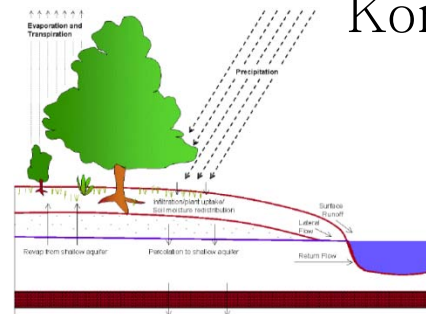


An Interface System to Couple the SWAT2005 Model with HyGIS(HyGIS-SWAT)

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2010.08.05



KOREA INSTITUTE OF
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21세기 프론티어 연구개발 사업
수자원의 지속적 확보기술개발 사업단
Sustainable Water Resources Research Center

Contents

- 1. HyGIS?**
- 2. HyGIS-Model ?**
- 3. SWAT / GIS-SWAT**
- 4. HyGIS-SWAT**
- 5. Conclusions**

GEOMania

- Korean GIS software
- Not includes hydro module

GEOMania + HyGIS

- HyGIS was developed in 2007
- Added on GEOMania universal GIS tool(GMMap)
- Includes hydro module

HyGIS-Model
(HyGIS-SWAT)

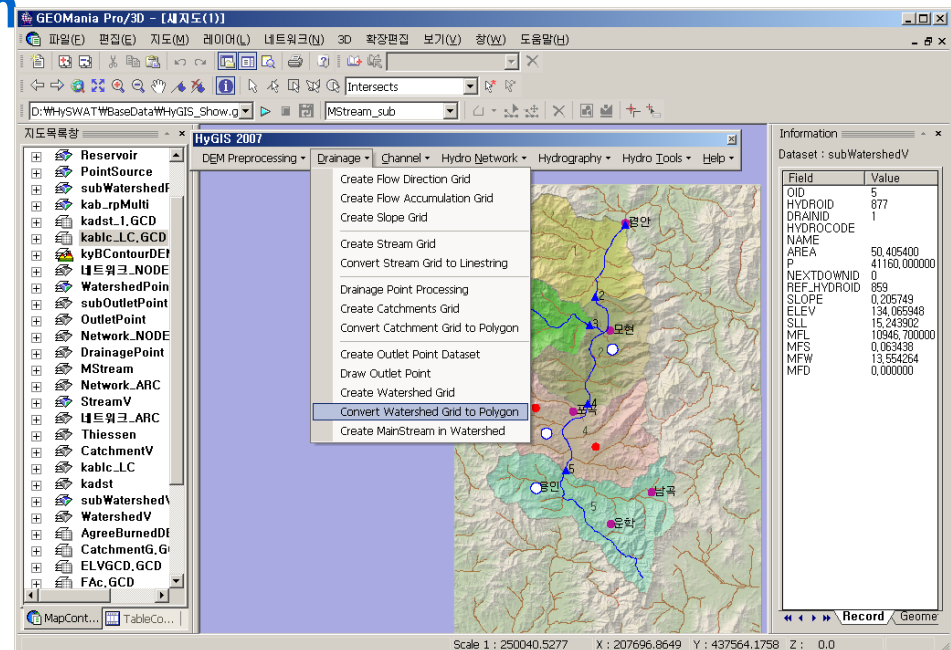
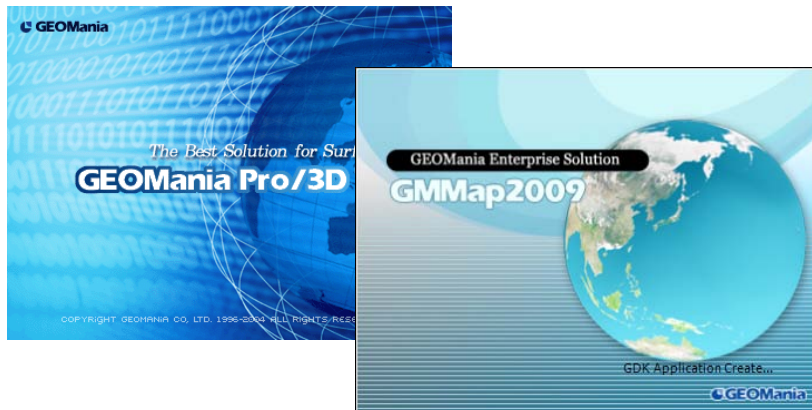
- A modeling system cooperates with HyGIS

**Technology for
GIS based Hydro System**

HyGIS ?

Overview

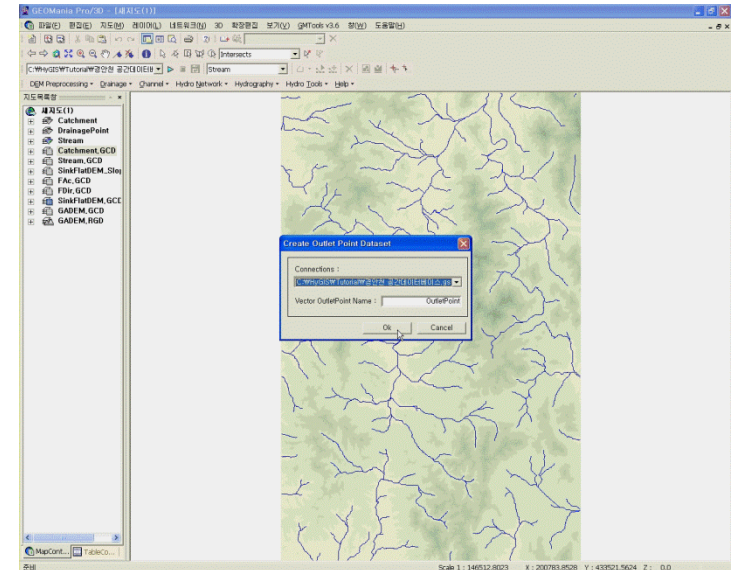
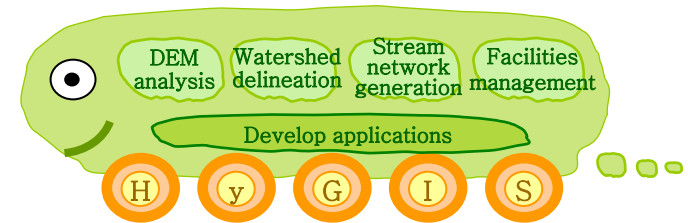
- HyGIS(Hydro Geographic Information System)
- Helps users can apply GIS to water resources analysis and management efficiently
- Database system
(spatial, non-spatial, time series / static, dynamic)
- Component based system
- Operated as extension module of GEOMania



