

BASINS/HSPF模式操作教學

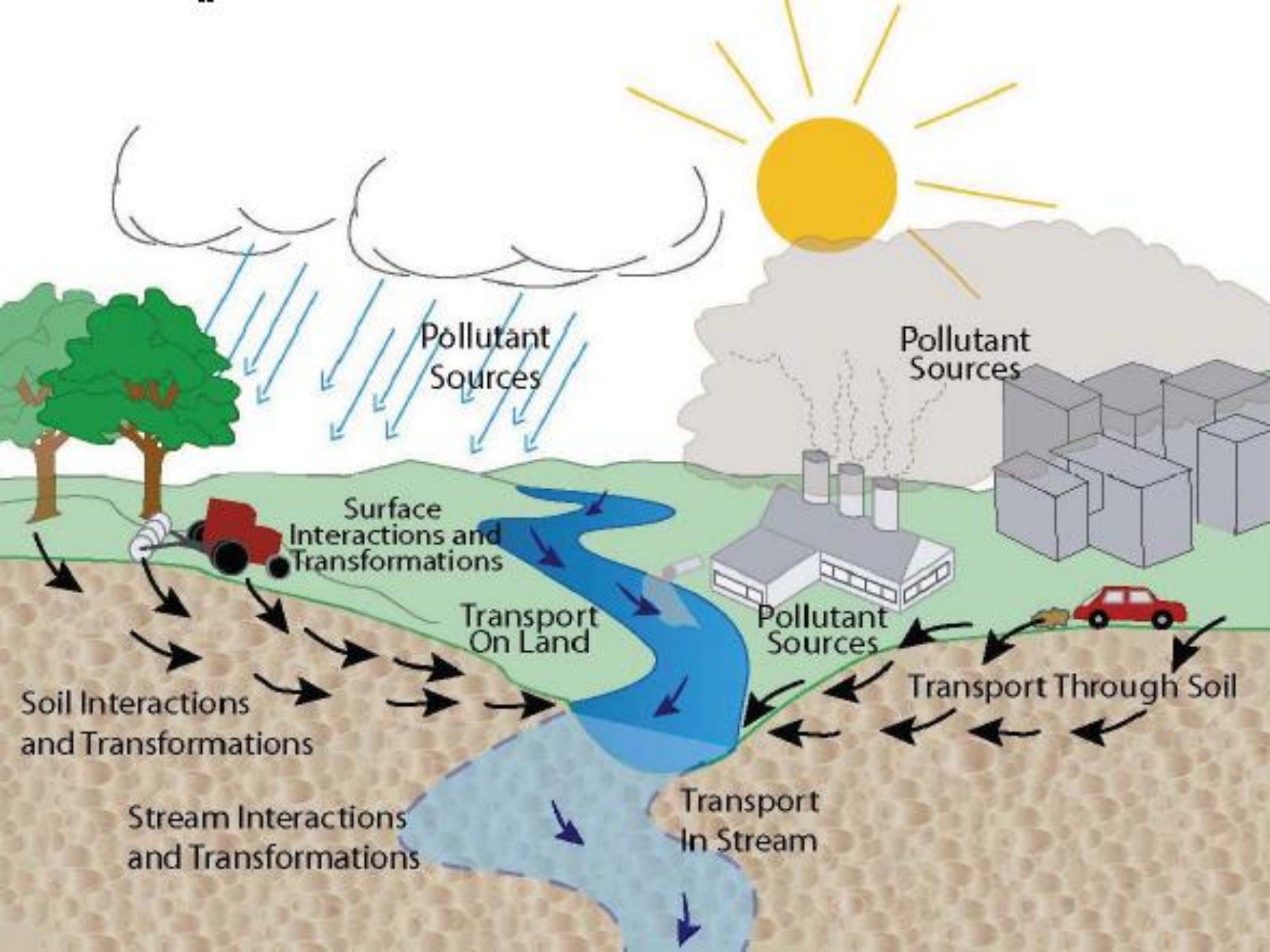
報告人：林玉婷
中華民國100年7月28日

報告大綱

2

- 模式介紹
- 操作流程

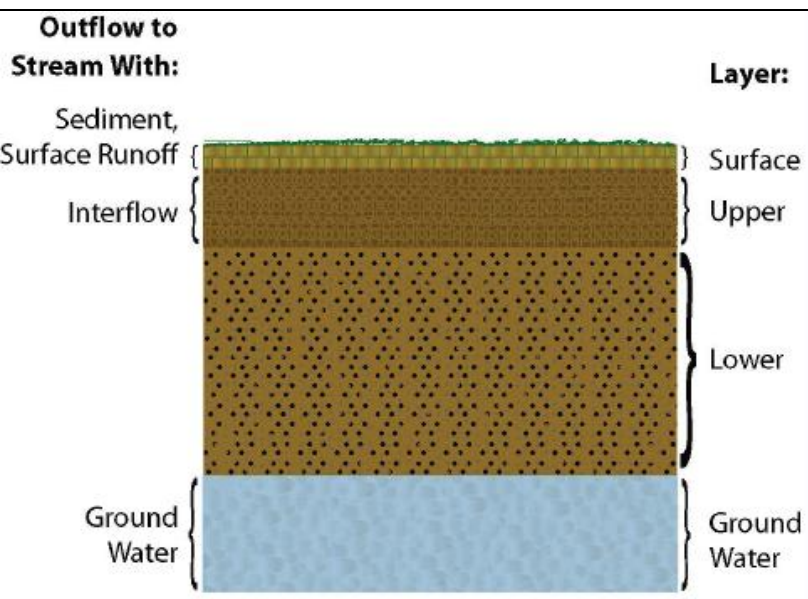
模式介紹



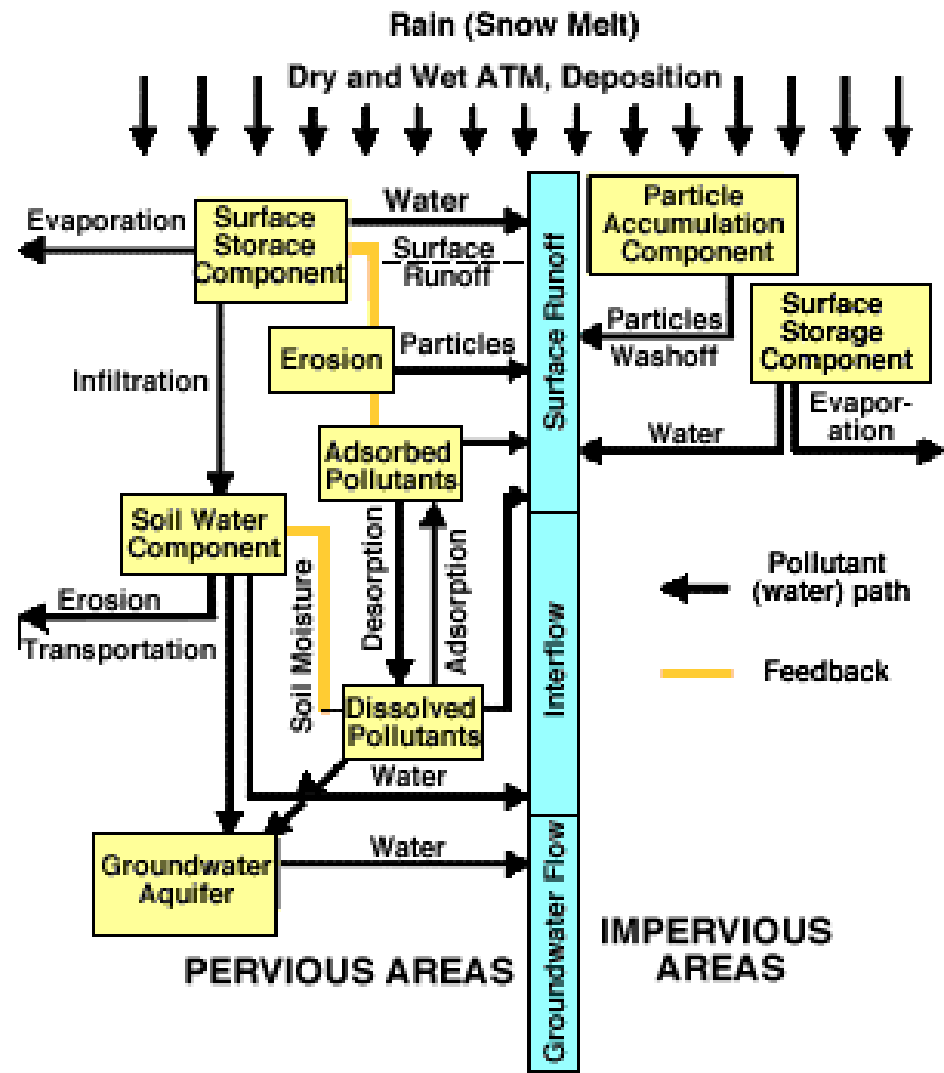
模式介紹

5

集水區非點源污染模式概念圖



COMPONENTS OF WATERSHED NONPOINT POLLUTION MODELS



模式介紹

BASINS簡介

- BASINS (Better Assessment Science Integrating Point And Nonpoint Sources)。
- 為美國環保署發展的集水區多目標環境分析系統，此系統結合地理資訊系統 (GIS)、集水區資料庫及多種水質模擬評估工具，包括 HSPF、SWMM、WASP 及 PLOAD。
- 以集水區的範疇為概念，將集水區資料及評估總量管制 (TMDL) 所需之點源及非點源污染分析，整合於內建GIS平台。

模式介紹



U.S. ENVIRONMENTAL PROTECTION AGENCY

BASINS (Better Assessment Science Integrating point & Non-point Sources)



[Recent Additions](#) | [Contact Us](#)

Search: ☐ All EPA ☒ This Area



You are here: [EPA Home](#) » [Water](#) » [Water Science](#) » [Water Quality Models and Tools](#) » BASINS

Water Quality Models
Home

BASINS Home

Basic Information

Downloads

Order CDs

Documentation

Frequent Questions

Training

Listserver

Related Tools, Utilities
& Features

Metadata

Related Links

BASINS is a multi-purpose environmental analysis system that integrates a geographical information system (GIS), national watershed data, and state-of-the-art environmental assessment and modeling tools into one convenient package.



BASINS 4.0 is now available! [Download BASINS](#).

- [Fact sheet about version 4.0](#) (April 17, 2007)
- [Press Release](#) (April 23, 2007)

- [Basic Information](#) about how the tool and its usefulness for multi-purpose environmental analysis.
- [Download](#) the latest version of the model, GIS application, updated system files, data, and tutorial.
- [Order CDs](#) from our publication center.
- [Documentation](#) including user manuals, case studies, and technical notes.
- [Frequent Questions](#) about applicability, data, models, and technical issues.

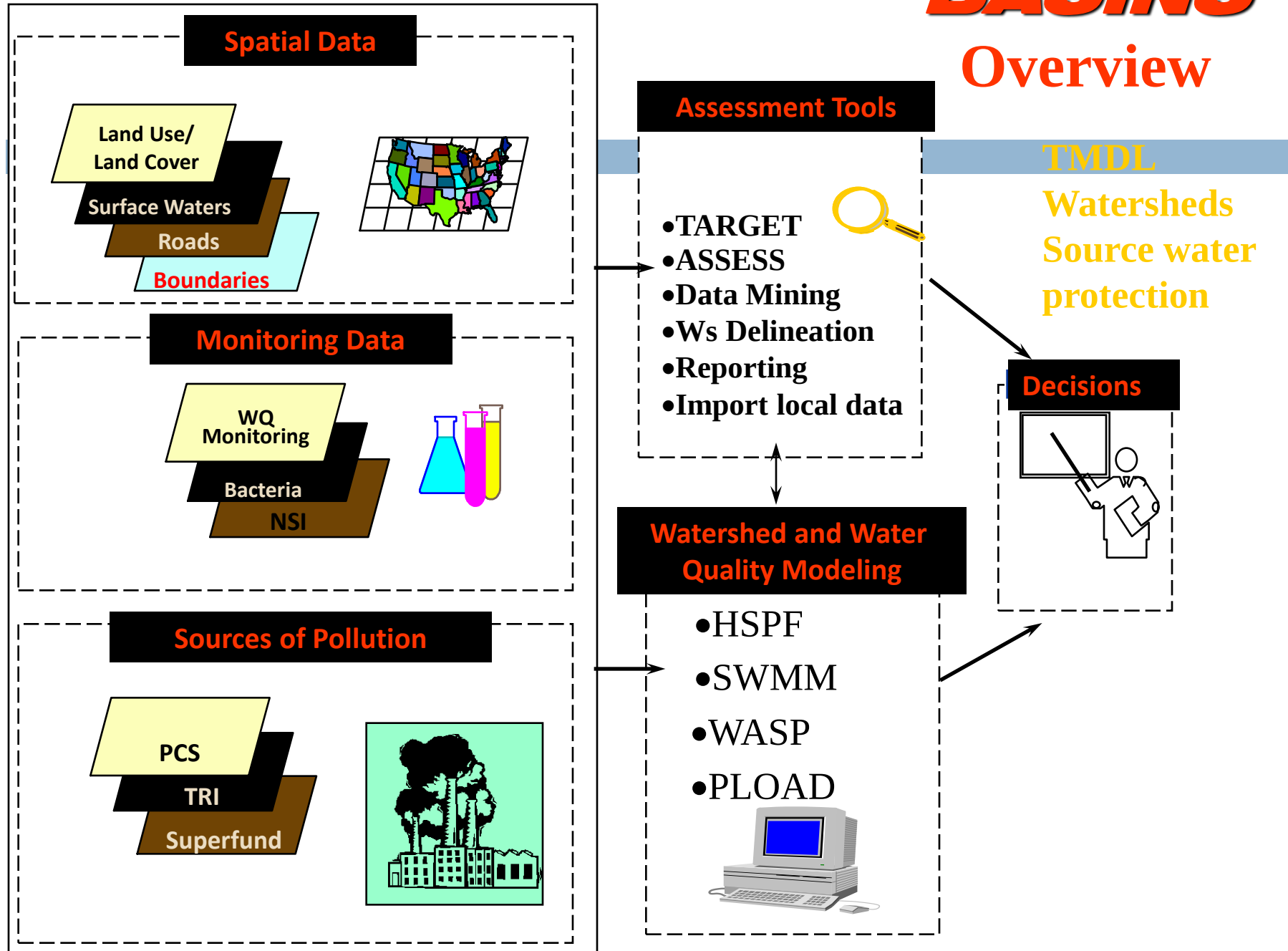
- [Training](#)—live classes and downloadable lectures and exercises.
- [Email listserv](#) acts as a forum for discussion and technical support. Join the Listserv or search the archives.
- [Other Tools, Utilities, & Features](#) to be used with basins.
- [Metadata](#) describing the content, quality, condition, and other characteristics of environmental data.
- [Related Links](#) within and outside EPA.

