Evaluation of the Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) Conference, June 15-17, 2009

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ASCENT

Atmospheric Science Collaborations and Enriching NeTworks

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Introduction

While women have made advances in some scientific disciplines, their advancement in atmospheric science has lagged. The Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) summer conference seeks to help women to overcome obstacles to their advancement in atmospheric science by developing professional relationships and collaborations among scientists of varying career stages.

Research Design and Methodology

This evaluation study was designed to provide formative feedback to program organizers about the conference design and logistics, and to gather information on the short- and long-term outcomes for participants. This study was conducted through the use of in-depth focus group interviews, survey instruments, participant observation at ASCENT events, and document analysis. This report will focus on findings from the post-workshop survey administered at the 2009 ASCENT conference. A brief report on findings from focus groups conducted during the ASCENT conference is forthcoming. To determine longer-term outcomes from the ASCENT program, alumni will be interviewed during the ASCENT reunion meeting and will complete a follow-up survey in spring 2010.

Analysis Methods

The quantitative survey data were entered into the statistical software package SPSS where descriptive statistics were computed. Frequencies are reported for most of the ratings items, and means for some of the items. All items were rated on a 5-point likert scale (1=strongly disagree, 5=strongly agree). Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted because the small sample sizes for the surveys precluded meaningful statistical analyses of group differences.

Write-in responses to the open-ended questions were entered into NVIVO qualitative analysis software and coded as follows. Each new idea raised in a response was given a unique code name. As these same ideas were raised by later respondents, a tally was added to an existing code reflecting that idea. Frequencies of responses for open-ended items were also tabulated.

Demographics of survey respondents

Twenty-five ASCENT participants completed the post-conference survey. The sample consisted of 20 junior scientists and five senior scientists. All survey respondents were Caucasian, with the exception of one Asian-American scientist. Among junior scientists, nine were assistant professors, seven were postdoctoral researchers, three were research scientists, and one was a late-stage graduate student. Junior scientists primarily came from research universities and national laboratories. Almost half of the junior scientists (45%) had participated in similar training to ASCENT.

Findings

Obstacles faced by women in atmospheric science

One of the objectives of ASCENT was to provide a forum for women to discuss barriers they have encountered in their careers and to learn about the challenges faced by women in scientific disciplines. Work-life balance and family issues were the most frequently cited career obstacle by ASCENT participants. Women also noted isolation, not being taken seriously by others, lack of institutional support, communication issues (e.g., difficulty with negotiation, gendered communication styles, etc.), a lack of female mentors or role models, a male-oriented culture in science, and, in the worst cases, intimidation and harassment. Postdoctoral researchers, in particular, faced acute obstacles because of the transient nature of their positions. Postdoctoral researchers described a lack of access to resources and institutional support, and work-life balance issues. The transient nature of postdoctoral positions was difficult for dual-career couples and some women reported delaying childrearing decisions during the postdoctoral phase.

Conference design and logistics

Overall, participants were very satisfied with the conference schedule and the variety of formal and informal activities during ASCENT. In fact, 92% of all participants agreed or strongly agreed that they were satisfied with the overall design of the conference. Additionally, 84% of all participants agreed or strongly agreed that the mix of activities met their needs. In open-ended items, women reported that the specific mix of conference activities (e.g. break-out sessions, guest speaker talks, poster session, time for informal socializing) helped to foster both professional collaborations and personal friendships and support networks.

Break-out sessions

For the most part, the conference topics met participants' expectations and needs. Overall, 72% of participants agreed or strongly agreed that the break-out session topics were helpful to their professional development (five junior scientists and two senior scientists were neutral, and no participants disagreed). However, several sub-groups of junior scientists did not feel that their needs were as well served by the topics at hand. For instance, postdoctoral researchers and tenure-track faculty noted that they had different needs and requested workshops specific to their career stages. Participants from primarily undergraduate institutions and smaller universities also felt that their needs differed from colleagues at research universities or government laboratories.

Although most participants were satisfied with the break-out session topics, they had some suggestions for future topics. These include: communication skills/styles, grant writing, student advising, time management, alternative career paths, and career decision-making processes.

Guest speaker talks

Senior scientists served as guest speakers during the ASCENT conference, discussing their research interests, personal career paths, and challenges and successes that they had experienced as women scientists. Overall, 85% of junior scientists agreed or strongly agreed that the guest

speaker sessions were helpful to their professional development, noting that the presentations were motivating, inspiring, and thought-provoking. However, some participants commented that the research portions of the guest speaker talks were too technical given the variety of sub-fields represented at the conference.

Keynote address

The keynote address performed many of the same functions as the guest speaker talks in motivating and inspiring junior scientists. Overall, 92% of junior scientists agreed or strongly agreed that the keynote address was helpful to their professional development.

Poster session

The poster session helped junior scientists to share their research with others and build potential research collaborations. However, many participants felt that the poster sessions were too short and did not provide enough time to see all the posters and discuss research ideas. Only 52% of participants felt that adequate time was given for the poster session.

Mentoring

The majority of junior scientists, in survey comments and from participant-observation, were appreciative of the mentoring they received from senior scientists. Many junior scientists attended the conference in order to find a female mentor in their field. However, attendees recommended that organizers provide a more structured opportunity for junior and senior scientists to meet one another prior to the pairing process.

Workshop outcomes

Women reported a variety of gains from participation in the ASCENT conference. The most frequent gain cited by both junior and senior participants was enhancing their professional network. Junior scientists also gained knowledge about the issues faced by women in science and access to resources to help them overcome these obstacles. Senior scientists noted gains in mentoring. The majority of ASCENT participants—both junior and senior scientists—anticipated that they will collaborate with someone that they met at ASCENT. Women who were not atmospheric chemists had more difficulty in finding research collaborators.

Conclusion

As an underrepresented group in atmospheric science, women face a variety of barriers to their advancement and success in the field. The ASCENT conference provided a forum for women to discuss these issues and to develop professional and personal networks among women atmospheric scientists at varying career stages. Almost all participants reported that they enhanced their professional networks, formed personal support networks of women scientists, and gained knowledge and access to resources that will help them in their careers, although longer-term outcomes from the conference are still to be determined.

Introduction

While women have made advances in some scientific disciplines, there is still a considerable lack of women in atmospheric science, particularly in academic positions. In 2002, women comprised 29% of all bachelor's degrees and 26% of all doctoral degrees awarded in atmospheric science (NSF, 2006), yet only 10% of atmospheric science faculty at Ph.D. granting institutions (Holmes, Connell, Frey & Ongley, 2003). In recent years, women in atmospheric science have not increased their representation on university faculties; in fact, their numbers have stagnated (Winkler et al., 1996).

