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ABSTRACT BOOK

VOLUME I

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ABSTRACT BOOK

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Preface

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This is an Abstract Book featuring a selection of abstracts submitted for the 15th Biennial Pan Ocean Remote Sensing Conference (PORSEC). This is the first time we are publishing pre-conference Abstract Book, due to restrictions in organizing the conference since the global pandemic of COVID-19 outbreak. It continues the legacy of seven previous special IJRS issues of PORSEC conferences, held in Busan, Korea; Guangzhou, China; Keelung, Taiwan; Kochi, India; Bali, Indonesia; Fortaleza, Brazil and Jeju Island, the Republic of Korea, respectively (Levy and Gower 2008, 2010, 2012; Gower and Levy 2014; Levy, Vignudelli, Gower 2016, 2018; and Levy, Nimit, Vignudelli, Gower, 2020). Established in 1990 (the International Space Year), with the name of "Pacific Ocean Remote Sensing Conference", PORSEC has gained equal popularity among leading and aspirant countries in this field as a platform for sharing ocean remote sensing research and applications. The now regular component of capacity building in the form of pre-conference tutorial is one of the most acclaimed aspects PORSECs and has cultivated young brains to pursue works for the benefit of the mankind.

A total of 29 abstracts submitted for PORSEC2020 (now postponed till further update) have been included for publication after review by the scientific committee. Similar to the full papers submitted, the majority of the abstracts had regional science problems in focus. The researchers have made use of Altimeter, SAR (Synthetic Aperture Radar), AVHRR (Advanced Very-High Resolution Radiometer) and Ocean Colour data to mainly address the coastal and near-shore applications of ocean remote sensing. This points to the progress in ocean remote sensing science which previously (in past decades) had its major focus on the open ocean due to various restrictions near shore. Herein researchers have applied Artificial Intelligence (AI) techniques, which is becoming a norm in the geospatial studies as well. The topics often include coastal water monitoring and disaster mitigation reflecting the needs of tropical countries, especially in southeast Asia due to a changing climate and unpredictability in the weather therein. Summarily, this proceeding aligns well with the goals of UN Decade of Ocean Science for Sustainable Development (2021-2030).

Herewith, we would like to express gratitude to the Asia Pacific Network (APN) for Global Change Research, Committee on Space Research (COSPAR), Scientific Committee on Oceanic Research (SCOR), Institution of Geospatial and Remote Sensing Malaysia (IGRSM), and Malaysia Convention & Exhibition Bureau (MyCEB) for the financial supports. A sincere "thank you" to our collaborators from the Malaysia Space Agency and local universities including the

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OBSERVATION OF WAVE PROPAGATION IN THE COAST USING DRONES

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ABSTRACT

Wave information on the coast is very important for analyzing shoreline changes due to sediment transport as well as for the design of coastal structures. However, most of the wave observations in the coast are performed locally as a point measurement using hydraulic pressure gauges or ADCP equipment, and temporal/spatial wave observation over the entire coast is a very difficult task. Therefore, to secure the spatial wave information such as wave propagation, refraction, and diffraction, waves are numerically simulated over the interesting coastal area with verification with only a few local in-situ wave measurements. Recent advances in image analysis technology and a widespread of convenient aerial imaging equipment, such as drones, have made it possible to observe wave propagation in coastal areas temporally/spatially. In particular, the hovering technology of drones and the technique of stabilization of images taken during hovering with minute movement can produce orthoimages of wave propagation which also can generate movies for wave patterns similar to the numerically simulated wave movies. In this study, we introduce the process of making a wave propagation movie using orthoimages taken by drones on the coast like numerical wave model results and also show the technique of analyzing the wave characteristics from the spatiotemporal wave propagation images.

Keywords: Drone; Hovering; Image Stabilization; Orthoimage; Wave

THE COASTAL SEA LEVELS FROM SYNTHETIC APERTURE RADAR (SAR) ALTIMETRY OVER THE SOUTHEAST ASIA REGIONS

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ABSTRACT

This paper presents the detailed analysis on the performance of the advanced Synthetic Aperture Radar (SAR) altimetry over the largest archipelagos at the Southeast Asia. Advances in data processing, combined with technological progress such as the advent of SAR altimetry from Cryosat-2 and Sentinel-3, have yielded more accurate retrievals of the geophysical parameters (i.e. sea level, wave height and wind speed) in coastal zones, typically within several hundred meters from the coastline. However, the aforementioned advancement is only applicable when the satellite track run perpendicular to the coastline because of the fine altimetric footprint (~300 m) in along-track direction. In a case when the satellite track run parallel to the shoreline, the accuracy of geophysical parameters degrades, particularly within ~7 km from the coastline. This is because of the across-track spatial resolution is sparse (~7 km), similar to those of the conventional satellite altimetry (e.g. Jason series and Envisat), leading to erroneous estimation in the altimetric signals. The results from this study identified that there are three major waveform classes in the regions, where 91% of waveforms are classified as ocean-like waveform. The ocean-like waveform is recorded at location beyond 500 m from the coastline. However, in the satellite tracks parallel to the coastline, the non-ocean waveforms are recorded within 7 km from the coastline. The standard deviations (STDs) of the geophysical parameters of sea level anomaly (SLA), significant wave height (SWH) and wind speed (WS) are recorded as high within 2 km band from the coastline. That is, >200 cm for SLA, >2.5 m for SWH, and > 2 m for WS. These values somewhat decrease when leaving the coastline, but for the WS, the value remains high at 2 m within 2-10 km from the coastline. The residual with geoidal height (EIGEN6C4 Model) indicates that the STD exceed 250 cm within 2 km band, and between 50-150 cm within 4-10 km bands. Further study is currently on-going to validate the SAMOSA+ retracked SLA with tide gauge data.