Source: <http://www.epa.gov/waterscience/basins/>

BASINS

Overview

8



模式介紹

發展演進

- BASINS 1.0 – May 1996
- BASINS 2.0 – January 1999
- BASINS 3.0 – June 2001
- BASINS 3.1 – August 2004 incremental release
- **BASINS 4.0** – March 2007
 - ▣ Update 1 – November 2007
 - ▣ Update 2 – August 2008
 - ▣ **Update 3 – May 2010**

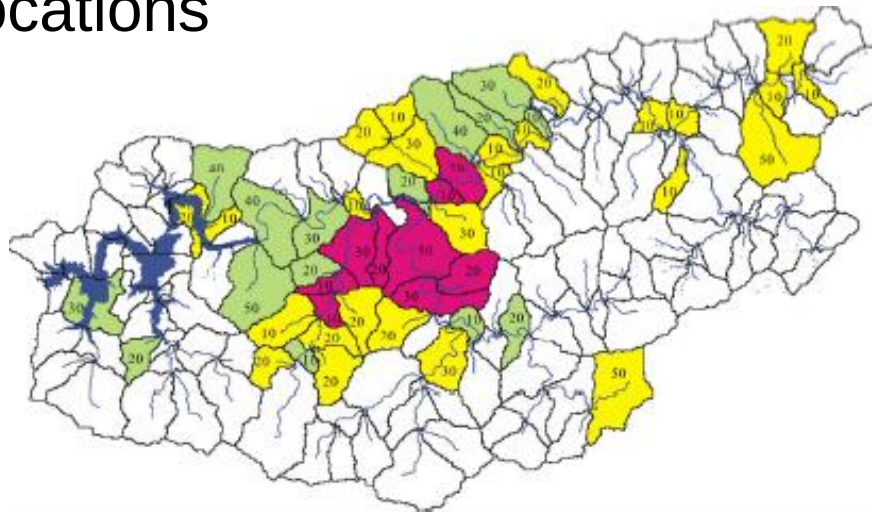
模式介紹

10

Water Environment Research Center

BASINS/HSPF目的

- 提供集水區總量管制發展與管理評估：
 1. Characterization of Water Quality Data
 2. Identification of Pollution Sources
 3. Load Allocations



翡翠水庫集水區非點源污染削減措施整體規劃之研究(台北水源局,2005)

模式介紹

11

Water Environment Research Center

總量管制

- TMDL, Total Maximum Daily Load
- 以集水區為單元，訂定水質標準目標，再依照水體之涵容能力來估計點源及非點源污染之分配量，從而確定每個污染源所需要消減的污染量，使水體接受此污染源時仍可符合水質標準。

$$TMDL = WLA + LA + MOS$$

Margin of safety (5%~10%TMDL)

Portion of the TMDL allocated to point sources

Portion of the TMDL allocated to nonpoint sources

Loading capacity of the water-body

模式介紹

12

Water Environment Research Center

BASINS/HSPF 特色

- 將集水區資料及評估總量管制（TMDL）所需之點源及非點源污染分析，整合於內建GIS平台的架構下，方便資料進行組織與展示。
- Free to Download 
- 資料量需求較大
 - 研究區域相關圖層
 - 河道資料
 - 氣象、水文、水質監測
- 參數數量較多

模式介紹

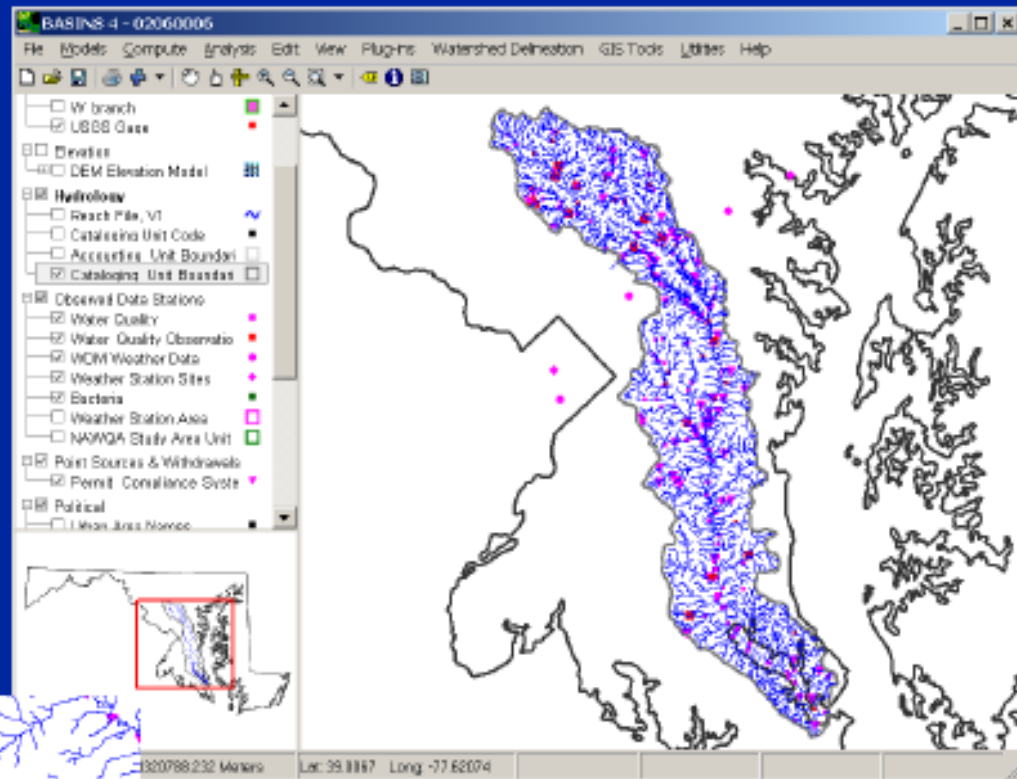
13

OPEN SOURCE ADVANTAGES

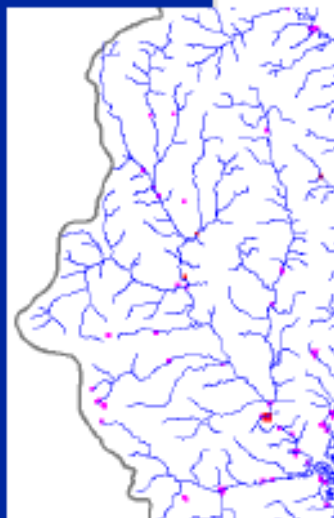
- No need to purchase expensive proprietary GIS products
- Source code for all components, including the foundational GIS software, will always be available to end users and the federal government
- Provides greater stability and transparency
- Open framework readily allows for inclusion of additional models and tools

BASINS DATA

Select data
layers to display



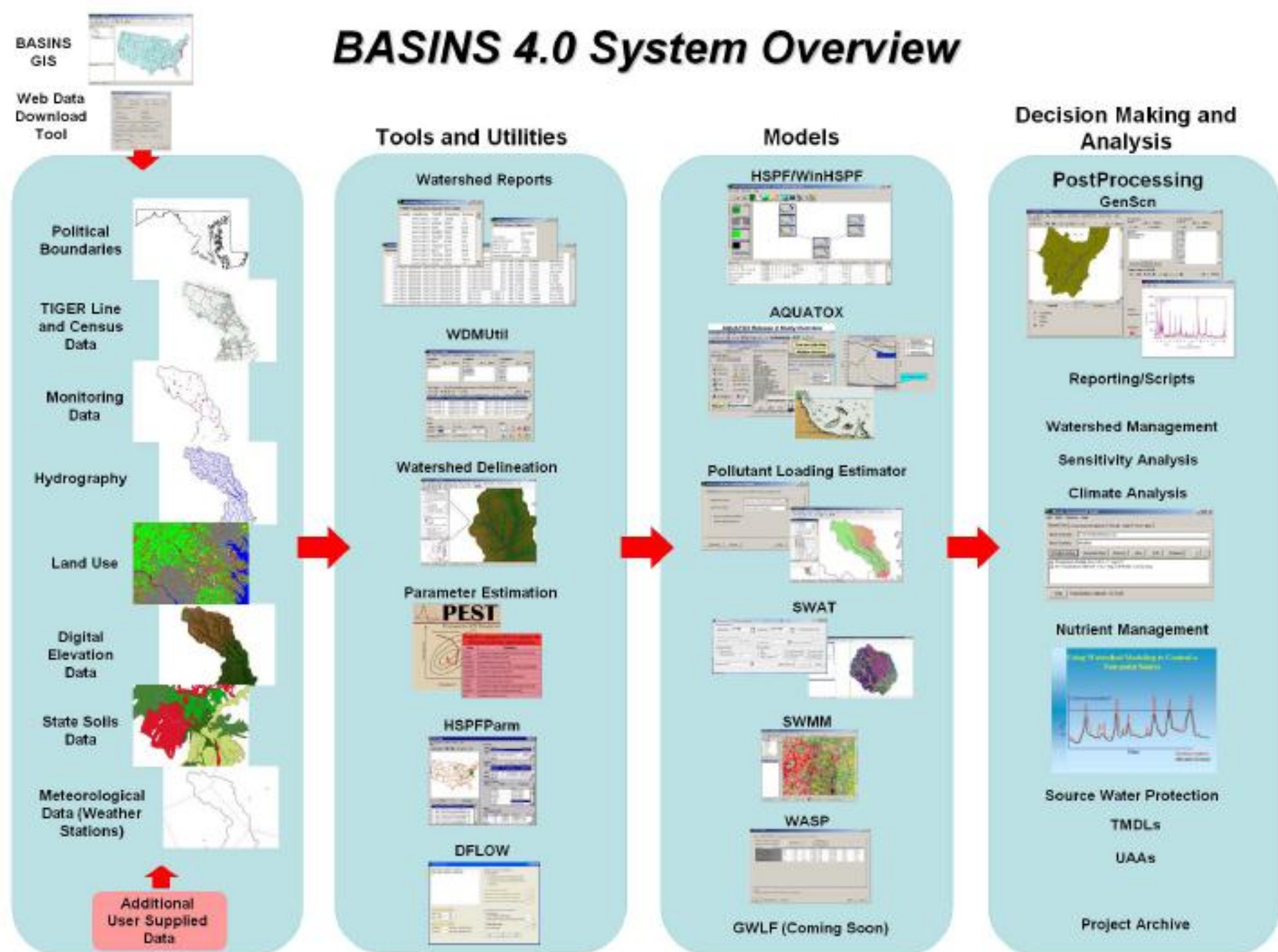
Zoom to
area of interest



Data included:

- Streams - Reach File 1, NHD
- Watershed boundaries
- Point source locations
- Monitoring locations

BASINS 4.0 System Overview



BASINS MODELS

HSPF / WinHSPF (Hydrologic Simulation Program, FORTRAN)

- Continuous simulation watershed model with fixed, user-selected, time steps
- Predicts loadings and instream water quality in mixed land use watersheds for:
 - Nutrients
 - Toxics
 - Bacteria
 - Sediment
- Data provided to Windows interface through a BASINS plug-in



