GEOARCHAEOLOGY OF TSUNAMIS AND THE REVIVAL OF NEO-CATASTROPHISM IN THE EASTERN MEDITERRANEAN

Christophe Morhange[*]- Amos Salamon[**] - Guénaelle Bony[*] - Clément Flaux[*] - Ehud Galili[***] - Jean-Philippe Goiran[♦] - Dov Zviely[♦♦]

1. Introduction

Over the past decade, the number of geoscience publications addressing tsunami events has increased exponentially. This rise may be related to the Sumatra tsunami that occurred during Christmas 2004 killing more than 230,000 people[1]. The impact of the catastrophe was imprinted in our collective imagination. Much frustration resulted not only because of the lack of prediction, but also due to the absence of transmission of the early warning signal in real time to the threatened populations. Regarding its universal influence, the tsunami of 2004 can be compared with the Lisbon earthquake and tsunami of 1755 which, thanks to the writings of Voltaire, became a major subject of scholastic debate among contemporaries who reflected on human fragility.

Numerous authors have described tsunamis in the ancient Mediterranean world[2]. However, it was not until the Lisbon earthquake of 1755 that modern Europe realized just how devastating natural hazards could be.

Voltaire's Candide of 1759 includes one of the earliest literary descriptions of a tsunami, which he heard first hand from a Portuguese witness: "À peine ont-ils mis le pied dans la ville en pleurant la mort de leur bienfaiteur, qu'ils sentent la terre trembler sous leurs pas; la mer s'élève en bouillonnant dans le port, et brise les vaisseaux qui sont à l'ancre. Des tourbillons de flammes et de cendres couvrent les rues et les places publiques; les maisons s'écroulent, les toits sont renversés sur les fondements, et les fondements se dispersent; trente mille habitants de tout âge et de tout sexe sont écrasés sous des ruines; le matelot disait en

[*] CEREGE-CNRS, Aix-Marseille University, IUF.
[**] Geological Survey of Israel.
[***] Zinman Institute of Archaeology, University of Haifa.
[♦] ARCHÉORIENT-CNRS, UMR 5133, Université Lumière LYON, MOM.
[♦♦] RIMS-The Leon Recanati Institute for Maritime Studies, University of Haifa.

1 Lavigne - Paris eds. 2011.

2 E.g. the catalogues by Guidoboni - Comastri - Traina 1994; Soloviev *et al.* 2000; Guidoboni - Comastri 2005; Ambraseys 2009.

sifflant et en jurant: 'Il y aura quelque chose à gagner ici. – Quelle peut être la raison suffisante de ce phénomène? disait Pangloss. – Voici le dernier jour du monde!' s'écriait Candide".

The earthquake and tsunami of Lisbon struck on All Saint's Day and provoked many reactions in the theologians and intelligentsia of the time. Apocalyptic accounts were given, horrifyingly depicting the death of thousands of innocent victims, the ruins of the entire city of Lisbon including many of its churches and the injustice of human fate under such circumstances. It contributed to an already ongoing philosophical debate on the origin of "evil". However, simultaneously, the Enlightenment movement opened the way to rational enquiry concerning the causes of natural catastrophes and what is presently called risk management[3].

Neocatastrophism is a doctrine postulating that major changes in the earth's history result from catastrophes rather than evolutionary processes[4]. This neocatastrophic dogma has been a recurrent theme in geoarchaeological studies. Its origins can be traced back to ancient myths, e.g. pre-modern Atlantis[5] and much later the submerged ancient cities discussed since the 19th century. An overemphasis on ancient texts, without evidence-based field-studies, has long hampered coastal geoarchaeology. Since the excavation of ancient Akrotiri in Santorini, and the hypothesized collapse of the "Minoan civilization" during the Santorini eruption and tsunami[6], the "collapse" of ancient civilizations has become a key focus of research, subliminally related to the myth of the biblical flood. For example, the ancient city of Helike on the southern coast of the Gulf of Corinth is an archetype[7]. In 373 BC, a catastrophic earthquake and tsunami is believed to have destroyed and submerged this ancient Greek city. Its location has never been accurately identified. This "sunken city" is supposed to have been silted over and disappeared without trace! For decades, Marinatos[8] unsuccessfully pursued the search for Helike. He looked forward to "the discovery of a whole ancient town far more precious and interesting than Pompei", which, he said, would be "almost surely the most spectacular archaeological discovery ever made" (in http://www.helike.org/, website of