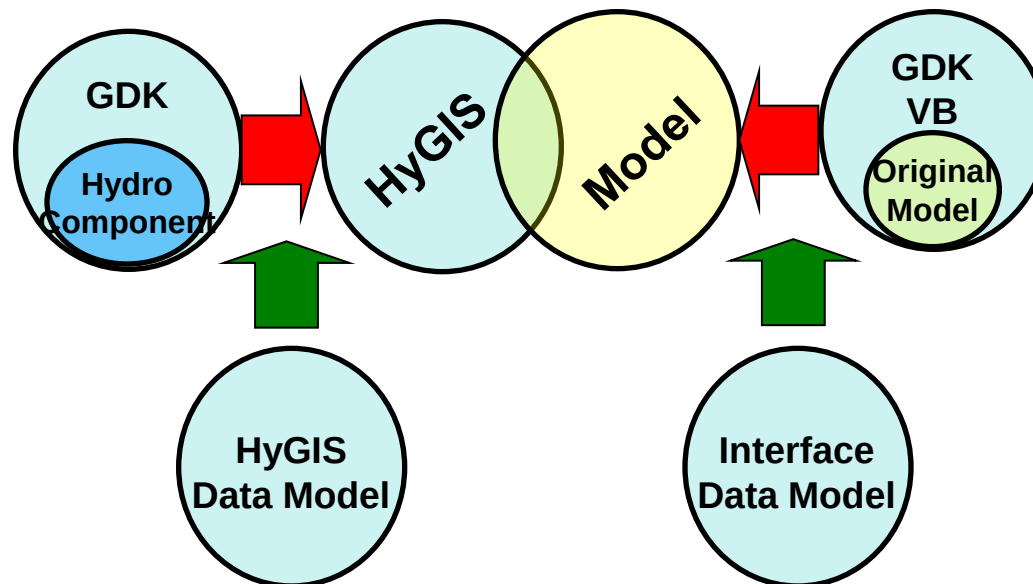
HyGIS ?

Features

- **DEM analysis**
 - Smoothing, sink & flat area treatment, burning
- **Extract spatial information**
 - Stream, watershed, hydrological geospatial parameters
- **Construct stream network**
 - Enables linear referencing, network searching
- **Develop applications**
 - Base system framework
 - Watershed management system
 - GIS based hydrologic, hydraulic, water quality modeling system, etc.

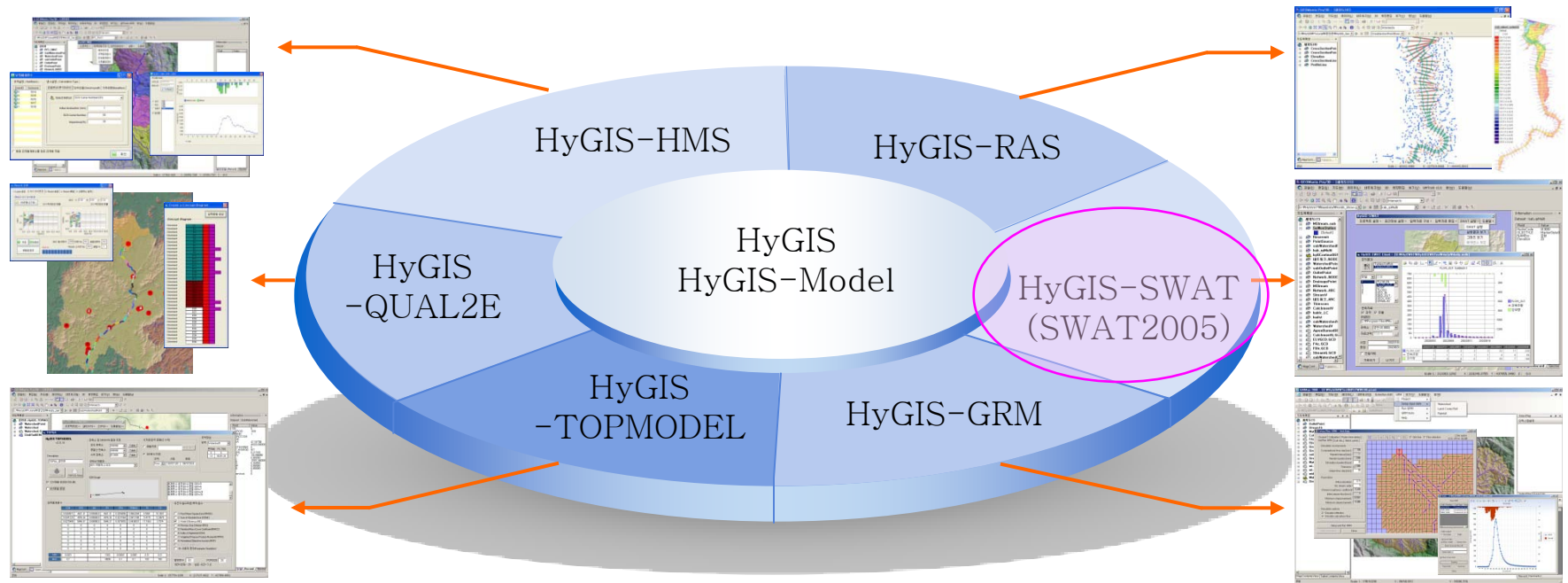


- HyGIS application
- Comprehensive name of the models operated in connection with HyGIS
- Using GDK(GEOMania Development Kits), HyGIS component, COM based programming language(Visual Basic .NET...)
- Added on GEOMania GIS tool as extension modules



HyGIS-Model ?

