



Supplementary Materials: Multi-segment Rupture Model of the 2016 Kumamoto Earthquake Revealed by InSAR and GPS Data

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Figure S1. The choice of the relative weight ratio of GPS relative to InSAR datasets. The RMSEs of GPS horizontal (red), GPS vertical (green), and InSAR LOS displacements vary with the relative weight ratios. The gray bar shows an equivalent weight of two datasets used in the inversion.



Figure S2. The smoothing factor κ determination using (a) the trade-off curve between the root mean square error (RMSE) and the roughness of the slip distribution model, (b) curve of the jRi values versus model roughness. The red cross corresponding to $\kappa = 2$ is the preferred smoothing factor chosen for the slip inversion.



Figure S3. Comparison of the RMSE and jRi values for the southeast dipping fault F1 and the northwest dipping fault F1.



Figure S4. Predicted vertical displacements from our preferred model and previous source models available. The white contours outline the asperities with a slip amplitude of over 2 m. The red lines denote the active faults.



Figure S5. Sensitivity test of Coulomb stress changes to effective coefficients of friction ($\mu' = 0.2, 0.4, 0.6, 0.8$) at different depths. The receiver fault is approximately paralleled to the seismogenic fault of the mainshock, with (strike, dip and rake) of (220°, 68°, -165°). Aftershocks with Mw>3.0 and hypocenter depths ranging d ± 2.5 km are denoted by green circles in each panel.



Figure S6. Sensitivity test of Coulomb stress changes to receiver faults at different depths, calculated from the preferred model with $\mu' = 0.4$. Four scenarios of receiver fault parameters with 220°/68°/-165° from our study, 226°/84°/-142° from NIED, 222°/77°/-163° from GCMT, and 224°/66°/-152° from USGS W-phase are used. Aftershocks with Mw>3.0 and hypocenter depths ranging d ± 2.5 km are denoted by green circles in each panel.



Figure S7. Sensitivity test of Coulomb stress changes to source models at different depths, resolved onto the receiver fault with 220°/68°/-165° with $\mu' = 0.4$. Five available source models of the 2016 Kumamoto earthquake are used. Aftershocks with Mw>3.0 and hypocenter depths ranging d ± 2.5 km are denoted by green circles in each panel. The white contours highlight the asperities with a slip amplitude of over 2 m.



Figure S8. Checkerboard test for resolution of the joint or individual inversion of InSAR and GPS data. The synthetic model has a slip amplitude of either 0 or 2 m at intervals. F1 F2 F3 F3 FH



Figure S9. Jackknife test results of a. the mean slip, b, the standard derivation (Std.) and c, the coefficient of variation (CV) of slip.

Table S1. Source parameters of the 2016 Kuma	amoto earthquake from inversion of various dataset
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Source	Datasets	Segment	Strike (°)	Dip (°)	Rake (°)	Max slip (m)	Moment (Nm)	Mw*
NIED	F-net	-	226	66	-163	-	4.42e+19	7.06
GCMT	GCN	-	222	77	-163	-	4.51e+19	7.07
USGS	W-phase	-	224	66	-152	-	4.66e+19	7.08
USGS	Body wave	-	215	75	-172	-	3.25e+19	6.97
Yagi et al. (2016)	Teleseismic body waves	-	234	64	-148	5.7	5.12e+19	7.11
Fukahata & Hashimoto (2016)	ALOS-2 InSAR	FF & HF	232 203	61 74	-	~5	-	-
Asano & Iwata (2016)	Strong motion	FF & HF	235 205	65 72	-146	5.13	4.50e+19	7.07
Hao et al., (2017)	Strong motion, teleseismic body and surface waves	FF & HF	235 205	60 73	-141 -174	5.7	4.24e+19	7.05
Yue et al., (2017)	GPS, strong motion, SAR images, pixel offset and surface offset data	curved	varied	varied	-	~10	6.64e+19	7.18
Himematsu & Furuya (2016)	ALOS-2 Pixel offset	F1, F2, F3	232 231	79 66	-	>5	3.47e+19	6.99
, , , ,			215	87				
Zhang et al., (2018)	Sentinel-1A InSAR, GPS, strong motion	FF, SF and NF	231	60	-155			
			205	70	-173	7.4	4.8e+19	7.09
			48	80	-126			
Our study	Sentinel-1A and ALOS-2 InSAR, GPS	F1, F2, F3 and FH	40	77	-165	5.6	4.89e+19	7.09
			236	57				
			226	63				
			205	74				

NIED, National Research Institute for Earth Science and Disaster Resilience.

https://www.fnet.bosai.go.jp/event/joho.php?LANG=en

GCMT, Global Centroid Moment Tensor Project. http://www.globalcmt.org/CMTsearch.html

USGS, United States Geological Survey. http://earthquake.usgs.gov/earthquakes/

GSN, Global Seismographic Network.

* Rigidity is assumed to be 32 GPa.



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