# Emmanuel Miguel Gonzalez

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## EDUCATION

**Ph.D., Plant Science** Aug 2019 – Aug 2024
University of Arizona, Tucson, AZ
Dissertation: *Interface Between Plant Science and Data Science: Extracting Insights From Phenomics Data*
Advisor: Dr. Duke Pauli

**B.S., General Biology, Minor in Chemistry** Aug 2016 – Jun 2019
Pacific Lutheran University, Tacoma, WA
Capstone: *Applications of Mesoporous Silica Nanoparticles in Plant Genetic Engineering*
Advisor: Dr. Neva Laurie-Berry

## PROFESSIONAL EXPERIENCE

**Assistant Research Scientist** Jul 2024 – Present
School of Computing and Augmented Intelligence, Ira A. Fulton Schools of Engineering, Arizona State University, Tempe, AZ
Supervisor: Dr. Paul T. Grogan

- Led the architecture and evolution of the Novel Observing Strategies Testbed (NOS-T), a NASA Earth Science Technology Office–funded distributed simulation platform for prototyping Earth observing missions, and of its open-source Python library NOS-T Tools (v2.1.1 to v3.6.0), including YAML configuration, OAuth 2.0 and Keycloak authentication, and event-driven scenario time control.
- Led integration and deployment of the Snow Observing Strategy with NASA Goddard Space Flight Center, closing the loop between NASA's Land Information System, an integer-optimization observation planner, a synthetic aperture radar simulator, and a Cesium visualization; two campaigns spanning 577 scenario days validated the testbed at technology readiness level 6; preliminary analyses show improved snow water equivalent estimates over the open-loop baseline.
- Developed the Framework for Orchestrated Role-based Generation in Education (FORGE), a design-science framework for instructor–AI collaboration on course materials, evaluated on 142 instructor prompts across two retrospective case studies in an undergraduate systems engineering course.
- Instructor of record for IEE 305 Information Systems Engineering and secondary mentor to two graduate research associates and two undergraduates on NASA-funded projects.

**Graduate Research Associate** Oct 2022 – Jul 2024
School of Plant Sciences, University of Arizona, Tucson, AZ
Advisor: Dr. Duke Pauli

- Developed topological data analysis software for plant phenotyping, deployed on 3D point clouds from the University of Arizona Field Scanalyzer, the world's largest outdoor plant phenotyping platform.
- Quantified leaf symptoms of sorghum charcoal rot in images of field-grown plants with deep neural networks, published in *The Plant Phenome Journal* (2024).
- Trained gene expression prediction models from leaf-level hyperspectral reflectance and RNA-Seq data collected in cotton field trials in Maricopa, AZ.

- Helped grow, maintain, and measure field trials of lettuce, sorghum, cotton, sunflower, and tepary bean at the University of Arizona Maricopa Agricultural Center.

**Graduate Research Assistant** Aug 2019 – Oct 2022

School of Plant Sciences, University of Arizona, Tucson, AZ
Advisor: Dr. Duke Pauli

- Developed PhytoOracle, a suite of modular, scalable processing pipelines for plant phenomics data (chlorophyll fluorescence, RGB, and thermal images; hyperspectral cubes; 3D point clouds) that associates repeated observations of individual plants across a growing season, enabling analysis of dynamic plant responses to abiotic and biotic stress at the single-plant scale in a distributed manner.
- Pre-processed and annotated image datasets for lettuce and sorghum plant detection (RGB and thermal), ground control point lid detection (RGB and thermal), reflectance panel detection (hyperspectral), and sorghum charcoal rot segmentation (RGB).
- Generated terabytes of processed phenomics image and trait data from the Field Scanalyzer, released publicly on the CyVerse Data Commons as one of the largest processed plant phenomics datasets available for gene discovery, crop improvement, and machine learning applications.
- Mentored undergraduates from biology, computer science, mathematics, information science, and data science.
- Helped grow, maintain, and measure field trials of lettuce, sorghum, cotton, sunflower, and tepary bean at the University of Arizona Maricopa Agricultural Center.

