Mapping total suspended matter using ocean color data over La Plata River Estuary, Argentina

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Keywords: total suspended matter, NIR, SWIR, MODIS, MERIS

Abstract: The La Plata River, located at 35°S on the Atlantic coast, is one of the largest waterways of South America. It carries a large amount of suspended particulate and dissolved organic matter, and is considered among the most turbid waters of the world. Very high values of total suspended matter (TSM) have been reported in this region, with mean values ranging from 100 to 300 mg l-1 and extreme concentrations up to 400 mg l-1. Satellite sensors have shown to be the best tools available to map river plumes and to study their influence on the adjacent ocean. However, global algorithms for remotely estimating sediment concentration are not currently available. Moreover such high sediment loads represent a challenge to atmospheric correction algorithms which usually relies in the assumption of zero water-leaving reflectance in the NIR or SWIR part of the spectrum (black pixel assumption). In the extremely turbid waters of La Plata Estuary such assumptions are not valid. Algorithms for TSM estimation using red and near infrared bands (645nm, 748nm, 859nm) of the MODIS-AQUA sensor are tested here. The derived results were found consistent with known values and their spatial distribution in the region. However, saturation of the MODIS 748 nm ocean band prevented retrieval of TSM values where the maximum turbidity is found. Further application of the algorithm to other sensors, like MERIS, is also considered, testing its potential for monitoring water environments in coastal regions.

Use of Ocean Colour data to estimate Chlorophyll trends in the Mediterranean Sea

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Keywords: Ocean Colour, Chlorophyll , Trend

Abstract: The achievement of a good ecological status in European waters by 2015 is the intent of the Water Framework Directive 2000/60. At this purpose, during the last years many studies have focused on the assessment of the state of coastal waters. Indeed these regions are characterized by ecological and environmental problems due to the impact of human activities. Change in surface chlorophyll concentration is one of the most important consequences of the exponential increase in human activities. In this work twelve years (1997 to 2009) of OC Mediterranean SeaWiFS re-analysis product (from MyOcean CNR-ISAC) and in-situ observations (from the EEA database) were used to develop environmental indicators from Ocean Colour data over the Mediterranean Sea suitable for environmental state assessment and for eutrophication monitoring. For this purpose, four non-parametric statistical tests, to evaluate chlorophyll trends, were selected from the literature (Ordinary Least Square Regression, Mann-Kendall test, Seasonal Kendall Test and Spearman partial rank correlation test) and applied to entire dataset of OC data, to EEA in situ dataset and to OC data sampled over in situ station. These analysis were first conducted over a test area to evaluate the sensibility of these methods to the input data sample (eg. annual mean, monthly mean, monthly residual after seasonal removal) and then applied to the entire Mediterranean Sea. The North Adriatic Sea, has been choose as test area, since this basin is characterized by Po river discharges, the presence of eutrophication problems and presence of both case-1 (open water) and case-2 (coastal water), which affect the quality of OC retrieval. Moreover in this area OC data are already validated in open ocean and coastal water against in situ data acquired by the scientific community. Preliminary results have shown that the Mann Kendall test applied to the monthly OC chlorophyll time series performs better than other methods, producing trends more consisted with the corresponding values obtained by using the EEA database. The application of the selected method to the entire Mediterranean Sea reveals that significant trends are present only in the coastal area of basin and in particular in the region affected by the major river outflows

Ocean color and distribution of suspended particulates in the St Lawrence estuary

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Keywords: suspended particulate matter, ocean color, estuaries, case II, erosion, sediments, remote sensing reflectance

Abstract: Distribution of total suspended particulate matter (SPM) in the St Lawrence estuary (SLE) is influenced by multiple oceanographic features (e.g., maximum turbidity zone, MTZ) and areas with high biological activity. Spatial patterns of SPM volumetric concentration was studied based on satellite-derived ocean color observations during three years characterized by low (2001), moderate (1999) and high (1998) runoff discharge. Optical estimates of SPM concentration were computed from remote sensing reflectance (Rrs) (wavelength = 670 nm, L2 MLAC, NASA) measurements obtained with SeaWiFS. Although larger SPM concentrations were generally found in association with the MTZ, we also detected locations in the lower (e.g., north shore riverine plumes) and upper (e.g., shallow areas around islands) estuary where persistent high values of SPM were also present. Our preliminary data do not suggest a simple relationship between freshwater discharge and average SPM concentration, and highlight the importance of additional environmental factors other than river runoff (e.g., wind) explaining the variability of SPM in the SLE.

Comparison between satellite radiometers and lidar fluorosensor in the Arctic Sea off the Svalbard Islands

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Keywords: satellite radiometer, lidar fluorosensor, chlorophill-a, Arctic Sea

Abstract: Ocean color satellite radiometers have widely proven their outstanding capabilities as diagnostic tools of the world ocean biogeochemical cycles. Recently, SeaWiFS, MODIS and MERIS images have been merged to provide a better coverage. Notwithstanding this remarkable success, chlorophyll-a measurements in coastal zones are still affected by not negligible uncertainties. In the framework of a collaboration with the Institute of Oceanology of the Polish Academy of Sciences, UTAPRAD-DIM (Diagnostics and Metrology Laboratory) of ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) deployed ELF (ENEA Lidar Fluorosensor) on-board the research vessel Oceania during the oceanographic campaigns near the Svalbard Islands in 2006, 2007 and 2008. The main parts of a lidar fluorosensor are a frequency tripled Nd:YAG and a telescope detecting Raman scattering by water, laser-induced fluorescence by CDOM (chromophoric dissolved organic matter) and algal pigments (chlorophyll-a, phycoerythrin and phycocyanin). ELF participated to oceanographic campaigns in the Mediterranean Sea, Indian Ocean, Pacific Ocean and Southern Ocean and its data have been used for cal/val activities and included in the "Worldwide Ocean Optics Database" of ONR (Office of Naval Research). In this study the lidar data collected in 2007 are compared to the satellite images in the Arctic Sea near the Svalbard Islands. The results confirm that, while the match-up of these sensors is good off shore, satellite values are substantially lower near the coasts.

Coastal Zone Marine Ecosystem Functioning: the TYR01 Experiment

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Keywords: Ocean Color, Ecosystem Functioning, lidar

Abstract: The TYR01 cruise took place in the Tyrrhenian Sea from October 29th 2010 to November 22nd 2010 on board of the R/V Urania of the Italian Cosiglio Nazionale delle Ricerche (CNR). The experiment was the result of the cooperative effort of several Italian research Institutions: ISAC-CNR Roma, IBF-CNR Pisa, ENEA, Stazione Zoologica "A. Dohrn" Napoli, Università Partenope Napoli, Università di Napoli 'Federico II'. The cruise rationale was the necessity to collect, process and analyze specific environmental data to be able to contribute to the understanding of the main mechanisms that drive the marine ecosystem functioning in the coastal areas of the central Tyrrhenian Sea and to validate/calibrate satellite estimate to extend in space and time in situ measurements. TYR01 will help to get to a first evaluation of the natural and anthropogenic pressures and impacts on the ecosystem, focusing on terrigenous input and its effects on marine organisms in autumn. The efficiency of the coastal dynamical processes in transporting and renewing the coastal waters has been investigated also by performing a Lagrangian In Situ Experiment (LISE). The strategy adopted to achieve the cruise objectives included the acquisition of hyperspectral radiation profile data, marine biochemical and biological data through water sample collection and analysis, and specific experiments, standard hydrographical data (292 CDT casts) and in situ LIDAR marine data. 1The TYR01 team: R. Santoleri, L. Addari, F. Artuso, C. Balestra, R. Barra, M. Bellaccio, F. Bignami, F. Bolinesi, B. Buongiorno Nardelli, R. Casotti, D. Cataldi, C. Cecilia, R. Chirico, S. Ciampichetti, F. Colao, S. Colelella, A. Conidi, E. D'Acunzo, N. Ferrara, R. Ferraro, V. Forneris, A. Fulgione, Y. Galletti, A. Lai, O. Mangoni, F. Margiotta, S. Marullo, I. Menicucci, A. Mercatini, L. Nannicini, A. Palucci, A. Passarelli, Y. Pennacchi, A. Pisano, C. Pizzi, A. Rakaj, S. Retelletti Brogi, M. Saggiomo, I. Santarpia, C. Santinelli, F. Tramontano, M. Trani, G. Volpe, E. Zambianchi

Estimation of the diffuse attenuation coefficient from Meris imagery and application to seabed habitat mapping

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Keywords: Meris, ocean colour, attenuation coefficient, seabed habitats, infralittoral, photix zone

Abstract: Accurate estimates of the diffuse attenuation coefficient is critical to understand physical processes such as heat transfer in the upper layer of the ocean and biological processes such as phytoplankton photosynthesis in the ocean euphotic zone. Light availability in the water column and at the seabed determines the euphotic zone - also called the infralittoral biological zone - and constrains the type and distribution of photosynthetic plants at the seabed. In an attempt to map European seabed habitats in the frame of the DG/MARE funded EuSeaMap project, one of the key issues was to determine the most likely extent of the infralittoral zone according to physical, geological and biological criteria and using observations and models. Satellite observations of the diffuse attenuation coefficient of either the downwelling spectral irradiance at wavelength 490 nm (Kd490) or the downwelling photosynthetically available radiation (KdPAR) is an effective method to provide large scale maps of these parameters at high spatial and temporal resolution. Several empirical and semi-analytical models are commonly used to map these coefficients from ocean colour satellite sensors. Most of the existing empirical or semi-analytical models have been calibrated on open ocean waters and provide good results in the high seas, but tend to underestimate the attenuation of light in coastal turbid waters. A new estimation of KdPAR and the euphotic depth for both European clear and turbid waters using MERIS reflectance at full resolution of 250 m is proposed here. Satellite-derived fields of Kd490 and the resultant Kdpar are validated using in situ measurements collected over the world. Maps at 250 m resolution of mean KdPAR, euphotic depth and residual energy at the bottom (in mol.photons.m-2.day-1) were computed over the period 2005-2009. These files were cross-tabulated with in situ field data of kelp (Laminaria spp.) on Atlantic shores and seagrass (Posidonia spp.) maps in the Mediterranean at locations where light is thought to be the limiting factor to the extension of plants with depth. The minimum values in percent of surface energy and mol.photons.m-2.day-1 were approximately equivalent to those reported in the literature and hence enabled the delineation of the lower limit of the infralittoral zone for the north-west Europe and western Mediterranean marine basins.

Phytoplankton absorption capacity in the Canadian Arctic. Implications for remote sensing of northern regions.

