The Caribbean Drought and Precipitation Monitoring Network:
The Concept and its Progress

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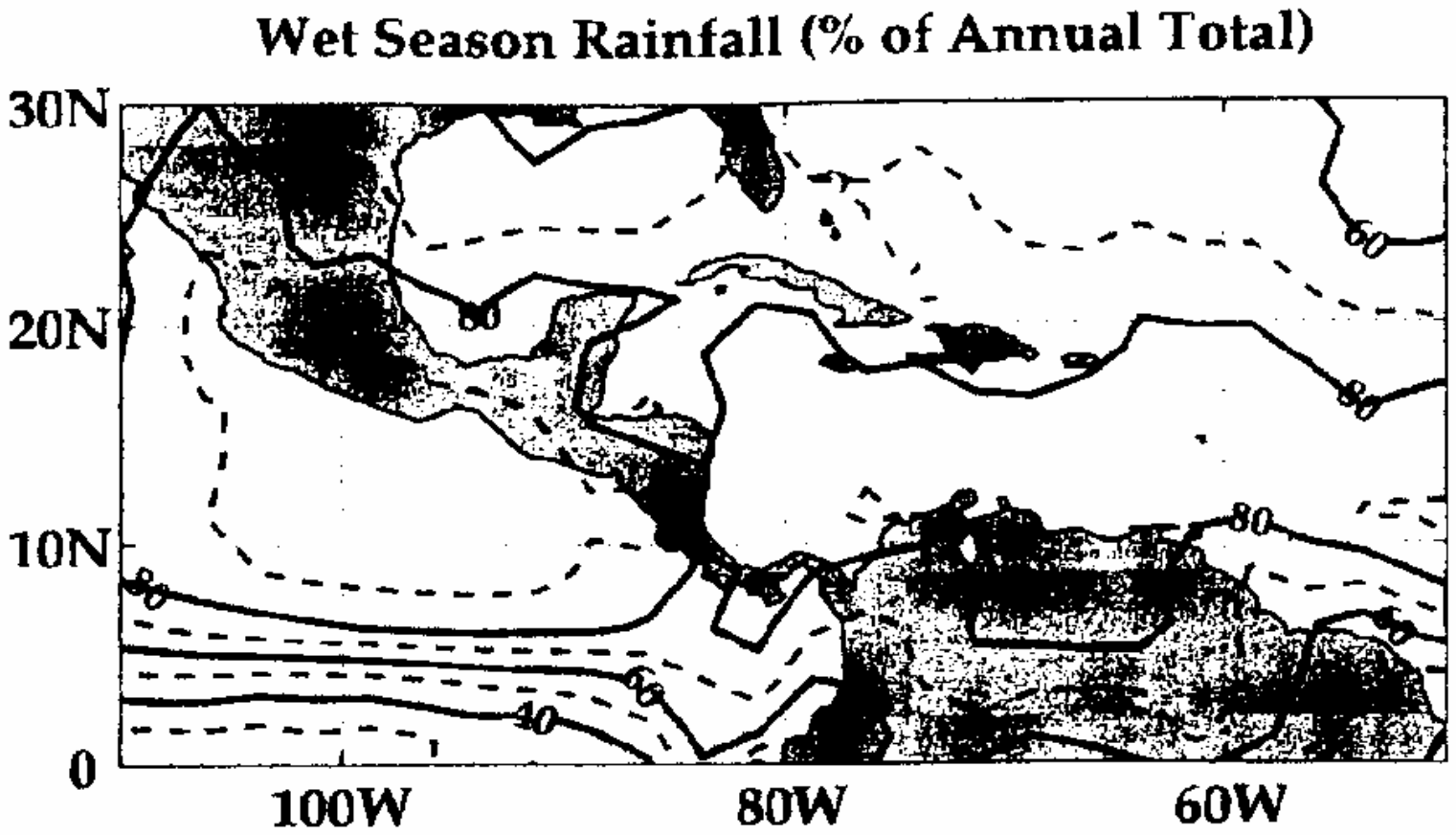


