

**Capacity Development Workshop on Improving Agricultural Productivity,
Water Use Efficiency and Rural Livelihoods**

28-30 January 2008, UNESCAP, Bangkok

Session 4 (29Jan 14:00-16:45):Improving Landuse Planning and Management

*Adapting to climate change in
managing land and other natural
resources: Regional experiences*

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Outline of Presentation

- INTRODUCTION
 - ◆ Climate Change
 - ◆ Agriculture
 - ◆ Land and Natural Resources (Water?) Management
- REGIONAL EXPERIENCES
 - ◆ Vulnerability
 - ◆ Climate Change Projection
 - ◆ Adaptation
- WHAT NEXT



INTRODUCTION - 1

- IPCC AR4- 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
- Focus: Vulnerability and Adaptation, in relations to Agriculture and Water



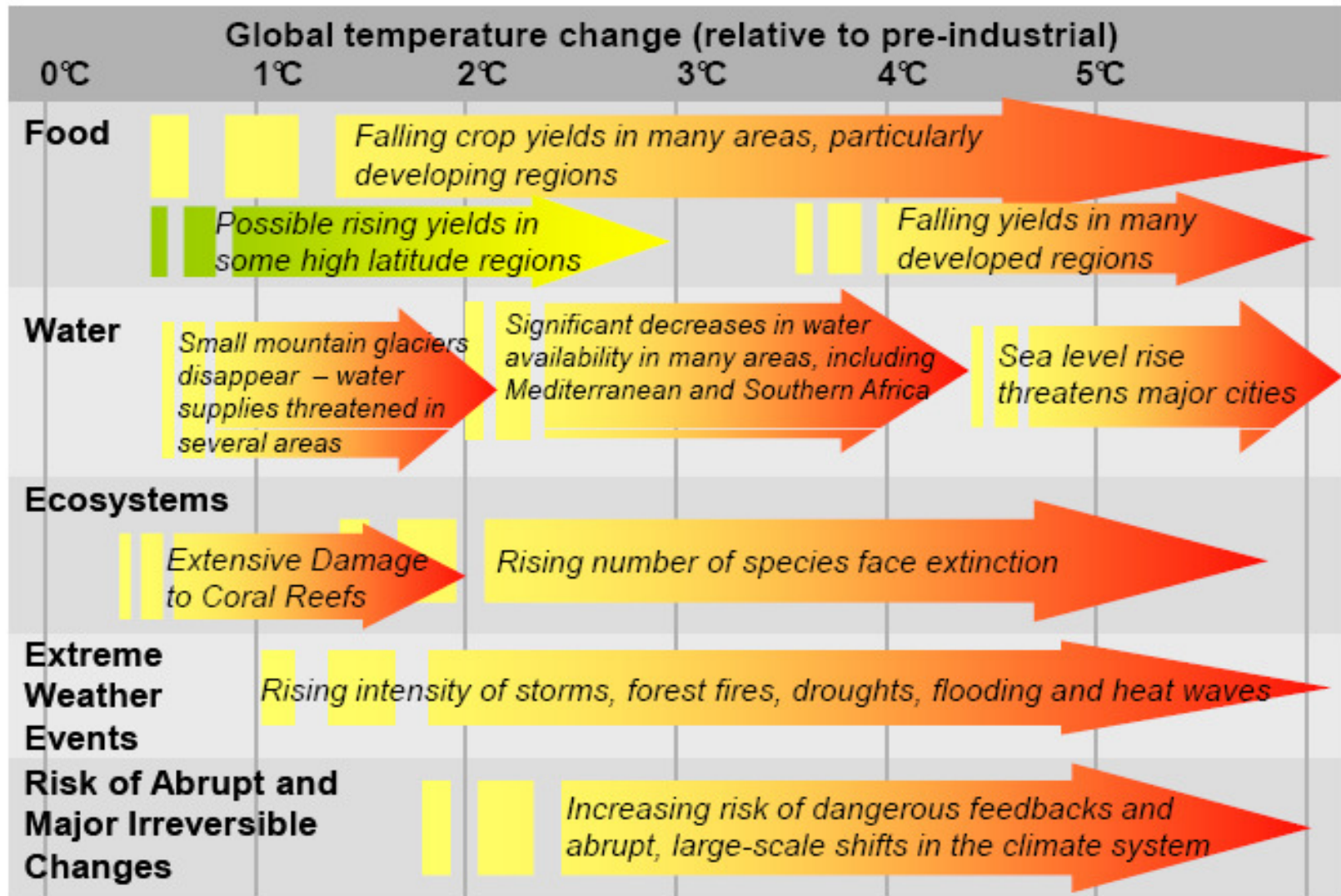
Stern Review: Economics of Climate Change

World Economic Forum, Davos, January 2007

- Climate Change will affect basic elements of life
 - ◆ Access to water, food production, health and environment
- 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)



Projected impacts of climate change (Stern, 2007)



IPCC, 2007

Examples of impacts associated with global average temperature change (Impacts will vary by extent of adaptation, rate of temperature change and socio-economic pathway)

