2010 International SWAT Conference

August 4-6, 2010

Mayfield Hotel
Seoul, Korea

Book of Abstracts

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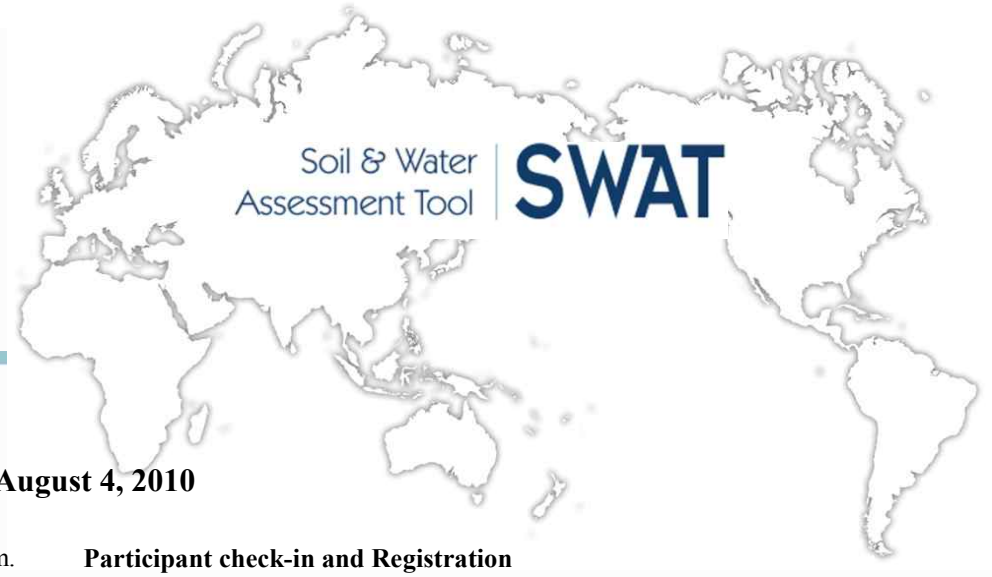

Wednesday, August 4, 2010

08:30 - 09:30 a.m.	**Participant check-in and Registration** Mayfield Hotel Grand Ballroom	
09:30 - 11:50 a.m.	**Opening Ceremony** Mayfield Hotel Grand Ballroom	**Moderator**: Philip Gassman Iowa State University
09:30 - 09:35 a.m.	**Opening Announcement:**	*Dr. Nam-Won Kim* *LOC-Chair, Korea Institute of Construction Technology, Korea*
09:35 - 09:40 a.m.	**Welcome Address:**	*Dr. Yong-Joo Cho* *President, Korea Institute of Construction Technology, Korea*
09:40 - 10:10 a.m.	**Keynote Speech 1:**	Outlook of SWAT Model as a Total Solution of Water, Pollutant, & Food Problem *Dr. Jeff Arnold* *USDA-ARS, USA*
10:10 - 10:40 a.m.	**Keynote Speech 2:**	Outcomes and Impacts by the Sustainable Water Resources Research Program (2001-2011) in Korea *Dr. Sung Kim* *Director, Sustainable Water Resources Research Center, Korea*
10:40 - 11:10 a.m.	**Model Development History:**	*Dr. Jimmy Williams* *Texas AgriLife Research, USA*
11:10 - 11:40 a.m.	**Recent Development and Features of ArcSWAT:**	*Dr. Raghavan Srinivasan* *Texas A&M University, USA*
11:40 - 11:50 a.m.	**Group Photo** (Garden Hall, Mayfield Hotel)	
11:50 a.m. - 1:00 p.m.	**Lunch** (Orchid room, Mayfield Hotel)	
1:00 - 3:20 p.m.	**SESSION A1 - Large Scale Applications** **SESSION B1 - Model Development**	**(Room A)** **(Room B)**

SESSION A1 - Large Scale Applications

Moderator: Taesoo Lee
Texas A&M University

1:00 - 1:20 p.m.	**A1-1** Hyunwoo Kang	*Improvement SWAT auto-calibration tool with flow clustering EI estimation system using K-means*
1:20 - 1:40 p.m.	**A1-2** Taesoo Lee	*Application of SWAT to estimate inflow to bays from ungaged large watersheds*
1:40 - 2:00 p.m.	**A1-3** Pierluigi Cau	*A relational data paradigm to manage SWAT simulations on the GRID for the Black Sea Catchment observation and assessment system*
2:00 - 2:20 p.m.	**A1-4** Nguyen Duy Binh	*SWAT application coupled with web technology for soil erosion assessment in north western region of Vietnam*
2:20 - 2:40 p.m.	**A1-5** Elham Rouholahnejad	*Hydrological modeling of the Black Sea Catchment using SWAT*
2:40 - 3:00 p.m.	**A1-6** Christine Kuendig	*Preliminary results of the application and calibration of a hydrological model in Europe*
3:00 - 3:20 p.m.	**A1-7** Hua Xie	*Hydrologic calibration of the SWAT model for African river basins using GRACE data*

SESSION B1 - Model Development

Moderator: Daniel Moriasi
USDA-ARS

1:00 - 1:20 p.m.	**B1-1** Jichul Ryu	*Enhancement of the SWAT-REMM system for simulation of T-N reduction efficiency with riparian buffer system at a Bonggok watershed*
1:20 - 1:40 p.m.	**B1-2** Youn Shik Park	*Development of the integrated SWAT-VFSMOD model*
1:40 - 2:00 p.m.	**B1-3** Daniel Moriasi	*New shallow water table depth algorithm in SWAT2005: recent modifications*
2:00 - 2:20 p.m.	**B1-4** Jaehak Jeong	*Modelling onsite wastewater systems in SWAT*
2:20 - 2:40 p.m.	**B1-5** Karim Abbaspour	*SWAT-CUP: A calibration and uncertainty analysis program for SWAT*
2:40 - 3:00 p.m.	**B1-6** Jaehak Jeong	*Development of subdaily erosion and sediment transport models in SWAT*
3:00 - 3:20 p.m.	**B1-7** Philip Gassman	*Simulation trends and other aspects regarding the worldwide use of the SWAT model*

3:20 - 3:40 p.m. **Coffee Break**

3:40 - 5:00 p.m.
SESSION A2 : Hydrology (1) **(Room A)**
SESSION B2: InStream Sediment and Pollutant Transport **(Room B)**
SESSION B3: BMPs **(Room B)**

SESSION A2 - Hydrology (1)

Moderator: Nam-Won Kim
Korea Institute of Construction Technology

3:40 - 4:00 p.m.	**A2-1** Eunjin Han	*Surface soil moisture assimilation with SWAT*
4:00 - 4:20 p.m.	**A2-2** Geun Ae Park	*The spatial analysis between SWAT simulated soil moisture, and MODIS LST and NDVI products*
4:20 - 4:40 p.m.	**A2-3** Ki-Wook Park	*Evaluation of SWAT model for irrigation reservoir operation*

SESSION B2: InStream Sediment and Pollutant Transport **Moderator:** Kwangsik Yoon
SESSION B3: BMPs Chonnam National University

3:40 - 4:00 p.m.	**B2-1** Chulgyum Kim	*Using SWAT for estimating impact of sediment and pollutant export in the Chungju Dam watershed, Korea*
4:00 - 4:20 p.m.	**B2-2** Nguyen Kim Loi	*Assessing the impacts of land use/ land cover changes and practices on water discharge and sedimentation using SWAT: Case study in Dong Nai watershed – Vietnam*
4:20 - 4:40 p.m.	**B3-1** Jae Ho Jang	*Evaluation of watershed management practices on receiving water quality using SWAT model*
4:40 - 5:00 p.m.	**B3-2** Tae Geun Kim	*Estimation of pollutants removal efficiency in the buffer strip using SWAT Model*

6:00- 8:00 p.m. **Welcome Dinner**
(Garden Hall)

Thursday, August 5, 2010

9:00 - 10:00 a.m. **SESSION A2: Hydrology (2)** **(Room A)**
SESSION B4: Database and GIS Application and Development (1) **(Room B)**

SESSION A2: Hydrology (2) **Moderator:** Do Hun Lee
Kyunghee University

9:00 - 9:20 a.m.	**A2-4** Paul D. Wagner	*Analyzing water resources in a monsoon-driven environment – an example from the Indian Western Ghats*
9:20 - 9:40 a.m.	**A2-5** Hyung-Kyung Joh	*Evaluation of mixed forest evapotranspiration and soil moisture using measured and SWAT simulated results in a hillslope watershed*
9:40 - 10:00 a.m.	**A2-6** Il-Moon Chung	*Integrated surface-groundwater analysis considering groundwater use in Pyoseon region, Jeju island, Korea*

SESSION B4: Database and GIS Application and Development (1) **Moderator:** Pierluigi Cau
Center for Advanced Studies, Research and Development in Sardinia

9:00 - 9:20 a.m.	**B4-1** Simone Manca	*The MVC client server architecture of the BSC-OS portal to digest, manage, and query SWAT data collections*
9:20 - 9:40 a.m.	**B4-2** Sudipta K. Mishra	*Development of a field based decision support tool integrated with socioeconomical model for managing water quality and quantity*
9:40 - 10:00 a.m.	**B4-3** Seong Joon Kim	*Evaluation of streamflow and water quality in an agricultural watershed of South Korea using SWAT and KOMPSAT-2 detailed land use information*

10:00 - 10:20 a.m. **Coffee Break**

10:20 a.m. - 11:40 p.m. **SESSION A3: Climate Change Applications (1)** **(Room A)**
SESSION B4: Database and GIS Application and Development (2) **(Room B)**

SESSION A3: Climate Change Applications (1)

Moderator: Seong Joon Kim
Konkuk University

10:20 - 10:40 a.m.	**A3-1** Hyun-Han Kwon	*Multivarite nonstationary Markov Chain model and its use for SWAT rainfall-runoff Model*
10:40 - 11:00 a.m.	**A3-2** Debjani Deb	*Hydrologic response to climate and landuse change in the Minnesota River Basin*
11:00 - 11:20 a.m.	**A3-3** Se-Woong Chung	*Impact of climate change on water and soil loss in Daecheong Reservoir Watershed*
11:20 a.m. - 11:40 p.m.	**A3-4** Jong-Yoon Park	*Assessment of MIROC3.2 hires climate change and CLUE-s land use change impacts on watershed hydrology using SWAT*

SESSION B4: Database and GIS Application and Development (2)

Moderator: Kyoungjae Lim
Kangwon National University

10:20 - 10:40 a.m.	**B4-4** Won-Ho Nam	*Development of Web-GIS based SWAT data generation system*
10:40 - 11:00 a.m.	**B4-5** Yunseok Choi	*Development of an interface system to couple SWAT2005 and HyGIS*
11:00 - 11:20 a.m.	**B4-6** Ali Najafinejad	*The effect of map spatial resolution on simulation result of SWAT, case study: chelchay watershed, Golestan province in Iran*

11:40 - 1:00 p.m. **Lunch**
(Orchid room, Mayfield Hotel)

1:00 - 6:00 p.m. **Depart for Conference Tour (Seoul City Tour)**
- Gyeongbokgung Palace (The oldest palace of Joseon Dynasty)
- Insadong (Experiencing the traditional culture of Korea)
Arrival at Mayfield Hotel

7:00 - 9:00 p.m. **Gala Dinner**
(Grand Ballroom)

Friday, August 6, 2010

9:00 - 10:20 a.m. **SESSION A3: Climate Change Applications (2)** **(Room A)**
SESSION B5: Biofuel and Plant Growth **(Room B)**
SESSION B6: Landscape Processes and Landscape / River Continuum **(Room B)**

SESSION A3: Climate Change Applications (2) **Moderator:** Karim Abbospour
EAWAG

9:00 - 9:20 a.m.	**A3-5** Woo Young Choi	*Estimation of climate change effect on nonpoint source pollution in Juam Lake Watershed*
9:20 - 9:40 a.m.	**A3-6** Soo Jun Kim	*The evaluation of climate change impacts on water resources system by using SWAT model*
9:40 - 10:00 a.m.	**A3-7** Hyung Jin Shin	*Projection of future watershed hydrology by applying SWAT through the prediction of vegetation community under MIROC3.2 hires climate change condition*
10:00 - 10:20 a.m.	**A3-8** Min Ji Park	*Comparison of watershed streamflows by using the predicted MIROC3.2hires GCM data and the observed weather data for the period of 2000-2009 under SWAT simulations*

SESSION B5: Biofuel and Plant Growth **Moderator:** Jeff Arnold
SESSION B6: Landscape Processes and Landscape / River Continuum USDA-ARS

9:00 - 9:20 a.m.	**B5-1** Miae Ha	*Hydrologic effects of bio-char applications on corn production fields in Illinois*
9:20 - 9:40 a.m.	**B5-2** Bikesh Shrestha	*Evaluating the impact of biofuel production on watershed hydrology using SWAT*
9:40 - 10:00 a.m.	**B6-1** Jeff Arnold	*An efficient delineation structure in SWAT to simulate the landscape/ river continuum*

10:20 - 10:40 a.m. **Coffee Break**

10:40 - 12:00 p.m. **SESSION A4: Pesticides, Bacteria, Metals and Pharmaceuticals** **(Room A)**
SESSION B7: Environmental Applications **(Room B)**

SESSION A4: Pesticides, Bacteria, Metals and Pharmaceuticals **Moderator:** Chehra Aboukinane / Virginia Jin
Al Akhawayn University / USDA-ARS

10:40 - 11:00 a.m.	**A4-1** Chehra Aboukinane	*Manipulation of the SWAT code to model veterinary antibiotics in the environment*
11:00 - 11:20 a.m.	**A4-2** Virginia Jin	*Potential soil transport of 17β-estradiol in a beneficial reuse system land-applying class B municipal biosolids for forage production in Central Texas*
11:20 - 11:40 a.m.	**A4-3** Joon Ha Kim	*Modeling approach on resuspension of E. coli from streambed using Soil and Water Assessment Tool (SWAT)*

SESSION B7: Environmental Applications

Moderator: Jaehak Jeong
Texas AgriLife Research

10:40 - 11:00 a.m.	**B7-1** Jitae Kim	*Modification of stream water temperature calculation equation of SWAT for the Han River Korea using regression analysis*
11:00 - 11:20 a.m.	**B7-2** Christopher L. Shope	*Simulating water quantity and quality and sediment transport under varying land use and climatic conditions in a monsoonal driven watershed*
11:20 - 11:40 a.m.	**B7-3** Katrin Bieger	*Modelling the impact of land use change on the water balance in the Xiangxi catchment (Three Gorges Region, China) using SWAT*

12:00 - 1:20 p.m. **Lunch**
(Orchid Room, Mayfield Hotel)

1:20 - 3:00 p.m. **SESSION A5: Sediment, Nutrients and Carbon (Room A)**
SESSION B8: Urban Processes and Management (Room B)
SESSION B9: Sensitivity Calibration and Uncertainty (Room B)

SESSION A5: Sediment, Nutrients and Carbon

Moderator: Philip Gassman
Iowa State University – CARD

1:20 - 1:40 p.m.	**A5-1** Khanh Linh Hoang	*Comparison of the SWAT model versus the DAISY-MIKE-SHE model for simulating the flow and nitrogen processes*
1:40 - 2:00 p.m.	**A5-2** Hiroaki Somura	*Application of SWAT for nutrient load discharge estimation*
2:00 - 2:20 p.m.	**A5-3** Jong-Pil Moon	*Study on setting appropriate size of riparian buffer zone in urban basin by using SWAT model*
2:20 - 2:40 p.m.	**A5-4** Phan Dinh Binh	*Land use change effects on discharge and sediment yields of Song Cau Catchment in Northern VietNam*

SESSION B8: Urban Processes and Management
SESSION B9: Sensitivity Calibration and Uncertainty

Moderator: Allan Jones
Texas AgriLife Research

1:20 - 1:40 p.m.	**B8-1** Jeongwoo Lee	*Hydrologic modeling of the White Rock Creek Watershed with SWAT-SWMM*
1:40 - 2:00 p.m.	**B8-2** Allan Jones	*Use of SWAT for urban water management projects in Texas*
2:00 - 2:20 p.m.	**B9-1** Jeongkon Kim	*Analysis of the impacts of spatial input data quality on determination of runoff and suspended sediment in the Imha Watershed using SWAT model*
2:20 - 2:40 p.m.	**B9-2** Sara Moftian	*Calibration of a SWAT hydrologic model for the Tamer Watershed in Northern Iran*
2:40 - 3:00 p.m.	**B9-3** Jaewoon Jung	*Simulation of streamflow using SWAT auto calibration tool over the Saemangeum Watershed*

