Health Impacts of Climate Variability and Change in Malaysia

Datuk Dr. Ir. M.S. Pillay, Dr. Lokman Hakim S,
Dr. Serafina C. F

Workshop on Climate Change and Health in South-East and East Asian Countries

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MALAYSIA

VIETNAM
THAILAND
Gulf of Thailand
SPRATLY ISLANDS
PHILIPPINES
Sulu Sea
Kota Baharu
Kuala Terengganu
South China Sea
Pulau Pinang
George Town
Taiping
Ipoh
Lumut
KUALA LUMPUR
Kuantan
Strait of Malacca
Klang
Seremban
Port Dickson
Melaka
Johor Bahru
SINGAPORE
INDONESIA
KEPULAUAN ANAMBAS (INDONESIA)
KEPULAUAN NATUNA (INDONESIA)
Kudat
Kota Kinabalu
Gunung Kinabatu
Sandakan
Sabah
Pulau Labuan
BRUNEI
Miri
Lahad Datu
Tawau
Pulau Sipadan
Pulau Ligitan
Bintulu
Sibu
Sarawak
Kuching
Borneo
Celebes Sea
INDONESIA
Equator
0 200 km
0 200 mi

The country

- Malaysia is a coastal nation
  - covers an area of 329,733 km2
  - coastal areas are home to more than 60% of the total population
  - most coastal regions are low-lying, areas that are less than 0.5m above the highest tide, or are within 100m inland of the high-water mark, would be especially vulnerable to sea level rise.
- Multi-ethnic and multi-cultural society
  - The population (2006): 26,640,000, growth rate of 2.4% per annum
  - Malays (50.4%), Chinese (23.7%), Indian (7.1%) other indigenous peoples (11%) and others 7.8%.
  - 81% lived in Peninsular Malaysia, with 19% living in Sabah and Sarawak.

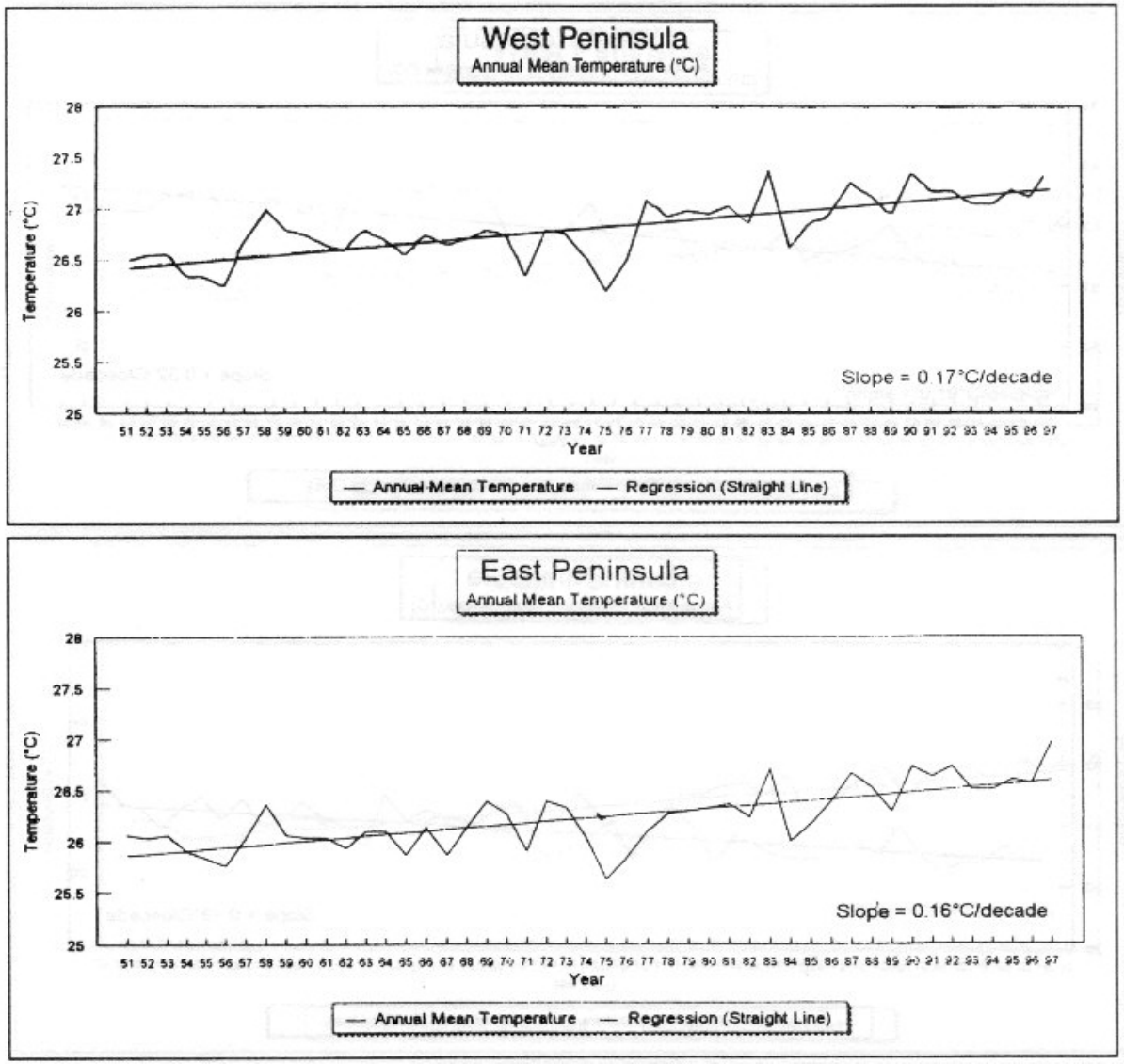
Economic and industrial development

- The Malaysian economy recorded a strong overall growth of 5.9% in 2006, compared with the 5.2% registered in 2005
- The annual growth was attributed to expansion in the manufacturing, services and the agriculture sectors.
- Manufacturing achieved a commendable 7% growth compared with the 5.2% recorded in 2005. Services sustained its growth of 6.5% while Agriculture also recorded an impressive growth from the 2.5% in 2005 to 6.4% in 2006, backed by the strong performance in the rubber and oil palm production during the year.
- The higher foreign direct investment (FDI) at RM18.1billion in the fourth quarter of 2006 compared with RM12.4billion in the third quarter also reflects the confidence in Malaysia's economy.

