

# MARCELO R. SOUZA

Ph.D. in Meteorology



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## Summary

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Marcelo has a Ph.D. in Meteorology from the Federal University of Santa Maria (Brazil), where he investigates the contribution of extratropical cyclones and their associated fronts on precipitation patterns and magnitudes over the Southern Hemisphere for the present and future climate, using data from multiple CMIP6 models and reanalysis. He also holds a Master of Science degree focused on the seasonal variability of cyclones over the Southwestern South Atlantic and a bachelor's degree in Oceanography from the Federal University of Santa Catarina (Brazil). As he started his early career as an atmospheric scientist, he engaged in scientific research covering the fields of climatology, synoptic meteorology, climate change, and numerical modeling. All this experience helped him develop solid and strong programming and computational skills (Python, Fortran, Shell, CDO, Linux environment) and fluency in working with large datasets (CMIP5/6), reanalysis, and model simulations (RegCM, WRF). He also has unique skills in data visualization.

## Research interests

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- Synoptic and mesoscale meteorology
- Dynamics of extratropical cyclones and the mechanisms behind their development
- Responses of high-impact weather systems and extreme events to global warming
- Climate change impacts

## Education

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### PH.D. IN METEOROLOGY

2019 - 2023

Federal University of Santa Maria / Brazil

Supervisor: Dr. Everson Dal Piva

Dissertation: Extratropical cyclones and associated precipitation in the Southern Hemisphere: present and future climate

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### M.SC. IN ENVIRONMENTAL AND WATER RESOURCES

2014 - 2016

Federal University of Itajubá / Brazil

Supervisor: Dr. Michelle Reboita

Thesis: Cyclones over the southwestern South Atlantic Ocean

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2008 - 2012

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## B.SC. IN OCEANOGRAPHY

Federal University of Santa Catarina / Brazil

Supervisor: Dr. Bárbara Ramos

Undergraduate Thesis: Dynamics of the sessile community on rocky shores  
under distinct oceanographic conditions

## Complementary Education

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Joint ICTP-Trieste/ICTP-SAIIR Advanced School  
on Regional Climate Modeling

Fall 2016

São Paulo State University, UNESP, Brazil

## Technical Skills

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### Python

- Data cleaning, analysis, and visualization
- **Statistical methods:** linear regression, statistical significance and hypothesis testing, composite and correlation analysis, EOF, extreme value theory
- **Large dataset handling:** CMIP5/6 ESGF, Pangeo
- **Machine learning techniques:** DBSCAN, K-Means clustering
- **Packages:** Xarray, Scipy, Metpy, Geopandas, Pandas, Scikit-learn, Numpy, Matplotlib, Cartopy, among others

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### Other programming languages and software

- FORTRAN
- Shell/Bash
- TRACK algorithm
- Climate Data Operators (CDO)
- ArcGIS

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### Numerical Modeling

- RegCM, WRF-ARW

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### Datasets

- **Model output data:** CMIP5/6
- **Reanalysis data:** ERA5, ERA-Interim, NCEP/NCAR, NCEP/DOE, CFSR
- **Analysis/forecast data:** GFS
- **Observational data:** GPCP, IBTrACS

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### File formats

- NetCDF, GRIB, .csv, .shp, .txt

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### Operational systems

- Linux, Windows

## Soft Skills

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**Communication:** Empathy, Active Listening, Public Speaking, Writing skills, Teamwork

**Critical Thinking:** Time Management, Deadline-oriented, Problem-solving skills,  
Willingness to learn

# Experience and Research Projects

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## **Project: Extratropical cyclones and associated precipitation in the Southern Hemisphere**

2019 - 2023

*Federal University of Santa Maria / Brazil*

*Supervisor: Dr. Everson Dal Piva*

The project focused on the behavior of extratropical cyclones and their associated precipitation in the Southern Hemisphere under current and future climate scenarios. Utilizing data from CMIP6 models, ERA5 reanalysis, and GPCP observations, automated algorithms were developed and applied to track cyclones and atmospheric fronts and also to attribute the precipitation associated with these systems over the 1979-2014 and 2070-2099 periods under the SSP5-8.5 scenario. One of the main results from this project is a poleward migration of extratropical cyclones in the future and an increase in cyclone propagation speed and associated precipitation, particularly along frontal zones.

