Supplementary files

for

Flood susceptibility mapping of the Western Ghat coastal belt using multi-source geospatial data and analytical hierarchy process (AHP)

Sumit Das

Department of Geography, Savitribai Phule Pune University, Pune 411007, India

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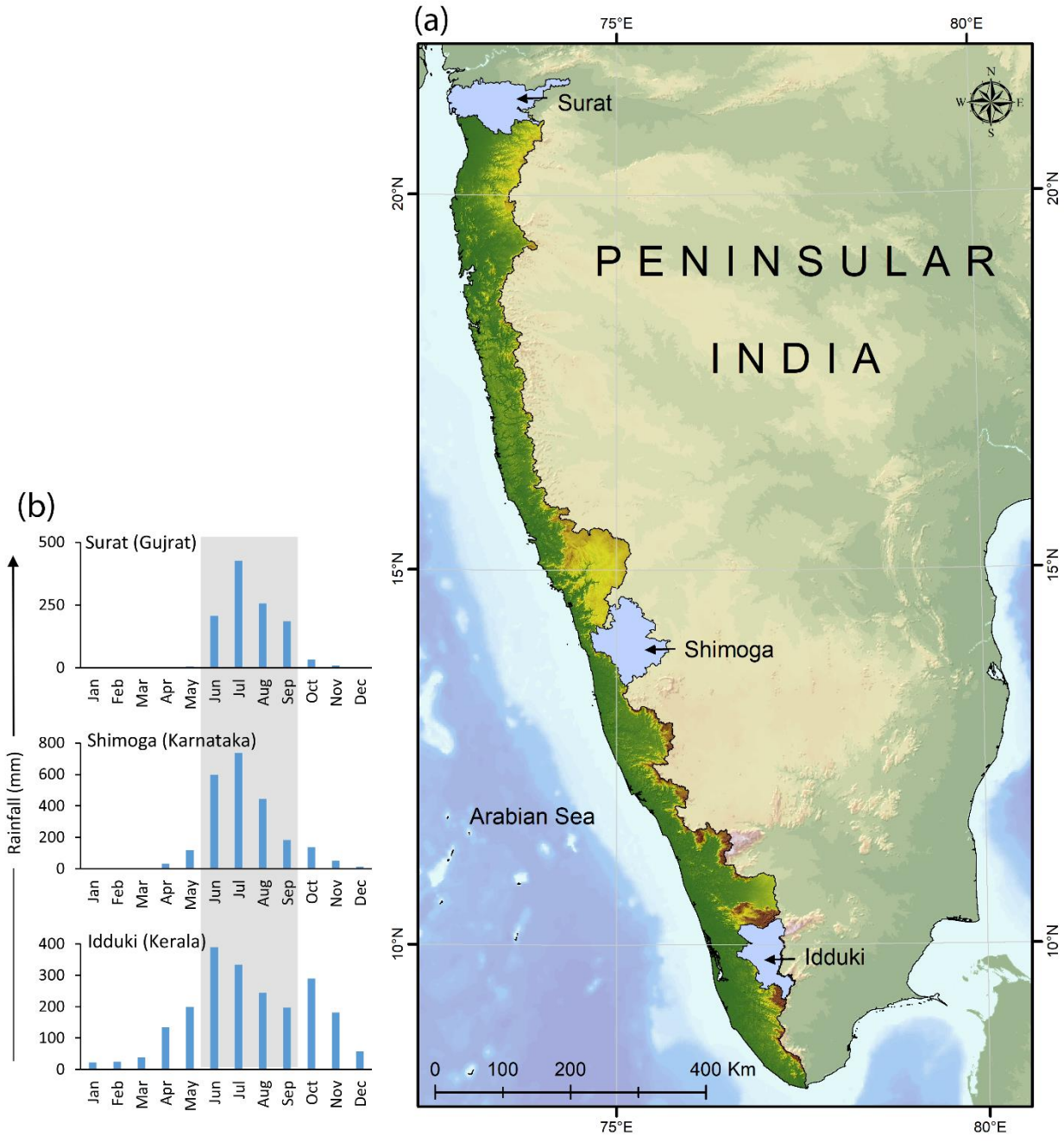

Fig. S1. Rainfall distribution in few districts within study area. (a) Location of the districts, (b) monthly rainfall distribution. It can be seen that almost all these districts located in the different section along the West Coast of India receive very high annual rainfall. However, the maximum rainfall occurs during monsoon months (gray shade).