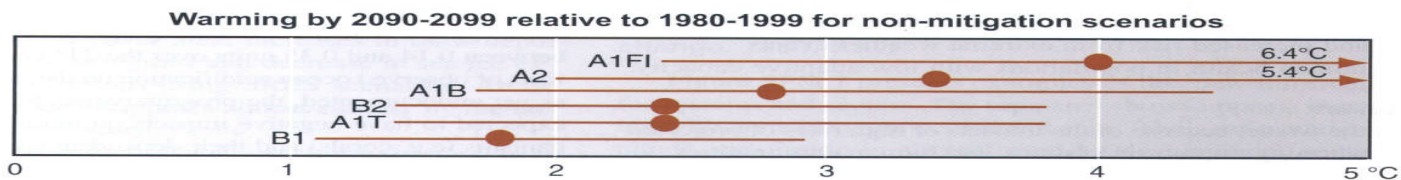
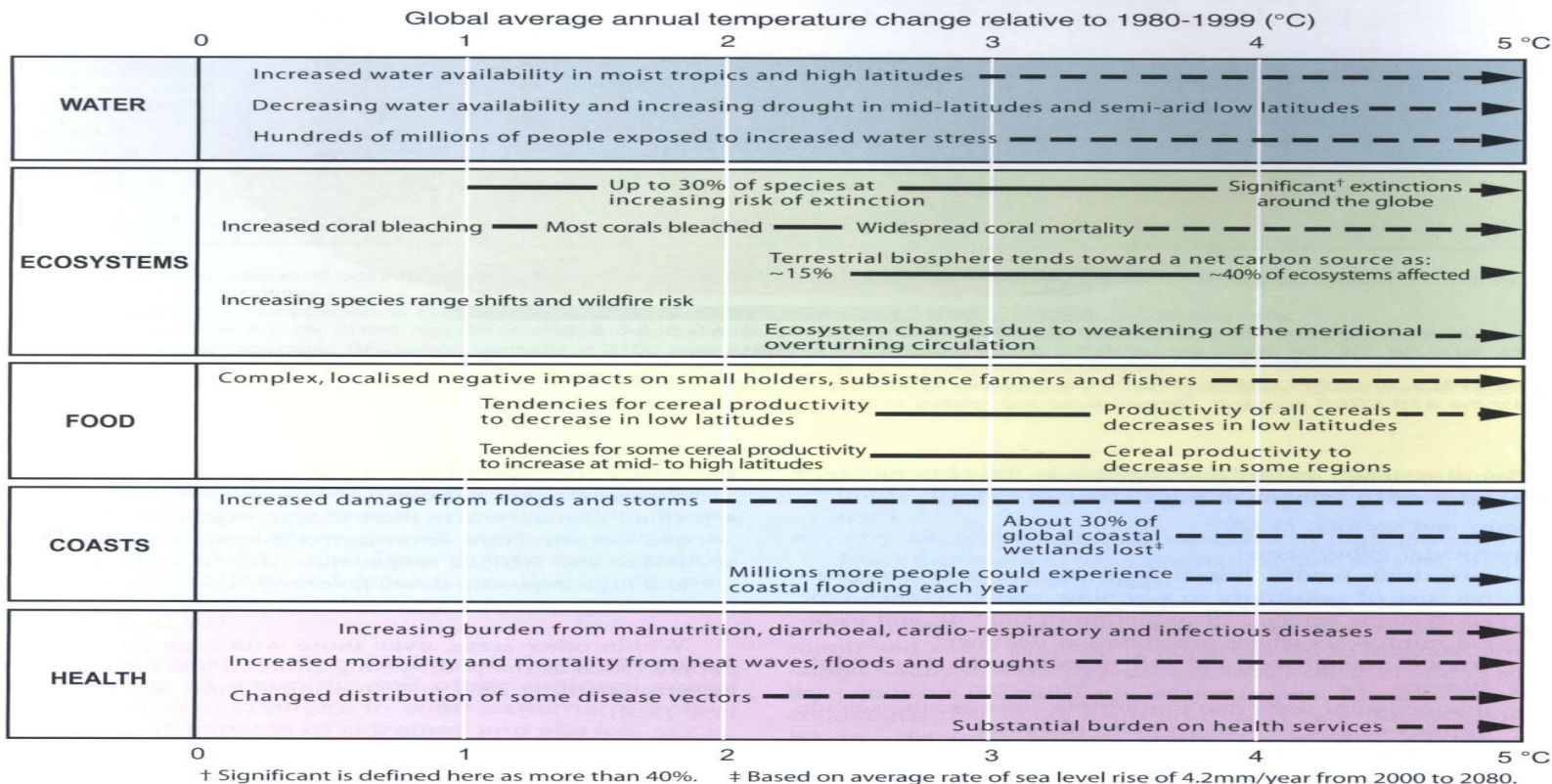


Figure SPM.7. Examples of impacts associated with projected global average surface warming. **Upper panel:** Illustrative examples of global impacts projected for climate changes (and sea level and atmospheric CO₂ where relevant) associated with different amounts of increase in global average surface temperature in the 21st century. The black lines link impacts; broken-line arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left-hand side of text indicates the approximate level of warming that is associated with the onset of a given impact. Quantitative entries for water scarcity and flooding represent the additional impacts of climate change relative to the conditions projected across the range of SRES scenarios A1FI, A2, B1 and B2. Adaptation to climate change is not included in these estimations. Confidence levels for all statements are high. **Lower panel:** Dots and bars indicate the best estimate and likely ranges of warming assessed for the six SRES marker scenarios for 2090-2099 relative to 1980-1999. {Figure 3.6}



Table SPM.3. Examples of possible impacts of climate change due to changes in extreme weather and climate events, based on projections to the mid- to late 21st century. These do not take into account any changes or developments in adaptive capacity. The likelihood estimates in column two relate to the phenomena listed in column one. {Table 3.2}

Phenomenon ^a and direction of trend	Likelihood of future trends based on projections for 21 st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems	Water resources	Human health	Industry, settlement and society
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	<i>Virtually certain^b</i>	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks	Effects on water resources relying on snowmelt; effects on some water supplies	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism
Warm spells/heat waves. Frequency increases over most land areas	<i>Very likely</i>	Reduced yields in warmer regions due to heat stress; increased danger of wildfire	Increased water demand; water quality problems, e.g. algal blooms	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on the elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	<i>Very likely</i>	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	<i>Likely</i>	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortage for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	<i>Likely</i>	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations; loss of property
Increased incidence of extreme high sea level (excludes tsunamis) ^c	<i>Likely^d</i>	Salinisation of irrigation water, estuaries and fresh-water systems	Decreased fresh-water availability due to saltwater intrusion	Increased risk of deaths and injuries by drowning in floods; migration-related health effects	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see tropical cyclones above

Notes:

- See Working Group I Table 3.7 for further details regarding definitions.
- Warming of the most extreme days and nights each year.
- Extreme high sea level depends on average sea level and on regional weather systems. It is defined as the highest 1% of hourly values of observed sea level at a station for a given reference period.
- In all scenarios, the projected global average sea level at 2100 is higher than in the reference period. The effect of changes in regional weather systems on sea level extremes has not been assessed.

The CC Challenges

- more frequent extreme weather conditions of floods and droughts in recent decade
 - ◆ Severe impact to various sectors
 - ★ Agriculture, forestry, biodiversity, water resources, coastal and marine resources, energy and public health
- limited downscaling of global climate models (GCMs) at appropriate finer grids
 - ◆ coarse resolution of GCMs does not incorporate the spatial variation of topography and land use at regional and smaller scales
 - ◆ Finer regional downscaling at regional and national level will provide
 - ★ Better and more reliable analysis of vulnerability
 - ★ Better and more confidence to plan for adaptation strategies



INTRODUCTION - 2

- Agriculture – already stressed by
 - ◆ population increase
 - ★ more mouth to feed
 - ◆ Industrialisation, urbanisation and service focus economies
 - ★ Competition for resources; land, water and human resources
 - ◆ Current economic/financial crunch
 - ★ Competition for financial allocation
- Climate Change impact will exacerbate all, further



Introduction - 3

- Land and Water Resources Management
 - ◆ Most developing and under developed countries have not integrate the managing of these 2 natural resources
 - ★ National Land and Water Councils are separate
 - ★ At the start of development, expedient & issues not so complex
 - ◆ Developed countries
 - ★ Started in similar manner
 - ★ Evolved, expedient to integrate as issues and challenges become more complex and intertwined
 - ◆ Issue: Can/should we help to jump start?
 - ★ Guidelines?, Frameworks for Development?



