Water Cycle and Climate - Research performance 2008

Summary

This research theme broadly addresses the following clusters of science and application profiles with the central aim of advancement of our understanding of the water and energy cycle and their interactions with climate, ecosystem and human activities:

Cluster 1 - Water and climate:
- Water, energy and carbon flow between soil, plants and atmosphere (precipitation, evaporation, transpiration, runoff, soil moisture, net radiation, heat flow and photosynthesis).
- Agricultural water use, crop growth and food security, with application to dry areas.

Cluster 2 - Water and ecosystems: Water quality (lakes, wetlands, rivers, coastal areas) and integrated water and environment management.

Cluster 3 - Water resources and security: Climate change adaptation in water resources; (global) earth observation data integration in water resources modeling and management studies; risk analysis in water resources using earth observation data (water erosion, sedimentation, water contamination risks), earth observation for Integrated Water Resources Management (IWRM) in (international) trans-boundary basins.

Externally funded research projects and PhD research projects are organized around these clusters.

To stimulate awareness and exchanges of research ideas, we have organized colloquia, joint lunch talks with the Department of Water Engineering and Management of the University of Twente, and seminars. The WRS/ITC colloquia series aims to increase the awareness of ITC colleagues in the recent Progress in Earth Observation and Water Resources. Expert colleagues from other universities and research organizations were invited for lecturing on the progresses and trends in their expertise fields. The lunch talks and seminar series aims to increase the interactions and awareness of WRS colleagues in each others' ongoing research activities and projects.

Scientific level

The WCC PhD candidates include students funded by scholarships, sandwich construction (co-funding by collaborating partners), ITC internal funding and external research funding agencies (EU, ESA, NWO).

External projects were realized mainly by means of joint research and education projects with partner institutions in related applications in water resources management, hydrology, global change, ecosystem monitoring, assessment and predictions. Ongoing research projects were conducted for EU, ESA, NWO-SRON, WOTRO programmes. Several new research projects were kicked-off in 2008, including the FP7 CEO_AEGIS project and the ESA-MOST Dragon II programme.

Overview of external funded WRS projects 2004 – 2012 - Contract research (2nd en 3rd budget)

Project acronym	Funding organisation	Period	Amount (€)
WACMOS	ESA	2009 – 2011	500,000
CEOP-AEGIS	EU-FP7	2008 – 2012	320,413
IWHR	IWHR	2008 – 2009	28,836
SENTINEL3 LSG	ESA	2008 – 2009	30,800
FLEX	ESA	2007 – 2008	20,000
EKP-MAHAKAM	WOTRO	2007 – 2011	95,350
EKP-BERAU	WOTRO	2006 – 2010	136,280
NWO EcoRTM	SRON	2004 – 2009	374,035
DRAGON YS	ESA	2005 – 2008	34,600

Many staff and PhD candidates participated in various international symposia, meetings and workshops, and chaired and co-chaired sessions and gave invited or key-note talks. All of these activities were important for network building and were largely funded by external research projects.

Many staff are active members of the various national and international scientific and professional societies (AGU, EGU, IEEE, IAHS, etc.) in personal capacity, participating in various international symposia, meetings and workshops. In particular, memberships in the FLEX Mission Assessment Group (W. Verhoef), Chairman of sub-division on remote sensing and data assimilation of the European Geosciences Union (EGU, Z. Su), the International Scientific Steering Committee of the Hydrological cycle in the Mediterranean EXperiment (ISSC HyMeX) (Z. Su) and the Earth Science Advisory Committee (to the director of Earth Observation Programmes of ESA) (Z. Su) are high profile representation of WRS/ITC.

WRS also coordinates ITC's contribution to the GEO capacity building committee (C. Mannaerts).

Both W. Verhoef and Z. Su were appointed as guest professors by the State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan University, Wuhan, in October 2008 for their lecturing in the ESA-MOST Dragon II advanced training course in land remote sensing.

Several WRS staff have continued to serve as reviewers for scientific journals and funding agencies.

The scientific level of the published papers is very high, among the highest in the respective disciplines and with increased citations. The H-index of the research leaders are in 10~12, with a 20% increase compared to a year ago, and is well about the average of both the remote sensing and hydrology groups in the Netherlands.