**Plant Genome Research Program Summer Intern** Jun 2018 – Aug 2018

Boyce Thompson Institute, Cornell University, Ithaca, NY
Advisor: Dr. Jim Giovannoni

- Quantified cold stress tolerance of *Solanum lycopersicoides* to identify lines of interest for further investigation of alleles controlling cold tolerance mechanisms and as a direct tomato breeding resource.

**Greenhouse Assistant** Aug 2017 – Jun 2019

Department of Biology, Pacific Lutheran University, Tacoma, WA
Advisor: Dr. Romey Haberle

- Maintained a collection of over 30 plant species and propagated *Taxus brevifolia* cuttings from local forests to reestablish its population on the university campus.

## PUBLICATIONS

***Refereed Journal Articles***

1. **Gonzalez, E.M.**, Zarei, A., Calleja, S., Christenson, C., Rozzi, B., Demieville, J., Hu, J., Eveland, A.L., Barnard, K., Lyons, E., Dilkes, B., & Pauli, D. (2024). Quantifying leaf symptoms of sorghum charcoal rot in images of field-grown plants using deep neural networks. *The Plant Phenome Journal*, 7(1), e20110. doi:10.1002/ppj2.20110
2. Luo, W., **Gonzalez, E.M.**, Zarei, A., Calleja, S., Rozzi, B., Demieville, J., Li, H., Truco, M.-J., Lavelle, D., Michelmore, R., Dyer, J.M., Jenks, M.A., & Pauli, D. (2024). Leaf cuticular wax composition of a genetically diverse collection of lettuce (*Lactuca sativa* L.) cultivars evaluated under field conditions. *Heliyon*, 10(6), e27226. doi:10.1016/j.heliyon.2024.e27226
3. **Gonzalez, E.M.**, Zarei, A., Hendler, N., Simmons, T., Zarei, A., Demieville, J., Strand, R., Rozzi, B., Calleja, S., Ellingson, H., Cosi, M., Davey, S., Lavelle, D.O., Truco, M.J., Swetnam, T.L., Merchant, N., Michelmore, R.W., Lyons, E., & Pauli, D. (2023). PhytoOracle: Scalable, modular phenomics data processing pipelines. *Frontiers in Plant Science*, 14, 1112973.

doi:10.3389/fpls.2023.1112973

4. Zarei, A., **Gonzalez, E.M.**, Merchant, N., Pauli, D., Lyons, E., & Barnard, K. (2022). MegaStitch: Robust large-scale image stitching. *IEEE Transactions on Geoscience and Remote Sensing*, 60, 4408309. doi:10.1109/TGRS.2022.3141907
5. Pugh, N.A., Thorp, K.R., **Gonzalez, E.M.**, Elshikha, D.E.M., & Pauli, D. (2021). Comparison of image georeferencing strategies for agricultural applications of small unoccupied aircraft systems. *The Plant Phenome Journal*, 4(1), e20026. doi:10.1002/ppj2.20026
6. Cosi, M., Forstedt, J.J., **Gonzalez, E.M.**, Xu, Z., Peri, S., Tuteja, R., Blumberg, K., Campbell, T., Merchant, N., & Lyons, E. (2021). StarBLAST: A scalable BLAST+ solution for the classroom. *Journal of Open Source Education*, 4(38), 102. doi:10.21105/jose.00102

***Refereed Conference Proceedings***

1. **Gonzalez, E.M.**, Grogan, P.T., Karakoc, D.B., Mizuyama, H., Sato, M., Suginouchi, S., & Zarreh, M. (2026). Modeling and comparison of U.S. and Japanese lettuce supply chain system architecture. In H. Mizuyama et al. (Eds.), *Advances in Production Management Systems. Cyber-Physical-Human Production Systems: Human-AI Collaboration and Beyond* (APMS 2025, Kamakura, Japan), IFIP Advances in Information and Communication Technology, vol. 767, pp. 258–272. Springer. doi:10.1007/978-3-032-03542-4_18
2. **Gonzalez, E.M.**, Zarei, A., Hendler, N., Cosi, M., Demieville, J., Calleja, S., Simmons, T., Ellingson, H., Merchant, N., Lyons, E., & Pauli, D. (2022). PhytoOracle: Scalable, modular phenomic data processing pipelines. Abstract, North American Plant Phenotyping Network (NAPPN) Annual Conference, Athens, GA. *ESS Open Archive*. doi:10.1002/essoar.10508789.1

