BAMS Article

Commitment to Active Allyship Is Required to Address the Lack of Hispanic and Latinx Representation in the Earth and Atmospheric Sciences

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ABSTRACT: In 2021, people of Hispanic and Latinx origin made up 6% of the atmospheric and Earth sciences workforce of the United States, yet they represent 20% of the population. Motivated by this disparity in Hispanic and Latinx representation in the atmospheric and Earth science workforce, this manuscript documents the lack of representation through existing limited demographic data. The analysis presents a clear gap in participation by Hispanic and Latinx people in academic settings, with a widening gap through each education and career stage. Several factors and challenges impacting the representation disparity include the lack of funding for and collaboration with Hispanic-serving institutions, limited opportunities due to immigration status, and limited support for international research collaborations. We highlight the need for actionable steps to address the lack of representation and provide targeted recommendations to federal funding agencies, educational institutions, faculty, and potential employers. While we wait for systemic cultural change from our scientific institutions, grassroots initiatives like those proudly led by the AMS Committee for Hispanic and Latinx Advancement will emerge to address the needs of the Hispanic and Latinx scientific and broader community. We briefly highlight some of those achievements. Lasting cultural change can only happen if our leaders are *active* allies in the creation of a more diverse, equitable, and inclusive future. Alongside our active allies we will continue to champion for change in our weather, water, and climate enterprise.

KEYWORDS: Atmosphere; Social Science; Education; Community; Societal impacts

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The U.S. Census Bureau (2021) estimates that people with Hispanic or Latino[1] origins are one of the fastest-growing groups in the nation (e.g., Fig. 1), representing 18.7% of the 331.5 million U.S. population. However, 8% of the science, technology, engineering, and mathematics (STEM) workforce and only 6% of the nearly 10,900 people employed in the atmospheric and space sciences are Hispanic or Latino (Pew Research Center 2021). Workers in occupations within STEM are more likely to have higher salaries, lower unemployment rates, and other positive outcomes than their non-STEM counterparts (Okrent and Burke 2021). Unfortunately, analysis suggests that "most Hispanic and Latinos see scientific professions as potentially 'unwelcoming' to Latino people" (Pew Research Center 2022).

[1] The U.S. Census Bureau defines "Hispanic or Latino" as individuals of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture of origin regardless of race.

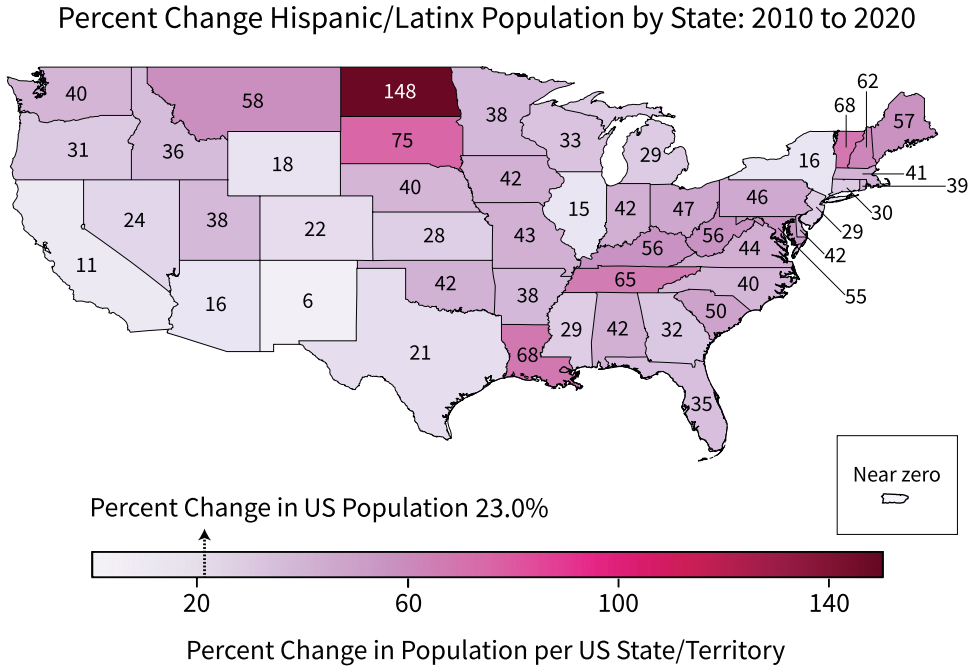

Fig. 1. Percent change of Hispanic and Latinx population for each of the lower 48 states and Puerto Rico between 2010 and 2020 (U.S. Census Bureau 2021).

Through a career in the Earth and atmospheric sciences, many of us (authors included) who identify as Hispanic and Latinx (a gender-neutral alternative for individuals of Latin American origin or descent) have had the privilege to receive a paid graduate education, provide for our families, support our communities, and increase our generational wealth. Although we have benefited from our career and education in science, they came at the price of our authenticity, sense of community, identity, and mental health (Morales et al. 2021). Additionally, the failure of our institutions by viewing us as monolithic groups rather than people of diverse cultural and language backgrounds contributes to inequities in terms of resources and opportunities (Tripati et al. 2023). There is a large cultural and dialect diversity within the Hispanic and Latinx community, for which there is a lack of acknowledgment or appreciation (Wildsmith et al. 2015).

Being the only Hispanic and Latinx students, graduate research assistants, postdocs, researchers, professors, or persons in our class, program, department, laboratory, field project, conference, or neighborhood often leads to feelings of isolation. This lower sense of belonging can result in higher risk of mental and physical health challenges (O'Brien et al. 2016; Muñoz and Villanueva 2019; Limas et al. 2022). A majority of Hispanic and Latinx people recently surveyed say "young Hispanic people would be at least a little more likely to pursue college degrees in STEM if the typical university had at least several Hispanic students in STEM degree programs" (Pew Research Center 2022). Given that Hispanic and Latinx first-generation college students are "especially likely" to view representation (e.g., "high-achieving Hispanic people") in STEM as a catalyst for greater engagement (Pew Research Center 2022), it is no surprise that many universities and research organizations developed programs designed to recruit and hire faculty and scientists from historically underrepresented groups. However, these recruitment initiatives often do not include successful retention strategies. Faculty hired through these types of programs tend to leave their positions at a higher rate than their counterparts (Gumpertz et al. 2017). STEM is the only field where Black and Latinx students are significantly more likely than their non-Hispanic White peers to switch majors to earn a degree in a non-STEM major (Riegle-Crumb et al. 2019). Hispanics and Latinx that earn degrees and work in STEM are significantly more likely than their non-Hispanic White counterparts to say they faced mistreatment (Pew Research Center 2022). In 2020, a survey of members of the American Meteorological Society (AMS) showed Hispanic and Latinx members are 2.8 times more likely to experience harassment or bullying at AMS-sponsored events (A. Piña et al. 2023, unpublished manuscript). This is unacceptable, and as a scientific community, we need to work toward creating systemic and lasting cultural changes (National Academies of Sciences, Engineering, and Medicine 2016).

Research shows that an individualistic culture dominates academic spaces in the United States, while Hispanic and Latinx culture are often characterized as collectivistic (Albert and Ha 2004; Stephens et al. 2012; Ortiz 2020; Morales et al. 2023). For first-generation students, like many of us entering Earth and atmospheric science degrees, a focus on independence increased the sense of difficulty in academic tasks and undermined performance (Stephens et al. 2012). Many Hispanic and Latinx core values include familialism, relationship building, collaboration, and community, which can often conflict with the demands and culture of academia (Tynan and Garbett 2007; Saldaña et al. 2013). For example, for as long as she can remember, the first author and her family annually visited relatives in Mexico. After declaring a major in atmospheric science, she felt the pressure and need to work through "winter break" preparing applications, proposals, attending scientific conferences, and catching up on research, thus leading to her not visiting family in Mexico for nearly a decade, i.e., until she completed her Ph.D. We frequently experience this cultural disparity when comparing our career goals, research interests, and service work to many of our non-Hispanic counterparts. This reflects the fact that our priorities and values are not represented in the majority

academic culture, leaving us feeling further isolated in programs instead of promoting the community/collaborative environment that would help us succeed. Hispanic and Latinx students have higher interests in the altruistic aspects of geoscience, i.e., using science to help people and the environment (Carter et al. 2021), and integrating social justice into their careers (McGee and Bentley 2017). However, most advertised careers value first-author publications and encourage competition between researchers for funding and ideas. Pushed into the margins, many Hispanics and Latinx are prompted to never join the field, forced to assimilate to the hyperindependent/competitive dominant academic culture, or leave the field in search of a career environment that aligns with their core values.

