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Response to Editor and Reviewer comments

First of all, we would like to thank the Editor for considering our manuscript and the Reviewers for their extensive work. Their valuable comments allowed us to further improve our manuscript. In the response below, we address the Reviewers comments, outline the changes made to the manuscript (the revised manuscript with "track changes" is available as the second part of this file) and provide rebuttals for comments not addressed. We also address the Short comments posted by the scientific community. The findings of the revised manuscript are not altered from the original submission.

Since the Reviewers proposed that we discuss in greater length the controls on sediment deposition, we have now added a Discussion (section 5) in the revised manuscript. Should the Editor believe that this inclusion violates the stated Aims and scope of the Journal (specifically: *"Any interpretation of data is outside the scope of regular articles.")*, we would of course comply with his suggestions.

Reviewer #1: Thomas M. Cronin

General comments

"Consequently, there are three main issues the authors could consider when writing the revision: 1) sea level rise – can a relative sea level curve be constructed ? The Mediterranean has a rich SL record, including the Holocene. The geophysical mapping in this paper would seem to help construct a new curve if the following two issues are also addressed too. 2) Chronology for the Holocene sedimentation is critical, including control points used to date the reflectors. Were selected cores used [or taken] with the express purpose of dating the seismic units? On page 8 and in Table 1 published cores and well data are mentioned but nothing specific is given on age/environment, sampling, repository etc. In Fig. 2 wells are shown but no specific information is given on age tiepoints [like C14 ages] or the specific proxies used to identify marine and paralic sediment facies [see # 3]. 3) Section 3.2 after using base on the Holocene in the earlier text, the term base of marine Holocene is used. How is marine sediment distinguished from nonmarine [perhaps Holocene transgressive fluvial deposits?]. There must be at least a brief discussion of proxies used to infer paleoenvironment of deposition."

Reply: (1) At present, the chronology of Holocene transgressive deposits in the Gulf of Trieste is not well constrained due to scarce sedimentological data limited to small parts of individual sedimentary bodies (Trincardi et al., 2011; Zecchin et al., 2015). Additionaly, the Late Pleistocene-Holocene boundary in the Northern Adriatic represents a diachronous boundary (Amorosi et al., 2017a, 2017b; Bruno et al., 2017). Consequentially geophysical data alone, without excellent chronographic constraints and the knowledge of the geological context of the dated sedimentary bodies, cannot be used to construct a new sea-level curve or to provide new data to existing ones. Whereas sea-level index points were previously determined from sedimentary cores from the Gulf of Trieste (Vacchi et al., 2016), the core density and the number of presently available and appropriate ^{14}C dates is not sufficient (Table 1) to precisely date the Late Pleisotocene-Holocene and/or paralic-marine boundary from our models (determined mainly from geophysical data), especially when considering local erosion and deposition effects. However, our datasets will be useful for determining optimal sample locations to obtain new sea-level index points and may be useful in the future for sea-level curve construction if sufficient core data will be available.

(2) The cores used in this study were not sampled by us, but were taken by various researchers, who provide detailed descriptions in their respective publications listed in the "References" section. The cores were obtained with different research aims in mind, were seldom correlated by geophysical data, and were often not dated (especially in the case of older cores from the 80's and 90's; see also revised Table 1 to which we now added available datings). Specific details on age/sampling … of the published cores/wells used in our study were not provided in the manuscript version you reviewed, since we primarily used them to constrain the "by nature non-unique" geophysical data to trustworthy sedimentological data (to correlate the base of the marine Holocene sediment and seafloor depth from geophysical data to the sedimentological data from the cores/wells and to validate the velocity used for the depth conversion of the geophysical data). However, the different sedimentary environments sampled in the cores are briefly described between L10-12 (p. 3) and depicted in Fig. 2. In order to demonstrate the different sedimentary environments and the different datings reported for the previously published cores, we added the requested data regarding the ages and samples (^{14}C dates and dated material) to **Table 1** and provided a short description in the revised manuscript between **L21-26 (p. 3)** (see also reply to the comment (3)).

(3) Due to the aforementioned core/well scarcity the marine and nonmarine Holocene sediments are mainly distinguished by the transparent acoustic character of the former. We agree with the Reviewer's suggestion to provide a brief discussion of proxies used to infer the paleoenvironments of deposition which can be found in section 2 between **L13-20 (p. 3)** in the revised manuscript. The term "base of Holocene" was replaced with "base of marine Holocene" throughout the revised manuscript.

"In sum, given the large literature cited in Tables 1 and 2, which is unrealistic for a reader to review, it is incumbent on the authors of a synthesis paper to at least include a short section discussing controls of the key topics of sediment age & environment. These are essential for a correct interpretation of the geophysical records and require only minor revisions."

Reply: Point taken, **Table 1** in the revised manuscript now includes published ^{14}C dates and dated material. Furthermore, a short discussion can now be found between **L13-26 (p. 3)** in the revised manuscript.

Specific comments

"Section 1.1. Technically the Holocene began _11.6-11.7 ka after the Younger Dryas. Fig 6 caption. Purple arrows indicate. . .. Fig 8 caption. SF signifies?"

Reply: Comments are noted and the manuscript is revised in accordance with the Reviewer's suggestions. The caption of Fig. 8 refers the reader to Fig. 3 for the explanation of symbols (L2 on p. 21 in the revised manuscript).

Reviewer #2: Cristina Bernardes

General comments

"The geophysical data, and consequently stratigraphic information, are very interesting. However it is not clearly demonstrated the amount of new data presented and the results previously published by the authors. The paper needs a minor revision addressing the comments and questions summarized below. Some aspects are essential for a correct interpretation of the geophysical units and stratigraphic record. In fact, the Mediterranean record has a satisfactory sea level information and 14C dating available. Some author's points to the influence of the late Holocene relative sea level change in the region, and its relationship with active tectonism and subsidence rates (e.g. Furlani et al. 2011)."

Reply: Point taken, we have clarified the previously used published data and new data (previously published only in internal reports). The section clarifying the used data is located in section 2 between **L2-10 (p. 3)** in the revised manuscript. Also the captions of **Tables 1-3** now contain a description specifically stating whether the data was previously published or was a part of an internal report or thesis. A brief discussion regarding radiometric dating was added to section 2 between **L21-26 (p. 3)**. Regarding the discussion on sea-level, please refer to point (1) of the first reply to Reviewer #1. A brief discussion regarding the active tectonics/subsidence rates is provided in section 5 between **L33-40 (p. 8)** in the revised manuscript.

Specific comments

"In the geological setting, it would be convenient to provide the reader with a brief description about the regional structure, as well as the influence of tectonic style, take into account the presence of strike-slip faults in the area which cause differential and significate downdrop in the Gulf of Trieste. This point is very important, even more the authors presents a "model of the base of the Holocene marine sediment" and its relationship with the bathymetric topic. More than a model, this question refers to characteristics of the basal surface and its topographic features. In this sense, can the differences observed in substrate depth (and the major depocenter in southeastern part of the gulf) be related with tectonic movements? Or is just an erosive process? These processes may also explain the origin of rougher morphologies observed in geophysical profiles and cores. Some data, published by other authors, allows to evaluate the tectonic behaviour of the studied area."

Reply: At first glance, the base of the Holocene marine surface, being the oldest surface in our dataset, represents an ideal marker to test the long-term effect of the proposed tectonic vertical movement. According to the tectonic rates (summarised in Biolchi et al. (2016)) and geodetic data from Rižnar et al. (2007), the diachronous base of the marine Holocene sediment should be offset by up to 10 meters during the last 8,000-10,000 years. However, it is evident from Fig. 7 that the morphology of the base of the Holocene marine sediment does not correlate to any of the structural elements mapped onshore (Fig. 1(b)). While we do suggest that the accommodation space and consequentially the general morphology of the base of the marine Holocene sediment in the Gulf of Trieste is mainly controlled by the pre-existing topography, we do not exclude localised small-scale geomorphic features of a tectonic origin. However, more detailed research would be needed for the identification of these potential features as the small deformation rates in the Gulf of Trieste would not considerably offset Holocene sedimentary successions. A brief discussion regarding the possible influence of tectonics on the Holocene marine sediment is provided in section 5 between **L33-40 (p. 8)**.

"The authors should consider the introduction of a simplified geological map of the studied region."

Reply: Point taken, we have modified **Figure 1** which now shows the geographical and geological setting of the studied area. The figure caption has been modified accordingly.

"Another important issue, is the inclusion of a section discussing the major controls (tectonic, eustatic or both) on the sediment supply, sedimentation rates and environment."

Reply: Point taken, a discussion regarding the major controls on the marine Holocene sediment supply, sedimentation rates and environment is included in the revised manuscript in section 5 between **L22 (p. 8) and L23 (p. 9)**.

"There must be a discussion, even brief, about the bases used to deduce deposit sequence and environmental conditions. For example, how do authors distinguish marine from nonmarine Holocene sediments? What is the true meaning of an area of the dune shaped features (NW of Piran)? (Sections 3.2 and 3.3., ex. fig. 8f). What are the main characteristics of the holocenic facies?"

Reply: Point taken, we have provided a discussion regarding the differentiation criteria between different depositional sequences in the revised manuscript in section 2 between **L13-20 (p. 3)**. Geophysical profiles below the dunes show the distinct reflector of the base of the Holocene (Fig. 8(f) in the manuscript), which can be also correlated to other geophysical profiles in the area. This lead us to believe that the dunes were formed in a marine environment, possibly even with a present-day process.

Short comments by Adam Tomašových

General comments

"Two recently published estimates of sedimentation rates and constraints on the thickness of Holocene deposits from the Gulf of Trieste can be added into the dabatase used in this manuscript - one location is from Bay of Panzano where a 1.5 m-thick core

spans 500 years (Tomasovych et al. 2017) and another location is about 1 km NW of Piran where a 1.5 m-long core spans 10,000 years (oldest shell ages in the lowermost part of the core) (Mautner et al. 2018). This second location is probably within the transect in the figure 8E. This core has a marked, 30 cm-thick oyster-Arca-rich shell bed covered by 8 cm of bioclastic sand on the top - it is probable that although this site was affected by sediment starvation/winnowing/bypassing, it was probably not affected by large-scale erosion. It would be useful to know what type of sediments occurs in the center of Cape Madona depression that is shown in 8E. What is the evidence that this depression is erosional and what mechanism can be responsible?"