REGIONAL EXPERIENCES -1

- Studies and R&D on Climate Change,
 - ◆ Mostly by the more developed countries
 - ◆ In developing countries generally carried out by International organizations and Donor Agencies of Developed Countries
 - ★ IPCC & UNFCCC
 - ★ UN and Partners: AIACC (UNEP/WMO, START, TWAS, GEF)
 - ★ ODAs (British, Swedish, Danish, Australian...
- Major Reasons for the lack of studies in developing countries
 - ◆ Other existing pressing priorities
 - ◆ Lack of awareness and limited funds



REGIONAL EXPERIENCES - 2

- AIACC (Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors) Studies,
 - ◆ Focus on filling Gaps in Scientific Knowledge and Capacity following AR3 of IPCC and Covers 24 regions and 46 countries with projects in
 - ★ Asia (5), Africa (11) and Latin America (5)
 - ◆ Focus on identifying vulnerabilities and recommendation for adaptations
 - ◆ The following slides are extracted from AIACC Studies



Water Resource Vulnerabilities -1

Level of concern	Outcomes of concern	Climate Drivers
High	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
	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



Water Resource Vulnerabilities - 2

Level of concern	Outcomes of concern	Climate Drivers
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>More frequent flood events that increase loss of life, damage to infrastructure, loss of crops and disruption of economic activities</p>	<p>Increase in heavy precipitation events</p>



Water Resource Vulnerabilities - 3

Level of concern	Outcomes of concern	Climate Drivers
Low	Losses to water users from localized, temporary and manageable fluctuations in water availability	Seasonal droughts



Land Vulnerabilities -1

Level of concern	Outcomes of concern	Climate Drivers
High	Wide spread desertification of land with irreversible changes to soil structure or nutrient status	<ul style="list-style-type: none">-Arid, semi-arid or sub-humid climate-Persistent decrease in rainfall, increased aridity-Increase in climate variability, including more frequent extreme droughts
	Widespread but reversible desertification of lands	<ul style="list-style-type: none">-Arid, semi-arid or sub-humid climate-Increase in climate variability, including more frequent extreme droughts



Land Vulnerabilities - 2

Level of concern	Outcomes of concern	Climate Drivers
Medium	Land degradation of limited geographic extent that is irreversible	-Increase aridity of limited geographic extent -Increase in climate variability, including more frequent extreme droughts
Low	Localized but reversible land degradation	Moderate, temporary drying of localized extent



AIACC on Adaptations

(From: *A Stitch in Time, Adapting to a Changing Climate*)

■ Lessons Learned

- ◆ **Adapt now!**
- ◆ **Adaptation is**
 - ★ development
 - ★ for ourselves
 - ★ Placed base
- ◆ **External help** is necessary and justified
 - ★ *Emission largely from the developed economies*
 - ★ *Impacts largely in developing economies, LCDs and SIDS*
- ◆ **Strengthen institutions**
- ◆ **Involve those at risk**
- ◆ **Use sector-based approach**
- ◆ **Expand** information, awareness, and technical knowledge.



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CSIRO MARINE and ATMOSPHERIC RESEARCH -1

(Climate in the Asia/Pacific Region, October 2006)

- Climate Change is likely to further alter the availability of water resources creating water stress
 - ◆ Affect millions and costs of managing water resources will rise
 - ◆ Areas currently in water crisis, Northeast China, deltas of Bangladesh and VietNam likely to experience significant land degradation
 - ◆ For LCDs, such impacts on agriculture, threaten both food security and national economy productivity
- Impact on Regional economies, largely negative
 - ◆ Lost of agricultural revenue and additional costs for managing water resources, coastlines and diseases
 - ◆ Existing challenges to human security significantly exacerbated



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CSIRO MARINE and ATMOSPHERIC RESEARCH - 2

(Climate in the Asia/Pacific Region, October 2006)

- The study further noted
 - ◆ The implications of such challenges to human security are difficult to anticipate
 - ★ Currently little awareness of these implications in the region
 - ★ Lacking – Regional Management frameworks for addressing climate change-induced security



Other programs

- Regional workshops/Forums
 - ◆ Other UN Org & Partners
 - ★ Training of Trainers Course IWRM as Tool for Adaptation to Climate Change “Acting Today, Preparing For Tomorrow “, CapNet/WMO/AguaJaring, 3-6 Nov 2008, Kuala Lumpur
 - ★ Climate Change Adaptation, Disaster Risk Reduction and Sustainable Development, UNDP/NDM-P, 19-20 January 2009, Hanoi
 - ★ Asia-Pacific Business Forum 2009/Climate Game Change – Innovations and Solutions for Climate Change Adaptation, UNESCAP/SIDA 22 January, Bangkok
 - ◆ ADB and Partners
 - ★ Regional Consultation for the Regional Review of the Economics of Climate Change in Southeast Asia (RRECCS), 21-22 Nov 2008, Jakarta
 - ★ Regional Workshop for Developing Partnership for Water and Climate Change Adaptation in the Asia Pacific, 1-5 Dec 2008, Bangi, Malaysia
 - ◆ MRC,
 - ★ Regional Forum on the MRC Climate Change and Adaptation Initiatives, 2-3 Feb, Bangkok

