



McGill



# Adapting to Climate Change

In the water resources sector

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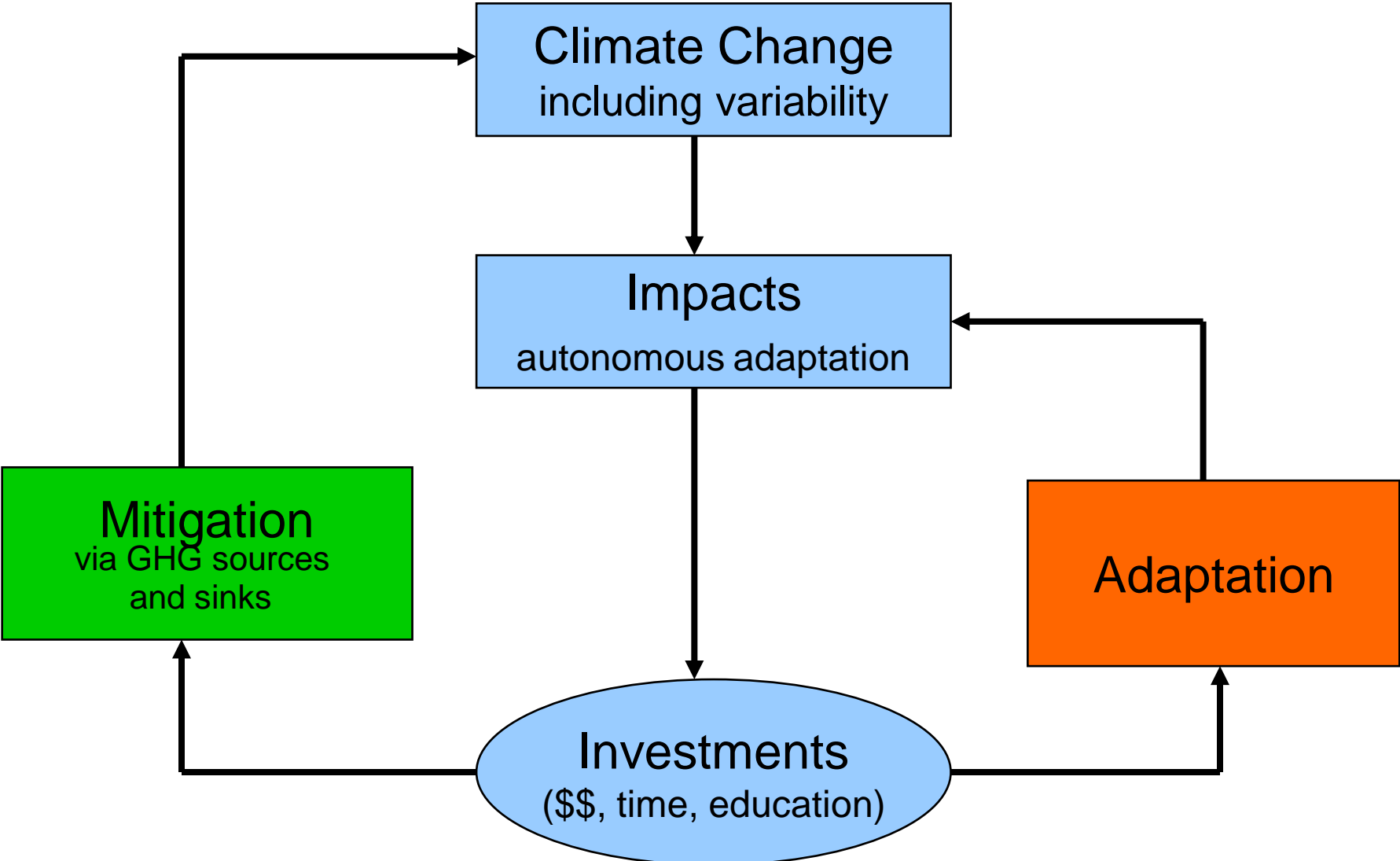
Advanced Integrated Water Resources Management course

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# Introduction

- Scarcity of water is a reality and it is a limiting factor for social and economic development in small islands
- There is a need for augmentation of existing water resources and for more efficient planning and management (water pollution, infrastructure, conservation...)

# TWO ACTIONS MUST BE TAKEN



# Adaptation is...

Adjustments in practices, processes, or structures of systems to projected or actual changes (of climate).