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3 Betâmio de Almeida 2009.
4 Ager 1993.
5 Vidal-Naquet 2005; Treuil 2012.
6 Marinatos 1939.
7 Pouqueville 1820; Marinatos 1960; Soter - Katsonopoulou 2011.
8 Marinatos 1960.

the Helike foundation). More recently, Katsonopoulou[9] has demonstrated that the submersion of Helike, reported by a great number of ancient sources, has been misinterpreted by modern scholarship and has erroneously led earlier efforts to locate the lost city in offshore sea areas.
The justified rise of interest in natural catastrophes that followed the Sumatra 2004 earthquake and tsunami, and the sharp surge in associated scientific publications, attracted our attention on how much of that increase is indeed a reflection of reality and to what extent there is a media exaggeration in geoarchaeology. Ambraseys[10] has already dealt with this mode of thinking in archaeoseismology, where researchers related catastrophic impact to archaic and historic events "… particularly when they are based on inadequate or biased historical evidence and also because they have become fashionable in recent years". The aim of this article is to correlate the bibliometric rise of tsunami papers in geoarchaeological research with the renewal of neo-catastrophic ideas (especially the use and abuse of catastrophic terminology).

2. Tsunami description and terminology

Tsunamis are the result of a large mass of water being displaced in a short time. This typically occurs with earth movements on the seabed during, for instance, underwater earthquakes, volcanic eruptions or submarine landslides. A second mechanism is a large amount of material suddenly entering the water, either from a coastal or offshore landslide, and even from a meteorite impact. In either case, the sudden displacement of a large mass of water initiates a train of waves that may have an extremely long wavelength of up to hundreds of kilometers, causing major devastation when it reaches the shoreline[11].
Tsunami is a Japanese word combining tsu (津) meaning port and nami (波) - wave(s). Literally, tsunami means "port-wave", a term used by the Japanese fishermen who could not observe any phenomenon at sea, but found their cities ravaged on their return to the port. The first occurrence of the word tsunami can be attributed to the Sanriku earthquake of December 1611[12]. In Japan, it was widely recognized that tsunami were associated with earthquakes. Various other terms such as *onami* (large

9 Katsonopoulou 2005.
10 Ambraseys 2005.
11 Cartwright - Nakamura 2008.
12 Cartwright - Nakamura 2008.

wave), *takanami* (high wave), *oshio* (large tide), *takashio* (high tide) or *kaisho* (roaring and resounding sea) were at times employed in Japanese. There was sometimes confusion in Japanese between tsunami and other phenomena producing large waves, flooding and destruction. However, the abundance of tsunamis in Japan alongside their clear association with earthquakes probably accounts for the recognition of tsunamis as a distinct phenomenon there and the variations in terminology reflect the complexity of the high-energy deposits associated with them[13].

3. Tectonic context of the Mediterranean

The Mediterranean occupies the convergence zone between three major tectonic plates, Africa, Eurasia and Arabia[14]. The result is a complex network of plate tectonic structures, most notably two major subduction zones in the western Mediterranean Sea (Calabrian arc subduction system) and the eastern Mediterranean Sea (Hellenic and Cyprus arcs subduction system). Seismic activity is strongly linked to these tectonic features, and because earthquakes often generate tsunamis, it is logical that the distribution of palaeo-tsunami sources mimics the seismotectonic trend (fig. 1)[15].