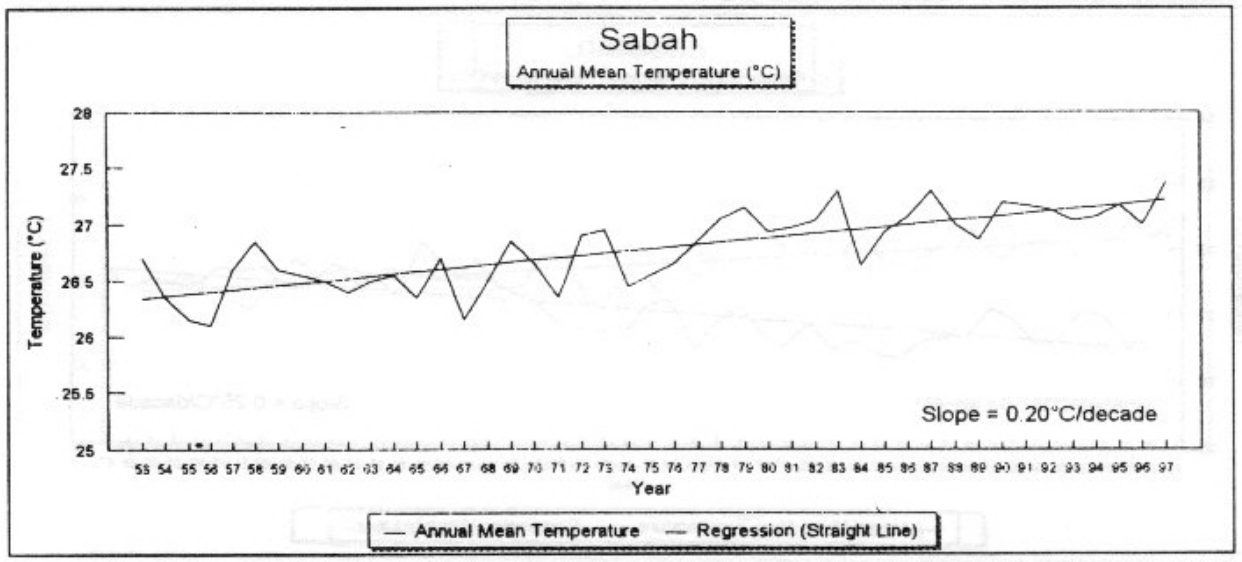
Climate

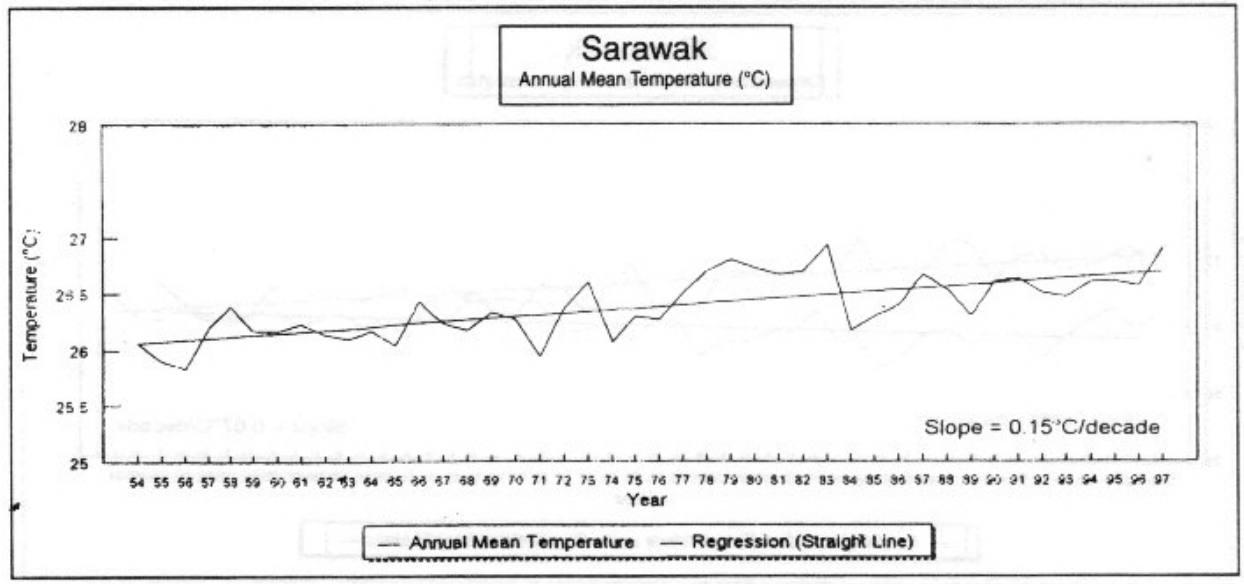
- Relatively uniform temperatures throughout the year
  - Mean temperature in the lowlands ranges between 26°C and 28°C
  - Although the annual variation of the daily mean temperature may be small (about 2°C to 3°C) the diurnal variation may be as large as 12°C.
- Seasonal variations in climate are more evidently marked by rainfall patterns
  - closely mirror changes in the monsoon winds blowing at different times of the year.
  - The Northeast monsoon is dominant from November to March, bringing moisture and more rain.
  - Between June and September, the Southwest monsoon winds blow.
  - Over 3,550 mm of rainfall a year are being recorded in the lowlands.

