partners. This report summarizes the findings of those needs assessments, and highlights community priorities for consideration in NCAR's DEO Strategic Plan.

The information in this document represents vital input regarding the needs and suggestions of the university and informal education communities, but it has not been assessed with regards to the capacity, priorities and skillsets at NCAR. This document will be combined with information from the literature regarding effective DEO programs, an ongoing internal assessment of NCAR's capacity for DEO; the NCAR, UCAR and NSF Strategic Plans, and additional conversations with stakeholders, to develop and guide NCAR's DEO Strategic Plan.

This needs assessment is being conducted in parallel to a number of other initiatives, including an audit of all existing NCAR DEO programs; discussion sessions with each NCAR laboratory to better understand DEO capacity, priorities, and skillsets, and consultation with an NCAR DEO Strategic Plan Advisory Group. The Advisory Group is composed of representatives from each lab and from the UCAR Center for Science Education, who have helped to guide the needs assessment survey and possibilities for future programs.

We note that, while the NCAR DEO Strategic Plan will only pertain to NCAR's activities, close collaboration with UCAR educational programs is essential for NCAR to reach K-12 education audiences, and fully realize opportunities with informal education partners.

## **DATA COLLECTION**

Data collection for this report took place between September 2015 and January 2016, and was threefold: University Department Survey, discussion groups at a UCAR Members Meeting breakout session: "University Expectations for NCAR's Diversity, Education & Outreach," and discussions with informal education institutions.

### ***University Department Survey***

A 20-question survey was developed in collaboration with the NCAR DEO Strategic Plan Advisory Group, NCAR's laboratories, UCAR Community Programs, and UCAR's internal evaluator, Valerie Williams. The questions posed were based on informal feedback that all of these groups have received from the university community in the past, and was designed to gather information about ways in which NCAR currently best

serves the community, gaps in these existing programs, and ways in which NCAR could better serve the community in the future. It was released to the UCAR Member University community in September 2015, using the online SurveyGizmo software (see Appendix B for the survey instrument). Responses to the survey were all anonymous.

The survey was subsequently distributed to a number of other 4- and 2-year university and community college departments with atmospheric science courses, and with whom NCAR already has a relationship, e.g. through internship partnerships, seminar speakers, lecture courses, workshops, and meetings. These departments were asked to pass the survey along to other similar institutions. Responses to the survey were all anonymous. The closing date for UCAR members was November 6th, and for non-UCAR members was December 4th. All respondents were asked to complete the survey as a department, rather than as individual faculty/staff members, in order to prevent large departments from dominating the results.

The survey asked about a number of topics related to DEO efforts, including familiarity with UCAR/NCAR DEO programs, the usefulness of different program types, the predicted usefulness of potential new programs and resources, and a series of open-ended questions garnering opinions on NCAR's role regarding DEO in partnership with the university community. The survey concluded with questions about each respondent institution's minority serving institution (MSI) status, UCAR member status, and institution type.

Two large university departments contacted us to inform us that the number of faculty in their departments made it impractical to respond as a single entity. We therefore worked with them to distribute a copy of the survey to each of their faculty members, and compile the faculty responses into a single response for the institution by averaging the results and concatenating the responses to open-ended questions. If any faculty member at the institution had heard of a program, it was marked as the institution being familiar with that program.

A total of 38 complete and 44 partial responses were received. Inspection of the partial surveys revealed that 5 institutions answered all but the final five demographic questions on the survey. Those 5 datasets were included in the final analysis on a question-by-question basis, to give a total sample of 43 respondents for most questions. This total comprised 34 UCAR member universities, three non-member universities, and five who declined to provide member status. The remaining 39 partial responses were discarded.

The response rate from UCAR Member Universities was 31%-39% (with the uncertainty due to the respondents who declined to provide member status).

***UCAR Members Meeting Breakout Groups***

On October 12-15, 2015, representatives from UCAR Member Universities gathered at NCAR for the annual UCAR Members' Meeting. One of the breakout sessions was focused on the DEO Needs Assessment. Attendance was voluntary and the session ran parallel to another discussion group. Approximately 45 attendees were briefed on preliminary results from the University Department Survey and split into topic groups to glean further information about the top four topics that had emerged from the first few weeks of responses on the survey, plus a fifth general discussion group. These topic groups were: internships; simplified climate models; visitor programs to and from NCAR; instrumentation courses and deployments; any other topics. Participants in the four topic-specific groups were asked a number of guided questions to better understand their departments' specific needs in these areas, what problems had arisen in the past, and what additional functionality they would like to see in the future. Participants in the general discussion group were asked general questions about what services NCAR could provide in the future to support their DEO efforts. All discussion groups were led by an NCAR or UCAR employee specializing in the topic area, and recorded by a dedicated minute-taker in each group. Half way through the session, participants were offered the chance to switch to a different topic group if they desired.

***One-on-One Discussions with Informal Education Institutions***

Throughout the months of November – January, NCAR Director for DEO, C. Brinkworth, participated in a number of face-to-face and telephone discussions with the Denver Public Library system, the Denver Botanic Gardens, the Denver Museum of Nature and Science, and Biosphere 2 to better understand their needs and the needs of their communities when partnering with science education institutions, and to explore potential collaborations. The local institutions approached for this report were specifically targeted as potential sites for piloting collaborations that may later be expanded nationally. Together, they reach an audience of approximately 7.5 million visitors each year. The discussions were unstructured, but generally followed similar themes of describing the work of NCAR and the informal education groups, exploring the demographics and needs of the communities in which these institutions operate, discussing existing programs of both parties, and identifying shared interests for potential collaboration. Follow-up meetings are scheduled for the coming weeks and months.

The new information reported here builds on the ongoing work of the UCAR Center for Science Education, which has existing relationships with national partners, such as the Association of Science-Technology Centers (ASTC), [informalscience.org](http://informalscience.org), the Smithsonian Affiliate Network (as of 2014, the UCAR Center for Science Education is a Smithsonian Affiliate organization), the Colorado Science Education Network, and [STAR\\_net](http://STAR_net). These existing relationships will form part of a more coordinated effort between UCAR and NCAR DEO in the future.

**Table 1:** Classification of university department survey respondents by MSI status and Basic Carnegie Classification

| University Classification                                       | Number of Respondents (N=43) |
|---|------------------------------|
| Minority-Serving Institution (MSI)                              | 10                           |
| Non-MSI   | 28                           |
| No Response   | 5                            |
| <b>Research University; very high research activity (RU/VH)</b> | 12                           |
| <b>Research University; high research activity (RU/H)</b>       | 5                            |
| <b>Doctoral/Research University (DRU)</b>                       | 9                            |
| <b>Master's College (all types)</b>                             | 4                            |
| <b>Baccalaureate/Associate's College (Bacc/ Assoc)</b>          | 1                            |
| <b>Associate's Colleges (all types)</b>                         | 4                            |
| <b>No Response</b>  | 8                            |

## DATA ANALYSIS

### *Quantitative Data:*

Responses to the university department survey were downloaded from SurveyGizmo in Excel format. For questions about the familiarity of existing resources, we tallied up the number of departments who reported having heard of the resource.

Likert scale responses on the usefulness of our existing and potential future program types were recoded from text to a numerical value using the following codes: “Not at all useful” = 0, “Somewhat Useful” = 1, “Very useful” or “Extremely useful” = 2, “Essential” = 3. The scales for existing programs ran from 0-3, while the scale for potential future programs ran from 0-2. Once recoded, we calculated the mean and standard deviation of the reported usefulness for each program type to provide an overall measure of the reported/anticipated usefulness of each program or resource (N = 43). We then repeated this calculation for different subsets of the data, split on MSI status and institution type (N = 37). Those institutions that declined to provide demographic data were excluded from this split analysis.

### *Qualitative Data:*

Text responses to all university department survey open-ended questions were sorted by topic, and by MSI status. The majority of respondents touched on multiple topics when

answering each question, so the qualitative data are therefore organized in this report by theme rather than by survey question. Summaries of the main outcomes around these themes are reported, and all of the qualitative feedback that we received can be found, unedited, in Appendix C.

