Supplementary material

Table S1. Geometry and kinematics, in the literature, of the sources of the 9 and 11 January 1693 earthquakes.

Earthquake	acronym	Associated Fault	Mw	Azimuth	Prevailing kinematics	Fault length (km)	Fault width (km)	References
09/1/1693	MEFS	Malta Escarpment Fault System	6.1	170	Normal	12.9	8.2	Azzaro and Barbano (2000)
11/1/1693	MEFS	Malta Escarpment Fault System	6.8	170	Normal	37	14.6	Azzaro and Barbano (2000)
11/1/1693	MEFS	Malta Escarpment Fault System	7.1	170	Normal	54.1	17.9	Piatanesi and Tinti (1998); Jacques et al. (2001); Argnani and Bonazzi (2005)
09/1/1693	AF	Avola fault	6.1	230	Normal	13		Bianca et al. (1999)
09/1/1693	MLF	Monte Lauro Fault	6.6	57	Thrust	24	11.9	DISS Working Group (2018)
11/1/1693	GF	Gravina di Catania	6.0	246	Thrust	9	5.9	DISS Working Group (2018)
11/1/1693	SLGF 1 and SLGF 2	Faults of the Scordia-Lentini Graben	7.1	70	Normal	54.1	17.9	D'Addezio and Valensise (1991)
11/1/1693	SRFS	Scicli Ragusa Fault System	7.4	11	Strike	81	22.3	Sirovich and Pettenati (2001); DISS Working Group (2018)
11/1/1693	SP	Subduction plane	8.0	230	Thrust	120	160	Gutscher et al. (2006)
11/1/1693	SBT	Sicilian Basal Thrust	6.8-7.1	270	Thrust	27-63	15-27	Lavecchia et al. (2007); DISS Working Group (2018)
11/1/1693	STEP	STEP fault system	7.4	290	transtensive	130		Polonia et al. (2012)

Table S2. Reports of environmental effects that could be related with coseismic faulting.

Description	Source
"[…] *Un campo o pezzo di terra avvallò pari pari, otto palmi d'altezza sotto il livello del terreno adiacente…Nel territorio di Sortino in una tenuta di Terre lunga un mezzo miglio, e assai meno larga si vede interpellatamente a poca distanza, affondata la Terra, e abbassata dalla parte dello stretto a lunghissime strisce, dove due, dove tre, e dove più palmi, e all'ultima parte finisce con una Voragine circolare assai profonda*" [A piece of land was completely lowered, eight palms of height below the level of the adjacent land ... In the territory of Sortino in an estate half a mile long, and much less wide the land is clearly lowered with very long stripes as far as a very deep circular chasm]	Boccone (1697)
"*Nella via regia che, da Lentini conduce a Catania, una volta avvenuta la scossa, una grande voragine, apertasi al suolo, inghiottì nelle profonde fauci alcuni mulattieri e anche le mule. In particolare, in quel rione a cui diedero il nome i Siculi (Bottedaceto = Buttaceto), la terra si aprì in modo spropositato, della quale fenditura la larghezza misurava otto palmi, la lunghezza 25 passi e la profondità fu tale che alcuni contadini vi gettarono dei sassi, ma udirono un cupo strepito soltanto dopo lungo tempo*" In the royal road connecting Lentini to Catania, after the shock, a great chasm appeared in the ground that swallowed some muleteers and mules in the deep jaws. In particular, in that district named by the Siculi (Bottedaceto = Buttaceto), the land incredibly opened, with a width of eight palms, a length 25 steps and it was so deep that some peasants threw stones hearing a dull noise only after a long time.	Bottone (1718)
"[…] *Per un terremoto seguito a Ianicattì (Canicattini) […] a 28 aprile 1693, mezza salmata di terreno (1 salma = 17.415,37 m²), con certa quantità di capre, e suo pastore sprofondarono, lasciano una voragine tanto alta, che a buttarvi sassi non si udiva il rumore di loro caduta*" For an earthquake occurred at Ianicattì (Canicattini) [...] on the 28 April 1693, half a *salma* of soil (1 salma = 17.415.37 m²), hosting a certain quantity of goats, and his shepherd, sank, leaving a chasm so high, that no sound was heard after throwing stones inside.	Boccone (1697)
"Vediamo la terra abbassarsi, come se fosse sradicata dal cardine, i monti posti davanti alla città di Paternò, che in ogni tempo impedirono la vista del mare di Catania, ora, dal momento che sprofondarono nella parte orientale, permisero la vista del mare dalla zona della città vecchia" We see the land lowering, as if it was deeply uprooted, the mountains standing in front of the city of Paternò, which used to hide the sight of Catania sea, now, since they sank in the eastern part, they allow the view of the sea from the old city	Bottone (1718)

