

STATISTICAL ANALYSIS AND DATA MINING

Research Article

Using spatiotemporal relational random forests to improve our understanding of severe weather processesAmy McGovern , David John Gagne II, Nathaniel Troutman, Rodger A. Brown, Jeffrey Basara, John K. Williams

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Abstract

Major severe weather events can cause a significant loss of life and property. We seek to revolutionize our understanding of and our ability to predict such events through the mining of severe weather data. Because weather is inherently a spatiotemporal phenomenon, mining such data requires a model capable of representing and reasoning about complex spatiotemporal dynamics, including temporally and spatially varying attributes and relationships. We introduce an augmented version of the Spatiotemporal Relational Random Forest, which is a random forest that learns with spatiotemporally varying relational data. Our algorithm maintains the strength and performance of random forests but extends their applicability, including the estimation of variable importance, to complex spatiotemporal relational domains. We apply the augmented Spatiotemporal Relational Random Forest to three severe weather data sets. These are: predicting atmospheric turbulence across the continental United States, examining the formation of tornadoes near strong frontal boundaries, and understanding the spatial evolution of drought across the southern plains of the United States. The results on such a wide variety of real - world domains demonstrate the extensive applicability of the Spatiotemporal Relational Random Forest. Our long - term goal is to significantly improve the ability to predict and warn about severe weather events. We expect that the tools and techniques we develop will be applicable to a wide range of complex spatiotemporal phenomena. © 2011 Wiley Periodicals, Inc. Statistical Analysis and Data Mining 4: 407–429, 2011

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