

NARBO

**3rd General Meeting of Network of Asian River Basin Organizations
Solo, Indonesia, February 20-22, 2008**

Water and Climate Change

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Outline

- Introduction - Water and Climate Change
- Current Issues with IWRM and Climate Change
- Global Warming
- What Next



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Definition

■ Water

- *... transparent colourless liquid found in seas and rivers ...and in rain...*

■ Resource

- *...available stock that can be drawn on... and ...country's collective wealth...*

■ Service

- *...work done for community... and ...provision of some public need...*

■ Water Resources Management

- *managing of the resources*

Water and Water Resources Management

■ Elements that should be included

□ Natural resources

- Land & water and related resources

□ Services

- Water supply (D&I, Agriculture, Environment/Bio-D/Low Flow)
- Pollution Control (Point source, non point source)
 - All water bodies
- Flood abatement (Natural phenomena, man made)
- Hydro Power, Transportation, Recreation etc

□ Governance

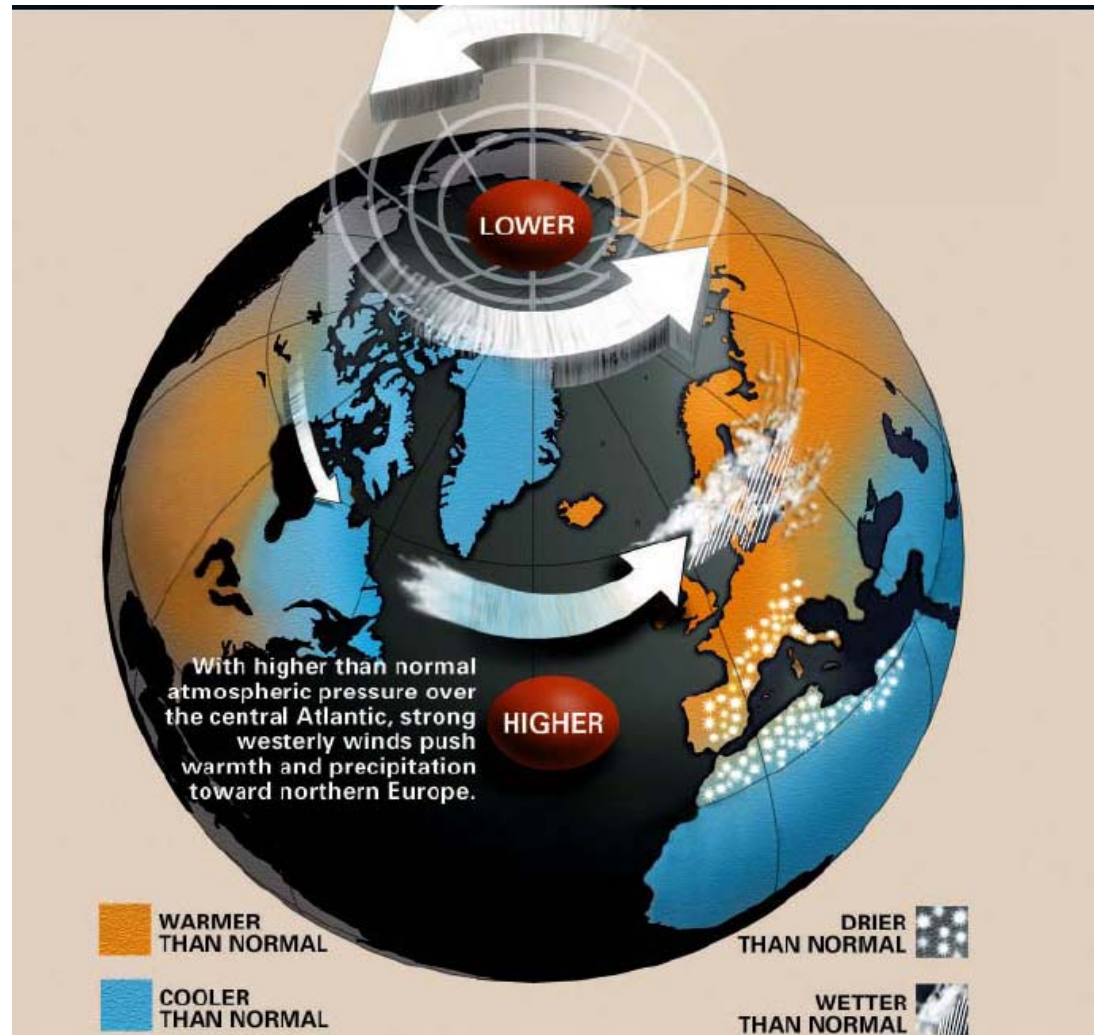
- Awareness and Advocacy
- Over-arching Policies
- Capacity Building
- Management Instruments
 - Institutions, Legislations, finance

□ Global Warming - Impact of Climate Change

- Vulnerability and Adaptation

Global Warming – Circulation change

- Anthropogenic forcing likely contributed to Global Warming and climate change
- Climate change is affecting storm tracks, winds and temperature patterns



UNFCCC

- United Nation Framework Convention on Climate Change – the UN organisation that ...
 - Acknowledging., noting ..., aware ..., recalling... reaffirming..., recognizing....., etc issues on CC for the UN
 - Determined to protect the climate system for present and future
- Parties to UNFCCC
 - Takes into account common but differentiated responsibilities
 - Annex 1 members
 - Annex 2 members
 - Non-Annex
- Organise the COP (Conference of Parties, supreme body of the convention) meetings
 - The last one, COP 13 in Bali

IPCC - Inter-governmental Panel on CC

- Inter-governmental Scientific Body
 - Consists of more than 2000 scientists from around the world
 - Analysed published reports as Assessment Reports (AR) into 3 WG (Working Groups)
 - Advises UNFCCC
- AR- assessment Reports 1 to 4, divided into 3 WG
 - WG1 – Inventories of GHGs emission
 - Emission of GHGs is assume largely due to anthropogenic excesses
 - WG2 – Vulnerability and Adaptation
 - Identifying where the vulnerabilities are and adapting or preparing to adapt to potential vulnerabilities
 - WG3 – Mitigation
 - Largely referring to how to mitigate the anthropogenic excesses in GHGs emission



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Relevance of IWRM and IRBM Concept

- There is no issue on the acceptance
 - Particularly among water people
 - Although if you want to be analytical, you can argue it both ways – Asit Biswas - SOS? (Same Old Stuff)
 - But it makes for easy branding and marketing
- Need now, to go beyond rhetoric to actual field implementation
 - UN/International/donor agencies
 - Synergistic Strategies to help build capacities, as many subscribe to the concept
 - Governments
 - Move out into other than water groups, particularly the political groups and the one holding the purse
 - NGO/CBO
 - The doers on the ground

River Basin

Has a limited carrying capacity, a function of hydrological and hydrodynamics



Hydrological: rainfall/runoff relationship within each river basin

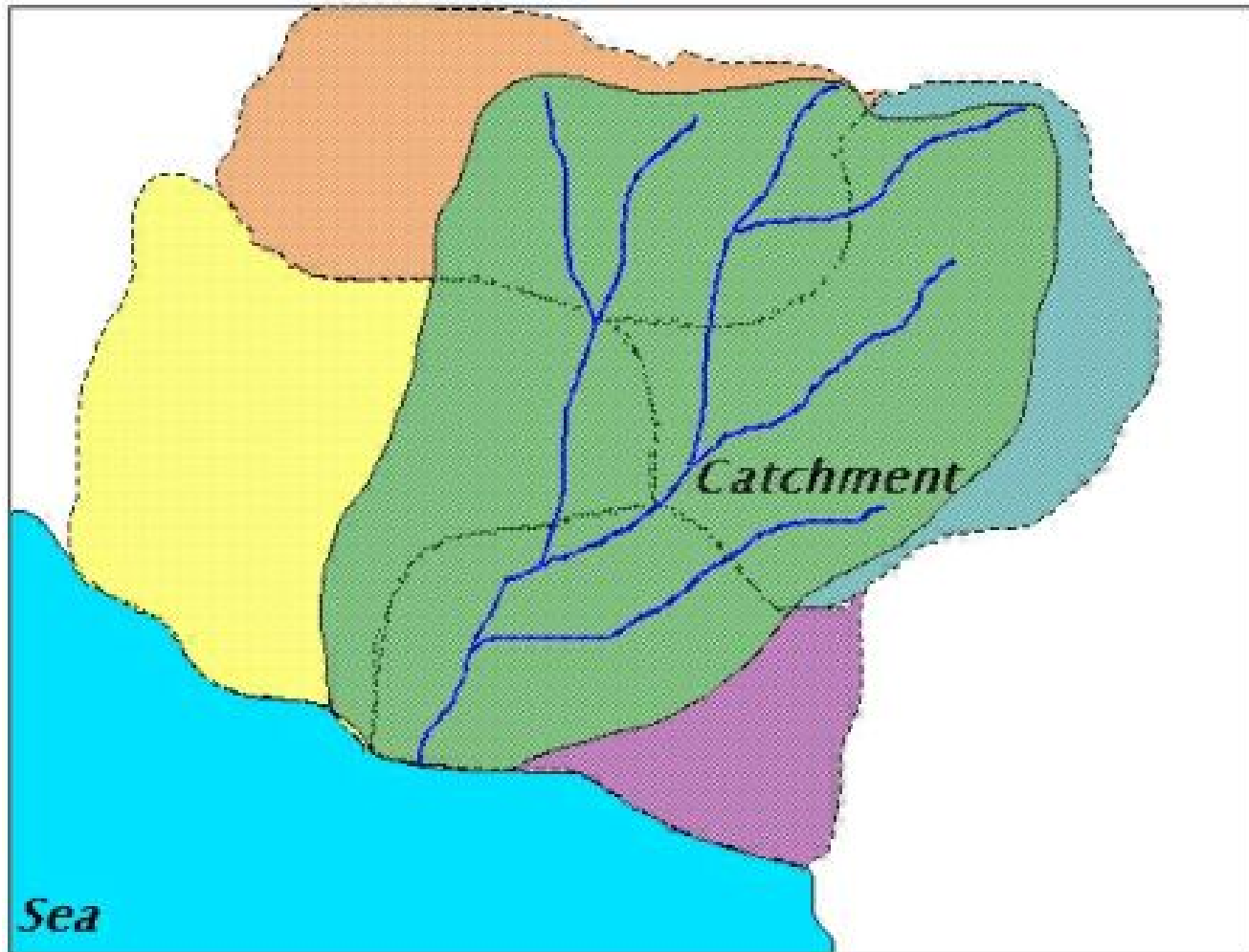
Hydrodynamic: change in flow condition, will affect all initial environmental condition

Acceptance of the concept

- Transboundaries – have its set of issues
 - International
 - Ganges-Brahmaputra, Mekong, Nile, etc
 - Inter regional/district
 - Myriads
- Governments that have accepted the concept
 - How far have it been incorporated in the development plans, beyond over arching policies
 - Since money talks, how far has it been accepted, if we are take budget allocation as KPI for the soft part of IWRM, of governments' acceptance

The area of River Basin

parts of different administration, countries, regions or districts





Regional success stories

Singapore River and Kallang Basin



- The catchment covers a fifth of the land area of Singapore.