Relevance

WRS continued its efforts in setting up of the ITC Earth Observation Research and Education sites. The set-up of the Lattrop COSMOS site is in progress with support from the local government, the COSMOS, the Natuurmonumenten and the Waterboard Regge and Dinkel; the Speulderbos forest site is in operation in collaboration with RIVM, ECN and Wageningen University; the Tibetan plateau sites are in operation in collaboration with the Chinese Academy of Sciences, where we have put in operation two regional soil moisture monitoring networks for calibration and validation of satellite products. Completion, upgrading and establishment of additional instrumentation and database will be continued further in 2009.

WRS maintains the ITC MSG GEONETCAST facility and continues efforts in developing applications and training packages. This facility has proven instrumental in several PhD and MSc research projects and is also used in the EU FP7 DeVeCoCast Project.

The upgraded "Supercomputer" Linux station X5 has been used extensively for running of several high-end radiative transfer codes and modelling systems by several PhD projects. This needs to be further maintained and enhanced in 2009. Software development efforts were concentrated on supporting research needs of PhD students and external research projects. Several algorithms implemented were successfully used in training courses and are being used in PhD and MSc research projects.

All these facilities and research datasets and earth observation sites are increasingly being integrated in regular education activities.

Our research activities are carried out in collaboration with leading research institutions in various ESA, EU and international projects. International recognition is by the organizing of the ESA-MOST Dragon advanced training course in land remote sensing and lecturing by Prof. W. Verhoef and Prof. Z. Su.

Partners

Our research partners are strong research groups in the geosciences and earth observation areas. More details of these collaborative partners can be found on the project listing of the ITC research website.

Coherence

As a whole the research theme has a strong coherence within the theme and in step with international scientific developments. Links to other themes (participation in PhD and MSc supervisions in other themes and other educational courses has increased with respect of 2007). This is also judged by its strong publication records (20% of ITC total ISI publications) and strong external research funding.

Evaluation

The scientific publication level and the successful acquisition of external research funds can be evaluated as being very positive. The active participation of the team members in various high-profile committees and consortia are clear indicators of international recognition of our research activities. It was felt that the major contributions in activities and achievements were centered around a few senior staff members. Efforts will continue in 2009 to further stimulate the active participation of and taking up of responsibilities by younger staff. In the current allocation model of research resources in ITC, no stimulation is put on the acquisition of external research funding (nether reflected in the research time nor in research budget allocation), thus constitutes a threat to the sustainable development of research capacity in the longer term, especially those funded by external sources that are often used by the academic world as a measure of vitality of a research group.

Annex: Some examples of research activities in 2008

Example 1: The Field Work in the Badain Jaran Desert, China
(PhD candidate: Yijina Zeng)

The coupled liquid and gaseous water movement in soil is the fundamental factor in the quantification of soil heat flux and surface evaporation, which is subsequently critical in the physics of land-surface processes on regional and global scales, in particular in relation to mass and energy fluxes between the ground and the atmosphere. As a part of work to quantify the detailed coupled liquid, vapor and heat flow processes in the arid region in China, the field work was conducted in the Badain Jaran Desert from 31 May to 21 August 2008 (Fig.1). During the observation period, the complete soil physical parameters and micrometeorological parameters were recorded with an interval of half-hour. With the field data and a soil water balance model, the diurnal patterns of the driving forces for coupled transport were plotted (Fig.2). Accordingly, the preliminary result of the soil moisture flux shows that the drying process in the desert sand is mainly controlled by the soil temperature gradients (Fig.3).