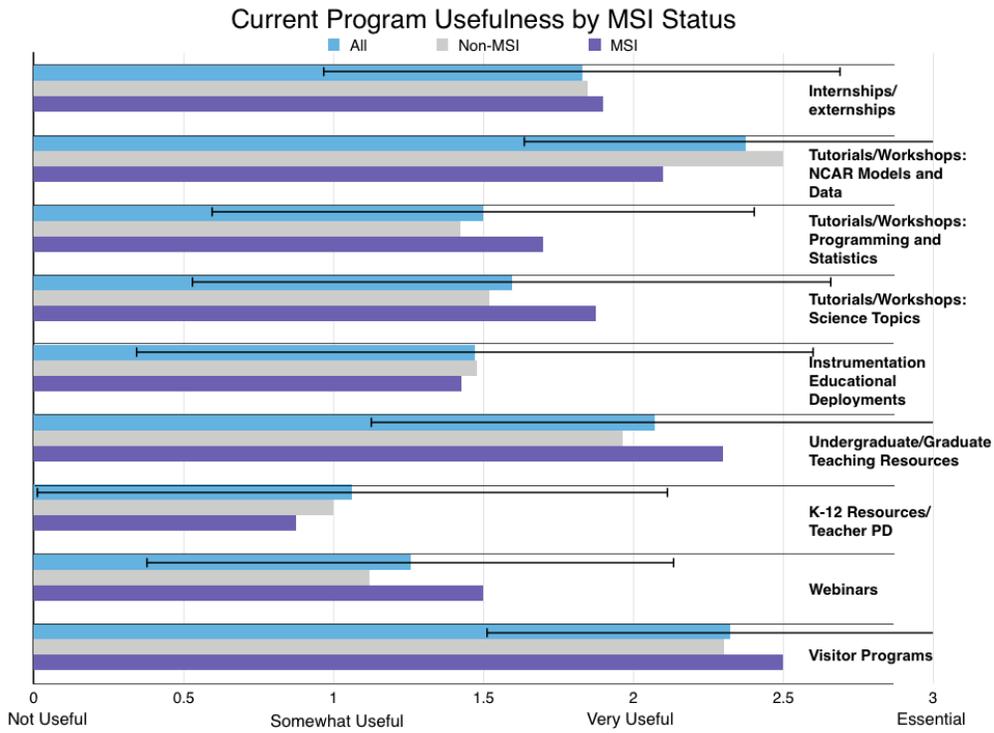
Notes from the UCAR Members' Meeting discussion groups and from meetings with informal education institutions were transcribed and analyzed for common themes. Many of the comments from the discussion groups concerned specific details of how future programs should be run; these are not reported here, but will be passed on to the project teams. Feedback that addressed more general needs and existing issues with our programs will guide our strategic planning, and are included in this report.

### **FINDINGS: University Needs**

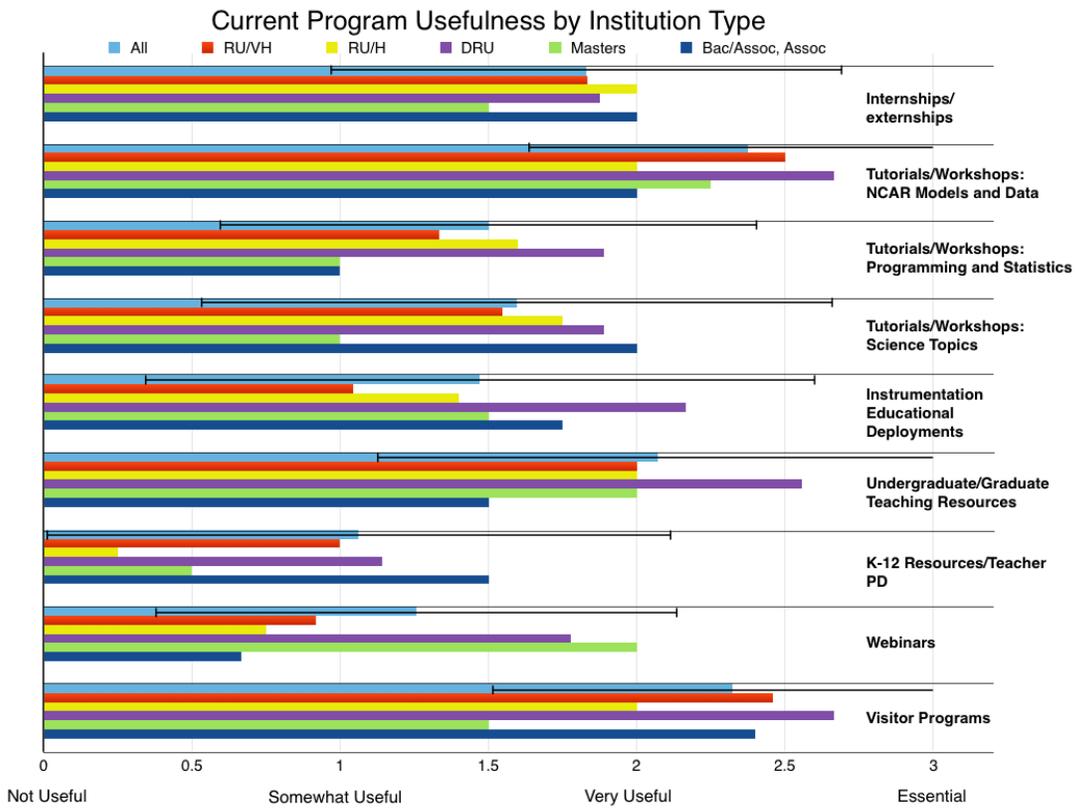
Responses from 43 departments were included in the results of our university department survey. Of these, 10 identified themselves as Minority-Serving Institutions (MSIs; 23%), 28 (65%) identified as non-MSIs, and five (12%) declined to respond. The departments spanned the full range of Basic Carnegie Classifications, from Associate's Colleges, to Research Universities with very high research activity (Table 1). For the purposes of this analysis, the single Baccalaureate institution was grouped with the Associate's Colleges when splitting data by Carnegie Classification.

**Familiarity with NCAR/UCAR Programs:** Respondents were asked to indicate whether they were familiar with 40 individual NCAR/UCAR DEO initiatives, spanning the whole organization and the full audience range from K-12 to professional scientist training. Responses indicated widely varying familiarity, from 39 institutions (91%) being aware of the SOARS program, 36 (84%) aware of the Visiting Student Program, 35 (81%) of the ASP Visiting Graduate Student program and the WRF tutorials and workshops, and 33 (77%) the COMET MetEd modules and the Community Earth System Model (CESM) workshops and tutorials. This was largely unsurprising, given the centrality of these programs to the interests of the UCAR Member Universities' science interests. At the low end, only two (5%) were aware of the Data Curation Education in Research Centers (DCERC) and the Software Engineering Assembly conferences and tutorials; however, it should be noted that the audience for this survey (largely atmospheric science departments) was not necessarily the target audience for these and many of the other listed initiatives that were low on familiarity, e.g. EOL's engineering-focused SUPER internship program, or programs within CISL and HAO.

Full results can be found in Appendix A.



**Figure 1:** Current NCAR DEO program/resource usefulness, split by the MSI status of the respondent.



**Figure 2:** Current NCAR DEO program/resource usefulness, split by the Carnegie Classification of the of the respondent. For more information on Carnegie classifications, see Table 1.

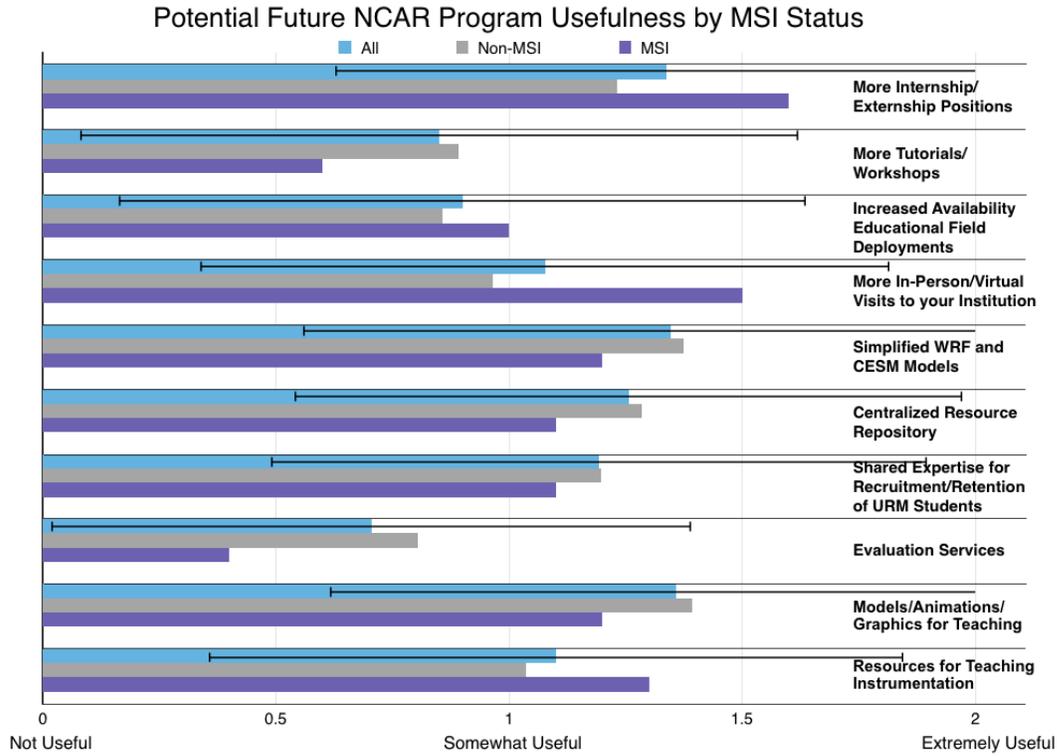
**Usefulness of Existing Program Types:** Respondents were asked to rate the usefulness of existing program types run by NCAR and UCAR. These included internships; workshops and tutorials on three topics: NCAR's models (e.g. WRF, CESM), programming and statistics (e.g. ImaGe, NCL), and science topics (e.g. CISM, Heliophysics Summer School); instrumentation educational deployments; undergraduate and graduate teaching resources; K-12 classroom and teacher professional development resources; webinars, and visitor programs to and from NCAR/UCAR. Results are shown in Figures 1 & 2. It should be noted that the standard deviations of the responses were large enough that the plotted differences between the needs of MSIs and non-MSIs, and between institution types, are not statistically significant.

