Posters – Abstracts

Holocene turbidite records off 2 margins segments of Algeria

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In the frame of the ASTARTE Project, we have developed a comparison of turbidite time series both in the Cheliff and in the Algiers offshore domains, searching for the recurrence intervals (return periods) of paleo-earthquakes and their link to tsunamis in the Holocene and beyond. We have used a consistent dataset of sediment cores collected between 2003 and 2007. A sedimentological and stratigraphic approach was performed on the most distal sediment cores of the area and on most complete proximal cores. The age model obtained is based on radiocarbon dating and measurements of oxygen stable isotopes on planktonic foraminifera collected from the hemipelagites interfingered with the turbidites.

The 2 segments of the Algerian margin off Chelif (West) and off Algiers (East), distant of about 200 km, show different time series and recurrence intervals; however, mean recurrences of wide-extent turbiditic events are similar (about 600-700 years) over the last 8-9 ka. The cycles are irregular in both cases, with short and long periods between events. The differences of cycles between both segments likely result from a variable distance of the sources of 6.5<M<7.5 events from zones of sedimentary instabilities at the slope break. Not all large earthquakes near the coast induced a tsunami, for which the area has a moderate potential; however, moderate to large tsunamis are expected, threatening the northern coasts of the Western Mediterranean Sea. We also notice that the main historical events over the last 700 years have clearly triggered large turbidity flows, and a good part are linked to reported tsunamis of moderate importance.

Tsunami evacuation exercise in Heraklion test-site

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The performance of tsunami evacuation exercises is an important component of the preparedness actions. During 2016 we designed and contacted a prototype evacuation exercise with the involvement of 30 volunteers and based on technological tools and processes which included: (1) simulation of a worst-case scenario and determination of the inundation zone, (2) the evacuation from three pre-defined coastal spots was initiated by sending SMS messages to the volunteers, (3) the evacuation route followed by each volunteer and the time needed to arrive in safe places was tracked with personalized GPS trackers, (4) the theoretically optimum routes and times needed to arrive in a pre-defined shelter were calculated with the use of the Road Graph Plugin of QGIS, (5) to evaluate the evacuation performance the theoretical and real times and routes followed were compared. Such a field exercise was organized in Heraklion, Crete Isl., Greece, on 12 April 2016. The test-area is part of the Hellenic Arc which is the most active geodynamic structure in the Mediterranean. Large earthquakes and volcanic eruptions triggered tsunamis that hit Heraklion in the past, such as in

17th century BC (Minoan volcanic event), AD 365, 1303, 1650 and 1956. The Minoan tsunami was selected as the worst-case scenario. The team of 30 volunteers was divided in 3 groups of 10 people each and gathered in 3 coastal spots of Heraklion situated ~400 m apart each other. Everyone was equipped with a mobile phone and a GPS device. Immediately after receiving in their mobile a tsunami warning SMS message the volunteers set on their personal GPS tracker and started evacuating on the best way they believed to do so. In each group, only 5 out of 10 volunteers were notified beforehand that the Eleftherias Square, located inland at distance satisfying evacuation needs for the selected scenario, would be a good shelter to go. Using QGIS we mapped the shortest path distances which found equal to 800, 700 and 680 m. Adopting average evacuation velocity of 3 km/h we found that these distances can be covered within 18, 16 and 15 min, respectively. The routes towards the settlement spots as well as the times needed to arrive there by the 30 volunteers were recorded by their personal GPS trackers. Processing of the GPS tracks and their comparison with the theoretical routes and times showed good evacuation performance which is encouraging for the next phases of the Heraklion tsunami hazard mitigation programme.

Searching for tsunamis evidence on the southern Portuguese continental shelf sedimentary record

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Tsunami onshore evidences are widely recognized all over the world. Contrarily, the knowledge of tsunami and paleo tsunami backwash deposits in continental shelf remains very poorly explored. The investigation of such records is crucial to better understand tsunami spread and consequences, to provide information a probabilistic estimation of tsunami occurrences and to improve hazard assessment.