模式介紹

17

Water Environment Research Center

HSPF簡介

- HSPF (Hydrological Simulation Program FORTTRAN)。
- 為美國環保署與Hydrocomp Inc. 所共同發展之非點源污染模式，可模擬集水區內之水量及水質變化情形。
- 將原本各自獨立的HSP、ARM及NPS三個模式整合，並進行改良而成。



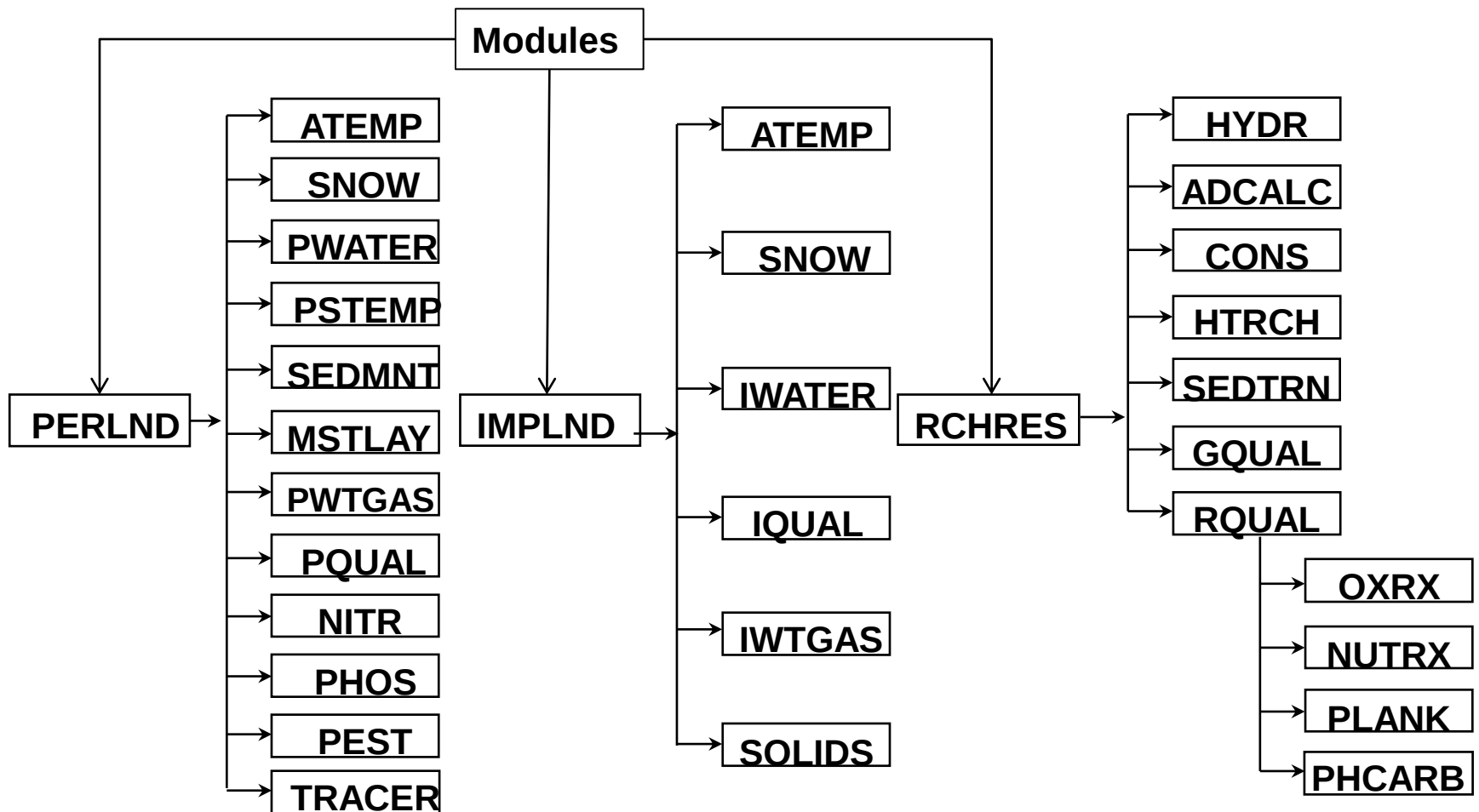
CONNECTION BETWEEN BASINS AND HSPF

- **BASINS/GIS data layers provided for HSPF setup**
 - DEM (grid)
 - *Used to determine the boundaries of the subwatersheds when delineating.*
 - Land Use (NLCD or GIRAS)
 - *Used to calculate land use distributions within each subwatershed.*
 - *Each land use is parameterized separately.*
 - Reach File, Version 1; NHD/NHDPlus
 - *One representative reach is selected for each subwatershed.*
 - *Shapefile is used to determine some of the necessary inputs associated with the stream network setup within the model*

模式介紹

19

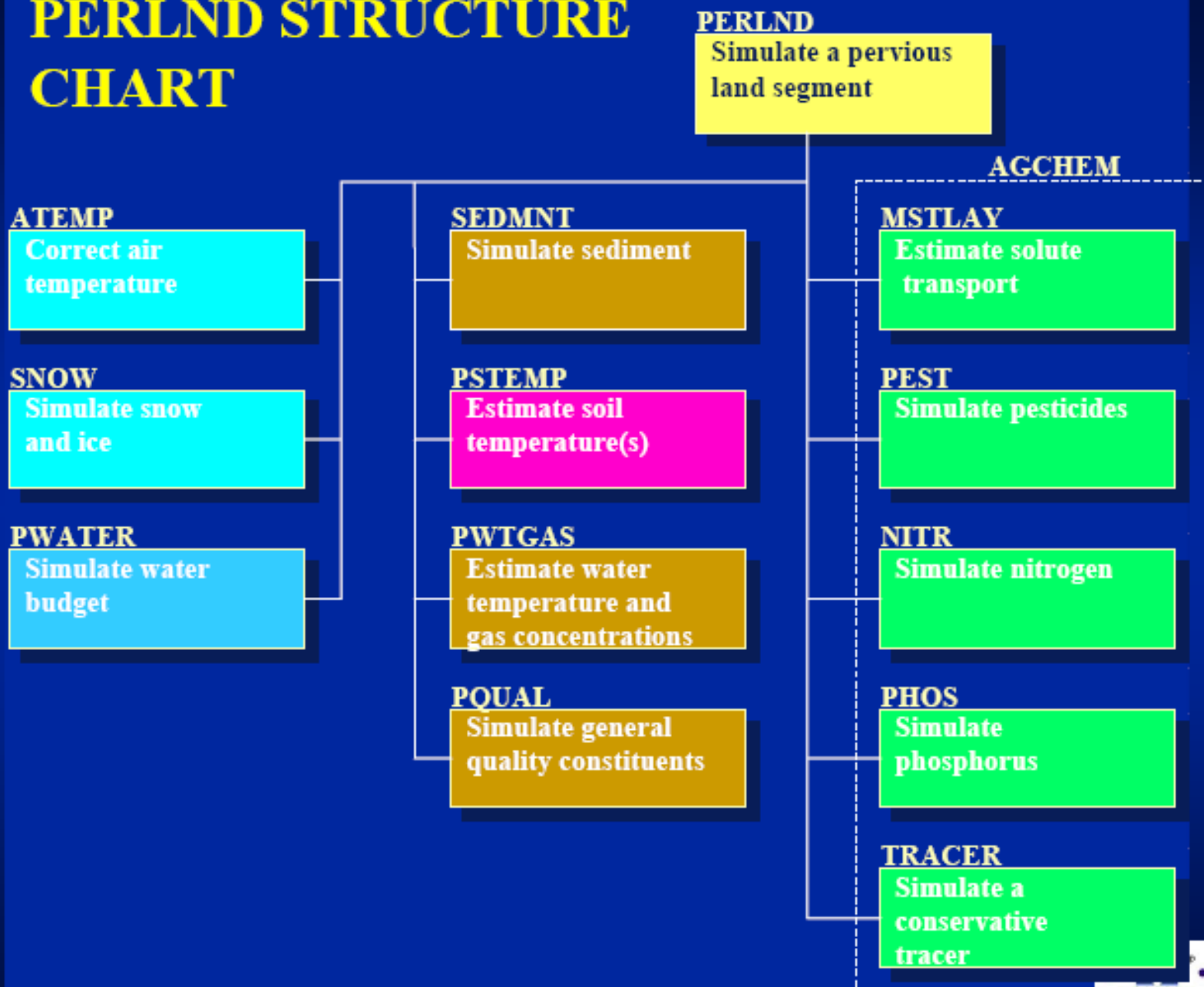
HSPF主要模組



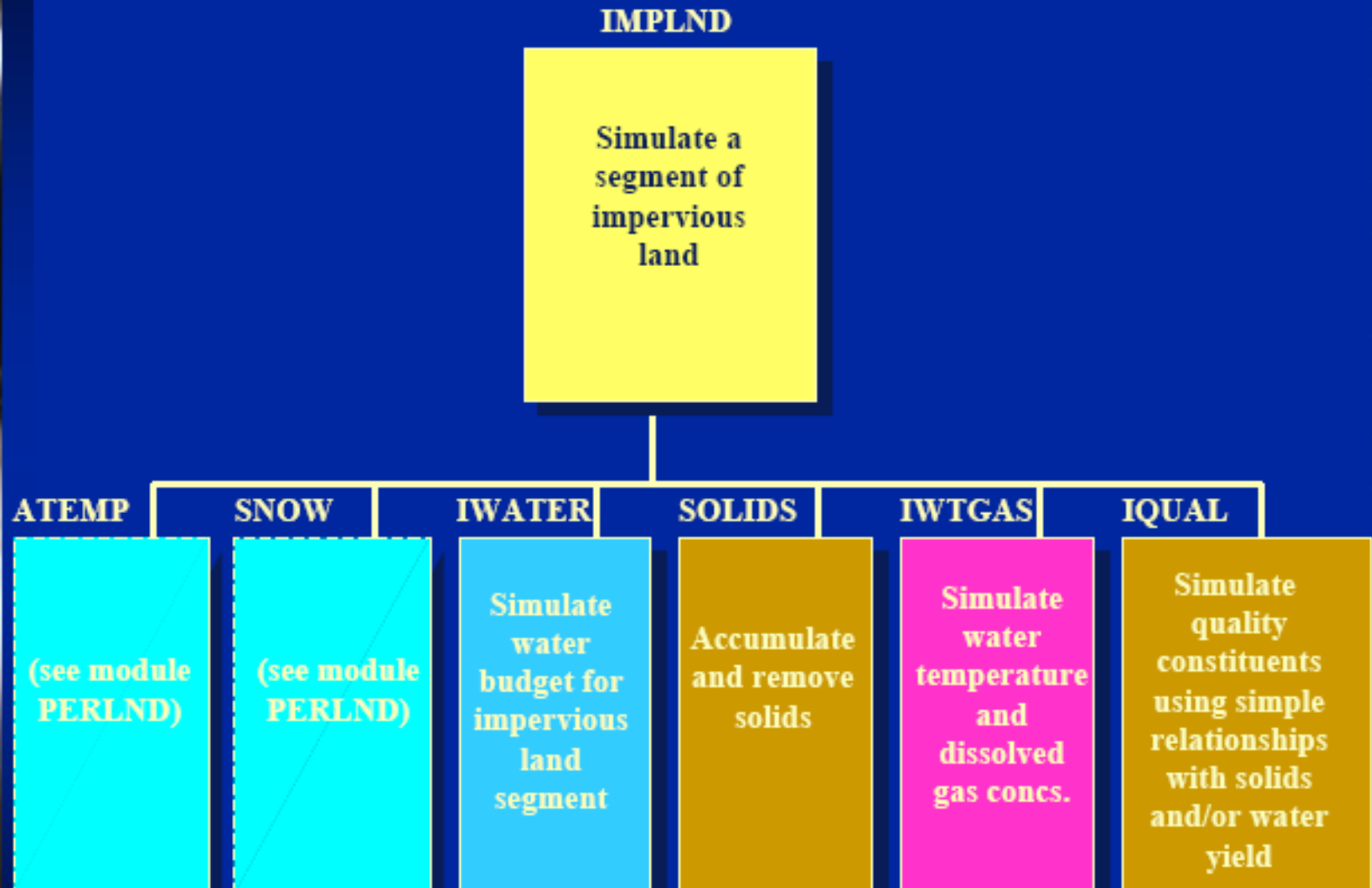
APPLICATION MODULES

<u>PERLND</u>	<u>IMPLND</u>	<u>RCHRES</u>	<u>BMP</u>
Snow	Snow	Hydraulics	Flow
Water	Water	Conservative	Any constituent simulated in PERLND, IMPLND or RCHRES
Sediment	Solids	Temperature	
Quality	Quality	Sediment	
Pesticide		Nonconservative	
Nitrogen		BOD/DO	
Phosphorus		Nitrogen	
Tracer		Phosphorus	
		Carbon	
		Plankton	

