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 2: New Observation and data processing methods

Abstract ID: 3608373

Research in Action: The Observation Impacts of Using Autonomous Saildrone Unmanned Surface Vehicles

Douglas, Elizabeth[1] [1]Saildrone, Alameda, United States liz@saildrone.com

Saildrone designs and manufactures wind and solar powered unmanned surface vehicles (USVs) which make cost-effective in-situ ocean data collection possible at scale. Saildrone USVs are 7m long by 4.5m tall and are capable of long-range autonomous wind-powered missions (up to 12 months) to any ocean location while carrying a sophisticated ocean, meteorological, and fisheries sensor package. This data is then streamed in real-time via satellite. These USVs facilitate the science of autonomous fish stock assessment for blue economy initiatives, and whale monitoring and marine mammal tracking in the Bering Sea; weather data collection and satellite calibration in the Tropical Pacific; and environmental monitoring of oil seeps and nitrate flows in the Gulf of Mexico, to name few.

To explore the theme of observation impacts of Saildrone USVs in more depth, this session will examine the chain of some of our recent missions with the National Oceanic and Atmospheric Administration (NOAA), such as missions researching the Northern Fur Seal. Since 2016, the team at NOAA Alaska Fisheries Science Center have used Saildrone Unmanned Surface Vehicles (USVs) to investigate the declining Northern Fur Seal population and the declines link to foraging behavior. The Saildrone USVs in-situ observations of pollock, the Northern Fur Seals main source of food, enable scientists to have the geographical and temporal data necessary to show direct links between the fur seals and pollock. Previously, the ability to conduct such a study was limited by fisheries survey timing and resource allocation (both in research vessel time and scientist availability). The fisheries survey for pollock was not conducted at a time necessary to observe fur seal mother behavior in the summer in the Bering Sea.

Furthermore, the speed at which the Saildrone USV can collect in-situ biogeochemistry data also results in more timely information that can be used for immediate impact to communities; for instance, how NOAA Alaska Regional Managers work with local communities where the Northern Fur Seal breeds - St. Paul Island and St. George Island. This session will conclude with an examination of how access to faster, geospatially relevant data enables these managers to provide guidance for communities on several topics - such as marine protected areas and subsistence harvest - that impact not only the day-to-day lives of marine mammals, but also the people that live with them on these islands.

Keywords: Observations - In-situ ocean observing systems, Observations - Observation impacts, Observations - Ocean monitoring based on observing systems, Applications - Fisheries, Applications - Ocean products for scientific, economic and societal use

Presenter:
Elizabeth Douglas
Saildrone
Alameda, United States
liz@saildrone.com

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

Abstract ID: 3601912

Elucidating Drivers of Surface Variations in Dissolved Oxygen Observed by Profiling Floats in the Gulf of Mexico

Gordon, Christopher[1], Fennel, Katja[1], Shay, Lynn[2], Brewster, Jodi[2], Rudzin, Johna[2] [1]Dalhousie University, Halifax, Canada [2]RSMAS, University of Miami, Miami, USA chris.gordon@dal.ca

In May 2017, 10 autonomous APEX floats were deployed in the northern Gulf of Mexico surrounding the site of the Deepwater Horizon oil spill, to test the observational component of a predictive system that combines observations and models and can aid in responding to a potential future spill. The floats were equipped with a unique suite of sensors including a CTD, 2 current velocity/shear sensors, a bio-optical triplet measuring chlorophyll fluorescence, particulate backscatter, and colored dissolved organic matter (CDOM), and an oxygen optode. Typically, ARGO floats operate on a 10-day profile cycle but for this deployment the mission parameters were altered during weather events, such as Hurricanes Irma and Nate, to profile continuously. Therefore, the floats resolve processes occurring on shorter timescales during these periods. Results from the continuous portions of the deployment will be presented, showing examples of physically driven changes in dissolved oxygen (e.g. air-sea flux, internal waves), as well as biochemically driven cases (e.g. net community production). This analysis shows how various processes can have a significant effect on the oxygen inventory in the surface ocean, and how those processes manifest themselves in the temperature, salinity, velocity, and bio-optical observations. The data stream and quality control of the float measurements are also discussed, as well as their role in the context of a predictive numerical model.

Keywords: Observations - In-situ ocean observing systems, Observations - New observation types, Models - Ecosystem/BGC modelling, ,

Presenter:
Christopher Gordon
Dalhousie University
Halifax, Canada
chris.gordon@dal.ca

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

Abstract ID: 3547255

Latitudinal and bathymetrical species richness patterns in the NW Pacific and adjacent Arctic Ocean

Saeedi, Hanieh[1], Costello, Mark [2], Warren, Dan[3], Brandt, Angelika[1] [1]Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany [2]University of Auckland, Auckland, New Zealand [3]Senckenberg Biodiversity and Climate Research Centre, Senckenberganlage 25, 60325 , Frankfurt am Main, Germany hanieh.saeedi@gmail.com

Global scale analyses have recently revealed that the latitudinal gradient in marine species richness is bimodal, peaking at low-mid latitudes but with a dip at the equator; and that marine species richness decreases with depth. However, these patterns may conceal regional differences that help clarify the causes in these gradients. We analysed both latitudinal and depth gradients of species richness in the NW Pacific and its adjacent Arctic Ocean using distribution records of all marine species from the Ocean Biogeographic Information System (OBIS) and Global Biodiversity Information Facility (GBIF). We used 324,916 distribution records of 17,414 species to calculate alpha (average), gamma (total) and ES50 (estimated species for 50 records) per latitudinal band and depth zone.