The study was dedicated on some pre-existing cores (3) from the POPEI project (FCT-POCTI/MAR/55618/2004), and one year after on MOWER cores (3), collected in a Spanish cruise where one of the ASTARTE members was participated. These cores are located in the continental shelf off Quarteira-Tavira, in the Algarve, south Portugal.

The methodology included XRF, MSCL, sedimentological (grain-size, carbonates, organic matter) and magnetic analyses (magnetic susceptibility (χ_{lf}), anhysteretic remanence (ARM) among others)

While some of the data is still being processed and analyzed, the present-day data do not clearly put in evidence any clear tsunamigenic event in the offshore sedimentary record. However, based on the variations in grain-size, XRF and magnetic parameters results, we've tried to discriminate some levels defined by more or less marked grain-size analysis variations (increase or decrease in grain-size), by the increase of terrigenous proxies (Fe/Ca and Si/Ca) or detrital source proxies (Si, Zr, Rb, Al, Fe and K) in XRF data and in magnetic mineral phases we've considered variations in several environmental magnetic parameters and their ratios along cores depth.

Based on these proxies, 26 "anomalous levels" were identified, 13 of which have anomalies of all three proxies (Sed, XRF, mag). These may correspond to high energy events, with

characteristics that we would expect from tsunamigenic events. Some of those are coincident in the three proxies (Sedimentology, XRF and Magnetism) and based on the available Pb210 and C14 data we've tried to date the selected levels. In 4 cores (all the Mower cores and in the 2-1CGP POPEI core), an age interval comprehending 1755 AD (the age of the Lisbon earthquake and tsunami) was identified, thus suggesting that these anomalous levels may correspond to a high energy event associated with the 1755 tsunami.

Development of Local Amplification Factors in the NEAM Region for Production of Regional Tsunami Hazard Maps

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The standard way of estimating tsunami inundation is by applying numerical run-up models. However, for a regional Probabilistic Tsunami Hazard Assessment (PTHA), applying inundation models may be too time-consuming. A less accurate but fast procedure, is to relate offshore near-shore surface elevations to maximum inundation heights by using amplification factors. These are based on the characteristics of the incident wave and the bathymetric slope. Here, we present a study where the amplification factor takes into account the local bathymetric profiles, and apply the technique for the NE Atlantic, the Mediterranean, and Connected Seas (NEAM Region). For each bathymetric transect, we compute the wave amplification from an offshore point to a point close to the shoreline using a linear shallow-water model for sinusoidal pulses of different period and polarity, and tabulate the amplification factors. We then demonstrate how the amplification factor method can be convolved with PTHA results to provide regional tsunami hazard maps. Finally, we demonstrate how the maximum inundation heights using the amplification factors can be validated and adjusted for bias, through comparison with results from inundation models.

Very low cost high frequency tide gauge: The Rotary Tide Gauge - Tsunamis, meteotsunamis / seiches, harbor oscillations, waves/swell and tide observations

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The Rotary Tide Gauge (RTGHF) develops the classical Tide Pole into a loating rotary barcoded cylinder coded in parallel multiband. This solution (patented RTGHF provides a direct reading of sea level, while modern tide gauges measure with intermediate methods (ie., radar, pressure, ultrasonic, bubbler and laser). To the best of our knowledge, some patents describe solutions through barcodes for non-agitated liquid environments and groundwater (calm water) where for instance pulley/counterweight and/or stilling well (orifice, filter and chamber) are used. Our solution (through the rotary system) is very adapted to agitated oceanographic environments (ie., waves/swell, harbor oscillations, seiches and tsunamis), and the levels and high frequency oscillations are read very easily. Moreover, RTGHF is also able to calibrate other tide gauges measuring through intermediate system (pressure, ultrasonic, radar, bubbler, laser, etc).

Black Sea tsunamis - monitoring and warning

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The Black Sea surrounding countries had been affected by tsunamis in the past, 22 events are described and documented by different authors, triggered by earthquakes and/or landslides. As a summary, 9 were generated in Crimea region, 4 in Bulgaria region, 6 in Georgia and Russia, and 3 in Turkey, with 2 of them generated by inland earthquakes. Only 3 of the 22 events are of uncertain source (landslide and/or earthquake). Twelve of these known events were generated in the 20th Century.