## TO:

1. minimize the negative impacts of future (climate) changes
2. take advantage of new opportunities that may be presented

Adaptation can occur in response to, or in anticipation of, changes in conditions.

# Adaptive capacity definition

- **Adaptive capacity** is the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

# Adaptive capacity

- Ways of increasing adaptive capacity include introducing climate change impacts into development planning:
  - Including adaptation measures into land-use planning and infrastructure design
  - Including measures to reduce vulnerability in existing disaster risk reduction strategies

# Vulnerability definition

- **Vulnerability** is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.
- Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Non-climatic stresses can increase vulnerability to climate change, e.g. coral reef ex.

# Vulnerability

- Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience.
- Climate change can also slow the pace of progress towards sustainable development (e.g. reaching the MDGs)



# Risk Management

- Systematic management of administrative decisions, organization, operational skills and responsibilities to apply policies, strategies and practices for **disaster risk reduction**



# Why water resources decision makers need to consider climate change

- Climate change is expected to bring increases in the frequency and intensity of extreme weather events (flooding, droughts and storms)
- Recent extreme events costs \$ millions
- Affect services, assets and infrastructure of communities
- Current planning and future development should incorporate climate change risks



**It is no longer appropriate to assume that past hydrological conditions will continue into the future**

# Adaptation responses

- Potential adaptive responses available to societies is very large
  - Technical (e.g. sea defences)
  - Behavioural (e.g. altered food choices)
  - Managerial (e.g. altered farm practices)
  - Policy (e.g. planning regulations)

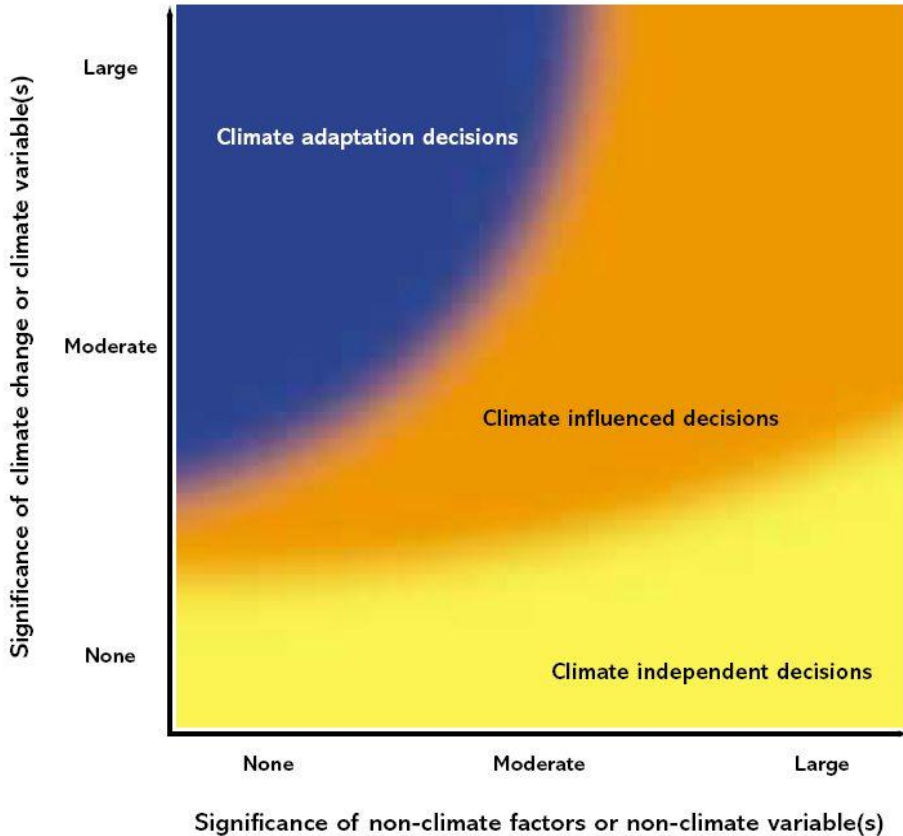


# Implementing adaptation

- Adaptation strategies are dependent on the specific, geographical and climate risk factors, as well as the institutional, political and financial constraints.
- Every adaptation strategy is a unique case!



- Adaptation measures are rarely undertaken in response to climate change alone, but can be integrated within, for example, existing water resources management, coastal defences and risk-reduction strategies.



