Developing Networks of Women Scientists: Outcomes from the Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) Workshop, 2009-2011

Final Report, Year 3

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ASCENT

Atmospheric Science Collaborations and Enriching NeTworks

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Table of Contents

List of Figures

Executive Summary

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 workshop seeks to help women to overcome career obstacles in atmospheric science by developing professional relationships and collaborations among scientists of varying career stages. This report presents final, summative findings on workshop outcomes from all three ASCENT summer workshops held from 2009 to 2011. The 2011 workshop was the final ASCENT workshop funded through the National Science Foundation's Partnerships for Adaptation, Implementation, and Dissemination (PAID) ADVANCE program.

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 summative 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 final findings from the post-workshop survey administered at all three ASCENT conferences. Thus the report will describe aggregate data from the three years. The report will also describe findings on the challenges faced by women atmospheric scientists as described by focus group participants at the three summer workshops.

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 only conducted on the entire three-year data set because the small sample sizes from individual workshops precluded meaningful statistical analyses of group differences.

Write-in responses to the open-ended questions and transcripts from focus group interviews 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

Over all three years of the ASCENT workshop, 79 women completed the post-workshop survey, 59 junior scientists and 20 senior scientists. Fifty-five of the women (70%) had never participated in a professional training similar to ASCENT, indicating that there is a great need for programs such as ASCENT for women atmospheric scientists.

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. All three years, ASCENT attendees participated in focus groups that addressed the obstacles they faced; post-survey questions also asked about career obstacles. Work-life balance and family issues were the most frequently cited career obstacle by ASCENT participants in both focus groups and on survey questions. Women also noted isolation, not being taken seriously by colleagues, lack of institutional support, discrimination and sexism, 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. Postdoctoral researchers described a lack of access to resources and support, and the transient nature of postdoctoral positions was difficult for dual-career couples. Some women reported delaying childrearing decisions during the postdoctoral phase. Postdoctoral researchers were more likely than junior faculty members to consider leaving the field due to these challenges.

Conference design and logistics

Overall, participants in all three workshops were very satisfied with the conference schedule and the variety of formal and informal activities during ASCENT. Over all three years, 95% of participants agreed or strongly agreed that they were satisfied with the design of the workshop. Additionally, 85% of all ASCENT participants agreed or strongly agreed that the mix of activities in ASCENT 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, visit to Storm Peak lab) helped to foster both professional collaborations and personal friendships and support networks. Given that the primary goal of ASCENT is to create networking relationships, 97% of all ASCENT participants reported that they were satisfied with the amount of time they spent interacting with colleagues at the workshop.

Break-out sessions

For the most part, the conference topics met participants' expectations and needs. Over all three years, 72% of participants agreed or strongly agreed that the break-out session topics were helpful to their professional development (the rest were neutral and no participants disagreed). Women reported that they gained valuable career tips, strategies, and advice during the break-out sessions. Participants also appreciated the open and confidential discussions in the break-out sessions.

Senior scientists' talks

Senior scientists served as guest speakers during the ASCENT conference, discussing their research interests, personal career paths, and the challenges and successes that they had experienced as women scientists. According to survey responses, these talks were one of the

most beneficial aspects of ASCENT for junior scientists, providing inspiration and motivation to overcome challenges and persist in their careers. Over all three years, 91% of junior scientists agreed or strongly agreed that the senior scientist talks were helpful to their professional development.

Keynote address

The keynote address performed many of the same functions as the guest speaker talks in motivating and inspiring junior scientists. Additionally, the keynote addresses also informed participants about the status of women in science and the challenges faced by women scientists. Over all three years, 89% of junior scientists agreed or strongly agreed that the keynote address was helpful to their professional development.

Mentoring

The vast 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. Senior scientists were also significantly more likely than junior scientists to report that they gained mentoring skills from ASCENT (statistically significant, $p<.05$).

Workshop outcomes

Women reported a variety of gains from the ASCENT workshop. The most frequent gain cited by both junior and senior participants was increasing their professional network; indeed, over all three years, 97% of participants reported that they enhanced their professional network. Junior scientists also gained knowledge about the issues faced by women in science and gained access to resources to help them overcome these obstacles. Ninety-three percent of all participants felt they learned about the obstacles faced by women scientists, and 90% of women felt they gained resources to overcome these obstacles. Additionally, 85% of all participants felt more confident about their future in their career after the workshop, and 87% of all participants felt more prepared to navigate their career path. Finally, 82% of all ASCENT participants reported after the workshop that they anticipated that they would collaborate with a colleague from ASCENT.

Conclusion

As an underrepresented group in atmospheric science, women face a variety of barriers to their advancement and success in the field. The ASCENT workshop 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. Longer-term data from the workshop affirm that women maintained their networks months after the workshop (see Thiry, 2010, 2011).

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 their career advancement (NRC, 2006; Solem & Foote, 2004).

Program Description

The Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) workshop 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 workshop 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, and field trips.

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 workshop design and logistics, and to gather information on participant outcomes. The study focuses on the personal and professional gains that attendees made from participating in ASCENT, their satisfaction with the program and its offerings, and the influence of participating 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 workshop and a post-workshop 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 workshop design, logistics, and mix of activities. This report will focus on findings from the post-workshop survey and focus groups. Findings from all three ASCENT workshops will be discussed in aggregate in this report as a summative statement on the overall outcomes from ASCENT.