The National Institute of Research and Development for Earth Physics (NIEP) is the national institution for earthquakes and tsunamis monitoring, detection and warning, improving lately its researches regarding tsunamis in the Black Sea. As part of the routine earthquake and tsunami monitoring activity, the first tsunami early-warning system in the Black Sea has been implemented in 2013 and is active during these last years.

In order to improve researches regarding the tsunami phenomena and the probability of occurrence, both seismic and tsunami hazard assessment for the Black Sea area have been accomplished, using different data from past events and also some recent investigations. Moreover, a web portal (tsunami.infp.ro) for worldwide and regional tsunami monitoring was developed and implemented by NIEP, as a result of the involvements in numerous national and international tsunami related projects.

NIEP is using a total number of 114 real time stations and 2 seismic arrays, 18 of the stations being located in Dobrogea area, for monitoring the seismic activity of the Black Sea. Moreover, there is a data exchange with the Black Sea surrounding countries involving the acquisition of real-time data for 17 stations from Bulgaria, Turkey, Georgia and Ukraine.

For tsunamis monitoring and warning, a number of 3 sea level monitoring stations, 1 infrasound barometer and 7 GPS/GNSS stations are installed in different locations along and near the Romanian shoreline, being part of the tsunami warning system.

The seismic source parameters are used as first indicator of tsunami generation, as the basis for the initial tsunami warning decision. The warnings are based on seismic parameters generated by Earthquake Early Warning System (EEWS) and Antelope software as a real-time processing and acquisition system. Warning reliability is improved using sea level data from the nearest coastal tide gauge station, which are a secondary tool to confirm the generation of a tsunami.

The Tsunami Analysis Tool (TAT) software, provided by the Joint Research Centre (JRC) of the European Commission, was installed and is used for tsunami modelling, in order to set maximum possible tsunami waves that could be generated and to establish minimum magnitude values that could trigger tsunamis in the Black Sea area. In particular, more studies were accomplished for the seismic sources that could affect the Romanian shore. The closest and most dangerous area is Shabla, Bulgaria, with some particularities of the source as follows: past observed magnitudes > 7 and a recurrence period of 175 years.

New observatory technologies that monitor gas hydrate stability off Norway

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The Norwegian Margin off Svalbard bears massive gas hydrates that have been demonstrated to be metastable as a function of seasonal temperature variations. At the uppermost part of the continental slope, above the gas hydrate stability zone, various methane emission sites were previously detected as acoustic plumes in echosounder recordings. New investigations

interpret the gas emission by methane from hydrate decomposition due to an increase in water temperature of 1°C during the past 30 years, which causes a downward movement of the upper boundary of the gas hydrate stability zone by 38 m.

Albeit a natural trigger, the induced temperature changes may be similar in effect to those induced by gas hydrate exploitation using warm water, as is currently discussed by several parties with a severe interest in mining methane from subseafloor gas hydrates. In order to assess the amount of gas that may be released even from moderate increase in temperature, cruise MSM57 with German RV Merian drills double boreholes using the mobile drilling sytem MeBo to sample hydrates for the first time in this area. Chemical analyses of the samples and physical parameters will be measured to define the phase boundary very precisely. This borehole based monitoring technology was supposed tob e developed in ASTARTE to collect crucial data concerning gas hydrate dissociation and sediment deformation processes. The aim is to assess the risk of slope failure as a function of gas hydrate dissociation (i.e. pore pressure increase) and could equally be exploited in EQ research where pore pressure is a proxy of co- and postseismic deformation.

