TOWARDS NEW INSIGHTS INTO SEISMIC HAZARD OF THE SALENTO PENINSULA (PUGLIA, SOUTHERN ITALY) FROM THE ANALYSIS OF FAR AND NEAR FIELD SEISMICITY

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Introduction. The Salento peninsula (Puglia, southern Italy) has been generally considered almost aseismic, but it has been hit by some high energy earthquakes over the last centuries. The strong earthquake affecting the Salento peninsula is represented by the February 20, 1743 earthquake (I_0= IX, Mw =7.1, Rovida *et al*., 2011), which caused severe damage in the Salento area. Moreover the Salento has been damaged by the strongest earthquakes occurred in Northern Apulia, Southern Apennines, Adriatic and Ionian sea, Albania and Greece that also triggered significant environmental effects.

The purpose of this study is opening new insights into the seismicity of Salento, through the analysis of far and near field seismicity, for providing a more realistic assessment of its seismic hazard.

Near and far field seismicity. The Salento Peninsula (Apulia, southern Italy) over the last centuries has been epicentral area of several low and medium energy earthquakes with magnitude $3 \leq Mw \leq 5$, apart from the February 20, 1743, earthquake with I_0 = IX and Mw = 7.1 (Rovida *et al*., 2011). Analyzing the CFTI4Med catalogue (Guidoboni *et al*., 2007), 13 earthquakes occurred in the XX century, with 3.2<Mw<4.6, and located in the Salento peninsula have been added to the CPTI11 extracted events (Fig.1).

The February 20, 1743 earthquake is considered the strongest seismic event occurred in the area in the last centuries, over a seismic period that began in 1741 (Margottini, 1985; Guidoboni *et al*., 2007; Galli *et al*., 2008). The event was felt in the whole Apulia region, in many cities as Napoli, Matera, Reggio Calabria, Messina in southern Italy, and even in some localities of Central and Northern Italy as Parma, Venezia, Vicenza, Trento and Udine, the last two cities far from the epicentral area more than a thousand kilometres. This earthquake was also felt in a wide sector of the Mediterranean area along the western coast of Greece, Albania and on Malta islands. It also generated massive environmental effects as a large tsunami (Mastronuzzi *et al*., 2007; Maramai *et al*., 2014). On the basis of the collected documentary and historical sources, together with the geomorphologic evidences of the earthquake environmental effects, the re-evaluation of the 1743 seismic event has been carried out, according to the ESI-07 scale (Michetti *et al*., 2007), assessing epicentral intensity I_0=XI and magnitude Mw≥7.1 (Nappi *et al*., 2016).

The instrumental seismicity in the Murge and in the Salento peninsula is characterized by scattered seismicity of low energy, mainly concentrated in the western sector of Salento, in the Gulf of Taranto and in the Otranto channel. In particular in the Gulf of Taranto moderate energy events with epicenters not far from the coasts of Salento have occurred, as in the case of the May 7, 1983 earthquake (Mw=5.0) (Tab. 1). Moreover, the area of the Otranto channel

Tab. 1 – Historical and recent earthquakes occurred in the Salento peninsula and surrounding seas extracted from CPTI04 (Gruppo di lavoro CPTI 2004), CPTI11 (Rovida *et al*., 2011, 2016), CFTI4Med (Guidoboni *et al*., 2007).

