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Analysis of Drought Risk Management Strategies using Dynamic Inoperability Input-Output Modeling and Event Tree Analysis†

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ABSTRACT

Climate change is expected to increase the frequency and intensity of droughts in many parts of the world. Since water is an essential resource for many economic activities, water scarcity can cause disruptions that manifest as losses in industrial outputs. These effects can propagate through economic systems as a result of the inherent interdependencies among economic sectors. Risk management strategies for droughts must therefore account for both direct and indirect effects of water supply disruptions. In this work, we propose a methodology for evaluating drought management strategies by combining economic input-output modeling with event tree analysis. We apply the methodology to a simulated drought scenario affecting the United States National Capital Region. Three risk management strategies, namely, reducing the initial level of water supply disruption, managing water consumption, and prioritizing water-use dependencies, are evaluated based on inoperability levels and cumulative economic losses. Results show that while managing water consumption yields the lowest cumulative economic losses in the region, reducing the initial level of water supply disruption and prioritizing water-use dependencies result in lower inoperability of critical sectors. These findings provide insights for decision makers in identifying critical sectors and formulating timely intervention strategies that minimize the over-all effects of drought to economic systems. Further, the proposed modeling framework for drought risk assessment can be applied to other regions to evaluate the effects of drought severity and management strategies over the drought timeline.

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KEYWORDS: drought risk management; input-output analysis; event trees; water-use dependencies; climate change