The MeBo borehole observatories monitor pore pressure, temperature and tilt, which would be a good indicators for gas hydrate and sediment deformation processes as a pore pressure increase in the formation would mean methane release, increasing stress and pore volume reduction, or both. The observatory is hosted in the uppermost portion of the drill string, which remains in the hole after completion of coring. A buoyant unit containing an Iridium telemetry can be released from the observatory in ordert o transmit data or an alert independently, e.g. after a pre-programmed threshhold value (e.g. a certain degree of tilt or an anhanced pore pressure level) is exceeded. Such an early warning mechanism could be used in similar scenarios where geohazards occur. Its design was originally going to be deployed on the ASTARTE MeBo cruise on RV Meteor, which unfortunately got postponed repeatedly and is now sheduled for Jan/Feb 2018. The device is versatile, cost-efficient, and will be available commercially in case of demand.

The ASTARTE Mass Transport Deposits data base - a web-based reference for submarine landslide research around Europe

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Within ASTARTE a web-based data base on Mass Transport Deposit (MTD) in the NEAM areas is being created that claims to be the future reference source for this kind of research in Europe. The aim is to integrate every existing scientific reference on the topic and update on new entries every 3 months, hosting information and detailed data, that are crucial e.g for tsunami modeling.

A relational database managed by ArcGIS for Desktop 10.3 software has been implemented to allow all partners to collaborate through a common platform for archiving and exchanging data and interpretations, such as MTD typology (slide, slump, debris, turbidite, etc), geometric characteristcs (location, depth, thickness, volume, slope, etc), but also age and dating method and eventually tsunamigenic potential.

Modeling of tsunami waves and seismic source of the 1790 Oran earthquake and its impact in the Alboran Sea

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The 9 October 1790 earthquake (Io IX - X MKS) generated severe damage in the Oran city (western Algeria) accompanied by a tsunami that affected coastal regions of the Alboran Sea. According to contemporaneous reports, the mainshock occurred at 1 am and few minutes, and the city was devastated as well as nearby villages. 22 aftershocks were felt the first day and the aftershock sequence lasted for about 2 months. The earthquake caused more than 4000 victims (among 8000 inhabitants) and other 1000 victims and several injuries with a large number of homeless in NW Algeria.

Oran originally occupied by the Spanish in 1509 was freed following the seismic damage and destruction of the military fort, as well as due to the siege of the Algerian army (under the lead of Ben Osman, the Bey of Mascara region). The earthquake damage account has two main contemporary sources: 1) The Algerian chroniclers Ben El Bachir and Ben Sahnoun - also biographer of Ben Osman - who report on the Oran city and surroundings from 1790 to 1792, and 2) from the Spanish administrative and religious reports under the authority of the local governor Cumbre-Hermosa. Locally, the earthquake caused damage in the major cities of Tlemcen, Mascara and Mostaganem and was clearly felt in Almeria and Cartagena crossing the Alboran Sea. Some minutes after the earthquakes, waves affected harbors of the Algerian, Moroccan and Spanish coastline, and inundations were observed in Almeria and Cartagena regions.

Here, we test 3 seismic sources corresponding to coastal fault zones in the Oran region, estimate seismic moments and use NAMI DANCE program to generate tide gauges. The modelling of earthquake rupture is performed using a elastic half-space with uniform properties (Okada, 1992). The obtained wave propagation and height are compared to the tsunami characteristics as observed in Mostaganem, Mellilia, Almeria and Cartagena regions. Further research programs are prepared in order to evaluate the impact of such coastal earthquakes in present-day harbours. This work is presented in the frame of EU-funded project ASTARTE (Assessment, STrategy And Risk Reduction for Tsunamis in Europe).

Application of the tsunami simulations to a real time demonstrator

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The aim was to validate the multi-branch calculations using various tsunami sources. Our multi-grid scheme, chosen in the West Mediterranean Sea, includes target areas along the French coastline for which high resolution bathymetric data are available. This demonstrator aims at: (1) confirming whether simulations based on nested grids are suitable in operational context, (2) identifying the best strategy in terms of grid resolution, multi-branch configuration and computing resources.

We illustrate our study with computations for one Mw7.5 seismic source along the Algerian margin. Results in terms of calculation times vs number of processors and grid configuration (multi-branch or mono-branch) are presented for each studied coastal area.