Time series of annual mean temperatures of West Coast Peninsula

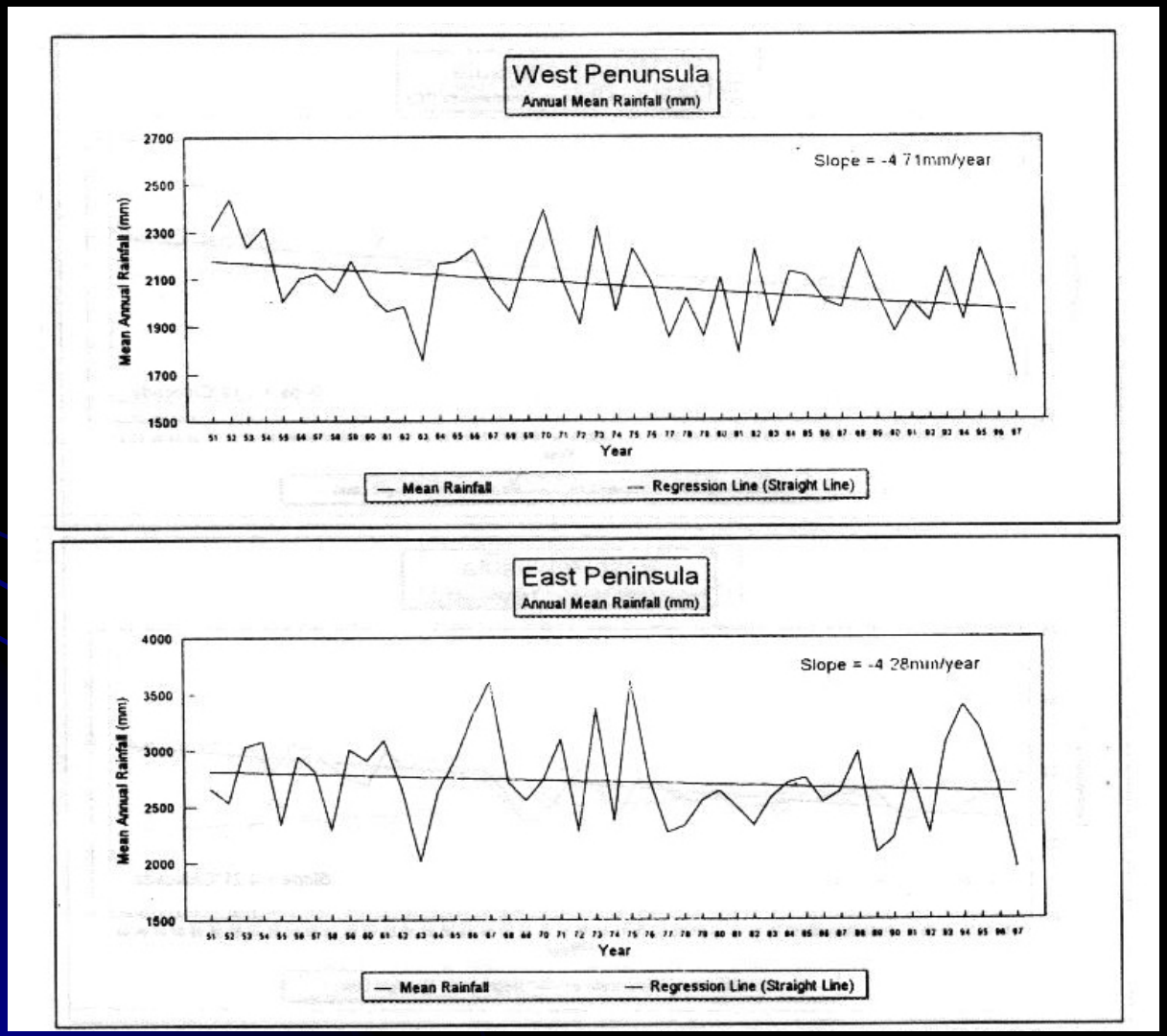


Time series of annual mean temperatures of East Coast Peninsula

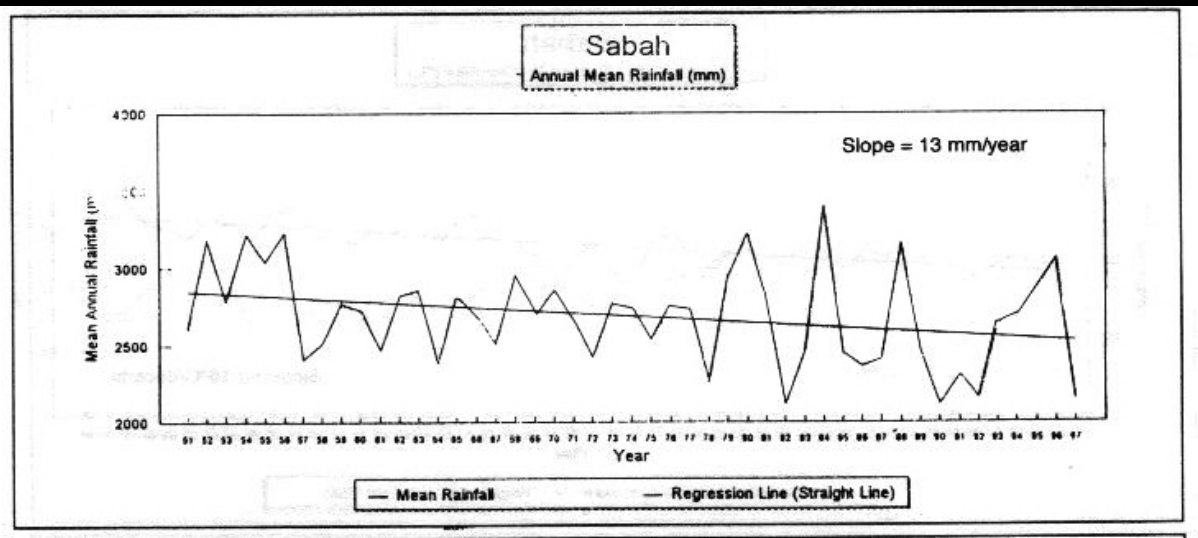


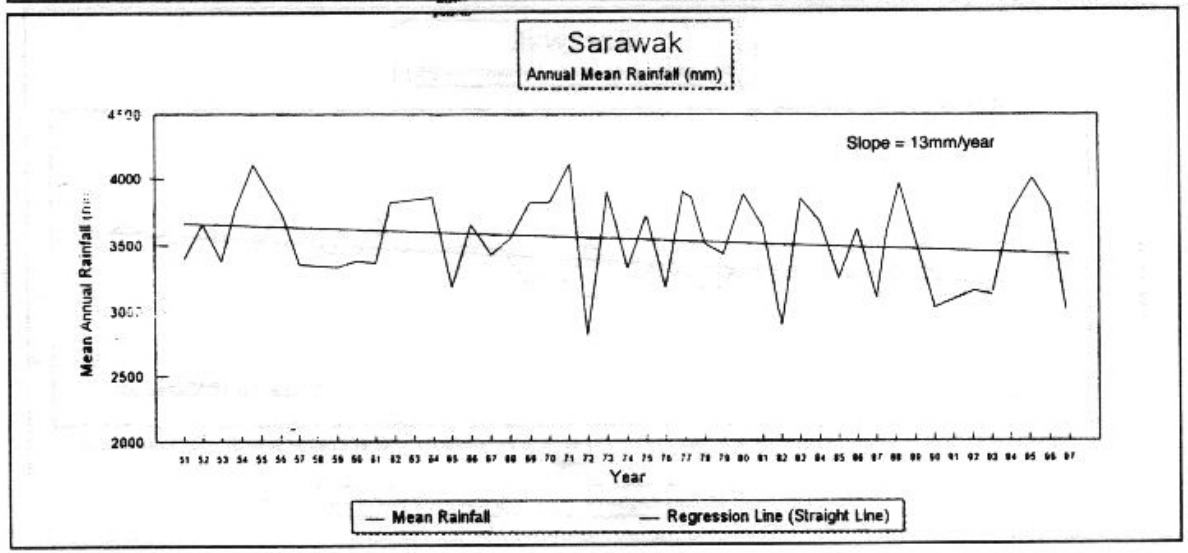