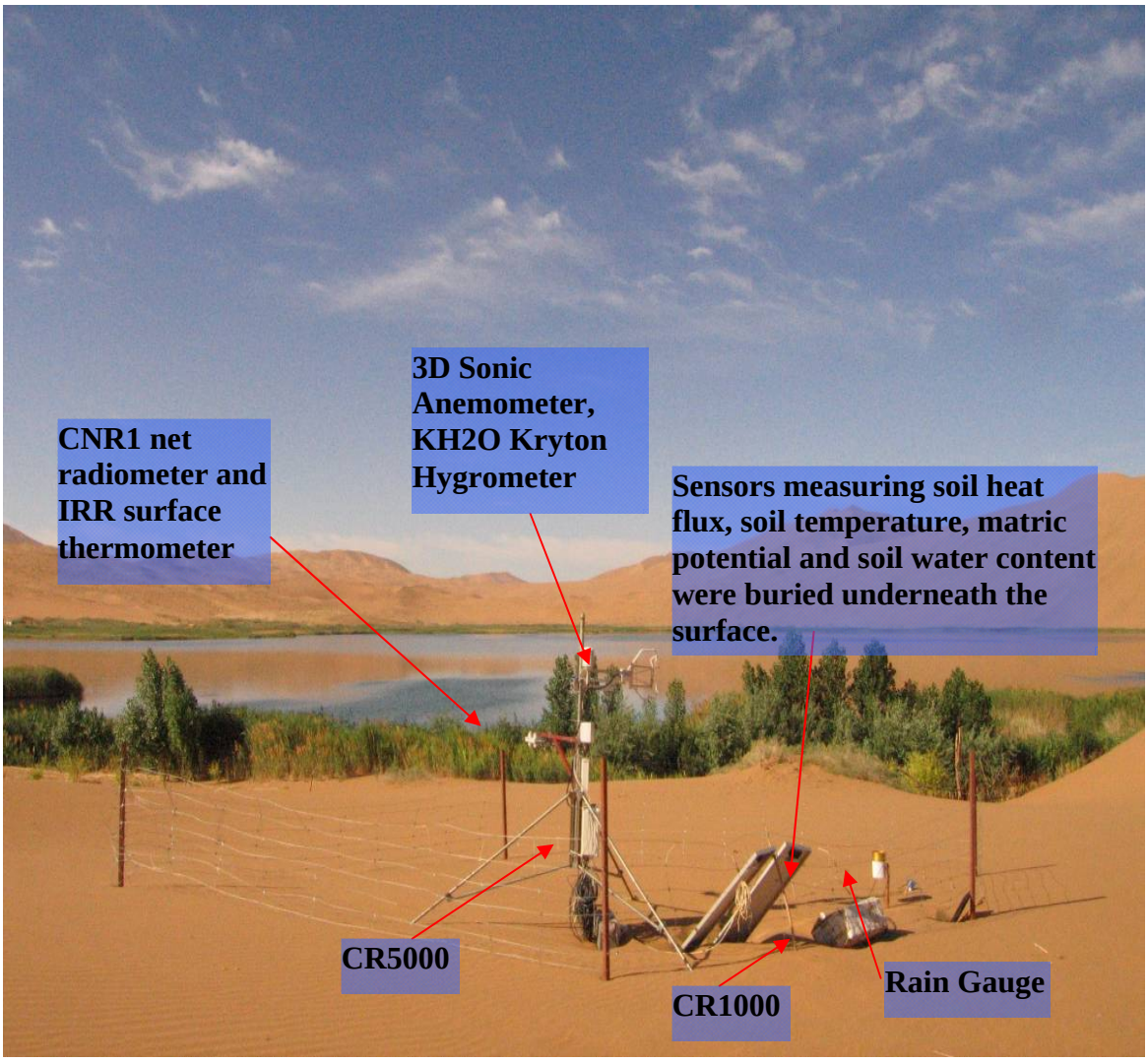


Fig.1 The picture of the field scale site in the Badain Jaran Desert

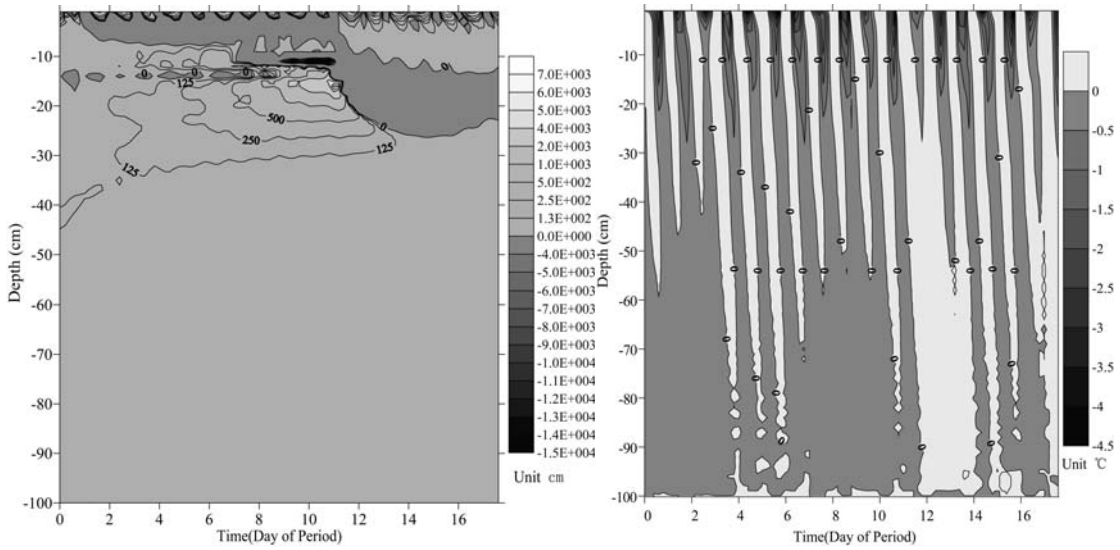


Fig.2 The driving forces pattern: a) the soil matric potential gradients; b) the soil temperature gradients

