



Workshop Report

COSPAR Capability Building Workshop on *Earth Observation of Transboundary Water Resources*

Venue: Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam

Dates: 26 Oct - 6 Nov 2015

Organizers:

Ho Chi Minh City University of Technology, Vietnam
University of Twente, Netherlands

Sponsors:

Committee on Space Research (COSPAR)
European Space Agency (ESA)
Ho Chi Minh City University of Technology, Vietnam
University of Twente, Netherlands

Website:

<http://cospar2015.hcmut.edu.vn/destination.html>

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1. Introduction and workshop objectives

The COSPAR Capability Building Workshop on ***Earth Observation of Transboundary Water Resources*** took place at Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam, 26 Oct - 6 Nov 2015. The workshop was co-organised by Ho Chi Minh City University of Technology (HCMUT) and the faculty of geo-information science and earth observation (ITC), University of Twente, the Netherlands.

Funding was provided by COSPAR, ESA, and the University of Twente. HCMUT provides the lecture room, and computing facilities for participants.

The rationale of the workshop was that transboundary water resources pose huge challenges for monitoring, assessment, planning, and management because the difficulty in collecting all needed data by traditional means and the different national and regional interests that need to be served. Often there is no agreement on how much water resource is available in a river basin and how it changes in space and time. Climate change and direct human intervention (e.g. via hydraulic-infrastructure and land use changes) have exacerbated these challenges further. Recent advances in Earth Observation (EO) however have opened many new opportunities for quantifying and analysing the terrestrial water cycle, including precipitation, evapotranspiration, soil moisture, water level of reservoirs and lakes, snow and glaciers, as well as storage changes in time and space. Because EO data are available from local to regional and global scale, use can be made to assist transboundary water resources management, in combination with in-situ observation data and modelling and data assimilation. As such the availabilities, changes and extremes in transboundary water resources can be transparently assessed for different regions and countries.

Satellite EO data from the European Space Agency (ESA) and the National Aeronautic and Space Administration (NASA) as well as from other national and regional space agencies provide indispensable resources for assessing the water resources variability. The challenges to users are how to translate the satellite data to water cycle and water resources information.

The aim of the training workshop was to provide trainings for young researchers from SE Asia to develop skills in the access, processing, analysis and use of satellite EO and in-situ data as well as state-of-the-art model outputs for transboundary water resources applications.

More specifically we aimed to provide hands-on guidance for the participants to be able to apply datasets and model outputs for their own specific regional applications. Focus was given to the applications of satellite data from ESA and NASA, including ESA's Climate Change Initiative (CCI) data. The workshop consisted of keynote lectures in the morning and practical hands-on sessions in the afternoon. Data and model outputs were provided by the organisers with a focus on open-access data so that the participants can continue to build on what they have learned during the workshop. The course will build upon recent advanced trainings in the ESA Dragon programme and the research programme and MSc curricula of ITC, University of Twente.

The following specific objectives were achieved:

- Provide theory and insights in the available EO and model data to study the terrestrial water cycle. Focus will be on precipitation, evapotranspiration, soil moisture, and changes in storages.
- Provide guide in downloading, processing and analysing the suite of EO-data available over transboundary river basins in SE Asia.
- Provide case studies in monitoring and evaluating water availability, extremes (floods and droughts) and water use relevant to water resources management and food security.

2. Data and processing software

Used satellite data included those from research and operational satellites and sensors, including MODIS,

GRACE, GPM/TRMM, SMAP, ERS, ENVISAT, SMOS, Sentinels, as well as other publically accessible sources.

Data from global reanalysis including those from ERA-Interim and GLDAS as well as in-situ data from other publically available sources were also used.

The operating system was windows system. The software used was open source and has been used annually at the ESA Dragon training courses. The software included ILWIS (ITC), BEAM (ESA) as well as other ones identified by the lecturers.

