Identification and ranking of subaerial volcanic tsunami hazard sources in Southeast Asia

Supplementary Material A - NETVOLC and MORVOLC code output

The figure illustrates the working principle of the NETVOLC (Euillades et al 2013) and MORVOLC (Grosse at al. 2009; 2012) codes. Firstly and using NETVOLC, and edifice boundary is extracted from DEM data by utilizing a minimum cost function to iteratively search for concave breaks in the slope of the volcano (or minimum profile convexity). This is shown in (a) for an idealized triangular cone volcano and (c, d) applied to Lewotobi volcano, Indonesia. This boundary is then used in MORVOLC to systematically extract and visualise morphometry data including elevation, slope steepness over various intervals and edifice portions, edifice volume and shape factors. A full list can be found in the table. The data is then the plotted as maps (c-e), 3D-views (f) and profiles (g).

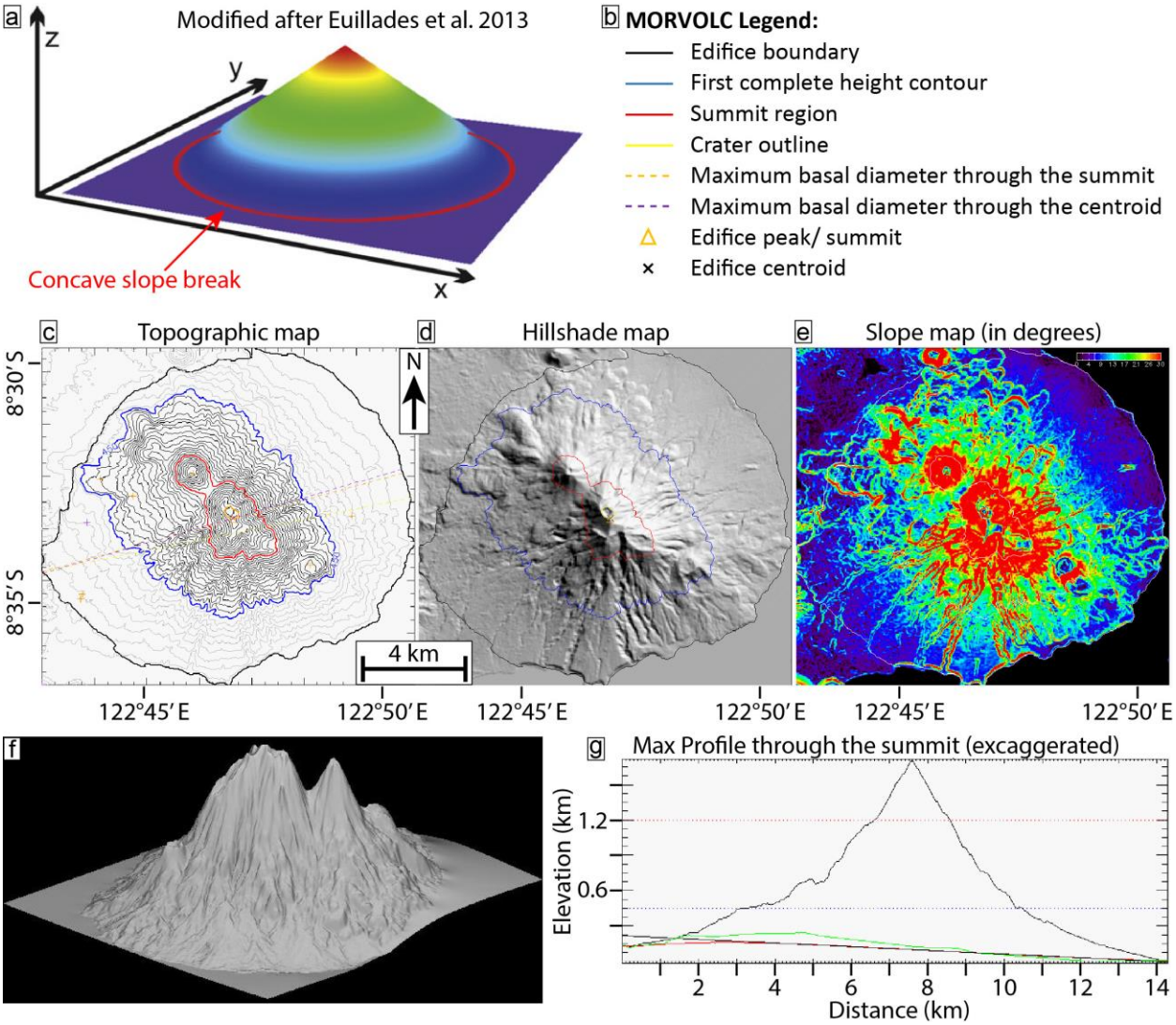

Table of the MORVOLC data output for Lewotobi volcano:

