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Modeling seismic hazard and landslide occurrence probabilities in northwestern Yunnan, China: exploring complex fault systems with multi-segment rupturing in a block rotational tectonic zone

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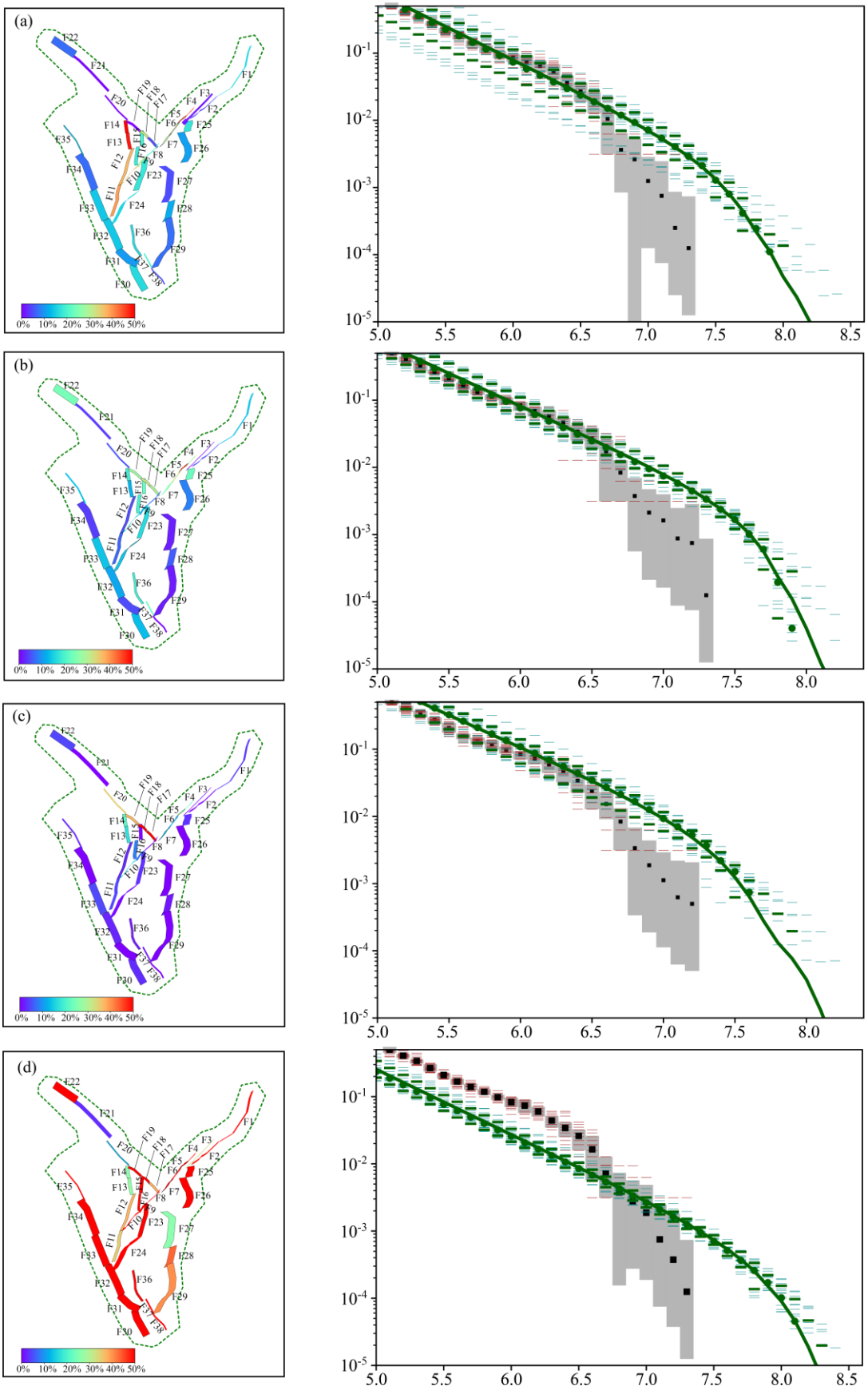
(a)
(b)
(c)
(d)
0% 10% 20% 30% 40% 50%
5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5
10^{-1}
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10^{-4}
10^{-5}

Figure S1. Calculated NMS ratios and comparison results for different models using the G-R relation and the scaling relationships from Wells and Coppersmith (1994). **(a)** Modeled Non-Mainshock Slip (NMS) Ratio. **(b)** Comparisons between the historical Seismicity rates for different models. Dashed green lines are the MFD of each model, and the solid green line is the mean MFD, green patches represent the uncertainty (16-84 percentiles). The dotted black line is the rate from the catalog; the dashed red lines are individual Monte Carlo sampled rates of the catalog exploring the uncertainties on the magnitudes of earthquakes, and gray rectangular show the one-sigma uncertainty on the earthquake rates in statistical analysis.

Table S1. Rupture Parameters of the Fault Segments in the Northwestern Yunnan Region.

