Equivalent Tower Height (ETH): Which is the most magnificent of peak on the Earth?

Introduction

When talking about the magnificence of a peak, people usually either talk about its elevation, relative height (rise), or use photos and videos taken nearby. However, none of these traditional factors is both accurate and objective enough, to convince one peak is more magnificent than another.

Criteria	Definition	Problems
Elevation	Rise from sea level	Most peaks locate far from sea
Topological Prominence	Rise from key col	Key col may be thousands of kilometers away, like Everest
Visual evidence	photos, satellite data, etc.	Hard to quantify

Kai Xu introduced the concept of "jut" (described in more detail below), to measure its maximum degree of rise from a nearby terrain. While jut provides a better measurement of the peak's impressiveness from a ground-observer's perspective, it usually favors tall cliffs or walls over peaks itself. This property sometimes diverts jut from the traditional definition of mountain peaks, especially in such cases:

- Peaks with high jut are not necessarily hard to climb. There usually exist routes that go around the steep cliff.
- Peaks with high jut are not necessarily noticeable from height, if they form relatively flat ridges with nearby peaks.

Equivalent Tower Height (ETH), arisen from the concept of "jut", works better in those aspects. Peaks with high ETH is not only guaranteed to look impressive from any direction, but also are hard to summit. Moreover, as an "averaged" version of jut, ETH is more resistant to noise in local terrain height data, allowing the computation from civil-precision data.

Jut: how much a peak rises from a ground observer

Jut of a peak P is defined as the maximum angle-reduced height of P above all surrounding points:

`jut(P) = max[h * sin(θ)] for any chosen Q`
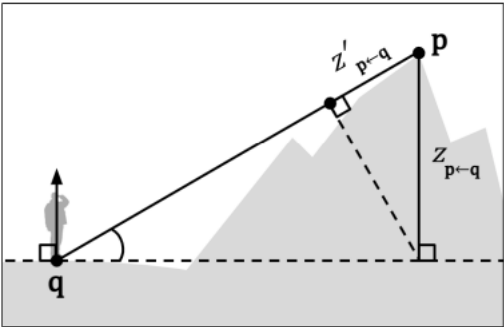
ETH: Jut applied to a cone-fitted peak

By definition, jut depends on the optimal observation location. To overcome this, we first fit a mountain peak to a perfect cone, then compute the cone's jut. As a cone is fully symmetric by rotation, the problem is reduced from 2-dimensional to a 1-dimensional.

Now the question is, how do we fit a peak (precisely speaking, a certain section below the summit) to a cone?

There exist many methods where an irregular shape fits into a ideal geometry, such as volume-based, cross-section-based, rotational-inertia-based. For simplicity, cross-section-based fitting is adopted in this work.

```
    Init: Eth <- 0
    for vertical_drop := 1..elevation below the summit,
        A <- Maximum connected area (including peak) with elevation >= (summit_elevation - vertical_drop)
        S <- area(A)
        R <- sqrt(S / PI)
        Alpha <- arctan(vertical_drop / R)
        AngleReducedHeight <- vertical_drop * sin(θ)
        Eth <- max(Eth, AngleReducedHeight)
    Return: Eth
```
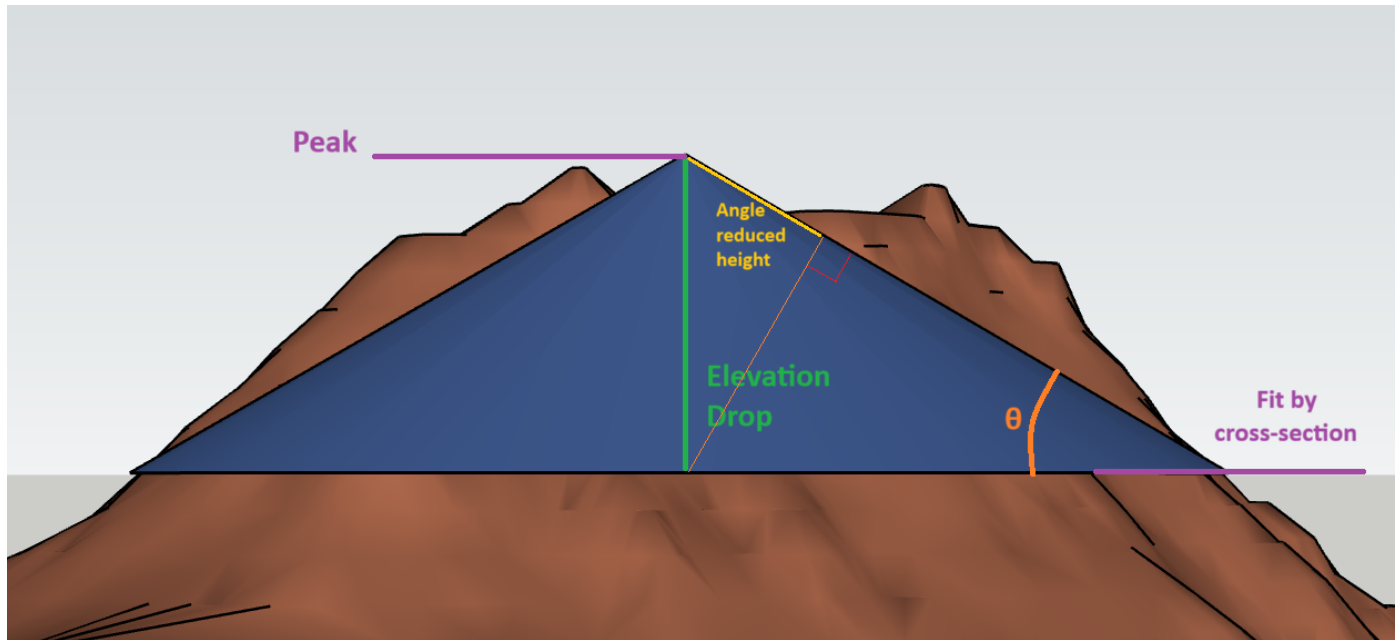
The name "Equivalent Tower Height", comes from its close relationship with human-made towers. A perfectly-slim tower, with nearly-zero cross-section along its entire height, receives ETH identical to its height. Therefore, some of the tallest human-made structures have ETH comparable to major mountain peaks.

