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Supporting Online Material for

Deformation and Slip Along the Sunda Megathrust in the Great 2005 Nias-Simeulue Earthquake

Richard W. Briggs,* Kerry Sieh, Aron J. Meltzner, Danny Natawidjaja, John Galetzka, Bambang Suwargadi, Ya-ju Hsu, Mark Simons, Nugroho Hananto, Imam Suprihanto, Dudi Prayudi, Jean-Philippe Avouac, Linette Prawirodirdjo, Yehuda Bock

*To whom correspondence should be addressed. E-mail: briggs@gps.caltech.edu

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Tables S1 and S2

We narrowed the constraints on the location of the zero uplift contour in the Banyak islands by using ASTER satellite imagery (Table S1). We followed the method of Meltzner et al. (*S1*), which we summarize briefly here. Because the color and brightness of a reef in an image depend on water depth above the reef, changes in water depths of several centimeters or more are recognizable on the image. Satellite images acquired prior to 28 March 2005 were compared with images acquired after the earthquake. We used a tidal model based on the harmonic tidal constituents of Egbert and Erofeeva (*S2*) and the software package NLOADF (*S3*) to determine the relative sea surface height (SSH) at each location at the acquisition time of each image. To document uplift of a reef, we looked for a post-earthquake image with more reef exposure than a pre-earthquake image of the same area taken at a lower tide; in that case, the difference in SSH between the two images provides a minimum amount of uplift. Similarly, a pre-earthquake image with more exposure than a post-earthquake image at a lower tide indicates subsidence; in this case, the difference in SSH gives the minimum subsidence.

Table S1. Coseismic uplift of the Banyak Islands from ASTER imagery

Site	Latitude	Longitude	Minimum uplift or maximum subsidence (cm)	Maximum uplift or minimum subsidence (cm)	Pre-earthquake image acquisition date	Post-earthquake image acquisition date
PBankaru1	2.0955	97.0783	8	-	2005/02/08	2005/08/19
PBankaru3	2.1111	97.0889	8	-	2005/02/08	2005/08/19
PBankaru4	2.1187	97.0969	8	-	2005/02/08	2005/08/19
PBankaru5	2.0789	97.1604	8	-	2005/02/08	2005/08/19
PBankaru6	2.0587	97.1458	8	-	2005/02/08	2005/08/19
PBankaru7	2.0210	97.1262	8	-	2005/02/08	2005/08/19
PTuangku1	2.2627	97.1805	-	-14	2002/01/31	2005/08/19
PTuangku2	2.2350	97.1821	-	-14	2002/01/31	2005/08/19
PTuangku3	2.2426	97.1700	-	-14	2002/01/31	2005/08/19
PTuangku4	2.2315	97.1468	-	-14	2002/01/31	2005/08/19
PTuangku5	2.2320	97.1146	-	8	2005/02/08	2005/08/19
PTuangku6	2.1605	97.2188	-	-14	2002/01/31	2005/08/19
PTuangku7	2.1554	97.2269	-	-14	2002/01/31	2005/08/19
PTuangku8	2.1091	97.2631	-	-15	2002/01/31	2005/08/19
PTuangku9	2.0623	97.3120	-	31	2002/01/31	2005/04/15
PTuangku9	2.0623	97.3120	-6	-	2000/08/30	2005/08/19
Jawijawi1	2.3551	97.5297	-	-28	2005/03/05	2005/08/19
Jawijawi2	2.3843	97.5574	-	-27	2005/03/05	2005/08/19

Table S2. Uplift and subsidence values (column codes at end of table)

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
1	KDR05-A	E Coast Nias, N of Graso	20-May-05	0.82452	97.89542	0	-43	-43	-	-	-	-3	30	1a	#
2	KDR05-B	Graso	20-May-05	0.74685	97.8874	0	-25	-25	-	-	-	-3	30	1b	#
3	LAG05-A	Lagundri	21-May-05	0.5735	97.73145	0	78	78	-	-	-	-3	30	1c	
4	NS05-C	Pulau Lawandra	21-May-05	0.92028	97.43152	4	242	238	-	-	-	-3	19	4	
5	RDJ05-A	Teluk Dalam harbor	21-May-05	0.5646	97.8266	4	-40	-44	-	-	-	-3	16	2	
6	RDJ05-B	Leuleuzaria	21-May-05	0.73452	97.65213	4	109	105	-	-	-	-3	16	4	
7	RDJ05-C	Sirombu Harbor	21-May-05	0.94257	97.41112	4	260	256	-	-	-	-3	16	4	
8	BW05-A	Pulau Bawa	22-May-05	0.83738	97.35239	4	182	178	-	-	-	-3	19	4	
9	RDJ05-D	Pulau Bugi	22-May-05	0.85778	97.38195	4	177	173	-	-	-	-3	21	4	
10	RDJ05-E	Faighunna	22-May-05	1.16787	97.29612	4	264	260	-	-	-	-4	19	4	
11	WNG05-A	Pulau Wunga	22-May-05	1.2255	97.09003	4	185	181	-	-	-	-4	19	4	
12	NS05-D	Onoza Lukhuyou	23-May-05	1.03196	97.38969	0	220	220	-	-	-	-3	30	1g	
13	NS05-E	Afulu Bay	23-May-05	1.2518	97.23883	4	238	234	-	-	-	-4	16	4	
14	NS05-F	Hiligeo Afia	23-May-05	1.4738	97.33134	-2	68	70	-	-	-	-4	23	3	
15	RDJ05-F	Tg. Takba	23-May-05	1.42203	97.15107	4	252	248	-	-	-	-4	19	4	
16	RDJ05-G	Lahewa	23-May-05	1.4022	97.17749	0	247	247	-	-	-	-4	30	1f	#
17	RDJ05-H	Pulau Senau	23-May-05	1.46603	97.25717	4	159	155	-	-	-	-4	16	4	
18	RDJ05-I	Pulau Hilimakora	23-May-05	1.43914	97.2285	4	185	181	-	-	-	-4	16	4	
19	LAI05-A	Laira village	24-May-05	1.1309	97.81693	0	-28	-28	-	-	-	-3	60	1a	#
20	PON05-A	Pulau Onolimbu Kecil	24-May-05	1.07913	97.93011	4	-23	-27	-	-	-	-3	16	2	
21	RDJ05-J	Tg. Laoya	24-May-05	1.50756	97.34628	-2	58	60	-	-	-	-4	12	3	
22	RDJ05-K	Teluk Siabang	24-May-05	1.52809	97.3715	-2	46	48	-	-	-	-4	6	3	
23	RDJ05-L	Teluk Fofola	24-May-05	1.51808	97.42186	-2	19	21	-	-	-	-4	6	3	
24	RDJ05-M	Teluk Fofola	24-May-05	1.47952	97.47365	4	-6	-10	-	-	-	-4	16	2	
25	KDR05-C	Haloban	26-May-05	2.22954	97.22876	4	-58	-62	-	-	-	-6	19	2	
26	KDR05-D	S Bangkaru	26-May-05	2.0145	97.12867	-2	72	74	-	-	-	-5	6	3	
27	KDR05-E	N Bangkaru	26-May-05	2.11266	97.12058	-2	18	20	-	-	-	-6	12	3	
28	RAD05-A	Pulau Babi	27-May-05	2.12245	96.66482	-2	98	***100***	-	-	-	-7	6	3	
29	RAD05-B	Pulau Lasia	27-May-05	2.1724	96.64616	-2	97	***99***	-	-	-	-7	23	3	
30	RDD05-B	Pasirtinggi	28-May-05	2.40138	96.48479	-2	68	***70***	-	-	-	-8	6	3	
31	RDD05-C	Pulau Batu Belahir	28-May-05	2.44173	96.4898	-2	60	***62***	-	-	-	-8	12	3	
32	MNC05-A	Pulau Mintjau	28-May-05	2.34892	96.19311	4	76	***72***	-	-	-	-1	16	4	
33	SSM05-A	Suak Orang	28-May-05	2.3417	96.46787	4	111	***107***	-	-	-	-7	16	4	
34	TPH05-A	Pulau Tapah	28-May-05	2.34528	96.24404	4	68	***64***	-	-	-	-3	19	4	
35	RDD05-D	Teluk Sinabang	29-May-05	2.50182	96.38086	-2	109	***111***	-	-	-	-9	23	3	
36	RDD05-E	Teluk Sinabang	29-May-05	2.51252	96.40407	-2	85	***87***	-	-	-	-9	6	3	
37	RDD05-F	Pulau Benal	29-May-05	2.53949	96.3585	-2	92	***94***	-	-	-	-9	23	3	
38	SMT05-A	Pulau Siumat	29-May-05	2.64586	96.39264	-2	62	***64***	-	-	-	-14	12	3	
39	SMT05-B	Gosong SSE of P. Siumat	29-May-05	2.56932	96.36008	-2	79	***81***	-	-	-	-10	23	3	
40	TDL05-A	Teluk Dalam	29-May-05	2.65409	96.13341	-2	50	52	-	-	12	-2	12 (2005), 6 (2002)	3	&
41	TDL05-B	Teluk Dalam (Sambai)	29-May-05	2.65153	96.19441	-2	62	64	-	-	6	-8	12 (2005), 12 (2002)	3	&
42	RND05-A	Sukamakmur	30-May-05	2.56318	96.31143	4	93	89	-	-	5	-9	16 (2005), 12 (2002)	4	&
43	RND05-B	Ujung Tinggi	30-May-05	2.57317	96.27461	-2	102	104	7	7	3	-8	6 (2005), 6 (2004), 6 (2002)	3	&
44	RND05-C	Tg. Alaban	30-May-05	2.6204	96.23818	4	69	65	9	9	3	-9	16 (2005), 6 (2004), 6 (2002)	4	&
45	ESM05-A	Tg. Marademan	31-May-05	2.75017	96.10368	-2	20	22	-	-	-	-11	23	3	
46	ESM05-B	Lunggung	31-May-05	2.78455	96.01256	-2	22	24	-	-	3	-	23 (2005), 12 (2002)	3	&
47	RDD05-G	Pulau Galagala	31-May-05	2.82795	95.96269	-2	17	19	6	6	-	-	12 (2005), 12 (2004)	3	
48	RDD05-H	Sibigo Bay	31-May-05	2.84252	95.91871	-2	12	14	20	22	-	-	12 (2005), 23 (2004)	3	*