A Singapore Success Story

On 27 February 1977, at the opening of the Upper Pierce Reservoir, the prime Minister, Lee Kuan Yew said *'It should be a way of life to keep the waters clean .. In ten years let us have fishing in the Singapore River and in the Kallang River.'*

In October 1977, The Ministry of the Environment , submitted an Action Plan to the Prime Minister

Singapore River and Kallang Basin

Source of Pollution

- Pigs and ducks Farms
- Vegetable Farms
- Hawkers
- Activities along Rivers
- Sewerage

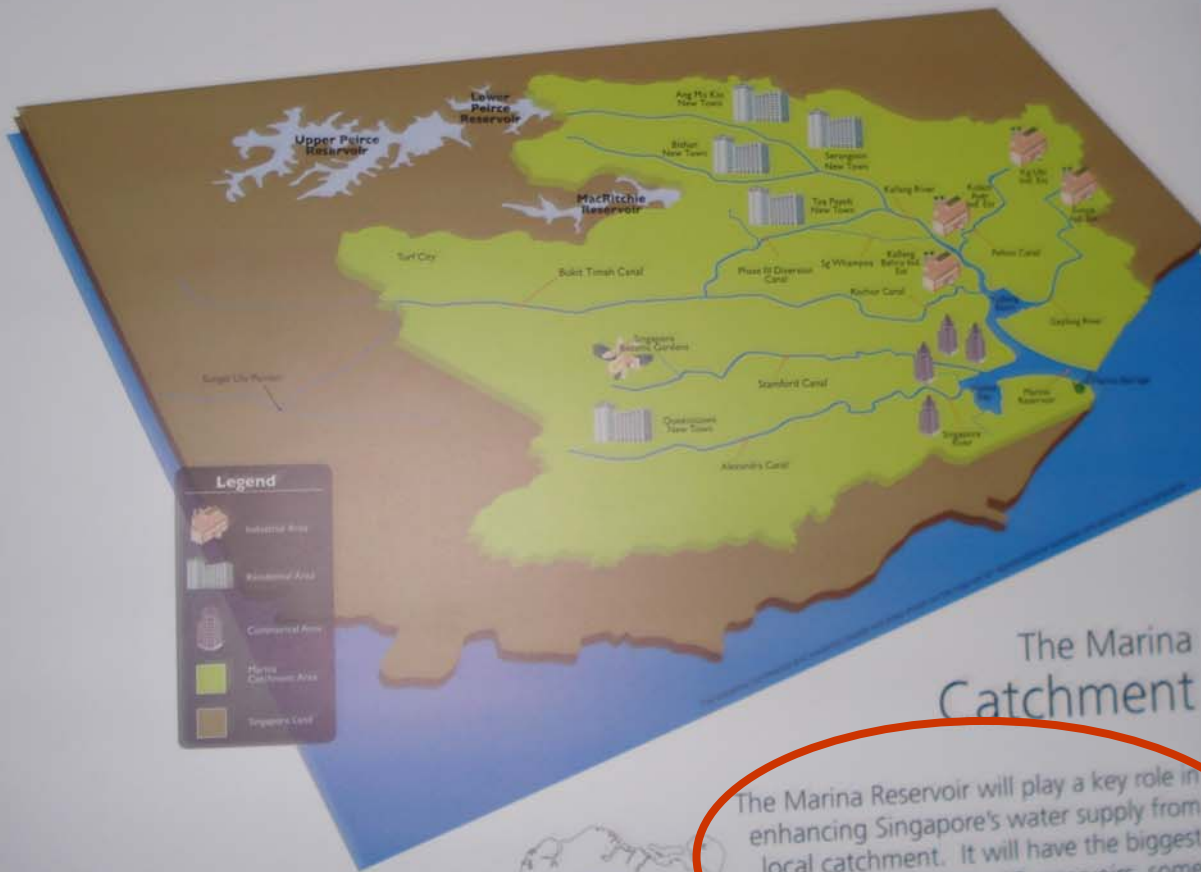


Singapore River and Kallang Basin

How did they do it?

- 26,000 squatter families were resettled to HDB flats
- 5,000 hawkers were relocated into food centres
- Moved factories to JTC, then only
- Removed more than 200 tonnes of rubbish
- Upgrade the riverside walkway along the river
- Upgrade parking lots along rivers
- Developed recreational areas along rivers
- Sand was brought in to form beaches for recreation

The Greatest Catchment



The Marina Catchment

The Marina Reservoir will play a key role in enhancing Singapore's water supply from local catchment. It will have the biggest catchment among the 15 reservoirs, some 10,000 hectares (ha) in size or about one-sixth of Singapore's land area.

Keeping the catchment clean

- The Marina catchment is the most urbanized compared to the catchments for the other reservoirs. This poses a far greater challenge in ensuring that clean water flows into the reservoir.
- Residential, commercial and light industrial premises can be found within this catchment.

To see clean waters in the future Marina Reservoir, everyone needs to play their part.

Our Approach

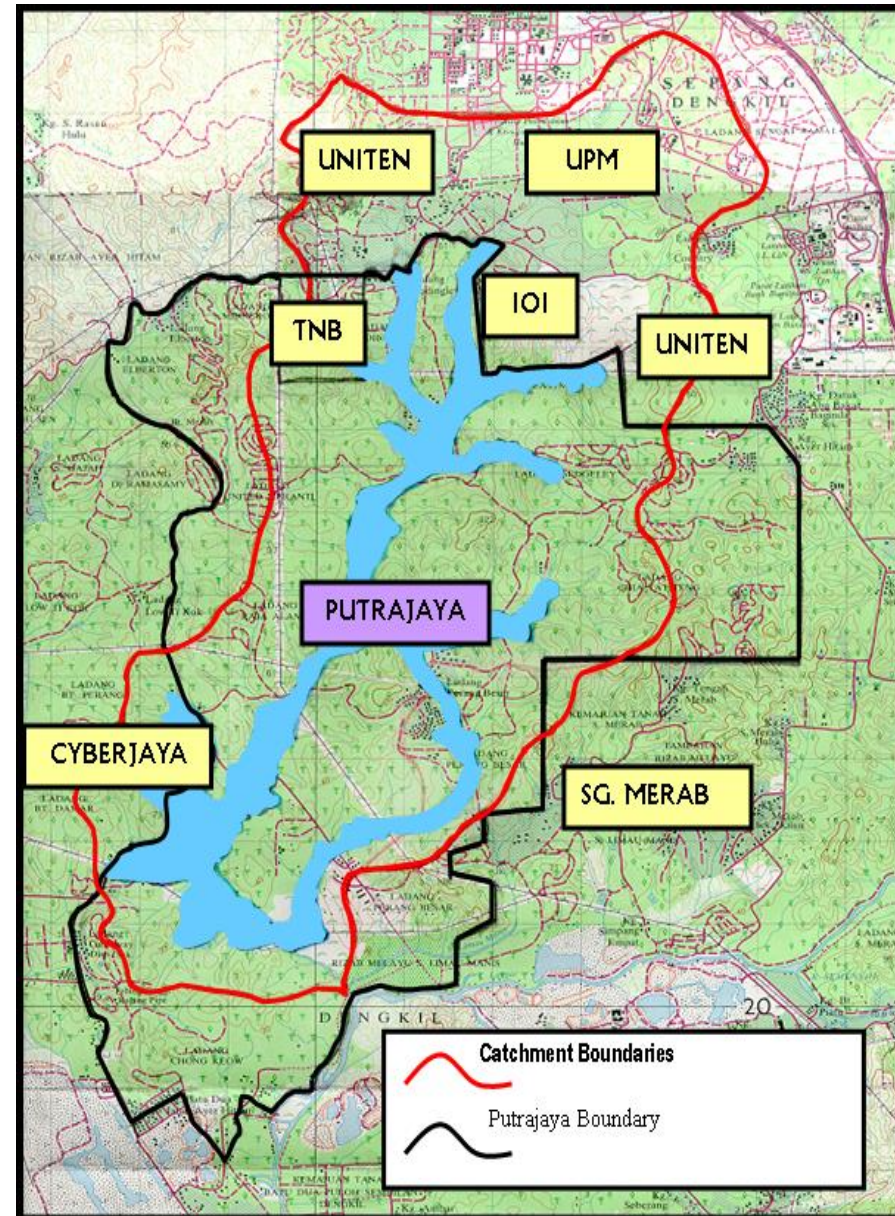
PUB needs to work with every Singaporean to ensure that clean waters flow into the catchment and subsequently into the Marina Reservoir. This landmark project will leverage on the positive synergy of PUB's 3P sectors (Private, Public and People sectors) to succeed.