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. How satisfied are participants 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 face 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

Two focus groups with attendees were conducted at each ASCENT workshop. Participants also completed a survey on the last day of the ASCENT workshop. All junior and senior scientists, with the exception of ASCENT organizers, were invited to complete the post-workshop survey. Follow-up surveys were distributed six months after the workshop to assess the longer-term outcomes of ASCENT. A final longitudinal report will be forthcoming in early 2012. The study procedures were approved by the Institutional Review Board 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 study participants

The survey sample over all three workshop consisted of 79 women atmospheric scientists and meteorologists. Fifty-eight (73%) survey respondents were junior scientists, while 20 (26%)

were senior scientists. The majority of respondents were also assistant professors or postdoctoral researchers. Specifically, 25 (32%) were postdoctoral researchers, 19 (24%) were assistant professors, 20 (25%) were research scientists, 6 (8%) were full professors, 3 (4%) were associate professors, 5 (6%) were in administrative or management positions, and one respondent was a graduate student. Additionally, 68 (86%) respondents were white/Caucasian, 7 (9%) were Asian/Pacific Islander, and 4 (5%) were multiracial. Finally, 55 (70%) women reported that they had never participated in a program like ASCENT, indicating that ASCENT is meeting a critical need in the atmospheric science community.

Findings

The findings section is organized as follows: 1) obstacles faced by women atmospheric scientists, 2) summative findings about the ASCENT workshop design, and 3) summative workshop outcomes from all three ASCENT summer workshops.

Obstacles faced by women in atmospheric science

Women scientists face an array of obstacles to their advancement and success in the field. One of the objectives of ASCENT is 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 survey items and focus group discussions, 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, as compiled from their survey responses over the entire ASCENT program. These survey findings were compiled from an open-ended question in which respondents were free to write about any barriers they may have encountered in their career. Most women wrote about one or two obstacles that were most salient for them. If women had been asked to select options from a pre-determined list of survey responses, the percentage of women selecting each category would surely be higher. If anything, open-ended questions underestimate the frequency with which women encounter these common career obstacles. The following discussion about career obstacles draws on both survey responses and focus group interviews.

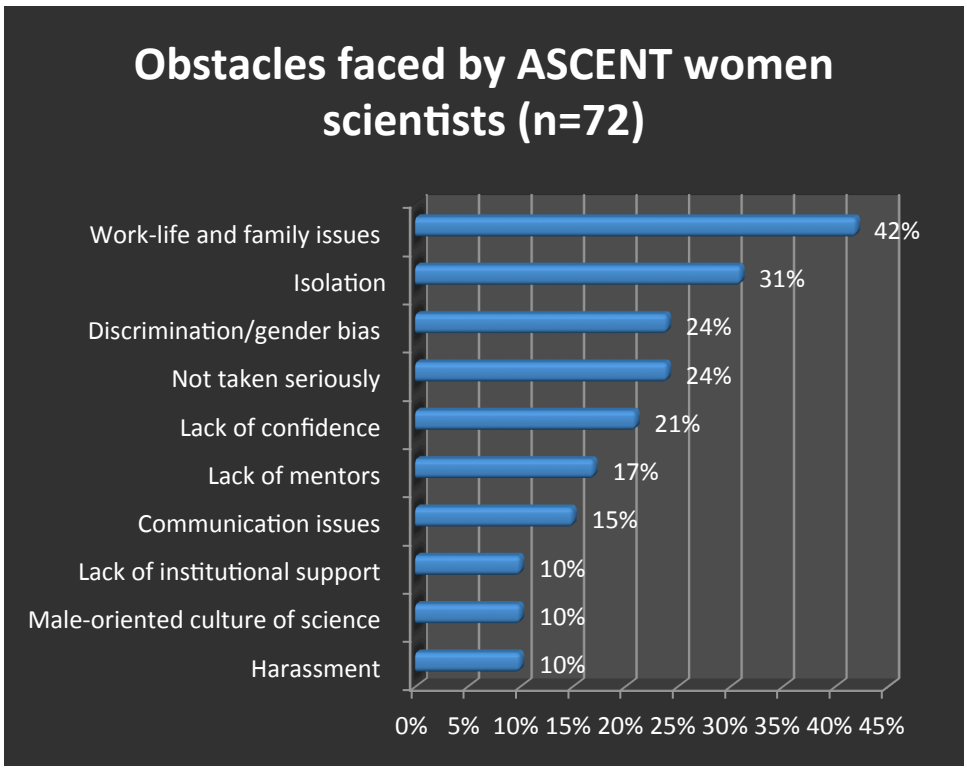

Fig. 1. Obstacles faced by women atmospheric scientists, survey responses

Work-life balance and family issues

Work-life balance and family issues, particularly for junior scientists raising young children, were the predominant obstacles cited by ASCENT participants over all three years of the program. Over the course of ASCENT, 42% of participants noted the challenges of work-life balance or family issues in response to an open-ended survey question about career obstacles. Additionally, these issues were raised in each focus group, generating much discussion and agreement about the challenges of balancing family and personal life with the demands of scientific research and field work.

Many participants commented that these issues have been significant factors influencing their career decisions or direction. Clearly, many 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; in focus groups, a few early-career 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 early-career 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.*

Other women felt that they had to "choose" between having a family or having a successful research career.

> *I think the greatest challenge has been the perceived choice between having a family and having a strong research career. I have heard a colleague make a comment about how another colleague's career went downhill after having children. I don't remember the exact words, but it left the impression that having children hindered a successful career.*

A lack of information or discussion about the challenges of balancing family and work could lead women to feel that they cannot possibly do both:

> *The biggest challenge I think I've faced was during graduate school-- there was simply a lack of acknowledgment in my graduate department of the potential issues that women scientists encounter in atmospheric science and science in general. I had a female advisor, and even she never discussed the sometimes daunting task of dealing with pushy male colleagues or how to negotiate starting a family when you are in the very early stages of your career. As a graduate student I started thinking that it wouldn't be possible to have both a fulfilling career and a fulfilling home life if I wanted to be at a top research university or government lab.*

Isolation

The second most common obstacle for ASCENT participants, in both survey responses and focus groups, was isolation or exclusion. Many ASCENT participants were the only women in their departments or had been the only women in their graduate or postdoctoral research groups or during fieldwork. 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 success.