Time series of annual rainfall of West Coast Peninsula



Time series of annual rainfall of Sabah and Sarawak

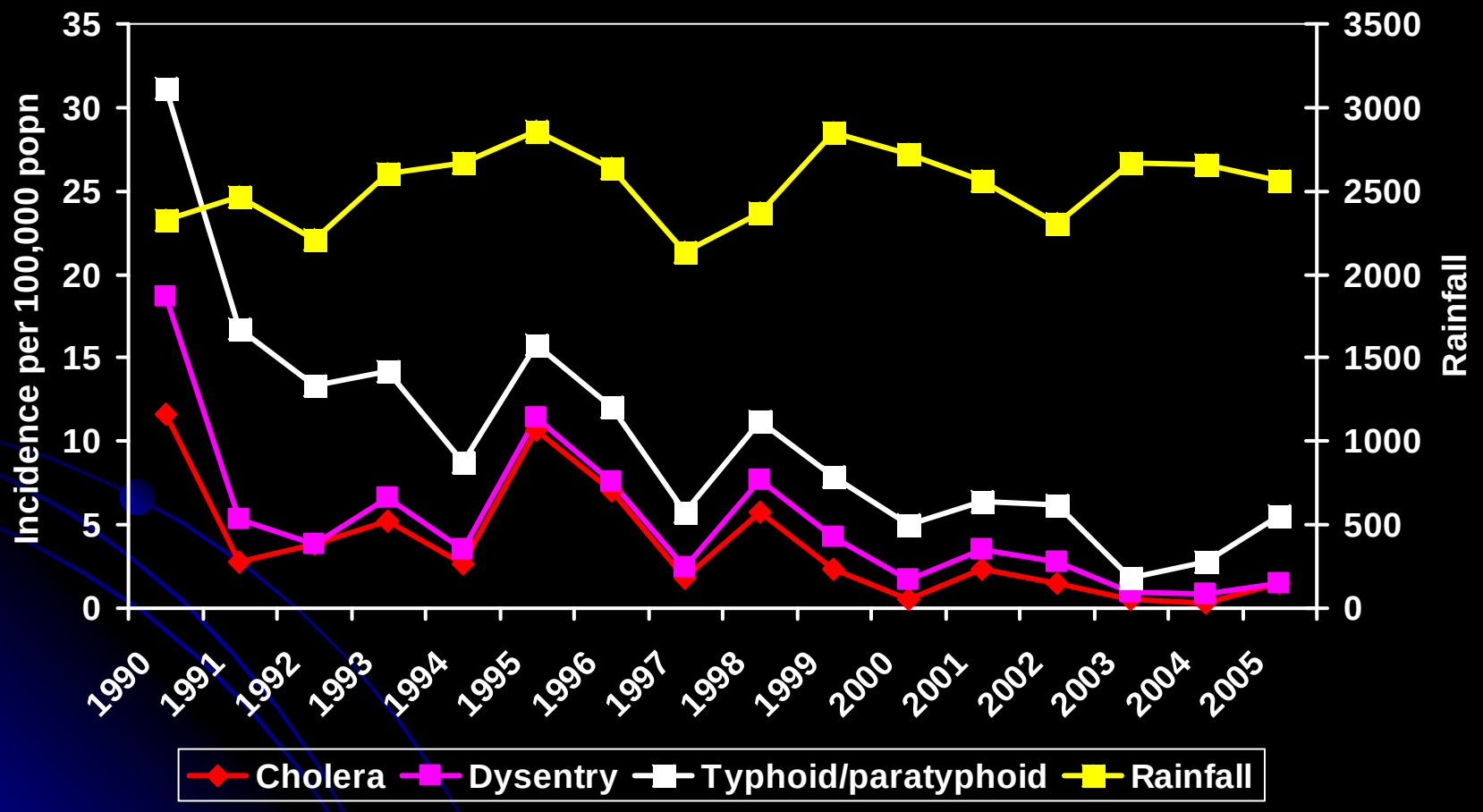




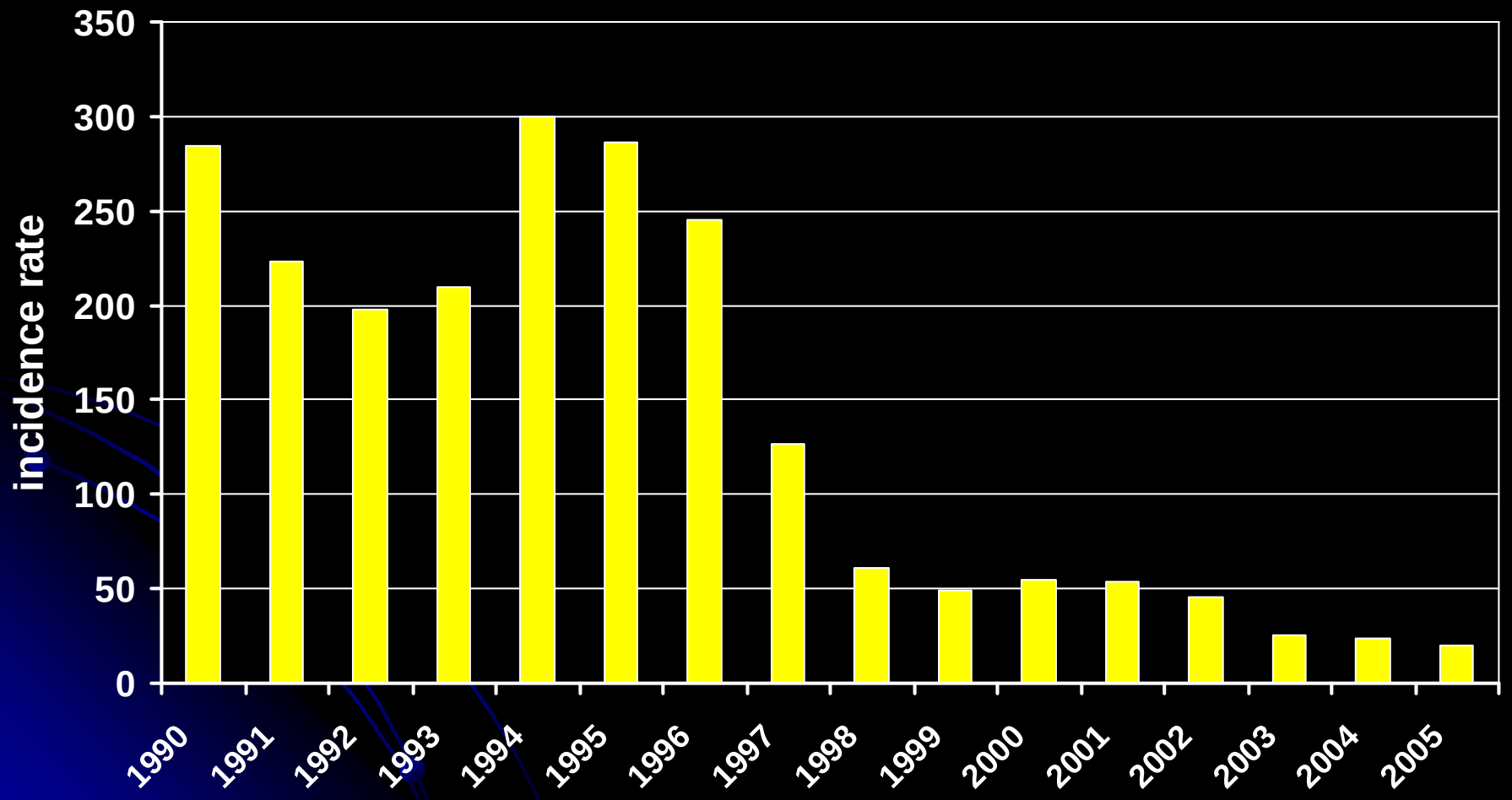
Current Burden of Climate-Sensitive Health Outcomes

