

Title: Seasonal habitat suitability of immature and mature albacore tuna (*Thunnus alalunga*) in the Indian Ocean using the satellite data

Authors: Ali Haghi Vayghan (Department Of Environmental Biology And Fisheries Science, National Taiwan Ocean University), Te-Cheng Liu (Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University), Ming-an Lee* (Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University) and Wan-Chen Yang (National Taiwan Ocean University)

Type: POSTER

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

For the effective management of an ecosystem, detailed knowledge of living resources is needed to implement ecosystem-based fishery management (EBFM) framework. Such EBFM compels scientists and decision makers to achieve sufficient (both temporal and spatial) information about essential habitats for the restoration and conservation of target fish stocks. Determining the oceanic habitats of migratory marine species is vital for each species and EBFM, especially in case of high time-varying distribution of habitats. This study considered the habitat suitability of mature and immature Albacore (ALB) tuna captured by the Taiwanese longline fisheries association in the Indian Ocean (IO). We employed maximum entropy (MaxEnt) model to draw habitat suitability and monitor seasonal differences of immature and mature ALB habitat suitability from 1998 to 2014. Immature and mature ALB prefer different seasonal habitat and environmental variables over the IO, which highlighted habitat varying selection of ALB in different life span in the IO. The most important environmental variables detected by the model showed immature and mature response to different environmental variable in different season. However, immature fish preferred low sea surface temperature (SST), eddy kinetic energy (EKE) and mixed layer depth (MLD); on the other hand, mature fish preferred high SST and lower net primary production (NPP) and MLD. Overall, the result of this study revealed immature and mature ALB preferring different habitats and environmental variables in different seasons, which emphasize the need for employing specific seasonal and even immature and mature different policies and management in the IO. Applying such different strategies for immature and mature individuals during different seasons will enhance Taiwanese fisherman to looking fast and helps decision makers to decide in depth the habitat characteristics of both immature and mature ALB. In addition, it will ease implementing EBFM in IO using detected most preferred environmental variables, and also seasonal migratory behavior of ALB during its life span.

Keywords: Albacore tuna, immature and mature, habitat suitability modeling, MaxEnt, Indian Ocean, ecosystem management

Title: SEMI-ARID CLIMATE IN THE CEARÁ STATE / BRAZIL

Authors: Juscelino Chaves Sales, Alisson da Conceição Ferreira, José Eduardo Vasconcelos de Moraes, Emmanuelle Oliveira Sancho, Glendo de Freitas Guimarães

Type: POSTER

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

Climate changes in the world have been occurring over time in certain regions of the planet mainly due to the action of man himself, who destroys nature through pollution of rivers, lakes, dams and water sources in general, deforestation, poor sanitation etc., the destruction of nature can cause serious problems on the planet, such as melting polar ice caps, earthquakes, tsunamis, floods, hurricanes, advancement of oceans in coastal areas, storms. Climate researchers show that there is an interaction of the atmosphere and the ocean waters, which is known as El Niño, causes an increase in the temperature of the Pacific Ocean, resulting in a decrease of rainfall in Brazil's northeast, where the state of Ceará is located, thus causing climate changes. In this state, in which predominates semiarid region, drought is over the years generating serious problems, such as desertification, and if it continues at this pace soon there will be regions fully formed by deserts. This paper analyzes the current situation in some areas of the state of Ceará that can reach an almost total lack of water, which would make the weather more severe as well as bring some serious impacts and issues, especially in how to make the water reach the affected localities, avoiding the rural exodus. The results show that some towns in the state can turn into desert, such as Canindé, region of the sertão of Crateús, and in the northern region of the state, having the municipality of Irauçuba as the more problematic.

Keywords: Drought, Desertification, Ocean

Title: Earth Observations to monitor and mediate social interactions in coastal areas: The case of the port area of Fortaleza and environmental impacts

Authors: Lucas Macedo Lopes* (Comission of Maritime, Port, Airport and Customs Law of Ceará Bar Association)

Type: POSTER

Session: (8) EDUCATION AND OUTREACH

The use of satellite images for monitoring the Earth's changing landscape is something that has become common in contemporary terms. With the ease and advancement of technology, any person is able to observe with such rich detail earth's surface (with tools such as Google Earth). In Brazil, as in all countries of the world, the coastal cities, where there are port terminals, are closely related to the historical role of ports, which dates from the early 1800s, with the arrival of the Portuguese royal family to Brazil and called opening of the ports to friendly nations on January 28, 1808. The port story begins with the first rudimentary facilities, built soon after the discovery, and still present today in some areas, going to the large structures of the port complex and specialized terminals that exist today throughout its coast. According to what is traditionally seen in port cities, the port area of Fortaleza adds low in general residents or low income and symbolically constituted as a low red- light area. Added to this reality are the violence and drug trafficking, as aspects of social degradation and environmental impacts caused by the emission of solid, liquid or spill of hazardous products. The construction of the Port of Fortaleza between 1939 and 1940 caused major environmental impacts and changed the whole dynamic of Fortaleza coast. As a result, Iracema Beach lost 200 meters of the beach in 50 years, while the Praia do Futuro won 500 meters beach strip. The areas images obtained over the decades could have been used to monitor land use and prevent minimal damage to the coast. With the construction of moles and other environmental interventions disorganized urban growth around the Port of Fortaleza, coastal dynamics affect both the environment and the population itself. As can be perceive from the study sample, this investigation seeks to combine the satellite photos technologies to monitor human interventions in coastal areas (as in the case of Fortaleza). The laws of man bow before the laws of nature, but when there is intense and irregular coastal farm the consequences may be irreversible. The legal system should be an ally to the forms of analysis of human behavior, as it must arise standards that will properly regulate the occupation and coastal exploitation (seeking to avoid environmental disasters). Thus, satellites images should be used but with higher frequencies to allow the competent public administration to develop and implement public policies to give harmony to social expectations, economic interests and the environment in the coastal zone.

Keywords:

Title: ENVIRONMENTAL MONITORING FOR DIFFERENCES THERMAL MEANS WITH THE SPRING USE

Authors: Nilvia Nara de Lucena Alves Ramos (DENA/UFC), Valéria Ramos Lourenço (DENA/UFC), Léa Moraes Nunes Teixeira (DENA/UFC), Carlos Alexandre Gomes Costa (DENA/UFC)

Type: POSTER

Session: (5) OPERATIONAL REMOTE SENSING

Remote sensing can be used for features of the changes studies of a site as a result of urban progress. From satellite images can be obtained environmental data post-processing, provide subsidies in the assessment of the changes as, for example, use and land cover and temperature variation. With the use of GIS (Geographic Information Systems) as SPRING which have image processing functions, spatial analysis and consult spatial databases can be carried out monitoring and evaluation of large areas accurately. The objective of the present work is the evaluation of the temperature differences by Landsat 5 TM images in the years 1997-2007 (first semester) 2001 to 2011 (second semester) of the municipality of Rio de Janeiro-RJ using the software SPRING. To characterize the orbits scenes images were acquired / point 217/76 of TM Landsat 5 bands 3, 4, 5 and 6. The choice of images was observing the cloud cover percentage. Due to the high percentage of images covered by clouds was not possible to match the pairs of images in summer and winter so we ordered pairs of images of the first and second semester. For the conversion of the thermal band in surface temperature, there was the implementation of the LEGAL program in the SPRING. After converting the temperature difference images were obtained and were drawn profiles (linear transects), being able then to characterize the land use changes for temperature drift areas. It can be observed that the highest occurring temperature difference of 1997-2007 was approximately 13.75 ° C in an urban area, whereas the biggest difference occurred between 2001-2011 was approximately 16.25 ° C in urban areas. It can be also observed that there is no deviation or little temperature drift in the remaining area exists vegetation, observing up even a small change in temperature for less with the appearance of vegetation. Therefore from the data obtained with the image processing is concluded that there was an increase in the temperature in the first and second semester for an interval of 10 years, However for better characterization should also consider climate data.

Keywords: Remote sensing, GIS, temperature, Rio de Janeiro

Title: Effects of intense rain in Caatinga biome's vegetation through SAVI analysis

Authors: Léa Moraes Nunes Teixeira* (Federal University of Ceará), David Bruno de Sousa Teixeira (Federal University of Ceará) and Carlos Alexandre Gomes Costa (Federal University of Ceará)

Type: POSTER

Session: (5) OPERATIONAL REMOTE SENSING

Precipitation rates influence the vegetation, especially those whose leaves respond directly to the presence or not of rain. The Caatinga biome, located in the Brazilian semiarid, has as main feature a deciduous vegetation that lose leaves to avoid an excessive water loss through transpiration. The climate in this area has two distinct seasons, a rainy one from February to June and a dry one starting in July and remaining until January. In spite of the historic low precipitation rates in Brazilian semiarid, the 2004 showed an unusual subsequent intensive rain events along of the year, that can positively impact the water availability and the response of the vegetation in the area. Inserted in this context, the remote sensing has been used as an important tool to evaluate and characterize the effects of the precipitation in the vegetation's behavior. This way, the Soil Adjusted Vegetation Index (SAVI) is able to assess the condition of the vegetation and estimates vegetation cover, and it is considered one of the most used vegetation indexes. The objective of this research is to evaluate the influences of an intense rainfall, event dated of 2004, analyzing temporal changes in the vegetation of the Aiuaba Experimental Basin (AEB), comparing the SAVI for this rainy year and the previous (2003) and the subsequent (2005) years. The research was conducted in the Aiuaba Experimental Basin, a fully preserved watershed with approximately 12km², covered with Caatinga vegetation and located into the ecological station of Aiuaba. To calculate the SAVI were used images from the satellite Landsat 5, analyzing the spatial pattern of vegetation at the AEB for the dry season using Quantum Geographic Information System (QGIS). Were selected images of the months July, August and September for 2003; July, October and November for 2004; and July, September and November for 2005. The criteria used to select the images were based in the minimal presence of clouds. After the image processing, it was obtained the minimum and maximum values and the averages of SAVI for each month and year observed. As results, the average calculated for 2003, 2004 and 2005 were respectively 0.105, 0.129 and 0.125. If compared, the SAVI average for 2003 was about 19% lower than 2004 and 16% lower than 2005. It can indicate that the high precipitation rates in the 2004's rainy season was able to increase the vegetation cover for this year and the following year. In conclusion, the SAVI results suggest the Caatinga biome's capacity to respond among greater precipitation events.

Keywords: Caatinga, SAVI, intense rain, semiarid

Title: A New Method for In-situ Calibration and Validation of Thermal Remote Sensing with the Instrument BEST: Buoyant Equipment for Skin Temperature

Authors: Chuqun CHEN*, Haibin YE, Shilin TANG (The State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences. Guangzhou, 510301)

Type: ORAL PRESENTATION

Session: (5) OPERATIONAL REMOTE SENSING

The Sea Surface Temperatures (SST) is an key parameter on air-sea interaction. The SST data are widely used in many subjects of meteorology and oceanography. With several decades development, the satellite remote sensing technology has become the main approach for global or regional SST data collection and plays more and more irreplaceable role on oceanography and meteorology studies. However, the satellite measured SST is more closely related to the skin temperature than the subsurface bulk temperature. It is not convictive to validate the satellite measured SST with the subsurface bulk temperature, which is generally measured at a depth of one meter or even deeper. In order to validate the satellite retrieved SST, or to conduct in-situ calibration of thermal sensors, it is necessary to measure skin temperature in-situ. In this report, a new methods for in-situ calibration of thermal sensors and validation of remotely-sensed SST is proposed with the new skin temperature instrument, the Buoyant Equipment for Skin Temperature (BEST). The new instrument BEST integrates thousand of thermistor sensors in one pole. The thermistor sensors are arrayed from 0.6 mm in the top part of the pole (with length of 60 cm) to 10 mm in the bottom part of the pole(with a length of 100 cm). The pole is vertically floated in the sea surface layer with the buoy part , and it can synchronically measure the temperatures of the bottom layer of the air, the skin layer and the surface layer of the water. The measured temperatures can be recorded every second at an accuracy of 0.05K The new method will employ 16 BESTs mooring in the ocean as a 4*4 grid with a column/row distance of 300 meters. The BEST grid will continuously measure the temperatures every second for months or years. The in-situ data will remarkably improve the spatial and temporal matching to remote sensing data with 1km*1km spatial resolution. it will certainly play an important role in in-situ calibration for thermal satellite sensors and in-situ validation of remotely-sensed SST products. In other hand, the in-situ temperature data with very high vertical spatial resolution will be applied for air-sea fluxes (heat, co2) research, and will play a role on air-sea interaction studies by providing the real interaction temperature of air-sea interaction.

Keywords: Sea surface temperature, Skin temperature instrument, Thermal remote sensing, In-situ validation, In-situ calibration

Title: Green Tide Monitoring in the Yellow Sea using GOCI and SAR images

Authors: Chan-Su Yang* (Integrated Ocean Sciences, University of Science & Technology, Marine Safety Research Center, Korea Institute of Ocean Science & Technology, Department of Convergence Study on the Ocean Science and Technology, Ocean Science and Technology School), Ahmed Harun-Al-Rashid (Integrated Ocean Sciences, University of Science & Technology, Marine Safety Research Center, Korea Institute of Ocean Science & Technology), Jong-JinJeong (Department of Convergence Study on the Ocean Science and Technology, Ocean Science and Technology School, Department of Applied Physics, Hanyang University, Korea)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

Extensive bloom of macroalgae is commonly termed as green tide which has become very common in summer in the Yellow Sea from 2007 covering hundreds of square kilometers of ocean surface in coastal and offshore near Qingdao, China. This has seriously impacted the Yellow Sea as it creates potential management problem to local government and management agencies because they are washed up onto the beach and was accounted as its highest in 2008. To understand the recent condition of green tide in the Yellow Sea we monitored the extent of macroalgae from May to August in 2016. The precise detection of macroalgae bloom has become possible due to high temporal (8 images per day) and spatial resolution (500 m) of images provided by Geostationary Ocean Color Imager (GOCI) and Synthetic Aperture Radar (SAR) images. A simple Normalized Difference Vegetation Index (NDVI) using GOCI Band-5 (660 nm) and Band-8 (865 nm) effectively discriminated the presence of vegetation floating on the sea surface. Monthly time-series of green tide detection was generated using macroalgae covering NDVI pixels that were characterized by higher values than surrounding macroalgae free water. NDVI threshold value of 0.05 was used to isolate the green tide pixels, and the green tide covered area was calculated using those pixels information. We found that the most frequently occurred area is nearby Qingdao of the Yellow Sea. During the study period highest days of occurrence was found in June 2016 (12 days with mean value of 4757.8 ± 3148.1 km² as green tide area) followed by July 2016 (11 days with mean value of 853.4 ± 1940 km² as covered area). The highest area covered by was accounted in 24 June 2016 (9998 km²). The frequencies of green tide occurring days and total area covered by were very less in months of May and August 2016.

Keywords: Green tide, GOCI, SAR, NDVI

Title: Significant wave height investigations in the South-Southeast of Brazil

Authors: Adrieni Ferreira de Andrade (Universidade Federal do Rio de Janeiro), Nina Dorian Esteves Gurgel do Amaral Sampaio* (Universidade Federal do Rio de Janeiro) and Nelson Violante de Carvalho (Universidade Federal do Rio de Janeiro)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

This study presents a large scale investigation of significant wave height (SWH) in the south-southeast of Brazil through altimeter data, mete-ocean buoys and wave model results investigations. SWH values of 2011 to 2013 from altimeters were accessed at GlobWave Data Base, which provides free access to consolidated satellite wave data and products from both SAR and altimeter missions in a common netCDF format. Beyond that, statistical wave parameters obtained from wave data collected by three mete-ocean buoys have been used. The three buoys are moored near Santos –SP, Florianópolis –SC and Rio Grande –RS. These buoys are part of PNBOIA program and maintained by Brazilian Navy. A WAVEWATCHIII simulation was performed for the same period. As initial and boundary conditions were used wind and ice height resolution reanalysis products of Climate Forecast System (CFS) database, from the National Centers for Environmental Prediction (NCEP) (SAHA et al, 2011). For grids configuration during waves simulation were implemented a grid with 1° resolution that covers the Atlantic Ocean and part of the Pacific Ocean and a second grid covering the interest area with a spatial resolution of 0.25° . The SWH data from altimeters were organized and interpolated in a grid with 1° resolution for each month. Moreover, two rays (one with 50km and other with 150km) from each buoy were created and a time series with altimeter data were generated. Preliminary visual comparisons between altimeter and model gridded data presented good correlation, as well as buoys, altimeter and model results of SWH time series. Therefore, using this methodology, we could investigate monthly variations of SWH using data from different sources. It was also shown that altimeters data is a reliable alternative for region with buoys measurements scarcity and for validating wave models.

