Inter-regional economic impacts of an extreme storm flood scenario considering transportation interruption: A case study in Shanghai, China

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Global climate warming and socioeconomic development would significantly increase the frequency and economic losses of extreme flood events in the future. But the overall economic consequences of extreme floods, including direct damages and indirect economic impacts, are rarely explicitly and comprehensively assessed. Furthermore, transportation network not only is one of critical infrastructure assets which are vulnerable to floods but also plays a key role in transporting inputs and products for economic sectors. Therefore, this paper aims to explore the potential effects of 1,000-year extreme storm flood scenario and transportation interruption caused by it on national and local economy, taking Shanghai as study area. By incorporating transportation cost induced demand changes and supply constraints by transport delay of inputs or goods, impacts of transport disruptions are clearly modelled. Moreover, some adaptive behaviors, like import substitution, supplier substitution of inputs, inventories, overproduction capacity, changes of transport modes, earlier start to reconstruction and so on, are also considered in inter-regional input-output (IRIO) model, because of the resilience of economic system. Our main results show that the following: (i) China may suffer substantial indirect economic losses (IELs), more than 1.11 times direct damages, and IELs in Shanghai may account for 27.91%. (ii) More negative economic impacts by transport disruptions spread to other indirectly affected regions, especially neighboring provinces, propagating through supply chain. (iii) Total IELs are very sensitive to transport delay time, and economic losses from the delay may increase nearly linearly after using up inventories during the disruptions of transportation. Those results highlight the importance of strengthening resilience of the transport system and fast repairs after disaster. Also, results of different hypothetical scenarios show benefits of adaptive strategies, thereby providing some insights into post-disaster economic recovery for related policymakers and stakeholders.