# Planned (anticipatory) adaptation vs reactive adaptation

- **Planned adaptation** is implemented before the impacts occur and is most effective where several options are considered, and typically involves collaboration among different groups. As well, numerous meetings and lengthy discussions are required to undertake planned adaptation.
- **Reactive adaptation** occurs after the impacts have been felt. This most commonly takes place after an unforeseen natural disaster, or when dealing with unmanaged systems.
- In most cases, planned adaptation is the most cost effective and efficient type of adaptation as it involves a well thought out -and priced- process or plan of action

# Planned adaptation

- Successfully planned and implemented adaptation measures can allow communities to respond effectively to the challenges of climate related events.
- Potential opportunities may also result from planned adaptation measures, such as increased number of green spaces if green spaces (parks) are implemented to reduce an urban heat-island effect.



# Types of adaptation measures

Category	Explanation	Example of climate related impact	Example of ensuing adaptation
<b><i>Business as usual</i></b>	Do nothing to reduce vulnerability and absorb losses	Storm surge	Abandon houses or structures affected by storm surge
<b><i>Prevent the loss</i></b>	Adopt measures to reduce vulnerability	Increase sea level rise	Build sea all (engineer structure) to withstand greater waves
<b><i>Spread or share the loss</i></b>	Spread burden of losses across different systems or populations	River flooding event	Purchase flood insurance
<b><i>Change the activity</i></b>	Stop activities that are not sustainable under the new climate, and substitute with other activities	Acidification of ocean waters	Halt tourist activities around coral reef areas to protect from stress factors
<b><i>Change the location</i></b>	Move the activity or system	Coastal erosion increase	Move houses and dwellings further inland
<b><i>Enhance adaptive capacity</i></b>	Enhance the resiliency of the system to improve its ability to deal with stress	Urban temperatures increasing	Reduce non-climatic stresses, such as contaminant outfall



# Integrating adaptation into decision making

- Climate change is one of a multiple of stressors to which water resources are vulnerable
- Vulnerability is a dynamic concept (changes with time)
- Adaptation is part of a planning process

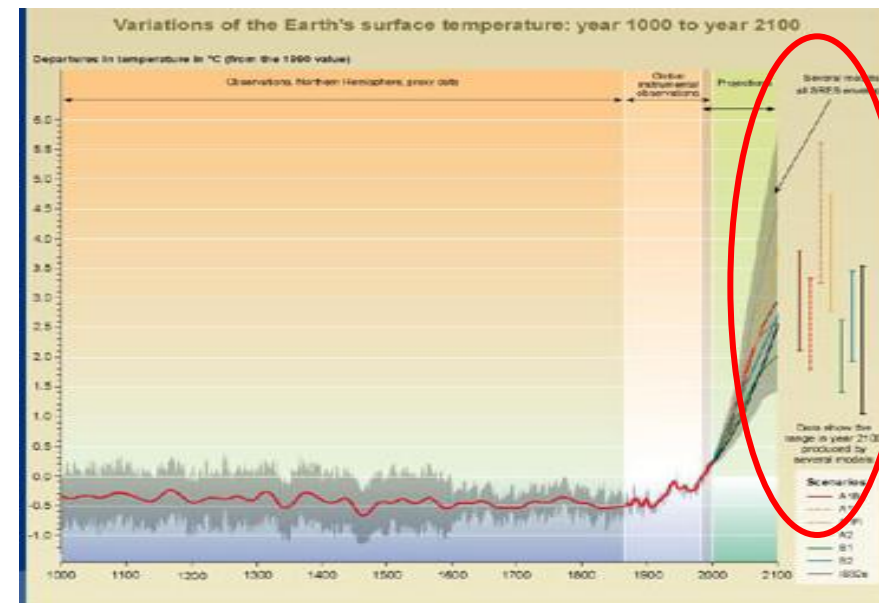
Types of adaptation to climate change		
	Anticipatory	Reactive
Natural Systems		<ul style="list-style-type: none"><li>• Changes in length of growing season</li><li>• Changes in ecosystem composition</li><li>• Wetland migration</li></ul>
Human Systems	<b>Private</b> <ul style="list-style-type: none"><li>• Purchase of insurance</li><li>• Construction of houses on silts</li><li>• Redesign of oil rigs</li></ul>	<ul style="list-style-type: none"><li>• Changes in farm practices</li><li>• Changes in insurance premiums</li><li>• Purchase of air-conditioning</li></ul>
	<b>Public</b> <ul style="list-style-type: none"><li>• Early-warning systems</li><li>• New building codes, design standards</li><li>• Incentives for relocation</li></ul>	<ul style="list-style-type: none"><li>• Compensatory payments, subsidies</li><li>• Enforcement of building codes</li><li>• Beach nourishment</li></ul>