Keywords: significant wave height, altimeter, wave modelling

Title: Climate Change Signals from Polar regions

Authors: Josefino C. Comiso* (Nasa Goddard Space Flight Center)

Status: PRESENTED

Code: O - 001

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

The results of analyses of more than 37 years of satellite passive microwave and infrared data suggest mixed signals about climate change in the Arctic and Antarctic regions. In the Arctic the sea ice cover has been declining at the rate of about 4% per decade but the key result has been the rapid decline of the perennial sea ice cover, which is ice that survives the summer melt. In recent years, the area of the perennial ice, which is the mainstay of Arctic sea ice and has been observed in situ for 1450 years, has been reduced by more than 50% since 1980. Concurrent satellite thermal infrared data also indicate a warming trend in the region that is more than 3 times that of global warming trend in part because of amplification caused by ice-albedo feedback effects. Such warming is strongly correlated with the decline of the sea ice cover and is likely associated with significant losses in the mass of the Greenland ice sheet and the glaciers in the Northern Hemisphere that has in part caused an enhanced sea level rise. The extent of the snow ice cover has also been reduced, especially in June, while the area of discontinuous permafrost has declined. In the Antarctic region, the sea ice cover is unexpectedly increasing in extent at a modest rate of 2% per decade during the same period with the 2014 extent showing a record high value. Global warming trends, however, are not expected to be uniform globally and in the Antarctic the trend in sea ice is actually coherent with observed cooling in the marginal sea ice zones and adjacent regions. Surface temperatures in the region are also strongly correlated with sea ice extents during growth and melt seasons suggesting an important role of temperature on the positive trend in the ice extent. This study also shows large discrepancies of observed temperature trends with those from reanalysis data suggesting that the mismatch in observed trends of sea ice and those from models is caused by the inability of the models to reproduce observed trends in surface temperatures.

Keywords: climate change sea ice surface temperature

Title: Melt rates of BC coastal mountain glaciers determined by Cryosat 2 altimetry

Authors: Jim Gower* (Institute Of Ocean Sciences)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

On the coast of BC and Alaska, glacial melt water is important in raising river flow rates and lowering river water temperatures in the summer, often making a critical difference to migrating juvenile salmon survival. Any increase in flow rate due to the present observed melting must be temporary as glaciers lose surface area and eventually disappear. Future impacts of long-term glacial melt on North American salmon fisheries are expected to be severe. Cryosat 2 provides significant new data on this melting trend.

Cryosat 2 altimetry of the area 49 to 53N, 122.2 to 127W for the period October 2010 to January 2016, is used to assess melt rates of glaciers in the southern part of the BC Coastal Mountain range. The SARIN altimeter on Cryosat 2 is in synthetic aperture mode in this area, recording heights of suitably-sloping targets out to distances of about 5km cross-track from nadir. Time series of target heights were assembled for targets in small sub-regions measuring 450 north-south by 560m east-west and overlapping by 75% in both directions, covering the study area. Height change rates were computed for approximately 111,000 sub-regions where 10 or more measurements are available. Time series for sub-regions below 1500m altitude give height change rates clustered symmetrically about zero, with an approximately Gaussian spread having full width to half height of +.175m/year. These targets of roughly unchanging height can be confirmed by visual inspection to be from rock or vegetation targets. Above 2000m the distribution of height change rates shows this same distribution for 44% of the points, but 56% of the points, which are from the surface of glaciers, show a broader distribution, all indicating melting by up to 2m/year. Absence of negative melt rates (i.e. growing glacier heights) is especially striking. Melt rates decrease with increasing altitude, from 1.6m/year at 1500m altitude down to about 1.1m/year at 2500m, and are also higher over the later period 2013-2016 than in 2010-2012, in agreement with observed local air temperature warming.

Keywords: altimetry, glaciers, fisheries

Title: Digital Elevation Model from Dunes of Lençóis Maranhenses National Park, Maranhão, Northeastern Brazil

Authors: André Luis Silva dos Santos* (Ifma), Denilson Silva Bezerra (CEUMA), Hélder Pereira Borges (IFMA) e Ana Paloma Cruz (CEUMA)

Type: POSTER

Session: (2) COASTAL IMPACTS

We are presenting a Digital Elevation Model (DEM) from dunes of Lençóis Maranhenses National Park (LMNP), Maranhão, Brazil, to support modeling studies to simulate how the dunes are formed using multi-temporal satellite images and ground truth with the collection of data through the post-processed kinematic GNSS positioning. The study area is located in the contact zone between three major Neotropical ecosystems: Amazonia, Caatinga, and Cerrado. The PNLM is a Brazilian conservation units of integral protection of nature located in the northeastern state of Maranhao, encompassing the largest dune fields in Brazil, wide shrubby areas (restingas), lakes, mangroves, and many freshwater lagoons. GNSS application in that area has occurred due to the difficulty of mapping the dune features through conventional methods such as theodolite, level, total station systems, because of their cost, time or precision when collecting data. We have recorded 5.605 geodetic points of dune features in the area. The results showed that for the survey (November/2015) a dune with 11.485m the maximum height and the ground base with 0.337m.

Keywords: Digital Elevation Model (DEM), Simulation, Lençóis Maranhenses National Park

Title: Use of ocean colour satellite data to study the effect of typhoons on phytoplankton composition in the South China Sea

Authors: Evgeny Morozov* (South China Sea Institute Of Oceanology, Chinese Academy Of Sciences) and DanLing Tang (South China Sea Institute of Oceanology, Chinese Academy of Sciences)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

Phytoplankton plays an important role in the global carbon cycle. At the same time, we know that distinct phytoplankton groups affect the carbon cycle differently. It has been shown earlier by in situ measurements that typhoons affect different phytoplankton types differently.

The influence of typhoons on phytoplankton community structure in the South China Sea (SCS) was studied for the first time with the use of ocean colour satellite data spanning the time period 1997 - 2016.

Cases of typhoons occurrence in SCS are analysed. The influence of typhoons on phytoplankton size, classes, and functional types distribution was studied. The study was performed with the use of chlorophyll-a abundance based and ocean colour spectrum based algorithms (Alvain et. al 2012, Ye and Tang 2013, IOCCG 2014). Two types of ocean colour data archives were used to reveal all the potential of the used algorithms and obtain extensive understanding of phytoplankton community structure, namely the NASA oceancolor Level 3 data archive and Ocean Color CCI multisensor merged data archive. Satellite data on Sea Surface Temperature and wind speed were used to facilitate the understanding of the processes determining typhoon influence on phytoplankton community structure.

Seasonal and interannual variations of phytoplankton size structure and of functional types composition in the South China Sea (SCS) were revealed using the ocean color satellite data. Detailed case studies of selected typhoons' influence on phytoplankton size structure and functional types composition were carried out.

References.

- 1) Alvain S., Loisel H., and Dessailly D. "Theoretical analysis of ocean color radiances anomalies and implications for phytoplankton groups detection in case 1 waters". Vol. 20, No. 2 / OPTICS EXPRESS 107, 2012.
- 2) IOCCG (2014). Phytoplankton Functional Types from Space. Sathyendranath, S. (ed.), Reports of the International Ocean-Colour Coordinating Group, No. 15, IOCCG, Dartmouth, Canada.
- 3) YeHaiJun, TangDanLing. "A Three-Component Model of Phytoplankton Size Classes for The South China Sea". Malaysian Journal of Science 32 (SCS Sp Issue) : 319-326 (2013)

Keywords: typhoon, South China Sea, Satellite remote sensing, Ocean Colour, Phytoplankton size classes, Phytoplankton functional types

Title: Potential and prospective seasonal distribution of hotspot habitat of albacore tuna (*Thunnus alalunga*) in the Indian Ocean using the satellite data

Authors: Ali Haghi Vayghan (Department Of Environmental Biology And Fisheries Science, National Taiwan Ocean University), Ming-an Lee* (Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University) and Wan-Chen Yang (National Taiwan Ocean University)

Type: POSTER

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

Having comprehensive view on potential habitat distribution is useful for the effective management of an ecosystem, however, detailed knowledge of hotspot distribution and prospective habitat of aquatic living resource is needed to implement high resolution long term ecosystem-based fishery management (EBFM) framework. This study represented the habitat suitability of Albacore (ALB) tuna based on 3 different scenarios of potential distribution, hotspot (core habitat) and prospective hotspot habitat suitability (on 2050) that was recorded by Taiwanese longline fisheries association in the Indian Ocean (IO). The study employed maximum entropy (MaxEnt) model to draw habitat suitability and monitor seasonal differences of ALB habitat suitability from 1998 to 2014. Surprisingly, the result uncovered that ALB preferred different seasonal habitat and environmental variables over the potential habitat, hotspot (core habitat) and prospective hotspot in IO. Moreover, it is also revealed that prospective habitat distribution of ALB will shift to southwestern of IO in 2050 (under worst case scenario of carbon emission, RCP85) and the available suitable habitat of ALB in different life spans will be lesser than its current extent in the IO. The most important environmental variables which was detected by the model showed, in a different scenario of habitat, ALB preferred different environmental variables in different season, even comparing with hotspot habitat. However, fish preferred sea surface temperature (SST), net primary production (NPP) and mixed layer depth (MLD) in potential habitat scenario; on the other side, ALB preferred SST, and sea surface height (SSH) and MLD for hotspot scenario. Overall, the result of this study uncovered that ALB hotspot habitat will alter in different seasons in 2050, which highlights urgent needs for employing specific seasonal and global (e.g. climate change) policies and planning in the IO. Applying such different strategies for ALB during different seasons will enhance global perspectives on future events and help Taiwanese fishermen to adapt fast, and decision makers to decide on the habitat characteristics of ALB in future prospective. In addition, the study could alarm the potential effects of global warming on available habitat of ALB to modifying EBFM in IO by controlling fluctuation of most preferred seasonal environmental variables.

Keywords: Albacore tuna, habitat suitability modeling, MaxEnt, climate change, Indian Ocean, ecosystem management

Title: An inter-comparison of QuickSCAT and ASCAT derived wind-field forcing toward modeling of coastal productivity in the coastal eastern Arabian Sea.

Authors: Kunal Chakraborty (Indian National Centre For Ocean Information Services), Nimit Kumar* (Indian National Centre For Ocean Information Services) and G. V. M. Gupta (Centre for Marine Living Resources and Ecology, Cochin)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

Coastal productivity supports livelihood of millions via fishery. It becomes significant especially for Arabian Sea, where coastal population is from emerging or underdeveloped economies. Simulating coastal productivity has been a difficult task for numerical ocean modelers. Appropriate boundary conditions and forcing is essential for a good model output. We compared influence of wind-fields derived from two different satellite sensors (scatterometers), namely QuickSCAT and ASCAT – on ROMS biophysical model simulation of coastal productivity in the coastal eastern Arabian Sea. Both scatterometers have different design and operational bandwidth with only a short overlap period of two years (2007-2009). We forced our model with both the wind-fields separately and compared outputs with in-situ and satellite observations. We found that QuickSCAT wind-fields forced model simulated higher productivity at shallower depths in compare to that forced by ASCAT wind-fields. We also compared the modeled chlorophyll values for various depths with those taken from in-situ observations and found that QuickSCAT forced model provided better correlation. Additionally, we compared the ability of both the models to simulate surface chlorophyll interannual variability with satellite derived data from SeaWiFS and MODIS-Aqua satellites. We found that overall, QuickSCAT forced model provided better correlation. Advancing from the attempts made for tropical Indian Ocean for simulation of surface currents, our findings are the first for biogeochemistry, for this part of the world.

Keywords: ROMS, Scatterometer, QuickSCAT, ASCAT, productivity, forcing

Title: Physical and biological forcing on spatio-temporal distribution of Hilsa shad in north-western Bay of Bengal using remote sensing data

Authors: Sourav Maity (Indian National Centre For Ocean Information Services), William T. Peterson (NOAA-Northwest Fisheries Science Center), T. Srinivasa Kumar (Indian National Centre For Ocean Information Services) and M. Nagaraja Kumar (Indian National Centre For Ocean Information Services), Nimit Kumar*

Type: ORAL PRESENTATION

Session: (5) OPERATIONAL REMOTE SENSING

Hilsa shad - *Tenualosailisha* is an anadromous fish that spends most of its life span in the open ocean of Bay of Bengal. With the onset of summer monsoon, the species ascends towards Ganga-Brahmaputra estuary for breeding and contributes significantly in the coastal and riverine fishery of West Bengal and Odisha states in India and the entire coastal states of Bangladesh. From many decades, the traditional fishermen of India and Bangladesh have targeted Hilsa fishing as one of the major source of their livelihood. In India, the trend of ascend in Hugli and Matla rivers seems to have declined in present years and most of the stock became restricted to the coastal and estuarine region. The species is over-exploited and the size of the stock is highly fluctuating inter-annually. In this present paper an effort has been provided to categorise plausible physical, biological and climate signals that trigger the inter-annual variability of the ascending shoal to figure out the appearances and disappearances patterns of Hilsa in the coastal stretch of north-western Bay of Bengal. From the remote sensing data, during the period of 2009-2016, it was observed that monsoon had significant contribution towards breeding migration as strong assemblage of fish has been observed in low saline regions. We also observed that though adults completely stop feeding phytoplankton during breeding migration, availability of optimum phytoplankton in spawning ground is indispensable for larval rearing.

Keywords: Hilsa, anadromous, Bay of Bengal, Hugli-Matla estuary, migration, Indian summer monsoon

Title: Near Real-Time Maritime Object Recognition using Multiple SAR Satellite Sensors

Authors: Björn Tings* (German Aerospace Center (dlr))

Type: ORAL PRESENTATION

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

Public and private users request for Maritime Situation Awareness (MSA) to gain the ability to support maritime safety and security in worldwide oceans and coastal waters. One important part of MSA is the observation of ship traffic. Today observation is mainly done using the alienated Automatic Identification System (AIS), which is almost continuously globally available. However, AIS is an unreliable data source, as it shows coverage caps in high traffic areas, is not broadcast by all ships and only provides limited information content. Thus, MSA needs support by more trustworthy earth observation data. In this paper the detectability of ship and ship wake signatures using Synthetic Aperture Radar (SAR) data acquired under different environmental conditions is analyzed. These signatures are the basis for recent research results on near real-time (NRT) ship parameter estimation and maritime object classification. In order to increase the spatial and temporal coverage of one single SAR satellite, the application on multiple satellites like RADARSAT-2, Sentinel-1A, Sentinel-1B or TerraSAR-X/TanDEM-X is presented.

Alternative Session: As SAR-data from the new Sentinel-1A and Sentinel-1B satellites will be presented, this paper was seen as part of the Session "New Technologies and Image Processing". Alternatively also the Session "Operational Remote Sensing" would be appropriate.

Keywords: maritime object recognition, Synthetic Aperture Radar, Near real-time, machine learning, morphological image processing, feature extraction

Title: Observing storm surges from satellite altimetry

Authors: Guoqi Han* (Fisheries And Oceans Canada)

Type: ORAL PRESENTATION

Session: (4) EXTREME EVENTS

Storm surges are the main factor that causes coastal flooding, resulting in catastrophic damage to properties and loss of life in coastal communities. Thus it is important to enhance our capabilities of observing and forecasting storm surges for mitigating damage and loss. In this talk we first review existing methods of monitoring storm surges. We then provide examples of storm surges observed by nadir satellite altimetry, during Hurricane Sandy, Igor, and Isaac, as well as other cyclone events. The satellite results are evaluated against tide-gauge data. The storm surges are discussed for dynamic mechanisms. Finally, we show the potential of a wide-swath altimetry mission to be launched in 2021, the Surface Water and Ocean Topography (SWOT), for observing storm surges.