3:00 - 3:30 p.m. **Break**

3:30 - 4:30 p.m. **Plenary Discussion**

4:30 - 5:00 p.m. **Closing**

Poster Presentations

Moderator : IL Moon Chung
Korea Institute of Construction Technology

SESSION PA1: Large Scale Applications

PA1-1 Jeong Eun Lee	*Runoff simulation using Global Data in the Hwacheon Dam Watershed, Korea*

SESSION PA2: Hydrology

PA2-1 Sangkeun Ha	*Runoff potential and water storage capacity of Korean Soil Mapping Units as affected by different topographic categories*
PA2-2 Sung-Kee Yang	*Analysis of impact of land use change on runoff through several Streams in Jeju Island, Korea*
PA2-3 Do-Hun Lee	*The impact of soil hydraulic conductivity variations on the simulated responses of SWAT model*
PA2-4 Wongeun Lee	*Estimation of reasonable CAPPI mesh size using SWAT model*
PA2-5 Gyo-Cheol Jeong	*Analysis of hydrologic component and water resource increasement for the watershed management and groundwater dam construction in Osipcheon*
PA2-6 Jaewan Choi	*Evaluation of runoff prediction at upper watershed of Daecheong Reservoir using SWAT-K model*
PA2-7 Pushpa Tuppad	*Multi-site landuse based calibration of SWAT simulated hydrologic components*
PA2-8 Ashish Pandey	Assessment of hydropower potential using the SWAT model for southern Mizoram, India

SESSION PA3: Climate Change Applicatoins

PA3-1 Youngdon Choi	*Water supply reliability assessment considering climate changes*
PA3-2 Masoud Taheriyoun	Assessment of the impact of climate change on watershed phosphorus load and reservoir eutrophication
PA3-3 *Yakob Mohammed*	*Climate change impact assessment on soil water availability and crop yield in Blue Nile Basin (Case Study Anjeni Watershed), Ethiopia*

SESSION PA5: Sediment, Nutrients and Carbon

PA5-1 Sangjun Im	*Effects of landuse on nonpoint sources pollutant loadings at small watersheds*
PA5-2 Jong-Pil Moon	*Estimation of runoff unit area loads for nutrients from sloping cropland and forest using SWAT model*

SESSION PB2: InStream Sediment and Pollutant Transport

PB2-1 Ah-Hyun Shin	*Modification of BOD simulation module in SWAT for proper water quality management in Korea*

SESSION PB7: Environmental Applications

PB7-1 Dongil Kim	*A study of modeling using linkage of watershed model and river water quality model*
PB7-2 Dongil Kim	*Study for protection of water resources from pollution using SWAT*
PB7-3 Y-H Jin	*Simulation of runoff and water quality data in the Jiseok Stream, Korea by SWAT model*

SESSION A1

Large Scale Applications

A1-1

Improvement SWAT Auto-Calibration tool with Flow Clustering EI Estimation System using K-means

Hyunwoo Kang[1], Youn Shik Park[2], Jonggun Kim[3], Won Seok Jang[4], Ji Chul Ryu[5], Nam Won Kim[6], Dong Su Gong[7], Kyoung Jae Lim[8]*

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Calibration and validation should be performed to secure accuracies in SWAT simulated results in various hydrology and water quality studies. When calibrating and validating SWAT model with measured data, the Nash-Sutcliffe efficiency coefficient (NSE) is used extensively, also it is used as a goal function of the Auto-Calibration in current SWAT model. However, it has been known that the NSE value is influenced sensitively by bigger values among given data by sacrificing accuracies in estimated lower flow values. In this study, K-means clustering algorithm was incorporated into the SWAT auto-calibration module. With this capability, the SWAT estimated low flow could match measured low flow data well because the NSE is calculated for low and high flow dataset separately. The improved SWAT auto-calibration module will provide very efficient tool for accurate simulation of hydrology and accompanying sediment and water quality with no additional input dataset.

Keywords: SWAT, Nash-Sutcliffe efficiency coefficient, Auto-calibration, K-means clustering

A1-2

Application of SWAT to estimate inflow to bays from ungaged large watersheds

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SWAT (Soil and Water Assessment Tool) model was applied to estimate inflow to the bays from Galveston and Matagorda Bay Watershed, Texas, US over previously used model, TXRR (Texas Rainfall Runoff Model). Two watersheds, Galveston and Matagorda Bay, were selected as a pilot study, one representing urbanized watershed (Galveston Bay) and the other representing rural watershed (Matagorda Bay).
Two separate projects were set up for each watershed. The flow calibration was conducted by two separated area within each watershed; 1) using flow data from available USGS gage stations (gauged subbasins) and 2) using inflow estimation to the bays by TWDB (Texas Water Development Board) (ungaged subbasins). The flow estimation in daily at each gage station showed from acceptable to good correlation coefficient (r^2) ranging from 0.42 to 0.71 with NSME (Nash-Sutcliffe Model Efficiency) ranging from 0.25 to 0.56. The monthly statistics of the total inflow to each bay showed good performance of SWAT model compared to the TXRR. The annual average inflow to the bay was estimated at 516m^3/s by SWAT and at 521m^3/s by TWDB for Galveston Bay. The correlation coefficient between two estimations was 0.930. For Matagorda Bay, the annual average inflow was at 163m^3/s by SWAT and at 162m^3/s by TWDB. The correlation coefficient was 0.899.

A1-3

A relational data paradigm to manage SWAT simulations on the GRID for the Black Sea Catchment observation and assessment system

P. Cau[1*], *S. Manca*[1], *C. Soru*[1], *D. Muroni*[1]
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The complexity of water resources management in the Black Sea basin represents an increasing challenge to policy makers of the region. An interdisciplinary approach is needed to collect, use and analyze large amounts of heterogeneous data, to apply environmental models and to design effective management strategies. More and more attention is being paid on the development and the use of models and technological ICT tools in order to help decision makers to estimate effects of point and diffuse pollution for the area.
The EnviroGRIDS (http://www.envirogrids.net/) project, funded in 2009 by the European Commission within the FP VII Program aims at building capacity for a Black Sea Catchment observation and assessment system supporting sustainable development. The ambition of the project is to improve transnational cooperation, develop and apply innovative, state of the art ICT technologies for monitoring states of the environment.
Our objective within the EnviroGRIDS project is to develop a Collaborative Working Environment (CWE) integrating the watershed scale SWAT (Soil and Water Assessment Tool) model within a web based technological framework optimized for data management and report production. The portal will exploit a GRID based Spatial Data Infrastructure (SDI), complex server side technologies (such as Relational DataBase Management System for data management, Mapserver as the GIS rendering engine, etc.) and client side applications. Our approach is founded on centralizing all the model-related data into complex Relational DB infrastructures. Shifting environmental application from the desktop oriented approach to the web based paradigm enhances flexibility in the whole system, extends the use of data and the sharing of experiences, fostering end user and citizen participation.
The GRID based Spatial Data Infrastructure (SDI) will expose catalogs of environmental data sets (e.g. land use, hydrology, and climate) that will be gathered and used to perform distributed spatially-explicit simulations to build scenarios of key environmental changes.
The development of the CWE portal will particularly target the needs of the Black Sea Commission (BSC) and the International Commission for the Protection of the Danube River (ICPDR) in order to help bridging the gap between science and policy.
We present a preliminary application of the system and the challenges we are facing to design and develop an efficient management tool for the whole Black Sea basin.

Keywords: Water cycle, modeling, SWAT, decision support system, web based interface.

A1-4

SWAT Application Coupled With Web Technology for Soil Erosion Assessment in North Western Region of Vietnam

Nguyen Duy Binh[1], Nguyen Anh Tuan[2], Hoang Le Huong[2]*
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Quantification of soil loss over a large area is a significant issue for soil and water conservation practitioners and policy makers but to disseminate that detailed soil erosion loss information to the public is also considered very important. Information and Communication Technology (ICT) has created opportunity to provide modeling results by using a number of online applications. In the present study, application of the SWAT (Soil and Water Assessment Tools) model was used to assess soil erosion over a 38,739 sq. km area of the Black (Da) river basin, North of Vietnam. The SWAT model was calibrated and validated in accordance with the observed daily streamflows at selected gauging stations. Subsequently, the calibrated model was used to examine changes of water and sediment yields as a result of the extreme weather conditions as well as impact of land use. Furthermore, a website and updating tools were designed to send most up-to-date simulated soil erosion information to internet. The purpose of this web application is to provide erosion information to relevant people including the farmers who are in remote area of Northwestern region of Vietnam. To develop this system, PHP, HTML, and Flash graphic applications were utilized. The results of this study are important for future extended SWAT modelling studies and dissemination of this results in other regions in Vietnam.

A1-5

Hydrological Modeling of the Black Sea Catchment using SWAT

Elham. Rouholahnejad[1*], *Karim C. Abbaspour*[2]
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The Black Sea Catchment (BSC) is internationally recognized for its ecologically unsustainable development and inadequate resource management leading to severe environmental, social and economical problems. This work is part of the 7th Framework European project entitled EnviroGrid (Building Capacity for a Black Sea Basin Observation and Assessment System supporting Sustainable Development). The main objective of this project is to use SWAT to build a hydrologic model of the BSC and to study the impact of climate and landuse change on all components of the water balance at subbasin level with monthly time steps. In a preliminary attempt, the 2 million km^2 drainage basin was discretized into 1629 subbasins. Based on the initial run, river discharge results were quite satisfactory for 33 stations distributed across the region and unsatisfactory for another set of 31 stations. We will investigate the problems with these stations and build a second and more detailed model of BSC with finer DEM, landuse, and climate information. The refined model will be calibrated using the SWAT-CUP calibration and uncertainty analysis package, which will be made to run on grid computing using the facilities of CERN. The calibrated hydrologic model will be used to study the impact of climate and landuse changes.

Keywords: Large-scale application, SWAT, SWAT-CUP, EnviroGrids

A1-6

Preliminary results of the application and calibration of a hydrological model in Europe

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Previous studies have shown that SWAT is applicable to large scales , but with an increasing scale, the data collection and preparation becomes more challenging and time consuming. Hence a first main goal of the project is to set up a European Database. Spatial maps such as elevation information, soil and landuse were obtained from global datasets (USGS) or from European projects (CORINE Land Cover Project). An extensive effort was made in setting up a European climate database which consists now of over 2000 climate records containing good quality data. For calibration purpose, a discharge dataset obtained from GRDC (Global Runoff Data Centre) is available containing around 150 monthly discharge observations. After a successful model setup, first calibration results using the SUFI-2 algorithm are promising but also outline the main problems to solve. Extreme climatic regimes such as those encountered in north-eastern Europe require special treatment in the calibration process. In the first results, a trend of underestimating runoff can be observed, independent of the location of the watershed. This leads to the conclusion that the climate station network may not lead to satisfying results as precipitation input is unreliable.

Keywords: SWAT, large scale application, Europe, hydrological modeling

A1-7

Hydrologic Calibration of the SWAT Model for African River Basins using GRACE data

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The Soil and Water Assessment Tool (SWAT) is a well-known river basin model with a proven track record of successful applications at smaller scales. In recent years the SWAT model has also shown potential for watershed studies at larger scales. In this presentation, we report on a study calibrating the SWAT model using total water storage variation data derived from the Gravity Recovery and Climate Experiment (GRACE) in an endeavor to develop large-scale SWAT applications to model the water budget of sub-Saharan Africa. Conventionally, the hydrologic calibration of SWAT relies solely on river discharge data. The use of the GRACE data provides additional constraints for SWAT model conditioning and offers the opportunity to evaluate and improve the SWAT model in regions where the river system is poorly monitored. However, incorporating the GRACE data into the SWAT model calibration is nontrivial due to the inherent uncertainties introduced in GRACE data processing. In our study, we chose to sample the SWAT output on a 0.5° latitude by 0.5° longitude grid and filter the grid-based SWAT estimates of total water storage variation to correct the filter-induced bias arising from the GRACE data processing. The methodology and preliminary results will be presented, and other data issues for developing large-scale SWAT application will also be discussed.

Keywords: SWAT, GRACE, Hydrologic calibration, sub-Saharan Africa

SESSION B1

Model Development

B1-1

Enhancement of the SWAT-REMM System for Simulation of T-N Reduction Efficiency with Riparian Buffer System at a Bonggok watershed

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In recent years, riparian buffer system has been known as one of the effective best management practices. However, establishment of riparian buffer system in aspect of plant species and its position in the riparian buffer zone has not been investigated due to lack of efficient evaluation method for the analysis of water quality improvement with established riparian buffer system. To solve this problem, the SWAT-REMM prototype model, which also have several limitations in applying it to other watersheds because many model input parameters are not read from the local input data, was developed by the researchers in Canada. Thus the SWAT-REMM enhanced was developed by improving four major limitations - 1) riparian buffers at designated reaches in the watersheds, 2) riparian buffer using soil properties at riparian buffer zone along reaches, 3) multiple weather stations at large scale watersheds, and 4) NO_3-N loads in baseflow flowing into riparian buffers. This enhanced SWAT-REMM system was applied to the Bonggok watershed in Korea. In this study, 3 riparian buffer scenarios with different widths (10m, 5m, and 1m) of buffer zones with different canopies. It was found that T-N reduction efficiency ranged from 14.8 to 54.0 % in each subwatershed in scenario 1 10m width of established riparian buffer system. Also, T-N reduction efficiency was from 6.9 to 31.6 % in each subwatershed in scenario 3 which has 1m width of established riparian buffer system. The reduction efficiency was not proportional to the width of riparian buffer system. As shown in this study, the SWAT-REMM enhanced system could be used to evaluate the effects of various riparian buffer scenarios on water quality improvement at spatiotemporal aspects. The SWAT-REMM enhanced system interface for ArcGIS should be developed for wide ranges of ArcGIS and SWAT users.

Keywords: Riparian buffer, RBS, SWAT, REMM, Water quality

B1-2

Development of the Integrated SWAT-VFSMOD model

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Because of negative impacts of sediment-laden water by accelerated soil erosion and transport processes, many researchers have been investigating to develop most effective soil erosion management practices. Hydraulic structures such as soil erosion control dams and grit chamber are installed widely. Instead of structural best management practices, non-structural best management practices, such as the Vegetative Filter Strip (VFS) has been thought as one of effective methods with less effort. The VFS is designed for reducing sediment from upland areas such as cultivated area. In addition, it has many positive functions by providing wildlife habitat. For these reasons, various researches regarding the VFS effects have been increasing in many countries. For maximum effects of the VFS on water quality improvement, the sediment trapping efficiency by VFS needs to be investigated and designed before its installation at the fields. For this purpose, the desktop-version of the VFSMOD system can used to estimate sediment trapping efficiency of vegetative filter strip under various field and vegetation conditions. However, the VFS effects at the receiving water body cannot be simulated with independent VFSMOD and SWAT system. In the current SWAT model, the VFS is simulated with simple regression equation, which is a function of VFS width solely. Thus the VFSMOD system was integrated with the SWAT model to simulate the VFS dynamically by considering most factors affecting the VFS performance, such as CN, soil type, rainfall, and other various factors, instead of evaluating its performance with VFS width only. With the integrated SWAT-VFSMOD system, SWAT simulated output data are used as input to the VFSMOD dynamically and its effects are simulated with existing SWAT routing component. It was found that the SWAT-VFSMOD system can be efficiently used to simulate VFS effects on water quality improvement.

Keywords: Filter strip, soil erosion, sediment, SWAT, water quality, VFSMOD

B1-3

New Shallow Water Table Depth Algorithm in SWAT2005: Recent Modifications

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The proximity of the shallow water table depth (*wtd*) to the soil surface impacts agricultural production, farm machine trafficability, and water quality due to agricultural chemical transport, soil salinity. Therefore, it is essential for hydrologic models to accurately simulate *wtd*. Recently, an alternative shallow *wtd* algorithm that relates drainage volume (*vol*) with *wtd* was incorporated into the Soil and Water Assessment Tool (SWAT Release 2005) model. Water table depth is computed as a function of *vol* and a factor *wtdconv*, which converts vol into *wtd*. The conversion factor *wtdconv* is currently a calibration parameter that is a function of the soil physical properties. However, at the watershed-scale where there are many fields (hydrologic response units, HRUs), it is difficult if not impossible to determine an optimum *wtdconv* value for each HRU through the calibration process. The objectives of this study were to: 1) modify the alternative shallow *wtd* algorithm in SWAT2005 so that *wtdconv* is automatically computed by the model as a function of soil physical properties and the location of the *wtd*, in order to eliminate determination of *wtdconv* through the calibration process; and 2) evaluate the modified *wtd* algorithm within SWAT2005 using measured water table depth data for three soils located in forest fields without tile drainage within the Muscatatuck River basin in southeast Indiana. On average the calibrated *wtdconv* yielded daily calibration and validation Nash-Sutcliffe efficiency (NSE) values of 0.64 and 0.41, respectively, the percent bias (PBIAS) values of -13% and -4%, respectively, and root mean square error (RMSE) values of 0.41 m and 0.59 m, respectively, while the automatic wtdconv yielded NSE values of 0.65 and 0.48, respectively, PBIAS values of -3% and 1%, respectively, and RMSE values of 0.40 m and 0.55 m, respectively, for the three observation wells. Based on these model outputs, there were no significant differences between the *wtd* simulated using the manually calibrated and the automatically computed *wtdconv* coefficient. Automatically computed coefficient *wtdconv* will enable this alternative shallow *wtd* algorithm to be used at the watershed scale.