The factors underlying the lack of women in academic science are varied and complex. Not only are women less likely to hold tenure-track positions, particularly at the junior and most senior levels (Marschke et al., 2007), they are also more likely to hold low-status, low-wage positions off the tenure-track (Harper et al., 2001; Park, 1996; Riger at al., 1997). Studies specific to the geosciences have also reported that doctoral women are overrepresented in low-status, non-tenure-track positions (Macfarlane & Luzzadder-Beach, 1996).

Women face subtle and pervasive biases to their career advancement (Valian, 1999). The challenges faced by academic women, in particular, have been well documented. Academic women, regardless of discipline, face work-life balance, family and childcare, and dual-career couple issues (Anders, 2004; Jacobs & Winslow, 2004; Macfarlane & Luzzadder-Beach, 1996; Mason & Goulden, 2004; Rosser, 2004). Due to their underrepresentation in scientific disciplines, some issues are unique to women in science. Studies of the science, technology, engineering, and mathematics (STEM) disciplines have found that women faculty encounter a lack of confidence (Solem & Foote, 2004), a male-dominated culture of science (Rosser, 2004), isolation (Rosser, 2004; Winkler, 2000), discrimination (Corley, 2005), a lack of female mentors and role models (Rosser, 2004), a lack of critical mass of women faculty in STEM academic departments (Etzkowitz et al., 2000), and institutional biases in recruitment and promotion processes (Seager, 2000). Women faculty are often disadvantaged in "social capital," or professional networks, yet these networks and the support and resources that they provide, are critical to women's success (Etzkowitz et al., 2000). Mentoring and professional networking with other women can help women faculty overcome some of the obstacles to career advancement, including isolation, and a lack of role models (NRC, 2006; Solem & Foote, 2004).

Program Description

The Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) conference seeks to help women overcome obstacles to their retention and advancement in the atmospheric sciences by encouraging professional networks and research collaborations among women scientists of varying career stages. ASCENT is a two and a half day program, with follow-up reunion events, to foster connections and mentoring relationships among women atmospheric scientists and meteorologists. The program involves a mix of structured and unstructured activities to help women form professional networks and identify research partners, enhance their knowledge about issues faced by women in science, and establish mentoring relationships

between junior and senior scientists. ASCENT activities include break-out sessions for participants to explore topics integral to women's advancement in the sciences, a poster session, a keynote address, guest speaker talks by senior scientists, and opportunities for informal socializing, dinners, field trips, and relaxation.

According to the grant proposal submitted to the National Science Foundation, the specific goals of ASCENT are:

- Ensure that junior women scientists know about and have access to resources and people who can help guide them through their career and life path.
- Encourage positive mentorship and create mentoring opportunities.
- Learn and teach others about primary obstacles for women in atmospheric sciences and meteorological fields, and develop or share communication tools to assist in navigating these obstacles.
- Encourage participants to meet potential scientific collaborators at other institutions.

Research Design and Methodology

This mixed-methods evaluation study was designed to provide formative feedback to program organizers on the conference design and logistics, and to gather information on participant outcomes. The study focuses on the personal and professional gains that attendees made from their participation in ASCENT, their satisfaction with the program and its offerings, and the influence of their participation in ASCENT on their professional networks, confidence, knowledge, skills, and career path. Particular activities, such as break-out sessions, informal socializing, and guest speaker sessions, were also probed, to better understand the processes through which specific outcomes arise.

This study was conducted through the use of in-depth focus group interviews, survey instruments, participant observation at ASCENT conferences and events, and document analysis of participants' applications to ASCENT. Focus group interviews were conducted during the ASCENT conference and a post-conference survey was administered on the final day of the program. Participant observation during the conference and informal conversations with attendees also provided feedback about conference design, activities, and outcomes.

Focus group interviews during the conference were designed to probe the obstacles faced by women in atmospheric science, the supports that have helped women to face those obstacles, and the ways in which participants anticipate that they will use the knowledge, skills, and professional networks gained from ASCENT in their careers. The survey instrument was designed to focus on the same themes, as well as elicit feedback about the conference design, logistics, and mix of activities. This report will focus on findings from the post-conference survey instrument. A brief report on the findings from the focus group interviews will be forthcoming. A more detailed report on findings from focus groups at all three ASCENT workshops will be completed at the end of the grant period. Follow-up interviews to identify long-term impacts of the ASCENT program will be conducted at the reunion meeting and a follow-up survey will be administered in spring 2010.

This study is of interest not only to ASCENT organizers for improving and evaluating their program but of national relevance, given the low numbers of women in atmospheric science and the lack of research on issues specific to women atmospheric scientists. The ASCENT model of encouraging professional networks of women within a specific scientific sub-discipline has also not been studied to determine the efficacy, viability, and outcomes from such a model. Research and evaluation of the ASCENT program may determine whether this could be a national model for fostering collaborations and mentoring relationships among women scientists in specific sub-fields.

Therefore, the evaluation questions addressed by this study are:

1. What gains do attendees, particularly junior scientists, make from their participation in ASCENT? What are the short- and long-term outcomes from participation in ASCENT?
2. Are participants satisfied with the ASCENT conference, and its design and mix of activities?
3. What elements of the ASCENT conference are critical to participants' gains (e.g. break-out session topics, mentoring, time for informal socializing, etc.), and how do these elements contribute to their gains?
4. What obstacles do women in atmospheric science and what supports have helped them to overcome these obstacles?
5. What can be suggested for improvement of the ASCENT program itself, and to facilitate better support of women atmospheric scientists in university or research positions?

Data collection procedures

Ten ASCENT attendees participated in two focus group interviews during the conference. As noted previously, findings from these focus group interviews will be forthcoming. Participants also completed a survey at the end of the ASCENT conference. All junior and senior scientists, with the exception of ASCENT organizers, were invited to complete the survey on the final day of the institute. Twenty-five participants completed the survey. The study procedures were approved by the Human Research Committee of the University of Colorado at Boulder.

Analysis methods

The quantitative data were entered into the statistical software package SPSS where descriptive statistics were computed. Frequencies are reported for most of the ratings items, and means for some of the multiple-choice items. Items are rated on a 5-point likert scale (1=strongly disagree, 5=strongly agree). Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted because the small sample sizes for the surveys precluded meaningful statistical analyses of group differences.

Write-in responses to the open-ended questions were entered into NVIVO qualitative analysis software and coded as follows. Each new idea raised in a written response was given a unique code name. As these same ideas were raised by later respondents, a tally was added to an

existing code reflecting that idea. At times the write-in answers were brief and represented a single category, but more frequently, responses contained ideas that fit under multiple categories, and these were coded separately. Frequencies of responses to open-ended items were calculated and reported.