Keywords: Storm surges, satellite altimetry, continental shelf wave, tide gauges

Title: Observational evidence of offshore transport of salt water and meandering of East India Coastal Current

Authors: Martin V Mathew* (National Institute Of Ocean Technology, Chennai), R Venkatesan (National Institute Of Ocean Technology, Chennai), Phanindra Reddy (National Institute Of Ocean Technology, Chennai), Jossia Joseph (National Institute Of Ocean Technology, Chennai) and Navaneeth K N (National Institute Of Ocean Technology, Chennai)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

The East India Coastal Current (EICC), the western boundary current of the Bay of Bengal (BoB), forms an integral part of the monsoon current system. Under the influence of alternating monsoons, the EICC reverses twice a year. Prior to the southwest monsoon, in February-April, the EICC is observed to be a continuous northward flow, which reverses after the cessation of southwest monsoon in October-December as a continuous equatorward flow. The BoB exhibits highly heterogeneous salinity distribution with extremely fresh waters found at the surface in the Northern part of the basin, and saltier waters at subsurface as well as to the south. Earlier studies reported that EICC plays an integral part in controlling the salinity distribution of Bay by exchanging water between the Arabian Sea and Bay of Bengal, thereby playing a crucial role in maintaining the large scale hydrological balance. Various in-situ and remotely sensed datasets such as moored buoy observations (temperature, salinity and currents), temperature and salinity profiles from ARGO floats, surface current from Ocean Surface Current Analysis-Real time (OSCAR) and Sea Surface Salinity (SSS) data based on Aquarius observation are used in the present study. Analysis of 5-day mean OSCAR surface currents in Bay of Bengal during the period 08 March 2013 to 17 May 2016 revealed the meandering of EICC at about 19°N during March 2013. Seven-day mean of Aquarius SSS revealed a northward advection of high saline water from the southern Bay of Bengal along the path of EICC. Observations from three moored buoys in open ocean also showed the changes in water column properties such as temperature, salinity and currents, accompanying an intensification of currents in association with meandering of EICC. The present study attempts to estimate the salt transport into northern Bay of Bengal through EICC and its influence on salt budget in Bay of Bengal.

Keywords: EICC, OSCAR, meandering, Aquarius

Title: The climate change impacts on the spatial distribution of yellowfin tuna (*Thunnus albacares*) in the Arabian Sea

Authors: Ming-an, Lee* (Department Of Environmental Biology And Fisheries Science, National Taiwan Ocean University) and You-Jin, Xu (Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University)

Type: ORAL PRESENTATION

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

* mexer no nome do(s) autor(s)

Yellowfin tuna (*Thunnusalbacares*) is one of the important commercial species of the Taiwanese longline(LL) fishery in the Arabian Sea. The 1 degree resolution catch data of yellowfin tuna and satellite-derived environment variables with the model data were collected during the period of 1998 - 2013. The Generalized Additive Models (GAMs) were used to explore the correlation between the catch rate (CPUE) of yellowfin tuna and oceanic environmental factors for evaluating the optimum environment and their spatial distributions of yellowfin tunas. The environmental changes caused by climate change may affect the distribution of yellowfin tuna of the Arabian Sea. This study intends to model the effect of climate change in a site-selection model, i.e., scenarios given in the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2013).

The model selection processes of GAMs showed that the cumulative deviations explained were 52%. The results showed that the catch rates were significantly correlated with the temporal (year and month), spatial (longitude and latitude), and environmental variables of sea surface temperature (SST), sea surface height (SSH), net primary production (NPP) and upwelling index(UP). We observed a positive association between catch rates and SST between 27.0-29.5°C, around 600-1000 mgC/m²d⁻¹ of NPP and SSH within 0.225-0.300 m. Based on this model, the predicted CPUE possibly influenced by climate change will significantly decrease - about 1.07-8.03% between 2006 and 2050 in the RCP 2.6~8.5 scenario. In addition, the possible fishing zone was also found to be reduced about 2.7~36.25% under the impacts of climate change.

Keywords: Yellowfin tuna, Arabian Sea, Remote sensing, GAMs, Climate change

Title: Modelling of Essential Fish Habitat Based on Remote Sensing, Spatial Analysis and Fishery Dynamic in the Coastal Waters off Western Taiwan

Authors: Sheng-yuan Teng* (Department Of Environmental Biology Fisheries Science, National Taiwan Ocean University), Ming-An Lee (Department Of Environmental Biology Fisheries Science, National Taiwan Ocean University), Nan-Jay Su (Department Of Environmental Biology Fisheries Science, National Taiwan Ocean University), Kuo-Wei Lan (Department Of Environmental Biology Fisheries Science, National Taiwan Ocean University), Yi Chang (Department of Hydraulic & Ocean Engineering and Institute of Ocean Technology and Marine Affairs, National Cheng Kung University) and Jheng-Tang Huang (Department Of Environmental Biology Fisheries Science, National Taiwan Ocean University)

Type: ORAL PRESENTATION

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

Black Seabream (*Acanthopagrus latus*) is one of the most important commercial species in the coastal fisheries of Taiwan. This study aims to understand the fishing activity of gillnet fishery and the community structure of fishery resources in coastal waters off western Taiwan. In this study, we collected logbook of sampled gillnet vessel, environmental data (i.e. Sea Surface Temperature, chlorophyll-a, sediment and depth) and data from voyage data recorder. We also investigated abundance and spatial distribution of hot spots for species that regularly released in recent years, and analyzed annual variation on community structure of fishery resources for species. Through ArcGIS software, spatial distribution of black seabream appeared widespread in each season. However, the range of CPUE is 1.58-2.16 kg/vessel/day in each season. Black seabream is mainly distributed in coastal waters of Chianan, but high CPUE concentrated in the coastal waters of Nanliao, Fishing Port of Yuanli in first and second quarter. In addition, Habitat Suitability Index (HSI) model showed that black seabream have high sensitivity to the habitat changes in its ocean environment. For the second quarter, distribution of HSI value is widespread and concentrated in the coastal waters of Yunlin and Chiayi in the third and fourth quarter. In future, results from this study could be used to understand the impacts on the environment, habitat and community structure of fishery resources, and provide suggestions for planning fishing management strategy.

Keywords: *Acanthopagrus latus*, Remote Sensing, Habitat Suitability Index, Western Taiwan

Title: The Response of Cloud Fraction to Climate Variability over the Extratropical Oceans as observed by MISR and MODIS

Authors: Andrew Geiss* (University Of Washington)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

The multi-satellite data are used by multiple stepwise processes to investigate the spatio-temporal variability of chlorophyll concentration and aerosol of the Northwestern Pacific marginal sea. The primary production may closely relate to the chlorophyll. Moreover, the chlorophyll may be affected by the nutrients, solar radiance, and sea surface temperature. In the study area, the dominant winds are the northeastern and southwestern monsoons. The atmospheric suspension material or dust of continental Asia will be transported to the study area by the prevailing wind. The solar energy is reduced by aerosol scattering. At the same time, the supply of oceanic energy becomes restricted. Otherwise, the suspended material and aerosols provide nutrients for the phytoplankton. The continental shelf water is clearly affected by terrigenous sources. Therefore, the satellite retrieved chlorophyll concentration has higher error in the continental shelf area. To improve the accuracy of the chlorophyll concentration algorithm with satellite data in the adjacent Taiwan ocean (with its continental shelf), the spectral radiometer will observe the ocean radiance intensity and reflectance in each season. Simultaneously, sampling the sea water to measure the chlorophyll concentration is used.

Keywords: MISR, MODIS, PDO, ENSO, Cloud Fraction, Climate Variability

Title: Upwelling and phytoplankton bloom along the southern coast of Sri Lanka

Authors: Gang Pan* (China-sri Lanka Joint Centre For Education And Research, Chinese Academy Of Sciences, China)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

Many Indian Ocean fisheries are closely tied to eddies and upwelling variability. During the Southwest Monsoon, increased chlorophyll concentrations were observed from Moderate Resolution Imaging Spectrometer (MODIS) imagery along the southern coast of Sri Lanka. These phytoplankton blooms are associated with high primary productivity and have been attributed to coastal upwelling. Chlorophyll concentrations appeared low during the Northeast monsoon, but feeding aggregations of blue whales (*Balaenoptera musculus*) along the southern coast indicated evidence of high productivity. This means that upwelling along the southern coast was prevalent throughout the year, instead of being limited to the Southwest Monsoon as previously thought. This study explored elements of the dynamics of the surface circulation and coastal upwelling in the waters around Sri Lanka using satellite imagery and in-situ observations. Quantifying these processes will be informative in predicting how these wake eddies and the upwelling associated with them might change in the future and, in particular, how they will respond to climate change and global warming.

Keywords: Upwelling, Phytoplankton, Monsoon, Sri Lanka

Title: **STUDY FOR TSUNAMI DETECTION WITH VHF OCEAN RADAR IN THE EAST OF ENSHU COAST**

Authors: Shin'ichi Sakai* (Central Research Institute Of Electric Power Industry) and masafumi Matsuyama (Central Research Institute Of Electric Power Industry)

Type: ORAL PRESENTATION

Session: (4) EXTREME EVENTS

Surface current observations off the east Enshu coast were taken with two VHF ocean radars from December 2013 to April 2014, and the radial current at each radar site with the spatial resolution of 0.5km was alternately measured every 5 minutes in the maximum range of about 17km off the coast. Tsunami simulations of great earthquakes along the Nankai Trough located about 100km off the south Japan coast were also conducted with a four segments model based on non-linear long-wave theory. The pseudo current data of tsunami propagation were composed to superimpose the tsunami simulation data on the observational current data to investigate the practicality of ocean radar observation for tsunami detection. We selected two coastal current patterns derived by ocean radars for the pseudo data: a strong westerly current and strong southeasterly current with current speed of 50 to 60cm/s. The results of primary tsunami simulations of 9 cases with changing earthquake conditions indicate that the tsunami mainly comes from southeast direction to the Enshu coast and arrives in almost 20 minutes after the earthquake occurrence. The result indicates that the temporal phase of the current variation due to tsunami precedes that of the sea level variation, implying that the monitoring of current signals has an advantage over the direct sea level monitoring for tsunami detection. We investigated the availability of several current-based tsunami indexes based on the pseudo radial current data, which is more useful to capture the high-speed tsunami propagation than the pseudo current vector data with a 5 minutes delay produced by the spatial and temporal interpolations. The results show that the maximum tsunami height based on radial current velocity and water depth well represents the spatial and temporal variation of tsunami events. The tsunami detection time and position change somewhat in response to the magnitude of the earthquake or the line of sight and observational direction of the radar. In case that the criteria of tsunami arrival is defined as $\Delta < 1 \sigma$, the window time from the tsunami detection to tsunami attack of the Enshu coast is approximately about 5 to 15 minutes with the VHF ocean radar observation. Though it is certified the radar-based surface current observation is useful for tsunami detection, it should be noted that the observational data of the radar are contaminated by noises under severe weather conditions such as typhoon or large-scale depression due to the variability of the radio wave conditions. As the result, to investigate the radar signals at the time of typhoon NOUL and ETAU in 2015 that passed near the study area, the coverage area of the observation declines by 1/4 to 1/3, compared with the usual coverage area during about 18 hours around the closest time of each typhoon. The current speed also increases by over 50cm/s and up to 1.5m/s, which is higher than the usual situation range of about 20cm/s average.

Keywords: tsunami, ocean radar, Nankai Trough, numerical simulation, radial current observation

Title: Towards predictive capabilities of Oil Sardine (*Sardinella longiceps*) fishery along the southwest coast of India

Authors: Nimit Kumar* (Indian National Centre For Ocean Information Services), Sourav Maity (Indian National Centre For Ocean Information Services), N. Savavanane (2Centre for Marine Living Resources and Ecology, Cochin), Eli Holmes (Northwest Fisheries Science Center, NOAA), Cara Wilson (Southwest Fisheries Science Center, NOAA), Vera L Trainer (Northwest Fisheries Science Center, NOAA), William Peterson (Northwest Fisheries Science Center, NOAA), Mark Wells (University of Maine, USA), Nagaraja Kumar M (Indian National Centre For Ocean Information Services) e Srinivasa Kumar T (Indian National Centre For Ocean Information Services)

Type: ORAL PRESENTATION

Session: (5) OPERATIONAL REMOTE SENSING

Owing to the large population, limited area and growth at the base of population bell, India will continue to rely on marine resources for its nutritional requirements for the next few decades. Marine captured fishery in India is concentrated in the coastal waters and is chiefly supported by coastal productivity. Monsoonal wind reversal leads to upwelling, which is reported to support fishery of Oil Sardine (*Sardinella longiceps*) along the southwest coast of India. Policy makers need information such as seasonal outlook in order to tackle the inherent uncertainty in this fishery due to its close-coupling with monsoon. This study presents outcomes from the collaboration between India and USA, to resolve these issues. We studied Oil sardine landings at the Kerala state for multiple decades. We also attempted to find the correlation of fish landings with various met-ocean parameters. These include sea surface temperature, sea surface chlorophyll, sea surface height, upwelling index, and precipitation; among others. First outcomes suggest that precipitation may be important factor for fish landings. Lag analysis suggest that precipitation in the previous quarter influences most of the landings. Similar correlation was found with upwelling, sea surface height, and chlorophyll – but at a lag of eight to nine quarters. These outcomes can help India in development of seasonal outlooks for fish landings.

Keywords: Fishery, Oil Sardine, Upwelling, Monsoon

Title: COMPARISON OF 4DVAR AND 3DVAR DATA ASSIMILATION TECHNIQUES FOR SIMULATION OF EXTREME EVENTS OVER INDIAN REGION

Authors: Rekha Bharali Gogoi* (North Eastern Space Applications Centre), Shyam Sundar Kundu (North Eastern Space Applications Centre) and P L N raju (North Eastern Space Applications Centre)

Type: ORAL PRESENTATION

Session: (4) EXTREME EVENTS

Extreme weather events such as flash flood due to heavy rain, thunderstorm, cyclone etc. are periodic phenomena in India. Every year India loses a huge part of its revenue due to the devastation brought by these extreme events. However due to the advances in weather prediction now days it becomes possible to predict weather well in advance. During the last decade only technique employed for advanced weather forecast is the high resolution Numerical Weather Prediction (NWP) model. NWP models are mathematical models that represent the evolution of atmospheric systems as accurate as possible depending on the precise analysis of the atmospheric state. Data Assimilation is a process to bridge the gap between NWP models and observations of various weather parameters such as temperature, pressure, humidity, wind etc. to best estimate the initial atmospheric state for NWP models. In this study the Weather Research and Forecasting Model (Skamaroch et al. 2005) and variational data assimilation techniques such as 3DVAR (Barker et al. 2004) and 4DVAR (Huang et al. 2009) were employed. Various types of meteorological observations from the archived Global Forecast System (GFS) are assimilated, namely winds, temperature, moisture, and surface pressure from radiosondes, ships, and surface stations winds from profilers and cloud tracked winds from satellites. The assimilation window of 4DVar covers the period from -3 h to +3 h of each analysis time assimilating all the observations distributed over a 6-h window at exact time whereas in 3DVAR assimilation is done at an approximate analysis time. Two case studies were carried out to compare the performance of both the methods. One case study was the flood event of Jammu and Kashmir due to heavy down pour during 28th March 2015 to 31st March 2015 and another case study was the recently occurred Cyclone Roanu initiated at Bay of Bangle during 16th May 2016 to 22nd May 2016. For their inter comparison the root-mean-square error (RMSE) of horizontal winds (U, V), temperature T, and the mixing ratio of water vapor Q were calculated between model forecasts and radiosonde observations over the model domain and rainfall forecast was compared with Global Precipitation Measurement (GPM) daily rainfall data. It was observed that 4DVAR consistently outperforms 3DVar for both horizontal winds and temperature but 4DVar has more moisture RMSE to that of 3DVAR. It was also observed that with 4DVAR, the rainfall bearing mesoscale convective system was triggered at the right location and time, and spatial distribution of rainfall were also correctly simulated as compared to 3DVAR. But there was underestimation of rainfall amount by 4DVAR. This may be due to the higher RMSE of moisture variable of 4DVAR signifying that the simple moist physics used in the adjoint model of 4DVar is not able to represent moisture field precisely.

Keywords: Extreme events, 3DVAR, 4DVAR

Title: Spatial and temporal variability of anticyclonic water circulation under the influence of synoptic processes around the Urup Island of the Kuril ridge

Authors: Galina Vlasova* (Poi Febras)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

Kuril archipelago, including more than 30 large and many small islands, stretching for 1,200 km from Hokkaido Island to the Kamchatka Peninsula, separates the Sea of Okhotsk from the Pacific Ocean. Deep straits, Bussol and Kruzenshtern, divide it into three groups: the northern, central, and southern. The Urup Island is part of the southern group of the Kuril Islands, separated by Strait from the island Iturup, by the Urup Strait from the islands of Black Brothers, by Boussole Strait from the island Simushir. Monsoon climate is characterized by significant changes due to the remoteness from the continent. The southwestern part of the island is the most warm due to the warm Soya current. The northeastern part of the island is cold due to the low temperatures of the neighboring Sea of Okhotsk and the cold Kurile current.

Intensive water exchange between the Sea of Okhotsk and the Pacific Ocean takes place in the straits Freeze, Urup and Bussol, processes which are complicated by regional climate characteristics, tides, volcanic and complex topography. Specific water structure is formed under the influence of all the above factors in the study region.

