Remote Sensing Based Monitoring of Carbon Sequestration, Degradation and Emission in Coastal and Inland Ecosystems (CarbMonit)

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Coastal and inland waters play a vital role in carbon sequestration and exchange. Recentestimates show that even though these ecosystems occupy only a small fraction of the Earth's surface, they play a quantitatively significant role in the global carbon cycle and hence in the climate system. However, this active role remains poorly understood, as carbon sources, carbon sinks and sedimentation in these complex ecosystems is highly sensitive to catchment conditions, climate and ecosystem management. Because climate change will modify catchment sources, local hydrology and degradation processes, significant modifications on carbon sequestration and emission to the atmosphere is expected in the coming decades.

In the present proposal, leading research institutions in China and Italy will work in close collaboration for two years to examine several key mechanisms in carbon sequestration and release from European and Chinese aquatic ecosystems and develop new technologies to improve our analysis and monitoring capacities.

The two main objectives of this proposal are: the development of algorithms for the analysis of carbon dynamics in optically complex aquatic ecosystems; the development of models to examine temporal and spatial variability carbon related bio-optical properties of major aquatic ecosystems in Europe and Asia.

The study areas considered include the lakes and impoundments of the lower reaches of the Yangtze River, the Yangtse River Estuary, and the coastal lakes and coastal waters of the Tyrrhenian Sea. These ecosystems, characterised by complex optical conditions (Case II waters), require new algorithms for the estimation of bio-optical properties, fundamental to improve our understanding of carbon dynamics.

Research activities will focus on the development of; 1) radiative transfer models to analyse the light-field modulation due to the high turbidity; 2) MERIS, HY-1B, CZI algorithms to examine the spatial and temporal dynamics of dissolved and particulate carbon in Case II waters; 3) carbon emission models incorporating satellite estimated optical and infrared characteristics, in-situ measurements and laboratory experiments. By combining radiative transfer models with carbon models, fundamental information on photodegradation, phytoplankton net production, bacterial activity and organic carbon deposition will be gained. The resulting estimates of the short term sequestration and release of inorganic/organic carbon and the long term deposition of organic carbon will be examined in relation to lake basin and climate scenarios.

In situ research will be performed as part of the following financed projects; Medcodyn (EU Circle ERA Net), EU SESAME integrated project and Chinese Academy of Sciences Knowledge Innovation Projects (KZCX2-YW-QN311 & KZCX2-EW-QN308). The participation of junior researchers will be facilitated by Strategic Leading Projects of Chinese Academy of Sciences: Carbon Budget Certification and Its Related Issues on Climate Change (XDA05050106). Researcher mobility will be funded by related grants from the Chinese Academy of Sciences and the University of Siena.

Gaining a better understanding of the dynamics of carbon (sequestration and release) in aquatic ecosystems represents a major international challenge. A clear benefit of the present research is to provide new bio-optical instruments to the study of the potential feedback between the changing global climate and carbon emissions from this high productive ecosystems.

沿海和内陆生态系统中碳的固定、降解及释放的遥感监测

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沿海及内陆水体在固碳和碳交换中起着非常重要的作用。最新研究表明，尽管这些生态系统仅占地球表面的一小部分，但在全球碳循环乃至气候系统中扮演着举足轻重的角色。在复杂生态系统中，流域环境、气候和生态系统管理对碳源、碳汇以及碳沉积的影响甚为显著，故而造成了沿海和内陆水体对其的影响鲜为人知。受气候变化可能改变流域汇集源、水文状态及降解过程的影响，碳的固定及释放将会在今后的几十年间发生显著的变化。

中方和意（大利）方研究人员将在本项目中通力合作，研究欧洲和中国水生生态系统碳的固定和释放过程中的几个关键机制，并将研发新的技术手段来提高现有的分析和监测能力。

本项目的主要研究目标包括：（1）改进或发展新的适用于碳动力过程监测的生物光学特性反演算法；（2）研发适用于欧洲和亚洲主要水生生态系统中的碳相关模型，初步揭示这些水体的生物光学特性的时空变异特征。研究区域包括中国长江下游的部分湖库（包括长江口）以及欧洲第勒尼安海的沿岸水体和近岸湖泊。

本项目的具体研究内容包括：（1）研发适合于高浑浊度水体的辐射传输模型；（2）基于MERIS、HY-1B、CZI数据，构建溶解态和颗粒态碳的反演算法；（3）基于卫星反演结果，借助现场测量和室内试验，研发碳释放模型。辐射传输模型和碳模型的耦合，将有助于我们获取光降解、浮游植物净生产力、细菌活性和有机碳沉降等的基础性信息。

本项目将在以下项目的支持下完成：Medcodyn（EUCircle ERA Net）、EU SESAME、中国科学院知识创新工程（KZCX2-YW-QN311 & KZCX2-EW-QN308）。年青的研究者还将受到中国科学院战略性先导科技专项课题"陆地生态系统固碳参量遥感监测及估算技术研究"（XDA05050106）的资助。研究员们的交流也将会受到中国科学院和锡耶纳大学的相关支持和赞助。针对水生生态系统中碳动力过程的进一步认识和理解，是一个富有国际挑战性的学术课题。

本项目将为高生产力的生态系统中碳的释放与气候变化间的潜在反馈机制提供一个全新的生物光学研究手段。