Suitability of GPS technology for the CENALT purpose: Definition of optimum sensor locations

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The potential detection capability of the GPS technology is tested for the tsunami alert purpose in the West Mediterranean basin. Different scenarios of seismic sources along the Algerian margin and in the Ligurian Sea are considered, they are based on the fault database currently used at CENALT.
Results of this study show that only few surface deformations caused by offshore sources could be observed on land in the Algerian region. Hence, a GPS sensors network would be useful only on two specific coastal areas: between the West of Collo and the city of Skikda, and between the West of Chetaïbi and the city of Annaba. For the Ligurian region, the French areas prone to coseismic deformation related to marine sources are the region from Saint-Tropez to the Italian border, the North-East Corsican coast (around the city of Aléria) and the region of the Scandola natural reserve (West part of Corsica). For the Ligurian sources, the GPS measurements cannot always clear up the ambiguities between offshore and on land earthquakes. Hence, the epicenter localization is crucial. GPS calculations developed in this study require pre-registered fault parameters; their reliability so depend on the state-of-art on the fault mapping and description.

Complexity of earthquake rupture dynamics and tsunami hazard applications

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Heterogeneous static slip distributions have been shown to affect the characteristics and impact of the ensuing tsunami, especially for coastlines in the near-field of the seismic source. Stochastic source models offer a fast, effective way of producing heterogeneous slip distributions. Such models are based on an amplitude spectrum that represents the slip across a wide range of faulting types and tectonic environments. Large synthetic datasets of slip distributions can be generated in this way for hazard assessment procedures with the assumption that, on average, the probability for slip is uniform across the fault surface. However, for individual events, spatial complexities may generate preferential slip distributions depending, for example, on the nucleation depth, and enhanced slip towards the free surface.
To incorporate such complexities in hazard assessment we numerically model the rupture propagation along a Tohoku-like subduction interface. In a pilot study involving 500 simulations a simplified homogeneous medium, a slip weakening friction law and stochastic initial stress distributions were applied. We found that the resulting slip distributions are clustered based on whether the rupture reached the surface and on the earthquake's magnitude. We investigated this finding further by testing the sensitivity of the slip distribution to variation of the input parameters in the numerical model (i.e. frictional properties and elastic features of the environment media). Additionally, we used a heterogeneous elastic medium parameterized taking into account the seismic profiles available for the Tohoku region. A bi-material slip weakening friction law was employed that incorporated a non-instantaneous coupling between the frictional strength and the dynamic variation of the normal traction on the fault. The resulting slip distributions have been analysed in terms of size, duration and whether the simulated rupture is able to reach the surface. This analysis

showed that rupture favours propagation up-dip towards the trench due to the material contrast and interaction of the fault with standing waves from the free surface. A further complexity in our numerical simulations was the use of a friction law that accounts for the expected lithological variation from a clay-rich shallow environment to a rock-like environment at depth. By shifting the location of the asperities thrust earthquakes, mega-thrust earthquakes, and possibly tsunami earthquakes were produced.
Finally, a preliminary investigation between features observed in the above numerical simulations and inverted data for real events, is presented as a check on the reliability of the numerical modelling.

Seismicity rates inferred from neotectonic modeling

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In this work we aimed at quantifying the recurrence rates of the seismogenic structures along the Eurasia-Africa plate boundary from geodynamic constraints, i.e., caused by deformation rates imposed by plate tectonic motion. We first produced a neotectonic model for the region, to quantify the long-term deformation rates (slip rates on active faults and permanent strain rate in the continuum). Then we calculated earthquake recurrence rates from the obtained deformation rates. Special focus on the potentially tsunamigenic sources and areas was given.

