Francisco Zambrano

- Providencia, Santiago, Chile
- Chilean-Italian

Skills

R	10+ yrs.
Python	2 yrs.
Matlab	3 yrs.
GIS	10 yrs.
Rmarkdown	6 yrs.
Quarto	1 yr.
Spatial Data Analysis	10 yrs.
Desarrollo web	5 yrs.

Software

- Git
- RStudio - Positron
- VS Code
- Terminal
- QGIS
- SAGA
- SNAP - ESA

Summary

Spatial data scientist and academic with over a decade of experience in climate monitoring and water resource management using remote sensing and geospatial analysis. My work focuses on understanding climate variability and droughts, with a focus on vegetation dynamics and water use efficiency. My goal is to apply data geoscience to generate knowledge and solutions that contribute to climate resilience and practical decision-making to address the water crisis.

Experience

Associate Professor — **02/2018 - 08/2025**

Earth observation center
Hemera - Universidad Mayor

I was awarded and led projects funded by ANID for more than 600 million euros, including a Fondecyt Initiation Grant, a FONDEF IDeA Grant, and a drought fund. I coordinated the development of the ODES-Chile and SatOri platforms, focused on climate change adaptation through Earth observation and spatial analysis. In the academic field, I taught undergraduate and graduate courses in GIS (QGIS) and spatial data science with R, training students in technologies applied to environmental and territorial management.

Visiting Scholar — **09/2016 - 12/2016**

International Institute for Geo-Information Science and Earth Observation (ITC)
Univerity of Twente, Enschede, The Netherlands

I led a study to predict drought-induced agricultural productivity declines in Chile, integrating time series satellite data (MODIS, CHIRPS) and advanced spatial analysis techniques. The results of this research were published in the journal Remote Sensing of Environment.

Visiting Scholar — **01/2016 - 06/2016**

Center for Advanced Land Management Information Technologies (CALMIT)
National Drought Mitigation Center (NDMC)
University of Nebraska, Lincoln, Nebraska, United States

I led a study on the evaluation of satellite products for estimating precipitation in Chile and their applicability for drought monitoring. The results were published in the journal Atmospheric Research.

Assistant Researcher — **14/2012 - 03/2015**

Quilamapu Regional Research Center
National Institute of Agricultural Research (INIA)

I processed and analyzed data from weather stations and satellites for drought studies and monitoring in Chile. I also automated the generation of monthly drought and agroclimate reports, which are incorporated into the regional agro-climate reports.

Other professional experiences — **09/2007 - 12/2012**

Public services in Chile
CNR | DGA | INDAP

I have worked as an engineer in public services such as the General Directorate of Water (DGA), the National Irrigation Commission (CNR), and the Agricultural Development Institute (INDAP) in different regions of Chile on issues related to water resources, agriculture, and water user organizations (WOUs).

Spatial data

- MODIS
- ERA5/ERA5-Land
- CHIRPS
- Sentinel-1/2/5p
- Landsat 7/8/9
- SoilGrid
- CMIP6

Data Science

- R-programming
- Getting and cleaning data
- Exploratory data analysis
- Reproducible Research
- Statistical Inference
- Regression Models
- Practical Machine Learning
- Developing Data Products

Awards

- Hackaton Winner in the OpenGeoHub Summer School, Siegburg, Germany, 2022.
- Doctorate Scholarship, National Research & Development Agency, Chile, 2014.

Education

03/2014 - 09/2017

PhD. in Agricultural Engineering, mention in Water Resources
Universidad de Concepción

Thesis: Agricultural drought in Chile: from assessment to prediction using satellite data

03/2000 - 09/2007

Agricultural Civil Engineer

Universidad de Concepción

Teaching Experience

Spatial Analysis with R. Lecturer. Graduate Program **2019-2023**
Universidad Mayor

I trained students in theoretical concepts and the practical application of spatial interpolation methods using R software (course link).

Advanced Use of Geographic Information Systems. Lecturer. Undergraduate Program **2022-2025**
Universidad Mayor

I taught theoretical and practical classes to train students in the use of R as a powerful Geographic Information Systems (GIS) tool. Topics covered included the management of vector and raster data, as well as the application of spatial operations for geospatial analysis (course link).

