OCEANIC AND ATMOSPHERIC PROCESSES IN CHINESE COASTAL ZONES

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List of Principal Investigators (PIs)

Topic Nr.	PIs	Title
31451_1	*Prof.Werner Alpers,* *Prof. DanLing Tang*	***Upwelling***
31451_2	*Dr. Alexis Mouche,* *Prof. Biao Zhang*	***Coastal Winds***
31451_3	*Prof. Johnny Johannessen,* *Prof. Yunxuan Zhou*	***River-diluted waters***
31451_4	*Prof. John Remedios,* *Prof. Chuqun Chen*	***SST retrieval***
31451_5	*Dr. Samantha Lavender,* *Dr. Shilin Tang*	***Atmospheric corrections***
31451_6	*Dr. Federica Braga* *Dr. Qianguo Xing*	***Water exchanges (EPHESURS)***

EXECUTIVE SUMMARY

The first two subproposals deal with two of the most prominent oceanic features at Chinese coasts: coastal upwelling and river-diluted waters as encountered in the Yangtze river plume.

1) Upwelling regions, in particular the ones north of Taiwan, in the Taiwan Strait, along the Chinese east coast, and east of Hainan, are areas of high fish production and subject to high spatial and temporal variability, which is of high relevance for fish production and management.
2) The Yangtze River transports nutrients into the estuary of the East China Sea and causes phytoplankton blooming into the neighboring seas and sometimes harmful algal blooms causing fish kill. Monitoring the Yangtze River Plume and studying its dynamics is of great importance for the.
3) The third subproposal deals with “Atmospheric phenomena over Chinese coastal waters”, which is closely connected to the first two oceanic sub-projects, since coastal winds strongly affect river runoffs and upwelling. In the case of upwelling, coastal winds are the dominant factor causing its variability. A new algorithm has recently developed by the European PI of this sub-project, Alexis Mouche, to retrieve low to medium strong near-surface winds from synthetic aperture radar (SAR) data (Mouche et. al., 2012). Also strong wind events as often encountered over the Chinese Seas in the form of tropical storms and typhoons will be studied using another new wind retrieval algorithm from SAR images applicable for high winds, which was recently developed by the Chinese PI of this sub-project, Biao Zhang.
4) The fourth subproposal deals with improving sea surface temperature (SST) from satellite data. SST data and ocean color data of coastal and open ocean marine waters are key variables, being widely used in many aspects of meteorology and oceanography, e.g., for process studies and also for assimilation into numerical models to aid weather prediction.
5) The fifth subproposal deals with improving atmospheric corrections needed to retrieve ocean color data from optical data because more than 90% of the top-of-atmosphere radiance in the visible (VIS) bands measured by satellite sensors comes from a combination of atmospherically scattered radiation and surface reflection rather than from the ocean near-surface water reflectance.
6) The sixth subproposal deals with Chinese coastal waters which are highly impacted by hydrological processes such as morphological changes and mixing between continental fresh waters (surficial and groundwater) and marine waters. The salt contamination, water pollution and land sinking, are producing serious damages to the marine water, freshwater resources as well as jeopardize the eco-biological system. In order to perform a correct coastal management, hydrological processes have to be understood in depth.

ABSTRACT 31451_1: "Upwelling"

European Principal Investigator	***Chinese Principal Investigator***
Prof. Werner Alpers (University of Hamburg,Germany)	Prof. DanLing Tang (SCSIO, CAS,CHINA)

Upwelling areas are of great importance for fishery. They are regions of high primary productivity and therefore of high fish population. Since upwelling regions account for about 50% of the world's fish catch, they are of great commercial interest. Studying their behavior and variation is a key issue in oceanographic research. There are several upwelling region in the South China Sea (SCS) and the East China Sea (ECS), the best known ones are located off the east coast of Vietnam, the east coast of Hainan, the north coast of Taiwan, and the northeastern coast of China. Upwelling regions are subject to large temporal and spatial variability, mostly due to variation of the wind. These temporal variations are not yet fully understood. Usually upwelling is studied using ship-borne measurements or/and sea surface temperature (SST) and chlorophyll-a (Chl-a) measurements from space.

In this sub-project we shall study upwelling areas in the South China and East China Sea by including synthetic aperture radar (SAR) data. As far as we know, this has not been done before. We shall use mainly archived SAR images from the ERS, Envisat, Sentinel 1, COSMO-SkyMed, and ALOS satellites. Upwelling areas manifest themselves on SAR images as areas of reduced radar backscatter or as lines which are radar signatures of oceanic fronts. We shall analyze SAR images in conjunction with SST and Chl-a data, and, if available, also with in-situ data acquired from ships or anchored buoys. The regions of interest (ROI) are the upwelling areas north of Taiwan, in the Strait of Taiwan, along the northeastern coast of China, and east of Hainan.

The reason why SAR has not been employed systematically in studies of upwelling regions is the fact that it is not easy to separate radar signatures originating from upwelling from radar signatures originating other oceanic or from atmospheric phenomena. The challenge is to achieve this separation. The perspective is good, since the European PI of this sub-project has studied radar signatures of oceanic and atmospheric features for decades and has published many papers on this subject.