Reply: The suggested cores are now included in the revised manuscript in section 4 between **L15-19 (p. 8)**. The erosion in the Cape Madona depression was already described in Trobec (2015), where geophysical data demonstrates erosion of the marine Holocene sequence and in places even of the Late Pleistocene continental sedimentary sequence. The sediments in the center of Cape Madona depression are still being studied in the scope of the ongoing PhD project of the first author, but preliminary results show that there the partly eroded subhorizontal continental sediments are covered by a thin (up to a meter thick) cover of Holocene marine sediment (Trobec et al., 2018). We attribute the erosion process to periods of enhanced current activity possibly reinforced by seabed fluid flow which is common in the Slovenian nearshore area (Orožen Adamič, 2002; Žumer, 2004; Faganeli et al., 2005).

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Thickness of marine Holocene sediment in the Gulf of Trieste (Northern Adriatic Sea)

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Abstract. We use various geophysical datasets (multibeam and singlebeam echosounder data, sub-bottom profiling Chirp and sonar data and very high resolution boomer seismic data) along with published sedimentological data and depth data from nautical charts in order to create models of the depth of the seafloor and the base of Holocene marine sediment in the Gulf of Trieste. The two models are later used in order to calculate the thickness of marine Holocene sediment which has been depositing on the Late Pleistocene alluvial plain since the Holocene transgression in the Italian and Slovenian part of the gulf. Thicker Holocene marine sedimentary sequences averaging at around 5 meters are characteristic for the SE part of the gulf. In other parts of the gulf the Holocene marine sedimentary cover is very thin or even absent, except in close proximity of the shoreline and fluvial sediment sources, in the area of the Trezza Grande paleodelta and above topographic depressions of the Late Pleistocene base. The presented datasets available from the OGS SNAP data repository (https://doi.org/10.6092/6ad9b1e6-c977-cec9-8a2d-db10c7f90adc) represent a valuable reference for a wide variety of research disciplines dealing with the dynamic Earth system in the Gulf of Trieste and could use as a valuable tool for designing sampling and geophysical campaigns in the studied area.

1 Introduction

The Gulf of Trieste is a shallow gulf with an average depth at around 20 meters located in the northernmost part of the Adriatic Sea where it is surrounded by Italian, Slovenian and Croatian coasts (Fig. 1). After the Last Glacial Maximum with the onset of the Holocene transgression, marine sediment started depositing approximately 10,000 years ago in this area (Marocco, 1991; Ogorelec et al., 1991, 1997; Lambeck et al., 2004; Covelli et al., 2006; Ogrinc et al., 2007; Trincardi et al., 2011b).

Early research of Holocene marine sediment in the Gulf of Trieste was mainly limited to sedimentological and geochemical investigations of data acquired with a relatively small number of cores and wells located onshore and offshore the gulf in the 80's and 90's (Ogorelec et al., 1981, 1991, 1997; Marocco et al., 1984; Marocco, 1989, 1991; Faganeli et al., 1991; Gordini et al., 2002; Covelli et al., 2006; Ogrinc et al., 2007) and investigations for the Italian Marine Geological Map 1:250.000 of Venice (Trincardi et al., 2011a, 2011b). The development of cost-effective geophysical methods in recent years resulted in a number of geophysical surveys undertaken in the last decade that were focused on high-resolution geophysical investigation of the seafloor and the sub-seafloor geological structure of the gulf (Gordini et al., 2003, 2004, 2006, Gordini, 2007, 2009; Romeo, 2009; Trincardi et al., 2011a, 2011b, 2014; Kolega and Poklar, 2012; Slavec, 2012; Zampa et al., 2015; Zecchin et al., 2015; Trobec, 2015; Trobec et al., 2016, 2017). ~~These~~ Some of these extensive datasets along with additional unpublished data spanning over a mayor part of the gulf allowed us to assess the thickness of the Holocene marine sediment in the Gulf of Trieste.

This work aims to present the first comprehensive model of the distribution and thickness of Holocene marine sediment in the Slovenian and Italian parts of the Gulf of Trieste. The model is derived from geophysical, core/well, nautical chart data and in parts complemented with the published Holocene marine thicknesses from Trincardi et al. (2011b).

1.1 Geological setting of the study area

A simplified geological overview of the surroundings of the Gulf of Trieste is shown on Fig. 1(b) and consists of Quaternary alluvial sediment (grey) of the Friuli plain on the north, Cretaceous – Paleogene carbonates (green) of the Classical Karst on the northeast and Paleogene marls and sandstones of the flysch (orange) of the Istria peninsula and Trieste coastline on the southern and eastern part of the gulf ~~(Placer, 2015; Biolchi et al., 2016; Jurkovšek et al., 2016)~~. A similar geological sequence can be observed in geophysical data offshore the gulf area where the carbonate platform is followed by a flysch succession which is overlain by a few hundred meters of Quaternary sediment deposited during the transgressive-regressive cycles (Busetti et al., 2010a, 2010b; Cimolino et al., 2010; Vrabec et al., 2014). The youngest sedimentary sequence in the Gulf of Trieste is represented by Holocene marine sediment which has been depositing for the last 10,000 years since the onset of the Holocene transgression following the ~~Last Glacial Maximum~~Younger Dryas (Ogorelec et al., 1981, 1997; Lambeck et al., 2004; Covelli et al., 2006; Trincardi et al., 2011b; Zecchin et al., 2015). Many authors suggest that the base on which marine sediment has been depositing, represents relict continental-paralic sedimentary environments predating the Holocene sea transgression in the Gulf of Trieste (Ogorelec et al., 1981, 1991, 1997; Marocco, 1989; Lambeck et al., 2004; Covelli et al., 2006; Trincardi et al., 2011b; Slavec, 2012; Zecchin et al., 2015; Trobec, 2015; Trobec et al., 2017). The sediments of the Holocene marine transgression provided a thin and discontinuous deposit occurring on an erosive surface of the Late Pleistocene sediments due to subaerial exposure (Trincardi et al., 2011a).

2 Data used and modelling of the different surfaces

Numerous geophysical surveys were conducted between 2000 and 2015 in the Gulf of Trieste by the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) and by Harpha Sea d.o.o in cooperation with the Department of Geology of the University of Ljubljana (Fig. 4 and 5, Tables 2 and 3). Most of the data and results from these surveys were so far published only in internal reports and/or theses and are here presented to a wider audience for the first time.

Geophysical data was correlated and calibrated with ~~published~~ core/well data previously published in other scientific publications (Table 1 and Figs. 2 and 3 ~~(~~;Ogorelec et al., 1981, 1991, 1997; Marocco et al., 1984; Marocco, 1989; Gordini et al., 2002; Covelli et al., 2006; Romeo, 2009; Trincardi et al., 2011b; Zecchin et al., 2015). The cores/wells usually document a transition from an alluvial to paralic and later marine sedimentary environment. However, in some cores the marine or paralic sedimentary sequence is absent or the marine and paralic sediments are deposited directly on the bedrock (Figs. 2, 3 and 8(d)).

The calibration of the geophysical data with the stratigraphy of core/well data available for the Gulf of Trieste (Table 1) indicates that the Holocene marine sediment is represented on high-resolution acoustic sonar and seismic boomer profiles as a characteristic transparent acoustic/seismic facies which shows absent or very faint low amplitude internal reflections (e.g. Fig. 3). On geophysical profiles Holocene paralic and/or Late Pleistocene continental sedimentary units are separated from the Holocene marine sediment by a prominent middle-high amplitude reflection and furthermore demonstrate significantly dissimilar acoustic facies containing several reflections of varying reflection geometries, amplitudes and continuity (Romeo, 2009; Slavec, 2011, 2012; Trobec, 2015; Trobec et al., 2017).

Reported conventional radiocarbon ages from published core/well data (Table 1) show that Holocene marine sediment started depositing on the alluvial sedimentary sequence approximately 9,150 years BP in the Gulf of Trieste. The Holocene marine sequence started depositing later where it overlies paralic sequences for which conventional radiocarbon ages younger than approximately 8,800 years BP are reported (Table 1). The reported radiocarbon ages in Table 1 clearly show that the alluvial- or paralic-Holocene marine boundary in the Gulf of Trieste is diachronous.

Geophysical datasets along with previously published core/well data allowed us to create a model of the distribution and thickness of Holocene marine sediment in the Italian and Slovenian parts of the gulf. The different datasets and methods used to create each model are described in detail in the subsequent subchapters.

2.1 The bathymetric model

In order to create the bathymetric model of the Gulf of Trieste we used multibeam and singlebeam sonar data complemented with ~~high-~~high-resolution ~~single-~~single-channel seismic (boomer and chirp) (Fig. 4, Tables 2 and 3). In addition, water depths of 28 points in the Gulf of Panzano were determined from the Slovenian nautical chart of the Gulf of Trieste (Ministry of Transport of the Republic of Slovenia, 2005) and the "Da Punta Tagliamento a Pula" nautical chart (Istituto Idrografico della Marina, 2004). We also used depths of published cores/wells in the Gulf (Table 1, Fig. 2). The used datasets are depicted in Fig. 4. In order to constrain the model, we used the coastline contour for which we assumed a seafloor depth value equal to 0 m above sea-level.

Multibeam sonar data included data acquired during the reflection seismic surveys in the central and Slovenian part of the gulf in the years 2009 and 2013 (Table 2). In addition, a ~~multibeam~~ multibeam-based bathymetric model of Slovenian territorial waters (Slavec, 2012) acquired by Harpha Sea d.o.o. was also used. Smaller areas surveyed by OGS by multibeam sonar also include three areas in front of the Grado-Marano lagoon: The Porto Buso inlet, Morgo inlet and the Grado inlet (Figs. 1 and 4, Table 2).