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Keywords: arctic, phytoplankton, optical properties

Abstract: The Arctic Ocean is currently experiencing significant changes caused by the acceleration of sea ice cover decline. The opening of vast open water areas in the summer leads to potential changes in the trophic structure beginning with the phytoplankton biomass. Considering the vast areas involved, remote sensing appears as a promising method to monitor marine ecosystem changes. Algorithms already exist to discriminate diatoms and flagellates from ocean color data. These algorithms however need to be validated for arctic waters as they were based on phytoplankton light absorption properties measured in temperate waters. Phytoplankton light absorption spectra (apsy"66(psy"6C)) of different Canadian arctic seas (Hudson Bay, northern Baffin Bay, Canadian Archipelago and Amundsen Gulf) were thus measured to evaluate these algorithms. Results showed that the maxima of chlorophyll a specific light absorption coefficients apsy"66*(440) in arctic seas (apsy"66(440)/TChl a) were lower than those of temperate oceans during the fall period but were similar during spring/summer. The packaging effect generally associated with this phenomenon was present (<apsy"66*(676)> = [0.017 – 0.023] m2/mg TChl a) in the algal assemblage during fall and almost not over spring and summer (<apsy"66*(676)> = [0.020 - 0.035] m2/mg TChl a). During the fall period, highest blue-to-red (<apsy"66(440)/ apsy"66(675)>) ratios were found in the Hudson Bay which were associated with the dominance of green algae containing Chl b (microphytoplankton > 2 psy"6Dm). In arctic regions however, the yellow-brown algae of nano and micrometer sizes containing Chl c was associated with lower blue-to-red ratios. In the eastern side (northern Baffin Bay), microphytoplankton was dominant whereas nanophytoplankton (< 2 psy"6Dm) was predominant in the western Canadian Arctic (Amundsen Gulf). Measurements of the others absorption coefficients (i.e. non algal matter ana(440) and colored dissolved organic matter aCDOM(440)) showed that phytoplankton light absorption apsy"66(440) values can be relatively high during spring and early summer but not during fall.

ocOC - from Ocean Colour to Organic Carbon

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Keywords: MERIS, Ocean Colour, cDOM, Laptev Sea

Abstract: The terrigenous carbon export into the Arctic shelf systems is a major component of the Arctic Organic Carbon (OC) cycle. Mac Guire et al. in their review on the Arctic Carbon Cycle recommendate to strengthen observations and design the research sector of 'scaling' that is a key challenge to link the processes observed and understood on fine scales to larger scales, e.g., needed for modeling. Here, remote sensing observations can become important tools. Recent development of satellite ocean color sensors such as MODIS, SeaWiFS, MERIS has been accompanied by an increased effort to establish Ocean Colour (OC) algorithms (e.g., for chlorophyll, suspended matter, coloured dissolved organic matter). The 'OCoc-from Ocean Colour to Organic Carbon' project

(IPY-project 1176), funded by the German Research Foundation (DFG), is an Ocean Colour study joined with the Arctic Coastal Dynamics ACD network and Arctic Circum-polar Coastal Observatory Network ACCO-Net (IPY-project 90). OCoc uses MERIS data for synoptical monitoring of terrigenous suspended and organic matter in the late-summer ice-free waters of the Laptev See region. MERIS Reduced Resolution (RR)-LIB data are processed towards optical aquatic parameters using Beam-Visat4.2 and the MERIS case2 regional processor for coastal application (C2R). Calculated aquatic parameters are optical coefficients and calculated concentrations of chlorophyll, total suspended matter and coloured dissolved organic matter absorption from the water leaving reflectances. The Laptev Sea is characterized by a very shallow topography and considerable Regions of Fresh water Influence ROFIs. The maximum river discharge of the Lena River, the second largest Arctic river in terms of annual fresh water discharge happens during the spring ice-breakup in June. Fluvial systems serve as point sources for high fluxes of dissolved and particulate terrigenous materials. The Laptev Sea coast is a highly dynamic mainly sedimentary ice-rich system that delivers vast amounts of interstorage carbon and old carbon from syncryogenic deposits. Initial comparisons with expedition data (cDOM, transparency, SPM, turbidity, chlorophyll) from the German-Russian TRANSDRIFT expeditions and from German-Russian expeditions at the Laptev Sea Coast (2008 to 2010) are presented. MERIS-C2R optical parameters such as the first attenuation depth, 'Z90', seem adequately to represent true conditions. Whereas the derived concentration parameters seem to be overestimated. The synoptic information of the optical MERIS-C2R parameters offers an immediate wealth of information. The spatial patterns of the processed MERIS C2R time series show the inter-annual scale of the atmospherically driven large-scale circulation patterns. On event scales, we need to investigate if weather patterns potentially contribute to short pulses and circulation patterns.

Regional approach to ocean colour remote sensing of coastal waters
CoastColour

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Keywords: ocean colour, meris, coast zone, sentinel 3, coastcolour, marcoast

Abstract: In recent years the ecology and quality of coastal waters has moved into the focal point not only of science but also of administration and environmental policies. The Water Framework Directive (WFD) and the Flora Fauna Habitat Directive (FFH) of the European Community have set important milestones in environmental politics and stewardship. Similar directives and acts of other countries worldwide follow similar goals. Management of the environment always requires a scientifically-based analysis of the system and continuous monitoring. Due to the highly dynamic nature of coastal zone waters and its vast extent, remote sensing has always been an important element of monitoring, from which coastal science and administration expect an essential contribution to ecosystem-based management of marine resources.
Responding to this, ESA designed the MERIS instrument specifically to provide measurements most suitable for coastal zone management and research. In space for 9 years, MERIS has delivered a unique global dataset of coastal zones at 300m spatial resolution, which requires dedicated processing with internationally agreed algorithms, and provision of products targeted to specific user needs, properly documented and easily accessible.
An international team of ocean colour experts is cooperating in the ESA CoastColour project to address these problems by comparison and combination of a quasi analytical method with non-linear multiple parameter inversion techniques, which are based on fully bi-directional radiative transfer computations. Atmospheric correction procedures have been developed using regional aerosol models based on a reconstruction of the water leaving radiance reflectance from the full TOA reflectance spectrum together with the adjacency effect correction. A fuzzy logic classification scheme guides the TOA spectrum to the most appropriate algorithm included in a library, and procedures determine out of scope conditions of an algorithm and the uncertainty of each product on a pixel by pixel basis is included.
This presentation provides an overview of the regionally tuned algorithms developed for 27 globally distributed coastal sites, and the approaches to validation and product intercomparison.

Spectroscopy of chromophoric organic substances released by soil fungi into water

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Keywords: Microscopic fungi, soil, fluorescence, absorption, spectroscopy, natural organic matter (NOM), humic substances

Abstract: Humic substances are a major component of the organic matter reservoir in marine water and sediments. While it is under debate whether microscopic fungi (micromycetes) are capable to produce humic-like substances, undoubtedly they play important role in lignin degradation and humic substances turnover. It was established that some micromycetes produce dark brown polymers in the presence of dead plant biomass and thereby might contribute directly to the pool of humic substances in a salt marsh estuary (Filip and Alberts,1988). These fungal polymers resemble humic substances in many respects. It was also shown that micromycetes are active decomposers of soil organic substances (Badis et al., 2009) and even can modify such refractory humic substances like brown coal (Hofrichter and Fakoussa, 2004). Earlier it was reported that fungal activity towards humic substances depends on their pigmentation (Kononova, 1966; Valmaseda et al., 1989), and that some dark colored species of fungi are capable more effectively utilize humic substances than non-pigmented.

To study possible contribution of microscopic fungi to the pool of chromophoric organic matter naturally occurring in water we have analyzed spectral properties of organic matter released by differently colored fungi strains grown in aqueous medium. Soil fungi strains with different pigmentation (from non-colored to dark-brown species) were cultivated in liquid Czapek medium with addition or without addition of potassium humate for 2-6 weeks. Typical absorption spectra of fungal exudates are featureless, with a monotonic decline with wavelength increasing from 200 to 700 nm. In some cases several absorption peaks have been observed. We attribute them to phenolics or quinones (maximum located around 290 nm) and to carotenoids or melanin pigments (the band spreading from 400 to 500 nm). Typical fluorescence spectra of fungal exudates excited at 270 nm consist of two broad overlapping bands: with maximum around 350 nm (fluorescence of protein complexes) and around 420 nm (fungal metabolite products). With excitation at 310 nm the position of the second band is shifted towards shorter wavelengths. This resembles the spectral

features of dissolved organic matter occurring in natural water (Gorshkova et al., 2006). After fungi growing in the humate-containing medium the maximum position in its fluorescence spectrum shifts towards typical for fungal metabolites (from 500 nm to shorter wavelengths). Our experiments revealed microbial degradation of coal-originated humate to chromophoric organic matter of smaller molecular size. We resume that transformations of humic substances by fungal cultures can be monitored and characterized using spectral measurements.

Chlorophyll a mapping of optically complex coastal waters using regionally specific neural network-based algorithms for MERIS full resolution data

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Keywords: MERIS, neural network, clorophyll a, case II water

Abstract: In typical case 2 waters an accurate remote sensing retrieval of chlorophyll a (chla) is still challenging. There is a widespread understanding that universally applicable water constituent retrieval algorithms are currently not feasible, shifting the research focus to regionally specific implementations of powerful inversion methods. In this study a series of algorithms for the retrieval of chlorophyll a in the Galician rias (NW Spain) from MERIS full resolution data were developed based on Multilayer perceptron (MLP) artificial neural networks and fuzzy c-mean clustering techniques (FCM) using different quality levels. The quality levels were given to the data set as a function of quality flags. All the NNs developed in this study showed high R2 and low root mean square error (RMSE) values in both training and validation sets. The algorithms were applied to six MERIS images delivered from the area at July 2008, in order to create chla maps. The best performance parameters were given for the NN trained with high-quality data using the most abundant cluster found in the rias. The transport of high phytoplankton biomass areas during the upwelling cycle was clearly captured in the images. Relatively high biomass "patches" were detected in detail inside the rias. There was a significant variation in the timing and the extent of the chla peak areas related to the winds and surface currents. A local-based algorithm for the chla retrieval from an ocean colour sensor with the characteristics of MERIS can be a great support in quantitative monitoring of chla and study of harmful algal events in Galician rias.

