

Pablo Venegas Garcia

Curriculum Vitae

Summary of Qualifications

- Develop and validate mathematical models to address research questions in environmental science and microbial ecology.
- Design and conduct laboratory experiments, integrating biogeochemical results with computational models and environmental data to assess methane emissions from Canadian oil sands tailings and evaluate mitigation strategies.
- Coordinate interdisciplinary research and laboratory activities, build collaborations, and communicate findings to technical and nontechnical audiences through outreach.
- Teach undergraduate and graduate courses in the mathematical sciences, including mathematical theory and modelling.

Current Employment and Teaching

- 2024 - present **Postdoctoral Researcher and Experimental & Networking Manager**, *Interdisciplinary Lab for Mathematical Ecology & Epidemiology (ILMEE)*, University of Alberta, Edmonton, Alberta, Canada
Develop and validate mathematical models of hydrocarbon biodegradation and methane emissions from oil sands tailings, and assess the potential for hydrogen sulfide release under sulfate-based mitigation strategies. Design and conduct laboratory experiments, analyze biogeochemical data, coordinate research activities and collaborations, and lead networking and outreach.
- 2026 **Co-Instructor**, *Department of Mathematical and Statistical Sciences*, University of Alberta, Edmonton, Alberta, Canada
Math 572 - Mathematical Modelling in Industry/Government/Sciences

Education

- 2018 - 2024 **Ph.D. in Mathematical and Statistical Sciences, Applied Mathematics**, *University of Alberta*, Edmonton, Alberta, Canada
Thesis titled: "Modelling microbial processes of soil organic matter mineralization and methane production."
- 2017 **M.Sc. in Applied and Industrial Mathematics**, *Universidad Autónoma Metropolitana-Iztapalapa*, Ciudad de México, México
- 2013 **B.Sc. in Physics and Mathematics**, *Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Michoacán, México

Research Expertise

- Mechanistic and stoichiometric modelling of microbial and environmental systems.

- Microbial organic matter degradation and hydrocarbon biodegradation in Canadian oil sands tailings.
- Methane production, emissions, and mitigation, including sulfate amendment and potential hydrogen sulfide release.
- Tailings and end-pit lake reclamation assessment.

--- Current Research Projects

- 2023 - present **Predicting methane emissions from Alberta oil sands regions using a holistic modeling and monitoring system**, *NSERC Alliance Mission project; PI: Hao Wang*, University of Alberta, Edmonton, Alberta, Canada
Develop and validate mathematical models using laboratory and monitoring data to estimate methane emissions from oil sands tailings.
- 2018 - present **Experimental investigation of hydrocarbon biodegradation in oil sands tailings**, University of Alberta, Edmonton, Alberta, Canada
Design and conduct laboratory experiments, collect measurements of hydrocarbon degradation and methane production, and analyze time-series data to investigate microbial processes under different environmental conditions.

--- Research Leadership, Mentorship, and Coordination

- May - August 2026 **Science Experiential Skills Advantage (SESA) Co-supervisor**, *Undergraduate research mentorship*, University of Alberta, Edmonton, Alberta, Canada
Provided primary supervision to an undergraduate student studying methane emission trends in end-pit lakes, with guidance in data analysis, mathematical modelling, model validation, scientific interpretation, and research writing.
- 2026 **Student Mentorship and Scholarship Support**, *Women in STEM Scholarship, Government of Alberta*, University of Alberta, Edmonton, Alberta, Canada
Mentored a student and provided a reference letter in support of their successful scholarship application.
- 2023 - 2025 **ILMEE Stoichiometry, Biodegradation, and Ecotoxicology Research Subgroup Leader**, University of Alberta, Edmonton, Alberta, Canada
Coordinated subgroup research activities and project organization, facilitated interdisciplinary discussions, and mentored subgroup members.

--- Publications

- Saha, E., Wang, O., Chakraborty, A., **Venegas Garcia, P.**, Milne, R., & Wang, H. (2025). Dispersion based Neural Network Model for Methane Monitoring in Albertan Tailings Ponds. *Journal of Environmental Management*, 395, 127748.
- Cheng, H., Hamidoglu, A., Sysoeva, L., **Garcia, P. V.**, Milne, R., Burkus, Z., & Wang, H. (2025). A novel evolutionary game-based low-methane application in three-echelon energy supply chains. *Applied Energy*, 401, 126777.
- Afzal, I., **Venegas Garcia, P.**, Kuznetsova, A., Foght, J., Wang, H., Ulrich, A., & Siddique, T. (2025). Mitigation of Methane Emissions from Oil Sands Tailings by Redox Amendment: Mathematical Modeling of Empirical Observations. *ACS ES&T Engineering*.

