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Seismic hazard assessment of Sub-Saharan Africa using geodetic strain rate models

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The East African Rift System (EARS) is the major active tectonic feature of the Sub-Saharan Africa (SSA) region. Although the seismicity level of such a divergent plate boundary can be described as moderate, several earthquakes have been reported in historical times causing a non-negligible level of damage, albeit mostly due to the high vulnerability of the local buildings and structures. Formulation and enforcement of national seismic codes is therefore an essential future risk mitigation strategy. Nonetheless, a reliable risk assessment cannot be done without the calibration of an updated seismic hazard model for the region.

Unfortunately, the major issue in assessing seismic hazard in Sub-Saharan Africa is the lack of basic information needed to construct source and ground motion models. The historical earthquake record is largely incomplete, while instrumental catalogue is complete down to sufficient magnitude only for a relatively short time span. In addition, mapping of seimogenically active faults is still an on-going program. Recent studies have identified major seismogenic lineaments, but there is substantial lack of kinematic information for intermediate-to-small scale tectonic features, information that is essential for the proper calibration of earthquake recurrence models.

To compensate this lack of information, we experiment the use of a strain rate model recently developed by Stamps et al. (2015) in the framework of a earthquake hazard and risk project along the EARS supported by USAID and jointly carried out by GEM and AfricaArray. We use the inferred geodetic strain rates to derive estimates of total scalar moment release, subsequently used to constrain earthquake recurrence relationships for both area (as distributed seismicity) and fault source models. The rates obtained indirectly from strain rates and more classically derived from the available seismic catalogues are then compared and combined into a unique mixed earthquake recurrence model, which is subsequently used as the base for seismic hazard calculations. Uncertainties of such model have been explored through sensitivity testing and are here discussed to adequately quantify the influence of current working assumptions to the final hazard model.