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(Listed according to the alphabetic order of the last name)

Title: Spatial Prediction and Laws of Geography

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Abstract: Spatial prediction is one of the most important spatial analytical tasks for geographers and anyone who conducted analysis related to phenomena of spatial variation because it provides the needed information on spatial variation with a discrete set of field observations. Currently spatial prediction is based on either the First Law of Geography or the statistical principle or the combination of these two. These existing theories for spatial prediction require the set of samples to be over certain size with special distributions as well as the relationships extracted from the samples to be spatially stable (stationary). These requirements render existing techniques unsuitable for spatial prediction over large and complex geographic areas at high spatial resolution which is a norm for geographic analysis in this digital era. This paper first examines utilities of the existing Laws of Geography and the statistical principles for spatial prediction and then presents a new thinking about spatial prediction based on a different geographic principle (one may refer to it as the Third Law of Geography) which focuses on the similarity of geographic configuration of locations. Under this principle, prediction of spatial variation can be made on the basis of the similarity of geographic configurations between a sample and a prediction point. This allows the representativeness of a single sample to be used in prediction, in contrast to an explicit relationship from an entire sample set. A set of case studies (ranging from soil mapping, landslide susceptibility mapping, to wildlife susceptibility mapping) on the topic of spatial prediction, sampling improvement, uncertainty quantification and bias mitigation show that spatial prediction based on the new principle does not require samples to be over specific size nor to be of a particular spatial distribution to achieve a high quality prediction. The prediction uncertainty associated with spatial prediction based on the new principle is more indicative to quality of the prediction, thus more effective in allocating error reduction efforts and in mitigating spatial bias in sampling. These properties are particularly important to spatial prediction in geospatial big data science where more than often sample sets are not as representative as expected. This finding suggests that the new theory provides the possibility of transforming spatial prediction to meet the need of this new digital era.

Key words: Spatial prediction; Law of Geography; Third Law of Geography, sampling, uncertainty, spatial big data.

Biography of Professor A-Xing Zhu:

Prof. A-Xing Zhu is a full professor at the Department of Geography, the University of Wisconsin-Madison where he teaches courses on GIS and physical geography, currently serves as the Editor-in-Chief for Annals of GIS. He is also an adjunct professor at Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences and an endowed professor at the School of Geography, Nanjing Normal University.

He obtained his Bachelor degree from the Department of Geography, Beijing Normal University, Beijing, China in 1983 and his Master's in Geography from the University of Calgary in 1987, Canada, and his Ph.D. degree from the Department of Geography, University of Toronto, Canada, in 1994.

His research interests are GIS/Remote Sensing techniques, fuzzy logic, artificial intelligence methods, and their application in spatial prediction and watershed modeling. Recently, he has developed a research interest in high performance computing and cloud computing for geographic analysis. His work in this area was showcased in February of 2003 at a congressional briefing on the role of geographic information science and technology in meeting the nation's scientific, economic and social needs.

He is the recipient of the following awards: The Manasse Chair Professor, the Hamel Faculty Fellow award, and the Vilas Associate Award from University of Wisconsin-Madison; Service Excellence Award and Education Excellence Award from the International Association of Chinese Professionals in Geographic Information Sciences; Integraph Award for best scientific paper in spatial data standards from the American Society for Photogrammetry and Remote Sensing

He has published 2 books, over 300 research articles and 3 invention patents. He has obtained over $20 million (US dollar equivalent) of research funding.