Furthermore, our motivation for increasing the representation of Hispanic and Latinx people in our weather, water, and climate enterprise is driven by the disproportionate extreme weather and climate change impacts felt by marginalized and vulnerable populations in the United States, which include Hispanic and Latinx people (Thomas et al. 2019). Increased representation of Hispanic and Latinx people in the Earth and atmospheric sciences could lead to improved communication of risks and impacts before, during, and after extreme weather events. For example, only recently were the significant inequities in understanding severe weather watches and warnings between English and Spanish language speakers highlighted in the community (Trujillo-Falcón et al. 2022). Many current Hispanic and Latinx atmospheric scientists, some of the authors included, recall the impact and influence of when meteorologist John Morales informed Spanish-speaking communities of the extreme risks and potential life-threatening situation during Hurricane Andrew (1992) in south Florida.

The following analysis serves to provide a baseline dataset for discussion and informed actional pathways to motivate the weather, water, and climate community to be part of the solution. In the second section, we identify the representation gaps at all levels of academia and examine the role of Hispanic-serving institutions (HSIs). We highlight data gaps, challenges, and limitations in our work. In the third section, we motivate interconnected and evidence-based approaches to create a pathway for systemic organizational change in our field and strategic recommendations for federal agencies, educational institutions, faculty, and potential employers. The fourth section introduces a change management plan to facilitate long-lasting change. In the fifth section, we introduce the efforts of the grassroots organization that became the AMS Committee for Hispanic and Latinx Advancement, and the sixth section concludes with final thoughts.

We preface by acknowledging that this small group of Hispanic and Latinx professionals do not and cannot have all the answers or perfect recommendations applicable to all institutions and situations. The National Academies of Sciences, Engineering, and Medicine (2016) concluded that addressing barriers to a representative STEM workforce, the U.S. undergraduate STEM education system will require a series of interconnected and evidence-based approaches to create systemic organizational change for success. The lack of Hispanic and Latinx representation is a systemic and pervasive problem, which took root long before any of us were born (e.g., exclusion of Black and Brown people from higher education, legal school segregation until the 1950s landmark Supreme Court case of *Brown v. Board of Education*); thus, thoughtful and inclusive solutions will also take time to create.

Existing data substantiates the gap in representation of Hispanic and Latinx graduates

To help our scientific community have these discussions on Hispanic and Latinx representation in Earth and atmospheric sciences, we need to know the number of Hispanic and Latinx graduates and their trends over time, and assess any additional demographic information to understand the current situation. Although we *are* the data and our lived experiences support the lack of representation, we want to provide statistics from publicly available data sources to further support the argument.

Data sources. Publicly available demographic data from postsecondary institutions are sourced from the Integrated Postsecondary Education Data System (IPEDS; U.S. Department of Education 2019, accessed 2021). We focused our analysis on 4-yr colleges and universities that offered degrees in the physical, Earth, and atmospheric sciences from 2009 to 2020, and partitioned the data by the provided gender, racial, and ethnic background categories. There are limitations associated with IPEDS data (Jaquette and Parra 2014), including the potential for a lack of reporting from some universities during particular years, but we note consistency across our chosen survey disciplines in the reporting of undergraduate and graduate completions. Since scientists that pursue careers in the Earth and atmospheric sciences include graduates with degrees in broader majors, such as physics and Earth science, we considered three categories of disciplines as organized by IPEDS (online supplementary Tables 1 and 2; https://doi.org/10.1175/BAMS-D-22-0075.2). The first group of disciplines is the broadest and called "physical sciences," which includes chemistry, physics, astronomy, and Earth sciences (see supplementary Table 1 for a complete list). A total of 452 physical sciences institutions were analyzed. We named the second group of disciplines "Earth and atmospheric sciences" (EAS), which includes hydrology, geochemistry, oceanography, and paleontology (supplementary Table 2 contains the complete list). A total of 268 EAS institutions were analyzed. Last, the "atmospheric sciences and meteorology" (ATM) discipline group is limited to degrees granted in ATM (supplementary Table 2). A total of 94 ATM institutions were analyzed. We note that all ATM disciplines are contained within the EAS listing, and all EAS disciplines are contained within the physical sciences disciplines, but we stratified disciplines in this way to not exclude degree granting institutions with broader fields of study from our analysis. The 2020 U.S. Census data (U.S. Census Bureau 2021) were also used to determine percentages of people of Hispanic and Latinx ethnicity in U.S. states and territories.

Institutions were further classified as HSIs (full list in supplementary Table 3; Laden 2004), emerging Hispanic institutions (EHIs; full list in supplementary Table 4; Gooden and Martin 2014), and University Corporation for Atmospheric Research (UCAR) member institutions (UCAR 2022). UCAR member institutions receive benefits that include priority for fellowship awards and attendance at annual meetings of UCAR members. The list of non-HSI/non-EHI are provided in supplemental Table 5. Carnegie classifications (Kosar and Scott 2018) for doctoral degree awarding institutions were also included, i.e., "very high research activity" (R1) and "high research activity" (R2).

Undergraduate degree completions. HSIs and EHIs are producing the highest number of Hispanic and Latinx bachelor's degree completions in EAS (supplementary Table 6). Only 5 of the top 30 ranked institutions in bachelor's degree completions were not classified as R1 or R2, e.g., University of Puerto Rico at Mayagüez (supplementary Table 6). A geographic comparison of the top-30-ranked institutions emphasizes the importance of location (Figs. 2a,b). For example, institutions with the most EAS bachelor's degrees awarded from 2009 to 2020 in the United States (regardless of demographic) are scattered across the country (Fig. 2a). In contrast, institutions with the most EAS bachelor's degrees awarded to Hispanic and Latinx students are more concentrated in certain regions, including California, Texas, the mid-Atlantic, and Puerto Rico (Fig. 2b).

Considering the ratio of EAS degree completions by Hispanic and Latinx students to EAS degree completions by all demographics, results show substantial disparity (supplementary Table 7); a high ranking in Hispanic/Latinx graduates may still be associated with severe underrepresentation in total degrees awarded. For example, while The Pennsylvania State University awarded 97 degrees to Hispanic and Latinx students from 2009 to 2020 (placing it ninth; supplementary Table 7), those degrees represented only 4.4% of all EAS bachelor's

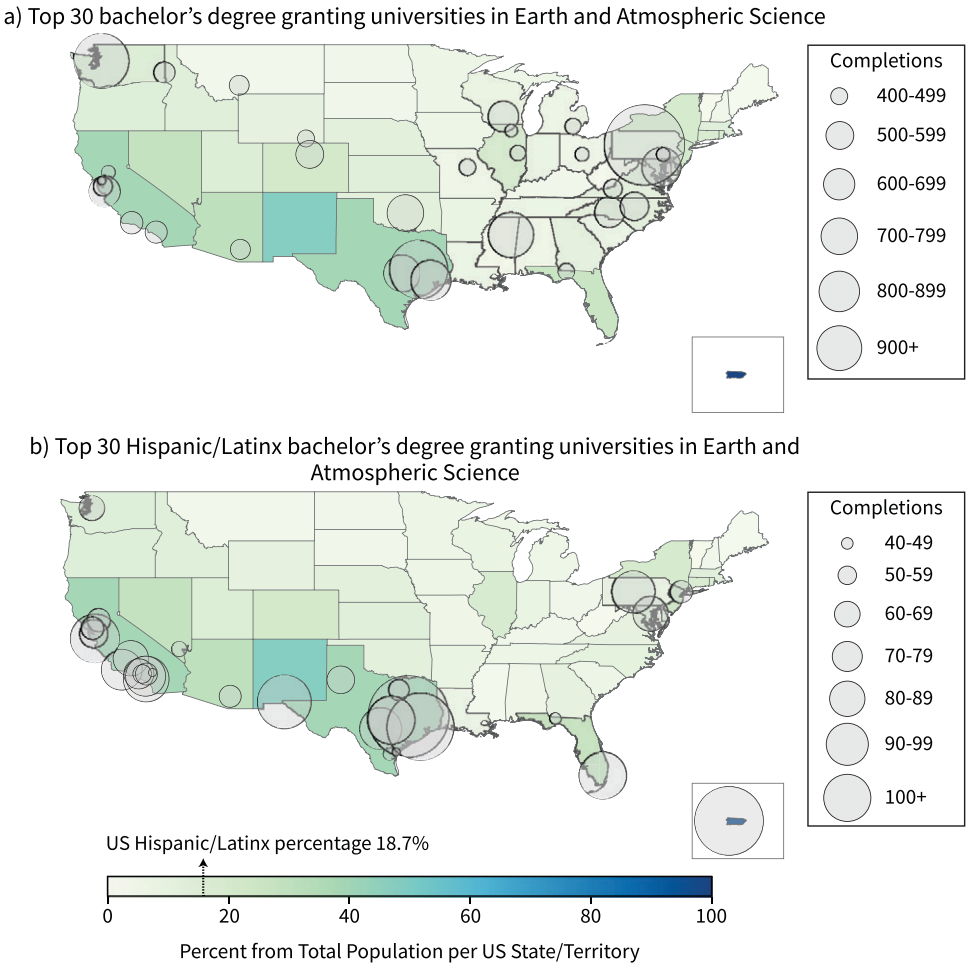

Fig. 2. Top 30 U.S. 4-yr colleges and universities ranked by total degree completions (2009–20) for bachelor's degree in EAS for (a) all demographics (grand total) and (b) only Hispanic and Latinx students. Shading represents the percentage of people of Hispanic and Latinx ethnicity from total population for each of the lower 48 states and Puerto Rico, with the national percentage denoted as well (as shown in the color bar). Circle markers indicate the approximate geographic location of each college or university, with the size of each marker representing the number of degree completions (as shown in the legend). The school rankings are also available in supplementary Table 7 [for (a)] and supplementary Table 6 [for (b)].

degrees at the university (supplementary Table 7), a percentage that is lower than the Hispanic and Latinx population of the state (7.8%; Fig. 2). In contrast, the University of Puerto Rico at Mayagüez reported 96.8% of all EAS bachelor's degrees completed by Hispanic and Latinx students, which is similar to the high Hispanic and Latinx population of Puerto Rico (98.1%; U.S. Census Bureau 2021). Other institutions with a similar or higher percentage of EAS bachelor's degrees completed by Hispanic and Latinx students relative to the Hispanic and Latinx population of their home state are University of Texas at El Paso, Florida International University, California State University–Los Angeles, and Texas A&M–Kingsville (supplemental Table 6).