Progress towards the implementation of a Brillouin-LIDAR for remote sensing of the temperature profile in the ocean

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Keywords: lidar, remote, sensing, water, temperature, ocean, laser, fiber, Rubidium, magnet

Abstract: Interaction between the atmosphere and the ocean takes place primarily in the upper ocean mixed layer. Therefore, knowledge of the temperature profile in this region is of particular interest, as it would provide valuable input to climate studies, weather forecasts and oceanography in general [1]. Currently, this is realized by in-situ techniques such as buoys, gliders and XBTs (expandable bathythermographs).
In order to provide an attractive alternative, a lidar method based on Brillouin scattering is currently in development. This remote sensing technique allows to deliver cost-effective on-line data covering an extended region of the ocean. Guagliardo et al. proposed Brillouin scattering as a potential temperature tracer already in 1980 [2]. Due to recent progress in laser technology, the implementation is now possible.
The working principle of a Brillouin lidar is as follows: Short laser pulses are sent into the ocean. They undergo spontaneous Brillouin scattering on moving density fluctuations in the water. The backscattered light contains blue and red shifted frequency components with respect to the incident light. Therefore, the shift of the Brillouin lines is sensitive to the local speed of sound. As the dependency of the sound velocity on the temperature is known, the water temperature information can be extracted from the measured Brillouin shift [3].
The Brillouin lidar we propose consists of two main components: (1) The light source is a pulsed, three stage Yb-doped fiber amplifier with subsequent frequency doubling [4]. (2) The measurement of the Brillouin shift is performed by spectrally highly resolving atomic edge-filter in the form of an excited state Faraday anomalous dispersion optical filter (ESFADOF) [5]. Both components are intrinsically insensitive to vibrations and exhibit low power consumption. Therefore, the system is perfectly suited for the operation from a mobile platform.
The Yb-doped fiber amplifier can be operated within a range of 1030-1100nm [6]. Therefore, after frequency doubling, its operating wavelength can be matched to the ESFADOF receiver within the green spectral range. Due to the employment of a spectrally narrow seed laser, the generated pulses are nearly Fourier transform limited. This is crucial in order to minimize the broadening of the Brillouin lines by the incident light. At a pulse length of 10ns and an repetition rate of 1 kHz, the amplifier provides laser pulses with an energy of up to 131μJ at 532nm [7]. Using this laser system we succeeded in demonstrating the proof of concept for a Brillouin lidar system: In addition to the first temperature measurements employing a frequency-doubled fiber amplifier, we have performed first range resolved measurements in our laboratory set-up [8]. To determine the Brillouin shift, a scanning Fabry-Perot interferometer was used in these measurements. However, this setup is not capable of real-time measurements.
Switching to our ESFADOF will provide this capability. The core of the ESFADOF filter is an optically pumped Rubidium gas cell, which is exposed to a strong magnetic field [9]. This allows

making use of the anomalous dispersion in the vicinity of an atomic transition. As a result, the filter can provide a frequency-dependent rotation of polarization. By placing the device between a crossed pair of polarizers, steep transmission edges with sub-GHz widths arise. These static edges allow determining the Brillouin frequency shift by simply measuring the intensity of the light which is transmitted through the cell. At present, we can generate edges with a maximum transmission of 21

In the near future, the output energy of the pulsed fiber amplifier will be further increased by employing a photonic crystal fiber (PCF). The maximum transmission of the ESFADOF can be further increased by extending the interaction length of the incoming light with the Rubidium. This will allow us to set the next milestone in the development of the Brillouin lidar: the successful interplay of the ESFADOF with the fiber amplifier under laboratory conditions.

In this contribution, we will present our recent progress of both the laser system and the implementation of our ESFADOF setup.

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GENERATION OF OCEAN VECTORS ASSOCIATED WITH SURFACE CURRENTS IN THE COASTAL ZONE: PERSPECTIVE OF GEOSTATIONARY SATELLITE OBSERVATIONS

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Keywords: surface currents, geostationary, monitoring, SEVIRI, GOES-R

Abstract: Geostationary satellites continuously monitor the oceans providing the opportunity to track the motion of characteristic features associated with surface currents. The objective of this presentation is to describe the physical basis and mathematical development of an approach to determine ocean vectors associated with surface currents by analysing consecutive geostationary observations. This approach is performed in two stages. The first stage selects targets on the ocean surface that are characterized by prominent gradients in the surface properties, such as surface temperature or brightness temperature. The second stage considers those targets as tracers and monitors their movement between consecutive images (cloud free) estimating the speed and direction of identified targets (ocean vectors) related to surface currents. These resulting ocean vectors undergo extensive quality control. This approach is intended to be applied to data from the Advanced Baseline Imager (ABI) on GOES-R satellites to be launched 2015 and beyond. The proxy data set used for testing the approach and evaluating the results is the Spinning Enhanced Visible and Infra-red Imager (SEVIRI) instrument onboard the European Meteosat Second Generation (MSG) satellite. The comparison of preliminary ocean vectors with results of ocean models and the system of predominant coastal ocean currents shows that proposed approach could be effectively used for near real time monitoring of ocean vectors associated with ocean currents as well as for studying surface ocean circulation.

Estimation of chlorophyll-a concentration using an empirical bio-optical algorithm and MERIS imagery for monitoring of coastal waters

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Keywords: Bio-optical algorithms, chlorophyll-a, coastal waters, Bay of Biscay, quality assessment

Abstract: Remote sensing algorithms designed for the estimation of chlorophyll-a (chl-a) at global scales, are less accurate in coastal areas; this is due to the variability and specificity of optically-active in-water constituents. Hence, local parameterisation is necessary to improve its estimation in these areas, where chl-a is considered as a proxy of the eutrophication problems. The application of the European Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) requires an extensive monitoring and assessment of this parameter and, the use of remote sensing technologies, will permit an improvement in terms of space and time. Therefore, using the Bay of Biscay coastal waters that are affected by Basque rivers runoff, as a case study, the objective

of this investigation is to estimate chl-a concentration by: (i) developing an empirical algorithm and applying it to MERIS imagery; and (ii) exploring the influence of suspended matter, phytoplankton species and pigment content, on this algorithm. The chl-a algorithm was developed with in-situ spectral measurements, performed with a TriOS field spectrometer, and biogeochemical data. It was then validated with the jack-knife resampling procedure, showing a coefficient of determination of r2jac = 0.68. An increase in total suspended matter concentration between 0 and 6.6 g.m-3 did not have an effect on chl-a retrieval by the empirical algorithm. Twenty-three accessory phytoplankton pigments determined with High Performance Liquid Chromatography (HPLC), and corresponding to 56 different phytoplankton species, did not show an effect on the retrieval of chl-a by the developed algorithm either. Subsequently, the algorithm was applied to the reflectance bands provided by the MERIS level 2 product, showing better results than the MERIS chl-a product for coastal waters (Algal Index Pigment II). The good spatial resolution of the MERIS products in combination with a regionally parameterised algorithm, allows a better estimation of chl-a in coastal areas influenced by river discharges. Hence, this estimation will permit an improved monitoring of coastal water quality, within the WFD and the MSFD.

Remote sensing of surface roughness using optical range – time images of water surface

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Keywords: optics of ocean, sea waves, spectral analysis, image processing, remote sensing, capillary waves

Abstract: The paper is devoted to the development of optical method for investigation of surface waves using RTI images (images in range – time – intensity coordinates) constructed from optical sections of surface. The high-speed optical system based on linear array of CCD photodiodes for registration RTI images of capillary waves using artificial illumination is created. The data on free and bounded capillary waves, surface wave's breaking derived with this system is presented. The joint laboratory experiments with optical system and X-band scatterometer were conducted and the scattering mechanisms for radio waves by the waved surface were investigated. The technique for creating of large scale RTI images of sea surface under grazing angles was developed. The principles of using such technique for a ship or airplanes permitting to eliminate the influence of ship's or airplane's tossing are proposed. This system is useful for monitoring of coastal zones and inland waters. Some examples of RTI images recording from sea and river shore for various wind conditions and for oil slicks are presented. The damping of surface roughness in oil slicks were calculated taking into account shadowing of surface waves under grazing angles and the method for retrieval of sea surface wave characteristics is proposed. The ship complex of optical and radio devices for investigation of sea surface waves and upper subsurface layer is described. This complex includes optical devices for registration of sea wave spectra, radar, X and Ka-bands scatterometers, ADCP and STD probes.

Monitoring Intertidal Flats using Multi-Sensor Remote Sensing

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Keywords: intertidal flats, synergistic classification, optical and SAR remote sensing

Abstract: Intertidal flats are ecologically and economically of very high importance. Monitoring methods are in place to assess the status of this ecosystem. However, these are limited by the difficulty to access the area and high costs of field campaigns. Therefore, utilisation of remote sensing techniques can provide additional valuable information about this highly dynamic system. The close interaction with the users enables the development of products and services dedicated to serving the requirements of end users, especially in respect to the reporting duties for TMAP, WFD and Natura 2000. Different remote sensing techniques are used for the characterisation of intertidal flats. On the one hand, optical remote sensing data provide information about the spectral reflectance of the different surface types such as different sediment types (sand, mud), mussel or oyster beds, sea grass or macro algae. Linear spectral unmixing and indices of different bands provide characteristic values for the different surfaces. On the other hand, radar techniques are used to gain information about the surface roughness of the different areas. The surface roughness is caused e.g. by ripples of sandy areas or oysters building their beds on the tidal flats. Beside these two remote sensing techniques, we include the knowledge of a tidal flat area by defining probabilities for different surface types to occur on certain regions. The combination of all three data sources enables a classification of the flats covering a large area. Validation is performed using in-situ measurements acquired during projects following dedicated protocols that enable the comparability of EO and ground truth data and data acquired the operational monitoring programmes. The long-term experience and close cooperation with users lead to a good understanding of the data and the potential of the data and results. The users are aware of the potential and the limits of the classification results.

Remote sensing as a tool to monitor and analyse Abruzzo coastal changes

Preliminary results from the ASI COSMOCoast project

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Keywords: Coastal zone management, Very High Resolution, Radar, Optical

Abstract: A clear view of actual and past processes affecting coastal areas at local and regional scale is the essential starting point to identify trends, issue forecasts and plan any protective measure. When this is not achieved, local interventions (eg breakwaters, groynes) may simply transfer the problem to adjacent areas, calling for further remedial measures and additional costs: this has happened since the 90's along the Abruzzo coasts (Italy, Adriatic sea). In low coastal areas, the simplest parameter which can be monitored as proxy of the very complex dynamic equilibrium between mean sea level height, tide/wave energy and amount of incoming sediment is the shoreline, defined as the instantaneous divide between water and land. It has to be noted that even small tidal variation in such low relief areas can affect by several meters the position of the water divide: for cartographic purposes tidal and geomorphologic information is needed to cor-

rect for such effect. The COSMOCoast project, carried within the framework of an ASI contract (I/067/09/0), is applying standard image processing, object-oriented approaches and neural nets for boundary detection along the Abruzzo coast from high to very high resolution actual satellite data (eg COSMO-SkyMed, Formosat-2, IKONOS, Kompsat 2, Prism, Quickbird). The temporal observation window is extended backwards by a decade by exploiting older data at a much lower resolution (ERS). Validation data are provided by a kinematic GPS as well as by a ground lidar campaign carried out simultaneously to satellite overpass. Boundary-extraction tests run on COSMO-SkyMed spotlight acquisitions taken with different polarisations and incidence angles have been carried out: the NN outperformed the traditional techniques (based on Sobel's and Robert's operators) both in terms of accuracy detection and of computational burden. Segmentation of optical data acquired by different satellites also provide very good results. A second acquisition campaign is foreseen for 2011, whilst all processing results are being ingested in a GIS for quality and accuracy checking, validation, analysis of changes and definition of indicators.

