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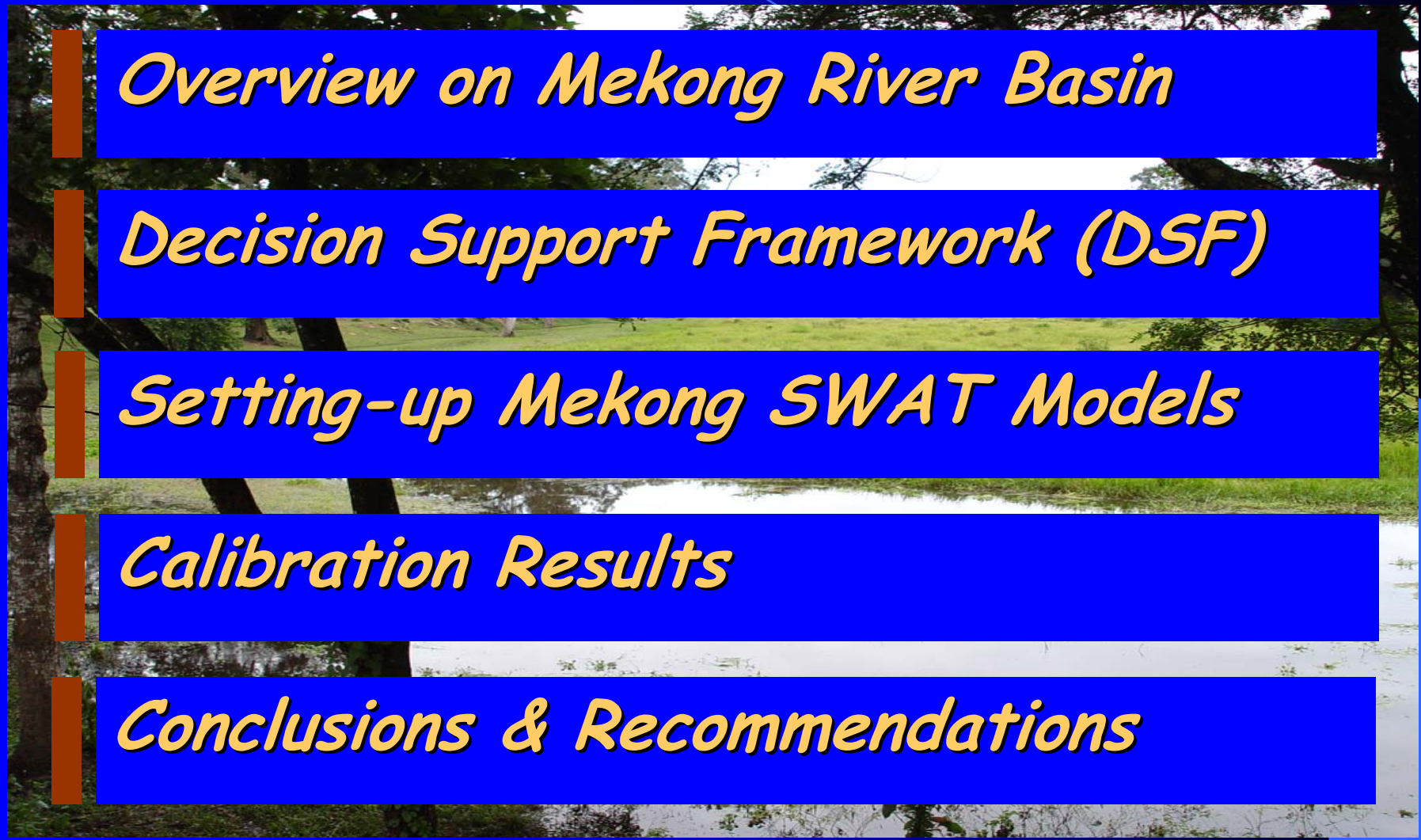
Application of SWAT Model to The MRC DSF

Le Duc Trung
Kittipong Jirayoot
Mekong River Commission Secretariat
Vientiane, Lao PDR

Topics

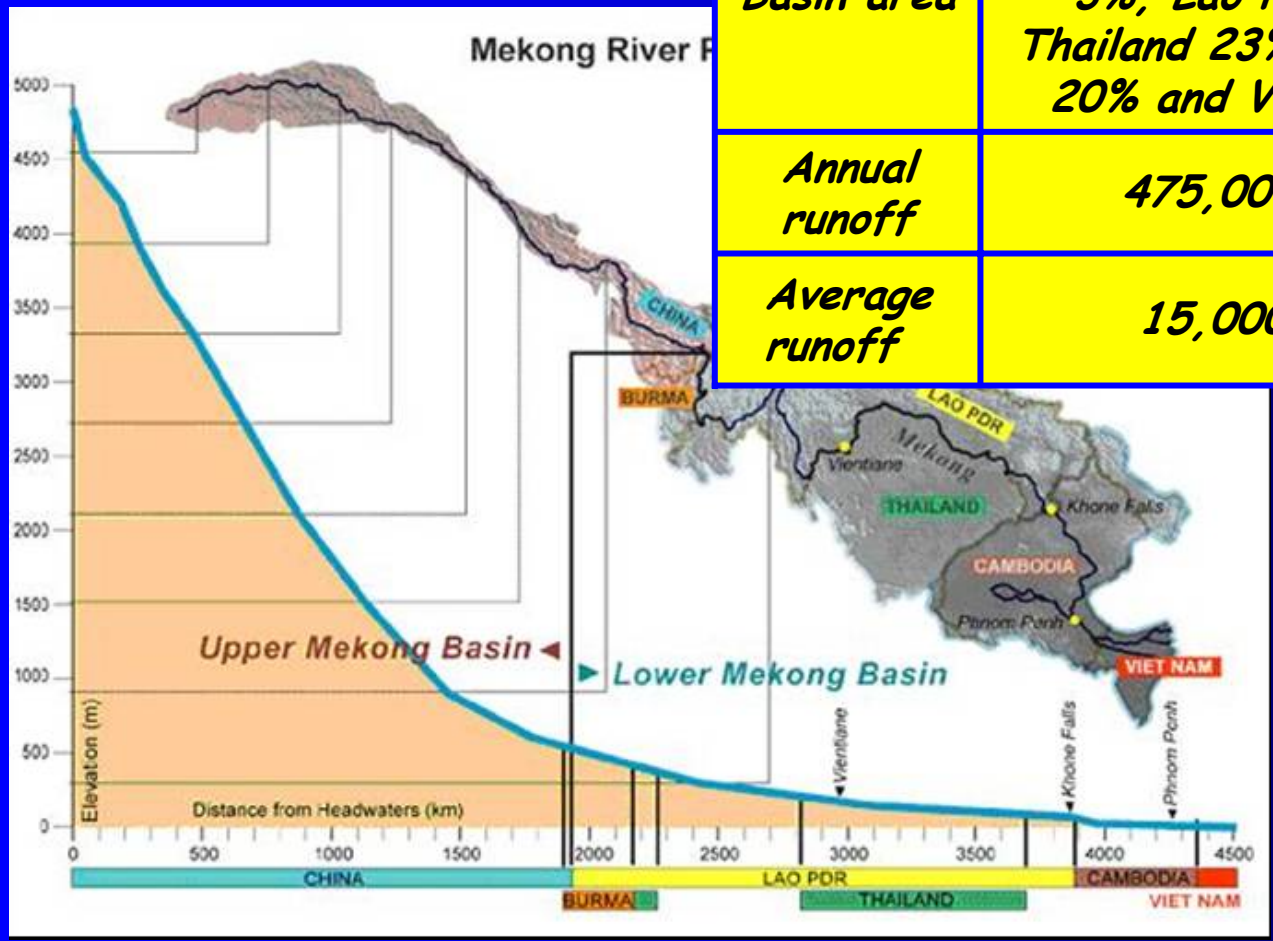


- Overview on Mekong River Basin
- Decision Support Framework (DSF)
- Setting-up Mekong SWAT Models
- Calibration Results
- Conclusions & Recommendations