Table S2. Uplift and subsidence values (column codes at end of table)

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
49	RDD05-I	Lewak	31-May-05	2.929448	95.803847	-2	-	-	45	47	-	-	6	3	
50	TDL05-C	Silioggar	31-May-05	2.70829	96.14709	-2	43	45	-	-	6	-	12 (2005), 12 (2002)	3	&
51	RND05-D	Tg. Lokupau	1-Jun-05	2.87021	95.76554	-2	-	-	103	105	-	-	6	3	
52	RND05-E	Tg. Bodeh	1-Jun-05	2.90709	95.77261	4	-	-	63	59	-	-	16	4	
53	RND05-F	Teluk Sanalor	1-Jun-05	2.84594	95.77324	-2	-	-	111	113	-	-	12	3	
54	RND05-G	Tg. Senivung	1-Jun-05	2.82562	95.72099	4	-	-	132	128	-	-	16	4	
55	RND05-H	Langkis	1-Jun-05	2.74971	95.71635	-2	-	-	149	151	-	-	12	3	
56	RND05-I	Pulau Lekon	1-Jun-05	2.71033	95.74496	-2	-	-	136	138	-	-	23	3	
57	USL05-A	Udjung Salang	1-Jun-05	2.70809	95.76126	-2	-	-	119	121	-	-	23	3	
58	BHN05-A	Behena	2-Jun-05	2.61297	95.88687	4	-	-	87	83	11	-	16 (2004), 6 (2002)	4	
59	RDD05-J	Pulau Lekon	2-Jun-05	2.71416	95.72983	-2	-	-	143	145	-	-	6	3	
60	RDD05-K	N of Tg. Usuj	2-Jun-05	2.63413	95.80612	4	-	-	83	79	-	-	16	4	
61	RDD05-L	Bunong	2-Jun-05	2.51883	96.12925	4	51	47	3	4	13	-	16 (2005), 16 (2004), 6 (2002)	4	
62	WSM05-A	Tg. Lambajo	2-Jun-05	2.56613	95.99538	4	-	-	56	52	22	-	16 (2004), 6 (2002)	4	
63	WSM05-B	Situfajaya village	2-Jun-05	2.55271	96.09277	0	56	56	-	-	-	-	60	1d	%
64	GSG05-B	Busung Bay	3-Jun-05	2.38387	96.33331	-2	142	***144***	-	-	-	-6	6	3	
65	RND05-J	Suak Orang	3-Jun-05	2.33247	96.44501	0	140	***140***	-	-	-	-7	60	1d	
66	RND05-K	Teluk Delayan	3-Jun-05	2.349	96.37622	0	130	***130***	-	-	-	-6	60	1d	
67	RND05-L	Teluk Lasiung	3-Jun-05	2.42943	96.27641	0	125	***125***	-	-	-	-5	60	1d	
68	11M05-A	Pulau Sarangbaung	4-Jun-05	1.69859	97.44043	4	-38	-42	-	-	-	-4	16	2	
69	BBI05-A	Pulau Babi	4-Jun-05	2.09274	96.61512	4	109	***105***	-	-	-	-6	19	4	
70	ENS05-A	Tg. Balogara	5-Jun-05	1.34238	97.57471	-2	3	5	-	-	-	-4	6	3	
71	ENS05-B	Laaya	6-Jun-05	1.46285	97.49255	-2	2	4	-	-	-	-4	6	3	
72	ENS05-C	Tg. Tambalou	6-Jun-05	1.38996	97.54171	-2	9	11	-	-	-	-4	6	3	
73	GST05-A	Poa Bay, Gunungsitoli	7-Jun-05	1.2475	97.64712	-2	22	24	-	-	-	-4	6	3	
74	NSB05-A	Lambaru Promontory	7-Jun-05	1.14977	97.80125	0	-40	-40	-	-	-	-3	40	1e	#
75	PON05-B	Pulau Onolimbu	7-Jun-05	1.07498	97.90152	4	-11	-15	-	-	-	-3	16	2	
76	SMB05-A	Pulau Sumabawa	8-Jun-05	0.90951	98.0188	4	-45	-49	-	-	-	-3	16	2	
77	SUM05-A	Pulau Sumasebua	8-Jun-05	1.02557	97.95253	4	-18	-22	-	-	-	-3	16	2	
78	MNS05-A	Pulau Mansalar (NW)	9-Jun-05	1.70205	98.47491	4	-17	-21	-	-	-	-3	16	2	
79	PBTO5-A	Pulau Bintanah	9-Jun-05	1.47766	98.18179	4	-111	-115	-	-	-	-3	19	2	
80	LKT05-A	Pulau Lakota	10-Jun-05	1.84731	98.02609	4	-64	-68	-	-	-	-3	16	2	
81	BYK05-A	Pulau Lambudong	11-Jun-05	2.24658	97.34369	4	-69	-73	-	-	-	-5	16	2	
82	BYK05-B	Pulau Samut	11-Jun-05	2.12918	97.35417	4	-54	-58	-	-	-	-5	16	2	
83	BYK05-C	Pulau Pabandah	11-Jun-05	2.20672	97.31592	4	-70	-74	-	-	-	-5	16	2	
84	BYK05-D	Pulau Lailana	12-Jun-05	2.27714	97.23001	4	-57	-61	-	-	-	-6	16	2	
85	BYK05-F	Pulau Tuangku (S) - Teluk Mariabah	13-Jun-05	2.04494	97.33258	4	-21	-25	-	-	-	-5	16	2	
86	BYK05-G	Pulau Sarangalu	14-Jun-05	1.98375	97.38846	4	-22	-26	-	-	-	-5	16	2	
87	BYK05-H	Pulau Pinang	14-Jun-05	2.0436	97.38953	4	-39	-43	-	-	-	-5	16	2	
88	BYK05-I	Pulau Palambak	14-Jun-05	2.15998	97.44103	4	-84	-88	-	-	-	-5	16	2	
89	BYK05-J	Mibung Bay, Pulau Bale	15-Jun-05	2.34281	97.3906	4	-103	-107	-	-	-	-5	16	2	
90	BYK05-K	Pulau Bagu	15-Jun-05	2.29184	97.40535	4	-91	-95	-	-	-	-5	16	2	
91	BYK05-L	Pulau Rangit Besar	15-Jun-05	2.23972	97.42859	4	-92	-96	-	-	-	-5	16	2	
92	KRG05-B	Pulau Karang	16-Jun-05	1.97249	98.35587	4	-31	-35	-	-	-	-3	16	2	
93	MNS05-B	Pulau Mansalar (SE)	17-Jun-05	1.61987	98.6096	4	-32	-36	-	-	-	-3	16	2	
94	SIB05-A	Pulau Poncan Besar	17-Jun-05	1.70628	98.76357	4	-34	-38	-	-	-	-2	16	2	
95	PIR05-A	Pulau Ilir	18-Jun-05	1.27593	98.82305	4	-30	-34	-	-	-	-2	16	2	
96	NS205-A	Pulau Mausi	1-Jul-05	1.35913	97.10654	-2	223	225	-	-	-	-4	12	3	
97	NS205-B	Tg. Linga	1-Jul-05	1.41481	97.06493	-2	221	223	-	-	-	-4	6	3	
98	NS205-D	Pulau Imana	3-Jul-05	0.85389	97.32775	4	192	188	-	-	-	-3	19	4	
99	NS205-E	Tg. Saetsy	4-Jul-05	0.79105	97.63127	4	147	143	-	-	-	-3	16	4	

