OceanPredict '19
GODAE OceanView Symposium | 6-10 May 2019 Halifax, Canada
Advancing the science and application of ocean predictions

Theme 6: User Applications and Societal Benefit

Session 2b: Other applications: navigation, acoustics, storm surges, ecosystems

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Canadian oceanic forecast product dissemination for end-user applications

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Over the last 10 years, Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada have been developing ocean forecasting capability under the interdepartmental CONCEPTS network (Canadian Operational Network of Coupled Environmental Prediction Systems). Under the purview of CONCEPTS, the DFO Service Desk for Operational Oceanography (SeDOO) was created in 2017 to better disseminate operational ocean products of the Government of Canada. Its mission is to facilitate the application of hydrodynamic models for end-users requiring observations and forecast information to support their operational marine applications. This includes supporting hydrographic electronic navigation and search and rescue services provided by the Canadian Hydrographic Service and the Canadian Coast Guard, respectively. The primary role of SeDOO is to participate in the data distribution processes to ensure product accessibility and compatibility between data format and end-users systems. An approach based on feedback interactions between clients/end-users and providers is proposed as a promising way to improve the quality of oceanic products (i.e., analysis and forecast), particularly in Canadian waters. The data access process and visualization tools are presented.

Keywords: Applications - Search and rescue, Applications - Ship navigation, Applications - Marine pollution, Applications - Ocean products for scientific, economic and societal use, Applications - Disaster & risk management

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Big data for winter navigation in the Northern Baltic Sea: Developments and application opportunities

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In Finnish waters, the presence of seasonal sea ice necessitates specific requirements for ship design and operational procedures for winter navigation. An essential aspect in the implementation of the winter navigation system is the provision of ice information by meteorological services to shipping companies, icebreakers, and regulatory authorities. Ice information is obtained from various sources, including on-site observation reports, ocean, sea ice, and atmospheric prediction models, and satellite imagery. Simultaneously, technological advances in marine technology have enabled, through the well-established implementation of the Automatic Identification System, the collection of navigational data of the vast majority of commercial shipping traffic.

Recently, efforts have been made to develop an integrated database of shipping traffic data, ocean and ice observation and prediction data, and other contextual data. This database focuses on winter conditions in Finnish sea areas. It contains navigational data of vessels in the sea area (positions, speeds, courses), data about these vessels (dimensions, ice classes, available power), ocean, sea ice, and atmospheric predictions (wave and current conditions, ice characteristics, wind speeds, air temperatures) and observations. It can also be linked with specific smaller datasets, such as accident databases. This comprehensive shipping database provides a rich source to understand several aspects of maritime traffic in winter conditions. Through data analysis techniques, derived data products can be developed to assist decision making in specific operations, or to plan the overall maritime traffic system.

In this talk, an overview is fist given of the integrated database. Then a selection of derived data products is presented, with potential applications for decision support for onboard navigational operations, or for tactical and strategic planning for maritime authorities. Finally, several data uncertainties, and future development prospects and related issues, are discussed.

Keywords: Applications - Ship navigation, Applications - Ocean products for scientific, economic and societal use, Applications - Disaster & risk management, Applications - Search and rescue, Applications - Marine pollution

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Under the Ocean Protection Plan, CHS is developing new dynamic hydrographic products and services to ensure the safety of navigation under new IHO standards

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The Ocean protection Plan,initiated by the Canadian Federal Government in 2017, has granted new resources to the Canadian Hydrographic Serviceto fill important gaps in hydrography and charting in critical areas across the country with limited and out-of-date navigational information including high risk coastal and inland water zones as well as 23 of the busiest, highest traffic commercial ports and waterways across the country. It also provides more extensive efforts over five years to fill hydrographic data gaps in the Arctic as well as in near-shore areas in B.C., Newfoundland and Labrador, Gulf St. Lawrence and Great Lakes Basin. This initiative also strengthens navigational safety and the prevention of marine incidents by delivering dynamic e-navigation products (tide and water level, under-keel and overhead information) in key areas such as Kitimat, Vancouver, Fraser River, Straits Canso, St. John and St. Lawrence River Quebec-Montreal corridor. This presentation will present some progress through the development and new approaches towardsdynamic hydrographic products and CHSs nationaltidal gauge network.