Keywords: Coastal Altimetry; Coastal Sea Levels; Synthetic Aperture Radar; Waveform Retracking

DIURNAL CYCLE OF SURFACTANT-ASSOCIATED BACTERIA IN THE SEA SURFACE MICROLAYER AND ITS POTENTIAL EFFECT ON SURFACE SLICK VISIBILITY IN SAR

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ABSTRACT

The sea surface microlayer (SML) consists of the upper 1 mm of the ocean's surface and is an important boundary layer between the air and sea. The SML is occupied by a variety of organisms, including genera of bacteria that are capable of producing surface active agents (surfactants). When surfactants accumulate within the SML they produce sea surface slicks and dampen short gravity-capillary waves. Slicks can be visible to the eye and are sometimes even better seen in synthetic aperture radar (SAR) imagery. SAR technology can also help to visualize the surfactant-associated slicks that are formed due to bacteria processing organic material in the subsurface water (SSW). Understanding of the microbial genera that are capable of surfactant production associated with organic materials, such as dispersed oil or other biological materials in the water column, under different environmental conditions may help to implement SAR technology into global marine ecosystem assessment. In this study, we are focused on the effect of UV exposure on the abundance of surfactant-associated bacteria within the SML and SSW. We have implemented the sampling approach described in detail in Parks et al. (IJRS Special Issue 2020). The in situ microlayer samples were collected in July-August 2018 and November 2019 at two sites in the Straits of Florida (Looe Key and Fort Lauderdale) during RADARSAT-2 satellite overpasses. The DNA microbial data were analyzed at the Argonne National Laboratory using the Illumina MiSeq, a next generation sequencer. This data indicates a statistically significant difference between day and night bacterial abundance in the SML. We hypothesize that the UV exposure of the SML during the day results in a lower abundance of the surfactant-associated bacteria that are sensitive to UV radiation. At the same time a few surfactant- or oil-associated bacteria, which are known to be resistant to UV radiation, were found in the SML mainly during the daytime. The diurnal variability of the surfactant-associated bacteria in the SML may affect the presence of sea surface slicks visible in airborne SAR.

Keywords: Sea Surface Microlayer; Sea Surface Slicks; Surfactants; Surfactant-Associated Bacteria; Synthetic Aperture Radar

AN IMPROVED CLOUD MASKING ALGORITHM FOR GOCI IMAGES OVER TURBID COASTAL WATERS

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ABSTRACT

Clouds severely hinder the radiative transmission of visible light, and correctly masking cloudy and non-cloudy pixels is crucial in processing ocean color remote sensing data. However, cloud masking over turbid waters is prone to misjudgment, leading to loss of non-cloudy pixel data. This research proposes an improved threshold algorithm to classify cloudy and non-cloudy pixels based on spectral variability of Rayleigh-corrected reflectance acquired by the Geostationary Ocean Color Imager (GOCI). Compared with other existing cloud masking algorithms, it is verified that this improved algorithm can more realistically reflect the spatial positions and shapes of clouds, and more accurate pixels of turbid waters were restored. This improved algorithm was effectively applied to cloud recognition in turbid coastal waters of East China Sea. This research provides an improved cloud masking algorithm for spaceborne ocean color sensors without short-wave infrared bands (SWIR) in their data processing over partly cloudy turbid-water images.

Keywords: Cloud Masking; Remote Sensing; Spectral Variability; Turbid Water

EXPLORING SPATIO-TEMPORAL OF WIND AND WAVE TOWARDS ENERGY HARVESTING IN MALAYSIA: A REVIEW

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ABSTRACT

Wind and wave energies are one of the major renewable resources for electricity generation that is environmentally friendly. Since Malaysia is vastly surrounded by oceans, these renewable energies have a significant potential for future power generation. Thus, better understanding of wind and wave patterns over space and time is essential before further action can be taken for harvesting energy. To date, most of the previous studies only discussed the wind and wave energies potential in the perspective of geographical without considering the temporal aspect that can also alter the formation of energy patterns. As wind and wave are highly changeable over space and time, decision on identifying best location for harvesting these energies will be very challenging. Therefore, a comprehensive literature review from various exploration techniques has been conducted in order to determine the important of considering space and time for exploring wind and wave patterns. From this review, we have discovered a very limited number of studies which have considered spatial and temporal aspect simultaneously for wind and wave patterns. Such consideration is essential because the spatio-temporal patterns can closely represent the natural behavior of wind and wave. Furthermore, the discovered patterns could estimate the amount of energy that can be harvested in Malaysia throughout the year. Finally, this study will propose the best approach for exploring inclusive wind and wave patterns potential in Malaysian oceans for alternative power generation.