Table S3. Hierarchical parameters (modified after Pirrotta et al., 2016)

Parameters	Description	Abbreviation	Assumed values	References
Strahler order	indicates the phase of maturity of the hydrographic network	The fluvial drainage is subdivided in several segments going from a flow junction to the successive one. An order, indicated by a roman number, is associated to each segment of the hydrographic network. The headwater tributaries have the first (I) order. Then, when two segments of the same order meet, the successive fluvial segment gains a major order than the previous. Thus, two I order channels produce a II order segment; two II orders provide a III order, and so on	Hierarchical number is the highest order of the stream network	Horton, 1945; Strahler, 1952
Bifurcation ratio	They describe the degree of branching of the hydrographic network and highlight possible hierarchical anomalies	$\mathbf{R_{b(u-u+1)} = N_u/N_{u+1}}$ where $\mathbf{N_u}$ is the number of fluvial segments of a given order; $\mathbf{N_{u+1}}$ is the number of fluvial segments of the immediately higher order	It considers how many segments of a given order there are, with respect to the highest order	Horton, 1945; Strahler, 1952; Avena et al., 1967
Direct bifurcation ratio		$\mathbf{R_{bd} = N_{du}/N_{u+1}}$ where $\mathbf{N_{du}}$ represents the number of fluvial segments of a given order that flow in segments of the next, higher order; $\mathbf{N_{u+1}}$ is the number of segments of the next higher order	It considers how many segments of a given order flow into the highest order	
Bifurcation index (R)		$\mathbf{R = R_b - R_{db}}$ $\mathbf{R_b}$ encompasses all the segments of a given order, including also the anomalous drainage, while $\mathbf{R_{bd}}$ considers only the not anomalous segments.	For a well-organized basin, ($\mathbf{R_b \approx R_{bd}}$) R must approach to zero; on the contrary, high values of **R** indicate that the fluvial network has not a good hierarchical organization	
Anomaly parameter	It indicates the fluvial anomalies	**An**	i.e. a river segment of a given order u flowing into a segment of order u+2. It is calculated for each u order	Avena et al., 1967
Hierarchical anomaly number	It indicates the fluvial anomalies	$\mathbf{H_a}$ is the minimum number of first-order segments occurring to disallow hierarchical anomaly	High values indicate significant hierarchical anomalies	Avena et al., 1967
Hierarchical anomaly index	It allows a better quantification of drainage anomalies	$\mathbf{\Delta_a = H_a / N_1}$ where $\mathbf{H_a}$ is the number of the hierarchical anomaly and $\mathbf{N_1}$ is the number of first-order segments of the network	values approaching to 0 indicate a good hierarchical organization of the basin, while values approaching to or over 1 show a low degree of hierarchical organization	

Table S4. Geomorphic indexes (modified after Pirrotta et al., 2016)

Geomorphic indexes	description	Abbreviation	Assumed values	Reference
Asymmetry factor	allows evaluating the asymmetry of the basin that can be due to broad lateral tilting or uplift and subsidence of discrete blocks	**AF= 100(Ar/At)** Where **Ar** is the area of the basin on the hydrographic right, with respect to the main stream segment; **At** is	AF value greater than 50 indicates shifting towards hydrographic left whereas a value lower than 50 indicates rightwards shifting	Hare and Gardner, 1985; Cox, 1994; Pinter, 2005; Molin et al., 2004