- Common communicable diseases sensitive to climate (WHO, 2004) and endemic in Malaysia
  - Climate is the primary factor in epidemic
    - Cholera, Malaria
  - Climate plays significant role
    - Meningococcal meningitis, dengue, Japanese encephalitis, leptospirosis, rickettsial infections

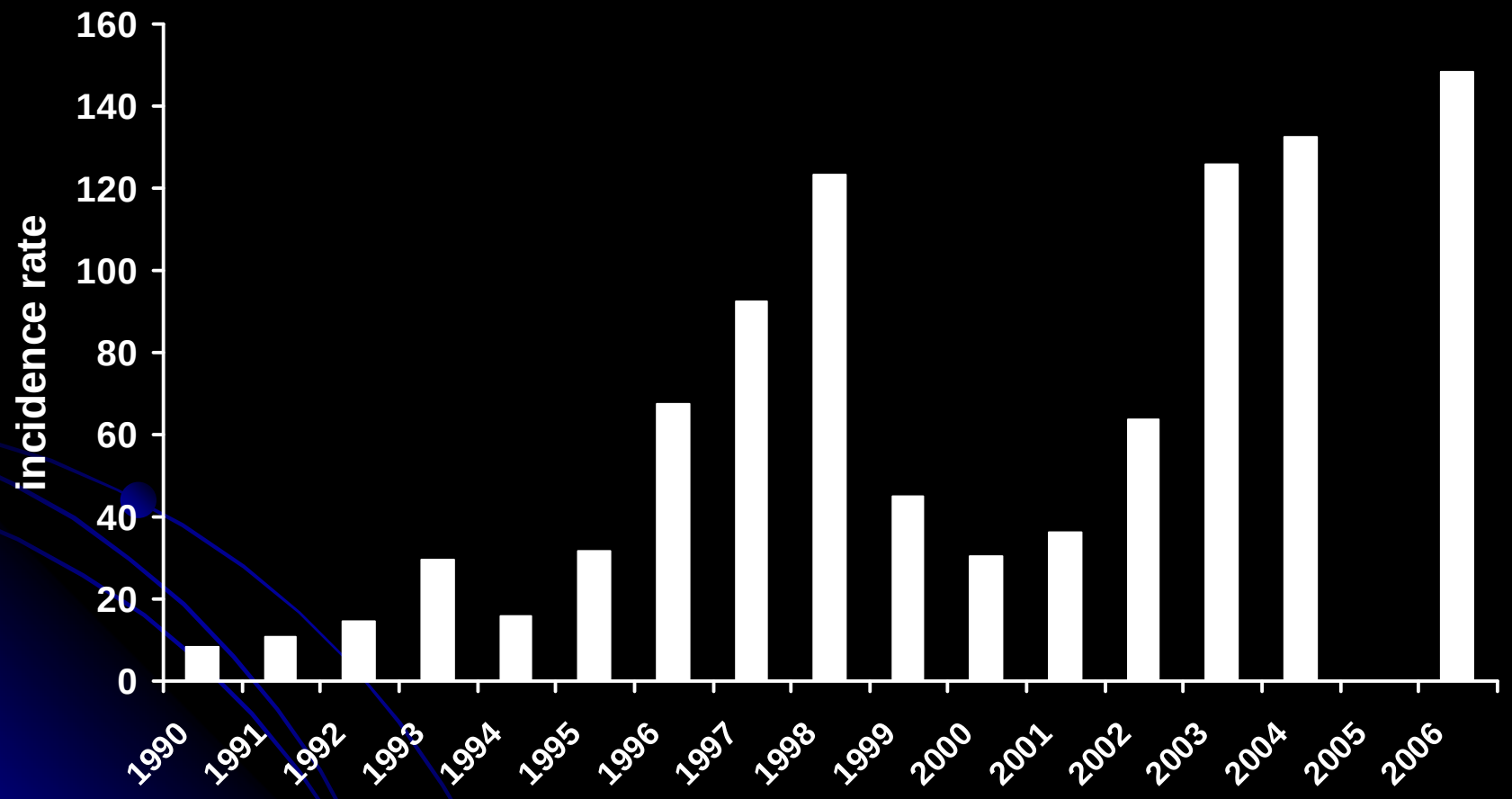
Food and water-borne diseases



Incidence of malaria per 100,000 population in Malaysia



Incidence of dengue per 100,000 population

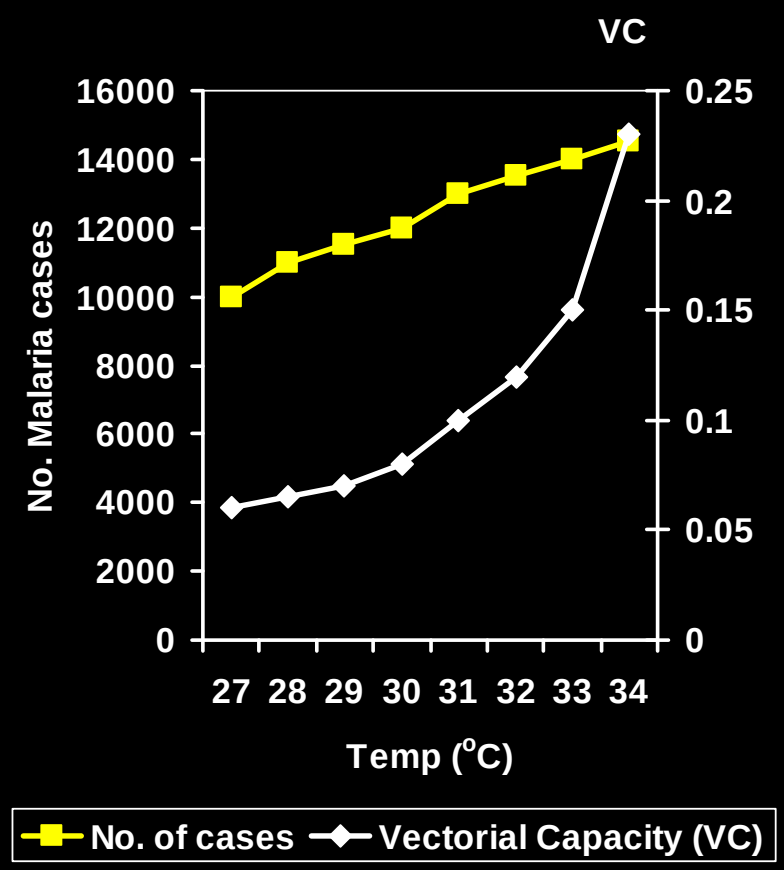


Potential Impacts of Climate Change on Health Burdens

- Very little work has been done in projecting potential impacts of climate change on health burdens