PARAMETER	VALUE	DESCRIPTION
General data		
Name	Lewotobi	volcano name
Columns	465	number of columns of the volcano DEM
Rows	422	number of rows of the volcano DEM
PXsizeX	30.6421	pixel dimension in x (m)
PXsizeY	30.6421	pixel dimension in y (m)
Equidistance	50	chosen equidistance of elevation curves (m)
LAT	81.545531	summit location latitude
LON	121.53436	summit location longitude
Proj_E	475945.64	summit location Projection East
Proj_N	9054402.7	summit location Projection North
ElevMin	-1.16E-09	lowermost elevation (m)
ElevMax	1699.36	summit elevation (m)
Base size (metric)		
AreaBase	130.29694	base area (km2)
WidthBase	12880.187	avg base width (m): diameter of circle of equal area as base
AxisBaseMin(s)	11235.978	min base diameter that passes through summit point (m)
AxisBaseMax(s)	14301.172	max base diameter that passes through summit point (m)
AxisBaseMean(s)	12899.546	mean of base diameters that pass through summit point (m)
AxisBaseMin(bc)	11212.582	min base diameter that passes through base centroid (m)
AxisBaseMax(bc)	14273.1	max base diameter that passes through base centroid (m)
AxisBaseMean(bc)	12901.269	mean of base diameters that pass through base centroid (m)
AxisBaseMax	14374.509	max base diameter that does not have to pass through any point (m)
Lowermost closed curve (main flank) elevation & size (metric)		
ElevLowCurve	450	elevation of lowermost closed curve (ie start of main flank) (m)
ElevLowCurveFraction	0.264806	elevation fraction of lowermost closed curve (ie start of main flank)
AreaLowCurve	51.729595	lowermost curve (ie main flank) area (km^2)
WidthLowCurve	8115.674	lowermost curve (ie main flank) width (m): diameter of circle of equal area as lowermost curve
AxisLowCurve	10502.965	max lowermost curve (ie main flank) diameter that does not have to pass through any point (m)

Summit region elevation & size (metric)		
ElevSummitReg	1200	elevation of curve considered start of summit region (m)
ElevSummitRegFraction	0.706149	elevation fraction of curve considered start of summit region
AreaSummitReg	7.1215696	summit region area (km^2)
WidthSummitReg	3011.223	summit region width (m): diameter of circle of equal area as summit region
AxisSummitRegMax(cont)	5103.9772	max summit region diameter that does not have to pass through any point (m)
Height (metric)		
HeightMax	1699.36	max edifice height considering summit and lowermost elevation as base (m)
HeightPoly1	1601.09	edifice height considering max height between DEM and first degree polynomial surface (m)
HeightTIN	1573.84	edifice height considering max height between DEM and TIN surface (m)
HeightIDW	1599.94	edifice height considering max height between DEM and INVERSE DISTANCE surface (m)
Volume (metric)		
VolMax	58.263303	max edifice volume considering lowermost elevation as base (km^3)
VolPoly1	46.018245	edifice volume using first degree polynomial surface as base (km^3)
VolTIN	42.88968	edifice volume using TIN surface as base (km^3)
VolIDW	45.416306	edifice volume using INVERSE DISTANCE surface as base (km^3)
Plan shape (dimensionless)		
EIoutline	1.2454942	ellipticity index of edifice outline
IIoutline	1.1749534	irregularity index of edifice outline
EIavg	2.11017	average ellipticity index of main elevation curves of edifice flank
IIavg	1.3545	average irregularity index of main elevation curves of edifice flank
Profile shape (dimensionless)		
HWratioPOLY1	0.12430681	height/width(base) ratio (considering poly1 base height and basal width)
HWratioTIN	0.1221909	height/width(base) ratio (considering TIN base height and basal width)
HWratioIDW	0.12421738	height/width(base) ratio (considering IDW base height and basal width)
WWratio(cont)	0.23378722	width(summit)/width(base) ratio
Slope (degrees)		
SlopeMin(tot)	1.66E-15	min slope value of whole edifice (degrees)
SlopeMax(tot)	58.5457	max slope value of whole edifice (degrees)
SlopeMean(tot)	15.3357	mean slope of whole edifice (degrees)
SlopeMedian(tot)	12.9426	median slope of whole edifice (degrees)

