

HOW MUCH MODELLING IS ENOUGH?

Robyn Johnston and Vladimir Smakhtin

*International Water Management Institute (IWMI)
Colombo, Sri Lanka*



OBJECTIVES

- For representative large river basins:
 - Review the types and accessibility of basin-scale models;
 - Identify overlaps and duplicate investments;
 - Establish gaps in knowledge;
- Examine possibilities for improved coordination and effectiveness of investments in basin model development and application globally



RIVER BASIN MODELS

- Part of development programs for major transboundary river basins, funded by the World Bank.
- Main uses:
 - national water resources planning and management
 - transboundary water resources negotiation and coordination
 - flood forecasting and mitigation
- Historical and on-going investments:
 - Mekong – MRC DSF ~ \$20 mill since 2000
 - Nile – NBI DSF ~ \$25 mill since 1994
 - Indus - WAPDA IBM / IBMR - 30 years of development; \$14 mill over 2008–2014
- In addition, since 2000 - countless numbers of sub-basin modeling studies by national agencies, academia and international partners



MEKONG

- Diversity

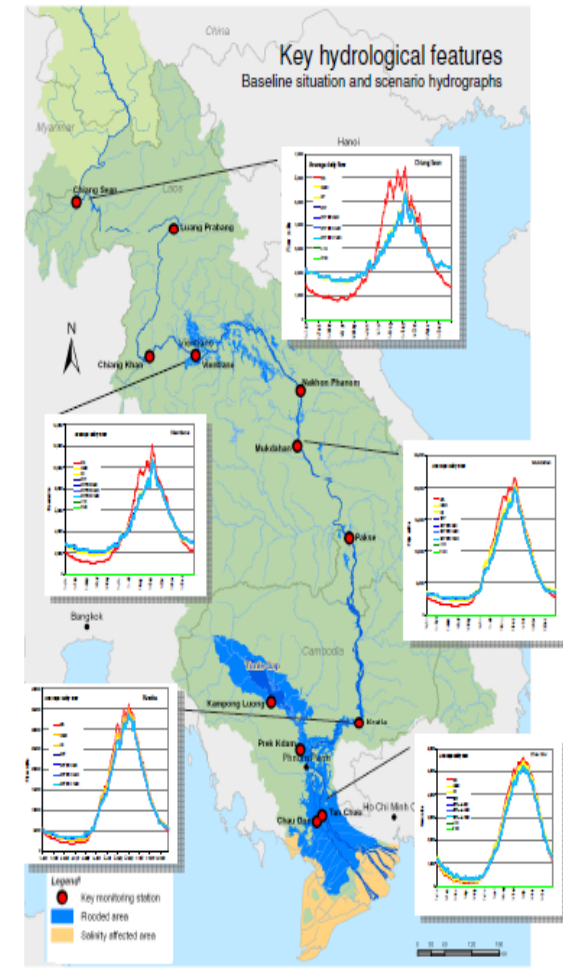
- four major model suites:
 - MRC DSF : SWAT, IQQM and iSIS;
 - U. Washington: VIC;
 - MIKE suite (ADB, JICA);
 - WUP-FIN suite (EIA, VMod)
- >18 different models reported, including 7 hydrodynamic models for Mekong delta and floodplain
- Extensive modeling in Vietnam (VRSAP) and Thailand

- Objectives:

- Transboundary cooperation
- Exploration of basin planning scenarios and hydropower impacts
- Flood forecasting and management

- Access

- MRC provides access to model setup info through online toolbox
- Software for DSF is proprietary
- Regional hydro-meteorological database available



MEKONG

- Achievements
 - Shared understanding of “big picture” hydrology of the basin
 - Impact on the debate – e.g. Chinese dams vs dams in Low Mekong; withdrawals upstream of Viet Nam delta
- Issues
 - Incremental improvements in accuracy of hydrology will have little impact on decisions. Issues of mainstream hydropower – economics and fish migration – dominate
 - Existing basin model suites are appropriate for different applications (Adamson, 2006)
 - National modeling objectives differ from basin-wide



