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 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.

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

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

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

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

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.

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

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

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

Zambrano, F., Vrieling, A., Nelson, A., Meroni, M., & Tadesse, T. (2018). Prediction of agricultural drought in Chile from multiple spatio-temporal data sources. 2018, GC51H-0882. https://ui.adsabs.harvard.edu/abs/2018AGUFMGC51H0882Z

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

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

I have presented at the most prestigious conferences worldwide in terms of Earth observation, such as: American Geophysical Union (AGU), European Geosciences Union (EGU) and the International Geoscience and Remote Sensing Symposium (IGARSS).

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

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

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

Zambrano, F., Vrieling, A., Meza, F., Duran-Llacer, I., Fernández, F., Venegas-González, A., Raab, N., & Craven, D. (2025). Shifts in water supply and demand shape land cover change across Chile. EGU General Assembly. https://doi.org/10.5194/egusphere-egu25-20588

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. https://doi.org/10.5194/egusphere-egu24-19099

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). The response of Groundwater-Dependent Ecosystems to drought in central Chile. EGU General Assembly. https://doi.org/10.5194/egusphere-egu24-20738

Zambrano, F., Meza, F., & Raab, N. (2023). 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. 2023, H43F-2151. AGU Fall Meeting Abstracts. https://ui.adsabs.harvard.edu/abs/2023AGUFM.H43F2151Z

Meza, F., Raab, N., & **Zambrano, F.** (2023). Multivariate Drought Index Combining Meteorological Information, Remote Sensing data and Biophysical Crop Simulation Models: Application in the Araucanía Region, Chile. 2023, H43F-2148. AGU Fall Meeting Abstracts.