Focusing on Hispanic and Latinx bachelor's degree completions only in atmospheric science, the previous top 30 institutions are replaced by new, previously unranked institutions (supplemental Table 8). For example, the University of the Incarnate Word now appears in the top 30 institutions (supplemental Table 8), but the University of Puerto Rico at Mayagüez is no longer ranked because they lack a bachelor's degree program in ATM; the meteorology program is instead housed within the physics department, which offers a meteorology curriculum sequence. However, Texas A&M University at College Station remained consistently

ranked first, with 60 Hispanic and Latinx bachelor's degree completions in ATM (2009–20; supplemental Table 8).

Of the top 30 institutions with the most ATM bachelor's degrees awarded to Hispanic and Latinx students, 20 of them were not HSIs or EHIs (supplemental Table 8). Results show that fewer institutions with ATM programs have large proportions of Hispanic and Latinx full-time undergraduate student enrollments (supplemental Tables 8 and 9), which may be explained by the fact that many EHI/HSIs do not offer ATM programs. Overall, only two of the top 30 ATM institutions awarded more than 20% of ATM degrees to Hispanic and Latinx students: University of the Incarnate Word and University of Illinois at Urbana–Champaign (supplemental Table 8). These percentages of ATM degrees awarded to Hispanic and Latinx students are greater than the Hispanic and Latinx populations of Texas (39%) and Illinois (18%), respectively (Fig. 3). Geographically, more top institutions, ranked by ATM bachelor's degree completions for *all* demographics, are located across the upper Midwest as compared to institutions ranked by Hispanic and Latinx ATM bachelor's degree completions, which have comparatively larger densities across California, south Florida, and Texas (Fig. 3b; similar to Chapa and De la Rosa 2006). However, there is more geographic diversity in the ATM programs top ranked by Hispanic and Latinx degree completions (Fig. 3b) as compared to EAS (Fig. 2b). This may be in part due to the smaller sample size of institutions that offer ATM (94) as compared to EAS (268) degrees.

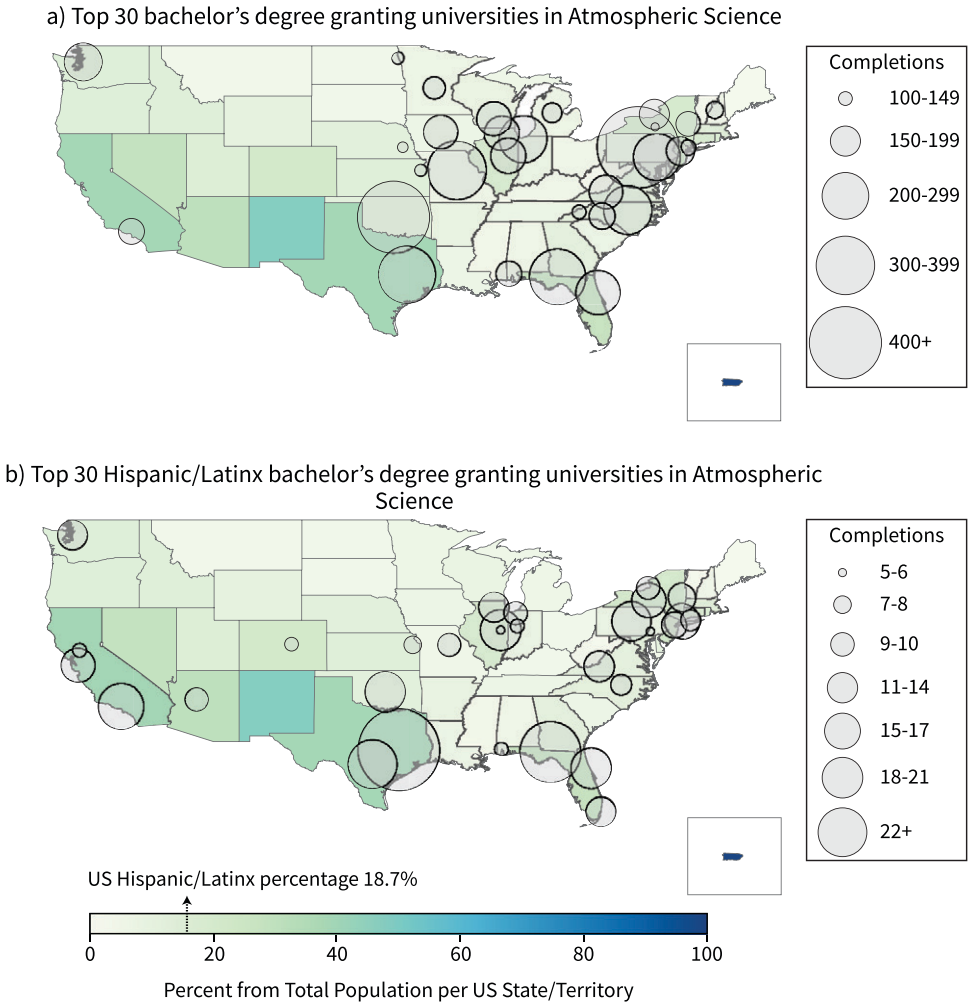

Fig. 3. As in Fig. 2, but for the top 30 U.S. 4-yr colleges and universities for bachelor's degrees in ATM (2009–20). The school rankings are also available in supplementary Table 9 [for (a)] and supplementary Table 8 [for (b)].

Graduate degree completions. The number of HSIs and EHIs that are top-ranked EAS graduate programs (based on Hispanic and Latinx degree completions) differ considerably from ATM graduate programs (Fig. 4). Ranking the top 10 institutions by Hispanic and Latinx master's degree completions in EAS reveals that eight are HSIs or EHIs (Fig. 4a). In contrast, only 4 of the top 10 institutions in ATM are HSIs or EHIs (Fig. 4b). Similar results exist for doctoral degree completions (Figs. 4c,d). Many of the top ranked schools for master's degrees in EAS are geographically based in California, Florida, Puerto Rico, and Texas. However, geographic location appears to be less of a factor for ATM master's degree completions. Several top-10-ranked schools for Hispanic and Latinx doctoral degree completions

