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Probabilistic Seismic Hazard Assessment of South Africa

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The Council for Geoscience last released national seismic hazard maps of South Africa in 1992 [1]. Since then, there has been a great improvement in availability of reliable up-to-date data that can be used to create a new 'living' database, which would be very useful in preparing new seismic hazard maps of South Africa. Thus, reported here are results of research work conducted to prepare new state-of-the-art seismic hazard maps of South Africa. A probabilistic seismic hazard assessment (PSHA) methodology was implemented. In PSHA, a reliable seismic source characterisation (SSC) model and a ground motion characterisation (GMC) model are essential. An SSC model defines the seismogenic potential, locations, sizes, and rates of future earthquakes. Ideally the model gives a clear definition of the causative faults that give rise to the observed seismicity. However, information to identify such faults in South Africa is not available. The alternative is the creation of a source model made up of characterised area source zones that encompass the possible sources of earthquakes likely to contribute towards the seismic hazard of the region. Though limited in quantity and usefulness, available geological, geodetic, seismic and geophysical data were useful in demarcating the zones and in assisting with the evaluation of seismic source characteristics. An approach was taken that began with the consideration and collection of hazard-significant technical issues and data. Typical and important data that were obtained included a homogenised catalogue of earthquakes and information used in the compilation of the seismotectonic map of Africa. The seismic source characterisation process began with the identification of criteria that were used to define the seismic sources. These criteria were identified based on due consideration of the stable continental region tectonic regime and the types of seismic sources that might be present (*e.g.*, fault sources and area source zones). Based on these considerations, unique seismic sources were defined to account for distinct *differences* in the following criteria: 1. Major geologic and tectonic boundaries 2. Earthquake recurrence rate 3. Maximum earthquake magnitude (Mmax) 4. Expected future earthquake characteristics (*e.g.*, style of faulting, rupture orientation, seismogenic thickness) 5. Probability that a fault is seismogenic. Application of these criteria helped in the preparation of a seismic source model made up of 22 area source zones and two fault sources (Kango and Hebron faults). The seismic sources were then characterised in terms of their earthquake recurrence, (i.e. b value and activity rates), as well as the maximum magnitude for each source. Given the lack of suitable strong motion data, no ground motion prediction equations (GMPEs) exist for South Africa. Thus a decision was made to make use of available GMPEs that were derived for other stable continental regions of similar tectonic characteristics to South Africa. Two such models [2, 3] were selected and used in the hazard

calculation. Using the obtained SSC and GMC models, the hazard was calculated with the OpenQuake software. Peak ground acceleration and spectral acceleration maps for 10% probability of exceedance in 50 years were produced.

References:

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