Singlebeam sonar data was acquired along the coast of the Tagliamento delta between the Baseleghe and Lignano inlets, from the Morgo inlet to the Marina Julia beach and in a dense grid in front of the Porto Buso inlet (Figs. 1 and 4, Table 2).

Single channel seismic and acoustic data were acquired in various surveys (Table 2 and Fig. 4). Interpretation of the geophysical profiles was done by means of the IHS Kingdom® software. We used seismic and acoustic profiles to determine the seafloor depth where singlebeam or multibeam bathymetric data were not acquired. The seismic and acoustic profiles used to create the bathymetric model stretch over a large part of the western part of the gulf, offshore Grado, southeast of Miramare and in the Bay of Muggia (Figs. 1 and 4).

The multibeam and singlebeam sonar data coupled with the interpreted depths of the seafloor from acoustic and seismic profiles were imported in the SKUA-GOCAD™ Paradigm software package in order to perform quality control and consequent adjustments to the dataset. In order to convert the seismic and acoustic data from the time to the depth domain, 1,514 m/s was assumed as the velocity of sound in the water column. This value represented the average value of sound velocity profiler measurements acquired together with the datasets used in this study. After the conversion gridding of the bathymetric model was done with the 'Discrete Smooth Interpolation' (DSI) method (Mallet, 1992, 1997) in the SKUA-GOCAD™ software package. The coordinates of the pointsets building the model were clipped to the coastline extent and later exported as a column based text file and a geotiff grid with a 50 m x 50 m cell size. The resulting model contained some areas with negative depth values that resulted from lack of geophysical data in the near proximity of the coast. In addition, the morphologically very dynamic northern part of the research area starting from the Isonzo mouth towards the west also contained negative depth values due to transient sedimentary bodies elevated above or just below the sea-level that were present at the time of the various surveys but were not delineated by the coastline shapefile used to clip the dataset. In order to still represent these dynamic shallow areas while eliminating artificial negative depths from our dataset, we replaced all the negative values in the geotiff grid and the column based text file with a depth value of 0.2 m.

2.2 Model of the base of the Holocene marine sediment

Seismic (boomer) and acoustic data (Chirp and parametric sub-bottom sonar) were used in order to create a model of the base of the Holocene marine sediment in the Gulf of Trieste (Fig. 5 and Table 3). In general, the used profiles span throughout the Gulf of Trieste but are also located in the inner parts of the Grado Lagoon, Bay of Muggia and in the Bay of Koper (Fig. 5). The base of the marine Holocene sediment was determined from reflection characteristics visible from profiles that were interpreted by means of the IHS Kingdom® software and calibrated with the cores listed in Table 1. In general, the base of the Holocene marine sediment on geophysical profiles can be recognised as a prominent reflector underlying the acoustically transparent marine sediment (Figs. 3 and 8; Slavec, 2011, 2012; Trobec, 2015; Trobec et al., 2017). Additionally, depths of the base of Holocene marine sediment determined from offshore and onshore well and core data from Italy and Slovenia were included in the model and are shown in Table 1 and Figs. 2 and 5.

This dataset was imported, quality controlled and adjusted in the SKUA-GOCAD™ software package. A velocity of 1,530 m/s was assumed for the velocity of sound traveling through the Holocene marine sediment and used for the conversion of seismic and acoustic data from time to depth domain. Afterwards, gridding of the model of the base of the Holocene was done in the SKUA-GOCAD™ software package with the DSI interpolation method. Even though the sound velocity of the sediment overlying the flysch in the Gulf of Trieste was determined at 1,610 m/s (Masoli et al., 2015), we decided for a lower value because Masoli et al. (2015) considered a few ten meters thick Late Pleistocene – Holocene sedimentary sequence where compaction most probably already affected the velocity value. Considering that: a) the typical sound velocity of a marine water saturated sediment is approximately 1,500 m/s (Anderson and Hampton, 1980; Yuan et al., 1992); b) the average value of sound velocity profiler measurements acquired together with the datasets used in this study is 1,514 m/s; c) that the Holocene marine sediment thickness in our study is an order of magnitude smaller than the sediment considered in Masoli et al. (2015), leads us to believe that our chosen velocity is reasonable for our conversion. The coordinates of the pointsets building the model were clipped to the coastline extent and later exported as a column based text file and a geotiff grid with a 50 m x 50 m cell size.

2.3 Modeling the thickness of Holocene marine sediment

A model of the thickness of Holocene marine sediment in the Gulf of Trieste was created with the SKUA-GOCAD™ software. In order to create the model, the difference between the bathymetric model and the model of the base of the Holocene was calculated. Data used to create the model of the base of the Holocene spanned over a smaller area compared to the bathymetric model (Figs. 4, 5, 6 and 7). In areas where data coverage was insufficient or even absent (grey areas bounded by black dashed lines on Fig. 5), we used data from the 'Carta degli spessori dei sistemi di stazionamento alto (HST)' published by Trincardi et al. (2011b), for which we assumed 1,530 m/s as the velocity of sound traveling through the sediment. We excluded the areas inside the Grado-Marano lagoon from the model due to dubious interpretation of geophysical profiles (signal reverberation) resulting from shallow seafloor depth and because these Holocene sediments were deposited in a lagoonal, rather than a marine sedimentary environment. The coordinates of the pointsets building the model were clipped to the coastline extent and later exported as a column based text file and a geotiff grid with a 50 m x 50 m cell size. The model contained negative thickness values in areas of erosion (e.g. Fig. 8(e)) and in the western part of the research area, where Holocene marine sediment is very thin or even absent and is therefore very difficult to model. In this area thicker sedimentary sequences can seldom be found only as infill of Late Pleistocene channels (Figs. 8(a) and (c)). When modelling such geometries, the base of the Holocene surface tends to rise above the seafloor outside the channel as a convex more or less pronounced bulge. This in turn results as artificial negative thickness values. In order to honour the data, we replaced all the negative values in the geotiff grid and the column based text file with a thickness value of zero.

3 Results

3.1 Bathymetry of the Gulf of Trieste

The bathymetry of the seabed of the Gulf of Trieste has a generally smooth morphology. Depth values in our model vary between 0.2 and 32.6 meters below sea level with a mean of 16.2 meters and standard deviation of 6.2 (Fig. 6). In the southeastern and eastern parts of the gulf depth exceeds the 20 meter isobath approximately 4 kilometres away from the shore at most, while in the northern and northwestern parts the distance needed is approximately twice as much (but can reach up to 20 kilometres).

The Trezza Grande paleodelta (Gordini et al., 2002; Zecchin et al., 2015) and the dune shaped features NW of Piran (Slavec, 2012) are topographically higher areas visible on Fig. 6. The deepest feature on the bathymetric model is the elongate Cape Madona depression stretching in a SW-NE direction north of Piran (Fig. 6) which also represents the deepest point of the Gulf of Trieste with a depth of 38 meters (Ministry of Transport of the Republic of Slovenia, 2005; Slavec, 2012). A deeper area where depths exceed 25 meters is located north of the Piran and west of the Bay of Muggia.

3.2 Base of the Holocene marine sediment

Contrary to the smoothness of the bathymetric model, the model of the base of the Holocene marine sediment presents rougher morphologies (Fig. 7), which are evident also from Figs. 3 and 8. The model of the base of the Holocene is located between 6.6 and 31.0 meters below sea level with a mean of 19.8 meters and a standard deviation of 5.7. In general, the model can be divided in two parts, the shallower northwestern and the deeper southeastern part (Fig. 7). This difference in depth is also evident from geophysical profiles (Figs. 8(a) and (b) and core data (Fig. 2).

The northwestern part is shallower than 20 meters and in general rises as we approach the coastline. Local topographical highs are located in the southern part of the Trezza Grande area (Fig. 7). In places the model exhibits channel-like features that are a few meters deeper from the surrounding topography, but their exact course is difficult to map due to insufficient profile coverage.

The base of Holocene marine sediment in the southeastern part of the Gulf forms a basin that is in general deeper than 25 meters below sea level (Fig. 7) and is also visible on geophysical profiles and recognisable in core data (Figs. 8 and 2). Shallower depths can only be observed in the Bay of Muggia and in the immediate vicinity of the coastline where it rises rapidly on a very short distance (Fig. 7). A slightly deeper section oriented in a WNW-ESE direction approximately 6 km north of Piran is evident and corresponds to the meander belt of the Paleorižana (Slavec, 2012; Trobec et al., 2017).

3.3 Thickness of Holocene marine sediment

The modelled thickness of the Holocene marine sediment in the Gulf of Trieste extends ranges between 0 and 24.0 meters with a mean thickness of 3.2 meters and a standard deviation of 2.8. In general, the inner parts of the gulf are covered by very thin drapes of Holocene marine sediment that can also be partially absent (Figs. 9, 8(a) and (b)). Towards the shore, the Holocene sedimentary sequence gradually thickens and appears as a coastal sedimentary wedge that can exceed thicknesses of ten meters near the coastline and in the internal parts of bays.

The map of the thickness of the Holocene marine sediment in the Gulf of Trieste can be divided into two parts, the central – western part with thinner marine sequences and the southeastern part of the gulf with thicker Holocene marine sediments (Fig. 9). This is prominent difference is clearly evident from geophysical profiles spanning trough a larger part of the Gulf (Figs. 8(a) and (b)) and from a simplified W-E stratigraphic profile from the published cores (Fig. 2).

The central - western part of the gulf is characterized by a very thin Holocene sedimentary cover which rarely exceeds a thickness of three meters (Figs. 9, 8(a) and (b)). Where the thin sediments are not well resolved or even unresolvable with the high resolution geophysical methods used in this study, we assume they are absent or only a few centimetres thick. Thicker Holocene sedimentary sequences can be observed only in the vicinity of the Tagliamento delta (Figs. 9, 3 and 4 from Zecchin et al., 2015), the Trezza Grande paleodelta (Figs. 2 and 9; Figs. 4 and 5 from Zecchin et al., 2015) and in the central part of the bay where thicker sedimentary sequences fill pre-Holocene paleochannels (Figs. 9, 7, 8(a), (b) and (c)).