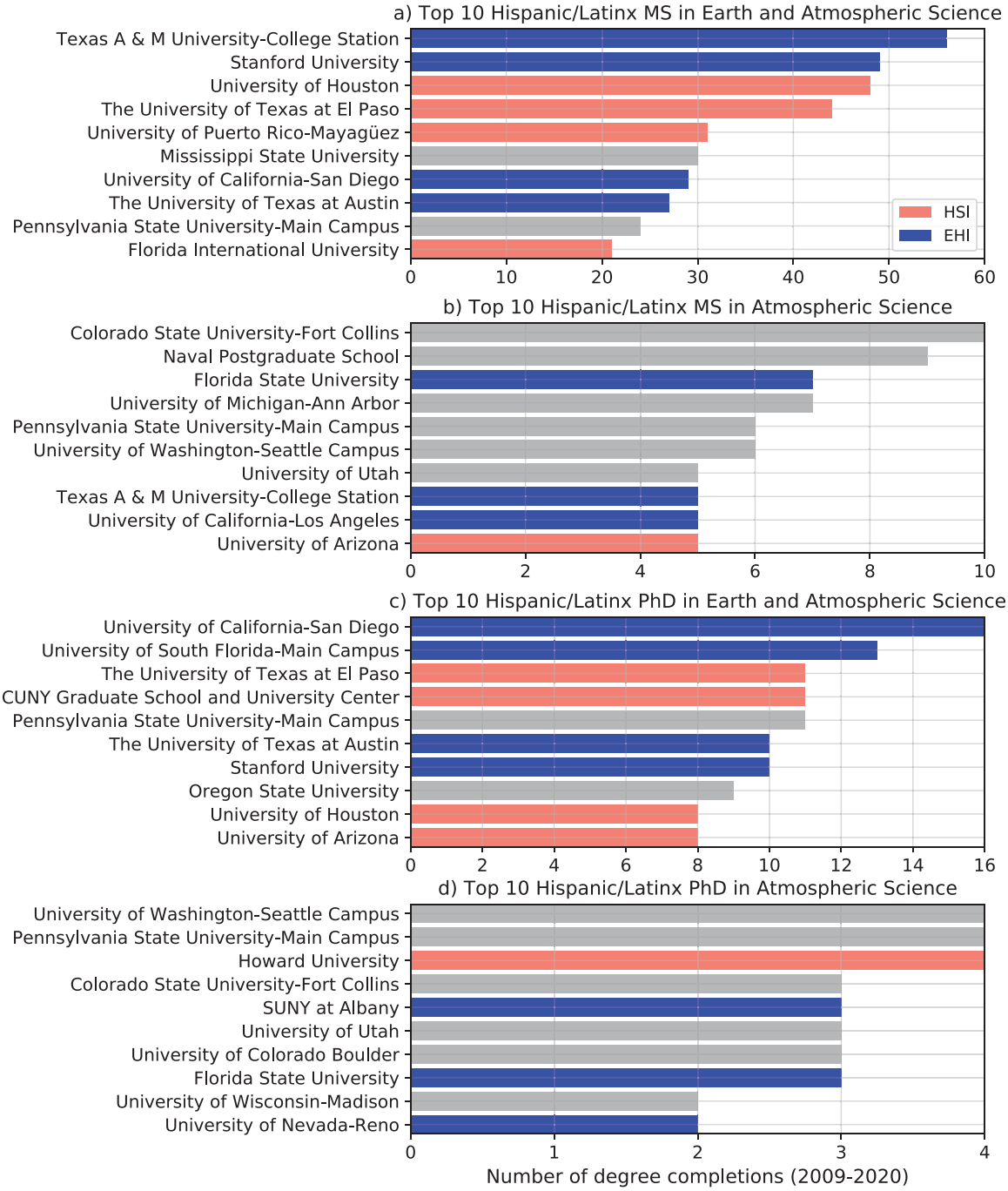

Fig. 4. Top 10 U.S. 4-yr colleges and universities ranked by Hispanic or Latinx degree completions (2009–20) for (a) master's degree in EAS, (b) master's degree in ATM, (c) doctoral degree in EAS, and (d) doctoral degree in ATM. The *x* axis shows the number of degrees awarded from 2009 to 2020 for each institution. Pink and blue bars represent schools considered HSI or EHI, respectively. Gray bars represent schools that are non-HSI/non-EHI.

in EAS and ATM (Figs. 4c,d) are in Texas, California, and Florida (U.S. Census Bureau 2021). We note that numerous other states appear on the list as well. Many listed graduate school programs are at R1 or R2 universities, which potentially enables the hiring and recruitment of Hispanic and Latinx students for funded research assistantships.

Data characteristics by discipline and over time. For the broadest discipline classification, "physical sciences" (supplementary Tables 6 and 7), 12.5% of all bachelor's degree completions are attained by Hispanic and Latinx students (Fig. 5a). This percentage is higher than EAS (10.4%; Fig. 5b) and closer to, but still below, the national average of the Hispanic and Latinx population (about 18%; U.S. Census Bureau 2021). The percentage of bachelor's degree completions by Hispanic and Latinx students reduces to 5.8% when considering only ATM (Fig. 5c). While the physical sciences, EAS, and ATM all exhibit a low percentage of graduate degree completions by Hispanic and Latinx students (for both master's degrees, Figs. 5d–f, and doctoral degrees, Figs. 5g–i), the percentage of graduate degree completions in ATM is consistently comparatively lower.

Analysis of Hispanic and Latinx EAS bachelor's degree completions at HSIs relative to all EAS degree completions at all institutions (to account for population increase) shows an increase of 5% during 2009–20 (Fig. 6a). Increases are also evident at EHIs and non-HSIs/EHIs,

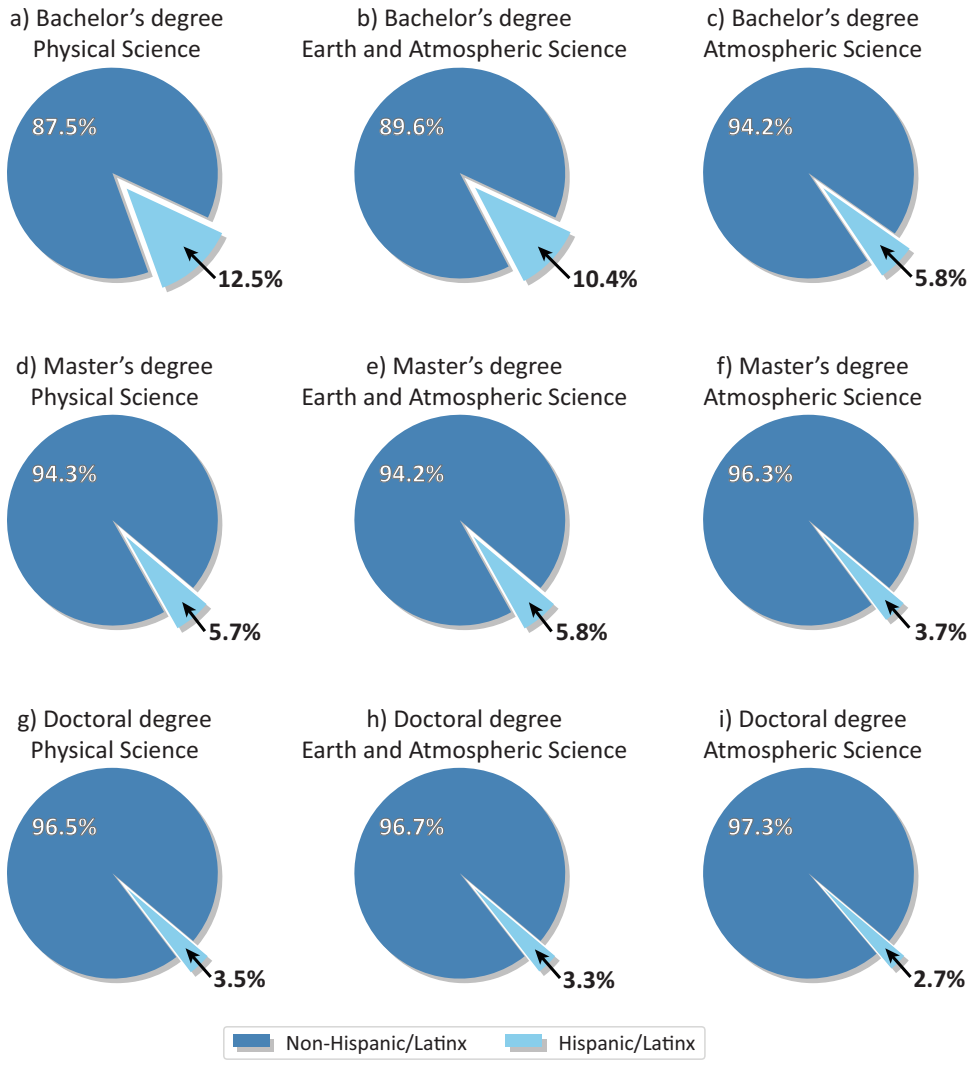

Fig. 5. Percentage of degree completions stratified by Latinx and Hispanic ethnicity at all U.S. 4-yr colleges and universities (2009–20). Degree completions shown for (a),(d),(g) physical science, (b),(e),(h) EAS, and (c),(f),(i) ATM. Latinx and Hispanic and Latinx degree completions as indicated in the legend.

but at a slower rate (Fig. 6a). Hispanic and Latinx master's degree completions in EAS relative to all degree completions are also greater at HSIs than EHIs and non-HSIs/EHIs (Fig. 6c). Year-to-year variation in the number of doctoral degrees awarded to Hispanic and Latinx graduate students in EAS is substantial, and as a result, trends in doctoral degree completions are more difficult to interpret (Fig. 6e). More annual variability is evident, likely due to the smaller number of Hispanic and Latinx master's degree completions in EAS. We note that normalization by all EAS degree completions in Fig. 6 may not fully account for population increase because many Hispanic/Latinx college-aged people may have not entered universities nor completed degrees at 4-yr institutions.

An analysis of total bachelor's degree completions in EAS stratified by gender shows an upward trend as well, with more Hispanic and Latinx men graduating on a yearly basis compared to Hispanic and Latinx women (Fig. 6b). The gender gap in degree completions is smaller for graduate degrees in EAS, with more Hispanic and Latinx women earning graduate degrees during some years (Figs. 6d,f). However, more variability is also observed on a yearly basis for graduate degrees, potentially due to the smaller sample size associated with Hispanic and Latinx master's and Ph.D. degree completions.