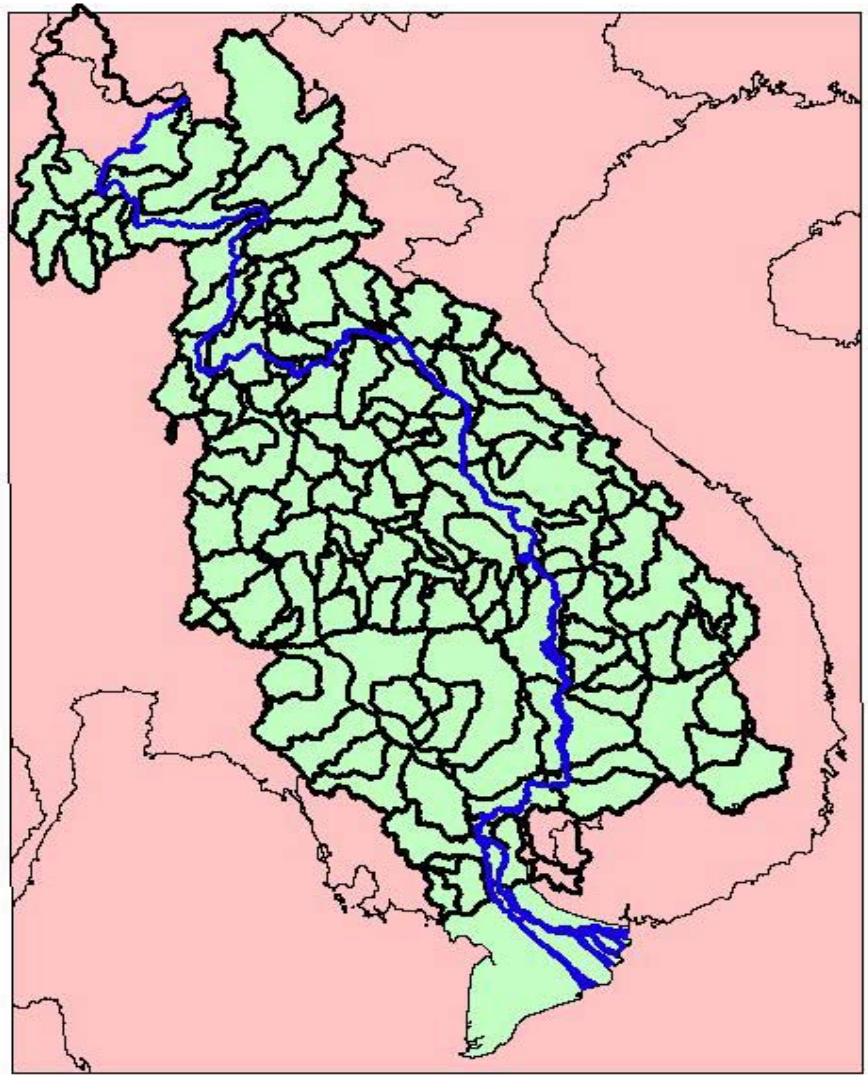
Overview on Mekong River Basin

Mekong River Basin

Item	Description	Rank
Length	4,800 km	12
Basin area	795,000 km² (China 21%, Myanmar 3%, Lao PDR 25%, Thailand 23%, Cambodia 20% and Vietnam 8%	21
Annual runoff	475,000 MCM	8
Average runoff	15,000 m³/s	8



Lower Mekong River Basin



Area ≈ 620,000 km²

River Length ≈ 2,700 km

(China Border to Sea)

- ***Basin Development Plan***
- ***Water Utilization Programme***
- ***Environment Programme***
- ***& Sectoral Programmes***


Decision Support
Framework (DSF)
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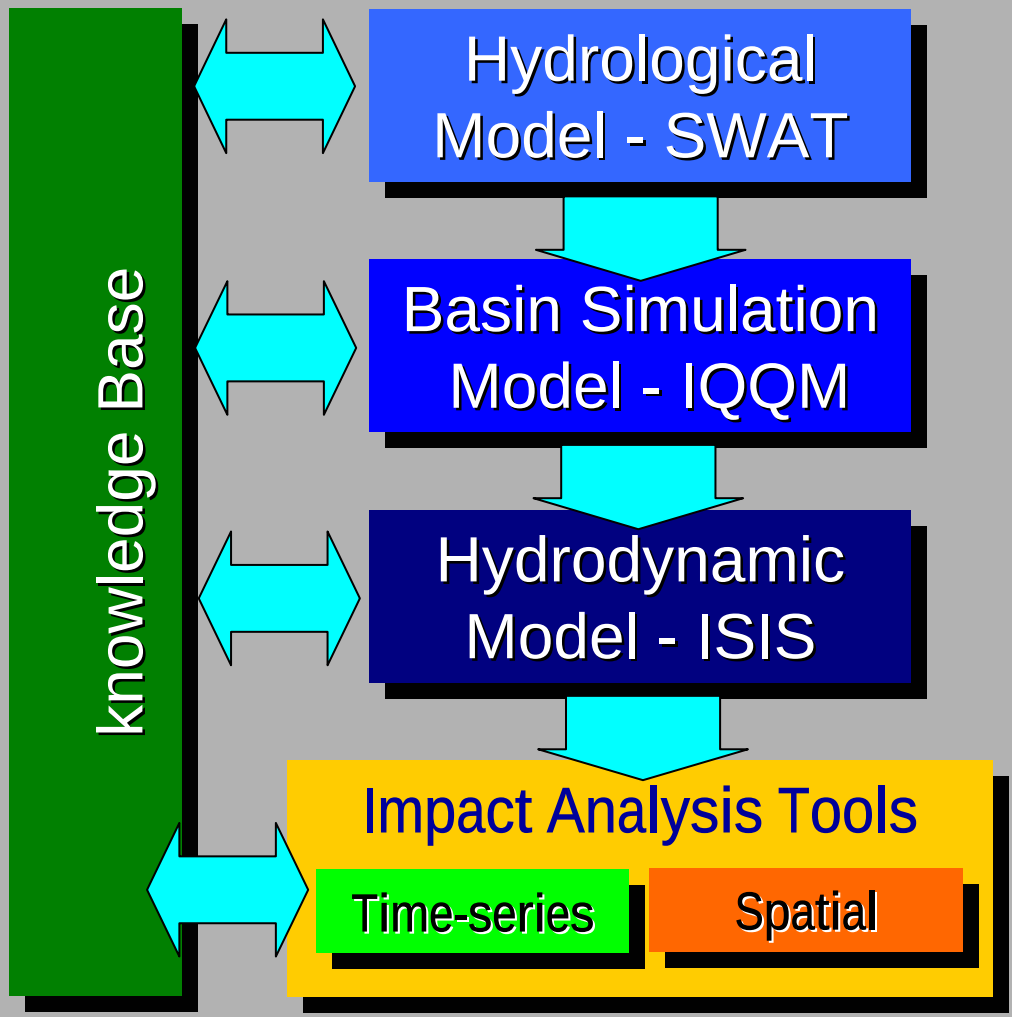
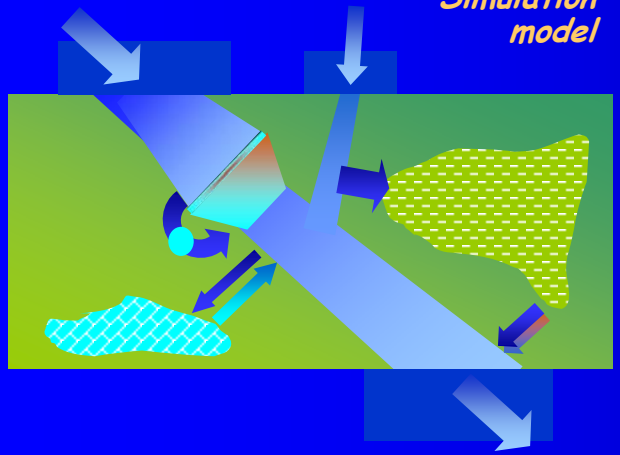
Decision Support Framework



