EGU22-1484
https://doi.org/10.5194/egusphere-egu22-1484
EGU General Assembly 2022

Recent advances in global analysis of critical infrastructure networks in a changing climate

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There has been rapid progress in the development of capabilities to analyse infrastructure networks on very large scales, up to global scales. This is enabled by the growing availability of geospatial data products with global coverage and computational capabilities, which enable processing of these datasets and analytics on large-scale. Global analyses of the risks from climatic hazards to infrastructure networks serve several important purposes:

- Quantified risk estimates in future climate scenarios contribute to the overall picture of the scale of climate risks worldwide, which helps to motivate climate mitigation and adaptation.
- Geospatial analysis of hotspots of infrastructure vulnerability helps to target adaptation actions.
- Cost-benefit analysis of adaptation enables the prioritization of scarce adaptation resources.
- Quantified climate risk analysis is increasingly required for financial disclosure of physical climate risks by infrastructure investors.

There are inevitable limitations to global-scale analyses, but they enable cross-country comparisons, and the monitoring of changing risks and national infrastructure resilience. Global analyses also provide a convenient starting point for national analyses and a motivation to collect better data to inform national-scale decisions.

Here we present recent developments in capability for global-scale climate risk analysis to infrastructure networks. The analysis combines (i) global-scale probabilistic hazard layers (including floods, hurricanes and coastal storm surges); (ii) infrastructure asset and network exposure, for energy, transport and telecommunications networks (iii) analysis of the people and economic activities that are dependent upon these networks. This quantified risk analysis framework has been efficiently implemented for global-scale computations, yielding new results on the scale of climate-related risks. Analysis of resource flows on networks and their connection to infrastructure users is enabling calculation of the numbers of people and economic activity that

may be disrupted in catastrophic events. A recent development has been in the introduction of probabilistic event sets for hurricanes and flooding, which enables accurate estimation of the impacts from spatially extensive extreme events. The research is being made available as part of the Global Resilience Index Initiative https://www.cgfi.ac.uk/global-resilience-index-initiative/ and as an open source toolset and interface for geospatial visualisation.