Introduction to Geographic Information Systems. Lecturer. Undergraduate Program **2023-2025**
Universidad Mayor

Instruction and training in Geographic Information Systems (GIS) using the open-source software QGIS. I designed and delivered practical workshops on key concepts such as: introduction to GIS, management of vector and raster data, coordinate reference systems, and spatial analysis (course link).

Data Mining. Lecturer. Undergraduate Program **2021-2022**
Universidad Mayor

I trained students in processes of importing, organizing, and transforming data, using R software for data science (course link).

Management of Geographic Information. Lecturer. Undergraduate Program **2019-2022**
Universidad Mayor

Instruction and training in Geographic Information Systems (GIS) using the open-source software QGIS. I designed and delivered practical workshops on key concepts such as: introduction to GIS, management of vector and raster data, coordinate reference systems, and spatial analysis.

Soil-Plant-Water Relationships. Lecturer. Undergraduate Program **2018**
Universidad Mayor

I introduced the fundamental concepts of the principles of soil-plant-atmosphere water relations and water transport in this system.

Funded projects

I have directed and participated in eight projects awarded by the National Agency for Research and Development (ANID).

Crea Ciencia 2030 **01/2025 -10/2025**
Leading director

Title: Impact of climate change on avocado phenology and native sclerophyllous forest according to access to potential groundwater in the Aconcagua River basin

Contact

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ODES-Chile (FSEQ210022) **03/2022 - 10/2023**

Leading director

We created ODES-Chile, a multi-scale drought observatory for Chile, an early warning system to mitigate agricultural and ecological impacts. (https://odes-chile.org).

SatOri (ID21I10297) **03/2022 - 12/2024**

Leading director

We created SatOri, a satellite system for optimizing irrigation in cherry orchards (https://s4tori.cl).

Fondecyt Iniciación 11190360 **03/2020 - 03/2022**

Principal researcher

I led research that evaluated biomass prediction in wheat and corn using satellite data and machine learning techniques.

Fondecyt Postdoctorado **03/2023 - 03/2025**

Sponsoring researcher

I sponsored the project titled: Assessing Current and Future Water Availability for Agriculture and Terrestrial Ecosystems Under Different Land-Use Scenarios in the Aconcagua Basin: Toward Adaptation to Drought.

Fondecyt Regular (1210526) **03/2021 - 12/2024**

Co-researcher

Title: Multivariate drought monitoring system: biophysical modeling, remote sensing, and hydroclimatic information for drought analysis and prediction in agriculture.

Projects submitted (on evaluation)

In 2025, I have presented three projects that are currently under evaluation by the National Research and Development Agency (ANID).

Fondecyt Regular 2026 **01/2026**

Principal Researcher

Title: From Drought to Resilience: A New Framework for Climate-Adaptive Agriculture Through Water-Efficient Crops and Landscape Optimization in Aridified Regions

Fondef Tecnologías Avanzadas 2025 **08/2025**

Lead director

Title: ODES-Adapta: information platform for agricultural adaptation to climate change in the Aconcagua River basin

Anillos de Investigación en Áreas Temáticas 2025 **10/2025**

Lead director

Title: Towards sustainable agricultural adaptation amid water scarcity and declining biodiversity in the Aconcagua Basin.

Publications

Since 2016, I have had over 500 citations, of which ~90% are articles published as first or corresponding author, with an h-index of 7.

1. **Zambrano, F.**, Vrieling, A., Meza, F., Duran-Llacer, I., Fernández, F., Venegas-González, A., Raab, N., & Craven, D. (2025). From Drought to Aridification: Land-cover fingerprints of a drying Chile. *Earth's Future*. (under revision, second round)

2. **Zambrano, F.**, Herrera, A., Olguín, M., Miranda, M., Garrido, J., & Almeida, A. M. (2025). Prediction of the daily spatial variation of stem water potential in cherry orchards using weather and Sentinel-2 data. *Agricultural Water Management, 318*, 109721. https://doi.org/10.1016/j.agwat.2025.109721

3. Amouroux, P. Larrain, R. **Zambrano, F.**. (2025). Remote sensing and Ecosystem services: Case study of the South American dung beetles, Frickius variolosus (Coleoptera: Geotrupidae). (manuscript under development).