Discussion on data limitations. The results presented in this study show a clear gap in participation by Hispanic and Latinx people in EAS academic settings. However, we acknowledge that the statistics presented are limited. The only objective source of data used in this study is from the publicly available IPEDS website. These data only permit assessment of educational outcomes at the undergraduate and graduate levels, with additional categorical

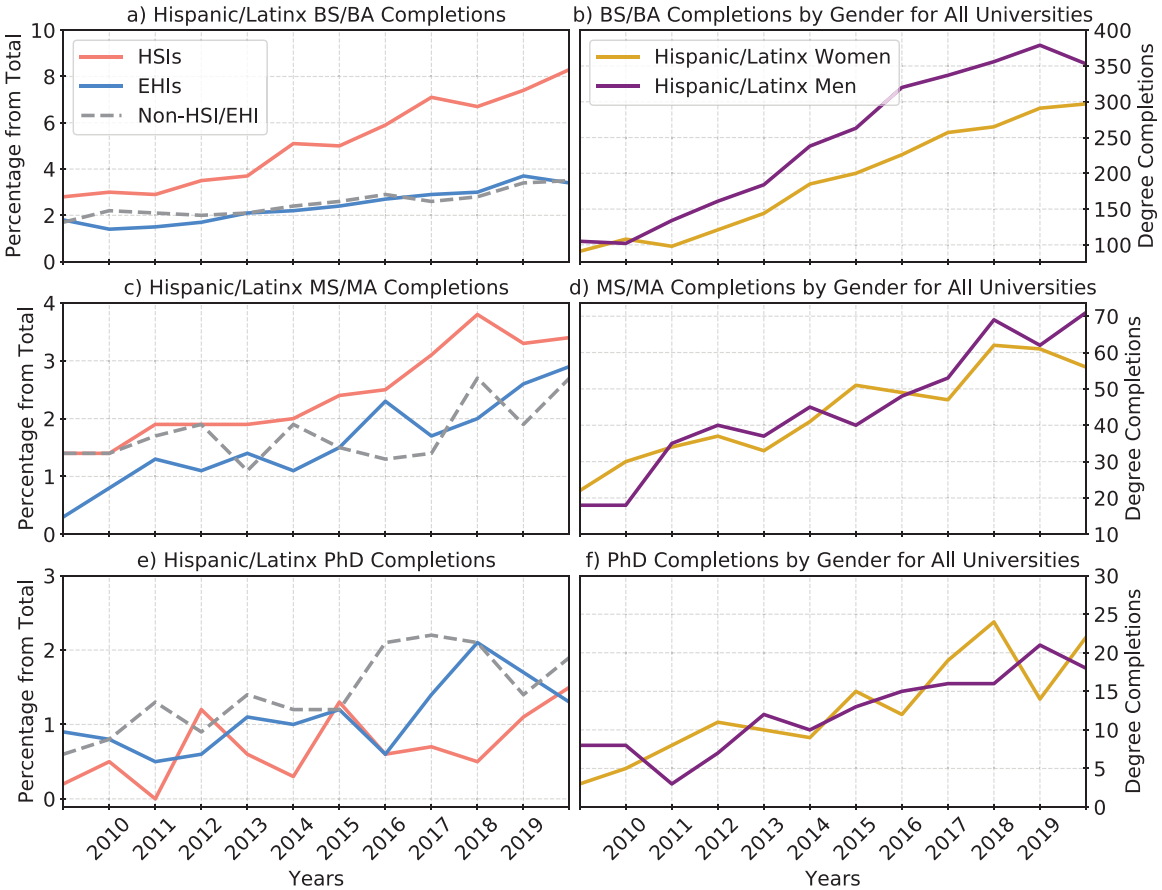

Fig. 6. Temporal trends for various EAS stratifications of data (2009–20). (left) The percentage of Hispanic and Latinx degree completions relative to all students stratified by HSI, EHI, and non-HSI/EHI institutions for (a) B.S./B.A., (c) M.S./M.A., and (e) Ph.D. degrees. (right) Hispanic and Latinx degree completions stratified by binary gender for (b) B.S./B.A., (d) M.S./M.A., and (f) Ph.D. degrees. ATM trends were omitted due to limited sample size when stratified by year.

parsing of institutions by level of research activity, HSI and EHI, and UCAR membership. We note that experiences and feelings of exclusion may differ depending on whether a Hispanic and Latinx student has lived in the United States since birth or childhood or if they came to the United States as an adult. However, currently available data do not permit delineation of these two groups of Hispanic and Latinx students.

At the undergraduate level, we show a clear geographic correlation between the highest Hispanic and Latinx populations and the institutions where Hispanic and Latinx students are receiving their degrees (Figs. 2 and 3). Nonetheless, this study cannot ascertain whether this is due to students preferring to be close to family or to limited economic resources (no financial aid and/or not being able to afford out-of-state tuition). With these limited data, we cannot address *why* Hispanic and Latinx students are choosing a wider geographic range of education institutions to pursue graduate school and if it is related to paid assistantships. At the postgraduate level, there is no publicly available information on whether Hispanic and Latinx doctoral graduates are continuing into STEM careers. Although the data do not currently exist, the career paths followed by graduate students after graduation should be accounted for. We advocate for the standardized collection of demographic data pertaining to postdoctoral researchers, laboratory scientists, private sector scientists, and STEM faculty (e.g., Bhattacharya et al. 2021) in order to understand the career paths of these highly skilled experts.

Personally addressing the lack of Hispanic and Latinx representation in academia. As current ATM graduate students, postdocs, and professors, we are concerned, yet not surprised by the low number of EAS and ATM degrees awarded to Hispanic and Latinx students. As some of the few Hispanic and Latinx people in our ATM departments and laboratories, we acutely experience the isolation within academia that is clearly depicted by these findings. Whether it is a recurring lack of connection to peers/colleagues or participating in diversity, equity, inclusion, and accessibility (DEIA) work, we are constantly reminded of our "otherness" within this field. Developing a sense of belonging has been the hardest, most time consuming, and most crucial part of continual participation in ATM. While we cannot be sure that proximity to family is the direct cause for many of the findings presented above, the authors do consider proximity to family, level of professional and personal understanding from potential mentors, and degree of isolation for any potential academic or career opportunities. ATM and EAS degree programs must account for these factors in order to successfully attract more Hispanic and Latinx students.

Actionable pathway and strategic recommendations

To provide equitable opportunities in education and careers to Hispanic and Latinx people, we need answers to the remaining unknowns. We must first understand the reasoning behind the lack of representation, and we cannot do so without sufficient data to realize the extent of the issue. For this, federal funding agencies, educational institutions, faculty and instructors, and potential employers need to contribute significantly to the funding of objective, detailed, and long-term surveying. It is due to the lack of dedicated funds that this study cannot pursue the objective surveying needed to better understand the needs of our community. Recent studies have shown that very few proposals related to marginalized groups are being funded (Odedina and Stern 2021; Chen et al. 2022).

In the face of limited objective data, the importance of subjective data (e.g., anecdotal, qualitative surveying) should be elevated and valued. As scientists, we often focus on the numbers; however, those quantitative data often leave out the lived experiences of the people behind those statistics. Anecdotal evidence can truly inform institutions on how they are failing marginalized students, beyond the lack of representation, and how to implement

successful support programs (Solorzano 1998; Malone and Barabino 2009; González 2006, 2007; Saldaña et al. 2013; Ramos and Yi 2020). This reality has motivated the authors to not only share the limited statistics addressing the issue, but also provide recommendations on how to move forward based on collective experiences and peer-reviewed research.

The following sections provide targeted actions and recommendations for federal funding agencies, educational institutions, faculty and instructors, and potential employers at research laboratories and operations centers to provide opportunity to the Hispanic and Latinx community.

Federal funding agencies. At the national level, it is important that federal agencies 1) provide data that paint a more nuanced and realistic demographic picture of our scientific enterprise, 2) further evaluate funding practices and educational programs, 3) expand funding for HSI programs, and 4) expand availability of grants to facilitate international collaborations.

Although IPEDS does provide data on instructional staff, these data lack stratification by research and educational focus, limiting our ability to assess temporal trends for EAS, ATM, or the physical sciences. As a result, we cannot make conclusions of hidden inequities that may exist in academic programs across the United States. It is of utmost importance that data also emphasize the career paths of EAS/ATM alumni (National Academies of Sciences, Engineering, and Medicine 2016) to better understand the loss of students as they proceed through educational programs, i.e., "leaky pipeline" (Seaton 2011), and the existing barriers acting to slow down or exclude certain groups of students, i.e., "hostile obstacle course" (Berhe et al. 2022) in STEM. Additionally, many surveys disseminated to undergraduate and graduate students and used to monitor the changing demographics in our STEM fields do not include options beyond the gender binary of male or female (DeHority et al. 2021; Freeman 2021). Federal funding agencies must therefore include more nuanced demographic questions in their future surveys to assess the true state of underrepresented groups in EAS/ATM (National Academies of Sciences, Engineering, and Medicine 2016). In this way, inequities could be properly quantified and more effectively addressed.