Table S2. Uplift and subsidence values (column codes at end of table)

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
100	NS205-F	Tg. Lodawa	4-Jul-05	0.60012	97.68626	4	100	96	-	-	-	-3	16	4	
101	NS205-G	Ilinamenia	5-Jul-05	0.63357	97.89736	4	-20	-24	-	-	-	-3	16	2	
102	NS205-I	Pohili Bay	6-Jul-05	0.56422	97.77323	4	32	28	-	-	-	-3	16	4	
103	KS05-42	NW Simeulue	17-Jan-05	2.80665	95.71368	4	-	-	153	149	-	-	19	4	
104	KS05-43	NE Simeulue	17-Jan-05	2.91409	95.83584	4	-	-	39	35	-	-	19	4	
105	KS05-53	W Simeulue	18-Jan-05	2.61317	95.87225	0	-	-	-	-	5	-	12	3	
106	KS05-55	W Simeulue	18-Jan-05	2.54773	95.93723	-3	-	-	43	46	-	-	23	3	
107	KS05-70	N Simeulue	18-Jan-05	2.86137	95.76308	4	-	-	130	126	-	-	21	4	
108	KS05-72	NE Simeulue	18-Jan-05	2.84368	95.91775	-2	-	-	20	22	-	-	23	3	
109	SAL05-A	Salur	18-Jan-05	2.44275	96.241	0	-	-	-30	-30	-	-	30	1a	#
110	PSMK	Pulau Simuk	28-Mar-05	-0.08931	97.86091	-	-	25	-	-	-	-	1	5	
111	PTLO	Pulau Telo	28-Mar-05	-0.0546	98.28004	-	-	-1	-	-	-	-	1	5	
112	PBAI	Pulau Bais	28-Mar-05	-0.0316	98.52622	-	-	-1	-	-	-	-	1	5	
113	LHWA	Lahewa, Nias	28-Mar-05	1.38354	97.13445	-	-	290	-	-	-	-	1	5	
114	LEWK	Lewak, Simeulue	28-Mar-05	2.92359	95.80406	-	-	2	-	-	-	-	1	5	
115	BSIM	Bandara, Simeulue	28-Mar-05	2.40925	96.32616	-	-	165	-	-	-	-	1	5	

Column codes for Table S2

a. ***Observation number***

b. ***Site code***

c. ***Nearby landmark***

d. ***Date of observation (UTC)***

e. ***Latitude***

Decimal degrees, WGS 84 datum

f. ***Longitude***

Decimal degrees, WGS 84 datum

g. ***Tidal correction (cm)***

We apply two types of tidal corrections. The first accounts for extreme low tides that are, on average, 4 cm below *Porites* HLS in the study area. This correction is applied to the difference between pre-earthquake HLS and the tide model prediction of extreme low tide on uplifted coral heads. The second correction accounts for the difference between the lowest low tide after the earthquake but before the time of our measurement, and the predicted annual extreme low tide during the same interval. This second correction (usually about 2 cm) is accounted for in all measurements utilizing post-earthquake HLS. At sites where more than one uplift event was recognized, the second type of correction (~2 cm) was applied to 2004 uplift where appropriate, and no correction was necessary for 2002 uplift measurements.

h. ***Observed March 28 2005 uplift (cm)***

These are the raw uplift values we observed in the field.

i. ***Final March 28 2005 uplift (cm)***

Includes tidal correction for coral measurements (see **g** above). Values in italics are net uplift for the 2004 and 2005 ruptures on southern Simeulue. Because there was probably subsidence during the 2004 rupture that we could not quantify when we visited these sites after the 2005 rupture, the italicized values represent minimum uplift for the 2005 event. An estimate of December 2004 coseismic subsidence as derived from an elastic model (*S4*) is given in column **m**.

j. ***Observed December 26 2004 uplift (cm)***

These are the raw uplift values we observed in the field.

k. ***Final December 26 2004 uplift (cm)***

Included tidal correction for coral measurements (see **g** above).

l. ***2002 uplift (cm)***

We attribute a small pre-2004 uplift to the Mw 7.3 2002 earthquake. The uplift is determined from HLS to HLS measurements on the same head and no tidal corrections are applied. These measurements are based on only a few heads at each location and lack exact age control, and thus these measurements provide only a rough approximation of 2002-related deformation.

m. ***Elastic model of December 26, 2004 coseismic subsidence (cm)***

This is an estimate of tectonic subsidence due to the December 26 rupture derived from the elastic dislocation model of Subarya et al. (*S4*) .

n. ***Total uplift uncertainty ± 2δ (cm)***

We estimate the standard error in our uplift and subsidence measurements in the following general manner:

$$2\sigma = \sqrt{(\textbf{inst. error})^2 + (\textbf{HLS unc.})^2 + (\textbf{tide model})^2}$$

where the uncorrelated errors are

inst. error = Survey instrument error of 1-2 cm.

HLS unc. = Coral microatoll HLS uncertainty of 3-20 cm. This term incorporates pre- and post-earthquake HLS uncertainty within single heads and between multiple heads, and also accounts for possible undetected secondary deformation in locations with relatively few (<3 heads) measurements.

tide model = Tide model to HLS uncertainty of 15 cm. This term accounts for tide model uncertainties and the variation between coral HLS and tide model extreme low tide predictions.

Where there are multiple measurements at a site, uncertainties are broken down by year of uplift.

o. ***Measurement types***

This column summarizes the types of measurements for the most recent event made at each location. Uplift measurements for older events were always determined by measuring the distance between HLS and HLS (measurement type 3, below).

1 Non-coral uplift estimates. These measurements are the most subjective and are assigned large ad-hoc uncertainties. The non-coral measurement types are as follows:

1a Minimum subsidence estimated from water depth in a previously dry back-berm depression.

1b Minimum subsidence estimated from thickness of tidally-entrained sand on a buried pre-March 2005 grassy surface.

1c Uplift estimated from pre- and post-earthquake high tide elevations recorded by algae growth limits.

1d Uplift based on beach profiles and correlation of high tide erosional scarps and/or beach berm crests.

1e Submergence of apparent pre-earthquake high-tide mark below post-earthquake model high tide.

1f Minimum uplift estimated from pre-earthquake high tide limit as estimated from mangrove lower leaf line, and post-earthquake model high tide.

1g Minimum uplift estimated from the old high tide mark on coconut palm root balls and post-earthquake model of high tide level.

2 Submergence determined from the difference between pre-earthquake microatoll HLS and post-earthquake extreme low tide.

3 Uplift is the difference between pre- and post-earthquake microatoll HLS.

4 Uplift is the difference between pre-earthquake microatoll HLS and post-earthquake model elevation of extreme low tide.

5 Uplift determined from coseismic vertical offset of continuous stations of the SuGAr CGPS network.

p. ***Notes***

Throughout the table, a dash signifies no observation.

