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THE IMPACT OF SEA LEVEL CHANGES ON AN URBANIZED AREA: THE CASE OF THE CITY OF BARI (APULIA)

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ABSTRACT: Pagliarulo R. & Antonioli F. *The impact of sea level changes on an urbanized area: the case of the city of Bari (Apulia).* (IT ISSN 0394-3356, 2011)
This paper considers the different depths of the ancient floor levels in the crypt of St. Nicholas Basilica (Bari), built in 1087 AD along the sea, as markers and compares them to eustatic sea level curve for the Adriatic coastline reconstructed on the basis of the Lambeck's predictive model for the Late Pleistocene and Holocene changes in local relative sea level. (Lambeck *et al*.,2011). The palaeo sea levels have been obtained measuring: 1) the pavement levels in the crypt; 2) the groundwater table at the time of the construction of the Basilica and in 1956. The results give an interesting contribution to calibrate the predicted sea level curve for the last 1000 year.

RIASSUNTO: Pagliarulo R. & Antonioli F. L'impatto delle variazioni del livello mare su un'area urbanizzata: il caso della città di Bari (Puglia). (IT ISSN 0394-3356, 2011)
Questo lavoro prende in considerazioni diversi livelli di calpestio della cripta della Basilica di San Nicola a Bari, costruita sul mare nel 1087 e li confronta con la locale curva di riferimento di risalita del modello di Lambeck et al., (2011). I paleo livelli del mare sono stati ricavati da misure sulla superficie piezometrica della falda acquifera sia al tempo della costruzione della Basilica, sia successivamente. I risultati forniscono interessanti spunti di confronto per la calibrazione della curva negli ultimi 1000 anni.

Key words: relative sea level curve, Adriatic sea, watertable, seawater intrusion

Parole chiave: Curva di risalita del mare, Mare Adriatico, falda, intrusione marina

Lately, published and new data are available in defining sea-level change in many location all along the Italian coastline. (ANTONIOLI *et al.,* 2009; LAMBECK *et al.,* 2004; 2011). The database provides predicted sea level curves since the Last Glacial Maximum. The curves are reconstructed on the basis of geomorphological markers, coastal archaeological data and sedimentary core analysis. This paper is a contribution to the use of a measurement methodology, to calibrate and adjust the predicted values of sea level rise. Archeological data coming from past floor levels of the crypt of St. Nicholas Basilica in Bari are used in comparing these depths to the predicted sea level curve for the last 1000 yr. The Basilica, built between 1087 and 1197, safeguards the Saint's relics and stands imposing in the old town of Bari overlooking the Adriatic Sea. (Fig.1). The crypt was originary a hypogean. The old town of Bari is located on a little peninsula protruding to the sea. From the geological point of view it is founded on limestones of the Apulian carbonatic plate. In particular, the Formation of "Calcari di Bari" represents the bedrock for the whole area and consists of a sequence of greywhitish limestones, dolomitic limestones and dolomites in strata whose thickness ranges from about some decimeters to a few meters. The age is referable to Upper Albian-Early Cenomanian. Eustatic sea level change occurred since Middle Pleistocene characterized the coast with the deposition of marine terraces. (PIERI *et al*., 2009). They are arranged in several orders, the lower ones outcrop on the western and eastern part of the town, partly deleted by urbanization. They consist in sand dune bodies, actually at a height of 4-5 m a.m.s.l., overlaying both the calcareous sandstones of Upper Pliocene- Lower Pleistocene and the Mesozoic limestones. These deposits consist of porous yellowish calcarenites with clear oblique lamination. The fossil content is given by Gasteropoda and Helix. (ZEZZA, 1971). The age of the deposits can be referred to Upper Pleistocene. Although they do not include any special indicator it is possible to refer these deposits to a generic Thyrrenian. (PIERI, 1975). For this reason uplift rates are rather difficult to determine. The South Adriatic coast was not colonized by warm fauna during the warmest sea highstands, but it is considered to be stable.
The functional depths of the ancient floor levels in the crypt of St. Nicholas Basilica enables us to determine the mean sea level, since the year of the construction, quite precisely. By means of historical sources it has been possible to have information about the piezometric surface of the groundwater, its changes and the relationship with the current and past sea level. This coastal area is affected by sea water intrusion. (COTECCHIA, 1981). It is the induced flow of sea water into fresh