SlopeSD(tot)	9.8259	standard deviation of slope of whole edifice (degrees)
SlopeMean(flank)	14.5043	mean slope of edifice flank below summit region (degrees)
SlopeMedian(flank)	12.3	median slope of edifice flank below summit region (degrees)
SlopeSD(flank)	9.24581	standard deviation of slope of edifice flank below summit region (degrees)
SlopeMean(lowflank)	10.7242	mean slope of edifice low flank below first closed curve (degrees)
SlopeMedian(lowflank)	8.92146	median slope of edifice low flank below first closed curve (degrees)
SlopeSD(lowflank)	6.82392	standard deviation of slope of edifice low flank below first closed curve (degrees)
SlopeMean(mainflank)	21.2147	mean slope of edifice main flank above first closed curved and below summit region (degrees)
SlopeMedian(mainflank)	20.3128	median slope of edifice main flank above first closed curved and below summit region (degrees)
SlopeSD(mainflank)	9.17467	standard deviation of slope of edifice main flank above first closed curved and below summit region (degrees)
SlopeMean(summit)	30.2164	mean slope of summit region (degrees)
SlopeMedian(summit)	31.5854	median slope of summit region (degrees)
SlopeSD(summit)	7.79459	standard deviation of slope of summit region (degrees)
ElevSlopeMax	1200	elevation of flank interval (top value) with max avg slope (m)
HeightFracSlopeMax	0.706149	height fraction of flank interval (top value) with max avg slope
SlopeAvgMax	28.6346	avg slope of flank interval with max avg slope (degrees)
Orientation (degrees)		
AzimAxisBaseMax(s)	74.7245	azimuth of max base diameter that passes through summit point (degrees)
AzimAxisBaseMax(bc)	73.8323	azimuth of max base diameter that passes through base centroid (degrees)
AzimAxisBaseMax	78.6901	azimuth of max base diameter that does not have to pass through any point (degrees)
AzimCurvesAvg	129.262	avg circular azimuth of max diameters of main curves on edifice flank (degrees)
Peaks & holes		
PeaksNumTot	7	total number of secondary peaks
PeaksNumFlank	6	number of secondary peaks on edifice flank
PeaksNumSummit	1	number of secondary peaks on summit region
HolesNumTot	2	total number of holes
HolesNumFlank	2	number of holes on edifice flank
HolesNumSummit	0	number of holes on summit region
Various		
NumMainCurvesFlank	16	number of main elevation curves on edifice flank

NumMainCurvesSummit	8	number of main elevation curves on summit region
NumSlopeBins	34	number of slope bins (max edifice height / chosen equidistance)
Summit crater/caldera		
CraterElevMin	1551.78	lowermost crater elevation (m)
CraterElevMinNorm	0.913156	normalized lowermost crater elevation (fraction)
CraterArea	0.17886774	crater area (km^2)
CraterWidth	477.22267	crater avg width contour-based (m)
CraterAxisMax	572.44166	max crater diameter (m)
CraterAxisMean	509.4546	mean crater diameter (m)
CraterAzimAxisMax	105.524	azimuth of max crater diameter (degrees)
CraterDepthMax	147.58	max crater depth using uppermost crater elevation as top (m)
CraterDepthIDW	68.2279	crater depth using IDW surface as top (m)
CraterVolMax	0.017637607	max crater volume using uppermost crater elevation as top (km^3)
CraterVolIDW	0.003995437	crater volume using IDW surface as top (km^3)
CraterEIoutline	1.438866	ellipticity index of crater outline
CraterIIoutline	1.0896038	irregularity index of crater outline
CraterDWratio	0.005297121	crater depth / crater width ratio
CraterWbaseWratio	0.037050913	crater width / edifice base width ratio
CraterWsummitWratio	0.15848135	crater width / summit region width ratio
CraterDedifHratio(max)	0.0868444	crater depth / edifice height ratio (considering max values)
CraterDedifHratio(idw)	0.042644	crater depth / edifice height ratio (considering IDW values)
CraterVedifVratio(idw)	8.80E-05	crater volume / edifice volume ratio (considering IDW values)
CraterSlopeMin	0.85252	min slope value of whole crater (degrees)
CraterSlopeMax	42.3845	max slope value of whole crater (degrees)
CraterSlopeMean	21.3609	mean slope value of whole crater (degrees)
CraterSlopeMedian	21.1633	median slope value of whole crater (degrees)
CraterSlopeSD	10.57	standard deviation of slope values of whole crater (degrees)