NILE

Diversity

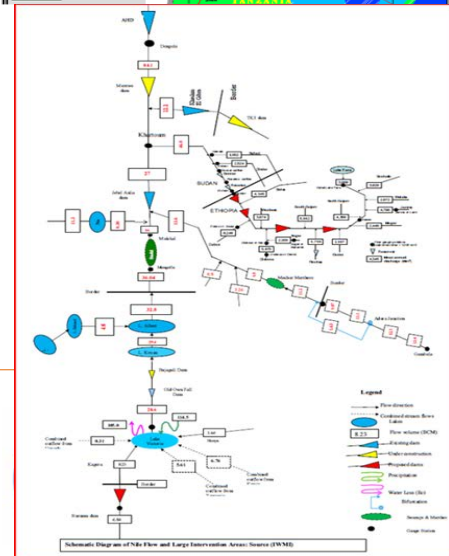
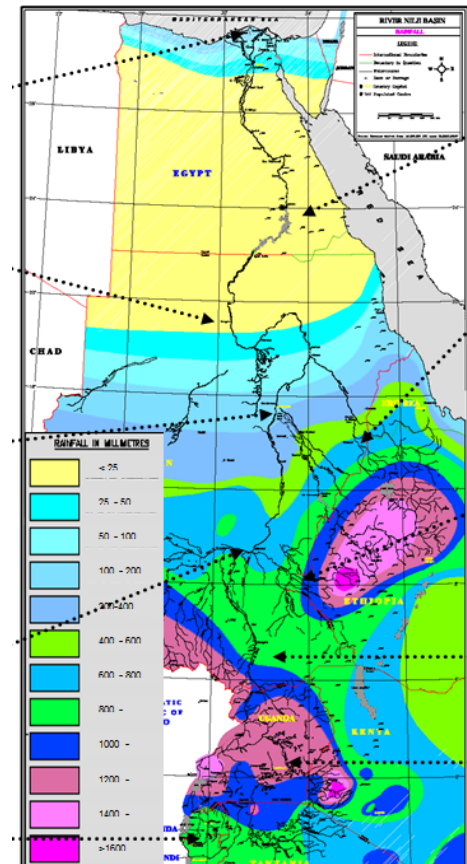
- 4 main Basin scale model suites (with NBI), >12 models,
- developed by various international organizations / initiatives – WB, UNESCO-IHE, HydroMet, TecoNile, FAONile / Georgia Tech, FRIEND/Nile; academia
- Sub-basin models with national agencies, e.g.
 - Egypt - NRI / HRI - suite of 9 different models for flood forecasting, dam operations, canal management
 - Ethiopia – multiple models for Blue Nile sub-basin (>20 SWAT applications alone)

Objective

- promote transboundary cooperation and negotiations
- National objectives in Ethiopia and Egypt – more operational

Access

- Political constraints to sharing data and results throughout the Basin
- No public release of flow data from Egypt since ~ 2000
- Can access NBI DST by arrangement



NILE

- Achievements

- Reasonable understanding of basin-scale dynamics and implications of development options
- Detailed models developed for operational use at national level could feed into basin-scale assessments

- Issues

- Political constraints to collaboration
- Plethora of international organizations working in Nile Basin, no coordination
- Data availability and sharing hardly improved over 3 decades