Agencies, such as NSF, NASA, and NOAA, have funded numerous initiatives and programs directed at bolstering the participation of marginalized identities in atmospheric and related sciences and should analyze statistics and outcomes of these targeted programs over time. Objective surveys could additionally gather data on the educational outcomes of these targeted programs at the undergraduate and graduate level directly from principal investigators (PIs). To be able to track whether efforts to increase representation are effective at creating meaningful and lasting change, federal funding agencies would need to contribute long-term investments to support demographic data collection, analysis, and management. Initiatives to bolster educational opportunities for marginalized students may not translate to them having an equal level of success in leading grant projects. There have been several recent studies exposing the disparity in proposal funding awarded to groups and PIs of marginalized origin (Ginther et al. 2011; Chen et al. 2022). Thus, it is also important to objectively examine the funding rates for PIs of Hispanic and Latinx origin, alongside other such marginalized groups.

Federal agencies need to expand their support for HSI schools across the country, as they are essential in expanding the diversity of our enterprise. Nineteen of the 30 U.S. universities that award the most EAS bachelor's degrees to Hispanic and Latinx students are HSIs (supplementary Table 6), and 75% of these HSIs are classified as R2 universities or have no classification (supplementary Table 6). The University of Puerto Rico at Mayagüez, for example, awards a high number of EAS degrees (supplementary Table 6), with most of their graduates continuing to graduate school or being hired into positions at NOAA/NWS, within news media/broadcasting, or as university faculty/staff

(M. I. Oyola-Merced et al. 2023, unpublished manuscript). HSIs are training excellent scientists and meteorologists while facing numerous challenges: (i) limited funding, (ii) incoming students inadequately prepared for college-level work and in need of remedial courses, (iii) student retention, and (iv) difficulty recruiting faculty that can meet the needs of the diverse student body (de los Santos and Cuamea 2010). During the COVID-19 pandemic, many HSIs lacked the infrastructure and capacity to quickly shift their programs online, further highlighting the need for federal funding agencies to invest in institutions serving Hispanic and Latinx communities (Kapoor 2020; Vargas Poppe et al. 2020). As the Hispanic and Latinx population of the United States increases, more institutions will likely become EHI/HSIs. We argue that being an EHI/HSI should be about more than just the proportion of enrolled Hispanic and Latinx students; current and emerging HSIs must also assess student experience and ensure they are truly serving their increasing Hispanic and Latinx student populations and appropriately taking care of their needs (Bohanon 2019).

General funding of science in other countries can vary depending on the change of political administrations. For example, political transitions in Brazil and Mexico within the previous 5 years have decimated internal scientific capacities of both countries (Guglielmi 2019; M. Rodrigues 2021; McKie 2021). Thus, it is common to see field campaigns in low-income countries like those in Latin America and the Caribbean to be led by U.S. academics and researchers and funded by federal agencies (Adame 2021), e.g., the North American Monsoon Experiment (NAME; Higgins and Gochis 2007), the Variability of American Monsoon Systems (VAMOS; Vera et al. 2006), and the Remote sensing of Electrification, Lightning, And Mesoscale/microscale Processes with Adaptive Ground Observations (RELAMPAGO; Nesbitt et al. 2021). Less commonly seen is U.S. federal funding agencies funding international research collaborations due to funding restrictions. Federal funding agencies can promote science equity and support the end of neocolonial research practices (Adame 2021), i.e., U.S. academics collect data from other countries without fostering local partnerships, through expanding the resources available to fund international research collaborations. Importantly, U.S. scientists must make efforts to immerse themselves in the culture and language to help build trust and long-lasting relationships (e.g., Rasmussen et al. 2021; Henny et al. 2022). The NSF Partnerships for International Research and Education (PIRE) is one of the few mechanisms available to conduct research with international collaborators and provide international educational experiences for students (NSF 2018). We recommend federal funding agencies make any existing grant opportunities that can facilitate international collaborations more widely accessible and visible and create new equitable funding opportunities.

Educational institutions. Universities and other educational institutions play a significant role in preparing and inspiring the next generation of Hispanic and Latinx students. In order for these institutions to better serve Hispanic and Latinx communities we recommend 1) understanding the needs of significantly disadvantaged Hispanic and Latinx populations, such as undocumented, temporary status, and international students and scientists, 2) fostering partnerships with community colleges, 3) supporting ATM programs at EHI/HSIs, 4) recruiting for and implementing undergraduate research opportunities, 5) incentivizing DEI, education, and outreach, and 6) increasing community engagement.

Our families represent important support systems for us. Finding an ATM program within reach of this support made it possible for some of us to survive during the first years of our graduate programs—a time when we felt most affected by the lack of community at our respective institutions. ATM and EAS programs that are geographically located far from support systems for Hispanic and Latinx students can address this need by cultivating a mutually beneficial and supportive environment for students and their advisors. We need to feel *radically* welcomed, seen, and heard. Given that we are often motivated by our potential impact on

something larger than ourselves, we need our personal and professional contributions to be taken seriously and contextualized by our motivation. Research and academic advisors must work to not only meet the emotional and academic needs of Hispanic and Latinx students, but propel them to thrive in a scholarly environment. This is critical for the advancement and retention of Hispanic and Latinx students in ATM and EAS fields.

Importantly, hidden communities must be considered and provided equitable experiences throughout their entire education. Within the Hispanic and Latinx community, certain groups do not have access to the same resources, opportunities, and experiences as others: namely, undocumented, temporary status, and international students. Undocumented students are ineligible for federal financial aid and most scholarships, including many STEM scholarships granted by government agencies and professional institutions. Within the atmospheric sciences, undocumented students are ineligible for career-defining internships that often encourage participation of Hispanic and Latinx students, e.g., the NOAA Hollings Scholarship and Educational Partnership Program with Minority Serving Institutions (EPP/MSI), Research Experiences for Undergraduates (REU), and Significant Opportunities in Atmospheric Research and Science (SOARS) programs. Access to scientific conferences is limited for undocumented students, unless the conference is in their hometown, college town, or virtual, as traveling long distances increases their risk of deportation. Contrary to common belief, no federal law prohibits the admission of undocumented[2] immigrants to U.S. educational institutions. However, as of January 2022, only 17 U.S. states embrace policies that explicitly mention undocumented students' access to higher education (NCSL 2021). Increasing opportunities for these significantly marginalized portions of the Hispanic and Latinx demographic can only result in increased participation in our enterprise and diversity of thought in scientific approaches.

Unlike undocumented immigrants, Deferred Action for Childhood Arrivals (DACA)[3] and Temporary Protected Status (TPS)[4] recipients have *temporary, nonpermanent* protection from deportation and are qualified to obtain U.S. work permits and driver's licenses. However, due to their unclear residency status, these students are also ineligible to receive federal financial aid, grants, and most scholarships in the United States, and are disqualified from applying to opportunities involving U.S. government agencies (e.g., NOAA, NSF). Opportunities, however, *do* exist through NOAA cooperative institutes, which only require a work permit. DACA and TPS recipients are required to reapply for their programs every few years, resulting in hundreds of dollars spent on application fees and costly legal support. With policies changing regularly, and recent measures to strike down both the DACA and TPS programs, these students live in a constant state of anxiety about whether their protections will be eliminated (Malgaña-Salgado 2018). Academic programs in EAS and ATM should be aware of undocumented, DACA, and TPS groups and have resources to help them be included and supported. Several guides have been developed to inform institutions and faculty in ways they can support undocumented, DACA, and TPS students throughout their education, such as Cook and Gaylord (2018) and TheDream.US (2021).

Our international counterparts from Latin America also face numerous barriers in their scientific advancement compared to scientists within the Global North (R. R. Rodrigues 2021). These barriers include less funding availability and limited access to resources vital for research, including high performance computing, IT support, and subscriptions to scientific journals or software (Carbon Brief Staff 2021; Valenzuela-Toro and Viglino 2021). To become a

[2] Undocumented is defined individuals born abroad who are not U.S. citizens or legal residents. Present day, there are 65,000 undocumented students in the United States according to College Board (2023).

[3] DACA is a program created by the Department of Homeland Security in 2012, aimed at deferring immigration action, such as deportation, for undocumented children that meet criteria. Since 2012, DACA has been granted to 832,881 people in the United States (AIC 2021a).

[4] TPS is a nonpermanent status provided to nationals of certain countries experiencing problems that make it difficult, unsafe, or life-threatening for their nationals to be deported back to those countries. Within Hispanic and Latinx community, this program has helped as of September 2021 El Salvador, Haiti, Honduras, Nicaragua, and Venezuela (AIC 2021b).

recognized leader and be actively involved within the community of atmospheric and related sciences, it is an unofficial prerequisite to read, write, and speak English. International scientists in Latin America may not have adequate access to English translation services for their manuscripts. The language barrier further adds difficulty when starting a research position or collaboration in the United States, as it takes time to express ideas in a nonnative language, which additionally deters active participation in professional meetings and conferences. Additionally, the Portuguese language and Brazilians are often left out from conversations on the needs of the Hispanic and Latinx community. Allyship with Latin American scientists includes acknowledgment and promotion of their scientific contributions by inviting them to speak at conferences or department seminars, offering visit opportunities at U.S. institutions, awarding committee memberships within professional societies, and organizing award nominations on their behalf. Any collaborations with Latin American countries should include partnerships at project inception and participation at a research capacity, i.e., more than just helping with field work or education and outreach events.