The organisers have proposed to establish a network of participants for providing technical advice after they have returned home after the workshop through the ITC allumuni networks and the ITC water and climate group (facebook) and have encouraged the participants to set up collaborative research projects with the organisers and with each other, which had proven a successful strategy in the ESA TIGER and the ESA Dragon programme, in which ITC of the University of Twente has been responsible for advanced training courses.

3. Participants

The participants are mainly junior researchers and staff members from universities and governmental organisations involved in areas of hydrometeorology, water resources and earth observation. 46 candidates from SE Asian countries were selected among more than 100 applicants by the deadline of the application. But four selected candidates could not participate in the workshop due to logistical problems (visa, travel limitation for governmental employee in Myanmar or Pakistan due to the Earth quake, etc.).

4. Organising committee

The science organising committee consisted of Dr. Pierre-Philippe Mathieu (ESA, COSPAR PCB), Prof. Ernesto Lopez Baeza (COSPAR PCB), Prof. Z. Bob Su (University of Twente, ITC), and Dr. Vu Hien Phan (HCMUT, Faculty of Civil Engineering).

Local organising committee consisted of Dr. Tam Minh Nguyen (HCMUT, Faculty of Civil Engineering), Assoc. Prof. Dr. Duc Trong Tran (HCMUT, Faculty of Civil Engineering), and Dr. Vu Hien Phan (HCMUT, Faculty of Civil Engineering).

5. Lecturers and supporting staff

The supporting staff included:

ME. Viet Tuan Duong, ME. Ngan Truong Nguyen, Mrs. Nga Kim Nguyen of the Department of Geomatics Engineering, HCMUT and Mrs. Anke de Koning of the Department of Water Resources, ITC, University of Twente.

The Lecturers were:

Assoc. Prof. Dr. Wataru Takeuchi

Institute of Industrial Science,
The University of Tokyo, Tokyo, Japan
Email: wataru@iis.u-tokyo.ac.jp
Topic: drought monitoring

Dr. Quan Nguyen- Hong

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Topic: water availability & runoff

Dr. Nguyen Lam-Dao

Vietnam Southern Satellite Technology Application Center (STAC)

Vietnam National Satellite Center (VNSC)

Vietnam Academy of Science and Technology (VAST), Ho Chi Minh City, Vietnam

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Topic: river bank monitoring (erosion)

Dr. Vu Phan- Hien

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Topic: water in lakes/reservoirs and glaciers

Professor Bob Su

University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC), Chairman of
Department of Water Resources

Hengelosestraat 99, P.O.Box 217, 7500 AE Enschede, The Netherlands

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Topic: water cycle, precipitation, evaporation, soil moisture

Professor Thuy Le-Toan

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Topic: Monitoring Rice and Flood

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Topic: Introduction to COSPAR

MSc. Lichun Wang

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Topic: tools for data access, data access & practicals

6. Programme overview

	Day 1 (26/10)	Day 2 (27/10)	Day 3 (28/10)	Day 4 (29/10)	Day 5 (30/10)	Day 6 (31/10)	Day 7 (1/11)	Day 8 (2/11)	Day 9 (3/11)	Day 10 (4/11)	Day 11 (5/11)	Day 12 (6/11)
Lecture (8:30-10:00)	Opening & Introduction	Precipitation 1	Evaporation 1	Monitoring Rice and Flood	The 14th Conference Science & Technology	River bank monitoring	Excursion	COSPAR lecture (J-L Fellous)	Remote sensing for agriculture	Geometric dependency of lakes on glacial runoff	Remote Sensing of soil moisture	Group presentations 1 Q&A
Tea Break												
Lecture (10:30-12:00)	EO Water cycle	Precipitation 2	Evaporation 2	Monitoring Rice and Flood	The 14th Conference Science & Technology	River bank monitoring	Excursion	Water in lakes/reservoirs and glaciers	Drought monitoring methods	Water availability & runoff	Water cycle integration	Group presentations 2 Q&A
Lunch												
Practical (13:00-14:30)	Tools for data access	Practical	Practical – SEBS	Practical	The 14th Conference Science & Technology	Practical - River bank monitoring	Excursion	Practical	Practical	Practical – SRTM river networks	Practical	Closing ceremony
Tea Break												
Practical (15:00-17:00)	Data access	Practical data merging	Practical – SEBS	Practical	The 14th Conference Science & Technology	Practical	Excursion	Practical	Practical	Practical - SWAT	Practical	
Dinner												

- Participants were divided into 4~8 groups each choosing a preferred topic/region to work out during the practical sessions and presentations of results were made on the last day.