Keywords: Ocean Energy; Renewable Energy; Wave; Wind

ESTIMATING WATER LEVELS VARIATIONS IN TARBELA DAM USING SATELLITE RADAR ALTIMETRY

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ABSTRACT

Tarbela dam on Indus River is considered as one of the largest dams of Pakistan. It is the first storage that supplies water to irrigate Punjab and Sindh provinces of Pakistan. In this study, satellite radar altimetry for inland waters will be used for measuring the water levels at Tarbela dam. Satellite optical imagery and radar altimetry together have provided significant advances in understanding and monitoring the water storage changes of lakes and reservoirs. Sentinel 3A tracks along with the gauge data at Tarbela dam are to be compared. Time series gauge data will be used to validate the altimetry derived water levels. Previously, another study at Sukkur and Guddu Barrages on River Indus, altimetry Sentinel 3A tracks were compared with gauge data. The two datasets show a good agreement with correlations higher than 0.9 and root mean square difference (RMSD) less than 45 cm. This study proves that the satellite radar altimetry technique is advantageous at ungauged locations. For Tarbela dam similar good results are expected. This technique can be helpful in reducing the flood risks and can facilitate flood forecasting in all weather conditions.

Keywords: Indus River; Remote Sensing; Satellite Radar Altimetry; Water Levels

DERIVATION OF THE HABITAT SUITABILITY INDEX FOR THE TODARODES PACIFICUS (JAPANESE COMMON SQUID) AROUND SOUTH KOREA

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ABSTRACT

Recent changes in marine fishery resources in South Korea have been a big concern over the last decades. The climate regime shift has led to not only a change in the dominant fishery resources, but also a decline in fishery landings for several species. The habitat suitability index (HSI) has been widely used to detect and forecast fishing ground formations. In this study, the catch data of the Todarodes pacificus (Japanese Common Squid) and satellite-derived environmental parameters were used to estimate the HSI for the T. pacificus around South Korea. Most of the total catch was found in the regions with sea surface temperature (SST) of 14.91–27.26 ℃, sea surface height anomaly (SSHA) of 0.05–0.20 m, chlorophyll-a of 0.32–1.35 mg m-3, and primary production of 480.4–850.2 mg C m-2 d-1. Based on these results, the HSI model for T. pacificus was derived. A strong positive relationship (R2 = 0.9260) was found between the HSI and the fishery landings. The climatological monthly mean HSI from 2002 to 2016 showed several hotspots, coinciding with the spawning and feeding grounds of T. pacificus. This outcome implies that our estimated HSI can yield a reliable prediction of the fishing ground for T. pacificus around South Korea.

Keywords: Habitat Suitability Index; Ocean Color; Primary Production; South Korea; Todarodes Pacificus

SPATIAL RESOLUTION OF SEA SURFACE TEMPERATURE OBSERVED BY THE AMSR2 ONBOARD THE GCOM-W SATELLITE

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ABSTRACT

Sea surface temperature (SST), a key variable in the climate system, is observed by satellite microwave radiometers and infrared radiometers. Microwave radiometers are capable of measuring SST through clouds and provide global coverage of SST, while their spatial resolution is lower than that of infrared radiometers. Recently the Japan Aerospace Exploration Agency (JAXA) has released a new SST product that uses 10-GHz channel in SST retrieval of the Advanced Microwave Scanning Radiometer 2 (AMSR2) onboard the Global Change Observation Mission-Water (GCOM-W) satellite. The 10-GHz SST is considered higher in spatial resolution than standard microwave SST that uses 7-GHz channel, because of smaller instantaneous field of view of 10 GHz, though its resolution has not been examined yet. This study evaluated the spatial resolution of the AMSR2 10-GHz SST by comparing with high-resolution infrared SST measured by the Japanese geostationary meteorological satellite, Himawari 8, mainly in a wavenumber domain, focusing on the Kuroshio Extension region. We found that the AMSR2 10-GHz SST successfully captures small and sharp fronts of the Kuroshio Extension and eddies and its resolution is approximately 90 km in wavelength, which is considerably higher than that of the standard microwave SST.

Keywords: AMSR2; Satellite Observations; Sea Surface Temperature; Spatial Resolution

TURBIDITY SENSING APPROACH THROUGH IMAGE PROCESSING FOR SATELLITE APPLICATION

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ABSTRACT

The presence of suspended particles in the water body can cause turbidity where the water loses its transparency characteristic. This paper presents an approach of monitoring the turbidity of water body through imaging sensor of space-borne application. The image of water body will be taken by satellite system through visible (VIS) and near-infrared (NIR) bands and will be sent to the ground station for image processing. NIR band image is essential for classification process while red and green bands from VIS spectrum are used for Normalized Difference Turbidity Index (NDTI) computation. The algorithm of the image processing is obtained by applying the preliminary data from UAV. In this paper, the data processing technique is applied to detect the turbid water from the image captured. Based on the technique reviewed, deep learning seemed to be the common architecture used for digital image analysis. Level 0 and 1 segmentations are used to classify the water area and distinguish the color differences in each pixel based on the ground truth of the applied datasets. The imagery can provide an early determination of turbidity. Therefore, this technique can complement the existing turbidity measurement especially for remote watercourses that are difficult to be reached by Department of Environment personnel.