> *[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.*

Discrimination/gender bias

ASCENT participants recounted numerous instances of discrimination, sexism, and gender bias that they had either experienced themselves or witnessed. These episodes negatively impacted women's confidence, and in the worst cases, could negatively impact a woman's career path or ability to advance in the discipline. This discrimination was compounded for racial minority women who often faced negative stereotypes, lower expectations, or discrimination based on their race as well as their gender.

Gender bias could lead to inequitable salary which diminishes a woman's earnings over her lifetime. In a focus group, a research scientist in a national lab related that she learned that she was being paid less than scientists in similar positions in other divisions. The human resources department was unresponsive to her requests for a raise.

Women also felt discriminated against in terms of their workload or expectations for service work. Many ASCENT participants, in both survey responses and focus groups, expressed that they were asked to participate in more service work than male colleagues, detracting from their ability to complete their research requirements. A focus group participant commented:

> *And the other big thing is being aware that they're asking the women scientists to do a lot more in the committees. And that's the other issue, like the saying no thing, I mean I know that I have an equal male who, he and I started about the same time, and I know I do about five times as much crap that he does.*

Many women also shared stories in focus groups about disparaging or demeaning comments that men have made to them. Sometimes these comments were meant to be light-hearted or playful, but failed miserably. For example, one woman recounted a story of connecting with a few women scientist friends at a conference. A male colleague ran into them and referred to them as the "female mafia." Thus, many of these comments only reinforced women's isolation and "otherness" in the field of atmospheric science.

And, in the worst cases of discrimination, women's careers suffered. A woman in a focus group described an instance where her supervisor was selecting a scientist for a field campaign. The

male and female candidates were equally qualified, yet he selected the male candidate because he didn't see the female as "fitting in with the pilots." Therefore, discrimination could have far-reaching impacts, from reinforcing feelings of isolation and lack of confidence, to inhibiting women's advancement in the field.

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.*

In focus groups and survey responses, women discussed feeling at odds with male models of communication that predominate in the sciences. Women noted that men are often more aggressive and/or impatient communicators, and they felt that their more collaborative or nurturing mode of communication did not fit with that model. Women struggled with adapting to male patterns of communication while keeping their own identity.

Sadly, women's reports of communication difficulties did not only involve communication with male colleagues, but often described difficult communication and relationships with female colleagues. Several ASCENT participants, notably junior scientists, felt that they had actually received more support from male than female colleagues in their career. These women reported that they felt negatively judged or evaluated by their women colleagues, particularly for their appearance or dress. The comment below was typical of these types of challenges:

> *I find that I am constantly being judged based upon the way I look. I believe that no matter what people say, it is not all equal in our field. Unfortunately, at the same time, women can be the worst enemies in a field that is dominated by men. In order to prove themselves, they end up stepping on other women to get ahead. Also jealousy may exist among women that drive a lot of the meanness.*

Another participant contributed:

> *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.*

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 their 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.*

Women also felt that they were treated differently than men in professional meetings and had to prove their competence more than men. While men were automatically assumed to be competent and capable, women often mentioned that they were not automatically taken seriously and had to work harder to prove their competence, as described in this excerpt from a focus group:

> *I think that men really do get treated differently because first of all, when a man says something they usually trust it on face value. And I've always found that if I say something people usually question it or look it up to make sure. (GROUP LAUGHS) I notice that a lot more than if a guy says something, it's like oh yeah, that must be right. I was like, what? You wanted to look it up and he's—okay. (GROUP LAUGHS) I've noticed watching male colleagues PhD defenses that people seem more interested rather than critical and grilling, it's a bit of a different approach. Like in their defenses, it's almost like their committee is there as spectators more than as testing. And there is a lot more intimidation when women are there. It's like they need you to really prove that you deserve to be there [if you're a woman].*

In focus groups, women also shared stories of colleagues who insisted on conferring with a male colleague for expertise or advice, and would not accept assistance from a woman. Other women described being ignored in meetings; for instance, when a male colleague raised an idea previously raised by a woman and ignored, the idea was accepted and praised. Thus, ASCENT participants had multiple examples of ways in which their work and ideas were not taken as seriously as their male colleagues.

Lack of confidence

In large part because of their isolation in the field of atmospheric science, many ASCENT participants described a lack of confidence in their abilities and achievements. In survey responses and focus groups, junior scientists often discussed a general lack of confidence. Senior scientists often mentioned that a lack of confidence was a challenge earlier in their careers. For instance, the survey comment below was typical of those from junior scientists:

> *There have been many challenges. My biggest challenge is doubting my abilities and finding a balance between honestly recognizing my intellectual limitations and feeling that my contributions have been minimal (ie have been based entirely on others' achievements)*

A lack of confidence often led women to advocate less effectively for themselves, as described in

the following survey comment:

> *The challenges I faced have been being confident in what I do, and in what I request; that is not confident means I may back down on my request or I may not request something in the first place.*

The lack of women in the field of atmospheric science also led some to doubt their abilities or scientific contributions.

> *In a nutshell, the main challenge throughout my career has been external perceptions and internal doubts about whether I'm a "real" -- technically rigorous -- mechanical engineer.*

A lack of mentors and role models

The dearth of women in atmospheric science has also contributed to a lack of female mentors for younger scientists. Some participants mentioned that there are few older women in the field to serve as role models. 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. Even some of the senior scientists felt that they could use a female mentor.