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## **Teaching Assistant**

Fall 2022

*Federal University of Santa Maria / Brazil*

*Supervisor: Dr. Nathalie Boiaski*

Developed educational materials and taught classes for the Global Changes course at the bachelor's program in Meteorology.

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## **Teaching Assistant**

Fall 2020

*Federal University of Santa Maria / Brazil*

*Supervisor: Dr. Nathalie Boiaski*

Developed educational materials and taught classes for the Observational Climatology and Statistics course in the bachelor's program in Meteorology.

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## **Project: Weather and Climate in South America**

2014 - 2017

*Federal University of Itajubá / Brazil*

*Supervisor: Dr. Michelle Reboita*

The project aimed to investigate the different atmospheric systems influencing weather and climate in South America using the regional climate model RegCM4 and conducting sensitivity experiments.

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## **Project: Cyclones over the southwestern South Atlantic Ocean**

2014 - 2016

*Federal University of Itajubá / Brazil*

*Supervisor: Dr. Michelle Reboita*

Based on studies that have shown a high frequency of cyclogenesis in the South Atlantic's southwest, particularly along the coasts of southern Brazil, Uruguay, and southeast Argentina, this project aims to assess cyclone climatology simulated by RegCM4 and HadGEM2-ES for the current climate (1979-2005) and future periods (2020-2050 and 2070-2089) under the RCP8.5 scenario, evaluating the model's performance to reproduce South Atlantic cyclogenesis patterns.

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## **Teaching Assistant**

Spring 2015

*Federal University of Itajubá / Brazil*

*Supervisor: Dr. Michelle Reboita*

Assisted class activities for the Applied Geometry course at the bachelor's program in Atmospheric Sciences.

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**Project: Dynamics of the sessile community on rocky shores under distinct oceanographic conditions**

2012

Federal University of Santa Catarina / Brazil

Supervisor: Dr. Bárbara Ramos

This project aimed to assess the ecological dynamics of rocky shore environments at two beaches on Santa Catarina Island (Brazil) influenced by the coastal dynamics associated with extreme events.

## Research Funding and Grants

### Scholarships

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Coordination for the Improvement of Higher Education Personnel Foundation (CAPES), Ministry of Education –

2019 - 2023

**Ph.D. Scholarship**

Grant Number: 88882.428276/2019-01

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Coordination for the Improvement of Higher Education Personnel Foundation (CAPES), Ministry of Education –

2014 - 2016

**M.Sc. Scholarship**

Grant Number: 1385752

## Scientific Publications

### Peer-reviewed papers:

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1. **Souza, M. R.**, Piva, E. D., Nascimento, E. L., Gan, M. A., Anabor, V., Gozzo, L. F. Southern Hemisphere extratropical cyclones in a warming climate: climatology, characteristics and future changes. *International Journal of Climatology* (in prep). 2024.
  2. **Souza, M. R.**; Piva, E. D. Storm tracks and cyclogenesis over the Southern Ocean: An overview with the HadGEM3-GC3.1 model. *International Journal of Climatology*, v. 43, p. 7565-7587, 2023. <https://doi.org/10.1002/joc.8280>
  3. Reboita, M. S.; Amaro, T. R. & **Souza, M. R.** Winds: intensity and power density simulated by RegCM4 over South America in present and future climate. *Climate Dynamics*, v. 51, p. 187-205, 2018. <https://doi.org/10.1007/s00382-017-3913-5>
  4. Reboita, M. S.; Rocha, R. P.; **Souza, M. R.**; Llopart, M. Extratropical cyclones over the southwestern South Atlantic Ocean: HadGEM2-ES and RegCM4 projections. *International Journal of Climatology*, v. 38, p. 2866-287, 2018. <https://doi.org/10.1002/joc.5468>
  5. **Souza, M. R.**; Dupas, F. A.; Reboita, M. S. Apparent Surface Temperature in the Tavares River Watershed, Florianópolis. *Brazilian Journal of Climatology*, v. 21, p. 1-19, 2017. <http://dx.doi.org/10.5380/abclima.v21i0.46247>

