

Supporting Information for "Nyiragongo crater collapses measured by multi-sensor SAR amplitude time series"

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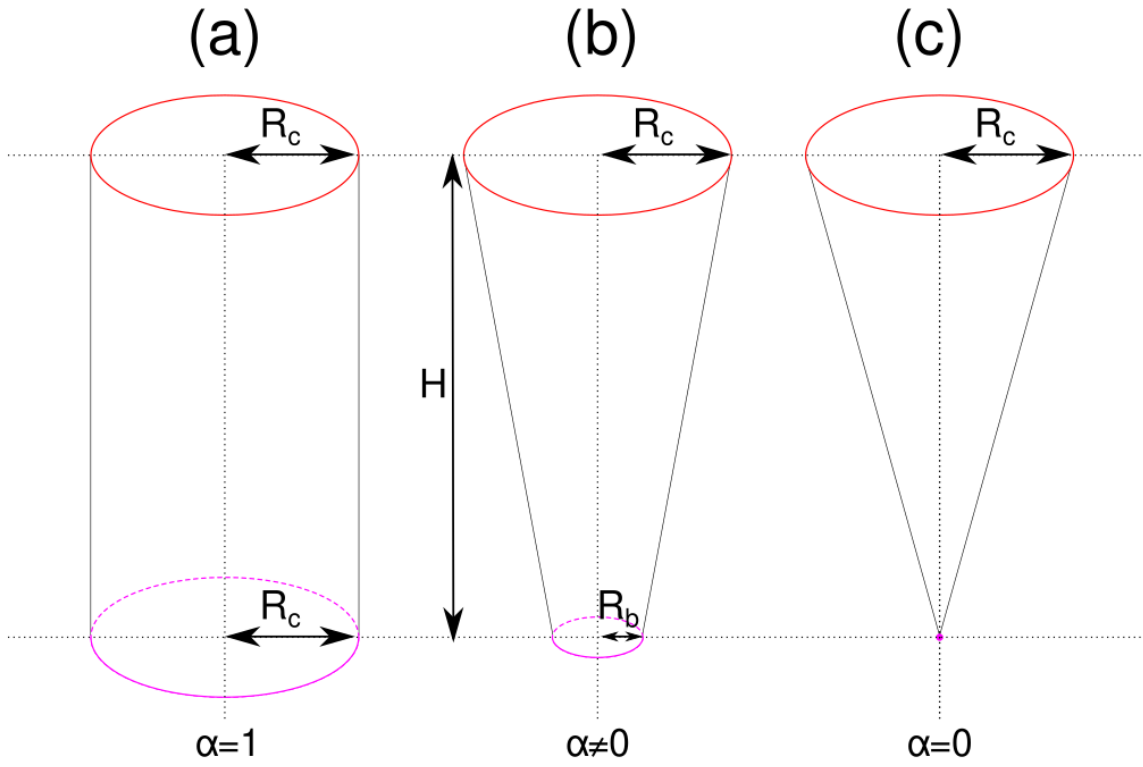


Figure S1. Schematic end-members geometry of the crater collapse which radius is R_c at the top and $R_b \leq R_c$ at the bottom and depth is H . (a) Cylinder $R_b = R_c$. (b) Truncated cone $0 < R_b < R_c$. (c) Cone $R_b = 0$.