The purpose of this article is to study the spatial and temporal variability of anticyclonic water structures in the zone of Urup under the influence of "the northwest" type of atmospheric processes, Polyakova, based on numerical modeling. A quasi-stationary baroclinic model was used for the realization of this goal. The current function is calculated in the upper quasi-homogeneous layer taking into account the vertical distribution of the water density, bottom topography, and atmospheric circulation in the model. Numerical experiments were carried out for all seasons of the period covered by the available expeditionary data (1949-1994).

Analysis of water circulation schemes, resulting from calculations, shows that the picture of currents is presented by complex set of diverse meandering and vortex formation under the influence of this type, but the general hydrometeorological trend remains. Specifically: the seasonal spatial and temporal variability of the hydrodynamic structure correlates accurately with that in the atmosphere.

Keywords: Kurile ridge, the Sea of Okhotsk, north-western part of the Pacific Ocean, the Straits Freeze, Bussol, Urup, atmospheric processes, water circulation, numerical modeling

Title: A robust method for correction of stray light effects on GOCI radiometric data

Authors: Nagendra Jaiganesh (Indian Institute Of Technology Madras), Rakesh Kumar Singh (Indian Institute Of Technology Madras), Palanisamy Shanmugam* (Indian Institute Of Technology Madras) and Yu-Hwan Ahn (Korea Institute of Ocean Science and Technology)

Type: ORAL PRESENTATION

Session: (5) OPERATIONAL REMOTE SENSING

A robust method is developed to minimize stray light effects on GOCI radiometric data. The new method relies solely on the GOCI image parameters and is dependent on the slot boundary information, which makes it being a robust operational method for processing GOCI data. This method is applied to several GOCI images and its results are examined in different levels of derived products. Validation of GOCI products such as remote sensing reflectance is conducted using MODIS-Aqua products. GOCI products were found to closely match with those of the MODIS-Aqua products, despite some discrepancy arising from the differences in sensor sensitivity and calibration methods. The results for different slot pairs showed reduced radiance discontinuity (2% and 0.1% in Level 1 and 2 products respectively). The proposed method has a great potential to minimize the stray light effect and facilitates generating mosaicked operational ocean colour products around Korea.

Keywords: Stray light, GOCI, Remote sensing reflectance and MODIS

Title: Reconstruction of rain rates from X-SAR measurements using tomography

Authors: Marco Moscatelli (Northwest Research Associates (affiliate)) and Gad Levy* (Northwest Research Associates)

Type: ORAL PRESENTATION

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

This study focuses on improving the three-dimensional rain rate retrieval from backscattering coefficients measured by a space-borne X-SAR sensor (Synthetic Aperture Radar, an active microwave sensor that measures the phase difference between several radar waves emitted along the flight direction from an antenna attached to a satellite towards a surface to generate high-resolution images) using tomography. The use of tomography, combined with the use of an inversion model, permits retrieval of new information about the distribution of very large precipitation events due to the high spatial resolution provided by SAR sensors, which is better than that of other sensors operating in higher frequency bands such as the Precipitation Radar on the TRMM satellite. Three data sets were constructed for this study, one by performing a simulation with a virtual laboratory called SAM, one from the DLR TerraSAR-X satellite, and one from the NOAA NexRad weather radar system. All of these data sets contain information about the two-dimensional backscattering coefficients or vertical profiles of the atmospheric specific attenuation of the observed environment. An algorithm is constructed by making some assumptions to simplify an inversion model, and is tested using the synthetic data. The results obtained by using these artificial data show that the reconstruction of the three-dimensional rain rate distribution is excellent if performed for small events. The algorithm is then applied to the real case of Hurricane Gustav (2008). In this case, the results show that in case of severe precipitation events the reconstructions obtained are good, but with a higher retrieval error, due to the assumptions made to simplify the inversion model. Removal of the simplifications introduced in the inversion model will allow for future improved reconstructions of the rain rate distribution.

Keywords: Rain retrieval, X-SAR, Hurricane

Title: The European Space Agency Earth Observation Programme and the Copernicus Sentinel Missions for Oceanographic Science

Authors: Jérôme Benveniste* (European Space Agency)

Type: ORAL PRESENTATION

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

The Copernicus Programme is a European initiative for the implementation of information services dealing with environment and security, based on observational data received from Earth Observation (EO) satellites and ground based information. Within this context, ESA is responsible in particular for the implementation of the Copernicus Space Component, consisting of Contributing Missions and of dedicated operational Sentinel missions.

The ESA Sentinel Missions constitute a series of operational satellites responding to the Earth Observation needs of the European Commission and the European Space Agency Global Monitoring for Environment and Security (GMES) Programme, now called "Copernicus". This paper describes the Sentinel-1 mission, an imaging synthetic aperture radar (SAR) satellite constellation at C-band, the Sentinel-2 mission, carrying an optical high-resolution imager, the Sentinel-3 mission to provide ocean and land colour products (OLCI), sea and land surface temperature and vegetation products (SLSTR), and sea, ice and land surface topography (Synthetic Aperture Radar Altimeter, SRAL) and the Sentinel-6 mission, a reference radar altimetry mission pursuing the heritage of the Topex/Poseidon and Jason series and their requirements for oceanographic research and applications.

The scientific exploitation of the operational Sentinel missions is encouraged by ESA through its Earth Observation R&D Programme. The prime objective is to federate, support and expand the international research community that the ERS, ENVISAT and the Earth Explorers have built up over the last 25 years. The aim is to further strengthen the leadership of the European Earth Observation research community by enabling them to extensively exploit present and future European operational EO missions, to address new scientific research that is opened by free and open access to data from operational EO missions. The Programme is based on community-wide recommendations for actions on key research issues, gathered through a series of international thematic workshops and scientific user consultation meetings such as the Sentinel-3 for Science Workshop held in June 2015 in Venice, Italy. The Programme work plan includes the launch of new R&D studies for scientific exploitation of the Sentinels, the development of open-source multi-mission scientific toolboxes, the organisation of advanced international training courses, summer schools and educational materials, as well as activities for promoting the scientific use of EO data, also via the organisation of workshops.

Keywords: Copernicus, Sentinel

Title: Classification of Double Inter-Tropical Convergence Zones over the Indian Ocean and their Relation to the Indian Summer Monsoon

Authors: Andrew Geiss* (University Of Washington) and Gad Levy (NorthWest Research Associates)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

The Inter-Tropical Convergence Zone (ITCZ) is a persistent band of organized convection in the tropics which arises due to the surface convergence of the Hadley cells, and is an important feature of the Earth's general circulation. Frequently, the ITCZ develops a second band of convection, which is referred to as a double ITCZ. Double ITCZs in the tropical east Pacific have been heavily studied, and their development is understood to be linked to seasonal changes in sea-surface temperature. The existence of double ITCZs over the tropical Indian Ocean is well documented, but the underlying mechanism is poorly understood. We develop an algorithm for identification and classification of double ITCZs over the tropical Indian Ocean using NOAA outgoing long-wave radiation data. We create a thirty year index of double ITCZ occurrences and identify cases of dual zonal bands of convection which are not equatorially symmetric and may be associated with intra-seasonal fluctuations in the Indian Summer Monsoon.

Keywords: OLR, Indian Ocean, Summer Monsoon, Double ITCZ

Title: ADJUSTMENT OF SEA SURFACE TEMPERATURE TO AIR TEMPERATURE UNDER LOW WIND SPEED CONDITIONS AND STABLE STRATIFICATION IN THE ATMOSPHERIC BOUNDARY LAYER

Authors: Alexander Soloviev* (Nova Southeastern University) and Peter Minnett (University of Miami)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

Under low wind speed conditions and stable stratification in the atmospheric boundary layer, momentum, latent and sensible heat fluxes drop practically to zero (Kara et al 2005). The turbulent mixing below the sea surface vanishes and the thin near-surface layer of the ocean rapidly warms by the absorption of solar radiation. However, when the sea surface temperature (SST) and exceeds the air temperature, the interfacial momentum and heat fluxes increase and restore the near-surface mixed layer. As a result, the diurnal warming significantly slows down.

Importantly, this effect has the tendency to equilibrate spatial patterns of SST, while the water below a thin near-surface layer of the ocean may still remain relatively cold and horizontally inhomogeneous (Katsaros and Soloviev 2003). A similar effect is believed to contribute to the equilibration of SST spatial patterns during summer months as observed in the IR satellite imagery in such places like the Gulf of Mexico and the Straits of Florida. This situation is also applicable to upwelling regions or cold wakes of hurricanes.

In this work, a 3D large eddy simulation (LES) model (Matt et al. 2014), parametrically coupled with the air layer and capable of resolving the thermal molecular sublayer and diurnal thermocline, has been implemented with computational fluid dynamics tools to study the response of the aqueous thermal molecular sublayer of the ocean to external forcing. (LES models are able to account for nonlocal transport and have a better performance than local, diffusive type models.) The solar radiation is included as a volume source of heat using a nine-exponential parameterization the sensible and latent heat and longwave radiation are included as surface fluxes and, wind stress is applied to the top of the numerical domain. Periodic boundary conditions are implemented along the wind direction.

Computational experiments have demonstrated that under stable atmospheric stratification, the SST equilibrates with the air temperature under low wind speed conditions within minutes. In the process of rapid warming, the SST may exceed the air temperature and atmospheric conditions become unstable. The warming continues under unstable atmospheric conditions but at a much slower rate.

The results of this numerical experiment explains why stable conditions in the marine boundary layer are rarely observed when SST is determined with infrared rather than conventional air-sea techniques (Minnett et al 2005). As an example, we demonstrate the histogram of air-sea ΔT measured radiometrically from the Explorer of the Seas during one year. The results of this study are expected to improve boundary layer representation in mesoscale and large scale ocean-atmosphere models.

Keywords: Sea surface temperature, air-sea fluxes, turbulent mixing, large eddy simulation

Title: Satellite oceanography in application to natural sea slicks and the presence of surfactant-associated bacteria

Authors: Kathryn Howe* (Nova Southeastern University)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

The damping of Bragg waves due to surfactants decreases sea surface roughness and results in slicks on the sea surface. Under favorable conditions, slicks are visible in synthetic aperture radar (SAR) imagery. Presence of slicks alters air-sea gas and momentum exchange rates (Carlson et al. 1988, Cunliffe et al. 2013, Liss and Duce 2005). Natural surfactants are byproducts of the life processes of marine organisms, such as seaweed, phytoplankton, and zooplankton (Gade et al. 2013). Our focus is on the role of bacteria in these processes. DNA analysis is being used to study the bacterial content and community composition of the sea surface microlayer and associated subsurface water. A new approach has been implemented, which has significantly reduced potential contamination of microlayer samples during collection, handling, and processing in the lab (Kurata et al. 2016 Hamilton et al. 2015). These methods have been further expanded to continue reduction of contamination, including enhancing sterilization and sample storage procedures. We analyze the samples using quantitative PCR (qPCR) to show the relative abundance of *Bacillus* spp., which is known as a potentially surfactant-associated bacteria (Satpute et al. 2010). Microlayer samples were collected from the Straits of Florida during TerraSAR-X and Radarsat-2 overpasses in 2010, 2011, and 2013. During a research cruise on the Gulf of Mexico Research Initiative (CARTHE) project in February 2016, over 100 samples were collected in the Gulf of Mexico near De Soto Canyon. Some of these samples were close to the time of a TerraSAR-X satellite image. The latest qPCR results show a wide range of variability in abundance of *Bacillus* in the sea surface microlayer compared to the subsurface water, which we have been analyzing in connection to surface slicks. We are in the process of obtaining NextGen sequencing (Illumina MiSeq) results, which will help to determine the bacterial community composition of the sea surface microlayer and subsurface samples. We plan to expand our observational sites to several locations in the World Ocean.

Keywords: microlayer, surfactants, SAR

Title: Influence of Dust Storms and Rainfall and Dynamics of Salinity and Chlorophyll Concentrations of the Arabian Sea and Bay of Bengal

Authors: Ramesh P. Singh* (Chapman University)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

The Indian continent is surrounded by the Arabian Sea in the west and by the Bay of Bengal in the east. During pre-monsoon season, the dust originates from the Arabian peninsula, travels over the Arabian Sea and enters over the Indian region and gets transported over the Indo-Gangetic plains and over the Bay of Bengal. During pre-monsoon and monsoon seasons, Himalayan snow and glaciers melt, enhancing the flow of the rivers and surface runoff in the Bay of Bengal. Five of the world's largest rivers, the Brahmaputra, Ganga, Irrawaddy, Godavari and Mahanadi, flow in the eastern parts of India into the Bay of Bengal (BoB). We have analyzed satellite measured salinity, sea surface temperature, chlorophyll-a and rainfall data from 2011-2015 in the Arabian Sea and the Bay of Bengal. The Arabian Sea and the Bay of Bengal suffer from higher atmospheric pollution due to dust storms and anthropogenic activities of the Indo-Gangetic plains, home of 900 million people, affecting the ocean color parameters (Chl-a, salinity and sea surface temperature) in the Arabian sea and the Bay of Bengal water. During monsoon season, higher flux of fresh water decrease the water salinity of Bay of Bengal. The monthly and seasonal dynamics and comparison of chlorophyll-a concentration, salinity, and sea surface temperature of water of the Arabian Sea and the Bay of Bengal, and role in climate change will be discussed.

Keywords: Bay of Bengal, Arabian Sea, Dust storm, Rainfall

Title: Influence of the Indian ocean in modulating the rainfall variability over India

Authors: G R Chinthalu* (Indian Institute Of Tropical Meteorology)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

In the present study we have examined Indian summer monsoon rainfall variability related to excess (2013, 117%)and deficient (2014, 88% and 2015, 86%) monsoon seasons. Compared to long period average, the former was excess while the later resulted in consecutive deficient monsoons. In order to understand, the intraseasonal variability, we have analysed monthly means of ocean atmospheric parameters such as sea surface temperature (SST) salinity, latent heat flux (LHF), Mixed layer depth, wind, pressure, relative humidity, and TRMM derived rainfall data in the domain 30°N-30°S, 40-120°E, during the pre monsoon (March-May) and monsoon (June-September) periods. The analysis of latent heat flux over Arabian sea during June -September varied in the range of 240 wm^{-2} in 2013, while it was 200 wm^{-2} and 180 wm^{-2} in 2014-2015. This has resulted in strong cross equatorial flow in the excess monsoon year, while in the case of deficient monsoon years there was a significant decrease. This has impacted the convective activity during the monsoon seasons, resulting in excess and deficient monsoons over India. In depth analysis of related ocean atmospheric parameters will be presented in the conference.

Keywords: South west monsoon , ocean atmosphere interactions, latent heat flux , excess ,deficient rainfall
excess

Title: GOCE USER TOOLBOX AND TUTORIAL

Authors: Jérôme Benveniste* (European Space Agency, Frascati, Italy) e Per Knudsen (Technical University of Denmark, Kgs. Lyngby, Denmark)

Type: POSTER

Session: (8) EDUCATION AND OUTREACH

The Gravity field and steady-state Ocean Circulation Explorer (GOCE) User Toolbox, GUT, is a compilation of tools for the utilisation and analysis of GOCE Level 2 products. GUT support applications in Geodesy, Oceanography and Solid Earth Physics. The GUT Tutorial provides information and guidance on how to use the toolbox for a variety of applications. GUT consists of a series of advanced computer routines that carry out the required computations. It may be used on Windows PCs, UNIX/Linux Workstations, and Mac. The toolbox is supported by The GUT Algorithm Description and User Guide and The GUT Install Guide. A set of a priori data and models are made available as well. Without any doubt the development of the GOCE user toolbox have played a major role in paving the way to successful use of the GOCE data for oceanography.

The GUT version 2.2 was released in April 2014 and beside some bug-fixes it adds the capability for the computation of Simple Bouguer Anomaly (Solid-Earth). A new GUT version 3 has been released at end 2015. GUTv3 was further developed through a collaborative effort where the scientific communities participate aiming at an implementation of the remaining functionalities and facilitating a wider span of research in the fields of Geodesy, Oceanography and Solid earth studies. Accordingly, the GUT version 3 has:

- An attractive and easy to use Graphic User Interface (GUI) for the toolbox,
- Enhanced toolbox with some further software functionalities such as facilities for the use of gradients, anisotropic diffusive filtering and computation of Bouguer and isostatic gravity anomalies.
- An associated GUT VCM tool for analyzing the GOCE variance covariance matrices.