The southeastern part of the gulf is characterised by a thicker sedimentary cover which averages at about 5 meters (Figs. 9, 2, 8(a) and (b)). Further examination reveals that in some places in close proximity of the shoreline the Holocene sedimentary cover often thins out or is unresolvable on geophysical profiles (for example near Debeli rtič, Fig. 8(d)). This effect is a consequence of basement rock (predominantly flysch) outcropping and/or subcropping near the seafloor. In the Cape Madona depression in front of Piran (Fig. 6) the marine Holocene sedimentary sequence is not recognisable due to erosion which can also be identified on geophysical profiles down to the Late Pleistocene sediment (Fig. 8(e)). In addition to thick marine Holocene sedimentary deposits in the internal parts of bays (Figs. 9 and 2), thicker sedimentary sequences can be observed over buried paleochannels (Figs. 9, 8(a), (b) and (c); Slavec, 2012; Trobec, 2015, Trobec et al., 2017) and in the area of the dune shaped features NW of Piran (Figs. 6, 8(f) and 9).

4 Model quality assessment

While our work was done with great care and attention to detail in order to produce accurate results, we would like to emphasize that the model is primarily intended to illustrate the general trend of the thickness of Holocene marine sediment in the Gulf of Trieste and cannot account for strong local thickness variations. This is a result of several factors that are described in the following section.

As mentioned in Sect. 3.2 and 3.3, the surface of the base of the Holocene marine sediment can be very undulated due to the pre-existing paleotopography and/or due to subcropping or outcropping of the basement rock on the seafloor near the eastern and southern coastline (Fig. 8(d)). Combined with areas where density of acoustic and seismic profiles is not adequate, this undulation can lead to artefacts that are later outstretched throughout the model of the base of the Holocene and consequentially affect the values of the model of the thickness. Discrepancies of the map with the natural state are also a result of the gridding algorithm used (Mallet, 1992, 1997). Due to the inherent two-way travel time attribute of the acquired data in the case of geophysical profiles, a major influencing factor on the models are the chosen velocity for the conversion to the time domain and the local sound velocity variations in the Holocene sediment which are unknown. As there are no measurements of speed of sound traveling solely through the Holocene sediment of the Gulf of Trieste, we used a conservative approximation of the speed of sound traveling through the sedimentary column, which could lead to systematic underestimation of the thickness throughout the whole study area. Due to a lack of sound velocity measurements we also assumed a model without velocity variations. Finally, due to scarce cores/wells, the presence of marine sediment in the Holocene sedimentary sequence was assessed mostly by following visual criteria when investigating geophysical profiles. We considered the acoustically transparent Holocene seismic facies to represent sediment primarily deposited in a marine environment. In order to avoid including predominantly paralic Holocene sediment in the model, we excluded the Grado-Marano lagoon area from the model of the thickness of Holocene marine sediment.

The first opportunity to test the quality of our model was presented by two 1.5 m long cores composed entirely of Holocene marine sediment (Mautner et al., 2018; Tomašových et al., 2017) that were published after the creation of our dataset. The cores M28 and M53 were collected in the Bay of Panzano and NW of Piran. In both locations the modelled thicknesses of the Holocene marine sequence exceed 1.5 m which demonstrates the quality of our model and the potential of our dataset for planning of future core collecting campaigns.

5 Main controls influencing the deposition of Holocene marine sediment

As demonstrated in section 3.3 and shown in Fig. 9 the thickness of Holocene marine sediment in the Gulf of Trieste varies significantly. Generally, we can attribute the thickness variations to a complex interplay of sedimentologic, tectonic and oceanographic factors, which we briefly discuss in this section.

Holocene marine sequences deposited where accommodation space was available. In the northern part of the Gulf of Trieste accommodation space was limited by the topography produced by prodeltas of the Isonzo-Tagliamento rivers at the start of the Holocene sea ingression. Tentatively, the morphological highs in the northern part of the gulf visible in Fig. 7 could be interpreted as the remnants of these prodeltas, as in the case of the Trezza Grande paleodelta (Zecchin et al., 2015). Absence of prodeltas of comparable size in the southern part of the gulf during the Holocene ingression provided more accommodation space for the subsequent deposition of thicker marine sequences. Another factor influencing the available accommodation space is differential surface deformation. While many authors recognised regional subsidence (in the order of magnitude of tenths of a millimetre per year) in the Northern Adriatic (Antonioli et al., 2009; Ferranti et al., 2006; Lambeck et al., 2004; Sánchez et al., in review, 2018), locally variable vertical rates were recognised from geodetic, geomorphological, sedimentological and archaeological data in the Gulf of Trieste that were attributed to active tectonics (Antonioli et al., 2007; Biolchi et al., 2016; Faivre et al., 2011; Furlani et al., 2011; Melis et al., 2012; Rižnar et al., 2007). As the area of the Gulf of Trieste is a slowly deforming region, tectonics most probably plays a minor role in controlling the Holocene marine sediment thickness and/or the accommodation space available for its deposition.

The Holocene marine sediment in the Gulf of Trieste is composed of mixed marine bioclastic and detrital material originating from fluvial sources and surface run-off (Covelli et al., 2004; Ogorelec et al., 1991; Mandac Soczka and Faganeli, 2015). The main riverine inputs in the Gulf of Trieste are shown in Fig. 1. Compared to the rivers draining the Southern Alps (rivers west from Timavo), the rivers flowing in the gulf along the eastern and southeastern coasts have relatively small catchment areas (a few hundreds of km^2 compared to thousands of km^2) which are limited to the extent of the flysch bedrock. The oceanographic circulation in the lower part of the water column in the gulf has a counterclockwise rotation with the inflow from the southern and outflow along the northern coasts (Cosoli et al., 2013; Malačič et al., 2012). The inflow and outflow velocities are of a comparable magnitude (Malačič et al., 2012), therefore we would expect thicker Holocene marine sequences near the northern coastlines where major riverine sources provide larger amounts of detrital material compared to the small rivers and surface run-off in the southern and southeastern part of the gulf. However, sediment input in the northern coastline is localised at the river mouths and a relatively narrow coastal prograding wedge can be observed (Fig. 9). Greater thicknesses of Holocene marine sediment extending a few kilometres offshore can be observed along the southern and southeastern flysch coastlines (Fig. 9) where an extensive and continuous coastal prograding wedge is formed due to the proximity of the outcropping flysch which is the source material for large amounts of detrital material derived from the erosion and weathering of the formation all along the coast. This indicates an important geological control on the amount and type of available detrital material and/or an important oceanographic factor controlling the proportion of detrital material transported by currents and detrital material available for deposition.

As demonstrated in this section, no straightforward explanation for the variable Holocene marine thickness can be provided at present, as it seems to be controlled by several interlinked factors. More research will be needed in order to better understand the weight of each of the controls influencing Holocene marine sediment deposition.

~~5~~ 6 Data availability

An important moment of data lifecycle is that when observations are shared with other team members or domain experts in general. This introduces the possibility to replicate the experiment, to re-use the data in other contexts, and to provide data with additional value. OGS is deeply involved in the curation and dissemination of its data assets and has in this perspective developed a web based data system called SNAP (Diviacco et al 2015, Diviacco and Busato 2013) which grants that the contained data are findable, accessible, interoperable and reusable (FAIR). The system is based on fully compliant OGC O&M and SensorML metadata and offers previewing facilities that allow remote data access and download once the end user checked whether they are what he/she is looking for. DOIs are assigned to the datasets residing in the system so that they can be directly accessed resolving the DOIs or simply following the corresponding URLs. In the case of the models used in this study, they are accessible at the following URL: https://dx.doi.org/10.6092/6ad9b1e6-c977-cec9-8a2d-db10c7f90adc. This points to a landing page which has been built following the standards set in the UNESCO Ocean data Publication Cookbook (Leadbetter et al., 2013), and offers further metadata details and an interactive preview of the dataset. To download data, a registration to the system is required.

The data described in this study are available as column based text files containing data points with X, Y and Z/thickness coordinates in the UTM 33 North coordinate system (datum: WGS 84). In order to facilitate their use (especially with GIS software) these datasets are also available as 50 x 50 m elevation grids clipped to the extent of the coastline in the widely compatible Geotiff format along with georeferencing information (the *.proj and *.tfw files). Depth contours of the models are also available in the shapefile format.

~~6~~ 7 Conclusions

Together with the published datasets (https://dx.doi.org/10.6092/6ad9b1e6-c977-cec9-8a2d-db10c7f90adc), this paper represents the second assessment of the thickness of Holocene marine sediment in a major part of the Gulf of Trieste with employing new datasets from a wide range of different geophysical methods and published sedimentological data from wells and cores.

Geophysical profiles along with core/well data show a basin in the Late Pleistocene topography in the southeastern part of the Gulf that served as a depocentre for the significantly thicker Holocene marine sedimentary sequences compared to the rest of the gulf. While the exact cause for the basin formation exceeds the scope of this paper, we suspect it represents an interplay between different tectonic, sedimentologic, climatic and oceanographic factors that need to be further examined in order to better understand the distribution of Holocene marine sediment in the Gulf of Trieste. Additionally, thicker Holocene marine sequences can be observed above paleochannels, in the Trezza Grande area and in the internal parts of bays and in close proximity of the shoreline, where the thickness is probably governed by increased amounts of available sediment transported by rivers ~~(Covelli et al., 2004; Mandac Soczka and Faganeli, 2015)~~ and surface run-off from rocky coasts of the southeastern part and due to increased amounts of fluvially transported sediment from the alluvial plains of the northern and northwestern coasts of the gulf. In the central part of the ~~Gulf~~ gulf the Holocene marine sequences are very thin or even absent (unresolvable on geophysical profiles).

Our work provides a solid reference for a wide variety of disciplines involved in future studies of Holocene sediment in the area, especially regarding sampling sites and/or survey selection. Furthermore, the thickness model provides important implications for further sedimentological, geomorphological, paleoenvironmental, neotectonic and oceanographic studies of the Gulf of Trieste.