While differences between the usefulness of different program types are also not statistically significant, we do find that the answers to the open-ended questions support many of these differences; for example, respondents made unprompted comments that our tutorials and workshops are of high importance, and should remain a high priority. We find that the most useful current programs for our member universities are NCAR's faculty, postdoc, and graduate student visitor programs, our undergraduate and graduate teaching resources (including teaching modules and materials for use in the classroom), and our data and modeling workshops and tutorials.

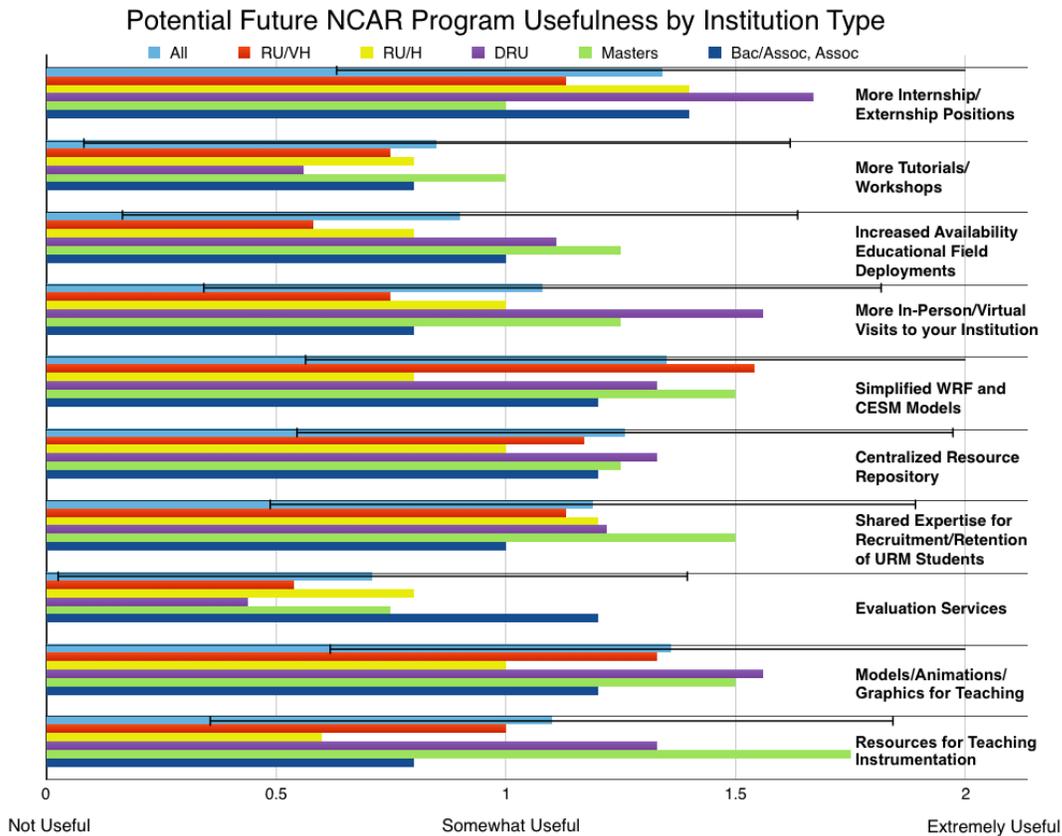
**Usefulness of Potential Future Program Types:** Respondents were asked to rate the usefulness of potential future program types that might be created or expanded by NCAR/UCAR. These included more internship positions; more tutorials/workshops; increased availability of instrument educational field deployments; more visits by NCAR scientists to institutions; simplified WRF and CESM models for use in the classroom; a centralized repository for undergraduate, graduate, and K-12 teaching materials; shared expertise in the recruitment and retention of underrepresented students; evaluation services for DEO programs; models, animations and graphics for use in teaching, and resources for teaching instrumentation courses. Results are shown in Figures 3 & 4.

We find that the highest rated areas include more internship positions for students, simplified WRF and CESM models, and more models, animations and graphics for use in undergraduate and graduate teaching, however none of these preferences are statistically significant compared to other resource types. Interestingly, despite the open-ended comments regarding the usefulness of existing tutorials and workshops, and the desire for NCAR to provide more, this was not apparent in the Likert scale responses.

Opinions on the usefulness of resources for teaching about instrumentation showed a bimodal split, with some institutions ranking this resource type as extremely useful, while others ranked it as not at all useful. This was reflected in the open-ended comments from respondents.



**Figure 3:** Departments' rating of usefulness of potential future NCAR DEO program and resource types, split by MSI status of respondent.



**Figure 4:** Departments' rating of usefulness of potential future NCAR DEO program and resource types, split by Carnegie Classification of respondent. For more about Carnegie Classification, see Table 1.

**Open-Ended Questions:** The survey asked a number of open-ended questions about NCAR's existing and future roles in diversity, education and outreach, and ways in which NCAR and UCAR can support the university community. Responses to each question often covered far more than the question asked, and so we have chosen to discuss them all together in this report. The findings below are organized by theme, and are summaries of the feedback we received in each area. Where feedback differed by university MSI status, this is noted. Feedback from the UCAR Members' Meeting discussion groups is included throughout where appropriate. Full, unedited feedback from all respondents can be found in Appendix C.

### ***Visits to and from NCAR***

Overall themes included shorter and more flexible visits for undergraduates, graduate students, and professionals. Twenty-one institutions commented that these visits are a priority for them. While most institutions (16) prefer in-person visits, a minority (two) indicated that virtual visits would be useful. There does not appear to be a correlation of this preference with university status. Some respondents indicated that it is difficult for students to visit NCAR without some prior contact and, as such, opportunities to visit and collaborate with NCAR scientists can be difficult to access for some students. All of these themes were reflected in the discussion group participants.

The stated purpose of these visits was multi-faceted, with respondents indicating that students should visit NCAR to collaborate with scientists, to acquire specific academic and technical skills, and to broaden their knowledge of available career paths and opportunities in the geosciences. Faculty and postdoctoral researchers are primarily interested in visiting NCAR to build scientific collaborations.

Themes for visits by NCAR scientists to universities focused on building scientific collaborations, teaching technical skills to students, and making students, staff, and faculty aware of NCAR opportunities and resources.

### ***Student & Postdoc Development***

Common themes include increasing the number of internship positions available at NCAR, and expanding those positions to more science areas, including climate science, severe weather, meteorology, and atmospheric chemistry. Twelve universities specifically asked for more of these opportunities.

Career support was a popular request (nine respondents), especially helping universities to expose students to the full range of career options and requirements for employment outside academia. Workshops for postdocs and early career scientists were also mentioned.

Another strong theme was encouraging NCAR scientists to take more of a mentorship role with undergraduate and graduate students, with nine requests for student research opportunities and collaborations on student projects based at their home institutions.

Finally, seven respondents and many discussion group participants highlighted programs that help to build undergraduate skills such as computing, modeling, and exposure to broader science areas. Summer Schools designed to cover these topics were proposed as future programs.

### ***Diversity, Equity & Inclusion***

The responses on this topic were strongly correlated by MSI status. Six of nine non-MSI institutions who responded to this question expressed a desire for shared expertise and best practices across UCAR member institutions for the recruitment and support of underrepresented students. Visitors from non-MSI institutions feel very welcome here, and the occasional challenges are logistical, such as needing better information about when workshops are taking place, and more frequent invitations from NCAR for people to visit.

Meanwhile, MSIs praised the success of the SOARS program, but expressed frustration with NCAR and UCAR's record and environment on diversity issues, and encouraged NCAR to provide better internal training on diversity, equity and inclusion, provide more transparency regarding goals and metrics on diversity, and to work with the MSI community to hold NCAR accountable.