Keywords: Toolbox, GOCE

Title: Equatorial Waves in the Western Tropical Atlantic Detected by Satellite Altimetry

Authors: Ana Paula Morais Krelling* (Ufc), Ilson Carlos Almeida da Silveira (USP), Paulo Simionatto Polito (USP) e Avijit Gangopadhyay (UMASSD)

Type: POSTER

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

The occurrence of Tropical Instability Waves has been repeatedly reported in the Tropical Atlantic. These waves have been observed mainly in chlorophyll concentration from satellite data. Specifically, in the western portion of the Tropical Atlantic, second-baroclinic-mode perturbations were observed, influencing the intensity of ocean currents in this area, in particular the North Brazil Undercurrent and its associated mesoscale features. In this work, we use AVISO altimetry data for a zonal slice along 4°S in the Atlantic. We filter these data with a finite-impulse-response filter to identify the oscillations with the wavelength and period as identified in in situ observations off the Brazilian coast. After the detection of the signal in altimetry data, we turn to the characterization of the meridional mode associated with these equatorial waves. For that, we make a map of the correlation coefficients between the sea level anomaly time-series in the western tropical Atlantic and at the point where we identified the generation of the oscillations from the FIR filter results. We conclude that the FIR filter is a suitable tool for separating signals of different wavelengths and periods, and our results suggest that the oscillation observed is a second-baroclinic-mode, second-meridional-mode oscillation.

Keywords: Satellite, Altimetry, Mesoscale, Equatorial Waves

Title: GPD+ WET TROPOSPHERIC CORRECTIONS FOR EIGHT ALTIMETRIC MISSIONS

Authors: Joana Fernandes (U Porto), Clara Lázaro (U Porto) e Jérôme Benveniste* (European Space Agency, Frascati, Italy)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

Due to its large space-temporal variability, the delay induced by the water vapour and liquid water content of the atmosphere in the altimeter signal, called the wet tropospheric path delay (WPD), is still one of the largest sources of uncertainty in satellite altimetry. In the scope of the ESA Sea Level Climate Change Initiative (SL_cci) project, the University of Porto (UPorto) has been developing methods to improve the wet tropospheric correction (WTC) that corrects for the effect of the WPD in the altimetric measurements. Developed as a coastal algorithm to remove land effects in the microwave radiometers (MWR) on board altimeter missions, the GNSS-derived Path Delay (GPD) methodology evolved over time, and is currently correcting for invalid observations due to land, ice and rain contamination, band instrument malfunction in open ocean, coastal, and polar regions. The most recent version of the algorithm, GPD Plus (GPD+) computes wet path delays based on: i) WTC from the on-board MWR measurements, whenever they exist and are valid; ii) new WTC values estimated through space-time objective analysis of all available data sources, whenever the previous are considered invalid. In the estimation of the new WTC values, the following data sets are used: valid measurements from the on-board MWR, water vapour products derived from a set of 17 scanning imaging radiometers (SI-MWR) on board various remote sensing satellites and tropospheric delays derived from Global Navigation Satellite Systems (GNSS) coastal and island stations. In the estimation process, WTC derived from an atmospheric model such as the European Centre for Medium-range Weather Forecasts (ECMWF) ReAnalysis (ERA) Interim or the operational (Op) model are used as first guess, which is the adopted value in the absence of measurements. The corrections are provided for the most recent products of all missions used to generate the SL Essential Climate Variable (ECV): TOPEX/Poseidon, Jason-1, Jason-2, ERS-1, ERS-2, Envisat, CryoSat-2 and SARAL/ALtiKa. In order to obtain the best WTC for use in the version 2 of the SL_cci ECV, new products have been developed, based on recently released on-board MWR WTC for missions such as Envisat and SARAL/AltiKa. For consistency and long term stability of the WTC datasets, the radiometers used in the GPD+ estimations were previously calibrated against the stable and independently-calibrated Special Sensor Microwave Imager (SSM/I) and SSM/I Sounder (SSM/IS) sensors on-board the Defense Meteorological Satellite Program satellite series (F10, F11, F13, F14, F16 and F17). The new products reduce the sea level anomaly variance, both along-track and at crossovers with respect to previous non-calibrated versions and to other WTC data sets such as AVISO Composite (Comp) correction and atmospheric models. Improvements are particularly significant for TP and all ESA missions, especially in the coastal regions and at high latitudes.

Keywords: Radar Altimetry, Wet Tropospheric Correction, Water vapour, GNSS Path Delay

Title: The Variation of Chlorophyll Concentration over the Northwestern Pacific and Related with the Aerosols

Authors: Shih-jen Huang* (Department Of Marine Environmental Informatics, National Taiwan Ocean University), Nan-Jung Kuo (Department of Marine Environmental Informatics, National Taiwan Ocean University), Chung-Ru Ho (Department of Marine Environmental Informatics, National Taiwan University) e Yao-Tsai Lo (Department of Marine Environmental Informatics, National Taiwan Ocean University)

Type: POSTER

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

The multi-satellite data are used by multiple stepwise processes to investigate the spatiotemporal variability of chlorophyll concentration and aerosol of the Northwestern Pacific marginal sea. The primary production may closely relate to the chlorophyll. Moreover, the chlorophyll may be affected by the nutrients, solar radiance, and sea surface temperature. In the study area, the dominant winds are the northeastern and southwestern monsoons. The atmospheric suspension material or dust of continental Asia will be transported to the study area by the prevailing wind. The solar energy will be reduced by the aerosol scattering. Meanwhile, the supply of oceanic energy will be restricted. Otherwise, the suspension materials, aerosols, will provide nutrients for the phytoplankton. The continental shelf water is affected by terrigenous obviously. Therefore, the satellite retrieved chlorophyll concentration has higher error in the continental shelf area. To promote the accuracy of the chlorophyll concentration algorithm with satellite data in the adjacent Taiwan ocean (with the continental shelf), the spectral radiometer will observe the ocean radiance intensity and reflectance in each season. Simultaneously, sampling the sea water to measure the chlorophyll concentration is used.

Keywords: chlorophyll concentration, aerosol, continental shelf

Title: Assessing the impacts of the sediment-rich mining waste-water discharge on the Doce River plume and adjacent coastal waters, SE Brazil, using multi-platform remote sensing tools

Authors: Natalia Rudorff Oliveira* (Instituto Nacional de Pesquisas Espaciais), Gustavo Ortiz (INPE) e Milton Kappel (INPE)

Type: POSTER

Session: (2) COASTAL IMPACTS

On November 5th, 2015, an iron mining dam located in southeast Brazil (Mariana, MG), collapsed delivering approximately 50 million m³ of muddy waste water into the Doce River watershed, causing major environmental and social disaster. Sixteen days after the disaster, the mud wave reached the ocean forming a dense reddish sediment plume. Since then collaborative efforts have been applied to monitor the dispersion of the sediment plume and provide value-added information for decision makers to send bulletins and alerts of the water quality for swimming, diving and fishing activities, and management of marine protected areas (e.g. turtle breeding beaches, algal banks and coral reefs). The present work shows how multi-platform satellite data was used to track changes in the river plume and map the potentially affected areas. Near-real-time MODIS-Aqua and Terra surface reflectance and turbidity maps were used to monitor the water quality and plume dispersion in a daily basis. Combined with weather synoptic charts (CPTEC/INPE), sea surface wind fields (ASCAT-MetOP-A/B (ESA) and RapidScat-ISS (NASA)) and wave model outputs (WWATCH), these products were used to monitor the sea state and changes in the main flow of the river plume. Higher resolution Landsat (EOS/NASA) images (30m) were used to obtain more detailed turbidity maps, to evaluate the evolution of the water quality in the plume core, mixing zone, and surrounding coastal waters, and compare with previous images to track changes before and after the disaster. The Doce River plume has naturally a high spatial-temporal variability in terms of water quality, size, and main direction, due to combined effects of the watershed drainage and river outflow (especially during the rainy season), and variations in the coastal currents, forced by semi-diurnal mesotides (1.5-2.5m), changes in the dominant wind direction (by synoptic and mesoscale meteorological phenomena), and arrival of swells. The muddy waste-water outflow increased the turbidity and dispersion area of the Doce River plume, whereas natural processes acted on either enhancing or diminishing the affected area in the coastal zone, at different time scales. Challenges such as the spectral mixture of other sediment sources (due to bottom resuspension and other rivers), cloud coverage, and limited surface water sampling, impose some limitations for the remote sensing tools. Nonetheless, multi-platform satellite products provide unique information of the horizontal distribution of the surface river plume and coastal waters, as well as information regarding the sea state, at different spatial-temporal scales. These tools should further be combined to in situ surveys and modelling experiments, to provide an integrated analysis of the impacts of the altered river in the coastal zone, and to monitor the recovery of the system.

Keywords: Doce River plume, coastal waters, sediment-rich mining waste water, remote sensing

Title: CREATION OF A MODEL FOR AUTOMATIC PROGNOSTIC ANALYSIS OF THE COASTAL EVOLUTION IN ICAPUI, BRAZIL, USING GIS.

Authors: Stefanny Soares Matos* (Universidade Federal do Ceara - Ufc), Willamys Rangel Nunes de Sousa (UNIVERSIDADE FEDERAL DO CEARA - UFC), Michael Vandesteen Silva Souto (UNIVERSIDADE FEDERAL DO CEARA - UFC), Cláudio Ângelo da Silva Neto (UNIVERSIDADE FEDERAL DO CEARA - UFC) e Cynthia Romariz Duarte (UNIVERSIDADE FEDERAL DO CEARA - UFC)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

Coastal erosional processes have become a great issue globally. Especially, when harmful effects are considered upon human installation in the coastal zone. Some of the many socio-economics activities involved contribute to large urban concentration, for instance, easy access to oceanic navigation, fishery, tourism and leisure. Approximately 20% of the world's population live 30 km far from the coast while almost twice this number live 100 km far from the coast. The Northeast region in Brazil fits in well the description above in which coastal erosion is a problem that concerns as the people who live in those areas as the tourist entrepreneurs and industry allocated near the beach area such as wind farms in Ceara State. In this context, the sea level rising has been considered one of the main conditional factors of the erosional effect, which was reported by the Intergovernmental Panel on Climate Change (IPCC). Thus, this work has the shoreline of the city of Icapui, located in the East coast of Ceara, as the object of analysis. The aim is to create a prognostic model to analyze the evolution of the coastal zone, which has a strong coastal dynamics influencing the shoreline changes. Based on geostatistics estimations for the gradual development of the shoreline, data from past to present is being analyzed to picture the evolution for future decades. Therefore, the entire analysis will be automated for prognostic analysis of the coastal evolution. For this, it was used remote sensing multi source data analysis. The study started with the acquisition and image processing of Landsat (5, 7 and 8) imagery. The images were preprocessed, processed using bands composition and Modified Normalized Difference Water Index (MNDWI) for 1990, 2000, 2005, 2010, and 2015. Those techniques allowed the extraction of shorelines that will feed the prognostic model. Subsequently, the geostatistics estimations for the shoreline evolution will be made using linear regression, supervised classification, and image mining creating a consistent geostatistical model that attends to the geological and geomorphological complexity of the study area. Finally, the products will be manipulated based on a Geographic Information Systems (GIS) environment and the processes will be automated. The results will be important to improve coastal ecosystems management for they rise an opportunity to reduce or even avoid the negative impacts caused by coastal erosion.

Keywords: Coastal erosion, prognostic analysis; automation model; linear regression.

Title: Effects of Eddy on the Kuroshio Variation East of Taiwan

Authors: Chen-Chih Lin (Department of Marine Environmental Informatics, National Taiwan Ocean University), Chung-Ru Ho* (Department of Marine Environmental Informatics, National Taiwan Ocean University) e Po-Chun Hsu (Department of Marine Environmental Informatics, National Taiwan Ocean University)

Type: POSTER

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

Kuroshio, a western boundary current in the North Pacific Ocean, flows northward along the east coast of Luzon to Taiwan. There is an eddy-rich zone located at 18° - 26° N, 122° - 160° E, which has been identified by previous studies. These eddies propagate westward and interact with the Kuroshio when they impinge it. To better understand this kind of phenomenon, satellite altimeter data from 1993 to 2013 are used in this study. The Kuroshio axis is defined as a line with the maximum surface velocity along the Kuroshio path. The velocity of Kuroshio is calculated from the absolute dynamic topography data with the geostrophic relation. The results show that the Kuroshio shift occurred 13 times from 1993 to 2013, and these shifts were caused by westward or northward moving cyclonic eddies when they propagated to the east of Luzon Strait and Taiwan Island. The average duration of the shifts was 27 days with the maximum duration of 80 days. The position of the Kuroshio axis was shifted by the size of the eddy rather than by its eddy kinetic energy. Under the circumstances of a cyclonic eddy, the mean speed of the Kuroshio axis drops approximately 84% from 0.75 m/s to 0.63 m/s.

Keywords: Eddy, Kuroshio, Altimetry, Taiwan

Title: Real time inspection system of failures in wind turbine blades using quadrotor and computer vision algorithms

Authors: Bárbara Barros Carlos* (ITIC)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

In the face of global climate change scenario, the importance of renewable energies grow increasingly in government planning spaces about their energy matrixes. In Brazil, the wind potential has attracted the interest of several manufacturers and representatives of the main countries involved in wind energy. It is known that modern wind turbines have about 100 meters high and its blades are assaulted by elements over time as well as gradually wear out. Deterioration can cause reduction in energy production in the early stages and a catastrophic collapse of the blades if pass unnoticed. This has motivated studies related to inspection of wind turbine blades, a role that has traditionally been carried out in ground with simple visual inspections or in a riskiest way through ropes or access platforms. Faced with this situation, a new approach using Unmanned Aerial Vehicle (UAV) is quickly becoming an intermediate solution. In this way, this work aims to create a real time inspection system of failures in wind turbine blades using quadrotor and computer vision algorithms.

This work describes the equipment which is composed of a quadrotor — developed through classic techniques of modeling, control and stability, with low-cost hardware — and a pattern recognition system of failure in real time — developed based on traditional techniques of image segmentation, real time video transmission and image georeferencing. With this inspection system it will be possible to carry out remotely controlled flights by an operator in wind farms where the quadrotor is going to fly over the vicinity of the wind turbine blades searching for a pre-defined pattern of failure. The image, already georeferenced, will be transmitted from the quadrotor to a base station, in real time, where the recognition system will be analyzing it and seeking the pattern of failure. If found, a tag will be added to each failure and the operator will be able to see it also in real time. As the image is georeferenced, on further analysis it will be possible to identify the exact location of the wind turbine and what its flaws. This equipment provide visual inspections with higher resolution than in ground; faster and easier, less costly and risky than the access techniques by rope and finally the automation of processing and data analysis.

Keywords:

Title: AQUA/MODIS SST products validation using in situ observations from PIRATA buoys in the tropical Atlantic Ocean

Authors: Suzana Sales Ribeiro*, Daysiane Barbosa Brandão

Type: POSTER

Session: (5) OPERATIONAL REMOTE SENSING

Satellite-derived products can have their quality declined if a validation technique is not applied. In this study, Sea Surface Temperature (SST) in situ observations obtained from Pilot Research Moored Array in the Tropical Atlantic (PIRATA) buoys are used to validate SST data retrieved from MODIS (Moderate-Resolution Imaging Spectroradiometer) sensor, which is part of the satellite AQUA payload. We used daily data from 20 buoys of the PIRATA's program located in tropical Atlantic Ocean between the latitudes 21° N and 19° S and longitudes 38° W and 8° E. The AQUA/MODIS satellite data used in this work has spatial resolution of 4 km and are also daily SST values varying from a minimum of 19.7°C to a maximum of 30.2 °C, while AQUA/MODIS values varied between 17 °C and 32.7 °C. PIRATA's buoys data presented a standard deviation of 0.5 to 2.4, and the satellite data, of 0.8 to 2.6. This difference can be explained taking into account that there were many gaps in satellite datasets because of cloud coverage. The statistical analysis showed that SST obtained from both moored buoys and MODIS was positively and linearly correlated. After that a simple linear regression model was fitted for each buoy. The linear model accuracy was achieved by calculating Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). High correlation coefficient values ($R^2=0.9$) were found for the buoys positioned at 6° S - 8° E and 19° S - 34° W, followed by $R^2=0.86$ for the buoys positioned at 0° N-10° W and 10° S- 10° W. Except for five buoys, all the others shows R^2 values above 0.7, indicating a good fit between PIRATA buoys and AQUA/MODIS data. Concerning the RMSE, the lowest RMSE values = 0.54 were found for the buoys at 14° S - 32° W and 8° S- 30° W, and RMSE = 0.55 for the buoys located at 19° S - 34° W and 10° S-10° W, all of them located at South Atlantic Ocean. Therefore, the points with better adjustment between in situ and remote data are located at the southernmost part of the sampling area. The MAE and RMSE presented values between 0 and 1 indicating the good linear model ($SST_{aqua_modis} = SST_{buoys} + b$) skill to predict satellite SST based on PIRATA buoys data. Therefore, the obtained results showed that there is good agreement between in situ and AQUA/MODIS data. The linear regression models showed low error indexes and significant R^2 , emphasizing that these models can be used to replace satellite SST missing values, for instance due to cover cover, with PIRATA data.