> *I'm a senior person and maybe it's some kind of ceiling I've hit because I would like to have a mentor now because I'm moving more into management and things but I don't have anybody. It's kind of like I'm expected to just know it all.*

A lack of support, from either male or female mentors could result in women leaving the field of atmospheric science, as described in the following excerpt from a focus group:

> *I think for the women that I know that have left it is the support structure, it's the intimidation, it's the way the PhD is structured of grilling you and being on your feet and thinking really fast and a lot of women that are very capable of that, I mean they are capable but it doesn't come as easily, I guess I should say. And the intimidation factor and the fact that most of the professors you are around are male and you don't have a lot of female role models and you just don't see how it is exactly going to shape, how it is going to work out. And so I mean for me I think the only way I got through was because I had at the time, that group was mostly female and that was huge for me.*

Lack of institutional support

Many women also felt that their departments or institutions were unsupportive of women scientists. Women often reported a lack of supportive maternity leave and childcare policies at their institutions. On the post-workshop survey, one woman listed the following concerns as obstacles she has faced as a woman in science. These concerns were typical of many other survey responses.

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

Other women, especially junior scientists considering starting families, felt that their institutions may not be supportive of their choices.

> *I feel like my challenges will increase once I start a family. I worry about how understanding my workplace will be.*

Academic women, in particular, felt that their institutions were not supportive or flexible in accommodating their work-life needs. As an example, one woman in a focus group described various professions in which it is normal and accepted for women to work part-time so that they may also raise children. In academe, on the other hand, women felt that they would be perceived as less committed or less serious scientists if they worked part-time.

Male-oriented culture of science

A scientific culture that is male-dominated and focused on competition 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 [years old]. 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.*

In focus groups, several women also described incidents of harassment during field campaigns, or inappropriate comments about their looks from male colleagues, especially older men.

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. Many of these obstacles have been described in the literature on women in science; however, the isolation, discrimination, and harassment that some women experienced in field campaigns seems unique to atmospheric science and other disciplines that conduct field research.

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 learn about and discuss issues related to women in science, and to either be a mentor or find a mentor. Figure 2 details all participants'—both junior and senior scientists—motivations for attending ASCENT.

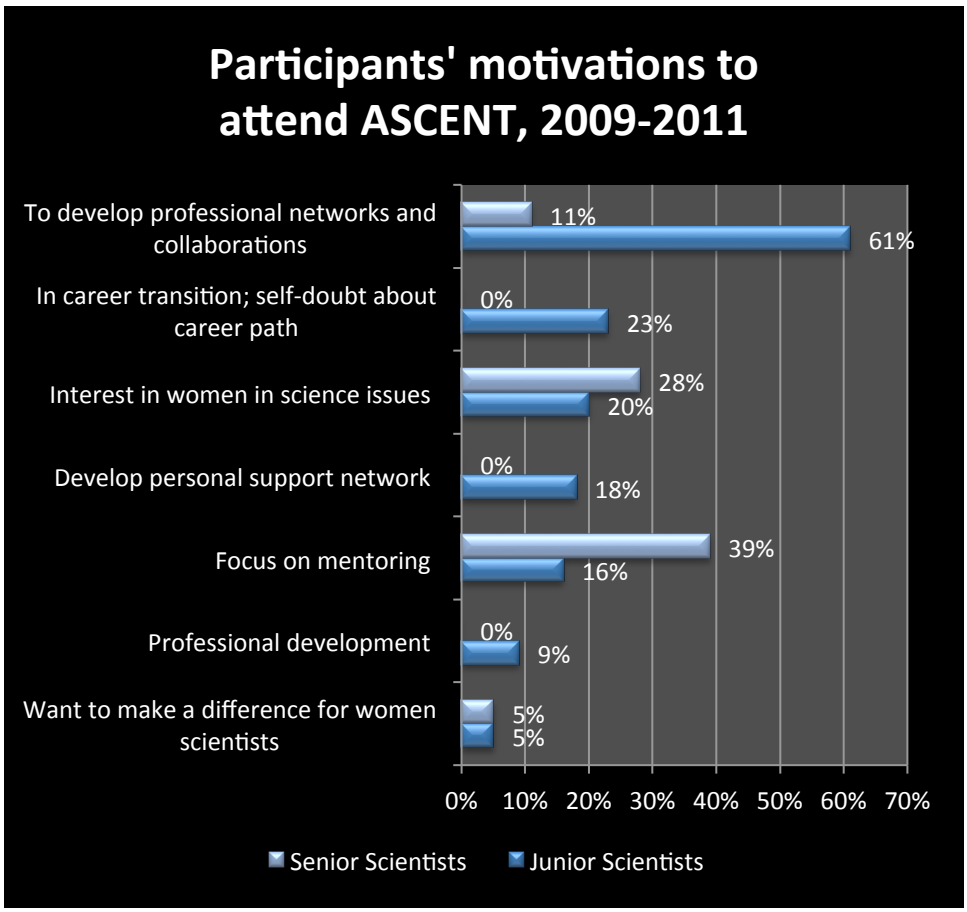

Figure 2. All participants' motivations for attending ASCENT

The most common motivation for attending ASCENT for junior scientists 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.*

Other women were in a career transition or were beginning to doubt their current career path. These participants were motivated to hear others' stories and experiences, particularly regarding work-life balance or family issues when transitioning from a postdoctoral to a faculty position.

> *I am imminently transitioning to a faculty position and feel that hearing about other women's experiences who have gone through or about to go through this transition would be useful and empowering to me. The opportunity to meet and potentially foster future collaborators was a high priority for me.*

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.*

The focus on mentoring was the largest draw for senior scientists. As can be seen by the differences in responses between junior and senior scientists, senior women had already developed professional and personal support networks. Thus, these types of interactions were not as significant for senior women as they were for junior women. However, many senior scientists wanted to support early-career women and were highly motivated by the opportunity to be a mentor to a young scientist.