***Non-refereed Conference Proceedings***

1. Calleja, S., **Gonzalez, E.M.**, & Pauli, D. (2022). UAV-based thermal imagery for detecting varietal differences in cotton. Abstract, NAPPN Annual Conference, Athens, GA. *ESS Open Archive*. doi:10.1002/essoar.10508798.1
2. Hendler, N., **Gonzalez, E.M.**, Zarei, A., Simmons, T., Demieville, J., Calleja, S., Lyons, E., & Pauli, D. (2022). Improvements on multiway ICP registration for reconstructing individual plants from 3D field scans. Abstract, NAPPN Annual Conference, Athens, GA. *ESS Open Archive*. doi:10.1002/essoar.10508793.1

***Manuscripts in Preparation, Review, and Revision***

1. **Gonzalez, E.M.**, Banafsheh, H., Ramachandran, D., Wrzesien, M.L., Kumar, S.V., Vuyovich, C.M., & Grogan, P.T. Novel Observing Strategies Testbed: A lightweight, collaborative platform for prototyping Earth observing missions. Submitted to *Earth Science Informatics*. doi:10.21203/rs.3.rs-11323528/v1
2. **Gonzalez, E.M.** & Grogan, P.T. FORGE: A framework for orchestrated role-based generation in education. Submitted to *Education and Information Technologies*. doi:10.21203/rs.3.rs-11446615/v1

***Other Publications***

1. **Gonzalez, E.M.** (2024). *Interface between plant science and data science: Extracting insights from phenomics data*. Ph.D. dissertation, University of Arizona, Tucson, AZ. hdl.handle.net/10150/674722

## SOFTWARE AND DATASETS

1. NOS-T Tools, open-source Python library for the Novel Observing Strategies Testbed, versions 2.1.1 to 3.6.0, architecture lead. https://github.com/code-lab-org/nost-tools
2. PhytoOracle, open-source distributed phenomics processing pipelines and workflow manager, architecture lead. https://github.com/phytooracle
3. Charcoal rot detection models, Docker image, and labeled sorghum image dataset, companion to Gonzalez et al. (2024), MIT license. https://github.com/phytooracle/charcoal-dryrot-quantification
4. PhytoOracle processed field phenomics archive from the University of Arizona Field Scanalyzer: terabytes of image and trait data for lettuce and sorghum, public on the CyVerse Data Commons. https://de.cyverse.org/data/ds/iplant/home/shared/phytooracle?type=folder&resourceId=0ceeda16-6a44-11eb-93ad-90e2ba675364
5. MegaStitch, large-scale image georeferencing and stitching, co-developer. https://github.com/ariyanzri/MegaStitch

## PRESENTATIONS

***Invited Talks***

1. Novel Observing Strategies Testbed: Lightweight, distributed, event-driven simulation for Earth observing missions. Invited talk, NASA Earth Science Technology Interchange Meeting (ESTIM 2026), Chicago, IL. — Sep 2026
2. Fine-scale phenotyping: Leveraging supervised and unsupervised machine learning to study shapes. Invited lecture, University of Illinois Center for Digital Agriculture AI Foundry for Agricultural Applications Short Course, online. — Jun 2023
3. Navigating the challenges of field phenotyping implementation. Invited lecture, University of Illinois Center for Digital Agriculture AI Foundry for Agricultural Applications Short Course, online. — Jun 2023
4. Transforming a quarter petabyte of field phenomics data into functional traits. Invited talk, W4168 Multistate Research Working Group, Tucson, AZ. — Oct 2022
5. Big data plant phenomics. Invited talk, University of Arizona Data Science Fellows, Tucson, AZ. — Jun 2022
6. PhytoOracle: A case study in big data phenomics. Talk, AG2PI Field Day, online. — Dec 2020
7. PhytoOracle: Leveraging CyVerse, containers, and open-source tools for phenomic data processing at scale. Talk, University of Arizona Transdisciplinary Research in the Principles of Data Science (TRIPODS), online. — Dec 2020
8. PhytoOracle: Leveraging CyVerse, containers, and open-source tools for phenomic data processing at scale. Webinar, CyVerse Webinar Series, online. — Nov 2020