Observation on the suspended sediment concentrations in the coastal area using Geostationary Ocean Color Imager (GOCI)

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Keywords: Suspended sediment concentration, Coastal water, Tidal cycle, GOCI, Sediment movement

Abstract: In this study, we tested the applicability of the geostationary ocean color imager (GOCI) to the detection of temporal and daily variation in SS on the coastal water in the west coast of Korea. GOCI is the world's first ocean color observation satellite positioned at the geostationary orbit. It has been launched in June, 2010 and is planned for use in real-time monitoring of the ocean environment around Korean Peninsula by daily analysis of ocean environment measurements of chlorophyll concentration, dissolved organic matter (DOM), and SS for seven years. Differently from the existing polar-orbit satellite, GOCI can get the data every one hour from 10 AM to 5 PM Local Time (eight times per day) around the Korean sea areas. This temporal resolution of the GOCI is very efficient to an ocean environmental analysis. A more detailed time-series monitoring will be possible for the spread and movement of the red-tide, SS, DOM and the other polluted materials. GOCI also have higher radiometric and spectral resolution as well as the temporal resolution, so that more precise processing of the atmosphere for the aerosol type analysis, yellow dust and cloud detection is feasible. Here we investigate the change in optical reflectance presented in the time-series GOCI images. They are compared with the estimated SS from the water samples collected at the time correspondent to the image acquisition. Through this, it can be expected that the qualitative monitoring of temporal and daily variation in SS concentrations in the Korean coastal waters would be possible.

Oil seep in the Black Sea, Georgian section imaged and studied with the ERS-1/2 and Envisat SARs

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Keywords: SAR images, oil slicks, Black Sea.

Abstract:
The offshore section of the South-East Black Sea is still mainly oil gas unexplored, presenting a high risk, but high perspectives as well. It is well-known that there are several active oil seeps onshore and offshore here. One of them in the Georgian section of the Black Sea has been studied using the ERS-1/2 and Envisat synthetic aperture radar (SAR) images. It seems for the first time it was imaged from space in 1993 by ERS-1. To understand its behavior and its spatio-temporal characteristics all SAR images available in the ESA' archive were collected. This seep has been mapped with use of geoinformation approach, when all oil slicks visible on the SAR images of the sea surface were collected in geographic information system (GIS). In particular, analysis in GIS, integrating the vector contours of oil slicks from SAR images, the nautical map of scale 1:100000 and other complementary data (bottom topography, geology), first, revealed a relationship of detected oil slicks with the oilgas seeps on the sea floor at the underwater Kobuleti ridge, and, second, provided estimates of seep rate in the SE part of the Black Sea. As revealed in GIS an oil source located on the sea floor at depth of approx. 1150 m. Based on analysis of the slick' areas, seep rate can reach up to thousands metric tonnes of crude oil per year. This means that this seep is of the main sources of natural oil 'pollution' in the region of the SE Black Sea, and requires getting more exploration attention. It is concluded, therefore, that SAR imagery providing detailed information on the shape and size of oil slicks and pinpointing their location from space, gives a new look at oil seep problem.

Oil pollution detection using shipborne LIF/LIDAR

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Abstract: The use of real time data for oil pollution detection is very important for the monitoring of coastal waters. For this reason it is widely accepted the necessity of new technologic and tools in order to improve the oil spill detection methods. In this paper we present the results of Laser Induced Fluorescence (LIF) technique and GIS tools for the monitoring of innocuous dyes spilled in the Ría de Vigo waters. This study was carried out in the framework of the DEOSOM (AMPERA) project. The aim of this study was to explore a shipborne LIDAR-system recently designed by LDI Laser Diagnostic Instruments (Tallinn, Estonia). The device was utilized onboard different vessels for monitoring of coastal waters and detection of oil spills and organic pollutants. The field tests were carried out by University of Vigo and Galician Coast Guard. Several Biological innocuous dyes were used to simulate an oil spill in the Ria de Vigo waters. The results were integrated into web-GIS-application for visualization purposes. The GIS-application in this work is based on open source Mapserver 5.x and Google Earth plug-in. The design of a web-based GIS-system would allow users to operate with geographical data without a GIS application installed on the local computer and would make possible to share the information and experience among a wide range of users and experts.

LIF lidar as an early warning tool for oil pipeline integrity monitoring

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Keywords: Lidar, Fluorescence, Oil pollution

Abstract: Most oil pipelines in operation today were built decades ago. Over the last few years, there has been a substantial increase in reported leaks, increasing the focus on early detection. There are several technologies employed for the task, mainly for major leaks detection. Ground and airborne visual observation are the most commonly used providing post-factum information. The Fluorescent Lidar Systems (FLS-Lidar) of LDI were initially developed for environmental monitoring of marine and coastal environments. They proved the capability of minor oil pollution detection in water and on land. A dedicated FLS-AI (Airborne, Integrity) lidar has been developed for surveillance of ground, underground and underwater pipelines. The system is operated in combination with ground truthing by LDI's Spectral Fluorescence Signatures (SFS) technique. The work presents the results of developments and field tests. The pilot experiments showed good potentials of the technology and revealed specific challenges to be addressed in operational use.

Evaluation of water pollution by LIF LIDAR

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Keywords: LIF LIDAR, oil spill, detection

Abstract: Within the framework of ERA-AMPERA Program (Project DEOSOM), INOV is developing a modular sensor for oil spill detection and evaluation. The sensor is based on laser-induced fluorescence (LIF LIDAR). It may be installed aboard watercraft and used for intensive surveillance of harbourages, rivers, channels, and coastal waters. The report presents experimental results obtained up to now with the LIF LIDAR detector prototype and typical crude brands, transported and processed in the Mediterranean region, which include: (i) investigation of dynamics of oil film on the water surface in the laboratory conditions, (ii) study of LIF spectra of spills depending on the oil type and film thickness for several oil types, (iii) detection of a an experimental spill in the Atlantic Ocean coastal waters near Vigo (Spain), in which less polluting agent, rhodamine, was used instead of oil, (iv) LIF spectra calibration using water Raman scattering peak and (v) detection of the LIF spectra of dissolved organic matter.
The results obtained testify good applicability of the LIF LIDAR technique for oil detection and possibility of automatic oil-spill surveillance by analysis of the LIF spectra.

Assessing the fundamental potential for spectral linear unmixing of coral reef substrates

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Keywords: coral reef, endmembers, unmixing, benthic cover, verification, hyperspectral,

Abstract: In heterogenous environments spatial resolution can be an important limiting factor for remote sensing objectives. When the substrate is complex, sub-pixel analyses, such as spectral linear unmixing, can be applied to estimate the partial contributions of known endmembers. However, marine substrates pose additional challenges, since the water column above the substrate diffuses and scatters the signal, and benthic types of interest typically contain spectroscopically similar pigments. Previous studies on remote sensing analysis of coral reefs have often indicated poor accuracy, but it is not clear if this is due to the fundamental spectral similarity of endmembers or due to confounding effect of environmental noise. This study aims at testing the fundamental feasibility of unmixing marine substrates by omitting environmental effects such as water column or wind ripples. The combination of artificial lighting, minimal amount of water over the mixed substrate and a goniometric system set up in a dark lab provided completely controlled conditions and an opportunity to verify an upper limit to what can be achieved by linear unmixing in these environments. In contrast with a previous similar study, results indicate successful sub-pixel estimations for common marine substrates are possible under conditions of minimum environmental noise. Unconstrained unmixing was found to produce better results and produced significantly less negative contribution values. Spectral similarities between the designated marine substrates are highlighted as a key cause of unmixing inaccuracy. This suggests that even without the effect of water column, substrate definition and selection poses an important role in marine substrate analysis.

Detection of oil pollution on the ground with LIF LiDAR

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Keywords: oil pollution, ground, lidar, LIF

Abstract: The paper addresses the issue of the influence of various soils and vegetation to the capability of oil pollution detection on the ground with the method of Laser Induced Fluorescence (LIF). The compact hyperspectral FLS-SUV lidar (sensing wavelength 308 nm) was used in the experiments with controlled oil contamination on different grounds typical for coastal zone: clay, soil, shore sand and pebble, also covered by moss and grass. The spectral data of selected sample set were collected and analyzed to reveal the oil pollution on the ground manifested directly by characteristic spectral pattern or indirectly through variation of LIF spectra of vegetation. The peculiarities of LIF spectra and short time dynamics of grass and moss fluorescence under pollution stress were studied. As a result, the minimal levels of oil pollution on different grounds have been specified, when the influence of the underlying surface can be neglected. It was also shown that at lower pollution levels the LIF spectra observed by lidar constitute linear superposition of the fluorescence response of ground and oil to the excitation light.

Some Peculiarities of the Preprocessing of Spectral Data and Images

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Keywords: imaging spectrometer data, preprocessing

Abstract: Some Peculiarities of the Preprocessing of Spectral Data and Images Valentin Atanassov, Georgi Jelev, Lubomira Kraleva Space and Solar-Terrestrial Research Institute, Bulgarian Academy of Sciences 1000 Sofia, 6 oscovsk str., p .box. 799, vatanassov@space.bas.bg
Abstract. Remotely sensed spectral data and images are acquired under significant additional effects accompanying their major formation process, which greatly determine measurement accuracy. In order to be used in subsequent quantitative analysis and assessment, this data should be subject to preliminary processing aiming to improve its accuracy and credibility. The paper considers some major problems related with preliminary processing of remotely sensed spectral data and images. The major factors are analyzed, which affect the occurrence of data noise or uncertainties and the methods for reduction or removal thereof. Assessment is made of the extent to which available equipment and technologies may help reduce measurement errors.

Application of Spectral Fluorescence Signature technique for in-vivo analysis of algae in top layers of Baltic sea waters

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Keywords: Fluorescence Signature, Baltic sea, phytoplankton, Chl a

Abstract: The distribution of DOM and phytoplankton were studied in the Baltic Sea waters near Poland using the method of Spectral Fluorescence Signatures (SFS) in spring cruise of April 2010. The spectrofluorimeter Fluo-Imager M53B (LDI AS, Estonia) was used in flow-through mode at the sampling stations, and distinct samples measurements were done from sea surface (0 – 5 mm) and from the surface layer 6 – 150 mm. The samples were used for extraction of phytoplankton pigments and further calibration of Fluo-Imager M53B in-vivo data. Obtained values for Chl a and other pigments of phytoplankton in coastal and open sea waters showed significant differences of algae community in these areas. Application of multivariate method of SFS analysis has allowed to achieve good correlation between the data obtained at differences stations in the extracted and live samples (r2 up to 0,8). The noticeable increase of Chl a concentration was detected in the river estuary and polluted water areas, and the upper layer of water was characterized with higher concentration of DOM. The studies demonstrated the application of SFS technique not only for qualitative and quantitative analysis of DOM and natural phytoplankton in-vivo, but also for the calibration of LIF lidar data.