# Planning for climate change impacts

- While there is general scientific consensus that global average temperatures are rising and will continue to rise, there is a degree of **uncertainty** associated with the magnitude of change and its impacts (rate of greenhouse gas emissions, and magnitude of warming and the accompanying changes in precipitation, storms and extreme events).
- Climate models that predict long-term climate are based on large spatial grids. The level of uncertainty increases as the GCMs are downscaled and applied to smaller areas in an attempt to predict local impacts of climate change.

# Integrating adaptation into decision making processes

- However, despite levels of uncertainty associated with the impacts of climate change
- Inclusion of climate change impacts represents **due diligence (precautionary approach)**
- One way of coping with different levels of certainty is the **no regrets (win-win)** approach



IPCC, 2001

# Uncertainty has 2 implications:

1. Adaptation procedures need to be developed that do not rely on precise projections of river discharges, groundwater, etc.
2. Based on studies, it is difficult to assess the water-related consequences of climate policies and GHG emission pathways

# Therefore..

- ...get into the habit of systematically adopting and implementing development strategies based on objective and measurable criteria that are environmentally sounds and integrative

# Major areas of adaptation for small islands (selected)

- Water resources
- Watershed management
- Reef conservation
- Agricultural and forest management
- Conservation of biodiversity
- ...

# IWRM as an instrument to explore adaptation to climate change

- Successfully integrated WRM could:
  - Reshape planning processes
  - Coordinate land and water management
  - Recognize water quantity and quality links
  - Protect and restore natural systems
  - Conjunctive use of surface and groundwater
  - Capture societies views
  - Resolve conflicts among competing users