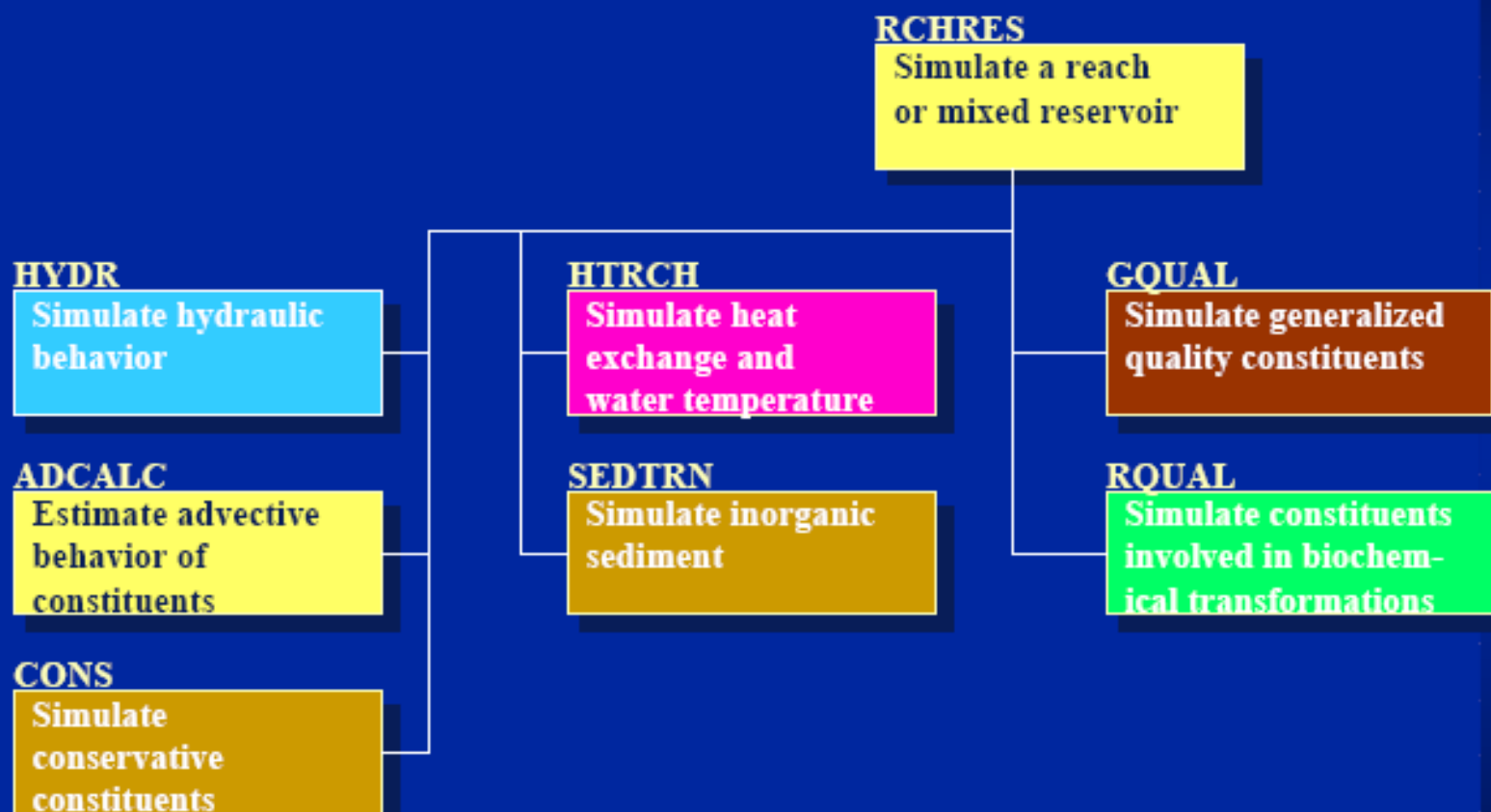
PERLND STRUCTURE CHART



IMPLND STRUCTURE CHART



RCHRES STRUCTURE CHART



模擬單元 (PERLAND)

● 必須 ◎ 建議1 ○ 可選擇	Adjusted Air Temp	Snow	Basic Hydrology	Soil Erosion	Soil Temperature	Water Temperature	Dissolved Oxygen	Carbon Dioxide	General WQ	Pesticides	Nitrogen	Phosphorus	Tracers
ATEMP	●	◎3	○	○	◎3	◎3	◎3	◎3	○	○	◎3	◎3	○
SNOW		●	○	○		○	○	○	○	○	○	○	○
PWATER			●	●		●	●	●	●	●	●	●	●
SEDMNT				●					●2	●	●	●	
PSTEMP					●	◎	◎	◎		○4	◎	◎	
PWTGAS						●	●	●					
PQUAL									●				
MSTLAY										●	●	●	●
PEST										●			
NITR											●		
PHOS												●	
TRACER													●

1. 除非有觀測值或計算值可以取代，否則仍然是需要的
2. 只有在模擬物與泥砂有關時才需要
3. 假如觀測站與模擬區域之間有高程差異，則建議使用ATEMP
4. 當一階吸附作用取代Freundlich平衡時，則需使用PSTEMP

模擬單元 (IMPLND)

● 必須 ◎ 建議¹ ○ 可選擇	Adjusted Air Temp	Snow	Basic Hydrology	Solids	Water Temperature	Dissolved Oxygen	Carbon Dioxide	General WQ
ATEM	●	◎ ³	○	○	◎ ³	◎ ³	◎ ³	○
SNOW		●	○	○	○	○	○	○
IWATER			●	●	●	●	●	●
SOLIDS				●				● ²
IWTGAS					●	●	●	
IQUAL								●
1.除非有觀測值或計算值可以取代，否則仍然是需要的 2.只有在鈺模擬的物質與沉積物有關時才有效 3.假如觀測站與模擬區域之間有高程上的差異，則建議使用ATEMP								

模擬單元 (RCHRES)

		Flow Routing	Conservative	Water Temperature	Sediment	General WQ	Pesticides	Dissolved Oxygen	BOD	Inorganic Phosphorus	Inorganic Nitrogen	Benthic Algae	Phytoplankton	Organic C, N & P	Zooplankton	pH	Carbon Dioxide	Total Inorganic Carbon
● 必須 ◎ 建議 ¹ ○ 可選擇		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
			●													◎	◎	◎
				●	◎ ²	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
					●	◎ ³	◎ ³	○ ⁵	○ ⁵	● ⁴	● ⁴	● ⁴	● ⁴	● ⁴	● ⁴	● ⁴	● ⁴	● ⁴
						●	●											
RQUAL	OXRX							●	●	●	●	●	●	●	●	●	●	●
	NUTRX							○ ⁶	○ ⁶	●	●	●	●	●	●	●	●	●
	PLANK							○ ⁶	○ ⁶	○ ⁶	○ ⁶	●	●	●	●	●	●	●
	PHCARB															●	●	●

1. 除非有觀測值或計算值可取代，否則仍需要
2. 只有使用Toffaleti或Colby的泥砂傳輸方法時才需要
3. 只有在模擬物與泥砂有關時才需要，如果考慮光解作用則建議使用
4. 只有在NH₃/PO₄與泥砂有關時才需要，否則仍非常建議使用
5. 只有在NUTRX開啟且考慮與泥砂有關時才需要，否則仍非常建議使用
6. 非常建議考慮整個營養鹽和生物循環之關係

模式介紹

27

Water Environment Research Center

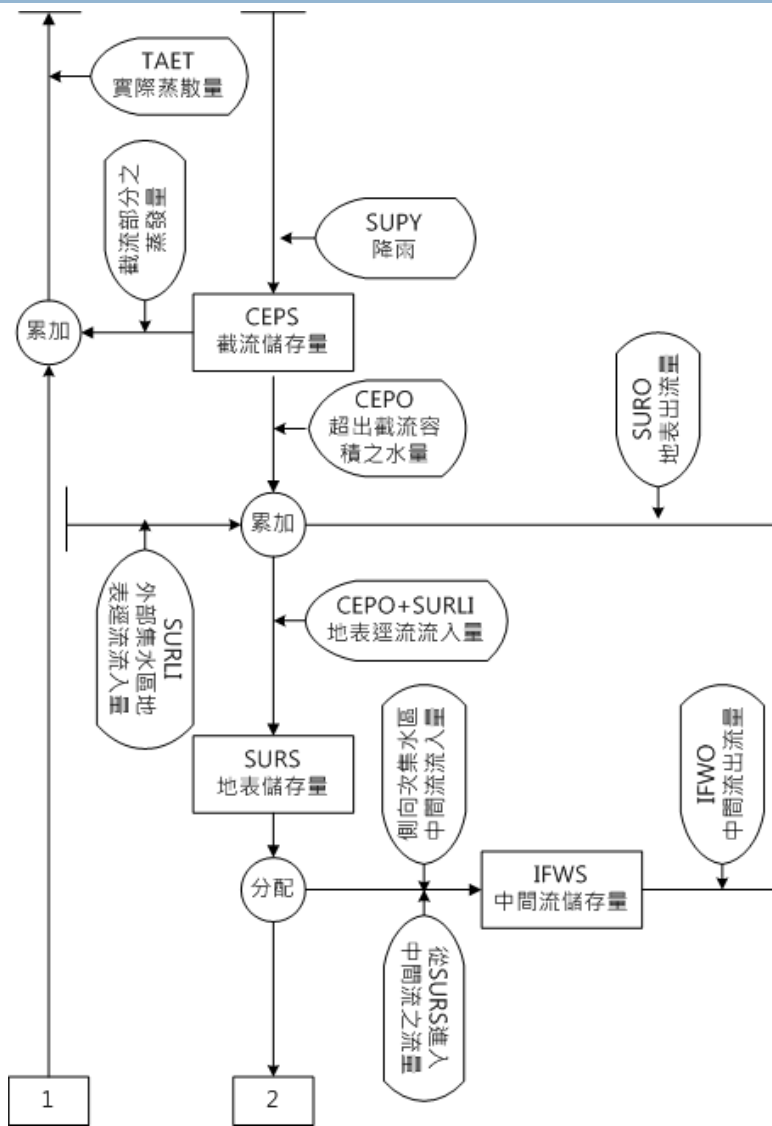
水文模擬

- 透水區(PERLND)水量收支平衡副程式(PWATER)
 - 在地表水量部分以 **Chezy-Manning 公式結合經驗式** 演算流達河道時的逕流量，在地面下水量部分則以 **入滲及經驗退水法則** 估計到達河道的流量。
- 河道區(RCHRES)水力計算副程式(HYDR)
 - 根據水流之 **連續方程式(Continuity Equation)** 計算每一段河道出口點的流量。