Demographics of survey respondents

The survey sample consists of 20 junior scientists and five senior scientists. All survey respondents were Caucasian, with the exception of one Asian-American scientist. Among junior scientists, nine were assistant professors, seven were postdoctoral researchers, three were research scientists, and one was a late-stage graduate student. Junior scientists primarily came from research universities and national laboratories: thirteen from doctoral-granting universities, five from government laboratories or research institutes, and two from primarily undergraduate institutions (PUIs). Almost half of the junior scientists (45%) had participated in similar training to ASCENT.

Findings

The findings section is organized as follows. First, the obstacles faced by women atmospheric scientists are discussed because these issues frame the goals of ASCENT and shed light on participants' experiences and outcomes. Next, participants' feedback about the conference design, logistics, and activities is discussed. Finally, participants' self-reported outcomes at the end of the conference are discussed. Long-term outcomes of the workshop are still to be determined.

Obstacles faced by women in atmospheric science

As noted previously, women in science face a litany of obstacles to their advancement and success in the field. Participants of the ASCENT program, both junior and senior scientists, were no exception. One of the objectives of ASCENT was to provide a forum for women to discuss barriers they have faced and to learn about issues faced by women in scientific disciplines. In response to an open-ended survey question, women described facing a variety of obstacles in their careers, many of which have been documented in the literature. Figure 1 illustrates the barriers faced by both junior and senior female atmospheric scientists.

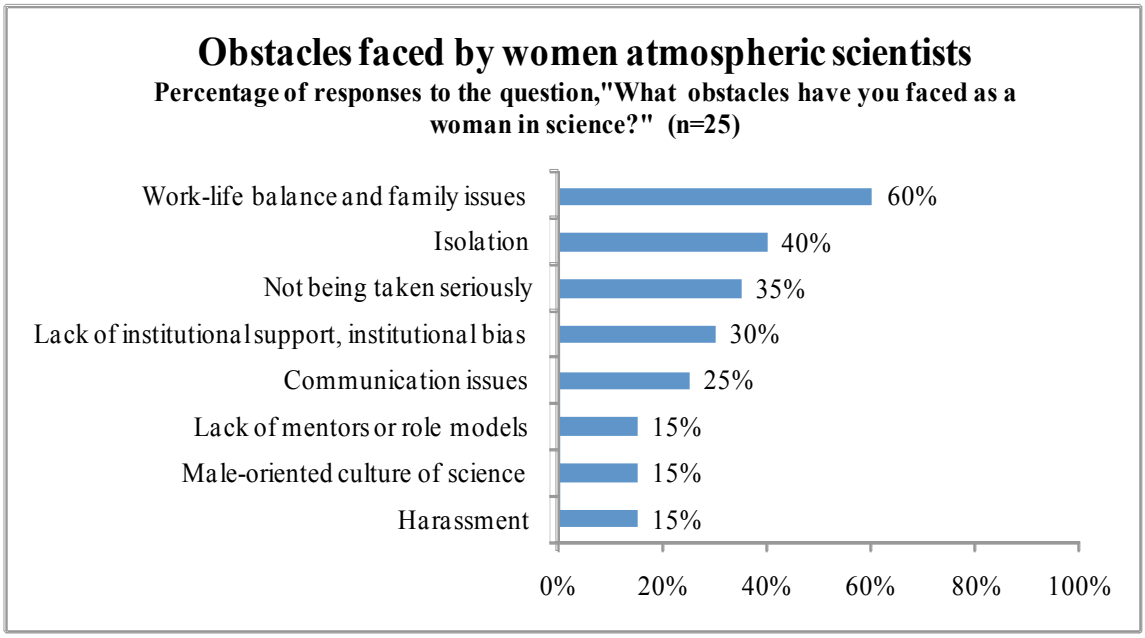

Fig. 1. Obstacles faced by women atmospheric scientists

Work-life balance and family issues

Work-life balance and family issues, particularly for junior faculty raising young children, were the predominant obstacles cited by ASCENT participants. Sixty percent of ASCENT participants noted the challenges of work-life balance or family obstacles in response to an open-ended survey question about obstacles they have faced as a woman scientist. Many participants commented that these issues have been significant factors influencing their career decisions or direction. Clearly, the majority of ASCENT participants—particularly junior scientists—were grappling with issues such as childcare, maternity leave, dual-career relationships, and balancing the workload and lifestyle of an atmospheric scientist with family life and personal interests. A lack of resolution to these issues could have serious consequences; a few women noted that work-life balance issues had made them less committed to a scientific career.

Work-life balance issues were particularly acute for postdoctoral researchers. The timing of the postdoctoral experience coincides with marriage and the start of a family for many women. In participant-observation at the ASCENT workshop, many junior scientists discussed the struggle of deciding whether to have children as a postdoctoral researcher, particularly given the transience of the position. In break-out sessions, women provided more details about the hardships of the postdoctoral phase. Some women mentioned that their spouses could not find employment or that they were separated from their spouses during this period. Other women delayed having a family and discussed the stress of feeling unsettled and transient during a period in their life in which they wanted to start a family and establish a career.

The survey response below suggests that dual-career couples may also face problems during the postdoctoral phase. The consequences of negative postdoctoral experiences can be serious as some women shift their goals and career plans away from scientific research or research-oriented universities.

> *I feel that taking 2 postdocs at 2 years a piece made me struggle with my personal life— not sure if a man would have had similar problems with spouse/partner. I had very large problems with fellow (male) colleagues –turf issues and attitude issues— at both of my postdocs. This struggle made it difficult to imagine being at a large research university.*

Isolation

Isolation was also a common obstacle mentioned by women in their survey responses. Many ASCENT participants were the only women in their departments or had been the only women in their graduate or postdoctoral research groups or fieldwork experiences. Many women felt a lack of understanding and support from male colleagues.

> *In general, it is just more difficult being a minority. I have many examples but I think one sums it up. My first week as an assistant professor, a senior colleague said, "You'll never get tenure unless you find a wife."*

Isolation also led some women to feel intimidated or ignored by male colleagues.

> *The biggest challenge at times has just been being one of the few women on a particular field study or lab and making sure your presence is known.*

Some women also felt that isolation hindered their opportunities for recognition and advancement.

> *[The obstacles I've faced are] Being left out of higher-level meetings where important decisions were made, and feeling like my work wasn't taken seriously, being the target of condescending behavior.*

Communication issues

Many ASCENT participants also expressed a lack of confidence in their professional communication skills. In particular, some women described difficulty in communicating with male scientists.