Keywords: Image Processing; Remote Sensing; Satellite Application; Turbidity

THE IMPACT OF THE CHANGES IN MARINE ENVIRONMENT ASSOCIATED WITH PRIMARY PRODUCTIVITY REQUIRED ON SUMMERTIME AROUND THE TAIWAN BANK

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ABSTRACT

The Taiwan Bank (TB) is located in the southern Taiwan Strait, the marine environments are affected by currents and bathymetric lead to forming upwelling in summer. The purpose of the study were transferred the fishery data into primary productivity required (PPR) to quantify the energy of habitat ecosystem (upwelling, front, non-upwelling) under the changes of marine environments by using Generalized additive model. The analysis results show the dominated pelagic fish species lead by Scombridae, Carangidae and Trachurus japonicas, while benthic were dominated by Mene maculate, Loliginidae. The marine environments variation in spatial-temporal reveals the upwelling intensity was the strongest in June and the weakest in August. The GAM analysis show the primary productivity was the mainly factor of the tolerance for benthic species, and the highest deviance explained (28.5%) was occurred in the front area. The pelagic species wasn't only affected by high primary productivity but also with sea surface temperature and upwelling intensity. The changed climatic index of Multivariate ENSO Index also revealed negativity effected in upwelling and non-upwelling area. Overall, the PPR of benthic species were controlled by primary productivity instead, and the pelagic species resources were varied with marine environments under the climate change.

Keywords: Upwelling; Generalized additive model; Primary productivity required; Taiwan Bank; and Multivariate ENSO Index

COASTAL MEAN DYNAMIC TOPOGRAPHY OVER PENINSULAR MALAYSIA BY GEODETIC METHODS

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ABSTRACT

Coastal Mean Dynamic Topography (MDT) can be determined either by the ocean approach or geodetic approach. Through geodetic approach, MDT can be computed by directly subtracting the geoid height from the ellipsoidal Mean Sea Surface (MSS). The MSS can be estimated using spacebased technology such as satellite altimetry and coastal tide gauge by connecting the tide gauge datum to the global reference frame from Global Navigation Satellite System (GNSS) positioning. Several global MDT model have been published today using MSS model derived from long term averaged altimetric data and global geoid model. However, the lack of precise geoid model over marine region and the accuracy of altimetric data degrades rapidly when approaching coastal region become the critical issue to obtain precise MDT data over coastal region. In this study, coastal MDT along the Peninsular Malaysia has been determined using regional geoid model namely as Peninsular Malaysia Gravimetric Geoid Model Year 2020 (PMGG2020) and MSS_CNES_CLS2015, a MSS model computed based on 20-year (1993–2012) satellite altimetry data. The coastal MDT produced in this study was verified using eleven (11) tide gauge MDT along the Peninsular Malaysia coastal region. Based on the comparison, the accuracy of coastal MDT is about ±0.784m. The accurate coastal MDT information is beneficial to study the physical oceanography, tidal modeling, geoid modeling and current circulation.

Keywords: Coastal; Geoid; Mean Dynamic Topography; Mean Sea Surface

SYNCHRONOUS RELATIONSHIP IN THE DISTRIBUTIONS AND ABUNDANCES OF THE *SCOMBEROMORUS* SPECIES ASSOCIATED WITH OCEANIC ENVIRONMENTS IN THE TAIWAN STRAITS

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ABSTRACT

Scomberomorus species are important commercial species for trammel net fisheries in the Taiwan Strait, especially for the *Scomberomorus commerson* accounted for 91.79 % of the total catch. However, the catch production of *Scomberomorus* species encounter many challenge, and showing decline trends. The past studies are mainly concentrated in a single species or group, however, the synchronous relationships between the *Scomberomorus* species was unclear. The high resolution fishery data collected from Taiwanese trammel net fleets to explore the *Scomberomorus* species interactions including the abundances and distributions. The positive and negative feedbacks among these *Scomberomorus* species could help to stabilize ecosystem structures. The distributions of the *Scomberomorus* species revealed the seasonal variety, and mainly concentrated around the Taiwan Bank. The fitted generalized additive models (GAMs) to spatiotemporal catch rates of *Scomberomorus* species with oceanographic factors including the sea surface temperature (SST), sea surface salinity (SSS), sea surface height (SSH), and Chlorophyll-a (CHL-a) would be performed.. The GAMs results revealed different environments would affect to *Scomberomorus* species catch among different time period, such as, SST was the most important factor in springtime but the most important factor was CHL-a in wintertime. Our further results will reveal the interactions of *Scomberomorus* species including synchronous and non-synchronous relationship also suggested not be overlooked in stock management plans for effective conservation.