B1-4

Modelling Onsite Wastewater Systems in SWAT

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It is common practice to use onsite wastewater systems (OWSs) to treat domestic wastewater in the United States and the use of OWSs is growing every year with the development of new residential houses. However, OWSs are considered a cause of significant non-point pollution sources to water bodies especially in rural and suburban areas. OWSs discharge septic tank effluent to the soil wherein percolation through an unsaturated zone provides treatment of many pollutants. Remaining constituents are eventually transported via ground water into surface waters. Watershed scale models can serve as useful tools for tracking the fate of nutrients discharged to the receiving waters of a river basin. The objective of this study is to develop modeling capability within the Soil Water Assessment Tool (SWAT) to simulate various types of OWSs and quantify environmental impacts by assessing nutrient loadings to the watershed. The new biozone module simulates biophysical processes taking place in the biologically active soil layer (biozone) that receives septic tank effluent. The new capability, available in ArcSWAT 2009 version, has significant impacts on predicting water quality of the receiving waters due to the combined effect of all point and nonpoint source loads, including septic tanks. The new algorithm incorporates the impacts of effluents delivered from conventional, advanced and failing septic tank systems on downstream water quality in a large watershed. Model parameters were calibrated to monitoring well data collected at residential sites in Hoods Creek Watershed, NC. Integrated modeling approach will also be presented.

B1-5

SWAT-CUP: A Calibration and Uncertainty Analysis Program for SWAT

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As watershed models are being used more and more for making management decisions, it is imperative that they are calibrated and validated with proper attention given to sensitivity and various uncertainties. Technically, calibration of complex watershed models is not an easy task for reasons ranging from lack of observed data to the large number of parameters and the long time that model execution requires. Conceptually, calibration of watershed models is beset with four important issues. These are i) parameterization, ii) objective function definition, iii) uncertainty quantification, and finally, iv) conditionality of the calibrated model. In this paper we discuss these issues and describe a program generally referred to as the CUP (Calibration and Uncertainty Procedures) and its coupling with the hydrologic program Soil and Water Assessment Toll (SWAT). SWAT-CUP consists of five different optimization programs Sequential Uncertainty Fitting ver. 2 (SUFI2), Generalized Likelihood Uncertainty Estimation (GLUE), Parameter Solution (ParaSol), Monte Carlo Markov Chain (MCMC), and Particle Swarm Optimization (PSO), which are linked with similar inputs to SWAT. This easy-to-use program allows the user to compare different optimization algorithms as well as the effect of different objective functions (only with SUFI2) on the final parameter sets. The program allows detailed parameterization of the model based on hydrologic group, soil and landuse type, subbasin, and slope. The program further allows for the calibration of rainfall and temperature data. The SWAT-CUP interface allows visualization of the 95% prediction uncertainty (95PPU) band along with observed and best simulation results in the same graph, and calculates local and global sensitivities. The five procedures are briefly described here. No attempt is made to compare the procedures as this is beyond the scope of this paper.

Keywords: Calibration, uncertainty, Sufi2, GLUE, ParaSol, MCMC, PSO, SWAT-CUP

B1-6

Development of Subdaily Erosion and Sediment Transport Models in SWAT

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In collaboration with City of Austin, Texas, Texas AgriLife Research Scientists are developing algorithms within SWAT for simulation of stormwater best management practices (BMPs) such as detention basin, wet pond, sedimentation filtration pond, retention irrigation. Modeling small watersheds often requires time steps as small as minutes to realistically capture the instantaneous flow and pollutant transport coming from upland areas. SWAT 2005 uses the Modified Universal Soil Loss Equation (MUSLE) for processing upland erosion and the transport of sediments to the stream. While MUSLE model works well at daily simulation scale, the model is inadequate for subdaily simulations mostly because the model is not physically-based, but is conceptualized based on field data collected in the United States. To make the SWAT erosion processes calculated at the same time scale as subdaily flow, MUSLE equation was replaced by a set of physically-based erosion models. In the new algorithm, splash erosion is calculated based on the kinetic energy delivered by rain drops adapted from European Soil Erosion Model (EUROSEM) model, and overland flow erosion is estimated using a physically based equation adapted from ANSWERS model. Two instream sediment routing models including Yang's model and Brownlie model were also added. Sensitivity of new parameters was evaluated and the erosion and sediment transport modules were tested on Riesel Experimental Watershed in Texas USA.

B1-7

Simulation trends and other aspects regarding the worldwide use of the SWAT model

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The Soil and Water Assessment Tool (SWAT) is one of the most widely used watershed-scale water quality models in the world. Over 500 peer-reviewed SWAT-related journal articles have been published and hundreds more have been published in conference proceedings and other formats. The SWAT model has proven to be a very flexible tool for investigating a range of hydrologic and water quality problems at different watershed scales, as well as very adaptable for applications requiring imprdlfoved hydrologic and other enhanced simulation needs. We investigate here the various technological, networking, and other factors that have supported expanded use of SWAT, and also highlight current worldwide simulation trends and possible impediments to future increased usage of the model. Examples of technological advances include easy access to web-based documentation, user-support groups, and SWAT literature, a variety of Geographic Information System (GIS) interface tools, pre- and post-processing calibration, statistical evaluation, and other software, and an open source code which has proven to be a model development catalyst for multiple user groups. Extensive networking regarding the use of SWAT has also developed, via internet-based user support groups, model training workshops, regional working groups, regional and international conferences, and targeted development workshops. The use of SWAT has expanded dramatically, not only in developed regions such as North America and Europe but also in developing nations such as China, India, and Iran. Several important trends have also emerged regarding improved hydrologic, best management practice (BMP), and pollutant transport methods, which will be further highlighted.

SESSION A2

Hydrology (1)

A2-1

Surface soil moisture assimilation with SWAT

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Soil moisture is one of the most critical state variables in hydrologic modeling. Certain studies have demonstrated that assimilating observed surface soil moisture into a hydrologic model results in improved predictions of profile soil water content. With the Soil and Water Assessment Tool (SWAT), however, there is a lack of investigative research as to how the spatial variability of inputs affect the potential capability of data assimilation techniques, especially the assimilation of remotely sensed surface soil moisture data. Therefore, a synthetic experiment is performed to better understand how soil moisture data assimilation affects various hydrologic processes in the model at the watershed scale. The study area for this work is the Upper Cedar Creek Watershed (UCCW) which is located in the St. Joseph Watershed in northeastern Indiana. The predominant land use in the UCCW is agricultural (79%), with major crops of corn and soybeans, and minor crops of winter wheat, oats, alfalfa, and pasture. The area receives approximately 94 cm of annual precipitation and has average daily temperatures ranging from -1^{o}C to 28^{o}C. In the UCCW, the USDA, Agricultural Research Service National Soil Erosion Research Laboratory (NSERL) maintains a hydrometerological network where five years of precipitation and soil moisture data are available. The model is first run with rainfall data from the National Climatic Data Center (NCDC) and the NSERL raingauge network to represent the "true" state. Subsequently, the model is run for the same time period with an intentionally poor set of initial conditions and "limited" forcing data. Instead of using all available rainfall data from data sources, simulation was performed using only the NCDC data. These "limited" inputs are to represent our imperfect knowledge of the true hydrologic processes. By limiting precipitation input, which is the driving force of soil moisture and streamflow, while keeping other model parameters unchanged, we determined how the updated soil water condition with surface measured soil moisture influences model predictions of profile soil water content, runoff and streamflow. Model evaluations were conducted by using time series graphs and standard statistical measures including the correlation coefficient (R), mean bias error (MBE), and root mean square error (RMSE).

Keywords: SWAT, data assimilation, soil moisture

A2-2

The Spatial Analysis between SWAT Simulated Soil Moisture, and MODIS LST and NDVI Products

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This study is to identify how much the Terra MODIS NDVI (Normalized Difference Vegetation Index) and LST (Land Surface Temperature) can explain the soil moisture by using the SWAT (Soil and Water Assessment Tool) simulated results. For a 2,694.4 km^2 dam watershed of South Korea, 9 years (2000-2008) monthly MODIS NDVIs and LSTs were compared with the SWAT simulated soil moistures (SM). Before the analysis, the SWAT model was calibrated and verified using the 9 years daily streamflow at 3 gauging stations and 6 years (2003-2008) daily soil moistures at 3 locations with the watershed. The average Nash-Sutcliffe model efficiencies during streamflow validation were 0.7, 0.7, and 0.7 respectively. The correlation of SM with NDVI was on the similar level with LST for the forest leaf growing (March-June) and falling period (September-December). The soil moisture showed an inverse proportion with NDVI and LST during the leaf growing period. The low correlation appeared in case of dispersed storms occurred during the period regardless of the leaf growing or falling periods.

Keywords: SWAT, MODIS, NDVI, LST, soil moisture

A2-3

Evaluation of SWAT Model for Irrigation Reservoir Operation

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The objective of this study is to evaluate SWAT-K model in paddy irrigation area in korea. SWAT model was applied to Idong reservoir watershed which represents a typical korean rural watershed in Yongin city. Field data to assess irrigation water are monitored from irrigation district, reservoir, stream. Several reservoirs with small size in upper stream area of Idong reservoir such as Yongduck, Misan, Nogok which are working on irrigation area of approximately 800ha. Also, Return flow and spillway release water make an effect on streamflow of inlet stream to Idong reservoir.
Simulation results compared with HOMWRS model are calculated as 2.2 Mm^3 and 1.7 Mm^3 in 2007, 1.3 Mm^3 and 1.6 Mm^3 in 2008. Irrigation amount by SWAT are 918 mm/year and monitored data are 875mm in the irrigation district. As a result of this study, Irrigation water balance can be calculated by SWAT model. As a result of this study, Misan subbasin without reservoir effect had a good result with the daily and monthly streamflow comparison. It has a very similar trend with observed data with reservoir effect. It is necessary to study reservoir effect, return flow and water use which are influencing rural watershed streamflow.

Keywords: SWAT-K, HOMWRS, Agricultural reservoir, Reservoir operation

SESSION B2

InStream Sediment and Pollutant Transport

B2-1

Using SWAT for estimating impact of sediment and pollutant export in the Chungju Dam watershed, Korea

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The SWAT model has been used to estimate the impact of sediment, nitrogen, and phosphorus export flowing into the Chungju Dam of the Han River basin in Korea, which is a multi-purpose dam with the storage capacity of 2.75 billion ㎥, approximately 0.6 billion ㎥ of flood regulation, and the annual power generation of 844 millions kWh. The watershed area is 6,648 ㎢ that accounts for 19.3% of the entire area of the Han River basin. The model was calibrated against measured daily flows using Nash-Sutcliffe model efficiency and R squared, and calibrated against water quality data sampled infrequently using temporal-window statistics. After calibration and validation, simulated data from the model for the period 1980~2009 were used in order to investigate the in-stream sediment and pollutant transmission characteristics. Using transmission ratios of each sub-watershed stream, the total transmission ratios of pollutant loads to the Dam site were estimated. Downstream areas had higher transmission ratios than upstream areas, which indicated the application of practices to reduce pollutant export into the stream waterbodies near the mouth of the watershed would be more effective than application of the same practices on upstream areas near the head of the watershed. For the whole watershed, non-point sources accounted for 99.6% of sediment, 88.0% of T-N, and 73.8% of T-P loads into the Dam.

Keywords: SWAT, Chungju Dam, In-stream, Transmission characteristics, sediment, Nitrogen, Phosphorus

B2-2

Assessing the Impacts of Land use/ Land cover Changes and Practices on Water Discharge and Sedimentation using SWAT: Case study in Dong Nai watershed – Vietnam

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The Soil and Water Assessment Tool (SWAT) has been widely applied for modeling watershed hydrology and simulating the movement of non-point source pollution. The SWAT is a physically – based continuous time hydrologic model with Arcview GIS interface developed by the Blackland Research and Extension Center and the USDA-ARS (Arnold et al., 1998) to predict the impact of land management practices on water, sediment, and agricultural chemical yields in large complex basins with varying soil type, land use and management conditions over long periods of time. This study is aimed at assessing factors contributing to reservoir sedimentation, water discharge using SWAT model in Dong Nai watershed as case study. It is especially important in the Dong Nai watershed where the soil is highly erodible and forest conversion for agricultural cropping is in serious condition. This study was also focused on how surface runoff and sediment yield was impacted when land use in the watershed resource is changed. The SWAT model was applied to evaluate the effect of main input data of SWAT (land use, soil, human practices) to sediment yield in Tri An reservoir, Dong Nai watershed, Vietnam.

Keyword: Land use/Land cover change, Surface discharge, Sedimentation, SWAT, Dong Nai watershed

SESSION B3

BMPs

B3-1

Evaluation of Watershed Management Practices on receiving water quality using SWAT model

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To implement water quality management in upper watershed of portable water resource, it is necessary to assess point and non point source pollution loads, identify critical watershed pollution sources which are regional management priority missions, and act on best management plans. The SWAT model would be applied to evaluate the pollutant removal capacity with various best management practices (BMPs) in Kyeongan stream watershed which plays an important role in water quality conservation and improvement of Paldang reservoir. The methods for the representation of various BMPs scenarios with SWAT is developed and evaluated. Riparian buffer strip, agricultural conservation practices to reduce fertilizer, sediment, and nutrients occurring from farm field (Grassed swale, Contour farming/Parallel terrace, Field border, Farm retention pond, Grade stabilization structure), and wash land such as wetland and pond to extend detention and improve water quality are represented in SWAT. And to represent the expansion of existing Waste Water Treatment Plants in SWAT model, reduction effect for point source pollutants was simulated. As the result of simulation, the removal rates of SS, TN, TP from scenarios of Kyeongan stream watershed are the average annual SS yield by 4.4% to 64.3%, the average annual TN yield by 1.0% to 32.2%, and the average annual TP yield by 1.3% to 38.7%, respectively. This study has demonstrated that the SWAT is a very reliable and useful water quality and quantity assessment tool, and the BMPs representation in SWAT for watershed management is able to effectively simulate in Kyeongan Stream watershed.

Keyword: BMPs representation, BMPs evaluation, NPS pollution, Pollutant removal capacity, SWAT, Watershed management

B3-2

Estimation of Pollutants Removal Efficiency in the Buffer Strip Using SWAT Model

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The construction of buffer strip is one of nonpoint sources pollutants controls. SWAT model would be applied to estimate the pollutant removals through the buffer strip. According to measures for the water quality, the non business purpose land would be changed into the grass as the buffer-strip and the changes of landuse effects on the results of the model. Under the rainfall conditions in 2007, the removal rates of SS, BOD, TN, TP are 11.5%, 9.5%, 1.2%, 4.5%. During the rainy days the removal rates of the buffer strip resulted in 92.3% of SS, 91.2% of BOD, 82.4% of TN, and 83.5% of TP. The pollutants from nonpoint sources were effectively removed by over 80% through the buffer strips.

Keywords: SWAT, buffer strip, nonpoint sources

SESSION A2

Hydrology (2)

A2-4

Analyzing water resources in a monsoon-driven environment – an example from the Indian Western Ghats

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In India water availability is typically dominated by a pronounced seasonality resulting from the monsoon-driven rainfall regime. Besides this environmental situation, many regions show an increasing water demand due to rapid population growth, industrial development, and intensified (irrigation) agriculture. Such a situation is particularly the case in the meso-scale catchment of the Mula and the Mutha river (2036 km²), located in the Western Ghats upstream of the fast growing city of Pune.
In this study a coarse resolution (1 km) general and a high resolution (30 m) current land use map were used to derive recent land use changes and their impacts on the catchment hydrology, particularly evapotranspiration. SWAT was used to set up two watershed models based on the different land use maps. A focus is set on the use of freely available data from international archives and remote sensing.

Our first findings show the relevance of using high resolution remotely sensed data to evaluate land use changes. Based on these data SWAT allows to evaluate impacts on water availability, especially in agricultural areas. Crop specific evapotranspiration rates and leaf area development were reasonably modeled. However, further improvements regarding soil parameterization and forest transpiration are necessary.