Evaluation with real-world data

Elevation dataset

We choose ASTER Global Digital Elevation Model V003 due to its public accessibility at earthdata.nasa.gov. The dataset features a spatial resolution of 1 arc second (~30m). Although it claims to have a elevation precision of 16 meters, it's observed to be much poorer in areas with rugged terrian. For instance, the highest point in the dataset is only 8802m, about 50m below Mt Everest's true elevation 8849m. If a peak measures 5% lower than its true elevation, we will skip its evaluation to avoid wrong results.

Compute maximum connected area from grid samples

We perform a DFS or BFS starting from the peak point to get set S, where every point in S is higher or equal to elevation_threshold = peak_elevation - elevation_drop.

All quads Q containing at least 1 vertex in S is taken into consideration:

1. If all 4 vertice are in S, count Q as a full grid.
2. Otherwise, perform an interpolation on two of its edges and form a straight line across Q with elevation == elevation_threshold. Count Q as a partial grid sliced by the straight line.

This illustration shows how we define Mt Everest's area above 8750m by interpolating a contour. Elevation data is imaginary for display only.
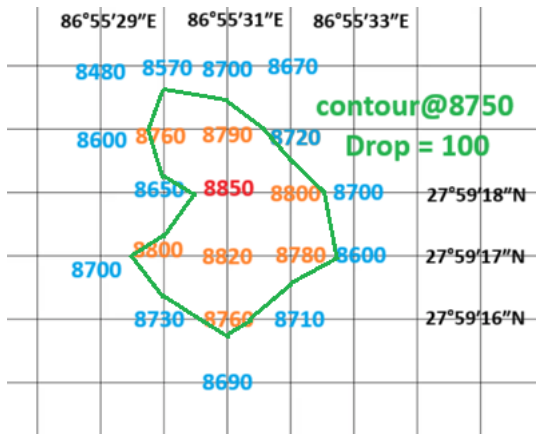
Once we know the number of grids, we can multiply it by a single grid (1 by 1 arc second)'s area, which only depends on latitude.

This calculation method provides relatively accurate estimation at reasonable implementation complexity.

Peak selection

We use two lists on wikipedia, providing 213 peaks combined.

1. https://en.wikipedia.org/wiki/List_of_mountain_peaks_by_prominence
2. https://en.wikipedia.org/wiki/List_of_highest_mountains_on_Earth

Cut-off

Although there's no limit how far vertical drop can extend to, we are not interested in areas too far from the summit, where the cone has become too flat to result in high ETH values. We increase vertical drop until the following criteria is reached:

1. Connected area reaches 30 kilometers from peak;
2. sin(Alpha) < 0.30 AND vertical_drop >= 1000 meters.

Additionally, vertical drop starts from 300 meters to lower the effect of data noise around the summit, and increases at the step of 200 meters. These thresholds work well for ultra prominent and high peaks, but need be different for lower and more flat ones.

Result

Tier Zero Club (Overall Maximum)

> Noticeably, Alaska stands out from the rest of ~8000m giants.

Name	ETH	True Elevation (observation error)
Denali/Mckinley	1546	6190 (-0.3%)
K2/Qogir	1511	8611 (-0.8%)
Dhaulagiri I	1342	8167 (-0.3%)
Mount Saint Elias	1306	5489 (-0.2%)
Nanga Parbat	1227	8126 (-0.7%)
Rakaposhi	1220	7788 (-1.6%)

Front runner within each elevation drop range

> Those peaks are the steepest among those of similar scale.

Name	Elevation Range	Max slope angle (degree) within range	True Elevation (observation error)
Baintha Brakk/The Orge	500~1300	50	7285 (-1.4%)
K2/Qogir	1300~2400	49	8611 (-0.8%)
Denali/Mckinley	2400~2900	34	6190 (-0.3%)
Nange Parbat	> 2900	25	8126 (-0.7%)

Steepest @ last 700m till summit

> These peaks only welcome the most skilled climbers. No surprise, Karakoram dominates.

Name	Slope angle (degree)	True Elevation (observation error)
Baintha Brakk/The Orge	50	7285 (-1.4%)
K1/Masherbrum	49	7821 (-0.8%)
K2/Qogir	49	8611 (-0.8%)
Nanda Devi	48	7816 (-0.3%)
Muztagh Tower	45	7276 (-3.6%)

How steepness changes with elevation drop

The following plot has X axis inversed: `1 / sin(θ)`. Points with greater **slope**, i.e. closer to top-left area, reaches greater ETH.