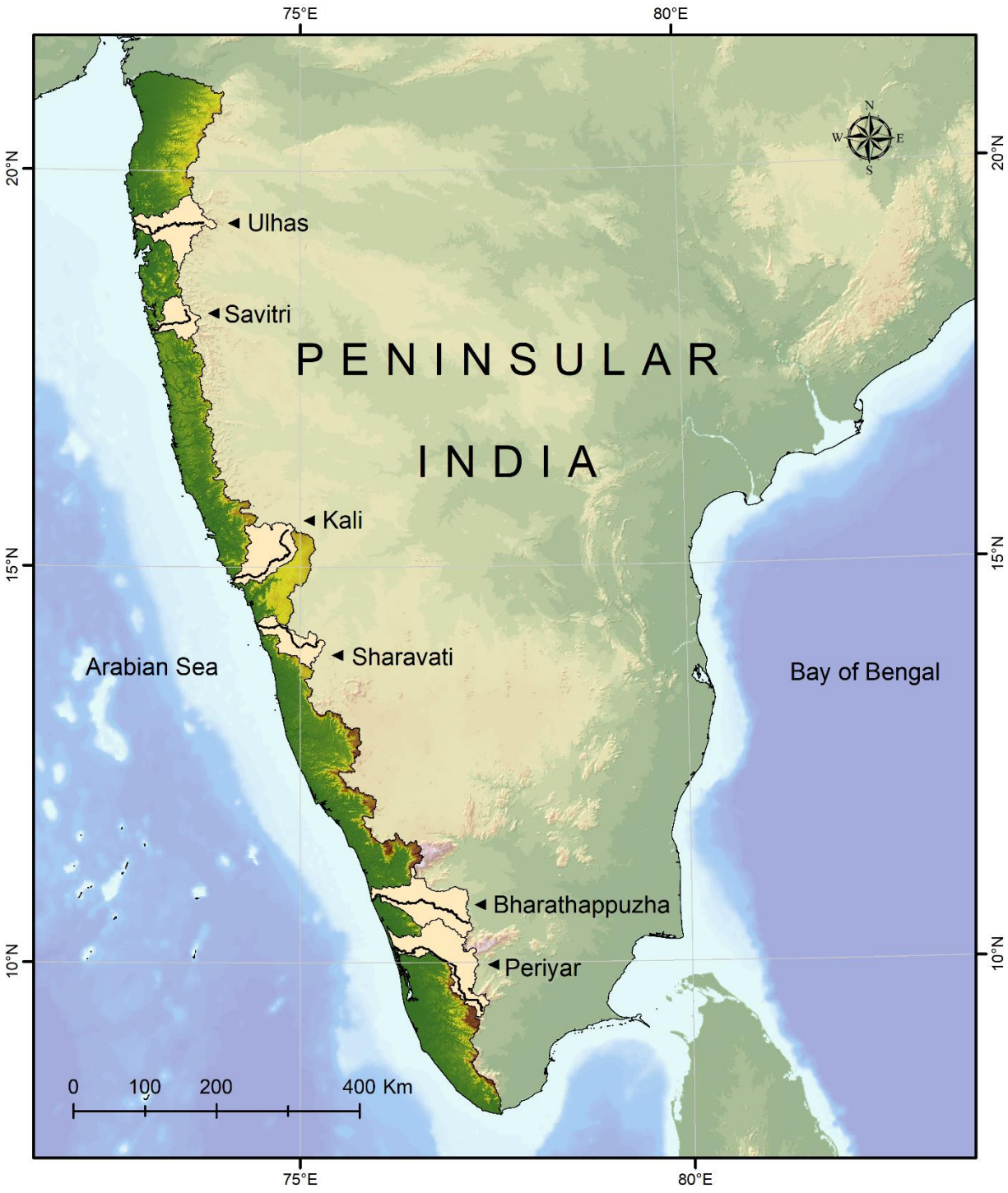

Fig. S2. Location of the six major rivers that are considered for longitudinal profile and FSI analysis.