模式介紹

28

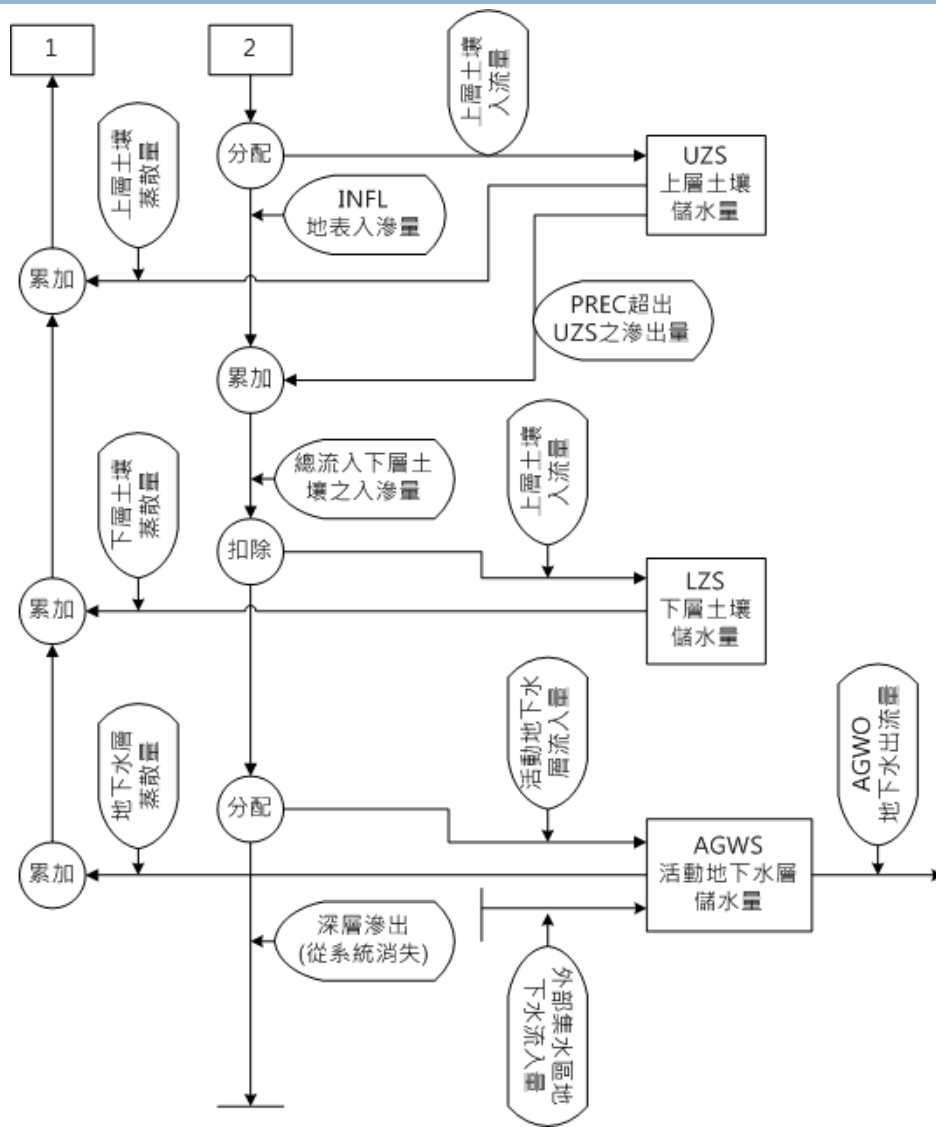
PWATER副程式



模式介紹

29

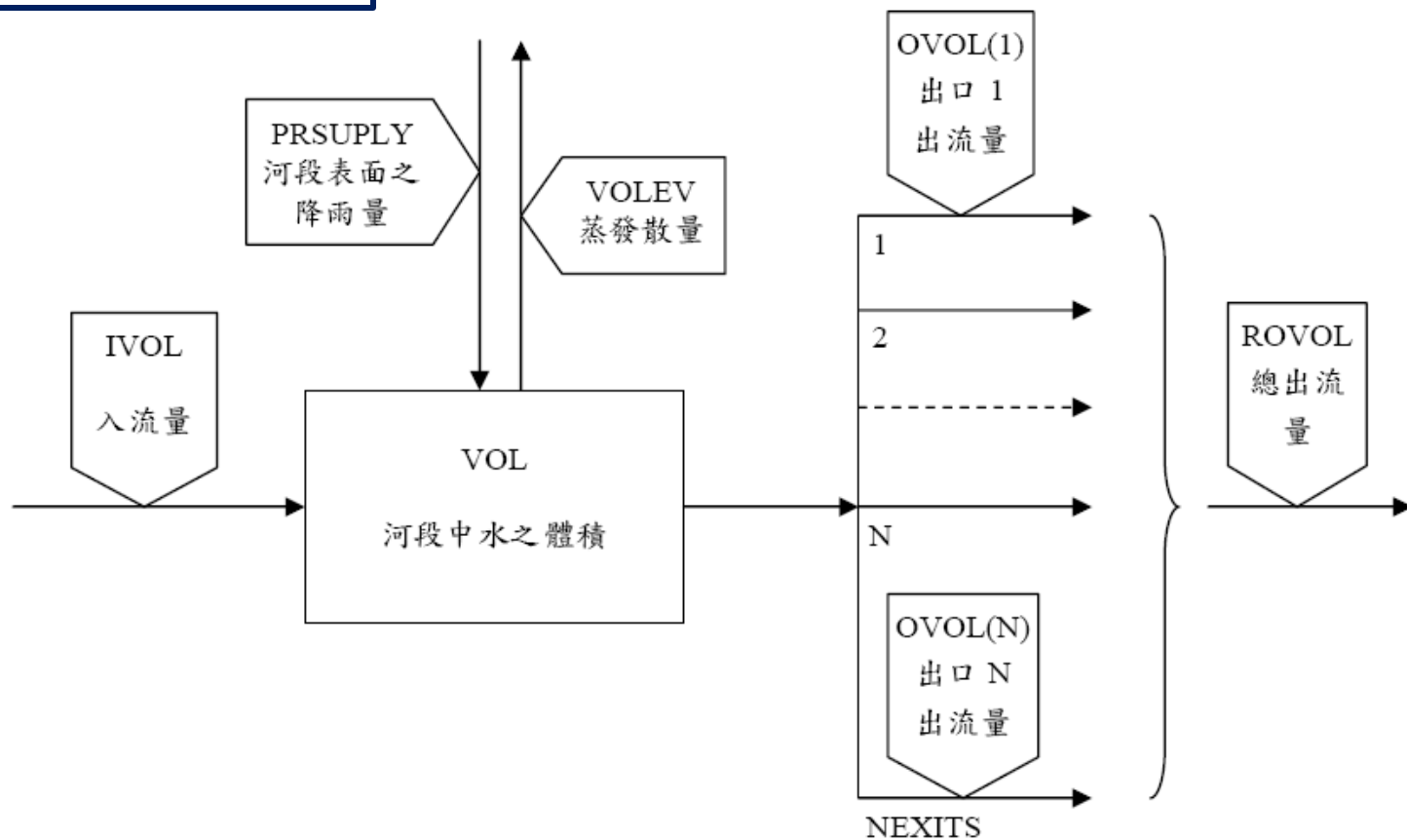
PWATER副程式



模式介紹

30

HYDR副程式



模式介紹

31

Water Environment Research Center

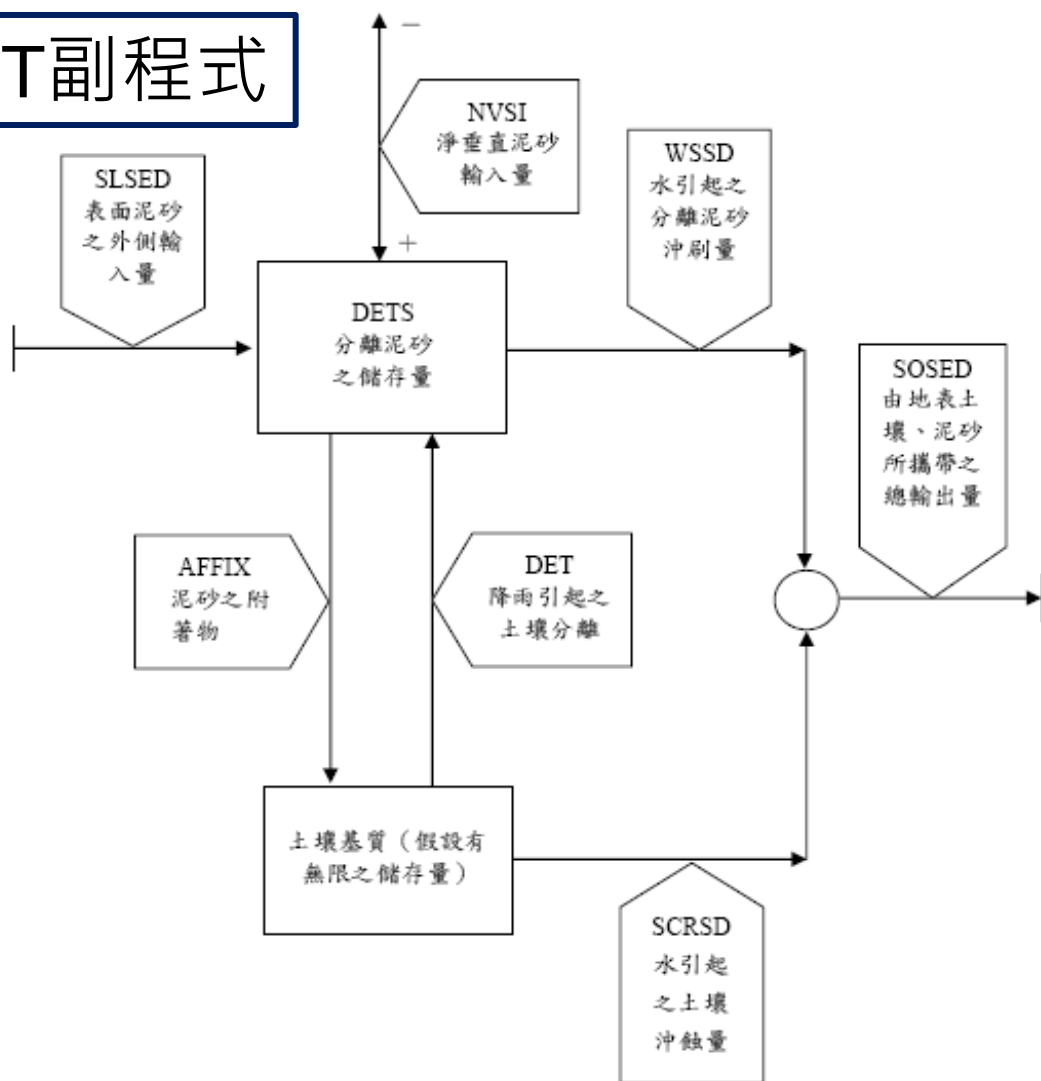
水質模擬

- 透水區(PERLND)泥砂模擬副程式(SED MNT)
 - SED MNT主要在模擬泥砂之**生成** (Production) 及 **運移** (Removal) ，考慮大氣沉降及降雨引起的土壤分離 (Detachment of Soil) 、漫地流沖刷等因素，計算由地表土壤、泥砂所攜帶之總輸出量。
- 河道區(RCHRES)泥砂行為副程式(SED TRN)
 - SED TRN考慮河道中懸浮及底床之砂土 (Sand) 、 粉土 (Silt) 、黏土 (Clay) 儲存量，藉由**沖蝕**和**沉澱**的轉換過程，計算河道中之泥砂總出流量。

模式介紹

32

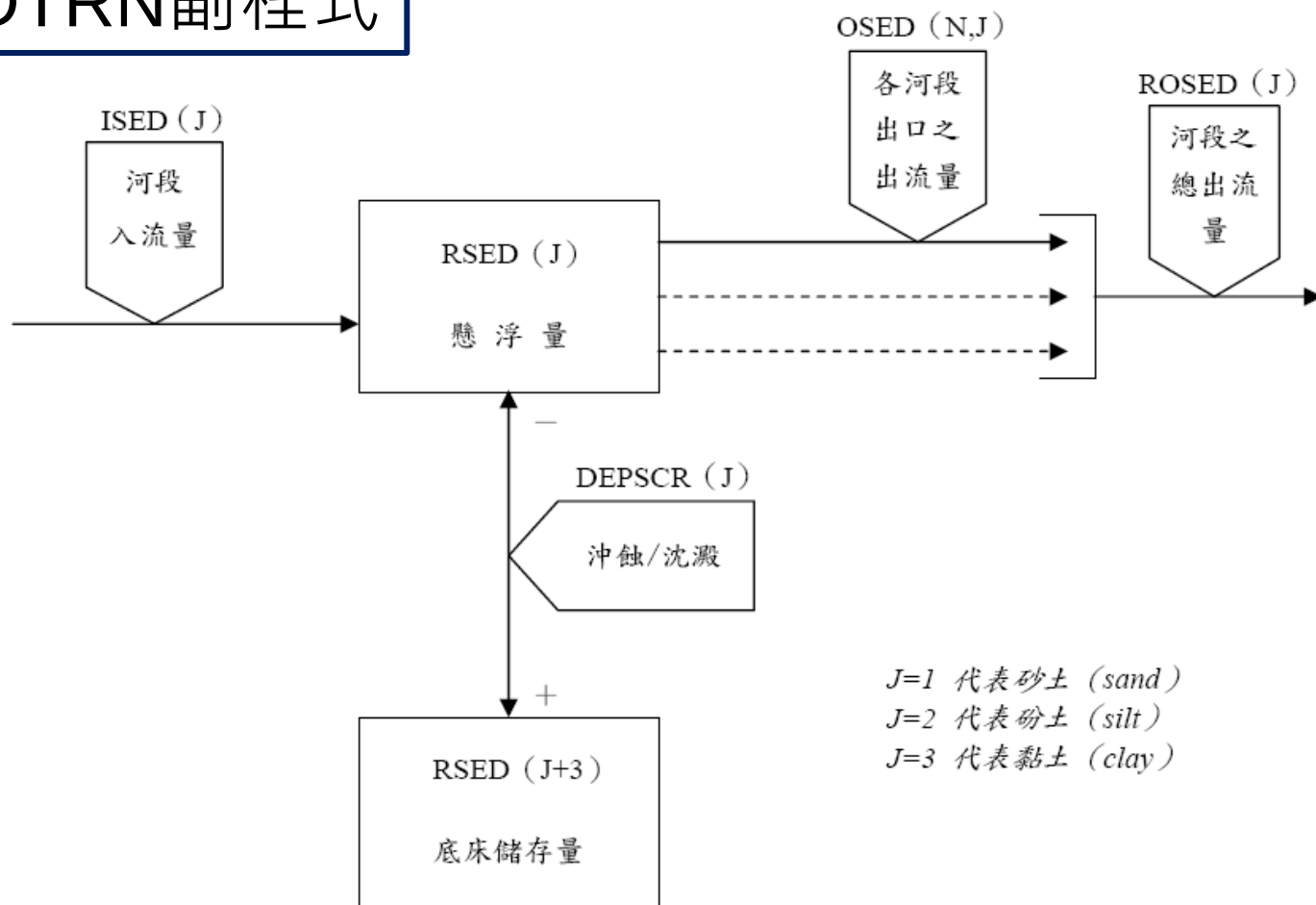
SEDMNT副程式



模式介紹

33

SEDTRN副程式



模式介紹

水質模擬

□ 透水區(PERLND)水質模擬副程式PQUAL

- PQUAL主要是運用水和泥砂之關係來模擬水質，考慮路面和土壤之沖蝕、沉澱、運移等因素，包括地表、中間流、地下水流之模擬物質出流量。

□ 河道區(RCHRES)水質行為副程式GQUAL

- GQUAL主要在模擬一般水質行為，考慮和泥砂之吸附（ Adsorption ）、脫附（ Desorption ）、衰減（ Decay ）關係，及化合物本身的水解（ Hydrolysis ）、氧化（ Oxidation ）、光解（ Photolysis ）、揮發（ Volatilization ）、生物（ Biodegradation ）等作用，計算水中模擬物質之濃度或負荷量。