4. **Zambrano, F.** Herrea, A., Molina-Roco, M. (2025). Early prediction of wheat biomass using Sentinel-1/2, PlanetScope, and in-situ weather data. *Remote Sensing Applications: Society and Environment*. (manuscript submitted, Sep. 2025)

5. Duran Llacer, I., Gómez-Escalonilla, V., Aliaga, M., Arumi, J. L., **Zambrano, F.**, Rodríguez López, L., Rebeca, M. R., & Martínez-Santos, P. (2025). Approach to mapping Groundwater-Dependent Ecosystems through machine learning in Central Chile. *Groundwater for Sustainable Development*. (under revision)

6. Duran-Llacer, I., Salazar, A. A., Mondaca, P., Rodríguez-López, L., Martínez-Retureta, R., **Zambrano, F.**, Llanos, F., & Frappart, F. (2025). Influence of Avocado Plantations as Driver of Land Use and Land Cover Change in Chile's Aconcagua Basin. *Land, 14*(4), 750. https://doi.org/10.3390/land14040750

7. Fernández, F. J., Vásquez-Lavín, F., Ponce, R. D., Garreaud, R., Hernández, F., Link, O., **Zambrano, F.**, & Hanemann, M. (2023). The economics impacts of long-run droughts: Challenges, gaps, and way forward. *Journal of Environmental Management, 344*, 118726. https://doi.org/10.1016/j.jenvman.2023.118726

8. **Zambrano, F.** (2023). Four decades of satellite data for agricultural drought monitoring throughout the growing season in Central Chile. En R. M. Vijay P. Singh Deepak Jhajharia & R. Kumar (Eds.), *Integrated Drought Management, Two Volume Set* (p. 28). CRC Press.

9. Molina, J., González-Orenga, S., Vicente, O., Boscaiu, M., Llinares, J. V., **Zambrano, F.**, & Santibáñez, C. (2022). Effect of acetylsalicylic acid and ammonium sulphate on productive and physiological parameters in Stipa caudata under water shortage conditions. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 50*(1), 12645. https://doi.org/10.15835/nbha50112645

10. Jopia, A., **Zambrano, F.**, Pérez-Martínez, W., Vidal-Páez, P., Molina, J., & Mardones, F. de la H. (2020). Time-series of vegetation indices (VNIR/SWIR) derived from sentinel-2 (A/B) to assess turgor pressure in Kiwifruit. *ISPRS International Journal of Geo-Information, 9*(11), 641. https://doi.org/10.3390/ijgi9110641

11. Rivas, Y., Rivera, D., Gallardo, R., Lagos, E., Yevenes, M., **Zambrano, F.**, & Mendoza, J. (2020). Water availability, quality, and use in rural communities of the Chilean Coastal Range. *Journal of Soil and Water Conservation, 75*(1), 75–90. https://doi.org/10.2489/jswc.75.1.75

12. **Zambrano, F.**, Vrieling, A., Nelson, A., Meroni, M., & Tadesse, T. (2018). Prediction of drought-induced reduction of agricultural productivity in Chile from MODIS, rainfall estimates, and climate oscillation indices. Remote Sensing of Environment, 219, 15-30. https://doi.org/10.1016/j.rse.2018.10.006

13. **Zambrano, F.**, Wardlow, B., Tadesse, T., Lillo-Saavedra, M., & Lagos, O. (2017). Evaluating satellite-derived long-term historical precipitation datasets for drought monitoring in Chile. *Atmospheric Research, 186*, 26–42. https://doi.org/10.1016/j.atmosres.2016.11.006

14. **Zambrano, F.**, Lillo-Saavedra, M., Verbist, K., & Lagos, O. (2016). Sixteen years of agricultural drought assessment of the BioBío region in Chile using a 250 m resolution vegetation condition index (VCI). *Remote Sensing, 8*(6), 1–20. https://doi.org/10.3390/rs8060530

Conferences

1. **Vasquez, I.**, Zambrano, F. (2025, November 12–14). *"Identification of Optimal Areas for Green Hydrogen Production in Chile Using Random Forest and Spatial Data"*. 5th Conference on Energy, Efficiency and Environmental Sustainability (CEES 2025)

2. **Zambrano, F.**, Vrieling, A., Meza, F., Duran-Llacer, I., Fernández, F., Venegas-González, A., Raab, N., & Craven, D. (2025, Noviembre 3-7). *"De la sequía a la aridificación: huellas del uso de suelo de un Chile en proceso de escasez hídrica"*. SICyR Simposio Internacional Clima y Resilencia en Tiempos de Cambio, Santiago y Viña del Mar, Chile.