Malaysia:

Putrajaya Lake Management

- Created Federal Administrative Capital
- 70% of the catchment is within the Putrajaya area
- 30% located outside Putrajaya area shared by other stakeholders i.e. UPM, MARDI, IOI, UNITEN, Sg. Merab Malay Reserve and Cyberjaya
- Catchment lies within the jurisdiction of Majlis Perbandaran Sepang (MPSp), Majlis Perbandaran Subang Jaya (MPSJ) and Perbadanan Putrajaya (PPj)



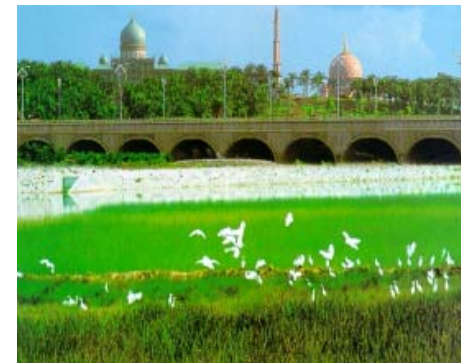


Lembangan Sungai Langkat



PUTRAJAYA WETLAND PARK

- Introducing nature into the urban fabric
- Man made wetlands to act as a natural filter for lake water quality



nts



PUTRAJAYA WETLANDS



**ZONE INTERMITTENT
INUNDATION (ZII)**



**MAINTENANCE
TRACK & V-DRAIN**



Elements of Success

- Political Commitment
- Sufficient Funds



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- Introduction - Water and Climate Change
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- **Global Warming**
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Climate Change

- Largely agreed by a huge scientific community (IPCC – International Governmental Panel on CC with more than 2000 scientist globally)
- Stern Review: Economics of Climate Change, World Economic Forum, Davos, January 2007
 - Climate Change will affect basic elements of life
 - Access to water, food production, health and environment
- Still there are skeptics, and 2 sides to a coin
 - An inconvenient truth, Al Gore,
 - Nobel Prize Winner & Fmr US V-President
 - A convenient untruth, Myron Ebell,
 - Competitive Enterprise Institute, in Washington, D.C

But IPCC studiesAR4

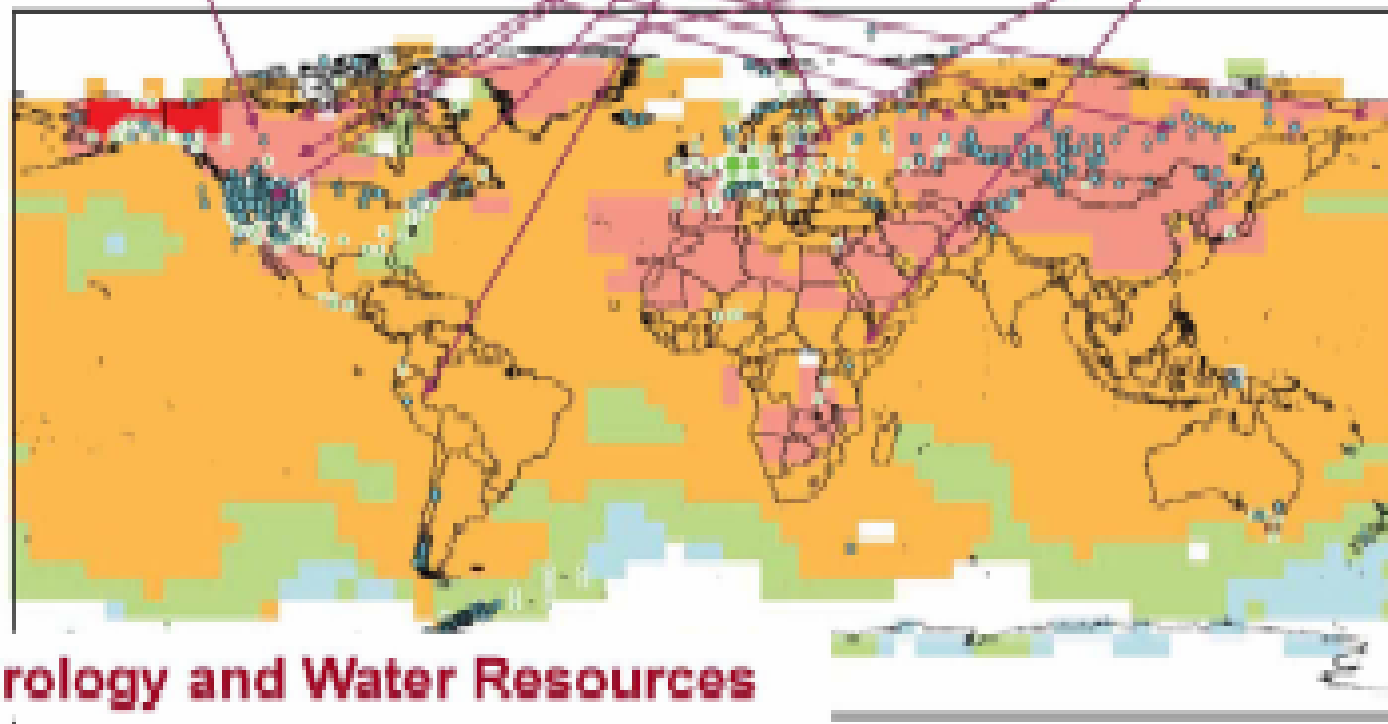
Many More Studies ...

| Sector | # studies assessed | |
|--------------------------------|--------------------|-------|
| | TAR* | AR4** |
| Cryosphere | 23 | 59 |
| Hydrology and Water Resources | | 49 |
| Coastal Processes and Zones | 4 | 56 |
| Aquatic Biological Systems | 14 | 117 |
| Terrestrial Biological Systems | 46 | 178 |
| Agriculture and Forestry | 5 | 49 |
| Human Health | 5 | 51 |
| Disasters and Hazards | 3 | 18 |
| Total | 95 | 577 |

Arctic Drainage

Earlier Stream Flow

Warming Lakes



Hydrology and Water Resources

Earlier spring discharge from snow melt, Enhanced glacial melt, Warming lakes and rivers (high confidence)