> *I often find it more difficult to talk with male scientists than with female, especially when I first meet them; this is mainly a problem because of the small number of female scientists in our field.*

Not being taken seriously

Many ASCENT participants also felt that they were not taken seriously by colleagues, particularly male scientists, because of their gender. Although a few women also noted that they were not taken seriously by senior female colleagues. In focus groups, women also described incidents of "tokenism" and the concern that colleagues thought that they had achieved their positions because they were women. On the post-workshop survey, one participant wrote:

I have been told that women in science "need help" to succeed.

A lack of mentors and role models

The dearth of women in atmospheric science has also contributed to a lack of female mentors or role models for younger scientists. Some participants mentioned that there are few older women in the field to serve as mentors or role models. However, one participant noted on her survey that she had had conflicts with senior women scientists in her department. The need for female mentors and role models was widespread among junior scientists; as will be discussed later, some junior scientists were motivated to attend ASCENT because they were seeking women mentors.

When I first started in my department, two women scientists asked me, "why do you get dolled up for work?" I do not get dolled up—but I do dress nicely, comb my hair, wear a tiny bit of make-up. The two people who I thought might be good role models or mentors are more focused on my clothes.

Lack of institutional support

Many women also felt that their departments or institutions were unsupportive of women scientists. Women noted a lack of supportive maternity leave and childcare policies at their institutions. One woman listed the following concerns as obstacles she has faced as a woman in science.

Unsupportive department head, lack of leave for childbirth, lack of flexibility in role statement, lack of information.

Male-oriented culture of science

A scientific culture that is male-dominated and male-oriented was perceived as another obstacle. Some women felt that they did not conform to the male culture of science.

I haven't had major overt discrimination, but I often worry that I may have to compromise a lot of myself to properly fit into the culture of science—but I don't want to have to do this!

Harassment

Perhaps most egregiously, a few women recounted episodes of sexual harassment or inappropriate behavior from male colleagues.

As a faculty member, I get inappropriate comments—not directed at me necessarily, but directed towards women and the role from former professors, collaborators, and from current co-workers.

> *I worked at an institution that was predominantly 95% male and over 40. There I had unwanted advances from others. Also I had a very hard time getting work that was appropriate for my skill level. I was constantly referred to as a girl, undermining my intelligence.*

Therefore, ASCENT participants—like many women in science—faced numerous obstacles to their retention and advancement in atmospheric science. A few of these obstacles, such as family and child-rearing issues, seemed to be more acute for junior faculty and postdoctoral researchers because of their current stage of life. However, both junior and senior scientists recounted numerous other obstacles, including isolation, lack of institutional support, not being taken seriously by other scientists, "tokenism," a lack of female mentors and role models, and, in the worst cases, intimidation and sexual harassment.

Now that we have described the issues faced by women atmospheric scientists, we will discuss how participants learned about the ASCENT program, their motivations for attending, and their feedback about the conference design and activities. Finally, we address the outcomes from ASCENT, particularly participants' personal and professional gains.

How participants found out about ASCENT

Participants learned about the ASCENT conference through a variety of means. The Earth Science Women's Network (ESWN), an online community of women geoscientists, was the most common forum in which participants learned about the ASCENT conference—45% of junior scientists learned about ASCENT through the ESWN listserv or the EWSN mixer at the American Geophysical Union (AGU) fall meeting. Additionally, 30% of junior scientists learned about ASCENT through their departmental chair, postdoctoral advisor, or former graduate advisor; 15% of junior scientists learned about ASCENT from the organizers; 15% of junior scientists learned about ASCENT from a colleague; and 10% of junior scientists learned about ASCENT from CLIMLIST, a listserv for climatologists. Senior scientists reported that they were invited to participate in ASCENT, although one senior scientist also commented that she learned about the conference from a colleague.

Participants' motivations for attending ASCENT

Almost all participants—both junior and senior scientists—were motivated to attend ASCENT to develop personal and professional networks of women scientists, to gain support, and to learn about and discuss issues related to women in science. As junior scientists are the target audience of the ASCENT program, their motivations for attending ASCENT are detailed in figure 2.

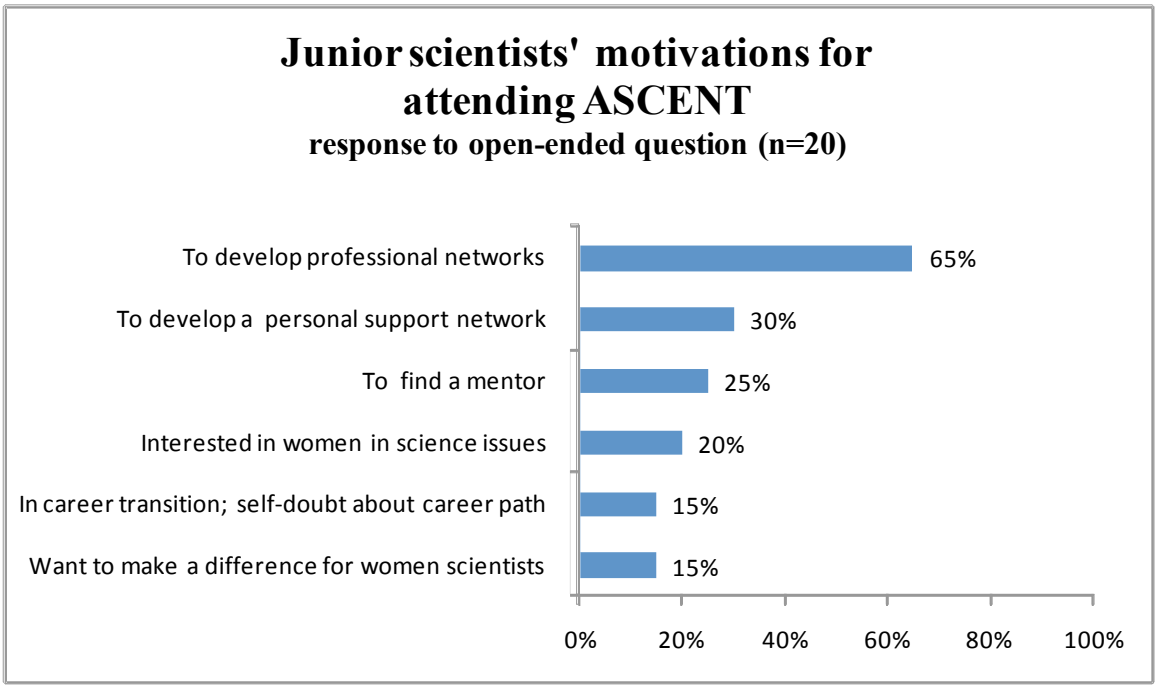

Figure 2. Junior scientists' motivations for attending ASCENT

In keeping with the goal of ASCENT to help women develop professional networks within atmospheric science, the most common motivation for attending the conference was to build a network of women scientists. Many of the junior scientists were isolated intellectually, not just because of their gender, but also because some of them were the only atmospheric scientist in their department, or were located in an area without a large atmospheric science presence. For these women, the opportunity to expand their professional networks was essential for their career success.

