The Santa Barbara Charter: Broadening Participation in Environmental Data Science

PREAMBLE

This charter addresses the need to develop a culture and practice in environmental data science (EDS) where people of all identities can participate, thrive, and attain satisfying and rewarding careers. The actions taken to improve the situations of those most marginalized, disenfranchised, underrepresented, and excluded will increase the quality of experience for all. As we collectively seek to navigate a path to a more inclusive and equitable future for EDS, we acknowledge previous efforts from others that have inspired and informed our efforts, including but not limited to the Baltimore Charter for Women Astronomers[1], the Environmental Data Science Inclusion Network[2], and colleagues in the geosciences[3]. In constructing this charter, we hold fundamental that:

- ALL people are equally capable of participating in EDS
- Embracing diverse perspectives is necessary to advancing EDS for greatest impact
- Formal and informal discriminatory practices and systems require concerted effort by those with positional power to affect change
- Equitable systems for recruitment, training, evaluation, and reward necessitate intervention to overcome biased institutions
- We must practice FAIR and CARE principles[4] and respect data sovereignty
- We aspire to a 'do no harm' ethos as a guiding principle for our practice and are committed to critically and continually assessing our practice

RATIONALE

Environmental data science (EDS) is an emerging and rapidly expanding field that faces challenges of being exclusive and inequitable due to historic and structural prejudices and

[1] https://www.stsci.edu/stsci/meetings/WiA/BaltoCharter.html
[2] https://qubeshub.org/community/groups/edsin/
[3] https://egusphere.copernicus.org/preprints/2022/egusphere-2022-116/
[4] https://www.nature.com/articles/s41597-021-00892-0

barriers precluding full and inclusive participation across the broad social and economic spectrum (Berman and Bourne et al. 2015, Behl et al. 2021, Marin-Spiotta et al. 2023). Data science is a comparably new field, first coined in 1974 (Cao 2017); EDS is even more nascent, with the first topical journal established in 2022. EDS is a multi- and inter- disciplinary field that brings together methodological approaches such as scientific computing, statistics, and computer science to glean insights from noisy, structured, and unstructured data within diverse environmental science disciplines to solve environmental problems. Thus, EDS spans, non-exhaustively, computation, data, earth, environmental, geospatial, and social sciences, borrowing concepts and synthesizing broadly to provide novel findings and solutions.

Inclusion and participation of people across the full social, cultural and economic spectrum in EDS is critical morally, functionally, and ethically. Morally, creating inclusive spaces is the right thing to do, and we have a social obligation to acknowledge and dismantle structural inequalities and barriers to broaden participation in EDS. Functionally, creating space for diverse perspectives and experiences across the spectrum of humanity leverages our collective and unique knowledge and experiences to allow for deeper and more nuanced insights. Without this inclusion and participation, we risk missing essential perspectives and connections, and key insights needed for solving environmental problems (NSF 2023). Ethically, data are not strictly objective, can carry intrinsic power and meaning to those who generate and/or use it, and can differentially impact communities. Data and data applications can be leveraged for both good and harm, necessitating the participation and representation of communities and parties that may be affected. Data ownership, access, accessibility, governance, and sovereignty are particularly thorny issues in EDS ethics that require full inclusion and participation, particularly of sovereign, impacted, and at-risk communities across the entire data lifecycle.

Evidence from other fields highlights the dire consequences of including only a narrow subsection of the population in the workforce. A narrow workforce risks missing important insights from those who do not have a seat at the table (NSF 2023). Diversity is a strength because every individual has unique experiences and insights that collectively are necessary to solve large problems. A lack of inclusion and resultant excluded perspectives can passively perpetuate harmful communications and practices. Examples of harmful communication include gendered language and images in communication and education materials (Dele-Ajayi et al. 2020), as well as racist terminology, such as master/slave in coding (which has recently been disadopted (Landau 2020) and "pioneer" and "colonizer" in ecology (Cheng et al. 2023). Examples of harmful practices include the immoral, unethical, and unjust outcomes of data application, which range from "benign" failures of facial recognition software to recognize darker faces to "malignant" discriminatory hiring (Denton et al. 2021, Peyush 2022), sentencing (Brackey 2019, Mesa 2021), and predictive policing (Angwin et al. 2016) practices. Of note, the architectures of these data applications may not be inherently racist – rather, the programs inherit the racism inherent to the underlying data structure, making discrimination an incidental (but not inevitable) outcome. Perpetuating existing frameworks without scrutiny is how foundational errors and biases become systemic, and we have the opportunity to confront these issues now to build a more inclusive future.