A2-5

Evaluation of Mixed Forest Evapotranspiration and Soil Moisture using Measured and SWAT Simulated Results in a Hillslope Watershed

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This study is to evaluate the SWAT soil moisture, evapotranspiration and streamflow by comparing with the measured data in a 8.54 km^2 hillslope watershed of South Korea. By using 2007 daily streamflow at the watershed outlet, 3 months daily evapotranspiration and 6 months soil moisture data measured at mixed forest, the SWAT model was calibrated. The uncertainty of soil moisture parameters, available soil water capacity, soil bulk density, and soil evaporation compensation coefficient, and the evapotranspiration parameters, plant uptake compensation factor, soil evaporation compensation factor, and maximum canopy storage were interpreted by the measured data during the calibration. The model was validated with 2008 streamflow, evapotranspiration and soil moisture, and 4 years (2003-2006) streamflow. The coefficient of determination (R^2) for soil moisture and evapotranspiration were 0.67 and 0.57, and the R^2 and Nash-Sutcliffe model efficiency for streamflow were 0.76 and 0.77 respectively.

Keywords: soil moisture, evapotranspiration, streamflow, measured data, SWAT

A2-6

Integrated surface-groundwater analysis considering groundwater use in Pyoseon region, Jeju island, Korea

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The surface runoff characteristics of Pyoseon region in Jeju island are quite different from those of inland. Most of streams show dried characteristics by means of large portion of recharge which goes to the deep aquifer. It means that there is no baseflow in the upper area of watershed. However groundwater discharge is more and more increasing as approaching to the downstream near to sea. The quantity of groundwater use in this area is very large enough to affect the hydrologic component. For this reason, the integrated SWAT-MODFLOW model is used to simulate the complex runoff structure including groundwater recharge/discharge as well as the effect of water use by pumping with 198 wells. Statistical analysis shows that SWAT-MODFLOW produces a reasonable water budget which shows similar pattern of observed one. Hydrologic component variation due to the well pumping in the area is analyzed by using the Well package in MODFLOW. The comprehensive results show that the most of groundwater discharge is moved to the sea, so careful management of groundwater is needed for reasonable groundwater planning.

Keywords: SWAT-MODFLOW, Jeju island, groundwater discharge, well pumping

SESSION B4

Database and GIS Application and Development (1)

B4-1

The MVC client server architecture of the BSC-OS portal to digest, manage, and query SWAT data collections

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In recent years the progress in network based technologies, computer simulation, and high performance computing is highly extending the possibilities in environmental sciences, and is changing the way in which land management systems can operate. Earth scientists, public and private agencies are moving ever more to the Internet client-server paradigm, searching ever more for data, models and applications.
The Black Sea Catchment Observation and Assessment System (BSC-OS is being developed in the 4-year EnviroGRIDS project under the EC Seventh Framework Programme. The project aims to address the subjects of environmental unsustainable development and inadequate water and soil resource management in the Black Sea Catchment area. The enviroGRIDS project is the first truly trans-national effort to address many socio-economic and environmental issues in the region, involving about 15 European countries for a total of 27 partners.
The system will expose a shared information system based on a set of loosely coupled web applications. The Collaborative Working environment (CWE), to be developed in Task 2 of Work package 6, is the front end for the SWAT reporting production mechanism and data visualization of the BSC-OS portal that will provide an easy access to contents and services.
The CWE that operates on the boundary of public water protection agencies, scientific/technical partners, stakeholders and citizens will significantly address the need to build local, national and regional capacity also through active interaction between the partners and cooperation to the GEOSS and INSPIRE initiatives.
The report production mechanism of the BSC-OS portal, based on the BASHYT (www.eraprogetti.com) software, will be farther developed to meet the challenges of such complex enlarged working environment. The BASHYT framework, exploits the Model View Controller (MVC) architectural pattern. This isolates "domain logic" (the application logic for the user) from input and presentation (GUI), permitting the massive use of Velocity Templates stored in the database of the portal. Such paradigm allows the enabled users to write, share and expose on the WEB their Templates in the portal as Applications. Each Template is a stand-alone script (written in VTL - Velocity scripting language) that combines data such as SWAT simulations, maps, users' roles, to produce a web page (in a HTML format). Applications for the reporting production, in this way, will use the full features of the web browser, so it is possible to integrate JavaScript / AJAX objects in the same developing environment.
The use of such innovative interactive tools for data manipulation and report production is expected to increase data interpretation abilities at present exploited mainly with the ArcSWAT and AvSWAT stand alone desktop applications.

B4-2

Development of a field based Decision support Tool integrated with socio-economical model for managing Water Quality and Quantity

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Human activity is intricately linked to the quality and quantity of water resources. Although many studies have examined human-water dynamics, the complexity of such coupled systems is not well understood largely because of gaps in our knowledge of water-cycle processes which are heavily influenced by socio-economic drivers. Considerable research has been performed to develop an understanding of the impact of local land use decisions on field and catchment processes at an annual basis. Still less is known about the impact of economic and environmental outcomes on decision-making processes at the local and national level. This study proposes to support a new approach which integrates physical and socioeconomic modeling with computational intelligence.

Often times farms interact with complicated environmental and social-economic factors while making farmland management decisions. To study human decision-making processes under different uncertainty, in our socio-economical model called 'agent-based model' (ABM), we develop alternative scenarios based on three main driving forces of farm-based decision making: climate, federal energy and agricultural policies, and market value of crops and fuels.

Through this study, tools have been developed which integrate the output from ABM model with the SWAT model at farm field level. Based on the ABM simulation results, we further investigate how the water quality responds differently under different scenarios. Current work also includes modification of decision modules to reflect agricultural practices in Iowa and the incorporation of agricultural policies.

Keywords: Human-water dynamics, Socio-economical model (ABM), Water quality model (SWAT), Decision support tool

B4-3

Evaluation of Streamflow and Water Quality in an Agricultural Watershed of South Korea using SWAT and KOMPSAT-2 Detailed Land Use Information

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This study is to evaluate the SWAT (Soil Water Assessment Tool) streamflow, sediment, T-N (Total-Nitrogen), and T-P (Total-Phosphorous) in case of using a quite detailed land use data, and discuss the discrepancy in model parameters when applying comparatively coarse land use data. Detailed land use information is crucial to establish agricultural BMPs (best management practices) as a watershed scale. The spatial resolution of land use also critically influences the watershed runoff and soil erosion directly linked to the sediment and nutrients transports, and finally affects the stream flow and water quality during the model run such as SWAT. Now, as the high spatial resolution of satellite image such as IKONOS, QuickBird, and KOMPSAT is available, it is possible to use a detailed land use data for model setup. For a 260 km^2 agricultural watershed located in the northwest part of South Korea, the 2 m resolution land use was prepared using KOMPSAT (Korea Multi-Purpose SATellite)-2 satellite image acquired in 17th September 2007. The KOMPSAT land use was classified into 26 categories compatible with USGS (United States Geological Survey) Level-I explaining the type of upland crops. Using the land use data, the SWAT model was calibrated with 2 years (2001-2002) daily streamflow and monthly water quality (sediment, T-N and T-P) data, and validated for another 2 years (2003-2004) data. The average Nash–Sutcliffe model efficiency of streamflow during validation was 0.81, and the coefficient of determination (R^2) of sediment, T-N and T-P were 0.94, 0.62, and 0.46 respectively. To identify the scale effect of land use in the modeling, the SWAT was once more calibrated and validated using 30 m land use of Landsat satellite classified into 8 categories comprising the upland crops as one category. The average Nash–Sutcliffe model efficiency of streamflow during validation was 0.76, and the coefficient of determination (R^2) of sediment, T-N and T-P were 0.87, 0.59, and 0.43 respectively. Even though the two results have modeling errors and there are some problems for one to one comparison between parameters, we found that the watershed CN (curve number) parameter that affects the watershed runoff showed a big difference between 2 land use applications. The KOMPSAT watershed CN was calibrated with 11.4 greater than the Landsat watershed CN. This difference came from the increase of impervious areas viz. paved roads, residential areas, and bare fields that were not classified in Landsat land use. The increased CN resulted in the increase of surface runoff and streamflow. The increased surface runoff by different occurrence in space and streamflow subsequently influenced the sediment transport and affected the T-N and T-P transports. Further analysis will be done especially for the model parameters between 2 land use applications.

Keywords: SWAT, Land use, KOMPSAT-2, Landsat, Scale effect, Sediment, T-N, T-P

SESSION A3

Climate Change Applications (1)

A3-1

Multivarite Nonstationary Markov Chain Model and Its Use for SWAT Rainfall-Runoff Model

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Precipitation and runoff are key elements in the hydrologic cycle because of their important roles in water supply, flood prevention, river restoration, and ecosystem management. Global climate change, widely accepted to be happening, is anticipated to have enormous consequences on future hydrologic patterns. Studies on the potential changes in global, regional, and local hydrologic patterns under global climate change scenarios have been an intense area of research in recent years. The present study contributes to this research topic through evaluation of design flood under climate change. The study utilizes a weather state-based, stochastic multivariate model as a conditional probability model for simulating the precipitation field. An important premise of this study is that large-scale climatic patterns serve as a major driver of persistent year-to-year changes in precipitation probabilities. The simulated precipitation through the proposed downscaling model is used to evaluate change in design floods that are calculated by SWAT rainfall-runoff model. A case study is also performed with the Soyang Dam watershed in South Korea as the study basin. Finally, a comprehensive discussion on design flood under climate change is made.

A3-2

Hydrologic response to climate and landuse change in the Minnesota River Basin

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Predicting the combined effects of climate change and urbanization from empirical data is difficult and has a lot of uncertainty associated with it. However, forecasting the combined hydrological impacts of such anthropogenic changes is important in developing proactive strategies to protect water resources. Therefore, as part of EPA's Global Climate Research Program (GCRP), the implications of future climate prediction derived from four global climate models (GCMs) and future landuse forecasts obtained from Integrated Climate and Land Use Scenarios (ICLUS) datasets were used to evaluate possible future changes in the hydrologic response of the Minnesota River basin. The Soil Water Assessment Tool (SWAT) was used to investigate these complex stressors. This study uses the North American Regional Climate Change Assessment Project (NARCCAP) simulations of climate change over the period of 2040-2070 and the ICLUS demographic model to project population to 2100 for each county in the conterminous U.S. and will provide an initial assessment of separate and combined effects of urbanization and climate change on the hydrology of the Minnesota River Basin in USA. The results from this study will help policymakers and stakeholders to reassess proactive management actions that may enable the society to adapt these changes.

A3-3

Impact of Climate Change on Water and Soil Loss in Daecheong Reservoir Watershed

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The impact of climate change on the water budget and soil losses in the watershed of Daecheong Reservoir(Korea) was assessed using the Soil and Water Assessment Tool (SWAT). Future climate data including precipitation, temperature and humidity generated by introducing a regional climate model (Mesoscale Model Version 5, MM5) to dynamically downscale global circulation model (European Centre Hamburg Model Version 4, ECHAM4) were used to simulate the hydrological responses and soil erosion processes in the future 100 years (2001-2100) assuming the Special Report on Emissions Scenario(SRES) A1B. The results indicated that the climate change may increase the amount of surface runoff and thereby sediment load to the reservoir. Spatially, the impact was relatively more significant in the subbasin Bocheongcheon because of its lower occupation rate of forest land compared to other subbasins. Seasonally, the increase of surface runoff and soil loss was more significant during late summer and fall season when both flood control and turbidity flow control are necessary for reservoir operations. Occurrence of large flood events during these period is more signigicant for turbidity management because the suspended solids that remained water column can be resuspended by vertical mixing during winter turnover period. The study results provide useful information for the development of adaptive management strategy for the reservoir to cope with the expected impact of future climate change.

A3-4

Assessment of MIROC3.2 hires Climate Change and CLUE-s Land Use Change Impacts on Watershed Hydrology using SWAT

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This study is to evaluate the future potential climate and land use change impacts on hydrologic components for a mountainous dam watershed of South Korea. The MIROC3.2 hires GCM A1B data of 2020s, 2050s and 2080s was prepared through change factor simple statistical downscaling method. The future land uses were predicted by the conservation of land use and its effects model (CLUE-s) using Landsat satellite images from 1975 to 2000. By applying the future predicted climate and land use data to SWAT, the watershed hydrologic components of evapotranspiration, groundwater recharge, and streamflow were evaluated. For the future 2080s temperature increase of + 4.8 ℃, and 6.2 % forest decrease and 4.8 % grass increase conditions, The future evapotranspiration (ET) was mostly affected by the climate change than land use change. The 2080s ET showed + 23.1 % by climate change only while + 28.8 % change by climate plus land use changes scenario. The future groundwater recharge (GW) and streamflow (ST) were more affected by the land change. The future land use change impact on GW and ST were up to + 14.4 % and + 18.6 % respectively. The results notify that the groundwater resources will become more important in the future.

Keywords: Climate change, Land use change, Hydrologic component, CLUE, SWAT

SESSION B4

Database and GIS Application and Development (2)

B4-4

Development of Web-GIS based SWAT Data Generation System

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Watershed topographical data is essential in the management for water resources and watershed management in terms of hydrologic analysis. Collecting watershed topographical and meteorological data is the first step for simulating hydrological models and calculating hydrological components. This study describes a specialized Web-based Geographic Information Systems, Soil Water Assessment Tool model data generation system, which was developed to support SWAT model operation using Web-GIS capability for map browsing, online watershed delineation and topographical and meteorological data extraction. This system tested its operability extracting watershed topographical and meteorological data in real time and the extracted spatial and weather data were seamlessly imported to ArcSWAT system demonstrating its usability. The Web-GIS would be useful to users who are willing to operate SWAT models for the various watershed management purposes in terms of spatial and weather preparing.

Keywords: SWAT, Real Time, Web-GIS

B4-5

Development of an interface system to couple SWAT2005 with HyGIS

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SWAT model was developed by USDA ARS(Agricultural Research Service) in early 1990s, and recently SWAT2005 model was developed. SWAT2000 model was generally used by using the interface system with ArcVeiw or HyGIS-SWAT. Recently, ArcSWAT was developed to run SWAT2005 model in connection with ArcGIS. In this study, the interface system coupling SWAT2005 model with HyGIS was developed to run SWAT2005 model in HyGIS system through analyzing input and output module of SWAT2005 model and upgrading previous version of HyGIS-SWAT. This study can contribute providing the environment to run SWAT2005 model by using domestic data proper to the situation of Korea effectively on the basis of GIS and database.

Keywords: SWAT2005, HyGIS, HyGIS-SWAT

B4-6

The effect of map spatial resolution on simulation result of SWAT, case study: chelchay watershed, Golestan province in Iran

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Policy maker and watershed managers like to know impacts of the effects of watershed management measures. Complexity of watersheds natural system makes the direct study of management impacts difficult. So some models are developed for these evaluations that one of them is SWAT model (soil and water assessment tool). The aim of this paper is studying of spatial resolutions impact of input maps on runoff and sediment results from SWAT model. To achieve this aim, two series input maps with different spatial resolutions. First simulation was with high resolution maps from detailed study with 1: 50000 scale and second simulation was with global maps of the SWAT. Study area is Chelchay watershed in Golestan province, one of the sub watersheds of Gorgan River, with 25683 ha area and 766 mm mean annual rainfall. After the running of model using these two series of maps, the model results are assessed before calibration. The amounts of R^2 for runoff volume in first and second simulation respectively were 0.29 and 0.26. and for daily sediment concentration were respectively 0.4 and 0.03. The results showed that using maps with higher spatial resolution increased the model ability in estimation of runoff and sediment concentration. The significance of spatial resolutions in estimation of sediment concentration is higher than runoff. Also model can predict the seasonal changes of runoff before calibration.

Keyword: spatial resolution, SWAT model, runoff, sediment concentration, Chelchay, Iran

SESSION A3

Climate Change Applications (2)

A3-5

Estimation of Climate Change Effect on Nonpoint Source Pollution in Juam Lake Watershed

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The potential effect of future climate change on the nonpoint source pollution from the Oenam Cheon watershed, which was a subwatershed of Juam Lake watershed was evaluated with SWAT model. For the analysis of future climate change the GCM(CGCM3.2_T63) data by SRES(Special Report on Emission Scenarios) A2, A1B and B1 scenarios of the IPCC(Intergovermental Panal on Climate Change) were adopted. The future climate data (2010~2100) were corrected using 30 years (1971~2000) weather data of Gwangju station and downscaled by change factor (CF) method.