> *The focus on networking and mentoring really was the deciding factor for me. Plus that everyone was in the same/similar field of research that makes collaborations possible.*

> *At a small school in a state where very few atmospheric scientists are, it is difficult to find collaborations in research. My main motivation was to meet potential collaborators and colleagues that could help me continue a career in atmospheric science and get tenure when I have very few resources.*

The female demographic of the conference also contributed to participants' motivations to attend ASCENT. The all-women conference created a safe environment in which scientists could network and share challenges and successes.

> *I wanted to network with atmospheric scientists in a safe environment.*

A few women also sought a network of support from other women scientists who have faced similar challenges and hoped to derive motivation to stay in the field.

> *[I chose to attend ASCENT to develop a] Broader network; motivation to persist (the feeling that I am not alone in certain struggles); deeper understanding of the reasons why women leave academia or why/how they stay.*

Some women sought female mentors or role models in atmospheric science. A few of these women also wanted guidance from senior scientists about their career path and decisions.

> *Difficulty finding mentoring at existing institution, I also have self-doubt about my career direction.*

Finally, some women were motivated to participate in ASCENT because of their interest in issues related to women in science. They saw ASCENT as a forum in which they could learn more about the obstacles that women face in science and as a platform from which they could institute change in their departments or workplaces.

> *I feel strongly that more needs to be done to support women moving into upper-tier atmospheric science positions (in all career arenas). I am the first woman faculty in my department and so want to bring messages of change to my own workplace.*

In sum, ASCENT participants cited a variety of motivations for attending the conference. Most frequently, women wanted to develop a professional network of other female atmospheric scientists. They also sought a safe environment in which to discuss personal and professional challenges.

Conference logistics

Application process

In an open-ended question, participants were asked to provide feedback about the application process. All respondents answered that the application process was "fine" or "easy." One participant requested the capability of saving the application online for future editing. Additionally, on a likert-scale survey item, 100% of junior scientists agreed that the application process was convenient and 95% of them agreed that the process was clear. Senior scientists did not apply to the conference; they were invited.

Financial Aid

Prior to the ASCENT conference, a few junior scientists requested scholarships to cover their travel costs. Although ASCENT provided food and lodging, participants paid for their own travel. In response to a survey item about financial issues, the majority of participants noted that their departments or organizations reimbursed their travel costs. Several women also used start-up funds supplied by their department. A few women commented that they had paid for travel themselves but either did not mind doing so or had combined travel to the conference with a personal vacation. Participants were asked if they would have benefited from a travel scholarship, but the only women who responded "yes" were those who had already received such

a scholarship. Therefore, the organizers seemed to have met the needs of the few participants who needed financial support.

Website

Most participants used the ASCENT website prior to the conference. Besides submitting their applications, the majority of participants—both junior and senior scientists—noted that they utilized the website to learn about the goals and objectives of the ASCENT program. Some participants also used the site to check the workshop schedule and get travel information, and a few used it to look up information about speakers or other participants. A few women also reported that they had showed the website to their department chair or postdoctoral advisor when trying to secure travel funds. Therefore, in a few cases, women used the website for marketing purposes in order to receive their chair or advisors' professional and financial support.

Participants also offered a few suggestions for revisions to the content and organization of the website. The most common suggestions were: 1) to provide more specific information about the conference, particularly overall goals and conference topics; 2) use the website as a resource to provide more information about funding opportunities or similar professional development workshops for women scientists; and 3) provide links to more resources related to faculty development, particularly concerning issues related to women in science. The following comments from participants illustrate some of these requests.

> *More info about workshop details and specific goals would be nice.*
>
> *I hope to use the website as well for funding and workshop information.*
>
> *Provide links to reports or websites that describe similar programs elsewhere to enhance understanding of the ASCENT objectives.*

Conference design

Conference schedule and mix of activities

Overall, participants were very satisfied with the workshop schedule and the variety of formal and informal activities. In fact, 92% of all participants agreed or strongly agreed that they were satisfied with the overall design of the conference. Additionally, 84% of all participants agreed or strongly agreed that the mix of activities within the institute met their needs; three participants were neutral and one disagreed. Finally, most participants were satisfied with the amount of activities per day: 80% of participants agreed or strongly agreed that the conference days had "the right amount of activities."

In open-ended items, women reported that the specific mix of workshop activities helped to foster both professional collaborations and personal friendships and support networks.

> *I think the mix of activities was actually perfect. The socializing time was important for collaboration, both professional and personal (as in forming support networks), but the socializing would not be as useful without the break-out sessions and poster discussions.*

There were a few suggestions for revisions to the conference design, schedule or logistics. Four women noted that the days were long; they felt that the schedule was too "packed." Several women recommended altering the workshop to three full days instead of two and a half days or adopting a schedule similar to a Gordon Research Conference with morning activities and afternoon free time. Some women also requested that the optional waterfall hike or hot springs trip on the final day be included in the main agenda. Finally, a few women noted that more snacks and higher protein breakfasts would help them to maintain energy for the busy days.

Conference topics

For the most part, the conference topics met participants' needs. Overall, 72% of participants agreed or strongly agreed that the break-out session topics were helpful to their professional development (five junior scientists and two senior scientists were neutral, and no participants disagreed).

> *I thought they were fantastic, relevant topics, led by amazing people.*

However, several sub-groups of junior scientists did not feel that their needs were as well served by the topics at hand. For instance, postdoctoral researchers and tenure-track faculty noted that they had different needs and requested workshop topics specific to their career stages. For instance, postdoctoral researchers wanted more information on *finding* an academic job, rather than obtaining tenure once in such a position.

