Close Water Cycle at the River Basin Scale Using Remote Sensing Data

European PI(s)
Prof. Harry VEREECKEN, h.vereecken@fz-juelich.de

Chinese PI(s)
Prof. LI Xin, lixin@lzb.ac.cn

The overall objective of this project is to close the water cycle at the river basin scale. Water budget components including precipitation, evapotranspiration (ET), soil moisture (SM), snow water equivalent (SWE), runoff, and groundwater storage will be estimated using multi-source remote sensing observations and corresponding time series products of these variables will be generated. These products, in combination with hydrology and land surface modeling will be integrated by data assimilation methods to precisely close the land water budget at the river basin scale.

Research Content

The proposed project will be performed in the Heihe River Basin (HRB), China, as well as the Rur Catchment (RC), Germany. In cooperation with other funded projects, three key experimental areas (KEAs) will be identified to conduct intensive and long-term observations which are distributed in the up, middle and down streams of the HRB. Similarly, within the RC three KEAs, namely Selhausen (agriculture), Rollesbroich (grassland) and Wuestebach (forest) are intensively instrumented by the Terrestrial Environmental Observatories (TERENO) long-term research initiative. In order to reach the overall goal, the following steps are important: First, estimation approaches for the key hydrological variables, i.e., precipitation, ET, SM, SWE and groundwater storage will be further developed and validated based on the good foundations we have laid during the Dragon 2 period. Secondly, by continuously accumulating various satellite observations and combined with the outcomes of the developed retrieval algorithms, we intend to create a series of basin scale remote sensing products regarding those water cycle components, such as ET (1km), SM (1km), SWE (1km) and precipitation (10km) in the selected research river basins from 2012 to 2015. Thirdly, based on the land data assimilation method, the created remote sensing products will be merged into hydrological and land surface models to obtain high-resolution, spatiotemporal consistent data sets in order to close the land water budget at the river basin scale and to improve the predictability of water resources.

Deliverables

1. Annual scientific progress reports on Dragon 3 programme symposiums.
2. Improved estimation approaches for the key hydrological variables, i.e., precipitation, ET, SM, SWE and groundwater storage.
3. Time series of basin scale remote sensing and assimilated data products, e.g. ET, SM and SWE over both study areas from 2012 to 2015.
4. Reports and documents on the performance of the retrieval algorithms.
5. Final report that consists of the assessment of the ESA&#65533;&hibar;s data applicability in the study areas, the improved estimation methodologies for the key hydrological variables and an integrated study to close the land water budget at basin scale.

Funding

This research will be financially supported by:

1. Heihe Watershed Allied Telemetry Experimental Research (Hi-WATER): A project group funded by the National Natural Science Foundation of China.
2. Methodology and experiment for remote sensing scale transformation supporting the integrated research on the eco-hydrological processes of the Heihe River Basin: A Main Direction Program of Knowledge Innovation of Chinese Academy of Sciences.

3. Predicting hydrological fluxes in the Haihe river basin using remote sensing and data assimilation methods: DFG/NSFC Germany-Sino cooperation project.
4. Long-term validation of SMOS data products and parameter retrieval for the SMOS Level-2 processor with data assimilation methods: German Ministry of Economics and Technology.
5. SMos data ASsimilation for PARameter EStimation in hydrological and radiative transfer models: ESA Support to Science Element.

利用遥感数据闭合流域尺度水循环

中方项目负责人：李新研究员
欧方项目负责人：Prof. Harry Vereecken

摘要

本课题的总目标是闭合流域尺度水循环。遥感观测将用来估算水循环中的重要分量，包括降水、蒸散发、土壤水分、雪水当量、径流以及地下水，并且生产这些变量的时间序列产品。最终，在陆面数据同化的统一框架下，集成这些遥感产品，并结合水文模型和陆面过程模型，精确闭合流域尺度水循环。

研究内容

本课题的研究工作将在中国的黑河流域和德国的Rur流域进行。在"黑河生态水文遥感试验（HiWATER）"及其他项目的支持下，我们将在黑河流域上、中、下游各建立一个重点试验区以开展加强或长期观测。同样，在Rur流域，我们也将根据不同的地表覆盖建立三个重点试验区，分别为Selhausen（针对农田），Rollesbroich（草地）和Wuestebach（森林），这几个试验区有很好的观测基础设施，如陆地环境长期观测系统（TERENO）。为了实现课题设定的目标，研究工作将分为以下几个重要步骤：

1. 在"龙计划"2期成果的基础上，进一步发展和验证针对水文变量的估算/反演方法，如降水、蒸散发、土壤水分、雪水当量和地下水储量。
2. 在以上算法发展的基础上，随着卫星遥感观测的不断积累，我们将生产从2012到2015年，试验流域的几个重要变量的遥感产品，如蒸散发（空间分辨率1 km）、土壤水分（1 km）、雪水当量（1 km）和降水（10 km）。
3. 依靠陆面数据同化的方法论，将以上得到的遥感产品与水文模型和陆面过程模型结合，获得高分辨率的，时空一致的数据集，从而实现精确闭合流域尺度水循环和提高水资源预报精度的目标。

产出物

1. 在"龙计划"3期研讨会上展示年度研究成果。
2. 发展针对水文变量的遥感估算方法。变量包括降水、蒸散发、土壤水分、雪水当量、径流以及地下水。
3. 2012至2015年，流域水循环变量的遥感和同化产品时间序列，如蒸散发、土壤水分、雪水当量。
4.所发展的遥感反演算法的性能报告和算法文档。
5. 对ESA卫星数据在研究区可用性的定量评价，发展的水文循环变量遥感估算方法，以及针对闭合流域水循环的集成研究等内容的最终成果报告。

资助情况

本课题可以获得以下项目在经费上的支持：
1. 国家自然科学基金委资助项目群：黑河流域生态-水文过程综合遥感观测联合试验。
2. 中国科学院西部行动计划项目：黑河流域生态-水文遥感产品生产算法研究与应用试验。
3. 中德合作项目：利用遥感数据和数据同化方法预报海河流域水文通量。
4. Long-term validation of SMOS data products and parameter retrieval for the SMOS Level-2 processor with data assimilation methods: German Ministry of Economics and Technology.
5. SMos data ASsimilation for PARameter EStimation in hydrological and radiative transfer models: ESA Support to Science Element.