Author contributions

AT interpreted acoustic data from the Slovenian part of the gulf, modeled the surfaces and thickness, prepared the figures and wrote the manuscript. MB conceived and managed the study, interpreted the geophysical data from the Italian part of the Gulf and contributed in writing the manuscript. FZ, LB, AC, EG, RR and IT acquired the multibeam, singlebeam and sonar data in various campaigns in the Italian part of the Gulf. AB, EG and RR interpreted various geophysical datasets in the Italian part. LB, EG, IT and FZ processed the geophysical data from the Italian part. SP acquired and processed the multibeam dataset and the sub-bottom sonar profiles from the Slovenian part of the gulf. PD managed data and metadata handling on the online repository. MV interpreted acoustic data from the Slovenian part of the gulf.

Competing interests

The authors declare that they have no conflict of interest.

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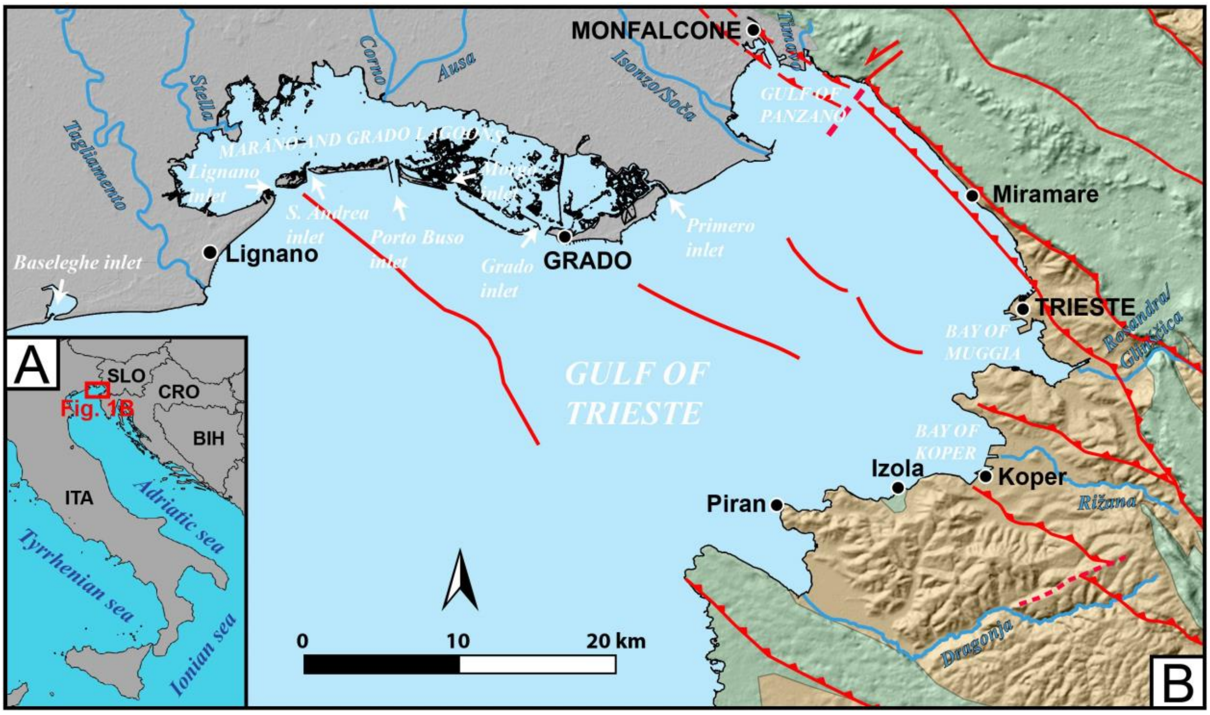

Figure 1: Location of the study area; (A) Regional map; (B) ~~Geographic surroundings of the study area~~ A simplified geological map of the area (after Busetti et al., 2010a; Carulli et al., 2006; Carulli, 2011; EMODnet, 2018; Jurkovšek et al., 2016; Placer et al., 2010; Placer, 2015; Pleničar et al., 1969). Mesozoic carbonates are marked with green, Eocene flysch with orange and Quaternary sediment with grey.

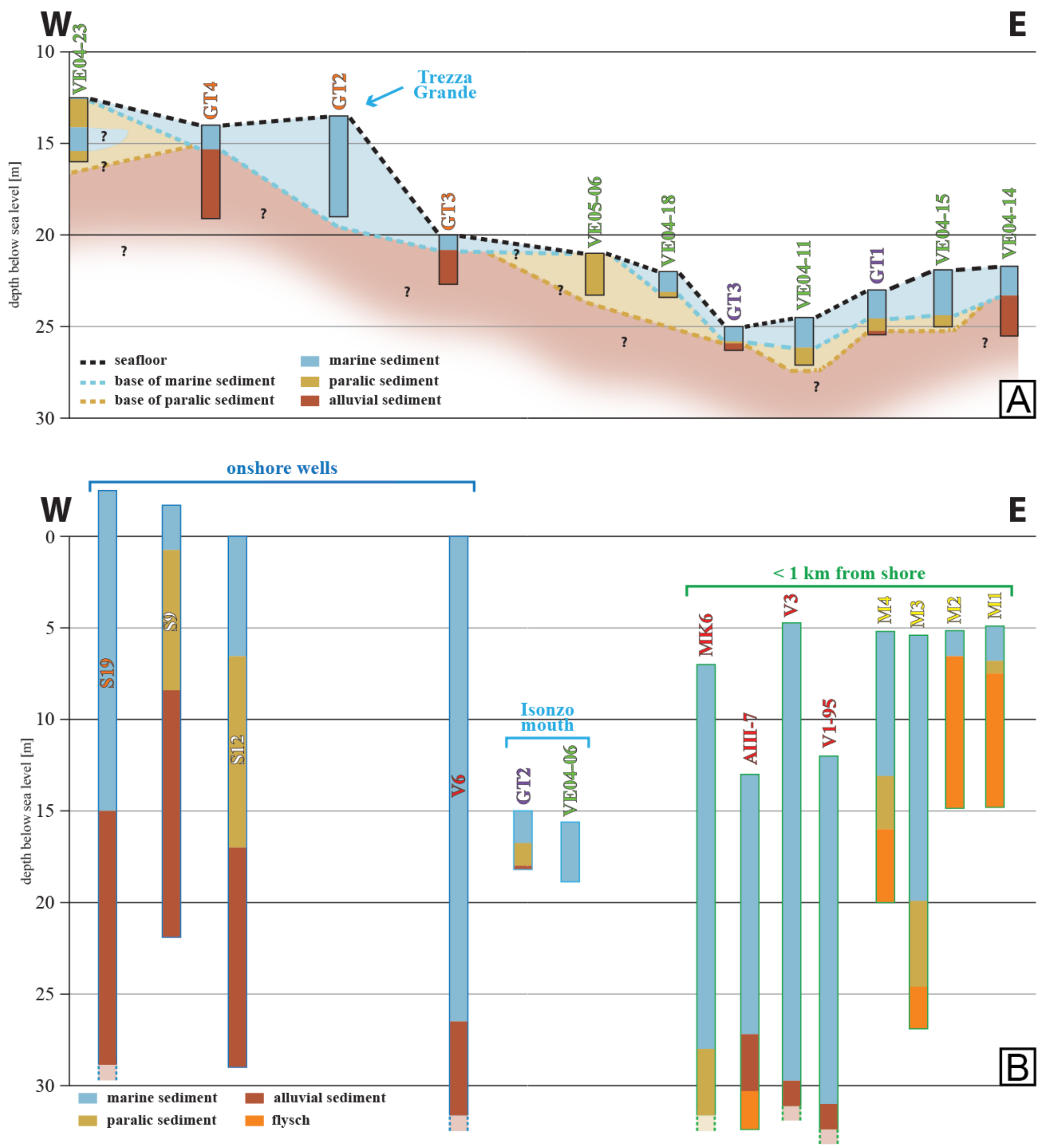

Figure 2: Simplified stratigraphy of all the cores and wells used in this study (Table 1; for details see Ogorelec et al., 1981, 1991, 1997; Marocco et al., 1984; Marocco, 1989; Gordini et al., 2002; Covelli et al., 2006; Romeo, 2009; Trincardi et al., 2011b; Zecchin et al., 2015). Note that the distance between the cores/wells is not in scale; (a) A simplified W-E stratigraphic profile of the cores located in the central part of the Gulf of Trieste; (b) Wells and cores used in the study that were not suitable for the stratigraphic profile due to their location or proximity to the shore or fluvial sedimentary sources (see Figs. 4 and 5 for location). Wells outlined in dark blue are located onshore. Cores outlined in bright blue are located in close proximity of the present-day Isonzo river mouth. Cores outlined in green

are located less than 1 kilometre from the shoreline. Dashed bottoms of wells indicate that their whole stratigraphy is not illustrated in the figure and that the reader should refer to the original publications for further information.

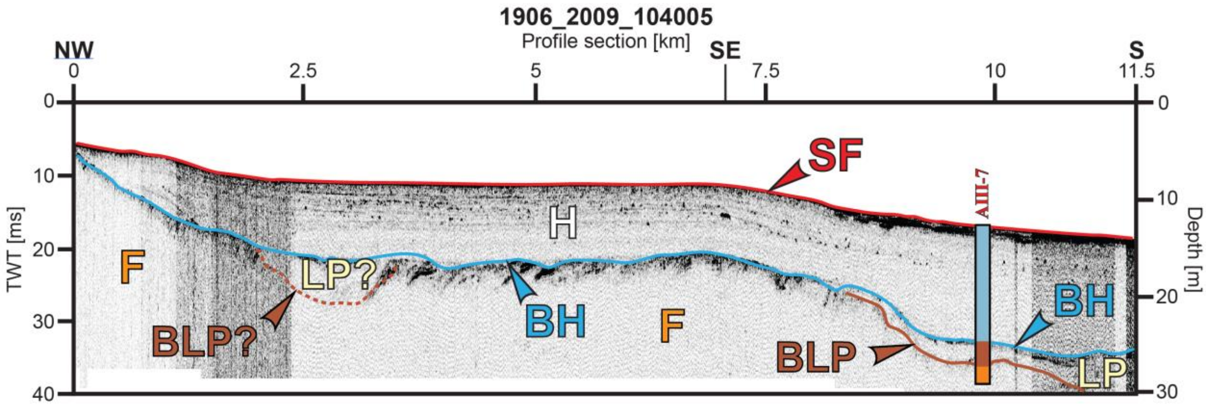

Figure 3: An example of an acoustic profile, acquired along the northern coast of the Istria Peninsula, which is correlated with the core AIII-7 from Ogorelec et al., 1997 (SF – seafloor, H – Holocene marine sediment, BH – reflector that marks the base of the Holocene sediment, LP – Late Pleistocene sediment, BLP – base of the Late Pleistocene sediment, F – flysch, TWT – two-way travel time). For location of the profile see Fig. 5.