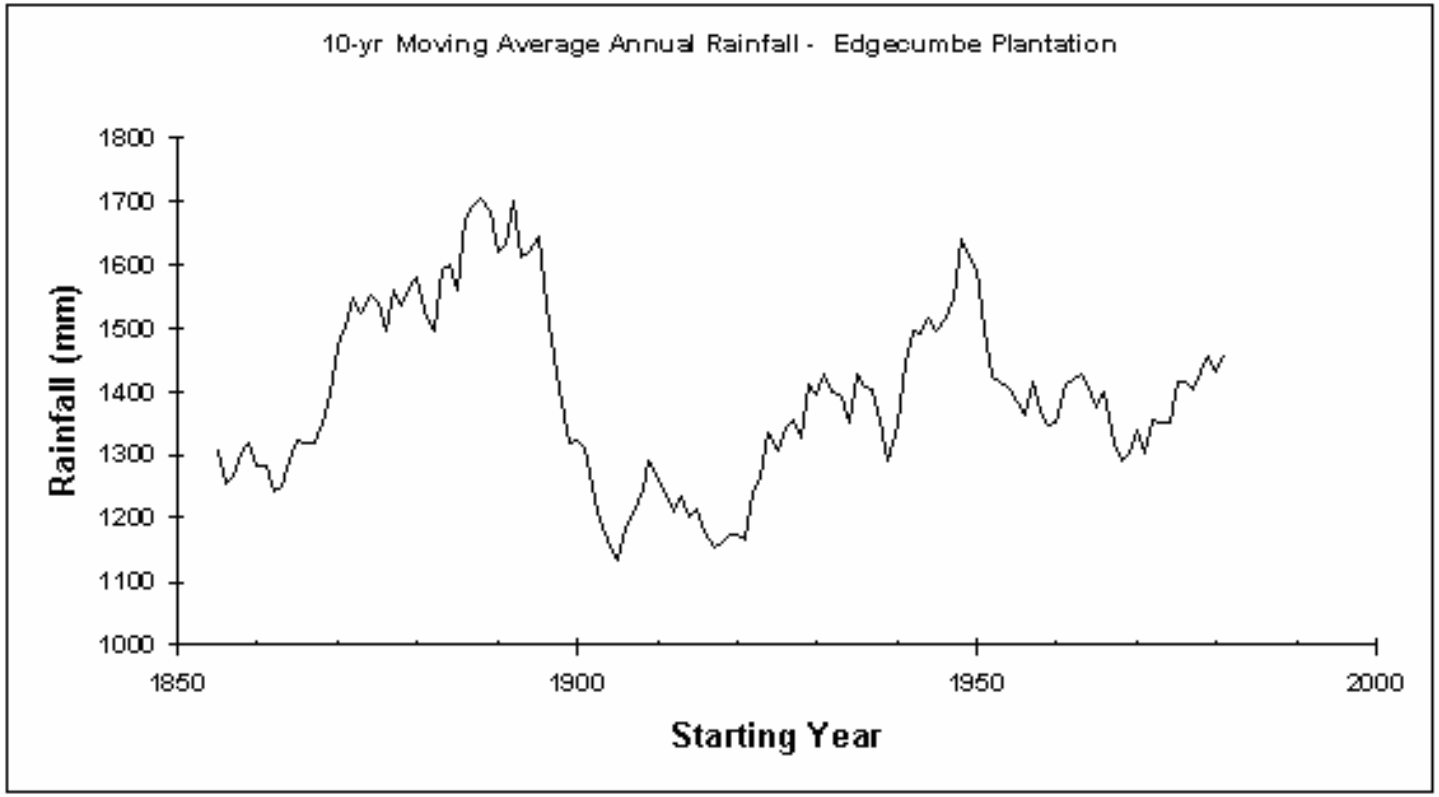
Figure 6 Wet season (May to November) rainfall as a percentage of annual rainfall (taken from Enfield and Alfaro, 1999).

