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## Present-day and future global economic losses associated with physical climate risks to ports

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Reliable port infrastructure is essential to facilitate maritime trade across global supply-chains. Physical climate risks can disrupt port operations, which, apart from infrastructure damages (i.e. direct impacts), can have domestic and cross-border economic losses through transport dependencies on ports (i.e. systemic impacts). For instance, Hurricane Katrina (2005) disrupted operations in multiple ports in New Orleans, resulting in more than USD800 million export losses and price spikes of food products, affecting supply-chains globally (Trepte and Rice, 2014). Both climate change and changes in global trade flows (in absolute terms and trade patterns) can increase systemic risks to ports and economies in the future. In order to improve the resilience of the transport and supply-chain networks, present-day and future climate-induced systemic risks to ports need to be quantified on a global scale.

Here we present a global analysis of present-day and future systemic risk to ports due to physical climate impacts (cyclones, fluvial flooding, coastal flooding, pluvial flooding). To do this, we combine multi-hazard risk estimates of global port infrastructure (Verschuur et al. 2021, under review), covering ~1400 ports, with the output of a newly developed global maritime freight model that quantifies the dependencies of sectors and nations on ports. We show how climate-induced port disruptions can initiate economic ripple effects across geographies, although the vulnerability to these impacts differ across countries and sectors. Moreover, we project how systemic risk would increase by 2050 under various climate and trade scenarios, supporting the business case for adaptation.

These results can help inform resilience strategies at the port-level (e.g. port elevation), as well as the supply-chain level (e.g. diversification of transport and import). Moreover, it can support national port infrastructure planning to reduce the systemic risk.