

# JORGE A. GARCIA

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June 2023 ♦ Waterloo ♦ Canada

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## RESEARCH INTERESTS

Applied Optimization (linear/nonlinear)  
Applied Machine Learning  
Agent-Based Modelling

Computable General Equilibrium Models  
Bayesian Decision-Making  
Complex Systems

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## EDUCATION

**PhD, Systems Design Engineering** 2014-2018

*University of Waterloo*

Thesis: Rule Derivation for Agent-Based Models of Complex Systems: Nuclear Waste Management and Road Networks Case Studies.

**MSc with honours, Operations Research - Systems Engineering** 2011-2013

*National Autonomous University of Mexico (UNAM)*

Thesis: Methodology for production planning using simulation and integer programming.

**BSc, Industrial Management** 2004-2009

*National Polytechnic Institute (IPN)*

Thesis: Development and Implementation of a ISO 9001:2008 Quality Management System on a civil engineering company.

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## RESEARCH EXPERIENCE

**Research Associate - Core Modeller for Global Water Futures** Jul 2022 - Currently

Water Institute/Department of Economics, University of Waterloo

*Waterloo ON, Canada*

- Extend a computable general equilibrium model to multiple Canadian regions.
- Build nonlinear optimization models for water resources analyses.
- Formulate machine learning models applied to discrete choice experiments.
- Formulate and solve regression models describing water-related surveys.

**Post-Doctoral Fellow - Core Modeller for Global Water Futures** Jun 2018 - Jul 2022

Water Institute/Department of Economics, University of Waterloo

*Waterloo ON, Canada*

- Developed a computable general equilibrium (CGE) model for Canada.
- Carried out hydro-economic analyses using quadratic programming and input-output models.
- Utilized distributed cluster of computers (Compute Canada) to implement intensive solvers.
- Implemented data-driven methods for discrete choice models.
- Performed GIS analyses using python (geopandas) and R (sf).

## Doctoral Research

Department of Systems Design Engineering, University of Waterloo

2014 - Jun 2018

Waterloo ON, Canada

- Estimated lifetimes of nuclear waste used fuel containers under microbiologically-induced corrosion.
- Derived rules of behaviour for agent-based models describing the reaction-diffusion equation.
- Formulated and solved optimal travel time models for road networks.
- Conceived and implemented equivalent representations using agents and bayesian decision-making.

## Masters Research

Department of Systems Engineering, UNAM

2011 - 2013

Mexico City, Mexico

- Formulated integer programs for production planning in a small manufacturing company.
- Performed discrete-event simulations of a metro station in Mexico City and a manufacturing process.
- Collected data on sales and passenger arrivals and performed time series analyses.

## TEACHING EXPERIENCE

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### Teacher Assistant

University of Waterloo

Aug 2014 - Dec 2017

Waterloo ON, Canada

- Matrices and linear systems (SYDE 113).
- Numerical and applied calculus (SYDE 114).
- Probability and statistics (SYDE 212).
- Fundamental engineering math 1 (SYDE 111).
- Fundamental engineering math 2 (SYDE 112).
- Digital systems (SYDE 192).

My activities included: *tutorials, office hours, marking, lab.*

## PEER-REVIEWED PUBLICATIONS

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- **Garcia-Hernandez, Jorge A.** and Brouwer, Roy and Pinto, Rute, (2022). Estimating the Total Economic Costs of Nutrient Emission Reduction Policies to Halt Eutrophication in the Great Lakes. *Water Resources Research*. <https://doi.org/10.1029/2021WR030772>
- Martin-Hernandez, Edgar, **Garcia-Hernandez, Jorge A.** et al., (2023). Multi-sectorial assessment of phosphorus in Ontario, Canada: mapping flows and analysis of the potential for recovery and reuse. *Resources, Conservation and Recycling*. Accepted, In the Press.
- **Garcia-Hernandez, J. A.** Alamanos, Angelos (2023). Optimization in Water Resources Management. Book chapter in *Elgar Encyclopedia of Water Policy, Economics and Management*. Edward Elgar Publishing. Accepted, In the Press. <https://www.e-elgar.com/shop/usd/elgar-encyclopedia-of-water-policy-economics-and-management-9781802202939.html>
- **Garcia-Hernandez, J. A.**, Alamanos, A. (2022). Integrated Modelling Approaches for Sustainable Agri-Economic Growth and Environmental Improvement: Examples from Canada, Greece, and Ireland. *Land*, 11, 1548. <https://doi.org/10.3390/land11091548>
- Alamanos, Angelos; **Garcia, Jorge A.**; Linnane, Suzanne; and McGrath, Triona. (2022). Integrated modelling for the optimal resource use, production-economic outputs, and emissions control: A Goal Programming model for Irish agriculture. *Proceedings of the 39th IAHR World Congress*. <https://doi.org/10.3850/IAHR-39WC2521716X2022890>