Keywords: Applications - Ocean products for scientific, economic and societal use, Applications - Ship navigation, Applications - Capacity building, Applications - Coastal protection, DA - Data assimilation applications

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An Atlas of the Changing Soundscape in Canadian Oceans

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Underwater noise generated by human activities such as shipping raises concerns about its potential impact on marine life, for instance, by affecting their ability to navigate, communicate, feed, and reproduce. With increased shipping activity along traditional routes and the opening of new shipping lanes, changes in noise distribution in Canadian waters are expected. The Canadian Species at Risk Act imposes to protect the habitats of endangered species from degradation. It is therefore imperative to better understand and quantify the impacts of shipping noise on marine life, so that adequate and efficient protective measures can be implemented where necessary. To aid these efforts, MERIDIAN (Marine Environmental Research Infrastructure for Data Integration and Application Network) and collaborators are developing a web-based, interactive Ocean Soundscape Atlas that will enable users to visualize and explore modeled noise levels in a multitude of dimensions including latitude, longitude, depth, time, frequency, and source type, and obtain impact risk estimates in areas of interest. The Ocean Soundscape Atlas uses validated physical models to determine the levels of noise in Canadian waters due to shipping activity and geophysical environmental noise sources such as wind and waves. The Atlas will provide a novel interface between researchers, on one hand, and managers, policy makers, and the general public, on the other hand, facilitating the transfer of scientific information from researchers to the public and more generally contributing to an increased ocean literacy. The Atlas will allow managers and policy makers to monitor trends in the state of the ocean acoustic environment, and hence ensure more timely, effective, and efficient marine environmental conservation and management of the valued and especially protected marine species.

Keywords: Applications - Acoustic applications, Applications - Environmental assessment, Applications - Ocean literacy, Applications - Sustainable use of ocean resources for economic growth (blue economy), Systems - Visualisation

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Storm Surge Simulation According to the Change of the Moving Speed of Typhoons, MAEMI(0314) and CHABA(1618)

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Typhoon SOULIK (1819), which passed through the Korea peninsula in August 2018, was expected to cause serious damage on the west coast via storm surge. However it moved relatively slowly compared to other typhoons, making it difficult to predict the path, speed and damage intensity of the typhoon. Therefore, accurate prediction of storm surge is important to reduce the damage caused by typhoons. In this study, storm surge simulations were carried out to investigate the change in sea level with the change in the speed of MAEMI (1314) and CHABA (1618) which made landfall in the southern coast in the past. Typhoon MAEMI (0314) caused a storm surge of up to 2.1 m in Masan, resulting in property damage worth $ 48.8 billion and 133 deaths. In addition, Typhoon CHABA (1618) caused a storm surge of up to 1.1 m in Masan, resulting in property damage worth $ 1.83 billion and seven deaths.

In this study, the Delft3D Flexible Mesh (FM) model developed by Deltales of the Netherlands was used to determine the change in sea levels according to changes in typhoon movement speed. The Delft3D FM model uses finite volume equations with non-structural lattice models such as triangles, squares, pentagons to simulate storm surges, water levels, waves, sediment transport, water quality and ecology. Using the tide data from the tide station of the Korea Hydrographic and Oceanographic Administration, tide verification was performed at eight stations in the Korean peninsula. Simulation of the storm surge was performed by inputting the calculated wind field using the typhoon parameter model operated by the Korea Ocean Institute of Science and Technology. The results of the numerical model show that the maximum sea level errors for three regions (Yeosu, Tongyeong and Masan) in the southern coast of the peninsula were slightly overestimated in the range of 2 ~ 18 cm. However the model results generally agree with the observations. As the typhoon speed increased the peak duration shortened in all three regions. The maximum surge height increased in Yeosu but decreased in Tongyeong and Masan owing to geographical differences.

Keywords: Applications - Disaster & risk management, Applications - Coastal protection, Models - Ocean model configurations, Models - Model assessments and verification, Models - Model grid structure and resolution

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A seasonal forecasting tool for the northern Gulf of Mexico hypoxic zone

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We present and evaluate a tool for producing seasonal forecasts of the hypoxic zone in the northern Gulf of Mexico. This region receives large amounts of freshwater and nutrients from the Mississippi-Atchafalaya River Basin. On the continental shelf in the northern Gulf, the high nutrient load promotes phytoplankton production, high respiration rates during algal decomposition and, in conjunction with water column stratification, the development of bottom water hypoxia (O2<62.5 mmol m-3). Hypoxic conditions have detrimental effects on benthic organisms that propagate through the foodweb and impact the ecology and commercial fisheries in the region. Coupled circulation-biogeochemical models provide high-resolution information to managers on present and past states of hypoxia of the northern Gulf but cannot be used directly to forecast hypoxia because they require atmospheric forcing that is not available far enough into the future. We present a weighted-average method to calculate a time-resolved forecast of the size and location of the hypoxic zone throughout the summer based on the nitrate load in spring and a 34-year, high-resolution biogeochemical hindcast (1985-2018). The mid-summer forecast compares reasonably well with observations (r2=0.85). Forecast skill is degraded in years with anomalous wind forcing and freshwater discharge in summer. Their effect on the forecast is quantified.

Keywords: Applications - Ocean products for scientific, economic and societal use, Applications - Water quality, Models - Ecosystem/BGC modelling, Systems - Probabilistic forecasting,

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