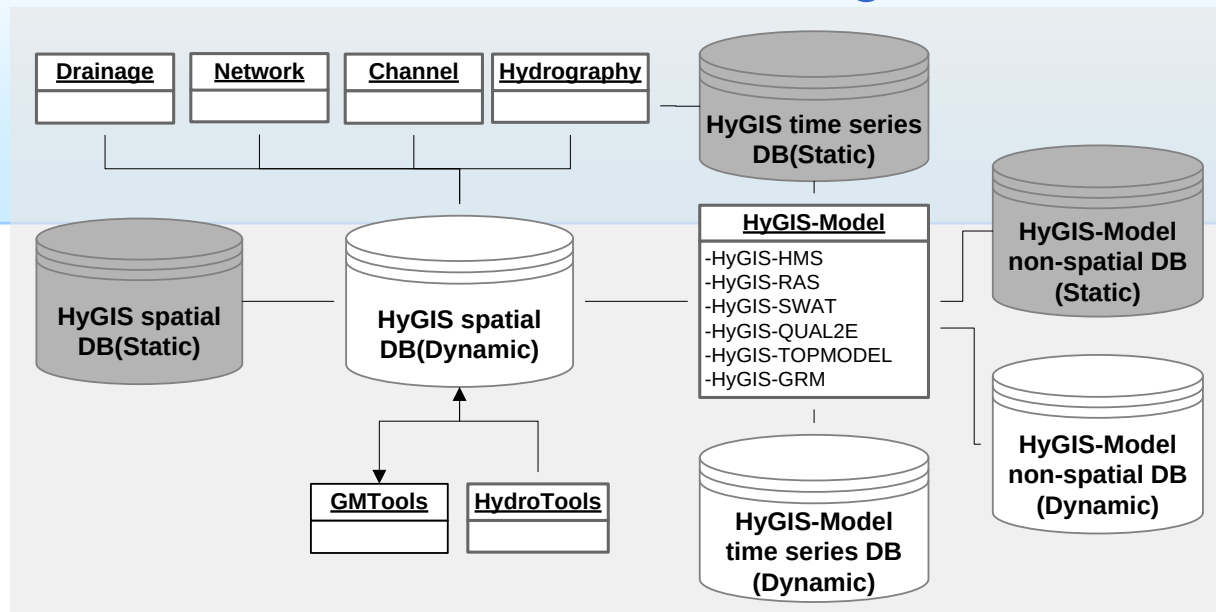
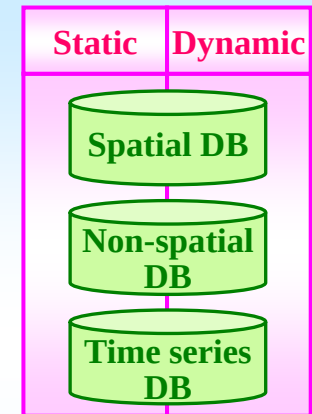
Extension modules



HyGIS-Model ?

Database operation/data flow

- HyGIS / HyGIS-Model are database system
- 6 conceptual databases(mdb)
 - Static/dynamic and spatial/non-spatial/time series
- RDB environment confirms stable and efficient database operation
- Input data are extracted from static DB and modeling results are stored in dynamic DB



SWAT

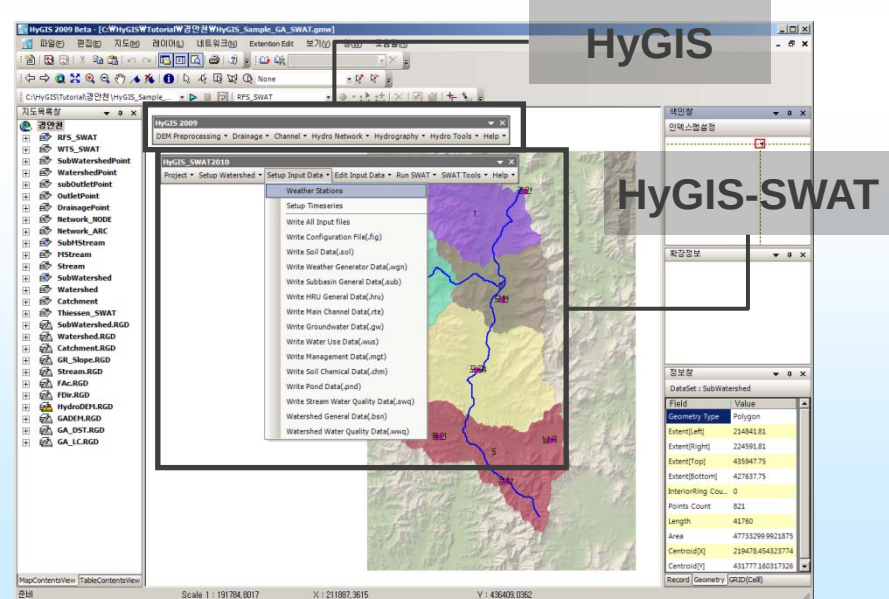
- **SWAT(Soil and Water Assessment Tool)**
 - **USDA Agricultural Research Service(ARS), Jeff Arnold.**
- **Predicts the impact of land management on water, sediment and agricultural chemical**
- **SWAT2000(2003, 2005, 2009)**
- **Uses any amount of topographic data, time series data, non-spatial data**
- **Coorporated with GIS software(ArcView, ArcGIS)**
- **BASINS(Better Assessment Science Integrating point and Nonpoint Sources, EPA)**

