UNIWERSYTET SZCZECIŃSKI
INSTYTUT NAUK O MORZU I ŚRODOWISKU

Deep-time Digital Earth
IUGS Big Science Program

DDE Marginal Seas Task Group

Annual Activity Report 2021 (short)

1. Introduction

The Executive Committee of the Deep-time Digital Earth (DDE) Big Sciences Program of the International Union of Geological Sciences (IUGS) has established a DDE Marginal Seas Task Group (MargSeas TG) in January 2021. The Task Group consists of 12 Scientists from 9 countries.

The vision of the Marginal Seas Task Group is to describe the processes operating in marginal seas holistically as an interaction between geo-, ecosystem, climate and socioeconomic systems during the late Pleistocene, Holocene and Anthropocene based on big data analyses, functional numerical models and AI approaches. For model validation we shall use data bases reflecting stages of marginal seas development. These models allow reconstruction of the geologic history of study areas, as well as the generation of future projections and scenarios. The development of this strategy is regarded the **mission** of the Marginal Seas TG. Our **vision** will be the balance between the protection of the natural environment of marginal seas and the economic use of their resources based on new data and new model driven cognition methods.

Mission, vision, targets and work plans refer to the DDE website https://www.ddeworld.org/working and to a presentation at the 2nd Working- and Task Group meeting of the DDE held online on May 5, 2021 (https://youtu.be/YORJBwzMF7M)

2. Activities and Achievements 2020 / 2021

2.1 Sharing global geoscience knowledge through scientific networking

An international and interdisciplinary network of scientists focused on marginal seas research has been established for knowledge sharing using three main tracks of communication:

2.1.1 Regular Marginal Seas Webinars:

As a response to the increasing importance of the investigation of marginal seas the Institute of Marine and Environmental Sciences, University of Szczecin, has started first in the Winter Semester 2021/2022 monthly an online MargSeas seminar (webinar). Internationally acknowledged scientists have been invited to present lectures and discussions of modern marginal seas research results (enclosure 1).

2.1.2 International conferences:

- **Online-conference "Marginal Seas – Past and Future" (Dec 16/17, 2020)**

  This conference was hosted by the University of Szczecin, Poland and co-organized by the DDE Marginal Seas Task Group together with the Baltic Earth scientific network. For technical program and scientific summary see https://baltic.earth/ems2.

- **Online-conference "Marine Geology: Marginal Seas – Past and Future" (Dec 14-17, 2021)**

  The conference was hosted by the Guangzhou Marine Geological Survey / Geological Survey of China. The DDE Marginal Seas Task Group served as co-organizer.
  For technical program see https://www.baltic earth.eu/imperia/md/assets/baltic_earth/baltic_earth/baltic_earth/ying_wen_hui_yi_shou_ce_mg_conference_program_2021.12-final.pdf.
  for abstracts of presentations see https://www.baltic-earth.eu/imperia/md/assets/baltic_earth/baltic_earth/baltic_earth/ying_wen_zhai_yao_ji__abstracts-mg_conference_2021.12-final.pdf

2.1.3 Publications

Selected manuscripts presented at the online-conference **"Marginal Seas – Past and Future"** (Dec 16/17, 2020) will be published in a **Special Issue** of the Elsevier Journal OCEANOLOGIA.
13 manuscripts have been submitted, 5 of them are published online already.

7 manuscripts have been prepared by members of the DDE Marginal Seas Task Group: Bailey and Cawthra (2021), Grande and Foglini (in revision), Groh and Harff (in review), Porz et al. (in review), Soomere (in revision), Zhang et al. (in revision), Zhamoida et al. (in revision)

The editorial work is supposed to be completed in March 2022 so that the SI will appear in 2022.