SWAT model was calibrated using monitored flow and water quality data. Nonpoint source pollution load under climate change scenarios was simulated with calibrated SWAT model parameters and downscaled weather data. Future climate data projected increased rainfall except B1 scenario. Temperature also showed increased trend for all scenarios and the highest increase of 4.1? for maximum and 3.2? for minimum temperature were predicted for A2 scenario.

SWAT model simulated decreased runoff for A1B and B1 scenarios due to increased evapotranspiration by increased temperature. But, SWAT simultion showed increased runoff under B1 scenario. Except B1 scenario, T-N and T-P loads were expected to be increasing under climate change scenario. T-N was expected to increase up to 55.6% compared to baseline and 80.1% increase was predicted for T-P, respectively.

A3-6

The Evaluation of Climate Change Impacts on Water Resources System by Using SWAT Model

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Global climate change has brought significant changes in the hydrological environment temporally and spatially. Those changes also have occurred in the Korean peninsular for the last several decades, increasing the magnitude of damage by droughts and floods.
As an attempt to explore the impact of drought which may be worsened by the climate change, the water balance of the Han-river basin is evaluated. However, enormous uncertainty and various assumptions may be involved in the evaluation of future water balance. Thus, to obtain results as subjective as possible and to minimize the uncertainty in the estimation, we suggest a methodology consisting of three successive sub-procedures: daily rainfall generation for 90 years (2010-2100) by the MM5 RCM with the A1B scenario, daily discharge simulations by SWAT using the generated daily rainfall data, and monthly water scarcity analysis by estimating water balance, relied on the SWAT simulation. In the analysis, the amount of water consumption has influence on water balance in the future critically. To consider the influence, we come up with three water consumption scenarios, namely, “LOW”, “MEDIUM”, and “HIGH”, depending on the expected amount of water consumption.
Firstly, the fifty sets of daily rainfall data for 90 years are generated based on the MM5 RCM with the A1B scenario to produce various daily rainfall events as much as possible. Secondly, each set is used as an input for the SWAT to generate the fifty sets of daily discharges during the drought period of each year of the simulation period (2010-2100). Finally, water scarcity analysis is performed by estimating water balance based on 150 combinations from three water consumption scenarios and the fifty sets of daily discharges.
As results, it is expected that water scarcity in the Han-river basin will increase for each water consumption scenario in the future. Also, the spatial water scarcity analysis shows that water shortage will increase from several sub-basins currently to the entire Han-river basin in the future. The results of this study can be used to establish appropriate plans for minimizing the impact of drought resulted from the climate change in Korean peninsula.

Keywords : Climatic Change, SWAT Model, Water Balance, Water Scarcity

A3-7

Projection of future watershed hydrology by applying SWAT through the prediction of vegetation community under MIROC3.2 hires climate change condition

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This study is to evaluate the future watershed hydrology by predicting the forest community under MIROC3.2 A1B climate change scenario. The future data were downscaled by applying Change Factor statistical method through bias-correction using 30 years past weather data. The SWAT model was adopted for the hydrology evaluation, and the Youngsangang watershed (3,455 km^2) watershed located in the southwestern part of South Korea was selected. To predict the future distribution of forest vegetations, here simply classified into 3 categories of deciduous, coniferous, and mixed forest, the present forest distributions were represented by multinomial logit model with environmental variables viz. precipitation (P), temperature (T), elevation, degree of base saturation, and soil organic matter using 30 years (1971-2000) P and T. The future forest community was predicted by applying the MIROC3.2 A1B future climate change scenario. The future change of + 4.1 ℃ temperature and + 20.7 mm (1.5 %) precipitation in 2080s predicted 841.4 % (from 85.0 km^2 to 800.2 km^2) increase, 38.8 % (from 1413.4 km^2 to 865.3 km^2) decrease, and 85.8 % (from 194.8 km^2 to 27.7 km^2) decrease of deciduous, coniferous, and mixed forest areas respectively. Before the future assessment, the SWAT model was calibrated and validated using 5 years (1998–2002) and 6 years (2003-2008) observed dam inflow data with the average Nash-Shutcliffe model efficiency of 0.65 and 0.62 respectively. By applying the climate change and forest community scenario, the future watershed evaportanspiration of 2020s, 2050s and 2080s showed + 15.4 mm/yr, + 63.4 mm/yr, and + 85.7 mm/yr changes respectively based on the present evaportanspiration of 474.35 mm/yr.

Keywords: SWAT, Evaportanspiration, Multinomial logit model, climate change, forest community

A3-8

Comparison of Watershed Streamflows by Using the Predicted MIROC3.2hires GCM Data and the Observed Weather Data for the Period of 2000-2009 under SWAT Simulation

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The IPCC (Intergovernmental Panel on Climate Change) has offered GCM (General Circulation Model) data both the simulated in 20th century (1900~1999, 20C3M) and the predicted in the future 100 or 200 years (from 2000 to 2099 or 2199). Most water resources impact assessment studies using climate change scenarios have been conducted based on the IPCC GCM data during the past couple of decades. Even the evaluation of climate change impact on watershed hydrology and aqua-environment became a worldwide big issue and important to build a nationwide policy for the future proper adaptation against the abnormal weather, the assessment results have uncertainties such as GCM data in itself, downscaling methods, and model structure and parameters to be resolved. This study traces back the past decade's (2000-2009) GCM climate change data that were predicted in 2000 as of 2010, and compares the GCM data with the ground observed climate data for the same period. After that, we tried to identify the propagation of hydrological discrepancy by applying the two climate data through model run. For the climate change data, the MIROC3.2hires GCM data was selected and the SWAT (Soil & Water Assessment Tool) model was adopted to evaluate the difference of streamflows for the period of 2000 to 2009. For a 6,585.1 km^2 watershed located in the northeastern part of South Korea, the 2000-2009 MIROC3.2hires climate data of the IPCC SRES (Special Report on Emissions Scenarios) A1B and B1 scenarios were prepared through the bias correction and LARS-WG (Long Ashton Research Station – Weather Generator) downscaling using the past 3 decades observed data at 5 meteorological stations. Before the evaluation, the SWAT model was calibrated and validated with the 10 years (2000-2009) observed weather and streamflow data. The average Nash-Shutcliffe model efficiency was 0.66 during the model validation. The discrepancies on MIROC3.2hires GCM data and the corresponding hydrological behavior viz. streamflow, evapotranspiration, soil moisture content, groundwater recharge will be evaluated and discussed in depth.

Keywords: SWAT, climate change, uncertainty, GCM, LARS-WG, past decade, MIROC3.2hires

SESSION B5

Biofuel and Plant Growth

B5-1

Hydrologic effects of bio-char applications on corn production fields in Illinois

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The SWAT model simulations were used to determine the hydrological effects of bio-char applications on corn production fields in northern Illinois. A bioenergy research project in northern Illinois has been initiated to determine optimum locations for mobile pyrolysis units that use corn stover to produce bio-oil. The mobile pyrolysis units have a feedstock rate of 40 tons/day. The pyrolysis units produce bio-oil, syn-gas and bio-char. As much as 30% of the feedstock put into the pyrolysis units ends up as bio-char. The bio-char will be incorporated into the soil in the feedstock production fields. The SWAT model was used to assess hydrologic changes due to the bio-char applications. First, SWAT simulations were calibrated and validated for existing conditions. Then SWAT was used to simulate hydrologic responses for fields amended with bio-char. Hydrologic properties altered in soils amended with bio-char include water holding capacity, porosity, bulk density, nutrient content, soil erosion and crop production. Hydrologic changes due to bio-char applications to corn production fields in northern Illinois will be presented in this paper.

Keywords: SWAT, bio-char, hydrologic response, soil properties, Illinois, corn fields

B5-2

Evaluating the Impact of Biofuel Production on Watershed Hydrology Using SWAT

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Government of Thailand has perceived biofuel as a suitable source of alternative energy to meet the increasing energy demand and reduce imports of fossil fuel. Considerable amount of land is being converted for biofuel production. This land use change can have significant impacts on water resources in terms of both quantity and quality. In this paper Soil and Water Assessment Tool (SWAT) model is used to evaluate the impact of land use change for biofuel production on hydrology of a small watershed, Khlong Phlo in the Rayong province of eastern Thailand. Several land use change scenarios consisting of oil palm, cassava and sugarcane expansion were evaluated. Modeling results indicate that expansion of cassava and sugarcane coverage will decrease annual evapotranspiration and baseflow but increase annual surface runoff and water yield from the watershed which leads to increased sediment, nitrate and total phosphorus extraction into the surface water. Even though land conversion into oil palm plantation showed no significant effect on the water yield, the increased nitrate loss to the surface water is likely to affect the water quality of watershed. This study also reveals that the implication on annual water balance and extent of water quality degradation depends on type of crop chosen to produce biofuel and types of vegetation it replaces. In order to strengthen the study results, a research at a large scale at basin level is recommended.

Keywords: biofuel, land use change, hydrology, Khlong Phlo watershed, SWAT

SESSION B6

Landscape Processes and Landscape / River Continuum

B6-1

An Efficient Delineation Structure in SWAT to Simulate the Landscape/ River Continuum

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Modeling the cumulative discharge, sediment and solute load of large watersheds (>1000sq. km) requires a balance between data availability, computer processing, and model structure. Large model runs for continental scale assessment are common and assist in evaluating the nation's water quality, the viability and cost benefit of best management practices in the farm bill, amd climate change impacts on water resources. The model runs allow for broad scale evaluation of changes in management, climate, and the impact of legislation on the nations watersheds. In order for a model to be representative of the abiotic and biotic systems, it must represent linkages between the various landscape units at a scale that allows reasonable output. The challenge is to be able to realistically code the functions derived from studies at the hillslope and small catchment scale into models that operate at the meso (.100-1000km^2) and large (>1000km^2) scales. The purpose of this paper is twofold: (1) demonstrate a new way to aggregate detailed watershed processes within subwatersheds which meet the lower limits of dissagregation based on gage density and (2) to allow user defined routing strategies within these basins so that small headwater processes can be assimilated into the large watershed model while at the same time minimizing computer processing. We propose and demonstrate a flexible, computationally efficient stream network model which will integrate soil, landscape elements into a spatially explicit network of stream reaches.

SESSION A4

Pesticides, Bacteria, Metals and Pharmaceuticals

A4-1

Manipulation of the SWAT Code to Model Veterinary Antibiotics in the Environment

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Veterinary antibiotics (VAs) are widely used to treat diseases and protect the health of animals. They are also incorporated into animal feed to improve growth rate and feed efficiency. As VAs are poorly adsorbed in animal intestines, the majority is excreted unchanged in feces and urine. Given that land application of animal waste as a supplement to fertilizers is often a common practice in many countries, there is a growing international concern about the potential impact of antibiotic residues in the environment. Unlike other conventional industrial chemical pollutants, VAs possess several characteristics that make them different while assessing and modeling their fate and transport in the environment. Some of these attributes include: Solubility, pH (both soil and aqueous), organic carbon content, molecular structure, ionization, dissociation constant, octanol water distribution coefficient and sludge sorption/desorption. During this study, the SWAT code was modified to include few major parameters mentioned above to model VAs as well as other veterinary medicines in agricultural dominated watersheds. The watershed used for model testing was the Shell Creek Watershed, which is located in Northeastern Nebraska and drains an area of 1214 square km in parts of Boone, Colfax, Madison, and Platte Counties. Cattles and swine feedlot operations within the Shell Creek drainage constitute the major contributor to VAs loadings. Other major water quality issues include erosion, sedimentation, nitrogen, and phosphorus as well as degradation from other non-point sources and loss of aquatic and wildlife habitat.

A4-2

Potential Soil Transport of 17β-estradiol in a Beneficial Reuse System Land-applying Class B Municipal Biosolids for Forage Production in Central Texas

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The impact of anthropogenic chemicals on water quality, wildlife, and human health has received increasing attention in recent years. One potential source of anthropogenic compounds is land-based recycling programs which apply municipal wastes (biosolids) to large tracts of agricultural land in lieu of chemical fertilizers. Fertilizing with biosolids may increase the risk of soil and water pollution by excess nutrients, metals, endocrine disrupting chemicals (EDCs), and other organic contaminants. It is also unclear how these compounds move through soils to enter natural waters and how different land-based recycling management strategies could be used to minimize chemical movement and transport. We used the USDA-ARS's Soil and Water Assessment Tool (SWAT) pesticide submodel to simulate potential movement of 17β-estradiol through soils at a municipally-operated beneficial reuse site in central Texas that surface applies biosolids to agricultural land for commercial forage production. Specifically, we were interested in the effects of cropping system affects EDC movement, as well as the effects of uncommon, large rainfall events that could potentially flush EDCs from biosolids-applied areas. Two simulations were run (1980-2006, 1980-2007) in which one simulation included a historically high 2007 rainfall year. SWAT simulations showed that the perennial biofuel crop switchgrass reduced leaching of 17β-estradiol through surface soils (A horizon) by 21-23% compared to the current coastal Bermudagrass forage crop. No leaching of 17β-estradiol was simulated to occur through the bottom of the soil profile (1.5 m), but leaching through surface soils (A horizon) increased by 90% with the inclusion of the 2007 rainfall year. Our results suggest that anomalous rainfall events may trigger flushes of EDCs through the soil. The results from this study will be used to aid the development of an emerging contaminants sub-model in SWAT for predicting transport and fate of EDCs and other biosolids-derived organic pollutants. Ultimately, our research findings will assist the development of more sustainable, economically and ecologically sound land-based biosolids recycling management plans.

A4-3

Modeling approach on resuspension of *E. coli* from streambed using Soil and Water Assessment Tool (SWAT)

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Streambed sediment has been attracting attention as a reservoir for bacteria, including pathogenic strains. Soil and Water Assessment Tool (SWAT) has been augmented with a bacteria transport module in SWAT2005 where the die-off of bacteria is the only in-stream process. The purpose of this study was to evaluate the prospective significance of streambed *E. coli* release and deposition within the SWAT microbial water quality simulations. The modified SWAT was applied to the Komacwon Creek (KMC) watershed, South Korea. Sensitivity analyses and calibrations were separately performed on both hydrologic and bacteria-associated parameters. Hydrometric validation results display a very good linear relationship between observed and predicted data (Nash-Sutcliffe efficiency E = 0.82 and 0.85 for calibration and validation steps) and indicate satisfactory simulation of hydrologic processes within the catchment. Based on recommended values for the quantification of catchment modeling accuracy, predictions for *E. coli* can be described as unsatisfactory; this may attribute to the lack of data on wildlife. Although the uncertainty of *E. coli* concentrations in streambed sediments and from wildlife probably affected the performance of the modified SWAT model, this study qualitatively confirmed the significance of EC release from streambed and deposition for the SWAT microbial water quality simulations.

SESSION B7

Environmental Applications

B7-1

Modification of stream water temperature calculation equation of SWAT for the Han River Korea using regression analysis

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Stream water temperature is one of the important factors affecting ecosystems and water quality of rivers. However, water temperature records are not easily available therefore air temperature is usually used to estimate water temperature in many studies. In recent, researchers are seeking other climatic parameters which have correlation with water temperature. In the SWAT model, stream/air temperature relation equation developed by Stefan and Preud'homme in 1993 is used to estimate water temperature from air temperature. This equation was derived from linear regression of air and water temperature in 11 rivers in the USA. Purpose of this study was to derive stream water estimation equation in the Han River, Korea then compare the results to the equation in the SWAT model. Among the 48 water quality measuring points in the Han River water temperature records of 33 points excluding dams and urban areas were used. Linear regression using 8 day interval water temperature records of 33 measuring points and air temperature records of 14 weather stations was carried out. The prediction performance of air/stream water temperature regression equation in this study was higher than original equation of the SWAT model. Through the regression analysis of other variables such as wind speed, relative humidity, solar radiation and discharge, it was found that air temperature was the most important variable in stream water temperature estimation. The results of multiple regression of these variables with stream water temperature were shown that the prediction performance was the highest when solar radiation was included.

Keywords: SWAT, stream/air temperature, multiple regression

B7-2

Simulating Water Quantity and Quality and Sediment Transport under Varying Land Use and Climatic Conditions in a Monsoonal Driven Watershed

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Integrated modeling of water and solute fluxes throughout a small catchment is under investigation with the spatially-distributed SWAT2005. Field-based meteorological conditions, hydrology, biology, solute and sediment transport, and social and land use pattern data collected in the Haean-myun Basin are used to parameterize and calibrate the model. Key processes that regulate both water quantity and quality are examined to simulate sediment, nitrogen, phosphorous, and dissolved organic carbon outputs.

Several integrated experimental strategies such as monitoring of soil water dynamics and sediment transport measured within run-off plots during extreme event periods are being used to calibrate the soil water and erosion module in SWAT. Topographically variable, spatio-temporal surface water and groundwater elevation and concentration datasets are being collected.