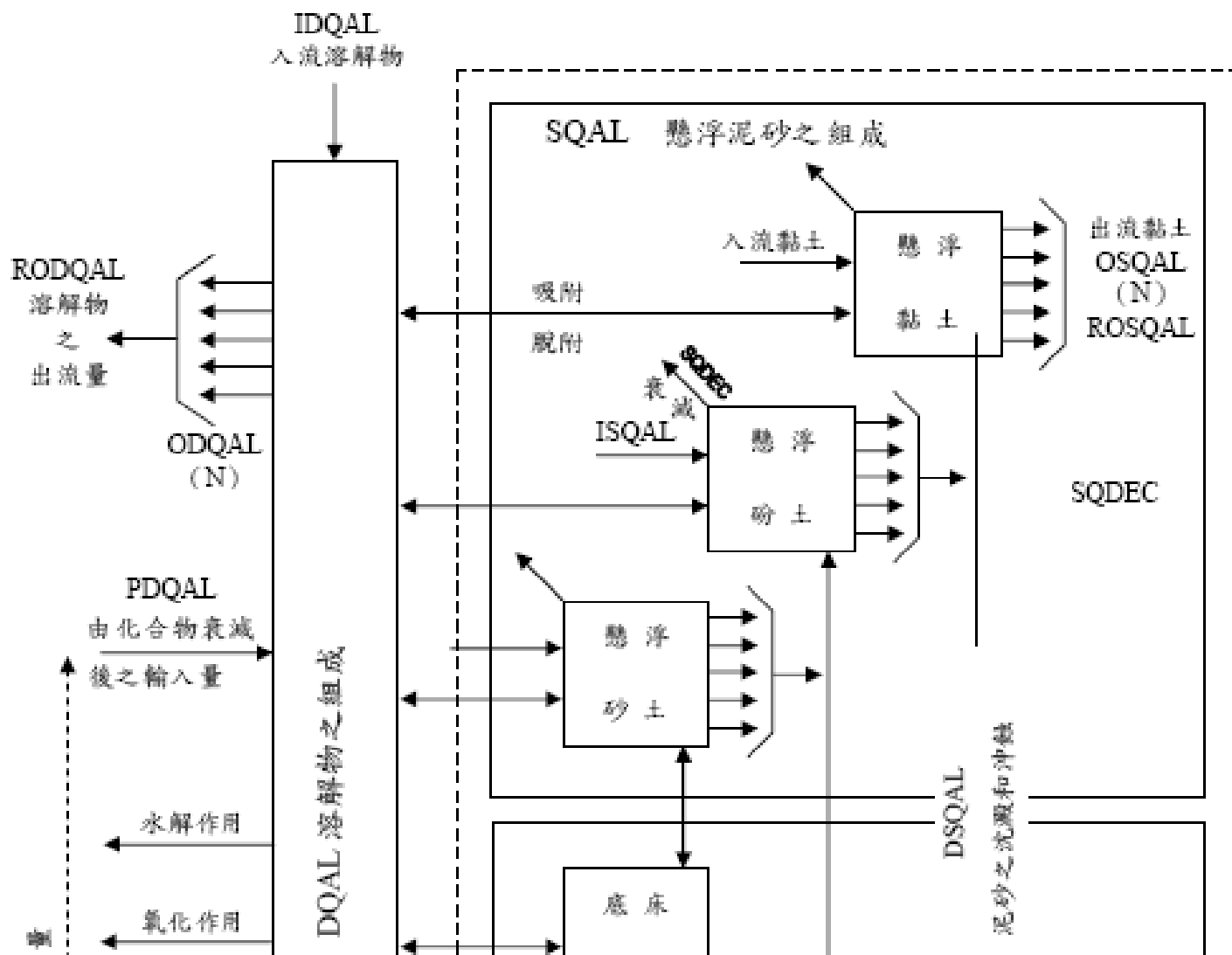
模式介紹

PQUAL副程式

模式介紹

36

GQUAI



操作流程

操作流程

38

模式輸入資料

- GIS關資料
 - ▣ 土地利用、高程、邊界
- 氣象資料
 - ▣ 降雨、蒸發、溫度、風速、日輻射、蒸發散潛勢、露點溫度、雲覆蓋量
- 流量資料
- 水質資料

操作流程

39

Water Environment Research Center

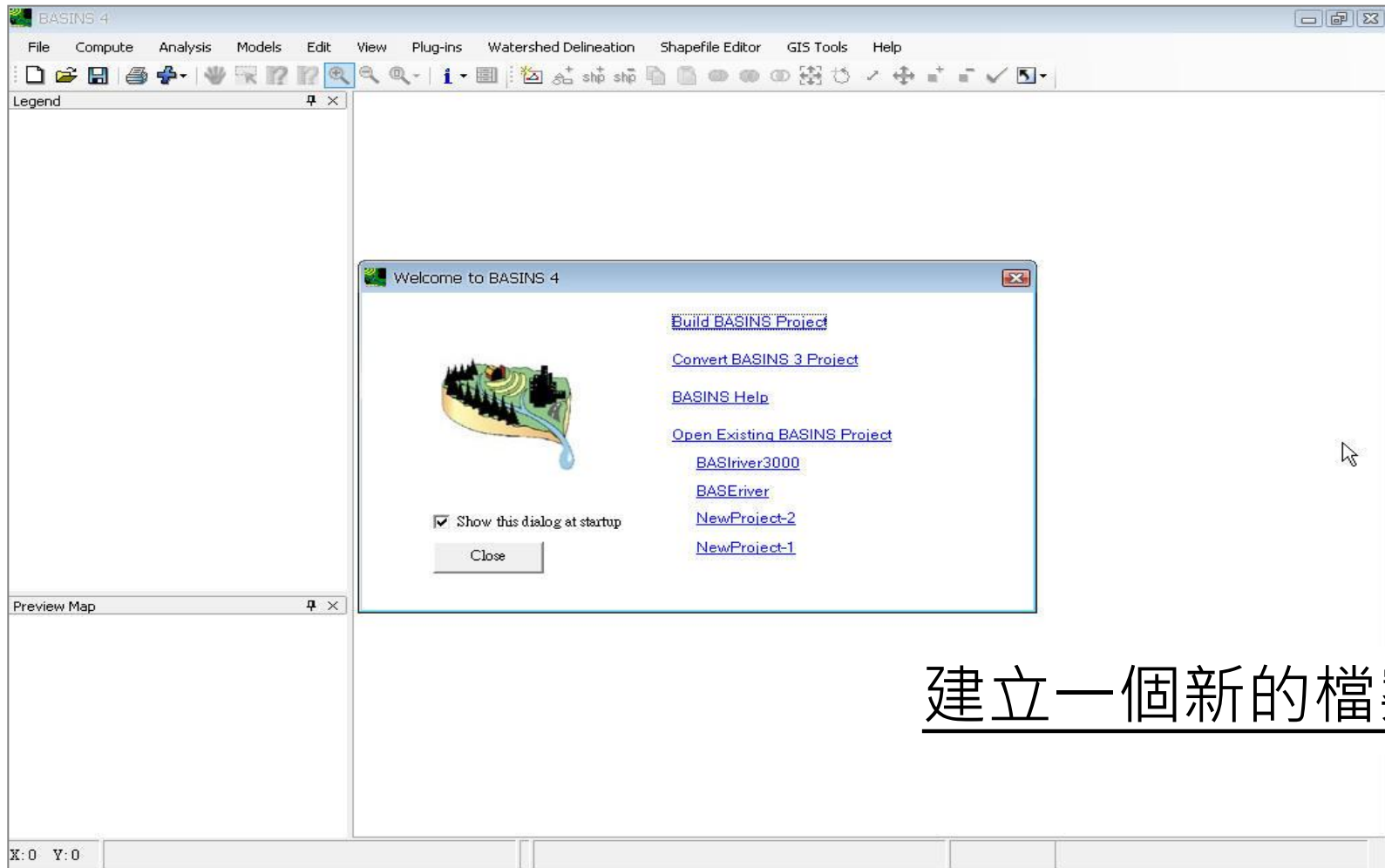
BASINS 4.0 執行流程概述

- 由主程式 ，載入各種GIS資料，如土地使用、邊界、高程圖等，再由要研究之集水區域實施研究區塊劃分，製作成 *.wsd 。
- 將各種氣象資料匯入 ，製作成 *.wdm 檔。
- 開啟 ，將*.wsd 及*.wdm 檔匯入，修改所需模擬目標之參數，並執行之。
- 在 ，將HSPF所執行之結果，予以圖表方式呈現，方便分析。

操作流程

40

Water Environment Research Center



建立一個新的檔案

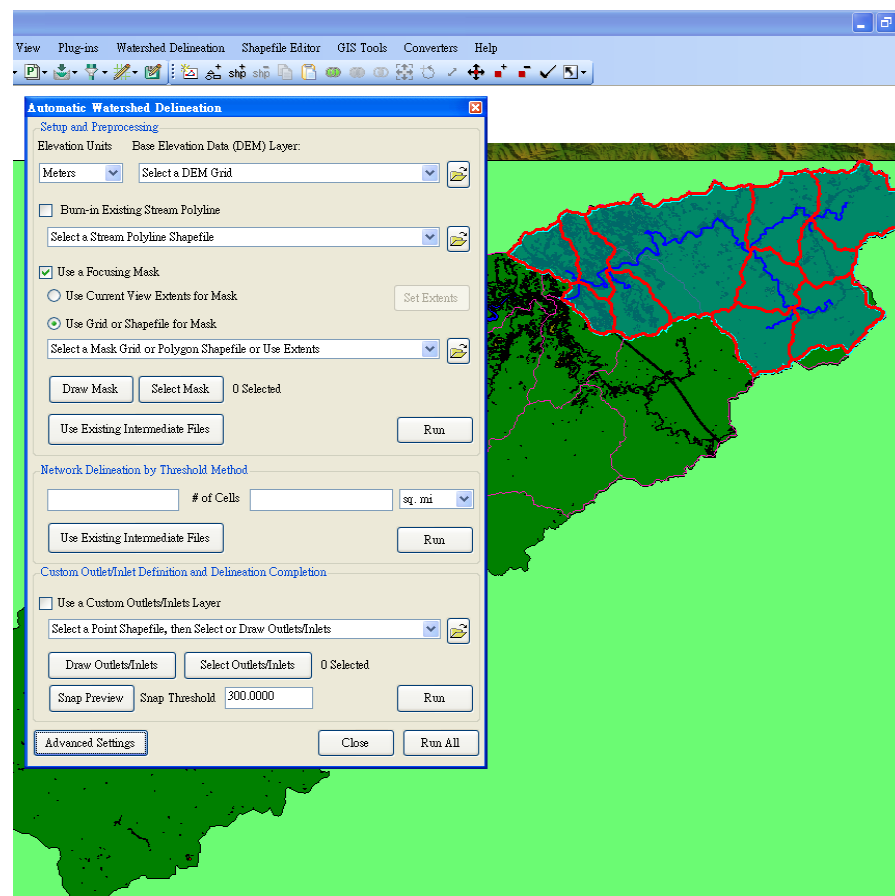
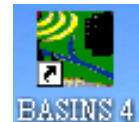
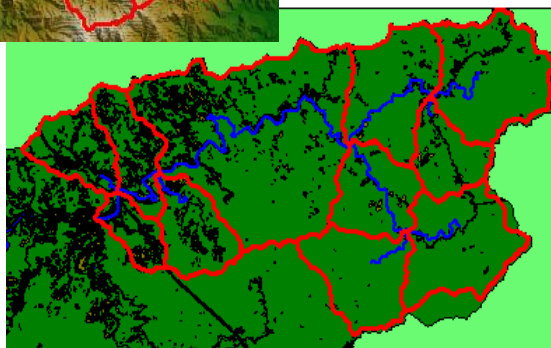
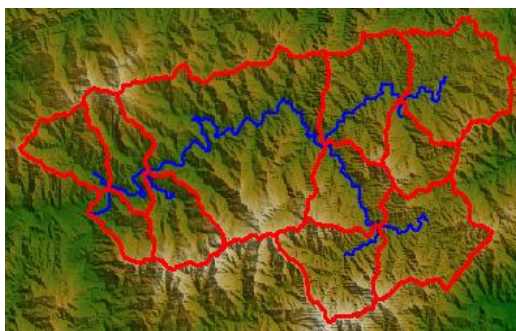
操作流程