> *As a postdoc I would have liked more sessions on the academic job hunt, perhaps a special session could be geared for postdocs.*

> *The career development workshop was heavily focused on getting tenure. However, I am still just trying to find a job. It might have been better to separate junior faculty from postdocs.*

Additionally, there were not many attendees from undergraduate institutions; consequently, the break-out sessions were more oriented toward scientists at government laboratories and research universities. Scientists from smaller universities and undergraduate colleges requested topics or sessions that were geared toward their unique needs. Faculty at primarily undergraduate institutions (PUIs) undertake different sorts of research projects than scientists at research universities by necessity; their research support consists of undergraduates with less technical knowledge and skills than doctoral students, and they often do not have access to the most sophisticated equipment. Therefore, it is important for them to form collaborations with colleagues at research universities so they may gain greater access to resources and state-of-the-art equipment. While networking and collaborations were essential for faculty of smaller schools and teaching colleges, they desired break-out session topics oriented for their specific needs at

small schools with fewer resources. These participants requested more discussion of undergraduate research, advising, and teaching.

> *More focus on undergraduate research and the specific challenges for undergraduate institutions.*
>
> *The emphasis on government labs or large research institutions did not necessarily match my needs for mentoring at a smaller school.*

Participants' suggestions for future topics

Although participants were largely satisfied with the break-out session topics, they had some suggestions for future topics. These include:

- Communication skills/styles
- Grant writing
- Student advising
- Time management
- Alternative career paths
- Career decision-making processes

The most frequent suggestion was a stronger emphasis on communication skills. Participants suggested workshops focusing on specific, targeted communications topics, such as negotiation or gendered communication styles. They recommended bringing in communications experts to lead these workshops and to open the session to the whole group, rather than incorporating the topic into a break-out session in which not all participants were able to attend. Several of the women who were not assigned to the communication workshop felt that they had missed an important topic that would benefit them in their career. The following comments are representative of the recommendations concerning communications.

> *I think it would be helpful to have a specialist in gender communication issues talk to attendees and provide hand-outs with tips and tools for improving our interactions with male scientists.*
>
> *It'd be great to have the people who run COACh [Committee on the Advancement of Women in Chemistry, the University of Oregon] come and do the effective communication workshop.*
>
> *Perhaps something from a specialist or professional facilitator on communication, time management, personality types and working with them, etc.*

Although communication styles was the most frequent suggestion for future workshop topics, participants had other suggestions as well. Survey respondents also recommended grant writing, advice on undergraduate or doctoral student advising, time management, alternative career paths (e.g., non-academic or non-research career paths), and discussion of career decision-making processes.

Outcomes from the break-out sessions

As already noted, most participants were satisfied with the topics of the break-out sessions. The break-out sessions also had many other benefits for participants. Participants' primary outcome from these sessions was gains in knowledge about the issues facing women in science. Women also received many personal gains, including a sense of support and feeling that they were not alone in the obstacles that they have faced in their career paths. The interactive format and discussion-based nature of the break-out sessions was essential to fostering these new understandings. The following comments are representative of open-ended survey responses about the break-out sessions:

> *[The most helpful part of ASCENT was]The break-out sessions where we were able to get to deeper issues that underlie the problems for women in science.*
>
> *It is helpful to know that successful women scientists face similar situations no matter where they work or what they do. This information came through the guest speakers and the break-out groups.*
>
> *I found the break-out groups most useful. I think because they really gave me some new ideas and perspectives.*
>
> *I enjoyed the break-out sessions, the discussion environment was fruitful.*

In addition, participants had some suggestions for improvement of the break-out sessions. A few women mentioned that the break-out sessions would benefit from more structure and more focused topics and goals. A few women also noted that the write-up session after the break-out may have been unnecessary because it did not generate new ideas.

> *I suggest very focused topics and smaller groups. (e.g. practice negotiation).*
>
> *The break-out sessions were mixed. I enjoyed the discussions but conclusions/take-home messages were a little vague.*

Additionally, almost all participants were in favor of retaining the break-out session rather than switching to a panel session format. In a quantitative survey item, participants were asked whether they would prefer a panel format to break-out sessions; only three out of twenty-five agreed, indicating that participants preferred the discussion-based, break-out format to other possible conference formats. Finally, almost all participants agreed that there was adequate time for break-out sessions, although three participants disagreed.

Guest speakers

Senior scientists served as guest speakers during the ASCENT conference, presenting their research interests, personal career paths, and challenges and successes that they had experienced as women scientists. These personal and professional stories were very meaningful to junior

scientists. Overall, 85% of junior scientists agreed or strongly agreed that the guest speaker sessions were helpful to their professional development. In open-ended comments, participants noted that the presentations were motivating, inspiring, and thought-provoking.

> *The speaker presentations were very useful due to good encapsulation of workshop themes and opportunity for group interaction.*
>
> *[the most useful part of ASCENT was] listening to the senior scientists describe their career paths and particularly the challenges along the way. These were inspiring.*
>
> *It was useful to have role models as I navigate my career path.*

However, some participants reported that the research portion of some of the guest speakers' talks was too technical for a broad scientific audience. ASCENT participants represented a range of sub-fields within atmospheric science; therefore, they suggested that research discussions be tailored to a general scientific audience.

> *Some of the talks were way too technical. None of the talks were in my area and many of them didn't target a general audience.*

Participants were also satisfied with the length of guest speaker talks: 100% of participants agreed or strongly agreed that the amount of time given for guest speaker talks was adequate.

Keynote address

The keynote address performed many of the same functions as the guest speaker talks in motivating and inspiring junior scientists. Overall, 90% of junior scientists agreed or strongly agreed that the keynote address was helpful to their professional development. The keynote speaker's descriptions of overcoming personal challenges gave some junior scientists the hope that they, too, could overcome adversity. Although, one junior scientist thought the "stories of personal challenge were depressing."

> *The keynote speaker had wonderful tips. Having someone so knowledgeable in navigating an academic career was great.*

The keynote address also set the tone for the conference. The personal content of the talk created an "open" and "safe" environment for the rest of the conference.

> *The keynote speech was truly inspiring and useful to set the theme.*
>
> *I think the keynote on the first morning set the perfect tone and then really helped everyone be up for whatever was next.*

Poster session

The poster session helped junior scientists to share their research with others and build potential research collaborations. The poster session also helped senior scientists to learn about the research interests and activities of junior scientists, potentially enhancing mentoring relationships.

> *The poster session was also good because people really get to know your research.*

> *The poster session and information discussions created potential collaborations*

However, participants reported that the poster sessions were too short and did not provide enough time to see all the posters and discuss research ideas. In fact, only 52% of participants felt that adequate time was given for the poster session. Several participants suggested re-organizing the poster session so that the presenters also have the opportunity to view others' posters.

> *We needed more poster session time, also give a chance for poster presenters to see other posters (i.e. A-D at posters for 15 minutes, E-L at posters for other 15)*

.

