Toulouse Biotechnology Institute
Bio & Chemical Engineering

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Postodoctoral researcher

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Actual position and research subjects

Advancing Soil Carbon Sequestration Strategies for Low-fossil-Carbon Agriculture

This postdoctoral research explores innovative approaches to soil carbon sequestration (SCS) as a key pathway toward more sustainable, low-carbon agricultural systems. The project aims to unlock practical solutions for increasing the amount of carbon stored in agricultural soils while safeguarding crop productivity, ecosystem resilience, and long-term environmental quality.

The research combines multi-criteria decision analysis (MCDA) with advanced life cycle assessment (LCA) to evaluate and prioritize a wide variety of soil carbon management strategies, including agroforestry, biochar application, cover cropping, and organic matter amendments. By integrating environmental, agronomic, and socio-economic dimensions, this approach provides a transparent and science-based framework for identifying the most effective and context-appropriate solutions for climate-smart agriculture.

Complementary modeling tools, such as uncertainty analysis and scenario simulation, are used to assess broader impacts on greenhouse gas emissions, nutrient cycling, land use, and resource efficiency. The resulting insights offer practical, data-driven guidance for policymakers, researchers, and farmers working to align agricultural practices with national climate and soil sustainability goals. The ultimate objective is to transform cutting-edge research into actionable strategies that accelerate the adoption of sustainable land management and credible carbon mitigation pathways across agriculture.

Education and Diploma

- 2023 – PhD in Process and Environmental Engineering
- 2018 – MSc in Energy and Environmental Engineering
- 2015 – Chemical Engineer

Teaching

- 2019 – 2024 Technical University of Manabí, Department of Chemical, Biotechnological, and Food Processing and School of Agro-Industries

Toulouse Biotechnology Institute
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Courses: Mass Balance, Fluid Mechanics, Analytical Chemistry, Environmental Impact Assessment
- 2024, 2025 INSA Toulouse, BioEcoTechnology Master

Courses: Life Cycle Assessment
- June 2025 BioEco Graduate School: Summer School

Courses: Life Cycle Assessment

Others

- **Supervised or co-supervised**: 15 engineering students, 6 master students
- **Stays as a visiting scientist**: INSA Toulouse
- **Contribution to research projects**: FSPI project for doctoral research between France and Ecuador; Cambioscop; Sustainable Transition toward low fossil carbon economies; Ecosystem of Carbon Dioxide Removals – Soil carbon sequestration team
- **Other**: Board Member of ECS EGU Soil System Sciences Division (EGU Early Career Scientists, 2025); Outstanding Student and PhD Presentation (EGU Soil Systems Sciences Division, 2023), Best Teacher Awards, Technical University of Manabí, Ecuador (2021, 2022, 2023); Merit scholarship for exceptional academic results. (Directorate General of Higher Education, Portugal, 2017-2018); Best Student of the Faculty of Mathematical, Physical, and Chemical Sciences, Technical University of Manabí (2012-2016).

List of selected publications

- **Andrade Diaz, C.**, Zamora-Ledezma, E., Hamelin, L. (2025). A spatial dataset on Ecuadorian cropping systems and theoretical crop residue potentials. Data in Brief, 111910. https://doi.org/10.1016/j.dib.2025.111910
- **Andrade Diaz, C.**, Albers, A., Zamora-Ledezma, E., Hamelin, L. (2024). The interplay between bioeconomy and the maintenance of long-term soil organic carbon stock in agricultural soils: A systematic review. Renewable and Sustainable Energy Reviews, 189, 113890. https://doi.org/10.1016/j.rser.2023.113890
- **Andrade Diaz,** C., Clivot, H., Albers, A., Zamora-Ledezma, E., Hamelin, L. (2023). The crop residue conundrum: Maintaining long-term soil organic carbon stocks while reinforcing the bioeconomy, compatible endeavors? Applied Energy. https://doi.org/10.1016/j.apenergy.2022.120192
- **Andrade Diaz, C.,** Balugani, E., Zamora-Ledezma, E., Hamelin, L. (2023). Modelling the long-term carbon storage potential from recalcitrant matter inputs in tropical arable croplands https://doi.org/10.21203/rs.3.rs-3086337/v1
- **Andrade Diaz,** C., Zamora-Ledezma, E., Hamelin, L. (2023). To harvest or not? Tradeoffs between SOC maintenance and overall environmental performance of harvesting crop residues for the bioeconomy. https://doi.org/10.21203/rs.3.rs-3093300/v1
- **Andrade, C.A.,** Zambrano-Intriago, L.A., Oliveira, N.S., Vieira, J.; Quiroz-Fernandez, L.; Rodríguez-Díaz, J. (2020) Adsorption Behavior and Mechanism of Oxytetracycline on Rice Husk Ash: Kinetics, Equilibrium, and Thermodynamics of the Process. Water Air Soil Pollut 231, 103 . https://doi.org/10.1007/s11270-020-04473-6
- Pita, M., Fernández-Andrade, K. J., Quiroz-Fernández, S., Rodríguez-Díaz, J. M., & **Andrade Diaz, C.,** (2024). Assessment of biomass as an effective adsorbent for the removal of pharmaceutical compounds: A literature review. Case Studies in Chemical and Environmental Engineering, 100596 https://doi.org/10.1016/j.cscee.2023.100596

- Rodríguez-Díaz, J.M., **Andrade, C.A.**, Zambrano-Intriago, L.A. et al. (2021). Laboratory Adsorption Studies on Ni(II) and Zn(II) Solutions by Sugarcane-Bagasse Ash. Water Air Soil Pollut 232, 9. https://doi.org/10.1007/s11270-021-05046-x