41

Water Environment Research Center

圖層資料輸入

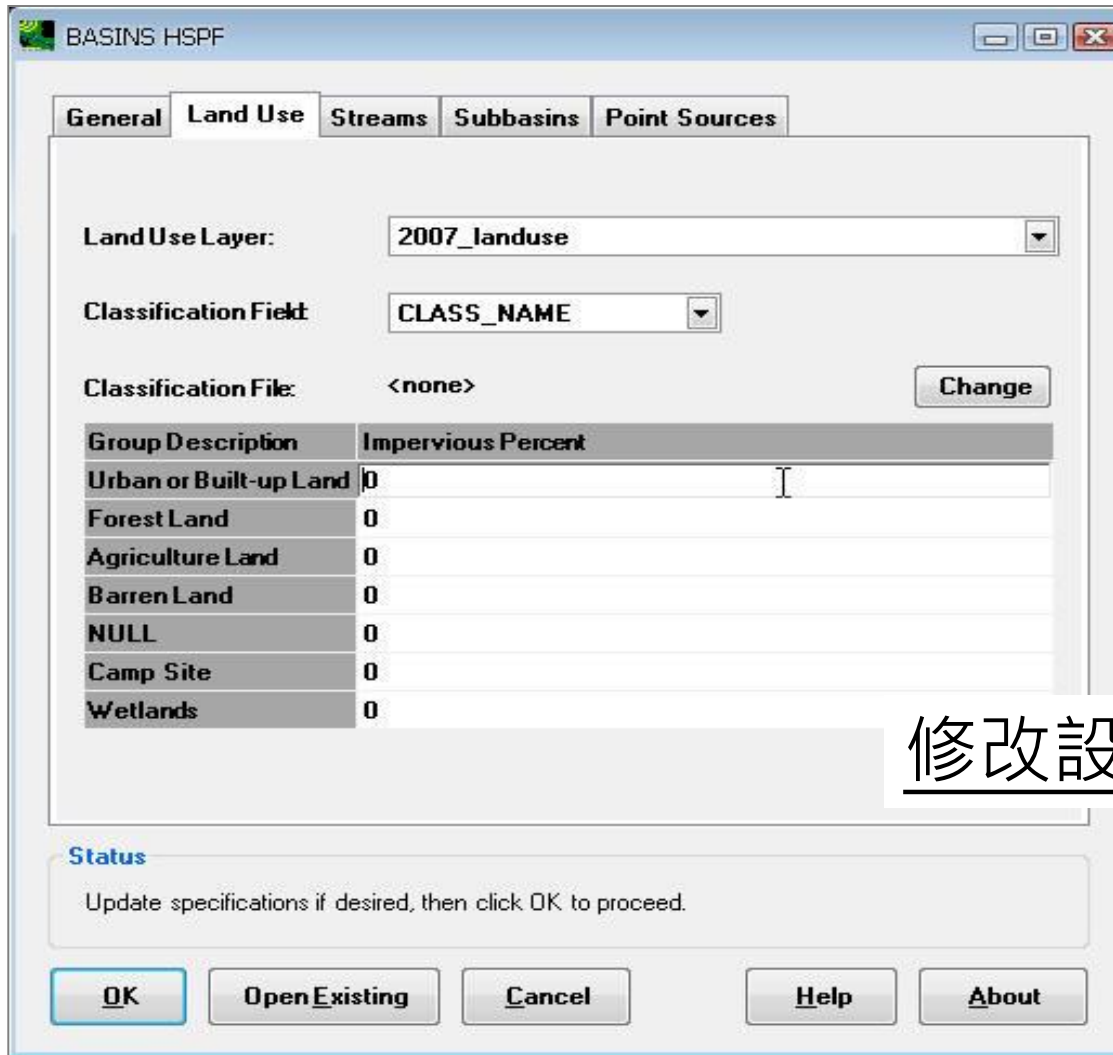
□ 土地利用、高程、邊界



操作流程

42

Water Environment Research Center



The image shows the 'BASINS HSPF' dialog box with the 'Land Use' tab selected. The 'Land Use Layer' is set to '2007_landuse' and the 'Classification Field' is 'CLASS_NAME'. The 'Classification File' is '<none>' with a 'Change' button. A table lists land use categories and their 'Impervious Percent' values, all currently set to 0. The 'Status' section at the bottom says 'Update specifications if desired, then click OK to proceed.' and there are buttons for 'OK', 'Open Existing', 'Cancel', 'Help', and 'About'.

BASINS HSPF

General Land Use Streams Subbasins Point Sources

Land Use Layer: 2007_landuse

Classification Field: CLASS_NAME

Classification File: <none> **Change**

Group Description	Impervious Percent
Urban or Built-up Land	0
Forest Land	0
Agriculture Land	0
Barren Land	0
NULL	0
Camp Site	0
Wetlands	0

Status

Update specifications if desired, then click OK to proceed.

OK **Open Existing** **Cancel** **Help** **About**



修改設定其透水率

操作流程

43

觀測資料輸入

氣象資料

- 降雨、蒸發、溫度、風速、日輻射、蒸發散潛勢、露點溫度、雲覆蓋量

流量資料

水質資料

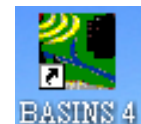
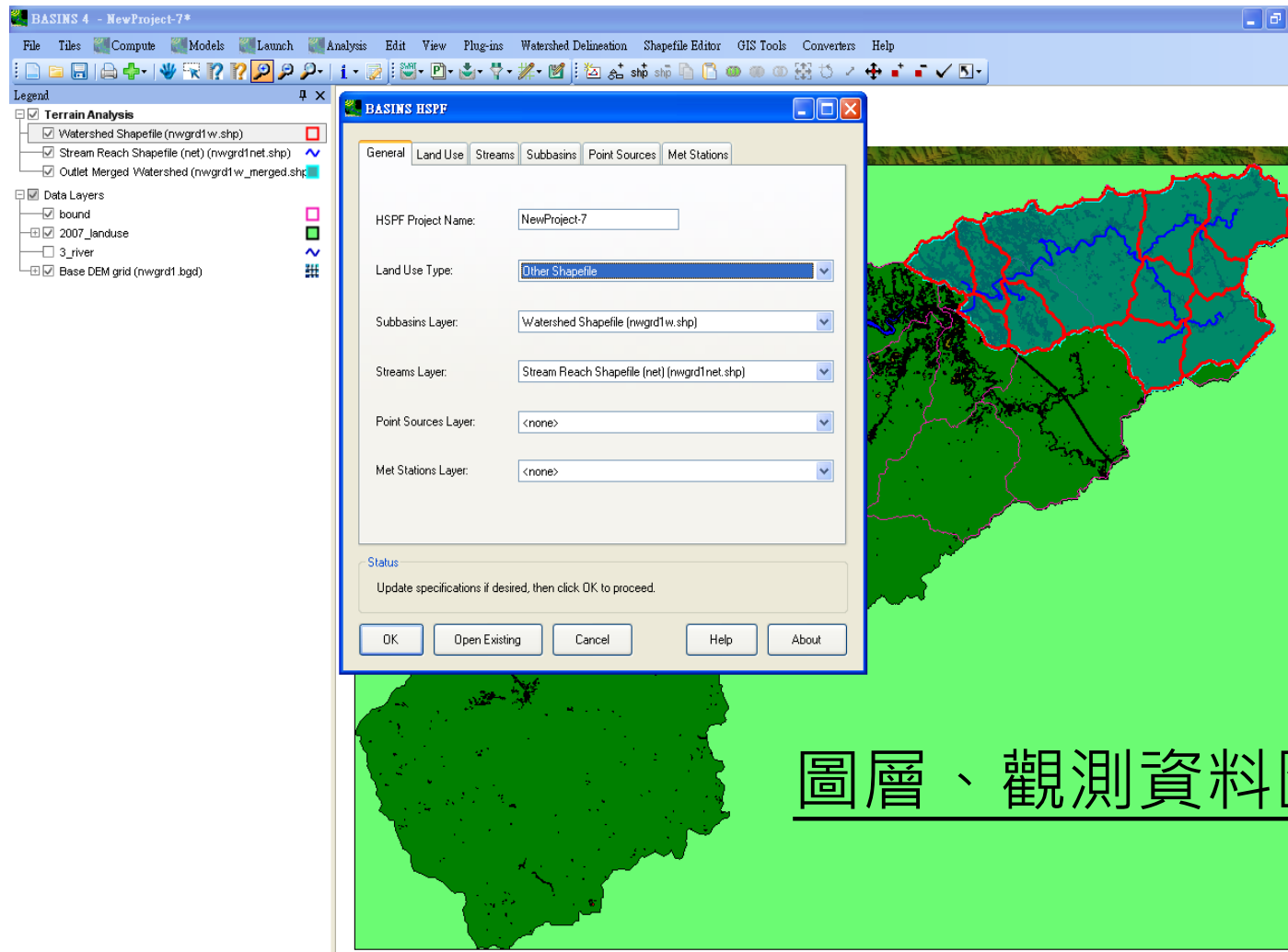
Line	DATE	TIME	DSN
1	OBSERVED		
2	peishin		
3	ATEM		
4	HOURLY ATEM		
5	DATE		
6	2007	01 01 00	63.68
7	2007	01 01 01	63.14
8	2007	01 01 02	62.78
9	2007	01 01 03	62.60
10	2007	01 01 04	61.34
11	2007	01 01 05	60.80
12	2007	01 01 06	59.90
13	2007	01 01 07	59.00
14	2007	01 01 08	60.08
15	2007	01 01 09	66.38
16	2007	01 01 10	70.88
17	2007	01 01 11	74.84
18	2007	01 01 12	76.28
19	2007	01 01 13	78.44
20	2007	01 01 14	78.08
21	2007	01 01 15	76.64
22	2007	01 01 16	72.14
23	2007	01 01 17	69.44
24	2007	01 01 18	67.64
25	2007	01 01 19	66.74
26	2007	01 01 20	66.20
27	2007	01 01 21	65.48
28	2007	01 01 22	64.58
29	2007	01 01 23	63.50
30	2007	01 02 00	62.78
31	2007	01 02 01	63.50
32	2007	01 02 02	63.68
33	2007	01 02 03	64.04
34	2007	01 02 04	63.68
35	2007	01 02 05	64.04
36	2007	01 02 06	64.94
37	2007	01 02 07	66.38
38	2007	01 02 08	66.74
39	2007	01 02 09	67.28
40	2007	01 02 10	68.54
41	2007	01 02 11	68.18
42	2007	01 02 12	68.90
43	2007	01 02 13	69.98
44	2007	01 02 14	71.24
45	2007	01 02 15	69.98
46	2007	01 02 16	68.54
47	2007	01 02 17	68.18
48	2007	01 02 18	67.64
49	2007	01 02 19	67.64



