How subduction velocity and width of the seismogenic zone control subduction megathrusts seismicity

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Seismic characteristics of subduction megathrusts have been related to various geodynamic parameters. However, correlations are generally weak and difficult to interpret due to the short instrumental record and multi-parameter influence. Here we use benchmarked against each other analog- and numerical models to investigate how subduction velocity $V_s$ and the width of the seismogenic zone $W$ control seismic rate $\tau$, characteristic seismic rate $\tau_c$, maximum magnitude $M_{max}$ and moment release rate $MRR$. The models create thousands of years long timeseries of stress build up and release via frictional instabilities (i.e. modeled earthquakes). We find that $M_{max}$ increases with $W$ and is unaffected by $V_s$, $\tau$ increases with $V_s$, $\tau_c$ increases with $V_s/W$, $MRR$ increases with $V_s*W$. In nature, only the positive correlation between $V_s$ and $\tau$ is significant. By random sampling our time series we suggest that a minimum span of 1 to 5 times $\tau_c$ (or even longer timeseries in case of outliers) would be needed to observe at least one event that rupture the 80% of the maximum rupture width.