- Mondal, B., Mandal, S., Tiwari, P. K., Wang, H., & **Garcia, P. V.** (2025). Deterministic and stochastic plankton dynamics: Effects of contamination, refuge, and additional food sources. *Ecological Complexity*, 61, 101117.
- **Venegas Garcia, P.**, & Wang, H. (2023). A Data-Validated Stoichiometric Model for the Priming Effect. *Bulletin of Mathematical Biology*, 85(6), 53.
- Kirkow, V., Wang, H., **Garcia, P. V.**, Ahmed, S., & Heggerud, C. M. (2022). Impacts of a changing environment on a stoichiometric producer-grazer system: A stochastic modelling approach. *Ecological Modelling*, 469, 109971.
- Wang, H., **Garcia, P. V.**, Ahmed, S., & Heggerud, C. M. (2022). Mathematical comparison and empirical review of the Monod and Droop forms for resource-based population dynamics. *Ecological Modelling*, 466, 109887.

Submitted Work and Scientific Advising

- 2026 **First Author.** Potential environmental burden shifting in methane mitigation for oil sands tailings: sulfate amendment and hydrogen sulfide risk. **Under review.** *PNAS*.
- 2026 **Co-author.** Nitrate Amendment Inhibits Methane Production During Long-term Hydrocarbon Biodegradation in Oil Sands Tailings. Submitted to *Environmental Science & Technology*.
- 2026 **Co-author.** Firm-Level Methane Abatement under Sulfate-Intensity Standards: Hydrogen Sulfide Trade-Off in Oil Sands Tailings. Submitted to *ACS Sustainable Resource Management*.
- 2025 **ILMEE Advisor.** Zambrano-Luna, B. A., Sysoeva, L., Gao, S., Milne, R., Burkus, Z., & Wang, H. (2025). Improved monitoring of methane emissions for the oil and gas sector with Sentinel-2 satellite observations. *Atmospheric Environment*, 121594.
- 2025 **ILMEE Advisor.** Sysoeva, L., Bouderbala, I., Kent, M. H., Saha, E., Zambrano-Luna, B. A., Milne, R., & Wang, H. (2025). Decoding methane concentration in Alberta oil sands: A machine learning exploration. *Ecological Indicators*, 170, 112835.

Previous Employment

- 2024 **Term Lecturer**, *Faculty of Science*, University of Alberta, Edmonton, Alberta, Canada
Math 572 - Mathematical Modelling - INDUSTRY/GOV/SCI
- 2023 - 2024 **Graduate Research Assistant Fellowship**, *Supervisor: Hao Wang*, University of Alberta, Edmonton, Alberta, Canada
- 2018 - 2023 **Graduate Teaching Assistant**, *Faculty of Graduate Studies and Research*, University of Alberta, Edmonton, Alberta, Canada
- 2017 **Lecturer**, *ENES, National School of Higher Education*, Universidad Nacional Autónoma de México, Morelia, Michoacán, México
Mathematical models in Biology

2013 - 2017 **Research Assistant, IIES, Ecosystems and Sustainability Research Institute, Universidad Nacional Autónoma de México**, Morelia, Michoacán, México
Algorithm developer for signal processing; led field campaigns.

Scholarships & Awards

- 2024 **Faculty of Science Dissertation Award**, "*Modelling microbial processes of soil organic matter mineralization and methane production*", University of Alberta, Edmonton, Alberta, Canada
- 2018 **University of Alberta Entry Scholarship**, *Valued at \$10,000*, University of Alberta, Edmonton, Alberta, Canada

Teaching Experience

Main Instructor and Course Development

- 2024 **Mathematical Biology, MATH 572**, *University of Alberta*, Edmonton, Alberta, Canada
Main instructor, Fall Term.
- 2017 **Mathematical Models in Ecology**, *Universidad Nacional Autónoma de México*, Morelia, Michoacán, México
Lead instructor and curriculum developer, Ecology Undergraduate Program.

Teaching Assistant – Laboratory Instruction

- 2022 **Ordinary Differential Equations**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Fall Term.
- 2022 **Mathematical Biology, Ordinary Differential Equations**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Winter Term.
- 2021 **Calculus II**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Spring and Fall Terms.
- 2021 **Mathematical Modeling I, Calculus II**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Winter Term.
- 2020 **Calculus II**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Winter, Spring, and Fall Terms.
- 2019 **Calculus II**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Fall Term.
- 2019 **Mathematical Biology**, *University of Alberta*, Edmonton, Alberta, Canada
Laboratory instructor, Winter Term.

Teaching Assistant – Grading

- 2022 **Linear Algebra, Intermediate Calculus IV**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Summer Term.