操作流程

44

Water Environment Research Center



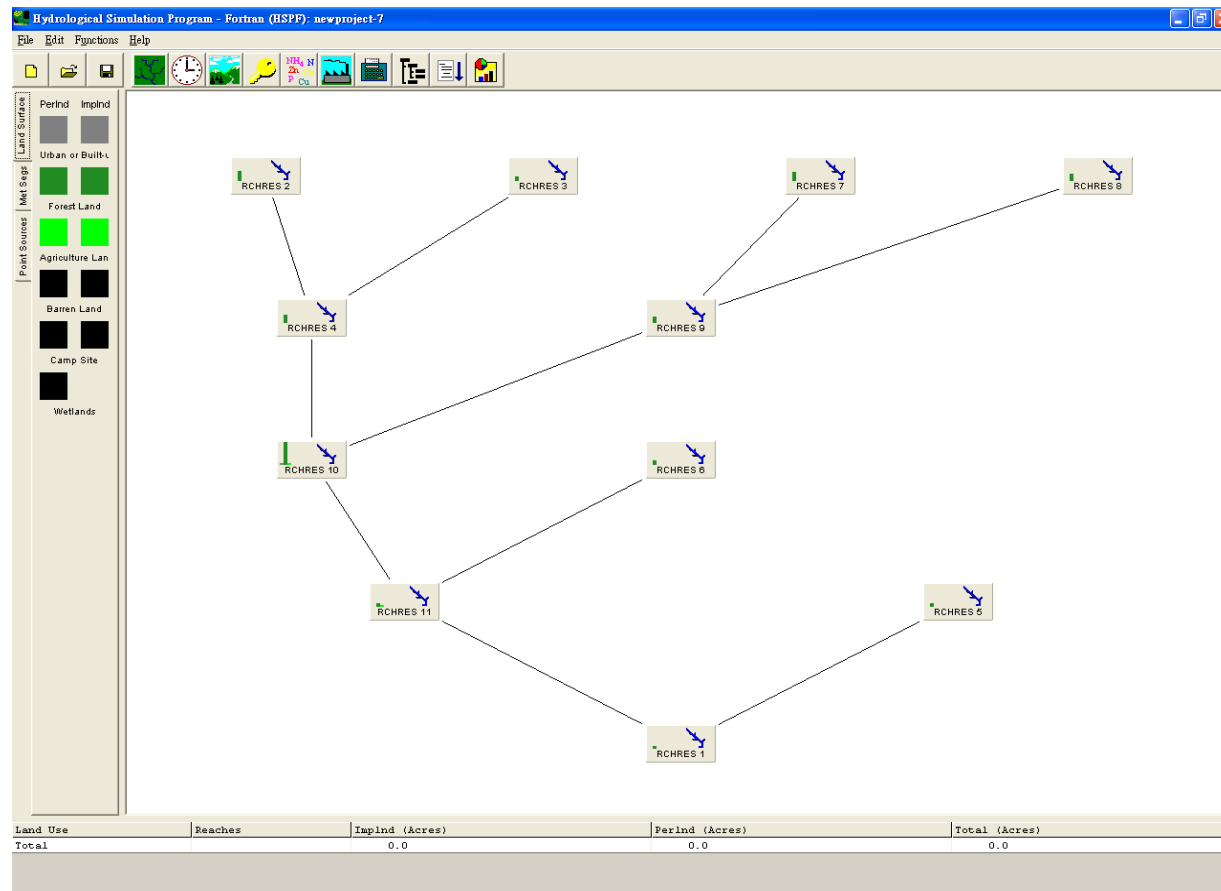
圖層、觀測資料匯入HSPF

操作流程

45

Water Environment Research Center

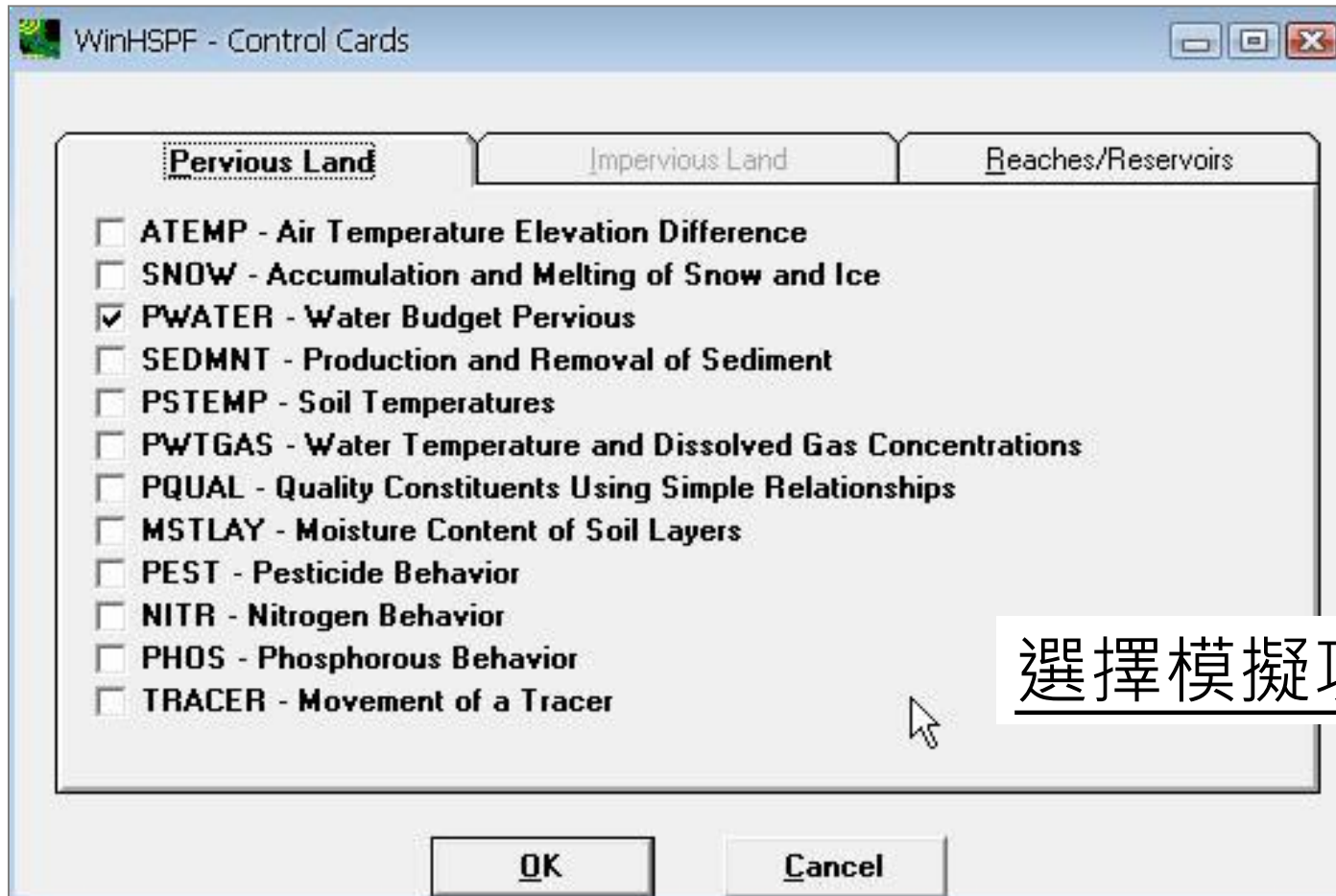
執行WinHSPF



操作流程

46

Water Environment Research Center

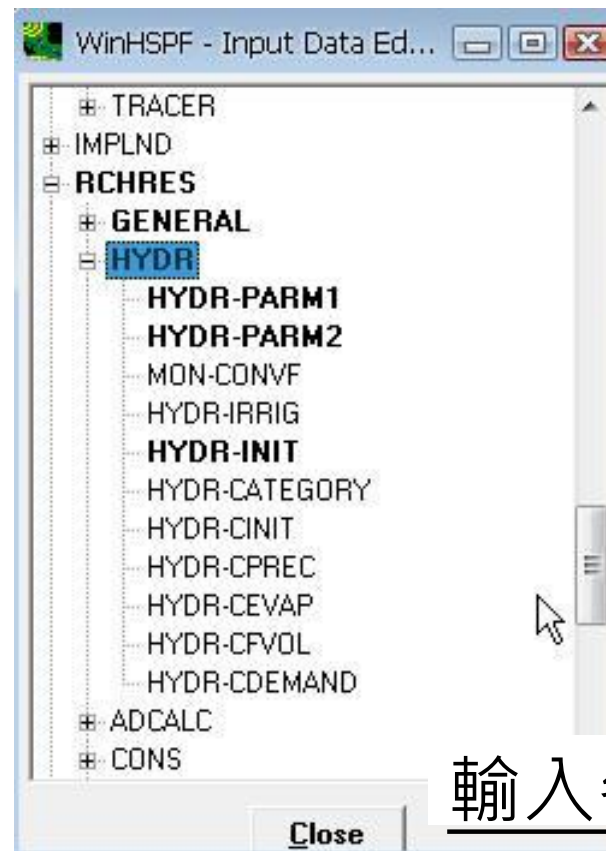
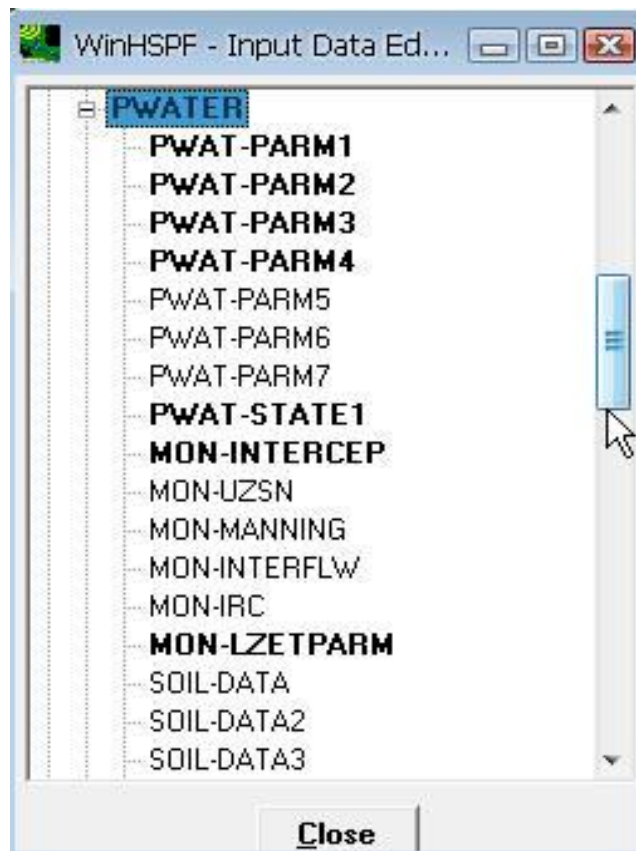


選擇模擬項目

操作流程

47

Water Environment Research Center



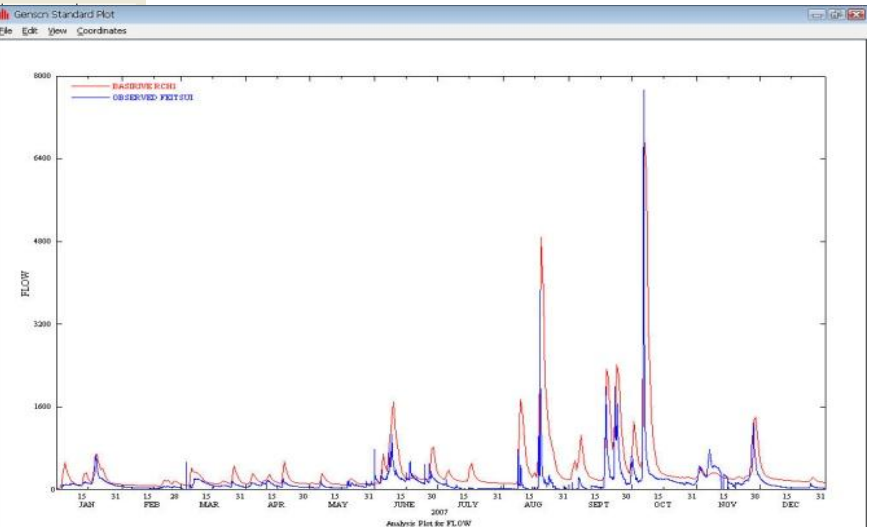
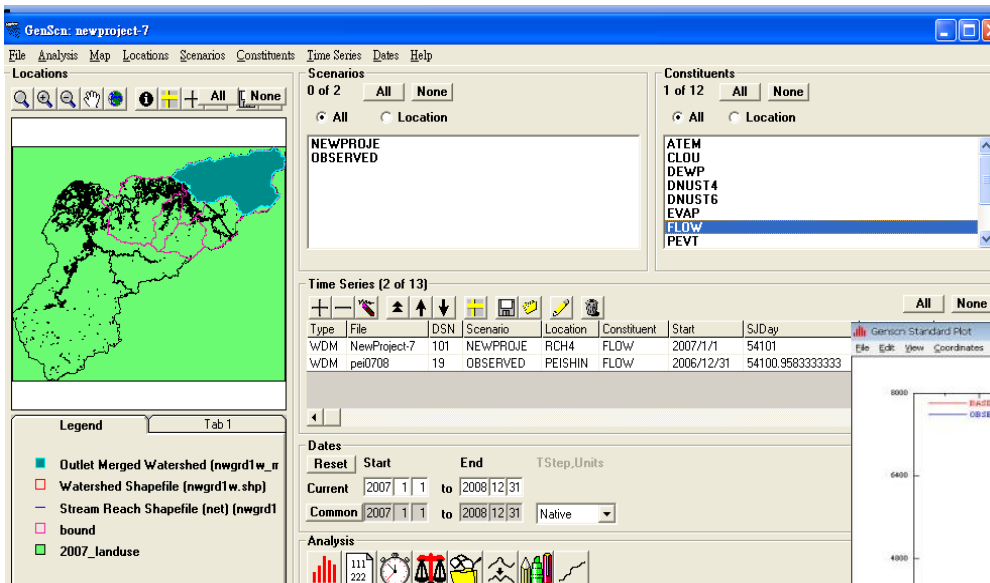
輸入參數

操作流程

48

Water Environment Research Center

圖示&統計分析



簡報結束
謝謝聆聽

資料編輯

50

名稱	說明	ID/DNS
PREC	降雨量	11
EVAP	蒸發量	12
ATEM	溫度	13
WIND	風速	14
SOLR	輻射	15
PEVT	蒸發散潛勢	16
DEWP	露點溫度	17
CLOU	雲覆蓋量	18