Table S1: Pair-wise comparison matrix for eleven different components for flood susceptibility model. (CR- 0.0854)

Parameters	Elevation	Slope	Distance from river	Drainage density	Flow accumulation	TWI	Rainfall	Landuse	Soil	TRI	Geology
Elevation	1	2	2	3	4	5	5	6	7	8	8
Slope	1/2	1	2	3	3	4	5	6	7	8	8
Distance from river	1/2	1/2	1	2	3	4	4	5	6	7	7
Drainage density	1/3	1/3	1/2	1	2	3	3	4	5	7	8
Flow accumulation	1/4	1/3	1/3	1/2	1	2	2	3	4	5	6
TWI	1/5	1/4	1/4	1/3	1/2	1	2	4	5	7	7
Rainfall	1/5	1/5	1/4	1/3	1/2	1/2	1	2	3	5	6
Landuse	1/6	1/6	1/5	1/4	1/3	1/4	1/2	1	2	4	5
Soil	1/7	1/7	1/6	1/5	1/4	1/5	1/3	1/2	1	3	4
TRI	1/8	1/8	1/7	1/7	1/5	1/7	1/5	1/4	1/3	1	3
Geology	1/8	1/8	1/7	1/8	1/6	1/7	1/6	1/5	1/4	1/3	1

Table S2: Normalized pair-wise comparison matrix and corresponding weights of each factor for flood susceptibility model

Parameters	Elevation	Slope	Distance from river	Drainage density	Flow accumulation	TWI	Rainfall	Landuse	Soil	TRI	Geology	W^F_i
Elevation	0.2822	0.3863	0.2862	0.2756	0.2675	0.247	0.2155	0.1877	0.1724	0.1445	0.1269	0.236
Slope	0.1411	0.1931	0.2862	0.2756	0.2006	0.1976	0.2155	0.1877	0.1724	0.1445	0.1269	0.195
Distance from river	0.1411	0.0965	0.1431	0.1837	0.2006	0.1976	0.1724	0.1564	0.1478	0.1265	0.1111	0.152
Drainage density	0.094	0.0643	0.0715	0.0918	0.1337	0.1482	0.1293	0.1251	0.1232	0.1265	0.1269	0.112
Flow accumulation	0.0705	0.0643	0.0477	0.0459	0.0668	0.0988	0.0862	0.0938	0.0985	0.0903	0.0952	0.078
TWI	0.0564	0.0482	0.0357	0.0306	0.0334	0.0494	0.0862	0.1251	0.1232	0.1265	0.1111	0.075
Rainfall	0.0564	0.0386	0.0357	0.0306	0.0334	0.0247	0.0431	0.0625	0.0739	0.0903	0.0952	0.053
Landuse	0.047	0.0321	0.0286	0.0229	0.0222	0.0123	0.0215	0.0312	0.0492	0.0722	0.0793	0.038
Soil	0.0403	0.0275	0.0238	0.0183	0.0167	0.0098	0.0143	0.0156	0.0246	0.0542	0.0634	0.028
TRI	0.0352	0.0241	0.0204	0.0131	0.0133	0.007	0.0086	0.0078	0.0082	0.018	0.0476	0.019
Geology	0.0352	0.0241	0.0204	0.0114	0.0111	0.007	0.0071	0.0062	0.0061	0.006	0.0158	0.014

Table S3: Sub-criteria of each parameter and the pairwise comparison matrix and their weights for flood susceptibility model