The modeling framework described is used to perform scenario simulations examining temporal changes in land use practices and climatic effects on water quantity and quality in complex terrain. An important part of this work is examining the social relationship between land management practices and the value of sustainable resources. A link between the small catchment population structure and these management practices to the resultant ecosystem services provided is being pursued. The water quality and sediment results from this catchment in conjunction with stochastic estimates from the remainder of the watershed impact the Lake Soyang reservoir, a drinking water supply to Seoul. Future work includes extrapolation of several catchment results with differing land use patterns to quantify potential nutrient loading within the Lake Soyang reservoir.

B7-3

Modelling the impact of land use change on the water balance in the Xiangxi catchment (Three Gorges Region, China) using SWAT

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The Three Gorges Region in China is currently facing a large scale land use change. Due to the impoundment of the Three Gorges Reservoir, agricultural areas had to shift uphill from the fertile valley bottoms to steep, formerly wooded slopes. Also, many villages and towns had to be relocated including the construction of new infrastructure.
The impacts of the ongoing land use change are currently assessed by the Sino-German project „YANGTZE: Land use change – Erosion – Mass Movements“. Five project partners from Germany are currently working in the Xiangxi Catchment, the chosen investigation area, focussing on different aspects of this topic. The sub-project „Diffuse Inputs“ tries to link the results of the other four sub-projects „Land Use Change“, „Remote Sensing“, „Erosion“ and „Mass Movements“ to the water quantity and quality of Xiangxi River and aims to fill the gap between the terrestrial and the aquatic part of the catchment.
The main tool used in this study is the SWAT model (Arnold et al. 1998). The input data is provided by the German project partners and Chinese cooperation partners and authorities. The database is completed by results of own fieldwork and literature data. The SWAT model is used to simulate the water balance as well as the sediment and phosphorus transport in the catchment. In order to assess the impact of the recent land use change caused by the construction of the Three Gorges Dam and to develop sustainable land use options from an eco-hydrological point of view, simulations will be run with different land use maps and possible future land use scenarios.
A particular challenge to the model application is posed by two factors of human activity in the catchment. Firstly, there is a large number of small hydropower stations along the rivers and secondly, extensive sediment dredging takes place in the riverbeds. Both of these factors significantly affect the water, sediment, and phosphorus transport in the rivers and thus have to be accounted for in the model.

SESSION A5

Sediment, Nutrients and Carbon

A5-1

COMPARISON OF THE SWAT MODEL VERSUS THE DAISY-MIKE-SHE MODEL FOR SIMULATING THE FLOW AND NITROGEN PROCESSES

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As diffuse pollution from agriculture is a major concern, catchment scale modelling is a useful tool in estimating pollution loads from the agricutural activities in the river basin. In the Odense river basin, farmland accounts for 68% of the basin area and is the most important source of pollution. The paper discusses (1) the set-up of the SWAT model for the Odense river basin for simulating hydrology and nitrogen transport and transformation (2) evaluate the performance of SWAT in modelling water quantity and nitrogen dynamics by comparison to observations and previousDAISY-MIKE SHE model simulations.
SWAT is a semi-distributed catchment model which simulates water quantity and pollutant loadings based on hydraulic respond units (HRUs). The effect of biological or chemical reactions on nitrate transformation in groundwater is specified in SWAT by the half-life nitrate parameter which is uniform for the whole shallow aquifer. The DAISY MIKE-SHE approach consists of coupling a physically-based root zone model DAISY and a physically-based and fully distributed catchment model MIKE-SHE which are running sequentially. DAISY simulates the crop growth, root development and calculates daily mass of nitrate leaching which are then used as input for MIKE SHE to simulate groundwater and surface water. The MIKE SHE model simulates denitrification in groundwater by considering both oxidized and reduced layers which are seperated by the redoxcline. It is assumed in MIKE SHE that nitrate reaching the redoxcline is removed instantaneously.
The input data is kept the same for the two models. Moreover, parameters in DAISY-MIKE SHE and SWAT that are compatible with each other should have the same value. A sensitivity analysis and calibration are then implemented for flow and nitrogen simulation in SWAT. The performance of SWAT and DAISY-MIKE SHE are compared in terms of the conceptual approach which affects the acurracy of flow and nitrogen simulation. According to premilinary results for Odense river basin, SWAT has problem in simulating low flow in the dry period.

Keywords: SWAT, DAISY-MIKE SHE, nitrogen, denitrification

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A5-2

Application of SWAT for nutrient load discharge estimation

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Impact assessments of land use change, population growth/decrease and watershed development to water quantity and quality are one of the most important topics in a basin. As well, integrated managements of water environment from river basin to downstream such as lake are also very important for conservation and sustainable use of its resources. In recent years, water quality in lakes are tried to improve until under environmental standard by emission control of pollutant loads to lake and rivers through putting an adequate sewage system in place and development of laws, though water quality in lakes have not been improved well as we expected. One of the reasons is considered to be pollutant loads discharged from non-point sources such as agricultural land. When considering watershed management and improvement of water environment in lakes, both information of lakes and rivers will be necessary. Thus, we tried to represent nutrient load discharge from the Hii River basin to brackish lake, called Lake Shinji. The Hii River basin is located in the eastern part of Shimane Prefecture, Japan. The catchment area of the Hii River basin is about 920 km^2. Forest is dominant in the area. Over 80% of the area is forest and less than 10% is used for agriculture. Major crop is rice. We applied the SWAT model to the basin by a daily time step. We paid attention to total nitrogen and phosphorus load discharges from the river. For calibrating model parameter values, SWAT-CUP was used in the study. As a result, SWAT could simulate fluctuations of load discharges following precipitation pattern relatively well. But parameter values still need to be calibrated to get more accurate results for considering an impact of the watershed management or something against downstream lake water environments.

A5-3

Study on Setting Appropriate Size of Riparian Buffer Zone in Urban Basin by Using SWAT Model

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The riparian buffer zone plays an important role in water quality, wildlife habitat and disaster prevention, and improves the water quality by removing suspended matters and filtering pollutants. Especially, as the arrival rate of pollutants influences directly the water quality in this area where is the transition zone between the aquatic ecosystem and terrestrial ecosystem, the riparian buffer area plays an important role in the ecological aspect. The efficiency of pollutant emission mitigation in riparian buffer zone is greatly influenced by the size of riparian buffer zone and it is necessary to set an appropriate size of riparian buffer zone in the area whose land is highly used such as urban area. In this study, we applied SWAT model to Yudeungcheon, Daejeoncheon and Gapcheon, the three biggest rivers in Daejeon Metropolitan city of korea which is a typical urban area, and analyzed the nutrients reduction effect according to the size of riparian buffer zone, by setting the size (width) of riparian buffer zone in 15m, 30m, 50m, 100m, 200m, 300m, 500m and 1000m. We examined the applicability of SWAT model by the nutrients loadings in Boksu, Indong and Hoeduck which were measurement stations of Yudeungcheon, Daejeoncheon and Gapcheon respectively from 2002 to 2005. As a result, Estimation Efficiency Analysis(COE) of monthly loadings were 0.59 to 0.78 for T-N, and 0.59 to 0.73 for T-P respectively, which shows the high applicability and reproducibility of SWAT model. We calculated the mitigation amount of nutrient emission loadings by varying the size (width) of riparian buffer zone. The decision criteria of the size of riparian buffer zone was determined as 10% of mitigation amount of nonpoint pollution source in 2010, target year, according to the water pollution maximum load system in Daejeon Metropolitan City. As a result, the emission amount of total nitrogen and total phosphorus were reduced by 10% and 12% respectively with deciduous tree and by 15.1% and 15.9% respectively with evergreen tree on the condition of 100m of riparian buffer zone in Boksu station, by 14.9% and 15.9% with deciduous tree and by 12.9% and 12.9% respectively with evergreen tree on the condition of 100m of riparian buffer zone in Indong station, and by 9.8% and 16.3% with deciduous tree on the condition of 300m of riparian buffer zone in Hoeduck where the evergreen tree was not effective. In conclusion, the size of riparian buffer zone and the mitigation effect varied with the stations: Boksu station where were lots of farmlands in the watershed of river; Indong station which was urban area for residence and commerce; Hoeduck station where urban area and farmland were mixed. In view of the fact that the evergreen tree was not effective, the mitigation effect, the size and the species of tree of riparian buffer zone were to be differently decided according to the conditions of land use in the watershed of river in target stations.

Keywords: SWAT model, Riparian buffer zone, Gapcheon, nutrients, total nitrogen, total phosphorus.

A5-4

Land Use Change Effects on Discharge and Sediment Yields of Song Cau Catchment in Northern VietNam

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The purpose of this paper is to implement the "Soil and Water Assessment Tool" model in order to examine the effects of land use change scenarios have on discharge and sediment yields of the Song Cau catchment in Northern Viet Nam. Prior to the scenarios, the particular hydrological and erosion regime of the catchment, representative of the tropical climate, was fully demonstrated. SWAT successfully predicted soil losses from different HRUs that caused significant sediment yields.
Facing the problem of reservoir inadequacy in the near future, the study attempted to assess the impact of pre-specified land use change scenarios, in terms of quantifying the results from the application of crop rotations and special cultivation techniques that was the most susceptible to erosion. All scenarios resulted in a decrease in soil losses and sediment yields comparing to the current state. The model predicted explicitly the consequences of non-structural mitigation measures against erosion. The understanding of land use changes in relation to its driving factors provides essential information for land use planning and sustainable management of soil resources, under the special conditions of Viet Nam.

Keywords: SWAT, Agricultural land, Sediment yields, Land use change scenarios.

SESSION B8

Urban Processes and Management

B8-1

Hydrologic Modeling of the White Rock Creek Watershed with SWAT-SWMM

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The development of a watershed area can significantly impact the natural flow in a stream network mainly due to an increase in surface runoff and an alteration of spatial flow pattern. In the field of hydrology, there have been extensive studies assessing the effect of urbanization on watershed runoff using hydrologic models. The storm water management model (SWMM) developed by the US Environmental Protection Agency (EPA) is a widely used dynamic rainfall-runoff model for analyzing quantity and quality problems in urban area. However, the SWMM can not sufficiently account for land uses other than urban area. To overcome this shortcoming and to better represent characteristics of both urban and natural area, a comprehensive integrated hydrologic model, SWAT-SWMM has been developed in which the RUNOFF block of SWMM is linked to the Soil and Water Assessment Tool (SWAT). The SWAT-SWMM model can be regarded as an advanced SWAT because it has a capability to simulate flow routing in urban drainage system such as pipe network. The main aim of this work was to apply SWAT-SWMM to the White Rock Creek watershed in USA for assessing hydrologic impact of urbanization. Uncalibrated runs by SWAT-SWMM and SWAT were carried out, and the results were compared each other to find out the characteristics of several outputs. After model calibration, results of SWAT-SWMM simulation showing the extent of the relationship between runoff and development were presented.

Keywords: SWAT, SWMM, urbanization

B8-2

Use of SWAT for Urban Water Management Projects in Texas

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The SWAT model is being used for a number of urban water quality and storm water management projects in Texas. As a result, a number of improvements have been made in the model and in techniques used to represent urban landscapes and urban stormwater management practices, and urban water management technologies. Major activities that have recently been completed or are under way include the following:

Modeling of Urban Watersheds and Stormwater Best Management Practices (BMPs). In highly urbanized areas impervious surfaces produce rapid runoff in response to heavy rainfall. Working with the City of Austin, Texas, SWAT has been adapted and calibrated using sub-hourly time steps to simulate runoff, erosion, and sediment transport in both rural and urban watersheds around Austin. Process-based SWAT algorithms for conventional/innovative urban BMPs such as wet pond, retention-irrigation, sedimentation-filtration, and detention pond are under development to evaluate these BMPs and their impacts on downstream flooding and water quality. A guide line for modelling low impact developments (e.g., porous pavement, cistern, rain garden) will also be made in collaboration with Water Environment Research Foundation – an ongoing national BMP/LID modelling initiative.

Trinity River Basin Environmental Restoration Initiative. The Dallas-Fort Worth Metropolitan Area is home to over 6 million people, almost all of whom live in the Upper Trinity River watershed. SWAT has been used to simulate the impacts of urban development, small flood control reservoirs, and agricultural practices on nutrient and sediment loading of 12 water supply reservoirs in the area. Detailed water quality monitoring, sediment surveys, and economic modeling are being used to develop watershed protection plans for three of these reservoirs.

The North Central Texas Council of Governments developed the integrated Storm Water Management (iSWM™) design *manual* for construction, a systematic methodology for minimizing water pollution associated with construction in cities. The "Conservation Practices Modeling Guide for SWAT and APEX" has been developed to facilitate simulation of iSWM and other conservation practices with SWAT. Work has begun to facilitate simulation of these and other stormwater management practices using SWAT interface software.

Projects have recently begun to use SWAT in the design of several “new urbanism” multi-use developments, municipalities, and their extraterritorial jurisdictions.

SESSION B9

Sensitivity Calibration and Uncertainty

B9-1

Analysis of the Impacts of Spatial Input Data Quality on Determination of Runoff and Suspended Sediment in the Imha Watershed using SWAT Model

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This study attempted to assess the impacts of different spatial data quality and the efficiency of a SWAT model that was established to identify runoff and suspended sediments in the Imha watershed of the Nakdong River basin, South Korea. For the purpose of this, the impacts of five DEM grid sizes (i.e. 30m, 60m, 90m, 120m and 150m) on model inputs (e.g. geomorphologic inputs) and outputs (e.g. water budgets and sediment yields) were examined in the first place. And a further analysis was undertaken using 8 different scenarios based on the combination of 30m and 120m DEMs with different scales of land cover maps (i.e. 1:25,000 and 1:50,000) and soil type maps (i.e. 1:50,000 and 1:250,000). A statistical analysis for the goodness-of-fit tests of data measured at two field stations revealed that model efficiency improved in terms of the estimation of runoff and sediment yields when 30m resolution DEMs was used. No significant improvement in such estimation, however, was found when all finer scales of land cover and soil maps were used.

Keywords: SWAT, spatial data resolution, runoff, suspended sediment, Imha watershed.

B9-2

Calibration of a SWAT hydrologic model for the Tamer Watershed in Northern Iran

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SWAT2005 (Soil and Water Assessment Tool) was used to simulate runoff and investigate the effect of various rain-gauge stations on the results of the model in Tamer watershed in northern Iran. The calibrated model will be used to predict the impact of different management operations on the runoff, sediment, and nutrient loads in the 1524 km^2 watershed. SUFI2 version 2.1.5 was used to calibration and performs uncertainty analysis of the model. The watershed studied included two climate and rain gauge stations Tamer and Golidagh. Tamer is located at the very end of the watershed and Golidagh is located at the top of the watershed. The model was run with Golidagh rain gauge station for the years 1999-2005 and with Tamer rain gauge station for the years 1990-1993. The calibration and validation of the model was performed for the years 1990-1993. The results showed that the model had reliably simulated runoff in both of stations. Four factor were considered in judging the model performance of runoff: *P-factor*, *R-factor*, R^2 and *NS*. The respective values of each were, respectively, 0.65, 1.2, 0.55 and 0.55 for calibration and 0.56, 1.2, 0.77 and 0.7, respectively for validation.

B9-3

Simulation of Streamflow using SWAT Auto Calibration Tool over the Saemangeum Watershed

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Application of a hydrological component of the Soil and Water Assessment Tool(SWAT) model was attempted to estimate long-term stream flow from the Samangeum watershed. Hydrologic parameters calibration for basin scale such as Samangeum watershed is quite challenging task since huge variations of hydrologic properties of HRU's. In this study, the sensitivity analysis was conducted initially. The most sensitive parameters were: channel effective hydraulic conductivity(CH_K2), SCS Curve Number II value (CN2), surface runoff lag time(SURLAG), base flow alpha factor (Alpha_Bf), soil evaporation compensation factor(ESCO), and available water capacity (Sol_Awc), respectively. After sensitivity analysis, some important parameters were selected for optimization. Calibration of selected parameters was conducted using SWAT auto calibration tool over the Saemangeum Watershed. The comparison between the observed and simulated stream flow indicated that there is a good agreement between the observed and simulated discharge, which was verified by coefficient of determination (R^2) and Nash Sutcliffe efficiency (NSE) greater than 0.5. We found that auto-calibration tool of SWAT was reliable for the optimization of parameters reflecting Saemangeum Watershed conditions.

