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Development of Dynamic Water Resources Assessment System for WMO RA II

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The Workshop proposed for:

1. Dissemination and testing of new methods for

Dynamic Water Resources Assessment System;

2. Establishment of RA II wide Dynamic Water Resources

Assessment System;

and

3. Discussion for application of the Dynamic Water

Resources Assessment System and future improvements

"WRA is"

- A tool to evaluate water resources in relation to a reference frame, or evaluate the dynamics of the water resource in relation to human impacts or demand
- Part of the IWRM approach, linking social and economic factors to the sustainability of water resources
- Depending on the objective of the assessment, WRA may look at a range of physical features in assessing the dynamics of the water resource
- Assessments for large or long-term projects need to include examination of changes in land use and possible soil degradation as well as climate variability and change

"Purpose of WRA"

- Conducting a WRA help us to establish a common, agreed and trusted information base that can be used by stakeholders as a basis for informed and effective decision making
- In general WRA helps us for clarifying and quantifying different issues like:
 - Current status of water resources at different scales, including inter- and intra-annual variability
 - Current water use (including variability), and the resulting social and environmental trade-offs
 - Scale related externalities, especially when patterns of water use are considered over a range of temporal and spatial scales
 - Social and institutional factors affecting access to water and their reliability
 - Opportunities for saving or making water distribution and use more productive, efficient and/or equitable
 - Efficiency and transparency of existing water-related policies and decision making processes
 - Conflicts between existing information sets, and the overall accuracy of government statistics 4

"Development of DWAT System"

- Effective water resource policy and planning requires comprehensive, consistent and robust information on water generation, distribution, storage, availability and use
- To meet this need, providing crucial information for managers, planners and policy makers, Dynamic Water resources Assessment Tool (DWAT) was developed
- This continental-to-regional scale water balance modelling system supports reporting and assessment of water flows and stores on a daily time scale
- In addition, the system was designed to meet present and future water demands, while maintaining a range of hydrologic variation necessary to preserve the ecological and environmental integrity of the basin

"DWAT System"

- Has a landscape model component and a river model component that were developed and validated against a range of data sources
- Has basic hydrological functions and is consisted of pre-process (based on GIS process) and water balance process
- Is a continuous, long-term, and physical parameter model designed to simulate the runoff of pervious and impervious zones separately
- Has hydrologic components such as infiltration, groundwater flow, evapotranspiration, channel routing, etc.

For the first time, we have a tool that can consistently account for important aspects of water resources, including runoff and river flow, soil water storage, groundwater recharge for some catchment in KOREA

"Characteristics of DWAT System"

- Physical parameter-based link-node type model
- Quantitative assessment of the characteristics of the short/long-term changes in water cycles
- Simple, practical and easily accessible
- Guaranteed satisfactory results with minimal data and efforts
- Easy user convenience system (GUI)
- Provision of results through diverse tables and figures





- Pervious and impervious area for rainfall-runoff process
- One soil layer and one aquifer
- Groundwater pumping



Pervious/Impervious Area

Evapotranspiration

- Potential evapotranspiration by the Penman-Monteith equation
- Actual evapotranspiration by the leaf area index and soil moisture accounting

Climate							
 Evapotranspiration 							
Method	Monthly Coefficient 🔹						
Jan	Monthly Coefficient						
Feb	Leaf Area Index						
Mar	FAO56						
Apr	0.7						
May	0.7						
Jun	0.7						
Jul	0.7 0.7 0.7						
Aug							
Sep							
Oct	0.7						
Nov	0.7						
Dec	0.7						



Infiltration

- Infiltration and deep percolation to the aquifer are analyzed based on the physical parameters of soil layer; soil depth, saturated hydraulic conductivity, horizontal hydraulic conductivity, saturated moisture contents, residual moisture contents and Mualem's n
- Soil moisture increasing by the rainfall and depression storage
- Infiltration methods; Rainfall excess, Green & Ampt and Horton





Groundwater

- Groundwater runoff are simulated using the relationship between groundwater level and river stage
- Designed to consider groundwater pumping and leakage from water supply networks
- Groundwater movement from an aquifer to adjacent aquifer (based on groundwater hydraulic gradient)