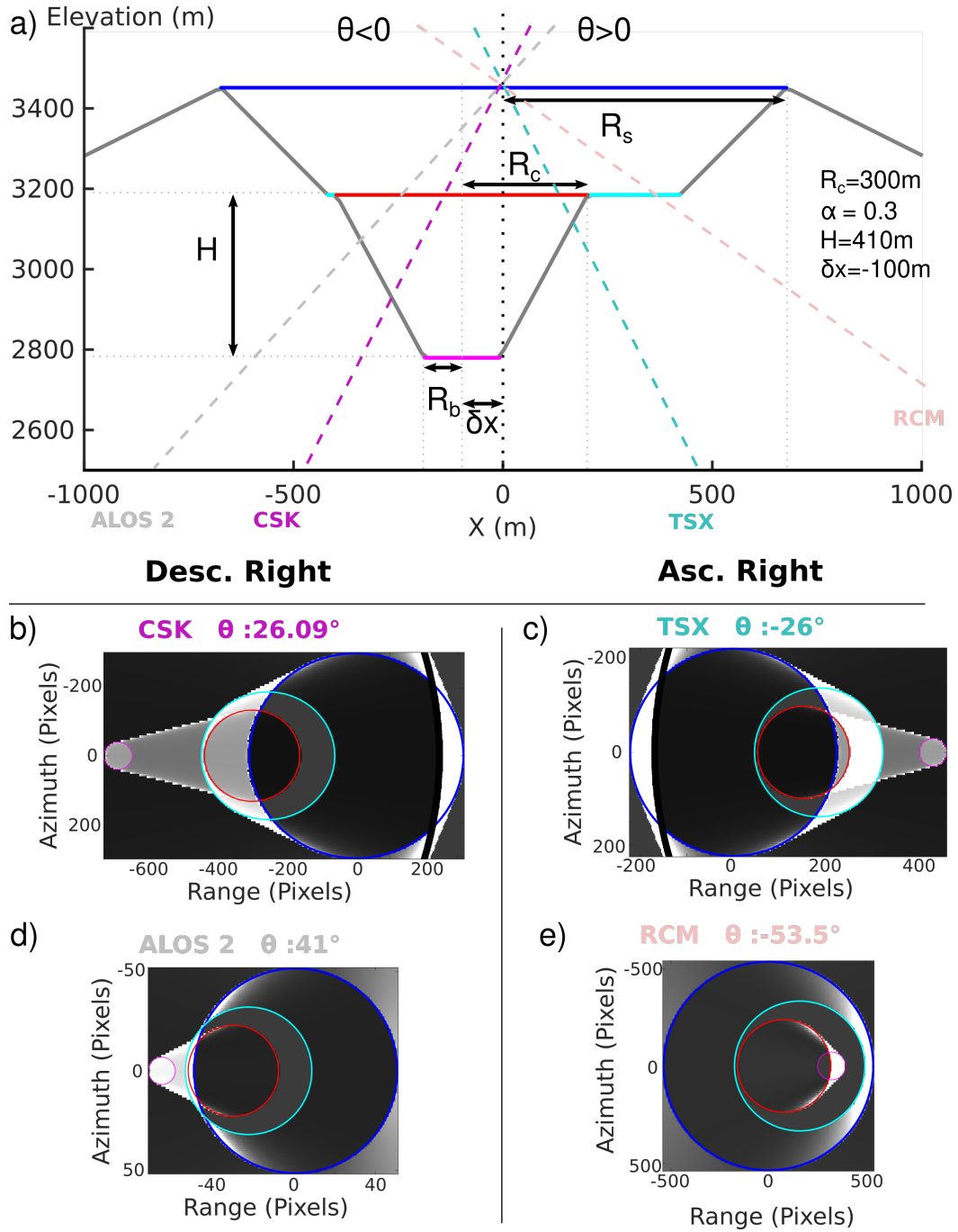


Figure S2. Simplified simulated amplitude for a 3D model and 4 different looking-angles. We simulate a collapse crater 410 m deep below Z_{P2} with a radius of 300 m. Its center is shifted by 100 m westward of P2 center. (a) Cross-section view of simulated geometry. (b), (c), (d) and (e) represent simulations for CSK descending, TSX ascending, ALOS-2 descending and RCM ascending acquisitions.