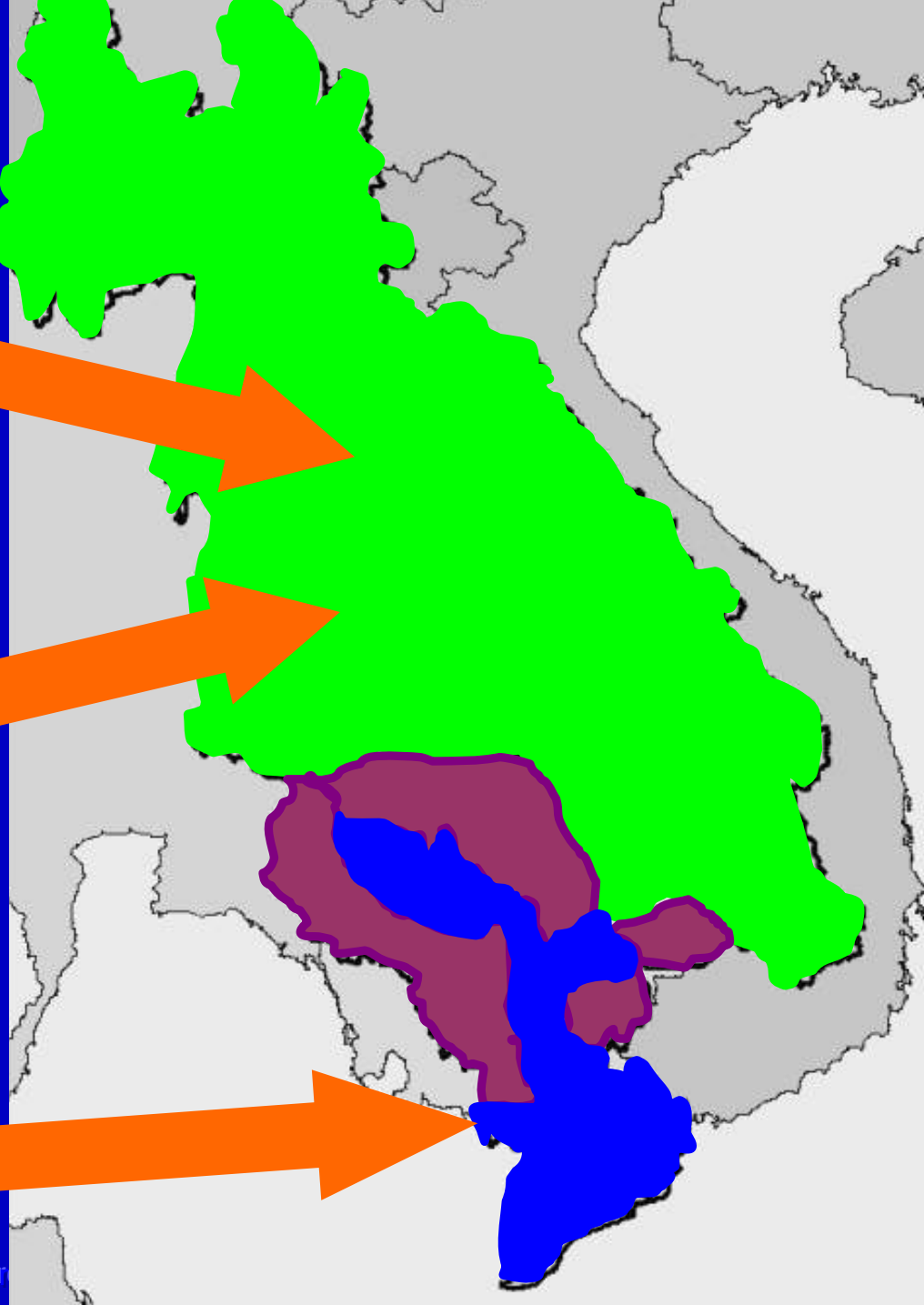
Scope of DSF

Hydrological Model SWAT

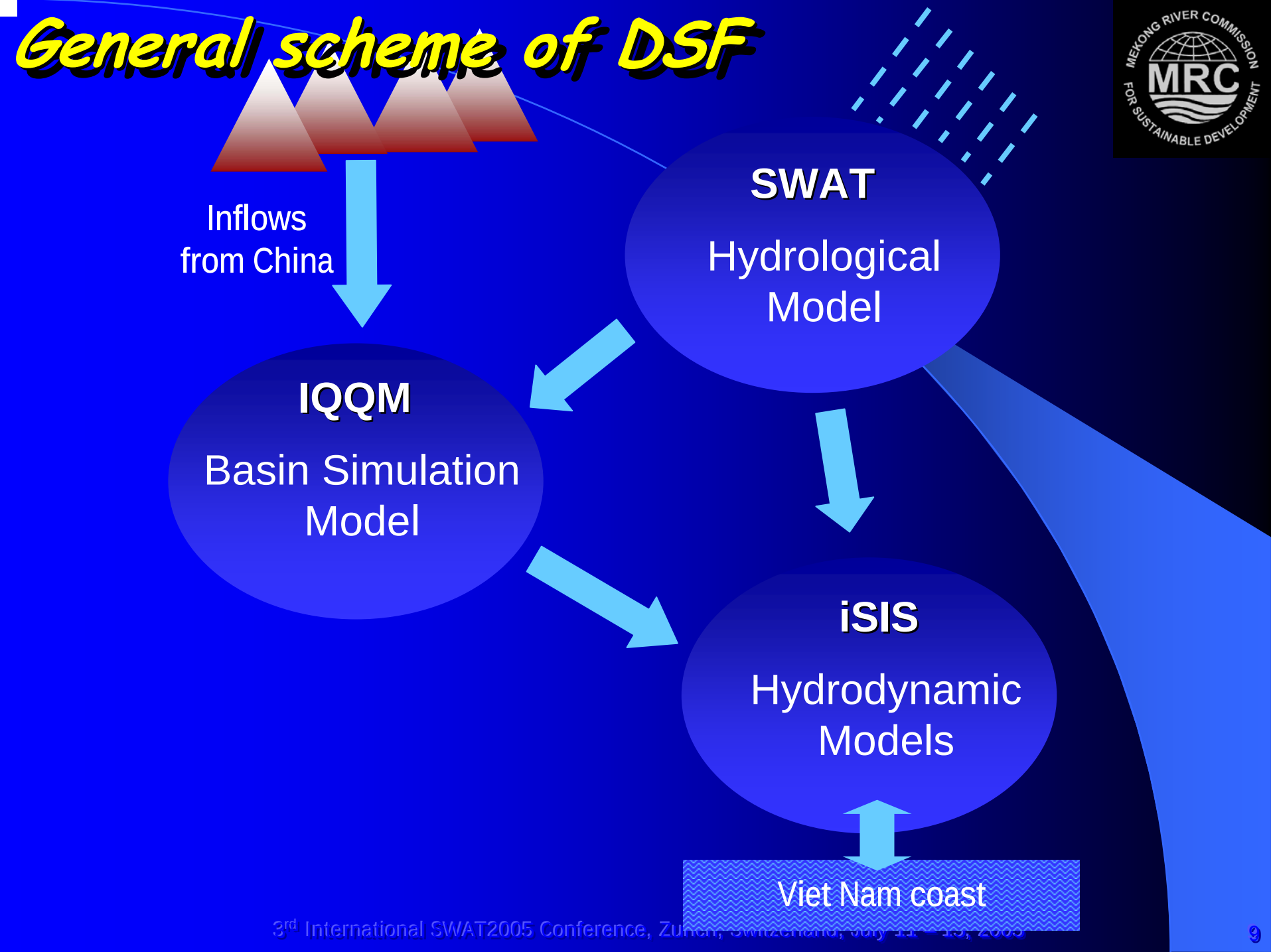
Simulation model



Hydrodynamic model



General scheme of DSF



Impact Analysis Tools

Spatial data

Administrative, Physical and Planning

- Administrative boundaries (national)
- Administrative boundaries (provincial)
- Administrative boundaries (district/village)
- Cities of the LMB
- Industrial growth areas
- Road network of LMB
- River network
- Hydromet Network
- Dam and reservoir data
- BDP Sub-Areas
- Sub-basin schematisation for SWAT/IQQM
- Planning Units within iSIS area
- ISIS regional model schematisation
- ISIS detailed model schematisation
- Networks for fish migration
- Networks for navigation

Topography

- Digital Elevation Models
- River cross-section data in IQQM area
- River cross-section data in iSIS area

Socio-Economic/Demographic

- Population - totals
- Population - other parameters
- Agricultural impact data
- Social impact data

Land Resources and Imagery

- Forest cover 1993 and 1997
- Land Cover/Land Use Map
- MRC Soil Map
- Satellite imagery 1999-2000
- Satellite imagery 2001
- Flooded area maps

Environment and Fisheries

- Sensitive habitat areas
- Fish migration routes
- Freshwater aquaculture
- Brackish water aquaculture

Agriculture and Irrigation

- Crop areas, patterns, calendars

Consumptive Demands

- MRC Irrigation Database
- Soil moisture capacities
- Consumptive use crop factors
- Irrigation efficiencies
- Urban water demands per capita
- Urban water demands
- Other consumptive demands
- Consumptive factors for “other” demands

In-stream Demands

- Navigation requirements
- Fish migration requirements
- Ecological requirements
- Dilution requirements

Time-series data

Climate

- Selected station daily climatic data, 1985-2001
- Sub-basin daily climatic data, 1985-2001
- Climate change scenario data

Rainfall

- Selected station daily rainfall data, 1985-2001
- Sub-basin daily rainfall data, 1985-2001

Gauged Flow

- Selected station daily gauged flow data, 1985-2001

Tidal and River Levels

- Observed flood levels and flows in Delta for 2000 and 2001
- Tidal levels for 1998-2001
- Tidal levels for 1985-2001