Documentation of palaeotsunamis in Santorini Isl. from historical accounts and sediment deposits

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Volcanic eruptions in the island complex of Thera (Santorini), including the extra-caldera submarine volcanic edifice of Kolumbo, have taken a long historical record after the 17th century BC giant Minoan eruption which generated a large tsunami documented in eastern Mediterranean from tsunami sediment deposits and archaeological evidence. In AD 1649-1650 the Kolumbo eruptive activity concluded its paroxysmal phase in 29 September 1650 with a destructive tsunami in South Aegean islands including Perissa village in eastern Santorini as it comes out from documentary sources. In an archaeological section in Perissa we found two distinct sea sand layers of thickness ranging from 5 to 10 cm and interbedded in sediments consisting by Minoan pumice and tephra transported and deposited in Perissa due to erosion in the nearby limestone Mesa Vouno mountain. The archaeological ground level is occupied by graves of early Byzantine era (7th-8th century AD). The site gradually covered by the Mesa Vouno sediments and remained unknown until the soil was eroded by the large Kolumbo 1650 tsunami. The site is situated ~150-180 m from the present shoreline and at elevation of ca. 6 m. There is no doubt that the two sand layers post-date 8th century AD given that they overtop the ground level. The large seismic tsunami of 8 Aug. 1303 generated in Crete and well-known from historical documents that flooded large part pf the eastern Mediterranean basin, as well as the Kolumbo 1650 tsunami are candidate events to interpret the two sand layers found in Perissa. The 9 July 1956 seismic tsunami generated in the area is not likely a candidate since in

Perissa it penetrated inland no more than ~15-20 m. Extreme sea-level due to storm surges may not account for sediment deposition at such long distance and elevation from the sea level.

Fast characterization of moment magnitude and focal mechanisms in the context of tsunami warning in the NEAM region (W-phase and PDFM2 algorithms)

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Several large earthquakes (Mw ≥ 7.5) have been reported in the North East Atlantic and Mediterranean Seas (NEAM) region; however most of the tsunami potential seismic sources are in a magnitude range of 6.5 ≤ Mw ≤ 7.5. The CENALT, in operation since 2012 as the French National Tsunami Warning Centre and Candidate Tsunami Service Provider, has to issue warning messages within 15 minutes of the earthquake origin time. The Mw magnitude, the focal depth and the fault type are the most relevant parameters used to issue tsunami warnings. Two seismic source inversion methods are implemented at CENALT: the W-phase algorithm and the PDFM2 algorithm, based on the surface waves and first P wave motions. We assess both methods with 29 events of Mw ≥ 5.8 for the period 2010-2015 in the NEAM region. Comparison with the Global Centroid Moment Tensor catalog shows that the W-phase and PDFM2 algorithms give accurate results in 10 min and 20 min respectively.

Earthquake recurrence intervals from offshore paleoseismology in Ionian Sea

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The Ionian Sea (Central Mediterranean) is affected by strong historical seismicity often associated with tsunamis (e.g. - 1908 Messina M7.1, 1693 Catania M7.5). We performed stratigraphic analysis, identified micro-fossils and obtained radiocarbon dates in order to establish the chronology of turbidite deposits sampled in sediment cores. These piston cores, along with CHIRP echosounder profiles, were acquired during the CIRCEE survey, with R/V Le Suroit in October 2013, in the western Ionian Sea, including the western part of Calabrian accretionary wedge and the base of the Malta Escarpment.

Over the past 25 kyears our cores reveal 19 turbidite deposits that can be correlated across at least 2 cores. During the glacial period (22 - 10 ka) 10 turbidites are observed suggesting a recurrence interval close to 1000 years, whereas between 10 ka and 2 ka (1 AD) only 3 turbidites are observed, suggesting a much longer recurrence interval (or loss of deposits through erosion or a difference in the available sediment supply). This may be due to the influence of lower sea-level and higher supply of available sediment during the last glacial maximum (LGM) and during the ensuing period of rapid eustatic sea-level rise.

Towards Probabilistic Tsunami Forecast (PTF) in the NEAMTWS

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INGV

Tsunamis are strongly controlled by the focal mechanism and slip distribution of the causative earthquake. In some regions tsunami risk may be reasonably assumed to be dominated by thrust earthquakes occurring on specific subduction zone segments nearby. In these cases, the faulting mechanism of the causative earthquake can be assumed to be known in advance with a relative confidence and limited uncertainty. Even in such tectonic contexts there have been some exceptions though, with outer-rise or intra-slab tsunamigenic earthquakes occurring sometimes as a surprise. Several methods are being developed and applied worldwide and also within ASTARTE for the rapid estimation of the focal mechanism, or for the rapid source inversion based on seismic data, on GNSS data, or joint inversions. These methods are meant to be applicable before or in the absence of tsunami data availability for early tsunami warning.