  - Temperature and vectorial capacity of Anopheles maculatus
  - Rainfal and dengue outbreak
- To be addressed in NC2

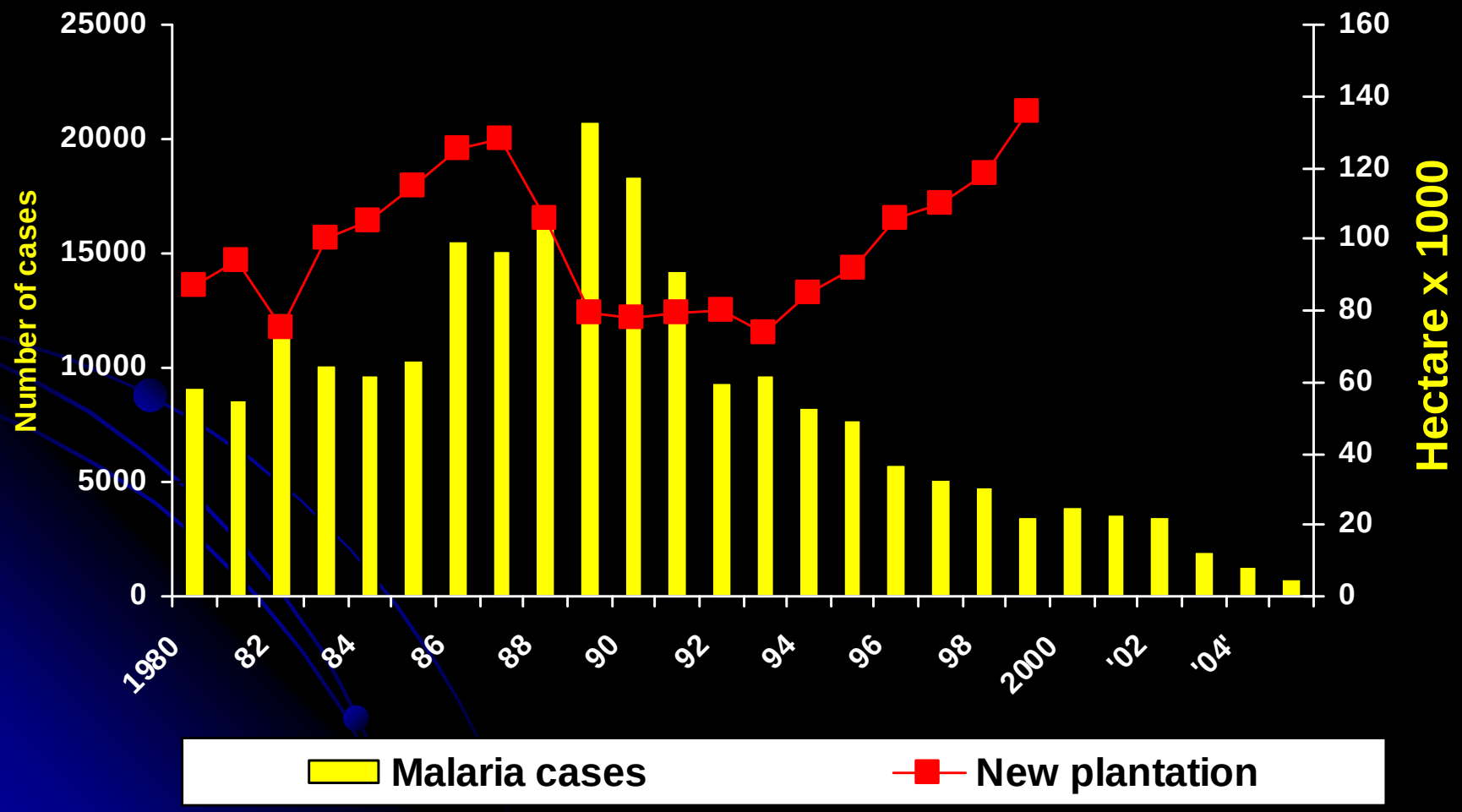
Temperature, vectorial capacity of *Ann. maculatus* and projected number of malaria cases (Ambu et al. 2003)

Temp (°C)	Esti. Ma	Esti. A	Esti. N	C
27	20	0.043	10	0.069
28	21	0.043	9.9	0.075
29	22	0.043	9.8	0.081
30	25	0.050	9.7	0.096
31	27	0.050	9.6	0.12
32	30	0.050	9.5	0.14
33	35	0.050	9.4	0.17
34	40	0.050	9.3	0.20



Changing land-use & malaria outbreaks in Malaysia

(Source: MOH & Statistic Department, Malaysia)