- **Garcia-Hernandez, J. A.**; Ponnambalam, K.; Sivaraman, M. (2021). Lifetimes of Used Nuclear Fuel Containers Affected by Sulphate-Reducing Bacteria Reactions inside the Canadian Deep Geological Repository. *Applied Sciences*,11(17),7806 <https://doi.org/10.3390/app11177806>
- **Garcia-Hernandez, Jorge A.** and Brouwer, Roy, (2020). A multiregional input–output optimization model to assess impacts of water supply disruptions under climate change on the Great Lakes economy. *Economic Systems Research*. <https://doi.org/10.1080/09535314.2020.1805414>
- Sivaraman M., **Garcia-Hernandez, J. A.**, Ponnambalam K., (2019). Microbial Corrosion of Used Fuel Containers. *Proceedings of the 4th Nuclear Waste Management, Decommissioning and Environmental Restoration, Canadian Nuclear Society*.
- **Garcia, J. A.**, Ponnambalam, K., and Sivaraman, M. (2018). Lifetimes of Used Fuel Containers Assuming Sulphate-Reducing Bacterial Activity. *Proceedings of the 8th International Conference on Simulation Methods in Nuclear Science and Engineering, Canadian Nuclear Society*.
- **Garcia-Hernandez, Jorge A.**, (2018). Rule Derivation for Agent-Based Models of Complex Systems: Nuclear Waste Management and Road Networks Case Studies. *PhD thesis, Systems Design Engineering, UWSpace* <http://hdl.handle.net/10012/13325>.
- **Garcia-Hernandez, J.A.**, Ponnambalam K. (2015). Stochastic programming for train distribution in a metro transportation system. *Proceedings of the 27th European Modeling and Simulation Symposium*.
- **Garcia, J.A.** (2013). Production capacity and investment policy for a manufacturing company using simulation and integer programming. *Proceedings of the 25th European Modelling and Simulation Symposium*.
- **Garcia-Hernandez, Jorge Andres**, (2013). Methodology for production planning using simulation and integer programming. *MSc thesis, Operations Research, UNAM*. <http://132.248.9.195/ptd2013/febrero/0689556/Index.html>.
- **Garcia, J.A.** and Flores, Idalia (2012). Simulation of the operation of a metro station. *Proceedings of the 24th European Modelling and Simulation Symposium*.
- **Garcia-Hernandez, Jorge Andres**, et al., (2011). Development and Implementation of a ISO 9001:2008 Quality Management System on a civil engineering company. *BSc thesis, Industrial Management, IPN*. <https://tesis.ipn.mx/handle/123456789/8396>.

## SUBMITTED OR WORK-IN-PROGRESS PAPERS

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- **Garcia-Hernandez, Jorge A.** and Brouwer, Roy, (2023). Water Markets as a Coping Mechanism for Climate-induced Water Changes on the Canadian Economy: A Computable General Equilibrium Approach. *To be submitted soon*. See model here: [https://jorge-antares.github.io/files/cge\\_w.pdf](https://jorge-antares.github.io/files/cge_w.pdf).
- Brouwer, Roy, Pinto, Rute, **Garcia-Hernandez, J. A.** et al., (2023). Spatial Economic Optimization of Nutrient Reduction Measures on Agricultural Land to Improve Watershed Water Quality: A Coupled Modelling Approach. *Canadian Journal of Agricultural Economics (accepted pending revision)*.
- **Garcia-Hernandez, J. A.**, Brouwer, R., Pinto, R., and Cheng, T., (2023). A System of Environmental-Economic Accounting for the Canadian Great Lakes Economy. *In preparation to be submitted*.

## PEER-REVIEWED CONFERENCES

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- **Garcia-Hernandez, Jorge A.** and Brouwer, Roy. (2023). A Computable General Equilibrium Model to Study Water Markets as a Coping Mechanism for Climate-Induced Water Changes on the Canadian Economy. *57th Annual Conference of the Canadian Economics Association, Winnipeg, Manitoba*.
- **Garcia-Hernandez, Jorge A.** and Brouwer, Roy. (2023). Pan-Canadian Hydro-Economic Model to Study the Economy-Wide Impacts of Climate Change and Water Markets as a Coping Mechanism. *Global Water Futures Annual Conference, Saskatoon, Saskatchewan*.

- **Garcia-Hernandez, Jorge A.** and Alamanos, Angelos. (2022). A multi-objective optimization framework for water resources allocation considering stakeholder input. *7th International Electronic Conference on Water Sciences*.
- Alamanos, Angelos; **Garcia, Jorge A.**; Linnane, Suzanne; and McGrath, Triona. (2022). Integrated modelling for the optimal resource use, production-economic outputs, and emissions control: A Goal Programming model for Irish agriculture. *39th IAHR World Congress*.
- **Garcia-Hernandez, J. A.**, Brouwer, R., & Pinto, R. (2021). Estimating the total economic costs of nutrient emission reduction policies to halt eutrophication in the Great Lakes. *64th International Association for the Great Lakes Research (IAGLR); 2021 European Association of Environmental and Resource Economists*.
- **Garcia-Hernandez, J. A.**, Alamanos, A. (2021). Balancing Phosphorus Runoff Reduction and Farmers' utility: An Optimization for Lake Erie Area. *64th International Association for the Great Lakes Research (IAGLR)*.
- **Garcia-Hernandez, J. A.**, Brouwer, R., & Pinto, R. (2019). Assessing the Economic Impacts of Water Scarcity on the Great Lakes Basin using a Supply Side Input-Output Model. *2019 European Association of Environmental and Resource Economists*.
- **Garcia-Hernandez, J.A.**, Ponnambalam K. (2018). Bayesian Algorithm to Estimate Travel Times in Road Networks. *Conference on Modelling Complex Urban Environments*.
- **Garcia-Hernandez, J.A.**, Ponnambalam K. (2015). Stochastic programming for train distribution in a metro transportation system. *27th European Modeling and Simulation Symposium*.
- **Garcia, J.A.** (2013). Production capacity and investment policy for a manufacturing company using simulation and integer programming. *25th European Modelling and Simulation Symposium*.
- **Garcia, J.A.** and Flores, Idalia (2012). Simulation of the operation of a metro station. *24th European Modelling and Simulation Symposium*.