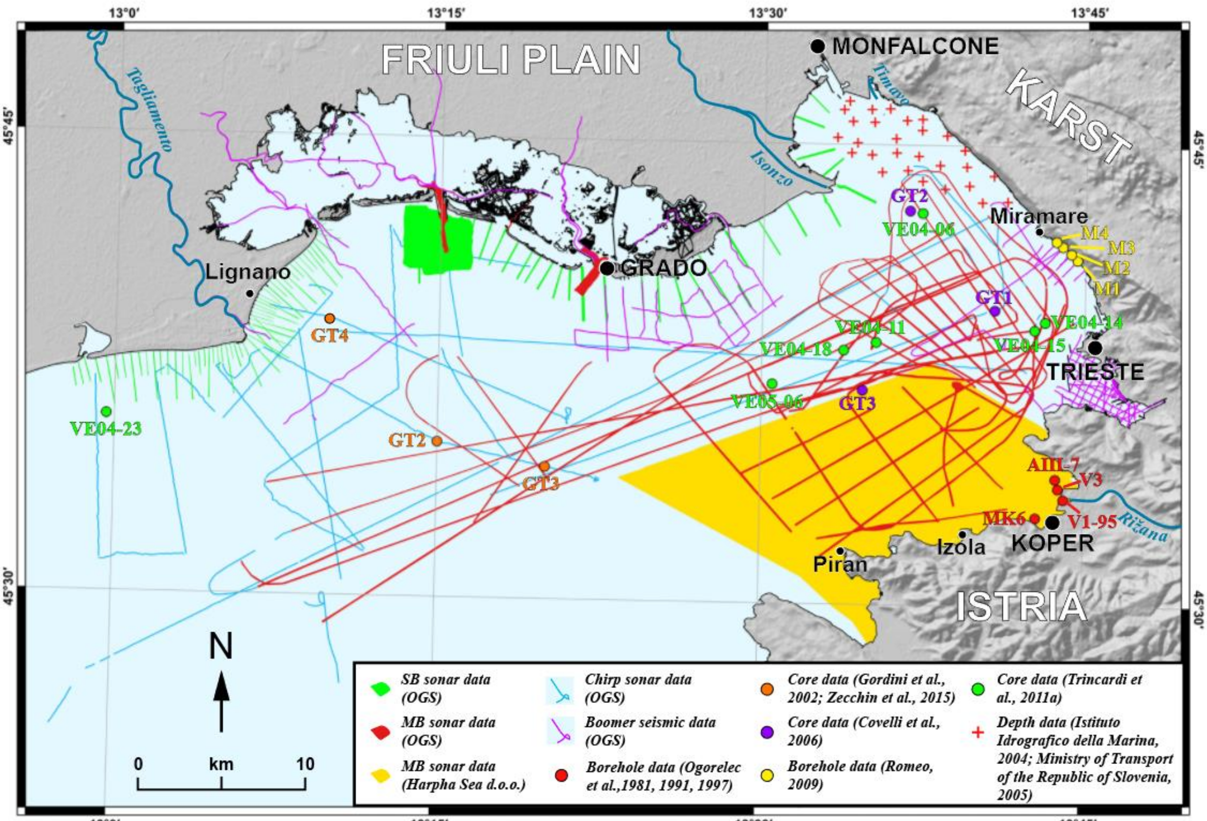

Figure 4: Locations of the datasets used for the bathymetric model of the Gulf of Trieste.

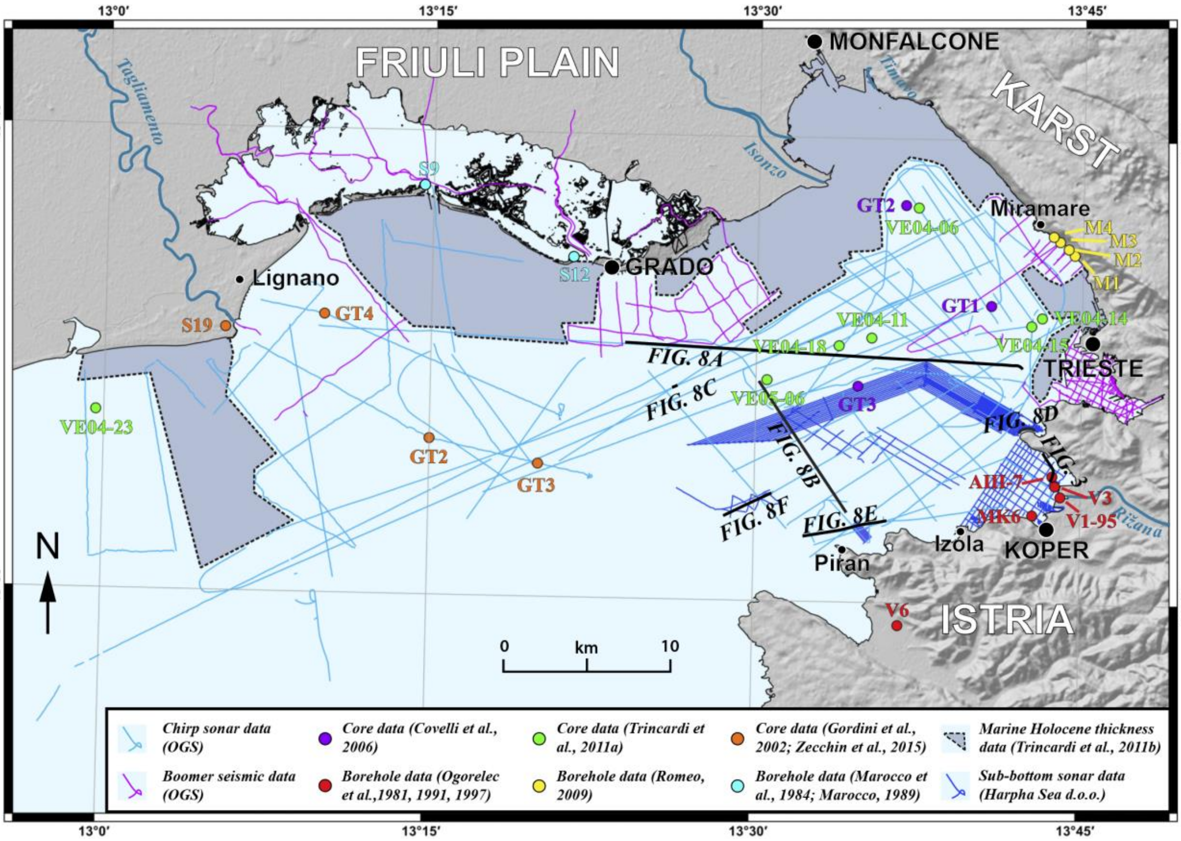

Figure 5: Locations of the datasets used for the model of the base of the Holocene. Black lines indicate locations of acoustic profiles shown in Figs. 3 and 8. Note that the black dashed lines mark areas where published data from Trincardi et al. (2011b) was used for the model of the thickness of Holocene marine sediment.

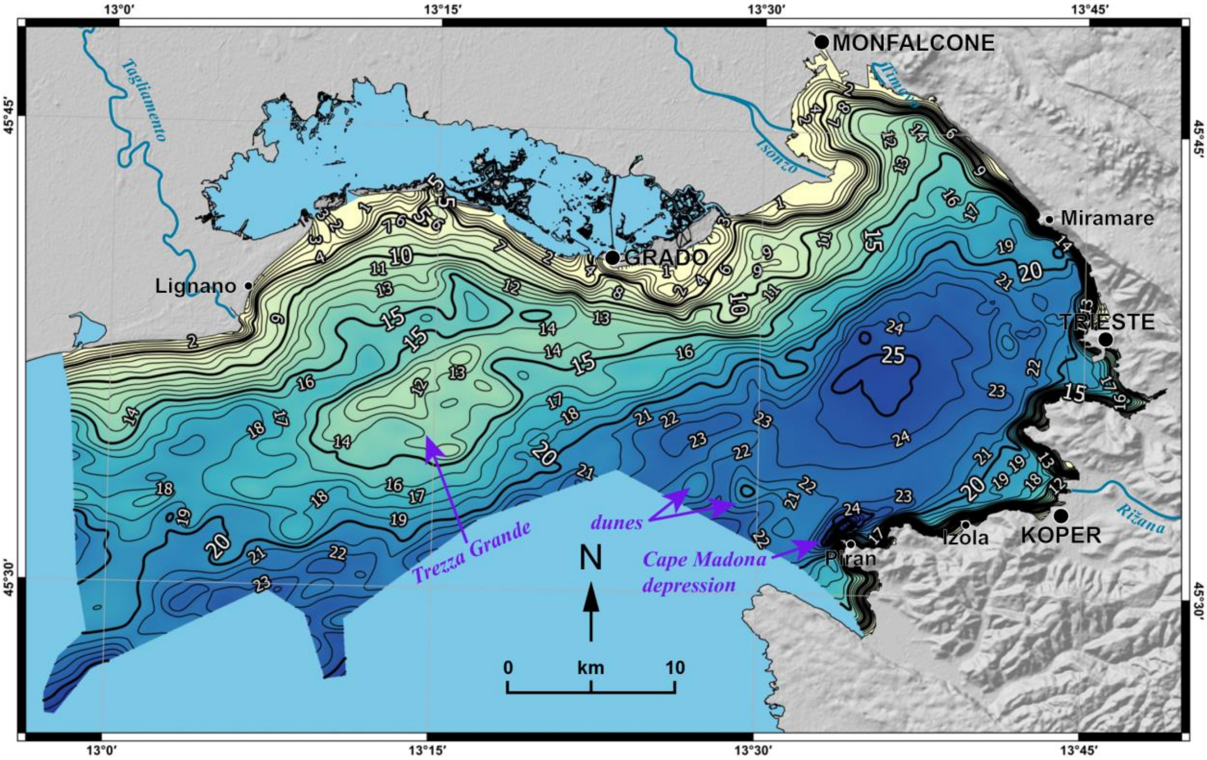

Figure 6: Map of the bathymetry of the Gulf of Trieste (in meters) with ~~indicated~~ prominent morphological features indicated with purple arrows.