7. Local facility

Excellent facilities were provided by HCMUT including a lecture room, a computer lab, a canteen and hotel for participants and lecturers.

8. The 14th conference on science and technology and social events

The participants and lecturers participated in the 14th conference on science and technology organised by HCMUT on 30 October 2015. Some lectures were invited as key-note speakers of the conference (Le-Toan, Su, Lam-Dao) and provided excellent opportunities for participants and lecturers to interact with other staff and students not directly involved in the workshop.

An excursion was organised to the Mekong delta on 1 Nov. 2015 to experience the Vietnamese culture. Very enthusiastic responses were received from the participants. The participants have organised various cultural activities at the hotel and in the city and many were recorded on facebook.

9. Workshop outcome and evaluation

A team of international and national experts provided teaching and practicals. The state of art science and techniques in Earth Observation of Transboundary Water Resources was offered.

1. **Anticipated outcomes (deliverables):** Participants were expected to have gained knowledge and skills in EO data access, processing and analysis for transboundary water resources monitoring. Participants have received workshop materials (on USB) and related software as open source codes for adaptation to their specific applications.
2. **The format of the workshop** was a two-week workshop with lectures given by international and local experts with hands-on practical sessions. The workshop focused on the assessment and monitoring of precipitation, evapotranspiration, soil moisture, and derived runoff and storage variables. Lectures were combined with hands-on practicals of regional case studies. A computer lab was available with freely available software for visualization and processing. Laptops from participants were also be used to facilitate to identify and utilize observational data and model/assimilation products as well as to adapt to particular applications after the workshop.
3. **Participants** were asked to form working groups choosing a topic of interest and worked together during the workshop. Seven groups were formed and excellent research-grade presentations were given before the closing of the workshop.

An online evaluation was conducted before the final group work presentation. Very positive responses were received from participants and suggestions made for organising future workshops.

10. Appendixes

1. List of participants
2. List of group works
3. Some photos
4. Workshop evaluation

1. List of participants

	Name	Gender	Nationality	University / Institute	Work Place	Email
1	Aaron Aw Teik Hong	Male	Malaysian	Universiti Putra Malaysia	Malaysia	aarouroni@yahoo.com
2	Aldwin Torres Almo	Male	Philippines	Marine Science Institute, University of the Philippines, Philippines	Philippines	aldwin.almo@gmail.com
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16	Liu Jiandong	Male	Chinese	National University of Singapore	Singapore	liuj@u.nus.edu

	Name	Gender	Nationality	University / Institute	Work Place	Email
17	Mai Toan Thang	Male	Vietnamese	Ho Chi Minh City Institute for Environment and Resources	Vietnam	mth2610@gmail.com
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30	Noor Salehan Mohammad Sabli	Female	Malaysian	University Technology Malaysia	Malaysia	salehansabli@gmail.com

	Name	Gender	Nationality	University / Institute	Work Place	Email
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42	Vuong Quoc Viet	Male	Vietnamese	Geomatics Center, Information Technology Park, VNU HCM	Vietnam	quoc.viets@yahoo.com

2. List of group works

Work Group 1: *Sumaira Zafar, Noor Salehan Mohammad Sabli, Arie Antasari Kushadiwijayanto, Chit Bo Bo Win, Aung Ko Miyint, and San Win*

Topic: Delineation of stream network and identification of blockages in rivers of Karachi District-Pakistan