- Srinivasan and Arnold (1994)
 - SWAT 1990 / GRASS – C programming language
- Bian et al. (1998)
 - SWAT 1990 / ArcInfo – Arc Macro Language(AML)
- Di Luzio et al. (1998) - SWAT 1996 / ArcView – Avenue
- Di Luzio et al. (2002)
 - SWAT 2000 / ArcView – Avenue(AVSWAT2000)
- Di Luzio et al. (2002)
 - Improved 1998 interface and was incorporated in BASINS(BASINS SWAT)
- Francisco Olivera and Milver Valenzuela(2004)
 - SWAT2000 / ArcGIS – Visual Basic(ArcGIS-SWAT)
- M. Winchell, R. Srinivasan, M. Di Luzio, J. Arnold(2008)
 - SWAT2005 / ArcGIS - ArcSWAT2.1
- M. Winchell, R. Srinivasan, M. Di Luzio, J. Arnold(2010)
 - SWAT2009 / ArcGIS – ArcSWAT2009

HyGIS-SWAT ?

Overview

- HyGIS-SWAT
 - for the SWAT2000 model in 2007(Ref. AVSWAT2000)
 - for the SWAT2005 model in 2009
- Interface system to run SWAT2005 in HyGIS
- Make input files and treat modeling results
- Call SWAT2005.exe
- Using GDK(GEOMania Development Kits) and Visual Basic .NET
- Added on GMMMap as extension module

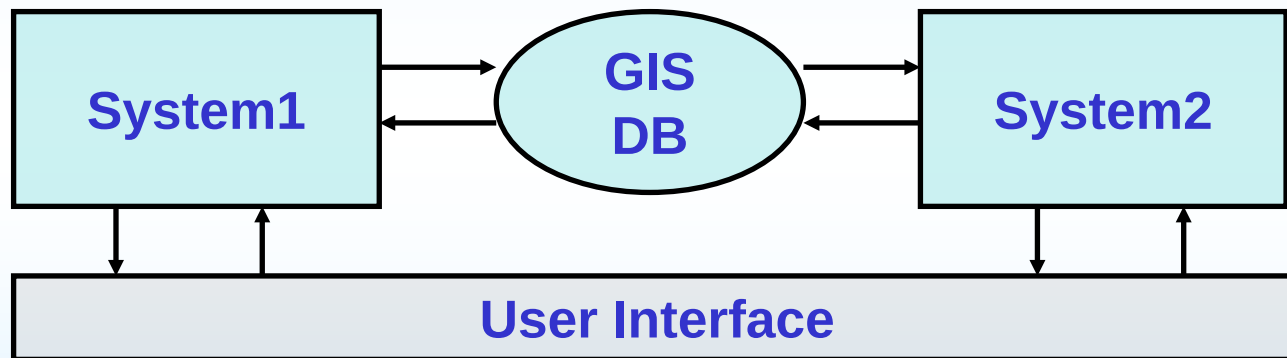


- Interchange

- Separated GUI, interchanging input files by user

- Interface

- Pre/post processing, running model, user interface



- Integration

- Integrate more than one system into one system.

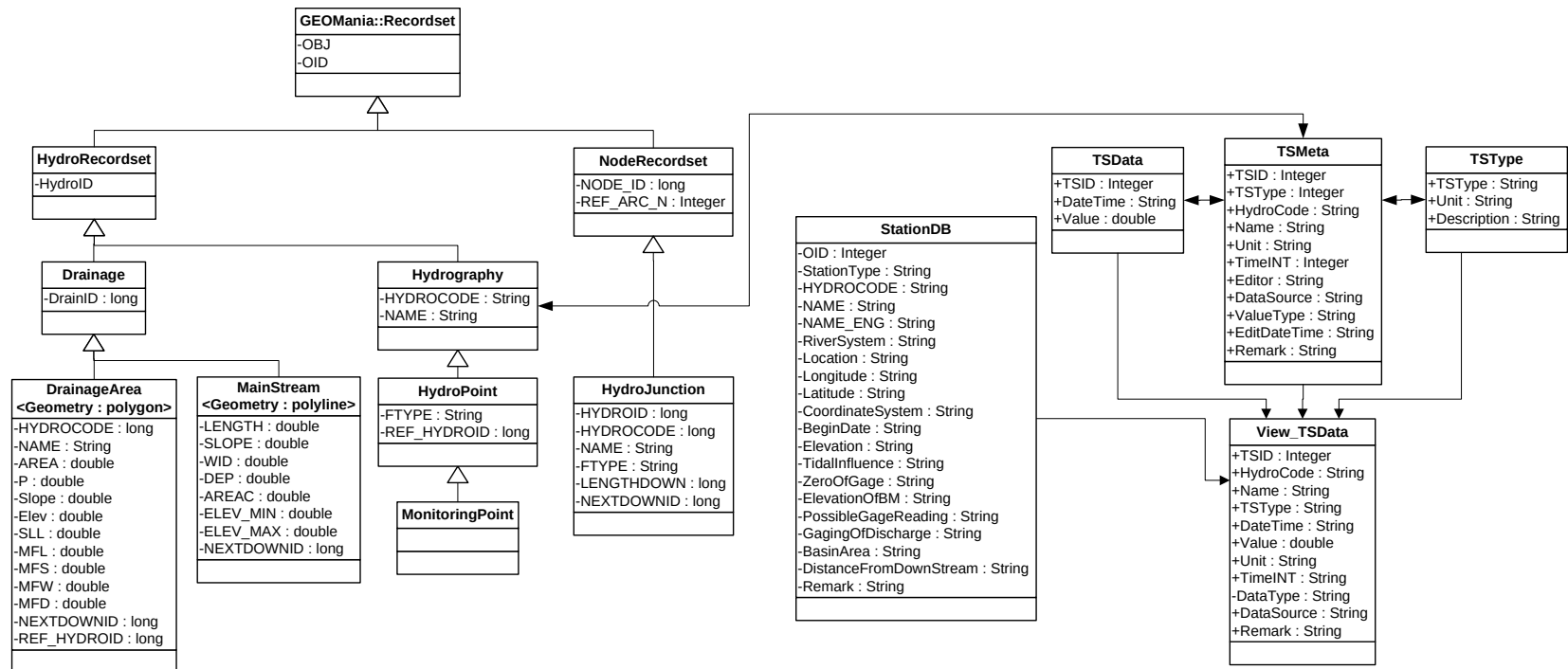
- HyGIS, HyGIS-Model
 - Interface system based on GIS and database
- Spatial database : GSS (from GEOMania GIS)
 - GEOMania Pro/3D, GMMMap
- Non-spatial, timeseries database : MDB
 - MS Access
- Using GDK, VS2008, VB.NET (.NET framework 3.5)