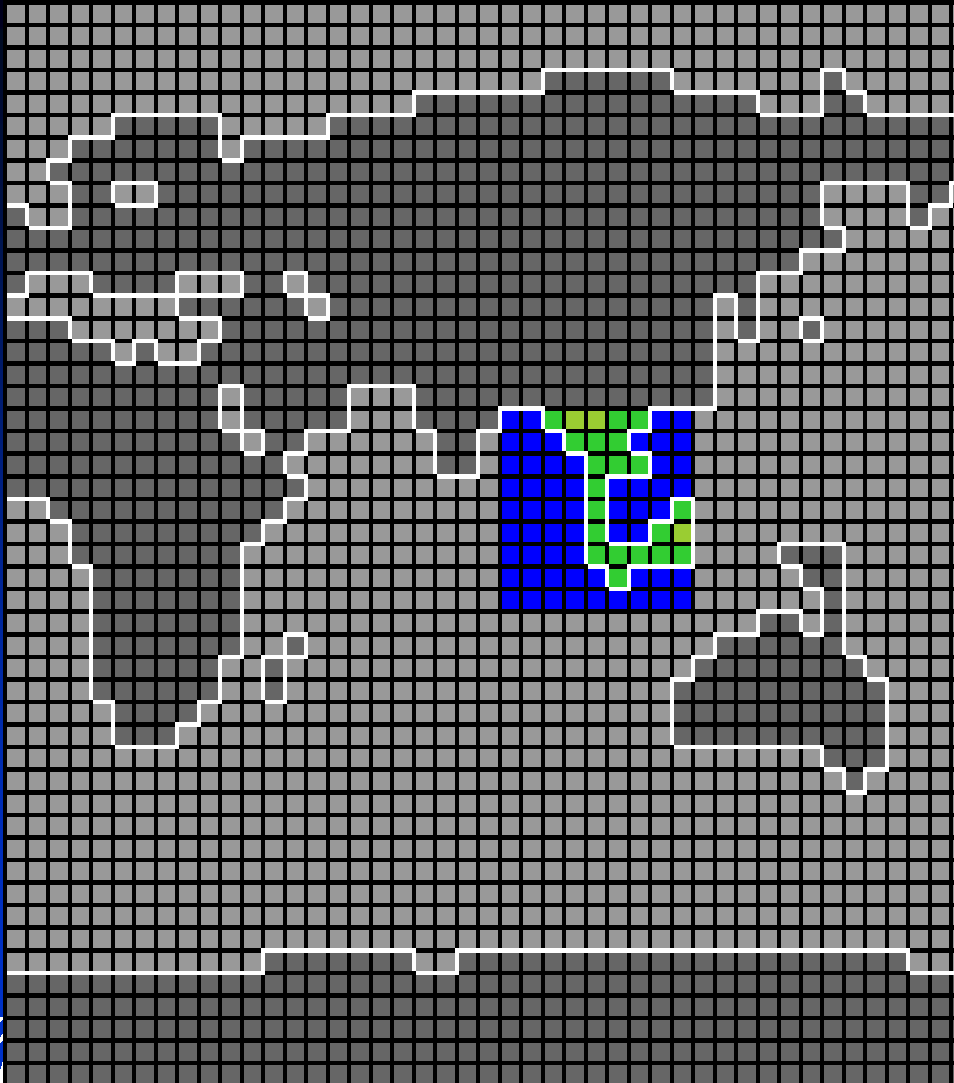


Country level Case Study : Malaysia

- Carried out Climate Projection Studies
 - ◆ Use Dynamic Analysis at 9km grid
 - ◆ Take into account land processes (topography, river flow, evaporation, water storage, etc)
 - ◆ Identified the vulnerabilities
- The output of these studies are/will be inputs to
 - ◆ National adaptation plans and strategies
 - ◆ Preparing NC2 to UNFCCC



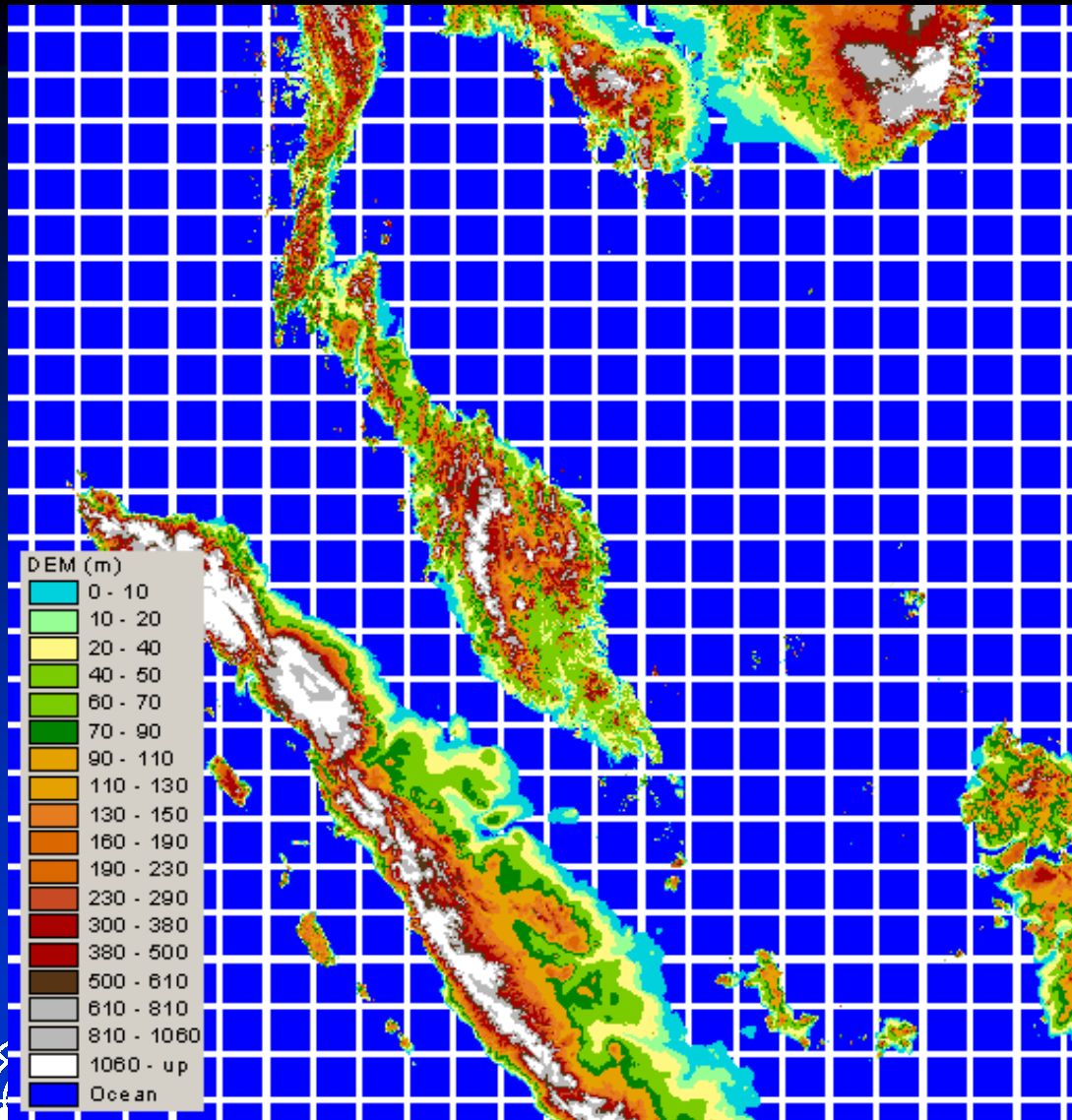
Model Schematization Nesting 1st Domains



1. 1st domain is longitudes span from East 91°-114° and its latitudes span from 5° S to 15° N.
2. 1st domain has 23 x 24 grids and a grid resolution of 81 km, which covers a region of 1863 km x 1944 km
3. RegHCM-PM is nested into the First Generation Coupled General Circulation Model of the Canadian GCM (CGCM1)
4. CGCM1 provides the initial fields and boundary conditions to the RegHCM-PM, and then the CGCM1 simulation results are downscaled to the region of Peninsular Malaysia through several nesting procedures.