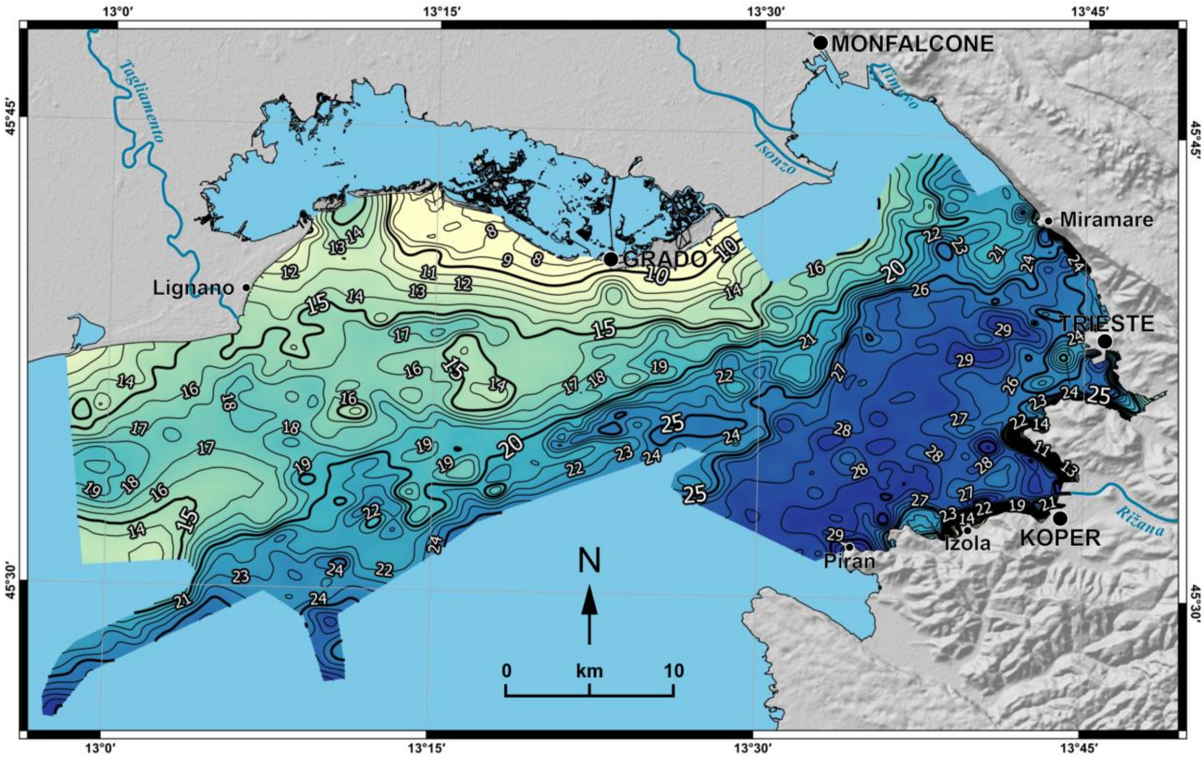

Figure 7: Map of the depth of the base of the Holocene marine sediment in meters.

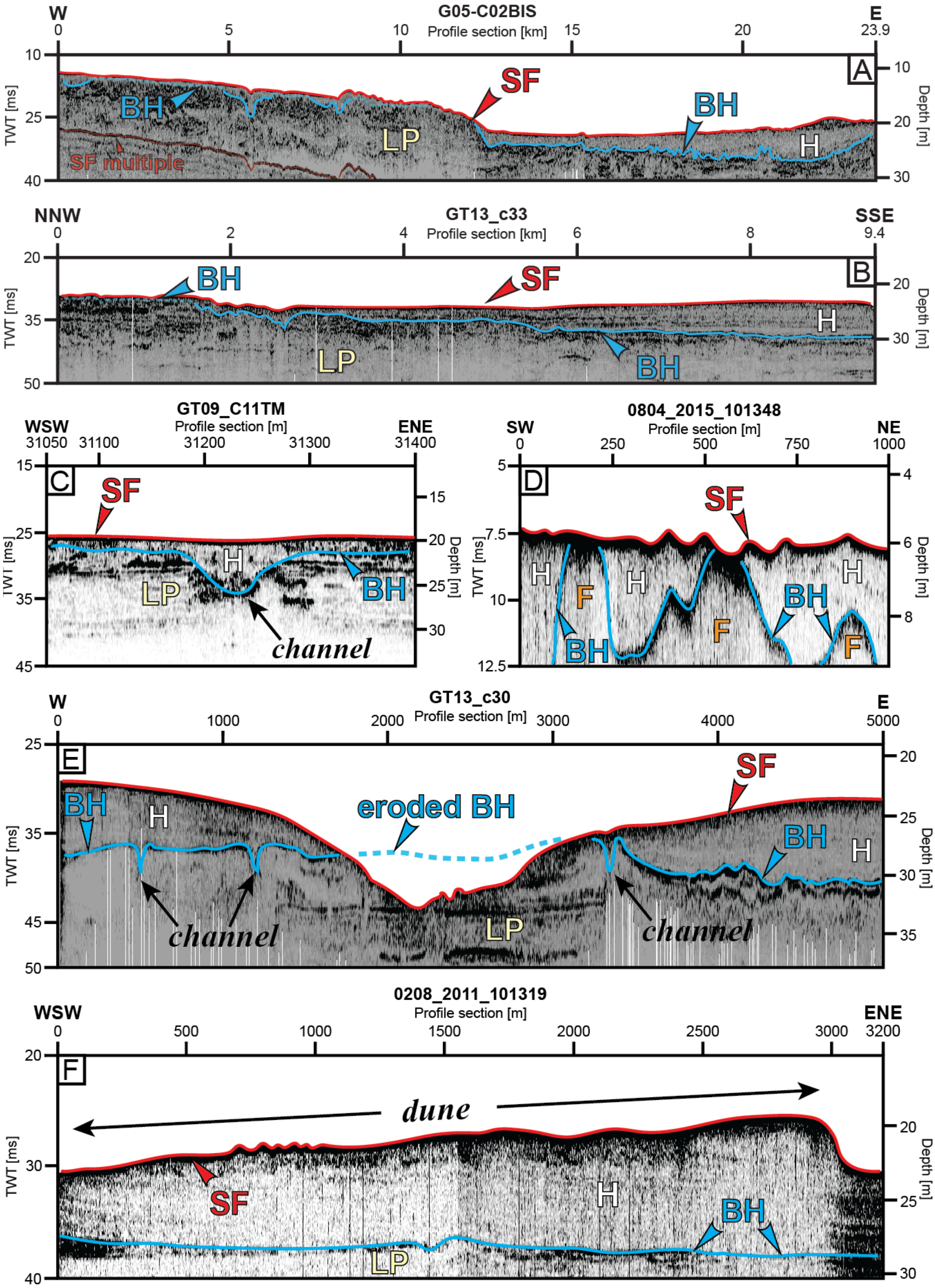

Figure 8: Examples of sub-bottom and Chirp sonar profiles (for explanation of symbols refer to caption of Fig. 3); (a-b) Regional Chirp profiles show that the Late Pleistocene paleotopography forms a basin in the eastern part which serves as a depocentre for the Holocene marine sediment (dashed blue line – base of the Holocene sediment where the sedimentary sequence is very thin or even absent or eroded); (a) A W-E oriented profile showing a difference in

marine Holocene thickness in the western and eastern part of the Gulf. Note that thicker Holocene marine sequences in the western part of the Gulf are filling channel-like features; (b) A NNW-SSE oriented profile showing the same difference in Holocene marine thickness; (c-f) Variations of the thickness of marine Holocene sediment; (c) A profile from the central part of the Gulf, where a thin Holocene marine sediment cover is characteristic, except where it fills pre-existing channels; (d) Variation of Holocene sediment thickness controlled by the pre-existing Flysch paleotopography in the area of Debeli rtič; (e) Holocene sediment erosion in the seafloor depression in front of Piran (Fig. 6), note also Holocene filling of pre-existing channels; (f) Thicker Holocene sedimentary sequences visible on a profile crossing the area of dunes in front of Piran (Fig. 6). For locations of the profiles see Fig. 5.

