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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Paleotsunami deposits along the coast of Egypt correlate with historical earthquake records of eastern Mediterranean" *by* Asem Salama et al.

Asem Salama et al.

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Please find attached the reply to RC1 (R. Paris), RC2 (P. Costa) and RC3 (C. J. Dabrio Gonzalez) on our manuscript nhess-2018-62 titled "Paleotsunami deposits along the coast of Egypt correlate with historical earthquake records of eastern Mediterranean.

We are grateful to all three referees that helped us to clarify our text and figures and improve the presentation of our article. All comments, remarks and questions of each referee (and related annotations in manuscript) are addressed in our revised version (see underlined sections in article) and a detailed answer has been prepared in order to clarify the article (see attached sheets).

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RC3 (C. J. Dabrio Gonzalez) consist in remarks and questions added directly in the annotated manuscript (in a separate file). The referee asked for many detailed explanations that helped in the text and figure clarifications. Among them, the Bayesian analysis of data that provide a useful probability density function for the inferred ages of past tsunamis, and that allows a more correct correlation with historical catalogues.

All answers to comments and remarks of RC3 are here below:

Reply to RC3, Review of Cristino Jose Dabrio Gonzalez

Section 1 main comments

Comment #1: Line 81,Yalciner et al. (2014) estimated that up to 500 km3 landslide volume, with wave height ranging from 0.4 to 4 m, might have taken place offshore the Nile Delta. When? Reply These results are based on modelling outputs of Yalciner et al. (2014), but there is not enough measurements to emphasize the tsunami landslide offshore the Nile Delta until now. Line 80-82.

Comment #2: Lines 87 to 96, is this relevant for the Mediterranean examples? Reply It appeared to us important to show some significant worldwide paleotsunami studies. As for the Mediterranean, beside the study in Sicily (de Martini et al., 2012), we add examples of paleotsunami studies in Crete (Minoura et al., 2000), Turkey (Papadopoulos et al., 2012) and in Israel (Tyuleneva et al., 2017), in lines 102 - 108.

Comment #3: I could not locate it in the massive figure (earthquakes 1303)? ⇒ comment in line 132 Hardly visible figure 1⇒ comment in line 160 The areas symbol not visible Reply Figure 1 is updated with star symbol to clarify the location of historical earthquakes

Comment #4 Line 138, what do you mean with felt shaking? Reply Felt earthquake shaking

Comment #5 Line 164, the dunes are weathered where the rocky headlands outcrop What is meaning? Reply Changed in “When the sand dunes are removed they leave

rocky headland outcrops" in line 175.

Comment #6: Line 211 the outlet of sea water not well indicated in figure 2 Reply Figure 2 is updated with an arrow to the outlet of sea water.

Comment #7: Line 227 to 235 If samples sent to 3 labs it is most likely that results are difficult to compare explain this. Did you try test sample to the three labs to check the accuracy of measurements? Reply A single sample only was sent to two laboratories (Poznan laboratory - Poland, CIRAM in France) in order to test the accuracy of dating and we received similar results.

Comment #8: Line 235, I think that this methodological approach deserves some more exploration or do you simply push some keys to get date? Reply The Bayesian method (conditional probability) included in the Oxcal program of Bronk Ramsey (2009) provides simulated ages that require an analysis of sedimentary sequence and preliminary stratigraphic chronology aided with a careful collection of datable samples. It is certainly not a "push-button" procedure.

Comment #9: Line 240, About Salama 2017 this is not a document that you can easily consult Reply The Salama (2017) PhD thesis dissertation is in the public domain and can be easily obtained at the University of Strasbourg Library.

Comment #10: Line 252, Contains broken shells of marine origin any idea of taxonomy Reply We characterize the size or quantity of broken shells that contribute to the identification of the high energy sedimentary layers, rather than to identify the shells themselves. We did not do the systematic taxonomy of broken shells.

Comment #11: Line 254-257, In the abstract, the authors agree that they interpret the coarse layers as tsunamigenic after studying a variety of features and analytical results... and here they just jump to this interpretation of landward decrease of grain size. I don't completely catch the idea. Please check ! Reply We here describe the landward decrease of grain size of the white sandy layer from Kefr Saber trenches.

This interpretative section is moved to discussion. Lines 553-555.

Comment #12: Line 273, Located ∼ 30 - 73 cm depth in all trenches P1 to P4 suggests clarify ? -30 and -73 or between -30 and -73 (43 cm in thickness) Reply Changed in "located between 25 and 55 cm depth in all trenches". Line 271.