Keywords:

Title: Short time Analysis of Coastline Based on RapidEye Satellite Images in the port of Pecém terminal area, Ceará, Brazil

Authors: Cynthia Romariz Duarte* (Universidade Federal do Ceará), Fernando Pellon de Miranda (Petrobrás), Aline Moreira Damasceno (Universidade Federal do Ceará), Linara Ivina de Castro Rodrigues (Universidade Federal do Ceará), Claudio Ângelo da Silva Neto (Universidade Federal do Ceará) e Luiz Landau (COPPE - UFRJ)

Type: POSTER

Session: (2) COASTAL IMPACTS

Coastal environments are highly dynamic and sensitive to interference and variations caused by the numerous natural and anthropogenic agents. The anthropogenic agents can cause changes in the pattern of propagation of waves and currents, and interfere with the availability and mobility of sediments. Tides, waves, currents and wind can cause morphodynamic instability along the shoreline. The northern coast of Northeastern Brazil has undergone intense erosion in recent years. However, as a result of the construction of the port of Pecém, the features of the beach and the shoreline have been modified differently than adjacent areas. This paper describes the use of remote sensing images integrated with a Geographic Information System to evaluate the sedimentary balance and morphological changes seen on the sandy beach that is under the influence area of the port terminal of Pecém. The changes were quantified using two methods applied to RapidEye images in a short time of analysis. The DSAS method (Digital Shoreline Analysis System) was used to map the coastline changes and calculate these changes over time. The statistical method used in DSAS was the LRR (Linear Regression Rate), which uses linear regression using all the data collected through transects generated to the shoreline, on different dates, so estimating the changes that have occurred in each year. In the application of DSAS it was observed that there was an increase in the width of the beach west of the port, calculated by the polygon change approach that estimates the area, through the intersection and union of polygons, calculating the difference between the areas of two moments. The results showed changes in coastal morphology through a short time analysis demonstrating that the anthropic interventions in the region are causing profound transformations of the natural elements that make up the landscape of the region. Between 2011 and 2014, the investigated area suffered an accretion process of more than 106,000 m² in a stretch of about 3 km. The high spatial resolution satellite images, digital processing imaging techniques, and the geostatistical methods proved effective in this study, allowed for the understanding of recent developments in the area.

Keywords: Shoreline, RapidEye, DSAS, Port of Pecém.

Title: Suspended sediment characteristics and transport in Lingdingyang Bay of the Pearl River Estuary

Authors: Weihong He* (South China Sea Institute Of Oceanology, Chinese Academy Of Sciences) e
Guangping Liu (South China Sea Institute of Oceanology, Chinese Academy of Sciences)

Type: POSTER

Session: (2) COASTAL IMPACTS

The Lingdingyang Bay is the biggest outlet of the Pearl River Estuary and is surrounded by several large cities that are undergoing rapid economic development. It is a sensitive land-ocean interaction zone and therefore of international interest. This study analyzes the suspended sediment characteristics and transport of the Lingdingyang Bay by in situ and satellite data. The tide current plays a more important role in the suspended sediment transport. The suspended sediment characteristics and transport are in close connection to the hydrodynamics, especially river runoff and the tidal regime. Tidal pumping, gravitational circulation and sediment resuspension and deposition processes are the most important factors in the transport of the suspended sediment in Lingdingyang Bay.

Keywords: suspended sediment, Pearl River Estuary, tide, Lingdingyang Bay, sediment transport

Title: SAR ALTIMETRY PROCESSING ON DEMAND SERVICE FOR CRYOSAT-2 AND SENTINEL-3 AT ESA G-POD

Authors: Salvatore Dinardo (He Space, Darmstadt, Germany), Marco Restano (SERCO/ESRIN, Frascati, Italy), Américo Ambrózio (DEIMOS/ESRIN, Frascati, Italy) e Jérôme Benveniste* (European Space Agency, Frascati, Italy)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

The G-POD SARvatore service to users for the exploitation of CryoSat-2 data was designed and developed by the Altimetry Team at ESA-ESRIN (Earth Observation – Exploitation, Research and Development). The G-POD service coined SARvatore (SAR Versatile Altimetric Toolkit for Ocean Research & Exploitation) is a web platform that allows any scientist to process on-line, on-demand and with user-selectable configuration CryoSat-2 SAR/SARin data, from L1a (FBR) data products up to SAR/SARin Level-2 geophysical data products. The Processor takes advantage of the G-POD (Grid Processing On Demand) distributed computing platform (350 CPUs in ~70 Working Nodes) to timely deliver output data products and to interface with ESA-ESRIN FBR data archive (155'000 SAR passes and 41'000 SARin passes). The output data products are generated in standard NetCDF format (using CF Convention), therefore being compatible with the Multi-Mission Radar Altimetry Toolbox (BRAT) and other NetCDF tools. By using the G-POD graphical interface, it is straightforward to select a geographical area of interest within the timeframe related to the Cryosat-2 SAR/SARin FBR data products availability in the service catalogue. The processor prototype is versatile, allowing users to customize and to adapt the processing according to their specific requirements by setting a list of configurable options. After the task submission, users can follow, in real time, the status of the processing, which can be lengthy due to the required intense number-crunching inherent to SAR processing. From the web interface, users can choose to generate experimental SAR data products as stack data and RIP (Range Integrated Power) waveforms. The processing service, initially developed to support the awarded development contracts by confronting the deliverables to ESA's prototype, is now made available to the worldwide SAR Altimetry Community for research & development experiments, for on-site demonstrations/training in training courses and workshops, for cross-comparison to third party products, for the exploitation of the Sentinel-3 Surface Topography Mission, for producing data and graphics for publications, etc. Initially, the processing was designed and uniquely optimized for open ocean studies. It was based on the SAMOSA model developed for the Sentinel-3 Ground Segment using CryoSat data (Cotton et al., 2008; Ray et al., 2014). However, since June 2015, a new retracker (SAMOSA+) is offered within the service as a dedicated retracker for coastal zone, inland water and sea-ice/ice-sheet. A new flavor of the service will be initiated, exclusively dedicated to the processing of Sentinel-3 data products. The service is open, free of charge (supported by the ESA SEOM Programme Element) for worldwide scientific applications and available at https://gpod.eo.esa.int/services/CRYOSAT_SAR/.

Keywords: SAR Altimetry, SAMOSA, Processing on Demand, G-POD, SARvatore

Title: IMPROVED OCEANOGRAPHIC MEASUREMENTS WITH CRYOSAT SAR ALTIMETRY

Authors: David Cotton (Satoc, Stockport, United Kingdom), Pablo Nilo Garcia (isardSAT S.L., Barcelona, Spain), Mathilde Cancet (NOVELTIS, Ramonville Saint-Agne, France), Ole Andersen (Danish National Space Institute, Kgs Lyngby, Denmark), Francisco Martin (Starlab Ltd, Oxford, United Kingdom), Paolo Cipollini (National Oceanography Centre, Southampton, United Kingdom), Marco Restano (SERCO/ESRIN, Frascati, Italy), Américo Ambrózio (DEIMOS/ESRIN, Frascati, Italy) e Jérôme Benveniste* (European Space Agency, Frascati, Italy)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

The ESA CryoSat mission is the first space mission to carry a radar altimeter that can operate in Synthetic Aperture Radar "SAR" (or delay-Doppler) and interferometric SAR (SARin) modes. Studies on CryoSat data have analysed and confirmed the improved ocean measuring capability offered by SAR mode altimetry, through increased resolution and precision in sea surface height and wave height measurements, and have also added significantly to our understanding of the issues around the processing and interpretation of SAR altimeter echoes.

We present work in four themes, building on work initiated in the CryoSat Plus for Oceans project (CP4O), each investigating different aspects of the opportunities offered by this new technology. The first two studies address the coastal zone, a critical region for providing a link between open-ocean and shelf sea measurements with those from coastal in-situ measurements, in particular tide gauges. Although much has been achieved in recent years through the Coastal Altimetry community, (<http://www.coastalt.eu/community>) there is a limit to the capabilities of pulse-limited altimetry, which often leaves an unmeasured "white strip" right at the coastline. Firstly, a thorough analysis was made of the performance of "SAR" altimeter data (delay-Doppler processed) in the coastal zone. This quantified the performance, confirming the significant improvement over "conventional" pulse-limited altimetry. In the second study a processing scheme was developed with CryoSat SARin mode data to enable the retrieval of valid oceanographic measurements in coastal areas with complex topography. Thanks to further development of the algorithms, a new approach was achieved that can also be applied to SAR and conventional altimetry data (e.g., Sentinel-3, Jason series, Envisat). The third part of the project developed and evaluated improvements to the SAMOSA altimeter retracker that is implemented in the Sentinel-3 processing chain. The modifications to the processing scheme should support improved performance in terms of accuracy and efficiency in retrieving oceanographic geophysical parameters from altimeter data.

Finally, we describe the development of a state of the art tidal atlas for the Arctic Ocean with CryoSat altimeter data. Through its high inclination orbit, the CryoSat mission provides the most complete altimeter data set ever used in this region, and so should enable the production of a highly accurate Arctic tidal model. This in turn will improve the quality of CryoSat Sea Surface Height measurements and all derived products (e.g. mean sea surface, mean dynamic topography). Together these studies provide an important foundation for exploiting data from the Sentinel-3 and Sentinel-6/Jason-CS missions.

Keywords: CryoSat, Sentinel-3, Radar Altimetry

Title: Oil slick characterization with use of co-polarized Radarsat-2 and TerraSAR-X SAR images

Authors: Dmitry V. Ivonin (P. P. Shirshov Institute Of Oceanology Russian Academy Of Sciences), Andrey Yu Ivanov* (P. P. Shirshov Institute Of Oceanology Russian Academy Of Sciences), Camilla Brekke (University of Tromsø - The Arctic University of Norway) e Stine Skrunes (University of Tromsø - The Arctic University of Norway)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

A new polarimetric technique recently proposed by Ivonin et al. (2016) is tested on dual channel co-polarization Radarsat-2 and TerraSAR-X synthetic aperture radar (SAR) images acquired over the North Sea in 2011 and 2012 during controlled oil-on-water experiments and containing various types of oil slicks. The technique has been developed on the basis of the normalized radar cross section model by Kudryavtsev et al. (2003), taking into account scattering from wavebreaking as well as from Bragg capillary-gravity waves. The technique uses a new polarimetric parameter called RND (ratio of Resonant to Nonresonant signal Damping), which is related, on the one side, to a proportion of damping of short capillary-gravity waves in the slick and, on the other side, to damping of wavebreaking.

In this study we are concentrating on extending possibilities of the technique to simultaneous re-processing of Radarsat-2 (C-band) and TerraSAR-X (X-band) SAR images as well as to the technique robustness in the case of noisy images. The test images, three Radarsat-2 and two TerraSAR-X, were obtained during the oil-on-water exercises, when three types of oil (crude, plant/vegetable, emulsion) with different chemical properties were released. The plant oil was used there to simulate natural biogenic slicks. The SAR images spanned incidence angles from 27° to 42° and some of them had a high level of noise in comparison to the minimal level of the signal in slicks. A noise subtraction was applied before the image processing. To unify C- and X-band images processing we proposed to study RND parameter behavior in terms of the Bragg wavenumber, k , which is uniquely defined for a given frequency band and the incidence angle.

It is demonstrated that, in a such image noisy conditions, when the signal lies several decibels below the noise level, this technique gives a possibility to relate polarimetric parameters of C- and X-band SAR images for the same type of slicks. For example, RND of oil emulsions can be described for different frequency bands and different incidence angles as approximately $3.3k^{-0.27}$ law (in the range of Bragg wavenumbers from 115 to 270 rad/m and for wind speeds of about 1.5-3.5 m/s). At the same time, the RND of plant oil is well separated from the emulsion RND and lies below this curve.

This technique is further expected to operate in an automatic mode for discrimination between emulsion and biogenic slicks on both Radarsat-2 and TerraSAR-X SAR images, and is ready for implementation.

This work was supported by the Russian Science Foundation, project 14-05-93084, and by the Research Council of Norway through the GlobOilRisk project (BIA grant No. 235444), the NORRUSS project (grant No. 233896) and CIRFA (grant No. 237906).

Keywords: SAR images, co-polarization, polarimetric parameter, oil slick discrimination

Title: Spot 5 and RapidEye images applied in the research of beach ridges at the municipality of Icapuí – Ceara, Northeastern Brazil

Authors: Allison de Oliveira Maia* (Universidade Federal do Ceará), Cláudio Ângelo da Silva Neto (Universidade Federal do Ceará), Cynthia Romariz Duarte (Universidade Federal do Ceará) e Michael Vandesteem Silva Souto (Universidade Federal do Ceará)

Type: POSTER

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

Recent observations in Ceará state, especially on the coast of Icapuí municipality, allowed the identification of sedimentary structures related to the beach ridges system. These structures correspond to the deposition of sediments of Quaternary age, related to marine regression in the last seven thousand years. The beach ridges are present in two main areas in the municipality: east, in Ibicuitaba district and west, in Gamboa district. They are delimited by the Holocene sediments of geomorphological compartment called cliff, belonging to the Barreiras Formation, and the dune fields that are adjacent to the coastline. In this area, dozens of shrimp tanks occupy the marine terraces, intercepting these structures, being an environmental impact factor that hinders the understanding of coastal evolution on site. In this study a Spot 5 scene, HRG sensor (path/row: 726/359), with 10m spatial resolution, obtained on 07/16/2012, and a RapidEye scene, REIS sensor (ID: 2436922), with 5m spatial resolution, obtained on 05/24/2014 were used. Digital image processing techniques were employed in order to evaluate which of the two satellite images provides the best result for identification of beach ridges. In the first approach, techniques, generically called “enhancements” have been used on the image, applying convolution filtering in ENVI 5.0 software. Then, a band ratio operation between the green and red channels was performed for each scene, because the spectral ranges of these two bands have the closest values in the two images. After analyzing the products generated by the digital image processing, it was observed that, considering the filtering techniques, Spot 5 image showed a better quality of contrast and sharpness of objects in visual analysis when compared to RapidEye image. Considering the ratio of green and red bands, the results presented by the Spot 5 image was also higher than that obtained in the RapidEye image, because even with a lower spatial resolution, the response presented by the spectral resolution of the Spot 5 image was more relevant to the identification of the targets of interest. Therefore, by analyzing these two aspects, it can be concluded that the Spot 5 image is the best choice for enhancement, identification and mapping of sedimentary structures present in the area.

Keywords: remote sensing, digital image processing, beach ridges, Icapuí, Spot 5, RapidEye

Title: Identification of susceptibility of harmful algal blooms and determining the key monitoring zones in the coastal water of Hainan Island

Authors: LÜ Shu-guo (Hainan Research Academy of Environmental Sciences, Haikou 570206, China), TANG Dan-ling* (State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China), GUAN Xue-bin (Hainan Research Academy of Environmental Sciences, Haikou 570206, China), CEN Jing-yi (Research Center for Harmful Algae and Marine Biology, Jinan University, Guangzhou 510632, China) e LÜ Song-Hui (Research Center for Harmful Algae and Marine Biology, Jinan University, Guangzhou 510632, China)

Type: POSTER

Session: (2) COASTAL IMPACTS

Key areas identification, zone division, and long-term monitoring are key to establishing harmful algae blooms (HABs) early warning systems. Based on the historical records of HABs in the coastal waters of Hainan Island, severities of HABs events were evaluated by analyzing the comprehensive information of occurrence frequency, scale, damage degree, and toxicity of causative species in different areas. Combining the diffusing capacity and nutrient availability with the degree of severity of historical records, high incidence regions, prone regions and potential regions of HABs were identified in the coastal waters of Hainan Island by using GIS tools. Based on susceptible grades, environmental function zoning of coastal water, and field data, the key monitoring regions were determined and graded

Keywords: Harmful algal blooms; Susceptibility; Key monitoring zones; Hainan Island

Title: Surface waves spectrum retrieval algorithm based on measurements of the Doppler spectrum width and shift of the reflected microwave radiation

Authors: Yuriy Titichenko* (The Institute Of Applied Physics Of The Russian Academy Of Sciences), Vladimir Karaev (The Institute Of Applied Physics Of The Russian Academy Of Sciences) e Maria Ryabkova (The Institute Of Applied Physics Of The Russian Academy Of Sciences)

Type: POSTER

Session: (5) OPERATIONAL REMOTE SENSING

This report proposes a new retrieval algorithm of surface waves spectrum using Doppler radar measurements. For the analysis, this algorithm uses the width and the shift of the Doppler spectrum of the radiation reflected by water surface. We consider the reflection in quasi-specular region fully described by the Kirchhoff approximation without Bragg scattering contribution. The incidence angle must be different from the vertical for the Doppler spectrum shift to be different from zero; on the other hand, the incidence angle must be less than 10-15 degrees to satisfy the condition of quasi-specular reflections. The algorithm is based on the selection of the parameters of the surface waves spectrum model for the best matches between the width and the shift of the Doppler spectrum of the reflected radiation and the measurements.

