

CONTACT INFORMATION	Department of Mathematics & Statistics McMaster University, Hamilton Hall, Room 415 1280 Main Street West, Hamilton, ON, Canada L8S 4K1	✉ math@sungjumoon.com ✉ moons18@mcmaster.ca 🌐 www.sungjumoon.com
RESEARCH INTERESTS	Applied nonlinear dynamics and chaos theory; Numerical weather modeling and prediction; Atmospheric predictability; Data assimilation; Infectious disease dynamics; Agent-based modeling	
EDUCATION	<p>Seoul National University, Seoul, South Korea Ph.D. in Earth and Environmental Sciences (focus: nonlinear dynamics and chaos), Aug 2021 Dissertation: <i>High-Dimensional Lorenz Systems, Atmospheric Predictability, and Data Assimilation</i> Advisor: Jong-Jin Baik</p> <p>Syracuse University, Syracuse, NY, USA M.S. in Mathematics, May 2016</p> <p>Wake Forest University, Winston-Salem, NC, USA B.S. in Mathematics (Honors) and B.A. in Classical Studies, May 2013 Honors thesis: <i>Computational Modeling of Precautionary Behavior During an Epidemic</i></p>	
EMPLOYMENT HISTORY	<p>Postdoctoral Fellow Apr 2022–Present McMaster University, Department of Mathematics & Statistics The Fields Institute, Mathematics for Public Health (MfPH) Network</p> <p>Postdoctoral Fellow Sep 2021–Mar 2022 Seoul National University, Research Institute for Basic Sciences</p> <p>Technical Research Personnel Sep 2018–Aug 2021 Seoul National University, School of Earth and Environmental Sciences In fulfillment of the South Korean military service requirement</p>	Hamilton, ON, Canada
SELECTED RESEARCH PROJECTS	<p>Agent-Based Modeling of Co-circulating Viral Strains Apr 2022–Present PI: Thomas Hurd (1956–2022) and Michael C. Wolfson (uOttawa) In collaboration with Steve Gribble (StatCan) Concurrently developing compartmental and agent-based models for co-circulation of two viral strains with comparison analysis from the model-user standpoint</p> <p>Atmospheric Predictability and Chaos Sep 2021–Present Partial grant funding through National Research Foundation of Korea (NRF) Investigating the relationship between the atmosphere’s chaotic nature and its predictability with a particular focus on the effects of changing a model’s spatial resolution or numerical precision</p> <p>Effects of Pandemic-induced Restrictions on Air Quality Jul 2020–Mar 2021 PI: Jong-Jin Baik (Seoul National U.) Analysis of air quality fluctuations during the period under strict social distancing in South Korea based on data collected by air quality monitoring stations</p> <p>Chaos and Synchronization in High-Order Lorenz Models Nov 2018–Oct 2021 Small Grant for Exploratory Research (SGER), National Research Foundation of Korea (NRF) PI: Jong-Jin Baik (Seoul National U.) Rigorous derivation and analysis of high-dimensional extensions of the Lorenz system with additional physically-relevant features, focusing on bifurcation and chaos synchronization</p>	

Mathematical Modeling in Epidemiology

Sep 2011–May 2013

co-PIs: Frederick Chen and Miaohua Jiang (Wake Forest U.)

Undergraduate honors thesis project developing a computational epidemiological model in the presence of risk-taking vs. risk-averse populations with and without the learning-based behavioral changes during a hypothetical infectious disease epidemic

TEACHING EXPERIENCE

Instructor of Record, Syracuse University

Spring 2016 Calculus for Life Sciences II (MAT 286)

Summer 2015 Algebraic Operations and Functions (MAT 112)

Fall 2014 Calculus I (MAT 295)

Teaching Assistant, Seoul National University

Fall 2021 Atmospheric Physics II (Undergraduate)

Fall 2020, Fall 2018, Fall 2017 Cloud Physics (Graduate)

Spring 2020 Topics in Atmospheric Science (Graduate)

Spring 2018 Mesoscale Meteorology (Graduate)

Recitation Instructor, Syracuse University

Fall 2015, Spring 2015 Calculus I (MAT 295)

Spring 2015 Business Calculus (MAT 284)

Spring 2014 Calculus II (MAT 296)

Fall 2013 Elementary Probability and Statistics I (MAT 121)

Math Clinic Tutor, Syracuse University (Fall 2013–Spring 2016)