> *I had a very strong desire to connect with other women in the scientific community to both get and give support. As a senior female scientist I found the opportunity to mentor younger women very exciting.*

Finally, some women—both junior and senior scientists—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, junior women wanted to develop a professional network of other female atmospheric scientists, while senior women were motivated by the opportunity to be a mentor. ASCENT

participants also sought a safe environment in which to discuss personal and professional challenges.

Workshop design

Workshop schedule and mix of activities

Overall, participants were very satisfied with the workshop schedule and the variety of formal and informal activities. In fact, 95% of all participants from the three ASCENT workshops agreed or strongly agreed that they were satisfied with the overall workshop design. Additionally, 85% of all ASCENT participants agreed or strongly agreed that the mix of workshop activities met their needs.

In open-ended survey 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.*

Women also appreciated the variety of formats throughout the ASCENT workshop, which helped to facilitate different kinds of interactions and discussions throughout the day.

> *The variety of activities gave me opportunities to get to know people in different settings, whether one-on-one, in a small group, or through the more formal presentations.*

There were only a few suggestions for revisions to the workshop design, schedule or logistics. Eleven percent of ASCENT participants felt the schedule was too full, and 8% requested more time for relaxation and informal socializing. Several women also recommended altering the workshop to three full days instead of two and a half days to allow for a more relaxed pace.

Interaction among workshop participants

Although a few ASCENT participants would have liked more time for socializing, the vast majority of participants from all three cohorts were satisfied with the amount of interaction they had with colleagues during the workshop.

Overall, 74% of all participants were satisfied with the amount of interaction with colleagues during break-out sessions. Participants from the 2011 cohort were less satisfied with the break-out interactions than the participants from the other cohorts (statistically significant at $p=.005$). The break-out sessions were cut short in the final year because several senior scientists ran over the allotted time for their talks, thus, 2011 participants would have liked to have had more time to interact and discuss with colleagues during the break-outs.

In contrast, 97% of all participants were satisfied with the amount of interaction they had with colleagues in the workshop overall. Though participants in 2011 desired more time for interaction during the break-outs, they clearly compensated because they were highly satisfied with their overall interactions throughout the course of the workshop. Thus, the ASCENT schedule and mix of activities allowed ample time for socializing and professional interactions during the two and a half day workshop.

Workshop topics

For the most part, the workshop topics met participants' needs. From all three workshops, 72% of participants agreed or strongly agreed that the break-out session topics were helpful to their professional development.

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

However, several small 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. Although, rather than separating the two groups, workshop topics and content could be re-framed to address the needs of both groups. Postdoctoral researchers, for instance, 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 involves undergraduates with less technical knowledge and skills than doctoral students, and they may not have access to the most sophisticated equipment. One solution to these issues is 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 (in order of frequency of the suggestion, from highest to lowest):

- Communication skills/styles
- Negotiation
- Conflict resolution
- Leadership/management skills
- Grant writing
- How to deal with gender bias/harassment
- Student advising/teaching
- Time management
- Alternative career paths

The most frequent suggestion was a stronger emphasis on communication skills. Participants suggested sessions 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 that not all participants could attend. Several of the women who were not assigned to a communication break-out session felt that they had missed an important topic that would benefit them in their career. Participants also requested training in conflict resolution or dealing with difficult colleagues or supervisors.

Although communication was the most frequent suggestion for future workshop topics, participants had other suggestions as well. Many ASCENT participants also requested training in leadership or management skills. 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. Over all three workshops, the main outcome from break-outs was career tips, advice, and strategies. Secondarily, women also reported 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. Women also reported that they learned more about the issues faced by women scientists. 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.*
>
> *[The most helpful part of ASCENT was break-out] discussions on tenure process and time management. I personally did not know many details on the process before the workshop, plus hearing experiences of other women was extremely beneficial. Time management discussion had provided some very good advice that I hope to follow.*
>
> *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.*

In addition, participants had some suggestions for improving the break-out sessions. A few women mentioned that the break-out sessions would benefit from more structure and more focused topics and goals.

> *Some structure for the breakout groups could be useful. For example, the ones that addressed specific skills could have been more structured. However, I enjoyed the interactive nature and the perspectives offered by participants, so the unstructured time is valuable as well.*
>
> *The break-out sessions were mixed. I enjoyed the discussions but conclusions/take-home messages were a little vague.*

Additionally, as mentioned previously, the break-out sessions in the 2011 workshop were shortened because of scheduling constraints, and thus, participants from that cohort requested longer break-out sessions with more interaction. The 2009 and 2010 break-outs did not stray from the schedule quite as much and this was not an issue during those years.

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. Over all three cohorts, 92% of junior scientists agreed or strongly agreed that the guest speaker sessions were helpful to their professional development. In open-ended comments, early-career women noted that the presentations were motivating, inspiring, and thought-provoking. Most importantly, the senior scientists' talks motivated young scientists to persist in their careers, even when they encounter obstacles.

> *Hearing the senior scientists talk about issues they had overcome and their advice was useful because it gives some perspective about how even these great scientists had hard*

choices to make and struggles to deal with. This is encouraging- it means that I shouldn't get too down or quit when things get hard.

The senior scientist talks also helped younger women to know that they are not alone in their struggles and challenges.

Hearing other women's experiences, both good and bad, and listening to how the situation panned out helps me a great deal. Sometimes I feel that I am alone in the challenges I face or the fear of failure in my scientific field. I found it very empowering and comforting during ASCENT to hear that other women scientists have felt similar to me at one point or another.

Overall, many of the junior scientists were inspired by the successful senior scientist role models.