Rainfall and dengue outbreak in Malaysia

- Modification of Mogi et al. 1990 model
- Study the threshold of rainfall actually required to trigger an outbreak
- Dengue incidence and rainfall data in 1986-1997
- Model indicated relatively fewer raining days are required for high transmission
- Heavy rain flushes off breeding habitats

No. days examined for rain	Low transmission: no. raining days required for an outbreak	High transmission: no. raining days required for an outbreak
30	2.89	0.47
60	4.57	2.15
90	6.25	3.83
120	7.93	5.51
150	9.61	7.19
180	11.29	8.87
210	12.97	10.55
240	14.65	12.33
270	16.33	13.91
300	18.01	15.59
330	19.69	17.27
360	21.37	18.95

Particularly Vulnerable Populations

- **Rural population**
  - **Vector-borne and food & water-borne diseases**
  - **Coastal areas**
  - **Mobile, interior natives**
- **Urban population**
  - **Air pollution**
  - **Heat-related morbidity?**

Programmes to Reduce/Mitigate greenhouse gas Emissions

- Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP)
- Biomass-based Power Generation and Co-generation in the Malaysian Palm Oil Industry (BioGen)
- Malaysia Building Integrated Photovoltaic (MBIPV)
- Comparative studies on carbon sequestration potentials
- Clean Development Mechanism (CDM) Projects – energy, waste, agriculture sectors

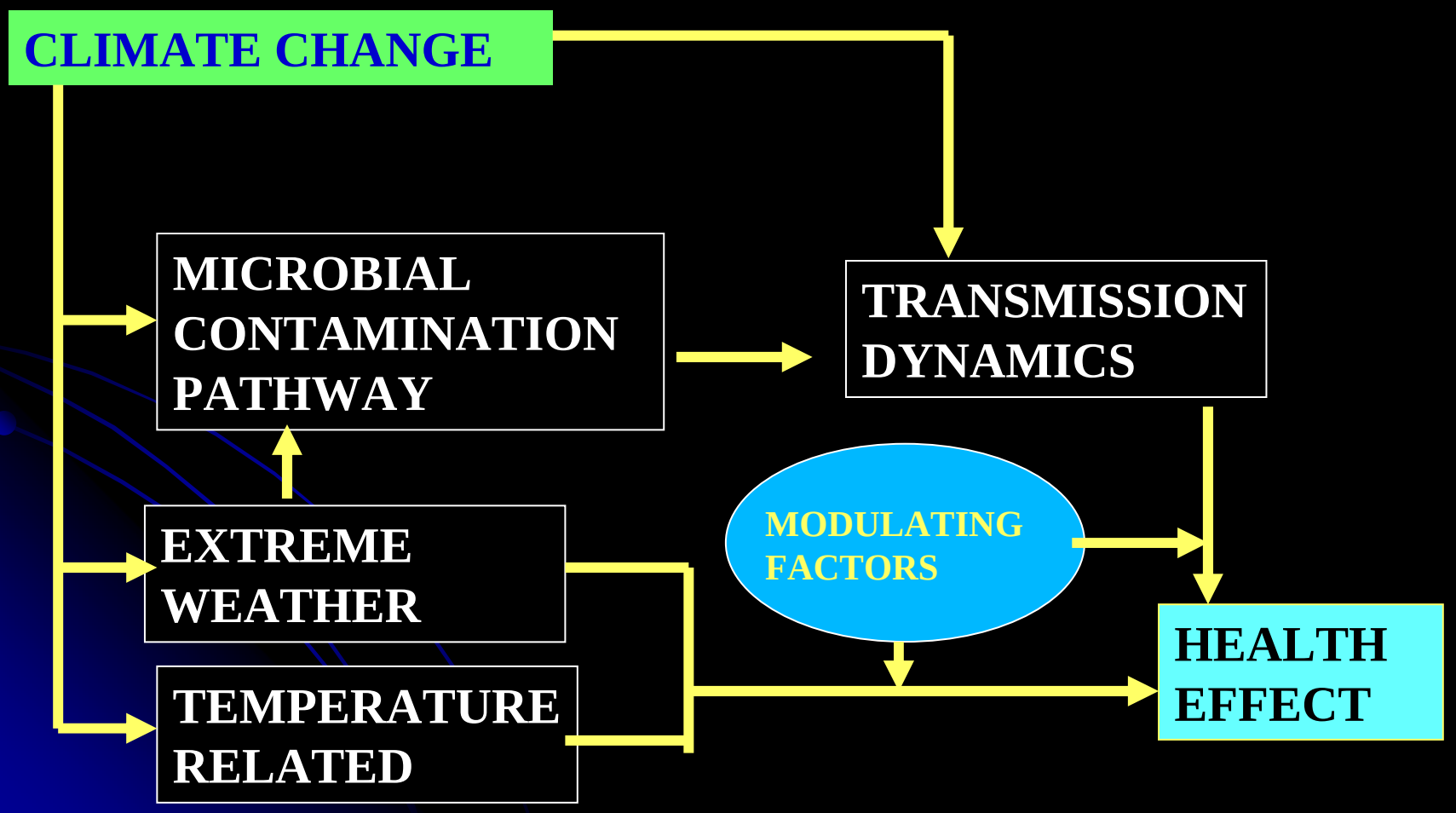
Climate Change-Related Studies and Projects

- Second National Communication (NC2) Project – GHG inventory; projections and mitigation options; vulnerability assessment and adaptation strategies
- Malaysian Meteorological Department studies including climate change modeling, global canopy programme and forest climate interaction study
- Climate change and Its Relationship to Disease Patterns in Malaysia
- Impact of Climate Change on Hydrologic Regime and Water Resources in Peninsular Malaysia

Climate Change-Related Studies and Projects

- National Coastal Vulnerability Index Study
- National Study for Effective Implementation of Integrated Water Resources Management (IWRM) in Malaysia
- Conservation and Sustainable Use of Tropical Peat Swamp Forests and Associated Wetlands Ecosystem
- National Self-Assessment for Capacity Building Needs for Global Environment Management

Data and Research Needs on the Potential Health Impacts of Climate Change



Adaptation to Current and Projected Climate-Related Health Burdens

- Continued investment in health infrastructures & human resource
  - Network of public health laboratories
- Continued vigilance on infectious diseases
- Strengthening surveillance system and disaster preparedness and response
  - Rapid Response Command Centre
  - Malaysian CDC in 9th MP
- Research & development

	Number of facilities		
	1980	1990	2005
Hospitals	93	95	122
Health Centres	351	497	809
Rural Health Clinics	1509	198	2008

Translational research: The way forward towards elimination of indigenous malaria by 2015