Date	T_0	I_0 (MCS)	I_{max}	M_w	Lat N	Long E	Location	Catalogue
1087-09-10		VI-VII	VI-VII	4.9	41.128	16.864	Bari	CPTI15
1713-01-03		V-VI	VI-VII	4.4	40.589	17.113	Bassa Murgia	CPTI15
1743-02-20	16:30	IX	IX-X	7.1-6.7	39.846	18.774	Ionian sea	CPTI15
1826-10-27	18:00	VI-VII	VI-VII	5.2	40.502	17.433	Salento	CPTI15
1844-02-07	22:16	VIII		5.6	42.000	17.000	Basso Adriatico	CPTI11
1848-08-03	00:05	VII		5.1	42.000	17.000	Basso Adriatico	CPTI11
1909-01-05	20:00	IV-V	IV-V	4.1	40.283	18.300	Vernole (Le)	CFTI4Med
1909-01-06	02:00	III	III	3.5	40.117	18.300	Maglie (LE)	CFTI4Med
1909-01-20	19:58	V	VI	4.6	40.183	18.033	Salento	CFTI4Med
1926-12-14	21:00	III	III	3.5	40.633	17.950	Brindisi	CFTI4Med
1931-04-24	21:10	III-IV	III-IV	3.7	40.550	17.717	Latiano (BR)	CFTI4Med
1932-07-19	12:31	III	III	3.5	40.750	17.317	Locorotondo (BA)	CFTI4Med
1935-03-01	12:38	IV	IV	3.9	40.350	18.167	Lecce	CFTI4Med
1935-03-01	17:17	III	III	3.5	40.350	18.167	Lecce	CFTI4Med
1935-05-29	13:00	IV	IV	3.9	39.800	18.367	S. Maria di Leuca LE)	CFTI4Med
1936-06-13	00:35	III	III	3.5	40.783	17.050	Bari-Taranto	CFTI4Med
1937-10-17	10:00	III	III	3.5	40.450	17.250	Taranto	CFTI4Med
1938-03-04	02:00	IV	IV	3.9	40.400	18.067	Trepuzzi (Le)	CFTI4Med
1947-06-20	21:30	II-III	II-III	3.2	40.533	17.433	Grottaglie (TA)	CFTI4Med
1948-05-07	15:57:24	V-VI		4.8	40.000	19.000	Canale d'Otranto	CPTI04, CPTI11
1974-06-29	22:32:03			4.1	39.648	18.833	Ionio Settentrionale	CPTI15
1974-10-01	00:34:40			3.9	39.699	18.814	Ionio Settentrionale	CPTI15
1974-10-07	11:43:40			4.5	39.786	18.915	Ionio Settentrionale	CPTI15
1974-10-20	11:25:50			5.0	39.572	18.826	Ionio Settentrionale	CPTI15
1974-10-22	07:29:04			4.4	39.705	18.717	Ionio Settentrionale	CPTI15
1974-11-23	07:52:28	VII		4.6	39.774	18.810	Alto Ionio	CPTI04, CPTI11
1974-11-23	18:46:36			4.8	39.742	18.839	Alto Ionio	CPTI11
1976-10-22	11:23:27			4.7	39.724	18.928	Ionio Settentrionale	CPTI15
1976-10-27	10:14:56			4.6	39.601	18.836	Ionio Settentrionale	CPTI15
1976-11-06	20:57:04			4.6	39.606	18.772	Ionio Settentrionale	CPTI15
1976-11-07	02:10:18			3.1	39.645	18.868	Ionio Settentrionale	CPTI15
1976-11-08	18:08:41			4.1	39.220	18.609	Ionio Settentrionale	CPTI15
1976-11-12	19:36:36			4.5	39.658	18.935	Ionio Settentrionale	CPTI15
1976-11-13	05:29:37			4.3	39.661	18.976	Alto Ionio	CPTI11
1977-06-05	23:19:47			4.1	39.601	18.831	Ionio Settentrionale	CPTI15
1983-05-07	22:09:14			5.0	40.062	17.890	Penisola salentina	CPTI11
1983-11-08	20:11:40			4.6	39.907	17.825	Penisola salentina	CPTI11
1985-09-19	04:54:26			4.0	39.673	18.832	Ionio Settentrionale	CPTI15
2001-09-23	21:16:57			5.0	39.767	18.001	Golfo di Taranto	CPTI15

has been hit by two seismic sequences in the 1974 (Mwmax=5.0) and 1976 (Mwmax=4.9). The increase in the number of seismic stations since 2000 provides a more complete hypocentral determinations of low magnitude earthquakes occurring in the Apulia foreland (Del Gaudio *et al*., 2005; Pierri *et al*., 2013). The distribution of earthquakes in the Salento Peninsula shows a clear concentration of seismic events along the NE-SW Taranto-Brindisi depression zone separating the Murge from the Salento Peninsula (Fig 1).