We found that ES50, gamma, and alpha species richness decreased with latitude and depth. Most (73%) species occurred in shallow depths (0 to 500 m). The Visayas and Sulu seas had the highest alpha species richness (more than 13,000 species per 50,000 km2). Both gamma and alpha diversity increased from the equator towards the low-latitudes (5-10˚N), with a sharp increase at latitude 10˚N, then further decreased at higher latitudes. The latitudes 60-70˚N had the lowest gamma and alpha diversity where there is almost no ocean area available. Model selection on Generalized Additive Models showed that the combined effects of all environmental predictors including dissolved and saturated oxygen, temperature, primary productivity, chlorophyll a, current, salinity, and nitrate produced the best model driving alpha species richness in both shallow and deep sea.

Keywords: Models - Model assessments and verification, Observations - Estimates of measurement errors, DA - Variational data assimilation, DA - Estimates of probabilities, Systems - Ocean reanalysis

Presenter:
Hanieh Saeedi
Senckenberg Research Institute and Natural History Museum
Frankfurt am Main, Germany
hanieh.saeedi@gmail.com

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

Abstract ID: 3609359

Verification of ocean prediction systems on the Labrador Shelf against an NOVA ARGO drifter

Davidson, Fraser[1], Xu, Jinshan[2], Smith, Gregory[3] [1]Fisheries and Oceans Canada, St. John's, Canada [2]Fisheries and Oceans Canada, Halifax, Canada [3]Environment and Climate Change Canada, Dorval, Canada
fraser.davidson@dfo-mpo.gc.ca

We deployed a NOVA ARGO float in shallow water (<200m) on the Labrador Shelf from July 2017 that is still collecting observations 18 months later. The float has operated in 200m of water or less with daily profiling that persisted through the 2018 winter ice season with up to 100% ice coverage on the Labrador Shelf. This presentation showcases the utility of profiling floats on the shelf as an efficient means from providing real time observations for ocean prediction and verification purposes, in an otherwise poorly sampled harsh ocean condition area.

Herein we present verification of various GODAE Global ocean prediction systems as well as climatology against the observed float data (temperature and salinity). We explore the increase in error between observed and climatological variables during periods of ice coverage. We also look at novel ways for evaluating ocean prediction performance against a given float. Finally we highlight the surprising survivability of this NOVA float as well as the utility of having profiling floats in shelf environments with higher profiling frequencies (>= 1 cycle per day).

Keywords: Systems - Prediction system performance & evaluation, Observations - In-situ ocean observing systems, Systems - Prediction system validation/ intercomparisons, Observations - Observing system needs and future challenges,

Presenter:
Fraser Davidson
Fisheries and Oceans Canada
St. John's, Canada
fraser.davidson@dfo-mpo.gc.ca

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

Abstract ID: 3613227

Do High-Frequency Radars Measure the Wave-Induced Stokes Drift?

Dussol, Abïgaëlle[1], Chavanne, Cedric[1], Dumont, Dany[1] [1]UQAR-ISMER, Rimouski, Canada
Abigaelle.Dussol@uqar.ca

High frequency (HF) radars measure ocean surface currents by sending electromagnetic (EM) waves in the HF radio band (3-30 MHz) and recording the EM waves backscattered by ocean surface gravity waves. The recorded signal is dominated by EM waves backscattered from ocean surface waves with half the EM wavelength, called Bragg waves. Since their phase velocity is affected not only by wave-current interactions with mean Eulerian currents, but also by wave-wave interactions with all the other waves present at the sea surface, the question arises as to whether HF radars measure a quantity related to the wave-induced Stokes drift in addition to mean Eulerian currents. This question is important for practical applications, such as the use of HF radars in search and rescue operations and oil spill mitigation, and for assimilating HF radar currents into numerical ocean models. However, the literature is inconsistent on the expression and even on the existence of the contribution of the wave-induced Stokes drift to the HF radar measurements. Three different expressions have been proposed in the literature: (1) the weighted depth-averaged Stokes drift, (2) the filtered surface Stokes drift, and (3) half of the surface Stokes drift. We evaluate these expressions for directional wave spectra measured by a bottom-mounted Acoustic Wave and Current (AWAC) profiler in the Lower St. Lawrence estuary, Canada. We then compare the resulting Stokes drift contributions to radial currents measured by four coastal HF radars (two WERA and two CODAR Seasondes), from which the mean surface Eulerian currents measured by the AWAC have been subtracted. Moderate but significant correlations are obtained for all three contributions. Linear regressions yield a slope close to 1 (within uncertainties) for half of the surface Stokes drift, while the slope differs significantly from 1 for the two other expressions. These results suggest that HF radars measure half of the surface Stokes drift in addition to mean Eulerian currents.