KEY CHARACTERISTICS OF MALARIA CONTROL PROGRAM: EVIDENCE-BASED, INTEGRATED, COORDINATED, INTER-SECTORAL

Epidemiological, entomological& transmission dynamics studies, clinical research, basic research, HSR

1961: Pilot Malaria Eradication Project

1967-1971: MEP

1972-1981: Anti-Malaria Program

1990-92: Field trial on insecticide treated bednet (ITN)

1990-2002: Drug resistance studies

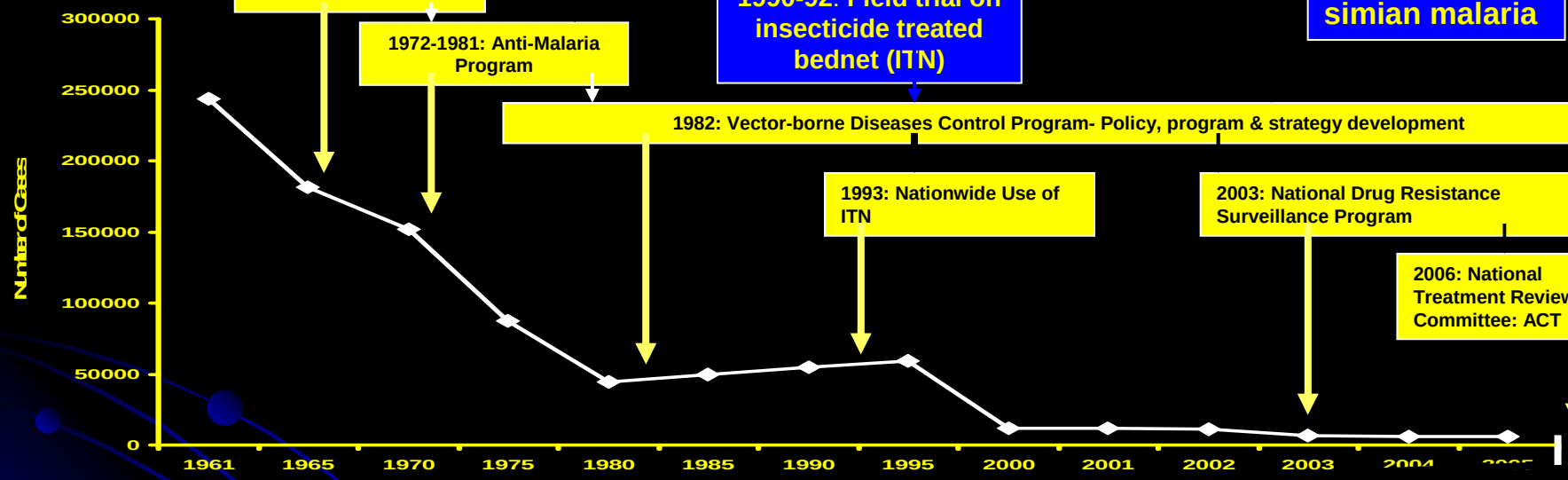
2004: Renewed studies on simian malaria

1982: Vector-borne Diseases Control Program- Policy, program & strategy development

1993: Nationwide Use of ITN

2003: National Drug Resistance Surveillance Program

2006: National Treatment Review Committee: ACT



ELIMINATING MALARIA: THE CHALLENGES

- REMOTE & MOBILE POPULATION – LOGISTIC DIFFICULTIES
- TRADITIONAL VECTOR SURVEILLANCE – INSENSITIVE, DIFFICULT & EXPENSIVE
- INCREASING DISTRIBUTION & DEGREE OF DRUG RESISTANCE TO COMMONLY USED DRUGS
- THREAT OF EMERGING SIMIAN MALARIA

RESEARCH APPROACH: 9TH MP 2006-2010

- INNOVATIVE STRATEGIES – e.g. LENGTHENING RESIDUAL EFFECT OF INSECTICIDE
- MODELING – INTEGRATING SPATIO-TEMPORAL DATA USING REMOTE SENSING & G.I.S
- SCREENING, DEVELOPMENT & TRIAL OF NEW ANTI-MALARIAL DRUGS
- TRANSMISSION DYNAMICS, EXPOSURE, EPIDEMIOLOGY & DIAGNOSTIC

Institutional Organization

(Highlighted: Members of Vulnerability & Adaptation Working Group of NC2)

- **Key organizations/institutions dealing with climate change**
  - **Ministry of Natural Resources and Environment;**
  - **Economic Planning Unit, Prime Minister Department;**
  - **Ministry of Energy, Water and Communication;**
  - **Ministry of Agriculture & Agro-Based Industries;**
  - **Ministry of Plantation Industries & Commodities;**
  - **Ministry of Science, Technology & Innovation;**
  - **Ministry of Health;**
  - **Ministry of Transport;**
  - **Ministry of Housing & Local Government;**
  - **Ministry of International Trade and Industry;**
  - **Ministry of Education;**
  - **Ministry of Higher Learning;**
  - **Malaysian Meteorological Department;**
  - **Department of Statistics;**
  - **Sabah State Economic Planning Unit;**
  - **Sarawak State Planning Unit;**
  - **Universities;**
  - **NGOs;**
  - **Industry representatives**

Issues and Challenges

- Modeling climate change
  - Capacity to better adapt, develop and run a climate model to generate relevant and localised scenarios
- GHG inventories
  - Research to establish local emission factors
  - Enhancement of institutional capacity for collection and collation of data
- Food sufficiency
  - Stress on food production due to anticipated rise in temperature and prolonged periods of drought
- Coastal vulnerability index (CVI)
  - National mapping exercise to identify coastal areas that are susceptible to the impacts of sea level rise

Issues and Challenges

- **Transfer of Technology**
  - Access to cost effective technology to reduce carbon emissions
- **Land Use, Land Use Change and Forestry**
  - Enhance management to balance development goals while reducing/avoiding deforestation and land degradation.
  - Academy of Science Malaysia Position Paper: Changing Landscape and rural health impact
- **Trans-boundary Haze**
  - Further enhance regional cooperation with neighbouring countries to prevent/reduce the haze

Issues & Challenges (Health)

- Data availability
  - Climatic parameters not available for all stations
  - Incomplete dengue data, available only for the last 7 years (1997-2004)
  - Data mining: manual key-in from hard copy (1997-2001)
- Data quality
  - Many missing data: 40% of the epidemiological week for 1997 and 1998
  - Double entry and wrong zoning of dengue cases
- Differences in diagnostic methods and reporting system
- Meteorological station representative-ness & disease transmission dynamics

Thank You