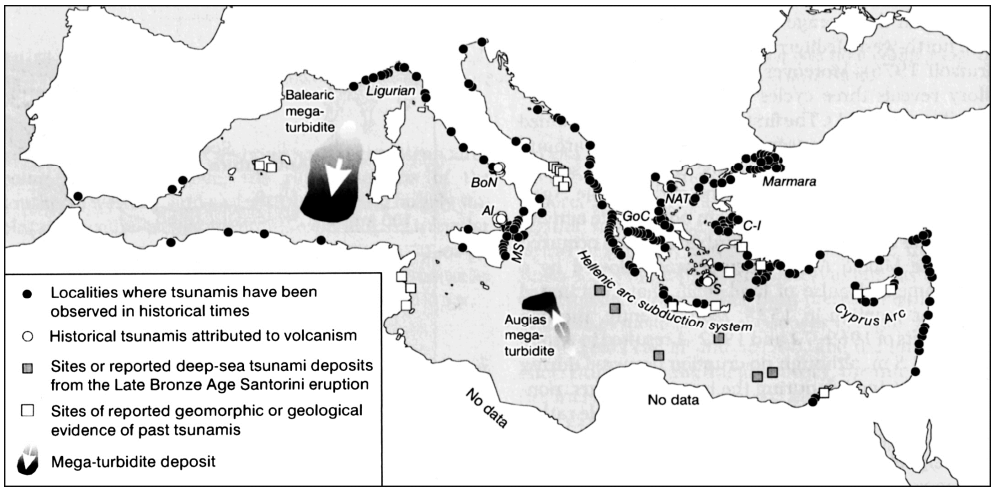

Fig. 1 - Tsunami activity and plate tectonics in the Mediterranean Sea. Historical data compiled by Stewart and Morhange (2009).

13 Shanmugan 2006.

14 McKenzie 1970; 1972; Billi *et al.* 2011; Jolivet *et al.* 2012; and references therein.

15 Tinti *et al.* 2005; Stewart - Morhange 2009.

Additionally, volcanic-induced tsunamis affecting the Tyrrhenian and Aegean seas, the steep-active margins of the north-western Mediterranean basin, the Levant passive margins and the Nile Cone, all mean that submarine slumps are potentially commonplace. The Mediterranean basin is thus listed as an area prone to earthquakes and tsunamis[16].

4. Bibliometric, a 'tsunami of tsunamis'

Bourgeois[17] analyzed the history of peer-reviewed articles, mainly in English, written about geological investigations of tsunami impacts. Her research included publications in the GeoRef and Web of Science databases, excluding papers dealing with tsunami sources. Bourgeois stresses the fact that until the Sumatra tsunami of 2004, a skeptical geological community commonly doubted works on traces of tsunamis, while some scientists argued that tsunamis do not leave deposits! Until the late 1980s, accounts on tsunamis were mostly restricted to isolated post-disaster reports[18].

Figure 2 shows that the literature on that topic expanded in the 1990s, largely spurred by a number of damaging tsunamis that occurred in the Pacific area (e.g. 1964 Alaska tsunami). That expansion also included seminal publications[19].

Scheffers and Kelletat[20] published a review of sedimentological and geomorphological tsunami imprints worldwide (fig. 3). They insisted that merely 5% of the publications spanning the past 50 years focus on the tsunami imprints left on the coastal landscape, highlighting the deficiency of reliable field evidence of tsunamis[21]. Most research was dedicated to tsunami-generating mechanisms and their dynamic modeling. This field of research has continued to expand, especially following the 2004 Sumatra tsunami. Using the Scopus database, Sagar *et al.*[22] estimated that up to ca. 1000 articles where published on the topic in 2005 and were most frequently cited as "a result of Indonesia's tsunami" (fig. 4).

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16 Salamon *et al.* 2007, in relation to the eastern Mediterranean sea.
17 Bourgeois 2009.
18 Engel - Brueckner 2011.
19 Atwater 1987; Dawson - Long - Smith 1988.
20 Scheffers - Kelletat 2003.
21 Dominey-Howes - Humphreys - Hessse 2006.
22 Sagar *et al.* 2010.