Bio-optical characterization of Asinara Gulf sea water in Sardinia (Italy) using both laser spectrofluorimeter and remote sensing data

An evaluation of MODIS algorithms

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Keywords: spectrofluorimeter, ocean colour satellite, calibration/validation, chlorophyll-a, bio-optical algorithm, MODIS, oil pollution

Abstract: Marine phytoplankton is recognized as one of the major climate driver, able to play an important role in climate regulation of the entire planet. Chlorophyll a (Chl-a) is considered a useful descriptor of the amount of phytoplankton in the aquatic ecosystems. The general objective of this research (financed by L.R. 7 of the Autonomous Region of Sardinia, Italy) is to calibrate MODIS bio-optical algorithm for better more accurate estimates of phytoplanktonic Chl-a in the Asinara Gulf, an area located in Northern Sardinia (Western Mediterranean). The northern coast of Sardinia is one of the most dynamic and vulnerable environments in the Western Mediterranean. It comprises the National Park of Asinara Island, is a part of the Sanctuary of the Cetaceans of the Mediterranean Sea and is well known for many beautiful tourist places. Important civil and industrial activities, both on the coastline (harbours, power plants and industrial areas), and in the catchment, coexist with these aspects of very high naturalistic quality and with fishery. This study involves InTReGA S.r.l., a spin-off company of ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development), the Department of Botanic, Ecologic and Geologic Sciences of Sassari University and UTAPRAD-DIM (Diagnostics and Metrology Laboratory) of ENEA and it is aimed to explore the suitability of the new laser spectrofluorometric apparatus CASPER (Compact and Advanced laser SPEctrometeR – Patent N° RM2005A000269) as a fast and accurate method to obtain "sea truth" values of Chl-a and other bio-optical parameters from simultaneous in situ measurements. The spectrofluorimeter CASPER is based on double laser excitation of water samples in the UV (266 nm) and Visible (405 nm) spectral region and a double filtration in order to detect both quantitative data, such as chromophoric dissolved organic matter (CDOM), proteins-like components (tyrosine, tryptophan), algal pigments (phycoerythrin, phycocyanin, different pigments belonging to the carotenoid groups, Chl-a), and qualitative data on the presence of hydrocarbons and oil pollution. The quantitative data are released in concentration units, after accurate calibrations with reference samples. The selection of sampling stations in the Asinara Gulf was principally made in order to collect fluorescence excitation spectra considering sites with different degree of pollution. Sea water samples from different depths have been collected and analysed at 18 stations since August 2010. The stations are located along six transects perpendicular to the coastline, respectively from less impacted areas to more impacted ones (from Cala Reale, in the Asinara Island, to Porto Torres, in the central part of the gulf). Each transect comprises three stations, respectively at 500 m, 1500 m and 3000 m from the coast. The accuracy and reliability of data (in particular Chl–a) obtained by CASPER have been evaluated comparing them with standard measurements, i.e. fluorimetric Chl-a (fChl-a) measured in situ with a multi-parameter probe (Idronaut and YSI 6600 V2). The fChl-a sensor has been calibrated regularly with water samples filtered through Whatman GF/C filters and analysed by spectrophotometry, after pigment extraction in 90On 11 January 2011, an incident occurred in the Asinara Gulf during fuel unloading operations of Fiume Santo power plant in the Porto Torres industrial area, causing the loss into the sea of about 50 ton of fuel oil. CASPER has proved to be a valid instrument also

for the investigation of polycyclic aromatic hydrocarbons (PAHs) and oil pollution (dispersed or in film) in water bodies, thanks to the double filtration system that discriminates oil fluorescence from dissolved organic matter signal that usually interferes with oil. At the moment "sea truth" data of Chl-a have being compared to the imagery collected by MODIS. But in order to reach better results, the bio-optical algorithm is going to be recalibrated according to the measurements of CASPER, thus providing new estimates of phytoplanktonic Chl-a in the Asinara Gulf. Another interesting perspective will be the correction of satellite data for the effects of CDOM presence, which reduces the depth range seen by the satellite. in particular in turbid coastal areas.

TOWARDS A VALIDATION OF ENVISAT RA-2 FULL RATE DATA IN COASTAL SYSTEMS: CASE STUDY OF THE GULF OF CADIZ

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Keywords: Validation, Coastal altimetry, Significant wave height, Wind, Gulf of Cadiz

Abstract: Research and development of altimetry in the coastal domain, a key region for the significant impact of changing oceans on society, economy, ecology and climatology, is a challenging target for exploiting and enlarging the number of applications relying on satellite data. In this context, ensuring a thorough validation of the nearshore altimetry information is a key activity. The study presented here addresses the case of the continental shelf of Gulf of Cadiz (SW Iberian Peninsula), a very special environment due to several peculiarities lying in the tourism, fishing, aquaculture and industry strategic importance. We validated geophysical parameters (significant wave height, wind speed and sea level) derived from ENVISAT RA-2 at full and low rates (18Hz and 1Hz respectively) from the COASTALT processor (18Hz) and Geophysical Data Records (1Hz), covering 8 years of data (2002-2009). We used ground truth in-situ measurements to check whether new improvements (reducing the uncertainties of the various terms concerning the coastal editing flag, tidal and atmospheric corrections, etc.) perform as good as standard altimetry in the open ocean. First results using low-rate data demonstrate the potential for accurate geophysical parameter retrieval much closer to the coast than routinely achieved.

TURBIDITY PATTERNS AND CLIMATE VARIABILITY IN THE GUADALQUIVIR ESTUARY (SW IBERIAN PENINSULA)

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Keywords: Guadalquivir Estuary,Turbidity plume, Primary production, NAO, MODIS

Abstract: During the last years, an increase in the intensity and frequency of floods in the SW of the Iberian Peninsula has occurred due to the storms rise. These phenomena coincide with negative North Atlantic Oscillation (NAO) phases, presenting a clear significant relationship between the climatic pattern that dominates the index variation and the flood events in the region. The pronounced episodes of rainfall intensify the rivers discharge and favor the input of nutrients and suspended particulate matter (SPM) in the continental shelf. The role of these rivers in the fertilization of the coastal area of the Gulf of Cadiz, mostly influenced by the Guadalquivir estuary, constitutes the major factor determining the productivity of the basin, from phytoplankton to fisheries resources as anchovy. Accordingly, the appearance of the turbidity events in the Guadalquivir mouth has a relevant impact on rates of primary production over the adjacent coastal region and on several socio-economic strategic activities such as aquaculture, fishing, tourism, navigation, etc. The mail goal of this study is to analyze the spatial and temporal variability of the river turbidity plume in connection with the meteorological and oceanographic processes controlling it. To achieve this aim, we have processed Moderate Resolution Imaging Spectroradiometer (MODIS) level L2 images covering a period of 8 years (2003 - 2010). In addition, several buoys have been deployed to measure biogeochemical parameters as temperature, salinity, chlorophyll, fluorescence and turbidity and a meteorological station located in the river mouth. The first preliminary results confirm that the appearance of the estuarine plume is associated with the increment in river discharge (negative NAO) during the rainy seasons and with tides and wind dynamic throughout the dry seasons. Therefore, these relationships between turbidity patterns and climate indices will improve the characterization of the Guadalquivir complicated system in the quantification of the primary production under scenarios of global change. We have developed an approach to successfully map turbidity in the estuary, and to understand and predict the phenomena that control the exchange of riverine/estuarine material with the coastal region. Thus, the incorporation of the MODIS synoptic observations as a valuable tool for operational monitoring of water quality is recommended and would benefit the knowledge of both physical oceanography and marine biology components in the Gulf of Cadiz.

Remote sensing reflectance and pigment analyses of invasive submers macrophytes

Species discrimination

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Keywords: multispectral, water remote sensing, RAMSES spectroradiometers invasive submers macrophytes, pigments, HPLC analyses

Abstract: The increasing temperatures of freshwater lakes in Bavaria induced by climate change benefit the expansion of the invasive submerged macrophytes Elodea nuttallii and Najas marina. To monitor the development of these species multispectral air- and spaceborne sensors shall be used (see contribution of Sebastian Rößler at this conference). To discriminate theses species from other common macrophytes like Chara spec. or Potamogeton perfoliatus systematical in situ measurements were carried out in 2010 during vegetation period at four sites at Lake Starnberg (47°55'N, 11°19'E). The multidimensional experimental setup permits a high spatiotemporal resolution. Measurements were carried out in a two week period at sunny conditions during solar noon with RAMSES spectroradiometers, gathering down- and upwelling irradiances (Ed Eu) and upwelling radiances (Lu). By comparing the calculated remote sensing reflectances with pigment contents achieved from HPLC analyses wavelengths for best possible species discrimination shall be found.

Project EnerBioAlgae (SUDOE): Fluorescence spectra techniques for the control of phytoplankton cultures and monitoring of wastewater parameters

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Abstract: There is a significant interest in alternative renewable energy sources due to the global increase of energy demands and the daily decrease of fossil fuel resources. Biofuel production from microalgae can be both sustainable and economically viable. Particularly in the case of algal growth in wastewater it is considered as possible to achieve the removal or biotranformation of pollutants from these types of waters and algal biomass production. EnerBioAlgae is project funded by the Interreg SUDOE program and led by the University of Vigo, Spain which aims to investigate the biofuel production by microalgae grown in several types of wastewater. Among the objectives of this project is the development of a system based on spectral fluorescence analysis techniques and neural network methods for the continuous monitoring of microalgae status and the different contaminants in the wastewater. In the first place this monitoring system is going to be developed and tested in continuous systems of microalgal cultivation (photobioreactors). In this study we present the objectives of the project. The possible applications of a spectral fluorescence analysis system in the monitoring and characterization of wastewater contaminants in coastal areas are also discussed.

Combined topographic-bathymetric data for monitoring biomorphologic effects of the Rance tidal power station management (West France)

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Keywords: Integrated Digital Terrain Model, Bathymetry, Topography, Aerial photography, Saltmarshes, Tidal power station, Rance estuary, West France.

Abstract: What are the biomorphologic modifications in the Rance estuary due to the management of the tidal power station, inaugurated by General de-Gaulle in 1966? This study aims at the creation of an integrated Topographic- Bathymetric Digital Terrain Model (DTM) based on different datasets (1) marine echosounder maps (acquired between 1953 and 1960) for the channel, (2) saltmarsh topographic data extracted from aerotriangulation of 1953 aerial photographs, and (3) the IGN BDALTIpsy"D3 data elevation model, settled in the 1970's dealing with the onshore-topography. This new generated DTM, revealing the morphology before the tidal power station, is combined to the detailed cartography of the saltmarsh digitised from aerial photographs acquired between 1953 and 2002. The study carried in Rance saltmarshes enhanced their surface regression from 1953 to 1978 and their stability since, due to probably hydrologic modifications induced in the Rance estuary after the tidal power plant management such us the change of tidal range and the period of slack water.

Remote determination of saline composition of mineral waters with the help of Raman spectroscopy

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Keywords: mineral water, Raman spectroscopy, artificial neural networks

Abstract: At present time, determination of saline composition of mineral waters (especially natural source waters with increased mineralization of some ion) and monitoring of technical and waste waters (containing salts of heavy metals, nitrates, nitrites, sulphates, sulfides etc in toxic amounts) are very topical. To solve these problems, express non-contact methods of diagnostics of nature waters are required, that can be implemented in real time. Principle opportunity of use of laser Raman spectroscopy for water media diagnostics is conditioned by high sensitivity of characteristics of Raman spectral bands to types and concentrations of substances dissolved in water. In this report results of determination of type and concentration of dissolved in water ions by using Raman spectroscopy are shown. Presence and concentration of complex anions or cations in water (for example NH4+, CO32-, NO3-, PO32-, SO42-) are measured using their own Raman bands near 300 – 2000 cm-1. Presence such ions as Na+, K+, Rb+, Ca2+, Cu2+, Cl-, I-, Br- etc. is determined using their influence on position and shape of water Raman valence band (near 2700 - 4000 cm-1). Simultaneous using high- and low-frequency regions of Raman spectra of water solutions (from 300 up to 4000 cm-1) provides probability of complete characterization of salt composition of mineral waters. Successful solution of this multi-parametrical inverse problem of laser Raman spectroscopy is provided by using artificial neural networks. It is demonstrated by authors that suggested method allows to determine concentration of complex cations and anions with accuracy 10-4-10-5 . Method was tested on natural mineral waters.