= Minimum value
& = These 2002 uplift values are our best interpretation of microatoll morphology, but their confirmation awaits more detailed study.
* = At Sibigo Bay, we measured net 2004 and 2005 uplift and then subtracted the 2004 uplift value we recorded at the same site during reconnaissance in January 2005.
% = Net 2004 plus 2005 uplift.

Figures S1-S10

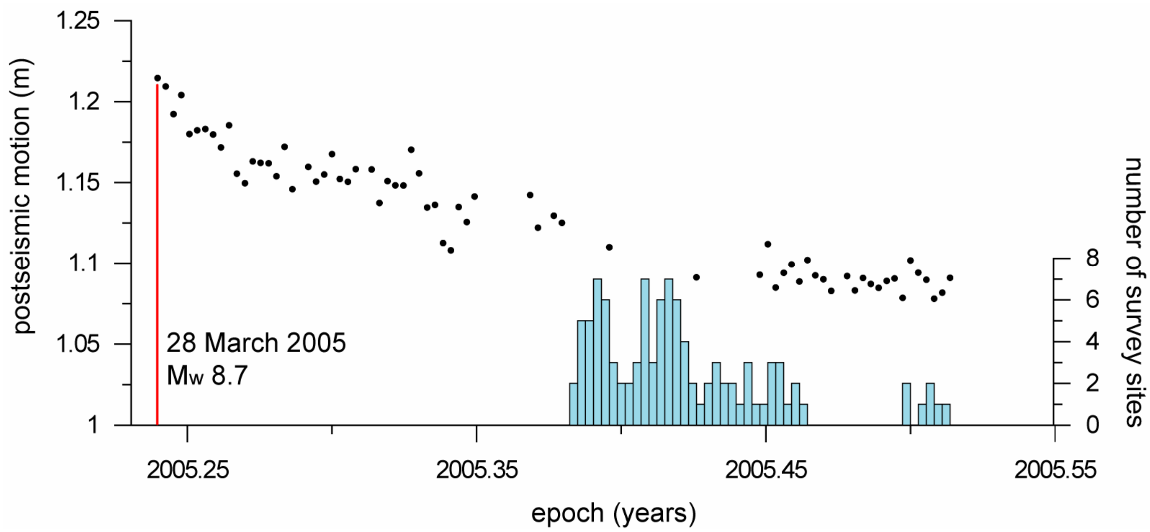

Figure S1. Time series of postseismic vertical position of CGPS station LHWA (dots) with respect to the dates of our coral uplift measurements after the 28 March earthquake (bars). Station LHWA recorded the maximum coseismic uplift observed during the 28 March event (2.90 m) and had subsided 0.09 – 0.13 m by the time of our field survey. This represents a only a modest (~4.5% maximum) change in post-earthquake elevation, and thus we have chosen not to include corrections for these relatively small motions in our maps and models of coseismic deformation.

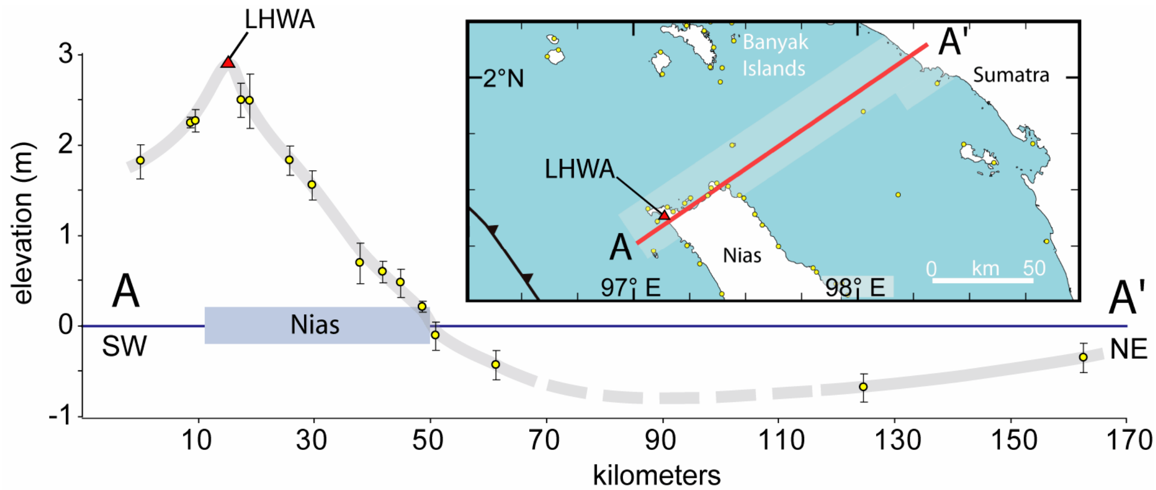

Figure S2. Trench-perpendicular profile (location A-A' in inset) illustrating the sharp uplift crest and broad subsidence trough associated with the 28 March 2005 M_w 8.7 Sunda megathrust rupture. The shaded portion of the map in the inset box is projected onto profile A-A'. Yellow dots are coral uplift measurements and the red triangle is the CGPS station LHWA near Lahewa, Nias.

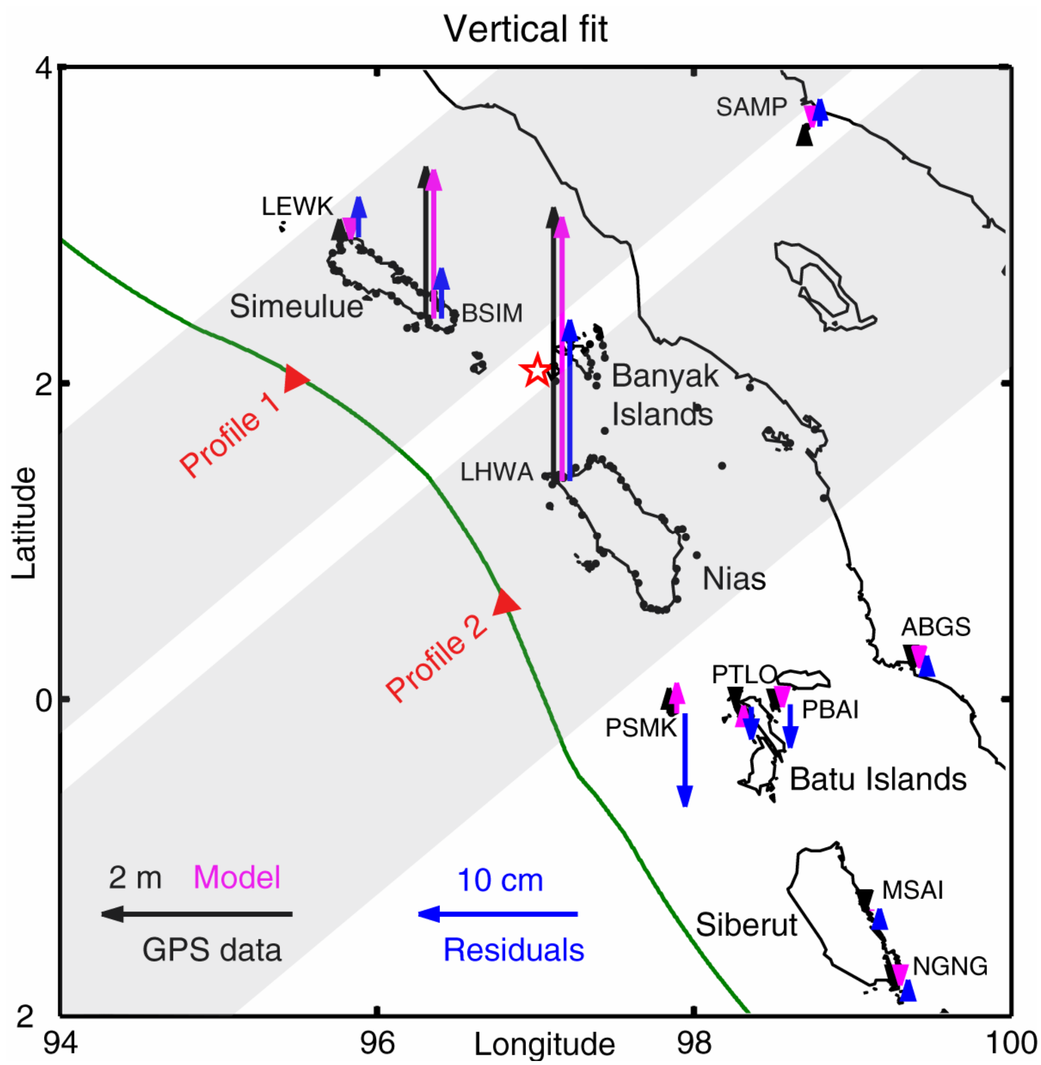

Figure S3. GPS data (black), model (lavender), and residuals (blue) for the elastic model vertical component of the 2005 rupture. The four-letter codes are the CGPS stations of the SuGAr network and black dots are the location of the non-CGPS uplift measurements. Grey swaths indicate the locations of profiles of the vertical components displayed in supplemental figures S4-S7. The green line marks the location of the Sunda deformation front.