***Seminars***

1. Transforming a quarter petabyte of field phenomics data into functional traits and beyond. Seminar, School of Plant Sciences, University of Arizona, Tucson, AZ. — Nov 2022
2. PhytoOracle: Transforming the way we see plants. Seminar, Genetics Graduate Interdisciplinary Program, University of Arizona, online. — Mar 2021

***Conference Presentations***

1. Insights from composing a closed-loop Earth observing system testbed across institutional boundaries. Poster, accepted for presentation, AGU Annual Meeting 2026, San Francisco, CA. — Dec 2026
2. AI-assisted development of technical assessments for systems engineering education: A multi-agent approach. Oral presentation, Conference on Systems Engineering Research (CSER 2026), Arlington, VA. — Apr 2026
3. Implementation and evaluation of a Snow Observing Strategy using the NOS-T distributed simulation framework. Oral presentation (presented by D. Ramachandran), CSER 2026, Arlington, VA. — Apr 2026
4. Using an MCP server to expose natural language prompts as an interface to TAT-C. Poster (presented by S. Yadav), CSER 2026, Arlington, VA. — Apr 2026
5. Advancing agile Earth science mission design with the Novel Observing Strategies Testbed. Poster, AGU Annual Meeting 2025, New Orleans, LA. — Dec 2025
6. Analyzing biotic and abiotic stress responses in sorghum using comprehensive field phenomics data. Poster, U.S. Department of Energy Biological and Environmental Research (BER) Annual Meeting, Bethesda, MD. — Apr 2024
7. Elucidating phenotypic variability in lettuce using high-resolution field phenomics data. Oral presentation, Specialty Crop Research Initiative Annual Meeting, Davis, CA. — Oct 2023
8. Using leaf-level hyperspectral reflectance to estimate gene expression in cotton non-destructively. Poster, American Society of Plant Biologists Plant Biology 2023, Savannah, GA. — Aug 2023
9. Extracting functional traits from large volumes of field phenomics data. Poster, U.S. Department of Energy BER Annual Meeting, Washington, DC. — Apr 2023
10. HypEx: A hyperspectral approach to gene expression prediction in cotton. Poster, American Seed Trade Association Vegetable and Flower Seed Conference, Orlando, FL. — Jan 2023
11. Transforming terabytes of field phenomics data into functional and hidden traits in lettuce. Oral presentation, Plant and Animal Genome Conference (PAG 30), San Diego, CA. — Jan 2023
12. PhytoOracle: Scalable, modular phenomic data processing pipelines. Poster, U.S. Department of Energy BER Annual Meeting, online. — Feb 2022
13. PhytoOracle: Scalable, modular phenomic data processing pipelines. Oral presentation, NAPPN Annual Conference, Athens, GA. — Feb 2022
14. UAV-based thermal imagery for detecting varietal differences in cotton. Lightning talk (presented by S. Calleja), NAPPN Annual Conference, Athens, GA. — Feb 2022
15. Improvements on multiway ICP registration for reconstructing individual plants from 3D field scans. Lightning talk (presented by N. Hendler), NAPPN Annual Conference, Athens, GA. — Feb 2022
16. PhytoOracle: Scalable, modular phenomic data processing pipelines. Oral presentation, Machine Learning for Cyber-Agricultural Systems Annual Conference, online. — Nov 2021

17. PhytoOracle: Leveraging open-source tools for phenomic data processing at scale. Poster, U.S. Department of Energy Biological Systems Science Division Meeting, online. Feb 2021