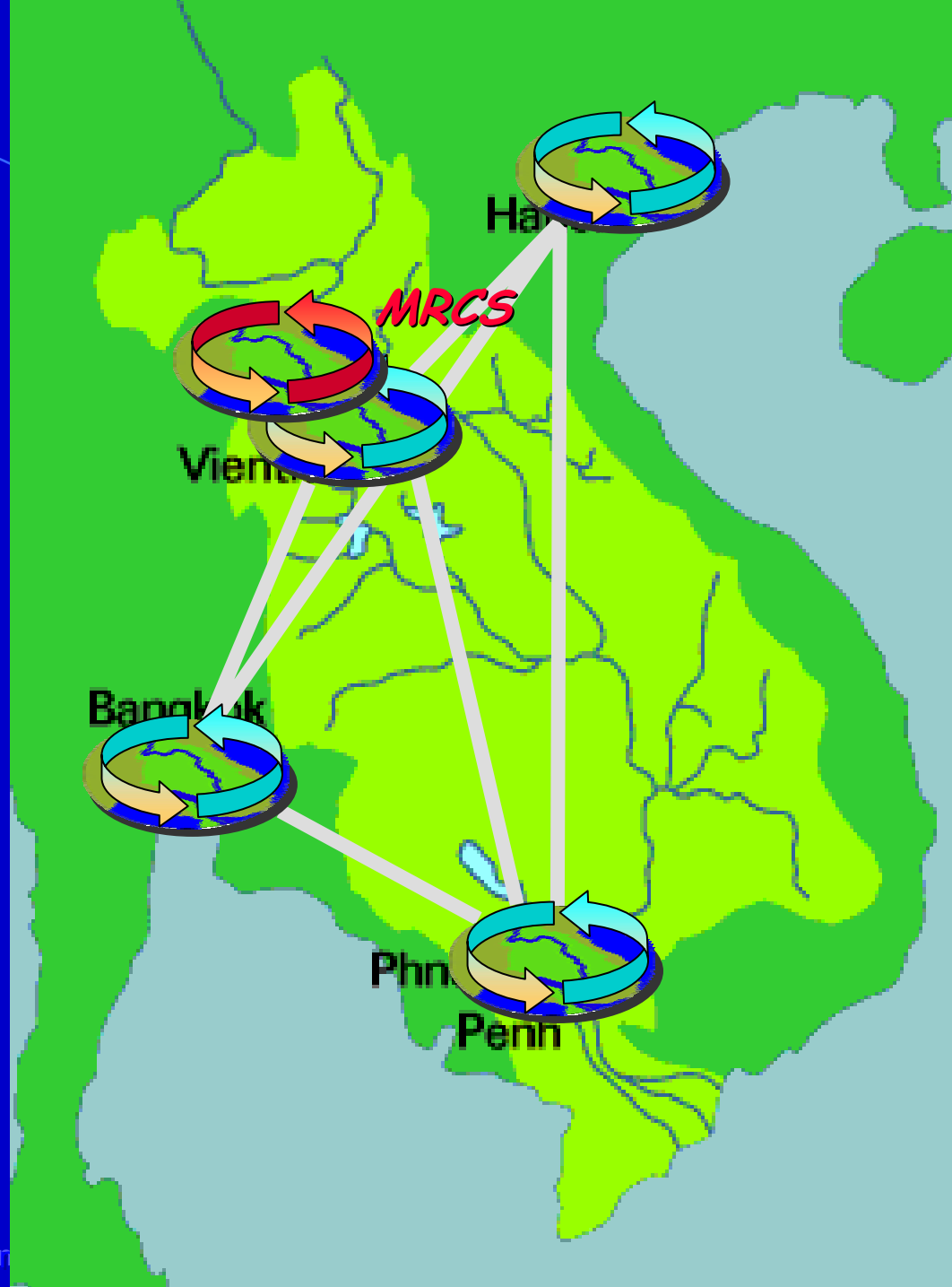
Salinity Levels

- Salinity levels for 1998 dry season
- Salinity levels for 1985-2001

Consumptive Demands

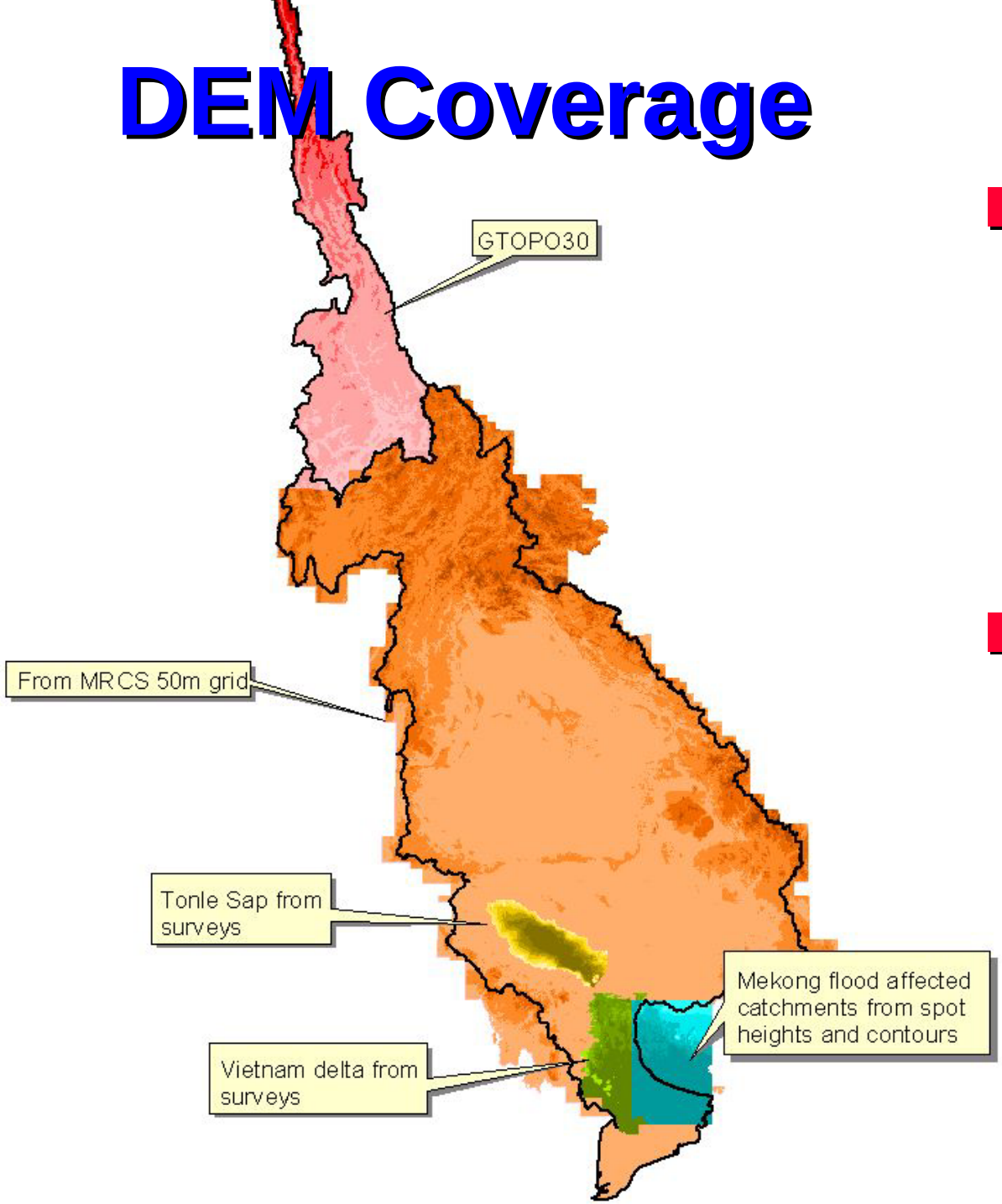
- Daily irrigation demands, 1985-2001
- Daily urban demands, 1985-2001
- Daily other consumptive demands, 1985-2001

- The **Decision Support Framework** is being set up in each country with a **Master Copy** held at the MRCS