3. Herrera, Abel., **Zambrano, F.** (2025, Noviembre 3-7). *Detección de variaciones en niveles de aguas subterráneas mediante datos GRACE reescalados a 9 km*. SICyR Simposio Internacional Clima y Resilencia en Tiempos de Cambio, Santiago y Viña del Mar, Chile.

4. **Zambrano, F.**, Vrieling, A., Meza, F., Duran-Llacer, I., Fernández, F., Venegas-González, A., Raab, N., & Craven, D. (2025, abril). *Shifts in water supply and demand shape land cover change across Chile*. EGU General Assembly, Viena, Austria.

5. **Zambrano, F.**, Vidal-Páez, P., & Hernández, B. (2024). *Comparison of crop water demand derived from sen-ET for orchards within the Aconcagua's river basin in Chile*. IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium, 3631–3634. https://doi.org/10.1109/IGARSS53475.2024.10642732

6. **Zambrano, F.**, & Duran-Llacer, I. (2024). *Assessment of drought in continental Chile for 1981–2023 by climate variables of water supply and demand, soil moisture, and vegetation*. IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium, 2764–2768. https://doi.org/10.1109/IGARSS53475.2024.10641240

7. Duran-Llacer, I., **Zambrano, F.**, Rodríguez-López, L., Martínez-Retureta, R., & Arumí, J. L. (2024). *Analysis of Drought in Agriculture and Natural Vegetation Areas in Central Chile*. IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium, 3643–3646. https://doi.org/10.1109/IGARSS53475.2024.10642727

8. **Zambrano, F.**, Meza, F., Raab, N., & Duran-Llacer, I. (2024, marzo 11). *Drought's trends over continental Chile using climatic variables of water demand and supply, soil moisture, and vegetation productivity*. EGU General Assembly, Viena, Austria. https://doi.org/10.5194/egusphere-egu24-19099

9. Duran-Llacer, I., **Zambrano, F.**, Gómez-Escalonilla Canales, V., Martínez Santos, P., Aliagada Alvarado, M., Rodríguez-López, L., Martínez-Retureta, R., & Arumí, J. L. (2024, abril). *The response of Groundwater-Dependent Ecosystems to drought in central Chile*. EGU General Assembly, Viena, Austria. https://doi.org/10.5194/egusphere-egu24-20738

10. **Zambrano, F.**, Kunst, J. (2023, octubre 18-20). *Un observatorio de sequía para Chile desarrollado con R-shiny*. LatinR 2023 Conferencia Latinoamericana sobre Uso de R en Investigación + Desarrollo, Montevideo, Uruguay.

11. Meza, F., Raab, N., Gil, P., Yáñez, G., **Zambrano, F.**, & Araya, J. (2023, septiembre 4-7). *Desarrollo de un modelo multivariado de predicción de sequía combinando fuentes de información meteorológica, de vegetación y de respuesta agrícola*. SICyR Simposio Internacional Clima y Resilencia en Tiempos de Cambio, Santiago y Viña del Mar, Chile.

12. **Zambrano, F.**, Meza, F., & Raab, N. (2023, diciembre 11-15). *Water supply and demand drought indices to assess its impact over land cover change and vegetation development in continental Chile for 2000-2023 by ERA5-Land and MODIS datasets*. AGU Fall Meeting, San Francisco, CA.

13. Craven, D., Fuentes, N., Saldaña, A., **Zambrano, F.**, & Lopatin, J. (2023, septiembre 4-7). *Matches and mismatches of biodiversity components and anthropogenic threat complexes across Chile*. SICyR Simposio Internacional Clima y Resilencia en Tiempos de Cambio, Santiago y Viña del Mar, Chile.