Remote determination of temperature and salinity in consideration of dissolved organic matter in natural waters using laser spectroscopy

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Keywords: Raman spectroscopy, temperature, salinity, dissolved organic matter, artificial neural networks

Abstract: During last years, the problem of remote determination of parameters of natural waters became very important. This is due to the fact that salinity and temperature are key parameters determining circulation of oceanic waters and therefore transfer of energy and mass in conterminous layers of ocean. Necessity of global monitoring of salinity and temperature arises from tendency observed during last years – decrease of icecap in polar latitudes because of global warming. Melting of ice leads to desalination of surface layer of ocean. It can give impulse to reconstruction of system of oceanic currents and be the reason of considerable climate changes not only in polar areas but in planetary scale. The authors of this study have previously suggested and realized a method of simultaneous determination of temperature (T) and salinity (S) of seawater using laser Raman spectroscopy [1-2]. In this report, the results of the next step of this work are presented – determination of temperature and salinity of natural water using Raman spectra, taking into account the influence of fluorescence of dissolved organic matter (DOM) as dispersant pedestal under Raman valence band. Thus, the three-parametrical inverse problem of laser spectroscopy was successfully solved using Raman and fluorescence spectra of water media. Modern methods of solution of multi-parametrical inverse problems and pattern recognition problems – artificial neural networks – were used. Accuracy of determination of temperature and salinity of water with presence of humic substance dissolved in water (from 0.1 up to 2 mg/l) is 0.4-0.5 C and 0.4-0.8 accordingly. 1. Bekkiev A, T Gogolinskaya (Dolenko) V Fadeev, 1983. Simultaneous determination of temperature and salinity of seawater by the method of laser Raman spectroscopy. Soviet Physics Doklady, 271 (4): 849-853. 2. S.A. Burikov, I.V. Churina, S.A. Dolenko, T.A. Dolenko, V.V. Fadeev. New approaches to determination of temperature and salinity of seawater by laser Raman spectroscopy. EARSeL Workshope “Remote sensing of the coastal zone”, 5-7 June 2003, Ghent, Belgium, Abstract book, p.5. EARSeL eProceedings 3, 2004, №3, pp.298-305.

Effects of variations in salinity and nitrogen concentration on the physiological characteristics of phytoplankton obtained using fluorescence spectroscopy techniques

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Keywords: phytoplankton, zooxanthellae, nonlinear laser fluorimetry, FIRe, heavy metals, salinity, nitrogen concentration

Abstract: Variations in salinity and nitrogen concentration in the aqueous environment are among the visible effects of the global climate changes. They affect the structure of the phytoplankton community and the physiological state of algae and cyanobacteria. We present the results of laboratory studies of these effects. We apply the combination of nonlinear laser fluorimetry technique and Fluorescence Induction and Relaxation (FIRe) fluorimetry to evaluate the photophysical parameters of photosystem II and chlorophyll a molecules of native samples of diatom algae Thalassiosira weissflogii, zooxanthellae Symbiodium sp. CCMP 2467 and cyanobacteria Synechococcus sp. CCMP 1379, grown under variations of salinity (40‰, 18‰ and 5‰) and nitrogen concentration (normal, x0.5, x2). Cyanobacteria are shown to be the most resistant to such variations, while zooxanthellae — the most sensitive species. This suggests that one of the effects of the global climate changes on the phytoplankton community might be the transformation of its structure towards the increasing role of cyanobacteria (one should keep in mind that some species of cyanobacteria are toxic). Another alarming outlook — the negative impact of climate changes on the physiological state of corals which are in symbiotic relationship with zooxanthellae. This suggests that the reasons for the well–known fact of the degradation of coral reefs are not entirely anthropogenic. We show that the negative effects of the climate changes on the zooxanthellae are more substantial under the influence of heavy metals which leads to conclusion that these factors are closely connected in the aqueous environment. We suggest that coral reef monitoring for the variations in the photophysical characteristics of the zooxanthellae might be one of the most effective ways for detecting the influence of the global climate changes on the marine biota in the early stages. It is advisable to monitor the coral reefs in the areas of the ocean with the minimal anthropogenic impact as "background stations" for climate changes monitoring.

Oil spill monitoring as the tool for global changes study

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Keywords: SAR, oil film, GIS

Abstract: This paper reviews and discusses the problem of the remote sensing of oil films in context of global changes. Sea surface oil films play a significant role in globally important processes such as exchange of momentum, heat and gas between the ocean and the atmosphere. Among remote sensing techniques, spaceborne SAR is considered to be a primary sensor for oil spill surveillance. Recent studies on oil pollution demonstrated high potential of the SAR-equipped satellites. The European and Asian seas have been chosen as test basins to work out an oil spill mapping technology using SAR image sets and geographic information systems. Wide use of GIS-approach for oil spill mapping offers a method for an estimation of the total ocean surface coverage with oil films on a regional and global scale. Such estimations will provide the important data to implement into the models of heat balance between sea, atmosphere and solar radiation and thus to evaluate the influence of oil films, both natural and man-made, on the global climate changes.

Fluorescent monitoring of the global climate change impact on water photosynthetic organisms. Studies in the Gulf Stream region

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Keywords: Fluorescent monitoring, Fluorescence Induction and Relaxation, Phytoplankton

Abstract: The global climate change is a universal process witch exerts influence on all aspects of ecosystem life, including the state of basic water ecosystem component — photosynthetic organisms. Changes themselves, however, are of microscopic value in common scale. Monitoring of such changes is extremely important and at the same time complicated. In the focus of present work are studies of the global climate change impact on water photosynthetic organisms revealing itself in photosynthetic apparatus photophysical characteristics by means of fluorescent technique. At the same time could be solved the "inverse problem" — development of the fluorescent methods of remote monitoring of climate change through photosynthetic organisms state change. As a proving ground for these problems the North Atlantic region was chosen, since it is especially subjected to global climate change impact and at the same time it forms to a great extent the climate of Europe. In the report we present the results, obtained in the 31st cruise of the research vessel "Akademik Ioffe". The expedition was carried out in the framework of the international project CliVar (Climate Variability and Predictability), and supposed to be the first stage of several years' natural studying of the global climate change impact on phytoplankton state by employment of fluorescent spectroscopy. We utilized the Fluorescence Induction and Relaxation (FIRe) technique which is built on measurement of photosynthetic organisms photosystem II kinetics of fluorescence in response to series of optical excitation pulses formed according to certain rule (protocol). The technique mentioned allows one to obtain a number of fluorescent parameters of photosystem II such as the lowest level of fluorescence under opened reaction centers F0, the highest level of fluorescence under closed reaction centers Fm, variable fluorescence (Fm-F0)/Fm, photosystem II absorption cross-section

psy"73, and so on, by analysis of which one can make a conclusion about the phytoplankton state in samples. Previously, in the laboratory research we studied the interrelation between these photophysical characteristics of photosystem II as whole and photophysical characteristics of chlorophyll "a" and other pigments obtainable by the nonlinear laser fluorimetry approach. A work proving ground was situated along N59°30' latitude between south end of Greenland and British Isles. The region is remarkable by the warm North Atlantic Current (Gulf Stream), one arm of which makes a loop before Iceland, and cold East Greenland Current, going along the Greenland coast. It leads to appearing of areas with diverse water temperature regime and areas with strongly pronounced thermal gradients. On the taken data bulk we analyzed changes regularity of phytoplankton photophysical parameters and correlated them with temperature and salinity changes. We generated data deposit for the present region over September, 2010.

Calculating coastal erosion of the Buor Khaya peninsula

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Keywords: arctic coast, change detection, geomorphology, stereophotogrammetry

Abstract: This work aims to measure coastline changes and to analyze their causes on a regional scale using optical remote sensing time series. Archived and historical satellite data sets (KH series) in combination with new acquisitions of high resolution image data (KOMPSAT-2, RapidEye, SPOT, ALOS-PRISM) allow monitoring of long and short term shoreline position changes and change rate determination. Acquisition of detailed field data is necessary for a better process understanding as well as for accurate GIS analyses and interpretation of remote sensing data. During the joint Russian-German Expedition in 2010, topographic surveys were conducted at six different coastline sections using precise geodetic methods.

The Buor Khaya peninsula (71-72°N, 132-134°E) in the southern central part of the Laptev Sea Region is situated between the Buor Khaya Gulf in the west and the Yana Bay in the east. The area around the northern cape "Mys Buor Khaya" is a key site of the International Polar Year coastal monitoring programme "Arctic Circumpolar Coastal Observatory Network" (ACCO-Net) and representative for Northeast Siberian lowlands. The peninsula consists of ice rich permafrost deposits and exhibits a typical Alas-Yedoma thermokarst relief with large interconnected drained thaw lake basins, numerous lakes, steep valleys and well drained uplands. Total elevation rarely exceeds 50m a.s.l.

Thawing of pure ground ice or ice within a heterogeneous medium reduces the strength of the thawed sediments and produces an easily removable ground. Thermoabrasion and –denudation are the dominant destructive cryogenic processes along the upper shoreface, causing coastal retreat rates of 1-4m per year. The elongated coastline of Buor Khaya reveals a high heterogeneity of geomorphological units. Consequently erosion rates are related to alas depressions, yedoma hills and transition zones.

Standardised calculation of coastal erosion is carried out for distinct coastline sections using the Digital Shoreline Analysis System within a GIS. For this purpose RapidEye serves as a data basis, since it provides consistent datasets over large coastline sections at high temporal and geometric resolution. For comparison with manually digitalized coastline positions, a progress to 3D change detection is done. Stereophotogrammetric processing is carried out for space-borne across track convergent slanting (SPOT), along track convergent slanting (CORONA) and along track overlapping wide range nadir (HEXAGON) image series. Mass movements and material input into the shelf sea are quantified by differencing of DEMs created from these data.

Semi-empirical model of backscattering in South Baltic coastal waters

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Keywords: backscattering, Baltic Sea, coastal waters, lakes

Abstract: The semi-empirical model of backscattering in the South Baltic coastal waters was developed based on relationships between the surface backscattering coefficients and concentration and physicochemical composition of the water constituents.To investigate the relationships between these parameters and concentration of suspended particulate matter (SPM) , the in situ measurements of these properties were collected during many cruises aboard the R/V Oceania. Spectral backscattering were measured by HobiLabs Hydroscat-4 (HS-4) at four different wavelengths: 420 nm, 488 nm, 555 nm, 620 nm. Analyses of discrete water samples of organic and inorganic suspended particulate matter were made in parallel with in situ measurements of backscattering of the South Baltic coastal waters and three Pomeranian lakes during May 2006 to September 2009. The semi-empirical model of backscattering in the South Baltic coastal waters was successfully applied to calculate backscattering coefficients in chosen Pomeranian lakes based on the known organic and inorganic suspended particulate content. Thanks to this calculations our knowledge about nature of processes associated with the transmission of light energy in case two waters was expanded. Correlation between bio-optical properties and inherent optical properties can be used to develop new and improve conventional remote sensing methods for monitoring of ecosystems in the coastal and inland waters. In the future, the results received on this project could be used to solve the inverse problem of hydro-optical system and become part of the algorithm for remote retrieval of the concentrations of various components of natural waters, based on information obtained from the satellite sensors.