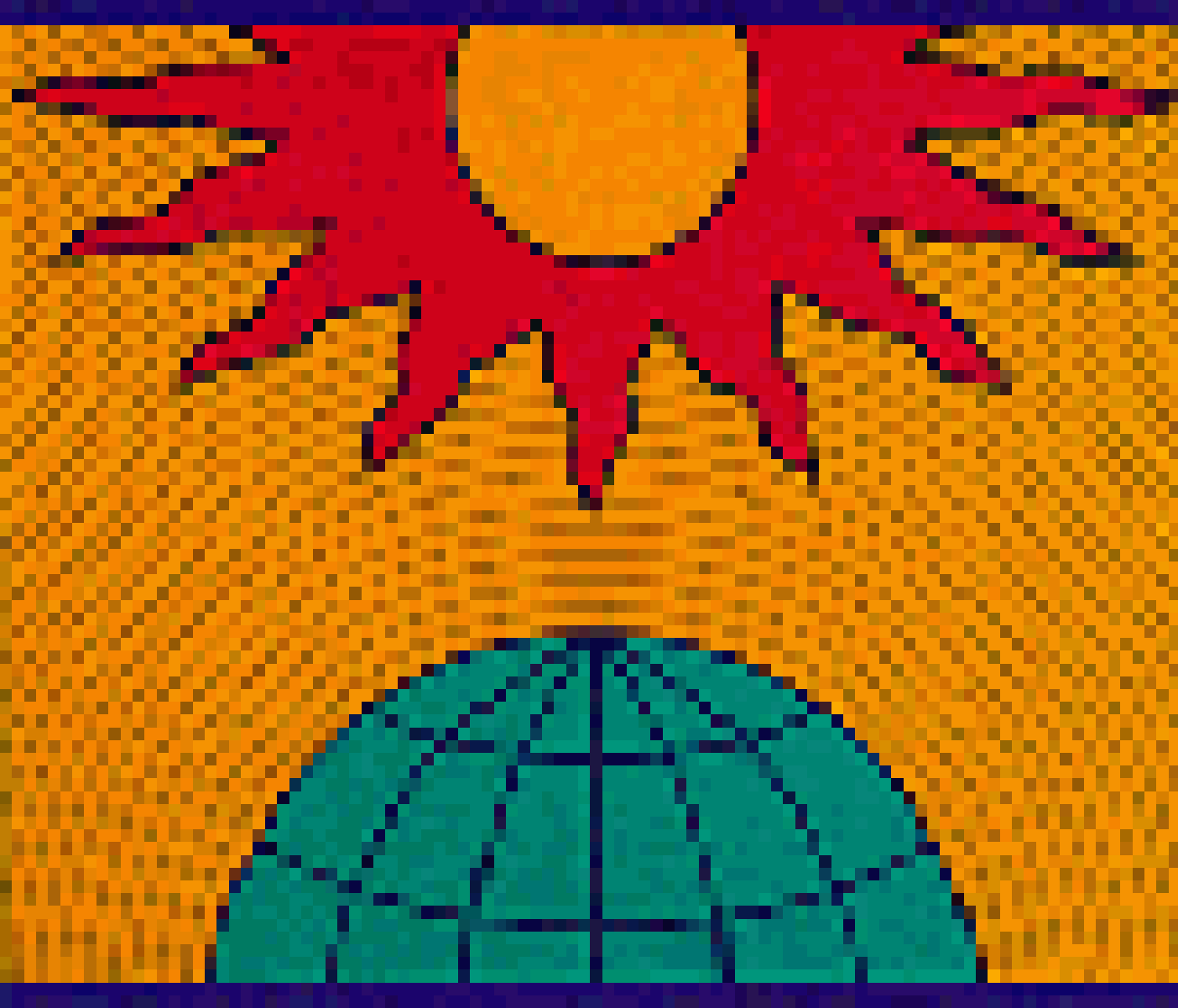
# Limits to adaptation

- Main determinants of a country's adaptive capacity to climate change are:
  - Economic wealth
  - Technology
  - Information and skills
  - Infrastructure
  - Institutions



# Moving forward with planned adaptation

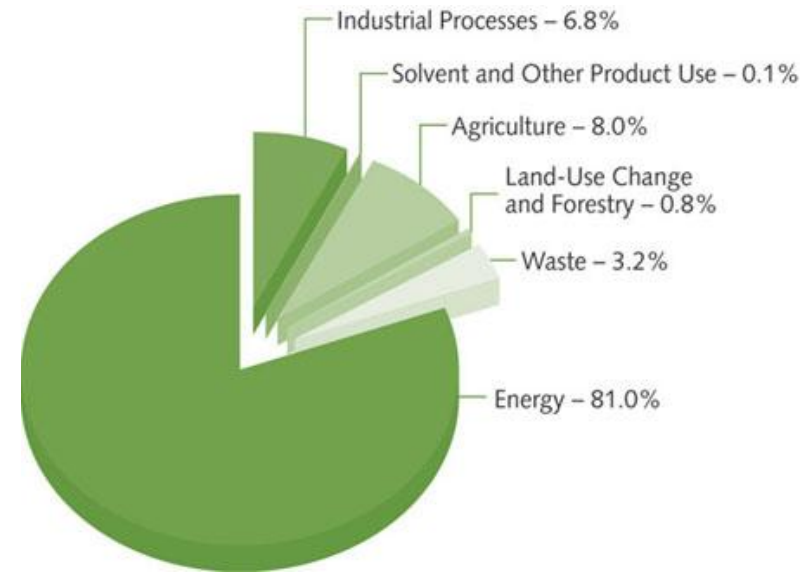
- Integration of climate change into existing decision making (e.g. land-use planning, disaster preparedness...)
- Proactive approach may avert need for higher costs associated with reactive measures
- Adaptation is all about resilience building



# Existing networks to aid with adaptation in the Caribbean

- Organisation of America States project funded by GEF
  - Caribbean Planning for Adaptation to Global Climate Change
- Adaptation to Climate Change in the Caribbean (ACCC)
- Section 16.5.5 Organisation of Eastern Caribbean States (OECS)
  - Whole island socio-ecological system mgt
- Regional Pan American Disaster Information System
- National Disaster Committees of UN's IDNDR
  - 17 established in the Caribbean
- Association of Caribbean States
  - Special Working Group for National Disasters

# What are GHGs?



Environment Canada, 2004

## Main greenhouse gases:

Water vapour (H<sub>2</sub>O)

Carbon dioxide (CO<sub>2</sub>) 78.7% of emissions=571Mt

Methane (CH<sub>4</sub>) 12.6 % of emissions = 91 Mt

Nitrous oxide (N<sub>2</sub>O) 7.4% of emissions = 54 Mt

CFC's 1.3 % of emissions = 10 Mt

GWP\*

1

21

310

\*warming potential over 100 yrs