2.2 Modeling of coastal dynamics

2.2.1 Initiating an international DDE Marginal Seas research project (MS Project).

The Executive Committee and the Science Committee of the Deep-time Digital Earth have approved for implementation a research project **"Morphological Evolution of Coastal Seas – Past and Future"** with the goals:

a) Integrating interdisciplinary data describing the structure and evolution of three exemplary Eurasian marginal seas (North Sea, Baltic Sea and South China Sea) over the past 130 kyr,

b) Developing advanced numerical methods ("Big-data" driven & mechanistic) of complex geo-systems to generate environmental scenarios for Eurasian coastal areas on the global, regional and local level,

c) Application of these methods to three targeted Eurasian marginal seas (North Sea, Baltic Sea and South China Sea) in order to reconstruct the geological and environmental history and to generate future scenarios for the end of this century by applying results of climate modeling,

d) To mitigate the threats of coastal erosion and other environmental hazards by developing strategies of sustainable management of the coastal zones based on numerical experiments,

e) Development of open digital platforms of FAIR data and model tools to allow societal stakeholders to generate cause-effect scenarios with the goal of optimizing impacts of environmental management.

Team / Partners:

Helmholtz Center Hereon, Geesthacht, Germany : Dr. Wenyan Zhang (PI), Dr. Eduardo Zorita, Dr. David Greenberg
One PhD student (in-kind support)
One Postdoc (DDE funding)

Guangzhou Marine Geological Survey (GMGS), China: Dr. Jinpeng Zhang
Two Postdocs with full engagement for 2 yrs (in-kind support)

China University of Geosciences (CUG); China: Prof. Dr. Xinong Xie,
One PhD student for 3 yrs (in-kind support)

University of Szczecin (USZ), Poland: Prof. Dr. Joanna Dudzinska-Nowak,
Two master students, one PhD student (in-kind support)

Technical University Dresden (TUD), Germany: Results achieved by Dr. Andreas Groh, will be integrated in the research results.

The online Kick-Off Meeting for the project was held online on Oct 6, 2021.

The contract between DDE and Helmholtz Center Hereon and the DDE Research Center of Excellence (Suzhou) was signed on October 26, 2021.

The Council of the International Association for Mathematical Geosciences (IAMG) has decided to sponsor scientific project meetings.

2.2.2 Inventory of selected Marginal Seas data bases:

Directly connected with the MS Project is the development of an inventory of data bases to be used for the application of morphodynamic models for coastal areas of the marginal seas to be compared: Baltic Sea, North Sea, South China Sea. MSc. Jakub Miluch have been hired by the University of Szczecin (financed by DDE) to establish a first approach of a Marginal Seas Data Base Inventory from June to August 2021 (MSDI project). He defended the results of his study online on Sept 22, 2021, to an evaluation committee consisting of members of the DDE Marginal Seas Task Group.
As final results a prototype of data base inventory MSDI was generated for a first implementation for the DDE Marginal Seas TG project "Morphological evolution of coastal seas – Past and Future". The prototype defines interfaces for future it may be developed and expanded into wider range of tasks of marginal seas research. The author developed a concept of keywords to navigate within the MSDI system assigned to categories such as: spatial hierarchy, process to be investigated, sphere, variable, data type and dimension of data field. A filtering algorithm shall help the user to retrieve databases web-addresses according to the user's inquiry. The concept of Marginal Seas Database Inventory (MSDI) shall provide convenient tools supporting marine geoscientists in searching for data sources. The results are summarized in a report (Miluch 2021) submitted to DDE on Jan 7, 2022.

Potential future steps in MSDI development would be a generalization to expand the inventory to more tasks and areas as well as to open wider scales of applications in marginal sea research.

3. Summary and Outlook

The establishment of the DDE Marginal Seas Task Group marks a step forward to understand comprehensively the functioning of marginal seas as buffer zones between continents and oceans helping to mitigate the threats of coastal environmental disasters and to promote planning for sustainable marine and coastal development.

Main results of the work phase 2020/2021:

- The Marginal Seas conferences served as base line studies for the further research program of the Marginal Seas Task Group.
- The development of the concept of Marginal Seas Database Inventory (MSDI) as a convenient tool supporting geoscientists by simplifying and fastening searching for data. The concept allows users of mathematical model applications in marine sciences to generate specific data sets for the parametrization of the models referred to the solution of a current scientific task.
- The successful application for funding of the project "Morphological Evolution of Coastal Seas – Past and Future" provides the sources for three years advanced marginal seas research.