Informal socializing and relaxation

The opportunity for informal socialization and relaxation also contributed to participants' networking gains. There were several opportunities each day for women to interact informally. In response to a likert-scale survey item, 100% of participants agreed or strongly agreed that "I was satisfied with the amount of interaction I had with colleagues in the ASCENT conference overall."

In response to open-ended items, participants reflected on the benefits of socializing and relaxing with other women scientists during the conference. Informal socializing allowed participants to get to know one another in a casual environment while building personal and professional relationships.

> *Informal socializing helped to build new bonds.*

However, in participant-observation during the conference, a few women mentioned that a more formal introduction at the beginning of the conference would help them to feel more comfortable and to better identify colleagues with similar research interests. These women suggested that a short, structured introduction or ice-breaker activity might help participants to identify potential research collaborators and could assist introverts in establishing connections. A few participants also suggested a short, "speed-dating" session early in the conference to allow all of the participants to interact individually. The following comment from the survey is representative of these comments.

> *It would have been nice to have an ice-breaker activity first thing Sunday evening (makes mingling much easier).*

Mentor pairing

Some junior scientists were motivated to attend ASCENT because they were seeking mentors and role models; therefore, the mentoring component of the conference was essential for their professional development. Many junior scientists, in survey comments and from participant-observation, were appreciative of the mentoring they received from senior scientists.

> *The mentor/mentee connection was great, and getting perspective of career paths from senior female scientists was helpful.*

> *The mentor pairing was the most useful part of ASCENT because we got to go into detail about our concerns. The one-on-one (3 on 1) interaction was great.*

Most junior scientists were satisfied with their interactions with their mentors, but a few were neutral. For example, 70% of junior scientists and 100% of senior scientists agreed or strongly agreed that "my interactions with my mentor or mentee were *professionally* beneficial." However, almost all participants reported that their interactions with their mentors or mentees were "*personally* beneficial" (90% of junior scientists and 100% of senior scientists agreed or strongly agreed with this statement). The junior scientists who reported less professional benefit from their mentor relationships were non-atmospheric chemists—the same scientists who had difficulty finding peer collaborators at ASCENT. In addition, a junior scientist noted that she was satisfied with having a range of senior scientists available to her for guidance and advice, and she did not feel the need to be paired with one specific mentor.

In survey responses and from participant-observation at the ASCENT conference, attendees also recommended a few revisions to the mentor pairing process. Both junior and senior scientists recommended that they have a more structured opportunity to meet one another prior to the pairing process. Many junior scientists did not feel that they were familiar with the senior scientists' research by the end of the first day of the conference, and the senior scientists had not met all of the junior scientists, making selecting a mentor or mentee difficult. Participants recommended establishing a more structured introduction between junior and senior scientists early in the conference so they may get to know one another earlier in the process, and moving the senior scientists' talks to the first day so that junior scientists could learn about their research interests prior to the mentor selection process.

Conference outcomes

We now address the short-term outcomes from participation in the ASCENT conference, the ways in which participants anticipate they may use their new networks and career knowledge, and their suggestions for sustaining networks after ASCENT.

Conference attendees, especially junior scientists, noted an array of personal and professional gains from their participation in ASCENT. Women reported that they enhanced their networks and developed potential research collaborations. They also stated that they gained knowledge,

skills, and access to resources that could help them in their careers and career decision-making. Finally, some participants also reported that they gained confidence, formed friendships, and developed a supportive network of women scientists. These gains align with participants' anticipated gains as stated on their applications. Almost 85% of applicants hoped to gain professional networks from ASCENT, 60% hoped to gain skills, and 47% hoped to gain personal support networks. Survey findings suggest that these expectations for the ASCENT conference were largely met.

Figure 3 illustrates the means for all survey items related to conference outcomes 1=strongly disagree, 5=strongly disagree). Perhaps because of the small sample sizes, there were few differences between junior and senior scientists in reported outcomes, with the exception of a few items.

Fig. 3 Means for outcomes for all participants

Comparison of gains between junior and senior scientists

The small number of senior scientists precluded statistical comparisons between groups, but there were a few notable differences in conference outcomes between junior and senior scientists. Senior scientists were more likely to report that they gained mentoring skills (senior scientist mean=4.0, junior scientist mean=3.0), while junior scientists were more likely to report that they gained knowledge and resources (junior scientist mean=4.4, senior scientist mean=3.8). Junior scientists were also slightly more likely to anticipate that they will collaborate with a colleague that they met at ASCENT (junior scientist mean=4.2, senior scientist mean=3.8). Both groups rated gains in "enhanced professional networks" equally, indicating that gains in networking and professional collaborations were not dependent on career stage.

Gains in collaborations and networking

The strongest outcome reported by all participants was developing networks and professional collaborations. In fact, 95% of junior scientists and 100% of senior scientists agreed or strongly agreed that "I enhanced my professional network." In response to an open-ended question, participants also cited networking as their strongest gain from the conference. Both junior and senior scientists noted the benefits of developing potential research partnerships and collaborations. Junior scientists also commented on the benefits of developing a relationship with a senior mentor or mentors.

> *I think I have gained a number of new mentors that will definitely help me throughout my career.*

> *I plan on keeping in touch with my mentor and reaching out to several others—for both advice and research collaborations.*

Participants also forged new relationships that may lead to potential grant proposals or research collaborations. In particular, women from smaller universities or colleges were able to identify peers at research universities to share resources, equipment, and research support.

> *It is likely that at least one collaborative grant will be written as a result (combining resources at my school with primarily UG institution).*

Some participants also generated ideas for research projects or papers from their networking during ASCENT.

> *Collaborations should enhance my career and I gained ideas about research and papers.*

Finally, participants noted that their networks were personally as well as professional beneficial.

> *The networks are supportive as well as scientifically beneficial.*

> *I have met some amazing women here who I hope will become life-long friends, colleagues, and collaborators.*
>
> *A safe place to discuss! A place to recharge and get new ideas about science/collaborations, personal and professional.*

However, a few women did not report the same level of benefit in professional networking. These scientists specialized in sub-fields that were not well represented at ASCENT and they had difficulty identifying colleagues with similar research interests. These few women noted that most participants were atmospheric chemists, and other sub-fields were not as well represented.