Comment #13: a- Lines 281 to 285, the location of the boulder and its relation with cores provided or I missed it. Reply We did not do a correlation between boulders and cores. We only took samples from the boulders in the first site at Kefr Saber. We found no boulders at the second site (El Alamein).

Comment #13: b- Did Goff et al.,2012 find boulders with Dendropoma? Reply This is a mistake. We removed Goff et al., 2012, and moved the section to discussion. Now in line 519 – 528.

Comment #13: c- Are the storms able to displace and regulate large boulders even in platforms several meters above sea level? Reply We did not do yet a detailed work on boulders in the northern coast of Egypt, but other studies such as Nott in 2003 (Waves, coastal boulder deposits and the importance of the pre-transport setting. Earth Planet. Sci. Lett. 210, 269–276) and Maouche et al. (2009; with common coauthors) compare the effects on boulders from storms and tsunamis using wave height and boulders characteristics (size, weight, density).

Comment #13: d- . . . again the location and stratigraphic position of the boulders are unknown Reply The large boulders are found at many sites along the northern coast of the Egypt, and we noticed them during our field investigations in Ras El Hekma, Ras El Alam, Rum, Mersa Matrouh, and Kefr Saber. We have taken only one sample from boulders at Kefr Saber site. We add the geographic location of boulder in line 521

Comment #14: Line 303, if these are fragments, it means that they are broken shells/bioclasts highly broken ?? please explain what is mean ? Reply We describe the size of bioclasts and highly broken means rich with fragments.

Comment #15: Line 307, X-ray scanning shows some turbiditic structures. . .. Turbiditic structures in the lagoon. . ..identified by X-ray ? Reply Turbiditic current structures may result from strong waves. Turbulently suspended sediments form density current that can be observed in X-ray scanning such as inclined stratification with cross-bedding and ripup clasts observed in cores 8 and 12, respectively. Line 316. (Fig.S4 in Suppl. material)

Comment #16: Line 332, and the outlet of sea water has revealed three tsunami layers please clarify ? Reply The sea water inundated the coast in lowland between high dunes, which allowed tsunami waves to deposit the three layers. Lines 338 – 340.

Comment #17: Line 376, Is gypsum detritus or cement? Reply The gypsum is cement.

Comment #18: Line 339 to 348 the description needs a little rewriting of English. Reply Corrected for English syntax and grammar.

Comment #19: Line 500, What do you mean by loading structure? Reply Changed in loadcast sedimentary structure. Line 491.

Comment #20: Lines 517 to 522, are w,x,y and z convential names or simply reformal terms used by you during . . ..? I could not read the last word Reply Yes, the w, x, y and z are simple labels of chronological events.

Comment #21: Line 525-535: I don't see the need of this simulation. You have brackets of ages and correlate with the described phenomena. Reply The Bayesian simulation provides an age range with probability density function (95.4%), which is more appropriate than a simple bracket of dates.

Comment #22: Line 532: Which is the origin of that debate? I preformed that you refer to the location of the epicenter. Please explain !. Reply The debate is on the earthquake location, size and its tsunamigenic capability. See also lines 157 to 160 and related references.

Comment #23: Line 533, The tsunami happened ! there is no possible debate about

this fact ? Reply Yes, indeed it occurred, but the debate in only on the tsunamigenic earthquake location.

Comment #24: Line 537-550, If you are talking about your recently penetrated cores why do you mix with other people and localities that have nothing to do with the Eastern Mediterranean? (These are not your cores!!!) Reply Well noted. We remove text and references to Shi et al., 1995; Gelfenbaum and Jaffee 2003 and Goff et al., 2001, 2004. Lines 541 - 556.

Comment #25: Line 547, Why you simulate ages when you have dating. Reply See reply to comment #21

Comment #26: Line 567, What is the type of organic matter? Reply We refer to organic carbon.

Comment #27: Line 575 to 577, the succession of sudden high-energy deposits with low energy and slow sedimentation may include reworked units with a disturbance in their chronological succession. Explain? Reply Reworked units include disorder in the chronological stratigraphic succession. Line 614.

Comment #28: Line 580, Including charcoal and perhaps rodent bones? Obviously worst ages of high energy events are those from shells (marine). What is your reply? Reply We meant that the large uncertainties in dates result from 1) mixed deposits (reworking) and 2) different type of samples (charcoal, bones and shells) analysed.

Comment #29: Line 811, I cannot distinguish the size of scale for figure 3 Reply Figure 3 is updated.

Comment #30: Line 823, These are hands with pointing fingers! Reply The figure and legend are updated to leave arrows.