In many ways ASCENT exceeded my expectations. I was struck by the very open and honest portrayals that the senior scientist women presented of their careers and personal/professional struggles and successes. I was hoping to come away from the workshop with some good ideas of how to move forward in my career... not only did I receive plenty of excellent advice, but I am leaving with a renewed sense of vigor for my field of study and more confidence that I might someday become a successful scientist, wife, mother, teacher, and leader.

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.

Overall, though, the most powerful and inspiring part of the senior scientist talks were their discussions of their career paths and struggles. These personal stories motivated and inspired young women that they, too, can persist and succeed in their careers.

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 all ASCENT participants agreed or strongly agreed that the keynote address was helpful to their professional development. The keynote speakers' descriptions of overcoming personal challenges gave some junior scientists the hope that they, too, could overcome adversity.

The guest and keynote speakers were most useful to me, because I learned a great deal of good advice on navigating a career path. I also gained confidence that I could do what other women have done, and that has energized me to move forward with my own career.

The keynote address also set the tone for the conference. The personal content of the talks created an "open" and "safe" environment for the rest of the conference, especially in the opening year of ASCENT.

> *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.*

While women from all cohorts rated the keynote address highly each year, the 2009 keynote was rated as the best by participants. When asked about the most helpful topics or activities of ASCENT, six women from 2009 listed the keynote address, while only one participant did so in each of the following years. This does not mean that the keynote was not well received in subsequent years—because it was—but simply that the personal nature of the 2009 keynote set a certain tone for the workshop that resonated with participants.

Poster session

The poster session helped junior scientists to share their research with others and build potential research collaborations. Senior scientists also learned 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, in 2009, participants reported that the poster sessions, at 60 to 90 minutes each, were too short and did not provide enough time to see all the posters and discuss research ideas. In subsequent years, the poster session was lengthened to two hours and so allotted time was not an issue in the 2010 or 2011 workshops.

Informal socializing and relaxation

The opportunity to informally socialize and relax with colleagues also contributed to participants' networking gains. There were several opportunities each day for women to interact informally over lunch, dinner, coffee breaks, and in the evening. Indeed, over all three workshops, 97% of participants were satisfied with the amount of interaction they had with colleagues throughout ASCENT.

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. The collaborations and networking that occurred during informal times augmented the outcomes from the break-out sessions and other ASCENT activities.

> *The most useful activity was simply the group dinners and adequate time for meeting women and establishing new relationships, this includes the mentor-mentee activities. This time for personal interactions provides fertile ground for the seeds planted in the talks and other sessions to sprout and flourish.*

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.*

Junior scientists particularly appreciated getting feedback about their career paths or work environments from senior scientists. The following comment from a post-workshop survey was typical of these types of comments.

> *The mentoring relationship has ALREADY been helpful and I think it will be phenomenal over the coming months. Being able to get feedback about situations I am facing at work is so helpful!*

Over all three years, 85% of ASCENT participants agreed or strongly agreed that "my interactions with my mentor or mentee were *professionally* beneficial." Even more participants reported that their interactions with their mentors or mentees were "*personally* beneficial" (90% of all ASCENT participants agreed or strongly agreed with this statement).

Workshop outcomes

I will now address the immediate outcomes to ASCENT participants, and the ways in which the women anticipate they may use their new networks and career knowledge. A final report on the long-term outcomes from ASCENT will be forthcoming in early 2012.

From all three workshops, attendees—especially junior scientists—noted an array of personal and professional gains from 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 women also reported that they gained confidence, formed friendships, and developed a supportive network of women scientists. In a few cases, junior scientists noted that they were more committed to their career and were inspired to tackle the obstacles they face in their career paths.

Figure 3 illustrates the means for all survey items related to conference outcomes (1=strongly disagree, 5=strongly agree).