14. Meza, F., Raab, N., & **Zambrano, F.** (2023, diciembre 11-15). *Multivariate Drought Index Combining Meteorological Information, Remote Sensing data and Biophysical Crop Simulation Models: Application in the Araucanía Region, Chile*. AGU Fall Meeting, San Francisco, CA.

15. Whitcraft, A. K., Sanchez Galvez, A., Puricelli, E., Humber, M., McNairn, H., Witkowski, K., Santos, C., Barbosa, L., Copati, E., Tiscornia, G., Fuentes, M., & **Zambrano, F.** (2020). *Agricultural Monitoring in the Americas (AMA): Bringing GEOGLAM and GEOSS to the Americas*. EO for Agriculture under Pressure 2020. ESA, Italia.

16. **Zambrano, F.** (2019, septiembre). *Predicción de la sequía agrícola en Chile: regresión lineal vs deep learning*. LatinR, Santiago, Chile.

17. **Zambrano, F.** (2019, agosto). *Prediction of Seasonal Agricultural Productivity Anomalies Derived from MODIS Data for the Cultivated Land of Chile*. 2019 Joint Satellite Conference. American Meteorological Society (AMS), Boston, USA.

18. **Zambrano, F.**, Vrieling, A., Nelson, A., Meroni, M., & Tadesse, T. (2018, diciembre). *Prediction of agricultural drought in Chile from multiple spatio-temporal data sources*. AGU Fall Meeting, Washington D.C., USA.

19. **Zambrano, F.** (2018, octubre). *Desarrollo de una plataforma web R-Shiny para alerta temprana de sequía agrícola*. IV Foro Nacional de Percepción Remota y SIG, Santiago, Chile.

20. **Zambrano, F.**, Lillo-Saavedra, M., & Verbist, K., Lagos, O. (2016, octubre 25). *Sixteen years of agricultural drought assessment of the BioBío region in Chile using a 250 m resolution Vegetation Condition Index (VCI)*. Proc. SPIE 9998, Remote Sensing for Agriculture, Ecosystems, and Hydrology XVIII. https://doi.org/10.1117/12.2235345

21. **Zambrano, F.**, Wardlow, B., & Tadesse, T. (2016, noviembre 29). *Evaluating satellite-derived long-term historical precipitation datasets for drought monitoring in Chile*. Proc. SPIE 9998, Remote Sensing for Agriculture, Ecosystems, and Hydrology XVIII. https://doi.org/10.1117/12.2241032

22. **Zambrano, F.**, Lillo-Saavedra, M., & Zambrano-Bigiarini, M. (2014, noviembre). *Drought analysis using the SPI and VCI indices in the Bío-Bío región*. International Expert Symposium 'Coping with Droughts', Santiago, Chile.

23. **Zambrano, F.**, Lillo-Saavedra, M., & Lagos, O. (2014, octubre). *Evaluación de la sequía agrícola, usando el índice VCI a 250m en la región del Bío-Bío, Chile*. 11th Latin American and Caribbean Conferences of Agricultural Engineering, Bogotá, Colombia.

24. **Zambrano, F.**, Lillo-Saavedra, M., & Lagos, O. (2014). *Evaluación de la sequía agrícola usando el índice VCI a 250m entre 2000-2012, en la región del Bío-Bío, Chile*. 65 Congreso de la Sociedad Agronómica de Chile, Chillán, Chile.

25. Lillo-Saavedra, M., Gonzalo, C., **Zambrano, F.**, & Merino, F. (2008). *Clasificación de imágenes fusionadas, un problema de explosión de información*. Actas del XIII Simposio SELPER La geomática al servicio de la Geociencia por un Desarrollo Sostenible, La Habana, Cuba.

26. Gonzalo, C., Lillo-Saavedra, M., Merino, F., & **Zambrano, F.** (2008). *Fusión iHS ponderada mediante dimensión fractal*. XIII Simposio de la Sociedad de Especialistas Latinoamericanos en Percepción Remota y Sistemas de Información Espacial (XIII SELPER), La Habana, Cuba.