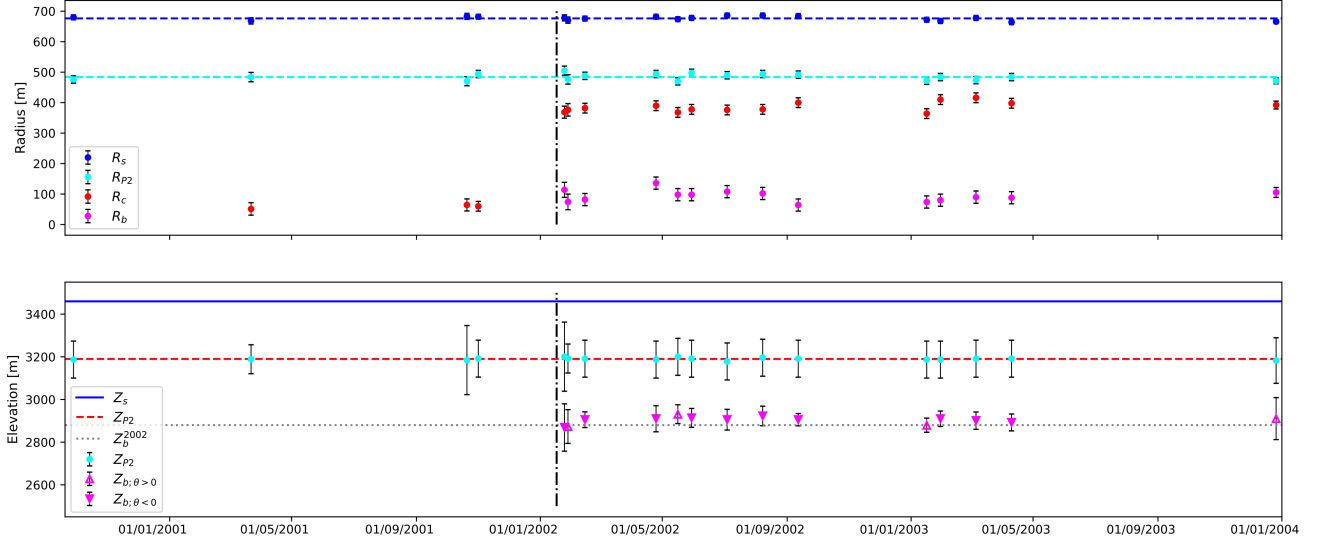


Figure S3. Time series of crater measures before and after the 2002 collapse. Summit (dark blue), P2 (cyan), collapse crater (red) and bottom crater (magenta) radii (a) and elevation (b) time series obtained by manually picking 4 ellipses on each SAR image. Error bars in (a) represents 2,3,4 and 5 times the azimuth pixel size respectively. Error bars in (b) on Z_{P2} represents 5 times the range pixel size. Error bars on Z_b are computed using Eq. 7.