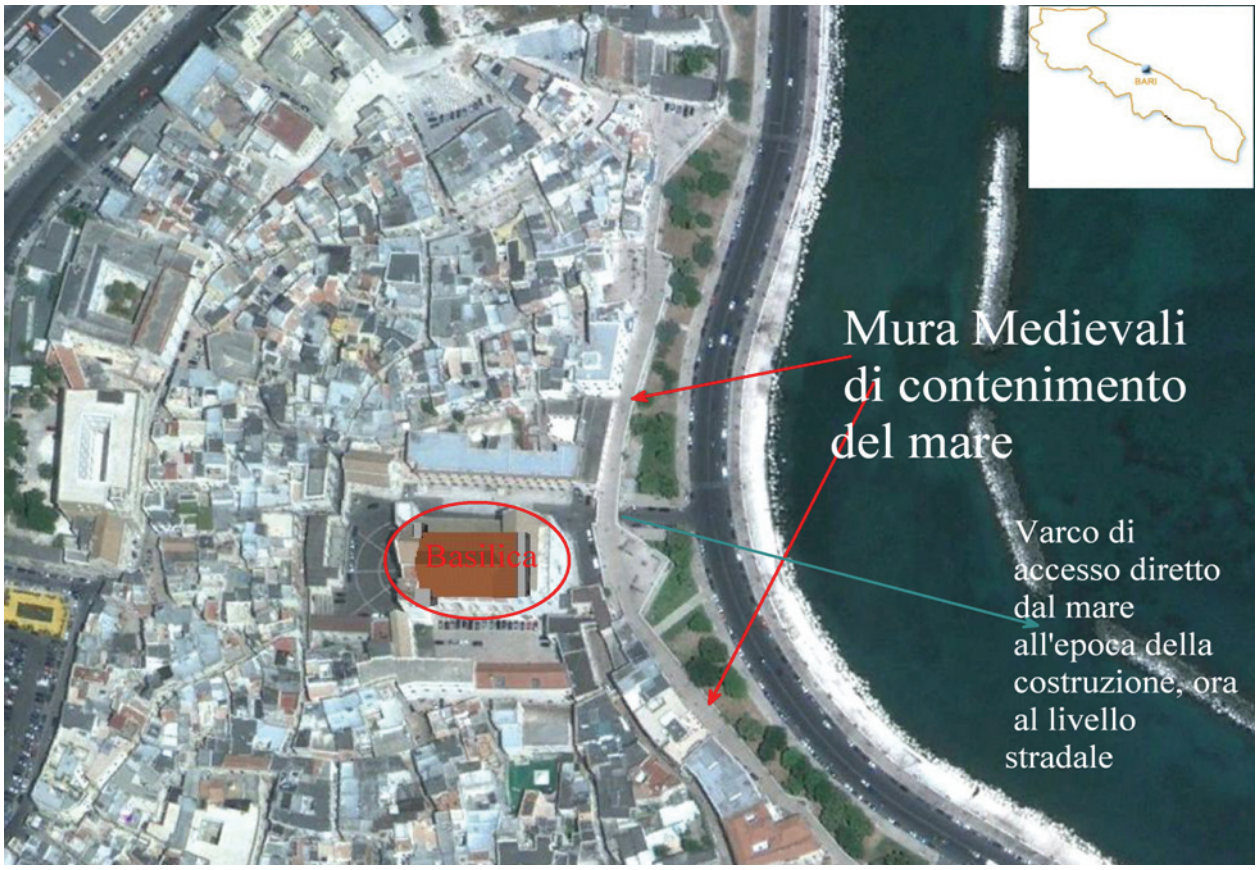

Fig. 1, The old town of Bari and the location of St. Nicholas Basilica
Il borgo antico di Bari e la localizzazione della Basilica di San Nicola

water aquifers. Because fresh water is less dense than salt water it floats on top. The boundary between salt water and fresh water is not distinct, the salt water interface is brackish with salt water and fresh water mixing. The rise in sea level causes flooding of coastal land by sea water, either for a long or a short period. In addition sea level changes boost sea water intrusion into coastal aquifer that are hydraulically connected to the sea. For this reason since 1087 it was necessary to raise the floor of the crypt as it has been flooding by sea water intrusion. (COTECCHIA *et al.*, 1983) (Fig. 2).

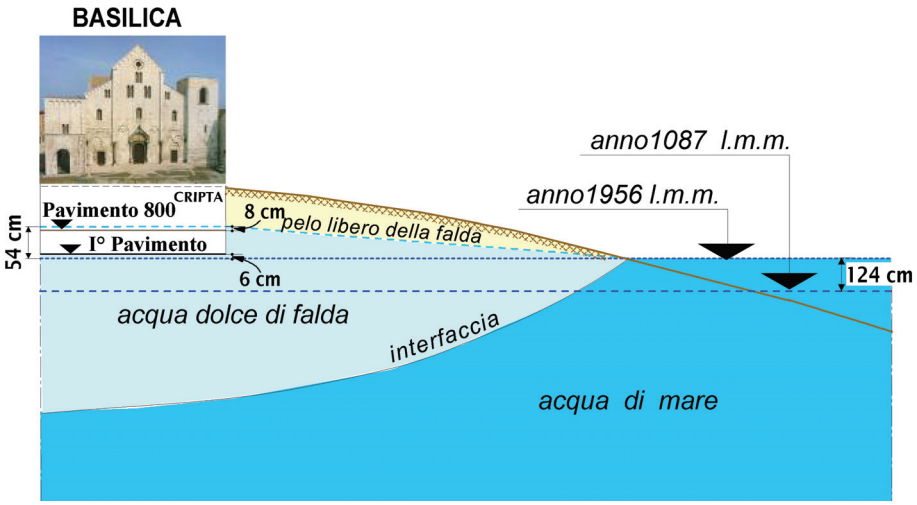

Fig. 2, Sea level changes and the impact of sea water intrusion on the structures of the crypt.
Variazioni del livello mare e influenza dell'intrusione marina sulle strutture della cripta.

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