SAR images will be compared with Chl-a and SST images and with model outputs. The analyses of Chl-a and SST data will be carried out by the group of the Chinese PI, DanLing Tang, in the South China Sea Institute of Oceanology (SCSIO) in Guangzhou, and the modelling by the group of the European Co-PI, Thomas Pohlmann at the Institute of Oceanography of the University of Hamburg. Thomas Pohlmann is an expert in modelling upwelling in Chinese waters. Together with a visiting scientist from China, J. Su, he has published two papers on upwelling at the eastern Hainan coast. At present he has, together with Daji Huang from SIO in Hangzhou, a project entitled "Analysis of fluxes in the East China Sea under the influence of climate change and their impact on the ecosystem and carbon cycle (CliFlux)", which is funded by a German-Chinese cooperation project.
Upwelling is strongly controlled by local winds. Therefore a good knowledge of the local winds is indispensable in studies of upwelling regions. Wind information will be provided by the sub-project "Atmospheric phenomena over Chinese coastal waters".

Also Dragon 4 projects dealing with detection of oil pollution on SAR images of the sea surface will profit from this sub-project, since biogenic surface films, which are often encountered in upwelling regions, cause similar radar signatures as mineral oil films. The challenge is to discriminate between radar signatures of mineral oil films and radar signatures of oil spill "look-alikes", which most often have their origin in biogenic slicks. Criteria will be developed in this sub-project.

ABSTRACT 31451_2: "Coastal Winds"	
European Principal Investigator Dr. Alexis Mouche (IFREMER,France)	***Chinese Principal Investigator*** Prof. Biao Zhang (NUIST,CHINA)
The aim of this sub-project is to obtain a better knowledge of coastal wind fields from SAR data. To this end, a new wind retrieval algorithm developed recently by the European PI, Alexis Mouche, and co-workers will be applied to investigate ocean surface wind fields over Chinese coastal waters. The SAR derived wind fields will be compared with model winds calculated by "the Atmospheric Integrated Rapid-cycle forecast model system" (AIR) of the Hong Kong Observatory. Coastal winds can sometimes be very strong at Chinese coasts and are often accompanied by strong rain in the form of rain cells and are a threat to small fishing vessels. Rain cells and extremely high winds as encountered in typhoons over Chinese waters will also be studied in this sub-project. To achieve this, another algorithm based on cross-polarization data and developed by the Chinese PI. Biao Zhang, will be applied for retrieving extreme high sea surface winds from SAR data, in particular from Sentinel 1 SAR data.	

ABSTRACT 31451_3: "River-diluted waters"	
European Principal Investigator Prof. Johnny Johannessen (Nansen Environmental and Remote Sensing Center,Norway)	***Chinese Principal Investigator*** Prof. Yunxuan Zhou (East China Normal University,CHINA)
Mapping the Yangtze River Plume is an important subject which are significant in the understanding of nutrient discharge and transportation from the estuary to the East China Sea. And it may also related to phytoplankton booming in the estuary and neighboring seas. We intend to map the salinity structure on the surface water with synergy of optical and microwave remote sensing methods. Together with in-situ observations and dynamic modeling of the plume we anticipate that some fresh views on the process of Yangtze River plume mix and transportation will come up. With new EO satellite data available, such as Chinese Gaofen-4 and EU satellite Sentinel-1&2, there exist possibilities that the plume mix and transportation process on daily basis and seasonal basis can be observed and modelled. Moreover, in this study the Yangtze River Plume transportation dynamics may also studied by mapping the plumes over the past decades, which may link the variations with large damming in the catchment. We adapt some of the classical methods for retrieval of sea surface salinity distribution with optical remote sensing data by establishing relationships between colored dissolved organic matters (CDOM) and salinity. We will also opt for sea surface brightness temperature methods with which sea surface salinity is obtained by using K-S model, where the brightness temperature is derived from scattering coefficient of SAR data. A Debye Equation based synergic method for sea surface salinity inversion will be thoroughly explored, in which sea surface temperature is synergically derived from brightness temperature through high resolution optical images and sea surface emittance calculated from SAR data. Currently the PIs co-operate a project sponsored by the National Natural Science Foundation of China (NSFC) from 2015 to 2018. In the same time one of the PIs is applying the project from NSFC for 2017-2020. The State Key Laboratory of Estuarine and Coastal Research at East China Normal University supports the cooperation with European partners in the framework of Dragon Programs. We also look for more fund to support the proposed research from Shanghai Municipal Commission of Science and Technology and other agencies in China.	

ABSTRACT 31451_4: "SST retrieval"

European Principal Investigator	***Chinese Principal Investigator***
Prof. John Remedios (National Centre for Earth Observation,UK)	Prof. Chuqun Chen (South China Sea Institute of Oceanology, Chinese Academy of Sciences,CHINA)

The surface temperature (SST) and bio-optical properties of coastal and open ocean marine waters are key variables, being widely used in many aspects of meteorology and oceanography e.g., for process studies and also assimilation into numerical models to aid weather prediction.