SESSION PA1

Large Scale Applications

PA1-1

POSTER PRESENTATIONS

Runoff Simulation using Global Data in the Hwacheon Dam Watershed, Korea

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Hwacheon Dam is a South Korean dam on the Bukhan River, constructed in 1944 for the purpose of electric power generation, flood control and water supply water to the Seoul metropolitan area. However, water inflow to the Han River has decreased by 12 percent since Imnam Dam (storage volume: 27 billion ㎥) was built in 2003 which is located in North Korea. This has caused environmental problems and water shortages in the Seoul metropolitan area. Therefore, it is required to assess the long effects of flow regime alteration resulting from the construction of Imnam Dam. To this end, SWAT-K was applied to Hwcheon Dam upstream area. SWAT-K model is the modified version of SWAT, in which some improved algorithms to better represent characteristics of Korean watersheds are incorporated.
For the model input data of North Korea area, meteorological data of GTS (Global Telecommunication System) and global soil data by FAO/UNESCO were used. Temporal variations of water resources is investigated with comparison of observed and simulated inflows at Hawcheon Dam site. Also, annual, monthly, seasonal decreases in water resources were evaluated using the flow duration curve analysis of simulated streamflow data with or without Imnam dam. The results of this study can be a useful data for the water resources planning and management in the Han River basin, Korea.

Keywords: SWAT, GTS, FAO/UNESCO, Global data, Flow Duration Curve

SESSION PA2

Hydrology

PA2-1

Runoff Potential and Water Storage Capacity of Korean Soil Mapping Units as Affected by Different Topographic Categories

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Topography is one of the most important factors of the environmental fate of materials, including soil erosion, runoff, and leaching. Mountainous or hilly landscapes occupy more than 80% of Korea, showing catenary relationships between adjoining soil mapping units (SMUs), soil phase. SMUs were classified into several grades for both of runoff potential, using soil hydrological groups defined by infiltration rate, and water storage capacity, considering soil texture, effective soil depth, and cobble content. Totally, SMUs with high runoff potential, low infiltration rate, occupied the highest portion and decreased in the order of low, moderately low, and moderately high runoff potential groups. SMUs with medium water storage capacity occupied the highest portion and decreased in the order of moderately low, low, moderately high, and high groups. Runoff potential of SMUs, therefore, mainly distributed in extreme ends, whereas water storage capacity was relatively close to normal distribution. SMUs of high land such as mountainous and hilly land had lower runoff potential than those of low land such as fluvial plain, and fluvial-marine plain with compacted layer. Riverside sandy soils without compacted layer, however, had low runoff potential and low water storage capacity. SMUs of fan & valley showed relatively high water storage capacity compared to other topographic categories. More than 60% SMUs in mountain foot-slope, fan & valley, and dilluvial terraces had high runoff potential, whereas SMUs in hilly land showed relatively uniform distribution in runoff potential. This was probably due to human land use such as arable farming, as well as soil forming factors including topography. Soil management practices in SMUs of a middle part of toposequence, including mountain foot-slope and fan & valley, therefore, could have an important role to determine the migration route of water and materials, and need to get more attention for conserving soil and water.

Keywords: Runoff potential, Water storage capacity, Soil mapping units.

PA2-2

Analysis of impact of land use change on runoff through several Streams in Jeju Island, Korea

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Jeju island, the highest level of rainfall region in Korea, is formed by vesicular volcanic rocks and ashes causing a half of the total rainfall permeates underground which leads the island to have the rich groundwater resources, although most of streams are dried. The expansion of agricultural land, massive establishment of tourist development and road construction in the upper area of the streams are increasing the damage rapidly nearby the lower area of the streams. For importance of integration of Jeju island's water resources, there are needs of a stable water supply along with preserving and managing of the groundwater, which is the only water source in island, and grasping the changes in stream flow amount due to prolonged land-cover map and its use for rational development and utilization.

The streams in Jeju island is developed in north and south area from the Halla Mountain where it is located in the middle of island, and their total number of 143 streams are distributed including district and small streams. Among the streams in the island, Chunmi stream, which is located in southern east of Jeju island, and Oaedo stream, Ongpo steram, Yunoui stream, which are typical examples with frequent runoff, were selected as a study watershed and applied SWAT model. For applying the SWAT model to island's four stream watersheds, data of weather and rainfall observation in each stream watershed from Jeju meteorological observatory were collected and analyzed dividing present and past 30 years data.

The study watershed's DEM was processed and applied using arc-info with 30m × 30m resolution DEM provided by Ministry of Environment, and the soil map data was used as an applied model data diving by 1: 25,000 precise soil map to soil series building 100m x 100m latticed size through Agricultural Soil Information System(ASIS) which offered by National Institute of Agricultural science and Technology. Landuse map was used as a model applying data by building 100m × 100m latticed size using year 1975 and 2000 landsat satellite image provided by Ministry of Environment and Arcview program. A few methods were applied to each part, such as, surface flow using a method of CN, Channel Routing using a method of Muskingum, Potential evapotranspiration using a method of Penman-Monteith. The results of the research that comparing change of direct flow in major streams, such as, Chunmi stream, Oaedo stream, Ongpo Stream, and Yunoui stream in the past and the present, due to the development of watershed and the changes of land use pattern aroused by urbanization through applying SWAT model, which is the semi-distributed runoff and rainfall, are summarized as follows.

Although the change of land-coverage in four major streams between the past and the present were slight, the areas of impermeable land in the lower area of the streams generally extended approximately two times higher than in the past. Therefore, it proved that amount of the direct runoff has a major impact on flood disaster increased by at least 1%~6%. Through the continuous extension of observing hydrological measures and discharge sites to collect advanced data for comparing and analyzing change of watershed runoff in streams as the urbanization progress, it should be quantitatively identifiable the change of hydrological patterns caused by urbanization.

PA2-3

The impact of soil hydraulic conductivity variations on the simulated responses of SWAT model

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The soil hydraulic conductivity is one of the important input variables for simulating SWAT model. However, the soil hydraulic conductivity values at the modeling scale are very limited and often unavailable in Korea. In order to simulate SWAT model the soil hydraulic conductivity values need to be estimated indirectly. One of the indirect methods of estimating soil hydraulic properties is to use pedo-transfer function (PTF) which provides soil hydraulic conductivity values using easily measurable soil information such as soil texture and organic matter.

In this study five different PTFs for the soil hydraulic conductivity were applied to investigate the impact of the soil hydraulic conductivity variation on the simulated responses of SWAT model at Bocheong-cheon and Ansung-cheon watersheds in Korea. The SWAT model was calibrated based on daily stream flow data using the shuffled complex evolution global optimization method. The simulated result of SWAT model shows that daily stream flow at outlet of watershed is independent of spatially averaged hydraulic conductivity of watershed. The relation between groundwater recharge and spatially averaged hydraulic conductivity of watershed exhibited the inverse relationship such that the monthly recharge decreased with an increase of spatially averaged hydraulic conductivity of watershed. The response of subsurface lateral flow revealed that the lateral flow increased with an increase of spatially averaged hydraulic conductivity of watershed showing positive relation. The simulated responses of SWAT model indicates that the proper identification of spatially consistent soil hydraulic conductivity has an important implication for modeling groundwater recharge and subsurface lateral flow at the watershed scale.

PA2-4

Estimation of Reasonable CAPPI Mesh Size Using SWAT Model

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The objective of this study is to determine the reasonable mesh interval with the comparison of effects of runoff rate from rainfall, which was simulated by ANN (Artificial Neural Network) according to CAPPI **(**Constant Altitude Plan Position Indicator) mesh size. There are no absolute selection criteria for the mesh size. But mesh size for generating precipitation from radar data is generally selected 4km×4km considering only wind effects. That selection method with just effects of wind speed has some limitations of applying to hydrologic processes.
The target basin of present study is the Soyangangdam watershed located in the east central area of Korea. Three rainfall observatories in Soyanggangdam basin have been operated. Hourly rainfall from observatories was used as target values for ANN model. Reflectivity (CAPPI), which is input values for ANN model, is obtained from Gwangdeok Mt. weather radar observatory located in the west of Soyanggangdam basin. The period of study is 2007 flood season (6/21~9/20) of Korea. ANN was considered for generating hourly rainfall at the grid point by mesh interval. Then, input of daily precipitation for SWAT was obtained by 24-hour accumulation of the simulated hourly rainfall. Virtual observatory, with MAP (Mean Area Precipitation) that is obtained as average of grid point in basin, is established in the centroid of each basin.
From comparison on runoff of SWAT according to mesh sizes, the low RMSE (Root Mean Square Error) between simulated and measured runoff at the Soyanggangdam outlet was displayed by 4km and 8km.

Keywords: SWAT, CAPPI, Artificial Neural Network

PA2-5

Analysis of Hydrologic Component and Water Resource Increasement for the Watershed Management and Groundwater Dam Construction in Osipcheon

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Recently, groundwater dam is becoming an alternative solution for water scarcity problem. The reason of this is that groundwater dams are less influence on the surrounding environments or the ecosystems compared to a surface water dams, and the surface land areas located upper part of groundwater dams can be used for any purposes while surface water dams need to have large submerged spaces on surface areas for water storage. Also, for the groundwater dams, it is easy to install and use water intake facilities while hard to collapse. The construction cost is also less than the one of the surface water dams.

With such, the groundwater dams have so many advantages for storing water resources, previous research can hardly found in this area, and even the effects of groundwater dams have not been fully analyzed in this country. In this study, therefore, the analysis of hydrologic component for the case of a groundwater dam were conducted with the various preparatory research, and also the influences of water level due to the construction of the dam were investigated. The final purpose of this research thus is to provide how much water amount can be obtained from the groundwater dam construction.

The application was made in one of reserved construction sites of the groundwater dams, which is the Osipcheon river basin located in Youngdeok-gun, Kyeongsangbuk-do province, southern part of Korea. In order to understand hydrologic characteristics of the study area, the topographic and geological features were investigated, and the geological distribution of the upper river areas were analyzed through the boring test. Also the vast ranges of the geological distribution and saturation zone of in the reserved area and upper river area were predicted by geophysical exploration method, and the effective porosity was calculated from in situ and laboratory measurements.

Lastly, groundwater level was computed using SWAT-MODFLOW model in order to find out the effects of groundwater dam construction. As a result, it was found that the water level has risen around 0.5m more after constructing. Because of that, the amount of 65,846m^3/day could be generated as an additional water for the study area when applying a maximum effective porosity value to the model application. This result suggests that the construction of groundwater dam can be a good way to solve water shortage problems for our country with given conditions and circumstances.

Keywords: groundwater dam, SWAT-MODFLOW, hydrologic component, effective porosity

PA2-6

Evaluation of Runoff Prediction at Upper Watershed of Daecheong Reservoir using SWAT-K Model

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There have been growing concerns of algal growth at Daecheong reservoir due to eutrophication with excess nutrient inflow. Rainfall-driven runoff and pollutant from watershed are responsible for eutrophication of the Daecheong reservoir. In this study, upper watershed of the Daecheong reservoir was selected and runoff characteristics were analyzed. The SWAT and SWAT-K model were used for evaluation of runoff. The R^2 and the EI value for runoff were 0.87 and -0.86 using the SWAT model, and the R^2 and the EI value were 0.93 and 0.46 using the SWAT-K model. As a result, SWAT-K model has been proven to predict runoff better, compared to SWAT model.

Keywords: SWAT model, SWAT-K model, Runoff

PA2-7

Multi-site landuse based calibration of SWAT simulated hydrologic components

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This project aims at assessing the impacts of several land use change and climate change scenarios on streamflow and water quality to support EPA's Global Climate Research Program's national-scale water quality assessment. The Appalachian-Chattahoochee-Flint (ACF) basin was one of the pilot watersheds simulated in the project. The SWAT model was applied to simulate hydrologic response of ACF River basin, which lies in parts of Georgia, Alabama, and Florida and covers an area of 50,764 km^2. The ACF basin empties into the Gulf of Mexico at Apalachicola Bay.
Within the ACF basin, one HUC 8 was chosen as calibration focus area where intensive model calibration was conducted. A multi-site landuse based calibration was attempted in order to obtain a better spatial calibration and yet have a single parameter set for the entire basin. The basin was calibrated and validated for flow, sediment, and nutrients. The entire ACF basin was divided into 101 sub-basins. The calibration focus area within ACF consisted of 21 subbasins and 1,342 HRUs. The model parameters were adjusted within the practical range to obtain reasonable fit between the simulated and measured flows and water quality. Two other locations: one predominantly forest and the other, predominantly urban were chosen to set the parameters for forest and urban areas, respectively, which were then applied across the entire watershed. There is essentially one set of parameters for a land use type for the entire basin. This approach resulted in very good model performance for the calibration focus area as well as at several other locations within the ACF basin.

Keywords: SWAT, Calibration, Hydrology, Sediment, Nutrients

PA2-8

ASSESSMENT OF HYDROPOWER POTENTIAL USING THE SWAT MODEL FOR SOUTHERN MIZORAM, INDIA

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In the present study, the Soil and Water Assessment Tool (SWAT) model has been applied to assess the water availability in the Mat River basin of Southern Mizoram, India. The results of the SWAT model along with satellite data have been utilized in the GIS framework to identify potential hydropower generation sites in the Mat River basin. Thirty three potential hydropower sites have been identified within the Mat river basin covering 147.325 km^2 area. A total of 3039.47 KW, 1127.16 KW and 804.98 KW power can be harnessed at 50 %, 75 % and 90% dependability respectively. The results reveal that hydropower potential sites can be efficiently evaluated by use of the SWAT model.

Keywords: Hydrological modeling, SWAT model, GIS, satellite data, hydropower.

SESSION PA3

Climate Change Applicatoins

PA3-1

Water Supply Reliability Assessment Considering Climate Changes

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This research was performed to examine changes in the timing of the growth of crops along with changes in temperatures due to climate changes and to analyze the change of water-supply-reliability by adding an analysis of the change of agricultural water supply patterns in the basin area of Miryang dam in Korea. Had-CM3 model from U.K. was the tool adopted for the GCM model, a stochastic, daily-meteorology-generation-model called LARS-WG was also used for downscaling and for the climate change scenario (A1B) which represents Korea's circumstances best. First of all, to calculate changes in the timing of the growth of crops during this period, the theory of GDD was applied. Except for the period of transplanting and irrigation, there was no choice but to find the proper accumulated temperature by comparing actual temperature data and the supply pattern of agricultural use due to limited temperature data. As a result, proper temperatures were found for each period. 400? for the preparation period of a nursery bed, 704? for a nursery bed's period, 1,295? for the rice-transplanting period, 1,744? for starting irrigation, and 3,972? for finishing irrigation. To analyze future agricultural supply patter changes, the A1B scenario of Had-CM3 model was adopted, and then Downscaling was conducted adopting LARS-WG. To conduct a stochastical analysis of LARS-WG, climate scenarios were generated for the periods 2011~2030, 2046~2065, 2080~2099 using the data of precipitation and Max/Min temperatures collected from the Miryang gauging station. Upon reviewing the result of the analysis of accumulated temperatures from 2011~2030, the supply of agricultural water was 10 days earlier, and in the next periods-2046~2065, 2080~2099 it also was 10 days earlier. With these results, it is assumed that the supply of agricultural water should be about 1 month ahead of the existing schedule to meet the proper growth conditions of crops. At first, water-supply-reliability was analyzed in case the total design discharge is supplied as a form of Firm Supply and considering agricultural water supply pattern change. In 2011~2030, it is not possible to supply water 2,156 out of 7,305 days, which makes water-supply-reliability 70.5%. In 2046~2065 and 2080~2099, it is not possible to supply water 460 and 643 out of 7,305 days, which makes water-supply-reliability 93.7% and 91.2%. Next, it is not considering agricultural water supply pattern change. The results show that it is not possible to supply water 2,197 out of 7,305, which makes water-supply-reliability 69.9. In 2046~2065 and 2080~2099, it is not possible to supply water 484 and 721 out of 7,305 days, which makes water-supply-reliability 93.4% and 90.2%.

From the results of the research, agricultural water supply patterns should be altered. And considering agricultural water supply patterns change, the reliability of water supply becomes more favorable too. Furthermore, since the unique characteristics of precipitation in Korea, which has high precipitation in the summer, water-supply-reliability has a pattern that the precipitation in September could significantly affect the chances of drought the following winter and spring. It could be presumed that better dam-maintenance could be done if the pattern of supply change of agricultural water use could be known in advance and the supply in the end of September is reduced.

However, it could be more risky to make changes to the constant supply pattern under these conditions due to the high uncertainty of future precipitation. Although, several researches

have been conducted concerning climate changes, in the field of water-industry, those researches have been solely dependent on precipitation. Even so, with the high uncertainty of precipitation, it is difficult for it to be reflected in government policy. Therefore, research in the field of water-supply-patterns or evapotranspiration according to the temperature or other diverse effects, which has higher reliability on anticipation, could obtain more reliable results in the future and that could result in water-resource maintenance to be safer and a more advantageous environment.