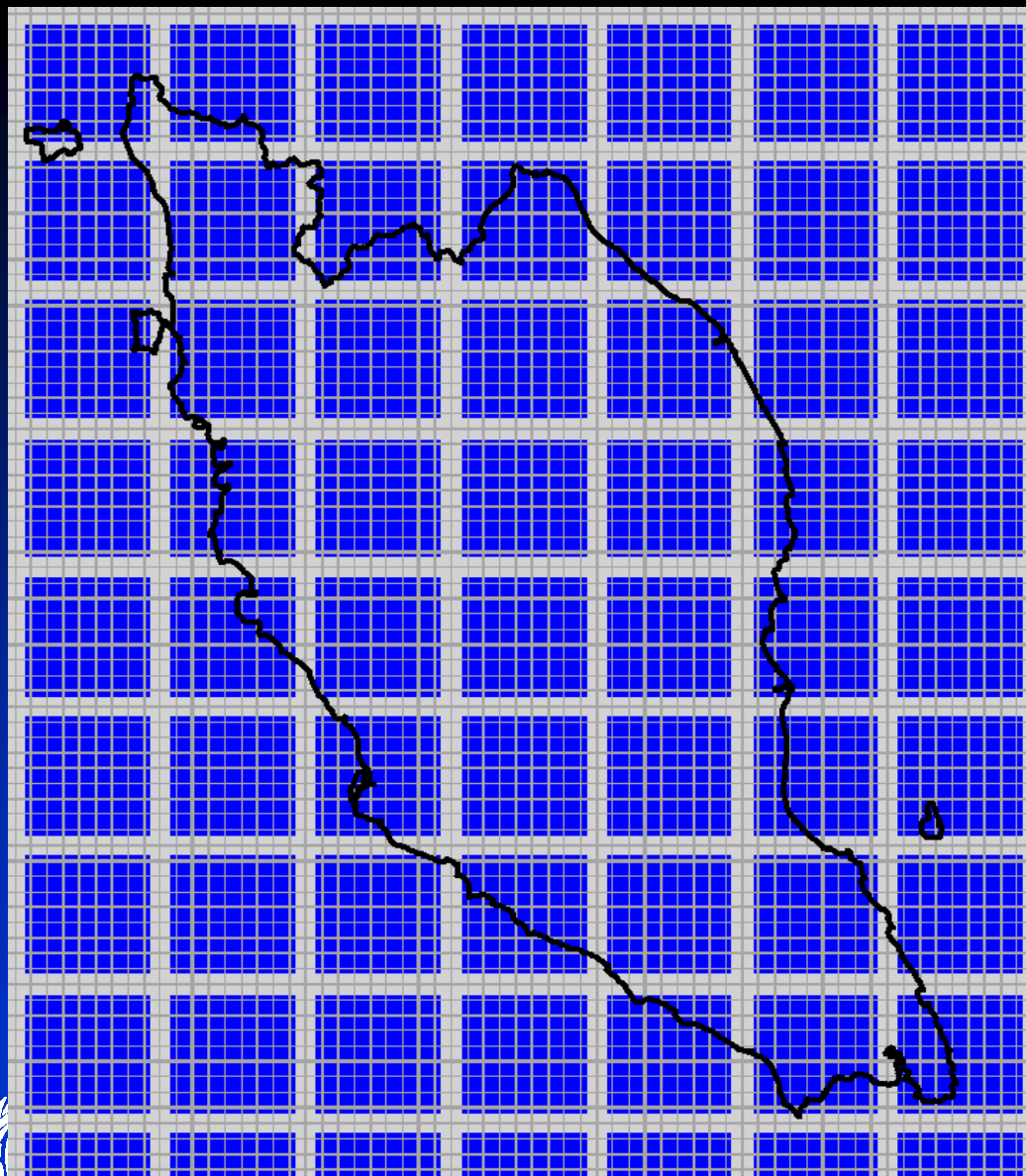
Model Schematization Nesting 1st Domains



1. The grid layout for the **1st domain of the RegHCM-PM** under Mercator projection. GTOPO30 DEM of the region is overlaid on the outer domain grids.
2. Regional Hydroclimate model (RegHCM) of Peninsular Malaysia was run first with its initial and boundary conditions provided from CGCM1 global historical atmospheric simulation data at 1st domain, covering the whole Peninsular Malaysia region and the surrounding areas



Model Schematization Nesting 2nd and 3rd Domains



1. The 2nd domain with 34 x 37 grids and a grid resolution of 27 km, which covers a region of 918 km x 999 km, is nested within the center of the 1st domain.
2. The inner domain (the 3rd domain) is nested within the center of the 2nd domain & has 64 x 76 grids at a grid resolution of 9 km, and covers a region of 576 km x 684 km.
3. The 3rd domain is the inner domain of the updated RegHCM-PM, which encompasses the entire Peninsular Malaysia and covers a part of Thailand in the north, Singapore in the south, and a part of Indonesia in the southeast.



Summary of Monthly Air Temperature

Subregion Name		West Coast	Klang	Selangor	Terengganu	Kelantan	Pahang
Maximum Monthly Air Temp (deg C)	Historical	28.9	27.7	27.7	28.2	28.0	28.3
	Future	30.7	29.7	29.5	29.9	29.6	29.9
	Increase	1.8	2.0	1.8	1.7	1.6	1.6
	% Increase	6.2%	7.2%	6.5%	6.0%	5.7%	5.7%
Mean Monthly Air Temp (deg C)	Historical	27.3	26.5	26.4	25.5	25.3	26.1
	Future	28.6	27.9	27.8	26.8	26.5	27.4
	Increase	1.3	1.4	1.4	1.3	1.2	1.3
	% Increase	4.7%	5.3%	5.3%	5.1%	4.7%	5.0%
Minimum Monthly Air Temp (deg C)	Historical	24.9	24.8	24.7	21.9	21.0	22.8
	Future	26.2	25.5	25.4	23.1	22.4	24.1
	Increase	1.3	0.7	0.7	1.2	1.4	1.3
	% Increase	5.2%	2.8%	2.8%	5.5%	6.7%	5.7%



Summary of Monthly Precipitation

Sub-region Name		West Coast	Klang	Selangor	Terengganu	Kelantan	Pahang	Perak	Kedah	Johor
Maximum Monthly Precip (mm)	Historical	600.0	436.2	564.1	1271.2	929.7	633.6	722.9	626.7	591.7
	Future	560.3	601.3	525.7	1913.9	1128.5	684.6	767.8	705.3	538.2
	Diff.	-39.7	165.1	-38.4	+642.7	+198.8	+51.0	+44.9	+78.3	-53.5
	(%)	-6.6	+37.8	-6.8	+50.6	+21.4	+8.0	+6.21	+12.5	-9.0
Mean Monthly Precip (mm)	Historical	179.2	190.1	190.2	289.0	221.8	198.5	192.9	173.6	187.3
	Future	176.2	182.3	180.9	299.0	239.5	208.4	199.4	176.6	180.0
	Diff.	-3.0	-7.8	-9.3	+10.0	+17.7	+9.9	+6.5	+3.0	-7.3
	(%)	-1.7	-4.1	+4.9	+3.5	+7.9	+4.9	+3.4	+1.7	-3.9
Minimum Monthly Precip (mm)	Historical	12.4	12.8	12.2	33.6	15.4	24.5	9.0	2.1	13.3
	Future	7.9	5.9	8.3	14.0	10.9	16.6	4.1	1.1	5.2
	Diff.	-4.5	-6.9	-3.9	-19.6	-4.5	-7.9	-4.9	-1.0	-8.1
	(%)	-36.3	-53.9	-32	-58.3	-29.2	-32.2	-54.4	-50	-60.9