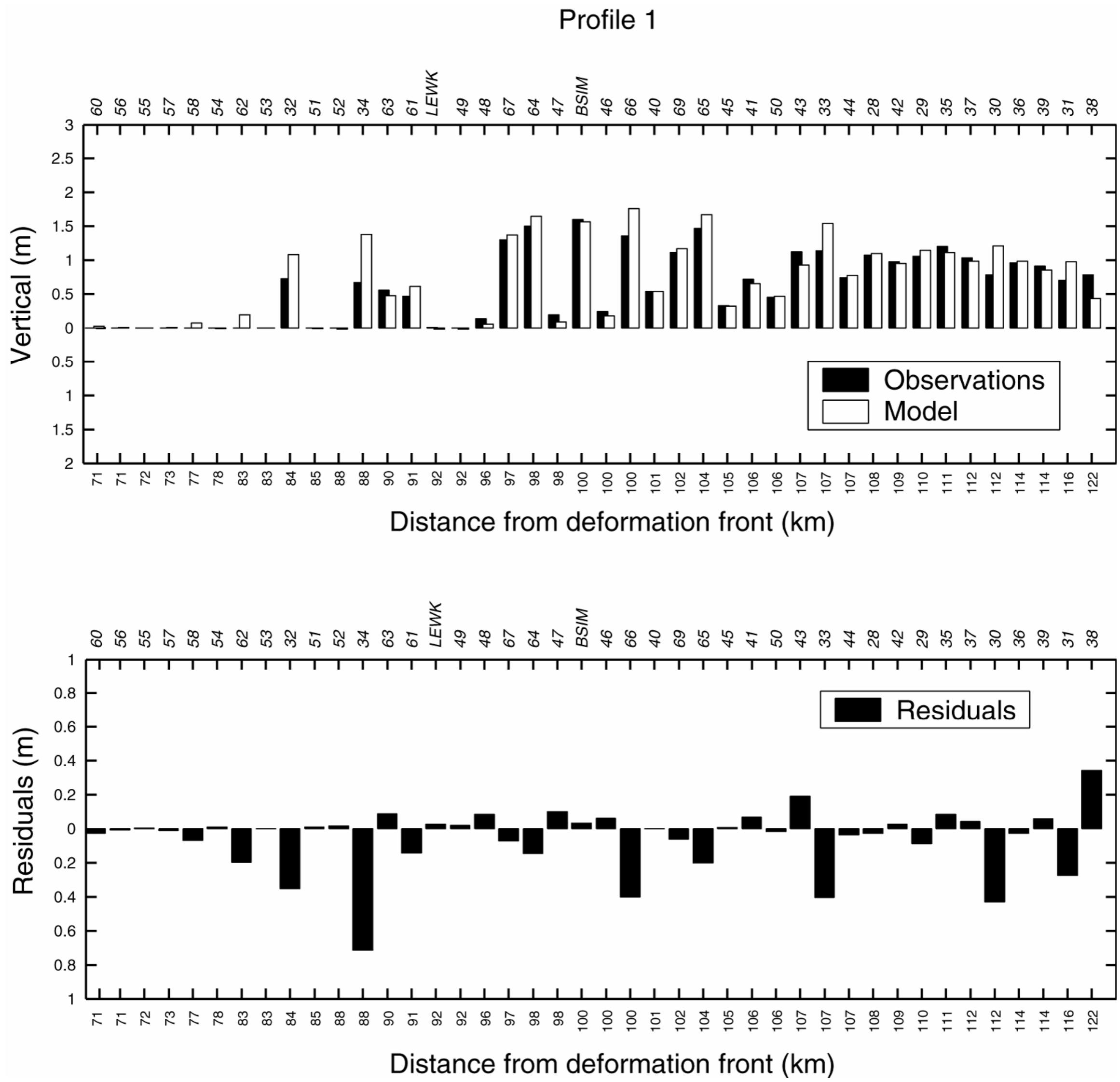

Figure S4. Profile 1 (see Fig. S3 for location) showing a comparison between field observations and CGPS measurements to elastic model predictions (top panel) and their residuals (bottom panel). The bottom numbers on each panel are the distance from the deformation front (red triangle in Fig. S3) and the top numbers are the CGPS stations or field observation numbers from Table S2.

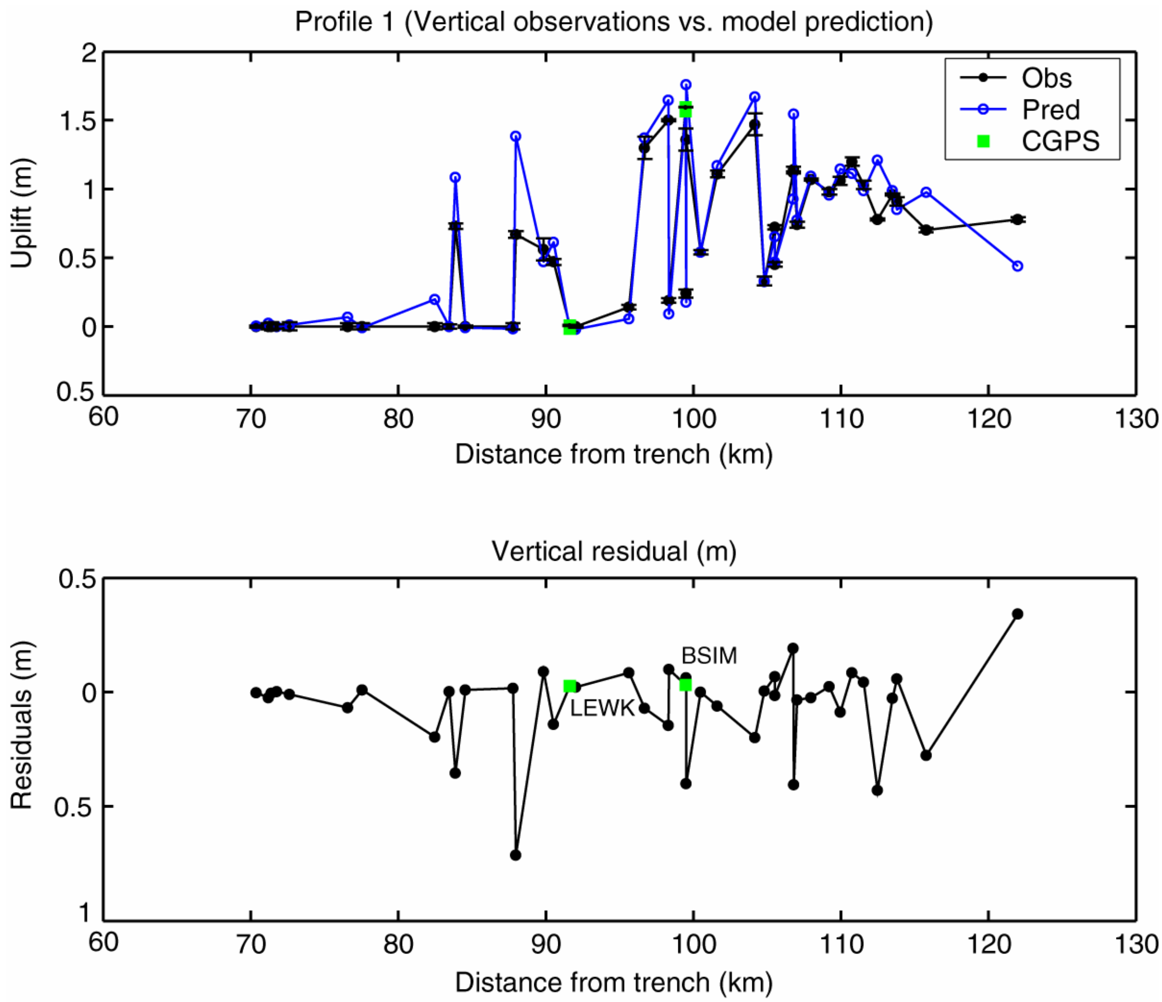

Figure S5. Profile 1 (see Fig. S3 for location) comparing field observations and CGPS measurements to elastic dislocation model predictions (top panel) and residuals (bottom panel) as a function of distance from the deformation front.

