MONITORING FROM SPACE FOR OCEAN AND COAST SUSTAINABILITY

European Leader Investigator	***Chinese Leader Investigator***
Dr. Sven Jacobsen German Aerospace Center, GERMANY	Prof. Xiaoming Li Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, CHINA

List of Principal Investigators (PIs)

Topic Nr.	PIs	Title
32281_1	*Prof. Susanne Lehner,* *Prof. Ming-Xia HE*	***Derivation of ocean dynamic parameters from spaceborne SAR***
32281_2	*Dr. Konstantinos Topouzelis,* *Prof. Xiao-Ming Li*	***Marine pollution detection and tracing based on satellite observation and modeling***

EXECUTIVE SUMMARY

China and Europe, as the strongest economic regions, both own large coastal zones and open seas. Marine and coastal zones are playing more and more important roles in the economic development of the two continents. However, the vulnerability of regional seas and coastal zones are also experiencing huge pressure during the development. Therefore, marine and coastal sustainability is a very important issue that both China and Europe is facing now. Monitoring from space is playing an indispensable role in marine and coastal environment protection, which also has shown strong capability of promoting the sustainable development of marine and coastal zones. The proposed program aims at combining the information extraction from space data and numerical modeling to achieve the service from upstream to downstream in support marine and coastal sustainability. In particularly, we will focus on the following three topics: 1) Derivation of environmental factors in the marine-atmosphere boundary layer, such as ocean surface wind, wave, current, from spaceborne satellite data, particularly from spaceborne synthetic aperture radar (SAR) data;2) Combining the new satellite techniques, the derived marine-meteo parameters and numerical modeling for marine pollution detection and tracing; 3) Demonstrating the coastal monitoring system based on satellite observation for ocean and coast sustainability.The deliverables of the program will include: 1) Innovation methodologies and algorithms of deriving marine-meteo parameters from spaceborne SAR data; 2) detecting and tracing marine pollution (oil spill and algae bloom) using both optical remote sensing and spaceborne SAR data; 3) and demonstrating a pre-operational system for coastal protection based on satellite observations and numerical modeling. The funding to support the proposed program is mainly from three sources: 1) The respective inner funding supporting for international cooperation; 2) The respective research funding of each teams involved in the project; 3) Team members from China and Germany will also try to seek available Sino-Germany cooperation funding.

ABSTRACT 32281_1: "Derivation of ocean dynamic parameters from spaceborne SAR"

European Principal Investigator	***Chinese Principal Investigator***
Prof. Susanne Lehner	Prof. Ming-Xia HE
(German Aerospace Center,Germany)	(Ocean University of China,CHINA)

Derivation of marine-meteo parameters is actually one of the most important subjects of ocean remote sensing. The primary objective of launching ocean satellites, particularly the microwave satellites, is to derive ocean-atmosphere dynamic parameters, including sea surface wind, wave and currents, on which scientists have made significant efforts. On the other hand, for the sustainable development of ocean and coast, monitoring of element marine-meteo parameters is a basic but very important issue, which can contribute to better understanding the variation of ocean and coast, the interaction of ocean and coast.

Among various microwave sensors, spaceborne SAR is still the most attractive sensor which can yield various information of ocean. Therefore, the project still focuses on developing novel algorithms and methods to derive marine-meteo parameters, as well as on studying ocean dynamics based on spaceborne SAR observations in combination with other satellite measurements, in situ observations and numerical modeling.

The objectives of this project are summarized as followings:

(1) Develop novel algorithms of retrieving sea surface wind, sea surface wave, and sea surface current from new generation spaceborne SAR data including but limited to, Sentinel-1, TerraSAR-X/TanDEM-X, CosMo-SkyMed, Radarsat-2, and GF-3 data;

(2) Demonstration of near real time (NRT) service of SAR marine-meteo parameters in regional seas;

General methods

(1) For the sea surface wind retrieval, on one hand, the existed X-band GMF (XMOD2) to derive sea surface wind from TerraSAR-/TanDEM-X will be further improved, which will be also applied for the Cosmo-SkyMed data to verify whether the GMF functions as well. On the other hand, new methods will be also developed based on new mode spaceborne SAR data, e.g., the Compact Polarization SAR data.

(2) The empirical algorithm CWAVE_ENV for the ENVISAT/ASAR wave mode data will be transferred to Sentinel-1 wave mode, in particularly the algorithm will solve the difficulties of different incidence angles between the two consecutive acquisitions of Sentinel-1 wave mode. This will contribute to a continuous global ocean wave measurements using spaceborne SAR wave mode data. For regional NRT service, we will try the combination of specific empirical algorithms and the non-linear inversion approach.

(3) The SAR Along-track-interferometry (ATI) technique is so far the best way to derive sea surface velocity in high spatial resolution, though it only yields the speed component in the line-of-sight. In the project, we will attempt to find an appropriate methods of eliminating of other contributions to the speed component in addition to the sea surface current fields. On the other hand, new methods will be also developed, e.g., the Maximum Cross Correlation (MCC), based on spaceborne SAR satellite constellation.

Funding issues:

The funding to support the proposed project is mainly from three sources: 1) the respective inner funding supporting for international cooperation; 2) the respective research funding from each team. 3) the Sino-Germany cooperation funding planned to apply from the German and Chinese side.

ABSTRACT 32281_2: "Marine pollution detection and tracing based on satellite observation and modeling"

European Principal Investigator	***Chinese Principal Investigator***
Dr. Konstantinos Topouzelis (University of Aegean,Greece)	Prof. Xiao-Ming Li (Institute of Remote Sensing and Digital Earth, CAS,CHINA)

Along with the extensive development in the coastal zones, not only limited to the nearshore regions, but also far to the offshore regions, marine and coastal environment is experiencing increasing risk in the past decades. For instance, the marine environment of China has deteriorated over recent decades associated with increasing eutrophication and waste disposal. The widely known macro algae bloom occurring frequently in the Yellow Sea is a typical consequence. On the other hand, we human are drilling in the offshore to obtain oil and gas, in both the European (North Sea) and Chinese water (Bohai Sea). Therefore, oil spill pollution is indeed a great threat to the sustainable development of ocean and coast.

Remote sensing observations provide rapid, frequent, synoptic and long term measurements of the marine surface waters, and thus they are playing an important role in the monitoring marine pollution, e.g., oil spill, and algae bloom. Therefore, in the proposed project, we aim to:

1) develop novel algorithms/methods to detect oil spill and algae bloom using both spaceborne SAR and optical remote sensing data, e.g., MODIS, Sentinel-2, the Chinese GF-1 and GF-2;

2) Combing multiple satellite observation and numerical modeling to trace oil spill pollution and algae bloom.

3) Demonstration of coastal monitoring system of marine pollution based on space observation and numerical modeling.

General methods:

1) For the oil spill detection and discrimination using spaceborne SAR data, we will combine the new methods, for example, based on polarimetric SAR, and the traditional methods, e.g., neutral network. Multiple spaceborne SAR observations and the GNOME model will be used together to trace oil spill trajectories.

2) To detect algae blooms using optical remote sensing, the threshold method will be applied. The advective component of phytoplankton/algae bloom can be estimated using simulated drifters driven by sea surface current, sea surface wind and wave.

3) A web-based system by integrating multiple satellite observations and numerical modeling will be used to demonstrate the tracing of macro algae bloom (green tide) in the Yellow Sea.

Funding issue:

The funding to support the proposed project is mainly from three sources: 1) the respective inner funding supporting for international cooperation; 2) the respective research funding from each team. 3) the Sino-Germany cooperation funding planned to apply from the German and Chinese side.