> *I would like to find research collaborators, but without a research-related colleague, I don't see myself contacting people that I have met here.*
>
> *I felt that I didn't share research areas with the other women. That limited my ability to enjoy the networking aspect. My suggestion for the future is to choose two or three fields and make sure that they are well represented. I was left feeling that networking at this conference was difficult for those of us who are not atmospheric chemists.*

Gains in knowledge

Attendees, notably junior scientists, reported that they gained knowledge, advice, and access to career resources from their participation in ASCENT. One-hundred percent of junior scientists agreed or strongly agreed that they "gained new knowledge about resources that will support me in my career." In contrast, only 40% of senior scientists agreed or strongly agreed with that statement. This finding indicates that the resources presented at ASCENT are appropriate and beneficial for the target audience of junior scientists.

Junior scientists noted that they gained strategies, resources, and advice for navigating their career paths. Some participants also mentioned that career discussions with other scientists helped them to gain perspective on their own careers and workplaces.

> *I believe there were many good pieces of information on how to be successful. Several discussions led to very detailed advice that sounded very useful.*
>
> *I have learned tips on teaching, writing, and dealing with departmental issues.*

Participants also learned about the barriers faced by women in science and gained knowledge of how to overcome those barriers. This knowledge was particularly important for junior scientists. Eighty percent of junior scientists agreed or strongly agreed that they learned about obstacles faced by women in their field, and 90% of junior scientists agreed or strongly agreed that that they "gained resources for helping to overcome the obstacles faced by women in science."

Personal gains

Women also noted personal gains from their participation in ASCENT, including increased confidence and a sense of support. Almost all junior scientists (85%) and 100% of senior scientists agreed or strongly agreed that "I feel more prepared to navigate my career path in my field." And 80% of both junior and senior scientists agreed or strongly agreed that "I feel more confident about my future in my career." Interactions with other scientists about career choices led one participant to gain confidence in navigating her own career path.

> *I have learned about the career paths of others and have gained more confidence in creating my own path.*

Although most junior scientists gained general confidence about their abilities to navigate their career paths, they were less likely to report gains in confidence about their professional relationships, particularly pertaining to specific skills. For example, 60% of junior scientist agreed or strongly agreed that they "feel more confident in their professional relationships (e.g. ability to negotiate, collaborate, etc.). About a third of junior scientists felt neutral about this statement and one participant disagreed. Although the majority of participants still reported gains in this area, the percentage is less than for other personal gains. This finding corroborates women's reports that they would like more specific training in communication, negotiation, and building professional relationships.

Participants' anticipated use of new networks and knowledge

In an open-ended question, participants commented on the ways in which they anticipated they will use their new knowledge and professional networks in their own careers. Most junior scientists (80%) agreed or strongly agreed that "I anticipate that I will collaborate professionally with a colleague that I met at ASCENT." The few junior scientists who were neutral or disagreed with that item were unable to find research collaborators in their sub-field. In a follow-up, open-ended question, the majority of junior scientists also commented that they will use the networks that they gained from ASCENT for research collaborations, grant writing, mentoring, support, and advice.

> *It's a great opportunity for me to learn from people who are ahead of me in the process. People have also started to give me names to help expand my knowledge of the network already.*

> *I think I have many more people to ask for advice from in the future.*

> *Through poster sessions and informal discussion, I have made a few connections with my work and the work of others. It is difficult to form collaborations without meeting face-to-face. I am encouraged by ASCENT to write formal proposals with other women. This will advance the visibility of successful young women scientists!*

Networking and developing research collaborations seemed particularly important to participants from undergraduate institutions or small universities with few resources.

> *Yes, absolutely [I will maintain my contacts from ASCENT]! Ideas and collaborations are necessary for success at a small school.*

> *I hope to collaborate with people at research institutions for instrumental support/modeling and advice on grant writing.*

Participants also planned to use the knowledge and skills that they gained from ASCENT in their careers. For example, some women noted that they will use the resources recommended during guest speaker talks or break-out sessions.

> *I plan to buy some of the books Sharon suggested and use some of the techniques we talked about in the break-outs. I also plan to be more pro-active about self-help.*

Several participants also mentioned that they planned to buy the books that were recommended during the mentoring break-out session.

Sharing the ideas and networks gained at ASCENT with colleagues

One-hundred percent of participants planned to share the ideas and knowledge that they gained from ASCENT with others. Most attendees mentioned that they planned to share their learning with other women scientists, although a few women also reported that they planned to share their experience at ASCENT with male colleagues or department heads. Some women also felt empowered to be more pro-active in their careers and had plans to follow through with concrete steps to advance their careers. The following comment from a participant illustrates many of the aforementioned ways that women planned to share their experiences at ASCENT with others.

> *I am a member of a women's writing group at my university and will share discussions I've had. Also, I will share collaboration opportunities with women I've met with my current collaborators, both male and female. And I will discuss with my chair some of my needs that I hadn't articulated previously.*

Sustaining networks among participants

The primary outcome from the ASCENT conference was the development of professional and personal networks among participants. Subsequently, almost all participants anticipated that they would maintain contact and build research collaborations with their fellow participants. Most women anticipated that they would use the moodle site, an electronic resource developed by organizers to help participants keep in touch and maintain their networks after the conference. However, most of these participants suggested that their use of the site may be conditional on its widespread adoption among the group and its utility in helping ASCENT alumni to sustain their networks and collaborations.

Participants also offered several suggestions of ways in which organizers can help alumni to sustain collaborations after the conference. Several participants suggested that organizers assign peer mentors as a resource of peer support and advice. Participants also recommended a reunion meeting at a national conference, such as the American Geophysical Union (AGU) annual meeting. More participants mentioned that they were likely to attend the AGU fall meeting rather than the American Meteorological Society (AMS) annual meeting. However, a few participants noted that they eschew large national conferences in favor of smaller, regional meetings. Other suggestions for maintaining alumni networks included an email listserv for former participants and occasional newsletter updates.

Conclusion

As an underrepresented group in atmospheric science, women face a variety of barriers to their advancement and success in the field. ASCENT participants cited many of the barriers identified in the literature about women in science, including family and work-life balance issues, isolation, lack of female mentors and role models, lack of institutional support, lack of confidence, and, in the worst cases, harassment from male colleagues. The ASCENT conference provided a forum for women to discuss these issues and to develop potential professional and personal networks of support among scientists of varying career stages. The majority of ASCENT participants reported that they enhanced their professional networks, developed potential research collaborations, formed personal support networks of women scientists, and gained knowledge and access to resources that will help them in their careers. However, a few women from fields outside of atmospheric chemistry had difficulty in forming professional networks. In sum, the ASCENT conference seemed to fulfill the goals of developing professional and personal networks of women atmospheric scientists, and providing access to knowledge and resources that may bolster career success. The long-term outcomes from the conference—such as the ways in which participants will use the networks, knowledge, and resources that they gained from ASCENT—are still to be determined.

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