Assessing and mapping multi-hazard risk susceptibility using a machine learning technique

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Figure S1 Location of the study area in Iran

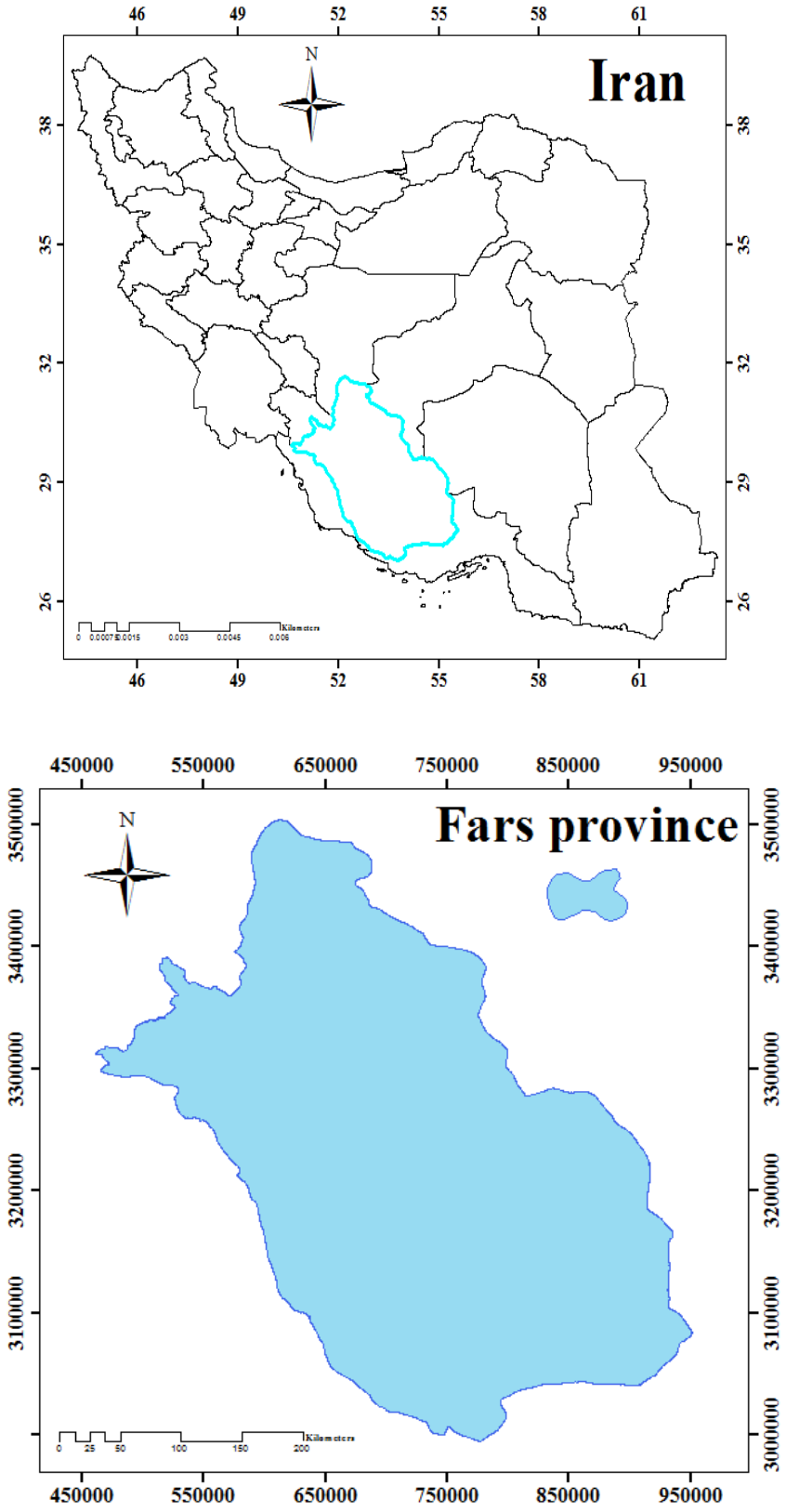