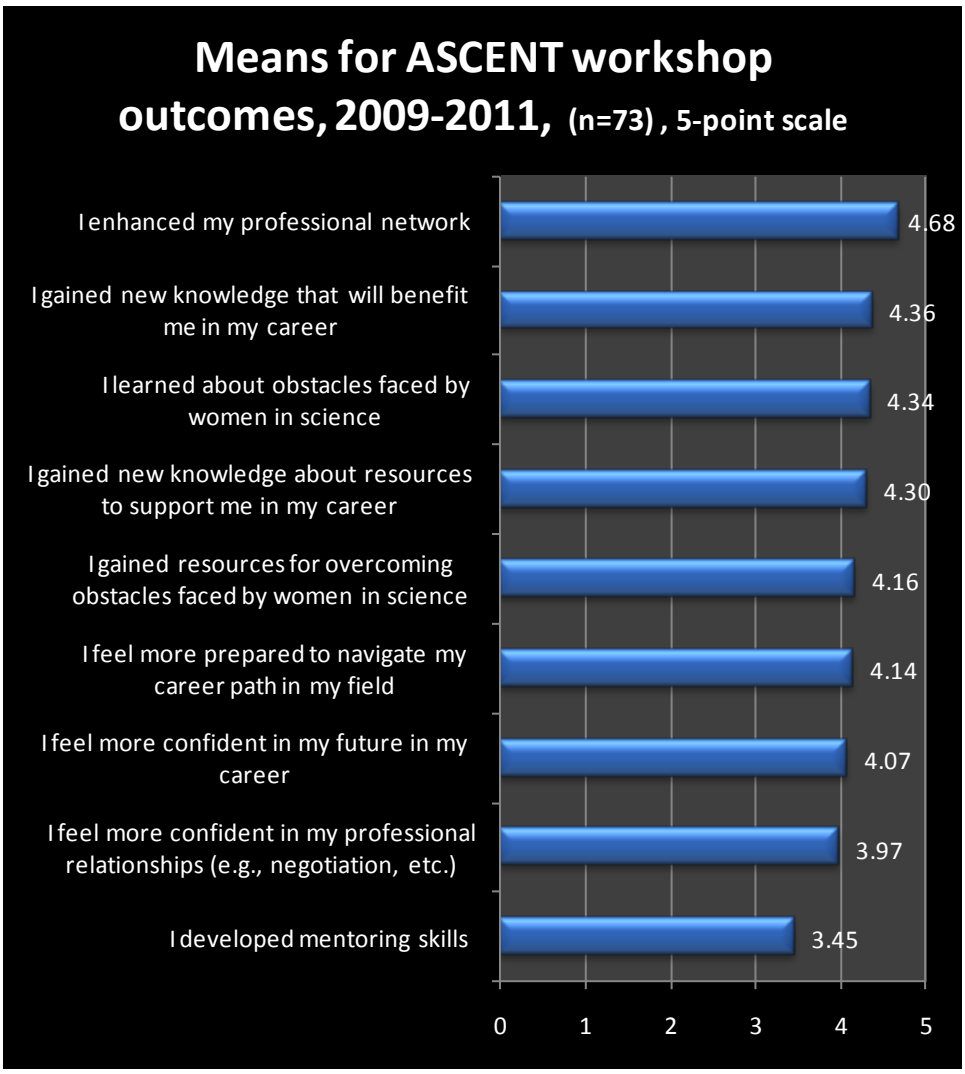

Fig. 3 Means for ASCENT workshop outcomes , 2009-2011

Comparison of gains between junior and senior scientists

Junior and senior women participated in ASCENT for different reasons given their career stage, and thus, it is not surprising that they displayed different gains from the workshop. Several of these differences were statistically significant. For instance, junior women were significantly more likely to have gained new knowledge about resources to support their career [$t(70)=2.22$, $p<.05$]. Senior women were significantly more likely to gain mentoring skills [$t(70)=-2.37$, $p<.05$].

However, other gains were similar for both junior and senior scientists. Both groups rated gains in "enhanced professional networks" equally, indicating that gains in networking were not dependent on career stage. Junior scientists valued the opportunity to meet potential research

partners and collaborators, while senior scientists appreciated the opportunity to meet and mentor younger women scientists.

Gains in collaborations and networking

The strongest outcome reported by all participants—both junior and senior scientists from all three workshops—was developing networks and professional collaborations. In fact, over all three workshops, 96% 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, the majority of 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).*

> *I met people - grad students, other junior scientists, academics, non academics, and senior scientists. I feel that I could "run into them" at a meeting in the future and feel comfortable. One of the senior scientists actually sought me out to ask about some of my data! We will now most likely collaborate by using my data to help interpret hers. That is a wonderful (unexpected) concrete result of this meeting.*

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.

> *I have met and talked to many women who are at a similar point in their life / career and I learned a lot about from how they deal with the demands from their employing university. It was very motivating to meet all the successful senior scientist and learn of the different pathways that brought them to where they are now and about obstacles on the way and how these were overcome. I think that I take away from this workshop not*

> *some very specific instructions of how certain problems should be addressed, but rather a general certitude that I am not alone and that it can be solved even if it is not easy.*
>
> *I have met some amazing women here who I hope will become life-long friends, colleagues, and collaborators.*

In sum, the networks created at ASCENT were both professional and personally benefits to the women scientists.

> *I plan to write a proposal very soon, and have gotten a jump start here at the workshop. I also feel I have a new pool of support and will turn to it for professional and / or personal help when it will be needed (e.g. for a proposal review or for an encouragement when I will feel I need it).*

Nevertheless, 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 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. In all, 91% of junior scientists and 88% of senior scientists agreed or strongly agreed that "I gained new knowledge that will benefit me in my career." As mentioned previously, junior scientists were more likely to agree that they gained resources to support their career.

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 important for junior scientists, yet senior scientists also learned from their experiences at ASCENT. Indeed, 91% of all junior scientists agreed or strongly agreed that they "learned about obstacles faced by women in science," yet 94% of all senior scientists also agreed or strongly agreed with that statement.

Personal gains

Women also reported that they gained personally from their participation in ASCENT, including increased confidence and a sense of support. Nearly all ASCENT participants from the three cohorts (82%) agreed or strongly agreed that "I feel more confident about my future in my career." And 86% of all ASCENT participants agreed or strongly agreed that "I feel more prepared to navigate my career path." These gains were almost as common among senior scientists as they were junior scientists, indicating that even senior women benefited from the networking and career reflection offered at ASCENT.

> *I have learned about the career paths of others and have gained more confidence in creating my own path.*
>
> *I learned lots of useful information, learned about experiences of other women in atmospheric sciences. It was great to meet women occupying such a variety of positions in the field, it made me reflect on possible life and career choices.*

Additionally, the quote below is another example of the dual scientific and personal benefits described by ASCENT participants:

> *I gained scientific knowledge that I plan to use to better inform my research. The knowledge of many different career paths helps bolster my determination.*

Although most junior scientists gained general confidence about their abilities to navigate their career paths, they were slightly less likely to report gains in confidence about their professional relationships, particularly pertaining to specific skills, such as negotiation. For example, 74% of all ASCENT participants agreed or strongly agreed that they "feel more confident in their professional relationships (e.g. ability to negotiate, collaborate, etc.). Junior and senior scientists reported similar gains in their confidence about their 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. In all, 82% of ASCENT participants reported that they plan to collaborate professionally with a colleague that they met at ASCENT. The few scientists who did not anticipate collaborating professionally were often unable to find research collaborators in their particular sub-field.

In a follow-up, open-ended question, the majority of ASCENT scientists, particularly junior scientists, also commented that they will use the networks that they gained from ASCENT for research collaborations, grant writing, mentoring, support, and advice. Women anticipated that they would seek both professional and personal advice from other participants.