Synchronous investigation of soil geometric mean particle diameter and lime using remotely sensed data

A case study: Pol-e-Dokhtar, the southwest of Lorestan province, Iran

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Keywords: geometric mean particle diameter (dg), PCA, remote sensing, soil lime, UnC

Abstract: The geometric mean particle diameter (dg) of soil constituents and lime (CaCO3) are the most important subjects from the viewpoint of soil management and superintendence. Nowadays, remote sensing technology which has emerged walking with the science development throughout the world, made the studying of soil properties (such as dg and lime) more facile, convenient and cost-efficient. Investigation of soil-dg and lime has performed in Pol-e-Dokhtar by data sets of IRS, P6-LISSIII that has taken in September 7th 2007. Subsequently some processes such as: Principal Component Analysis (PCA), Normalized Difference Vegetation Index (NDVI), Soil Line Euclidean distance (SLED) and Unsupervised Classification (UnC), were carried out for acquired satellite data sets. By stratified randomized sampling (SRS) method and according to the false color composite (FCC) and photomorphic units (PMU) of the study zone image, eventually 95 sample points were selected and collected from 0-5cm of soil surface. Afterwards, dg and CaCO3 were determined for each point in the soil lab. By means of multiple regression operations finally showed pronounced relations (at 1

A new resource for global lake surface water temperature and lake ice-cover data

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Keywords: Lake surface water temperature, lake ice-cover, satellite remote sensing, ATSR

Abstract: Lakes are a vital component of the Earth's fresh water resources, and are of fundamental importance for terrestrial life. Lake water temperature is one of the key parameters determining ecological conditions within a lake, as it influences both chemical and biological processes. In addition to the impact on lake ecology, lake water temperatures determine air-water heat and moisture exchanges, and are therefore vital for understanding the hydrological cycle. Lake surface water temperature (LSWT) and lake ice-cover (LIC) observations therefore have potential environmental and meteorological applications for inland water management and numerical weather prediction (NWP). The series of (Advanced) Along Track Scanning Radiometers, ATSRs provide exceptional radiometric qualities and dual-view scanning capability, making them suitable instruments for providing observations of LSWT and LIC globally. The ATSRs have previously been exploited for sea surface temperature (SST) observations in the ATSR Reprocessing for Climate (ARC) project. However, attempts to deliver LSWT as a by-product of SST retrieval or land surface temperature (LST) retrieval have not delivered sufficiently convincing results from ATSRs or other satellite borne instruments. The ARC-Lake project aims to unlock the potential of the ATSRs for observations of LSWT and LIC, and demonstrate the usefulness of these observations to climate science. Optimal estimation (OE) retrievals and probabilistic cloud screening methods have been developed to provide LSWT estimates from the series of ATSRs. Variations in physical properties such as elevation, salinity, and atmospheric conditions are accounted for through the forward modeling of observed radiances. Therefore, the OE retrieval scheme developed is generic – i.e., applicable to all lakes. LSWTs have been obtained for 250 of Earth's largest lakes from ATSR-2 and AATSR imagery from 1995 to 2009. Empirical orthogonal function (EOF) techniques have been applied to the LSWT retrievals (which contain gaps due to cloud cover) to reconstruct spatially and temporally complete time series of LSWT. The new LSWT observations and the EOF-based reconstructions offer benefits to numerical weather prediction (NWP), lake model validation, and improve our knowledge of the climatology of lakes globally. In this presentation, we discuss the array of LSWT and LIC data products available from the ARC-Lake project and their applications.

Monitoring of invasive aquatic plants by multispectral remote sensing

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Keywords: invasive hydrophytes, monitoring, multispectral, water column correction

Abstract: Since the increasing water temperatures in fresh water lakes due to climate change is assumed to favorite invasive aquatic plants, a monitoring system is required to estimate their effects on the ecosystem. Within the lakes of Upper Bavaria, an expansion of Najas marina and Elodea nuttallii is observed. The monitoring of these spatiotemporal highly variable developments requires rapid on-demand information, which must be based on multispectral remote sensing methods offering the needed temporal and spatial resolution. Although hyperspectral airborne sensors like HyMap were successful used to identify different species, these methods are not suitable for a frequent observation due to high costs, uncertain flight times and a major ecological impact trough the emissions of flight related greenhouse gases. For our study site – Lake Starnberg – different hyper- and multispectral air- and spaceborne sensors were compared in terms of possible species differentiation and the limitations due to reduced spatial, spectral or temporal resolution. Furthermore, two methods to correct for the water specific loss of radiation in the water column are evaluated. One uses a physically based process chain, on derive ground reflectance spectra with no effects of the water column, the second model is semi-empirical with several constraints and just relative ratios between different bands. Both methods were compared in terms of species discrimination with the aid of in-situ measured reflectances (see contribution of Patrick Wolf at this conference).

Object-Oriented Multi-dates Image Classification and Combined Topographic-Bathymetric Data as Useful Tools to Monitoring coastal zones

the Ichkeul Marches Vegetations (North Tunisia)

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Keywords: Vegetation monitoring, Object-oriented classification,Wetland marshes, Multi-spectral imagery, Topographicbathymetric Model, Ichkeul Park, North Tunisia.

Abstract: The purpose of this study is to show the feasibility of the integrated topographic-bathymetric data to improve the object-oriented classification of a multi-spectral imagery in order to monitor the coastal wetland vegetation. The study area concerns the Ichkeul Park : lake, marshes and mountain located in the north of Tunisia. First we settle the integrated topographic-bathymetric digital terrain model (DTM) by combining three datasets: the lake bathymetry, the marshes and the mountain topographies. Then the new topographicbathymetric DTM was used with multi-spectral imagery from the MSS Landsat (1972), TM Landsat (1987), ETM+ Landsat (2001) and Aster (2007) in order to classify Ichkeul marshes. This is done by using the object-oriented classification based on botanic field observations. This method improved global precision of marshes vegetation mapping. It gives a 92global classification precision with more than nine communities in 2007. However an Aster supervised classification based on pixel approach allowed identifying four plant associations with a global precision of 82al. 2006). We provide herein therefore an operational tool

to monitor any changes in wetland areas.

Classification of coral reef benthic composition using linear unmixing on spaceborne hyperspectral image

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Keywords: Hyperion, unmixing, coral reefs, classification, monitoring, benthic cover, end member, hyperspectral

Abstract: The potential for extracting benthic composition using linear unmixing of a marine park in the Red Sea from Hyperion sensor data was tested by exploring eight different image analysis variations. Two distinct image processing approaches were compared: (1) all-image-derived approach, using a priori assumptions paired with automatic endmember extraction techniques; and (2) an in-situ water properties sampling and in-situ endmember collection approach. In-situ approach focused on analysis with and without water column correction for comparison. Water column correction was based on the application of Beers Law with in-situ measurements of attenuation coefficient, k, together with locally measured bathymetry. In-situ spectral signatures of reef components were collected and used as endmember for linear unmixing. Variations of analysis included exploring effective spectral ranges, using different unmixing algorithms and software based semi-automatic spectral analysis. Final products are validated against visual interpretation of aerial photography and ground-truth data. Despite high spatial heterogeneity at the site and the relatively low spatial resolution and radiometric accuracy of Hyperion, results indicate successful unmixing potential in the detection of habitat level components, such as reef vs. sand. Best prediction accuracy achieved using unmixing of derivative data combined with in-situ data collection. The classification from automatically derived endmembers tended to be heavily affected by water depth.

PM 2.5 diurnal and seasonal variations over urban-coastal area

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Keywords: PM 2.5, TEOM, CMAQ,

Abstract: The atmospheric particulate matter is regulated by US. Environmental Protection Agency as major pollutant in an aggregate sense with total PM2.5 standards with limits on daily average and annual average concentrations. Air quality models are used in air quality decision making process in order to determine the levels of emission reductions for individual aerosol species of concern necessary to comply with the standards. Since models are used in the regulatory process, it is essential that their performance be evaluated thoroughly. The model used here for validation is CMAQ 4.7. The model predictions are compared against TEOM measured concentrations and diurnal and seasonal analysis are performed above the NYC-coastal area.

The role of earth observation for monitoring coastal evolution and ecosystem response to climate change

Exploration of enhanced data fusion techniques

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Keywords: Hydrodynamics, geomorphology, climate change, coastal management, monitoring, data fusion, satellite remote sensing

Abstract: The effects of changes in the earth's climate are clearly manifested at the land/sea interface as rising sea levels and variable hydrodynamic forcing combine to alter the nature and configuration of the coastline. These changes represent a potential threat to both the natural environment and coastal communities in terms of increased erosion and inundation risks. An understanding of the interaction between hydrodynamic and sedimentary process at a variety of temporal and spatial scales is fundamental to the effective management of the coastal zone. A wide variety of tools and data sources are currently used to develop a conceptual understanding of coastal morphology and ecosystem dynamics and to monitor or predict their response to both natural changes and to anthropogenic activities.

The application of Earth Observation data for coastal monitoring has been the subject of numerous studies during the past 10 years. Examples include flood risk mapping, pollution monitoring, waves, coastal erosion, nearshore bathymetry and marine water quality monitoring. The clear advantage in using satellite data for monitoring the marine environment is the facility to provide repeat surveys for large (and often inaccessible) areas at a cost that compares favourably with ship based surveys. However, in many cases the uptake of Earth Observation data for marine and coastal applications is restricted to airborne platforms such as LiDAR. This is due in part to the inherent limitations of earlier satellite systems and in particular, the limited spatial resolution that could be achieved near to the coast. More recently, improved coverage and the development of sophisticated image analysis techniques has enhanced the accuracy and resolution of the data that can be derived. This study explores the potential for improved integration of remote sensing data with in situ data sources and as input to numerical models with a view to fully exploiting the potential of earth observation for monitoring the response of coastal zones to changing physical forcing and climate change.

Monitoring POSIDONIA OCEANICA coastal ecosystems by means of HR satellite remote sensing multispectral and in situ techniques.