For thermally focused satellite missions, it is necessary to compare the properties of the datasets coming from different missions, and to assess the accuracy of different sea surface temperature (SST) products retrieved from the various satellite missions and often with different algorithms. As the satellite measured SST is more closely related to the skin SST than the subsurface SST it is not sufficient to just validate the satellite measured SST with subsurface SST measurements, which is generally measured at a depth of 20 cm or deeper. Therefore, for satellite validation, it is necessary to measure skin temperature in-situ.

In this topic, a few cruises for in-situ measurement of skin SST will be conducted off China and around the UK respectively, to check how temperature gradients in the upper ocean are changed especially in optically complex waters, where the biology and water constituents affect the distribution of solar radiation and therefore the temperature gradients. The skin SST will be measured by a new instrument, The Buoyant Equipment for Skin Temperature (BEST), which integrates thousands of arrayed thermistors, situated closely together at distances of up to 0.6 mm, which can synchronously measure the temperature of the atmosphere's bottom layer, skin layer and surface layer of the ocean to an accuracy of 0.05K.

The in-situ temperature profile data will be used to validate upper ocean temperature models, which simulate skin SST from depth SST. A new method for SST validation will be tested by improving the spatial matchup between the in-situ data and satellite data with an improved method of skin SST measurement. In addition, a comparison of the SST products retrieved from ESA (SLSTR) and Chinese (GF, HJ) satellite data with different algorithms will be conducted.

The academic exchange and training for young scientists will be implemented between the organizations from Europe and China, including conducting joint investigation cruises, joint workshops and short research visits.
This work will be supported by the following ongoing projects:
1. The National Natural Science Foundation of China (NSFC) project: New methodology for validation of remotely-sensed SST (No. 41276182).
2. Innovation Research Project from Chinese Academy of Sciences: Remotely-sensed SST in South China Sea and accuracy assessment.

ABSTRACT 31451_5: "Atmospheric corrections"	
European Principal Investigator Dr. Samantha Lavender (National Centre for Earth Observation,UK)	***Chinese Principal Investigator*** Dr. Shilin Tang (South China Sea Institute of Oceanology, Chinese Academy of Sciences,CHINA)

The atmospheric correction is crucial for ocean color remote sensing as because more than 90% of the top-of-atmosphere radiance in the visible (VIS) bands measured by satellite sensors comes from a combination of atmospherically scattered radiation and surface reflection rather than from the ocean near-surface water reflectance. The traditional atmospheric correction method relies on the "dark pixel" assumption that the water-leaving radiance is zero at the NIR wavelength. This assumption will not be valid in shallow water or turbid. In this topic, two areas will be selected to compare the atmospheric correction techniques developed by the two groups. One is in the Pearl River estuary, which is a coastal region with high turbidity. The other is the Xisha Islands, which is a shallow water with typical coral reef in China.

The work will be supported by the following projects:
1. The Innovation Group Program of State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences (no. LTOZZ1503)
2. National project of basic sciences and technology of china(no. 2012fy112400)

ABSTRACT 31451_6: "Water exchanges (EPHESURS)"	
European Principal Investigator Dr. Federica Braga (ISMAR, CNR, Italy)	***Chinese Principal Investigator*** Dr. Qianguo Xing (YIC, CAS,CHINA)

This topic "Ecological and physical effects of the surficial and ground water exchanges between land and sea" is a continuing research plan since dragaon 3 programme (ID:10558). A specific paper on this topic will be published in 2016 on "Journal of Coastal Research". In this project, thermal and optical data (SST and Ocean Color data) are mainly used ot monitor the land-sea interactions and effects. We hope to continue to expore this interesting topic during the Dragon 4 period.

China coastal waters are highly impacted by significant hydrological processes such as morphological changes and mixing between continental fresh waters (surficial and groundwater) and marine waters. These processes generally take place in coastal areas because of human activities superimposed to natural processes. The salt contamination, water pollution and land sinking, are producing serious damages to the marine water, freshwater resources as well as jeopardize the eco-biological system. In order to perform a correct coastal management, hydrological processes have to be in depth understood. The occurrence of alternating dry/wet conditions in transitional environments, such as wetlands, deltas, and lagoons, usually challenges the use of traditional direct and geophysical surveys for comprehensive hydrogeologic investigations.

The object of the project is to implement a new monitoring system integrating various Earth Observation techniques, in situ measurements. Advanced remote sensing techniques integrating thermal, optical imageries will be applied in these areas. Thermal data will be used to detect sea surface temperature anomaly. Optical data will be used to monitor water quality parameters. EO techniques based on SAR interferometry might be used to find the ground subsurface deformation. Through the implementation of this project, regional remote sensing algorithms and retrieval models will be proposed for runoff discharge, submarine ground water discharge, salty water intrusion will be established for the coastal waters in the north side of Shandong Peninsula and other potential China coastal waters.

Scientific publications, participation to DRAGON4 meetings and young scientist training as well as dissemination are import outcomes of this project. Funding from Chinese Academy Sciences and other departments of China (NSFC, SOA etc) will provide financial support to carrying out the project, including field measurements and laboratory data analysis.