> *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.*

> *Many of the junior scientists have or are considering having children, and I was particularly interested to hear the range of opinions and choices on balancing work and family, and the results of those choices. It is always good to hear from people who have been "on the front line" in that regard.*

The mentor-mentee relationship, in particular, offered junior scientists the opportunity to gain advice and career support from a more advanced colleague in their field.

> *I am going to send my faculty position application materials to my mentor. I am really excited to have someone to help me with this next step. My mentor has so much to offer. I feel very lucky to have been connected with her as a mentor.*

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

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

Many women had specific ideas and plans for collaboration or follow-up conversations based on interactions at ASCENT.

> *I hope to follow up with at least 3 interactions/conversations I had during my poster session. These include some comments made on my current work, a potential new idea in collaboration with someone I met at ASCENT and also some interest I had from a person that is dealing with a topic outside my field but potentially applicable.*

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 will definitely read some of the books that were suggested. Follow up with some of the junior and senior scientists I met (follow up for different reasons...collaboration, career mentoring, personal mentoring). Use some of the tips/tools for myself and hopefully in mentoring others.*

Sharing the ideas and networks gained at ASCENT with colleagues

One-hundred percent of all 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 comments from participants illustrate many of the 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.*

> *I want to share the "women facing challenges" information with my colleagues. Particularly, we are trying to address female student retention and faculty maternity leave policies. Some of the professional connections may also be of use to my colleagues, so I will share the information that I have gained I will also HIGHLY recommend this workshop to any women in atmospheric science.*

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 workshop 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 vast 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. The ASCENT workshop 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.

References

Anders, S.M. (2004). Why the Academic Pipeline Leaks: Fewer Men than Women Perceive Barriers to Becoming Professors. *Sex Roles*, *9/10*(51), 511-521.

Corley, E.A. (2005). How do Career Strategies, Gender, and Work Environment Affect Faculty Productivity Levels in University-Based Science Centers?, *Review of Policy Research*. *22*(5), 637-655.

Etzkowitz, H., Kemelgor, C. & Uzzi, B. (2000). *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge, UK: Cambridge University Press.

Harper, E.P., Baldwin, R.G., Gansneder, B.G., & Chronister, J.L. (2001). Full-time Women Faculty Off the Tenure-Track: Profile and Practice. *The Review of Higher Education*. 24(3), 237-257.

Holmes, M.A., O'Connell, S., Frey, C., & Ongley, L.K. (2003). Academic Specialties in U.S. are Shifting; Hiring of Women Geoscientists is Stagnating. *EOS*, 84(43), 460-461.

Jacobs, J.A. & Winslow, S.E. (2004). Overworked Faculty: Job Stresses and Family Demands. *Annals AAPSS*, *596*, 104-129.

Macfarlane, A., & Luzzadder-Beach, S. (1998). Achieving Equity between Women and Men in the Geosciences. *GSA Bulletin, 110(*12), 1590–1614.

Marschke, R., Laursen, S., Nielsen, J.M., & Rankin, P. (2007). Demographic Inertia Revisited: An Immodest Proposal to Achieve Equitable Gender Representation among Faculty in Higher Education. *The Journal of Higher Education*, *78*(1), 1-26.

Mason, M.A. & Goulden, M. (2004). Marriage and Baby Blues: Redefining Gender Equity in the Equity in the Academy. *Annals AAPSS*, *596*, 86-103.

National Research Council (2006). *To Recruit and Advance Women Students and Faculty in Science and Engineering.* Washington, D.C.: National Academies Press.

NSF; National Science Foundation (2006). *Science and Engineering Indicators 2006* (NSB 06-01). National Science Board. Arlington, VA: Author.

Park, S.M. (1996). Research, Teaching, and Service: Why Shouldn't Women's Work Count?, *The Journal of Higher Education*, *67*(1). 46-84.

Riger, S., Stokes, J., Raja, S. & Sullivan, M. (1997). Measuring Perceptions of the Work Environment for Women Faculty. *The Review of Higher Education*. *21*(1), 63-78.

Rosser, S.V. (2004). Using POWRE to ADVANCE: Institutional Barriers Identified by Women Scientists and Engineers., *NWSA Journal*, *16(*1), 50-78.

Seager, J. (2000). "And a Charming Wife": Gender, Marriage, and Manhood in the Job Search Process. *Professional Geographer*, *52*(4), 709-721.

Solem, S.M. & Foote, K.E. (2004). Concerns, Attitudes, and Abilities of Early-Career Geography Faculty, *Annals of the Association of American Geographers*, *94*(4), 889-912.

Thiry, H**.** (2010). *Long-Term Outcomes of the ASCENT workshop: Results from a Longitudinal Survey of 2009 ASCENT Participants*. Report to ASCENT. Boulder, CO: University of Colorado at Boulder, Ethnography & Evaluation Research.

Thiry, H. (2011). Long-term outcomes of the Atmospheric Science Collaborations and Enriching NeTworks (ASCENT) workshop: Comparison of results from longitudinal surveys of 2009 and 2010 ASCENT participants. Boulder, CO: University of Colorado at Boulder, Ethnography & Evaluation Research.

Valian, V. (1999). *Why So Slow? The Advancement of Women*. Cambridge, MA: The MIT Press.

Winkler, J.A. (2000). Faculty Reappointment, Tenure, and Promotion: Barriers for Women. *Professional Geographer*. *52*(4). 737-750.

Winkler, J.A., D. Tucker, & A. K. Smith, (1996) Salaries and Advancement of Women Faculty in Atmospheric Science: Some Reasons for Concern. *Bulletin of the American Meteorological Society*, *77*(3), 473–490.