Extended versions of the space-time ETAS model and application to the 2016 Kumamoto earthquake sequence

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We proposed an extended version of the space-time ETAS model which simultaneously incorporates focal depths and rupture geometries of large earthquakes. The depth component is decoupled from earthquake hypocenters and assumed to follow the Beta distribution. This 3D-hypocenter finite-source ETAS model is applied to the 2016 Kumamoto earthquake sequence. Results from other versions of ETAS models are also obtained as comparisons. To model the dynamically triggered seismicity in Yufuin-Beppu region, an extended source which is more than two times' length of the ruptured fault of the Kumamoto mainshock is taken as its triggering source. Our results show that about 11.2% of the total seismicity is the background rate. Within the triggering source of mainshock, proportions of earthquakes being recognized as direct aftershocks of two foreshocks and the mainshock are 3.6%, 2.7%, and 23.3%, respectively. The reconstructed patterns of aftershock productivity show significant migrations in space and time. In near field (10km from slip > 1m areas), the decay of aftershock productivity follows an inverse power law of distance, verifying that aftershocks occur as an effect of stress changes imparted by the mainshock. Areas of high aftershock productivity form complementary patterns for coseismic slips, meaning that aftershocks contribute to the postseismic relaxation process.

Keywords: ETAS model, aftershock productivity, dynamic triggering