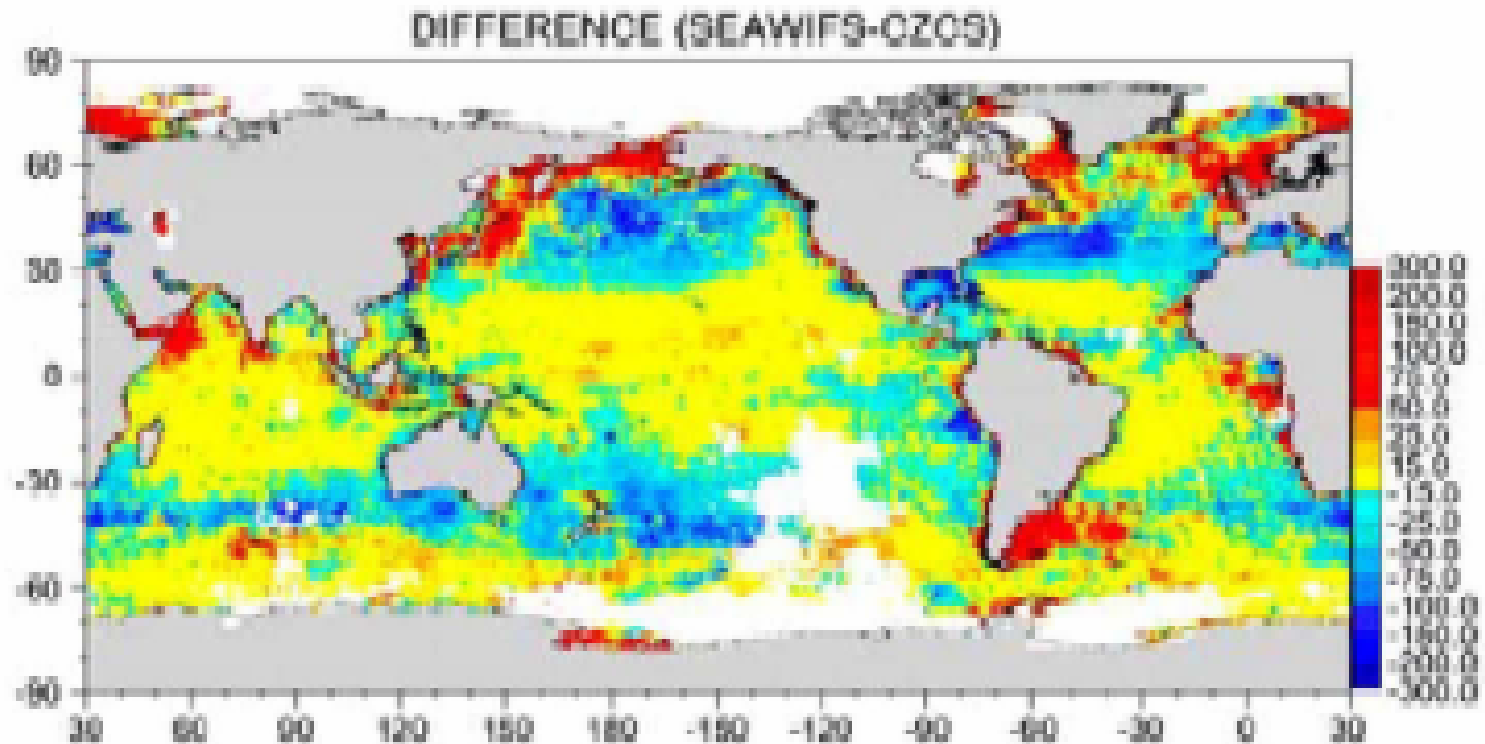
WMO

Intergovernmental Panel on Climate Change Working Group II



UNEP

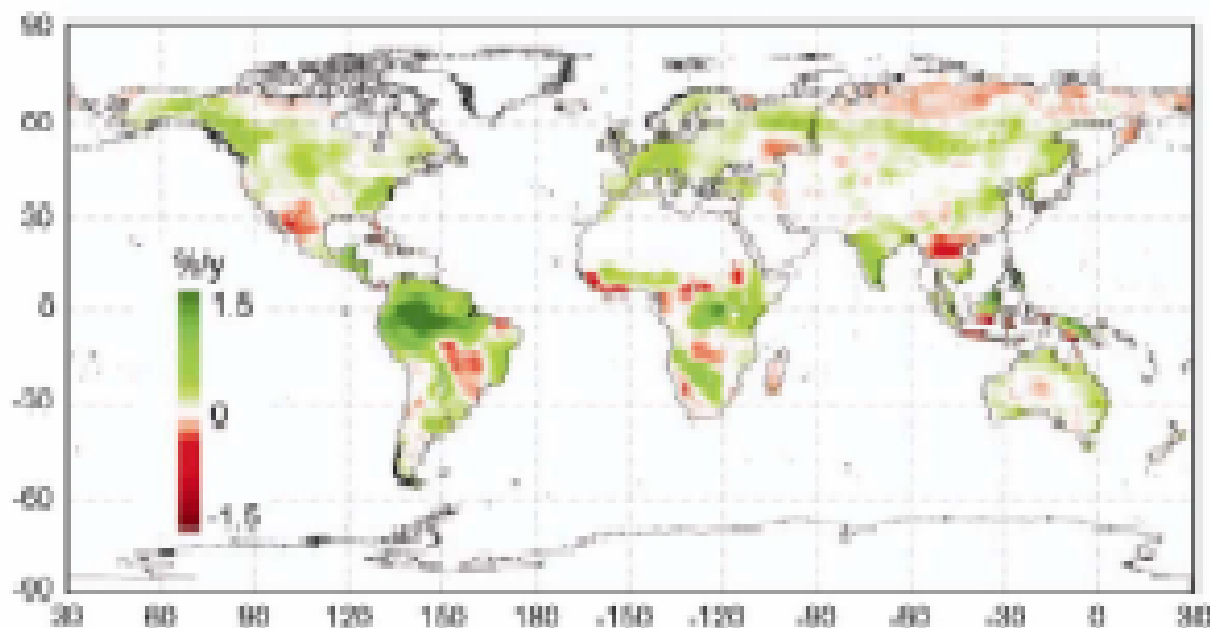
Marine



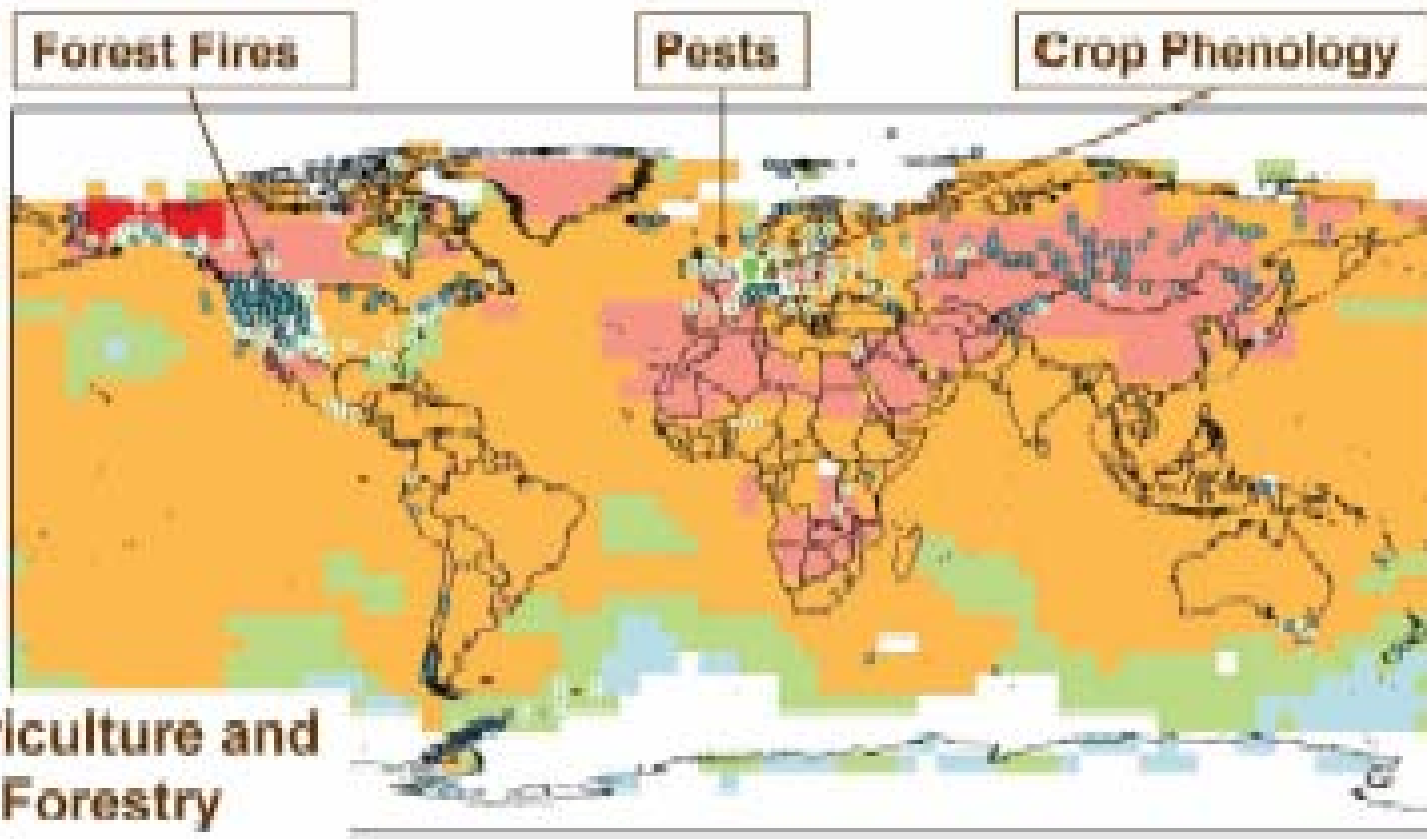
Global annual **ocean primary production** decreased from the CZCS era (1979-1986) to the present (1997-2002) by **6.3%** ($P < 0.05$). High latitude losses were 2.0 Pg C y^{-1} , which accounted for 70% of the global decline in photosynthetic carbon uptake.

Gregg et al., 2003

Terrestrial Biological Systems



An overall increase in NPP has been observed, consistent with rising atmospheric CO₂ and warming.



Agriculture and Forestry

The lengthening of the growing season has contributed to an observed increase in forest productivity in many regions

While warmer and drier conditions are partly responsible for reduced forest productivity, increased forest fires and pests in North America and the Mediterranean Basin.

Human Health

- An increase in high temperature extremes has been associated with excess mortality in Europe, which has prompted adaptation measures.
- There is emerging evidence of changes in the distribution of some human disease vectors in parts of Europe.
- Earlier onset and increases in the seasonal production of allergenic pollen have occurred in mid and high latitudes in the Northern Hemisphere.



i.e. In Europe the pollen season is expanding: on average it has increased by 10–11 days over the last 30 years.

Global Climate Projection from IPCC

- IPCC's first report in 1990, assessed projections
 - suggest global average temperature increases between about ***0.15° C and 0.3° C per decade for 1990 to 2005.***
- Model experiments show
 - even if all radiative forcing agents, constant @ year 2000 levels, a further warming trend would occur in the next two decades at a rate of about ***0.1° C per decade***, due mainly to the slow response of the oceans
- Sea level will continue to rise in the warming climate
 - not be geographically uniform, with regional sea level change varying within about ± 0.15 m

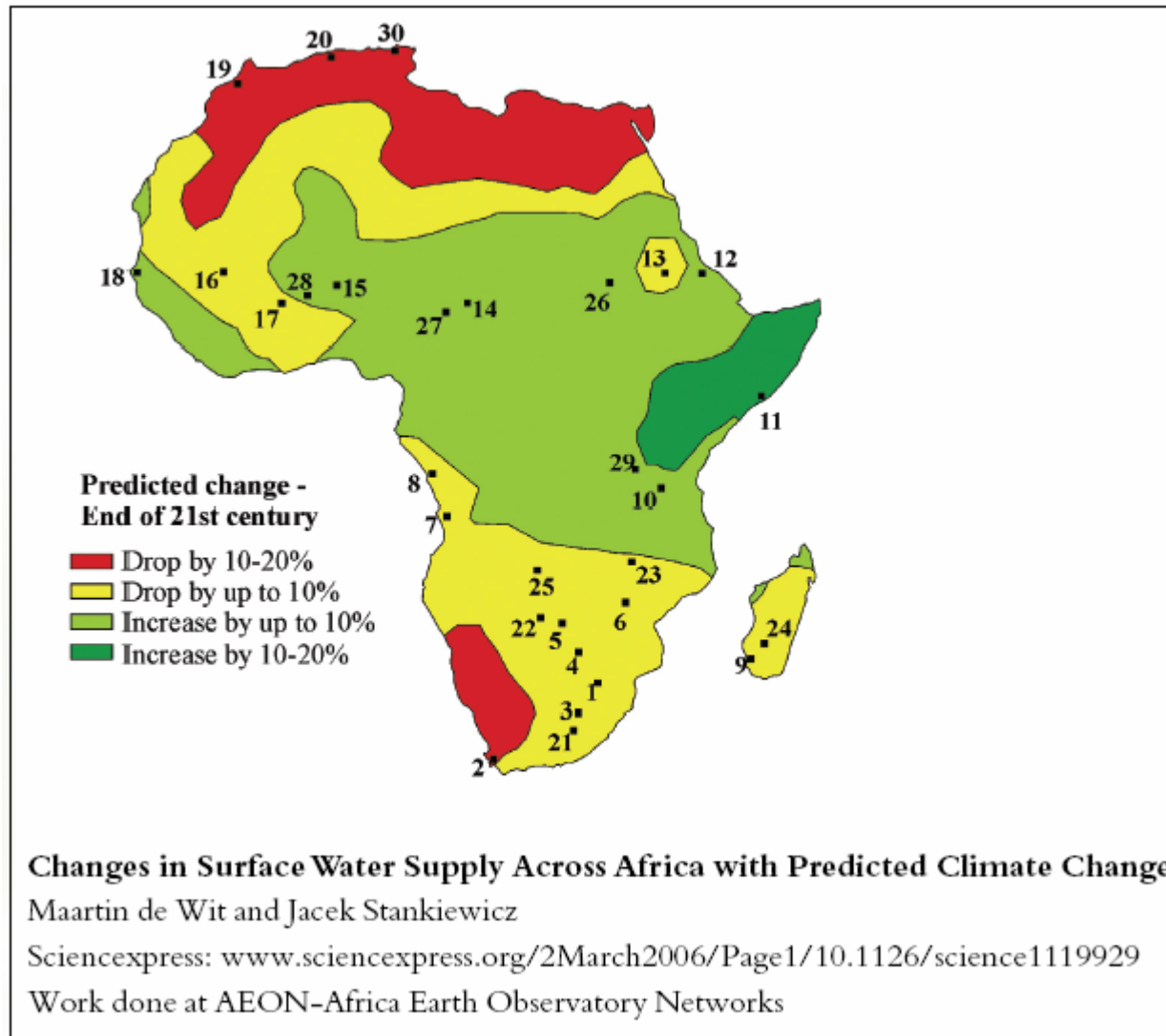
Results of IPCC AR4 WG2 - 2

- ***More specific information is now available*** across a wide range of systems and sectors concerning the nature of future impacts, including for ***some fields not covered in previous assessments*** such as in
 - ***fresh water resources and their environment***, ecosystems, coastal systems and low-lying areas
 - food, fibre and forest products
 - industry, settlement and society and health
- More specific ***information is now available*** across the regions of the world concerning the ***nature of future impacts***, including for some places not covered in previous assessments such as in Africa, ***Asia***, Australia and New Zealand, Europe, Latin America, North America, Polar Regions and Small Islands