Sr. No.	Parameters	Classes	1	2	3	4	5	6	7	CR	R^F_i
1	Elevation	0-163	1							0.0315	0.518
		164-422	1/3	1							0.218
		423-782	1/4	1/ 2	1						0.139
		783-1346	1/7	1/ 3	1/ 2	1					0.084
		1347-2674	1/9	1/ 5	1/ 4	1/ 3	1				0.041
2	Slope	0-4.15	1							0.0499	0.499
		4.16-9.79	1/ 3	1							0.276
		9.80-17.21	1/ 5	1/ 3	1						0.113
		17.22-27.31	1/ 6	1/ 5	1/ 2	1					0.070
		27.32-75.40	1/ 8	1/ 7	1/ 3	1/ 2	1				0.043
3	Distance from river	< 500	1							0.0550	0.400
		500-1000	1/ 2	1							0.258
		1001-1500	1/ 3	1/ 2	1						0.197
		1501-2000	1/ 3	1/ 3	1/ 3	1					0.102
		>2000	1/ 7	1/ 5	1/ 6	1/ 3	1				0.043
4	Drainage density	1.13-2.64	1							0.0181	0.433
		0.91-1.12	1/ 2	1							0.262
		0.71-0.90	1/ 3	1 /2	1						0.164
		0.48-0.70	1/ 5	1/ 3	1/ 2	1					0.089
		0-0.48	1/ 6	1/ 5	1/ 4	1/ 2	1				0.052
5	Flow accumulation	>50000	1							0.0158	0.423
		20001-50000	1/ 2	1							0.287
		10001-20000	1/ 3	1/ 2	1						0.151
		4001-10000	1/ 4	1/ 4	1/ 2	1					0.088
		0-4000	1/ 7	1/ 6	1/ 3	1/2	1				0.050
6	TWI	16.18-24.80	1							0.0548	0.421
		12.34-16.17	1/ 2	1							0.253
		9.52-12.33	1/ 3	1/ 2	1						0.192
		7.47-9.51	1/ 5	1/ 3	1/ 3	1					0.090
		3.11-7.46	1/ 6	1/ 5	1/ 6	1/ 3	1				0.045
7	Rainfall	4891-7663	1							0.0201	0.416
		3641-4890	1/ 2	1							0.262
		2755-3640	1/ 3	1/ 2	1						0.161
		1928-2754	1/ 4	1/ 3	1/ 2	1					0.099
		718-1927	1/ 5	1/ 4	1/ 3	1/ 2	1				0.062
8	Landuse	Waterbodies	1							0.0272	0.379
		Built up	1/ 2	1							0.249
		Agriculture	1/ 3	1/ 2	1						0.160
		Shrub	1/ 4	1/ 3	1/ 2	1					0.102
		Natural vegetation	1/ 5	1/ 4	1/ 3	1/ 2	1				0.065
		Barren land	1/ 6	1/ 5	1/ 4	1/ 3	1/ 2	1			0.043
9	Soil texture	Waterbodies	1							0.0384	0.331
		Clayey	1/ 2	1							0.231
		Clay skeletal	1/ 2	1/ 2	1						0.152
		Loamy	1/ 4	1/ 3	1/ 2	1					0.123

		Loamy skeletal	1/ 4	1/ 3	1/ 2	1/ 2	1				0.081
		Sandy	1/ 6	1/ 4	1/ 3	1/ 4	1/ 2	1			0.050
		Rocky outcrop	1/ 7	1/ 6	1/ 4	1/ 5	1/ 3	1/ 2	1		0.033
10	TRI	0-6.45	1							0.0796	0.398
		6.46-15.05	1 / 2	1							0.300
		15.06-26.89	1/ 3	1/ 3	1						0.171
		26.90-48.40	1/ 4	1/ 4	1/ 3	1					0.093
		48.41-274.30	1/ 7	1/ 7	1/ 6	1/ 4	1				0.037
11	Geology	Cenozoic	1							0.0096	0.539
		Mesozoic	1/ 2	1							0.297
		Precambrian	1/ 3	1/ 2	1						0.164

Table S4: Shorter reclassification of land-use and geology (See Figure in the main manuscript and Table S3 for difference)

Land-use			Geology	
Fig. 3h	Table S3		Fig. 3k	Table S3
Land-use	Land-use reclass		Geology classes	Geology reclasses
Cropland	Agriculture		Archean-Proterozoic	Precambrian
Built-up area	Built up		Cretaceous-Palaeocene	Mesozoic
Mixed forest	Natural vegetation		Miocene-Pliocene	Cenozoic
Shrubland	Shrub		Neoproterozoic	Precambrian
Barren land	Barren land		Proterozoic	Precambrian
Fallow land	Barren land		Archaean	Precambrian
Waste land	Barren land		Cenozoic	Cenozoic
Waterbodies	Waterbodies		Miocene-Pliocene	Cenozoic
Plantation	Agriculture		Paleoproterozoic	Precambrian
Mangrove	Natural vegetation		Proterozoic	Precambrian
Salt pan	Waterbodies		Quaternary	Cenozoic
Grassland	Shrub			
Deciduous broadleaf forest	Natural vegetation			
Evergreen broadleaf forest	Natural vegetation			
Permanent wetlands	Waterbodies			

