# Support of integrated water resources management by hydrological modelling and remote sensing of arid and semi-arid ecosystems in the Tarim basin BL/01/C39-40

**(Geographic) study area (country/region) :** China, Xinjiang Province

**Data used:** Meteorological and Hydrological datasets Tarim river basin

**Satellite imagery used:** Aqua/Terra MODIS, VEGETATION S10 NDVI, LANDSAT TM/ETM+, Chinese meteo (geostationary) satellite FY2C for period April – December 2005

## Context and objectives

The project aims to deliver a significant contribution to the water management problem solving in the Tarim river basin of the Xinjiang Province of the P.R. China. The Tarim river and basin forms one of the world's largest closed hydrological drainage systems, forms ideal land for agriculture (e.g., cotton production), but suffers from reduced water availability. Since the 1950's, excessive land reclamation, over-grazing, unreasonable utilization of water resources in the upper reaches of the basin in combination with temperature increase due to climate change, have intensified environmental deterioration. Since the 1970's a strong dry-out of the lower region has been observed. This dry-out seriously deteriorated the basin's downstream ecosystems, with an expanding desertification along the lower reaches of the river. In order to meet these problems, there is a strong need for integrated and sustainable water management planning in the region. The set-up of a comprehensive and integrated decision support system for the entire basin, based on **linked hydrological and ecological model**s, is identified as a basic research need. The research project contributes to this, and will set up a prototype decision support system. The project activities are linked with the HELP Programme of UNESCO, which has the Tarim basin as one of the study areas.

## Methodology

In order to meet the objectives, the project will:

- develop a regional surface water model on the basis of lumped conceptual rainfall-runoff models and river hydraulic models;
- investigate the interaction between the surface and groundwater for a selected sub-region of the Tarim basin, based on a distributed hydrological model linked to a hydraulic river model;
- produce rainfall, evaporation, snow cover and depth, soil moisture and land use data based on earth observation techniques
- produce earth observation input data for the hydrological models;
- analyse indications of long-term changes in land cover over the Tarim basin, and investigate the impact of these changes on the hydrology of the basin with available remotely sensed data.

## Results

- Remote sensing data acquired and remote sensing products developed for rainfall, evaporation, snow cover and depth, soil moisture and land use, daily for April – December 2005
- Earth observation based input data for the hydrological models, in the form of daily time series for the period April – December 2005
- Earth observation based sub-basins' averaged rainfall and evaporation input data for the hydrological models integrated with ground station data (after consistency check and quality control, and after temporal and spatial interpolation): daily time series for the period October 2004 – April 2006, and some periods in early 1980s
- Results of statistical time series processing of river flow series on baseflow, interflow and overland flow subflows, nearly independent quick and slow flow maxima and minima (peak and low flow extremes)
- Results of hydrological extreme value analysis of river flow series: flood and low flow frequency distributions
- Regional surface water model, and coupled river-groundwater model for the downstream Tarim region and the Kaidu sub-basin: model-structure identified, model parameters calibrated, validated and regionalized, and land use trends simulated

- Training and dissemination of earth observation products, remote sensing data processing techniques and hydrologic-hydraulic modelling tools to local partners

## Products and services

Remote sensing products:

- Aqua/Terra MODIS and VEGETATION S10 NDVI based actual evaporation, snow cover, snow depth, and soil moisture estimates, daily for April – December 2005
- LANDSAT TM/ETM+ based land cover maps, for selected dates
- FY2C satellite based rainfall maps, daily for April – December 2005

Hydrological/hydraulic water management decision support tools (software):

- regional surface water model implemented in the VHM software of K.U.Leuven and the MIKE11 software of DHI Water & Environment
- river-groundwater model for the downstream Tarim region and the Kaidu subbasin, implemented in the coupled MIKE11 – MIKE/SHE software of DHI Water & Environment

## Execution

**Period:** 01.12.2005 – 31.05.2008

**Research Team:**

- Katholieke Universiteit Leuven (K.U.Leuven), Hydraulics Laboratory ( Prof. P. Willems)
- Vlaamse Instelling voor Technologisch Onderzoek (VITO), Centre of Expertise of Remote Sensing and Earth Observation Processes ( Dr. F. Veroustraete, Dr. Q. Dong)
- Xinjiang Institute for Ecology and Geography (XIEG) of Chinese Academy of Sciences (CAS), Urumqi, China (X. Chen)
- Tarim Water Resources Management Bureau (TMB) in Korla, China
- Xinjiang Meteorological Administration (CEM/XMB) in Urumqi, China

## Discipline

Hydrology & freshwater resources
Integrated water management
General Earth observation
Hardware & software