As a wave spectrum model uses Karaev spectrum based on experimental data with the condition of coincidence of the slopes variance calculated by the full spectrum with slopes according to the Cox and Munk measurements. According to this model, the surface wind waves are completely determined by two parameters - wind speed and wind fetch. Instead, any other wave spectrum model with two parameters can be used.

The algorithm was tested on numerical simulation and experimental data. The experiment was conducted in the Black Sea on an offshore platform 500 meters from the shore. Doppler radar in continuous mode with a wavelength of 8 mm was used for the measurements. The antenna pattern has a symmetrical narrow 6 degrees aperture. String wave gauge fixed on the platform was used to control the effectiveness of the retrieval algorithm of surface waves spectrum. String wave gauge is the most reliable source of information on surface waves. As a result, according to radar measurements we were able to retrieve the surface waves spectrum that corresponded well to the string wave gauge measurements. After the retrieval of the surface waves spectrum it is possible to get more information about the waves, in particular, to estimate the significant wave height, which does not directly affect the width and the shift of the Doppler spectrum.

Acknowledgments. The reported study was supported by RFBR, research project No. 15-55-53046 GFEN_a.

Keywords: remote sensing, microwave radar, surface waves spectrum, field experiment, Doppler spectrum

Title: Use of Landsat images in the temporal analysis of coastline in the western portion of the city of Icapuí.

Authors: Cassiano Dias de Souza (Universidade Federal do Ceará), Linara Ivina de Castro Rodrigues* (Universidade Federal do Ceará), Cynthia Romariz Duarte (Universidade Federal do Ceará) e Michael Vandesteem Silva Souto (Universidade Federal do Ceará)

Type: POSTER

Session: (2) COASTAL IMPACTS

The coastal areas along the State of Ceará are continuously changing, due to both, the action of natural coastal dynamics, and anthropogenic actions. This study aimed to analyze the evolution of the shoreline between the years 1984 and 2014 using digital processing techniques applied in images of satellite Landsat 5 (TM) and Landsat 8 (OLI). The study area is located in the western portion of the city of Icapuí, a region known for its environmental complexity, presenting a mixed picture between natural beauties and human occupation. Set in a coastal region with a strong dynamic, environmentally characterized as fragile for being composed of geo-environmental units, Icapuí is subjected to intense action of coastal processes. Owing to the economic and landscape interest of these areas, it is important to study and monitor coastal this area, and the availability of time series of satellite images constitutes an important source of data for temporal analysis of impacts caused by the occupation and coastal evolution. After georeferencing the images, the ArcGis 10.2.2 software was used for processing and vectorization. The RGB color compositions chosen were 7-5-4 for the OLI sensor (Landsat 8), and 7-4-3 for the TM sensor (Landsat 5), both equivalent compositions, which help identify the immersed areas, wetlands, bodies of water and vegetation, making it possible to identify and quantify areas of erosion, deposition, and stability related to the shoreline. During the study period, variations along the coastline were observed, with emphasis on the portion of the beach of Ponta Grossa, where there was an increase in sedimentation.

Keywords: Coastal change, remote sensing, Landsat 5, Landsat 8

Title: Later winter species assemblages of fish larvae and copepods in relation to the thermal front in the southern East China Sea

Authors: Ming-an Lee* (Department Of Environmental Biology And Fishery Science, National Taiwan Ocean University), Yi-Chen Wang (Department Of Environmental Biology And Fishery Science, National Taiwan Ocean University), Yang-Chi Lan (Marine Fisheries Division, Fishery Research Institute) and Jheng-Tang Huang (Department Of Environmental Biology And Fishery Science)

Type: POSTER

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

This study investigated the composition of fish larvae and copepods associated with the marine environment on the continental shelf of the southern East China Sea in March 2013. A sea surface temperature (SST) front clearly formed in the continental shelf of northeast Taiwan. A total of 71.76 ind/m³ fish larvae, and 5068.91 ind/m³ of copepods was collected by an ORI net in this study. 104 fish species in 58 families and 73 copepod species in 18 families were identified. Cluster and canonical correlation analysis revealed that the species composition of fish larvae and copepod was possibly influenced by hydrographical conditions. In the continental shelf side of the SST front, the assembled groups were dominated by coastal species, such as *Engraulis japonicus*, *Paracalanus aculeatus* and *Corycaeus affinis* that were negatively correlated to sea surface water temperature, salinity, and bottom depth. The dominant species in the offshore side of the SST front belong to oceanic species, such as *Diaphus* B group, and *Oncaea venusta*. The results of Cluster-Euclidean Distance analysis indicated that the assembled copepod more closely corresponded with the SST front than fish larvae. It is suggested that the SST front may play a key role affecting the composition of fish larvae and copepods in late winter. In addition, the possible influence of food availability and spawning behavior on fish species composition was also discussed in this study.

Keywords: plankton, thermal front, East China Sea

Title: Morphological Changes in a Channel Tide: Applied Study in the surrounding areas of the Pecém Harbor Terminal, east coast of Ceará, northeastern of Brazil.

Authors: Aline Moreira Damasceno (Universidade Federal do Ceará), Linara Ivina de Castro Rodrigues* (Universidade Federal do Ceará), Paulo Ricardo Gorayeb Sucupira Junior (Universidade Federal do Ceará) e Cynthia Romariz Duarte (Universidade Federal do Ceará)

Type: POSTER

Session: (2) COASTAL IMPACTS

The coastline is configured according to the representation of interactions between the morphogenetic (tectonic-isostasia and variations of sea level), climatic, and oceanographic processes. Identifying and linking the components with the morphological characteristics and their processes are necessary to improve the use and management of coastal areas. The tidal action plays an important role with respect to morphodynamic and coastal hydrodynamics. The study area is inserted in a region near the Pecém Harbor Terminal (PHT). The PHT is located approximately 60 km from the city of Fortaleza, Ceará. The harbor was created in order to strengthen and provide sustainable growth of the industrial park of Ceará and the Northeast areas of Brazil, thus enabling the promotion of various integrated industrial activities. Before the construction of the Pecém port complex, erosive processes were observed by the interaction between changes in the wave climate in the headland and occupation of dune field that directly fed the beach. An offshore pier that aimed to provide autonomy to use and permanence of the Interim Shipping Terminal (IST) was built in 1998. However, this caused a decrease of approximately 70 meters from the shoreline. These modifications over the years caused the destruction of vacation homes, bars and stalls. Since 2001, with the implementation of protective structures and the removal of the IST, the beach goes through progradation processes. Based on that and with the use of remote sensing products, Landsat scenes made available by the USGS (United States Geological Survey) were used for the years 1994 and 2004 and images of the RapidEye constellation, provided by the Ministry of Environment were used for the years 2011 to 2014. The preprocessing of the images was made through ArcGIS 10.2™ and Envi 5.0 ©, involving steps of cut in the area, was realized the equalization of the images and subsequent creation of masks for the region. Later, a supervised classification was applied to delimit the banks of sediment, and the variation of the channel over the years, using the method of maximum likelihood classification, which takes into account the distances between the averages of the pixel values of the classes, using statistical parameters. The post-processing results in the creation of a quantitative database for the sediment yield of the area during the period under review to continue monitoring the tidal channel, aiming at the creation of statistical forecasting models for the tidal channel. Then, the expected results will be added to a subsequent analysis carried out with sediment collected in the field, seeking to relate the accumulation of sediments in the region to the occupation processes related to the PHT.

Keywords: supervised classification, remote sensing, coastal dynamic

Title: EFFECTS OF LONG DROUGHT IN NORTHEAST BRAZIL THROUGH NDVI ANALYSIS

Authors: David Bruno de Sousa Teixeira* (Federal University Of Ceara), Léa Moraes Nunes Teixeira (Federal University Of Ceara), Francisco Jairo Soares Pereira (Federal University Of Ceara) e Carlos Alexandre Gomes Costa (Federal University Of Ceara)

Type: POSTER

Session: (5) OPERATIONAL REMOTE SENSING

The lack of rain reflects in many problems for the maintenance of vegetation and ground cover which can be represented by vegetation indexes as the Normalized Difference Vegetation Index (NDVI). The Aiuaba Experimental Basin (AEB) with approximately 12km² and located in the Brazilian semiarid is an important part of the Caatinga biome and has faced reduced precipitation rates over the last five years. In addition, this area is part of the Ecological Station of Aiuaba, which is the largest federal conservation unit of the Caatinga biome. Aiuaba's climate has two distinct seasons, a rainy season through February to June and a dry season between July and January, which greatly influences the vegetal pattern because of the leaf shedding features of the Caatinga biome, reflecting in its spectral compartment. This way, the remote sensing is an efficient strategy to monitor and evaluate the effects of the weather in the vegetation, especially when used to calculate indexes as NDVI. This research has as main objective analyze temporal changes in the vegetation of the Aiuaba Experimental Basin after a long rain shortage, comparing the NDVI from 2010 that were the last significant rainy year and this index for 2015, the fifth consecutive rain shortage year, for both rainy and dry seasons. During the study were used images from the satellites Landsat 5 to analyze the presence of vegetation at the basin in 2010 and Landsat 8 to analyze it for 2015. The criteria used to select the images were based on the seasons (rainy and dry) and in the minimal of clouds. The NDVI was calculated to imagens of April and October for 2010, and July and October for 2015, using the software Quantum Geographic Information System (QGIS). The results of NDVI varied in 0.5 comparing the rainy and dry season for 2010, and for 2015 this variation was 0.38, representing a similar pattern for both years. Comparing the NDVI for the rainy season for both years, the 2015's NDVI was lower. However, for the dry season the results do not show substantial difference, with a variation of 0.02. In conclusion, despite the reduced rain conditions, the behavior of the vegetation in the Aiuaba Experimental Basin did not show a significant decrease in NDVI comparing both years and seasons analyzed. It demonstrates the capacity of the Caatinga biome to keep its vegetation features even under lowers rain precipitation conditions.

Keywords: Caatinga, NDVI, drought, semiarid.

Title: Bathymetric mapping using Support Vector Machine technique on Landsat 8 Imagery

Authors: Ankita Misra* (Indian Institute Of Technology- Bombay), Z. Vojinovic (UNESCO-IHE, Institute for Water Education), Balaji Ramakrishnan (Indian Institute of Technology- Bombay), R Ranasinghe (UNESCO-IHE, Institute for Water Education), Y. A. Abebe (UNESCO-IHE, Institute for Water Education) and Arjen Lujendijk (Deltares)

Session: (3) NEW TECHNOLOGIES AND IMAGE PROCESSING

Satellite imagery along with image processing techniques prove to be efficient tools for bathymetry retrieval as they provide time and cost effective alternatives to traditional methods of water depth estimation. In this paper, a non-linear machine learning technique of Support Vector Machine (SVM) is used to create shallow water bathymetry data along Ameland Inlet, Netherlands by combining echo-sounding measurements, and the blue and green bands of Landsat 8 imagery with 30m spatial resolution. For the data-set, 60% of data points are used for training and the remaining 40% data points are used for testing. The model utilizes the Radial Basis kernel function (non-linear) and the other training factors such as the smoothing parameter, penalty parameter C and insensitivity zone γ are selected and tuned based on the learning (i.e. training) process. The number of support vectors obtained in the training phase is 23.8% of the training data-set. The overall errors during training and test phases are 10.39% and 9.36%, respectively, reflecting that the model produces significant estimations for the depth range of 1-15m, considered in this study

The results obtained are also compared with those obtained from the widely used reflectance ratio transform model, which establishes a linear relationship between the water depth and the ratio of blue and green bands. A comparative evaluation between the estimated and actual depths is performed for both the methods to assess their efficiency in retrieving near-shore bathymetry. It is observed that SVM provides a significant correlation coefficient of $r^2 = 0.96$ with a Mean absolute error, MAE = 0.58 whereas in case of the ratio model the $r^2 = 0.93$ with a MAE = 0.85. Evidently, it can be suggested that SVM provides a better performance for this depth range and can be used effectively for deriving accurate and updated bathymetric maps. This can be further utilized in coastal management especially near harbors ports etc. where shallow depths can present risks to shipping and navigation near shoals and banks where rapid changes due to sedimentation, erosion and scouring of channels can lead to alteration in the bottom topography.

Keywords: Nearshore- Bathymetry, Eco-soundings, Landsat 8, Support Vector Machine, Radial basis kernel function, Ratio transform model

Title: Mapping of the sites suitable for Mariculture (Open Ocean Cage Culture) in the Indian Seas.

Authors: Nimit Kumar* (Indian National Centre for Ocean Information Services, Ocean Valley, Pragathinagar (BO), Nizampet (SO), Hyderabad-500090, India), Jyoti Nayak (Indian National Centre for Ocean Information Services, Ocean Valley, Pragathinagar (BO), Nizampet (SO), Hyderabad-500090, India), Ajay Nakhawa (Mumbai Research Centre of ICAR-Central Marine Fishery Research Institute, Mumbai-400061, India), Thirumalai Selvan (Mandapam Regional Centre of ICAR-Central Marine Fishery Research Institute, Cochin-682018, India) , Nagaraja Kumar M (Indian National Centre for Ocean Information Services, Ocean Valley, Pragathinagar (BO), Nizampet (SO), Hyderabad-500090, India), and Srinivasa Kumar T (Indian National Centre for Ocean Information Services, Ocean Valley, Pragathinagar (BO), Nizampet (SO), Hyderabad-500090, India)
Type: ORAL PRESENTATION

Session: (7) REMOTE SENSING DATA FOR POLICY MAKING

Global captured fishery is either stagnant or depleting. Stock often tumble or collapse due to exploitation pressure. Further, changing climate poses uncertainty over archaic practice of exploiting the marine resources. In India, fishery is mostly dependent on coastal ecosystem. Despite having favorable conditions within the Indian Exclusive Economic Zone (EEZ), entrepreneurs have not embraced mariculture yet. While global output from aquaculture fishery is on the verge of surpassing captured fishery, this can be the right time for India to take a first step toward blue revolution. A developed mariculture industry can help India mitigate malnutrition and land-use conflicts while effectively implement coastal zone regulations. Food resources farmed under controlled environment can help effectively control quality. Marine environment offer untapped resources for bio-fuel, drugs and other bio-active compounds. Mariculture can ensure accessing such resources without putting natural stock under the risk of over exploitation. In this regard, we showcase an effort to underline the potential of mariculture industry within the Indian EEZ. We adopted ranges of various oceanographic parameters that are reported to be optimum for mariculture. These include sea surface temperature, sea surface salinity, bathymetry, sea surface chlorophyll, water clarity, sea surface currents and significant wave height. We especially preferred adopting values from studies from tropical seas. The output maps were generated by using monthly climatology data of these parameters. Our findings can be helpful for state and federal agencies to demarcate zones favorable for mariculture, while planning newer shipping route or other economic activities in their region. At the same time, it can provide information to entrepreneurs on choosing the investment site.

Keywords: Mariculture, Fishery, Site suitability, GIS, Mapping

Title: Monitoring the spring bloom in Western Canada from satellites and buoys

Authors: Stephanie King* (Sea This Consulting) and Jim Gower (Fisheries and Oceans Canada)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

MERIS and MODIS satellite imagery in the spring shows a recurring pattern of surface chlorophyll fluorescence which suggests seeding of the early spring bloom in the Strait of Georgia from deep, glacial inlets. High chlorophyll values are first observed in the inlets in mid-February, then in waters near the mouth of the inlets, before spreading across the main body of the Strait in late February and early March. We call the pattern the "Malaspina Dragon" after its shape in satellite imagery in 2005, 2008, 2009 and 2015 shortly after it enters the Strait. It appears that the main spring bloom in the Strait of Georgia occurs earlier in years when this type of pattern occurs, suggesting that seeding from inlets should be added to the list of factors controlling timing. Since 2009, the presence and evolution of the bloom has also been monitored in situ from a number of platforms including from buoys, a dock, an ocean glider and ferries. Using a combined approach of satellite imagery and in situ measurements has proven to be a highly effective and low cost method for monitoring plankton variability in local waters.

