

BYEONGHWA JEONG, PhD

R&D Associate | Oak Ridge National Laboratory

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RESEARCH PROFILE

I am a geographer and spatial data scientist. I develop and apply computational and spatial analytical methods, including deep learning, machine learning and spatial statistics, for population and socioeconomic measurement, urban change and infrastructure risk.

RESEARCH AND PROFESSIONAL APPOINTMENTS

Oak Ridge National Laboratory

Oak Ridge, Tennessee, USA

R&D Associate

Feb 2025-present

Develop geospatial AI methods for large-scale population modelling using graph neural networks, computer vision, satellite embeddings, and spatial machine learning, with applications to population forecasting, socioeconomic estimation, disaster impacts, and infrastructure risk.

Develop a deep-learning framework using AlphaEarth satellite embeddings to reconstruct gridded population surfaces, explicitly modelling both populated and zero-population areas and evaluating geographic transferability across Taiwan, Ecuador, the Democratic Republic of the Congo, and Japan.

Train and evaluate PyTorch deep-learning and graph models on NVIDIA A100 and H200 GPU systems, with a focus on scalable architectures, geographic transferability, and efficient modelling of large spatial datasets.

Contribute to LandScan Global and LandScan Mosaic, including global gridded-population production, rapid population-impact estimation for disasters and conflicts, and development of population-model inputs.

Lead or co-lead research on multi-scale population forecasting, satellite-based population reconstruction, building-level wealth estimation, and hurricane-induced power-outage forecasting; submitted a \$228,000 competitive ORNL seed proposal as Principal Investigator on graph-based outage and population-impact prediction.

University of Toronto, School of Cities

Toronto, Ontario, Canada

Postdoctoral Research Fellow

Jul 2023-Jan 2025

Developed computational methods for building-level and downtown-scale recovery analysis using privacy-preserving footfall, real-estate, socioeconomic, and open geospatial data.

Estimated sampling uncertainty, imputed missing footfall observations, developed data-driven downtown boundaries, and applied clustering and explainable machine learning to investigate heterogeneous recovery patterns.

Held day-to-day responsibility for training a graduate research intern on an LLM-based urban-planning chatbot project, from research design and coding through manuscript development; the work resulted in a peer-reviewed publication for which I served as corresponding author.

Provided project-based computational training and iterative feedback to undergraduate research interns.

Daejeon Sejong Research Institute

Daejeon, South Korea

External Collaborative Researcher

Aug-Oct 2023; Oct-Dec 2024

Collected and analysed web and social-media text using TF-IDF, topic modelling, and network analysis for regional identity, civic participation, and science-city branding projects.

Contributed to data collection, preprocessing, interpretation, and policy-report preparation.

Daejeon Sejong Research Institute

Daejeon, South Korea

External Technical Consultant

Jul-Sep 2022

Advised on Python web scraping, text preprocessing, topic modelling, and network analysis for a social-media study of urban place identity.

Korea Environment Institute

Sejong, South Korea

Part-time Modeller

Aug-Oct 2021

Developed a deep-learning spatial interpolation model combining OCO-2 satellite observations and GEOS-Chem outputs to estimate unobserved atmospheric CO₂ values.

Korea Research Institute for Human Settlements

Sejong, South Korea

Assistant Research Fellow

Sep 2018-Sep 2019

Developed national grid-based indicators of access to schools, parks, and other daily infrastructure, and constructed longitudinal indicators of building age for territorial monitoring and policy analysis.

Kyungpook National University

Daegu, South Korea

Student Research Assistant

Nov 2015-Jun 2016

Analysed urban carbon patterns from OCO-2 satellite data and developed foundational skills in Python, geostatistics, and remote-sensing data processing.

EDUCATION

University College London

London, UK

PhD in Geography (Geospatial Data Science)

Sep 2019-Jun 2023

Thesis: An Integrated Deep Learning Model Using Retail, Residential and Footfall Change Data to Predict Retail Gentrification.

Supervisors: Professor Paul Longley and Professor James Cheshire.

