Tufts CEE Seminar Series Presents

Special Graduate Research Seminar
Highlighting the Current Research of Graduate Students

Friday February 19, 2021 12:00 PM Eastern Time (US and Canada)

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A Novel Pixel-based Multiple-Point Geostatistical Simulation Method for Stochastic Modeling of EarthResources
Research Associate: Snehamoy Chatterjee

ADEL ASADI

Uncertainty is an integral part of modeling Earth resources and environmental processes. Geostatistical simulation technique is a well-established tool for uncertainty quantification of earth systems modeling. Multiple-point statistical (MPS) algorithms are specifically advantageous when dealing with the complexity and heterogeneity of geological data. MPS algorithms take advantage of using training images to mimic physical reality. This research presents a novel and efficient pixel-based multiple-point geostatistical simulation method for stochastic simulation. Pixel-based simulation implies the sequential modeling of individual points on the simulation grid by borrowing spatial information from the training image and honoring conditioning data points. The method is developed by integrating advanced machine learning algorithms for different purposes including dimensionality reduction and clustering. For the purpose of automation, to ensure high-quality realizations, and to maintain reasonable computational time, multiple optimization and parameter tuning strategies were introduced. The model is validated by simulating a variety of categorical and continuous variables for both two and three-dimensional cases and conditional and unconditional simulations. The proposed algorithm can be applied in a variety of contexts, including but not limited to petroleum reservoir forecasting, seismic inversion, mineral resources modeling, gap-filling in remote sensing, and climate modeling. The developed model can be extended for spatio-temporal modeling, multivariate simulation, non-stationary modeling, and super-resolution realizations.

Understanding The Multi-Sector Impacts of Responses to Water Scarcity and Land Use Change
Research Associates: Jonathan Lamontagne, Mohamad Hejazi, Kate Calvin, and Patrick Reed

FLANNERY DOLAN

Natural resource scarcity affects multiple systems at regional and global scales. Responses to regional scarcity ripple through connected markets and ultimately influence the global economy. At the same time, global responses to scarcity may cause disproportionate effects on regional economies. In complex systems like the coupled natural-human system, such multiscale, multi-sector dynamics can be hard to anticipate. This study employs exploratory modeling and scenario discovery to examine the economic effects of water and land scarcity at regional and global scales using a human-Earth system model. Using this model, we compute a metric of the overall economic impact of resource scarcity based on the concept of economic surplus. This metric has the benefit of a strong theoretical grounding in the economics literature. Here, we assess the economic impact of water scarcity as well as the impact of different land use and land cover incentives and pathways. From a large scenario ensemble, we use scenario discovery to ascertain the most influential factors that induce either highly positive or highly negative economic impact. The results of this study provide insight into the multi-scale dynamics of the responses to natural resource scarcity and their economic implications.

Differential Overlap in Human, Animal Microbiomes and Resistomes in Rural Versus Urban Bangladesh
Research Associates: Erica R. Fuhrmeister, Latifah Hamzah, Angela R. Harris, Mir A. Ahmed, Emily S. Gurley, Syed M. Satter, Alexandria B. Boehm, Amy J. Pickering

JENNA M. SWARTHOUT

Low- and middle-income countries (LMICs) bear the largest mortality burden due to antimicrobial-resistant infections, partially due to human and animal antibiotic misuse. Especially in LMICs, where resources for medical and veterinary treatments are minimal, it is important to better understand exchange of antimicrobial resistance between humans and animals to ultimately develop feasible and cost-effective interventions. Differences between rural and urban communities in population density, antibiotic use, and the prevalence of cohabitating with animals could result in differential zoonotic exchange of gut-related bacteria and antimicrobial resistance genes (ARGs). Here, we determined the similarity in gut microbiomes and resistomes between humans and animals in rural compared to urban communities in Bangladesh. Human, goat, and chicken feces (n=145) were collected from Tongi (urban) and Mymensingh (rural), Bangladesh. Fecal samples were analyzed by 16S rRNA gene amplicon sequencing (gut microbiome) and long-read metagenomics (resistome and ARG overlap). This research provides genomic evidence of overlap of ARGs between humans and animals, especially in urban communities, and highlights chickens, in addition to humans, as important reservoirs of antimicrobial resistance.