- **Model(SWAT2005) analysis(vs. SWAT2000)**
 - **Input/output files format, parameters**
 - **New or removed variables/renamed or moved variables**
 - **New input file, renamed filename, file format changes**
 - **Applying sub-hourly precipitation**
- **Upgrade HyGIS-SWAT(for the SWAT2000)**
 - **Visual basic 6 -> Visual basic .NET**
 - **Add new GUIs, functions, and processes for new variables and new input files format**

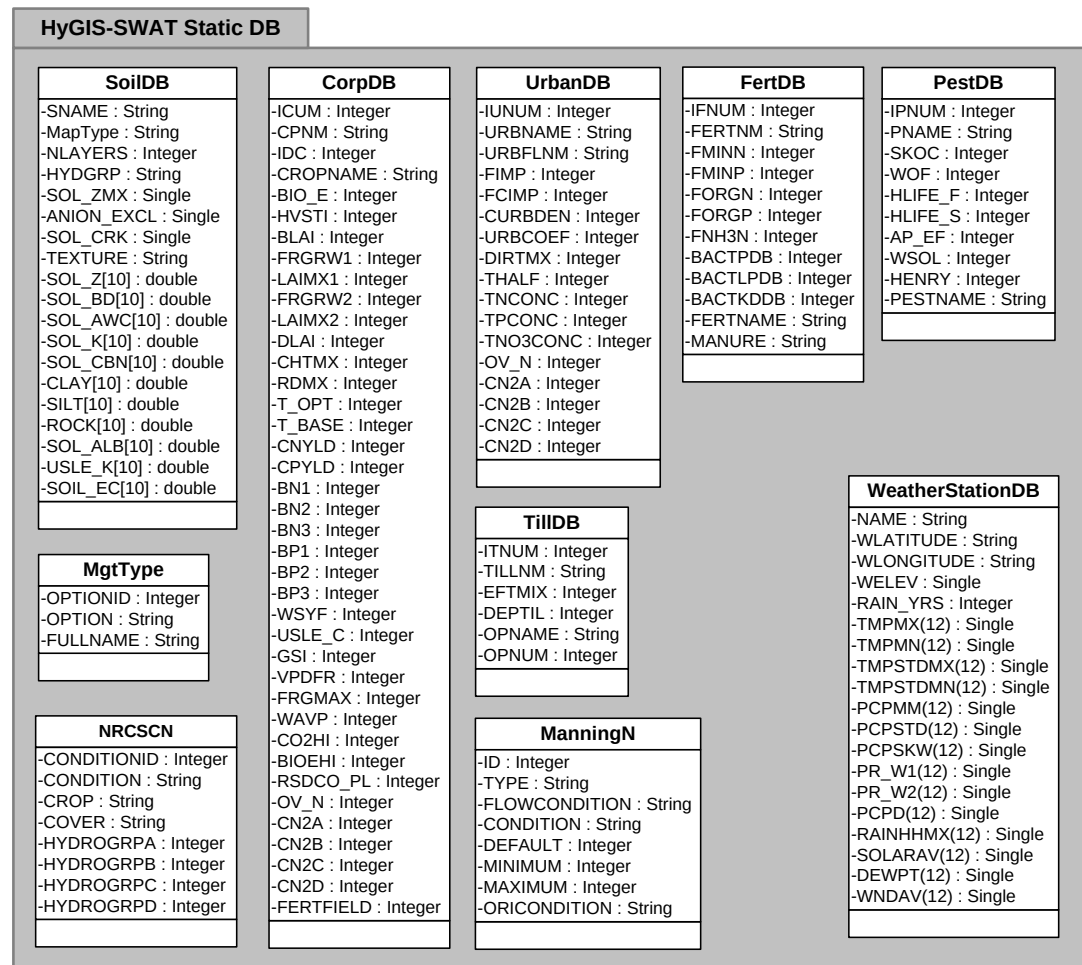
HyGIS-SWAT data model

Overview

- HyGIS spatial data model : adopts the concept of Arc Hydro data model
- HyGIS-SWAT data model : the application of HyGIS data model
- Spatial data model : drainage area, main stream, monitoring point, network information
- Monitoring point is connected with time series database
- Time series database table: TSType, TSMeta, TSData