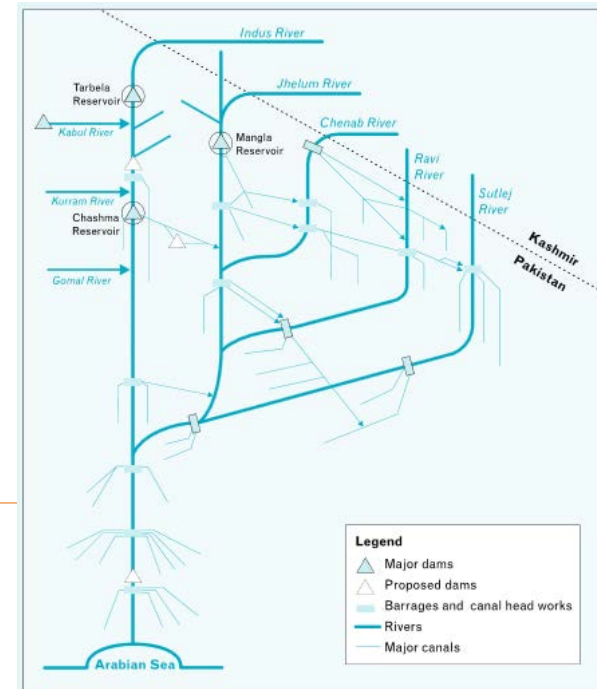
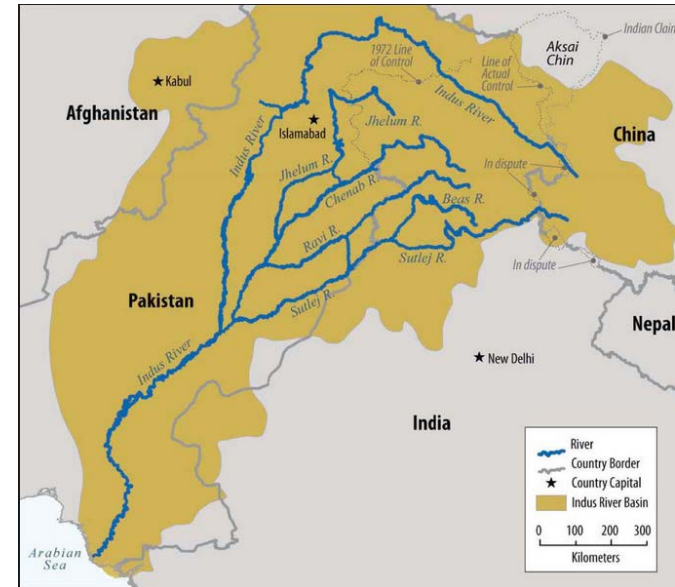
INDUS

Diversity

- Agro-hydrological Integrated Basin optimization Model (IBM / IBMR) - WAPDA and WB
- Rainfall-runoff models for ungauged flows and potential future changes – SWAT, UBC, HBV, SWIM, DHSVM
- Groundwater models (salinity and waterlogging in Indus Basin Irrigation System – IBIS) – MODFLOW, FEFLOW
- Operational flood forecasting - Delft-FEWS, IFAS

Objectives

- Planning and operation of IBIS including large groundwater component
- Flood forecasting and mitigation
- Planning and operating hydropower development



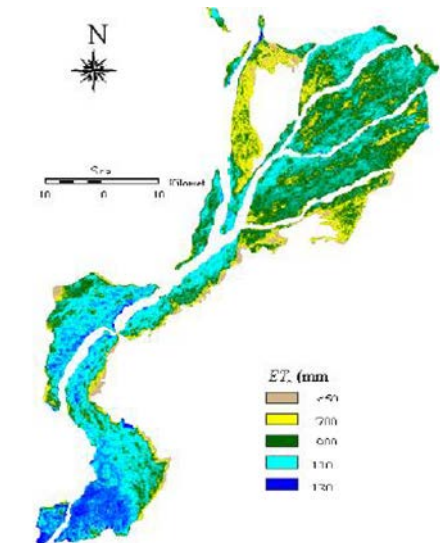
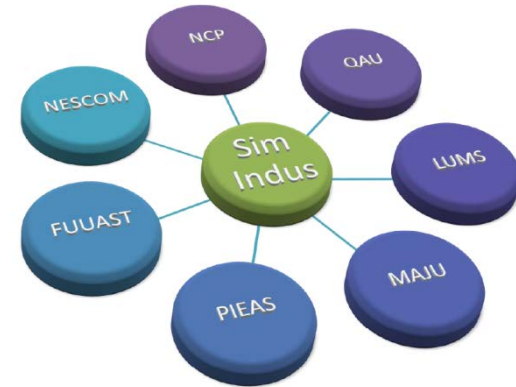
INDUS

- Achievements

- Use of models for planning and management of the IBIS
- Good resident national modeling capacity (e.g. SimIndus – technical consortium in Pakistan)