Figure S2 Training and validation points of three hazards

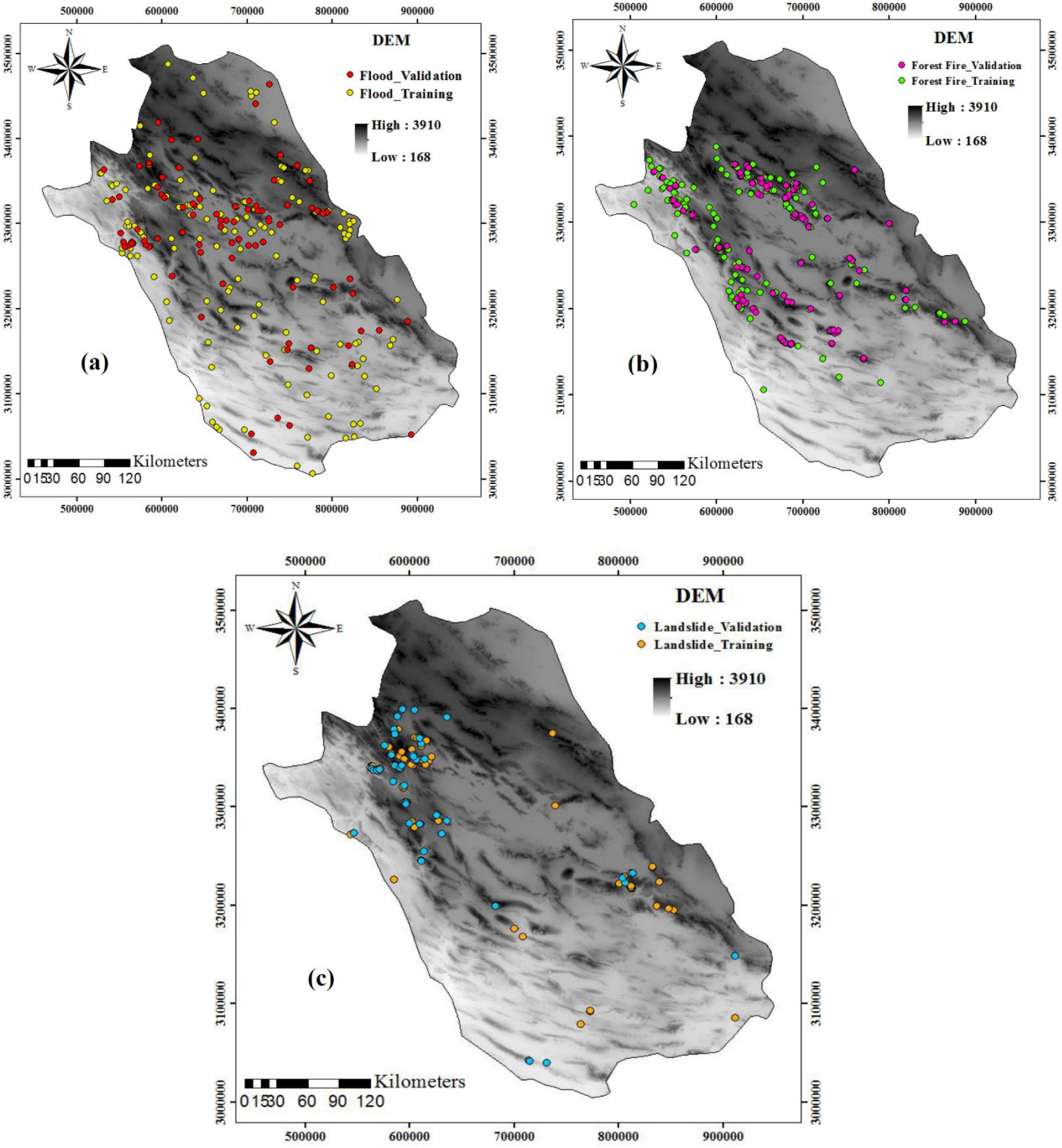

Figure S3 Maps of effective factors used for in order to danger of natural hazards in the study area