Results of IPCC AR4 WG2 - 3

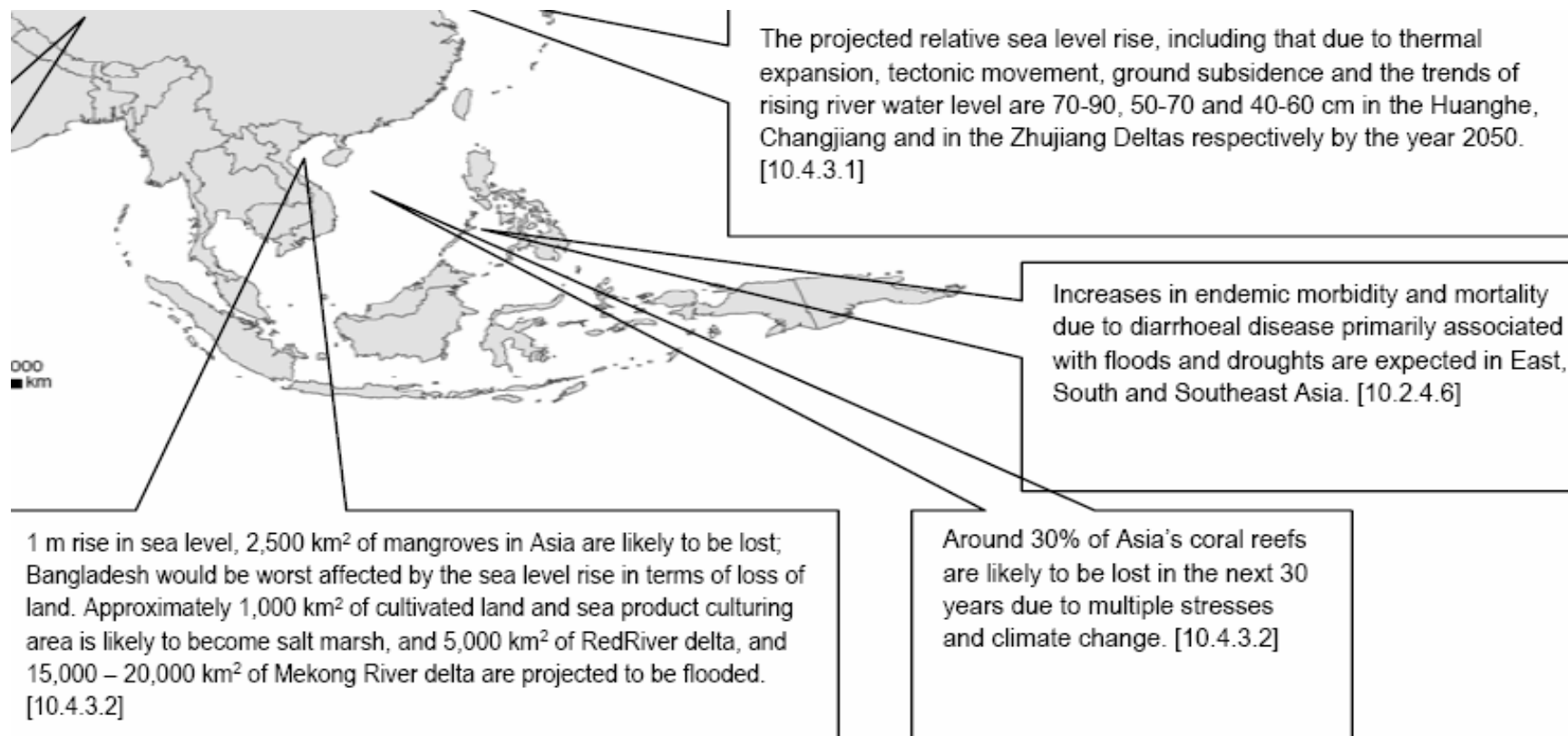
- ***Magnitudes of impact can now be estimated*** more systematically for a range of possible increases in global average temperature
 - Impacts due to altered frequencies and intensities of extreme weather, climate and sea level events are very likely to change
 - **Some large-scale climate events have the potential to cause very large impacts**, especially after the 21st Century
 - ***Impacts of climate change will vary regionally*** but, aggregated and discounted to the present, they are ***very likely to impose net annual costs which will increase over time as global temperatures increase.***

Africa



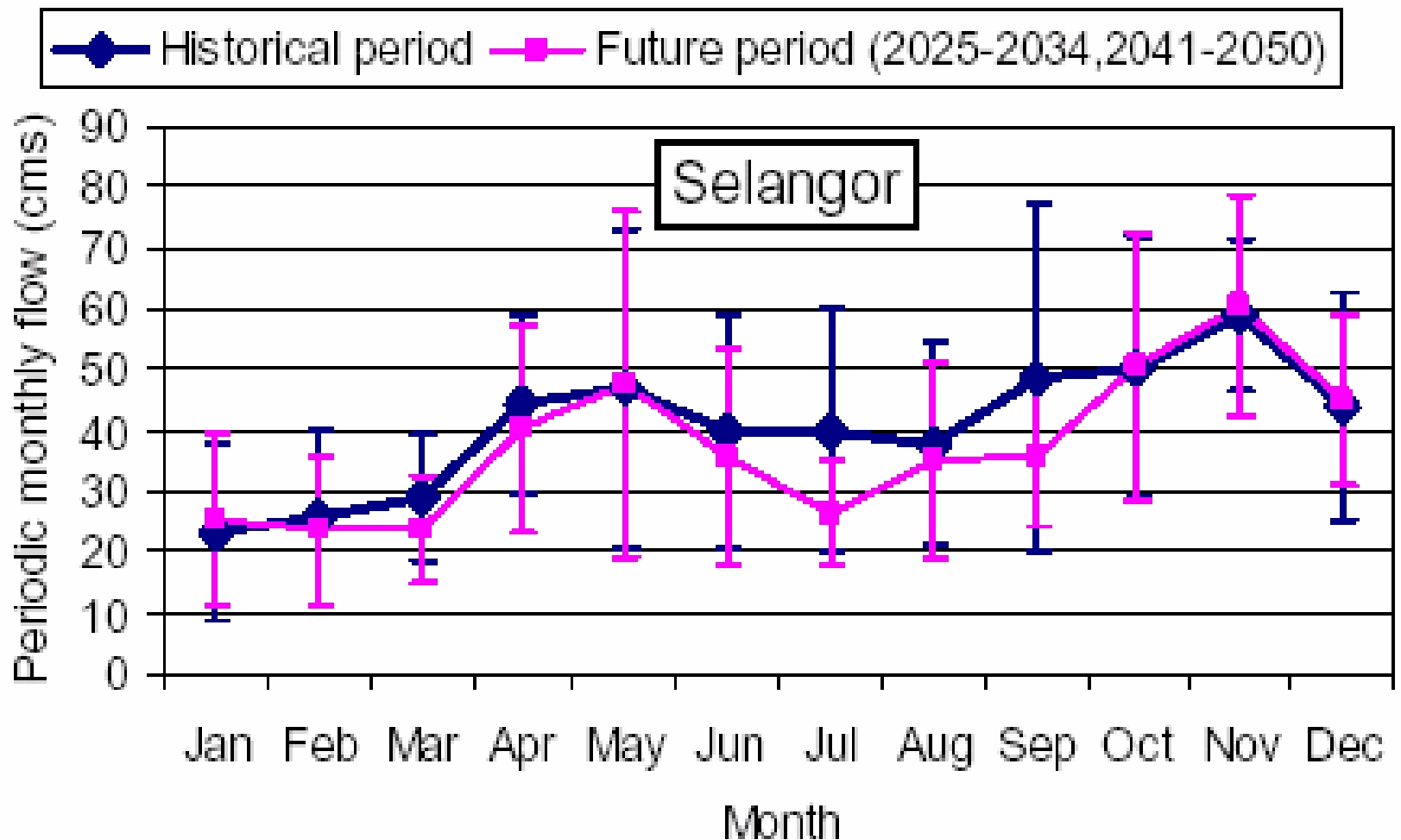
ASIA –

IPCC AR4, WG2 April, Brussels, 2007



Malaysia:

Eg of a Simulated Monthly River Flow
Periodic Means and Standard Deviations



Observed Climate Change

| | GLOBAL* | | MALAYSIA |
|---------------------------------|-----------|-----------|----------------------------|
| | 1906-2005 | | 1968-2002 |
| Surface temperature (°C) | 0.74 | | 0.49 – 0.91 (MMD)** |
| | 1961-2003 | 1993-2003 | 1986-2006 |
| Sea level rise (mm/yr) | 1.8 | 3.1 | 1.25 (DID @ Tg Piai)*** |

* IPCC 4TH ASSESSMENT REPORT (AR4), 2007

** INITIAL NATIONAL COMMUNICATION, 2000

*** NATIONAL COASTAL VULNERABILITY INDEX STUDY, DID, 2007

Climate Change Projection

| | GLOBAL* | | MALAYSIA** |
|---|---------|---------------|--|
| | 2050 | 2100 | 2050 |
| Surface temperature (°C) (Emission Scenario SRES*** A1B) | 1.6 | 2.8 | 1.5 |
| Sea level rise (m) (Emission Scenario SRES*** A1B) | | 0.21- 0.48 | - |
| Annual Rainfall (mm) | | | +10% (Kelantan, Terengganu & Pahang) -5% (Selangor & Johor) |
| River Flows (m3/s) | | | +11% to +43% (Flood Flows) -31% to 93% (Low Flows) |

* IPCC WG1 4TH ASSESSMENT REPORT (AR4), 2007

** STUDY ON IMPACT OF CLIMATE CHANGE ON HYDROLOGIC REGIME AND WATER RESOURCES OF P MALAYSIA, NAHRIM, 2006

*** SRES = Special Report on Emission Scenarios



Obvious Impacts

From: Mike Muller, TEC GWP

- where water availability is reduced, communities will either have to change their water habits to use less water, bring water from further afield, at greater cost, or both;
- hydroelectricity, an important source of non-polluting⁴ renewable source of energy, depends on reliable water sources. Lower river flows will reduce electricity supplies and power failures will affect the economic and social life of many communities unless new investments are made.
- more intense rainfall will increase the cost of flood protection works as well as that of associated infrastructure such as roads and stormwater drains.