	Barbados			Trinidad		
	CIMH	Drax Hall	G. Adams	Piarco	Mora Valley	S. Q. Estate
Jan	17	34	18	18	17	20
Feb	25	23	21	22	17	31
Mar	29	23	24	33	37	32
Apr	32	27	41	46	30	46
May	34	23	56	34	43	60
Jun	40	31	26	10	28	19
Jul	15	16	16	8	6	14
Aug	11	9	17	8	7	13
Sep	11	10	16	15	10	19
Oct	11	11	9	10	12	38
Nov	10	10	10	12	15	29
Dec	15	13	17	13	7	17

Table 4 Longest ever spell ending in the month for stations in Barbados and Trinidad. A dry day is when the rainfall is than 1 mm

10 Year Moving average of Rainfall from 1850s to 1990s

S Burton (CIMH)



Experiences with Drought and Flooding

Drought

- 1997/98 El Niño caused widespread drought and forest fires in Guyana and Trinidad – loss of animals, timber
- …Guyana experienced water rationing, cessation of logging and river transport in some places
- …forced rice farmers to leave 35 % of their rice fields uncultivated and affected more than 1500 Amerindian families in Southern Guyana
- In Jamaica drought in 1997, prompted the government to offer the sector a US$ 100 million assistance package
- 1999-2000 drought, rainfall was less than 25 % of the average in some places, Jamaican authorities reported crop losses of approximately US$ 6 million between October 1999 and March 2000
- Carriacou also accounts for 30% of the nation's livestock production, and experienced losses of 20 and 40% due to drought in 1984 and 1992, respectively

Flood

- Account for 70 % of all weather-related losses in the region's agriculture sector
- Guyana from January to February 2005 affected 37 % of the population, was blamed for the deaths of 34 people and
- Resulted in US$ 55 million in damage to agriculture sector which in 2004 accounted for 35.4 % of Guyana's GDP, US$ 250 million was lost in the housing sector
- A similar flood event in 2006 resulted in total losses to the sector of US$ 22.5 million
- In 2001, flooding associated with Hurricane Michelle, which resulted in some stations exceeding their average monthly total average on October 29 alone, damaged almost 2000 ha in crop farmland and approximately US$ 8 million in losses in crops and livestock

Caribbean Drought and Precipitation Monitoring Network (CDPMN)

- Precipitation status monitored using a number of indices
- …Standardized Precipitation Index; Palmer Drought Severity Index; Crop Moisture Index
- Other indicators (e.g. water levels, state of vegetation and ecosystems)
- Final precipitation status determined, by consensus, by a network of persons from different sectors, institutions and communities embracing the diversity in definitions and impacts of drought
- Short term and seasonal precipitation forecasts to provide a projection of future drought (1 - 6 months)

Deciding on Indicators

Physical Indicators

- Meteorological (precipitation, evaporation)
- ENSO
- Stream/river flow levels
- Ground water levels
- Reservoir and lake levels
- State of swamps, mangroves
- Soil Moisture

Deciding on Indicators

R. Reynold Murray

Bio-physical Indicators

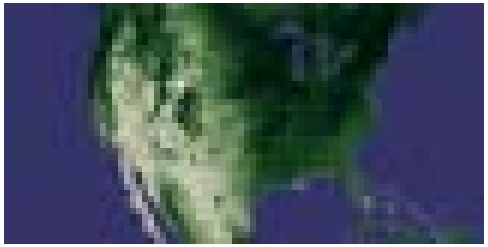
- Status of vegetation (plant yellowing)
- Activity of indigenous animals (e.g birds)
- Animal migration e.g. during very hot, dry periods, the ground dove migrates to the cooler areas in the higher elevations where it expects to find water and shelter from the heat.
- Emergence of certain plant pathogens e.g. Pink Mealybug
- Community/Local/traditional knowledge

