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

Theme 2: Observations for Ocean Prediction

Session 1: Observations in the subpolar and arctic oceans

Abstract ID: 3615602

Polar Ocean Observations: A Critical Gap in the Observing System and its effect on Environmental Prediction

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There is a growing need for operational oceanographic predictions in both the Arctic and Antarctic polar regions. In the former, this is driven by a declining ice cover accompanied by an increase in maritime traffic and exploitation of marine resources. Oceanographic predictions in the Antarctic are also important, both to support Antarctic operations and also to help elucidate processes governing sea ice and ice shelf stability. However, a significant gap exists in the ocean observing system in polar regions, compared to most areas of the global ocean, hindering the reliability of ocean and sea ice forecasts. This gap can also be seen from the spread in ocean and sea ice reanalyses for polar regions which provide an estimate of their uncertainty. The reduced reliability of polar predictions may affect the quality of various applications including search and rescue, coupling with numerical weather and seasonal predictions, historical reconstructions (reanalysis), aquaculture and environmental management including environmental emergency response. Here, we outline the status of existing ocean observational efforts in polar regions, discuss gaps, and explore perspectives for the future. Specific recommendations include a renewed call for open access to data, especially real-time data, as a critical capability for improved sea ice and weather forecasting and other environmental prediction needs. Dedicated efforts are also needed to make use of additional observations made as part of the Year of Polar Prediction (YOPP; 2017-19) to inform optimal observing system design. To provide a polar extension to the Argo network, it is recommended that a network of ice-tethered profilers and ice mass balance buoys be deployed and supported operationally in ice-covered areas together with autonomous profiling floats (potentially with ice detection capability) in seasonally-ice covered seas. Finally, additional efforts to better measure and parameterize surface exchanges in polar regions is much needed to improve coupled environmental prediction.

Presentation Format: Oral Session

Keywords: Observations - In-situ ocean observing systems, Observations - Ocean Obs '19, Observations - International ocean observation projects (e.g. YOPP, TPOS2020, etc.), Observations - Observing system needs and future challenges, Evolution - International and intergovernmental collaboration

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Slocum and Wave glider observations in the Northwest Atlantic and Gulf of Saint Lawrence

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The Coastal Environmental Observation Technology and Research (CEOTR) glider group operates seven Teledyne Webb Research Slocum gliders and two Liquid Robotics Wave gliders predominantly on the Scotian Shelf and in the Gulf of Saint Lawrence, supporting a variety of research projects in collaboration with investigators across Canada and the USA. The data collected has gone towards extending federal monitoring programs on the Scotian Shelf; validating models of ocean temperature and salinity; aiding in environmental assessments of the effects of the Maritime Link on snow crab behaviour; relating ocean conditions to salmon migration; and understanding the movements of marine mammals on the east and west coasts of Canada. Since all of our gliders are equipped with a CTD we have been able to obtain temperature and salinity measurements either throughout the water column with the Slocum glider or at the ocean surface with the Wave glider for all of our missions. To date, our gliders have traveled over 70 000 km on the Scotian Shelf and the Gulf of Saint Lawrence. These missions have spanned all seasons and up to force 10 winds on the Beaufort scale. Subsampled oceanographic data are sent through the iridium satellite network in near real-time. Full resolution data are obtained from the gliders once they are recovered. These data are processed and combined with metadata according to IOOS standards and then are publicly served through an ERDDAP server and submitted to international organizations for use by the general research community.

Presentation Format: Oral Session

Keywords: Observations - In-situ ocean observing systems, Observations - Integration of local/coastal measurements in the global observing system, Applications - Acoustic applications, Applications - Water quality,

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On whether or not to calibrate observations

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Learning from a hierarchy of biological systems has been proposed as a template for how ocean (and climate) modelling could be approached. Here we extend this form of exploration to elaborate on regression as the basis for many of the statistical models used to combine oceanographic models and observations. Ordinary linear regression assumes that each datum is the sum of two components: a deterministic term (linearly related to the shared explanatory variable, called truth) and a random term (unshared error). A slightly more sophisticated model includes shared and unshared components of both truth and error (i.e., including notions of unshared or partial truth and cross-correlated error). The solution of such a model is applied to various marine datasets with two simple questions in mind: how much variance remains as shared error when these components of truth and error are considered and how large does shared truth have to be to justify a calibration of one dataset to another? Two variables of interest are marine visibility and significant wave height, but other variables may be included.

Presentation Format: Oral Session

Keywords: DA - Fundamentals and methodologies of data assimilation, DA - Model and observation systematic errors, Observations - Observing system needs and future challenges, Observations - Estimates of measurement errors,

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How Might the Canadian Integrated Ocean Observing System Support Ocean Prediction Systems?

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The Canadian Integrated Ocean Observing System (CIOOS) is being built through a public, private and academic partnership and will bring together and leverage existing Canadian and International ocean observation data/programs/projects. It will generate value-added data products on an open web-based platform that maximizes utility to end-users, and provide timely access to a broad range of environmental information. CIOOS will improve coordination and collaboration among diverse data sources/holders, improve access to information for decision making and provide data support for a wide variety of applied and theoretical research efforts to better understand, monitor, and manage activities in Canadas Oceans.