Less Direct Impacts

From: Mike Muller, TEC GWP

- where urban and industrial wastes are discharged into rivers, acceptable water quality is achieved by diluting the pollutants. If streamflows are reduced, either pollution discharges will have to be reduced as well or treatment intensified simply to maintain the same environmental standards;
- bringing water from further afield will not only increase its cost but also intensify competition between users for the reduced amounts of water that are available. Social and economic impacts will include higher prices as well as the aggravation of rural unemployment as farmers lose their supplies to other users;
- increased flood risks will reduce the land available for settlement, aggravating the impact of sea-level rise in coastal cities;
- rising sea levels will infiltrate unusable saline water into coastal aquifers, reducing the water supplies of coastal communities, particularly in small island communities.

Looking at the IPCC reports ...

- While warming of the globe is through the emissions of GHGs and this emission need to be mitigated
- The impact of this warming has already arrived and affecting water related sectors
 - These are thought to be evident by the extreme events of floods and droughts currently experienced around the world
- Such that



If ENERGY is mitigation,
then

WATER is vulnerability and
adaptation



Thereforegiving IWRM and
IRBM process

- A lead role in managing the impact of vulnerabilities due to Climate Change



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Stern Review: Economics of Climate Change

World Economic Forum, Davos, January 2007

■ Adaptation

- Poorest countries are most vulnerable to climate change
- ...climate change be fully integrated in development policies ...
- ...international funding should support improved regional information on climate change impact ...
(*ie identify vulnerabilities*)

What Next

- Identifying Vulnerabilities
 - Climate Change Projection?
- Needed Actions to cope and adapt to the Climate Vulnerabilities
 - Immediate term
 - Medium term
 - Long term

Needed Actions

■ Immediate Term

- Incorporate in current development programs
 - Water Supply, Flood Mitigations and other infrastructure installations – will there be any design or O & M changes/requirements to infrastructures
 - Re-look at planned development, incorporate planning of water needs/environmental impacts from project visualisation
 - Agriculture – cropping practices need to be accommodated to changing rainfall patterns and increase temperature
 - Etc

Immediate to Medium Term

■ Climate Change Projection

- For each Country
- For each region
 - Southeast Asia?
- Current IPCC projection, 410km grid
 - IPCC advice
 - Scale of 410km grid need to be downscale at regional level for greater accuracy
 - Scale of 10km grid and below
 - Less costly to identify vulnerabilities through climate change projection

Climate Change Projection

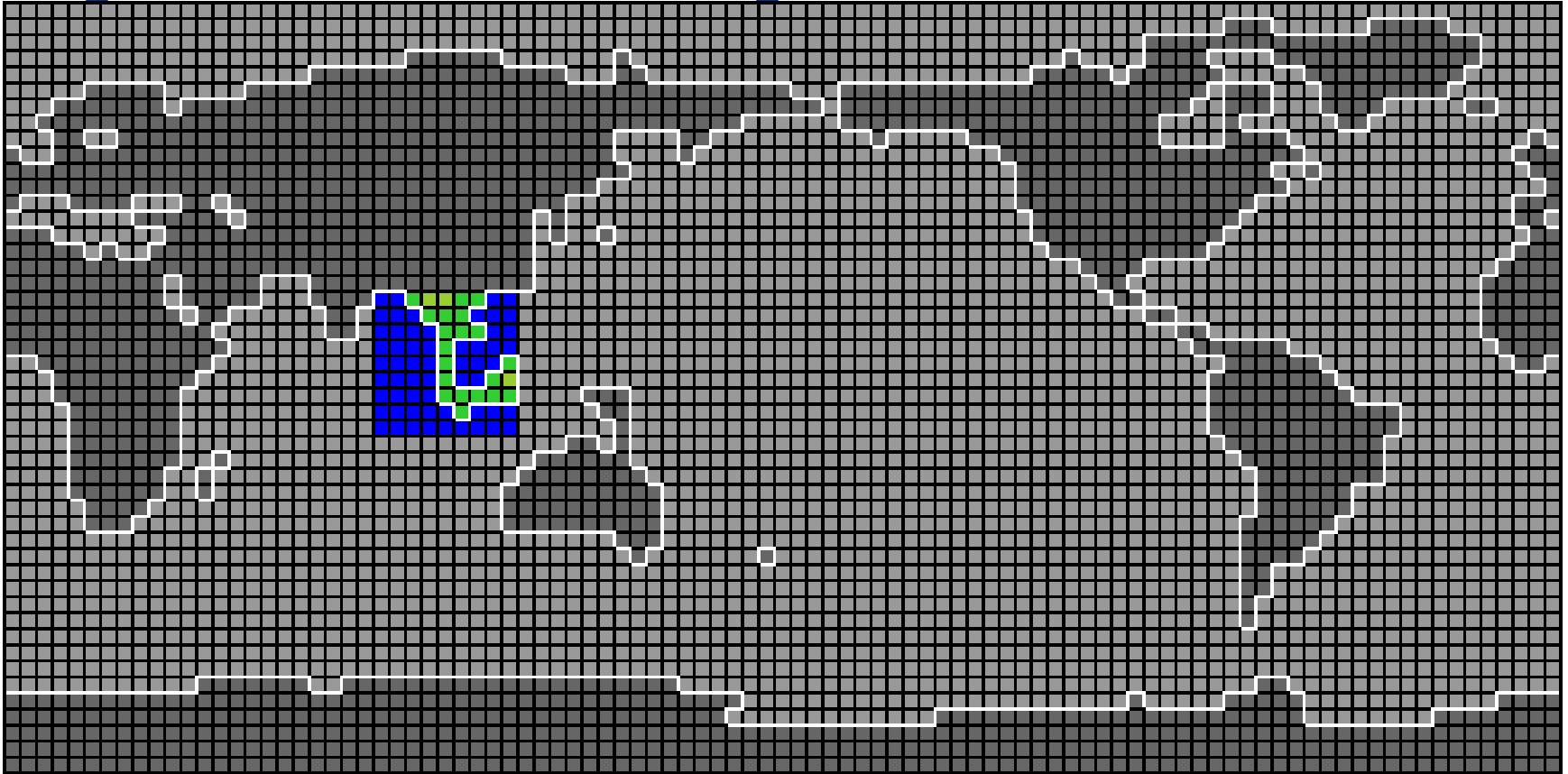
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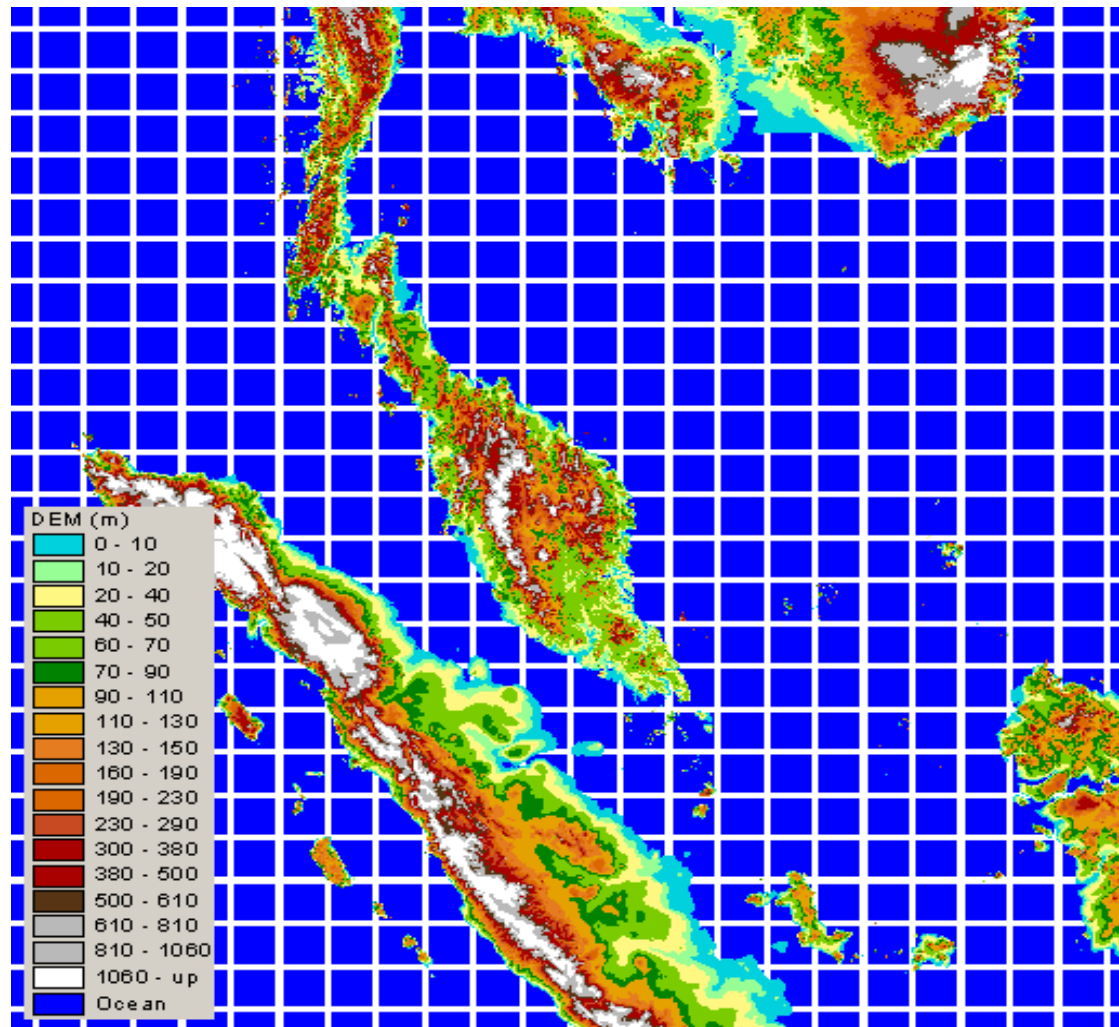
** STUDY ON IMPACT OF CLIMATE CHANGE ON HYDROLOGIC REGIME AND WATER RESOURCES OF P MALAYSIA, NAHRIM, 2006

