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The risk of large-scale trade bottlenecks due to simultaneous port disruptions

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Reliable port infrastructure is essential for the facilitation of international trade flows. Disruptions to port infrastructure can result in trade bottlenecks, in particular if multiple key ports are affected simultaneously due to natural disasters with large spatial footprints such as earthquakes and tropical cyclones (Verschuur et al. 2019). For instance, Hurricane Katrina (2005) disrupted port operations in multiple ports in New Orleans, which transport around 45% of the country's food and farm products, resulting in more than USD800 million export losses and price spikes of food products (Trepte and Rice, 2014). In order to improve the resilience of the transport and supply-chain network, the risk of large-scale trade bottlenecks need to be quantified on global scale. However, to date, the risk of single and multiple port failures due to large-scale natural disasters, and the resulting consequences, has not yet been explored.

Here, we present a global analysis of the risk of simultaneous port disruptions due to tropical cyclones and the associated risk of bottlenecks in the national and global maritime trade network. To do this, we have combined a new global dataset on the port-to-port trade network with 10,000 years of synthetic tropical cyclone tracks (Bloemendaal et al., 2020) and an impact-module that estimates the duration of the port disruption as a function of cyclone wind speed. We show how certain countries and specific economic sectors within countries are at risk of large-scale trade bottlenecks, mainly due to the concentration of trade in a few key ports that are geographically clustered.

These results can be used to stress test the global maritime transport network and inform strategies to improve supply-chain resilience (e.g. diversification of transport and import). Moreover, it can support port planning on a national level to make strategic investments to reduce the risk of trade bottlenecks or to design post-disaster emergency response strategies (e.g. rerouting strategies to alternative ports).