Keywords: Observations - In-situ ocean observing systems, DA - Assimilation of new observation types, Applications - Ocean products for scientific, economic and societal use, ,

Presenter:
Cedric Chavanne
UQAR-ISMER
Rimouski, Canada
cedric_chavanne@uqar.ca

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

Abstract ID: 3575613

Contribution of wide-swath altimetry missions to the ocean analysis and forecasting system in the global model

Benkiran, Mounir[1], Le Traon, Pierre-Yves[2], Rémy, Elisabeth[1] [1]Mercator-ocean, Ramonville, France [2]Mercator-ocean/ Ifremer, Ramonville, France mbenkiran@mercator-ocean.fr

The impact of forthcoming wide-swath altimetry missions to the ocean analysis and forecasting system, based on NEMO (Nucleus for European Modelling of the Ocean) and implemented in global model (1/12), was investigated by means of OSSEs (Observing System Simulation Experiments) performed during the period from January to December 2015. An eddy resolving OGCM (Ocean General Circulation Model) configuration was adopted to obtain the truth run representing the real state of the ocean in an OSSE approach. Satellite altimetry and in situ pseudo observations are extracted from this simulation. Those synthetic observations were assimilated into a different eddy resolving OGCM, implemented in the global model with horizontal resolution of 1/12 (~7 km) with very different atmospheric forcing, physical parameterization and vertical discretization. OSSEs were carried out using different observing system configurations, considering both conventional altimeters (Jason2, Sentinel3a and Sentinel3b) and a constellation of wide-swath altimeters, and investigating the sensitivity of the system to the instrumental error of wide-swath altimetry data. In this study wide-swath altimetry data were obtained using the SWOT simulator (Gaultier et al., 2016a), provided by JPL (Jet Propulsion Laboratory). The same synthetic observations of SST, T and S profiles were considered in all the experiments. The OSSEs performances were evaluated by comparing the results of each experiment with the truth data. We found wide-swath altimetry has a major impact for the ocean analyses.

Keywords: DA - Assimilation of new observation types, Observations - New observation types, Observations - Satellite ocean observing systems, ,

Presenter:
Mounir Benkiran
Mercator-ocean
Ramonville, France
mbenkiran@mercator-ocean.fr

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

Abstract ID: 3617784

Coastal Acoustic Tomography under Stratified Conditions in Lake Biwa, Japan

Wells, John [1], Taniguchi, Naokazu[2], Chen, Minmo[3], Huang, Chen-Fen[4], Uchida, Hiroki [1], Okubo, Kenji[5], Inoue, Eiso[6] [1]Ritsumeikan University, Kusatsu, Japan [2]Hiroshima Univ., Higashi Hiroshima, Japan [3]Hiroshima University, Higashi Hiroshima, Japan [4]National Taiwan University, Taipei, Taiwan [5]Okayama University, Okayama, Japan [6]Lake Biwa Environmental Research Institute, Otsu, Japan johncraigwells@gmail.com

We will present results from Coastal Acoustic Tomography (CAT) at horizontal ranges up to 14 km, believed to be the first field demonstration of CAT in a lake under stratified conditions. Acoustic arrival times reflect path-averaged temperatures, but our priority is to infer pathaveraged currents from Differential Travel Times (DTT) during reciprocal transmission. Our long
term purpose is to track currents and other physical fields by assimilating the CAT data, and other available dat a, into an operational forecast system. Such a system could contribute to Operational Oceanography via comp arative studies; for example our site permits investigation of orographic effects in the absence of tidal forcing.

Tests were performed in Nov 13-18, 2016 and Nov. 10-
28, 2017 in the North Basin of Lake Biwa, with average (maximal) depth of 41 (104) m. Even at the end of the 2 017 deployment, epilimnion temperatures were about 13C, versus 8 C in deep water. Acoustic ray-
tracing simulations predict that sound is strongly refracted at the thermocline. Accordingly, the thermocline ac ts as a mirror, and sound mostly passes through the hypolimnion. The western station for both tests was a wa ter intake with a bottom depth of 9 m, while the easternmost station was changed between 2016 (Bottom Dep th 35 m) and 2017 (BD 49 m). In Nov. 2017, at a range of 10.2 km, two
way or "reciprocal" transmission was achieved most of the time, with small but significant differences in eastw ard versus westward travel times. Under the assumption that path length in the two directions was equal, one computes path-
averaged currents around 5 cm per second, which agrees with the magnitude of currents measured by ADCP. Large fluctuations in received signal strength were observed, which might be due to internal waves modulating the sound channel. We will refer to data from 3D hydrodynamic simulations, and from thermistor chain recor ds, to interpret these and other characteristics of the CAT data. In addition, new data from a field campaign in the autumn of 2018 will be presented.

Keywords: Applications - Acoustic applications, Observations - New observation types, Observations - Estimates of measurement errors, Observations - In-situ ocean observing systems, DA - Assimilation of new observation types

Presenter:
John Wells
Ritsumeikan University
Kusatsu, Japan
johncraigwells@gmail.com