- Issues

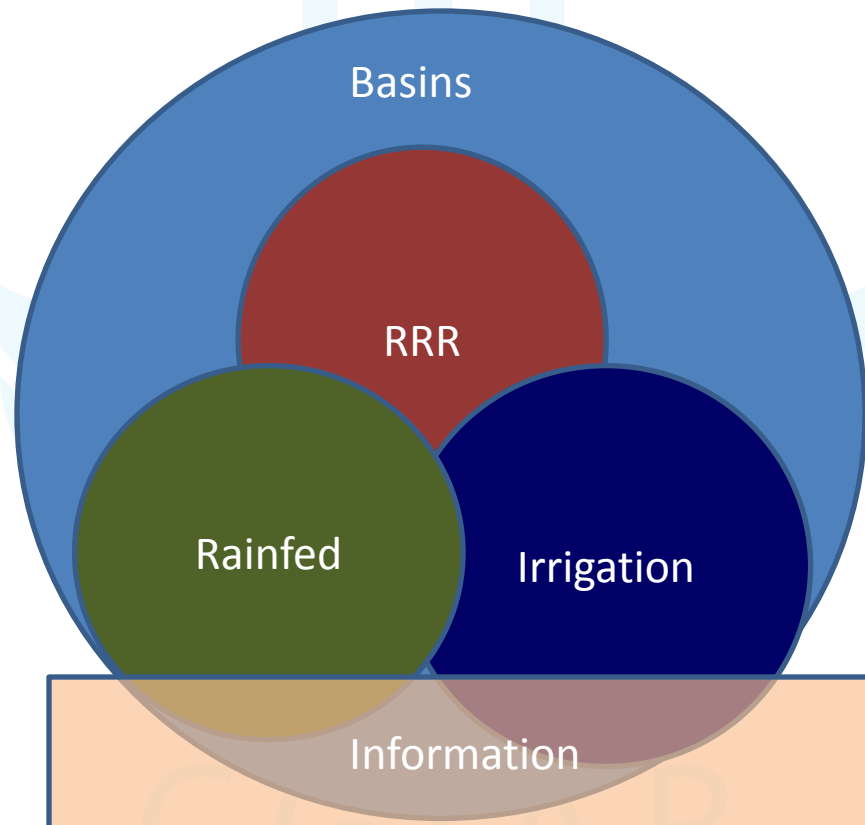
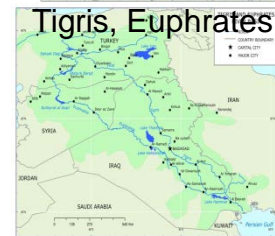
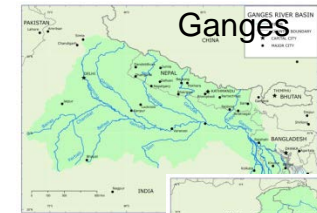
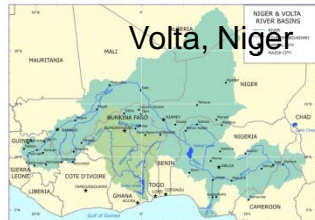
- A trans-boundary basin, with no TB management; IBMR is a Pakistan model for planning and management of IBIS
- Limited operational use still – expertise mainly in academia;
- Lack of data for operational use (canal flows etc) and overall - upstream



Bastiaanssen 2003



RIVER BASINS AND WLE PROGRAM



CAN MODELING EFFORT BE BETTER MANAGED?

Modeling is a learning process

- *We can try and speed it up by building on previous work: share your model files through your institutional web sites*

Large diversity of models (or repetition?)