***Workshops Taught***

1. Scientific computing and data analytics: A comprehensive toolkit for research. Hands-on workshop, Agricultural Genome to Phenome Initiative (AG2PI), online. Apr 2024
2. Object detection for plant phenotyping: A hands-on workshop. Hands-on workshop, University of Illinois Center for Digital Agriculture AI Foundry for Agricultural Applications Short Course, online. Jun 2023
3. Using interactive data visualization to make sense of large datasets. Hands-on workshop, University of Arizona Digital Scholarship and Data Science Fellowship, online. Nov 2022
4. Introduction to scientific computing: GitHub version control. Hands-on workshop, AG2PI, online. Apr 2022
5. Introduction to scientific computing: Shell scripts, data analysis, and machine learning. Hands-on workshop, AG2PI, online. Apr 2022
6. Introduction to scientific computing: Python and Jupyter notebooks. Hands-on workshop, AG2PI, online. Apr 2022
7. PhytoOracle: Scalable, modular phenomic data processing pipelines. Hands-on workshop, NAPPN Annual Conference, Athens, GA. Feb 2022
8. Hands-on machine learning with agricultural applications. Hands-on workshop, AG2PI, online. Feb 2022
9. As easy as 1-2-3: Machine learning in real-world projects. Hands-on workshop, Applied Concepts in Cyberinfrastructure, University of Arizona, Tucson, AZ. Sep 2021
10. Phenomic data processing using machine learning, distributed computing, and container technology. Hands-on workshop, AG2PI, online. Jul 2021
11. PhytoOracle: Scalable, modular data processing pipelines. Hands-on workshop, PhenomeForce, online. May 2021

## MEDIA APPEARANCES

1. "Ash in the sky, water on the run." ASU Engineering News. Feature on the Novel Observing Strategies Testbed; interviewed. https://news.engineering.asu.edu/2025/09/ash-in-the-sky-water-on-the-run/ Sep 2025
2. "A Land Grant Project." University of Arizona UITS Research Technologies, video. Interviewed. https://www.youtube.com/watch?v=VAxK1IMRGLY Oct 2022
3. "How the Night Sky Helped Emmanuel Gonzalez Love Plant Breeding." Seed World. Profile. https://www.seedworld.com/us/2022/10/04/how-the-night-sky-helped-emmanuel-gonzalez-love-plant-breeding-2/ Oct 2022

4. "How a 30-Ton Robot Could Help Crops Withstand Climate Change." The Wall Street Journal. Article and video on the University of Arizona Field Scanalyzer; interviewed in the video. https://www.wsj.com/articles/how-a-30-ton-robot-could-help-crops-withstand-climate-change-11597237276, https://youtu.be/da2gKRdMeXY — Aug 2020
5. "Senior Profiles: Class of 2019 Is Making a Difference." Pacific Lutheran University News. Graduation profile. https://www.plu.edu/news/archive/2019/05/24/senior-profiles-class-of-2019/ — May 2019

## RESEARCH GRANTS AND PROPOSALS

1. "New Observing Strategies Testbed (NOS-T) Development and Demonstration," National Aeronautics and Space Administration, Earth Science Technology Office, Advanced Information Systems Technology Program, Grant No. 80NSSC24K0875, P.T. Grogan (PI), **E.M. Gonzalez (Research Scientist)**, May 2024 – Apr 2029, $1,205,701.
2. "Disentangling Biotic and Abiotic Crop Stress Through Multi-Modal Fusion of EMIT, ECOSTRESS, and HLS," National Aeronautics and Space Administration, ROSES-2025 A.11 Early Career Investigator Program in Earth Science (NNH25ZDA001N-ECIPES), Proposal No. 25-ECIPES25-0278, **E.M. Gonzalez (PI)**; collaborators P.T. Grogan, H.R. Kerner, D. Pauli, A.E. Arnold, and K.R. Thorp. Submitted Jun 2026, 36 months, $299,936 requested. Not funded.
3. "Source-to-Sink Observing: Tasking Snow and Crop Sensors by Their Value to Agriculture," white paper circulated to the NASA Goddard Space Flight Center Hydrological Sciences Laboratory, Oct 2026, toward a proposal to the NASA ESTO Advanced Information Systems Technology and Earth Action Water Resources programs, **E.M. Gonzalez**, M.L. Wrzesien, S.V. Kumar, C.M. Vuyovich, and P.T. Grogan. In preparation.

## TEACHING EXPERIENCE

**Instructor, IEE 305 Information Systems Engineering** — Fall 2025, Spring 2027
School of Computing and Augmented Intelligence, Arizona State University

- Fall 2025: 57 enrolled, 27 responses; instructor rating 4.88/5.00 against a school mean of 4.32/5.00 for 300-level courses; course rating 4.67/5.00.
- Undergraduate course on entity-relationship and relational data modeling, database querying through a programming interface, and client–server information system development, assessed through nine implementation homeworks, three exams, and a group term project.