PA3-2

Assessment of the Impact of Climate Change on Watershed Phosphorus Load and Reservoir Eutrophication

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Massive industrialization and the extended use of fossil fuels have caused global climate dynamics and have changed land atmosphere interactions at unprecedented scales. Watershed phosphorus loads are the main cause of reservoir and lake eutrophication which is one of the main problems in water quality management. In this study, a triple model of climate change and watershed with a reservoir phosphorus models are used to evaluate the impact of climate change on watershed phosphorus yield and reservoir eutrophication. The climate change scenarios of a GCM (General Circulation Model) are utilized by a Statistical Downscaling Model (SDSM). The SWAT model is used to estimate the phosphorus load of the watershed based on specified soil and land use and the management practices. The SWAT model is calibrated and validated for a three year period of available observed data. Then 50 years of predicted data of precipitation and temperature are used in the SWAT model to evaluate the climate change impact. The model is applied to the Aharchai River watershed upstream of the Satarkhan reservoir in the northwestern part of Iran. The results show that the model can be considered as an efficient tool in planning the long term management of reservoir eutrophication and watershed phosphorus loads.

Keywords: Phosphorus Load, Climate Change, Statistical Downscaling, SWAT model.

PA3-3

Climate Change Impact Assessment on Soil Water Availability and Crop Yield in Blue Nile Basin (Case Study Anjeni Watershed), Ethiopia

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General Circulation Models (GCMs), currently the most advanced tools for estimating future climate change scenarios, operate at coarse (typically 0.5^{o}) resolutions. Downscaling of GCM output is necessary to assess the impact of climate change on local water management activities. This study was conducted to quantify changes in water availability and crop production under different climate change scenarios in the Anjeni watershed. This watershed (113.4 ha) is located in Northern Ethiopia at 37°31'E / 10°40'N. Within the watershed terracing is a common soil and water conservation practice. In order to estimate possible climate change impacts on water availability and crop production within the watershed, climate change scenarios of precipitation and temperature were developed for the South Gojam sub basin of area 16,762km^2, in which the watershed is located. The outputs of HadCM3 coupled atmosphere-ocean GCM model for the SRES A2 and SRES B2 emission scenarios were used to produce scenarios for the period 2011 to 2070. These outputs were downscaled to the watershed through the application of the Statistical Downscaling Model (SDSM). Results indicate that for both scenarios there is an increasing trend in annual temperature with A2 scenarios showing greater change than the B2 scenario. Significant variation of monthly and seasonal precipitation (i.e. a decrease in average Kiremt precipitation by about 9 and 7% in 2020 and 6 and 5% in 2050 for both A2 and B2 scenarios) was simulated. These changes in rainfall and temperature were used with the Soil Water Assessment Tool (SWAT) hydrological model to simulate future water availability and crop production. SWAT was calibrated with five years of monthly flow data (1986-1990) and then the model was re-run using the scenario data as input. The results indicate that for both scenarios there is an increasing trend in potential evapotranspiration as well as a reduction in the soil water content in the watershed. The study indicated that due to the combined effect of projected variation in seasonal rainfall, increases in temperature and consequent reduction in soil water, there is likely to be an overall decrease in crop production in the watershed.

Keywords: Anjeni watershed, Climate change, SDSM, Soil water availability, Crop yield and SWAT

SESSION PA5

Sediment, Nutrients and Carbon

PA5-1

Effects of Landuse on Nonpoint Sources Pollutant Loadings at small watersheds

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NPS pollutans are closely related to the watershed charateristics, as well as land use within the watershed. Forest watershed has a slower response time for initiation runoff, a lower peak discharge, and a smaller amount of runoff than the agricultural watershed. However, hydrologic and water quality processes in an agricultural watershed in Korea are characterized by typical cutivation system, paddy rice fields. This study was conducted to examine the effects of land-use on NPS pollutants from small watersheds in Korea. Rainfall, stream discharge, and associated sediment and nutrient loadings were periodically monitored at the outlets of forest and agricultural watersheds. The SWAT model was introduced in this study to generate the trends of water quantity and quality on the watershed outlets. A statistical evaluation was performed by comparing the simulated and measured values in terms of runoff, sediment, and nutrient loadings.

Keywords: SWAT, Landuse, Runoff, Sediment, Nutrient

PA5-2

Estimation of Runoff Unit Area Loads for Nutrients from Sloping Cropland and Forest using SWAT model

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Runoff unit area loads estimation of nonpoint source pollution for landuse have been customarily calculated based on observed runoff discharge and water quality for a certain specific year due to great expense for getting data, however, it is necessary to consider seriously in Korea which is the region with significant changes of runoff discharge for each year in river channel. In order to estimate runoff unit area loads of representative Nonpoint source pollutants such as T-N, T-P, it can be more reasonable to calculate unit area load based on estimating pollution runoff discharge for many years by using SWAT model.
In this study, Flowrate, T-N and T-P were measured for the SWAT calibration and verification from 2005 to 2006 in Bonggok watershed which located at Banpo-Myeon, Gongju City, Chungcheongnam-DO of the Republic of Korea as a representative forest area including reclamated sloping cropland. and then unit area load of T-N and T-P was estimated from sloping cropland and forest
As the result of implementing calibration and verification of SWAT model by using daily runoff discharge data which were actually measured during 2005~2006, Nash-Sutcliffe coefficient(NTD) for flowrate was 0.70~0.76 and Coefficient of Detemination(R^2) showed values of 0.80~83 and Nash-Sutcliffe coefficient(NTD) for T-N and T-P load was 0.54~0.72 and Coefficient of Detemination(R^2) showed values of 0.62~0.86. And then SWAT simulation was performed from 1997 to 2006 with optimal parameters determined through calibration process so as to estimate long-term unit area load from sloping cropland and forest in experimental watershed
As the result of calculating unit area load for T-N and T-P for the past 10 years with SWAT model, T-N unit area load from forest was 3.29kg/㎢?day and T-P unit area load was 0.15kg/㎢?day and T-N unit area load from sloping cropland was 11.15kg/㎢?day and T-P unit area load was 0.70kg/㎢?day. It showed that a little bigger than the unit area load suggested by calculation based on short-term measured data, it was judged that we can manage more efficiently nonpoint pollution sources in Target watershed by using average annual discharge load which was estimated with long-term simulation data of SWAT model .

Keywords: SWAT Model, T-N, T-P, Uunit area load, Sloping cropland, Forest, Nonpoint pollution source.

SESSION PB2

InStream Sediment and Pollutant Transport

PB2-1

Modification of BOD simulation module in SWAT for proper water quality management in Korea

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Accumulation of pollutants due to various reservoirs, dams and reduction of velocity downstream is one of the emerging difficulties in water quality management in Korea. Therefore, algae and organic matter are now being major concerns in water quality modeling rather than DO. It is also needed to enhance the structures of water quality models to have capability of simulating laboratory experiment BOD (Bottle BOD_5) which is a water quality standard of the TMDL program in Korea. However, it is difficult to solve these problems with the SWAT model which is one of the widely used water quality models in Korea, on account of the limitations of channel water quality module in simulating algae, organic matter and Bottle BOD_5 etc. To overcome these limitations, in this study, the enhanced channel water quality module of the SWAT model (SWAT-KQ) was suggested by linking the algorithms of the QUAL-NIER model to the SWAT model. The algorithms estimating the increase of internal organic matter by fractionization algal metabolism process and calculating Bottle BOD_5 were added and the results of proposed model were compared to those of the original SWAT2005 model. It is revealed that more accurate BOD values could be obtained with the SWAT-KQ model. Through the analysis on the BOD load duration curves based on flow exceedance probability, it is concluded that the BOD load should be reduced to satisfy the water quality standard. Finally, the SWAT-KQ model can be used as an effective tool for water quality management through the precise water quality simulation and long term pollution source analysis.

Keywords: Bottle BOD_5, load duration curve, Q-SWAT, QUAL-NIER

SESSION PB7

Environmental Applications

PB7-1

A Study of modeling using linkage of Watershed Model and river water quality model

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It is important to establish quantitative analysis in the non-point sources for efficient management of water quality. Recently, we has been to have hard time with non-point quantitative analysis, a necessary and sufficient condition of total maximum daily load analysis, because of representing natural complex phenomena. For accurate water quality modeling, Watershed and water quality model were linked and applied to a Milyang River Basin located on the Nakdong river. Each of the model has advantages to simulate water quality. Especially, SWAT model simulates non-point sources and QUALKO model simulates point sources. So. The simulation is linked to these model. A Watershed model of SWAT and a water quality model of QUALKO were applied to the study area.
The study watershed was divided into 2 sub-watershed such as Milyang A and Milyang B unit watershed. First, SWAT watershed model was estimated by using DEM(Digital Elevation Model), land use data, soil data, weather data, precipitation data and point load data. The result of the simulation was daily non-point load and flow data. The SWAT simulation results shows good agreements in terms of discharge, BOD, T-N, T-P. Additionally, for more exact simulation, it should be kept studying about variables and parameters which are needed for simulation. Secondly, the water quality model, QUALKO is a static model. It reflects head water, pollutant load and withdrawal very well. It consist of 3 head water source, 2 junction, 17 reach, 100 element, 27 point source. And it is connected to SWAT for non point source at the incremental flow section. As a result, concentration of the BOD increases about 10.65%, concentration of the T-N increases about 2.73% and concentration of the T-P increases about 7.32%. Totally, simulation results shows 5~10% increase of the concentration. Additionally, accurate simulation of point and non-point source for water quality management are useful in evaluating and deciding the water resource and environment management plan. And quantitative analysis plays an important roles in the non-point source treatment efficiency assessments. Through this study, point source and non-point source quantitative analysis system construction accomplish. And linking watershed model and river water quality model through each process is estimated in small watershed. The suggested technique will improve the accuracy of the water quality analysis. The methodologies presented in this study will contribute to basin-wide water quantity and quality management.

Keywords: SWAT, QUALKO, Point and nonpoint source

PB7-2

Study for Protection of Water Resources from Pollution using SWAT

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Due to recent urbanization and development, heavy rainfall has been more frequently occurring and there have been a lot of changes and efforts made to reflect contemporary trends in the runoff system. Furthermore, global warming is more severe than expected and the total amount of runoff is increasing with the current social infrastructures. In addition, non-point sources which are related to rainfall characteristics show tendency to increase.
The preliminary implementation of quantitative analysis should be required for the management of non-point sources. However, a lot of difficulties arise in conducting quantitative analysis because of complex topography. In addition to the relation between rainfall and runoff, it is difficult to analyze the travel time of contaminants and to divide point and non-point sources. In order to overcome these difficulties, the objective of this study consists of the establishment of accurate system for predicting non-point sources. The quantitative analysis of non-point sources in Nakdong river is performed in this study based on geographic information. And non-point sources are selected by calibrating loads using SWAT model with the condition in which both point and non-point sources coexist.
Therefore, this study is to get over these problems though non-point source analysis is estimated by watershed model, SWAT(Soil and Water Assessment Tools). Industrial dataset, sewage and wastewater plant databases are collected for the non-point source analysis by watershed model in the first place. And, the model is calibrated and validated using hydrograph and pollutograph (contaminants .vs. time) at the pour point . In this circumstance, point source data is ejected. The results can be estimated by non-point source loading data. Results show that the portion of non-point source pollution in the target watershed is about 40% of the total pollution.
Also the capacity of the riparian area for remediation of the non-point source such as SS, TP, and TN is analyzed.
In order to analyze water quality and the hydrologic characteristics of a watershed, SWAT model can be used as practical and worthwhile reference. By using the results from those models, quantitative analysis on water quality improvement for numerous conditions will be carried out and the best land use plans can be also established. Furthermore, continued implementation of management, assessment and monitoring will be conducted following the constructed riparian area.

Keywords: SWAT, Quantity analysis, Riparian area.

PB7-3

Simulation of Runoff and Water Quality Data in the Jiseok Stream, Korea by SWAT Model

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In the present study, runoff and water quality data were simulated in the Jiseok stream basin which is located in Hwasun county and Naju city in Korea by using Soil-Water Assessment Tool (SWAT) model. The Nampyung station which is the outlet point of the study basin was chosen for the application of SWAT model and the runoff and water quality data measured in 8-day interval could be readily collected for the station. The data period of 2002 was used for calibration of the model and the data from 2003 to 2005 were applied for verification of the model. Point source pollution data in the study basin were added to the model for accurate simulation of water quality. The simulation results revealed that the observed and simulated data for runoff were very similar and the pollution load data for water quality also showed similar tendency. However, the correlation coefficient between the observed and simulated data for water quality was relatively lower than the coefficient for runoff data. Consequently, it can be concluded that the SWAT model has strong applicability for hydrological and environmental data simulation.

Soil & Water Assessment Tool | SWAT

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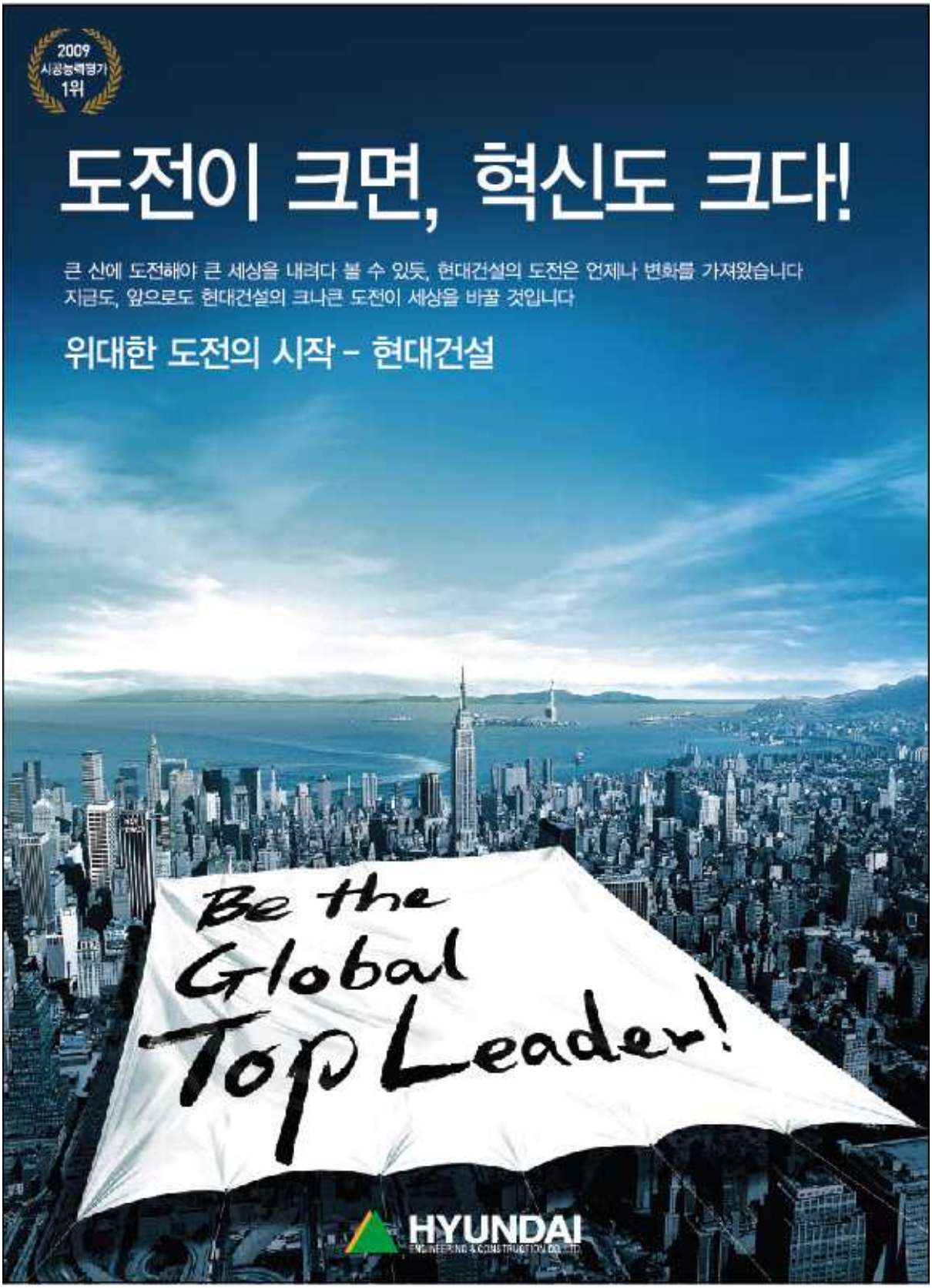
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