Peaks less than 900 ETH are partially shown due to tidiness consideration. Please refer to the appendix for the full list.
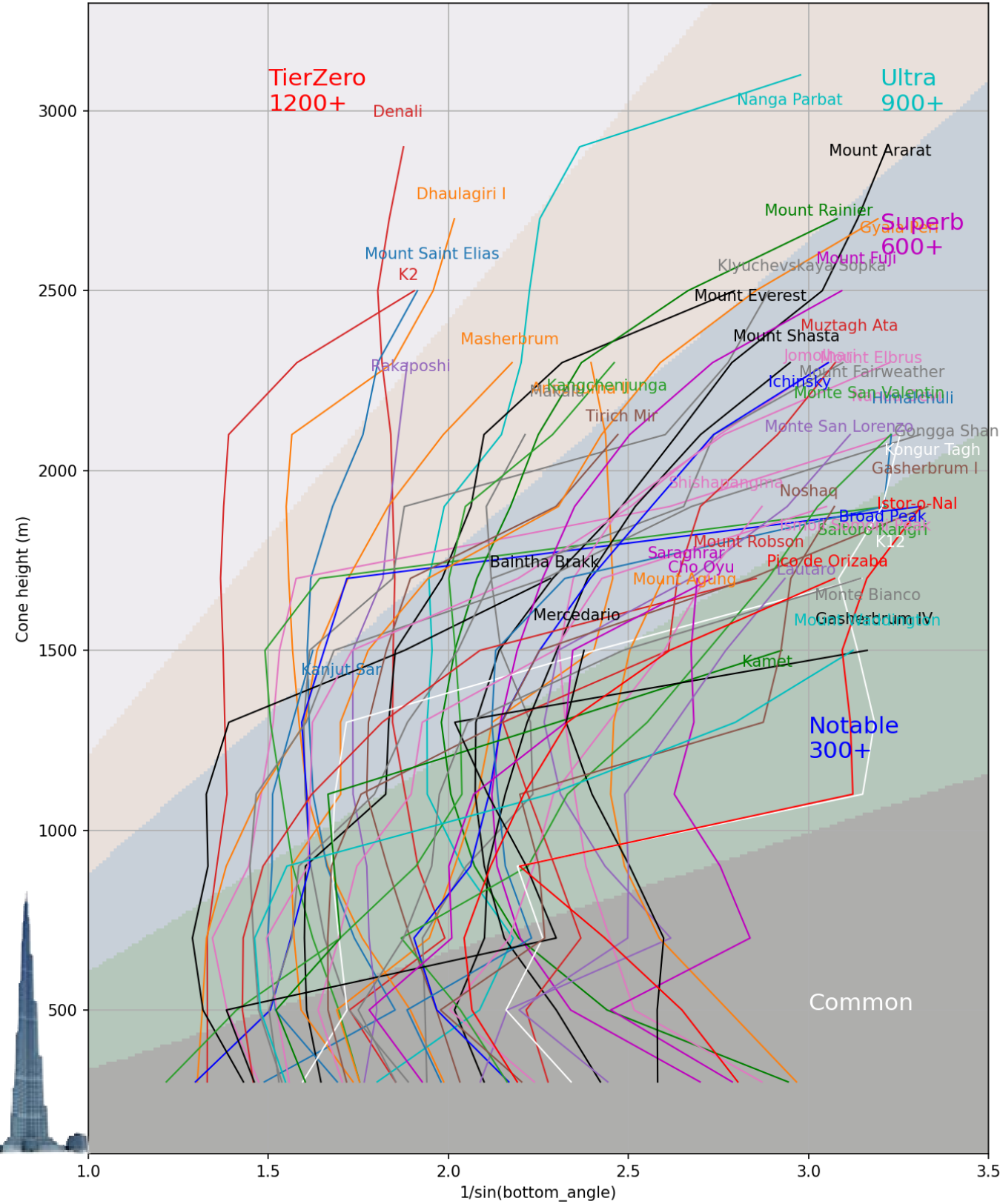
Appendix

Maximum connected area evaluation for Mt.Everest at different elevations

ArcSec^2 above 8502: 648.2

ArcSec^2 above 8302: 1664.0
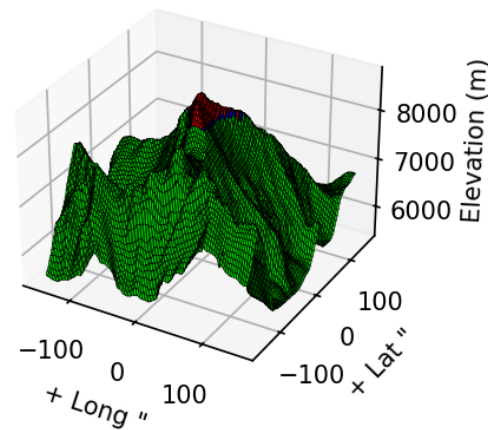
ArcSec^2 above 8102: 3222.5
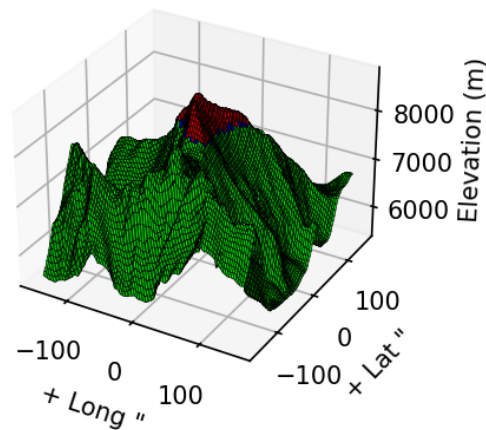
ArcSec^2 above 7902: 5356.4
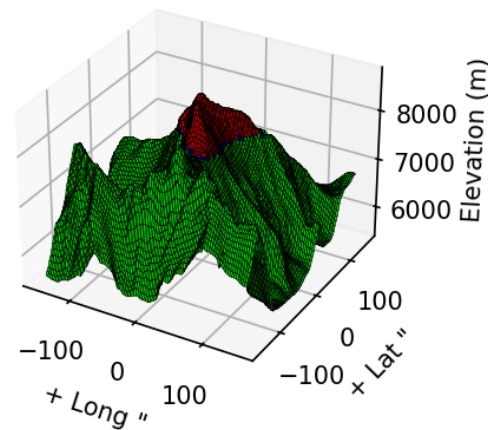
ArcSec^2 above 7702: 11902.7
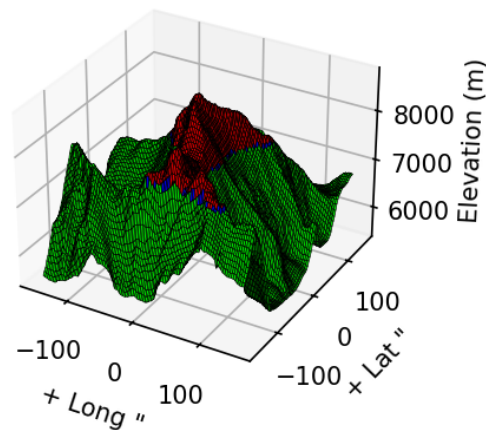
ArcSec^2 above 7502: 16840.9
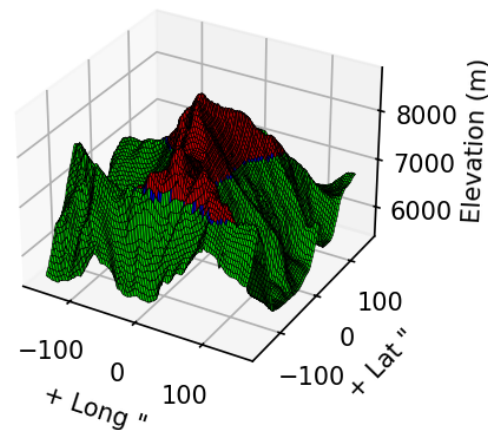
Full list of calculated ETH, ranked by elevation