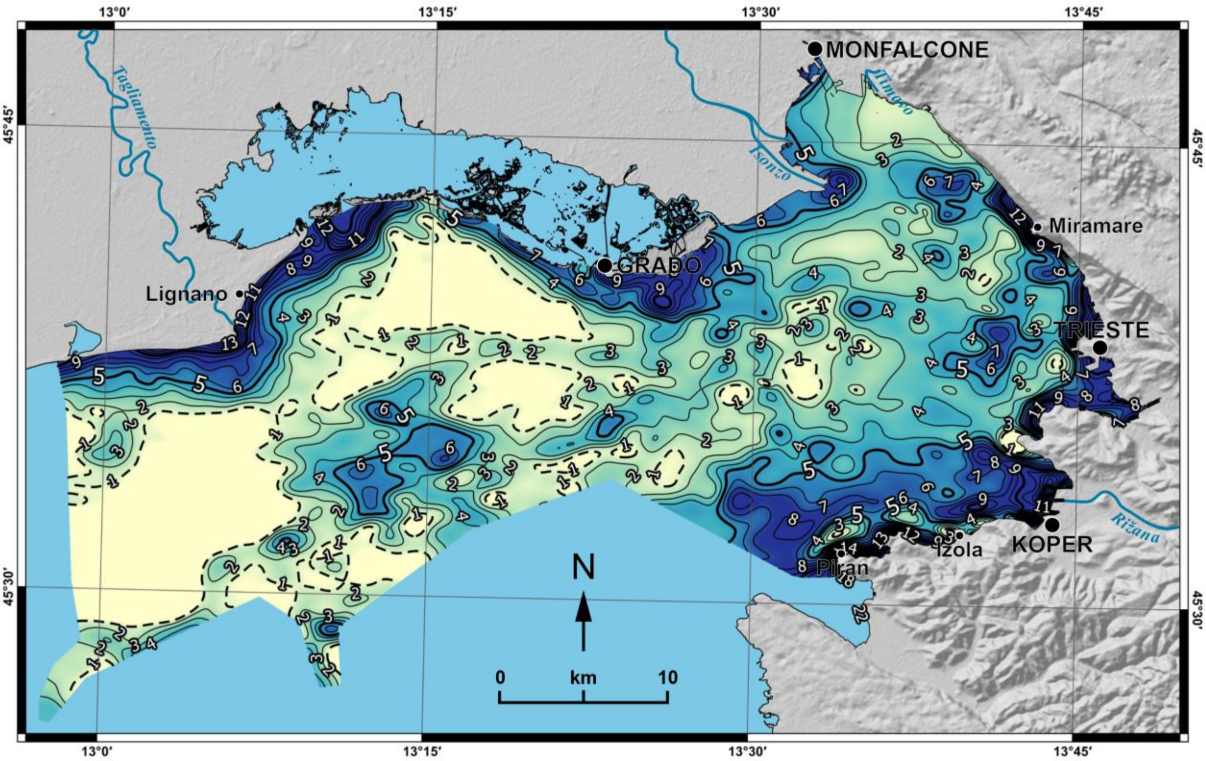

Figure ~~7~~9: Map of the thickness of the Holocene marine sediment in meters. Dashed black lines mark areas where Holocene marine sediment is thinner than one meter or even absent.

Core/well	Water depth [m]	Holocene thickness [m]	Dated material	Core depth of dated material [m]	Reported conventional ^{14}C age (years BP)	Reported calibrated ^{14}C age (years BP)	Reference	Label colour
VE04-06	15.6	>3.27	peat	2.90-2.91	8,530 ± 40	9,477-9,546	Trincardi et al., 2011a	green
VE04-11	24.5	1.63	peat	1.67-1.68	8,610 ± 50	9,516-9,689	Trincardi et al., 2011a	green

VE04-14	21.7	1.61	freshwater gastropod shell	3.48	9,630 ± 40	10,784-11,034	Trincardi et al., 2011a	green
VE04-15	21.9	2.48	peat	2.67-2.68	8,750 ± 55	9,549-9,920	Trincardi et al., 2011a	green
VE04-18	22	1.12	*Cerastoderma glaucum* shell	0.97-0.98	8,860 ± 40	9,265-9,507	Trincardi et al., 2011a	green
VE04-23	12.5	0.05	/	/	/	/	Trincardi et al., 2011a	green
VE05-06	21	0	peat	0.82-0.83	8,210 ± 45	9,021-9,302	Trincardi et al., 2011a	green
S12	0	6.55	/	/	/	/	Marocco et al., 1984	blue
S9	-1.7	2.45	beach shells	1.05	2,300 ± 105	/	Marocco, 1989	blue
			Cerastoderma glaucum shell	2.60	1,400 ± 290			
			organic material	5.76	3,660 ± 290			
			Cerastoderma glaucum shell	10.05	5,540 ± 225			
			peat	22.0	20,200 ± 720			
GT2	13.5	>5.43	/	/	/	/	Gordini et al., 2002 & Zecchin et al., 2015	orange
GT3	20	0.83	peat	0.86-0.88	18,630 ± 60	21,650-22,610	Gordini et al., 2002 & Zecchin et al., 2015	orange
GT4	14	1.32	/	/	/	/	~~Gordini et al., 2002 &~~/ Zecchin et al., 2015	orange
S19	-2.5	17.5	organic material	2.2	300 ± 110	/	Marocco, 1991; Gordini et al., 2002;~~ &~~ Zecchin et al., 2015	orange
			mollusc shells	15.2	2,040 ± 70			
GT1	23	1.55	sedimentary organic carbon	0.12	4,020 ± 30	/	Covelli et al., 2006	purple
			sedimentary organic carbon	0.31	4,170 ± 55			

			sedimentary organic carbon	0.72	7,320 ± 40			
			sedimentary organic carbon	1.60	9,030 ± 70			
			sedimentary organic carbon	2.00	9,140 ± 40			
			Viviparus contectus shell	2.38	9,610 ± 40			
GT2	15	1.75	sedimentary organic carbon	0.15	3,370 ± 40	/	Covelli et al., 2006	purple
			sedimentary organic carbon	0.55	3,820 ± 50			
			sedimentary organic carbon	1.55	5,860 ± 40			
			sedimentary organic carbon	1.95	9,380 ± 40			
			sedimentary organic carbon	2.75	9,040 ± 50			
			sedimentary organic carbon	2.95	8,270 ± 50			
			sedimentary organic carbon	3.15	8,770 ± 40			
GT3	25	0.85	sedimentary organic carbon	0.64	4,560 ± 35	/	Covelli et al., 2006	purple
			Cerastoderma glaucum shell	0.87	8,810 ± 40			
			sedimentary organic carbon	1.20	9,160 ± 50			
M1	4.9	1.9	/	/	/	/	Romeo, 2009	yellow
M2	5.15	1.4	/	/	/	/	Romeo, 2009	yellow
M3	5.4	14.5	/	/	/	/	Romeo, 2009	yellow
M4	5.2	7.9	/	/	/	/	Romeo, 2009	yellow
AIII-7	13	14.2	/	/	/	/	Ogorelec et al., 1997	red
V1-95	12	19	/	/	/	/	Ogorelec et al., 1997	red
MK6	7	21	/	/	/	/	Ogorelec et al., 1991, 1997	red
V3	4.5	25	/	/	/	/	Ogorelec et	red

							al., 1991, 1997	
V6	0	26.5	peat	26.5	9,160 ± 120	/	Ogorelec et al., 1981	red

Table 1: Previously published w~~W~~ells and cores used in this study with reported ^{14}C ages. The > symbol indicates, that the core contains only Holocene marine sediment.

Area	**Year**	**Institute**	**Type**	**Instrument**	**Quantity**	**Reference**
Porto Buso inlet	2006	OGS	Multibeam	Reson Seabat 8125	1.6 km^2	Cova, 2008
Grado inlet	2007	OGS	Multibeam	SWATHplus-Wide swath Bathymetry & Side scan sonar system Sea	1.7 km^2	Gordini, 2008a
Morgo inlet	2007	OGS	Multibeam	SWATHplus-Wide swath Bathymetry & Side scan sonar system Sea	0.3 km^2	Gordini, 2008a
Central part of the Gulf	2009	OGS	Multibeam	Reson SeaBat 8111 hull mounted	49 km^2	Zgur et al., 2010
Slovenian and Central part of the Gulf	2013	OGS	Multibeam	Reson SeaBat 8111 hull mounted	20.6 km^2	Zgur et al., 2013
Slovenian part of the Gulf	2006-2009	Harpha Sea d.o.o.	Multibeam	Reson SeaBat 8125 & Elac HydroStar 4300	205 km^2	Poglajen, 2012; Slavec, 2012
Porto Buso – Monfalcone	2007	OGS	Singlebeam	Garmin echosounder	62 km	Gordini, 2008b
Porto Buso	2007	OGS	Singlebeam	Garmin echosounder	250 km	Gordini, 2008c
Tagliamento Delta	2002-2003	OGS	Singlebeam	Lowrance LCX – 18C echosounder	120 km	Gordini et al., 2006

Table 2 – Multibeam and singlebeam datasets used for the bathymetric model (previously published only in internal reports/thesis).

Area	**Year**	**Institute**	**Type**	**Instrument**	**Quantity**	**References**
Lignano	2000	OGS	Boomer	Boomer CEA PULSAR 2002 & UWAK 05	61.7 km	Della Vedova et al., 2002

Lignano	2002-2003	OGS	Chirp	Datasonic Sub-bottom Profiler CHIRP CAP-6600	153.1 km	Gordini, 2009; Zecchin et al., 2015
Grado & Grado-Marano lagoon	2008	OGS	Boomer	Boomer CEA PULSAR 2002 & UWAK 05	60.9 km	Baradello et al, 2009
Miramare	2003	OGS	Boomer	Boomer CEA PULSAR 2002 & UWAK 05	16.2 km	Romeo, 2009
Gulf of Trieste	2005	OGS	Chirp	Benthos CHIRP II Hull mounted 16 transducers	179.2	Busetti et al., 2005
Gulf of Trieste	2009	OGS	Chirp	Benthos CHIRP II Hull mounted 16 transducers	516.4 km	Zgur et al., 2010
Gulf of Trieste	2013	OGS	Chirp	Benthos CHIRP II Hull mounted 16 transducers	160.3 km	Zgur et al., 2013
Muggia	2013	OGS	Boomer	Boomer CEA PULSAR 2002 & UWAK 05	76.5 km	Baradello et al., 2013
Piran-Koper	2013	OGS	Boomer	Boomer CEA PULSAR 2002 & UWAK 05	26.1 km	Baradello, pers. comm.
Slovenian waters	2009-2015	Harpha Sea d.o.o.	Parametric sub-bottom sonar	Innomar Parametric Sediment Echo Sounder SES-2000 Compact	560.8 km	Žerjal et al., 2015, Poglajen, pers. comm.
Strunjan bay	2013-2014	Harpha Sea d.o.o.	Parametric sub-bottom sonar	Innomar Parametric Sediment Echo Sounder SES-2000 Compact	53.3 km	Trobec, 2015

Table 3: Seismic and acoustic data used for the model of the base of the Holocene marine sediment (previously published only in internal reports/thesis).