Hamidreza Zoraghein

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Office of Social & Behavioral Science Research
Population Council
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Education

University of Colorado Boulder
Boulder, Colorado

Ph.D. Geography - Geographic Information Systems (GIS) *2013 – 2017*
Dissertation Title: Creating temporally consistent small area census units using advanced combinations of areal interpolation and spatial refinement: Method development and assessment.
Advisor: Dr. Stefan Leyk

K. N. Toosi University of Technology
Tehran, Iran

M.S. Civil Engineering - GIS (with Highest Honors) *2008 – 2011*

K. N. Toosi University of Technology
Tehran, Iran

B.S. Surveying Engineering *2004 – 2008*

Research Experience

Population Council

Associate I *Oct. 2019 - present*

Project: Demographic Modeling for Human and Environmental Research

- Co-led the launch of the Community Demographic Model website for analysis of human-environment dynamics
    - Led the coordination with external partners to complete the project
    - Led the virtual publicly available webinar with expert panel discussions about the CDM

- Completed Mexico's subnational urbanization and population projection models in collaboration with the country's PC office
    - Co-led expert discussions with Mexico's National Population Council (CONAPO) about population projections and scenario development consistent with the IPCC's Shared Socioeconomic Pathways (SSPs)

Project: A global projection of population by degree of urbanization
- An ongoing collaborative project with the City University of New York, University of Colorado, and Joint Research Centre of the European Commission

Project: High-resolution spatio-temporal forecasting of COVID-19 incidence using Machine Learning
- A collaborative project with the University of Colorado resulted in a predictive model that ranked 3rd in incident rate forecasts at the county level among all models in the COVID-19 ForecastHub used by CDC

Project: Assessment of India's vulnerability to different flood types
- Created high resolution population grids from India's settlement boundaries
- Created grids representing varying levels of different flood risks
- Integrated population grids with grids of different flood risks for exposure analysis

Frederick S. Pardee Center for International Futures

Research Scientist *Sept. 2018 - Oct. 2019*

Project: The multi-institutional Integrated Multi-scale, Multi-sector Modeling (IM3) project, with a focus on bringing together diverse modeling capabilities to study how the coupled human-Earth system responds to different stresses. *Funded by Department of Energy's Office of Science*
- Improved a demographic model for the SSP-based population projection at the U.S. state level
- Prepared the U.S. state-level spatial population downscaling model at 1 KM resolution
- Co-prepared the U.S. state-level demographic population projection model

National Center for Atmospheric Research

Postdoctoral Fellow   *Aug. 2017 - Aug. 2018*

Project: The multi-institutional Integrated Multi-scale, Multi-sector Modeling (IM3) project, with a focus on bringing together diverse modeling capabilities to study how the coupled human-Earth system responds to different stresses. *Funded by Department of Energy's Office of Science*

- Improved the urbanization projection model that estimates urbanization levels of individual countries, U.S. states, China provinces and India states by 2100
- Improved the initial U.S. urban/rural/total population grids in 1990 and 2000 based on the U.S. Census data that will be used as the main inputs to the final population gravity model

Project: IBSS: Multi-Scale processes affecting spatial population distributions, examining the different demographic, socioeconomic, and geographic factors and processes that influence population levels and distributions at different scales ranging from local to national. *Funded by NSF*

- Contributed to collaborative research with the Global Human Settlement Layer project to evaluate the accuracy and completeness of different GHSL products to map human settlement and population across different urban/peri-urban/rural landscapes in Massachusetts

National Center for Atmospheric Research

Graduate Research Assistant   *2015 - 2017*

Project: Improvement of the Community Demographic Model (CDM), developed in the Integrated Assessment Modeling (IAM) group at NCAR, with the aim to project population, age, gender, urban/rural residence and household type globally as demographic inputs to complex human-environment systems. *Funded by NSF*

- Improved the urbanization projection model by employing more input data for projection and transferred it to R
- Improved the household projection model that estimates the number of households for different education levels, urban/rural residence, and age groups globally by 2100 and transferred it to R

Department of Geography

Graduate Research Assistant   *2013-2017*

Project: Putting people in their place: Constructing a geography for census microdata, with the focus to construct time-series of demographic estimates within temporally consistent small-area census units using spatial analytical methods. *Funded by NSF*