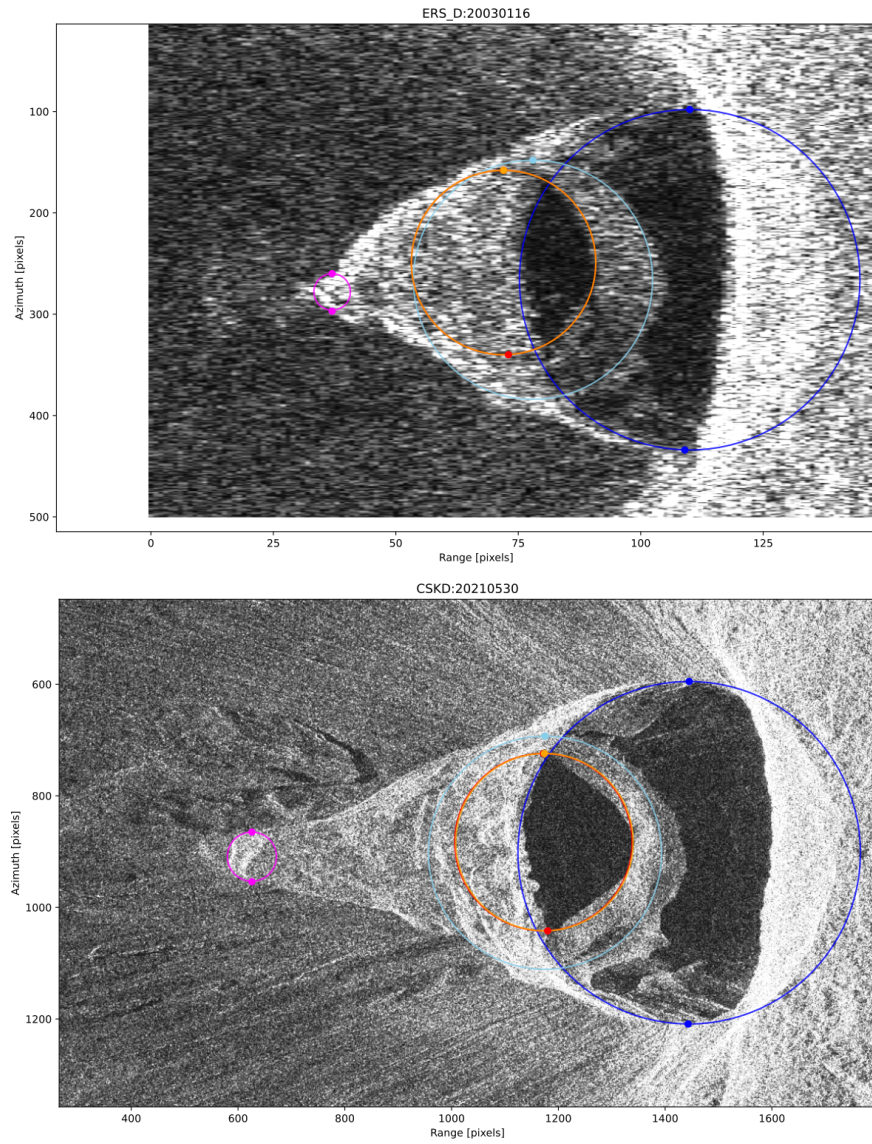


Figure S4. Comparison of an ERS image of the 2002 collapse with a CSK image of the 2021 collapse. Both images have similar incidence angles and had been scaled to display the same area.

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Table S1. List of SAR images used for analyzing the January 2002 Nyiragongo crater collapse.

Satellite	Mode		Date yyyy-mm-dd hh:mm:ss	Azimuth pixel size (m)	Range pixel size (m)	Incidence (°)
ERS	Descending	Right	2000-09-28 08:20:53	4.00	7.90	24.1
RSAT-1	Descending	Right	2001-03-22 03:36:04	5.1	4.7	46.8
RSAT-1	Ascending	Right	2001-10-20 16:27:06	4.9	11.6	-44.2
ERS	Ascending	Right	2001-10-31 20:43:50	4.00	7.90	-24.1
RSAT-1	Ascending	Right	2002-01-24 16:26:53	4.9	11.6	-44.3
RSAT-1	Descending	Right	2002-01-28 03:36:04	5.1	4.7	46.8
ERS	Ascending	Right	2002-02-13 20:43:43	4.00	7.90	-24.2
ERS	Ascending	Right	2002-04-24 20:43:48	4.00	7.90	-24.2
ERS	Descending	Right	2002-05-16 08:19:05	4.00	7.90	24.1
ERS	Ascending	Right	2002-05-29 20:43:54	4.00	7.90	-24.3
ERS	Ascending	Right	2002-07-03 20:43:57	4.00	7.90	-24.2
ERS	Ascending	Right	2002-08-07 20:43:58	4.00	7.90	-24.2
ERS	Ascending	Right	2002-09-11 20:44:00	4.00	7.90	-24.2
ERS	Descending	Right	2003-01-16 08:19:10	4.00	7.90	24.1
ERS	Ascending	Right	2003-01-29 20:43:54	4.00	7.90	-24.2
ERS	Ascending	Right	2003-03-05 20:43:51	4.00	7.90	-24.3
ERS	Ascending	Right	2003-04-09 20:43:46	4.00	7.90	-24.2
ENVISAT	Descending	Right	2003-12-26 07:39:10	3.24	7.80	43.04

Table S2. List of SAR images used for analyzing the May 2021 Nyiragongo crater collapse.