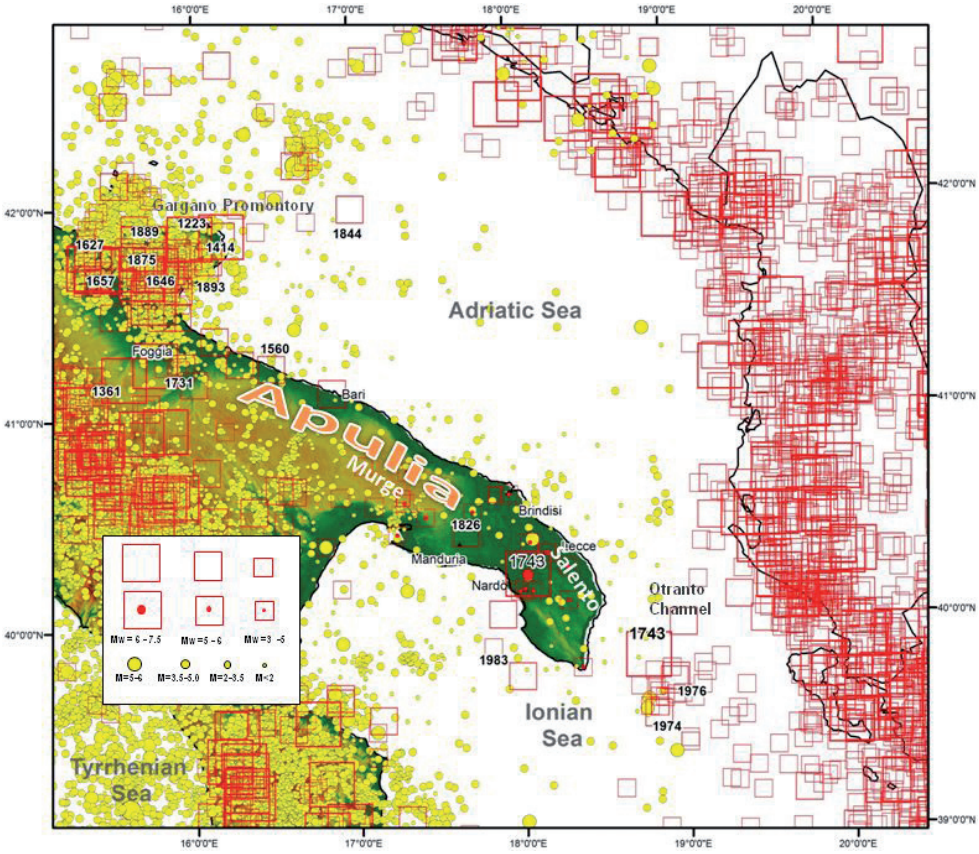

Fig. 1 – Historical seismicity of Apulia and surrounding areas: red squares represents earthquakes from the CPTI11catalogue (Rovida *et al*., 2011, 2016) for Southern Italy and from the SHARE European Earthquake Catalogue (Stucchi *et al*., 2013; Grünthal *et al*., 2013) for the Balkan peninsula; red squares, with full red circles inside, represent earthquakes of Salento peninsula from CFTI4Med catalogue (Guidoboni *et al*., 2007). The epicentre of the 1743 earthquake located onland (from CFTI4Med) and offshore (from CPTI11) in the Otranto Channel, is identified by the year of its occurrence. Instrumental seismicity of Apulia and surrounding areas: yellow circles represent earthquakes from ISIDE Working group (2016) (modified after Nappi *et al*., 2016).

The Salento area is hit by several strong earthquakes of neighbouring seismogenetic areas as northern Apulia, southern Apennines, Adriatic and Ionian sea, Albania and Greece (Fig. 1).