Summary of Monthly Flows

River		Klang	Selangor	Dungun	Kelan-tan	Pahang	Perak	Muda	Johor
Maximum Monthly Flows (cms)	Historical	31.2	107.9	398.4	1535.1	1697.4	523.7	307.4	82.7
	Future	45.8	108.5	569.5	1950.7	2176.6	578.2	340.0	94.0
	Diff.	+14.6	+0.6	+171.1	+415.6	+479.2	+54.5	+32.6	+11.3
	(%)	+46.8	+0.6	+42.9	+27.1	+28.2	+10.4	+10.6	+13.7
Mean Monthly Flows (cms)	Historical	14.4	40.7	93.4	535.9	669.6	286.4	105.6	32.7
	Future	13.3	37.5	98.3	601.7	718.1	299.7	104.0	31.8
	Diff.	-1.1	-3.2	+4.9	+65.8	+48.5	+13.3	-1.6	-0.9
	(%)	-7.6	-7.9	+5.2	+12.3	+7.2	+4.6	-1.5	-2.8
Minimum Monthly Flows (cms)	Historical	2.6	7.1	13.1	158.4	156.3	183.6	25.3	9.8
	Future	3.5	0.5	10.8	125.8	122.7	139.2	5.3	6.8
	Diff.	+0.9	-6.6	-2.3	-32.6	-33.6	-44.4	-20	-3
	(%)	+34.6	-93.0	-17.6	-20.6	-21.5	-24.2	-79.1	-30.6



What Next -1

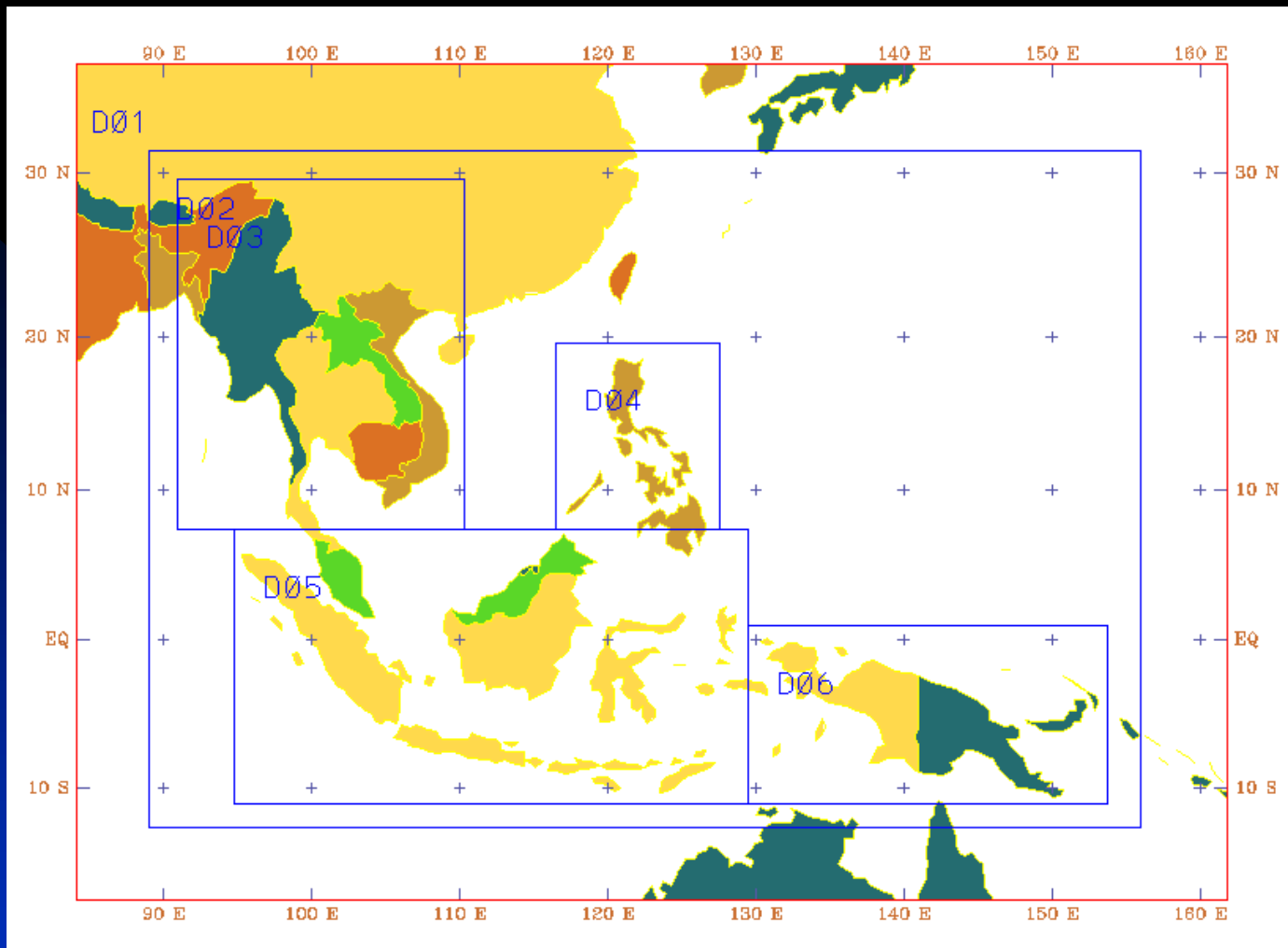
- In Summary, Climate Change
 - ◆ Create increase insecurities in food and water
 - ★ Lost of agricultural revenue and additional costs for managing water resources, coastlines and diseases
 - ★ Impact on regional economies, largely negative, ultimately affect national economy productivity
 - ★ challenges to existing human security significantly increase
 - ◆ CC Projection
 - ★ Minimal number countries have carried out
 - ★ LCDs and SIDs, most vulnerable, may not have any, accept IPCC's
 - ◆ Adaptation Strategies, Needed to combat immediate impact, especially impact to water related
 - ◆ CC Projection needed for Adaptation Strategies