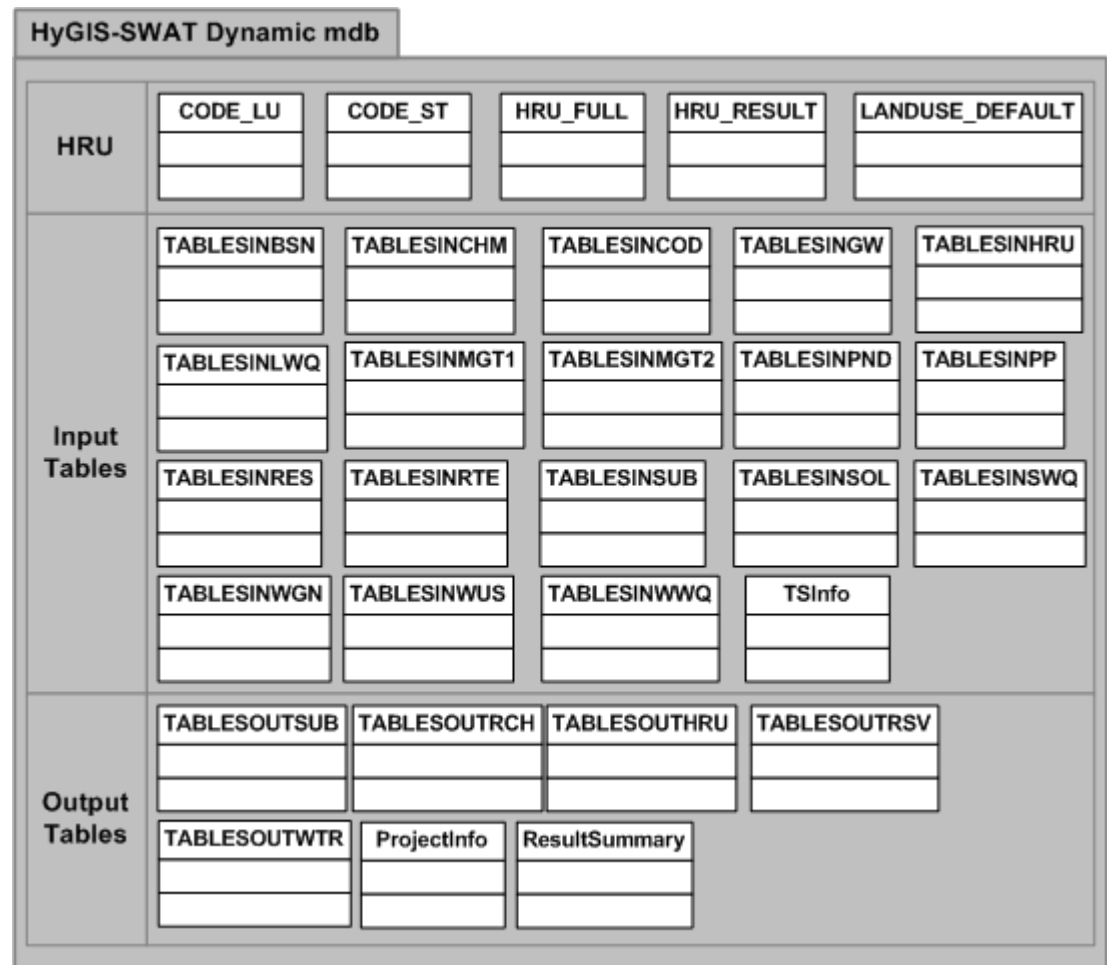
- Default value of SWAT input
- Physical values of land cover, soil, crop, fertilizer, etc.
- Weather station DB to generate weather data
- Set many parameters of SWAT using this DB
- Used to make dynamic DB