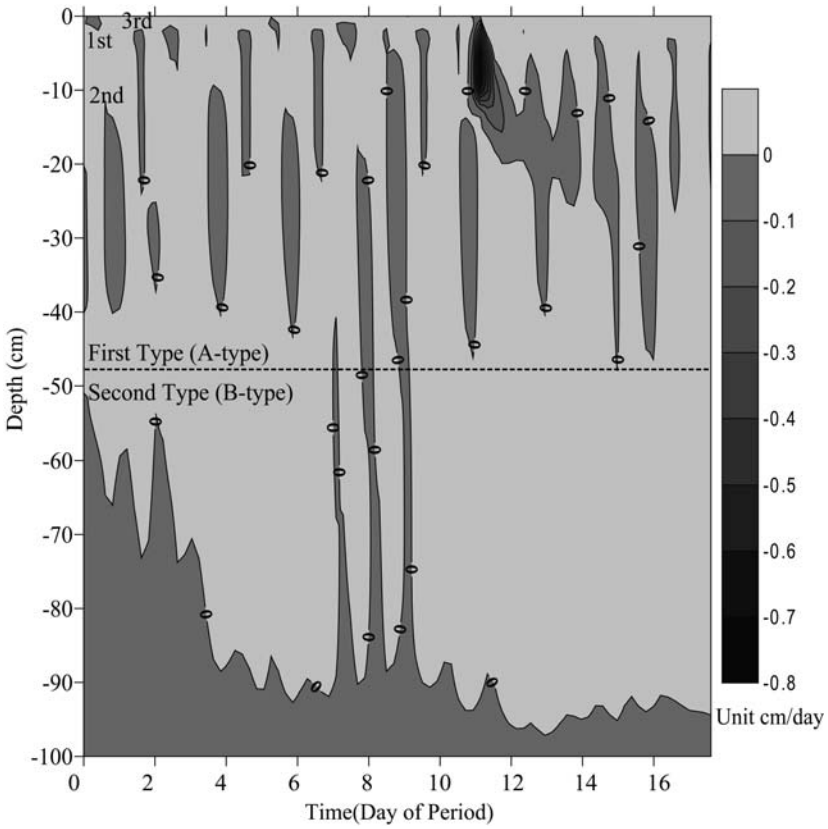


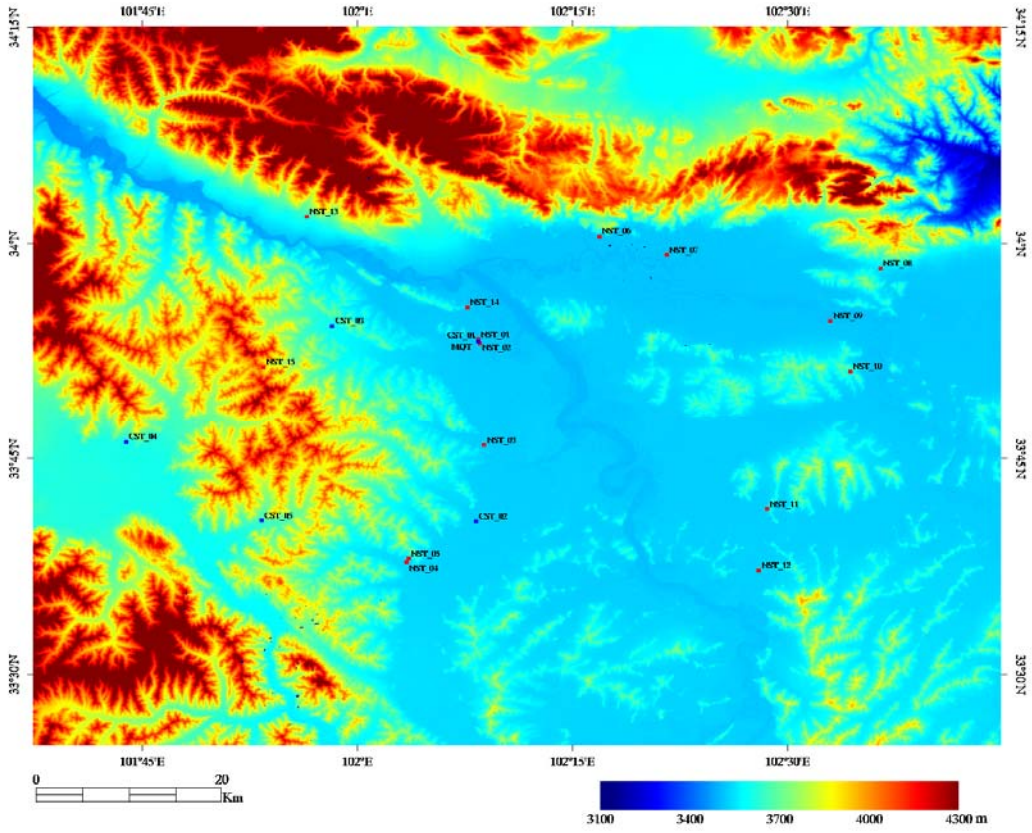
Fig.3 The diurnal pattern of the soil moisture fluxes. There were two kinds of shapes of zero flux isolines: A-type, which occurred in the shallow layer limited in the depth of 45cm close to surface with small time intervals and isolated shapes, and B-type, which occurred below the depth of 45cm with a radical variation (from the depth of 45 to 94cm) and kept the continuity. Consequently, the drying front fluctuated sharply from the upper borderlines of A-type and B-type darker areas.

Example 2: Estimation of global soil moisture
(PhD candidate: Laura Dente)

The main objective of Laura Dente PhD project is to investigate, develop and validate a method to synergistically use active and passive microwave data to estimate global soil moisture products. Satellite data with a coarse resolution are more suitable for large scale soil moisture monitoring because they are characterised by a larger swath and a higher revisit time than the fine resolution data. However, the validation of soil moisture products retrieved from coarse resolution sensors is a critical issue because of the large scale gap between in-situ soil moisture measurements and soil moisture estimates at 30-50km spatial resolution and due to the typically high spatial variability of soil moisture.
For this reason, extensive soil moisture monitoring networks and techniques to upscale the in situ data to the resolution cell of the satellite sensors are required to obtain ground information which can be compared to the satellite retrieved soil moisture products and to evaluate their consistency.
In this frame, the main objective of this fieldwork was to install an extensive soil moisture and soil temperature monitoring network.