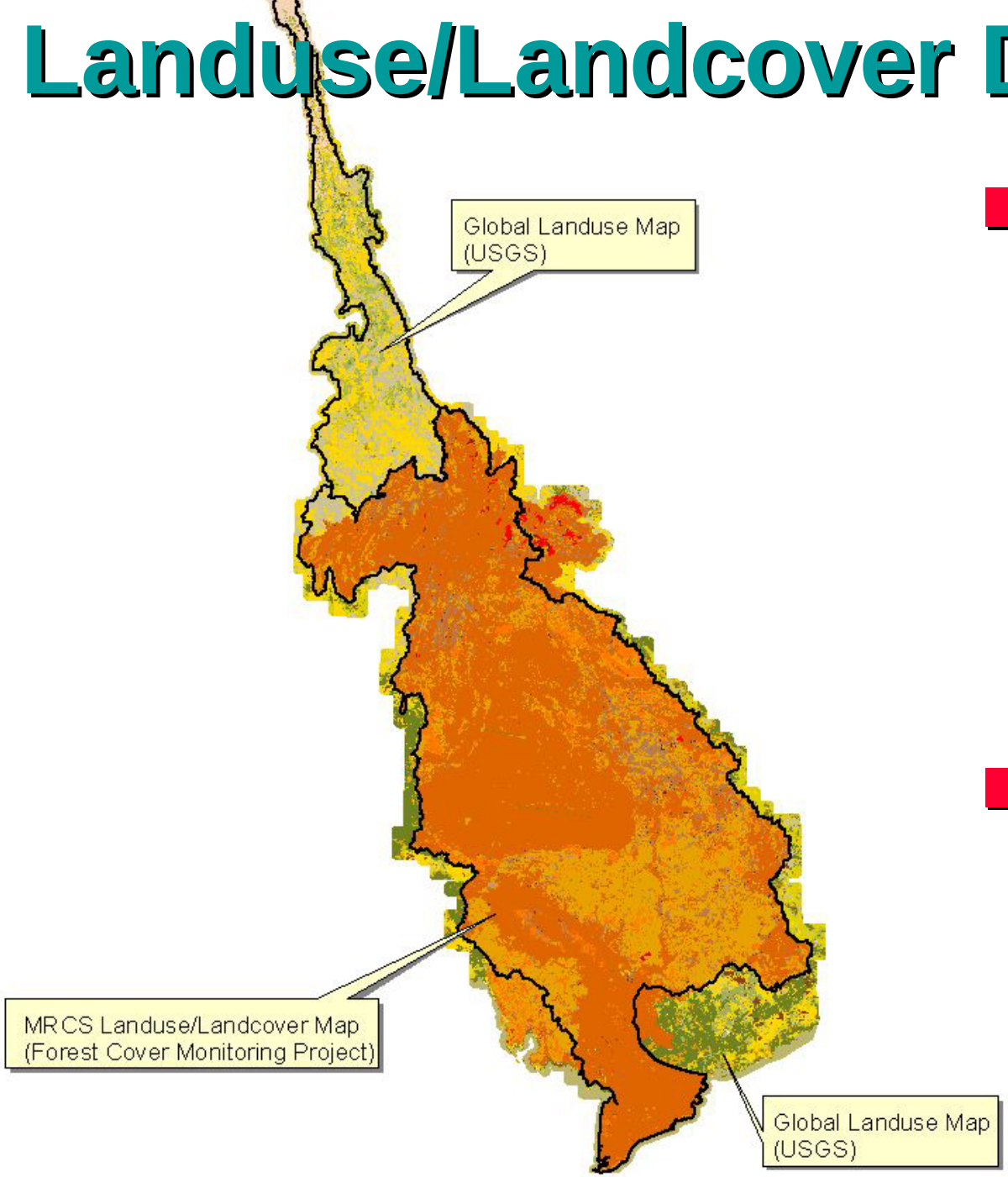
Setting-up Mekong SWAT Models

DEM Coverage



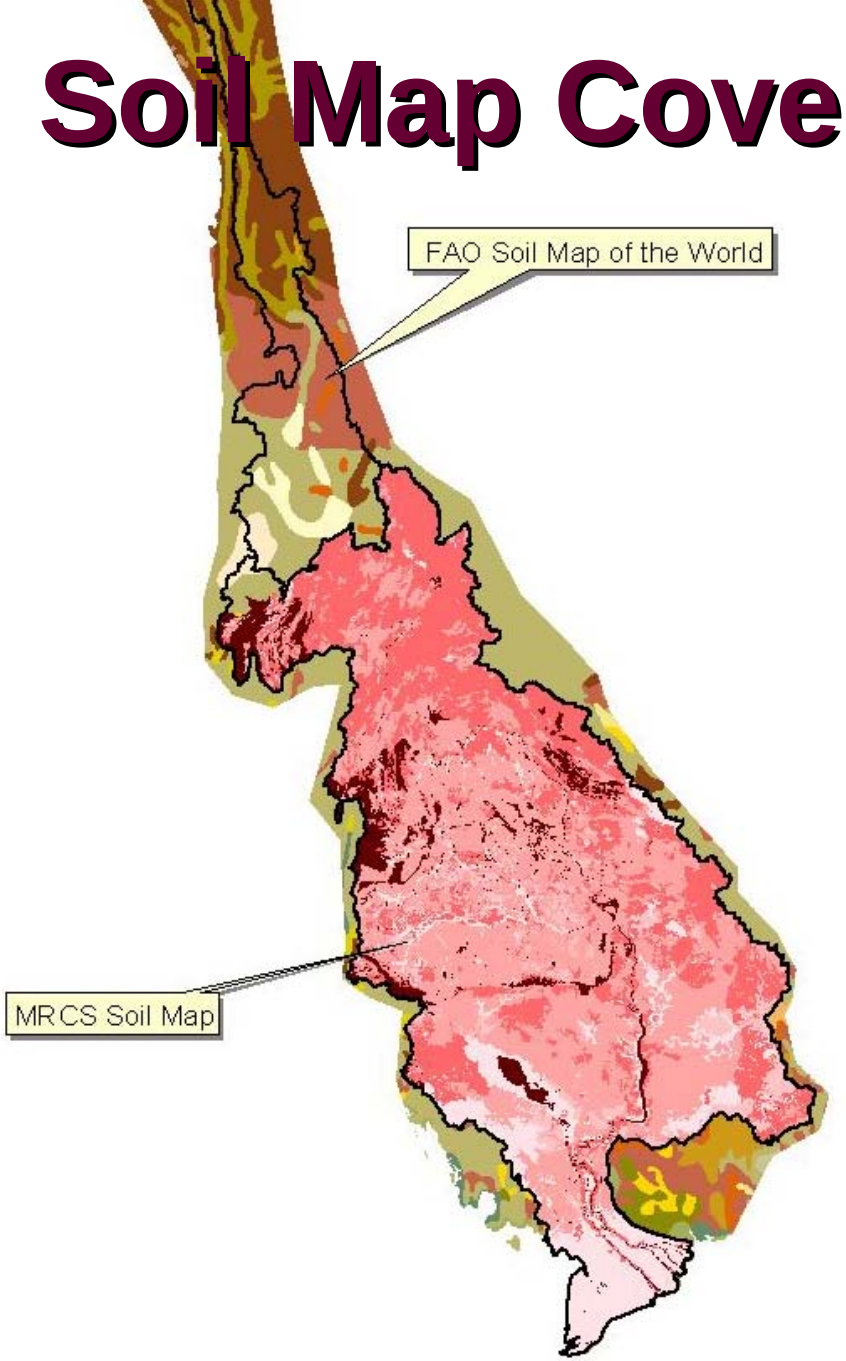
- MRCS 50m grid DEM with 1 m vertical resolution was re-sampled onto a 250m grid
- Coverage for catchments in the Mekong flood plain, DEM was derived from spot levels and contours

Landuse/Landcover Data



- The map derived from interpretation of satellite images for 1993 and 1997 under the Forest Cover Monitoring Project
- The combined map was reclassified into appropriate SWAT land cover classification