### ***Tutorials and Workshops***

Respondents generally expressed support for many of NCAR's existing workshops and tutorials, and seven encouraged NCAR to offer more Summer Schools and colloquia in topic areas beyond the climate sciences: for example, in severe weather, meteorology, scientific computing, and other science areas that comprise NCAR's research. Respondents identified these workshops and tutorials as a high priority area for NCAR's future resources.

### ***Communication***

It was apparent that many respondents find it difficult to keep up with the number of programs at NCAR, and find accessing these programs and other opportunities at NCAR difficult to navigate. Almost a quarter of survey respondents, and many participants in the discussion groups, urged greater communication, wider advertising, and a more unified portal to NCAR's DEO opportunities and resources.

### ***Simplified WRF and CESM Models***

There was a desire in both the survey and the breakout groups for simplified versions of WRF and CESM models that can be used in undergraduate and graduate teaching, along with homework exercises for students, and virtual tutorials. Many individuals expressed a

desire for a GUI-based system, or an online version that can run cross-platform. This area was explored in depth during the breakout group exercise, and details are being passed on to the development teams, who are already investigating simplified versions of our models. In response to this feedback, MMM is conducting a survey of WRF users at member institutions to better understand how faculty use WRF in the classroom, and what additional functionality they would like to see. This information will be shared with the CESM team.

### ***Instrumentation Support***

Support for instrumentation emerged as a current gap in the resources of a number of institutions. Interest in this topic was split, with nine departments considering this extremely useful, while 12 had no interest. The remaining respondents fell in between. Particular needs include educational deployments of instrumentation, and assistance in teaching undergraduate-level courses through teaching modules and visits from NCAR staff.

### ***Teaching Resources and Resource Database***

There was general support for continued and increased support for undergraduate and graduate teaching modules, models, animations and graphics that can be used in undergraduate classrooms, particularly when teaching about climate.

There were also a number of requests for active learning exercises, both in the survey and the breakout groups, and two respondents urged NCAR to partner with university departments to co-develop undergraduate and K-12 materials.

COMET's MetEd modules were referenced by four of the respondents as a useful resource, while others provided more detailed feedback on their specific future needs. This feedback will be passed on to the COMET team.

There were 10 requests for a repository of best practices and DEO resources at the K-12, undergraduate, and graduate levels. We note that this service is already largely provided by UCARConnect, and specific feedback has been passed on to that team.

### ***Evaluation Support***

There was little interest in NCAR providing evaluation service support for departments' DEO programs, although one respondent did express interest in UCAR|NCAR sharing our evaluation metrics so that other programs can align with them.

### ***Other Areas***

Among topics that we did not specifically ask about, two distinct themes emerged:

1) There were four survey requests for student access to NCAR's supercomputing facilities, and access for early career scientists who are not funded by the NSF.

2) Increased support for public outreach work emerged from both the survey and the breakout groups, with requests for NCAR to help build and train a network of public seminar speakers from institutions across the country. We note that some of this service is already provided by Climate Voices, and that specific feedback has been passed onto them.

Finding employment and opportunities for foreign nationals were also raised as a challenge, with restrictions on positions for non-US citizens noted by two respondents.

### **FINDINGS: Informal Education Institutions**

The conversations with informal education institutions are in an extremely early stage, but we have been able to identify a number of areas of common interest. All of the topics below are potential areas of collaboration, but there has been no commitment from any party; these are initial ideas only, and will be explored in further detail over the coming months.

These institutions have been approached due to their (relatively) close geographical location to NCAR. Our aim is to collaborate with these local organizations to develop and test programs that can be subsequently expanded nationwide.

**Denver Public Library (DPL):** The DPL system serves around 4 million visitors per year across its nine branches. The system serves a significant minority population, with after-school STEM programming at six branches, in areas with few alternative options for students. One of these branches serves as a pilot site for new initiatives.

The DPL has a number of existing STEM programs that potentially align with NCAR's mission, and a number of topics were discussed as potential collaborations. These included providing materials for STEM Programs in a Box; speakers for public lecture series, and scientists to support week-long STEM camps throughout the year at locations without ongoing after-school programming.

The Central Library hosts a Maker Space for teens, equipped with computers, 3D printers, Raspberry PI microcomputers, and materials and digital resources for student-led projects. There are two additional Idea Labs being developed at other branches in the region. We discussed the possibility of partnering to develop additional project ideas, particularly in programming and simplified climate models, for these spaces. There was also interest in further conversations about establishing an ozone garden at DPL, building on an existing partnership between NCAR, UCAR Center for Science Education, CU Boulder, and the National Park Service, among others.

**Denver Botanic Gardens (DBG):** DBG have three locations across the Denver area, and reach approximately 1.5 million visitors per year. Over the next three years, they are planning the construction of a new Center for Science and Art Education. Topics of common interest include research into the effects of climate change on water systems, climate change in the steppe regions, and sustainability regarding water, transportation, and energy. In the realm of DEO, DBG expressed interest in continuing conversations regarding exhibits on climate, earth, water and soil, a climate change lecture series, an ozone garden, and greater contact with Climate Voices.

**Denver Museum of Nature and Science (DMNS):** The DMNS serves around 1.7 million visitors a year, from across the country, with a mission to ignite passion for nature and science. They have recently updated their strategic plan to meet a more diverse population's needs by being more active in the community, and are beginning to involve the community in the mission of the museum. The DMNS curates two temporary exhibit halls. NCAR|UCAR is already planning to partner with DMNS on their upcoming FutureFest program, sending scientists and educators to engage 3200 middle school students in our research and careers in STEM. Future possibilities include collaboration on exhibits, speaker series, and Science on a Sphere.

**Biosphere 2:** Biosphere 2 (B2) is a unique indoor series of model ecosystems, based in Tucson, AZ, serving as an experimental laboratory for teams of multidisciplinary scientists. Potential collaborations with B2 include both scientific research and teacher training. B2 currently provides professional development training for around 30 K-12 educators each summer, and is interested in expanding their development opportunities to include areas relevant to NCAR science. Further conversations are set to take place in February/March 2016.

The UCAR Center for Science Education works with a number of other informal education institutions, and these collaborations would benefit from NCAR's involvement:

**The Smithsonian Institute:** In 2014 UCAR became a member of the Smithsonian Affiliations program. Membership in this program opens up many possibilities for collaborations with the various units that make up the Smithsonian Institution. To date, the UCAR Center for Science Education has collaborated with several Smithsonian museums and education offices to develop content for a new exhibit about climate change, and plans are in place to visit the Smithsonian in October 2016 to learn about how they improve museum interpretation for visitors with special needs. While UCAR benefits from membership in the Affiliations program because of the opportunities it provides to learn from the Smithsonian's research and experience with informal learning, the Smithsonian would also benefit from NCAR scientist involvement in their programs and projects.

**Association of Science and Technology Centers (ASTC):** UCAR is an institutional member of ASTC. Staff from the UCAR Center for Science Education participate in informal science education professional development offered by ASTC, including webinars and the annual conference. In the past, UCAR has collaborated with ASTC on climate change communication, and their staff have presented at the annual conference. In the past year they have been discussing a collaboration between The Wild Center and ASTC - UCAR and NCAR could have a role in helping with the Youth Climate Summit program by providing science expertise and assistance in climate change education.

**STAR\_Net:** The UCAR Center for Science Education has worked with the Space Science Institute (SSI) on a number of projects, including developing content for museum and library exhibits. STAR\_Net, run by SSI, is an active network of library education programs, and they are very interested in having NCAR scientists serve as content experts, speakers, bloggers, and partners on projects such as Ozone Gardens and other citizen science projects.

## **SUMMARY AND NEXT STEPS**

This report has summarized the findings from three types of needs assessment: a survey of university departments, university faculty breakout groups, and preliminary conversations with a number of informal education institutions. The information contained in this document confirmed much of the informal feedback that we have heard from the university community in the past, and the information herein has already been used to inform many of the existing DEO programs at NCAR|UCAR, through discussions with the Strategic Planning Advisory Group, meetings with the Lab Associate Directors, and presentations to the UCAR Center for Science Education, and UCAR Communications teams. In the near future, it will be used in conjunction with information from the literature about effective DEO programs; an internal assessment of NCAR's capacity for DEO; the NCAR, UCAR and NSF Strategic Plans, and additional conversations with stakeholders, to develop and guide NCAR's DEO Strategic Plan.