**Teaching Associate, PLS 170C2 Biotechnology and Sustainability** — Spring 2023
School of Plant Sciences, University of Arizona

- Undergraduate course for non-science majors; led discussions and graded assignments. Instructor: Dr. Samantha Orchard.

**Teaching Associate, PLS 429 Advanced Concepts in Cyberinfrastructure** — Fall 2021
School of Plant Sciences, University of Arizona

- Undergraduate and graduate course on high-performance computing and machine learning for plant science. Instructors: Dr. Eric H. Lyons and Nirav Merchant.

## MENTORING

**Hadis Banafsheh, Graduate Research Associate** 2024 – Present
Arizona State University; Snow Observing Strategy project

**Divya Ramachandran, Graduate Research Associate** 2024 – Present
Arizona State University; Snow Observing Strategy project

**Two undergraduates** 2024 – Present
Arizona State University; Earth observation research projects

**Approximately 30 undergraduates** 2019 – 2024
University of Arizona; phenomics data processing projects

## HONORS AND AWARDS

**American Society of Plant Biologists Equity, Diversity, and Inclusion Committee Recognition Travel Award** 2023
Competitive award recognizing mentoring of students from groups minoritized in the U.S. scientific workforce; full support to attend Plant Biology 2023 and society membership through 2024.

**Bayer Crop Science University Mentoring Program Mentee** 2023
Competitive one-on-one industry mentoring program.

**American Seed Trade Association Vegetable and Flower Seed Conference Graduate Student Delegate** 2023
Competitive travel award to present research to public- and private-sector seed industry professionals.

**National Association of Plant Breeders Borlaug Scholar** 2022
Competitive program supporting future leaders in plant breeding; mentored by Dr. David Bubeck, Research Director, Corteva Agriscience.

**North American Plant Phenotyping Network Graduate Student Travel Award** 2022
$1,000 travel award to present research at the NAPPN Annual Conference.

**University of Arizona College of Agriculture and Life Sciences Impact Leader Fellow** 2021
Competitive leadership development program.

**University of Arizona Libraries Digital Scholarship and Data Science Fellow** 2021
Competitive cohort program in instructional design, digital pedagogy, and open educational resources.

## PROFESSIONAL MEMBERSHIPS

American Geophysical Union 2024 – Present
North American Plant Phenotyping Network 2021 – Present
National Association of Plant Breeders 2019 – Present
American Society of Plant Biologists 2018 – Present

## SERVICE AND LEADERSHIP

- Manuscript reviewer: *Frontiers in Plant Science*, *Plant Methods*, *Scientific Reports*, *The Plant Phenome Journal*.

## TECHNICAL SKILLS

- **Programming:** Python, R, Bash, SQL, LaTeX
- **Machine learning and computer vision:** deep learning for image classification and segmentation (TensorFlow, Keras), classical machine learning (scikit-learn), image and 3D point cloud analysis (OpenCV, Open3D, CloudCompare)
- **Distributed and high-performance computing:** containerization (Docker, Singularity), workload scheduling (Slurm, CCTools Makeflow and Work Queue), cloud services (AWS S3, AWS Lambda), research data management (iRODS)
- **Distributed systems:** event-driven architecture and message brokers (RabbitMQ), authentication (Keycloak, OAuth 2.0), configuration-driven deployment (YAML), version control and open-source release (Git, GitHub)
- **Generative AI and LLM tooling:** LLM-assisted software development and course design with disclosed prompts (FORGE), Model Context Protocol server development
- **Geospatial and remote sensing:** GIS (ArcGIS, QGIS), photogrammetry and orthomosaics (OpenDroneMap, Pix4D, Agisoft Metashape), geospatial Python (GeoPandas, GDAL), 3D visualization (Cesium)
- **Statistics and genomics in R:** mixed models for field trials (ASReml-R, ASRtriala), co-expression networks (WGCNA), functional annotation (AnnotationHub, clusterProfiler)

## LANGUAGES

English, Spanish (native)