Deciding on Indicators

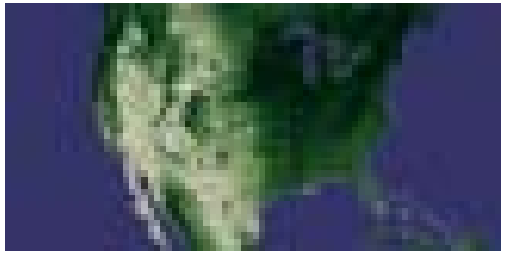
Scientifically derived Indicators

- SPI
- PDSI, CMI
- Percent Normal
- Deciles
- Vegetative Indices (e.g. NDVI)

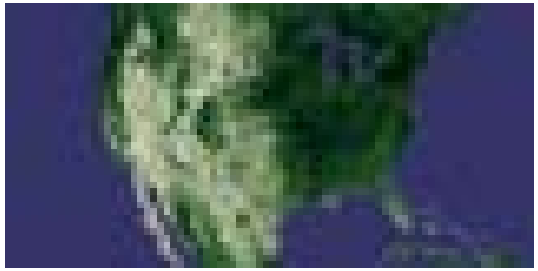
Drought North America



July 1981 - 2000 Average

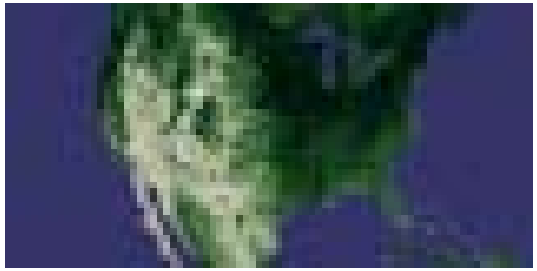


August 1981 - 2000 Average



NDVI average 1988

NDVI average 1993



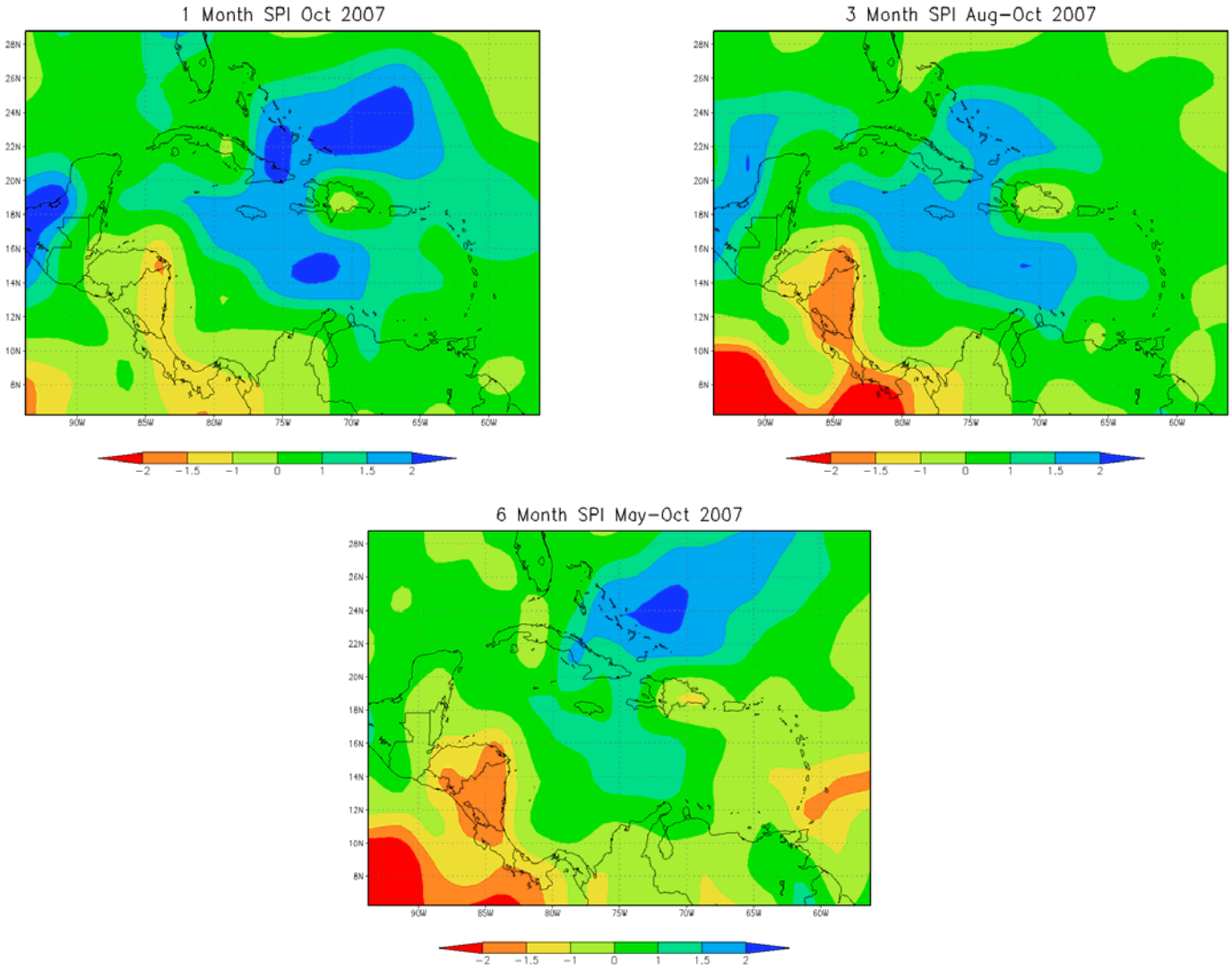
NDVI Average 2000

Drought 1988

Drought 1993

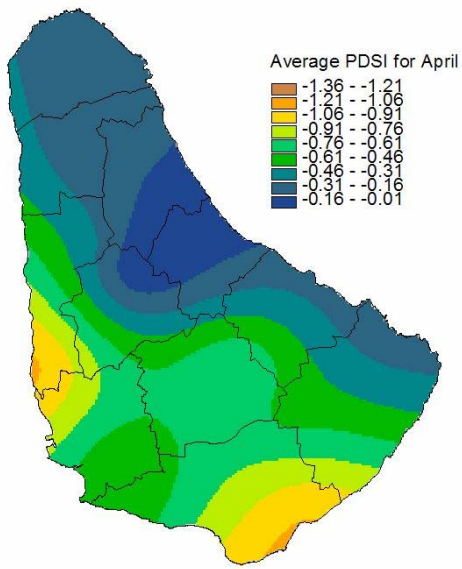
Drought 2000

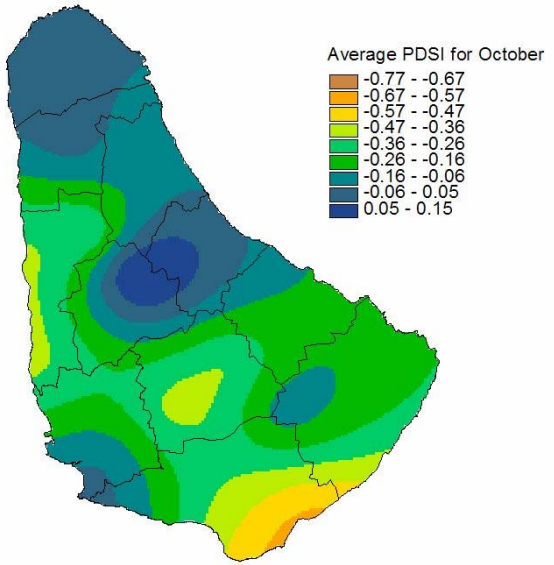
SPI for the Caribbean



1-, 3- and 6 - month SPI for the Caribbean for October 2007

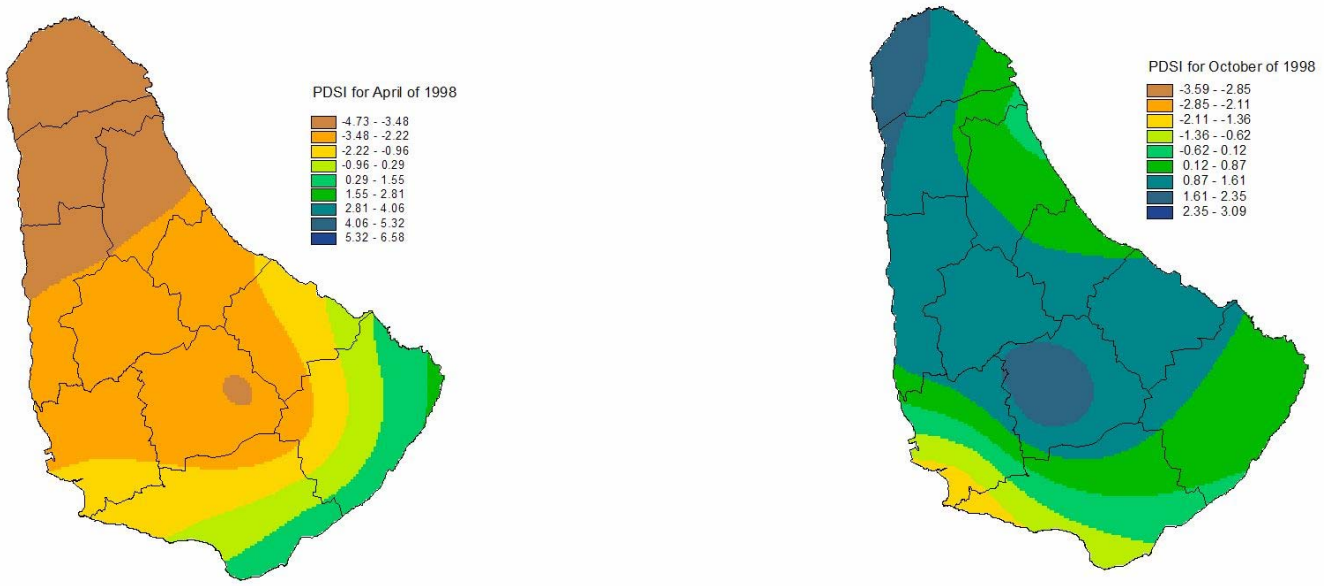
PDSI on Agricultural Drought in Barbados





Mean PDSI values for April and October

PDSI on Agricultural Drought in Barbados



PDSI values for April and October 1998 (an El Niño year)

Johanna Richardson