We recognize the intrinsic linkages between diversity and inclusion in those participating in EDS as a career and the equity and justice impacts on the communities affected by the work. A diverse workforce is worthwhile in all fields, but it is *necessary* for work that is equitable in impact. The disconnect between those who practice EDS and those who are impacted by its work therefore intrinsically links diversity, inclusion, equity, and justice within the framework of broadening participation in EDS. We mark a separation within our recommendations in this charter between those who practice and those who are impacted because a key factor to more ethical practice is broader participation within the professional sphere. Thus, this effort is

Berman, Francine D., and Philip E. Bourne. "Let's make gender diversity in data science a priority right from the start." PLoS biology 13.7 (2015): e1002206.
Behl, Mona, et al. "Changing the culture of coastal, ocean, and marine sciences." Oceanography 34.3 (2021): 53-60. Marin-Spiotta, Erika, et al. "Exclusionary behaviors reinforce historical biases and contribute to loss of talent in the Earth sciences." Earth's Future 11.3 (2023): e2022EF002912. Cao, L. "Data science: a comprehensive overview." ACM Computing Surveys (CSUR) 50.3 (2017): 1-42. National Science Foundation. Diversity and STEM: Women, Minorities, and Persons with Disabilities (2023). Dele-Ajayi, O, et al. "Tackling gender stereotypes in STEM educational resources." 2020 IEEE Frontiers in Education Conference (FIE). IEEE, 2020. Landau, E. Tech Confronts Its Use of the Labels 'Master' and 'Slave' July 6 2020 https://www.wired.com/story/tech-confronts-use-labels-master-slave/. Cheng, Susan J., et al. "Championing inclusive terminology in ecology and evolution." Trends in Ecology & Evolution (2023). Denton, Emily, et al. "On the genealogy of machine learning datasets: A critical history of ImageNet." Big Data & Society 8.2 (2021): 20539517211035955. Peyush, A. "AI Discrimination in Hiring, and What We Can Do About It" 2022 https://www.newamerica.org/oti/blog/ai-discrimination-in-hiring-and-what-we-can-do-about-it/. Brackey, A. Analysis of Racial Bias in Northpointe's COMPAS Algorithm. Diss. Tulane University School of Science and Engineering, 2019. Mesa "Can the criminal justice system's artificial intelligence ever be truly fair?", 2021. https://massivesci.com/articles/machine-learning-compas-racism-policing-fairness/. Angwin, J. et al. "Machine Bias", 2016. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

aimed at environmental data scientists, specifically those with positional power, both in the context of formal positions, such as reports and contractors, or informal, such as social and economic power asymmetries. We are at a key juncture to chart a path for this nascent field and we have the capacity to build an inclusive and diverse space from the ground up, inspiring the recommendations outlined below (in no particular order). We recognize that many of these recommendations are not exclusive to EDS and apply broadly to many disciplines. As the field moves forward, we hope that this community will reflect, and advance beyond these recommendations to address additional and equally important goals.

RECOMMENDATIONS

1. Adopt transparent and equitable recruitment, evaluation, and promotion practices.
An institution or organization's demographics should reflect the diversity of the population, either in the local geography or within the community served. To increase transparency in the hiring, evaluation, and promotion practices, standards for candidates and pay scale should be publicly available, and the standing demography should be publicly available. Institutions and organizations should critically examine hiring criteria for cultural, explicit, and implicit biases, and seek external review as necessary. Further, because EDS is a nascent field with little cohesive history, practitioners will have very different training and backgrounds. This is both a challenge (forcing institutions to broadly and creatively interpret candidates' skills) and an opportunity (to recruit people who have really diverse backgrounds), necessitating a broad and inclusive definition of what it means to be an environmental data scientist.

2. Adopt and promote more inclusive metrics of contribution to counter existing reward and promotion processes which can be overly narrow.
The ways we measure contribution in EDS specifically and STEM broadly are grounded in western values of production and capitalism and are perpetuated by existing institutional structures and processes. Recent research and opinions across STEM fields demonstrates that this lens reinforces existing structural barriers and discriminatory practices (Davies et al. 2021). However, there are more inclusive ways to measure and evaluate contribution that deemphasize the strict production vantage and facilitate a more holistic evaluation of contribution (Davies et al. 2021). For example, the adoption of policies and formal structures that recognize and directly reward sponsoring, counseling, networking, and advocating efforts by EDS professionals (*sensu* Davies et al. 2021). Those in positions of power should transparently adopt and advocate for these more inclusive metrics, which will begin to erode the existing processes that are grounded in and perpetuate structural inequities and injustices.

3. Ensure all communications– both internal and public facing– are inclusive and accessible.
Organizations communicate internally and externally through language, illustrations, documents, and discussion. Communication is important in the formation of expectations, both by those in power and those seeking entrance to the profession. Documents and discussions should be sensitive to bias that favors any identity. Those who represent EDS to the public must be particularly aware of the power of communication, which can carry conscious and unconscious explicit and implicit biases. In particular, public facing communications reflect on the EDS profession and community as a whole, and must be approached thoughtfully and prioritize inclusion.