University of Edinburgh

Edinburgh, UK

MSc in Geographical Information Science (Distinction)

Sep 2017-Aug 2018

Dissertation: Anticipation of Commercial Gentrification through Time and Space: Seoul, South Korea.

Kyungpook National University

Daegu, South Korea

BA in Geography

Mar 2008-Aug 2015

PEER-REVIEWED PUBLICATIONS

- Lee, B. and **Jeong, B.*** (2026). Development of grid-based population projection method: A modified cohort component approach applied to South Korea. *Population, Space and Place*, 32(1).
- **Jeong, B.** and Lee, B. (2026). Popnet: Computer vision based deep learning model for forecasting gridded population. *International Journal of Geographical Information Science*, 40(1).
- Zhou, X., **Jeong, B.***, and Chapple, K. (2025). A large language model-based chatbot system framework for urban planners. *Expert Systems with Applications*, 300, 130307.
- **Jeong, B.**, Song, J., and Kim, Y. (2025). A first open retail boundary dataset for South Korea using open data and computer vision. *Scientific Data*, 12, 622.
- **Jeong, B.** and Chapple, K. (2025). Does class matter? Understanding differential pandemic recovery via a building typology. *Environment and Planning B: Urban Analytics and City Science*.
- Forouhar, A., Chapple, K., Allen, J., **Jeong, B.**, and Greenberg, J. (2024). Assessing downtown recovery rates and determinants in North American cities after the COVID-19 pandemic. *Urban Studies*, 62(6), 1209-1231.
- **Jeong, B.**, Allen, J., and Chapple, K. (2024). A new commercial boundary dataset for metropolitan areas in the USA and Canada, built from open data. *Scientific Data*, 11, 422.
- **Jeong, B.** and Kim, J. (2020). Topic modeling of the transition of the sense of place in an urban regeneration area: A case study of Daegu Bangcheon Market. *Journal of Daegu Gyeongbuk Studies*, 19(1), 27-44.
- **Jeong, B.** and Kim, J. (2019). Application and evaluation of self-organising map-based spatial clustering for regional policy recommendations. *Journal of the Korean Geographical Society*, 54(3), 387-404.
- **Jeong, B.** and Um, J.-S. (2016). Comparative evaluation of South versus North Goseong County in terms of forest carbon offset potential. *Spatial Information Research*, 24(1).

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MANUSCRIPTS UNDER REVIEW

- **Jeong, B.**, Lebakula, V., and Urban, M. (2026). From grids to communities: A graph neural network framework for multi-scale population forecasting. *AAAI AI for Social Impact* (under review).
- **Jeong, B.**, Lee, S., and Myers, A. (2026). Dual-structure spatio-temporal graph learning for hurricane-induced power outage forecasting. *AAAI AI for Social Impact* (under review).

- **Jeong, B.** and Kim, J. (2026). Predicting retail gentrification through composite retail vitality index and spatial competition metrics. *International Journal of Urban Sciences* (under review).
- **Jeong, B.**, Tuccillo, J., and Gaboardi, J. (2026). Building-level wealth index prediction using DHS survey data and machine learning: A flexible multi-scale framework. *Computers, Environment and Urban Systems* (under review).

CURRENT RESEARCH PROJECTS

- **Interpretable population estimation from aerial imagery** - Developing a two-stage semantic-segmentation and regression framework with ensemble self-training, pseudo-label filtering, temporal transfer, and landscape-class contribution maps; manuscript submission planned in 2026.
- **Population surface reconstruction using AlphaEarth embeddings** - Developing a deep-learning framework that uses AlphaEarth satellite embeddings to reconstruct gridded population distributions while explicitly learning both populated and zero-population areas. The approach excludes GHSL-supported locations from training supervision and evaluates whether embedding-based predictions suppress potentially unsupported population allocations while preserving predictive accuracy on held-out populated cells. The framework is being evaluated across Taiwan, Ecuador, the Democratic Republic of the Congo, and Japan to assess geographic transferability.
- **Scalable latent global routing for large-scale spatio-temporal graph learning** - Developing ST-LAG, a latent-mediated graph architecture that combines sparse local graph propagation with node-to-latent global routing to model non-local dependencies without dense $N \times N$ node interactions, improving computational and memory efficiency for large-scale graphs.
- **Large-scale graph learning for population dynamics** - Applying ST-LAG to continental-scale gridded population forecasting across the United States, modeling both local spatial relationships and long-distance demographic dependencies over more than 150,000 spatial units.
- **Scalable regional power-outage forecasting** - Applying ST-LAG to extend hurricane-induced power-outage forecasting from Florida to the southeastern United States, modelling physical grid connectivity and non-local outage dependencies at a larger regional scale. Developing an API for integration into ORNL's EDGAR platform to support operational outage-risk prediction.

