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TransIRIO-D: Coupling a GIS-based transportation interruption model with the dynamic interregional input-output model (IRIO-D) for catastrophe's cascading effect simulation

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Diagnosing and simulating the cascading effect of disaster disturbance in the socio-economic system are central to the design of restoration and rehabilitation policies. Here, we develop a theory modeling framework (i.e. TransIRIO-D) to investigate the inter-regional linkage response by spreading both in the supply-demand chain and in the transportation chain. Three modules are built in the TranIRIO-D model. The first module, combining the interregional input-output model (IRIO) and the dynamically adaptive behaviours of market subjects after a catastrophe strike, reflects the spatial ripple effect from the supply-demand chain perspective. The second module simulates the linkage response of transportation interruption impacting on the inter-regional economy based on the GIS spatial analysis. The third module describes the difference of disaster disturbance in emergency phase and reconstruction phase, respectively. A case shows that the cascading effect of disaster disturbance in socio-economic system is underestimated if we just focus on the post-catastrophe reconstruction; the TransIRIO-D model can capture that disaster disturbance spread in the supply-demand chain and the transportation chain, and that disaster impacts for the inter-regional economic system in emergency disaster relief and emergent restoring transportation period is greatly severe than in reconstruction period after a catastrophe strikes. The multi-perspective and multi-module of the TransIRIO-D model provides the possibility of applying it to assess the indirect economic impact caused by multi-disasters. This study can provide a supplement for researching post-disaster restoration mechanism and provide a specific reference for planning risk management strategies.