Keywords: MODIS, chlorophyll, spring bloom, monitoring

Title: Optical detecting and monitoring system for major algal blooms in coastal and oceanic waters around India

Authors: Elamurugu Alias Gokul* (Indian Institute Of Technology Madras) and Palanisamy Shanmugam (Indian Institute Of Technology Madras)

Type: ORAL PRESENTATION

Session: (5) OPERATIONAL REMOTE SENSING

Detecting and monitoring the major algal blooms (including harmful algal blooms) is central to developing and strengthening the algal forecasting system in coastal and oceanic waters. Over the past few decades several techniques have been reported to detect and monitor algal blooms in coastal and oceanic waters around India. However, accurate detection of these algal blooms remains a major challenge. The present study is therefore motivated to develop an optical system that can be capable of utilizing remote sensing, in situ, and radiative transfer technique to detect and monitor the algal blooms using simulation and in-situ observational data. This optical system, in conjugation with a mathematical classification technique (SVD) was tested on several satellite ocean colour data and detected accurately the blooms of *Noctiluca scintillans/miliaris* (green/brown), *Trichodesmium erythraeum*, and *Cochlodinium polykrikoides* (red)). Statistical accuracy assessment measures based on overall, user's, and producer's accuracies as well as Kappa accuracy, further showed encouraging results when derived with the satellite-derived and in-situ match-up data. The proposed optical system is anticipated to provide researchers and managers with essential information on the development of these blooms and their dynamics at various spatial and temporal scales.

Keywords: Harmful algal blooms, Optical system, Remote sensing, Radiative transfer technique, and Singular value decomposition technique.

Title: Comparison between the Digital Shoreline Analysis System and the Change Polygon Method for the analysis of the shoreline changes in the municipality of Icapuí - Ceara, Northeastern Brazil

Authors: Cláudio Ângelo da Silva Neto* (Universidade Federal do Ceará), Allison de Oliveira Maia (Universidade Federal do Ceará), Aline Moreira Damasceno (Universidade Federal do Ceará), Paulo Ricardo Gorayeb Sucupira Júnior (Universidade Federal do Ceará), Cynthia Romariz Duarte (Universidade Federal do Ceará) and Michael Vandesteen Silva Souto (Universidade Federal do Ceará)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

This article presents a comparison of the application of remote sensing image processing techniques, in conjunction with GIS tools for the study of coastal evolution and monitoring of sediment budget of the shoreline of the municipality of Icapuí. Icapuí is located at the eastern end of the state of Ceará, identifying the progradation or retrogradation of the coastal environment and its potential to estimate changes in the morphology of the coast. This coastal zone was selected for this study because of its highly dynamic environment and, therefore, propitious to compare the techniques of DSAS (Digital Shoreline Analysis System) and Polygon Change Method, enabling the identification of the advantages and disadvantages of each method, understanding their best applications. Landsat images series were collected for the study period, WRS 216/063, where the Icapuí is inserted. Data from the tide gauge of the Areia Branca Port (RN), the closest to Icapuí and with similar tidal regime, assisted in the choice of images with less tide variation. Colored compositions were generated from the satellite images, using the bands in the near-infrared, short-wave infrared and red in RGB composition, enhancing the visual contrast between the portions of land and water, helping the vectoring of coast lines for the study period. The existing tidal channel structure in the area was used as a reference for dividing the coast line in the east and west portions, to facilitate the understanding of the dynamics in each of these areas and quantifying the coastal variation. Using DSAS technique was possible to define, through the generation of statistical data End Point Rate (EPR), the regions with most trend to erosion or accretion, creating a thematic map that visually highlights this change. The west shoreline obtained a variation between 2,14m and -7m over the evaluation time, suggesting an erosion trend in the area. The east coast line registered a variation between -7,02m and 12,67m, indicating a slight positive balance for the accretion. By applying the Change Polygon Method was possible to confirm the general trend evidenced by DSAS for each shoreline and to quantify the variation in them. Overall, it was possible to characterize the west shoreline as an environment with erosive predominance, where, in the study period, was recorded a negative balance of 171 km² in area. The east shoreline showed a pattern of slight accretion, resulting in a positive balance of 20 km² in area. Employing the techniques of DSAS and Change Polygon Method, it was possible to evaluate the advantages of both techniques. The DSAS technique presented better for the qualitative and regional analysis, while the Change Polygon Method proved to be a good tool for the quantitative and localized analysis. Both methods are complementary and equally important to improve the understanding of coastal dynamics in the region.

Keywords: coastal dynamics, shoreline changes, DSAS, Change Polygon Method

Title: Suspended fine sediment assessment in a coastal lagoon using remote sensing techniques.

Authors: Patrícia da Cunha Marroig* (Ufrj) and Susana Beatriz Vinzón (UFRJ)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

The Patos Lagoon system, located in the southern part of Brazil, receives contributions from a continental drainage basin of about 200,000 km², with approximately 9x10⁶ ton/year of suspended sediment being driven to the lagoon. This load, mostly in the fine fraction, causes significant silting rates, on the order of 106 ton/year, at the Rio Grande Port channels and basins, that are demanding and continuously dredging over the years. A possible small percentage of the total sediment load reaches the estuary directly, as a suspension, while the remaining settles in the bottom lagoon, according to the energy gradients and bathymetry. Thus, coarser sediment fraction will be found in the shallow areas, exposed to wave action, while silt and clay prevail in the deeper areas, protected from wave action.

Together with river discharge and waves, the local and remote winds are the main agent for water and sediment exchange between the sea and the Lagoon. Local NE wind will cause a set-up inside the Lagoon towards the entrance, whereas the NE remote wind will cause a set-down at the Lagoon's mouth by Ekman dynamics. The river discharge is responsible to increase/decrease the currents generated and the waves re-suspend the sediment deposited, facilitating the transport.

Fine sediments may be kept and transport in diluted suspension, which moves with the main water column currents, as mobile suspensions next to the bottom (benthic hyper concentrated suspensions) or can appear as a consolidated layer, which do not move horizontally. Eventually it may provide sediments to the water column, for instance during storms. In Patos Lagoon, the quantity of sediment transported has been estimated from data and numerical models. The suspended transport, 1.06x10⁶ ton/year, although an order of magnitude smaller than the bed transport, 1.14x10⁷ ton/year, is considerable, and of the same order to the quantity of sediments reaching the lagoon from the rivers.

The use of remote sensing data and digital image analysis has allowed developing studies in mapping and monitoring the natural resources, including quantification of sediment in suspension in coastal zones.

This study aims to identify the flux of suspended sediments from the Patos Lagoon to the estuary as dilute suspensions, using remote sensing reflectance and true colour images for determining fine sediments concentrations, and numerical modelling for hydrodynamics. Applying CSS algorithms in remote sensing reflectance, the superficial concentration of sediments in suspension can be estimated. Regarding that the concentration of fine sediments is barely constant in the water column, the value observed in surface is a good proxy for the diluted suspension in the water column. Based in this data and the hydrodynamic conditions, the fluxes from the Lagoon to the sea are thus quantified.

Keywords: Cohesive sediment, flux, Remote Sensing, Ocean Color, Patos Lagoon.

Title: Towards Improved Estimate of Turbulent Heat Flux over Global Oceans.

Authors: Abderrahim Bentamy* (Ifremer)

Type: ORAL PRESENTATION

Session: (6) OCEAN-ATMOSPHERE INTERACTIONS

For over a decade, several scientific groups have been developing air-sea heat flux information over global oceans that include latent (LHF) and sensible (SHF) fluxes. This paper aims at providing a new insight of the quality and error characteristics of daily turbulent heat flux estimates at various spatial and temporal scales. The study is performed within the European Space Agency (ESA) Ocean Heat Flux (OHF) project. The quality of all products, namely IFREMER, HOAPS-3, OAFflux, SeaFlux V1, J-OFURO 3, ERA Interim, CFSR, and MERRA, contributing to the OHF project is first determined through comprehensive comparison with daily-averaged LHF and SHF estimated from in-situ (moorings and ships) and from dedicated scientific campaign measurements. This paper also describes the determination of OHF multi-Product Ensemble (OHF/MPE) which is estimated over global ocean from selected flux analyses as inputs, interpolating them on common grid map of $0.25^{\circ} \times 0.25^{\circ}$ over ice-free global oceans. The accuracy and resolution of the resulting OHF/MPE are compared with those of input OHF products using same metrics, leading that OHF/MPE is more accurate than any of the contribution analyses. For instance the lowest root mean square difference (RMSD), characterizing the comparison between daily buoy and product LHF and SHF estimates, are found for OHF/MPE. The associated values estimated at each buoy location tend to be lower than 30W/m^2 and 10W/m^2 for LHF and SHF, respectively. The analysis of differences between seasonal mean of OHF/MPE and OHF product LHF as well as SHF show that the main depicted departures are mainly related to wind speed, specific air humidity, and air temperature issues.

Keywords: Fluxes, Turbulent, Heat, Budget

Title: Interannual and Intersensor Chlorophyll variability at Península Valdés, Argentina

Authors: Cara Wilson* (Noah/nmfs), Victoria J. Rowntree (Southern Right Whale Health Monitoring Program, (9120) Puerto Madryn, Chubut, Argentina) and Marcela M. Uhart (Southern Right Whale Health Monitoring Program, (9120) Puerto Madryn, Chubut, Argentina)

Type: ORAL PRESENTATION

Session: (2) COASTAL IMPACTS

SeaWiFS, MODIS and VIIRS sensors now provide an 19-year time series of chlorophyll data for the western South Atlantic which includes Península Valdés (PV), Argentina, an important calving ground for southern right whales (*Eubalaena australis*). These datasets were examined in the region of PV, in an attempt to understand the cause for a sudden increase in right whale calf mortality off PV that started in 2005. PV is located on the northern Patagonian coast of Argentina, south of Golfo San Matías (GSM) and situated between two gulfs, Golfo San José (GSJ) which opens to the north, and Golfo Nuevo (GN) which opens to the south. The average number of deaths went from < 6 deaths/year from 1971-2004 to 65 deaths/year in 2005-2014. Phytoplankton dynamics appear to have changed in the PV region since the 1990s. Spring phytoplankton blooms are a normal seasonal feature, and historically springtime chl values reached ~ 2 mg/m³. In 2004 a large bloom developed, with average chl > 20 chl mg/m³ in all three gulfs. Since then large-magnitude blooms (chl > 5 mg/m³) have occurred in GN almost every year (2007, 2008, 2010, 2012-2014). Large magnitude blooms do not occur as often in GSM and GSJ. The three sensors differ considerably in the chl values of these blooms. The MODIS bloom values being consistently higher than those from SeaWiFS but in better agreement with VIIRS values. Possible causes for differences in bloom values between the sensors will be discussed.

Keywords: chlorophyll, ocean color, *Eubalaena australis*

Title: Climatic Variability of the Caspian Sea Current System based on Satellite Altimetry Data

Authors: Sergey A. Lebedev* (Geophysical Center of the Russian Academy of Sciences) and Sergey A. Lebedev (Space Research Institute of the Russian Academy of Sciences)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

The investigation is devoted to the study of the variability of the dynamics of the Caspian Sea based on TOPEX/Poseidon and Jason-1/2 satellites altimetry data. The technique of calculating the synoptic dynamic topography (DT) as a superposition of the mean sea climate DT calculated by thermohydrodynamic models and field of sea level anomalies calculated by satellite altimetry data is considered. An analysis of the geostrophic currents vorticity confirmed the predominance of cyclonic circulation in the Northern and Middle Caspian and anticyclonic in the Southern. Analysis of variation of average velocity and vorticity shows that the average velocity is inversely proportional to the vorticity. Since 1993 to 2007, vorticity rose at a rate of $-0,17 \pm 0,02 \cdot 10^{-7}$ per year, and average velocity has increased at rate of $+0,11 \pm 0,06$ cm/year. After 2008 the situation has changed to the opposite. The vorticity has increased at a rate $+0,75 \pm 0,12 \cdot 10^{-7}$ per year, average velocity rose at rate of $-0,47 \pm 0,19$ cm/year.

This study was supported by grants of the Russian Science Foundation (No 14-17-00555)

Keywords: satellite altimetry, Caspian sea, Climatic change

Title: Introduction a new interdisciplinary subject: Remote Sensing Marine Ecology

Authors: Danling Tang* (South China Sea Institute Of Oceanology, chinese academy of Sciences) and Sufen Wang (South China Sea Institute of Oceanology, Chinese Academy of Sciences)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

This paper introduced the development of a new interdisciplinary subject that combines the two disciplines of remote sensing and marine ecology. This novel approach is now known as "Remote Sensing Marine Ecology". Within this novel context, we identified the occurrence in the ocean of wind-driven marine phytoplankton blooms, and proposed a new physical-biological mechanism to explain them, called the "wind-pump". We also contributed to the establishment of a system for typhoon disaster assessment and emergency management in Southern China.

Algal bloom not only can increase the primary production but also could result in negative ecological consequence, e.g., Harmful Algal Blooms (HABs). According to the classic theory for the formation of algal blooms "critical depth" and "eutrophication", oligotrophic sea area is usually difficult to form a large area of algal blooms, and actually the traditional observation is too sporadic to capture to the existence of algal blooms. Taking full advantage of multiple data from satellite remote sensing, this study: 1), introduces "Wind-driven algal blooms in open oceans: observation and mechanisms"; It explained how through classic coastal Ekman transport, the wind, through a variety of mechanisms is affecting the formation of algal blooms. Proposed is a conceptual model of "Strong wind -upwelling-nutrient-phytoplankton blooms" in Western South China Sea (SCS) to assess the role of wind-induced advection transport in phytoplankton bloom formation. It illustrates the nutrient resources that support long-term offshore phytoplankton blooms in the western SCS; 2), Proposed is a theory that "typhoons cause vertical mixing, induce phytoplankton blooms", and quantifies their important contribution to marine primary production; A new ecological index for typhoon and remote sensing inversion models are also proposed. 3), Finding of the spatial and temporal distributions pattern of harmful algal bloom (HAB), and species variations of HAB in the South Yellow Sea and East China Sea, and in the Pearl River estuary, and their oceanic dynamic mechanisms in relation to monsoon.

Keywords: Remote Sensing Marine Ecology, interdisciplinary, phytoplankton blooms

Title: Comprehensive analysis of mesoscale circulation in the Western Mediterranean Sea based on satellite data

Authors: Svetlana Karimova* (University Of Liège)

Type: ORAL PRESENTATION

Session: (1) LARGE AND MESO SCALE OCEANOGRAPHY

Satellite oceanography provides different ways for an investigation of mesoscale circulation features and eddies in particular. Thus, in thermal infrared imagery mesoscale eddies can be seen due to temperature contrasts between the adjacent water particles. Visible-range satellite imagery can manifest circulation elements as well, provided that there are organic or inorganic suspended particles in the water acting as passive tracers of the surface currents. Organic films on the water surface also visualize the circulation features and especially vortical structures while being observed by synthetic aperture radar (SAR). Finally, location of mesoscale vortices can be reconstructed indirectly using the data on sea level anomaly (SLA).

Unfortunately, none of the methods mentioned is perfect. Thus, in thermal imagery temperature contrasts are not distributed evenly, thereby masking some circulation features. Suspended material needed for manifestation of eddies in visible-range imagery is mostly available only in the near-coastal areas. Quite frequently SAR imagery does not provide any information about water circulation because of too high wind speeds during the survey. Due to their significant interpolation in space and time, gridded SLA products can detect in a reliable way only the presence of the biggest elements of mesoscale circulation.

In order to eliminate the shortcomings just mentioned and to reveal the actual spatial variations of mesoscale eddy activity in the Western Mediterranean, in the present study we are using three different satellite products. At first, mesoscale eddies have been investigated using NOAA AVHRR thermal infrared images covering the period 2011-2013. Secondly, a dataset of Envisat Advanced SAR imagery obtained in 2009-2011 was used for eddy detection. Finally, SLA maps for the same years have been analyzed as well.

Analysis of the SLA fields revealed that the closed contours of SLA traditionally being regarded as mesoscale eddy manifestations were distributed more or less evenly over the region of interest (even though the most long-lived contours were found mostly in the southernmost area). SST imagery indicated in its turn that most anticyclonic eddies were attributed to the flow along the southern coast the number of cyclonic eddies in such imagery was gradually decreasing northwards. Finally, SAR images confirmed that big eddies (mostly anticyclonic) are typically found in the southern half of the Western Mediterranean, while smaller cyclones are frequently observed in the northern half as well.

This research was supported by the University of Liege and the EU in the context of the FP7-PEOPLE-COFUND-BelPD project. SAR imagery was obtained under the grant of the European Space Agency # 14120 "Spiral eddy statistical analyses for the Mediterranean Sea using Envisat ASAR Imagery (SESAMeSEA)".

Keywords: mesoscale eddies, Western Mediterranean, SST, SAR, SLA