

LogoClim: WorldClim in NetLogo

Daniel Vartanian¹, Leandro Garcia², and Aline Martins de Carvalho³

¹ School of Arts, Sciences, and Humanities, University of São Paulo, São Paulo, Brazil ² School of Medicine, Queen's University Belfast, Belfast, United Kingdom ³ School of Public Health, University of São Paulo, São Paulo, Brazil

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Summary

LogoClim is a NetLogo model for simulating and visualizing global climate conditions. It allows researchers to integrate high-resolution climate data into agent-based models, supporting reproducible research in ecology, agriculture, environmental science, and other fields that rely on climate data integration.

The model utilizes raster data to represent climate variables such as temperature and precipitation over time. It incorporates historical data (1951-2024) and future climate projections (2021-2100) derived from global climate models under various Shared Socioeconomic Pathways (SSPs) (O'Neill et al., 2017). All climate inputs come from WorldClim 2.1, a widely used source of high-resolution, interpolated climate datasets based on weather station observations worldwide (Fick & Hijmans, 2017), available for academic and other non-commercial use.

LogoClim follows the FAIR Principles for Research Software (Barker et al., 2022) and is openly available on the CoMSES Network and GitHub. Figure 1 and Figure 2 illustrate the model's interface and functionality.

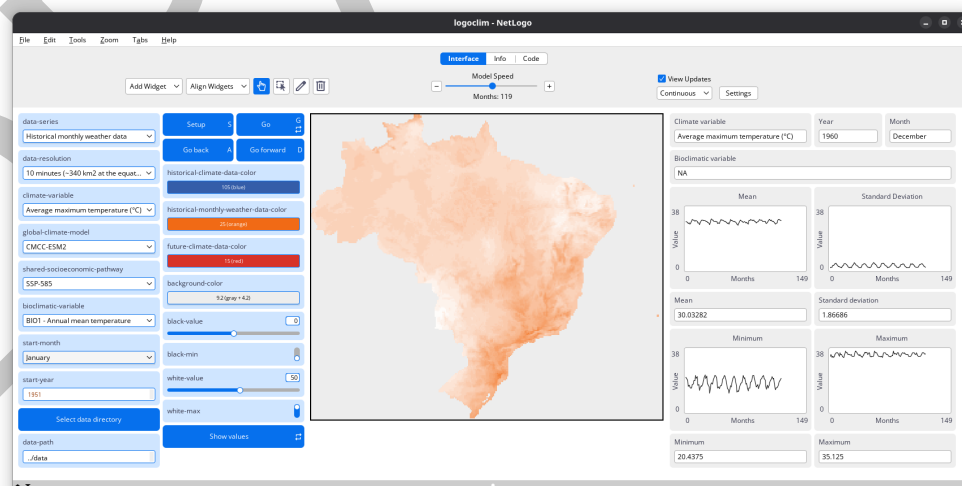


Figure 1: LogoClim Graphical User Interface — Brazil.

Statement of need

The lack of reproducibility is a major concern in science (Baker, 2016), including in computational research (Peng, 2011). This challenge is particularly relevant for agent-based models, which are used to simulate complex phenomena (Grimm et al., 2006, 2020). One effective strategy to address this issue is the development of open, specialized tools that enhance transparency and promote standardization, and reusability among researchers (Barba, 2022; Ram et al., 2019). This is why LogoClim was created.

The LogoClim model was developed for seamless integration with other models through NetLogo's LevelSpace extension (Hjorth et al., 2020), which enables parallel execution and data exchange between models. This integration capability makes it particularly valuable for agent-based simulations that incorporate climate data to study ecological, environmental, or social processes affected by climate conditions.

Motivation

The model was originally developed as part of a project by the Sustentarea Research and Extension Center, aimed at evaluating the impact of climate change on the health and nutrition of Brazilian children under five years old (Carvalho et al., 2023). During development, however, we recognized that the model had broader potential beyond the scope of our study. LogoClim can now be used as a submodel within agent-based models designed to help researchers, policymakers, and practitioners explore the potential impacts of climate change across different contexts and geographical areas.

How it works

LogoClim operates on a grid of patches, with each patch representing a geographic area and storing values for latitude, longitude, and selected climate variables. During simulation, patches update their colors based on the underlying data, enabling users to visualize spatial and temporal changes. The model interface also provides plots showing the mean, minimum, maximum, and standard deviation of the selected variable over time.

The model supports all three climate data series from WorldClim 2.1: long-term historical climate averages (1970–2000), historical monthly weather (1951–2024), and future climate projections (2021–2100). Each series is available at multiple spatial resolutions (from 10 minutes (~340 km² at the equator) to 30 seconds (~1 km² at the equator)), which can be selected within the model interface. Further details about each series are available on the WorldClim website.

The datasets are available for download from WorldClim 2.1, but must be converted to ASCII format for compatibility with NetLogo. To simplify this workflow, we provide Quarto notebooks with reproducible pipelines for downloading and processing the data. These notebooks can be customized to meet specific research needs.

We also provide example datasets for testing and demonstration. These files are available in the model's OSF repository and are ready to use with LogoClim.

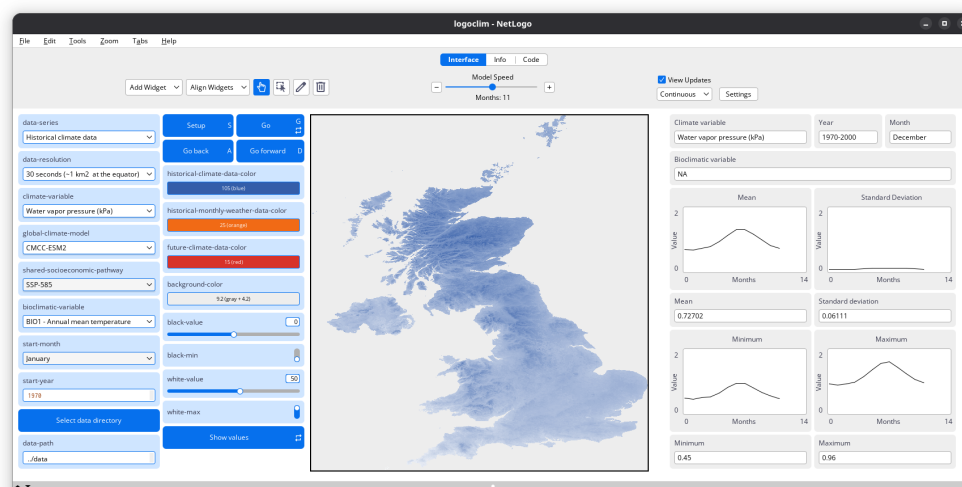


Figure 2: LogoClim Graphical User Interface — United Kingdom.

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Author contributions

The roles below were defined based on the Contributor Roles Taxonomy ([CRediT](#)).

Daniel Vartanian: Conceptualization, Data curation, Methodology, Project administration, Software, Validation, Visualization, Writing – original draft, and Writing – Review & editing.

Leandro Garcia: Validation, Writing – original draft, and Writing - Review & editing.

Aline Martins de Carvalho: Conceptualization, Funding acquisition, Project administration, Supervision, Validation, Writing – original draft, and Writing – Review & editing.

Additional information

LogoClim is an independent project with no affiliation to [WorldClim](#) or its developers. Users should be aware that WorldClim datasets are freely available for academic and other non-commercial use only. Any use of WorldClim data within LogoClim must comply with [WorldClim's licensing terms](#).

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