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Keywords: Coastal Ecosystems Remote Sensing, HR satellite sensors, Water column correction, Data mining and ANN

Abstract: Though the polar satellite Earth Observation (EO) missions are yet supporting since various decades the oceanographic studies with sea surface temperature and colour observation, the effective monitoring of coastal ecosystems, mainly constituted by seagrass photo-synthetic vegetation growing in shallow waters sea bottom, requires spatial and radiometric resolutions of the more recent sensors (IKONOS, Chris-Proba, Quick-Bird, World-View,..). On the other hand these key-elements of the marine environment which maintain the productivity chain while guarantee the coastal stability against the erosion, are threatened and under stress due to human impact continuously rising and ongoing climate changes, with potential effects on their preservation. In this context their sustainable management in order to be effective and efficient requires information

suitable in terms of spatio-temporal scales, accuracies and extents as those that could be provided by the currently available satellite HR (High Resolution) multispectral sensors cited above. To this end the SIMS (Seagrass Integrated Monitoring System) project, funded by ESA (European Space Agency) aims at implementing innovative EO-based methodologies for mapping and monitoring seagrass ecosystems, in particular POSIDONIA OCEANICA (PO), which at national level (in the Italian coast shallow waters are localized more than 40

Technological advances for ocean color satellite sensor calibration

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Keywords: fluorescence technique, TFLAP, ocean color

Abstract: Forecasting and prevention play a key role in the ecological risk analysis systems. The UNEP (United Nations Environment Programme) listed six priority areas which define the focus on the environmental challenges of the 21st century, among which Climate Change and Ecosystem management. In this context the world environmental policy is implementing complex decision systems based on economically sustainable activities comprehending forecasting models, satellite images and sustainable observatory networks. The oceanographic measurements nets are functional both for satellite calibration and mathematical models data assimilation as well as to support the early warning systems for environmental pollution control and prevention. In particular coastal areas, which are subjected to multiple anthropic pressures (industries, fishery, tourism), involve a continuous monitoring and forecasting of the dynamics and the potential effects. In these areas the implementation of a coastal sustainable observatory network has a strategic relevance for the ocean color satellite sensors calibration. Coastal waters can be classified like case 2 waters, where the optical properties of inorganic suspended matter and colored dissolved organic matter must be considered and separated by the chlorophyll a contribution. For this reason an accurate calibration of satellite measures is fundamental. Due to the high costs of mooring systems, research vessels, measure platforms and instrumentation a big effort was dedicated to the design, development and realization of new low cost oceanographic devices: the TFLAP (Marcelli et al. 2007). This work shows the application of this technology, based on fluorescence techniques, to ocean color satellite measures calibration.

Probe the Impact of Geometric Standard Deviation of Soil Particles (psy"73g) on Remote Sensing Study of Soil Texture

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Keywords: geometric standard deviation / homogeneity / remote sensing / soil particle / soil texture

Abstract: Homogeneity of soil particles is the potent factor which affects soil spectral signatures and known as the Geometric Standard Deviation of soil particles (psy"73g). This study presents the influence of psy"73g on spectral studying of soil texture using four spectral data sets of LISSIII-P6 and was coincident sampling operations. Subsequent to satellite data preprocessing, some operations were done such as: Normalized Difference Vegetation Index, Principal Component Analysis, Soil Line Euclidean Distance and Unsupervised Classification on acquired data. By stratified randomized sampling method and according to the false color composite and photomorphic units of the main image of the study area, 95 sample points were eventually selected and gathered from 0-5cm of soil surface. Afterwards, geometric standard deviation (psy"73g) and texture fragments were determined for each sample point in the soil lab. Samples were accordingly divided into two parts, on the basis of the computed geometric standard deviation: the first, psy"73g <10 (homogeneous soil) and the second, psy"73g psy"B310 (heterogeneous soil). Subsequently via correlation operations for both group, it was expressly displayed which in the first group (psy"73g <10), clay and sand had about 0.7-0.8 correlations with the remotely sensed data, whereas the second group (psy"73g psy"B310) had about 0-3-0.4. Hence, the geometric standard deviation (psy"73g) of the study region can powerfully impress soil spectral reflectance.

Potential of Rapideye Image Data for Wadden Sea Monitoring

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Keywords: Classification, Monitoring, Wadden Sea, Segmentation, Decision Tree

Abstract: RapidEye is a new German satellite constellation (launched on August 29, 2008) which acquires images at a spatial resolution of 6.5 m. The RapidEye constellation consists of five earth imaging satellites that contain identical sensors in the same orbital plane. This satellite system is especially suited for the monitoring of geographic areas such as the tidal lands of the Wadden Sea, because this constellation offers a potential revisit cycle of 24 hours. In comparison to other satellites such as Landsat or SPOT, the probability of recording a scene during low tide is much higher. In addition, the sensors provide a swath width of almost 80 km. This allows, for example, the recording of the east coast of the North Sea in one pass.
In this study, Rapideye is compared to Worldview 2 and Landsat with respect to data acquisition and classification potential. Its potential for Wadden Sea monitoring is especially compared to the Landsat TM sensor. For this purpose, we performed a classification and extracted and compared radiometric characteristics. For classification, we made use of a hierarchical object based approach. In the first step, a mask for the coastline was applied. As a next step, the images were segmented. Contrary to pixel based approaches, not the pixels but the segments were assigned to one class. This object based approach offers major advantages, because it considers not only the spectral information but also shape and texture of objects that are used for the description of the classes. Furthermore, neighborhood connections and context features are used to differentiate between the single segments.
The segmentation is then combined with a decision tree. The next step is to identify the water in the image due to spectral characteristics. For vegetation, the modified soil-adjusted vegetation index (MSAVI) and different texture measures are used. The sediments are differentiated by texture and spectral characteristics. For evaluation, producers' and users' accuracy and kappa coefficient are calculated and evaluated. The results show that a classification with Rapideye improved the overall classification accuracy by 30

Digital aerial photography to monitor changes in coastal areas based on direct georeferencing

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Keywords: Photogrammetry, Orientation, Matching, DEM/DTM, Accuracy

Abstract: Digital aerial photogrammetric cameras, such as the ZI-DMC, allow for the acquisition of very high resolution digital stereoscopic imagery, that can be delivered to customers in very short times. They are normally supported by direct georeferencing systems (DGR), which provide accurate exterior orientation parameters. These facts make this technique very useful in monitoring coastal areas, were fast responses may be needed, for example to assess the effects of storms, and where ground control point (GCP) collection for standard aerial triangulation may be difficult. This paper describes a monitoring program for costal zones carried out in the region of V. N. Gaia, in Portugal, using ZI-DMC imagery with 10 cm resolution. Parts of the surveyed area, in the mouth of river Douro, do not have man made features that can provide good control points, so the work is mainly based on the exterior orientation provided by the DGR system. Digital terrain models were derived automatically using a stereo-matching program. An accuracy analysis was carried out with ground control points surveyed in part of the area were man-made features are available. The horizontal accuracy was found to be in the order of 30 to 40 cm, both in planimetry and altimetry. This was due to small trends in the exterior orientation parameters, which could be calibrated with the GCPs. Using the improved parameters the accuracy became in the range of 10-20 cm, both in planimetry and altimetry. The resulting DEMs of sandy areas allowed for a detailed determination of volumetric changes between different flights and to assess the areas that are more prone to degradation. High resolution digital aerial photography is a very useful tool to monitor sandy beaches and dunes and has the advantage of being a non-invasive method. Provided that the GDR system is frequently calibrated in order to eliminate systematic errors, the accuracy of 3D data extracted can be similar to the image ground sampling.

A novel constraint ICA approach for multi-temporal hyperspectral images analysis

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Keywords: remote sensing data, hyperspectral data, multi-temporal hyperspectral data interpretation, multi-linear algebra, high-order tensor, ICA

Abstract: I- Introduction Nowadays, processing remote sensing data, as a forecasting tool for land surface study, allows an interpretation of images of the same scene taken at different times. However, the effective use of remotely sensed data stills a difficult task due to some limitations associated with the data resolution, processing, and costs. Recently, hyperspectral data has been shown to be a promising way for detecting imperceptible areas. The advent of hyperspectral data provides hundreds of relatively narrow and contiguous bands (psy"A310 nm) that may be useful for extracting land-use information. These images are spectrally over determined; they grant rich spectral information to identify, distinguish and to characterize spectrally similar materials. Thus, dynamic object analysis by satellite observation and multi-temporal images processing could become a necessity. However, the use of this kind of images over highly heterogeneous areas might be practically unsuitable since that number of land cover types will be present in each pixel. This will lead to the so-called mixed pixel problem [1]. Spectral unmixing is a common approach in which the pixel observed reflectance is modelled as a combination of spectrally pure "endmembers" spectrums. Thus, each endmember contributes to the observed spectrum (signal) according to a fractional abundance. II- Proposed approach The main objective of this paper is to propose a novel approach for multi-temporal hyperspectral data interpretation based on multi-linear algebra and high-order tensor. It provides a robust framework for change analysis and multi-temporal endmembers extraction. Input dataset can be arranged from images which are taken at different acquisition times and having different temporal/spectral resolutions. To achieve this goal, we propose a new data organization. Regularly and in widely applications, real-world data sets possess a particular processing scheme in addition to the necessary instantaneous independence required by ICA (Independent Component Analysis). As we know, ICA is a statistical technique which attempts to discover hidden sources or features from a set of observed data [2]. Typically, it represents a generative model where the sources are maximally independent, the observations are assumed to be linear mixtures of independent sources. If we consider a set of multi-temporal hyperspectral images, collected measurements contain both temporal and spatial indices. So, a data entry (pixel)

data= (x,y,[U+F06C],t) can depend on spatial position (x,y), wavelength [U+F06C] as well as time t. In this paper we incorporate prior knowledge about a mixing matrix during ICA computation. Since that we an idea about a mixing matrix, then we can weight the degree of con[U+FB01]dence in this location with respect to the independence constraint. The use of constraint ICA can help the computation algorithm to converge towards the desired solution. The ICA generally assumes that a set of p measured data points v(t)=[v1(t), v2(t), psy"BC, vP(t)]T was obtained by mixing k unknown sources s(t)=[s1(t), s2(t), psy"BC, sk(t)]T. These sources are assumed to be statistically independent. The mixing process is assumed to be linear, eq(1), A is the mixing matrix which size (k*p). v(t)=As(t), (1) Conventional ICA scheme used observations v(t) to estimate the de-mixing matrix W such : s(t)=W v(t). Many algorithms have been proposed to deal with remote-sensing images mixture like JADE, SOBI etc. FASTICA algorithm, which has been used successfully with satellite images, tend to separate the underling components maximizing the negentropy J(y) of each component Eq(x). J(y)=H(yGauss)-H(y) (2) H(.) :differential entropy; yGauss :gaussian random variable having the same variance as the output signal y. Only the component having the maximum negentropy will be extracted. An intelligent way to overcome this problem is to incorporate some prior information's about the desired sources. In this study, the cICA (constrained ICA) [x], which extract components by maximizing negentropy such in classical FASTICA algorithm, can use to select source signals given some reference signals. In our work, the reference signals have been given by experts having a solid knowledge about the temporal dataset of hyperspectral images and study area. At each step, the cICA uses a correlation measure to match reference signal with algorithm's output which is a de-mixing vector w. At each iteration, this vector is adjusted in order to maximize the statistical independence of the output while maximizing the closeness of the output reference signal. Finally, when the algorithm was converged, we can generate the mixing vector a from w. The performance of the proposed algorithm is tested against the conventional spatial and temporal ICAs over simulated and real data.