While our manuscript mainly reviewed the representation, resources, and composition of 4-yr academic programs, our scientific community must consider the impact that 2-yr institutions play in higher education, especially for underserved groups (Van Noy and Zeidenberg 2014). Community or 2-yr colleges have a substantially higher enrollment of Hispanic and Latinx students than 4-yr colleges or universities, which is not the case for any other demographic group (Chapa and De la Rosa 2006). Affordability of 4-yr colleges is a true burden, with 69% of Hispanic and Latinx students citing cost and 71% citing needing to work to support their family as a major or minor reason why they did not receive a bachelor's degree (Mora 2022). The high enrollment of Hispanic and Latinx students in 2-yr colleges, together with a high proportion of Latinx Ph.D.s who began their higher education in community colleges, suggests the need for 4-yr institutions to foster partnerships with community colleges. Recruitment programs and informational sessions should be oriented toward community college students, as these could have a large impact in increasing the amount of Hispanic and Latinx students in 4-yr programs. Additionally, we need to understand the relationship between 2-yr college Hispanic and Latinx students and those in ATM/EAS undergraduate or graduate programs. How do community colleges relate to low representation of Hispanic and Latinx students within ATM/EAS? How can universities and community colleges work together so that underserved groups, such as Hispanic and Latinx students, have valuable and appropriate resources when transitioning from one institution to another? How many community colleges offer EAS/ATM courses or degrees?

IPEDS results showed that EHI/HSIs are the institutions producing most of the Hispanic and Latinx EAS graduates (Fig. 4), yet most of the top ATM awarding institutions are not EHI/HSIs and not geographically located in areas with high populations of Hispanics and Latinx (Figs. 3 and 4). These observations suggest universities can establish or increase support and funding for ATM degree programs at EHI/HSIs to increase recruitment and representation within ATM.

A study by Russell et al. (2007) showed that the positive effects of undergraduate research opportunities (UROs) tended to be strongest among Hispanic and Latinx students, such as with their confidence in their research abilities, awareness of graduate school, and interest in a STEM career. Thus, we recommend providing paid research opportunities for Hispanic and Latinx college freshmen and sophomores. Smaller universities may not have the faculty or funding to host these UROs; thus, we suggest research-intensive universities collaborate with local community colleges and EHI/HSIs to help recruit Hispanic and Latinx students into UROs. Providing a group of mentors from diverse backgrounds (gender, race/ethnicity, or career level) who can "combine enthusiasm with interpersonal, organizational, and research skills" leads to positive student experiences and should be prioritized when implementing

URO programs (Russell et al. 2007). The UROs should be evaluated often and information on the participants' career path should be collected.

Many faculty are already aware, have the desire, and are actively working to improve DEIA within their institution, but receive no compensation nor credit for their efforts. Including community service, education and outreach, and DEIA efforts as part of tenure packages, position responsibilities and expectations, and annual assessments along with increased availability of funding for strategic initiatives can provide reinforcement to sustain cultural changes (Posselt 2016). Given the few Hispanic and Latinx people in senior roles, we need presidents, trustees, regents, deans, provosts, and department chairs to become active allies to change the current reward and incentive systems (Rosser 2009; Kezar et al. 2015; National Academies of Sciences, Engineering, and Medicine 2016; Griffin 2019). Only through changes in the systemic barriers and problems in our educational institutions can we create successful, long-lasting cultural change.

An additional challenge to recruitment is increasing interest in our field and awareness of careers in Earth and atmospheric science. Research has shown that early exposure to STEM is critical to spark a child's interest in STEM careers (e.g., Russell et al. 2007; Wang 2013; Chapman et al. 2020). Within the Hispanic and Latinx community in the United States, parents or other adult family members can influence the career choices of children (Chrispeels and Rivero 2001; Mitchell et al. 2008; Quiñones and Marquez Kiyama 2014; Davis and Maximilian 2017; Milner-Bolotin and Marotto 2018); thus, it stands to reason that engagement with Hispanic and Latinx adults could be an appropriate path for increasing awareness of STEM careers and their benefits to the community (Morales et al. 2023), undergraduate scholarships and funded graduate programs to reduce monetary burdens, and improved employment and income opportunities for their children. Bilingual informational sessions can be cohosted with community groups at community centers or colleges, where Hispanic and Latinx students and families can learn about EAS/ATM, careers available with an EAS/ATM degree and their salaries, available scholarships, and the altruistic reasons for pursuing these careers. The existence and persistence of Hispanics and Latinx in the Earth and atmospheric sciences can show students and families that this is a viable career and provide them with relatable role models from a community with which they can identify (e.g., Rodriguez and Blaney 2021; Crane et al. 2022).

Faculty and instructors. Faculty and instructors play an important role as agents for cultural change in academia (National Academies of Sciences, Engineering, and Medicine 2016). University faculty, instructors, and any staff directly interacting with students are recommended to 1) implement evidence-based guidelines on fostering an inclusive and safe learning environment and 2) demystify your hidden curriculum and embrace your role as a cultural navigator in academia.

An instructor's friendliness, helpfulness, and encouragement of class participation can contribute to a student's sense of belonging (Museus and Quaye 2009; Means and Pyne 2017). Undergraduate advisors have a strong influence on the science courses a student takes (Sherman-Morris and McNeal 2016). From personal experience, the first author would not have made it through that first year of physics and math courses without an incredibly supporting undergraduate advisor in the atmospheric science program who truly listened to their concerns and encouraged their curiosity and persistence. We highly recommend faculty, instructors, and staff review and implement the guidelines presented in the GEO REU handbook (Sloan and Haacker 2020), which covers topics such as creating engaging and inclusive recruitment and admissions (Posselt 2016), developing an antiracist program/laboratory (Chaudhary and Berhe 2020), mentoring models (Pandya et al. 2018), bystander intervention training, inclusivity and respect (Museus and Quaye 2009), sexual harassment prevention

(Fischer et al. 2021), and field safety (Demery and Pipkin 2021). Learning outcomes can also be influenced by cultural differences between faculty and students (Albert and Ha 2004). Dueñas and Gloria (2020) provide an insightful and useful discussion on how faculty, instructors, and advisors can "serve as cultural navigators" for Hispanic and Latinx students.

An additional hurdle to inclusivity in academia is the hidden curriculum, or the unspoken attitudes, knowledge, or behaviors learned from an academic or research setting (Villanueva et al. 2018). Some students may glean the information through interactions with faculty and advisors, but some may not have those relationships or may have advisors who assume or expect students to know these cultural norms. Many Hispanic and Latinx students entering EAS/ATM majors are first-generation college students and thus enter academia with little to no guidance on the unspoken rules or traditions of academia (Dueñas and Gloria 2020). To demystify the hidden curriculum, faculty and instructors must be introspective and mindful about their hidden curriculum and make that information explicit and accessible to all their students. On some of these occasions, it truly helps to speak from a perspective of curiosity and wanting to share information as opposed to needing to correct someone's behavior.

Prospective employers at research laboratories and operations centers. In addition to academic positions, Hispanic and Latinx EAS/ATM degree earners also pursue careers at research laboratories and operations centers. Prospective employers are recommended to 1) collect demographic data of their organization, 2) evaluate the workplace culture, 3) establish a mentorship program for early career employees, 4) understand the needs and unique challenges of foreign nationals, and 5) prioritize hiring of bilingual meteorologists.

Similar to instructional staff data from IPEDS, demographic data from research laboratories are difficult to assess due to their voluntary reporting nature and a lack of standardization across organizations. Although standardized demographic data are not publicly available for NOAA, NCAR, and NASA research laboratories, we know from our experiences working at these institutions that there is a severe lack of Hispanic and Latinx employees at the research level. Research laboratories and operations centers must survey and collect data on the Hispanic and Latinx representation in their staff and make the information publicly available, provided anonymity of participants is able to be preserved.

In addition to demographics, employers need to assess their workplace culture and determine if the present culture matches the needs and values of employees and the organization. Incoming employees tend to assess workplace culture through conversations with prior and current staff and asking colleagues about their experience working with the organization/laboratory/team (Flores 2022). Employers should make the effort to evaluate the workplace culture and identify any issues being experienced by staff. For example, does your laboratory have a high turnover culture? If so, why do employees not stay with the organization? Is there any pattern to which employees are departing? Focus groups could be interviewed through external evaluators to assess inclusivity with respect to numerous identities, e.g., gender, race, disability, age, foreign nationals, people caring for children or elderly family. Are employees having to spend more time dealing with workplace culture issues, leaving them with less time and energy to perform their job responsibilities? Additionally, employers should listen to employees when they identify barriers for effective execution of job requirements. Is there a data manager or data management plan in place? Is there sufficient administrative and technological support? Hall et al. (2023) provides detailed recommendations on inclusive policies and practices. They recommend organizations to introduce employees to the notion of inclusion, encourage employees to model inclusion, and sustain inclusive norms (Hall et al. 2023).