Comment #31: Line 832, Pdfs what is mean ? Reply Probability density functions

Comment #32: Lines 910-911, the aim of these figures is to show sites of trenches/drills

please use bigger characters to make them visible (Location, Orientation) Reply Figure 2 is updated.

Comment #33: Lines 917-919 (Figure 4), I'd suggest using BP age, as the traditional AD/BC is somewhat confusing. Then, the authors may return to AD/BC nomenclature to fit the more claimed pictures and view and add the middle line Reply The reason why we use AD/BC is because it can be easily compared with historical events in catalogues.

Comment #34: Lines 922 to 923, the numbers are invisible. Reply Figure 5a is updated.

Comment #35: Lines 926. Hard to read (not visible) Reply Figure 5b is updated.

Comment #36: Lines 932-934 (figure 7) (elevation above sea level and directions) Reply Figure 7 is updated.

Section 2: Comments of reviewers in the text changes in manuscript and the authors changes in text:

No. Lines edited Previous manuscript Revised manuscript New lines COMMENT 1 49 marine coastal lagoon 48 2 50 Shell shells 52 3 129 apart carried up apart and (or?) carried up 142 4 163 Fig.2 and Fig.3 Fig.2 175 Omit fig.3 5 165 ridge ridges 176 6 169 designated Likely 179 7 187 bivalve and shells bivalve shells 203 Bivalve also have a shell 8 187 the large number of mixed broken bivalve shells that occupy large vertical and lateral stratigraphic positions the large number of mixed broken bivalve shells that and gastropods occupy vertical and horizontal stratigraphic positions due to high wave current 202-204 C:clarify? R: done 193-194

9 191 than compared with 205 10 223 X-ray diffraction using Philips PW 1730 X-ray diffraction using a Philips PW 1730 measurement 240 11 226 magnetic susceptibility was measured for cores every 3 cm -120 samples were collected from cores for each 15 cm 233-240 C:Spacing of magnetic susce. And geochemical analysis R: done 12 238 description of trenches and cores sedimentary layers description of sedimentary

layers in trenches and cores with results of C14 dating 258 C: description of exposed trenches and cores penetrated in sedimentary layers R: We used suggestion from reviewer to add C14 dating to the title. 13 246 P1, P2, P3 and P4 are 20 to 40 distance P1, P2, P3 and P4 are 40 to 154 meters distance from shoreline 266 C: Distance to what? Request spacing between trenches? distance to dunes ridges R: I correct this lines 14 250 30-50 cm depth 25-55 cm below surface 271 I corrected the real depth 15 256 broke broken R: we omitted this sentence 16 259 display modern age yield modern age 276 C: The age is not displayed R: the sample are given modern from the laboratory result 17 261 100 cm depth below surface 278 18 263 collected charcoal samples charcoal samples collected 280 19 264 located recovered 281 20 264 depth below surface 282 21 268 between of 580 22 269 denotes of the deposit of reworked layers with in environment of young sedimentation in lagoon points to reworked of former deposits and redeposit on a lagoon. 581 23 281 Shells Dendropma Dendropoma (worm snails) 519-522 C:Does Dendorompa have a shell or is it a tube? R: Dendropma is a genus of irregularly coiled seasnails known as "worm shells" or "worm snails" we have two common species Dendropoma petraeum & Vermetus triquetrus 24 289 except except, 297 25 292 30 cm depth at ∼ 30 cm below surface 301 26 297 The core depth reached ∼2.14 m The core a depth of ∼2.14 m 305 27 298 From here the authors alternatively refer to coarse grained or to tsunami layers I changed here to high energy sedimentary layers 306 28 300 The first layer is ∼12.5 cm depth with 34.5 thick , brown clay sediments with poor sorting fine grain sediments The first layer is at ∼12.5 cm depth, ∼34.5 thick. It consists of poorly sorted brown clay, fine grained sediments 308,309 29 303 ∼75 m ∼75 cm 312 30 308 Shell Shells 317 31 311 40 cm depth 40 cm below surface 320 32 312 Shells fragments Shell fragments 321 33 313 The peak of magnetic susceptibility Low peak of magnetic susceptibility 322 34 319 as shown in core 2 is as shown in Fig.S2-2 323 35 321 two tsunami layers two penetrated tsunami layers 324 36 321 is 12 cm thick brown clay sediment is a 12 cm thick brown clay 325 37 325 with peak with low peak 329 Large / small peak? 38 326 components of halite amounts of halite 330 39 334 corresponding to 26 cm corresponding to a 26 cm 340 40