Abstract

Karachi district have extensive natural drainage network which comprised of three (3) major river systems and their tributaries. These natural non-perennial streams were used to drain out the rain water without any problem. Now the situation has been changed in the recent years due to an overutilization of floodplains and river beds for other commercial uses. These small river streams have been abandoned due to the development of settlements, industries and agricultural fields. Some of the streams have vanished and some are encroached by different land-uses. These streams are now covered with urban settlements and are serving as wastewater drains. This work was aimed to inspect the blockages and delineate the stream network of Karachi district. Topographic maps (scale of 1:50,000) of 1970s, developed by Survey of Pakistan, are used to identify the natural water channels' width and extent. Landsat satellite images (15 and 30 meter resolution) are used to identify the major landcovers of the study area. Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) and ASTER DEM of the study area are used to delineate the existing streams that become active in the rainy seasons. Results of this study reveal that these streams have been filled with sand/silt and gravels and stream beds/floodplains are now part of different landuse activities.

Work Group 2: *Aldwin Almo, Bormy Chanthong, Merced Mylanie Panganiban, Le Thi Phuong Thanh, and Sam Chak (the VINAJOY group)*

Topic: Mind your waters: meeting the needs and keeping the balance in the Lower Mekong Basin

Abstract

Challenges to the society by climate change, great floods, severe droughts, dam operations, intensified irrigation, as well as unsustainable land use all are related to availability of water. The objectives of this study are 1) to explore the potential impacts of land use/cover in the Mekong sub-basin in the Cambodia and its border with Southern Vietnam, 2) to describe the intensity and distribution of rainfall, and 3) to look on the rainfall patterns in the basin and its relations to estimated terrestrial water storage in the sub-basin. Data from the GLDAS output and satellite data are analysed for evapotranspiration, canopy storage, surface runoff, sub-surface runoff, land cover change, and rainfall patterns. It is concluded that TRMM has good correlation with ground data of the area, land surface parameters are spatially and temporally variables in the area, there could be a link between land cover change to some parameters of the terrestrial water storage, and spatial resolution is a limitation for the correlation of data. The following recommendations are made. A study using SEBS model and MODIS data (250m-1km spatial resolution) or Landsat (15-30m resolution) as input should be done to have a higher spatial resolution. GLDAS model output could be used in a bigger basin considering its spatial resolution. A longer temporal study should be done with the inclusion of soil moisture as additional parameter.

Work Group 3: Nguyen Thi Binh Phuong, Nguyen Thi Huyen, Nguyen Ba Duy, Aaron Aw Teik Hong, Nguyen Trong Khanh, and Tran Thi Le Hang

Topic: Using SWAT model to evaluate discharge at Dau Tieng Basin (upstream)

Abstract

Lower Mekong River delta plays an important role on livelihood for local residents in Vietnam. Therefore, monitoring and mapping rice crop systems and flooding frequency is motivated. In this study, we investigate the abilities of time series MODIS NDVI and time series Sentinel 1 SAR data in rice crop mapping and flooded frequency mapping over Lower Mekong River delta. Due to the time limit and lack of ground truth datasets, in this study, we concentrate on introducing methodology and data processing to produce output maps (rice crop systems map and flooded frequency map).

Work Group 4: Tran Thi Kim, Nguyen Tram Anh, Dang Thi Thanh Le, Do Thi Thuy Quyen, Mai Toan Thang, Suwash Chandra Acharya and Siriwat Boonwichai

Topic: Using SWAT model to evaluate discharge at Dau Tieng Basin (upstream)

Abstract

Water resources from Dau Tieng basin, upstream areas of Sai Gon River plays a very essential role in economic – social development of downstream provinces. Assessment of potential water resources in the region can be served for water resources planning toward sustainable development. The SWAT model was applied in this study to evaluate river flow in the rivers. The simulation data were used with the length of meteorological input data up to 33 years. The parameters of model were calibrated by SWAT-CUP with Sufi-2 algorithm (Semi Automated Sequential Uncertainty Fitting) using data of Tong Le Chan discharge station (2005- 2009), which was also used to analyze parameter sensitivity. The coefficient of determination (R^2), NSE index for the daily runoff were obtained as 0.62; 0.75 for calibration period; and 0.50; 0.76 for validation period, respectively. The results of this study can be used for other researches such as water balance calculation in the river basin or it can be used as inputs of water quality and sediment transport model in Sai Gon River.

