The role of spatial cross-correlation structures of ground motion fields for seismic risk assessment of spatially distributed assets and infrastructure networks

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The treatment of spatially distributed infrastructure networks is currently one of the most eminent developments in the research field of seismic hazard analysis and risk assessment. As a first step, as would be necessary for the risk assessment of spatially distributed building portfolios, it is essential to gain a comprehensive understanding for the spatial cross-correlation structure of ground motion intensity measures. Various models describing the spatial correlation and spectral cross-correlation of ground motion fields have been proposed in the last two decades and their effects on loss estimates have been evaluated for a broad range of spatially distributed assets. As a general result, treating the ground motion at a single site and spectral period that is statistically independent of the ground motion at all other sites and periods leads to a systematic overestimate of small frequent losses and, perhaps more critically, an underestimate of large rare losses. Whilst the incorporation of spatial cross-correlation structures leads to improved risk assessment for spatially distributed building portfolios, it is absolutely critical in order to estimate the connectivity and performance state of infrastructure networks, since their individual elements cannot be treated independently from each other. In order to evaluate the progress in this research field in detail, we aim at a selection and comparison of the currently available correlation models. Furthermore, the effect of the epistemic uncertainty arising from the diversity of available correlation models on the calculation of loss exceedence curves shall be investigated. This way we expect to provide a fundamental element of the groundwork on which further research in the direction of seismic risk assessment for infrastructure networks will be carried out. We hope to provide an easily accessible overview on this research aspect that facilitates the entrance into this research field for us and other researchers who consider participating in the development of a framework for seismic risk assessment of spatially distributed infrastructure networks.