Channel Routing

- Outflow hydrograph in the channel using several flow routing methods
- Muskingum Chart Current • + Result - Muskingum-Cunge Nodes Node 1. Link 1 Link 2 Link 3 Link 4 Link 5 Link 6 - Kinematic wave 5.5 Ε Link 7 Link 8 No routing Muskingun 4.5 Muskingum-cunge Field Field Kinematic wave flow_in(m³/s) 3 5 2.5 Add Remove 2 Field flow_out(m³/s)(Current.Lin.. 1.5 Discharge 0.5 Discharge I(t)03/09/16 00 04/0 Q(t)Inflow Transfer Function Outflow

Q(t) = Outflow

Reservoir

- Reservoir storage, water level and discharge are calculated using the initial storage, effective storage, intake, the specifications of spillways and discharge outlet in the reservoir
- Storage and water levels are renewed by inflows based on the relationships of stage-storage-area
- Evaporation from water surface and water supply from the reservoir
- Discharge into downstream through the drainage outlet pipe



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Type Constant									
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Series file									
Table									
Field									
WL-Volume-Area Relationship									
1 2 3 4 5									
WL(m)									
VOL(m3)									
AREA(m2)									

Wetland

- This module was designed to have any amount of water exceeding the storage capacity of wetlands overflow and discharge to the downstream
- Wetlands reflect vegetation and evaporation from water surface
- Storage and water levels are renewed by inflows based on the relationships of stage-storage-area
- Discharge into downstream through the drainage outlet pipe



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Pro	operty					•
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	WetLan	d node				
	Name			WetLand 1		
	Descript	Descript				
	Climate					
	Rainfall			Climate 1		
	Evaporation			Climate 1		
	Base					
	Init volume			10000		
	Maximu	Maximum storage		100000		
	Flood by	Flood bypass		1		
	Kgw	1		0.0005		
	Recharg	Recharge to				
Ξ	Pipe					
	Pipe height			1		
	Pipe area			0.5		
	Pipe coefficient			0.5		
	WL-Volun	ne-Area Re	lations	nip		
-		1	2	2	4	
	\u/l (m)	-	2	J	4	
-	(0) (0)					_
V	/UL(M3)					
A	REA(m2)					

Recycle & Import

- A recycle was planned so that water can be taken from rivers and supplied to other catchment
- the system was designed to reflect water supply from outside of the catchment





Property		×
Property		-
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Import node		
Name	Import 1	
Descript		
Туре	Constant	-
Constant		
Import water	10000	
Leakage	0	
Time series		
Series file		
Table		
Field		-
Type Intake type		

GIS Pre-processor

- Hydrologic models like DWAT require land use and soil data to determine the area and the hydrologic parameters of each land-soil category simulated within each sub-catchment
- The physical parameters of the system can be searched and optimized conveniently using GIS Pre-processor menu
- This tool allows users to load land use and soil themes into the current project and determine the land use/soil class combinations and distributions for the delineated catchment
- The complete process of watershed delineation and input parameters using GIS Pre-processor involves a sequence of steps
 - ✓ Importing DEM
 - Determining the slope direction at each pixel
 - ✓ Determining the "flow accumulation"
 - ✓ Calculation of preliminary stream network raster using a flow accumulation
 - ✓ Determining catchment area using channel threshold value
 - ✓ Overlay Soil map
 - ✓ Overlay Land use map



"What do DWAT System do?"

- Provide information on urban and rural water use and flow of surface water storage and aquifers
- Use a nationally-consistent landscape water balance model to estimate landscape water flows
- Evaluate trends in water availability and use at local, regional and national scales over daily timescales
- Analysis on the hydrological state of rivers, wetlands, storages and aquifers



"Using the DWAT System"

- This scientifically robust and nationally-consistent Assessment is intended to help users, particularly policy specialists and water resource managers to:
 - identify current and future water management challenges
 - compare the current and past states of water resources
 - improve understanding of the impacts of past and present water management practices on water resources
 - better understand interactions between climate, water and landscape
- Activities for which the National Water Resources Assessment can be used:
 - contributing to research and water reform by providing nationally and regionally consistent water resources information and data, such as, surface water, groundwater, urban and agricultural water supply and use
 - assisting government policy formulation and the development of broad scale strategic plans and decision-making

Thank you for your attention!

"All comments and suggestions are welcome"

For more information of the "Dynamic Water resources Assessment Tool", Please send contact Dr. Cheolhee JANG (<u>chjang@kict.re.kr</u>)