Satellite	Mode		Date yyyy-mm-dd hh:mm:ss	Azimuth pixel size (m)	Range pixel size (m)	Incidence (°)
S1	Ascending	Right	2021-05-13 16:21:18	14.05	2.33	-34.02
CSK	Ascending	Right	2021-05-16 04:03:41	2.26	1.25	-34.95
S1	Ascending	Right	2021-05-19 16:21:18	14.05	2.33	-34.02
S1	Descending	Right	2021-05-21 03:45:32	14.05	2.33	39.36
CSK	Descending	Right	2021-05-21 15:37:30	2.21	0.93	26.09
CSK	Descending	Right	2021-05-22 15:37:30	2.21	0.93	26.09
CSK	Ascending	Right	2021-05-23 04:03:41	2.26	1.25	-34.95
Capella	Ascending	Left	2021-05-23 19:28:48	1.66	1.5	30.23
RCM	Descending	Right	2021-05-24 03:46:01	1.25	0.82	40.75
TSX	Ascending	Right	2021-05-24 16:13:32	3	1.32	-26
RCM	Ascending	Right	2021-05-24 16:21:22	1.25	0.83	-41.5
S1	Ascending	Right	2021-05-25 16:21:18	14.05	2.33	-34.02
RCM	Ascending	Right	2021-05-25 16:29:19	1.25	1	-53.5
ICEYE	Ascending	Right	2021-05-25 19:49:16	0.19	0.42	-30.08
Capella	Ascending	Left	2021-05-26 04:39:45	1.66	1.64	34.4
ICEYE	Ascending	Right	2021-05-26 20:25:18	1.45	0.77	-24.09
ICEYE	Descending	Left	2021-05-28 07:45:54	0.18	0.42	-27.07
ALOS 2	Descending	Right	2021-05-28 09:41:00	13	8.6	41
CSK	Descending	Right	2021-05-30 15:37:30	2.21	0.93	26.09
S1	Ascending	Right	2021-05-31 16:21:18	14.05	2.33	-34.02
CSK	Ascending	Right	2021-06-01 04:03:41	2.26	1.25	-34.95
S1	Descending	Right	2021-06-02 03:45:32	14.05	2.33	39.36
ALOS 2	Ascending	Right	2021-06-03 22:20:29	13.06	8.58	-40.18
TSX	Ascending	Right	2021-06-04 16:13:32	3	1.32	-26
ICEYE	Ascending	Right	2021-06-05 19:49:50	0.18	0.42	-32.86
S1	Ascending	Right	2021-06-06 16:21:18	14.05	2.33	-34.02
CSK	Descending	Right	2021-06-07 15:37:30	2.21	0.93	26.09
S1	Descending	Right	2021-06-08 03:45:32	14.05	2.33	39.36
CSK	Ascending	Right	2021-06-08 04:03:41	2.26	1.25	-34.95
CSK	Ascending	Right	2021-06-09 04:03:41	2.26	1.25	-34.95
TSX	Descending	Right	2021-06-11 03:57:11	3.25	1.1	21.5
S1	Ascending	Right	2021-06-12 16:21:18	14.05	2.33	-34.02
S1	Descending	Right	2021-06-14 03:45:32	14.05	2.33	39.36
CSK	Descending	Right	2021-06-15 15:37:30	2.21	0.93	26.09
TSX	Ascending	Right	2021-06-15 16:13:32	3	1.32	-26
S1	Ascending	Right	2021-06-18 16:21:18	14.05	2.33	-34.02
S1	Descending	Right	2021-06-20 03:45:32	14.05	2.33	39.36
TSX	Descending	Right	2021-06-22 03:57:11	3.25	1.1	21.5
S1	Ascending	Right	2021-06-24 16:21:18	14.05	2.33	-34.02
S1	Ascending	Right	2021-06-30 16:21:18	14.05	2.33	-34.02
CSK	Descending	Right	2021-07-01 15:37:30	2.21	0.93	26.09
S1	Descending	Right	2021-07-02 03:45:32	14.05	2.33	39.36
CSK	Ascending	Right	2021-07-03 04:03:41	2.26	1.25	-34.95
S1	Ascending	Right	2021-07-06 16:21:18	14.05	2.33	-34.02

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Table S3. Crater depth estimates H taking into account a possible crater asymmetry. φ_1 and φ_2 are the crater slopes, ε quantify the crater asymmetry (see section 3.4 in main text).

Date (yyyy-mm-dd HH:MM)	$\varphi_1(^{\circ})$	$\varphi_2(^{\circ})$	$\varepsilon(^{\circ})$	H_{φ_1} (m)	H_{φ_2} (m)	$H_{mean\pm std}$ (m)
2021-05-24 16:17	-36	33	± 1.5	333	314	323 ± 9
2021-05-25 16:25	-21	29	± 4.1	560	638	599 ± 39
2021-05-28 08:43	-31	38	± 3.5	495	523	509 ± 14
2021-06-08 03:54	-29	40	± 5.4	489	510	500 ± 10
2021-06-15 15:55	-28	42	± 7.2	484	492	488 ± 4