Luan da Fonseca Santos

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Summary

I am an applied mathematician and currently a Postdoctoral Researcher Associate at Princeton University working with the FV3 team at the Geophysical Fluid Dynamics Laboratory (GFDL). My primary research area focuses on advancing numerical techniques for global atmospheric models. More specifically, I work with finite-volume and finite-difference methods for geophysical fluid dynamics on spherical computational grids, with a focus on mitigating grid-imprinting for enhanced accuracy in simulations.

Education

Institute of Mathematics and Statistics, University of São Paulo São Paulo, SP, Brazil

Ph.D. in Applied Mathematics *March 2020 - May 2024*

- Thesis title: Analysis of finite-volume advection schemes on cubed-sphere grids and an accurate alternative for divergent winds.
- With financial support from São Paulo Research Foundation (FAPESP), grant 20/10280-4 and CAPES.

M. Sc. in Applied Mathematics *March 2018 - March 2020*

- Dissertation title: Analysis of mimetic finite volume schemes on classical and moist shallow water models considering topography based local refinement in spherical Voronoi grids.
- With financial support from São Paulo Research Foundation (FAPESP), grant 17/25191-4.

B. Sc. in Applied Mathematics (GPA: 9.3/10) *2014 - 2017*

- Undergraduate thesis: Local refinement and interpolation in spherical icosahedral grids.
- Honorable mention for outstanding performance in the Applied Mathematics B.Sc. program.

Experience

Cooperative Institute for Modeling the Earth System, Princeton University Princeton, NJ, USA

Postdoctoral Researcher Associate *July 2024 - Present*

- Implementing and evaluating specific enhancements to FV3's numerical algorithms to advance the accuracy and efficiency of FV3-based weather and climate models. Supervisors: Dr. Lucas Harris and Dr. Joseph Mouallem.

Institute of Mathematics and Statistics, University of São Paulo São Paulo, SP, Brazil

Graduate Researcher Student *March 2018 - May 2024*

- Numerical methods for PDEs, finite-volume/difference schemes for geophysical fluid dynamics, locally refined Voronoi grids, cubed-sphere grids. Supervisor: Dr. Pedro Peixoto.
- Developed topography-based locally refined spherical Voronoi grids for South America and implemented a finite-volume moist shallow-water model to evaluate their effectiveness.
- Developed and implemented an enhanced transport scheme for the NOAA-GFDL FV3 model, achieving minimal additional computational overhead.

Undergraduate Researcher Student *July 2017- December 2017*

- Worked on the implementation of algorithms for generating topography-based, locally refined spherical Voronoi grids on the sphere. Funded by FAPESP, grant number 17/11542-0. Supervisor: Dr. Pedro Peixoto.

Teaching Assistant

- Grad courses: 1^{st} sem/2019, 1^{st} sem/2020 and 1^{st} sem/2021 - MAP5729 - Introduction to Numerical Analysis.
- Undergrad courses:
  - 2^{nd} sem/2019 - MAP2320 - Numerical methods for PDEs.
  - 2^{nd} sem/2018 - MAP0214 - Numerical Calculus with Applications to Physics.
  - 1^{st} sem/2017 - MAC0427 - Non-linear Optimization.

Inst. of Astronomy, Geophysics and Atmospheric Sci., University of São Paulo São Paulo, SP, Brazil

Part-time Computer Lab Monitor *January 2015 - July 2016*

- Ensured smooth operation of computer lab hardware and software, providing technical support to students and resolving any issues promptly.

Publication list

- Luan F. Santos and Pedro S. Peixoto (2024). Analysis of finite-volume transport schemes on cubed-sphere grids and an accurate scheme for divergent winds, **In review**, Preprint: http://dx.doi.org/10.2139/ssrn.4866660.
- Luan F. Santos and Pedro S. Peixoto (2021). Topography based local spherical Voronoi grid refinement on classical and moist shallow-water finite volume models, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-14-6919-2021.

Presentations and participation at events

- **2023**: Talk at the *FV3 group meeting*, GFDL/NOAA, Princeton, USA: *Enhancing accuracy of FV3 finite-volume operators.*
- **2021**: Participation in the ESCAPE2/Fondazione Alessandro Volta Summer school program - *Towards exascale computing for numerical weather prediction, Lake Como School of Advanced Studies (online).*
- **2021**: Talk at *PDEs on the sphere 2021*, Offenbach, Germany (online): *Topography based local spherical Voronoi grid refinement on classical and moist shallow-water finite volume models.*
- **2019**: Participation in the *Winter School in Atmospheric Numerical Modeling at CPTEC (Center for Weather Forecasting and Climate Studies), Cachoeira Paulista, SP, Brazil.*
- **2019**: Poster Presentation at *PDEs on the sphere 2019*, Montréal, Québec, Canada: *Topography based local refinement in spherical Voronoi grids.*

Referee Activities

- Meteorological Applications (2024).

Technical Skills

- Programming languages: Fortran, Python, C, and Matlab.
- Experience with parallel programming using OpenMP and MPI.
- General software and tools: Linux environment, Bash scripts, Git, remote servers, Vim, LaTeX.

Links

- Personal webpage: https://luanfs.github.io/
- Google scholar: https://scholar.google.com/citations?user=D-uXvM0AAAAJ&hl=en

Additional Information

- Citizenship: Brazilian.
- Languages: Portuguese (native) and English (advanced).