Main steps to go:

- Foster the internal co-operation and scientific exchange with DDE WTGs and the external co-operation with natural scientists, socio-economists, modelers and IT specialists for harmonization and standardization and data sharing of marginal seas geo-data and AI /numerical model design,
- Develop the co-operation with International science programs and societal stakeholders to generate cause-effect scenarios with the goal of optimizing environmental management strategies for sustainable development of marginal seas and their coastal zones,
- Expand the team's creativity by involving young scientists in particular by developing cooperation with the International Association for Mathematical Geosciences (IAMG).

References

Bailey, G., Cawthra, H., (in press): The significance of sea-level change and ancient submerged landscapes in human dispersal and development: A geoarchaeological perspective. OCEANOLOGIA, doi.org/10.1016/j.oceano.2021.10.002

Grande, V., Foglini, F., (in revision). Spatial data integration and harmonization in the Adriatic Sea – how to make data FAIR (Findable, Accessible Interoperable and Researchable) for habitat, geological mapping and process modelling. submitted to OCEANOLOGIA

Groh, A., Harff, J., (in review): Relative sea-level changes induced by glacial isostatic adjustment and sediment loads in the Beibu Gulf, South China Sea. submitted to OCEANOLOGIA.

Porz, L., Zhang, W., Schrum, C., (in review): Natural and anthropogenic influences on the development of mud depocenters in the southwestern Baltic Sea. submitted to OCEANOLOGIA

Soomere, T., (in revision). Numerical simulations of wave climate in the Baltic Sea. submitted to OCEANOLOGIA

Zhamoida, V., Sergeev, A. Ju., Budanov, L. M., Nosevich, E. S., Ryabchuk, D., Grigoriev, A. G., Neevin, I. A., Bashirova, L. D., Ponomarenke, E. P., Prishchepenko, D. V., Pushina, Z. V., (in revision): Quaternary Geology of the East Siberian Sea. submitted to OCEANOLOGIA

Zhang, J., Tomczak, M., Witkowski, A., Xia, Z., Li, C. (in revision). A fossil diatom-based reconstruction of sea-level changes for the Late Pleistocene and Holocene period in the NW South China Sea. submitted to OCEANOLOGIA

Miluch, J. 2021. Marginal Seas Database Inventory: concept, first approach and future steps. internal report, 27 p., 7 Fig., 3 Tabl.

Szczecin, Jan 7, 2022

Prof. Dr. Jan Harff
DDE Marginal Seas Task Group Leader
University of Szczecin

enclosure 1

UNIVERSITY OF SZCZECIN

INSTITUTE OF MARINE AND ENVIRONMENTAL SCIENCES

together with
DDE Marginal Seas Task Group
and
Section of Marine Geology, Polish Scientific Committee on Oceanic Research,
Polish Academy of Sciences
warmly invite for

SZCZECIN Marginal Seas Webinars

Winter Semester 2021/2022

October 21 2021 2 pm	**Prof. Dr. Tarmo Soomere** *Estonian Academy of Sciences, Tallinn, Estonia* Alongshore transport and variations of cut-and-fill cycle of beaches in marginal seas
November 4 2021 2 pm	**Dr. Federica Foglini** *National Research Council, Institute of Marine Sciences - Bologna, Italy* The Adriatic Sea - an ideal laboratory for a comprehensive view of oceanographic, geological, ecosystemic, climatic and anthropogenic drivers
December 9 2021 2 pm	**Prof. Dr. Witold Szczuciński** *University of Poznan, Institute of Geology, Poznan, Poland* Sedimentation processes and accumulation rates on continental shelves of South China Sea and Andaman Sea - insights from ^{210}Pb and ^{137}Cs
January 27 2022 2 pm	**Dr. Daria Ryabchuk** *A.P. Karpinsky Russian Geological Research Institute, St. Petersburg, Russia* Russian Arctic - environmental geology and coastal processes

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LIVE ON Microsoft Teams

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