### ***Significant findings***

The following emerged as significant findings from this report:

- Our visitor programs are valuable, and could be improved through more flexible visit criteria, greater advertising of opportunities, and increased scientific collaboration between NCAR scientists and other institutions;
- Student development support is a high priority for the university community, and the most useful programs are increased research opportunities both at NCAR through internships, and at students' home institutions with research projects co-supervised by

university faculty and NCAR staff, and more communication about additional career paths, and industry needs;

- Useful teaching resources include simplified CESM and WRF models, and additional teaching modules for teaching undergraduates about climate and instrumentation;
- NCAR/UCAR has significant room for improvement regarding diversity, equity and inclusion, and we are encouraged to put in place training for our staff, and work more effectively with MSIs on this issue;
- NCAR and UCAR has many DEO resources programs that the university community is not currently aware of, and that might meet many of the existing needs. NCAR should ensure that we effectively communicate these opportunities to the university community, and consolidate our information into a format that is easier to find and search;
- There are many promising opportunities to partner with informal education institutions in the Boulder/Denver area, and these can potentially serve as pilot sites for programs that will be scalable on a national level.

## **APPENDIX A: Familiarity of University Departments with NCAR/UCAR DEO Resources**

Table A.1: Familiarity of university departments with NCAR and UCAR's existing DEO programs.

| <b>Program</b>  | <b># of Departments indicating familiarity</b> |
|---|--|
| <b>Internships</b>  |  |
| Significant Opportunities in Atmospheric Research and Science (SOARS) | 39   |
| Summer Internships in Parallel Computational Science (SIParCS)        | 17   |
| Summer Undergraduate Program for Engineering Research (SUPER)         | 7  |
| Technical Internship Program (TIP)                                    | 5  |
| HAO-LASP REU  | 10   |
| Data Curation internship  | 2  |
| Pre-College Internship Program (PRECIP)                               | 6  |
| Unidata   | 29   |
| <b>Summer Schools/Workshops/Tutorials</b>                             |  |
| Center for Integrated Space Weather Modeling (CISM)                   | 15   |
| Community Earth System Model (CESM) Workshop & Tutorials              | 33   |
| GLOBE workshops   | 23   |
| Heliophysics Summer School  | 15   |
| Institute for Mathematics Applied to Geosciences (IMAGe) workshops    | 12   |
| NCAR Command Language (NCL) workshops                                 | 22   |
| Rising Voices   | 5  |
| Software Engineering Assembly (SEA) conference and tutorials          | 2  |
| UCAR Center for Science Education teacher professional development    | 8  |
| Undergraduate Leadership Workshop (ULW)                               | 20   |

| <b>Program</b>  | <b># of Departments indicating familiarity</b> |
|---|--|
| Unidata Users' Workshop   | 26   |
| Weather Research and Forecasting (WRF) tutorials/workshops          | 35   |
| <b>Training &amp; Education Resources</b>                           |  |
| NCAR/UCAR Graduate Student Mentors                                  | 26   |
| LAOF Educational Field Deployments                                  | 17   |
| SOARS REU Community Resources                                       | 28   |
| UCARConnect   | 29   |
| Comet MetEd Modules   | 33   |
| Field Campaign DEO Support  | 18   |
| NCAR/UCAR webinars  | 32   |
| UCAR Center for Science Education K-12 Resources                    | 10   |
| Collaboration with NCAR/UCAR DEO on Broader Impacts                 | 11   |
| Unidata data, software & training                                   | 31   |
| Digital Library for Earth System Education (DLESE)                  | 20   |
| National Science Digital Library (NSDL)                             | 11   |
| Climate Voices  | 16   |
| GLOBE protocols, data, and visualizations                           | 19   |
| Collaboration with the GLOBE International Scientist Network (GISL) | 8  |
| <b>NCAR/UCAR Visitor Programs</b>                                   |  |
| ASP Visiting Graduate Student Program                               | 35   |
| Research and Supercomputing Visitor Program (RSVP)                  | 11   |
| Visiting Scientist Program (VSP)                                    | 36   |
| NCAR Lab Visitor Programs   | 21   |
| UVisit  | 27   |

**APPENDIX B: Needs Assessment Survey Instrument**

**NCAR|UCAR Diversity, Education & Outreach Needs Assessment**

**Existing programs**

1) How useful do you currently find the following NCAR|UCAR program and resource types?\*

|  | Not at all useful | Somewhat useful | Very useful | Essential | Not applicable |
|--|-------------------|-----------------|-------------|-----------|----------------|
| Internship and externship positions  |                   |                 |             |           |                |
| Tutorials and workshops on NCAR models and data (e.g. CESM, WRF, Unidata)                        |                   |                 |             |           |                |
| Tutorials and workshops on programming and statistics  |                   |                 |             |           |                |
| Tutorials and workshops on science topics (e.g. CISM, Heliophysics Summer School, Rising Voices) |                   |                 |             |           |                |
| Instrumentation deployments and support for teaching   |                   |                 |             |           |                |
| Undergraduate and graduate teaching resources (e.g. COMET modules)                               |                   |                 |             |           |                |
| K-12 resources and teacher professional development  |                   |                 |             |           |                |
| Webinars   |                   |                 |             |           |                |
| Visitor programs (e.g. UVisit, ASP Visiting Graduate Student Program)                            |                   |                 |             |           |                |

**2) Which of the following NCAR|UCAR internship programs are you aware of? (Please check all that apply)**

- Significant Opportunities in Atmospheric Research and Science (SOARS)
- CISL - Summer Internships in Parallel Computational Science (SIParCS)
- EOL-Summer Undergraduate Program for Engineering Research (SUPER)
- EOL-Technical Internship Program (TIP)
- HAO-LASP Research for Undergraduate Program
- Data Curation Education in Research Centers (DCERC)
- RAL - Pre-College Internship Program (PRECIP)
- Unidata

**3) Which of these NCAR|UCAR workshops, summer schools, tutorials and conferences are you aware of? (Please check all that apply)**

- Center for Integrated Space Weather Modeling (CISM) summer school
- Community Earth System Model (CESM) workshop and tutorials
- GLOBE Workshops
- Heliophysics Summer School
- Institute for Mathematics Applied to Geosciences (IMAGe) workshops
- NCAR Command Language (NCL) workshops
- Rising Voices Workshop
- Software Engineering Assembly (SEA) conference and tutorials
- UCAR Center for Science Education teacher workshops
- Undergraduate Leadership Workshop (ULW)
- Unidata Users Workshops
- Weather Research and Forecasting (WRF) tutorials/workshops

**4) Which of the following NCAR|UCAR training and education resources are you aware of? (Please check all that apply)**

- NCAR|UCAR mentors for graduate students
- Educational Field Deployments (Lower Atmosphere Observing Facilities; LAOF)
- SOARS REU community resources
- UCARConnect
- COMET Met Ed modules

- Field campaign education and outreach support
- NCAR|UCAR webinars
- UCAR Center for Science Education: K12 Teaching Boxes, Videos, Interactive Technologies
- Collaboration with NCAR|UCAR education programs on Broader Impacts requirements for proposals
- Unidata data, software, and training
- Digital Library for Earth System Education (DLESE)
- National Science Digital Library (NSDL)
- Climate Voices: climate science communication content and tools
- GLOBE protocols, learning activities or data and visualizations
- Collaboration/communication with member(s) of the GLOBE International Scientist Network (GISN)

**5) Which of these NCAR|UCAR visitor programs are you aware of? (Please check all that apply)**

- ASP Visiting Graduate Student Program
- Research and Supercomputing Visitor Program (RSVP)
- Visiting Scientist Programs (VSP)
- Visitor Programs sponsored by individual NCAR|UCAR laboratories
- UVisit

**6) Do you have any feedback for us about any of our existing programs? Are there changes or additions that would be useful?**

## Future planning

7) NCAR|UCAR wants to ensure that our DEO Strategic Plan is focused on the best ways we can support you and your teaching, diversity, education, and outreach work, and future workforce needs.

The items below are some examples of ways in which we might expand our current programs and resource to do that. Please let us know how useful each of the following resources would be.\*

|  | Not useful | Somewhat useful | Extremely useful |
|--|------------|-----------------|------------------|
| More NCAR internship and externship positions and programs for your students (please describe below)                             |            |                 |                  |
| More tutorials/workshops (please give more information below on topics of interest)  |            |                 |                  |
| Increased availability of the Educational Field Deployment instruments   |            |                 |                  |
| More in-person or virtual visits to your institution   |            |                 |                  |
| Simplified versions of the WRF and CESM models for use in student projects   |            |                 |                  |
| Centralized repository for sharing graduate, undergraduate, K-12 education and public outreach materials                         |            |                 |                  |
| Sharing expertise about recruitment, retention, and promotion of students from underrepresented backgrounds                      |            |                 |                  |
| Evaluation services for your education & outreach programs   |            |                 |                  |
| Models, animations, and graphics for use with undergraduate and graduate teaching, and outreach programs (please describe below) |            |                 |                  |
| Resources for teaching instrumentation courses   |            |                 |                  |

Not useful

- 8) Please provide any additional information about your selections from Q7. What topics would be useful? Are there any additional programs or resources that would be helpful?
- 9) Where should NCAR|UCAR be directing our education and outreach resources to best support you?
- 10) Have you sent your students to NCAR|UCAR in the past 3 years? If yes, why? If no, why not?
- 11) Is there anything more than NCAR|UCAR could do to ensure that students and other visitors feel welcome when visiting us?
- 12) NCAR|UCAR looks to support our university partners in preparing students for future geoscience careers in academia, the private weather and climate enterprise, and research. What are the top two challenges that you face in this regard, and how could NCAR|UCAR best help you address them?
- 13) Please describe the most productive type of relationship you envision having with NCAR|UCAR as it relates to diversity, undergraduate and graduate education, K-12 education, and public outreach.\*
- 14) Please provide any additional feedback about ways we can help support your diversity, education and outreach efforts.