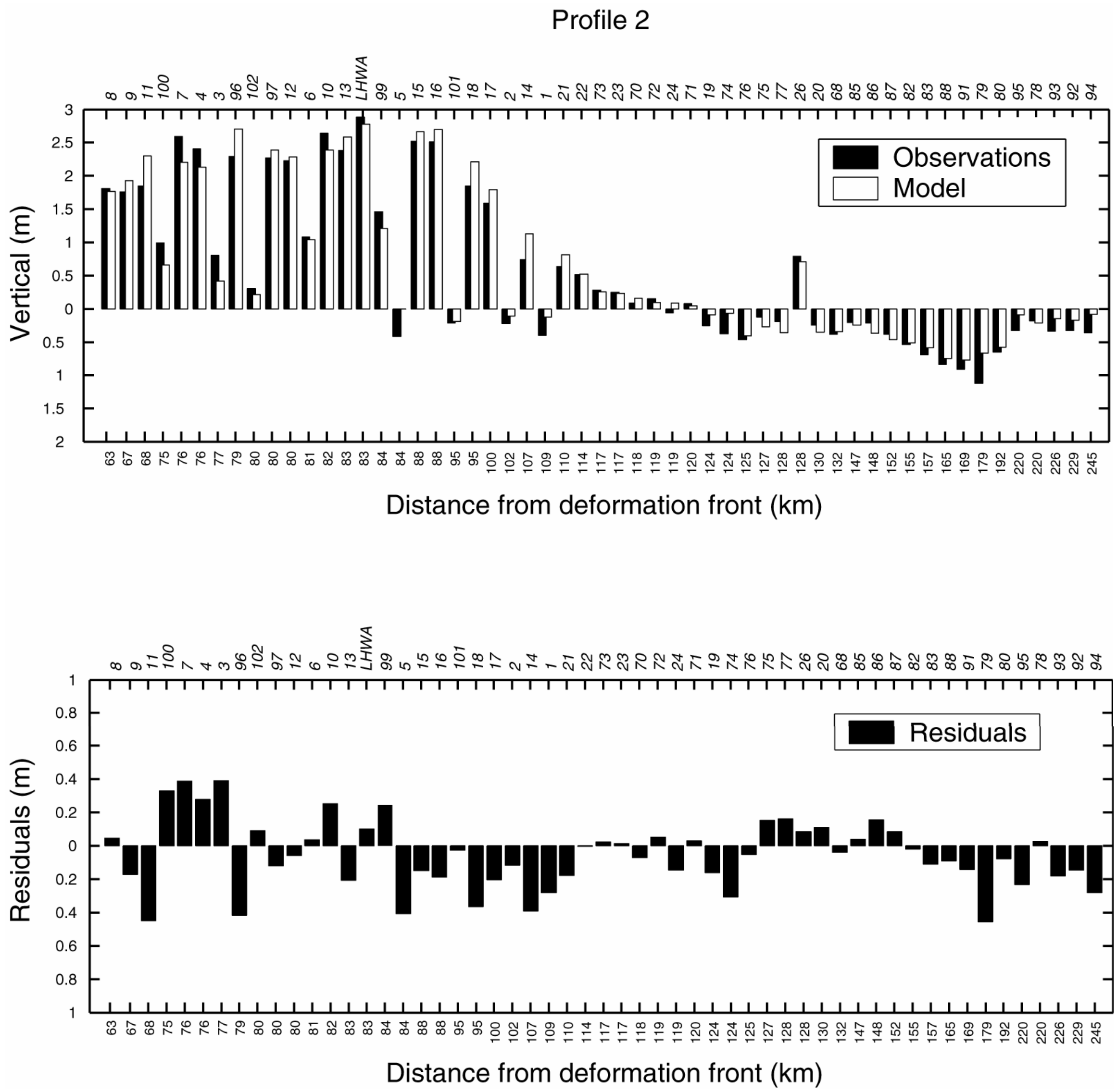

Figure S6. Profile 2 (see Fig. S3 for location) showing a comparison between field observations and CGPS measurements to elastic model predictions (top panel) and their residuals (bottom panel). The bottom numbers on each panel are the distance from the deformation front (red triangle in Fig. S3) and the top numbers are the CGPS stations or field observation numbers from Table S2.

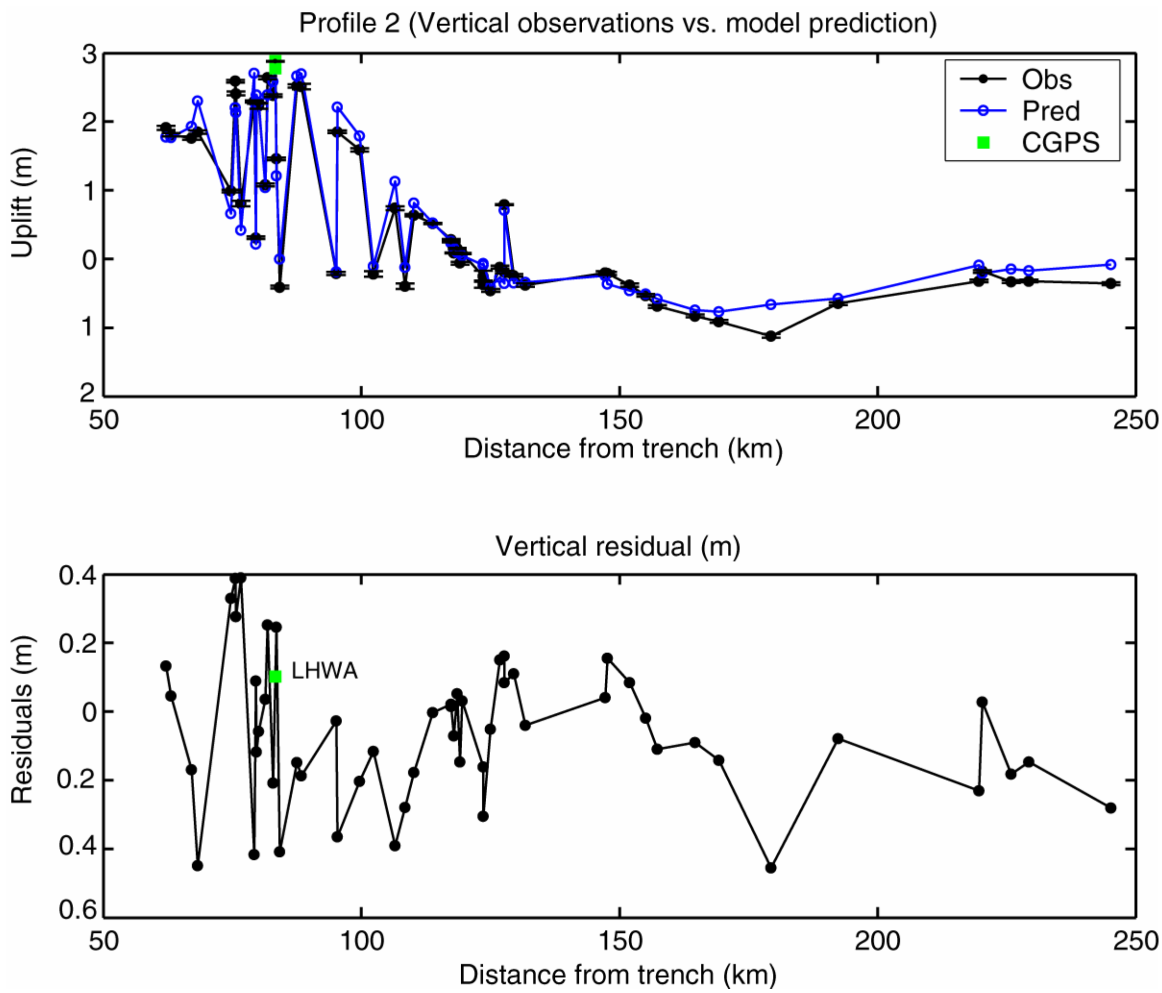

Figure S7. Profile 2 (see Fig. S3 for location) comparing field observations and CGPS measurements to elastic dislocation model predictions (top panel) and residuals (bottom panel) as a function of distance from the deformation front.

