

# Supporting the Retention and Advancement of Women in the Atmospheric Sciences

## What Women Are Saying

BY LINNEA M. AVALLONE, A. GANNET HALLAR, HEATHER THIRY, AND LAURA M. EDWARDS

There is substantial evidence that women, as a group, continue to be underrepresented in senior academic ranks (e.g., full professor, dean) within the science, technology, engineering, and mathematics (STEM) research fields. In part, this is because women faculty tend to be younger than their male counterparts, a situation resulting from the recent increase in the number of women science and engineering graduates. However, as summarized in a 2003 National Science Foundation (NSF) report, many studies report that even after controlling for this and other factors affecting promotions, women are less likely to appear in senior academic ranks. Underrepresentation of women in faculty ranks is especially noticeable within geosciences, where they constituted only 16% of overall faculty in 2005–06. At the same time, about 41% of the graduate students in these fields were female.

Despite growth in both the number and percentage of women entering the field, women in atmospheric sciences<sup>1</sup> are among the most underrepresented in tenure-track positions. In a 2004 study, O'Connell and Holmes report that, based on self-reported specialties within the geosciences, atmospheric sciences

<sup>1</sup> We use the term “atmospheric sciences” broadly, to include meteorology and related disciplines, as well as departments housing atmospheric sciences along with oceanography, Earth science, etc.

and meteorology ranked last in the percentage of females in tenure-track positions at Ph.D.-granting institutions. The recent National Research Council report on research-based doctorate-granting institutions gives the mean percentage of female faculty in these departments as 15.1%, with a range of 0%–50% and a standard deviation of 8%.

In their book *The Outer Circle*, Zuckerman, Cole, and Bruer note that the advancement of women scientists is limited by a complex set of factors, including lack of women mentors and role models, lack of critical mass, and isolation from collegial networks. Moreover, many women faculty members cited feelings of isolation as a major reason for their departure from academia (as described by Etzkowitz et al. in a 1994 *Science* article). Academic isolation includes exclusion from access to informal sources of professional information that are, in Etzkowitz's words, “indispensable to professional development, career advancement and the scientific process.” One contributing cause of challenges facing academic women is an historically male-oriented departmental culture, which can lead to isolation and discrimination, limiting the potential for research collaborations with other women scientists.

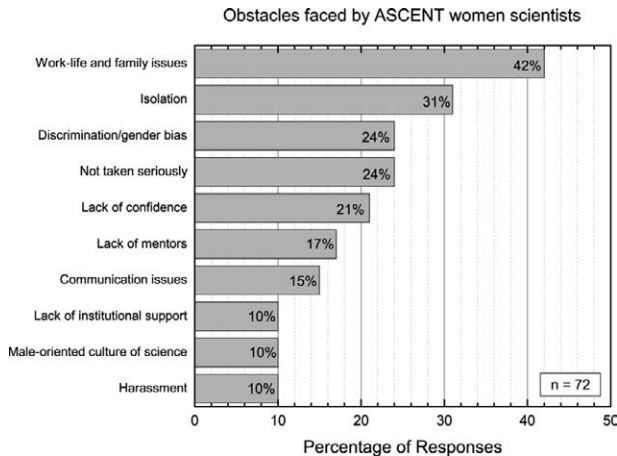
In view of the situation facing women in the sciences and the remarkably low numbers of women in atmospheric science faculty positions, we sought to

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**FIG. 1. Self-reported challenges faced by early-career and senior women attending ASCENT workshops.**

help address barriers to retention and advancement. With support from the NSF ADVANCE<sup>2</sup> program and based on the idea that women role models can have significant influence on younger women, particularly as they make career choices, we created a series of networking opportunities for female atmospheric sciences faculty, as well as postdoctoral researchers, at different stages in their careers.

The Atmospheric Sciences Collaborations and Enriching Networks (ASCENT) program comprised three annual workshops (in summers of 2009, 2010, and 2011), followed by reunion events at the subsequent fall American Geophysical Union (AGU) meetings and at the annual American Association of Aerosol Research (AAAR) conferences in 2010 and 2011. Each workshop was attended by about 20 early-career female atmospheric scientists selected by the organizers from applications solicited each year via listservs, announcements to departments, and advertisements in *EOS* and *BAMS*. About 10 senior scientists drawn from academe, government laboratories, and federal funding agencies were recruited each year by the organizers. The workshops consisted of both formal and informal activities to promote networking among the participants, plus breakout sessions to discuss issues related to career progression and to provide training on important career skills. Each early-career woman was paired with a senior woman as a mentor; these relationships have continued over time via e-mail, telephone, a semian-

nual newsletter, and meetings at conference reunion events. At the time of a survey conducted six months after each workshop, nearly 90% of participants had maintained contact with at least one other attendee. Additionally, 21% of participants have collaborated on a research project since the summer workshops, and 8% have written research proposals together. Since there are around 30–35 Ph.D.'s awarded to women in atmospheric science annually, the workshops have reached a substantial fraction (about two-thirds) of current early-career scientists in this field.

The evaluation study of ASCENT was designed to gather information on the short- and long-term outcomes for workshop participants, as well as on the barriers that these women have faced in their careers and the impact of the workshops on their perceptions of those barriers. The study also assessed the resources and knowledge that participants gained from the workshops to advance their careers. Data were obtained through the use of in-depth focus group interviews at each workshop and two survey instruments; a post-workshop survey was administered on the final day of each workshop, and a follow-up survey was e-mailed to participants six months after their attendance at ASCENT.