## About your institution

- 15) What is the Carnegie Classification (Basic) of your institution?  
([http://carnegieclassifications.iu.edu/lookup\\_listings/institution.php](http://carnegieclassifications.iu.edu/lookup_listings/institution.php); opens in new window)
- Assoc/Pub-R-S: Associate's--Public Rural-serving Small
  - Assoc/Pub-R-M: Associate's--Public Rural-serving Medium
  - Assoc/Pub-R-L: Associate's--Public Rural-serving Large
  - Assoc/Pub-S-SC: Associate's--Public Suburban-serving Single Campus

- ( ) Assoc/Pub-S-MC: Associate's--Public Suburban-serving Multicampus
- ( ) Assoc/Pub-U-SC: Associate's--Public Urban-serving Single Campus
- ( ) Assoc/Pub-U-MC: Associate's--Public Urban-serving Multicampus
- ( ) Assoc/Pub-Spec: Associate's--Public Special Use
- ( ) Assoc/PrivNFP: Associate's--Private Not-for-profit
- ( ) Assoc/PrivFP: Associate's--Private For-profit
- ( ) Assoc/Pub2in4: Associate's--Public 2-year colleges under 4-year universities
- ( ) Assoc/Pub4: Associate's--Public 4-year Primarily Associate's
- ( ) Assoc/PrivNFP4: Associate's--Private Not-for-profit 4-year Primarily Associate's
- ( ) Assoc/PrivFP4: Associate's--Private For-profit 4-year Primarily Associate's
- ( ) RU/VH: Research Universities (very high research activity)
- ( ) RU/H: Research Universities (high research activity)
- ( ) DRU: Doctoral/Research Universities
- ( ) Master's L: Master's Colleges and Universities (larger programs)
- ( ) Master's M: Master's Colleges and Universities (medium programs)
- ( ) Master's S: Master's Colleges and Universities (smaller programs)
- ( ) Bac/A&S: Baccalaureate Colleges--Arts & Sciences
- ( ) Bac/Diverse: Baccalaureate Colleges--Diverse Fields
- ( ) Bac/Assoc: Baccalaureate/Associate's Colleges
- ( ) Spec/Faith: Special Focus Institutions--Theological seminaries, Bible colleges, and other faith-related institutions
- ( ) Spec/Med: Special Focus Institutions--Medical schools and medical centers
- ( ) Spec/Health: Special Focus Institutions--Other health professions schools
- ( ) Spec/Engg: Special Focus Institutions--Schools of engineering
- ( ) Spec/Tech: Special Focus Institutions--Other technology-related schools
- ( ) Spec/Bus: Special Focus Institutions--Schools of business and management
- ( ) Spec/Arts: Special Focus Institutions--Schools of art, music, and design
- ( ) Spec/Law: Special Focus Institutions--Schools of law
- ( ) Spec/Other: Special Focus Institutions--Other special-focus institutions
- ( ) Tribal: Tribal Colleges

**16) Is your institution classified as a Minority Serving Institution?\***

- Yes
- No

**17) Is your institution located in an EPSCoR state?**

**(<http://www.nsf.gov/od/oia/programs/epscor/statewebsites.jsp>; opens in new window)**

- Yes
- No

**18) Are you a UCAR Member University?**

- Yes
- No

**19) How long have you been a UCAR Member University?**

- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21+ years

**20) Are you completing this survey as a joint response from your department, or as an individual?**

- Joint response from our department
- As an individual

## **Following up**

**21) Would you be willing to be contacted with follow-up questions to help us better understand your needs?\***

- Yes
- No

**22) Thank you for being willing to answer follow-up questions! Please either enter your email address below or, if you wish to preserve the anonymity of your survey responses, please send a separate email to Carolyn Brinkworth (carolyn@ucar.edu). We will be in touch after the closing date of this survey.**

**Thank You!**

## **APPENDIX C: Responses to Survey Open-Ended Questions**

The following quotes are the unedited responses we received from university departments in the survey. Many respondents answered more than the initial question asked, and so the following are loosely organized by theme, but many also overlap topic areas. Responses from Minority-Serving Institutions have been indicated by an asterisk. Where the response requires context, the question has been clarified in square brackets.

### **Visits**

\* 1. Visits - two way visits 2. Provide short visits to students [to NCAR] based on commonly agreed research topics

\* In person visits to university community like UVISIT would be very useful but I have not seen it so much in the past.

An opportunity for more undergraduate visits to NCAR would be nice. Right now we can only send one per year to the summer leadership workshop.

Virtual visits not useful, in-person visits useful.

Virtual visits by NCAR scientists would be amazing

\* Currently the ASP faculty visiting program seems to open every other year, or every 3 years. If this program can be open to application every year that would be really helpful!

\* Our experience indicates that the logistics of coordinating exchange of scientists to MSIs is often very difficult. Many of the issues are rooted in differences in institutional culture and (mis)perceptions harbored (mostly on the NCAR side) of the MSIs.

\* If UVisit is underutilized, resources may be redirected to ASP or VSP

\* Having UCAR manage visiting scientist programs for the national labs is extremely valuable

Student and NCAR/UCAR visits to campuses.

Visits from NCAR/UCAR scientists, and our visits to NCAR/UCAR help us to build a critical mass of ideas and collaborations.

[NCAR|UCAR should be directing education and outreach resources to best support us through] graduate student visitors.

[NCAR|UCAR should be directing education and outreach resources to best support us through] NCAR visits

NCAR has to invite visitors. In general, there is no blanket invitation, and there is no regular email listing the various options.

- \* Increase in financial support for graduate students visitors

- \* If there can be a way to connect students/scientists who are visiting at the same time, that might be helpful for networking.

Short (weeks to few months) visits of graduate student to NCAR to enhance their research

Graduate student programs and visiting opportunities.

- \* Minority student success in atmospheric sciences is shown to be linked to students acquiring academic and technical skills to work with state-of-the-art research equipment-visits by students to NCAR and NCAR scientists visiting and giving guest lectures and seminars in person or otherwise would increase more people to be exposed to the opportunities in the geosciences.

- \* Short visits (1 week or so) by students to NCAR and short visits by NCAR scientists to my university to build collaborative research.

- \* Flexibility in short-term visit to NCAR for the faculty.

### **Student Development**

Our program, and others like ours, would benefit from greater investment in internship and externship positions and programs that offer opportunities to those students who show promise of success but have not yet achieved mastery at their level.

- \* If there could be online tutorials, or youtube videos about career opportunities or successful stories of underrepresented students in the past, it will help me to show my students in class.

It would be useful for UCAR/NCAR to incentivize their scientists to participate in university activities such as teaching classes, mentoring students, and support students financially.

We have undergraduate students interested in atmospheric science and [they] would benefit from internships

Helping to teach our climate dynamics and climate modeling classes (see 8 above).

Increased numbers of internship and externship opportunities would benefit our program and its students

[NCAR|UCAR should be directing education and outreach resources to best support us through] undergraduate research opportunities

[NCAR|UCAR should be directing education and outreach resources to best support us through] undergraduate and graduate student internships

Please incentivize NCAR scientists to work more closely with university faculty and students.

Opportunities for our students is the most valuable addition. Definitely internships in the summer. Research projects that our students could participate in would also be very useful.

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] students visits that would expose students to applications of STEM training in atmospheric sciences.

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] useful mentors for students in various capacities (increased flexibility in the nature of the mentoring)

Any programs that would enable knowledge exchange between the university and private sectors would benefit both me and my students. If I knew what research topics and skills are most valuable to the private sector, then I could better tailor my curriculum and research programs.

[NCAR|UCAR could better support students through] Research funding to involve students in faculty research projects and other experiential learning opportunities.

Most of our undergrads are focused on weather forecasting and do not see the broader picture. The Summer Leadership Workshop changes that for participants, but this message needs to go out more broadly.