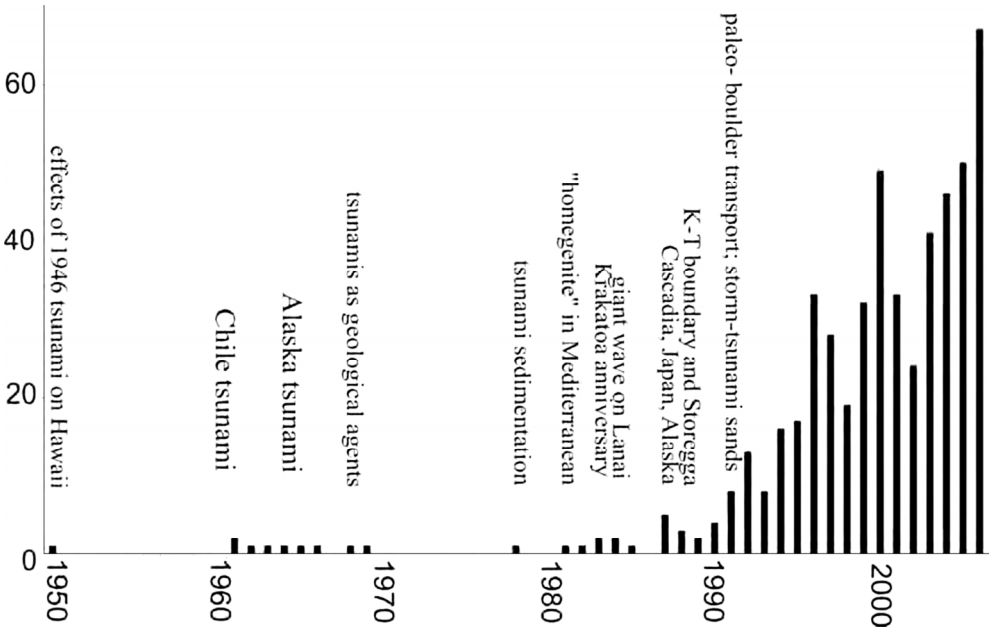

Fig. 2 - History of peer-reviewed articles on tsunami geology including government publications, based primarily on GeoRef and Web-of-Science databases. Non-English language articles are underrepresented (after Bourgeois 2009).

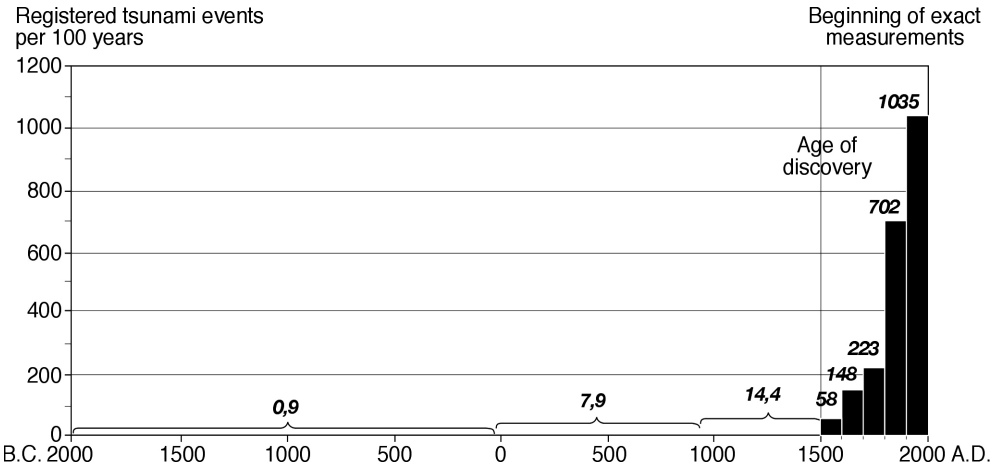

Fig. 3 - Temporal distribution of 2341 tsunami events listed in the database of the National Geophysical Data Center, USA. The database contains the events of the past 4000 years until 2001 AD (after Scheffers - Kelletat 2003).

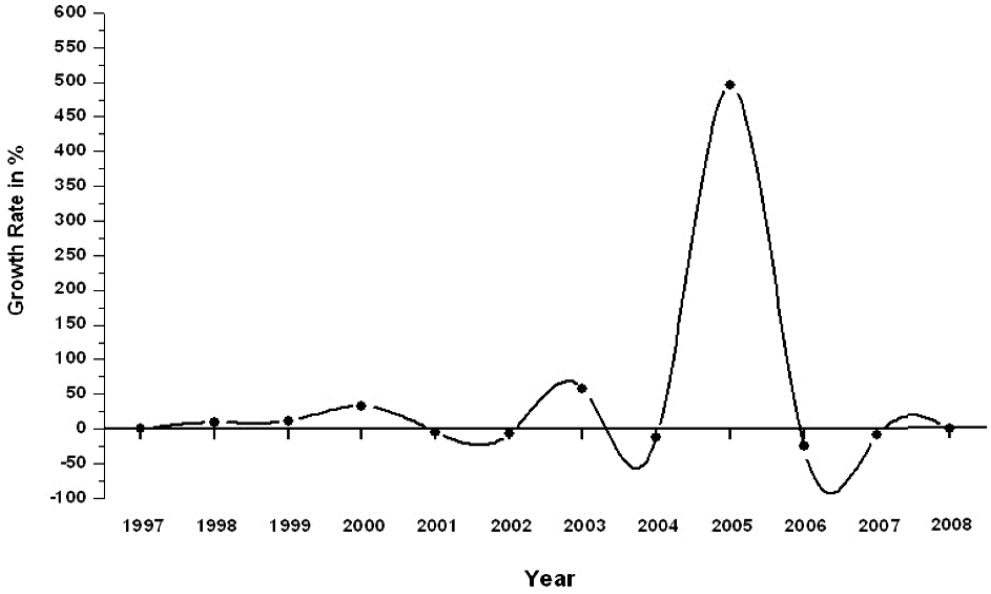

Fig. 4 - Growth rate of tsunami publications between 1997-2008 in Scopus data base (after Sagar *et al.* 2010).