What Next -2

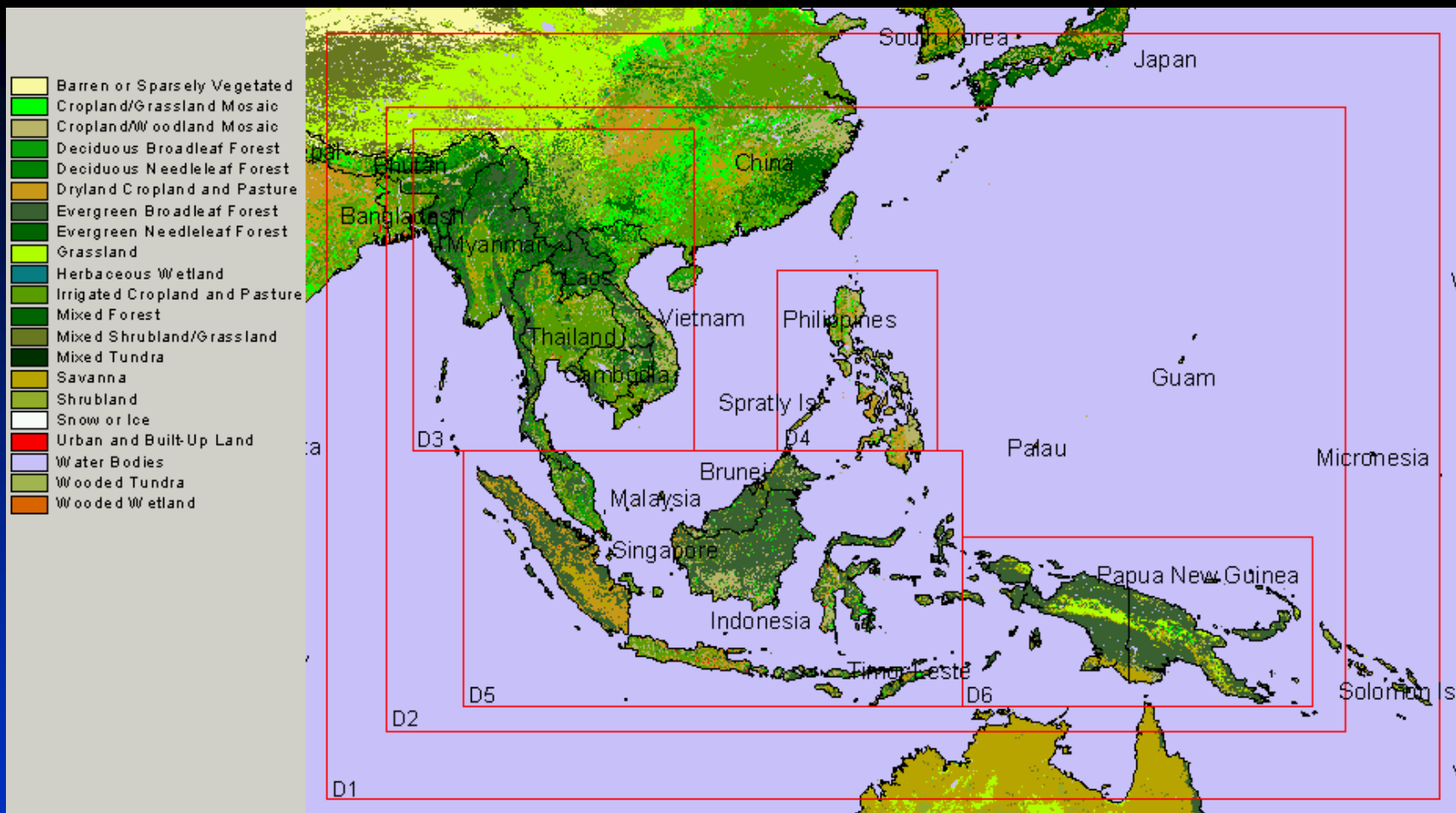
- Need to adapt
 - ◆ Review overarching policies
 - ★ Incorporate CC impact, vulnerabilities and adaptation requirements in all development initiatives
 - ◆ Look at low hanging fruits
 - ★ Review current policies and operations
 - Review O&M of systems including planting schedules and irrigation water efficiencies
 - Plan and Design rehabilitation strategies
- To adapt effectively, requires CC Projection at finer scale
 - ◆ Can international organizations facilitate?
 - ★ A stitch in time probably cost less than the huge cost of managing disasters
 - Lives and properties
 - Human wellbeing, insecurity and dignity, etc





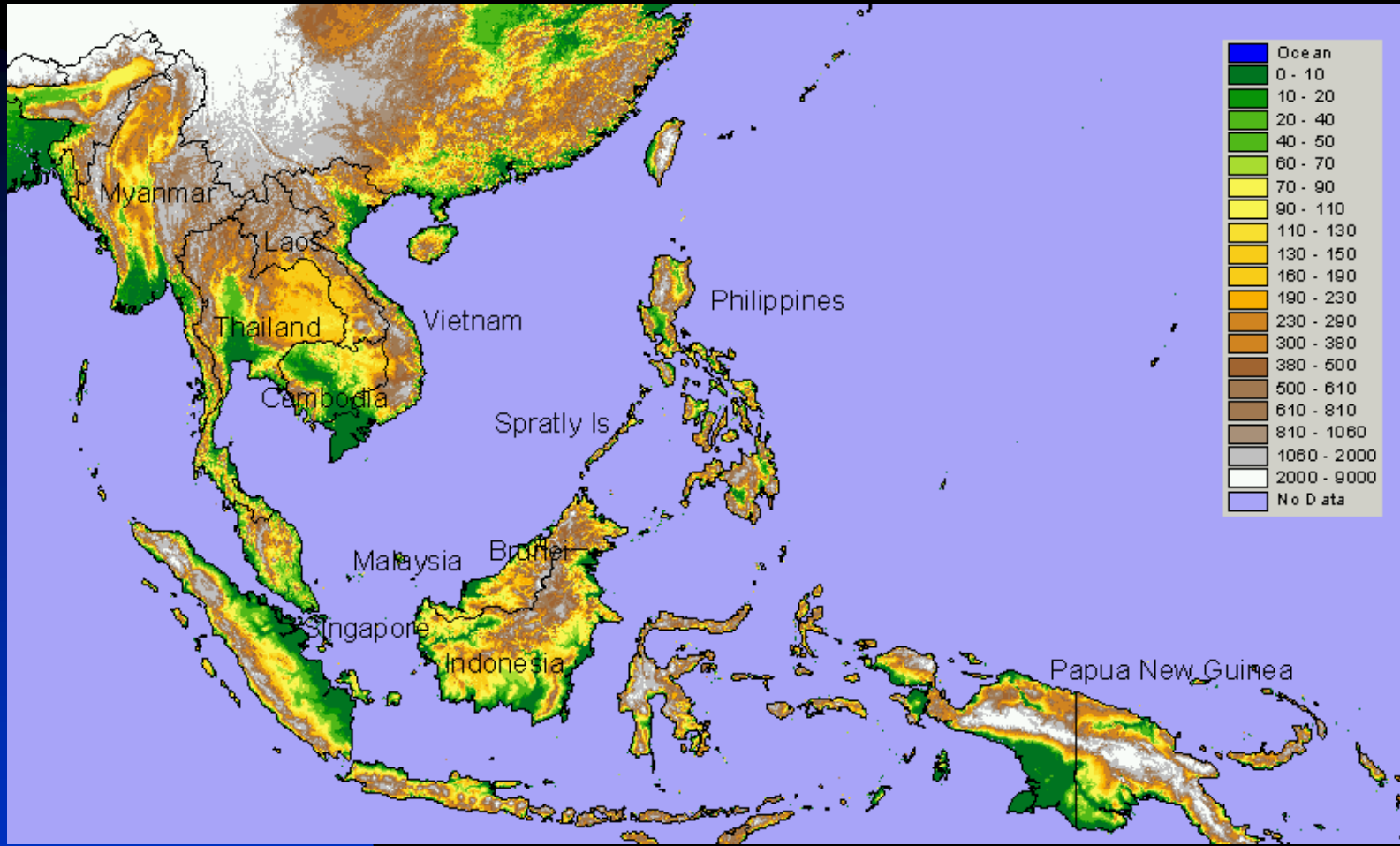
The modeling domains of Southeast Asia; D01 denotes the large outer domain, delineated by red lines; D02 is the intermediate domain, delineated by the large rectangular region that is bounded by blue lines; the domains D03, D04, D05 and D06 are the inner modeling domains. The modeling studies will be carried out at 12km grid resolution.