Keywords: *Scomberomorus* species; Synchronous relationship; Taiwan Strait

APPLICATION OF SPECTRAL MIXTURE METHOD FOR OIL DETECTION USING MULTI-SATELIITE IMAGES

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ABSTRACT

As the coastal maritime activities using ships increase, the number of ship accidents that cause oil spills increases year by year. The recent accident was confirmed to have leaked approximately 251.46 tons of oil from the LPG tanker and oil tanker collision at the Kamarajar Port in Ennore near Chennai in India on 28 January 2017. Using satellites capable of observing large areas at high resolution, we monitored oil spills around the site of the accident. The Landsat- 8 image of the southwestern part of the accident site on 5 February 2017 was acquired and RGB composite image confirmed the presence of oil spilled along the coast. We detected the oil by applying a spectral mixture analysis to the Landsat-8 image. This is an oil detection technique based on the maximum abundance fraction occupied by pixel-based endmembers. We applied N- findr for endmember extraction after applying PCA for band reduction. A representative spectrum of oil and seawater was extracted. The oil spectrum showed a larger reflectance than seawater, especially with double peaks at 483 nm and 1650 nm. The spatial distribution of large pixels occupying the oil spectrum fraction greater than about 60% and pixels occupying less than about 20% oil spectrum is presented. The results of this study are significant in that oil detection was performed using a pixel-based hyperspectral spectrum.

Keywords: Oil Spill; Satellite; Spectrum

MODULATIONS OF SUB-SEASONAL VARIATIONS IN THE SULAWESI SEA

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ABSTRACT

In the calm semi-enclosed Sulawesi Sea, sea surface height (SSH) measurements of a satellite altimeter often corrupt due to the presence of extraordinarily stronger microwave reflections from areas of calm sea surface water within its footprints, as known as “sigma0 blooms”. Recently, however, subwaveform retrackers are proposed to handle these sigma0 blooms, which enable to produce full time series of SSH in the Sulawesi Sea. Significant temporal variations associated with ENSO signals are recognized in in Jason-2 SSH anomaly data, which are also present in various numerical models. Apart from those ENSO signals, various sub-seasonal variations are present in Jason-2 data. Among them, variations with periods less than 60 days have been reported in in situ observations and models, but variations with approximately 90-day periods are not found in numerical models. The amplitude of these variations was found less significant in La Nina periods.

Keywords: Coastal Retracker; ENSO; Jason-2 Satellite Altimeter; Sub-Seasonal Variations; Sulawesi Sea

AN ANALYSIS OF THE VERTICAL THERMAL STRUCTURE OF THE SURFACE OCEAN USING SATELLITE-OBSERVED SEA SURFACE TEMPERATURE AND IN-SITU MEASUREMENTS

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ABSTRACT

Sea surface temperature (SST) is a crucial variable for understanding various oceanic phenomena and climate variability. Due to the active feedback process between the oceanic and atmospheric boundary, the vertical thermal structure near the sea surface varies according to depth. Several atmospheric conditions cause extreme fluctuations in the surface water temperature, and studies have shown that the difference between the skin and bulk water temperatures can reach over 6.6oC. Therefore, in order to improve accuracy of weather prediction and to produce optimized skin-bulk SST fields as input data for atmospheric and oceanic numerical models, the analysis of vertical thermal structure and its spatio-temporal variability near the sea surface must be preceded. This can be achieved by comparing water temperature data representing each depth. In this study, a total of 396,640 collocated matchup data were generated from July 2012 to October 2019 using in-situ skin SST observational data, satellite SST data, drifter measurements, and 5 m depth of ARGO float SST data. We analyzed the spatio-temporal variability of the skin-bulk thermal structure and how it fluctuates depending on various environmental factors through comparison of the generated matchup data.

Keywords: In-Situ SST Observational Data; Satellite SST Data; Spatiotemporal Variability; Vertical Thermal Structure

VMS AND GCOM-C SATELLITE DATA ANALYSIS TOWARDS CONSTRUCTING PFG ESTIMATION MODEL FOR PURSE SEINE FISHERIES IN BALI ISLAND

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ABSTRACT

An accurate estimate of a potential habitat of fish species enables us not only to understand the response of species to environmental changes but also to utilize it for an efficient use of fish resources. Habitat suitability index (HSI) model is widely used as a tool in practical exploration of potential fishing ground (PFG). The model performance highly depends on quantity (and quality) of fishing data as a model input, and in many cases, insufficient amount of fishing data reduces its performance. In recent years, a time series of GPS position data of fishing vessels can be derived automatically in real time. If we pick up fishing points from the GPS observation and improve the HSI model by adding updated position data, the model is expected to show better performance. In this study, we applied a hidden Markov model to GPS position data of purse seine fishing boats operated south of Bali Island derived from VMS (vessel monitoring system) observation for automatically estimating the "state" of fishing vessels at each minute. Furthermore, we will demonstrate a preliminary result of HSI model for PFG estimation developed using high-resolution GCOM-C and HIMAWARI satellite observation.

Keywords: Bali Island; Hidden Markov Model; GCOM-C; PFG Model; Purse Seine Fishery

CHANGES IN SEA SURFACE TEMPERATURES AND EXTREMES IN THE NORTHWEST PACIFIC AND RELATION TO CLIMATE CHANGE BASED ON SATELLITE DATA

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ABSTRACT

The changes in sea surface temperature (SST) and extremes in the Northwest Pacific, which showed the high variability and strong warming trend, were studied using the satellite data for the period of 1982 to 2018 for 37 years. As a result of the empirical orthogonal functions (EOF) analysis, the dominant warming signal was detected in the region between the Kuroshio Current and the Subarctic Current in the first mode (16.27%) and El Niño–Southern Oscillation (ENSO)-like variation were shown in the second mode (9.88%). The strong warm cores appeared in the northern boundary along the Kuroshio Current. It is possible to be caused by the overshooting of the current with a strong flow. In the offshore region, there was a strong warming trend reached to 0.05oC decade-1 in the wide region between the Kuroshio Current and the Subarctic Current.