In 2010, Marriner *et al.* also used the Scopus database to explore catastrophy-related keywords between 1950 and 2009 (fig. 5). First, the authors observed an exponential rise in neocatastrophic research from the 1980s onwards. Second, they argued that neocatastrophism became prominent in North America in the 1960s before being more widely espoused in Europe, essentially after the 1980s[23]. In many cases, the authors established a discernible offset between catastrophic terms coined in North American literature and their uptake in Europe. By contrast, since 2000 the uptake and assimilation of the term "tsunami" was simultaneous across different languages[24].

We have previously ascribed the rise of neocatastrophism in geoscience to at least three main factors[25]:

(1) geoscience is an applied discipline that has become critical in explaining, predicting and minimizing the impacts of natural hazards. It is hoped that increasing geological research will increase the ability to predict

[23] Marriner - Morhange 2013.
[24] Marriner - Morhange - Skrimshire 2010.
[25] Marriner - Morhange - Skrimshire 2010.

and warn of catastrophes and thus mitigate, if not prevent, the loss of human life and property[26];
(2) inherited geoscience thinking: from its origins through to the present day, one of geology's defining concepts has been the characterization of unconformities, be it in the traditional stratigraphic sense[27] or from the standpoint of sequence stratigraphy. In a way, the record of catastrophes closely mirrors scholarly focus on stratigraphic boundaries[28];
(3) the advent of radiometric dating techniques: the democratization of isotopic chronologies since the 1990s has allowed researchers to accurately date geological events[29]. The replacement of relative stratigraphies by an absolute time scale is a key to the proliferation of neocatastrophism in geoarchaeology, because it helps to constrain the timing of the studied events. This technological progress not only stimulated a growth in this research area, but also reinforced the scientific validity of neocatastrophism as a robust, evidence-based paradigm.
Four examples of tsunami impacts described below will allow us to better understand this hypothesis.

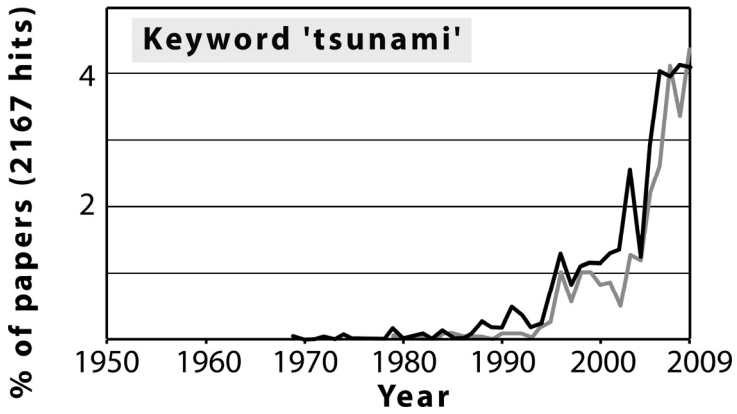

Fig. 5 - Keyword "tsunami" for the period 1950-2009. Source: Scopus, earth and planetary sciences. USA & Canada (black line), France, Germany, Italy & UK (gray line) (after Marriner - Morhange - Skrimshire 2010).

[26] Bryant 2005.
[27] Hooykaas 1959.
[28] Ager 1993.
[29] Allègre - Manhes - Gopel 1995.

5. Case studies

5.1. *Neolithic Atlit-Yam and the speculated fate of Neolithic communities around 8000 years ago*

The destruction of Atlit-Yam is an excellent example of media abuse. In a recent paper, Pareschi *et al.*[30] suggested that a tsunami generated by the collapse of the Etna volcano around 8300 years BP destroyed the Neolithic village of Atlit-Yam on the Carmel coast (Israel). In an interesting comment, Galili *et al.*[31] were not against the 8300 Etna tsunami but questioned its impacts along the Levantine coast. They asked why, despite the tsunami that was claimed to destroy the village around 8300 years BP, the settlement exhibits an uninterrupted sequence of occupation from ca. 9400 years BP to 8000 years BP. Moreover, the deposits recovered from the upper parts of the ancient wells, containing a mixture of consumed animal bones and cultural material, are typical of debris associated with human activities and do not represent debris introduced by a tsunami[32].
Indeed, the destruction of the Neolithic village by the 8300 BP Etna tsunami "finds no support in the archaeological, anthropological, faunal, botanical or sedimentary record from the site"[33]. For the archaeologists, the abandonment of Atlit-Yam ca. 8000 years BP clearly relates to well-documented global and progressive sea-level rise that submerged the site and forced the population to migrate further inland[34].