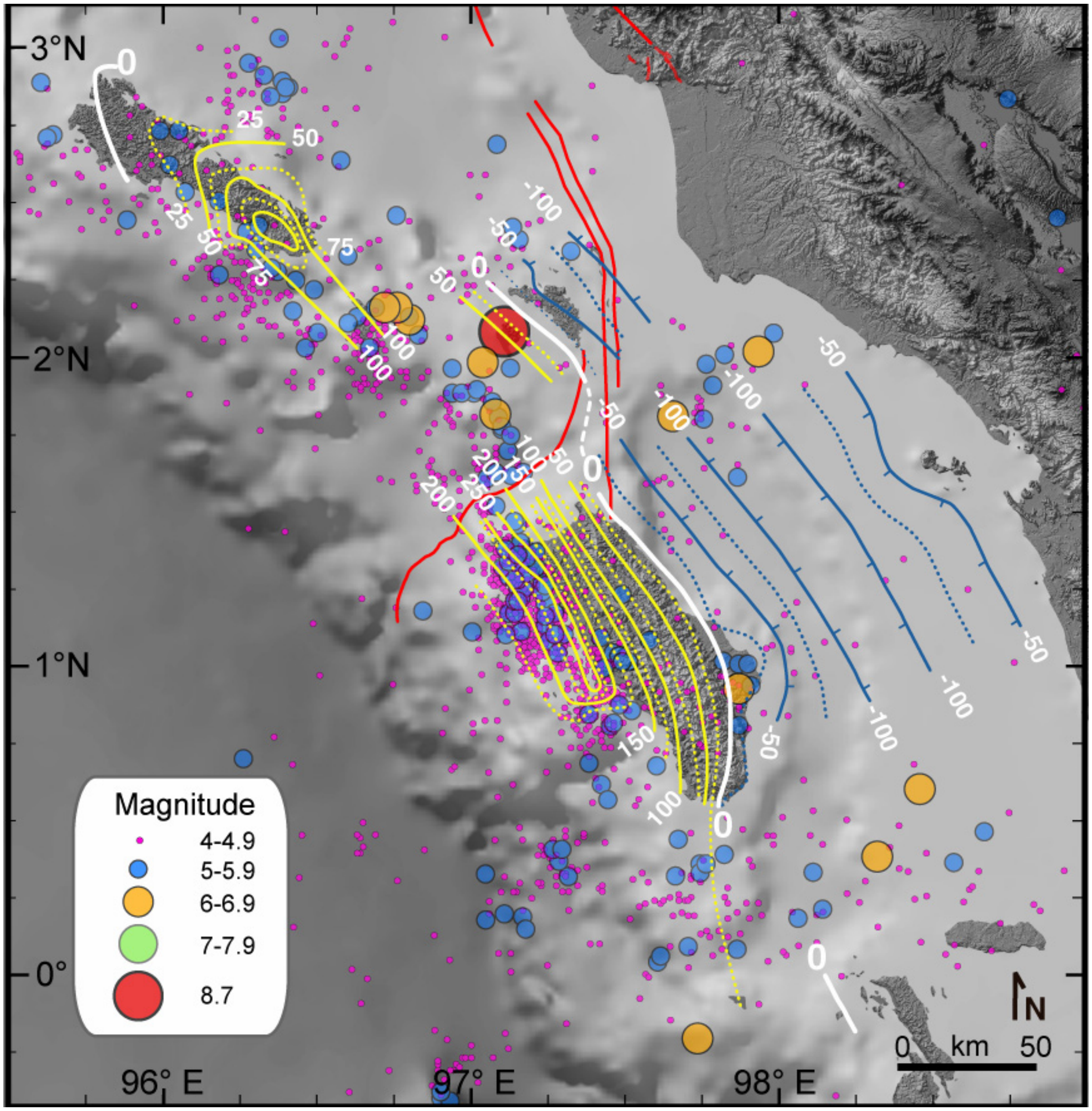

Figure S8. Aftershocks following the 28 March mainshock and 25 cm coseismic uplift contours from the 28 March 2005 rupture (yellow contours are uplift, blue are subsidence, and white is pivot line of no change). Aftershocks are concentrated beneath the western flank of the coseismic uplift belt and show a pronounced misalignment across the previously mapped Batee fault (*S5, S6*), which is shown as a red line. Aftershock locations up to 16 October 2005 from (*S7*). Shaded relief from (*S8, S9*).

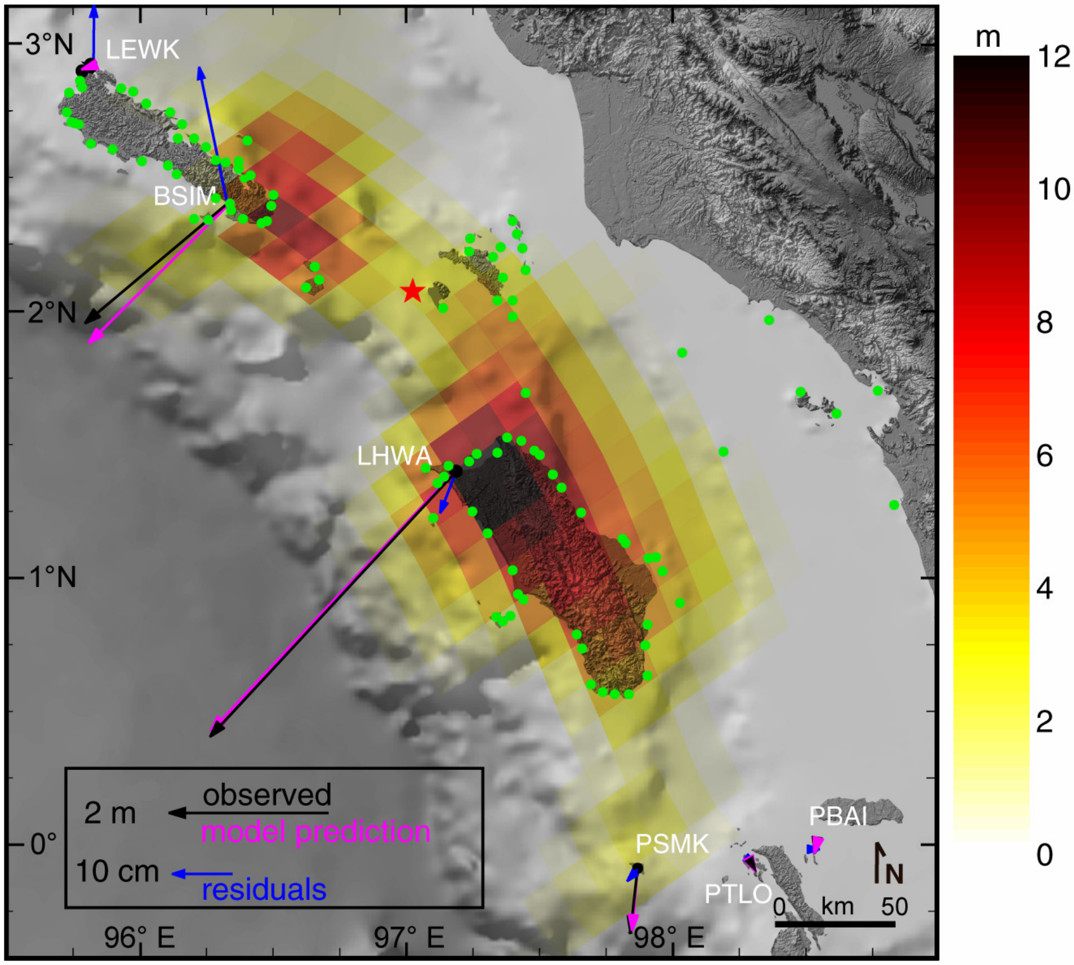

Figure S9. Map view of model coseismic slip distribution on the 28 March 2005 Nias-Simeulue fault plane with respect to predicted bathymetry (*S8*). Notice the apparent correlation between patches of higher slip and steeper sections of the deformation front. Horizontal displacements from CGPS are black and model values are pink. Model residuals are blue vectors (note change of scale). Epicenter of the March 2005 mainshock is a red star and uplift measurement sites are green circles. Four-letter codes are SuGAr CGPS stations. Shaded relief on land from (*S9*).