Our students typically do not fully comprehend the range of careers that are available to them with a degree in the atmospheric sciences. Webinars, seminars, and electronic

features involving those with atypical (i.e., not National Weather Service, broadcasting, or academia) careers in the atmospheric and related sciences would be helpful in this regard, particularly if those involved were fairly young and could more readily relate to college-aged individuals.

Skill building outside the science is hard to support in our small program (coding, running models, using HPC, and instruments). NCAR is essential for this. There is no Plan B

One challenge is the increasingly interdisciplinary environment in future careers. NCAR/UCAR could make more linkages in their outreach material/activities to hydrology/ecology/engineering

My top two challenges are recruiting a diverse, skilled set of students and getting them working with state of the art models on fast computers. My collaborations and interactions with UCAR/NCAR are fundamental to how I approach these challenges.

[Careers: We need] Quantitative information on work force needs. What is the private weather and climate enterprise, and where is it going?

[Career needs:] identifying important areas of current and future studies that our students might participate.

\* Administrators [are] unaware of geosciences career opportunities. Our students have lower involvement in outdoor activities, lower perceived knowledge of the geosciences, and lower family support to pursue the geosciences

[Career needs:] Broadening skills to include both academy/research path as well as industry path; Better connections to industry

[Career needs:] tours and research opportunities at the introductory level are crucial for early engagement.

\* Our students need better skills in atmospheric modeling, and NCAR/UCAR can help with this.

I strongly feel that co-supervision of student projects is the very best way to develop relationships between NCAR and the university community, but I recognize that this requires a significant commitment of time from NCAR staff who are already very busy.

I am aware of the SOARS program and the limited number of students it can help compared to the number that apply. I would like to see the SOARS office offer help to universities to do SOARS-type activities at universities so more students could be helped.

Developing research opportunities for undergraduates.

[NCAR/UCAR should be a] conduit for independent student research (research visits, access to resources)

I would suggest NCAR to provide more opportunities to under-represented students from smaller Universities.

A productive relationship would be one that has NCAR scientists working with undergraduates in their thesis projects.

\* [NCAR|UCAR can best help us through] internship programs

\* SOARS is an EXCELLENT program, but it does not reach a large number of students and has a high per student cost. I suggest an ADDITIONAL immersion model (week to 10 days) specifically for diverse students in their Sophomore year.

\* [NCAR|UCAR can best help us through] Student internship possibilities.

We have a consistent placement rate of students into internships and projects. We bring classes up for tours. These students bring back their knowledge and enthusiasm and share it with other students.

[Challenges] Poor math preparation. Lack of critical thinking skills.

### **Diversity, Equity & Inclusion**

\* We find this item: "Sharing expertise about recruitment, retention, and promotion of students from underrepresented backgrounds" curious. What is meant by this? Does NCAR perceive itself to be an expert or is it seeking expertise? Given the abject absence of diversity at NCAR the hope is that it is the latter but we suspect otherwise in this context.

[NCAR|UCAR should be directing education and outreach resources to best support us by] Increasing the pipeline of diverse undergraduates

Shared expertise regarding recruitment, retention, and promotion of students from all backgrounds would be of benefit to our program.

[NCAR|UCAR could better support students through] strategies for recruiting and retention of diverse students.

NCAR/UCAR resources help our diversity as it helps with our resources. Give us more time to focus on this ourselves.

We have that well covered for our own context.

We're only tangentially interested in having NCAR/UCAR involved in these activities.

\* Provide a culturally sensitive environment, an environment where students don't feel judged and get bored or pretend, but [are] encouraged to admit their deficiencies so they can learn and develop.

\* [Is there anything NCAR|UCAR could do better to make visitors feel welcome?] Yes but this would require a paradigm shift for most NCAR employees and administrators. The culture at NCAR is notorious for being exclusive - especially with respect to underserved or traditionally underrepresented populations. Our institution has been engaging NCAR for two decades and we have yet to engage in an honest conversation about diversity. There is only euphemism and excuse offered in response to a dismal record of employment, inclusion, and retention of African American scientists.

\* Perceptions of African American students and scientists (This may extend to other visibly ethnic groups with negative science stigmas attached) Openness to ideas that originate "outside" of NCAR that may result in change

NCAR/UCAR can serve as a central point of information for graduate recruitment especially from underrepresented groups. A database of graduating seniors in the NCAR/UCAR related fields will be very helpful.

As regards diversity, I think the major are where NCAR/UCAR can help is in recruiting students - starting in middle school. The SOARS program, while successful in recruiting lots of excellent students, provides but a small number of positions for the overall population of targeted students. As such, I believe it is becoming more like a club

It would be nice to see a "best practices" for increasing diversity. Right now we only have about 10% women. We used to be about 50% women. Not sure what happened! We have always had a low rate of minorities. I'd like some ideas on how to change that.

\* Enhance collaboration with minority serving institutions in area of diversity and outreach.

\* Establishing a feedback loop with MSIs that informs policy and programs on diversity Separating diversity from the four other elements may assist in providing enough focus on it to make a change.

\* I would like to see NCAR concentrate on the diversity within their organization (e.g. number of women in senior scientist role). NCAR could serve as a model for our community.

Make sure that the programs you introduce pay attention to special requirements of women and minorities. e.g. junior women faculty often cannot spend extended time visiting and so miss out on the opportunity. Students on financial aid generally have to earn a required minimum amount over the summer as part of their aid agreement. Sometimes these barriers are not obvious.

I think UCAR/NCAR could partner and host meetings for other groups, e.g., MPOWIR, to build better pathways to a diverse scientific community.

\* It is also about a cultural change and awareness of issues of diversity within the NCAR/UCAR Community. Boulder is an isolated community with little or no interaction with minority communities. What most people know about diversity and why it is important is mostly theoretical. People at NCAR need to change to embrace diversity in an effective way. It has to be a genuine deep rooted change of attitude and belief. So the Community also needs help to learn what minority communities have to go through in life and their challenges to appreciate the problems and be in a position to help.

\* Articulating goals and metrics associated with diversity would be a good start. For our group representing an MSI at the UCAR Members, we found the meeting to be an excellent laboratory for studying NCAR perceptions of race, diversity, and inclusion.

\* Release the UCAR information pertaining to salary and gender collected annual to the community. This data is extremely valuable for studies pertaining to gender equality, and has been unobtainable upon request.

[Is there anything that NCAR could do to make visitors feel more welcome?] Our experiences in this regard have largely been positive. To some extent, this may be best handled on an individual program or laboratory level.

I think it's pretty welcoming there. Never had a problem with that.

[Is there anything that NCAR could do to make visitors feel more welcome?] You do a great job.

Students enjoy the NCAR experience; they feel welcome.

From my own experiences with ASP and from the comments provided to me from recent student visits, I believe NCAR is doing an excellent job making students feel welcome when visiting NCAR.

## **Tutorials & Workshops**

\* The CESM tutorial was very useful for myself and my previous student. My current student benefitted from the WRF tutorial.

[M]ore programs such as the ASP Summer Colloquia, particularly in topic areas beyond just the climate sciences, would benefit our program and students. While our program does have a healthy climate science focus, we also have substantial expertise in traditional meteorological disciplines that, to large extent, have been underserved by recent ASP colloquia

I am a long time fan of the Geophysical Turbulence Program and IMAGE summer workshops. They are unique in longevity and consistent quality. Opportunities for undergraduates, graduate students, and post-docs are a fantastic way to reach the community and raise the level of US science broadly.

I'm particularly interested in ways to provide training remotely (e.g., the "virtual" visits above sparked my interest). For example, if a simplified version of CESM is developed, it would be nice if there were an online tutorial my students could take at the beginning of my climate modeling class.

\* The modeling tutorials have been valuable for a number of our graduate students

[NCAR|UCAR should be directing education and outreach resources to best support us through] Summer schools/workshops

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] Additional fellowship dollars to help in sending students to workshops would be helpful.

Courses in scientific computing (not just high performance).

Graduate education - I think the emphasis should be on providing workshops on introductory computational methods - perhaps best done by webinar. Most new graduate students have little computational skills. Thus a summer webinar course focussed on scientific computing starting from basic computations and program writing would be fantastic. This is much more a priority IMO than providing easy to use modules for already developed programs than WRF or CCSM

\* Workshop for early career scientists that highlight the opportunities, connections that we can use to stay in touch with NCAR

- \* NCAR support workshops to train students to use NCAR models/tools

### **Communication & Resource Databases**

\* A visit from UCAR every few years would greatly help our faculty learn and take advantage of the opportunities available.

\* More workshops on how faculty can leverage UCAR education/outreach activities would be valuable

I believe that more face-to-face "advertisement" of what NCAR/UCAR opportunities (workshops, internships, webinars, etc.) would be beneficial to students

An annual or semiannual email about all these programs would be useful to advertise them. I get a lot of monthly emails from UCAR/NCAR, but they don't advertise these programs.