Table S5. Pair-wise comparison matrix for four different components for flood vulnerability model. (CR- 0.0308)

Parameters	Population density	Literacy rate	Literate density	Road density
Population density	1	2	3	3
Literacy rate	1/2	1	2	2
Literate density	1/3	1/2	1	2
Road density	1/3	1/2	1/2	1

Table S6. Normalized pair-wise comparison matrix and corresponding weights of each factor for flood vulnerability model

Parameters	Population density	Literacy rate	Literate density	Road density	W^V_i
Population density	0.4615	0.500	0.4615	0.375	0.450
Literacy rate	0.2307	0.250	0.3076	0.250	0.260
Literate density	0.1538	0.125	0.1538	0.250	0.171
Road density	0.1538	0.125	0.0769	0.125	0.120

Table S7. Sub-criteria of each parameter and the pairwise comparison matrix and their weights for flood vulnerability model

Parameters	Sub class	1	2	3	4	5	CR	R^V_i
Population density (no/km^2)	49530-122621	1					0.0195	0.420
	13946-49529	1/2	1					0.266
	3367-13945	1/3	1/2	1				0.167
	481-3366	1/4	1/3	1/2	1			0.095
	0-480	1/6	1/5	1/4	1/2	1		0.053
Literacy Rate (%)	0-18	1					0.0141	0.423
	19-43	1/2	1					0.269
	44-60	1/3	1/2	1				0.157
	61-73	1/4	1/3	1/2	1			0.096
	>73	1/6	1/5	1/3	1/2	1		0.056
Literate population density (no/km^2)	0-1602	1					0.0306	0.411
	1603-8812	1/2	1					0.302
	8813-20829	1/3	1/3	1				0.143
	20830-41259	1/4	1/4	1/2	1			0.089
	>41259	1/6	1/5	1/3	1/2	1		0.054
Road density (km/km^2)	0.53-0.95	1					0.0295	0.405
	0.38-0.52	1/2	1					0.265
	0.24-0.37	1/3	1/2	1				0.163
	0.09-0.23	1/4	1/3	1/2	1			0.100
	0-0.08	1/4	1/4	1/3	1/2	1		0.067

Few online newspaper links that provide information about the floods in the Western Ghat coastal belt:

https://timesofindia.indiatimes.com/city/mumbai/railways-to-buy-inflatable-boats-for-rescue-operations/articleshow/70598095.cms

https://timesofindia.indiatimes.com/city/mumbai/thousands-evacuated-but-1-lakh-marooned-in-housing-societies/articleshow/70528781.cms

https://timesofindia.indiatimes.com/city/mumbai/plush-dombivli-township-built-on-flood-plains-of-river-goes-under/articleshow/70528749.cms

https://timesofindia.indiatimes.com/city/mumbai/tracks-damaged-expect-central-railway-travel-woes-today-too/articleshow/70528633.cms

https://timesofindia.indiatimes.com/videos/city/mumbai/mumbai-rains-navi-mumbai-remains-waterlogged-as-heavy-rains-continue/videoshow/70127461.cms

https://timesofindia.indiatimes.com/city/mumbai/mumbai-floods-famed-never-say-die-spirit-floats/articleshow/70040157.cms

https://www.thehindu.com/news/national/kerala/amicus-curiae-for-panel-to-identify-flood-causes/article26726699.ece

https://timesofindia.indiatimes.com/city/thiruvananthapuram/kerala-floods-death-toll-rises-to-31-25-landslides-reported/articleshow/65368087.cms

https://www.aljazeera.com/news/2018/08/shortage-medicine-drinking-water-kerala-flood-survivors-180819063140621.html

https://www.bbc.com/news/world-asia-india-45243868

https://www.financialexpress.com/india-news/kerala-flood-2019-latest-news-images-videos-karnataka-rains-live-updates-wayanad-landslide-rahul-gandhi/1672356/