Earthquake recurrence: One of the simplest calculations we can make is an estimate of the return period for nominal Nias-Simeulue earthquakes. From our coseismic slip model, we calculate an average slip of 6.6 m beneath Nias and 4.7 m beneath southern Simeulue (Fig. S10). At the latitude of Simeulue, the trench-normal component of convergence between the Sunda plate and the Indian plate and the Australian plate is 40 mm/yr and 50 mm/yr, respectively (*S10*). At these rates, 4.7 m of slip could recur every 95 to 115 years, on average. At the latitude of Nias, trench-normal convergence between the Sunda plate and the Indian plate and Australian plate is 33 and 37 mm/yr, respectively (note that the variation in these rates between Simeulue and Nias is due to the considerable change in trend of the deformation front between Nias and Simeulue). At these rates, 6.6 m of slip could recur every 180 to 200 years. At both latitudes, these estimates of recurrence reasonably approximate the interval between the 2005 earthquake and the previous large, destructive earthquake. The west coasts of both Nias and Simeulue experienced a devastating tsunami in 1907, 98 years prior (*S11*); and the previous large earthquake and tsunami to hit Nias was in 1861, 144 years prior (*S11, S12*). It is not clear, however, that the 2005 megathrust rupture is a strict repetition of the 1907 or 1861 earthquakes. The 1907 earthquake, in particular, appears to have been very different in that it is judged to have been merely a magnitude 7.6 (*S11*), and yet it produced a much larger tsunami on the west coast of Simeulue and northwestern Nias (*S13*). This suggests it may have resulted from rupture of a shallower patch of the megathrust, up-dip from the 2005 rupture.

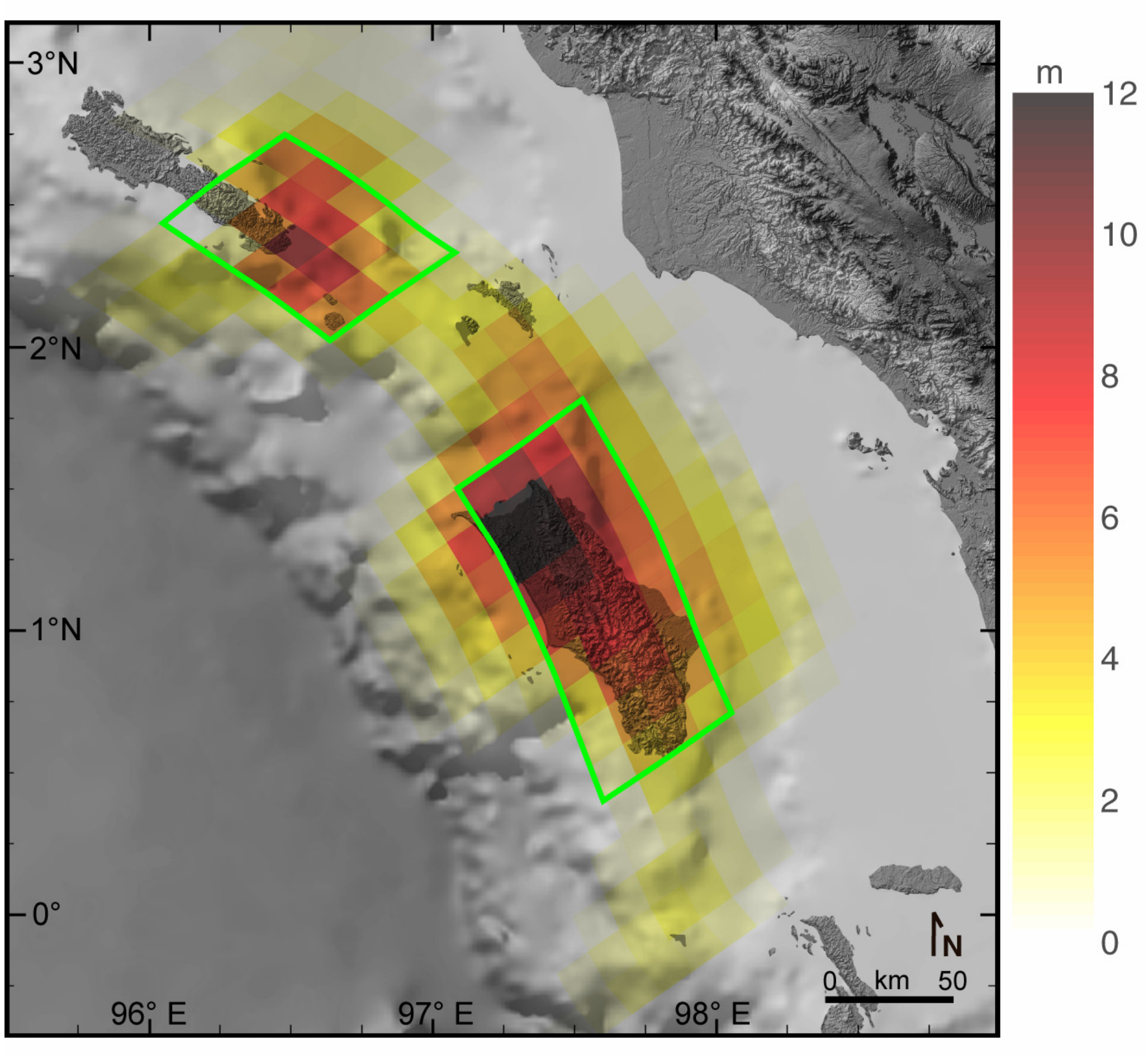

Figure S10. March 2005 coseismic slip (m = meters). Average slips of 4.7 m beneath southernmost Simeulue and 6.6 m beneath Nias occur within areas defined by green boxes. Shaded relief from (*S8, S9*).

Supporting Online Material: References

S1. A. J. Meltzner et al., *J. Geophys. Res.*, doi:10.1029/2005JB003891, in press.

S2. G. D. Egbert, S.Y. Erofeeva, *J. Atmos. Oceanic Technol.* **19**, 183 (2002)

S3. D. C. Agnew, *J. Geophys. Res.,* **102,** 5109 (1997)

S4. C. Subarya *et al.*, *Nature*, in press.

S5. J. R. Curray, *J. Asian Earth Sci.,* **25**, 187 (2005)

S6. K. Sieh, D. Natawidjaja, *J. of Geophys. Res.* **105**, 28,295 (2000)

S7. Seismicity obtained from the National Earthquake Information Center at http://neic.usgs.gov/neis/epic/

S8. W.H.F. Smith, D.T. Sandwell, *Science,* **277**, 5334 (1997)

S9. Shuttle Radar Topography Mission (SRTM) data from http://seamless.usgs.gov/

S10. L. Prawirodirdjo, L., Y. Bock, *J. Geophys. Res.,* **109,** B08405, doi:10.1029/2003JB002944 (2004)

S11. K. R. Newcomb, W. R. McCann, *J. Geophys. Res.,* **92**, 421 (1987)

S12. D. H. Natawidjaja et al., in preparation

S13. Oral traditions of Simeulue suggest that tsunami heights in 1907 were much greater than in 2005. For example, Zamzam, a 55-year-old resident of Salur village (N 2° 26.024’, E 96° 15.515’) was told by his grandmother that in 1907 the tsunami surge reached 13-15 m height on a banyan tree that is still alive today. In comparison, surge height in Salur following the December 2004 rupture was ~1.9-2.5 m based on our observations in January, and the surge height due to the tsunami caused by the March 2005 rupture was even less than in December.