4. Seek opportunities to engage and elevate underrepresented voices and respect alternative ways of knowing.
Individuals feel a greater sense of belonging in a community when they see themselves represented as participants and leaders in the field (Belanger et al. 2020). Institutions and organizations should center and cite people from diverse backgrounds in publications,

Davies, Sarah W., et al. "Promoting inclusive metrics of success and impact to dismantle a discriminatory reward system in science." *PLoS biology* 19.6 (2021): e3001282. Belanger, Aimee L., et al. "Putting belonging in context: Communal affordances signal belonging in STEM." *Personality and Social Psychology Bulletin* 46.8 (2020): 1186-1204.

presentations, training materials, and social media (Kwon et al. 2022). It is important to consider multiple axes of diversity in personal and professional identities, yet never reduce people to a single aspect of their identity (i.e.,tokenizing) or placing undue burden on an individual *because* of their identity (Shim 2020). It is also critical to respecting alternative ways of knowing, such as Indigenous and Traditional Knowledge, to develop solutions to our most pressing environmental challenges.

5. Establish clear codes of conduct that commit to safe and inclusive environments.
Everyone should feel physically and psychologically safe and welcome at work, and codes of conduct can formalize these commitments and build confidence in participants that the organization is committed to a safe and inclusive environment. Thus, all organizations should have a clear code of conduct that sets expectations around behaviors and interactions as well as outlines consequences of violations and steps for reporting (see next recommendation). Further, organizations should collaboratively and iteratively revisit and revise their code of conduct internally to ensure the needs of the community are being met.

6. Create reporting structures that protect harmed individuals and initiate comprehensive institutional responses.
Strong, swift, and substantial action must be taken to end workplace harassment and discrimination. Institutions should, and often do, have formal reporting structures for such conflicts. In many cases, the process for reporting must be anonymous or anonymized to protect the victim from retaliation, particularly if there is a formal or informal power asymmetry. In some cases, there may be a need to provide external review of cases if the offender is in a position of power or in cases where the organization is notably small. We suggest professional societies and unions as entities to fulfill this role. The steps for reporting and conflict resolution should be accessible and transparent, shared with new hires, and be public on an institutional website, and codes of conduct should be used to hold people accountable. Transparent processes for handling reports and anonymous feedback can empower team members, should their sense of belonging or safety be threatened.

7. Dedicate resources to diversity and inclusion service.
Often, the work required for diversity and inclusion efforts falls on individuals with marginalized identities, adding mental and emotional labor to an existing job description (Crescendo 2022, Winters 2020, Bloomberg 2023). Engagement in these efforts may not be part of the individual's explicit job description, is un- or under- funded, and is considered 'side of the desk' work. As such, engagement may not have tangible rewards in recruitment, evaluation, and promotion and may actively penalize the individual for participating (see recommendation 2). Dedicating resources to diversity and inclusion efforts can alleviate some of the added labor and ideally transform such service into reward. For example, organizations can incorporate language in hiring, evaluation, and promotion to explicitly value contributions to diversity and inclusion work. Commitment to broadening participation here extends to how we collaborate internally with colleagues and externally with the communities impacted by our science. This governance can include (but is not limited to) identifying who is deciding vs giving feedback, how proposals for decisions are constructed, how decisions are made (consent vs consensus vs majority vote), what documentation is open verses closed, and how to onboard/off-board members to the decision-making group. These practices are not typically included in academic training and need to be thoughtfully addressed by ongoing community co-training and co-design within EDS. There can be explicit and transparent compensation and/or incentives tied to service roles.

8. For policy and funding agencies, require evidence of an inclusive workforce.
Funding agencies have the power to drive structural changes in institutions because they control the flow of money. Many such agencies require statements of commitment to inclusion as part

Crescendo 2022. https://crescendowork.com/workplace-inclusion-blog/alleviating-the-burden-of-education-from-marginalized-employees. Winters 2020. https://theinclusionsolution.me/managing-the-toll-of-dei-work-dissecting-the-emotional-toll-and-fatigue-of-dei-work/. Bloomberg 2023. https://www.bloomberg.com/company/stories/understanding-the-emotional-tax-on-black-professionals-in-the-workplace/. Kwon, D. "The rise of citational justice: how scholars are making references fairer." *Nature* 603.7902 (2022): 568-571. Shim, J. "Token fatigue: tolls of marginalization in white male spaces." *Ethnic and Racial Studies* 44.7 (2021): 1115-1134.

of the application process (e.g. NSF). This commitment should be embedded into the operation and governance of research and reflected in project management. An increased emphasis, as well as documentation of commitment and evidence that the workforce reflects local demographics, could further the impact of policy and funding agencies on institutional culture.

CALL TO ACTION

Improving the situation of the all those marginalized and broadening participation will improve the experience of everyone in environmental data science, and it is the responsibility of practitioners at all levels, and resources should be explicitly allocated to these efforts. Department heads, directors, chairs, leaders, managers and funders in particular have the positional power to generate systemic change. Additionally, environmental data science practitioners, particularly those with positional power, have a responsibility to organize and speak out against bad political actors that aim to limit DEI work within academia. Diversity will be our strength and is necessary as we collectively and collaboratively work to solve grand environmental challenges to build a more sustainable, equitable, and just world. True excellence and transformation can only be achieved if everyone has a seat at the table and all voices can be heard.