

A Hybrid Intelligence Model for the Prediction of the Peak Flow of Debris Floods

Flood data and basin's characteristics data

Table S1. The information of case study basins

Province	River name	Hydrometric station	Longitude	Latitude	Area (km ²)	Average length of main channel (km)	Mean channel slope (%)	Average basin elevation (m)	Average Lag time (minute)	Average time of concentration (hour)
Gilan	Navrood	Kharjegil	48°-53'-45"	37°-42'-40"	265.23	32.5	5.1	1393.91	77.37	2.11
Mazandaran	Kasilian	Valikbon	53°-10'-23"	36°-05'-46"	67.8	15.2	4.7	1569	95.36	2.6
Tehran	Amameh	Amameh Kamarkhani	51°-32'-38"	35°-52'-01"	37.2	13.6	9.2	2650	81.6	2.25

Table S2. The information of Subbasin

Basin name	Subbasin name	Area (km ²)	CN	Lag time (minute)	Time of concentration (hour)
Navrood	W460	9.85	80.3	68.4	1.77
Navrood	W450	10.65	81.4	63.6	1.73
Navrood	W440	29.01	82.5	58.95	1.61
Navrood	W430	8.29	79.2	28.32	0.77
Navrood	W420	13.91	78.89	134.4	3.67
Navrood	W410	16.23	80.7	72	1.96
Navrood	W400	31.94	78.8	147.6	4.03
Navrood	W390	31.45	78.9	94.2	2.57
Navrood	W380	9.69	77.8	53.16	1.45
Navrood	W370	24.12	78.1	94.2	2.57
Navrood	W360	20.8	76.6	26.63	0.72
Navrood	W350	20.23	77.8	90.5	2.47
Navrood	W340	16.56	72.7	76.5	2.09
Navrood	W330	22.5	76.9	78.45	2.14
Kasilian	W220	7.42	79.35	75	2.05
Kasilian	W210	8.15	80.15	91.8	2.5
Kasilian	W200	6.35	78.59	63.5	1.73
Kasilian	W190	2.02	80.9	85.6	2.33
Kasilian	W180	6.94	80	90.5	2.47
Kasilian	W170	10.36	78.9	142.8	3.9
Kasilian	W160	8.97	81.15	100.4	2.7
Kasilian	W150	12.61	78.6	152.7	4.17
Kasilian	W140	0.1	77.6	76.8	2.0
Kasilian	W130	0.067	78.9	78.45	2.1
Kasilian	W120	4.8	80.3	91.5	2.5
Amameh	W180	12.34	85.32	78.5	2.1
Amameh	W170	1.83	83.25	68.1	1.86
Amameh	W160	1.21	81.45	86.8	2.37
Amameh	W150	2.15	82.31	84.8	2.37
Amameh	W140	4.04	83.45	95.5	2.61
Amameh	W130	4.05	80.69	96.35	2.63
Amameh	W120	2.31	81.87	73.42	2.00
Amameh	W110	5.17	84.12	71.4	1.95
Amameh	W100	4.1	81.76	80.5	2.2

Table S3. The information of floods occurrence

Event date	Province	Basin	Hydrometric station	Sediment concentration	Flood type	Observed Peak flow Observation (m ³ /s)	Observed Time of Peak flow (hr)	Cumulative rainfall (mm)
1997/04/05	Tehran	Amameh	Amameh Kamarkhani	0.0226	debris	2	17	32.31
2003/11/11	Gilan	Navrood	Kharjegil	0.0023	ordinary	3.5	12	16.5
2004/07/11	Gilan	Navrood	Kharjegil	0.0006	ordinary	9.6	19	23
2005/03/10	Gilan	Navrood	Kharjegil	0.0208	debris	13.8	22	26.6
2005/05/20	Gilan	Navrood	Kharjegil	0.0050	ordinary	4.4	20	7.5
2008/03/04	Mazandaran	Kasilian	Valikbon	0.0002	ordinary	3.7	19	10.66
2008/12/02	Mazandaran	Kasilian	Valikbon	0.0001	ordinary	7	44	14.5
2009/04/03	Mazandaran	Kasilian	Valikbon	0.0410	debris	6.1	18	13.75
2009/04/15	Mazandaran	Kasilian	Valikbon	0.0400	debris	3.9	18	10.3
2009/04/30	Tehran	Amameh	Amameh Kamarkhani	0.0019	ordinary	4.5	16	21.2
2009/08/15	Mazandaran	Kasilian	Valikbon	0.0004	ordinary	4.2	19	10.9
2009/09/24	Mazandaran	Kasilian	Valikbon	0.0017	ordinary	9.9	18	19.2
2009/11/03	Tehran	Amameh	Amameh Kamarkhani	0.0297	debris	4.8	18	55
2009/11/18	Tehran	Amameh	Amameh Kamarkhani	0.0001	ordinary	4.5	19	32.5
2010/02/28	Mazandaran	Kasilian	Valikbon	0.0005	ordinary	3	19	7.63
2011/03/14	Tehran	Amameh	Amameh Kamarkhani	0.0218	debris	4.9	34	35.5
2011/04/06	Tehran	Amameh	Amameh Kamarkhani	0.0009	ordinary	4.2	34	22.8
2011/08/26	Tehran	Amameh	Amameh Kamarkhani	0.0053	ordinary	1.5	8	30.8
2011/08/29	Tehran	Amameh	Amameh Kamarkhani	0.0006	ordinary	6	14	52.5
2011/09/28	Mazandaran	Kasilian	Valikbon	0.0066	ordinary	4.7	10	10.4
2012/03/31	Mazandaran	Kasilian	Valikbon	0.0371	debris	3.8	32	9.4
2012/04/07	Gilan	Navrood	Kharjegil	0.0036	ordinary	7.8	20	24
2012/04/14	Tehran	Amameh	Amameh Kamarkhani	0.0200	debris	4.6	8	31.8
2013/03/20	Mazandaran	Kasilian	Valikbon	0.0085	ordinary	2.3	19	8
2014/03/30	Tehran	Amameh	Amameh Kamarkhani	0.0039	ordinary	2.1	17	29.1
2014/04/03	Mazandaran	Kasilian	Valikbon	0.0020	ordinary	3	41	10
2014/09/30	Gilan	Navrood	Kharjegil	0.0166	ordinary	12.5	15	35.2
2014/10/19	Gilan	Navrood	Kharjegil	0.0201	debris	56.7	28	88.5
2014/11/04	Gilan	Navrood	Kharjegil	0.0213	debris	8.6	32	24.2
2014/11/24	Gilan	Navrood	Kharjegil	0.0047	ordinary	25	36	87..2
2015/03/30	Gilan	Navrood	Kharjegil	0.0005	ordinary	19.2	22	38.5
2015/07/20	Gilan	Navrood	Kharjegil	0.0002	ordinary	7	7	27.3
2015/08/26	Gilan	Navrood	Kharjegil	0.0211	debris	5.1	2	28
2015/09/17	Gilan	Navrood	Kharjegil	0.0252	debris	11.1	14	37.5
2015/12/01	Tehran	Amameh	Amameh Kamarkhani	0.0003	ordinary	9.2	33	54.5
2016/03/30	Mazandaran	Kasilian	Valikbon	0.0290	debris	6.2	19	12.4