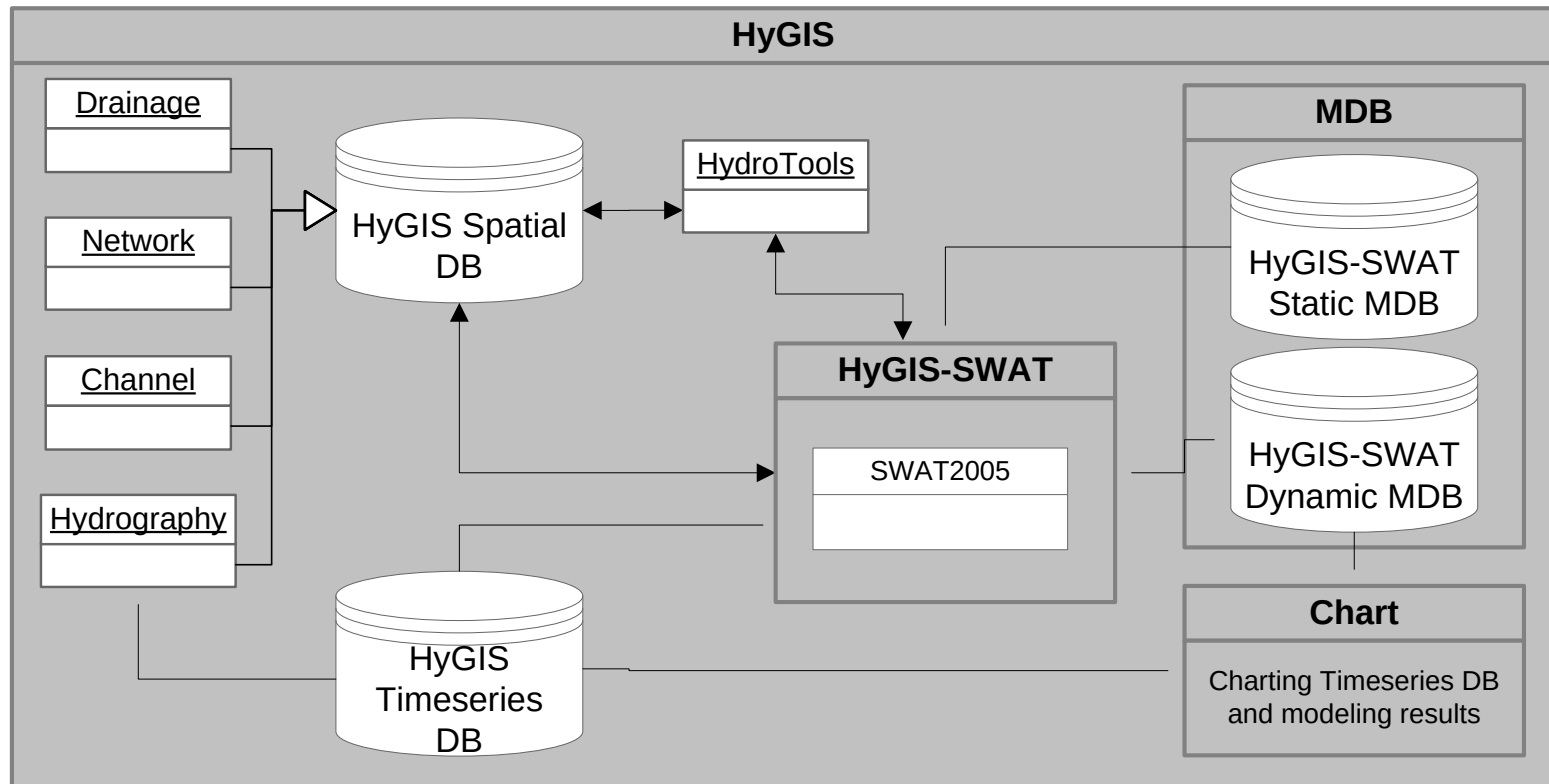


HyGIS-SWAT data model

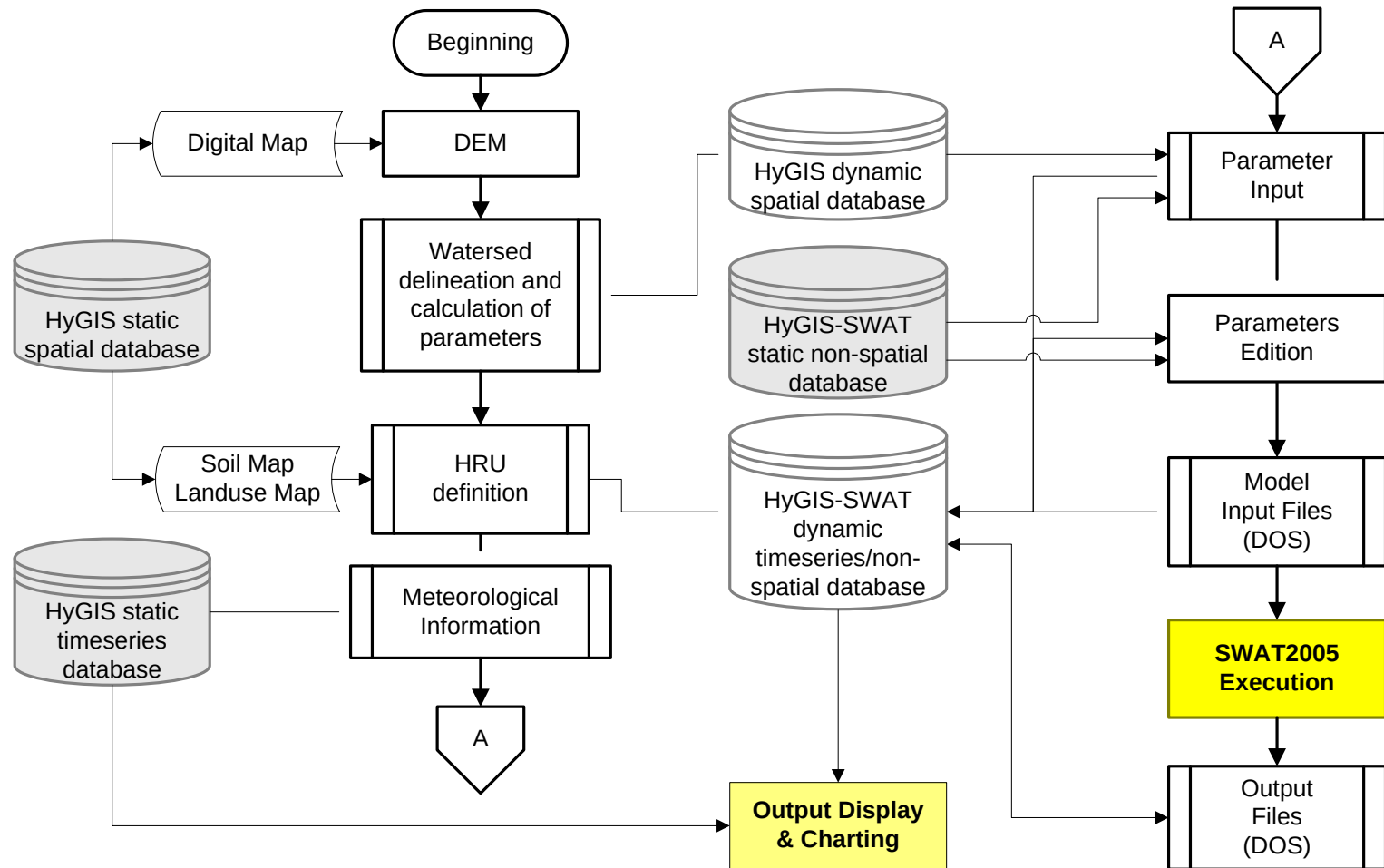
| Dynamic DB

- Composed of three groups - HRU, input, output
- HRU group : HRU calculation
- Input group
 - : directly used to make SWAT input files
- Output group
 - : main output files of sub, rch, hru, etc.
- Users can analyze output using tables and chart.





[Data flow of HyGIS-SWAT in HyGIS-Model environment]



HyGIS-SWAT

Operation process

GMMapBeta2009 - [C:\HyGIS\Tutorial\경안천\HyGIS_Sample_GA_SWAT.gmw]

파일(F) 편집(E) 지도(M) 레이어(L) 네트워크(N) Extension Edit 보기(V) 창(W) 도움말(H)

C:\HyGIS\Tutorial\경안천\HyGIS_Sample_GA_SWAT.gmw

New Project

- Open Project
- Save Project
- Save As Project
- Project Path
- Project Info

지도목록창

- 경안천
- RU
- W
- S
- W
- S
- O
- D
- DrainagePoint
- Network_NODE
- Network_ARC
- SubMStream
- MStream
- Stream
- SubWatershed
- Watershed
- GR_Slope.RGD
- Stream.RGD
- FAC.RGD
- FDir.RGD
- HydroDEM.RGD
- GADEM.RGD
- GA_DST.RGD
- GA_LC.RGD