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336 with a peak of magnetic susceptibility near zero value with a low peak value 343 C: a peak at zero value? R:changed to low peak 41 337 depth below surface 344 42 339 45 depth and show 45 cm depth and have 346 43 354 The core reach 73 cm depth The core reach a depth of 73 cm 362 44 365 broken shells fragments bioclasts 373 45 366 gastropod gastropod shell 374 46 380 bad poor 388 47 381 aminor a minor 388 48 383 provides 293-1113 BC provides age 293-1113 BC 391 49 385 The first tsaunmi layer is 16 cm thick pale silty clay The first tsunami layer is a 16 cm thick pale yellow silty clay 393 50 386 highly broken shell fragments bioclasts rich 394 Perhaphs you use highly small pieces of shells clarify? i.e rich 51 390 highly broken shells fragments and badly sorted angular gravel sediments shell fragments and poorly sorted angular gravel-sized clasts 398 52 394 ahigh content of organic matter and ripsup clasts a high content of organic matter and ripup clasts 402 53 399 Bad granulometeric sorting Poor sorting 407 54 404 high current wave high current energy wave C: current / waves? R:we omitted this sentence

55 415 70 cm depth showing 70 cm below surface with an estimated age of 423 56 445 It is characterized by and poor sorting, high magnetic susceptibility It is characterized poor sorting, low magnetic susceptibility 452 How high the organic matter and gypsum? I changed this miswriting low instead high 57 454 high energy tsunami waves high energy waves 461 58 452 The fourth sample is off sequence with respect the other samples C: Beyond the readi of the C14 method!!.

R: It is comparison with trend of the other samples, it is 39560 -40811 BC. The C14 is 50000 years. 59 459 located $\sim$ 10 cm to 170 located from $\sim$ 10 cm to 170 cm 466 60 460 identified three or four tsunami layers Identified four high energy sedimentary layers 467 3 or 4?

61 462 broken marine shells bioclasts 471 62 468 as due to sedimentary units that include reworked material as a result of reworking of older rocks. 556-567 This part are moved to discussion. 63 480 show expose 470 64 481 sand mixed with broken shells fragments that sand with bioclasts. We assume that 471 65 486 are well visible coarse

are well visible as coarse 477 66 488 become fine landward become finer grained and thinner 478 C: Finer grained or thinner ? R: both 67 489-490 sedimentary units indicate that this layer suggests tsunami deposits rather than storm sedimentary units suggest that these layers are tsunami deposits rather than storm. 481 68 495 The presence of goethite and pyrite Goethite and pyrite 486-487 69 496 was were 487 70 500 The pebbles pebbles 491 71 501 Goethite and pyrite goethite and pyrite 492 72 504 shells fragments Shell fragments 495 73 506 Folk 1968 omitted 497 C:Do Folk refer to tsunamis? R: No, only refer the equations of grain size and sorting . so, I omitted the reference from here 74 512 The bracket to bracket 508 75 514 due to the reworked sedimentation with due to highly reworked sedimentation and significant mix of old 510-511 76 517 result in sequence of ages allow the bracket of an event results in a sequence of ages that allows to bracket of an event 513-514 77 525 The identification of tsunami deposits The identification of assumed tsunami deposits 531-532 78 551 reworked C: reworked marine but reworked to a certain extent ? R: It is difficult to obtain the different process result in . . . 79 553 reworked deposits intercalated with new units C: insitu or autochthonous R: autochthonous 80 555 distinguish between old and new isotopic C: with respect to what? R: respect to age of dated samples 81 559 indicate indicates 595 82 560 tsunamis tsunami 596 83 561 The first are large earthquakes with The first two events correlate with 597 84 562 The evidence the 365 tsunami The existence of the 365 tsunami 599 85 564 Stanely et al., 2006 Stanley and Bernasconi 2006 600 86 564 main recognized 601 87 567 value content 604 88 Organic matter organic carbon matter 604 89 568 There record of past tsunami deposits is The record of past tsunami deposits along Egyptian Mediterranean coastline 605 90 574 are is 611 91 575 Correspondence with AD 365 earthquake the correspondence one of them with the AD 365 earthquake 612 92 579 with the Could not read the comment 93 584 nearby radiocarbon dating C: of nearby radiocarbon dating R: it means respect to the arranged new radiocarbon dates samples 94 587 have a large thickness is thicker 619 95 809 where? I add here at El ELAlamein site 876 96 811 dimensions panorama 878 97 812 flag flags 879 C:there are two of them

Notes: In annotated manuscript, - Page 14, 3 comments in lines 349 to 359 are hard to read (not visible) - Line 579 comments cannot be read.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-62/nhess-2018-62-AC3-supplement.pdf

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