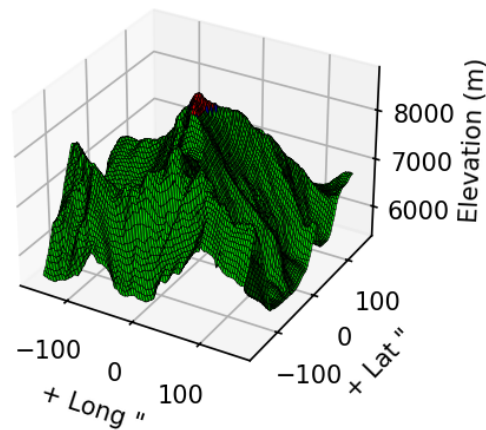| Peak	ETH	Latitude	Longitude	TrueElevation	ObservedElevation	sin(θ)@300	500	700	900	110
Mount Everest	1001	27.9881	86.925	8848	8802	0.60756109	0.622637542	0.624929977	0.623881295	0.54
K2	1511	35.88138889	76.51333333	8611	8546	0.75185289	0.751615566	0.751909776	0.737112555	0.72
Kangchenjunga	935	27.70333333	88.1475	8586	8552	0.822068687	0.708393516	0.588507417	0.523582767	0.49
Lhotse	776	27.96166667	86.93305556	8516	8447	0.691358871	0.625479749	0.398900296	0.422674228	0.43
Makalu	949	27.88972222	87.08888889	8485	8252	0.515463466	0.516820253	0.518683375	0.487965882	0.44
Cho Oyu	640	28.09416667	86.66083333	8188	8174	0.518893075	0.56182065	0.497630101	0.499679255	0.48
Dhaulagiri I	1342	28.69666667	83.49305556	8167	8146	0.503259162	0.527936083	0.567982683	0.600593175	0.62

Peak	ETH	Latitude	Longitude	TrueElevation	ObservedElevation	sin(θ)@300	500	700	900	110
Manaslu	850	28.55	84.55972222	8163	7942	0.563657302	0.578126113	0.598448825	0.604310877	0.61
Nanga Parbat	1227	35.23722222	74.58916667	8126	8066	0.554913246	0.479269192	0.458752365	0.490511128	0.51
Annapurna I	642	28.59555556	83.82027778	8091	7900	0.428535029	0.480656323	0.468485708	0.447360189	0.45
Gasherbrum I / K5	666	35.72444444	76.69638889	8080	7991	0.582394622	0.600361271	0.600637585	0.596906081	0.56
Broad Peak / K3	990	35.81055556	76.56833333	8051	7999	0.770789533	0.664298766	0.640129671	0.619213858	0.62
Gasherbrum II / K4	690	35.75777778	76.65333333	8035	7968	0.687536457	0.559210097	0.576161713	0.513780932	0.51
Shishapangma	662	28.35333333	85.77861111	8027	7945	0.446702052	0.499134312	0.461054962	0.446948154	0.43
Gyachung Kang	593	28.09805556	86.745	7952	7936	0.544669255	0.603498403	0.647064023	0.658833224	0.36
Annapurna II	960	28.53472222	84.12194444	7937	7921	0.5704073	0.591758507	0.513633654	0.49561453	0.48
Gasherbrum IV	644	35.76055556	76.61611111	7932	7796	0.684679358	0.722923118	0.434897262	0.451160468	0.47
Himalchuli	732	28.43666667	84.63972222	7893	7769	0.505197616	0.530515533	0.448238291	0.463396853	0.46
Distaghil Sar	549	36.32583333	75.18777778	7884	7846	0.542764214	0.533277952	0.552224674	0.504710575	0.49
Ngadi Chuli	E	28.50333333	84.56666667	7871	7247					
Khunyang Chhish	679	36.20527778	75.20777778	7823	7817	0.678433564	0.698808366	0.661534988	0.620222892	0.61
Masherbrum / K1	1057	35.64111111	76.30583333	7821	7758	0.767749299	0.759672547	0.753084535	0.723105717	0.67
Nanda Devi	1078	30.37583333	79.97083333	7816	7795	0.678888778	0.722026397	0.743811256	0.691929448	0.67
Chomo Lonzo	554	27.93055556	87.10777778	7804	7773	0.534984881	0.550881425	0.281769334	0.317031099	0.34
Batura Sar	584	36.51027778	74.5225	7795	7748	0.335004452	0.36902785	0.379488191	0.407555468	0.35
Rakaposhi	1220	36.1425	74.48944444	7788	7663	0.566153625	0.555192515	0.561899761	0.5639263	0.57
Namcha Barwa	E	29.63111111	95.05527778	7782	7323					
Kanjut Sar	924	36.20555556	75.41694444	7760	7734	0.591268682	0.658141806	0.667547056	0.66225215	0.66
Kamet	660	30.92	79.59166667	7756	7707	0.624053073	0.657315492	0.588302861	0.594371675	0.60
Dhaulagiri II	459	28.76277778	83.38833333	7751	7752	0.459599915	0.468624536	0.366135975	0.381402104	0.31
Saltoro Kangri / K10	1035	35.39916667	76.84805556	7742	7708	0.570274881	0.589887645	0.61608196	0.637979935	0.65
Jannu	499	27.68222222	88.04444444	7711	7346	0.661899088	0.518453506	0.53124105	0.554352166	
Tirich Mir	897	36.25527778	71.84166667	7708	7680	0.492160574	0.508388979	0.527978573	0.546447534	0.56
Gurla Mandhata	686	30.43861111	81.29666667	7694	7684	0.432670048	0.449668766	0.487130615	0.51421093	0.51
Saser Kangri I / K22	529	34.86666667	77.7525	7672	7651	0.577372709	0.596907131	0.5130565	0.507551851	0.42
Chogolisa	581	35.61305556	76.57472222	7665	7594	0.539848454	0.590699243	0.595242149	0.560182347	0.49
Kongur Tagh	645	38.59333333	75.31333333	7649	7629	0.42720654	0.462939988	0.44208493	0.45636161	0.31
Shispare	594	36.44055556	74.68083333	7611	7562	0.731317502	0.71345279	0.664882619	0.659685074	0.51
Trivor	498	36.2875	75.085	7577	7607	0.613578907	0.617913783	0.625499275	0.553719844	0.32
Gangkhar Puensum	516	28.04722222	90.45527778	7570	7525	0.347292725	0.361836649	0.389762711	0.39207063	0.38
Gongga Shan / Minya Konka	892	29.59527778	101.8797222	7556	7473	0.650474339	0.678976466	0.685610354	0.69030626	0.68
Annapurna III	323	28.585	83.99	7555	7529	0.487121212	0.499781857	0.461891166	0.276295611	
Skyang Kangri	657	35.92638889	76.5675	7545	7487	0.5586361	0.586423832	0.61586525	0.59143198	0.59
Changtse	F	28.02472222	86.91416667	7543	7798					
Kula Kangri	630	28.22694444	90.61638889	7538	7455	0.49635705	0.509183649	0.546344229	0.568022516	0.56