Work Group 5: LIU Jiangdong, DAS Jew, HOANG Phi Phung, NGUYEN Van Loi, TRAN Nguyen Ngoc, and NGUYEN Kim Anh

Topic: Precipitation datasets: trusted or not?

Abstract

Since one of the main sources of water is rainfall, proper information on precipitation and its variability in space and time is required for better studying ecosystems, climate changes or other applications. Though rainfall information from stations is considered reliable, the rain gauge network is relatively sparse with uneven distribution in many regions and gauge data may be missing because of malfunctioned instruments or management. In those regions, we should use rain information from precipitation datasets. However, reliability of those datasets is still questionable. The objectives of this presentation are to validate precipitation from two datasets (APHRODITE and TRMM) with gauge data and justify usages of each dataset based on comparison. Analyses have been done in selected sites: Vietnam and Singapore. The

results showed that both datasets may be used based on the purpose. While APHRODITE could be more reliable and have better correlation with gauge data, TRMM usually overestimated rainfall value. However, TRMM is better in detecting extreme events like floods.

Work Group 6: *NGUYEN Thi Ha Mi, Siti Nurhayati Binti KAMARUDDIN, LE Viet Hung, HO Dinh Bao, and NGUYEN Tien Quang*

Topic: using remote sensing to observe the change of Red River bank

Abstract

Red River is the biggest river in the North of Vietnam. It provides water and silt for human use as well as agricultural activities. However the changing of river bank over a period of time affected the water resources and land management. Extraction of the river bank change is an essential task of environment monitoring and land management and planning. Over the years the river bank change was affected by erosion, sedimentation and sand exploited. The pattern of river bank changes in Red River was identified using Landsat TM images acquired in 1996 and 2014. In this study we proposed a semi-automatic technique to extract the riverbank. The results showed that the changing of riverbank is very complex in this area, some area was tended toward erosion and some tended to accretion. The information is to support the local government in assessing, monitoring and making plan for land use planning in this region.

Work Group 7: *PHAM Duc Binh, Sukriti SUVEDI, Chudech LOSIRI, NGUYEN Ha Trang, PHAM Thi Ly, and VUONG Quoc Viet*

Topic: Monitoring surface water area in Tonle Sap lake Using LANDSAT and SAR observations

Abstract

Tonle Sap Lake plays an important role on livelihood for local residents in Cambodia and it has a significant impact on water cycle and ecosystem in the Lower Mekong delta. Changing of surface water extent of the lake considerably influences human lives and the nature environments in the region. Therefore, it is needed to monitor the change of the surface water area in the Tonle Sap Lake overtime. In our small project, we would like to estimate the change of water surface extent in the Tonle Sap Lake between 1995 and 2015), using optical satellite observations at 30m of spatial resolution from LANDSAT TM-5 and LANDSAT 8. Due to cloud contamination in the rain seasons, we only accessed to the water surface extent in the dry seasons (Februaries) when the lake was not covered by the cloud. For the second objective, we would like to access to the advantages and disadvantage of using SAR satellite observations for classifying between water and non-water using free-of-charge data from Sentinel-1A satellite. Inundation maps at the same time, derived from optical and SAR satellite observations also were compared together. To conclude, surface water extents in the Tonle Sap Lake in dry seasons did not change so much between 1995 and 2015, the difference of water surface extent was just about 150 km². In addition, inundation maps derived from only backscatter coefficients had low accuracy since the outputs change approximately 10% when changing the threshold by 1 dB. We suggested to combine LANDSAT and SAR imagery to obtain a better accuracy. For future work, we planned to combine MOD09A1 products of MODIS at 500m of spatial resolution, LANDSAT products at 30m of spatial resolution and SENTINEL-1A products at 10m of spatial resolution to make inundation maps for a longer period of time from 2000 until present.