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6. Reboita, M. S.; Corrêa, M. P.; **Souza, M. R.**; Silva, J. P. R. A Review of the Atmospheric Sciences Course in Southern Minas Gerais: Teaching, Research, Outreach, and Societal Benefits. *Brazilian Journal of Physical Geography*, v. 9, p. 2312-2324, 2016. <https://doi.org/10.5935/1984-2295.20160165>
  7. Reboita, M. S.; **Souza, M. R.**; Armando, R. P.; Freitas, C.; Martins, D.; Miller, G. The Causes of the Semiarid Climate in the Northeastern Sertão Region. *Brazilian Journal of Climatology*, v. 19, p. 254-277, 2016. <http://dx.doi.org/10.5380/abclima.v19i0.42091>
  8. Reboita, M. S.; **Souza, M. R.**; Silva, L. F.; Alves, M. A. Climatic Aspects of the State of Minas Gerais. *Brazilian Journal of Climatology*, v. 17, p. 206-226, 2015. <http://dx.doi.org/10.5380/abclima.v17i0.41493>

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#### **Abstracts and extended abstracts published in conference proceedings:**

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1. Reboita, M. S.; **Souza, M. R.**; Rocha, R. P. Extratropical cyclones over southwestern Atlantic Ocean: present and future climates projected by RegCM4. In: *EGU General Assembly*, Viena, Austria, 2017.
2. **Souza, M. R.**; Amaro, T. R.; Ferreira, A. F.; Carnevali, M. P.; Almeida, E. C.; Podesta, D. L.; Pons, N. A. D. Surface Apparent Temperature Dynamics of the Tavares River Watershed, Florianópolis (SC). In: *XVII Brazilian Symposium on Remote Sensing*, João Pessoa, Brazil, 2015.
3. Rocha, R. P.; Reboita, M. S.; **Souza, M. R.** Cyclones climatology over the South Atlantic Ocean in different reanalysis projects. In: *11th International Conference on Southern Hemisphere Meteorology and Oceanography*, Santiago, Chile, 2015.
4. Reboita, M. S.; Rocha, R. P.; **Souza, M. R.** Cyclones climatology over the southwestern South Atlantic Ocean projected by RegCM4 nested in HadGEM2-ES. In: *11th International Conference on Southern Hemisphere Meteorology and Oceanography*, Santiago, Chile, 2015.
5. Amaro, T.; **Souza, M. R.**; Reboita, M. S. Surface wind comparison in Minas Gerais: RegCM4, INMET, and ERA-INTERIM. In: *18th Brazilian Congress of Meteorology*, Recife, Brazil, 2014.
6. Almeida, E. C.; **Souza, M. R.**; Vital, R. C.; Bernardes, M. E. C. Environmental Education Practice at Major João Pereira State School, Itajubá-MG, with emphasis on energy and water consumption. In: *IX Seminar on Environment and Renewable Energies*, Itajubá, Brazil, 2014.
7. Dreyer, J.; Goncalves Neto, A.; Nascimento, L. V.; Puhl, P. R.; Behring, A.; Pereira, B.; Miranda, R. J.; **Souza, M. R.**; Ritter, F.; Bexiga, G.; Schmitt, P.; Fonseca, A. Oceanographic characterization of the southern region of Lagoa da Conceição (SC, Brazil) and its relationship with the eutrophication process. In: *IV Brazilian Congress of Oceanography*, Rio Grande, Brazil, 2010.

## Languages

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- **English:** Advanced (Reading, Listening, Speaking, Writing)
- **Spanish:** Advanced (Reading), Intermediate (Speaking, Listening, Writing)
- **Portuguese:** Native speaker

## Referees

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**Prof. Dr. Everson Dal Piva**

*Professor at the Federal University of Santa Maria / Brazil*

- **Relation:** Ph.D. Supervisor
- **Contact:** [everson.bento@gmail.com](mailto:everson.bento@gmail.com)

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**Prof. Dr. Ernani de Lima Nascimento**

*Professor at the Federal University of Santa Maria / Brazil*

- **Relation:** Professor during Ph.D. studies and member of the dissertation defense committee
- **Contact:** [ernani.nascimento@ufsm.br](mailto:ernani.nascimento@ufsm.br)

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**Prof. Dr. Vagner Anabor**

*Professor at the Federal University of Santa Maria / Brazil*

- **Relation:** Member of the dissertation defense committee
- **Contact:** [vanabor@ufsm.br](mailto:vanabor@ufsm.br)