- *Need to have a clear set of basin development objectives that models can support*
- *Increasing use of standard software (SWAT, MODFLOW, WEAP, MIKE), where appropriate. It should improve comparison and coordination but only if model assumptions / input data are shared*

Existing basin models are not always well verified / uncertainty is high

- *Focus more on improving data availability and sharing for input / calibration / validation than on developing / applying models with the same data limitations*

Political sensitivities make sharing national data and models for transboundary Basins difficult

- *Invest into new advanced data acquisition methods that spread across national / sub-national boundaries. Role for emerging international “decades” and initiatives*

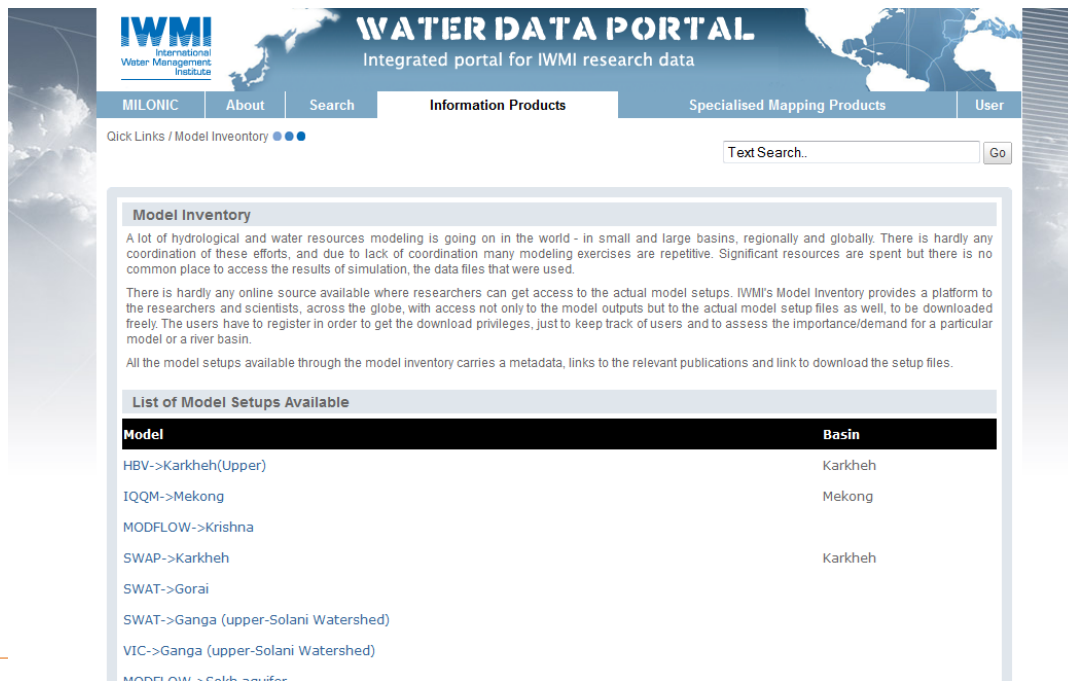
Existing models data /results for major basins are not always published / available

- *Develop model inventory for each major basin for free access by modeling community*



IWMI MODELING INVENTORY

- Collection of all setup files for about 30 recent modeling projects (SWAT, WEAP, VIC, MODFLOW for Volta, Nile, Mekong, Ganges and others)
- Soon will be online and continuously updated
- Can be replicated for every major river basin at the appropriate regional hubs



The screenshot displays the IWMI Water Data Portal interface. At the top, the IWMI logo is on the left, and the title "WATER DATA PORTAL" is centered, with the subtitle "Integrated portal for IWMI research data" below it. A navigation bar includes links for "MILONIC", "About", "Search", "Information Products", "Specialised Mapping Products", and "User". Below the navigation bar, there is a "Click Links / Model Inventory" link and a "Text Search" input field with a "Go" button. The main content area is titled "Model Inventory" and contains a paragraph explaining the purpose of the inventory: to provide a platform for researchers to access model setups and outputs. Below this text is a table titled "List of Model Setups Available".

Model	Basin
HBV->Karkheh(Upper)	Karkheh
IQQM->Mekong	Mekong
MODFLOW->Krishna	
SWAP->Karkheh	Karkheh
SWAT->Gorai	
SWAT->Ganga (upper-Solani Watershed)	
VIC->Ganga (upper-Solani Watershed)	



Water resources modeling efforts in world major river basin need to be better coordinated

THANK YOU