## DATA PUBLICATIONS & OTHER

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- **Garcia-Hernandez, J.**, Brouwer, R. , Pinto, R. (2022) Data for: Estimating the Total Economic Costs of Nutrient Emission Reduction Policies to Halt Eutrophication in the Great Lakes. *Federated Research Data Repository*. <https://doi.org/10.20383/103.0576>
- **Garcia-Hernandez, J.**, Brouwer, R (2023) (Poster) Pan-Canadian Hydro-Economic Model to Study the Economy-Wide Impacts of Climate Change and Water Markets as a Coping Mechanism. *UWSpace*. <http://hdl.handle.net/10012/19552>

## PROJECTS

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**Phosphorus flow emissions in Ontario.** (2022) Collected, quantified, and estimated emissions, releases, and disposals of phosphorus by the manufacturing and wastewater treatment sector located in Ontario, using different sources for 2003-2019. This piece was part of a collaborative project about mapping phosphorus flows in Ontario. <https://www.pollutionprobe.org/mapping-phosphorus-flows-in-the-ontario-economy/>

**Flickr data retriever.** (2022) Created and used a python class to retrieve photos from the Flickr API to build a regression model on valuation of ecosystem services in Ontario Canada. [https://github.com/jorge-antares/flickr\\_data\\_retriever](https://github.com/jorge-antares/flickr_data_retriever)

**Discrete Choice and Latent Variable for ANA.** (2020) Formulated and estimated a choice model for Attribute Non-Attendance using latent variables on Biogeme Python module.

**System of Environmental Economic Accounts for Ontario.** (2019) Created a database on economic (GDP by industry, population, jobs) and environmental data (water use, emissions) aggregated by the sub-basin drainage regions composing the Great Lakes, covering the 2001-2016 period.

## PROGRAMMING SKILLS

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Python	■ ■ ■ ■ ■
MATLAB	■ ■ ■ ■ ■
R	■ ■ ■ ■ ■
GAMS/Lingo	■ ■ ■ ■ ■
NetLogo	■ ■ ■ ■ ■
SQL	■ ■ ■ □ □
C++	■ ■ ■ □ □
bash/zsh	■ ■ ■ □ □
Java	■ ■ □ □ □
php/html/css	■ ■ □ □ □

## AWARDS / SCHOLARSHIPS

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2018	Graduate Research Studentship.
2014 - 2017	CONACYT Scholarship for PhD studies.
2016	SEP Complementary scholarship for graduate studies.
2013	UNAM - PAPIIT Research bursary.
2011 - 2013	CONACYT Scholarship for MSc studies.

## LANGUAGES

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- English: Professional working proficiency
- Spanish: Native proficiency

## OTHER ACTIVITIES

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| • Global Representative Program volunteer<br><i>University of Waterloo</i> | 2015-2018 |
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## NEWS/MEDIA

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- New report released mapping the flow of phosphorus in Ontario's economy. July 2022  
<https://uwaterloo.ca/water-institute/news/new-report-released-mapping-flow-phosphorus-ontarios-economy>
- Halting eutrophication in the Great Lakes: How much will it cost? 2021  
<https://uwaterloo.ca/water-institute-research/issue-13/faculty-arts/halting-eutrophication-great-lakes-how-much-will-it-cost>
- Measuring the economic impact of declining water levels in the Great Lakes Basin Sep. 29th, 2020  
By Leah Gerber, *The Record*, <https://www.therecord.com/news/waterloo-region/2020/09/29/measuring-the-economic-impact-of-declining-water-levels-in-the-great-lakes-basin.html>
- Two UW scientists developed a model to assess the economic impact of climate change on the Canadian Great Lakes Sep. 23th, 2020  
By Felicia Daryonoputri, *in print*, <https://uwimprint.ca/article/two-uw-scientists-developed-a-model-to-assess-the-economic-impact-of-climate-change-on-the-canadian-great-lakes/>
- Water supply and climate change: How will the Great Lakes economy be impacted? 2020  
<https://uwaterloo.ca/water-institute-research/issue-10/blue-economy/water-supply-and-climate-change-how-will-great-lakes-economy>

## REFERENCES

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