Watershed Layers

- Landuse/Soil Map
- HRU Setup

Weather Stations

- Setup Timeseries
- Write All Input files
- Write Configuration File(.fig)
- Write Soil Data(.sol)
- Write Weather Generator Data(.wgn)
- Write Subbasin General Data(.sub)
- Write HRU General Data(.hru)
- Write Main Channel Data(.rte)
- Write Groundwater Data(.gw)
- Write Water Use Data(.wus)
- Write Management Data(.mgt)
- Write Soil Chemical Data(.chm)
- Write Pond Data(.pnd)
- Write Stream Water Quality Data(.swq)
- Watershed General Data(.bsn)
- Watershed Water Quality Data(.wwq)

HyGIS-SWAT Static DB

- Point Source Discharges
- Edit Inlet Discharge
- Edit Reservoirs
- Edit Watershed General Data(.bsn)
- Edit Watershed Water Quality Data(.wwq)
- Edit Subbains Data

SWAT simulation

- Simulation result table
- Simulation result chart
- 매개변수 보정

색인창

인덱스맵설정

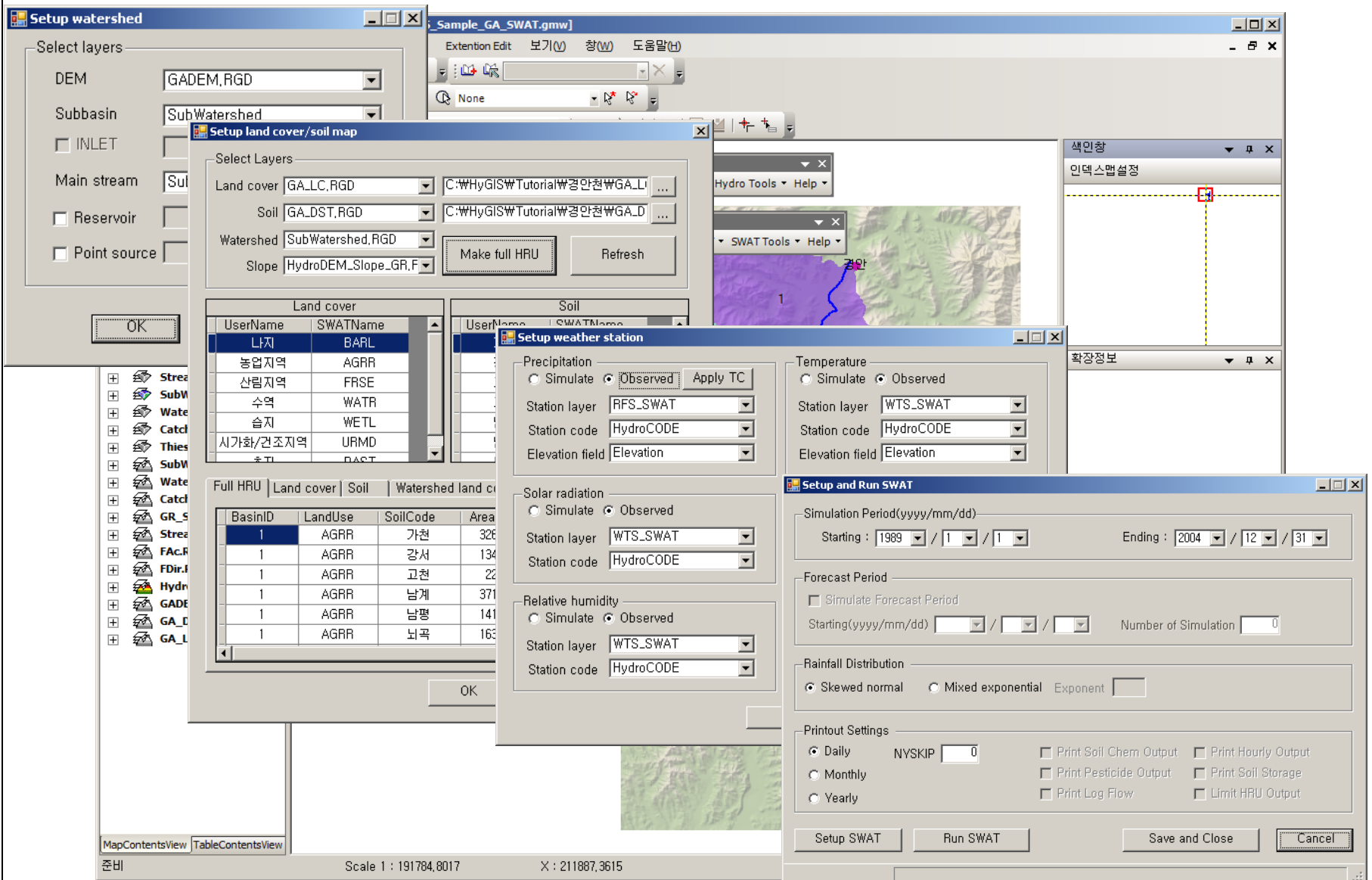
정보창

DataSet : SubWatershed

Field	Value
OBJ	[GEOMETRY]
OID	5
HYDROID	1832
DRAINID	1
HYDROCODE	
NAME	
AREA	47.7333
P	41760
NEXTDOWNID	0
REF_HYDROID	0
SLOPE	0.2170545512278...

Record | Geometry | GRID(Cell)

Scale 1 : 205544,1322 X : 228720,2965 Y : 440908,5303



Conclusions

- ✓ Develop the HyGIS-SWAT system
- ✓ Provide easy and convenient modeling environment with GIS and database
- ✓ Can make effectively the input database of SWAT model appropriate to Korea
- ✓ Obtain the technology for the nation wide modeling support system based on GIS and database
- ✓ Expect to be used as the convenient tool for applying the SWAT model

THANK YOU...
(<http://hygis.kict.re.kr>)