TECHNICAL REPORTS

- **Jeong, B.**, Lebakula, V., and Urban, M. (2026). *PopGNN: Graph neural network-based flexible future population forecasting model*. Oak Ridge National Laboratory.
- **Jeong, B.**, Adams, D., Zimmer, A., and Urban, M. (2026). Satellite embedding-based population imputation for areas with missing building-footprint data: A computer vision-based approach. Oak Ridge National Laboratory.

POLICY REPORTS

- Chapple, K., Forouhar, A., **Jeong, B.**, and Ortynsky, S. (2025). *Assessing the doom loop*. Lincoln Institute of Land Policy.
- Joo, H., Han, S., Jeong, E., **Jeong, B.**, Song, J., and Noh, M. (2025). *Big data-driven strategies for enhancing the 'Science City Daejeon' brand*. Daejeon Sejong Research Institute.
- Joo, H., Noh, M., and **Jeong, B.** (2024). *Basic research for citizen-participatory urban branding*. Daejeon Sejong Research Institute.
- Joo, H., Han, S., Yoon, S., Moon, J., and **Jeong, B.** (2023). *Discover 'regional things' using big-data analysis and civic collaboration*. Daejeon Sejong Research Institute.
- Lim, E., et al., including **Jeong, B.** (2021). *Development and utilisation of a multiple deprivation index for place-based living-facilities policy*. Korea Research Institute for Human Settlements.
- Lim, E., et al., including **Jeong, B.** (2019). *National Territorial Monitoring Report 2018*. National Geographic Information Institute.

DATASETS

- Lebakula, V., Gonzales, J., Stipek, C., Tsybina, E., Zimmer, A., Nukavarapu, N., **Jeong, B.**, Reynolds, B., Kaufman, J., Fan, J., Martin, A., Buck, W., Basford, S., Faxon, A., Meade, S., and Urban, M. (2025). *LandScan Global 2024*. Oak Ridge National Laboratory. Dataset. <https://doi.org/10.48690/1532445>

RESEARCH FUNDING AND PROPOSALS

Submitted as Principal Investigator

- **Principal Investigator.** *A Graph Neural Network Approach for Forecasting Disaster-Driven Power Outages and Population Impacts*. ORNL competitive internal Seed programme. \$228,000 requested. submitted 2026; decision pending.

Selected funded projects - team contributor

- **Project contributor.** *Marshalling a Robust Downtown Recovery for Ottawa*. Canadian Urban Institute. \$109,514 equivalent. Contributions: data curation and preprocessing, methodological selection, analysis, visualisation, and proposal writing.
- **Project contributor.** *Assessing the Doom Loop: Scenarios in Four North American Downtowns*. Lincoln Institute of Land Policy. \$52,931 equivalent. Contributions: data collection and preprocessing, explainable machine learning, analysis, and proposal writing.
- **Project contributor.** *Evaluation and Characteristics of Coastal Areas Using Image Segmentation*. Korea Maritime Institute. \$2,885 equivalent. Contributions: idea development, provision of core data, writing, and review.