Peak	ETH	Latitude	Longitude	TrueElevation	ObservedElevation	sin(θ)@300	500	700	900	110
Kongur Tiube	271	38.61583333	75.19583333	7530	7519	0.435801261	0.425055075	0.387712826	0.286526666	
Mamostong Kangri	640	35.14194444	77.5775	7516	7416	0.497665474	0.5207277	0.560658089	0.584866923	0.58
Saser Kangri II E	759	34.80472222	77.80666667	7513	7486	0.506155322	0.551583839	0.564382979	0.576747348	0.57
Muztagh Ata	748	38.27583333	75.11611111	7546	7509	0.439238217	0.451251625	0.422329787	0.435665894	0.45
Ismoil Somoni Peak	701	38.94305556	72.01583333	7495	7453	0.58654716	0.610508861	0.589838822	0.572860233	0.52
Saser Kangri III	439	34.84555556	77.785	7495	7443	0.628015555	0.64311622	0.627217232	0.354549572	0.35
Noshaq	618	36.43222222	71.82861111	7492	7475	0.453816832	0.505592794	0.440984834	0.444046687	0.45
Pumari Chhish	434	36.21138889	75.25027778	7492	7391	0.626243558	0.59820154	0.619771944	0.35186506	0.34
Passu Sar	256	36.48777778	74.58777778	7476	7470	0.430966872	0.479822188	0.266158108	0.284637336	
Yukshin Gardan Sar	581	36.25111111	75.37472222	7469	7401	0.596785336	0.649360161	0.683979582	0.541494474	0.52
Teram Kangri I	286	35.58	77.07833333	7462	7418	0.407606676	0.430200128	0.407896067	0.292984352	
Jongsong Peak	442	27.88166667	88.13583333	7462	7455	0.306489019	0.336373201	0.375459734	0.370073724	0.36
Malubiting	489	36.00333333	74.87527778	7458	7305	0.469523448	0.478786169	0.448670248	0.434991936	0.44
Gangapurna	331	28.605	83.96361111	7455	7436	0.653116102	0.662264078	0.239581893	0.256913146	
Jengish Chokusu / Pk Pobeda	836	42.03472222	80.12972222	7439	7420	0.54379777	0.575024281	0.538657586	0.508085141	0.46
K12	757	35.29583333	77.02222222	7428	7418	0.626890405	0.58193451	0.589645882	0.597012105	0.59
Yangra / Ganesh I	712	28.39138889	85.12722222	7422	7345	0.517349286	0.564153228	0.587837063	0.593410497	0.59
Sia Kangri	256	35.66333333	76.76166667	7422	7388	0.398808797	0.45855467	0.271456907	0.284001324	
Momhil Sar	592	36.31777778	75.03638889	7414	7389	0.669481868	0.679958728	0.684958034	0.658105442	
Kabru N	254	27.63388889	88.11666667	7412	7350	0.263192645	0.317793155	0.362745347	0.203416029	
Skil Brum	534	35.85083333	76.42861111	7410	7348	0.630031788	0.556382867	0.583068262	0.492502327	0.48
Haramosh Peak	792	35.84	74.8975	7409	7333	0.606879581	0.624583326	0.621425932	0.601800358	0.53
Istor-o-Nal	574	36.37555556	71.89833333	7403	7382	0.356637645	0.377534852	0.410727629	0.455015147	0.32
Ghent Kangri	466	35.51777778	76.80055556	7401	7325	0.410151848	0.44045027	0.43315825	0.438584452	0.42
Ultar	377	36.39083333	74.71666667	7388	7313	0.434861514	0.492837018	0.404580357	0.419031874	
Rimo I	377	35.355	77.36888889	7385	7216	0.637867071	0.611460197	0.429281303	0.418744185	
Churen Himal	227	28.73472222	83.2175	7385	7396	0.426460015	0.453694938	0.221388703	0.226194505	
Teram Kangri III	201	35.59972222	77.04805556	7382	7217	0.503884592	0.303722873	0.231640086	0.223381268	
Sherpi Kangri	653	35.46611111	76.78138889	7380	7226	0.615963926	0.660784407	0.613129343	0.605565874	0.59
Labuche Kang	276	28.30416667	86.35083333	7367	7324	0.492196097	0.485100193	0.328005523	0.30669994	
Kirat Chuli	528	27.78777778	88.19527778	7362	7321	0.567411075	0.566537972	0.583131512	0.587171629	0.40
Saraghrar	631	36.5475	72.115	7349	7319	0.358622537	0.408020828	0.352367434	0.363007692	0.38
Jomolhari	866	27.82666667	89.26777778	7326	7314	0.641956146	0.656543665	0.669063499	0.621188631	0.61
Chamlang	536	27.775	86.97972222	7321	7288	0.469019162	0.408381278	0.447036704	0.473725546	0.48
Chongtar	469	35.91527778	76.42916667	7315	7262	0.398641861	0.4505483	0.487601186	0.460700089	0.42
Baltoro Kangri	473	35.63916667	76.67333333	7312	7288	0.343145837	0.387285214	0.419649399	0.429459602	0.42
Siguang Ri	258	28.14722222	86.685	7309	7248	0.503435231	0.516377383	0.183192589	0.168530171	
The Crown / Huang Guan	670	36.10666667	76.20583333	7295	7194	0.716290902	0.74075236	0.665955525	0.6573046	0.60
Gyala Peri	889	29.81444444	94.96861111	7294	7229	0.576328447	0.628629971	0.636509765	0.639723702	0.58
Porong Ri	209	28.38944444	85.72	7292	7294	0.541291564	0.195603247	0.224075892	0.232426982	