Soil Map Coverage

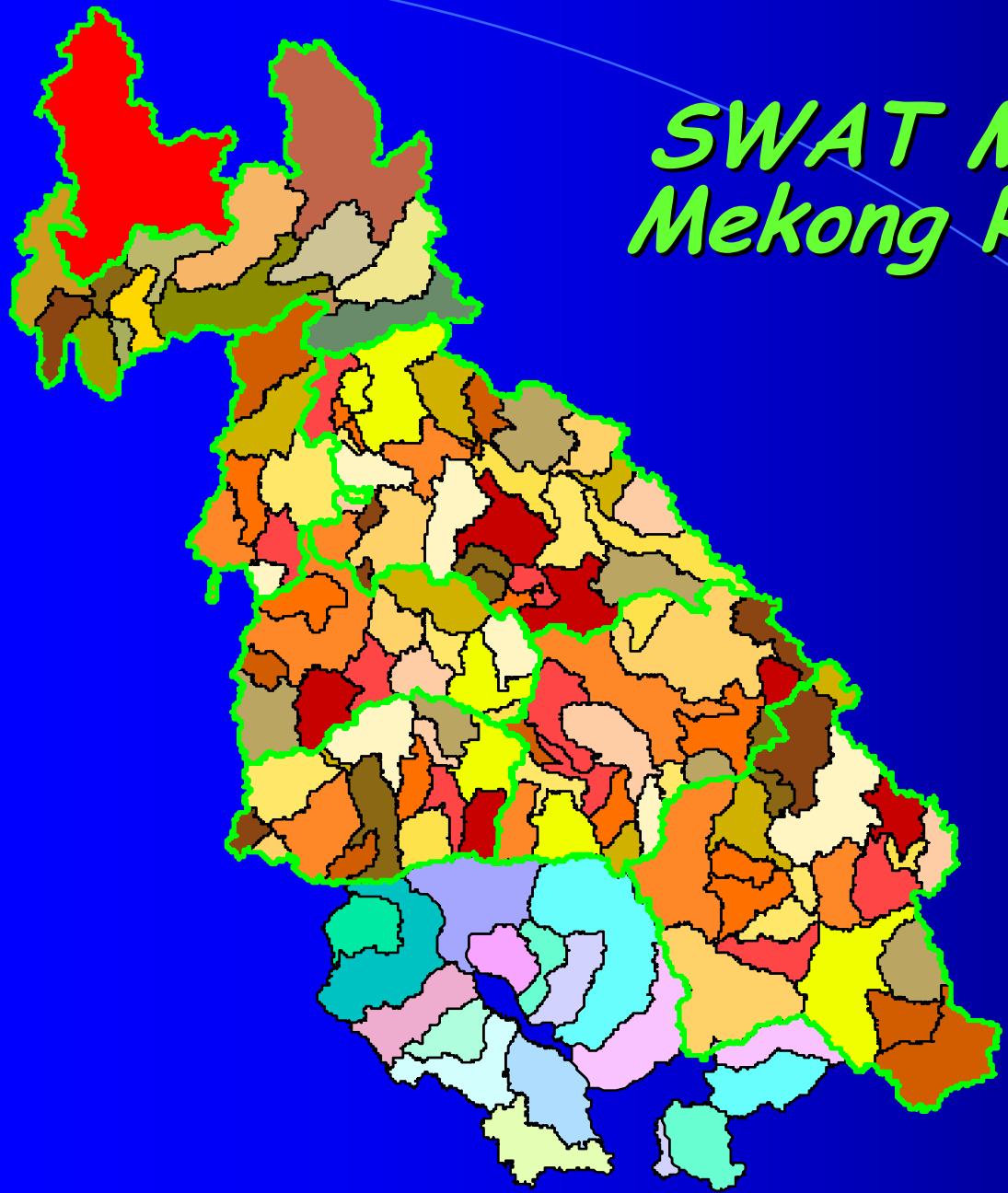


- *Soil Map available at the Mekong River Commission*
- *The Global Soils Database (USDA, FAO, ISRIC) was used*
- *Additional coverage was taken from the FAO Soil Map of the World*

Input Data

- Daily climatic data (from 38 hydro-met stations with spatially sparse distribution) was prepared for SWAT modeling and where necessary, supplemented with monthly records and long term monthly averages from FAO CLIMWAT
- Daily rainfall data from 358 stations was used
- Daily flow data (from 101 stations of a sparse and incomplete gauging network) is checked and prepared for SWAT modeling, and where necessary, infilled for period of 1985-1999

SWAT Models for Mekong River Basin



Total of 138 sub-basins (average sub-basin area as large as 4,000 km²) has been delineated with the coverage area of about 600,000 km²


Calibration Results
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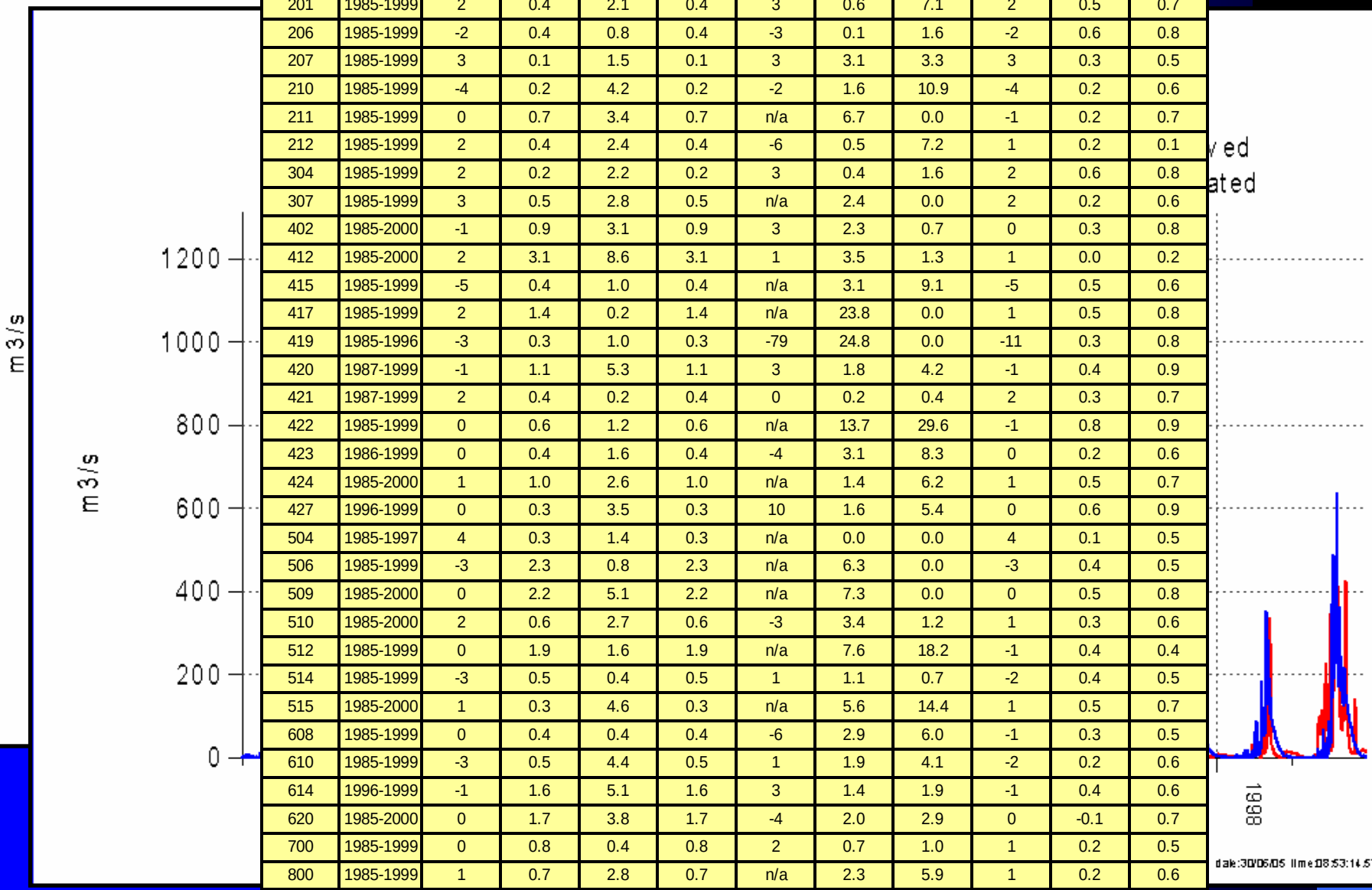
Calibration Result for Subbasin 304