5.2. *Late Bronze Age Santorini tsunami and speculated collapse of Minoan "civilization" around 1600 years BC*

One of the main Mediterranean centers of explosive eruptions is located in Santorini, and the eruption of the Thera volcano during the Late Bronze Age (ca. 1600 years BC) is considered to have been the most significant episode of Aegean explosive volcanism during the late Holocene[35]. Recent studies by Dominey-Howes (2004) and McCoy (2009) focused on "understanding the sequence of geological events that characterized the eruption, that led to and followed the explosion, as well as the possible impact of the catastrophe on surrounding cultures", and concluded that

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30 Pareschi - Boschi - Favalli 2007.
31 Galili *et al.* 2008.
32 Galili *et al.* 2008.
33 Galili *et al.* 2008.
34 Galili - Zviely - Weinstein-Evron 2005; Galili - Rosen 2011.
35 Friedrich *et al.* 2006.

numerous tsunamis might have been produced during most of the stages of its volcanic activity and caldera collapse.

The impact of the Late Bronze Age eruption of Santorini has been the focus of considerable research, yet despite the high magnitude of the event and the location of the volcano, it is still debated if the eruption significantly disrupted the cultural trajectory of the peoples of the Aegean and eastern Mediterranean. Since the seminal publication of Marinatos[36], claims for the important impact of the eruption have been considerable[37]. Marinatos was the first to suggest that the eruption was followed by a great tsunami which swept away the Minoan empire! In a less univocal text, Driessen[38] writes that "the eruption served as a catalyst, provoking changes that drastically altered the face of both Minoan Crete and the Bronze Age Aegean, and ultimately paved the way for the Hellenic civilization".

While within the Aegean Sea the Late Bronze Santorini tsunami most probably had a great impact, in accordance with field evidence suggesting seawater inundation at some archaeological sites along the northern coast of Crete[39], no reliable land-based geological evidence was found so far to support an eastern Mediterranean basin-wide tsunami[40]. Interestingly, model simulations[41] show that the tsunami waves attenuate significantly while passing through the Hellenic Islands on their way out into the Mediterranean.

In conclusion, all the geological evidence for the Late Bronze Santorini event points towards a high-energy event[42], yet the sedimentological imprints along the Aegean coasts indicate that the associated tsunami cannot solely explain the so-called disappearance of the "Minoan civilization". Beyond the Aegean Sea, however, the limited land-based tsunami evidence for the Santorini tsunami in the far field[43] is not in accordance with such an assumed catastrophe. Certainly this event needs further investigation before concluding its societal impact within and beyond the Aegean.

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36 Marinatos 1939.
37 Antonopoulos 1992; Driessen - Macdonald 2000, among others.
38 Driessen 2002.
39 Bruins - van der Plicht - Mac Gillivray 2009.
40 Dominey-Howes 2004.
41 Ward, UCSC, 2013, http://es.ucsc.edu/~ward/sant-tsu-ps-nn.mov.
42 McCoy 2009.
43 Possibly Goodman-Tchernov *et al.* 2009.

5.3. *Tsunamis in Alexandria's ancient harbour (Egypt)*

It is generally assumed that ancient harbours can act as sedimentary traps for palaeo-tsunamis[44].

In Alexandria, it appears that during the last 2000 years at least six tsunamis are historically documented (23 BC, 365 AD, 1303 AD, 1759/11, 1870, 1908?)[45]. To date, no sedimentary evidence exists for the 365 AD "universal" catastrophe in the harbour basins[46]. Two hypotheses must be considered to explain the apparent absence of deposits left by the tsunami of 365 AD:

(1) an error of geographical location is one possible option supported by Goiran[47], who found a continuous harbour facies apparently exhibiting no high-energy perturbation. Some authors argue that the reference to the 365 AD event in ancient texts does not refer to Alexandria in Egypt but to Alexandria Troas in Asia Minor[48];

(2) maintenance dredging might have removed traces of the tsunami deposit from the sedimentary archive[49].