If the early career workforce can be retained into later career stages, there may be greater representation of Hispanic and Latinx researchers in senior positions in the future.

We recommend establishing a mentorship program for early career researchers to diminish the "sink or swim" culture and provide career and technical mentorship and sponsorship (Bastian 2019). Mentors participating in these programs should be trained in equitable mentoring practices (e.g., Griffin 2019; Almond et al. 2020).

Many postdoctoral fellows and early career professionals are classified as foreign nationals. International scientists of Hispanic and Latinx descent face considerable challenges including (i) the fact that many postdocs or assistant professor positions are primarily for (or biased in favor of) U.S. citizens, (ii) constant pressure to maintain or update immigration status, which can lead to stress if an emergency arises in their home country, and (iii) visa issues associated with field campaign participation. Employers should be mindful of these unique circumstances and have resources available to assist their international employees.

The 2020 AMS members survey showed that 30% of Hispanic and Latinx members are employed in academia and 33% are employed in broadcasting (A. Piña et al. 2023, unpublished manuscript). Being a bilingual meteorologist is vital for communication with vulnerable communities, yet NWS and other government meteorologists are often not compensated with added wage or benefits for their bilingual services. The lack of appropriate compensation for additional work is a critical issue within media broadcasting as well, in addition to the already poor pay broadcasters receive relative to their bachelor's degree counterparts employed in forecasting and research positions (Bureau of Labor Statistics 2022). Bilingual meteorologists in the United States have to produce weather translations that can correctly communicate a message across Spanish dialects (Trujillo-Falcón et al. 2021). Our colleagues have expressed to us that in the news media industry, there are fears that saying "no" could lead to termination; thus, bilingual on-air meteorologists struggle with work–life balance. We recommend the media industry, as well as NWS operations centers, prioritize hiring bilingual meteorologists to reduce staff shortages resulting in increased work demands on bilingual meteorologists, and provide adequate compensation for translation services outside of their position requirements.

Embracing and adapting to cultural changes

While we can provide an actionable pathway for higher education institutions, funding agencies, research laboratories, faculty and instructors, and potential employers to positively change the lack of Hispanic and Latinx representation, it is naive to implement a change and expect the desired change to occur without an adequate and sustained support structure. The ADKAR model of change management provides a structured outcome-based guide to facilitate the long-term change we envision, i.e., *A*wareness of need for change, *D*esire to participate and support the change, *K*nowledge on how to change, *A*bility to implement required skills and behaviors, and *R*einforcement to sustain change (Hiatt 2006).

Active allies must be aware and understand the need for change with respect to DEIA and workplace culture. Objectively identifying the presence of DEIA problems through well-funded surveys performed by external evaluators is the elemental first step to reaching awareness. All employees of the institution need to have the desire to participate and commitment to change their environment, understand the negative effects of not successfully implementing this change, and how the individual will benefit from this change. The institution must support their employees in gaining the new skills or abilities to implement the change, as well as opportunities to practice. Knowledge can come from training and workshops, but these will not be effective if the individuals do not have the awareness or desire to change. If your institution is truly dedicated to making a lasting change in DEIA, dedicated DEIA coordinators should be hired to provide an outside perspective. DEIA coordinators can be the connector

between leadership and staff on change reinforcement to avoid individuals reverting to the old ways and avoid having the responsibility and extra work landing on employees who are passionate and active in DEIA efforts.

The power of grassroots initiatives

While we await systemic changes at the institutional level, our small and tightly knit community has organized to address the needs of the Hispanic and Latinx scientific community through the AMS Committee for Hispanic and Latinx Advancement (CHALA; Trujillo-Falcón et al. 2021). CHALA comprises scientific professionals representing academia, broadcast and communications, government agencies, and the private sector. Our mission is to (i) foster community, (ii) improve resources for multilingual scientists and the Hispanic and Latinx community, (iii) establish a joint network across sectors within the United States, Spain, and Latin America, and (iv) translate AMS documents into languages that serve the Hispanic and Latinx community. Our ambassadors are highly motivated and supportive of each other. We encourage other identity groups to coordinate and champion their communities as well. Below we proudly share highlights of our accomplishments since 2019:

- To engage the broader community in partnering with Spanish-speaking countries on research and operational efforts, CHALA academia ambassadors hosted an AMS webinar with a diverse group of panelists (Morales and Barrett 2021).
- Acknowledging the need for networking and career advice, CHALA student ambassadors hosted a panel connecting students with Hispanic and Latinx professionals in the weather, water, and climate enterprise. For some students this was their first time interacting with Hispanic and Latinx scientists and scholars.
- Advocacy for consistent Spanish translations of scientific terminology led to the inclusion of Spanish-language weather and climate dictionaries on the AMS Glossary home page (https://glossary.ametsoc.org/wiki/Welcome; Trujillo-Falcón et al. 2021) and the translation of AMS certification exams into Spanish.
- After learning that Hispanic and Latinx communities were disproportionately affected by lightning, CHALA in collaboration with the National Lightning Safety Council debuted a national lightning safety campaign in Spanish (Yas et al. 2021). These efforts were recognized by the World Meteorological Organization.

Conclusions

Our analysis shows that participation by Hispanic and Latinx people in the Earth and atmospheric sciences is limited as compared to the non-Hispanic White population. Hispanic and Latinx students are primarily obtaining bachelor's degrees in EAS from HSI and EHI institutions, and from institutions that are geographically proximal to states with larger Hispanic and Latinx populations. When delineating the physical sciences (which includes broader fields like physics and chemistry) and Earth sciences (which include fields like oceanography and geology) from the atmospheric sciences, institutions with ATM offerings show comparatively fewer Hispanic and Latinx full-time undergraduate and graduate student enrollments. Hispanic and Latinx graduate students are primarily attending R1 or R2 universities, which may be potentially related to funded research assistantship opportunities.

Long-term trends show some promise; a 5% increase in Hispanic and Latinx EAS bachelor's degree completions at HSIs has occurred during 2009–20. Too much variability exists in Hispanic and Latinx graduate degree completions to assess a meaningful trend due to the limited sample size. Significant data gaps exist in determining the career paths followed by Hispanic and Latinx people that obtain degrees in the physical sciences, EAS,

and ATM, and we argue for improved surveying of the student, postdoctoral, and professional populations to better understand the reasons behind lack of representation and to track whether efforts to increase representation are effective. The Hispanic and Latinx population share has been increasing across the United States (Fig. 1), and therefore, much progress is needed to build a STEM workforce that is representative of the diversity of the U.S. population.

We acknowledge the ongoing efforts in recruitment from our federal funding agencies, educational institutions, faculty and instructors, and research laboratories and operations centers; however, we recommend more strategic actions to reach Hispanic and Latinx individuals interested in careers within the weather, water, and climate enterprise. Increasing our recruitment efforts will be futile and harmful if we bring in students to a toxic environment that is detrimental to their mental health and one that they may ultimately leave. Addressing the lack of representation of Hispanics and Latinx in the Earth and atmospheric sciences will require systemic and long-lasting cultural changes to improve the academic environment to retain the current and incoming cohorts. We must strive to build an inclusive and welcoming environment where all can thrive while being their authentic self.

Hispanic and Latinx students have faced many challenges. Recollecting on the struggles that Hispanic and Latinx students have shared with us throughout the years and anecdotes provided by coauthors of this study themselves, we find ourselves in awe of the perseverance and resilience of *our* community. Our students demonstrate that they have the power to be their own inspirational voice, while also supporting their peers to rise along with them. Grassroots organization of communities with common values and goals, like AMS's Committee on Hispanic and Latinx Advancement, will continue to bridge the gap as scientific institutions and individuals adapt to the needed cultural change. United, we achieve our goals and lift each other when times are tough. Only through changes in the systemic barriers and problems in our educational institutions can we create successful, long-lasting cultural change. Consider how scientifically rich and diverse our scientific community would be if *all* students had access to the necessary resources and mentorship with *equity* in mind? That is the cultural revolution we will continue to champion alongside our active allies within the weather, water, and climate enterprise. We invite you to join us.

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Data availability statement. The data used for this study, along with the developed software (including tables and figures), are freely available and open source at https://github.com/mariajmolina/state-of-latinx. IPEDS data products pertaining to degree completions and instructional staff can also be obtained directly from IPEDS (https://nces.ed.gov/ipeds/). The list of UCAR member institutions is available at www.ucar.edu/who-we-are/membership/member-institutions. The Carnegie classification of institutions of higher education is also available at https://carnegieclassifications.iu.edu/.

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