NEW EARTH OBSERVATIONS TOOLS FOR WATER RESOURCE AND QUALITY MONITORING IN YANGTZE WETLANDS AND LAKES (EOWAQYWET)

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List of Principal Investigators (PIs)

Topic Nr.	PIs	Title
32442_1	*Dr. Claudia Kunzer,* *Prof. Yeqiao Wang*	***Water resource behaviours in Yangtze intermediate basin and wetlands' biodoversity (WaRYWeBio)***
32442_2	*Prof. Steven Loiselle,* *Prof. Hongtao Duan*	***New Earth Observation tools for biogeochemical studies of Yangtze Valley lakes (BioGeoLakes)***

EXECUTIVE SUMMARY

Dragon 4 EOWAQYWET built up on fruitful former Dragon2-3, is part of an integrated response to the Call Theme Hydrology & Cryosphere, being associated with "Cryosphere monitoring, snow, ice, glaciers & parameters" and " Multi - source hydrological data products to monitor High Asian River Basins and regional water security" projects leaded by M. Mementi and X. LI ; T. Bolch and T. YAO. EOWAQYWET consists in two sub projects WaRYWeBio, as "Water resource behaviours in Yangtze intermediate basin and wetlands' biodoversity and BioGeoLakes, for the ôNew Earth Observation tools for biogeochemical studies of Yangtze lakesö. Yangtze intermediate watershed contents 25% of the water resource in SE Asia, with 40% related to Poyang and Dongting Lakes. Yangtze wetlands and lakes, biodiversity jewels, deliver important ecosystem services such as flood regulation, water supply, and purification, food, recreational opportunities and climate regulation. Rapid changes the Yangtze Valley in terms of land use, demographics and economic conditions caused degradation and loss of wetlands as well as water eutrophication and pollution. The national and international community is called upon to provide novel monitoring and analysis tools for a more integrated and extensive management of these important resources.Objectives:ò Improve knowledge on water resource behaviours and water quality at lakes and intermediate Yangtze watershed scalesò Analyse the wetlandsÆ dynamics in order to have better understanding of the abundance of migratory wildfowl in relation to changes in Yangtze wetlandsò Development of EO based products to support improved decision makingò Qualify/quantify impact of meteorological, climatic and entropic parameters within a climate change context on water resources and quality Methods:ò Exploiting synergies between in situ measurements, acquired regularly in field and gauge stations as well during specific fields campaigns, and EO data, multi sources and multi-resolution data set: Sentinel series, TPM data, as well as Chinese satellites, this EOWAQYWET project addresses following sub-topics:ò Water surface and height seasonally behaviours based on long time EO series For water extent extraction and monitoring, crucial important issue, providing exploitable fundamental results for all others WPs. Automated or semi automated methods based on S1 and S2 will be set up, tested and validated. Water height will be derived from Alkita, Jason2/3, and of course SARL on S3 ò Wetlands vegetations mapping and inter and intra annual dynamics analysis exploiting HR and VHR space and UVA born sensors Comparison of flyway, time of residence, density of wintering wildfowl and biophysics parameters derived from EO data (vegetation type & stage, water occurrence, external factors..). Development of advanced algorithms characterizing optically complex waters, addressing: dissolved and particulate carbon concentration, algal blooms, black water events, macrophyte productivity, lake surface temperature, suspended inorganic matter, and biogeochemical modelling. Dynamics analysis of water resource in terms of cycle and sub cycle, relationship between indicators (water surfaces, water level, rainfall, evaporation, meso-scacle events ENSO, SOI,) will be investigated based on statistical techniques such as wave analysis. Water quality modelling to identify hydrodynamic water quality links based on EO data (LUCC,precipitation, evaporation and soil moisture, etc.) with respect to changing hydrological regimes, land cover and climate change. Funding will come from all ready ongoing projects in EU and China, EU FP7 INFORM, EU Ground Truth 2.0, CAS and NSFS, CNES RT projects. Participation of researchers and PhD students will be facilitated by CAS Strategic Leading Projects, Marie Curie, bilateral agreements as well as ESA Dragon grants 2016