Only Stanley and Bernasconi[50] seem to have found discrete traces of the 365 AD tsunami in drillings from the eastern bay of Alexandria, where they documented association of distinct biological biocenoses, with failed slump-like sediment strata, and important hiatuses that could have recorded the 365 AD event.

Whatever the reasons for the apparent absence of the 365 AD tsunami in the sediment archives, this example illustrates the complexity of studying tsunamis. Of course, the present lack of evidence for the 365 AD event cannot be considered as evidence for the non-existence of this event.

5.4. *Caesarea (Israel), from subtidal ballast to impacts of tsunamis, a moving interpretation*

In Israel, neocatastrophism seems to have particularly affected the study of the ancient harbour of Caesarea. This study is a good example not only because it was an archaeological site that was excavated using modern

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44 Marriner - Morhange 2007; Bony *et al.* 2012.
45 Guidoboni - Comastri - Traina 1994.
46 Jacques - Bousquet 1984; Stiros 2001; 2010; Guidoboni - Ebel 2009.
47 Goiran 2001; 2012; Goiran *et al.* 2005.
48 Soloviev *et al.* 2000.
49 Marriner - Morhange 2006.
50 Stanley - Bernasconi 2006.

multidisciplinary techniques[51], but also because neocatastrophism was introduced in its associated research themes. An account of the problems can be summarized in two stages.

Firstly, a neotectonic theory was developed by Mart and Perecman[52]. These authors claimed evidence for neotectonic activity in the ancient harbour of Caesarea, where large Herodian breakwaters are now submerged at depths of 5-8 m below present sea level, whereas other contemporary coastal installations in the same area remain at sea level. In their opinion, high-resolution seismic reflection surveys showed a series of coast-parallel faults that displaced both the aeolianite, which outcrops along the coastal zone, and the submerged breakwaters. These supposed faults present offsets of 1-3 m, down throwing their seaward side and leaving their landward flank stable. Mart and Perecman suggested that neotectonic movement of these faults, accentuated by liquefaction, caused the subsidence of the ancient breakwaters. They recall Neev *et al.*[53] that heavily focused on coastal neotectonism and stated that neotectonic activity has shaped the coast of the southern Levant during the past 2000 years. This first "Yoyo" theory was rapidly contradicted by further geological[54] and geophysical work[55]. Gill, for instance, demonstrated that the seismic profiles show an original lithological contrast rather than faulted and displaced marker horizons. Moreover, Galili and Galili *et al.*[56] demonstrated that the subsidence of the western basin of the harbour is due to foundations on unconsolidated sediments. Thus, the "subsidence" of the Roman moles can be attributed to underwater scouring, possible liquefaction and erosion which removed sands from under the moles rather than neotectonics.

Secondly, a theory invoking the impact of the 115 AD tsunami was developed[57]. Relying on underwater geoarchaeological excavations on the shallow shelf, they point to a tsunami that damaged the ancient harbour at Caesarea. They rely on the high-energy deposit which consists of a 0.5-m thick bed of reverse-graded shells, coarse sand, pebbles, and pottery deposited over a large area outside the harbour. The lower portion of the deposit was composed of angular shell fragments, and the upper portion of

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51 Raban 2009.
52 Mart - Perecman 1996.
53 Neev - Bakler - Emery 1987.
54 Sneh 2000.
55 Gill 1999.
56 Galili 1986; Galili - Sharvit 1998; Galili - Rosen 2011.
57 Reinhardt *et al.* 2006.

whole convex-up *Glycymeris* shells. Radiocarbon dating and optically stimulated luminescence dates constrain the age of the deposit to between the first century BC and the second century AD and the probable cause of the harbour destruction.

In 2009, the same research team[58] published another article wherein they identify three further tsunami events: (i) 1500 years ago; (ii) 2000 years ago and (iii) ca. 3500 years ago. This horizon is attributed to tsunami waves produced during the Late Bronze Age eruption of Santorini. Particle-size distribution, planar bedding and shell taphonomy hypothetically differentiate it from normal storm deposits.