PUBLICATIONS

15. S. Moon, J.-J. Baik, H.-J. Song, J.-Y. Han, 2022. Increasing model vertical resolution may not necessarily lead to improved atmospheric predictability. *Chaos* 32, 073120.
14. S. Moon, J.-J. Baik, 2021. Using the $(3N)$ -dimensional generalized Lorenz systems as a testbed for data assimilation: The ensemble Kalman filter. *Monthly Weather Review* 149, 3691–3705.
13. K.-H. Kwak, B.-S. Han, K. Park, S. Moon, H.-G. Jin, S.-B. Park, J.-J. Baik, 2021. Inter- and intra-city comparisons of $PM_{2.5}$ concentration changes under COVID-19 social distancing in seven major cities of South Korea. *Air Quality, Atmosphere & Health* 14, 1155–1168.
12. J. Park, S. Moon, J.M. Seo, J.-J. Baik, 2021. Systematic comparison between the generalized Lorenz equations and DNS in the two-dimensional Rayleigh–Bénard convection. *Chaos* 31, 073119.
11. M. Jwa, H.-G. Jin, J. Lee, S. Moon, J.-J. Baik, 2021. Characteristics of raindrop size distribution in Seoul, South Korea according to rain and weather types. *Asia-Pacific Journal of Atmospheric Sciences* 57, 605–617.
10. S. Moon, J.-J. Baik, S.-H. Hong, 2021. Coexisting attractors in a physically extended Lorenz system. *International Journal of Bifurcation and Chaos* 31, 2130016 (Featured).
9. S. Moon, J.-J. Baik, J.M. Seo, 2021. Chaos synchronization in generalized Lorenz systems and an application to image encryption. *Communications in Nonlinear Science and Numerical Simulation* 96, 105708.
8. S. Moon, J.-J. Baik, J.M. Seo, B.-S. Han, 2021. Effects of density-affecting scalar on the onset of chaos in a simplified model of thermal convection: A nonlinear dynamical perspective. *The European Physical Journal Plus* 136, 92.
7. B.-S. Han, K. Park, K.-H. Kwak, S.-B. Park, H.-G. Jin, S. Moon, J.-W. Kim, J.-J. Baik, 2020. Air quality change in Seoul, South Korea under COVID-19 social distancing: Focusing on $PM_{2.5}$. *International Journal of Environmental Research and Public Health* 17, 6208.

6. S. Moon, J.M. Seo, J.-J. Baik, 2020. High-dimensional generalizations of the Lorenz system and implications for predictability. *Physica Scripta* 95, 115201.
5. J.M. Seo, H. Lee, S. Moon, J.-J. Baik, 2020. How mountain geometry affects aerosol-cloud-precipitation interactions: Part I. Shallow convective clouds. *Journal of the Meteorological Society of Japan* 98, 43–60.
4. S. Moon, J.M. Seo, B.-S. Han, J. Park, J.-J. Baik, 2019. A physically extended Lorenz system. *Chaos* 29, 063129 (Featured).
3. Y.-L. Jeon, S. Moon, H. Lee, J.-J. Baik, J. Lkhamjav, 2018. Non-monotonic dependencies of cloud microphysics and precipitation on aerosol loading in deep convective clouds: A case study using the WRF model with bin microphysics. *Atmosphere* 9, 434.
2. J.M. Seo, J.-J. Baik, S. Moon, 2018. Orographic-convective flows, wave reflection, and gravity-wave momentum fluxes in a two-layer hydrostatic atmosphere. *Tellus* 70A, 1–16.
1. S. Moon, B.-S. Han, J. Park, J.M. Seo, J.-J. Baik, 2017. Periodicity and chaos of high-order Lorenz systems. *International Journal of Bifurcation and Chaos* 27, 1750176.

HONORS &
AWARDS

NRF Postdoctoral Training Grant (~\$120,000) Sep 2021–Aug 2023
National Research Foundation of Korea (NRF) (Relinquished Apr 2022)
Project: Atmospheric Predictability—From the Perspective of Chaos Theory

The KMS Award for Outstanding Dissertation Sep 2021
Korean Meteorological Society (KMS)

The College of Natural Sciences Best Ph.D. Dissertation Award Aug 2021
College of Natural Sciences, Seoul National University
1st place nomination by the School of Earth and Environmental Sciences

Pi Mu Epsilon, Wake Forest University Inducted 2013

URECA Summer Research Fellowship, Wake Forest University Summer 2012
Awarded to conduct undergraduate research over the summer
Co-directed by Frederick Chen (Economics) and Miaohua Jiang (Mathematics)

INVITED
SEMINARS

Chaos synchronization in high-dimensional Lorenz systems, School of Computing and Data Science, Wentworth Institute of Technology, Boston, MA, Jan 13, 2021, Online

Chaos synchronization and data assimilation, Department of Atmospheric Science, Yonsei University, Seoul, South Korea, Sep 28, 2021, Online

Chaos and atmospheric predictability, Department of Atmospheric Science, Kongju National University, Kongju, South Korea, Sep 14, 2021

CONFERENCE
PRESENTATIONS

Chaos Synchronization in Generalized Lorenz Systems and Connections to Data Assimilation, 15th International Conference on Chaotic Modeling, Simulation and Applications, CHAOS 2022, Athens, Greece, Jun 2022, Online