*** SRES = Special Report on Emission Scenarios

Data grid of CGCM1 that were used in the RegHCM-PM. The ocean grids which are used in the RegHCM-PM are shown as blue. The land grids which are used in the RegHCM-PM are shown as green.



The grid layout for the outer domain (1st Domain, 26x28 grids, 81 km resolution) of the RegHCM-PM under Mercator projection.



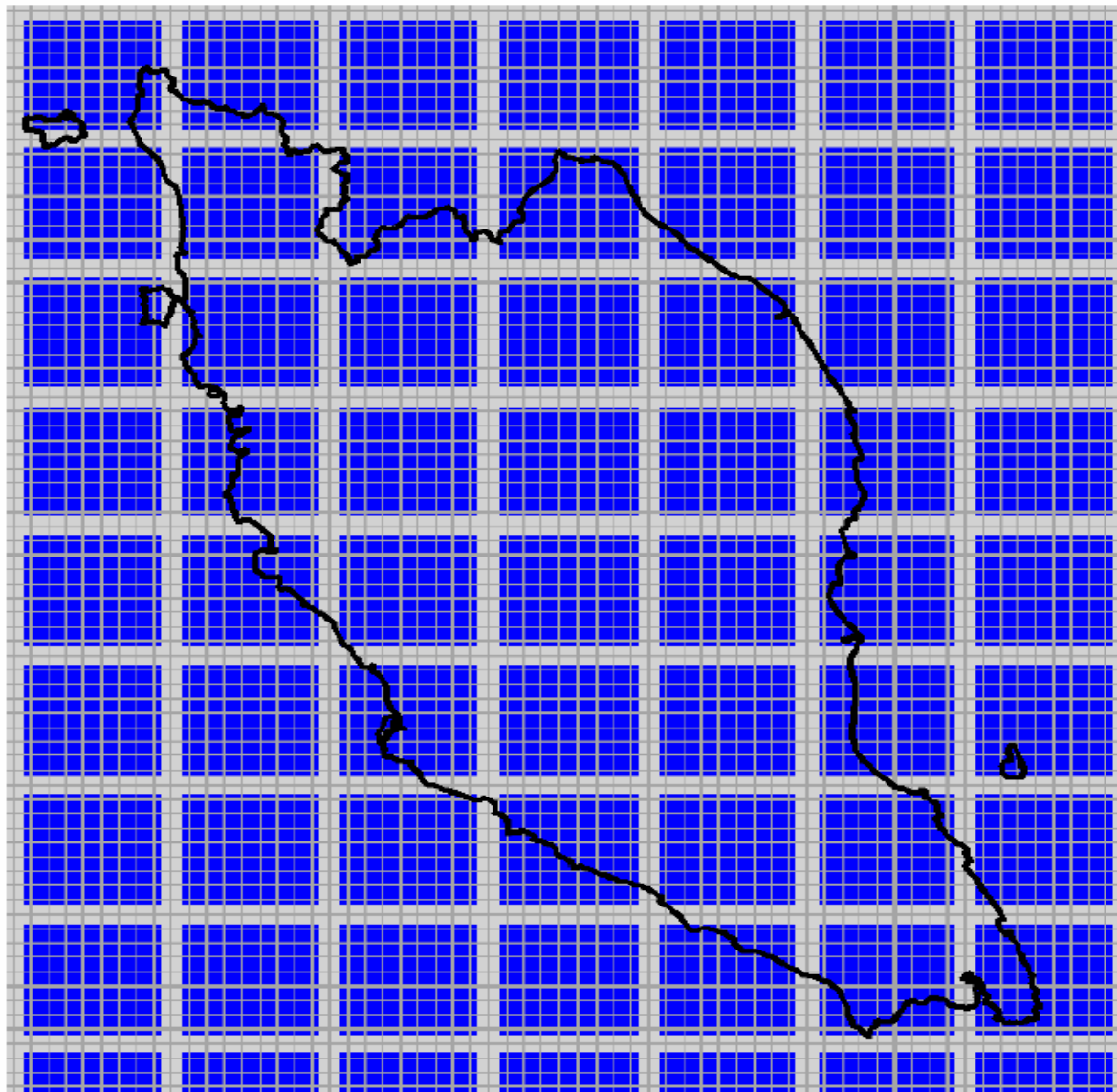


Figure 17 - Nested grids of the inner and the outer domains of RegHCM-PM under Mercator projection. The boundaries of the Peninsular Malaysia and nearby islands are overlaid on the grids.

Needed Actions

- Medium to Long Term - Paradigm shift? Mind set Change?
 - What is our perception of water supply/WRM
 - can we reduce litres/pax/day? – therefore reduce stress on water resources development
 - Singapore is below 170 litres/pax/day
 - GCC countries, 700-500 litres/pax/day
 - Malaysia, 270-450 litres/pax/day
 - What is our **overall objective in D&I water supply services**
 - Supply all that is needed by each individual or
 - Do we have a conscientious supply policy to ***ensure sustainable economic development***
 - **Agriculture** – can we have precision farming and less water wastage
 - Developed country the ratio is reverse, more on D & I, lesser water for agriculture, yet very high yield
 - Can we treat all our waste water before discharging into the drains and river systems
 - More recycle instead of basin transfers
 - Bonus – Clean river, healthy living

For Whom the bell tolls – Vulnerabilities in a changing Climate

Table 1. Water Resource Vulnerabilities

| Level of Concern | Outcomes of Concern | Climate Drivers | Other Drivers | AIACC Studies |
|------------------|--|---|---|---|
| High | <ul style="list-style-type: none"> ▪ Collapse of water system leading to severe and long-term water shortage | <ul style="list-style-type: none"> ▪ Persistent and severe decline in water balance due to reduced rainfall and/or higher temperatures ▪ Sea level rise causing salt-water intrusion into shallow aquifer of small island ▪ Disappearance of glacier | <ul style="list-style-type: none"> ▪ High dependence on single vulnerable water source ▪ Lack of alternative water sources ▪ High and growing water demand relative to reliable supply ▪ Failure of water and land-use policy, planning and management | |
| | <ul style="list-style-type: none"> ▪ Water scarcity that retards progress on Millennium Development Goals and threatens food security | <ul style="list-style-type: none"> ▪ Persistent, regional decrease in rainfall, increase in aridity ▪ More variable rainfall and runoff ▪ More frequent severe drought events | <ul style="list-style-type: none"> ▪ High and growing water demand relative to reliable supply ▪ High dependence on subsistence or small-scale rain-fed crop farming and herding ▪ Land degradation ▪ High poverty rate ▪ Insufficient investment in rural development ▪ Inequitable access to water ▪ Lack of social safety nets ▪ Governance failures | <ul style="list-style-type: none"> ▪ North Darfur, Sudan (Sanjak <i>et al.</i>, 2005) ▪ Northern Nigeria (Nyong <i>et al.</i>, 2005) ▪ Mongolia (Batima <i>et al.</i>, 2005) ▪ Mexico (Eakin <i>et al.</i>, 2005) |

| | | | | |
|--------|--|---|---|---|
| Medium | <ul style="list-style-type: none"> ▪ Losses from reallocations of water among competing users ▪ Non-violent but costly conflict among competing water users | <ul style="list-style-type: none"> ▪ Persistent and moderate decrease in rainfall, increase in aridity ▪ More variable rainfall and runoff ▪ More frequent severe drought events ▪ Changes in timing of runoff and water availability | <p>Governance failures</p> <ul style="list-style-type: none"> ▪ High and growing water demand relative to supply ▪ Extensive land use changes ▪ Pollution from industrial, agricultural and domestic sources ▪ Undefined or insecure water rights ▪ Poor performance of institutions for water planning, allocation and management | <ul style="list-style-type: none"> ▪ Western China (Yin <i>et al.</i>, 2005) ▪ Philippines (Pulhin <i>et al.</i>, 2005) ▪ South Africa (Nkomo <i>et al.</i>, 2005) |
| | <ul style="list-style-type: none"> ▪ More frequent flood events that increase loss of life, damage to infrastructure, loss of crops and disruption of economic activities | <ul style="list-style-type: none"> ▪ Increase in heavy precipitation events | <ul style="list-style-type: none"> ▪ Growth in populations and infrastructure in flood prone locations ▪ Poorly managed land-use change, including clearing of vegetation and filling of wetlands that can provide flood protection ▪ Ineffective disaster prevention, preparedness, warning and response systems | <ul style="list-style-type: none"> ▪ Argentina (Eakin <i>et al.</i>, 2005) ▪ Argentina (Barros <i>et al.</i> 2005) ▪ Thailand & Lao PDR (Chinvanno <i>et al.</i>, 2005) ▪ Philippines (Pulhin <i>et al.</i>, 2005) |
| Low | <ul style="list-style-type: none"> ▪ Losses to water users from localized, temporary and manageable fluctuations in water availability | <ul style="list-style-type: none"> ▪ Seasonal droughts | <p>More severe effects kept in check by:</p> <ul style="list-style-type: none"> ▪ Effective management, planning and policies for water demand and supply | <ul style="list-style-type: none"> ▪ Philippines (Pulhin <i>et al.</i>, 2005) ▪ Western China (Yin <i>et al.</i>, 2005) ▪ Thailand & Lao PDR (Chinvanno <i>et al.</i>, 2005) ▪ South Africa (Nkomo <i>et al.</i>, 2005) |