Examining the historical sources, there is no positive record of any tsunami that struck Caesarea in 115 AD, except an interpretation of vague accounts made by Shalem[59] that was later taken for granted by researchers as a fact[60]. Coarse sediment deposits that were previously considered to be ballast or storm deposits inside harbour basins are now reinterpreted systematically as tsunami deposits. Moreover, from an epistemological point of view, it is interesting to observe that analysis of the same bio-sedimentological proxies and facies can produce diverging conclusions without evoking tsunamis. For example, in 1999, Reinhardt and Raban[61] provided an alternative explanation for the harbour's destruction linked to seismic activity (under the influence of the work of Mart and Perecman?), but also by silting within the inner harbour that allowed this area to be used in a limited capacity. In any case, this evidence was presented to the readers as a definite tsunamite, leaving no space for uncertainty, and thus entering the neocatastrophic dogma.

6. Understanding the intellectual context

Since Schaeffer's pioneering neocatastrophic interpretations, natural hazards have been frequently evoked to explain the demise of ancient societies[62]. Present research, including geoarchaeology, is being transformed by three cultural agents to adapt to shifting socio-political demands, a central tenant of which is the mitigation of natural hazard:

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58 Goodman *et al.* 2009.
59 Shalem 1956.
60 Salamon *et al.* 2007; 2010.
61 Reinhardt - Raban 1999.
62 Jusseret - Sintubin 2013.

(1) the internet revolution has led to global research and standardization of evaluation methods and almost literally an access to every person in the world to every single scientific publication. It has brought about a disintegration of national schools of thought, long hampered by language and communication barriers;
(2) scientific production and the quest for "broad audience" science with the development of bibliometry during the 1960s. Marriner *et al.*[63] suggested that the quest for high-impact research has played a role in the development of neocatastrophism. Pressure on scientists to publish in high-impact journals means that neocatastrophism is a particularly rewarding area of the sciences. Current emphasis on citation indices to gauge scholarly production has further accentuated this trend. The "shock doctrine" appeals to a broad readership. This trend has been exacerbated by increasing difficulties in obtaining research grants in a world perceived as increasingly vulnerable. The politics of high-impact journals is particularly revealing. These publications are in the hands of full-time professional editors, invariably with a PhD background in their field of expertise, but nonetheless holding the function of a journalist with a media agenda. It is suggested that discourses of "shock" and "fear" correspond to a media-driven dramatization of natural and anthropogenic hazards, exploited to attract wider readership;
(3) cultural frameworks. The heightened public perception of large-scale coastal disasters is significant in framing public consciousness of catastrophes. Public and academic prioritization of catastrophes is premised not only upon access to knowledge of their occurrence, but their all-pervasiveness in mediatised social discourses. As already stated by Marriner and Morhange[64], public and scientific discourses on natural disasters routinely use a familiar repertoire of "catastrophic" vocabulary and the word "tsunami" became a common metaphor.
This is not to say that all the aforementioned agents are negative. The world has suffered several real disasters and the scientific community as well as the public and the media have been trying to learn from the past in order to minimize the potential impact of future catastrophes. It is the bad practice, superficial performance, biased interpretation and abuse of the scientific and media platforms that drags authentic research into neocatastrophism.

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[63] Marriner - Morhange - Skrimshire 2010.
[64] Marriner - Morhange 2013.

7. Conclusion

Ambraseys[65] suggested that "the reason for the revival of catastrophe hypotheses is perhaps that they are easy to explain. They are too simple, too obvious, and too coincidental, particularly when they are based on inadequate or biased historical evidence and also because they have become fashionable in recent years. If the solution to a problem is not immediately obvious, a catastrophe theory, which attracts considerable publicity, can account for it".

Multidisplinary data demonstrates that the demise of ancient cultures is usually a gradual process, spanning decades and centuries. Critical analysis of geomorphological, sedimentological, archaeological and chrono-stratigraphical data clearly shows that attributing ancient coastal destruction to tsunamis is at least partly speculative, as it was exemplified earlier in this work. This of course is not to say that tsunamis are not potentially destructive[66].

Despite the popular paradigm, which directly associates natural catastrophes with past human disasters (e.g. climate aridification and the collapse of civilizations)[67], closer examination of speculated palaeo-tsunamis often reveals a different story. It illustrates the complex nature of the relationship between coastal societies and high-energy processes and suggests that catastrophes may sometimes act as a stimulus rather than a hindrance to cultural development[68].

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65 Ambraseys 2005.
66 Bony *et al*. 2012.
67 Weiss - Bradley 2001.
68 Morhange - Marriner 2010; Stefanakis 2010; Leroy 2013.

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