Peak	ETH	Latitude	Longitude	TrueElevation	ObservedElevation	sin(θ)@300	500	700	900	110
Baintha Brakk / The Ogre	935	35.9475	75.75333333	7285	7181	0.698927091	0.758585365	0.775820194	0.750709692	0.75
Yutmaru Sar	432	36.22638889	75.36722222	7283	7267	0.617451702	0.593017665	0.476437233	0.479544416	
Baltistan Peak / K6	679	35.41833333	76.55166667	7282	7168	0.57792374	0.598598065	0.624970199	0.642826282	0.47
Kangpenqing / Gang Benchhen	499	28.55083333	85.54555556	7281	7274	0.431581227	0.484004594	0.494468485	0.50573032	0.41
Muztagh Tower	759	35.82777778	76.36111111	7276	7017	0.817649045	0.740085212	0.711761268	0.692298369	0.64
Mana Peak	287	30.88055556	79.61527778	7272	7186	0.62183904	0.437108793	0.409326282	0.237844641	
Diran	709	36.12027778	74.66166667	7266	7258	0.625461227	0.599922316	0.600012882	0.575433055	0.55
Labuche Kang III / East	241	28.30138889	86.38388889	7250	7251	0.604394898	0.416625857	0.290433179	0.267852132	
Putha Hiunchuli	535	28.74777778	83.14611111	7246	7236	0.552899694	0.560220706	0.5669743	0.519271235	0.48
Apsarasas Kangri	175	35.53861111	77.14861111	7245	7166	0.349857306	0.307867181	0.218652697	0.194489548	
Mukut Parbat	417	30.94916667	79.57	7242	7131	0.553123793	0.576572002	0.595668176	0.219865238	
Rimo III	F	35.37527778	77.36166667	7233	7174					
Langtang Lirung	677	28.25611111	85.51694444	7227	7207	0.535512868	0.535497063	0.547897953	0.544449621	0.52
Karjiang	362	28.2575	90.64694444	7221	7077	0.568892488	0.536040367	0.509988688	0.33532901	0.32
Annapurna Dakshin	352	28.51833333	83.80611111	7219	7119	0.42927356	0.477714094	0.502398581	0.185312521	
Khartaphu	232	28.06361111	86.9775	7213	7215	0.580856627	0.445516605	0.33191649	0.138480172	
Tongshanjiabu	446	28.18666667	89.9575	7207	7205	0.586834711	0.603254589	0.442364259	0.430926924	0.40
Malangutti Sar	230	36.36305556	75.14916667	7207	7163	0.432730567	0.459508356	0.205761036	0.195791153	
Noijin Kangsang / Norin Kang	475	28.94666667	90.17833333	7206	7196	0.457680563	0.423534436	0.423068369	0.401965021	0.39
Langtang Ri	314	28.38138889	85.68361111	7205	7174	0.595772569	0.629408871	0.194982392	0.211018643	
Kangphu Kang	423	28.15666667	90.07083333	7204	7181	0.446617644	0.476047368	0.462636304	0.434154139	0.38
Singhi Kangri	443	35.59972222	76.98361111	7202	7139	0.671278303	0.696313595	0.633137029		
Lupghar Sar	367	36.35027778	75.03694444	7200	7185	0.45930892	0.513187316	0.524081219	0.19964246	
Aconcagua	871	-32.65306	-70.01167	6960.8	6936	0.492269799	0.530750914	0.551471351	0.553501999	0.55
Ojos del Salado	181	-27.10944	-68.54222	6893	6870	0.33611499	0.265175079	0.258895622	0.188057574	
Kuh-e Bandaka	579	36.17917	70.98333	6812	6828	0.552295894	0.58056915	0.602163192	0.617111565	0.52
Chakragil	412	38.86583	75.10833	6760	6684	0.543027816	0.554893957	0.478419939	0.390584083	0.32
Mercedario	631	-31.97889	-70.11278	6720	6699	0.387425838	0.387611325	0.384928389	0.399470541	0.41
Xuelian Feng	703	42.26167	80.89	6627	6598	0.68937248	0.47438473	0.401722859	0.384354513	0.38
Buni Zom	414	36.15417	72.3275	6542	6466	0.694980296	0.590408032	0.590839015	0.330635258	0.30
Chimborazo	617	-1.46917	-78.8175	6263	6256	0.3733893	0.415804125	0.441075647	0.456558648	0.44
Denali / Mount McKinley	1546	63.0691028	-151.0062611	6190	6173	0.539563436	0.579584865	0.502484543	0.522182879	0.53
Mount Logan	641	60.56722	-140.40528	5959	5938	0.372978073	0.354902307	0.305073822	0.307454052	0.31
Mount Kilimanjaro	422	-3.06667	37.35917	5895	5883	0.180424745	0.245028433	0.288859681	0.318819125	0.33
Pico Simn Bolvar	199	10.83833	-73.68667	5720	5687	0.418385237	0.32437983	0.284973812	0.209342861	