Land And Water

■ 2 main Natural Resources

- Needed in all activities and economic initiatives
- Inter-twined in a tight and intimate matrix
- Like inseparable Siamese twin, each needs the other
- If not planned well, both can have negative impacts on the environment and economic development

■ Administrative regions and natural systems

- Usually differ
- How do we interface/integrate/merge
 - To make sense of our planning
- Can NARBO assist
 - To make contact, create awareness at all level, esp
 - Non-technical policy makers
 - Who hold the purse

River Basin - A geographical physical unit

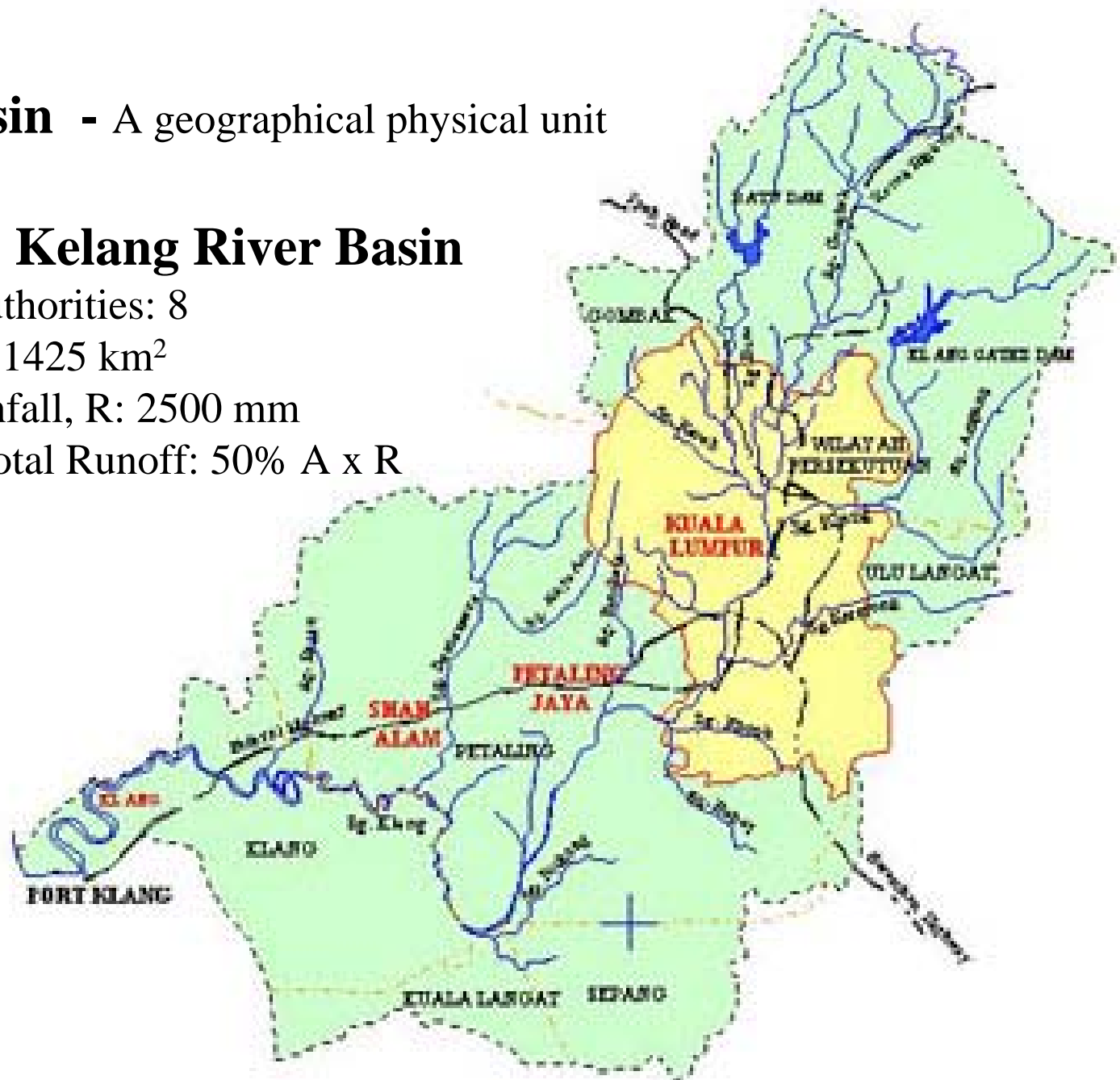
Sungai Kelang River Basin

Local Authorities: 8

Area, A: 1425 km²

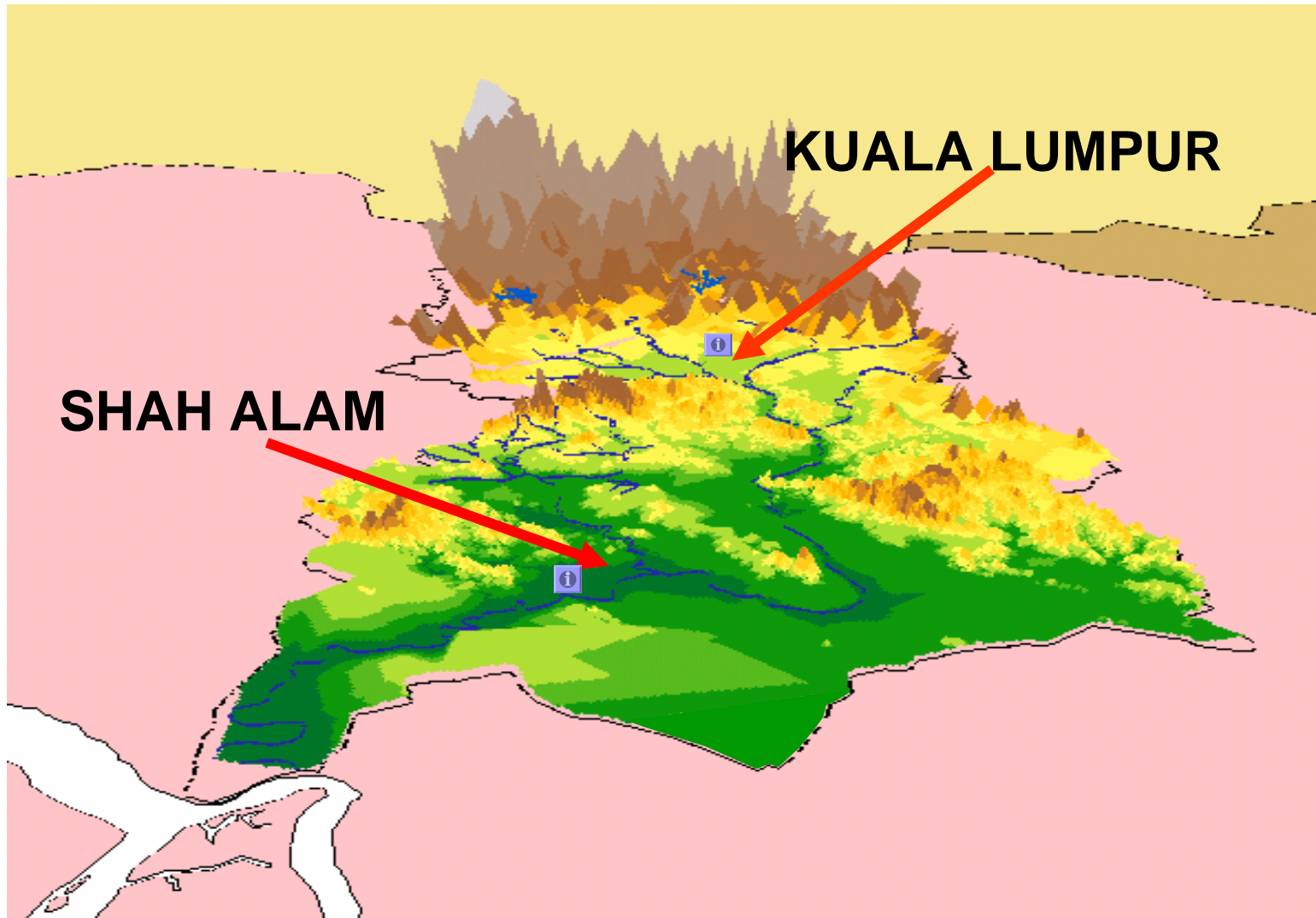
Ave Rainfall, R: 2500 mm

50% of total Runoff: 50% A x R



Klang River Basin

3-D



What Next

- Effecting a change in perception from the top policy makers to the field/on the ground/at the local level?
 - Integrated and holistic management within each basin/sub basin?
 - How?
- Administrative regions and natural systems
 - How do we interface/integrate/merge?
 - How do we incorporate the vulnerability and adaptation to climate changes?
- A Framework of action on WRM?
 - As guidelines for all related water sub-sectors to integrate for a holistic management
 - Weaving all the related elements, including impacts to climate changes, in a coherent matrix
 - And suggesting/providing milestones

What Next

- Can ADB & NARBO assist?
 - To facilitate the study for regional climate change projection and developing WRM Framework of Actions?
 - To make contact, create awareness at all level, especially with the
 - Non-technical policy makers
 - Who hold the purse

NARBO's & ADB's help

- Needed to influence
 - Regional economic and political groupings (ASEAN?) and countries
 - To provide policy and financial support to enable preparation of a framework of action for WRM that should include adaptation to Climate Change Projection
 - As climate impact will derail economic and social development and can cost political unrest



THANK YOU