3. Some photos

- a) Opening COSPAR CB Workshop: Organizing Committee (Dr. Tam Minh Nguyen, Assoc. Prof. Dr. Lau Ngoc Nguyen, Prof. Dr. Z. Bob Su, Dr. Vu Hien Phan, Ms. Lichun Wang) and participants.



Photo 1: Dr. Tam Minh Nguyen, Dean, Faculty of Civil Engineering welcomed all lecturers and participants to Ho Chi Minh City University of Technology, Vietnam



Photo 2: Prof. Dr. Z. Bob Su, Chair, Department of Water Resources, ITC, University of Twente, Netherlands gave the opening speech of the COSPAR CB Workshop, held in HCMUT, Vietnam.



Photo 3 & 4: each participant introduced himself / herself.



Photo 5: The group photo before the first lunch

b) Lecturers

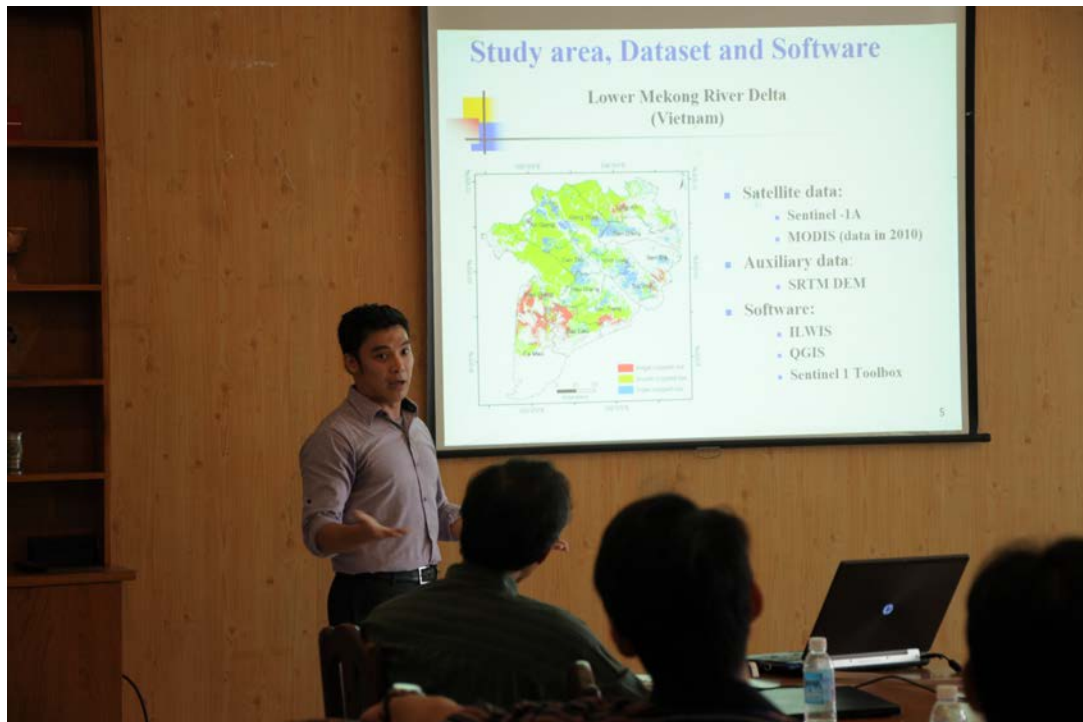


Photo 6: Prof. Thuy Le-Toan gave her lectures



Photo 7: Assoc. Prof. Dr. Wataru Takeuchi gave his lectures

c) Work group activities: seven groups made presentations and discussions together





d) Closing Ceremony and awarding certificates to participants: Organizing committee and local