Keywords: extreme; sea surface temperature; trend

IDENTIFICATION AND DETECTION OF INTERNAL WAVES OVER BAY OF BENGAL FROM SAR IMAGERIES

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ABSTRACT

Internal waves (IWs) are an important part of small-scale processes in oceans and they occur through the restoring action of buoyancy forces. Internal waves are common phenomenon on continental shelves when the water column is stratified. IWs are able to change the sea surface in subtle ways which enable them to create their own signature in SAR images. SAR images showing the variation in the relative intensity due to the changes in the sea surface roughness. Synthetic aperture radar (SAR) images are acquired from ENVISAT and ALOS PALSAR for the identification and detection of internal waves over the Bay of Bengal. Bay of Bengal is a semi enclosed sea with seasonally reversing monsoon conditions, low pressure systems and huge fresh water discharge. Tidal influence over underlying bathymetry changes also changes accordingly. So, IWs of different characters from weak manifestations to Rank-ordered packets of internal solitons propagating shoreward from the edge of the continental shelf were observed in the SAR images. IWs over continental shelves are important because they can attain large amplitudes and affect acoustic wave propagation. An automated method has been developed for extracting direction and wavelength of internal waves. Internal waves appear in all seasons over Bay of Bengal, mainly in September, October and November. In the Bay of Bengal, internal waves propagating both towards shore and away from the shore. High stratification near Ganga river and west coast of Burma favors frequent formation of IW in all seasons.

Keywords: Internal waves; SAR images; Bay of Bengal

SATELLITE ALTIMETRY TO STUDY COASTAL WAVE MEASUREMENTS OVER BAY OF BENGAL

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ABSTRACT

Coasts are among the most fragile and important areas of the oceans, making it vital to study, monitor, and protect them. Satellite altimetry is an important tool to measure and monitor important oceanographic processes but not limited to wind, wave and sea level changes. Observation of these processes are important especially over the coastal regions and is gaining importance nowadays. As the coastal altimetry is developing, several different new re-trackers were available to study these processes. In this present study, different retrackers like ALES, RED3, OCE3 and different coastal wave products like Prototype for Expertise on AltiKa for Coastal, Hydrology and Ice (PEACHI), Prototype Innovant de Système de Traitement pour les Applications Côtières et l'Hydrologie (PISTACH) and X TRACK data were selected to study coastal wave measurements. All the coastal wave products were compared against the in-situ data. An inter-comparison was carried out over the Bay of Bengal to observe the differences. All the re-trackers picks up oceanographic signals that were depicted in the buoy. Presence of seasonal signals is clearly observed indicates the Bay of Bengal wave climate is primarily influenced by monsoon winds. Some spikes also observed showing the presence of low pressure systems. The overall performance suggests the possible use of coastal altimetry in coastal regions of Bay of Bengal.

Keywords: Coastal Regions, Monsoon, Seasonal Behavior, Wave Measurements

RECENT TREND OF SATELLITE-OBSERVED SIGNIFICANT WAVE HEIGHT IN THE GLOBAL OCEAN

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ABSTRACT

The recent trend of significant wave height (SWH) in the global ocean were analyzed using satellite-observed data for the period from 1993 to 2016. The swell and wind sea components of SWH were also estimated by applying swell and wind sea probability. In this study, the annual and monthly mean of SWH including swell and wind sea component and wind speed were presented in the global ocean. The seasonal variability of SWH was evident except for the tropical ocean, and this property was more prevalent in the Northern Hemisphere. In addition, the trend of SWH analyzed in the global ocean. The trend of extreme SWH was also estimated using 99th-percentile SWHs on the basis of SWH statistical values within a given grid. The trend of SWH showed a negative value overall in the global ocean, but regional characteristics were different. The 99th-percentile SWH also presented a significant tendency to decrease except for the Antarctic and some regions of the North Pacific and the North Atlantic.

Keywords: significant wave height (SWH), satellite altimeter, global trend, extreme SWH, swell and wind sea SWH

SEA SURFACE HEIGHT VARIABILITY AND TRENDS IN SOUTH EAST ASIAN SEAS FROM 25-YEARS ALTIMETRY DATA

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ABSTRACT

The sea surface height (SSH) derived satellite altimeter in the last 25-years shows the acceleration of the global sea level rise driven by climate change. This study summarizes our current understanding of SSH variability and trends based on the 25-years satellite altimeter record in the Southeast Asian Seas (SEAS). The SSH derived altimetry show good agreement with tide gauge records in the SEAS. The SSH shows significant variability at annual and interannual time scale related to the seasonally reversing monsoons and El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) mode. Sea level trends show spatial variation in the SEAS. Some regions, such as in the internal waters of the SEAS, are experiencing a rise of up to 3 mm/year. In the Eastern Indian Ocean off Sumatra, Java and Ambon, sea level trends are positive, with most areas showing increases of 4-5 mm/year.