The (3N)- and (3N + 2)-dimensional generalizations of the Lorenz system, chaos synchronization, and their applications as a testbed Model for data assimilation algorithms, AMS Contributed Paper Session on Dynamical Systems and Applications, Joint Mathematics Meetings, Seattle, WA, USA, Apr 2022, Online

High-dimensional Lorenz systems, atmospheric predictability, and data assimilation: An overview, Autumn Meeting of the Korean Meteorological Society, Special Session for Emerging Scientists, Gwangju, South Korea, Oct 2021, Online

The generalized Lorenz systems: A new testbed model for data assimilation, Autumn Meeting of the Korean Meteorological Society, Gwangju, South Korea, Oct 2021, Online

Attractor coexistence in extended Lorenz systems revealed through bifurcation analysis, 14th International Conference on Chaotic Modeling, Simulation and Applications, CHAOS 2021, Athens, Greece, Jun 2021, Online

High-dimensional generalizations of the Lorenz system and implications for predictability, Autumn Meeting of the Korean Meteorological Society, Gyeongju, South Korea, Oct 2020, Online

The $(3N)$ - and $(3N + 2)$ -dimensional generalized Lorenz systems, 13th International Conference on Chaotic Modeling, Simulation and Applications, CHAOS 2020 Jun 2020, Florence, Italy (Withdrawn due to the global pandemic)

A physically extended Lorenz system, Autumn Meeting of the Korean Meteorological Society, Gyeongju, South Korea, Oct 2019

A physically extended Lorenz system, 1st International Conference on Climate Change and Environment in Central and North-East Asia (ICCCECNEA), National University of Mongolia, Ulaanbaatar, Mongolia, Sep 2019

Non-monotonic dependence of cloud microphysics and precipitation on aerosol loading in deep convective clouds: A case study using the WRF-bin model, Poster (with Y.-L. Jeon), 15th Conference on Cloud Physics/Atmospheric Radiation, American Meteorological Society, Vancouver, BC, Canada, July 2018

Chaos and periodicity of high-order Lorenz systems, Autumn Meeting of the Korean Meteorological Society, Busan, South Korea, Oct 2017

OTHER
WORKSHOPS &
CONFERENCES
ATTENDED

Understanding Machine Learning and Deep Learning, Korean Data and Information Science Society & Department of Statistics, Kyungpook National University, Daegu, South Korea, Jan 2020

Introduction to Parallel Programming Workshop, National Center for Meteorological Supercomputer, Cheongju, South Korea, Oct 2018

WRF Tutorial, National Center for Atmospheric Research (NCAR), Boulder, CO, USA, Jan 2018

Institute for Advanced Study/Park City Mathematics Institute (PCMI), Undergraduate Program, Park City, UT, USA, July 2013

PROFESSIONAL
MEMBERSHIPS

American Geophysical Union (AGU)
American Mathematical Society (AMS)
Korean Meteorological Society (KMS)
Society for Industrial and Applied Mathematics (SIAM)

SERVICE &
OUTREACH

MfPHest Organizing Committee, The Fields Institute, Jun–Oct 2022

Session Chair, 15th CHAOS 2021 International Conference, Special and Contributed Sessions: Chaos Theory–Quantum–Lorenz, Jun 2022

Undergraduate Research Mentor, Seoul National University
Seong-Ho Hong (2019; peer-reviewed publication in 2021)
Taehyeok Kim (2021)

Manuscript Reviews

International Journal of Modern Physics C
Nonlinear Dynamics

OTHER EXPERIENCE	<p>PhD Dissertation Template Development, Seoul National University, 2021 Designed and freely distributed a L^AT_EX template (available here)</p> <p>Republic of Korea Army Basic Training, Nonsan, South Korea, 2019</p> <p>Friday Weather Forecasting Activities, Seoul National University, 2016–2019</p> <p>Secretary, Wake Forest University Anthropology Club, 2010–2013</p>
COMMUNITY INVOLVEMENT	<p>Volunteer, Angel House, Goyang, South Korea, 2016–2019 Angel House is a residential facility for children and adults with developmental disabilities.</p> <p>Volunteer, Wake Saturdays, Winston–Salem, NC, USA, 2010–2013 Visited downtown every Saturday to have lunch with the local homeless population</p>
TECHNICAL SKILLS	<p>Proficient in L^AT_EX, MATLAB, and Python</p> <p>Familiar with Linux working environments, WRF, NCL, Fortran, and R</p> <p>Some experience implementing ensemble Kalman filter</p> <p>Currently learning AnyLogic and OpenM++ agent-based modeling (ABM) tools</p>
LANGUAGES	<p>Bilingual (English & Korean), Working knowledge of Latin</p>