		the area of the entire drainage basin		
Transverse Topographic Symmetry factor		**T= Da/Dd** where **Da** is the distance from the trunk stream to the basin midline; **Dd** is the distance from the basin watershed to the basin midline	The basin must be divided into constant intervals. Stability is indicated by low **T** values (Da approaches to zero); on the contrary, T values approaching to 1 indicate basin asymmetry and thus tilting	Cox, 1994
Basin elongation Ratio (Re)	describes the planimetric shape of the basin and its phase of maturity; a mature basin, draining on a stable area, has a shape similar to a circle, whereas a basin draining on an area that is suffering fast uplift shows elongated narrow shape	The shape is quantified as: $\mathbf{Re = (2\sqrt{A}:\sqrt{\Pi})/Lb}$ Where **A** is the basin area, **Lb** the length of the basin parallel to the principal drainage line.	The basin area is considered as a circle and its hypothetic diameter is compared to the basin length. High values indicate a shape approaching to a circle; on the contrary, low values indicate elongated basins whose shape depends on the tectonic control	Bull and McFadden, 1977; Molin et al., 2004
Hypsometric integral	quantifies the areal distribution of the elevation of the relief in the basin, describing the stage of the drainage basin or part of it, if youthful, mature or old. This parameter highlights possible local or more widely areal rejuvenation, due to regional uplift or fault dip movement	Hypsometric integral is measured for interval of elevation. The relative area (**a/A** ratio, with A total area and a the area of the basin above a give elevation h, and the relative elevation (**h/H** ratio, with **H** maximum basin elevation and **h** topographic elevation), are represented in the Cartesian graph	The curve shape indicates the evolution stage of the basin: an upward convex curve indicates a juvenile stage, a sigmoidal curve a mature stage, finally an upward concave curve a senile stage	Strahler, 1952
Stream length-gradient index (SL)	It is sensitive to change in channel slope and allows evaluating relationships among possible tectonic activity, rock resistance and topography. It is very sensitive to lithology, values must be punctually related to lithology cropping out	**SL = (DH/ DL) L** The trunk channel is divided into segments with constant increasing of elevation, **DH**; for each tract is measured the length **DL** and **L** that is the channel length from the midpoint of the reach upstream. The value of **SL** index is referred to the midpoint	Tectonic uplift will be expressed by high SL values. Anomalous high SL values not ascribable to lithological changes can represent punctual action of dip slip faults	Merritts and Vincent, 1989; Hack, 1973; Burbank and Anderson, 2001
Valley width-height ratio (Vf)		**Vf = 2Vfw/[(Eld-Esc)+ (Erd-Esc)]** Where **Vfw** is the width of the valley floor, **Eld** and **Erd** the elevations of the left and right valley watershed, respectively and **Esc** the elevation of the valley floor. A number of established valley profiles are obtained for fixed constant distance intervals; for each one, the width and elevations of valley and floor are measured	This index describes the maturity of the valley differentiating between broad-floored canyons, with relatively high values of **Vf**, and V-shape valleys, with relatively low values. Thus, high **Vf** values are associated with stability of the area where the drainage flows; on the contrary, low values express incised valleys generally associated to high regional uplift rate or local uplift due to active faults. Local uplift due to faults can be expressed by local variation of the **Vf** index that can change from relatively high values to low values for a given reach of the basin	Bull, 1977; Ouchi, 1985

Table S5. Values of geomorphic indexes, calculated from the mouth to the headwater of the basin; SL index is calculated for elevation range of 50 m.

	AF	Re	T	Vf	SL
Mulinello R.	50.11	0.39	0.49 0.45 0.30 0.03 0.53 0.74 0.51 0.43 0.20 0.29	V_{max} 56.37 V_{min} 1.48 $V_{average}$ 12.69	109.91 104.09 204.96 125.46 109.25 25.00
Marcellino R.	77.11	0.40	0.10 0.70 0.77 0.63 0.55 0.70 0.62 0.90 0.53 0.31 0.14 0.07	V_{max} 14.19 V_{min} 1.36 $V_{average}$ 5.89	306.05 229.02 331.24 271.90 195.66 211.91 137.22 186.16 136.90 119.42 89.81 59.09 51.50 25.00
Cantera R.	43.26	0.58	0.85 0.41 0.41 0.44 0.15 0.18 0.32	V_{max} 8.72 V_{min} 0.96 $V_{average}$ 3.57	415.62 126.22 138.52 183.04 143.40 129.55 119.82 68.01 17.50
Anapo R.	54.23	0.44	0.39 0.49 0.37 0.11 0.11 0.47 0.53 0.57 0.31 0.27 0.46 0.39	V_{max} 10.72 V_{min} 1.05 $V_{average}$ 3.03	215.84 467.75 1573.24 323.82 320.53 338.97 369.90 310.00 210.98 166.67 140.18 129.83 108.27 79.00 100.77 102.50 81.99 81.95 73.46 25.00