In Fig. 1, we present an analysis of self-reported obstacles gleaned from surveys of ASCENT attendees to illustrate the challenges facing both early-career and senior female atmospheric scientists. By far, the most-reported challenge among ASCENT participants is so-called work–life balance, which was cited by more than 40% of the respondents in an open-ended survey question. Nearly one-third of the participants reported feeling isolated, while about one-quarter had experienced discrimination or gender bias, or felt they were not taken seriously by colleagues.

Work–life balance—finding time to manage the demands of a career while also maintaining a healthy lifestyle, caring for family members, keeping up a home—and family issues were significant challenges for many ASCENT participants, including both early-career and senior scientists. Although work–life balance can be a concern for both genders, research published by Schiebinger and Gilmartin in 2012 shows that professional women still shoulder more of the nonwork burden than men. Couples who want an egalitarian relationship need to engage in advance planning to allow for two working parents with equitable household and child-rearing responsibilities. This involves negotiation and understanding that neither party will always get what they want. Identification and recognition of

<sup>2</sup> ADVANCE is a National Science Foundation program titled “Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers.”

methods to address the balance between family and work can assist early-career scientists in getting a foothold on these issues before they become problematic.

A lack of resolution of work–life balance issues could have serious consequences; in focus groups, a few early-career scientists noted that a lack of support for addressing these problems in the workplace had made them less committed to a scientific career. Other women struggled with the perception that they were less serious scientists because they had children or cared for aging parents. A survey response that typified this concern was:

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.

Above, we identified isolation as a reason that women leave their positions. In the 2006 NRC report on the recruitment and advancement of women, many female faculty stated that being the only woman or one of a few women in a department led to feelings of isolation. The report suggests combating this by strengthening mentoring and providing opportunities for faculty to discuss publicly difficult issues such as these. In addition, the 2008 work of Holmes et al. suggests that women need to comprise at least 15%–30% of an organization to start having an impact on that organization's culture, policy, and agenda. However, the career rank and composition of the women faculty are as important as their proportion within the department. Even when combining all ranks, women still represent a small fraction of the faculty of the 26 atmospheric science departments identified in the 2010 NRC statistics, with 14 at or below the 15% mark, and all but one below 25%.

Providing opportunities to develop professional networks is also a valuable means to combat isolation and to improve career prospects. Bozeman and Lee's 2005 study of 1,370 random samples from university professors and researchers who are affiliated with NSF and Department of Energy centers in U.S. universities showed conclusive evidence that the number of collaborators remains the strongest predictor of productivity, as measured by publication rate. In fact, more collaboration outside of one's own work group (e.g., persons in other universities or other nations) is associated with being male, being a tenured faculty member,

and an increase in total number of publications.

Participating in ASCENT reduced the sense of isolation felt by some attendees and empowered them to face challenges in their workplaces. While 31% of ASCENT attendees experienced isolation at the time of the workshop, only 15% reported feeling isolated six months after the workshop. Early-career scientists found it helpful to see that senior women had successful careers, despite facing common challenges. For example, an early career scientist observed:

Hearing other women's experiences, both good and bad, helps me a great deal. Sometimes I feel that I am alone in the challenges I face. I found it very empowering and comforting during ASCENT to hear that other women scientists have faced challenges similar to me at one point or another.

Communication underlies several of the obstacles identified by ASCENT attendees. The book, *Women Don't Ask*, by Babcock and Laschever, makes clear that women are less inclined to bargain, negotiate, or simply ask for something that is important to them—perhaps as much as four times less likely than men. Effective communication is critical for women to advance and get fair and equal treatment from managers and supervisors. Moreover, because there is evidence that women are less assertive than men in negotiating, training in negotiation is helpful for female faculty. Research described in *Women Don't Ask* shows that effective practices—anticipating roadblocks, planning countermoves, and resisting conceding too much—can be learned to help reduce anxiety in the negotiation process.

While outright discrimination on the basis of gender is rare, and has been discredited by some researchers as an explanation for the underrepresentation of women in science, subtle biases are still prevalent and important, particularly with respect to attracting women to the STEM fields. For instance, nearly one-quarter of ASCENT participants reported experiencing or witnessing gender bias or discrimination at some point in their careers. Inclusive instruction of introductory courses, especially at the high-school and college levels, can be crucial in creating positive classroom experiences for female (and minority) students. Focus groups conducted with geoscientists revealed that nearly 40% were attracted to their field by randomly taking an introductory course ([www.oawg.org/gendereq.htm](http://www.oawg.org/gendereq.htm)). Instructors of these courses may be unwittingly excluding female students by

doing such things as calling on male students more frequently and interrupting, or allowing others to interrupt, female students in class, or by framing homework or test questions in ways that favor the experiences of males. Faculty who are aware of these types of deterring behaviors can actively work to change them and to be welcoming of female science students, both inside and outside their classrooms.

While Hartten and LeMone (in a 2010 *BAMS* article) report that there has been significant growth in the number of tenure-track female faculty in the atmospheric sciences and the geosciences in general since the 1990s, comparison of the percentage of women pursuing graduate degrees with the fraction of female faculty shows that women have not yet reached parity in academic positions. There is more work yet to do! ASCENT, which has completed its three-year series of workshops, tested an approach to addressing the gender gap by providing early-career (and senior) women opportunities to expand their professional networks, thereby combating feelings of isolation, and offering mentoring on other important issues, such as work–life balance and communication skills. The assessment data suggest that the ASCENT workshops were successful, so that they might serve as a model for future, similar efforts. We urge both individuals and institutions to address the factors affecting the advancement of women, as identified by women themselves, with resources about best practices that are available through the literature, from the ADVANCE program ([www.portal.advance.vt.edu](http://www.portal.advance.vt.edu)), from organizations such as American Women in Science (AWIS) and American Association of University Women (AAUW), and from professional societies such as the AGU and AMS.

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