In the fall of 2018, three prototype regional associations were created with funding from the Department of Fisheries and Oceans (DFO) and the Marine Environmental Ocean Prediction and Response (MEOPAR) National Centre of Excellence and contributions from partner organizations in the regions. The Pacific Regional Association partners include Ocean Networks Canada and Tula. The Atlantic Regional Association partners include Dalhousie University, the Ocean Frontier Institute, the Ocean Tracking Network, the Marine Institute of Memorial University of Newfoundland and the Coastal and Ocean Information Network Atlantic. The Gulf Regional Association partner is the Saint Lawrence Global Observatory and will cover spatially the St. Lawrence Estuary and the Gulf of St. Lawrence. During the prototype phase of CIOOS the Regional Associations will concentrate on engaging with ocean data producers and consumers, and supporting the management and dissemination of a preliminary list of ocean variables: surface currents, water level, waves, wind, ice cover, temperature, salinity, density, dissolved oxygen, pH and nutrients (phytoplankton/Chl). Some additional variables may be explored.

Access to ocean observing data is key to both creating and evaluating ocean prediction systems; this presentation will present an opportunity for CIOOS representatives and attendees to explore how CIOOS can support ocean prediction activities in the prototype phase and beyond.

Presentation Format: Oral Session

Keywords: Observations - Integration of local/coastal measurements in the global observing system, Systems - Ocean product distribution/dissemination and accessibility, DA - Data assimilation applications, Evolution - Enhancing community collaboration (observations, modelling, operations, users), Systems - Visualisation

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Observations of oceanic mesoscale dynamics by satellite remote sensing

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Oceanic mesoscale dynamical processes are ubiquitous throughout the ocean. They connect large scale ocean circulation to small scale ocean turbulence, thus modulating the mass, momentum, and energy transport among multi-scale physical processes in the ocean. They also play a significantly important role in driving the functionality of ocean ecological systems, defining the trajectories of marine pollution plumes, and in constraining safety for marine search and rescues activities etc. Despite the important role they play, mesoscale dynamical processes, such as eddies and internal solitary waves, are generally difficult and expensive to monitor by conventional in situ observational methods, which demand high sampling resolutions in both temporal and spatial scales, and because of the unique randomness in the occurrence and development of these processes. Modern satellite remote sensing platforms provide observations over the ocean, with wide coverage and high resolution, which make them suitable to monitor the ocean mesoscale dynamical processes. In this presentation, we will introduce the application of synthetic aperture radar (SAR) to the monitoring of oceanic internal waves and eddies. As examples, we demonstrate that the information related to the mesoscale processes obtained from satellite remote sensing observations off the East Coast of Canada may be used to help detect and monitor the potential hot spots for marine primary production, and that these observations can be further adapted to estimate the potential habitat areas for important marine mammal species, for example, the endangered North Atlantic Right Whales.

Presentation Format: Oral Session

Keywords: Observations - Satellite ocean observing systems, Applications - Fisheries, Applications - Marine pollution, Applications - Search and rescue,

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Real-time ice and ocean properties from the Arctic Northwest Passage

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Oceanographic monitoring in the Arctic is important for understanding the physical, chemical, and biological environments, particularly given the enhanced warming of high latitude regions compared with the global average. Ongoing monitoring in Barrow Strait, in the Canadian Northwest Passage, by Fisheries and Oceans Canada scientists at the Bedford Institute of Oceanography have established a baseline of the physical environment that has been used for assessing Arctic ocean freshwater export, the role of sea-ice freeze-up and break-up on ecosystem dynamics, and prediction of sea-ice processes based on water property measurements. In recent years, the deployment of an underwater observatory has permitted the retrieval of year-round near real-time data from Barrow Strait using an underwater network comprised of acoustic modems, a subsea cable, and an Iridium connected shore station. A strength of the system design is that it permits real-time data retrieval even during Arctic winter conditions. We present an overview of the Barrow Strait real-time observatory system, the scientific goals motivating the real-time data stream, and examples of the newest instruments integrated into the system (including ice draft and passive acoustics).

Presentation Format: Oral Session

Keywords: Observations - In-situ ocean observing systems, Observations - Ocean monitoring based on observing systems, Applications - Ocean products for scientific, economic and societal use, Applications - Acoustic applications, Applications - Climate change research

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Evaluation of Arctic Ocean surface salinities from SMOS and two reanalyses against in situ data

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Although upper Arctic ocean stratification is mostly salinity-driven, the sea surface salinity (SSS) in the Arctic Ocean is still poorly known, due to its strong variability and the sparseness of in situ observations. Recently, two gridded SSS products have been derived from the European Space Agencys (ESA) Soil Moisture and Ocean Salinity (SMOS) mission, which are independently developed by the Barcelona Expert Centre (BEC) and the CATDS Ocean Salinity Expert Center (CEC-OS) at IFREMER. In parallel, there are two reanalysis products providing SSS from the Copernicus Marine Environment Monitoring Services (CMEMS), one global, one regional. The regionalArctic TOPAZ4 system assimilates a large set of sea-ice and ocean observations with an Ensemble Kalman Filter. The global reanalysis combines in situ and satellite data using a multivariate ensemble optimal interpolation method. In this study, focused on the Arctic Ocean, these four salinity products, together with two climatologies of WOA2013 and PHC, are evaluated against in situ datasets during 2011-2013. The deviations of SSS between the different products and against the in situ validation data show largest disagreements below the sea-ice and near the ice edge, especially in the summer months. In the Beaufort Sea, the summer SSS from the BEC product has the smallest - saline - bias (~0.6 psu) with the smallest root mean squared difference of 2.6 psu. This suggests a potential value of assimilating of this product into the forthcoming Arctic reanalyses.

Presentation Format: Oral Session

Keywords: Observations - Estimates of measurement errors, Observations - Satellite ocean observing systems, Systems - Ocean reanalysis, DA - Assimilation of new observation types, Applications - Climate change research

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