Keywords: altimetry; sea surface height; variability; monsoon; El Niño

COASTAL MONITORING USING OCEAN OBSERVATION CAMERA (OOC) ON MICRO SATELLITE RISESAT

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ABSTRACT

A Micro Satellite RISESAT (Rapid International Scientific Experiment Satellite) / Hodoyoshi-2, which is directed by Tohoku University and Hokkaido University of Japan, successfully launched by Epsilon rocket of Japan Aerospace Exploration Agency (JAXA) on January 18 at 8:50 AM, GMT +9, 2019. RISESAT carry 8 scientific instruments with a total mass of 10 kg of total weight of 50 kg. We developed Ocean Observation Camera (OOC) as one of earth observation sensors onboard RISESAT. The OOC is a multi-band WFOV (Wide Field of View) camera system in the VIS range designed for ocean surface observation. The spatial resolution is about 100 m in a swath width of about 65 km. This camera system will sweep the ocean surface in a continuous image acquisition mode. The main target area of OOC will be in the Arctic Ocean and Asia around Japan and Taiwan. The OOC has three wave length of visible, 405nm, 490nm, 555nm, and one near-infrared, 867nm. Visible bands will apply to detect CDOM (Colored Dissolved Organic Matter), chlorophyll-a and sediment materials and near-infrared band will apply to atmospheric correction. After mission check of RISESAT, we started to observe coastal region in the Arctic and sub-arctic seas. We present a preliminary result of coastal monitoring using OOC and discuss on future application.

Keywords: Micro Satellite, RISESAT, Coastal monitoring, Ocean observation camera, CDOM

APPLICATION OF ILLEGAL OIL BILGE DUMPING MONITORING USING SYNTHETIC APERTURE RADAR SATELLITE SENTINEL 1A DATA AND AUTOMATIC IDENTIFICATION SYSTEM BROADCAST SIGNALS OVER SUNDA STRAIT, BANTEN PROVINCE, INDONESIA

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ABSTRACT

The existence of oil in nature is widely utilized and very useful for human needs, such as : energy. The world demand for oil is high and need to be transported from the oil producer country into oil consumers. Until now, the most common transportation to transport oil is using ships (tanker ship) passing through the ocean. On the other hand, oil is dangerous to the ocean ecosystem if they were not maintained and treated carefully. Oil is one of the pollutants that make devastating impact on ocean ecosystem. One kind activity that related to the oil pollution is called bilge dumping. Bilge dumping is the disposal of waste water from a ship's lower hull. Bilge water is supposed to be treated before it's discharged, but sometimes vessel operators will bypass the pollution control equipment and flush oily, untreated bilge into the ocean, and those activity is direct violation of marine pollution law. Application of Synthetic Aperture Radar (SAR) Satellite using Sentinel 1A data is used in this research as an approach to conduct a preliminary investigation to estimate the oil bilge source. Constant False Alarm Rate (CFAR) algorithm is used to detect ships over the surface of the ocean and Machine Learning using Support Vector Machine (SVM) algorithm is used to detect and distinguished the oil bilge that discharge by the vessel, considering the texture and morphology of the oil in SAR images. Automatic Identification System (AIS) data is used in this research to validate the CFAR algorithm in ship detection and identify the identity of the ship. This research resulting in the detection of 178 km long of bilge oil around the southwest of Banten province, Indonesia. The CFAR algorithm and AIS Broadcasts data identifies an Indonesian oil product tanker as a suspect to the oil bilge dumping activity with at least 15 AIS broadcasts signals recorded by the satellite. Estimation of the oil bilge source is conducted by matching the ship track and oil bilge trace. Analysis in this research is utilize the Sentinel 1A data scene captured on July 2nd 2019 at 22:33 Universal Time Coordinate (UTC).

Keywords: Oil bilge - Synthetic Aperture Radar - CFAR algorithm - Machine Learning - AIS

CALCULATION OF SPATIAL CHARACTERISTICS AND AMPLITUDE OF INTERNAL WAVES BY SATELLITE OCEAN COLOR DATA IN THE JAPAN (EAST) SEA

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ABSTRACT

The aim of this work is to study the possibility of detecting signs of internal waves (IWs) and assessing their amplitude from ocean color data. Based on in-situ marine measurements of hydrological and bio-optical parameters of the seawater, an analysis was made of the variations of the simulated sea luminosity coefficients during the passage of IWs in the Sea of Japan (East). Calculations showed that for remote detection of IWs in seawater, color indices with wavelengths of 400-500 nm and remotely determined concentrations of chlorophyll-a are more accurate in accordance with algorithms such as OS2. The optimal spectral range for satellite identification of IWs is 440-500 nm, taking into account atmospheric correction errors. Spatio-temporal characteristics of IWs were estimated by modeling the corresponding chlorophyll-a vertical distributions and modeling various roughnesses of the sea surface using data from the GOCI-COMS-1. The amplitude assessment should take into account a number of conditions: a careful solution of the inverse problem of remote sensing of the color of the sea, taking into account the peculiarities of the regional optical characteristics of sea water, stratification of the optically active water components that form the color of the sea and the hydrological characteristics of the region.

Keywords: Sea Of Japan; Chlorophyll-a; Colored Dissolved Organic Matter; Sea Color; Color Indices; Internal Waves; Optically Active Components; Hydro-Physical Processes.