- Used advanced areal interpolation methods to create temporally consistent small-area population estimates from 1990 to 2010 in several study areas in the United States as a methodological breakthrough to study micro-scale demographic processes
- Developed a comprehensive and comparative framework to assess the effectiveness of using various multi-scale ancillary variables to model the population distribution more reliably
- Developed a complementary approach to improve the accuracy of estimating the population distribution in rural areas
- Developed a methodological solution to estimate the exposed population to natural hazards for different racial groups and age structures

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Project Development

- NYC Town and Gown, Climate Vulnerability, Impacts, and Adaptation Analysis (8/2022-2/2024) (Consultant, funded by NYC Mayor's office of climate resiliency via DCAS via Town and Gown)
- A global projection of population by degree of urbanization (12/2021-12/2024) (CO-PI, funded by the European Commission)
- High-resolution spatio-temporal forecasting of COVID-19 incidence using Machine Learning (CO-PI, funded by the Population Council and Hewlett Foundation)
- Recovering from a pandemic: Unraveling neighborhood geographic disparities in consumer and business behavior in 2021 (Consultant, Seed grant funded by the University of Colorado Boulder)

Publications

Refereed Publications

- Karimzadeh, M., Ngo, T., Lucas, B., and **Zoraghein, H.**, 2023. "Forecasting COVID-19 and Other Infectious Diseases for Proactive Policy: Artificial Intelligence Can Help.," *Journal of Urban Health*, 1-4.

- **Zoraghein, H.**, Pinchoff, J., Balk, D., Montgomery, M., and Engin, H., 2022. "People and infrastructure: multi-scale assessment of coastal and fluvial flood exposure in India.," *Environmental Research Communications*.

- Cramer, E. Y., Huang, Y., Wang, Y., Ray, E. L., Cornell, M., Bracher, J., ..., **Zoraghein, H.**, ... & Reich, N. G. 2022. "The United States COVID-19 Forecast Hub dataset.," *Scientific data*, 9(1), 1-15.

- Vahedi, B., Karimzadeh, M., and **Zoraghein, H.**, 2021. "Spatiotemporal prediction of COVID-19 cases using inter-and intra-county proxies of human interactions.," *Nature Communications*, 12 (1), 1-15.

- **Zoraghein, H.**, and O'Neill, B., 2020. "A spatial population downscaling model for integrated human-environment analysis in the U.S.," *Demographic Research*, 43, 1563-1606.

- Jiang, L., O'Neill, B., **Zoraghein, H.**, and Dahlke, S., 2020. "Population scenarios for U.S. states consistent with Shared Socioeconomic Pathways," *Environmental Research Letters*, 15 (9), 094097.

- **Zoraghein, H.**, and O'Neill, B., 2020. "U.S. state-level projections of the spatial distribution of population consistent with Shared Socioeconomic Pathways," *Sustainability*, 12 (8), 3374.

- **Zoraghein, H.**, O'Neill, B. Data Supplement: U.S. State-Level Projections of the Spatial Distribution of Population Consistent with Shared Socioeconomic Pathways. (Version v0.1.0) [Data set]. Available online: https://doi.org/10.5281/zenodo.3756179 (accessed on 19 April 2020).

- **Zoraghein, H.**, and Leyk, S., 2019. "Data-enriched interpolation for temporally consistent population compositions," *GIScience & Remote Sensing*, 56 (3), 430-461.

- Uhl, J., **Zoraghein, H.**, Leyk, S., Balk, D., Corbane, C., Syrris, V., and Florczyk, A., 2018. "Exposing the urban continuum: Implications and cross-comparison from an interdisciplinary perspective," *International Journal of Digital Earth*, 1-23.

- **Zoraghein, H.**, and Jiang, L., 2018. "The improved urbanization projections of the NCAR Community Demographic Model (CDM)," *NCAR Technical Note NCAR/TN-548+STR*.

- **Zoraghein, H.**, and Leyk, S., 2018. "Enhancing areal interpolation frameworks through dasymetric refinement to create consistent population estimates across censuses," *International Journal of Geographical Information Science*, 32 (10), 1948-1976.

- Jiang, L., **Zoraghein, H.**, and O'Neill, B., 2018. "Population projections for U.S. states under the Shared Socioeconomic Pathways based on global gridded population projections," *NCAR Technical Note NCAR/TN-542+STR*.