The strongest historical earthquakes with $I_0 \geq$VIII MCS (Rovida *et al*., 2011, 2016) in the Gargano area are:

- the 1223 (Gargano, I_0=VIII-IX MCS, Mw=5.8);
- the July 17, 1361 (Subappennino dauno, I_0=IX MCS, Mw=6.0);
- the 1414 (Gargano, I_0=VIII-IX, Mw=5.8);
- the May 11, 1560 (Costa pugliese centrale I_0=VIII MCS, Mw=5.7);
- the July 30, 1627 (Capitanata, I_0=X MCS, Mw=6.7);

- the May 31, 1646 (Gargano, I_0= X MCS, Mw=6.7);
- the January 29, 1657 (Capitanata, I_0=VIII-IX MCS, Mw=6.0);
- the March 20, 1731 (Tavoliere delle Puglie, I_0=IX MCS, Mw=6.3);
- the February 7, 1844 (Adriatic sea, I_0=VIII MCS, Mw=5.6);
- the December 6, 1875 (Gargano, I_0=VIII MCS, Mw=5.9);
- the August 10, 1893 (Gargano, I_0=VIII MCS, Mw=5.4)

The strongest historical seismic events of the Southern Apennines, powerfully felt in Salento with intensity I ≥ VI MCS are:

- the December 5, 1456 Molise earthquake (Imax = XI MCS) felt in Lecce and Brindisi with I=VI MCS (Figliuolo, 1988);
- the June 5, 1688 Sannio earthquake (Imax= XI) with collapse of the tower in Galatina (I=VII MCS, Serva, 1985);
- the September 8, 1694 Irpinia-Basilicata earthquake, (Imax=X-XI MCS) felt in Canosa with IX MCS, Brindisi, Lecce and Mesagne with I= V MCS. In Brindisi were observed tsunami environmental effects;
- the Febrary 5, 1783 ad following shocks (Imax= XI, MCS, Margottini, 1992) with felts in Salento peninsula (Margottini, 1992);
- the December 16, 1857 Basilicata earthquake, (Imax = XI MCS) felt in Canosa di Puglia with I=VIII MCS, in Altamura with I=VI-VII MCS, in Taranto with I=VI MCS and in Bari and Lecce with I=V MCS (Branno *et al*., 1985).

More recently, the July 23, 1930 (Imax =X MCS) and the November 23, 1980 (Imax =X MCS) Irpinia earthquakes gave rise to several ground effects, mostly hydrological variations, in the Apulian region (Porfido *et al*., 2007).

The Salento peninsula is less than 100 km far from Albanian and Greek coasts where many energetic earthquakes occur and are strongly felt in Salento. Well documented examples of earthquakes from central-eastern Mediterranean area, felt in Salento, are the following:

- the August 27, 1886 earthquake (Peloponnesus, Greece) felt in Salento with high intensity, I=VII MCS (Margottini, 1982; Papazachos *et al*., 2003; Serva *et al*., 2010; Grünthal *et al*., 2013);
- the May 28, 1897 earthquake (epicenter in Tripole, Greece) with intensity I=VI MCS in Salento (Papazachos *et al*., 2003; Serva *et al*., 2010, Grünthal *et al*., 2013);
- the August 11, 1903 earthquake (epicenter in Peloponnesus area) with I=IV-V MCS in Salento (Margottini 1982; Serva *et al*., 2010);
- the June 26, 1926 earthquake (epicenter close to Rhodes Imax=IX MSK, Ambraseys et al., 1998) felt throughout Southern Italy. The intensity in the town of Taranto (western Salento) was IV-V MCS (Castenetto et al., 1986);
- the August 28, 1962 earthquake (epicenter in Peloponnesus area) with I=VI MCS in Salento (Margottini 1982; Serva *et al*., 2010).

Conclusions. The current classification of the Salento seismic hazard is underestimated in our opinion and is prevalently attributed to the lack of high energy seismicity inside the area. Tab. 1 shows that the Salento is seismically active and characterized by historical and instrumental seismicity of low and moderate energy (3<M<5); this level of activity cannot be neglected.

This study has allowed us to point out a quite different scenario for the seismic hazard assessment of the Salento peninsula, currently classified in IV category (Seismic Classification Map of the Italian territory, MPSO4-Order PCM 3519/2006), taking into account also the effects due to the faraway and strong earthquakes located in the central Mediterranean, and the relative damages on urbanized and natural environment. Moreover, it is also important to remind, as regards the local risk level, that the Salento peninsula represents one of the most crowded touristic destination of the Southern Italy, all over the summer season.

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