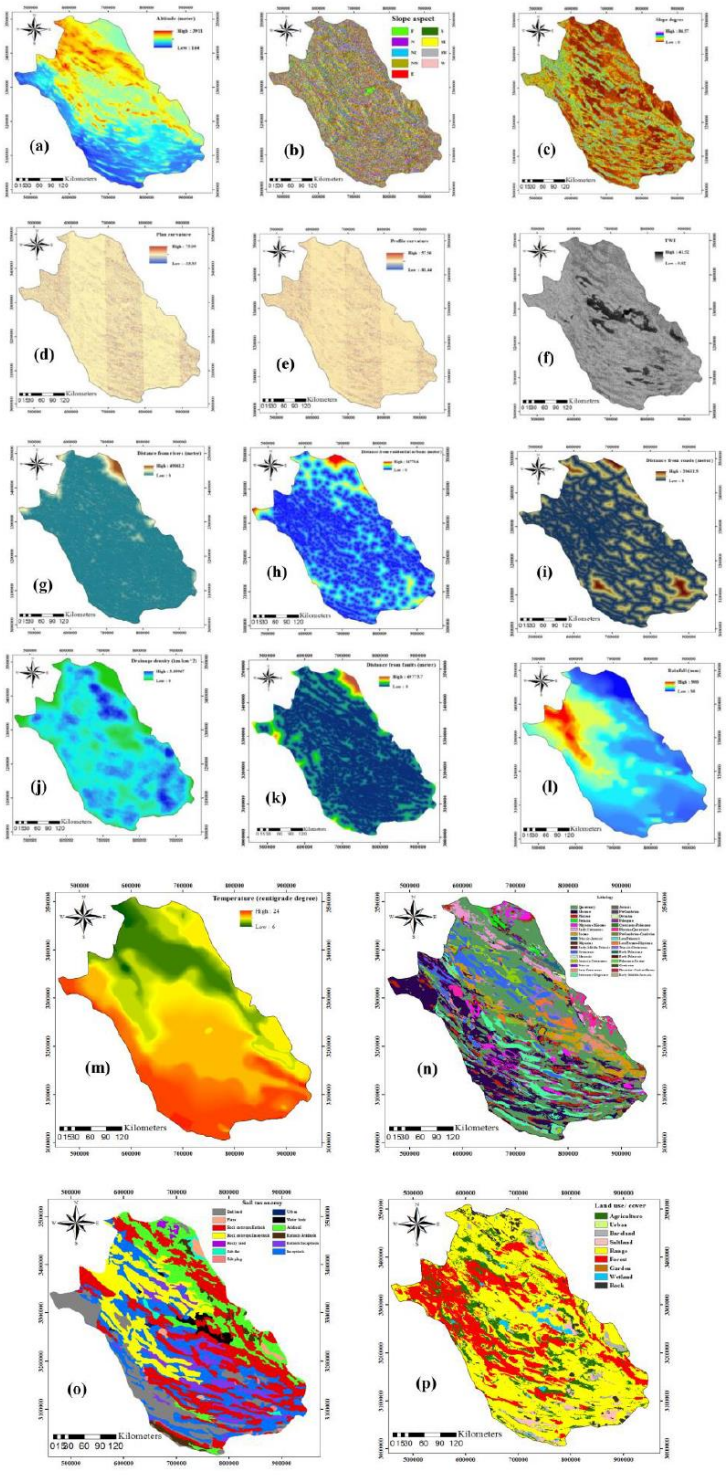

Figure S4 Percentages of susceptibility classes of three natural hazards

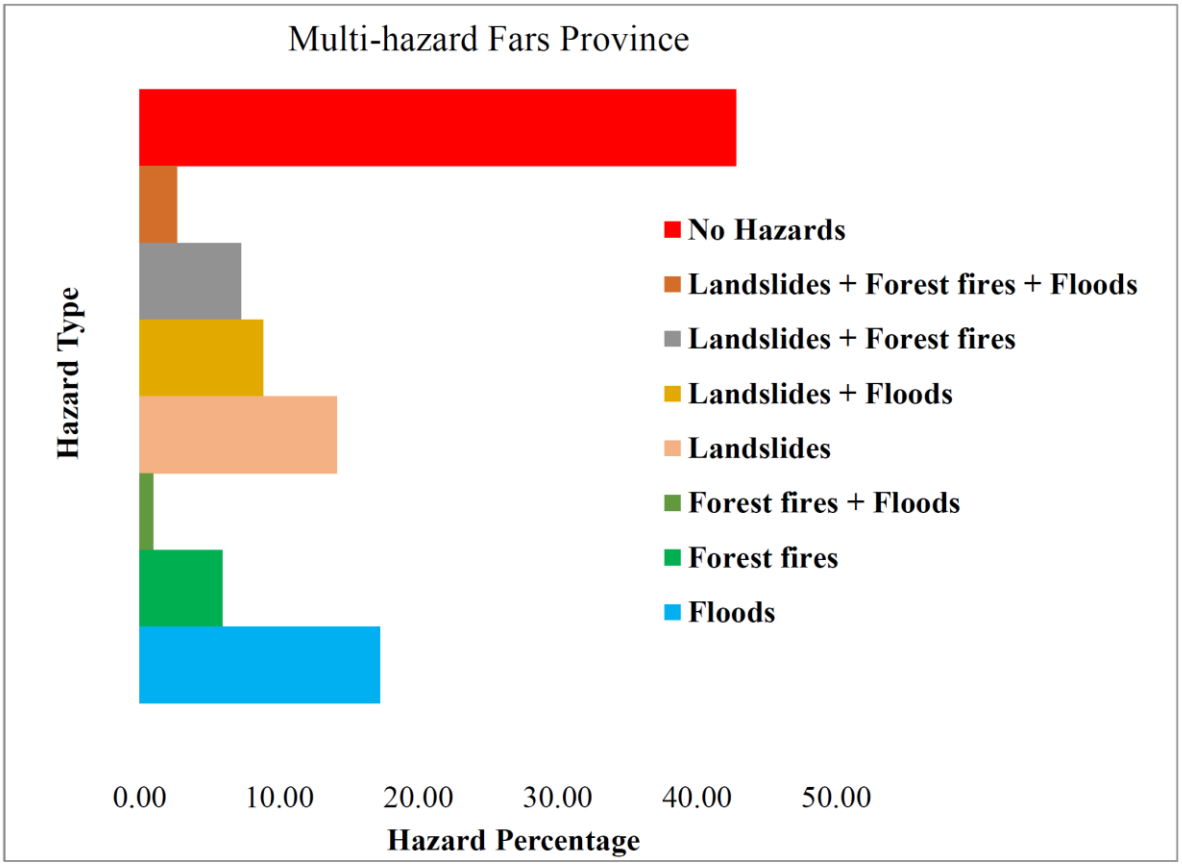

Table S1. Geology of the study area

Formation	Description	Lithological units	Age
-	Low level pediment fan and valley terrace deposits	Qft2, Qcf	Quaternary
Aghajari, Mishan	Brown to grey, calcareous, feature-forming sandstone and low weathering, gypsum- veined, red marl and siltstone	Mur, MuPlaj, Mmn, MPlfgp	Miocene
Bakhtyari	Alternating hard of consolidated, massive, feature forming conglomerate and low -weathering cross - bedded sandstone	Plc, Plbk	Pliocene
Jamal, Dorud	Massive to thick - bedded, dark - grey, partly reef type limestone and a thick yellow dolomite band in the upper part	Pj, P	Permian
-	Marl with intercalations of limestone	OMqm, OMql	Oligocene-Miocene
Taft	Thin to medium bedded argillaceous limestone and thick bedded to massive, grey orbitolina bearing limestone	Klsm, Klsol, Klsm, Ktl	Early Cretaceous
Jahrum	Grey and brown weathered, massive dolomite, low weathered thin to medium -bedded dolomite and massive, feature forming, buff dolomitic limestone	Eja, Ek	Eocene
Shemshak	Dark grey shale and sandstone	TRJs	Triassic-Jurassic
Lower Red	Red and green silty, gypsiferous marl, sandstone and gypsum	Olm,s,c	Oligocene
Shotori	Well - bedded, dense, yellow dolomite	TRsh	Early-Middle Triassic
Gurpi	Bluish grey marl and shale with subordinate thin - bedded argillaceous -limestone	Kgu	Cretaceous
Naiband	Sandstone, quartz arenite, shale and fossiliferous limestone	TRn	Mesozoic
-	Undivided Khami Group, consist of massive thin - bedded limestone comprising the following formations : Surmeh,Hith Anhydrite, Fahlian, Gadvan and Dariyan	JKkgp, KEpd-gu	Jurassic-Cretaceous