USE OF THE NEURAL NETWORK FOR SEPARATION OF THE CONTRIBUTIONS OF PHYTOPLANKTON AND COLOURED DISSOLVED ORGANIC MATTER TO THE REMOTE SENSED REFLECTANCE

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ABSTRACT

The neural network has been trained for the most efficient separation of the contributions of phytoplankton and coloured dissolved organic matters (CDOM) to remotely sensed ocean color data in optically complex waters. The SeaBASS open database for the entire World Ocean and the author's database of hydrooptical measurements in the northwestern part of the Pacific Ocean and the Eastern Arctic were used as initial data. Test and validation data sets included measurements from waters with different optical characteristics and different ratios between the contents of phytoplankton and CDOM due to various natural processes and the presence of various sources of substances. The initial parameters at the input of the neural network were the remote sensed reflectance of the sea in the visible range. The output parameters are the concentration of chlorophyll-a (C_chl_a) and the light absorption coefficient of CDOM at 443 nm (a_CDOM). The statistical metric for estimation the accuracy of the neural network was the standard deviation between the scattering diagrams “C_chl_a - a_CDOM” determined by remote sensing using the neural network and by reference contact methods. Such metric made it possible to train a neural network more resistant to the change of optical types of water.

Keywords: phytoplankton, coloured dissolved organic matter, neural network, ocean color, remote sensed reflectance

PREDICTING THE POTENTIAL HABITAT ZONE OF OIL FISH (*RUVETTUS PRETIOSUS*) IN THE SOUTHWESTERN INDIAN OCEAN WITH MAXIMUM ENTROPY MODELS AND SATELLITE DATA

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ABSTRACT

The oil fish (*Ruvettus pretiosus*) is one of the important caught species in the longliner of the southwest Indian Ocean. This study was tried to develop the potential habitat zone using the maximum entropy model with multi-satellite and longliner fishery data from 2010 to 2013. The monthly mean catch per unit effort (CPUE) of oil fish larger than 50 inds./1000 hooks occurred in March to August in time and distributed over 15~40°S and 15~55°E in space. The maximum entropy model with the AUC of each monthly model greater than 0.8 can was examined as useful tool to predict the habitat zone of the oil fish. Their optimal range of environmental variables in satellite-derived sea surface temperature and mix layer depth for the habitat of oil fish are suggested to be about 18-22 ° C and 40-150 m, respectively. The results would allow local information for southwestern India Ocean in order to implementing appropriate Ecosystem Based Fisheries Management (EBFM) program in future.

Key word: *Ruvettus Pretiosus*,Maxent, Satellite-Derived, Sea Surface Temperature

EXPLORING SPATIO–TEMPORAL PATTERNS OF WIND AND WAVE TOWARDS ENERGY HARVESTING IN MALAYSIA: A REVIEW

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ABSTRACT

Wind and wave energies are one of the major renewable ocean energy that are widely used for electricity generation. Renewable energies from ocean have a significant potential for future power generation in Malaysia since this country is vastly surrounded by oceans. Thus, better understanding of wind and wave patterns is essential before these energies can be harvested. The major characteristic of wind and wave is they are highly changeable over location and time. This fact anticipates the existence of considerable spatio-temporal aspects in estimating ocean energy since they can alter the ocean energy patterns in various ways. Therefore, a comprehensive review from various techniques has been conducted in order to determine the important of space and time for exploring wind-wave patterns. From this review, we have discovered a very limited number of studies that have considered spatial and temporal aspect simultaneously for analyzing wind and wave patterns. Discovering spatio-temporal patterns is essential because these patterns can represent the natural behavior of wind and wave throughout the year. Ultimately, this study has proposed a new approach that able to mine spatial and temporal aspect simultaneously for determining wind-wave patterns that can contribute to energy harvesting in future.

Keywords: Renewable Ocean Energy; Spatio-temporal Patterns; Wave; Wind

LONG-TERM OBSERVATIONS ON SEA SURFACE TEMPERATURE VARIABILITY IN THE GULF OF MANNAR WITH SPECIAL REFERENCE TO TSUNAMI IN 2004

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ABSTRACT

Long-term temporal and spatial observations of monthly, inter-annual and decadal variation of sea surface temperature (SST) in the Gulf of Mannar (GoM) were studied for the period 1870-2018; climatology data were obtained from the Met Office Hadley Centre, UK. Among all the months, the mean highest and lowest SST were 29.85^{0}C in April and 27.15^{0}C in August respectively. Monthly time series showed a cooling trend of SST by -0.05^{0}C from January to December. The mean annual highest and lowest SST were observed in 2015 and 1890 with SST of 28.93^{0}C and 27.45^{0}C respectively. Annual and decadal time series showed a warming trend of SST by 0.004^{0}C and 0.04^{0}C respectively from 1870 to 2018. The mean highest and lowest decadal SST were 28.56^{0}C in 2010-2018 and 27.78^{0}C in 1890-1889 respectively. The month of December having mean highest and lowest SST in 1910 (26.99^{0}C) and 2015 (29.03^{0}C). The mean SST of December, 2004 was (27.71^{0}C). The spatial distribution of climate trends through the decades across the GoM revealed a strong spatial gradient during 1870-2018. The area between 6-8^{0}N and 77-78^{0}E was warmer than all other places of GoM throughout the study period.

Keywords: Gulf of Mannar; Spatial; SST; Temporal