Peak	ETH	Latitude	Longitude	TrueElevation	ObservedElevation	sin(θ)@300	500	700	900	110
Mount Elbrus	766	43.35254	42.437875	5642	5651	0.348355398	0.39745994	0.408507732	0.41981572	0.42
Pico de Orizaba	574	19.03	-97.27	5636	5595	0.456366915	0.484168728	0.48930801	0.4723515	0.45
Mount Damavand	893	35.95528	52.10917	5610	5608	0.506181069	0.528471437	0.538334535	0.541301332	0.53
Jade Dragon Snow Mountain	253	27.09833	100.175	5596	5518	0.514110928	0.481340087	0.319651617	0.280991232	
Cerro del Bolsn	129	-27.21417	-66.09417	5552	5539	0.429370585	0.242211456	0.151745866	0.130035089	
Mount Saint Elias	1306	60.29222	-140.93139	5489	5479	0.671742043	0.539948392	0.57513152	0.60165803	0.61
Bogda Peak	353	43.80167	88.335	5445	5215	0.528082125	0.546443207	0.442262829	0.386378736	0.32
Ritacuba Blanco	134	6.49417	-72.2975	5410	5341	0.336732338	0.228381127	0.175734458	0.148388534	
Popocatepetl	591	19.0222194	-98.6277806	5400	5414	0.428874769	0.463263572	0.47628877	0.474417314	0.46
Mount Lucania	468	61.02333	-140.46556	5226	5234	0.483409197	0.445561743	0.450801917	0.459722556	0.36
Mount Kenya	F	-0.1	37.2	5199	3053					
Mount Ararat	901	39.70194	44.29833	5137	5137	0.412866928	0.434861229	0.464025131	0.476291225	0.48
Mount Stanley	236	0.38583	29.87167	5109	5023	0.416685118	0.399239257	0.336934276	0.181433761	
Mount Blackburn	636	61.73167	-143.43306	4996	5016	0.376064145	0.419649186	0.442935537	0.464107785	0.47
Pico Bolvar	146	8.540861	-71.0465	4981	4907	0.256330414	0.219054384	0.195234458	0.162053622	
Pik Talgar	219	43.1178389	77.3413333	4979	4978	0.458396997	0.438777704	0.260835252		
Jiuding Shan	312	31.54333	103.85333	4969	4941	0.357385693	0.368824595	0.37327193	0.347207812	
Vinson Massif	405	-78.52556	-85.61722	4892	4872	0.417744903	0.375973449	0.402137578	0.450047228	
Tomort	125	43.07333	94.34667	4886	4892	0.323549452	0.249281189	0.174311899		
Puncak Jaya	111	-4.083	137.183	4884	4829	0.37109381	0.17162609	0.119879958		
Sabalan	351	38.26694	47.83694	4811	4794	0.430528256	0.450637171	0.33675045	0.32962296	0.31
Monte Bianco/Mont Blanc	633	45.83278	6.865	4808	4804	0.539418902	0.571604134	0.533148121	0.511894098	0.50
Klyuchevskaya Sopka	1011	56.067	160.633	4750	4783	0.529569128	0.580013145	0.603984125	0.618162222	0.62
Mount Fairweather	802	58.90639	-137.52639	4671	4674	0.653996751	0.66600062	0.639016865	0.631208353	0.55
Mount Meru	664	-3.2467806	36.76025	4565	4533	0.427999533	0.456227797	0.445287057	0.424287421	0.38
Ras Dashen	83	13.23667	38.3725	4550	4528	0.135604036	0.120211289	0.118617146	0.086081026	
Mount Wilhelm	F	-5.8	145.03333	4509	4467					
Mount Karisimbi	286	-1.5	29.45	4507	4484	0.449712213	0.471251912	0.337896344	0.318092776	
Belukha Mountain	436	49.80694	86.58972	4506	4472	0.633159036	0.433713824	0.409217215	0.427166783	0.39
Mount Whitney	136	36.57861	-118.29194	4418	4401	0.446789207	0.272339953	0.156794856		
Mount Rainier	971	46.85167	-121.76028	4393	4391	0.339723883	0.409739232	0.455557354	0.482491229	0.49
Mount Shasta	780	41.4091972	-122.1948889	4317	4315	0.476394279	0.495777726	0.476171438	0.473992431	0.46
Volcn Tajumulco	359	15.033	-91.9	4220	4226	0.43814828	0.452971047	0.433619288	0.398636254	
Mount Hayes	890	63.62083	-146.715	4216	4192	0.732606286	0.638712294	0.673588082	0.693066812	0.70
Mauna Kea	145	19.82056	-155.46806	4205	4223	0.166030308	0.153719388	0.154263311	0.161512644	