In collaboration with the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI) of Chinese Academy of Science (CAS) and in the frame of the CEOP-AEGIS project, the site selected for this experiment is located near Maqu city (Gansu province, China) on the northern Tibetan plateau (33°30'-34°15'N, 101°38'-102°45'E) at the first major meander of the Yellow river and an altitude of approximately 3400 m a.s.l. The area is characterized by flat valleys of Yellow River and Black River and undulating hills and by quite uniform short grassland. Study of climate change and water cycle in the upper Yellow river are carried out by CAREERI/CAS in this site. A high micrometeorological tower is installed and several measurements are carried out, such as wind speed and direction, humidity, temperature at different heights, snow depth, soil temperature and soil moisture at different depths, precipitation, 4 components radiation, turbulence measurements. Moreover CAREERI/CAS has previously installed 5 soil moisture and soil temperature stations spread in the area.

Fieldwork in 2008:
15 soil moisture and soil temperature stations have been successfully installed in Maqu area, thanks to the extremely useful support of CAREERI institute.

The fieldwork team consisted of Laura Dente and Zoltan Vekerdy from ITC and of colleagues from CAREERI: Prof. Dr. WEN Jun – team leader, Lao Li – field engineer, Wang Lei - PhD candidate, Shixiao Kang - PhD candidate, Li Baozhen- driver, Wang – driver.
The stations cover an area of approximately 40*80 km. The locations have been selected in order to monitor soil moisture at different altitudes and in different type of soil.



The Maqu Integrated climate and environment observation station (top) and the regional soil moisture network (locations of probes, bottom)