Fault Name	Segment No.	Historical events		Characteristic EQ.		Paleo-earthquakes	Holocene slip rate (mm/yr) **		Dip		References
		Time	Mag.	Length (km)	Mag.* (M_W)		Horizontal	vertical	Direction	Angle (°)	
Lijiang-Xiaojinhe fault	F1			56	6.9		2.0±0.7	0.2±0.1	N	80	Gao et al., 2019 Ding et al., 2018
	F2	1976	*M*6.3	50	6.8		1.0±0.7	0.2±0.1	N	80	
	F3			92	7.3		1.0±0.7	0.2±0.1	N	80	
	F4			17	6.1		2.1±1.5	0.4±0.2	N	80	Gao et al., 2019 Ding et al., 2018
	F5			15	6.0		3.3±0.5	0.4±0.2	N	75	
	F6			23	6.3	7940~6540 a. BP 4740~4050 a. BP 1830~420 a. BP	3.3±1.2	0.4±0.2	N	75	
	F7			21	6.2	5120~3200 a. BP 2100~1200 a. BP	3.3±1.2	0.4±0.2	N	75	
	F8			25	6.4	44980~17660 a. BP 7210~3810 a. BP	2.4±0.5		N	75	Gao et al., 2019 Ding et al., 2018

					2540~1540 a. BP					
	F9			16	6.0		2.4±0.5	N	75	
	F10	1951	*M*6.4	42	6.7	5980±560 a. BP 1770±1000 a. BP	2.4±0.5	N	75	Gao et al., 2019 Ding et al., 2018
Longpan-Qiaohou fault	F11	1751	*M*6.7	49	6.8	10737±468 a. BP 6230±130 a. BP	2.2±1.2	0.2±0.2	W	75	Institute of Geology-State Seismological Bureau, and Yunnan Seismological Bureau, 1990; Tang et al., 2014
	F12	1925	*M*6.1	58	6.9				W	75	He and Chang, 2022
	F13			25	6.3				W	75	
	F14			19	6.1				W	75	
Yulong East fault	F15	1990	M_W6.6	23	6.3		~0.84	~0.70	E	75	Zhou et al., 2004; Han et al., 2004
	F16			30	6.5				E	75	

Zhongdian fault	F17			15	6.0		1.8±0.2	0.6±0.2	W	80	Chang et al.,2014; Chang et al., 2023; Cheng et al., 2020a
	F18	1966	*M*6.4	20	6.2				W	80	
	F19	1933	*M*6.3	23	6.3	4910~45aBP 7000 a BP 32.93~19.96 ka. BP			W	80	
	F20			48	6.8				E	80	
	F21			74	7.1				E	80	
	F22	1961	*M*6.1	39	6.6	1075±95 a BP 490±110 a BP			E	80	
Heqing-Eryuan fault	F23			49	6.8		2.0±1.0	0.7~1.0	W	80	Institute of Geology-State Seismological Bureau, and Yunnan Seismological Bureau, 1990; Han et al., 2005;
	F24	1839-2-7 1839-2-23	*M*6.3 *M*6.3	60	7.0				W	80	

											Sun et al.,2017
Ninglang fault	F25			16	6.0		0.5±0.4	0.0±0.3	W	80	Wu et al., 2023
	F26			49	6.8				W	80	
Chenghai fault	F27	1515	*M*7.8	62	7.0	9851 a BP 7400 a BP 5501 a BP 2299 a BP 1515 AD	3.0±1.5	1.7±0.3	W	80	Institute of Geology-State Seismological Bureau, and Yunnan Seismological Bureau, 1990; Yu et al., 2005
	F28	1515	*M*7.8	31	6.5	1606 *M*6			W	80	Institute of Geology-State Seismological Bureau, and Yunnan Seismological

										Bureau, 1990; Tang et al., 2017; Huang et al.,2018
	F29	1803	*M*6.3	82	7.2			W	80	Institute of Geology-State Seismological Bureau, and Yunnan Seismological Bureau, 1990; Tang et al., 2017; Huang et al., 2018
Weixi-Qiaohou fault	F30			43	6.7	~1.25	~0.91	W	80	Ren et al., 2007;
	F31			37	6.6			W	80	
	F32			49	6.8			W	80	
Tongdian-	F33			49	6.8	2.1±0.3	0.4±0.1	W	80	Chang et al.,

Weishan fault	F34			58	6.9	28000 a. BP			W	80	2016;2022
	F35			54	6.9				W	80	
Diancangshan East fault	F36	1925 1515	*M*6.9 *M*6.1	50	6.8	62 a BP 474 a BP ⩾2070 a. BP 2700 a BP 5500 a. BP 6500 a.BP ⩽10800 a BP	/	1.5±0.5	E	80	Guo et al., 1984; Zhou et al., 2004
Red River fault	F37	1623	*M*6.3	23	6.3		1.1 ± 0.4	/	W	80	Shi et al., 2018
	F38	1625	*M*6.8	32	6.5		1.1 ± 0.4	/	W	80	Shi et al., 2018; Li et al., 2016

* denotes the magnitude of characteristic earthquake is from the scaling law of Cheng et al. (2020b), while ** Left lateral strike slip rate and normal slip rate are positive, respectively.

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