ABSTRACT 32442_1: "Water resource behaviours in Yangtze intermediate basin and wetlands' biodoversity (WaRYWeBio)"

European Principal Investigator	***Chinese Principal Investigator***
Dr. Claudia Kunzer	Prof. Yeqiao WANG
(DLR,Germany)	(Nanchang Normal Un.,CHINA)

Successor of the very fruitful flood Dragon 3, facing challenges such as, water resources, environmental preservation, and public health, a new project is set up. Having water monitoring for wetland understanding and preservation as the corner stone, its goals are: 1- large and small water bodies monitoring, in terms of water extent and height, 3- wetland ecosystem understanding, 4- regional interaction and global context. Project presents a re-centered partnership extent around partners from two previous DRAGON3 projects, "flood-wetland -10557-" and "Dongting Lake flood dynamics -10697-", in terms of geography. it will be focus on the middle and lower Yangtze reaches, as, few hundred millions of inhabitants downstream of 3 Gorges dam, depend directly on the services that wetlands provide: regulating services such as flood storage; provisioning services such as fishing. From the largest Poyang and Dongting, it also includes smaller lakes, downstream in Anhui province, such as the Wuchang, Shenjin, Baidang….

WP1: Water extent monitoring: 1- insure the continuity of the monitoring ongoing since 2000 over Poyang and Dongting lakes, with temporal frequency of ten days based EO multi-mission resource; 2- develop the similar approach for smaller water bodies, exploiting archives and based on higher resolute data such as CSK, TerraSAR strip map and the Sentinel 2. DLR and SERTIT are participating tot the development of Sentinel 1 and 2,auto and semi automatic processing chains for water bodies extraction which would be validated, modified and reinforced thanks to the processing of times series over Dragon test sites.

WP2: Water height monitoring from space. Insure the continuity of the monitoring of the two largest lakes; Integrate more virtual gauge stations, about 50, all over the Yangtze course and associated lakes, compared and validated thanks to situ gauge measurements. Particular attention will be paid on new missions Sentinel3 and coming Jason 3.

WP3: Wetland mapping and biodiversity values analysis will be focused on the interaction between vegetation resources, water cycle analysis and human interactions and biodiversity. High resolution and superspectral imagery will be exploited for mapping the vegetation phenology and quality (in terms of feeding resources for birds). Associated with the water quality part of the project, part of the work will be focus on the inter and intra annual variations of floating and submerged vegetation. Theses vegetation are an interesting flap in term of water quality in regards to biodiversity. Plus, antropic elements, (dikes, tree planting, fishes farm / traps), will be derived from HR and VHR imagery. Final aim is to model, map and explain the distribution of biodiversity and their associated habitats, explaining spatio-temporal changes in biodiversity caused by biotic and abiotic factors.

WP4: Regional and global interactions. It consists in a better understanding of the monsoon lakes behaviors in a regional and global change context, enhancing potential drought tendency since the mid of the 2000 years with also a more and more earlier draw off of the water from the largest lakes (initially in mid September now regularly observed thanks to time series analysis in mi July , beginning of August. Rainfall, evaporation, river flows will be taking in account within component multi-scale analysis (wavelet…), of course attention will be paid to the influence of management of the 3GD as well as sans dragging in the lakes. Within this WP6 the cooperation with others DRAGON4 projects on water resource analysis, water cycle, cryosphere, will be tasked.

All along these WP, an important part is dedicated to the exploitation of multi-mission data, with the processing of SAR and optical imagery obtained by European sensors and TPM (Rapid eyes, CSK), and Chinese missions (Beijing 1, HJ-1AB). Sentinels constellation will be the key data of this project .

Project funding is coming from already ongoing international, bilateral projects, or nationales ones, both in EU and PR China, such as 1000 Talents, RT CNES on Sentienel Exploitation... Participation of research and students partially already handled will be reinforce thanks to ESA grants.