- **Zoraghein, H.**, Leyk, S., Ruther, M., and Buttenfield, B., 2016. "Exploiting temporal information in parcel data to refine small area population estimates," *Computers, Environment and Urban Systems*, 58, 19-28.

- **Zoraghein, H.**, Alesheikh, A., Alimohammadi, A., and Vahidnia, M., 2012. "The utilization of soft transformation and Genetic Algorithm to model two sources of uncertainty of Indicator Kriging," *Computers, Environment and Urban Systems*, 36 (6), 592-598.

- **Zoraghein, H.**, Alesheikh, A., Alimohammadi, A., and Vahidnia, M., 2012. "A new approach for interpolation of precipitation data by soft Indicator Kriging and Genetic Algorithm," *Iranian Remote Sensing and GIS*, 3 (3), 15-32 (In Persian).

Conference Proceedings

- **Zoraghein, H.**, and Leyk, S., "Estimating changes in urban land and urban population using refined areal interpolation techniques," *Proceedings of the ICA 2017*, Washington, D.C., 2-7 July 2017.

- **Zoraghein, H.**, and Leyk, S., "Building consistent multi-temporal population data at fine resolution through spatially refined areal interpolation," *Proceedings of GIScience 2016*, Montreal, Canada, 27-30 September 2016.

- **Zoraghein, H.**, Leyk, S., Buttenfield, B., and Ruther, M., "Spatio-temporal small area analysis for improved population estimation based on advanced dasymetric refinement," *Proceedings of AutoCarto 2016*, Albuquerque, New Mexico, 14-16 September 2016.

- **Zoraghein, H.**, Leyk, S., Ruther, M., and Buttenfield, B., "Deriving spatially refined consistent small area estimates over time using cadastral data," *Proceedings of GeoComputation 2015*, Dallas, Texas, 20-23 May 2015.

Broader Engagement Communications

- Community Demographic Model: Invest Today for a Resilient Tomorrow, Research Spotlight, Population Council (April 2022)
- New Website for Policy-Relevant Population Modeling Essential for Equitable Climate Action, Research Spotlight, Population Council (Video link) (November 2021)

Presentations

Conferences

- **Zoraghein, H.**, Pinchoff, J., Wong Z., and Karimzadeh, M., "Patterns and Growth of African Cities in Relation to Indicators of Development and Climate Resilience," Population Association of America, Atlanta, Georgia, 12-15 April 2023.
- Regules García, R., Gómez Ugarte Valerio, A., **Zoraghein, H**., and Jiang, L. "Subnational Population Estimates and Projections for Mexico Under the Shared Socioeconomic Pathways: Insights and Implications for Population Policy," Population Association of America, Atlanta, Georgia, 12-15 April 2023.
- Carbone, J., Jiang, L., O'Neill B., Shen, Y., and **Zoraghein, H.**, "Modeling the effects of climate on internal migration in the U.S.," Climate Mobility Research Symposium, New York, 16 September 2022.
- Jiang, L., **Zoraghein, H.**, O'Neill, B., Regules-Garcia, R., and Sathar, Z., "Multiscale demographic projections for climate change scenarios framework," Scenarios Forum 2022, Laxenburg, Austria, 20-22 June 2022.
- **Zoraghein, H.**, Khalil, M., and Sadiq, M., "Evaluation of urbanization status in Pakistan using emerging remote sensing products," Population Association of America, 6-9 April 2022.
- **Zoraghein, H.**, Pinchoff, J., Engin, H., Balk, D., and Montgomery, M., "Multi-scale demographically informed exposure assessment to different flood types in India," Population Association of America, 6-9 April 2022.
- **Zoraghein, H.**, and Jiang, L., "Toward a global urbanization analysis for subnational territories by exploring remote sensing-based products," International Population Conference, 5-10 Dec. 2021.
- Regules-Garcia, R., **Zoraghein, H.**, Vieitez, I., Torres, I., and Jiang, L., "Differences in future urbanization trends across Mexican states in the context of climate change: Implications for plans, policies, and practice," International Population Conference, 5-10 Dec. 2021.
- Jiang, L., and **Zoraghein, H.**, "How COVID-19 affects population distribution across the US states," Population Association of America, 5-8 May 2021.
- Jiang, L., and **Zoraghein, H.**, "The subnational urbanization projections for China, India and the United States," Population Association of America, Austin, Texas, 10-13 April 2019.
- Jiang, L., Dahlke, S., **Zoraghein, H.**, O'Neill, B., "Multi-scale population projections for the U.S. consistent with the SSPs," Scenarios Forum 2019, Denver, Colorado, 11-13 March 2019.
- **Zoraghein, H.**, "U.S. state level futuristic population downscaling at 1 KM resolution under SSPs for integrated assessment modeling," 2018 AGU Fall Meeting, Washington, D.C., 10-14 December 2018.
- Jiang, L., **Zoraghein, H.**, O'Neill, B., Shuqiang, X., Shenghe, L., and Wei, Q., "Subnational urbanization projections for provinces of China," 4th Asian Population Association Conference, Shanghai, China, 11-14 July 2018.
- Jiang, L., **Zoraghein, H.**, O'Neill, B., and Gao, J., "Consistent population scaling for integrated assessment of environmental change. Spatial population projections for the US states based on gridded population datasets," European Population Conference, Brussels, Belgium, 6-9 June 2018.
- Jiang, L., **Zoraghein, H.**, O'Neill, B., and Gao, J., "Consistent population scaling for integrated assessment of environmental change," Population Association of America, Denver, Colorado, 26-28 April 2018.
- **Zoraghein, H.**, Leyk, S., and Balk, D., "Changing urbania: Estimating changes in urban land and urban population using refined areal interpolation techniques," 2017 AGU Fall Meeting, New Orleans, Louisiana, 11-15 December 2017.
- Jiang, L., and **Zoraghein, H.**, "Subnational urbanization projections for the U.S. and China," IPC 2017 International Population Conference, Cape Town, South Africa, 29 October-4 November 2017.