Land cover map (GLCC) over the Southeast Asia region and proposed computational domains





Digital Elevation Model (GTOPO30) over the Southeast Asia Region



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FAO soil map over the Southeast Asia region. The color indicates soil map units



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What Next -3

- For Long term,
 - ◆ review planning and design of agricultural schemes (land, crop varieties and water efficiencies)
 - ★ vis-à-vis human security and other development projects and economic activities at country Level
 - ★ with cc projection available at finer scale
 - ◆ Possible Integrated National Framework for Land and Water Management (INFLWM) that provide niches for all to fit in, incrementally, over various time periods
 - ★ Set goals and action plans, flexible and can be modified with more information
 - ★ Allows monitoring of initiatives, agreements and commitments



Integrated National Framework LWM (INFLWM–Regional?)

- *Land and Water Resources Management be integrated within each natural physical unit (river basin?)*
 - ◆ Equity distribution of water for the land development of the various sectors and economic activities, taking into considerations basin focus
 - ★ water supply for industry, housing and agriculture, integrated and well coordinated
 - ◆ Clean and vibrant water bodies and better managed land
 - ◆ Biodiversity and gene bank, recognised, protected, thriving and contributing to the each country's economy
 - ◆ Floods, erosion, land slides and other land & water related challenges, well managed and under control



The INFLWM

- Focuses on governance; include capacity building and appropriate human and financial resources allocation
 - ◆ Incorporate land and water, together with other related resources, weaved in a matrix that
 - ★ Complement one another
 - ★ Workable, and developing incrementally, where necessary
 - ★ Supported, monitored, assisted and enforced by all stakeholders
 - ◆ Ensure sustainable economic growth and pristine environment
 - ◆ Must have action plans with targeted milestones



Suggested Milestones INFLWM

- Short Term
 - ◆ **2-3 years:** Develop initial framework, together with more detail milestones and prioritize action plans
 - ◆ Framework to provide niche areas for each related sectors and possibly in-built monitoring mechanism
 - ◆ Implement adaptations for low hanging fruits
- Medium Term
 - ◆ **3-10 years:** implement prioritized areas of actions for each sectors, such
 - ★ over-arching IWRM legislations to fit-in (adapt, adopt, amend) existing related laws and proposed related laws, which lies within a connected and contiguous single environmental system or units
 - ★ managed sustainably impact of global warming on climate changes on land and water resources
- Visionary Term
 - ◆ **Over 2 planning horizons or more,** each of 25 to 30 years
 - ★ Achieve prioritized and achievable targeted objectives
 - ★ May need to be packaged to anticipate/dovetail election schedules, not only to ensure compliance but to support in monitoring impacts



Schematic framework of anthropogenic climate change drivers, impacts and responses

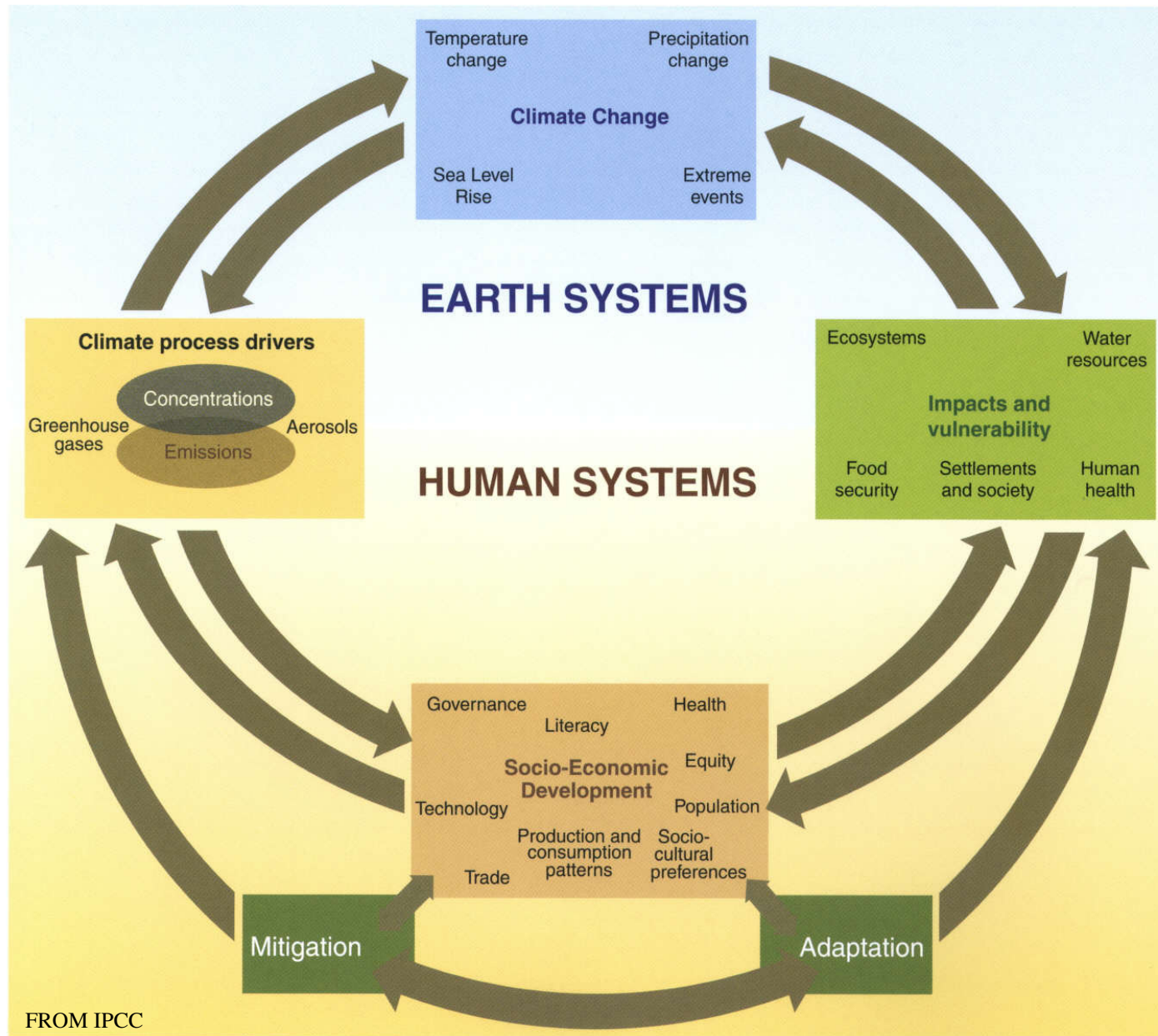


Figure I.1. Schematic framework representing anthropogenic drivers, impacts of and responses to climate change, and their linkages.



THANK YOU



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