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Toubkal	160	31.06194	-7.91611	4167	4136	0.42113392	0.227613939	0.18996195	0.178214321	
Mount Boising	F	-5.8	146.1	4150	3851					
El Melao	68	-28.8675	-67.1275	4150	4147	0.052476849	0.059433432	0.068549878	0.075152409	
Mount Kinabalu	F	6.075	116.55861	4095	4063					
Monte San Valentin	650	-46.595	-73.34583	4058	4020	0.462343655	0.491764326	0.53508683	0.45017504	0.42
Mount Cameroon	229	4.21667	9.1725	4040	4039	0.303786789	0.306584074	0.285219501	0.254992091	
Mount Waddington	580	51.37361	-125.26333	4019	3992	0.646277812	0.676771502	0.684094945	0.644649732	0.43
Mount Marcus Baker	218	61.43778	-147.75111	3991	4019	0.469653627	0.400528174	0.311495293		
Mount Robson	718	53.11056	-119.15667	3959	3943	0.685911015	0.700346603	0.699279603	0.673325876	0.61
Yushan	220	23.47	120.9572667	3952	3883	0.226456939	0.228114742	0.235301137	0.244864731	
Taftan	271	28.6	61.133	3941	3928	0.314266913	0.336547771	0.338203277	0.301234129	
Sauyr Zhotasy	64	47.04917	85.56667	3840	3827	0.214877829	0.110873111			
Saramati	258	25.733	95.033	3826	3832	0.362845857	0.36839935	0.340286017	0.286812383	
Cerro Chirrip	105	9.48417	-83.48861	3820	3793	0.099172627	0.115527406	0.125539521	0.116407829	
Mount Kerinci	587	-1.69694389	101.2644439	3805	3769	0.390500613	0.419260901	0.422573139	0.422208496	0.41
Mount Erebus	E	-77.533	167.283	3794	3198					
Mount Fuji	841	35.36056	138.7275	3776	3757	0.370500591	0.427439246	0.454624973	0.468393383	0.47
Mount Rinjani	455	-8.41667	116.46667	3726	3692	0.439256302	0.437104138	0.440191414	0.437394117	0.41
Aoraki/Mount Cook	450	-43.595	170.14194	3724	3682	0.546344917	0.569759109	0.579564659	0.481469828	0.40
Teide	493	28.272639	-16.643611	3715	3699	0.421668138	0.408112486	0.388097228	0.390312273	0.38
Monte San Lorenzo	674	-47.59167	-72.30667	3706	3623	0.478799948	0.462185576	0.382029565	0.410670205	0.43
Gunnbjrn Fjeld	245	68.9195	-29.8985333	3694	3688	0.579552937	0.300359782	0.260643487	0.271697375	
Semeru	413	-8.1	112.91667	3676	3667	0.382511638	0.434376995	0.455078932	0.458649008	0.35
Mount Suckling	154	-9.66917	149.01083	3676	3648	0.405203909	0.270252672	0.176812291	0.171427542	
Jabal An-Nabi Shu'ayb	109	15.27917	43.97583	3666	3661	0.177168133	0.170583325	0.155224806	0.105484041	
Lautaro	579	-49.019	-73.504	3623	3582	0.40938122	0.4552858	0.400321828	0.400044982	0.40
Ichinsky	767	55.67778	157.72167	3607	3621	0.461321123	0.50816689	0.525106571	0.485047036	0.47
Monarch Mountain	398	51.89944	-125.87583	3555	3432	0.708645861	0.712552991	0.527833031	0.442248672	0.34
Mulhacn	126	37.05333	-3.31139	3479	3462	0.303470503	0.204330863	0.148178367	0.139815397	
Mount Latimojong	137	-3.385	120.02417	3478	3436	0.22935592	0.226899015	0.166453148	0.151963544	
Mount Leuser	104	3.7975	97.21917	3466	3453	0.207018171	0.135831198	0.119444314	0.115398631	
Koryaksky	E	53.317	158.683	3456	3267					
Emi Koussi	52	19.78944	18.55111	3445	3439	0.096965817	0.067099807	0.074730609		
Mount Slamet	465	-7.239	109.22	3432	3411	0.335551773	0.380640989	0.383737886	0.377135354	0.36
Aneto	195	42.6309917	0.6566861	3404	3355	0.320042284	0.299508526	0.24349896	0.216858861	
Mount Etna	399	37.75083451	14.99322029	3403	3311	0.301545693	0.305996138	0.310396674	0.314249108	0.31
Arjuno-Welirang	266	-7.765	112.58972	3339	3329	0.402193798	0.310536577	0.302581149	0.295398724	

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Raung	251	-8.125	114.04167	3332	3297	0.25969427	0.268835723	0.276629501	0.278792232	
Shiveluch	877	56.6536333	161.3629667	3307	3270	0.471231077	0.525115058	0.550640447	0.514337024	0.50
Mount Lawu	455	-7.625	111.19167	3265	3257	0.274177013	0.297787241	0.323311145	0.338209387	0.34
Mount Siple	F	-73.433	-126.667	3110	3094					
Pico Duarte	131	19.03306	-71.00528	3098	3103	0.251344098	0.261316269	0.186794515	0.132594941	
Piton des Neiges	373	-21.09889	55.47889	3069	3066	0.31157421	0.365206402	0.39150006	0.363785472	0.33
Haleakal	153	20.71806	-156.25	3055	3069	0.183847697	0.188810571	0.192983802	0.170180365	
Mount Agung	655	-8.34194	115.50778	3031	3028	0.337069946	0.360175367	0.386746905	0.401778545	0.40
Mount Binaiya	209	-3.17333	129.455	3027	3033	0.266326389	0.276274874	0.248368178	0.231899227	
Jabal Shams	162	23.23738819	57.26379369	3019	2991	0.197170212	0.21646909	0.23156559	0.14585425	
Pico Basil	223	3.58333	8.76667	3011	2983	0.301210472	0.265216717	0.25974338	0.2478708	
Pico da Neblina	E	0.8054944	-66.0053583	2994	2774					
Mount Stephenson	223	-69.817	-69.717	2987	2928	0.485518618	0.296334451	0.319258036	0.232796358	
Pico do Ramelau	164	-8.90667	125.49333	2963	2930	0.279397467	0.257482006	0.234773901	0.167110671	
Mount Apo	206	6.9875	125.27083	2954	2928	0.410167113	0.412524637	0.268895759	0.200926497	
Mount Paget	573	-54.44083	-36.55528	2934	2907	0.367890297	0.425950463	0.45837116	0.467180734	0.46
Mount Pulag	116	16.58361	120.88361	2922	2928	0.228768879	0.229801986	0.16628591		
Maromokotro	79	-14.02278	48.96583	2876	2874	0.114120305	0.117420556	0.111973689	0.087790635	
Moncong Lompotabang	180	-5.346679069	119.9316665	2874	2874	0.275850749	0.231001519	0.210757316	0.199617562	
Mount Shishaldin	850	54.75	-163.967	2869	2857	0.631640626	0.651314267	0.645179217	0.623854928	0.59
Pico do Fogo	418	14.9492694	-24.3403694	2829	2778	0.438982265	0.485866719	0.50117317	0.4645127	

Note:

- E: Error in data (observed height far from truth height)
- F: Too flat / too close to its parent peak to be considered

Reference

Beyond Elevation: New Metrics to Quantify the Relief of Mountains and Surfaces of Any Terrestrial Body (Kai Xu, Yale University)