TEACHING, RESEARCH TRAINING, AND STUDENT DEVELOPMENT

Guest lecture

- **Mar 2025** - *Computer-vision methods for delineating regional boundaries*. Center for Territorial Monitoring, Korea Research Institute for Human Settlements (60-minute guest lecture about professional methods seminar).
- **Aug 2024** - *Applications of AI for predicting social phenomena*. Department of Geography Education, Korea National University of Education (60-minute guest lecture for undergraduate and postgraduate students).
- **Jun 2023** - *Social phenomena and spatial AI*. Department of Geography, Kyungpook National University (60-minute guest lecture for undergraduate and postgraduate students).

Research training and mentoring

- Primary day-to-day research mentor for Xiaoxin Zhou, graduate research intern, University of Toronto (approximately one year). Provided sustained training in research-question development, literature review, methodological reasoning, coding, analysis, interpretation, academic writing, and manuscript revision, alongside pastoral support. The project resulted in a peer-reviewed article in *Expert Systems with Applications* for which I served as corresponding author; the mentee subsequently entered doctoral study, supported by my academic reference.
- Provided project-based computational training to undergraduate research interns Christopher Kim and Brandon Choi, including analysis using project code and data, review of analytical outputs, and iterative feedback on coding, methodological choices, interpretation, and research communication.
- Initiated and led a collaborative research project with doctoral researchers Gaweon Shin and Changwha Oh, developing the overall research design, coordinating individual research tasks, advising on computational methods and analytical workflows, and providing iterative feedback on code, results, interpretation, and research communication.
- Provide mentoring to a doctoral student at the University of North Carolina at Charlotte through the 2026–2027 Korea-America Association for Geospatial and Environmental Sciences (KAGES) Mentoring Program, focusing on workload management and job-application preparation.

CONFERENCE PRESENTATIONS

- **2026** - *Building-level wealth index prediction using DHS data and machine learning*. American Association of Geographers Annual Meeting.
- **2024** - *Delineating commercial boundaries using an AI-based computer-vision technique with open data in South Korea*. AsiaCarto 2024.
- **2024** - *Typology of downtown recovery at the granular scale*. Geoinformatics 2024.

PROFESSIONAL SERVICE

Conference service

- Program Committee Member, 6th International Workshop on Big Data and AI-Assisted Tools, Methods, and Use Cases for Innovative Scientific Discovery, in conjunction with the 2026 IEEE International Conference on Big Data.
- Member of the Organising Committee, International Conference on Geospatial Information Science: Spatially Enabled Society with AI and Digital Twin (2019).

Journal reviewing

- International Journal of Geographical Information Science (2025)
- Computers and Electrical Engineering (2026)
- Papers in Regional Science (2026)
- Spatial Information Research (2026)
- Transactions in GIS (2026)
- Applied Spatial Analysis and Policy (2026).

Academic outreach

- Founded and currently run **Geo-opportunity (@geo_opportunity)**, an Instagram account that curates and shares PhD and postdoctoral opportunities in geography and GIS for students and early-career researchers.

HONOURS AND PRIZES

- **2020 - Best Paper Award**, Daegu Gyeongbuk Development Institute. Topic Modeling of the Transition of the Sense of Place in an Urban Regeneration Area.
- **2015 - Outstanding Paper Award**, Korea Spatial Information Society. Comparative Evaluation of Pixel-Value Signatures between UN A/R CDM Project Areas in South and North Goseong.
- **2013 - June-Myeong Scholarship for ArcGIS proficiency**, GEO C&I Corporation. \$300; approximately £220.

TECHNICAL SKILLS AND LANGUAGES

- **Programming and data engineering:** Python (pandas, GeoPandas, NumPy, PySpark), SQL/MariaDB, R, web scraping, reproducible geospatial workflows.
- **Machine learning and AI:** PyTorch, scikit-learn, XGBoost, computer vision, graph neural networks, spatio-temporal modelling, NLP, large language models, retrieval-augmented generation, prompt engineering, model explainability.
- **GIS and remote sensing:** ArcGIS, QGIS, Google Earth Engine, raster and vector analysis, OpenStreetMap, geospatial databases, spatial statistics and network analysis.
- **Computing:** HPC/GPU workflows.
- **Languages:** Korean (native), English (professional proficiency).