- 2020 **Mathematical Programming and Optimization I**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Fall Term.
- 2019 **Graph Theory**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Summer Term.
- 2019 **Introduction to Discrete Mathematics**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Spring Term.
- 2019 **Elementary Calculus I**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Winter Term.
- 2018 **Elementary Calculus I**, *University of Alberta*, Edmonton, Alberta, Canada
Grading teaching assistant, Fall Term.
- Instructor Assistant and Curriculum Development
- 2011 - 2012 **Ordinary Differential Equations**, *Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Michoacán, México
Instructor assistant and curriculum developer, Civil Engineering Undergraduate Program.

Patents

- 2016 Ruiz-Mercado, I., **Venegas García, P.**, & Guzmán Gómez, S. L. (2016). *SoftSUMit Software*. UNAM 03-2016-05271215-1700-01.

Past Research Experience

- 2016 - 2017 **Macroscopic models for two- and three-phase traffic flow**, *M.Sc. Thesis, Universidad Autónoma Metropolitana-Iztapalapa*, Ciudad de México, México
Advisor: Patricia Saavedra Barrera.
- 2011 - 2013 **PDE numerical solutions using the finite element method on irregular boundaries: UNAMalla and COMSOL Multiphysics applications**, *B.Sc. Thesis, Universidad Michoacana de San Nicolás de Hidalgo*, Morelia, Michoacán, México
Advisor: Mario César Suárez Arriaga.

Conference and Seminar Presentations

- 2025 **Mathematical Biology Seminar**. “Risks of methane mitigation via human-driven microbial community shifts in oil sands tailings.” University of Alberta, Edmonton, Canada.
- 2022 **Mathematical Biology Seminar**. “Mathematical Stoichiometry: Priming Effect.” University of Alberta, Edmonton, Canada.
- 2016 **XLIX National Conference of the Mexican Mathematical Society**. “Traffic Flow Modelling Including In/Out Ramps and Other Variants.” Aguascalientes, México.
- 2014 **XXIV National School of Optimization and Numerical Analysis**. “Use and Monitoring of Ecotechnologies in Rural Communities: A Numerical Approach.” Guanajuato, México.

- 2012 **Scientific Computing Laboratory Seminar.** *"PDE Numerical Solutions on Irregular Domains Using the Finite Element Method and UNAMalla."* UNAM, Ciudad de México, México.
- 2012 **XX Annual AGM Conference and I Latin American Geothermic Conference.** *"Finite Element Method Potential for Modelling Advanced Geothermic Systems."* Morelia, Michoacán, México.
- 2012 **XLV National Conference of the Mexican Mathematical Society.** *"Numerical Solutions of the Wave Equation on Irregular Domains Using Finite Element Method."* Querétaro, México.
- 2010 **Shenyang University of Technology Seminar.** *"Quaternion Algebra: Vector Rotation in $\mathbb{R}^3$, Applications in Object Positioning and Space Aircrafts."* Shenyang, China.
- 2010 **X International Mathematica Symposium.** *"Use of the Finite Element Method in Mathematica."* With Ph.D. Mario César Suárez Arriaga. Tsinghua University, Beijing, China.
- 2009 **XLII National Conference of the Mexican Mathematical Society.** *"Quaternion Algebra: Vector Rotation in $\mathbb{R}^3$."* Zacatecas, México.

Field Campaigns and Monitoring Experience

- 2018 **Adoption Processes of Biodigesters and Biogas Stoves in the Yucatan Peninsula: Field Monitoring of Usage Patterns and Impacts,** *Collaborative project with the NGO International Renewable Resources Institute and the company Biobolsa*
Field deployment of electronic monitors in remote rural homes in the Mayan Jungle and algorithm development for signal analysis.
- 2015 - 2016 **Integral Evaluation of Efficient Cookstoves in San Luis Potosí and Intervention Design,** *Ecotechnology Adoption and Monitoring Laboratory, Dr. Ilse Ruiz-Mercado, UNAM, Morelia, Michoacán, México*
Field deployment of electronic monitors in remote rural homes in the Huasteca Potosina, San Luis Potosí, México, and in-field algorithm development for signal analysis.
- 2015 **Monitoring Documentation,** *Ecotechnology Adoption and Monitoring Laboratory, Dr. Ilse Ruiz-Mercado, UNAM, Morelia, Michoacán, México*
Ruiz-Mercado, I., Eav, J., Venegas, P., Vaswani, M., Allen, T., Charron, D., & Smith, K. R. Wireless Stove Use Monitors (wSUMs) for remotely measuring cookstove usage.
- 2013 - 2014 **Wireless Stove Use Monitors (wSUMs),** *UNAM-UC Berkeley Project, Morelia, Michoacán, México*
Laboratory testing of sensor performance and field validation of fuel and stove usage metrics in rural Purépecha homes in Michoacán, México.

Extracurricular Activities

- 2021 - 2023 **SIGMAS Social and Sports Coordinator,** *Society in Graduate Mathematics and Statistics, University of Alberta, Edmonton, Alberta, Canada*

Additional Information

Languages Spanish: native language. English: CELPIP-G average score of 10.

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