Skills

- **Programming Languages:** Python (scipy, numpy, pandas, pyspark), and R (tidyverse, data.table, sf, terra, rjags)
- **Machine/Deep Learning Tools:** keras, tensorflow, scikit-learn, XGBoost
- **Professional Software:** ArcGIS, RStudio, Anaconda, QGIS, PostGIS, ENVI, git

Professional Certificates

- Deep Learning Specialization (DeepLearning.AI)
    - o Neural Networks and Deep Learning
    - o Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization
    - o Structuring Machine Learning Projects
    - o Convolutional Neural Networks
    - o Sequence Models
- TensorFlow Developer (DeepLearning.AI)
    - o Convolutional Neural Networks in TensorFlow
    - o Natural Language Processing in TensorFlow
    - o Sequences, Time Series and Prediction
- TensorFlow: Advanced Techniques (DeepLearning.AI)
    - o Custom Models, Layers, and Loss Functions with TensorFlow
    - o Custom and Distributed Training with TensorFlow
- Applied Machine Learning in Python (Coursera)

Honors and Awards

- PAA Poster Winner, Population Association of America (April 2023)
- PAA Poster Winner, Population Association of America (April 2019)
- Travel Grant, The U.S. National Committee to the International Cartographic Association (Feb. 2017)
- Student Scholarship in the Doctorate Category, American Society for Photogrammetry and Remote Sensing, Rocky Mountain Region (March 2017)
- Student Scholarship in the Doctorate Category, American Society for Photogrammetry and Remote Sensing, Rocky Mountain Region (March 2016)
- Travel Grant, The National Science Foundation (April 2015)
- Outstanding Teaching Assistant Award, Department of Geography, University of Colorado Boulder (March 2015)
- Student Scholarship in the Doctorate Category, American Society for Photogrammetry and Remote Sensing, Rocky Mountain Region (March 2015)
- Travel Grant, United Government of Graduate Students, University of Colorado Boulder (Feb. 2015)
- Outstanding Undergraduate Student Award, Department of Geodesy & Geomatics Engineering, K. N.Toosi University of Technology (Sept. 2008)

Professional Service

- Reviewer for the Nature Climate Change, Environmental Research Letters, Demography, Climatic Change, Communications Earth & Environment, International Journal of Digital Earth, International Journal of Geographic Information Science, Remote Sensing, Journal of Spatial Science, Population and Environment, and NCAR Technical Notes Series
- Co-organizer of the "Spatial Methods" Session for the PAA 2019

Professional Affiliations

- PAA (Population Association of America)

Languages

- English (Full Professional Proficiency), Persian (Native), French (Limited Working Proficiency)