There are some [programs] we are not aware of. We are familiar with a lot of these and take advantage of them. Some we are aware of and would like more access to.

Not always well advertised. Rising Voices I found out about by accident. Dates can be hard to find even if you know a workshop actually exists. The website should have a prominent location for upcoming due dates and event dates settled well in advance.

I'd like to hear about those that I did not check off above.

About NCAR/UCAR webinars: It would be great if we come to know in advance about scientific talks so that we can join live and ask questions. For those of us who are at smaller schools do not get enough opportunity to attend quality talks.

Need more activity in social media to reach current generation....too reliant on past dissemination methods

Honestly, there are too many programs to keep track of. This is not a problem with UCAR/NCAR specifically. It's just too much to follow all of the different media streams: UCARConnect, AtmosNews, UCAR Update emails, press releases, etc. I don't know what the solution is here. Wait for the Internet to settle down? ;^)

\* They are not advertised and most are unknown even for people working in the area.

\* I'm not aware of the many NCAR/UCAR programs and therefore don't find them useful. This needs to change, we need more outreach

- \* Can some of these many programs be consolidated? It is very difficult to learn and understand about all of these opportunities
- \* Most university students and faculty outside the community (geosciences) don't know anything about what NCAR is
- \* [NCAR|UCAR should be directing education and outreach resources to best support us through] Better outreach to create more awareness of existing programs
- \* It should be made clear where there are opportunities for UCAR member institutions to participate.

I find the system, check-in, shuttle, etc. all to be extremely easy to navigate. The only thing that I find a bit difficult to figure out is what conferences and meetings are going on at NCAR, which might conflict with or enhance visits at particular times. Improving the unified calendar and making sure that all events are featured would be a help.

UCAR outreach could better serve members by promoting university research in public news briefs (rather than focusing on NCAR scientists).

Data repository for "broader impacts" materials would be a valuable additional service.

The UCAR member meeting last year was useful in that I realized all of the resources that U/NCAR provide. To the extent that U/NCAR can help me find what I need/useful resources quickly, I could definitely make U/NCAR more of a partner with my program.

NCAR|UCAR provides "best practices and materials" repository, members contribute.

Make educational material online available to everyone, not just those registered with NCAR.

More efficient ways of finding information and material are needed, including easy ways that faculty can share resources (such as lectures, activities, and problem sets). Or single points of contact for different types of programs (e.g., one person I can direct all of my students who are interested in internships to, regardless of which specific program is appropriate). Someone to help me get where I need to go, despite the fact that I don't know where to start.

### **Simplified WRF/CESM Models**

To teach climate modeling, versions of WRF and CESM, along with exercises, would be very useful that could be used for homework and in class tutorials.

Workshop for running desktop versions of simplified models (e.g. CESM column model over land, ocean and/or ice.)

In a classroom setting, it would be useful to have a simple GUI to run numerical experiments with WRF or CESM.

I use WRF test cases as a basis for student projects. Modifying initial and boundary conditions is a somewhat cumbersome process

[NCAR|UCAR should be directing education and outreach resources to best support us by] simplification of models, not just for the tech-detail crowd, but for more applied use....

\* Making complex climate and weather models to be user friendly to operate. In the past they became less user friendly. 2. Assistance from NCAR/UCAR staff if there are technical problems to operate the models

Online versions of WRF and CESM for use in classes.

### **Undergraduate/Graduate Teaching Resources**

To teach climate dynamics to senior undergrads I would really like active learning exercises. I have been through the curated lists of such exercises, such as from CAMEL, and found almost none that are appropriate.

We have no specific requests regarding models, animations, and graphics for use in the classroom and in outreach programs; rather, we simply request that the MetEd resource continue to be maintained and, as interest and demand warrant, expanded to meet the needs of the community.

COMET is very useful, but introducing a paywall system for COMET would undermine the ability to use it in our classrooms.

Models, animations and graphics for use with teaching is fabulous and should continue.

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] more modules and simplified demos of climate models for u/g teaching.

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] Model animations could be made available, In particular high resolution future climate simulation or WRF hurricane simulations would be of great interest for educational purposes

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] educational resources and repositories

\* [NCAR|UCAR should be directing education and outreach resources to best support us through] Continued effort in developing climate system learning modules at the undergraduate level.

The resource repository above would be great if done well. There is already so much material out there. Some repositories allow you to search by grade level and general topic, but a more fine-grained search would be useful. I'm thinking to the level of individual figures/graphics and homework problems. I don't know if UCAR is interested in this at all, but a robust system would be very useful for me when putting together and improving classes. Or maybe this is just a pipe dream of mine.

The COMET modules are okay, but in general are very much too simplified for advance undergraduates

[NCAR|UCAR can best help us] as a resource for data and education content including teaching modules, animations, data visualizations and games concerning atmospheric and climate science fundamentals.

\* Educational tools to enhance teaching performance in classes

### **K-12 Resources**

A nationally certified data archive for educational materials that result from broader impacts on NSF projects is a role that NCAR could take on. Existing NSF (national) archives don't support archiving of educational "data."

Development of K-12 material that can be used for visits to local high schools.

Joint development of outreach modules for K-12 education from start to end (with evaluation of effectiveness)

K-12 education - As noted above, the major focus should be on exciting students so that they see the importance and value of a career in environmental/climate/earth science.

I envision a relationship where NCAR/UCAR uses resources developed by member institution professors to help create learning opportunities and best practices for use by K-12, NCAR/UCAR and other member institution professors. We have a great deal of education expertise that is not being well utilized.

\* In general, NCAR may not be the best organization to focus on K-12 and public outreach. In limited budgets, the prioritization needs to be on the science. I would rather see NCAR scientists partnering with outside organizations to provide expertise to K-12 education and public outreach. From an outside perspective, it appears that K-12 education and public outreach is growing at NCAR, while many atmospheric chemists are disappearing.

We do try to bring local students and high-school teachers for science camp and education. If we can get NCAR outreach specialist to talk in those camps/seminar remotely, it would be great.

\* Perhaps offer more national teacher workshops at NCAR

### **Instrumentation support**

We get very little institutional support for new observational equipment and maintenance. As such our laboratory courses are not up-to-date. We need more than just loans, but rather an NSF program that would supply instrumentation, up-dates and maintenance.

It would be useful for university faculty and instructors to have access to instrumentation and teaching modules specifically tailored to instrumentation.

We'd love to have someone from NCAR come to our institution for a semester and teach instrumentation.

I think the major areas concerning the university education process that UCAR could contribute are providing assistance with procuring/loaning instruments for our instrumentation courses

IMO, the major area of impact will be regarding instrumentation.

### **Postdoc Support/Development**

\* ASP program is very restricted and it would be benefit the University NCAR relations if this program could be enhanced by increase funds. I was wondering how much the VSP

program is utilized and perhaps excess funds in this program could be redirected to the ASP program.

\*There are many opportunities for new postdocs in atmospheric modeling, and more education/training in this area would be very advantageous."

[Career needs:] early faculty training workshops for postdocs/early faculties

### **Evaluation Support**

Evaluation services for education and outreach programs would be of benefit to our program

Develop metrics for success that span all UCAR members and not locally at UCAR/NCAR so that our incentives for working together are aligned

### **Other Issues**

The CISL/CHAP resources are fundamental to our success in NSF awards featuring computation

\* One thing I really hope that NCAR can change is the application for usage of Yellowstone supercomputer for early career scientists. I used to work at [redacted] using this supercomputer, but now after leaving [redacted] and currently without an NSF fund, I cannot use it at all.

UCAR should be directing its resources to the member universities. NCAR should be directing its resources to NCAR.

\* Have a community liaison in the working groups. Those person have been cut because of budget cuts.

[Career needs:] Availability of positions Broadening skills to include both academy/research path as well as industry path Stronger advocacy for federal funding of young scientists. Better connections to industry

\* The environment both in government and academia for foreign nationals is getting more challenging, particularly for those at the graduate level. Access to computing resources in particular is becoming more restricted. More opportunities for students to access computing resources would be valuable.

\*[Challenges:] 1.. Lack of academically qualified students who would be able to compete for the limited availability of openings for undergraduate students at NCAR.

Computational resources for students.

Public Outreach - IMO, the best way NCAR?UCAR can help in this regards is by helping universities organize public seminar series at different locations around the state. This organization also involves helping to support the travel of speakers - from within and external to NCAR. In large population states, these series have to be at many occasions across the state and be timed, perhaps, to be timed with other activities people might be attending. It would be great to use TV, but getting people to watch is difficult. Perhaps having a varying environmental minute, shown during commercials for athletic events might work? I think we already rich children well in schools, but they don't vote (yet)!

[NCAR|UCAR can best help us through] climate voices

\* Allowing application for usage of Yellowstone supercomputer