Khamehkat and and Neyriz	Thin to medium - bedded, dark grey dolomite ; thin - bedded dolomite, greenish shale and thin - bedded argillaceous limestone	TRe1, TRkk-nz	Triassic
Tarbur	Massive, shelly, cliff - forming partly anhydritic limestone	Ktb	Late Cretaceous
-	Undivided Asmari and Jahrum Formation, regardless to the disconformity separates them	EOas-ja	Paleocene-Oligocene
Baghamshah	Pale - green silty shale and sandstone	Jbg, Jf	Jurassic
Amphibolite Facies	Medium-grade, regional metamorphic rocks	pCmt1, pCmt2	Pre Cambrian
Shidhtu	Alternation of shale, marl and fossiliferous limestone, loccaly with intercalations of quartz arenite	Dsh	Devonian
Pabdeh	Blue and purple shale and marl interbedded with the argillaceous limestone	PeEpd	Paleogene
Amiran	Dark olive - brown, low weathered siltstone and sandstone with local development of chert conglomerates and shelly limestone	KPeam	Cretaceous-Paleocene
-	Fluvial conglomerate, Piedmont conglomerate and sandstone	PlQc	Pliocene-Quaternary
-	Rock salt, gypsum & blocks of contorted masses of sedimentary material such as black laminated fetid limestone, brown cherty dolomite, red sandstone & varigated shale in association with igneous rocks such as diabase, basalt, rhyolite and trachyte	pC-Ch	Pre Cambrian-Cambrian
-	Granite	PZ2gr	Late Paleozoic
-	-	Lake	Late Eocene-Oligocene
Kerman and Neyzar Radiolarites	Purple and red thin - bedded radiolarian chert with intercalations of neritic and pelagic limestone	TRKurl, pd	Triassic-Cretaceous
Barreh Koshan Complex and Rutchan Complex	Gneiss, anatectic granite, amphibolite, kyanite, staurolite schist, quartzite and minor marble	Pz1mt	Early Paleocene
-	Gneiss and anatectic granite	Pz1gn	Early Paleozoic

Sachun	Pale red marl, marlstone, limestone, gypsum and dolomite	PeEsa	Paleocene-Eocene
Lalun	Dark red meddium - grained arkosic to subarkosic sandstone and micaseous siltstone	Cl	Cambrian
Sargaz Complex	Mica schist, green schist, graphite schist, black pyyllit and minor marble	DC2met	Devonian-Carboniferous
Surmeh	Thick - bedded to massive dolomitic limestone, thin - bedded argillaceous limestone and marl	Jsm	Early Middle Jurassic

Table S2. Soil taxonomy of the studied area

Soil Taxonomy	Description
Bad land	Sundry lands when soil erosion increases its depth and width, becomes a bad land, that is one of the nine physiographic units
Playa	The shallow lakes located in arid and semi-arid soils, where they are clay and silt, is a barrier to water penetration. It can either be water or not, and if it contains water, it is caused by precipitation and the water is salty so that it salt is extracted
Rock outcrops/Entisols	The outcrop is destroyed due to the erosion of all existing materials or soil on the rock and the rock has been exposed./ Immersive soils that are just beginning to evolve, most of them, like the C horizon and bedrock, can also have a A horizon. but the rock outcrops properties are dominant in them
Rock outcrops/Inceptisols	The outcrop is destroyed due to the erosion of all existing materials or soil on the rock and the rock has been exposed./ Young soils are the most abundant soils in the world, the soils that begin to form the horizon and have a cosmic horizon, but t the rock outcrops properties are dominant in them
Rocky land	Rocky lands usually contain rocks can be angled or non-angular. If the rocks are displaced by water, they are circular and without angle, but if they are not caused by a force, for example, due to the force of gravity and on the basis of weight, they will flow from the mountain. Angle Had been
Salt flat	Salt shells are formed in flat lands
Salt plug	Holes or hills or salt domes
Urban	Urban land affected by human construction
Water body	There is a water horizon and the conditions are such that it encloses the water in the area

Aridisoil	The soils are arid and semi-arid regions and have a calcic horizon, natric, and gypsic horizons
Entisols/Aridisols	Soils that have both Aridisols and Entisols properties, but Entisols properties (immature soils) dominant
Entisols/ Entisols	The soil has Entisols region and Entisols propertise, but Entisols propertises is more dominant in the region
Inceptisols	Young soils are the most abundant soils in the world, the soils that begin to form the B horizon and have a Cambic horizon

Table S3. Predictive performance of the Random forest model in the validation process

RF model	**Area**	**Standard error**	**Asymptotic significant**	**Asymptotic 95% Confidence Interval**	
				Lower bound	**Upper bound**
Flood	0.834	.028	.000	.780	0.888
Forest fire	0.943	.016	.000	.912	0.974
Landslide	0.939	.023	.000	.893	.985