SWAT sub-basin	Period	High flows				Low flows			Overall		
		Vr (%)	FDC Error at Q%			Vr (%)	FDC Error at Q%		Vr (%)	Nash-Sutcliffe (CE)	
			5	25	50		75	95		Daily	Monthly
201	1985-1999	2	0.4	2.1	0.4	3	0.6	7.1	2	0.5	0.7
206	1985-1999	-2	0.4	0.8	0.4	-3	0.1	1.6	-2	0.6	0.8
207	1985-1999	3	0.1	1.5	0.1	3	3.1	3.3	3	0.3	0.5
210	1985-1999	-4	0.2	4.2	0.2	-2	1.6	10.9	-4	0.2	0.6
211	1985-1999	0	0.7	3.4	0.7	n/a	6.7	0.0	-1	0.2	0.7
212	1985-1999	2	0.4	2.4	0.4	-6	0.5	7.2	1	0.2	0.1
304	1985-1999	2	0.2	2.2	0.2	3	0.4	1.6	2	0.6	0.8
307	1985-1999	3	0.5	2.8	0.5	n/a	2.4	0.0	2	0.2	0.6
402	1985-2000	-1	0.9	3.1	0.9	3	2.3	0.7	0	0.3	0.8
412	1985-2000	2	3.1	8.6	3.1	1	3.5	1.3	1	0.0	0.2
415	1985-1999	-5	0.4	1.0	0.4	n/a	3.1	9.1	-5	0.5	0.6
417	1985-1999	2	1.4	0.2	1.4	n/a	23.8	0.0	1	0.5	0.8
419	1985-1996	-3	0.3	1.0	0.3	-79	24.8	0.0	-11	0.3	0.8
420	1987-1999	-1	1.1	5.3	1.1	3	1.8	4.2	-1	0.4	0.9
421	1987-1999	2	0.4	0.2	0.4	0	0.2	0.4	2	0.3	0.7
422	1985-1999	0	0.6	1.2	0.6	n/a	13.7	29.6	-1	0.8	0.9
423	1986-1999	0	0.4	1.6	0.4	-4	3.1	8.3	0	0.2	0.6
424	1985-2000	1	1.0	2.6	1.0	n/a	1.4	6.2	1	0.5	0.7
427	1996-1999	0	0.3	3.5	0.3	10	1.6	5.4	0	0.6	0.9
504	1985-1997	4	0.3	1.4	0.3	n/a	0.0	0.0	4	0.1	0.5
506	1985-1999	-3	2.3	0.8	2.3	n/a	6.3	0.0	-3	0.4	0.5
509	1985-2000	0	2.2	5.1	2.2	n/a	7.3	0.0	0	0.5	0.8
510	1985-2000	2	0.6	2.7	0.6	-3	3.4	1.2	1	0.3	0.6
512	1985-1999	0	1.9	1.6	1.9	n/a	7.6	18.2	-1	0.4	0.4
514	1985-1999	-3	0.5	0.4	0.5	1	1.1	0.7	-2	0.4	0.5
515	1985-2000	1	0.3	4.6	0.3	n/a	5.6	14.4	1	0.5	0.7
608	1985-1999	0	0.4	0.4	0.4	-6	2.9	6.0	-1	0.3	0.5
610	1985-1999	-3	0.5	4.4	0.5	1	1.9	4.1	-2	0.2	0.6
614	1996-1999	-1	1.6	5.1	1.6	3	1.4	1.9	-1	0.4	0.6
620	1985-2000	0	1.7	3.8	1.7	-4	2.0	2.9	0	-0.1	0.7
700	1985-1999	0	0.8	0.4	0.8	2	0.7	1.0	1	0.2	0.5
800	1985-1999	1	0.7	2.8	0.7	n/a	2.3	5.9	1	0.2	0.6



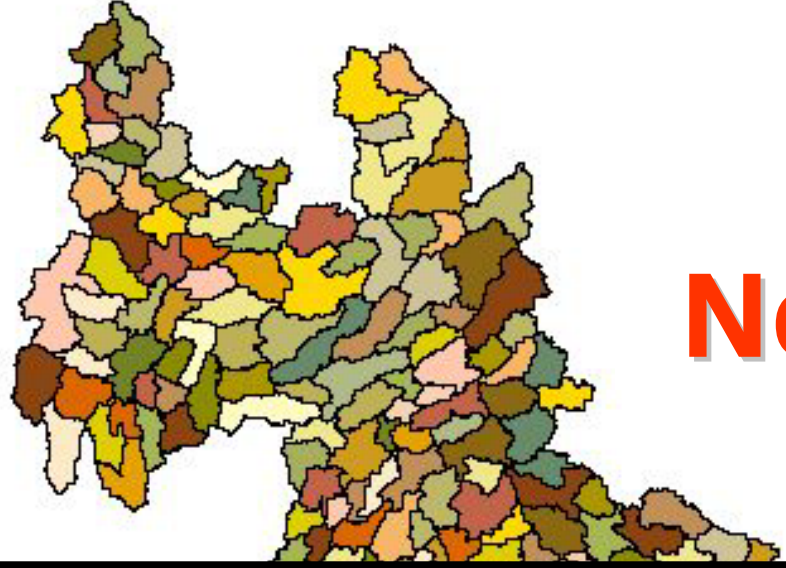
Conclusions & Recommendations

Conclusions

- SWAT Models (together with the basin simulation model) in Mekong Basin can achieve promising calibration performance on most tributaries (especially on monthly basis), and very good on the mainstream.
- The models (within the DSF) extensively used in testing various development scenarios in the efforts of the Basin Development Plan and Flow Management proves its usefulness and wide flexibility in reflecting most of the identified basin changes

Recommendations

- *Re-delineation for smaller sub-basins to accommodate for the spatial variability*
- *Multiple Hydrological Response Units (HRUs) are required for each sub-basins to capture the spatial variability of land-uses and soils*
- *Refining related input data followed by re-calibration*
- *Preparation for integration of SWAT2003 into the DSF*
- *Scenario assessment and water quality-related activities*



New sub-basins

NO	AREA	SUBBASINS	HRU
1	China - Chiangsaen	30	99
2	Chiangsaen - Luangprabang	60	174
3	Luangprabang - Vientiane	36	130
4	Vientiane - Mukdahan	94	301
5	Mukdahan - Pakse	59	197
6	Pakse - Kratie	118	327
7	Chi upto Yasothon	62	197
8	Mun upto Rasi Salai	51	142
		510	1567


THANK YOU