ABSTRACT 32442_2: "New Earth Observation tools for biogeochemical studies of Yangtze Valley lakes (BioGeoLakes)"

European Principal Investigator	***Chinese Principal Investigator***
Prof. Steven Loiselle (Univ. Siena,Italy)	Prof. Hongtao Duan (Nanjing institute of geography and limnology,CASli,CHINA)

The 2030 Sustainable Development Goals identify water and its management as crucial for providing the economic, social and environmental well-being of the present and future generations. The Yangtze River (Chang Jiang) is the longest river in Asia (6300 km) and has a drainage basin covering 18.8% of China. This basin includes important cities (e.g. Shanghai, Nanjing, Hefei, Changsha, Chongqing) and agricultural areas which contribute more than 40% to the national population and GDP. Water plays a central role and there are more than 600 lakes in the basin, including four of China's largest. These lakes play a fundamental role in regional biogeochemical cycles and provide major services to the regional communities. However, the extreme temporal and spatial variability of these massive but extremely shallow ecosystems prevents a reliable quantification of their dynamics with respect to changes in climate and land use. As a result, these ecosystems are poorly understood which has resulted in an unprecedented degradation. This has resulted in major changes to ecosystem productivity and functioning, with clear impacts on nutrient and carbon budgets. The national and international community is called upon to provide novel monitoring and analysis tools for a more integrated and extensive management of these important resources.

In the present sub-project, leading partners from China and EU will build upon the results of successful Dragon 3 projects to develop new methods to identify the dynamics and tipping points of nutrient and carbon dynamics in Yangtze Valley lakes. This will be achieved through a synoptic approach based on integrating Earth Observation (EO) methods, including past and future multispectral and radar imaging system. The present project will take advantage of the expertise and strong collaboration of partners to meet two main objectives: the development of new EO based methods for the analysis of the dynamics of water quality and carbon in optically complex lakes with respect to land use, climate and hydrological changes; the development of EO based instruments to support improved decision making. This project is paired with the coincident WaRYWeBio project, focusing on biodiversity in the same area and ecosystems, within the EOWAQYWET project.

The study lakes include Lakes Chaohu, Dongting, Poyang, and Taihu, all characterised by complex optical conditions (Case II waters), with seasonally and spatially bio-optical properties. The approaches and products of the project will make significant contributions to water resource management in South Asia, Africa, Europe and South America and provide new insights into the fundamental biogeochemical processes of lake functioning and their role in the larger (catchment and global scale) environmental balances.

Research activities will be characterised by an interdisciplinary, multi-scale approach conjugating EO with biogeochemistry:

• WP1) advanced algorithms for characterizing optically complex waters, addressing: dissolved and particulate carbon concentration, algal blooms, black water events, macrophyte productivity, lake surface temperature, suspended inorganic matter, vertical diffuse light attenuation and hydrology;

• WP2) quantitative analysis of the spatial and temporal lake dynamics, in terms of particulate and dissolved carbon and nutrients (N and P), with reference to primary productivity and hydrology and linking past and future EO data sources will be carried out,;

• WP3) biogeochemical modelling of shallow lake systems, incorporating satellite estimated bio-optical, LST and water level characteristics, in-situ measurements and controlled (micro and mesocosm) experiments to determine the links between catchment-related, climatic and hydrological conditions and lake carbon, nutrient and bio-optical dynamics;

• WP4) water quality modelling to identify hydrodynamic – water quality links based on EO data (LUCC, precipitation, evaporation and soil moisture, etc.) with respect to changing hydrological regimes, land cover and climate change.

The project will benefit from ongoing and past research in financed projects in both China and the EU, including; EU FP7 INFORM, EU Ground Truth 2.0, EU Circle ERA Net, EU SESAME, CAS Projects (KZCX2-YW-QN311 & KZCX2-EW-QN308) and NSFC project (41331174; 41431176) . The participation of junior researchers will be facilitated by CAS Strategic Leading Projects XDA05050106 and Marie Curie 2016. Researcher mobility will be funded by grants from the Chinese Academy of Sciences and EU partner funds.