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Improving Strain-Rate based Forecasts

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The creation of testable global seismic hazard maps implies the construction of seismicity models based on geodetic strain rates, earthquake data and plate-boundary schemes that provide homogeneous global coverage. The SHIFT/GSRM model of Bird and Liu (2007) was designed to provide a global high-resolution seismicity forecast model to be used in global hazard assessment. This approach uses the Global Strain Rate Map of Kreemer et al. (2014) to quantify earthquake rates around the globe without the need to map every seismic source. Although SHIFT/GSRM properly estimates rates of shallow seismicity in active continental regions, it underestimates rates of earthquake production in subduction zones by a factor of approximately 3. The model authors suggest that such underestimations may stem from the use of inappropriate geometric factors in the model formulation and a velocity-dependence of subduction seismicity.

In this study, we improve SHIFT/GSRM computations for 34 subduction zones using regional seismicity parameters such as seismogenic thickness, subduction dip angle and corner magnitudes reported in Heuret et al. (2011) and Kagan and Jackson (2016). Moreover, we propose an empirical method to constrain numerical values of shear modulus and seismic coupling that permits us to express rates of seismic moment release in terms of subduction velocities and geodetic strain rates. In agreement with Bird et al. (2010), we also identify an effect of fault dip on our SHIFT/GSRM predictions, which is included in our moment-rate equation. By taking this numerical term into account and computing SHIFT/GSRM forecasts at regional scales, we reduce the ratios between observed and SHIFT/GSRM predicted seismicity to an average factor of 1.3. We conclude that this improvement may have a positive impact on the GEAR1 model of Bird et al. (2015) towards the development and understanding of a testable global seismic hazard model.