Here, we present an alternative method under development, which combines a-priori information on the causative source zone with earthquake parameters assessed in near real time. The result is an ensemble tsunami forecast – analogous to that used by the meteo/severe weather community. Alert levels can be defined based on a chosen quantile of the ensemble describing the uncertainty in the forecast.

Extreme event archived in the geological record of the Japan Trench: New results from R/V Sonne Cruise SO251 towards establishing J-TRACK paleoseismology

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Our perspective of subduction zone´s earthquake magnitude and recurrence is limited by short historical records. Examining prehistoric extreme events preserved in the geological record is essential towards understanding large earthquakes and assessing the geohazard potential associated with such rare events. The research field of “subaquatic paleoseismology” is a promising approach to investigate deposits from the deep sea, where earthquakes leave traces preserved in stratigraphic succession. However, at present we lack comprehensive data set that allow conclusive distinctions between quality and completeness of the paleoseismic archives as they may relate to different sediment transport, erosion and deposition processes vs. variability of intrinsic seismogenic behavior across different segments.

Initially building on what sedimentary deposits were generated from the 2011 Magnitude 9 Tohoku-oki earthquake, the Japan Trench is a promising study area to investigate earthquake-triggered sediment remobilization processes and how they become embedded in the stratigraphic record. Here we present new results from the recent *R/V Sonne* expedition SO251 that acquired a complete high-resolution bathymetric map of the trench axis and nearly 2000 km of subbottom Parasound profiles, covering the entire along-strike extent of the Japan Trench from 36° to 40.3° N, and groundtruthed by several nearly 10m long piston cores retrieved from the very deep waters (7 to 8 km below sea level): Several smaller submarine landslide (up to several 100’s m of lateral extent) can be identified along the trench axis in the new bathymetric data set. These features were either not yet present, or not resolved in the lower-resolution bathymetric dataset acquired before 2011. Sub-bottom acoustic reflection data reveals striking, up to several meter thick, acoustically transparent bodies interbedded in the otherwise parallel reflection pattern of the trench fill basins, providing a temporal and spatial inventory of major sediment remobilization events along the Japan Trench with

potential quantitative constraints on volumes and mass fluxes of material mobilized during each event. Also the cores from the southern and northern part of the Japan Trench confirm previous findings from the central part near the Tohoku-oki epicenter, that the small deep-sea trench-fill basins, that are associated with very high sedimentation rates, comprise repeated thick turbidite sequences to be further tested for correlation to historic earthquakes. Eventually, the results of Cruise SO251 will be integrated with cores and data from various other cruises to provide a solid base for later long-coring efforts and scientific drilling, as proposed within the IODP JTRACK initiative, towards potentially producing a fascinating record unravelling an earthquake history that is 10 to a 100 times longer than currently available information.

Mass Transport Deposits of the Portuguese Proximal Continental Margin. Implications for tsunami record and tsunami hazard. The Tagus Delta Landslide and the MTDs off Algarve

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The Portuguese continental margin was affected by several historical and pre-historical earthquakes with the development of mass transport deposits (MTDs) identified by high-resolution seismic surveys and sediment coring and dating. Some of the described MTDs involved volumes of rock large enough to have tsunamigenic potential.

This work present two examples of MTDs, developed in different geological settings: (i) a landslide in the ebb-delta of the Tagus River and; (ii) a MTD in the Algarve continental shelf.

Ultra-high-resolution multichannel seismic reflection profiles acquired on both locations allowed the seismostratigraphic characterization of the deposits and the age models from the sediment dating constrained their age as belonging to the interval 13-8 ky for the Tagus river delta and 8.6-6 ky for the Algarve deposit.

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