Graduate Student
McGill University
Purpose of Research

- To:
  - Develop Standard Precipitation Indices (SPI) for Jamaica
  - Improve the performance of the Aggregated Drought Index (ADI) by making it spatially variable over small areas (ADI takes into account precipitation, evapotranspiration, streamflow, reservoir storage, soil water content
  - Predict the behaviour of the Rio Nuevo sub-watershed under future urbanization scenarios

Soil and Water Assessment Tool (SWAT)

- SWAT will be used in order to simulate the soil moisture conditions over very small land areas (10 km^2)
- The Aggregated Drought Index will then have a very high spatial resolution, thus allowing for a very powerful tool for monitoring drought
- The Rio Nuevo sub-watershed will be study area for this research

- The Standard Precipitation Index (SPI) will be developed for the entire island
- The Aggregated Drought Index (ADI) will be developed for the Rio-Nuevo sub-basin

Cooperation with Institute of Earth Sciences University of Applied Sciences

- Climate change in the Caribbean – Development of monitoring tools for water resources
- Caribbean Water Monitor: Small Island States, Water Resources and Climate Change

- FEASIBILITY STUDY

The Project

- Four nations chosen initially
- St. Kitts and Nevis, Antigua and Barbuda, Barbados, Trinidad and Tobago
- Will select any two of the four nations
- Collection, validation and analysis of historical data
- Application of Water Resources Indices

- Data a concern
- DATA RESCUE

The Project

- Development of Internet-based tools for monitoring water resources
- One week workshop/training for two CIMH staff
- Capacity Building Workshop at CIMH
- Final Report
- After project conclusion, the water monitoring tools are maintained by CIMH

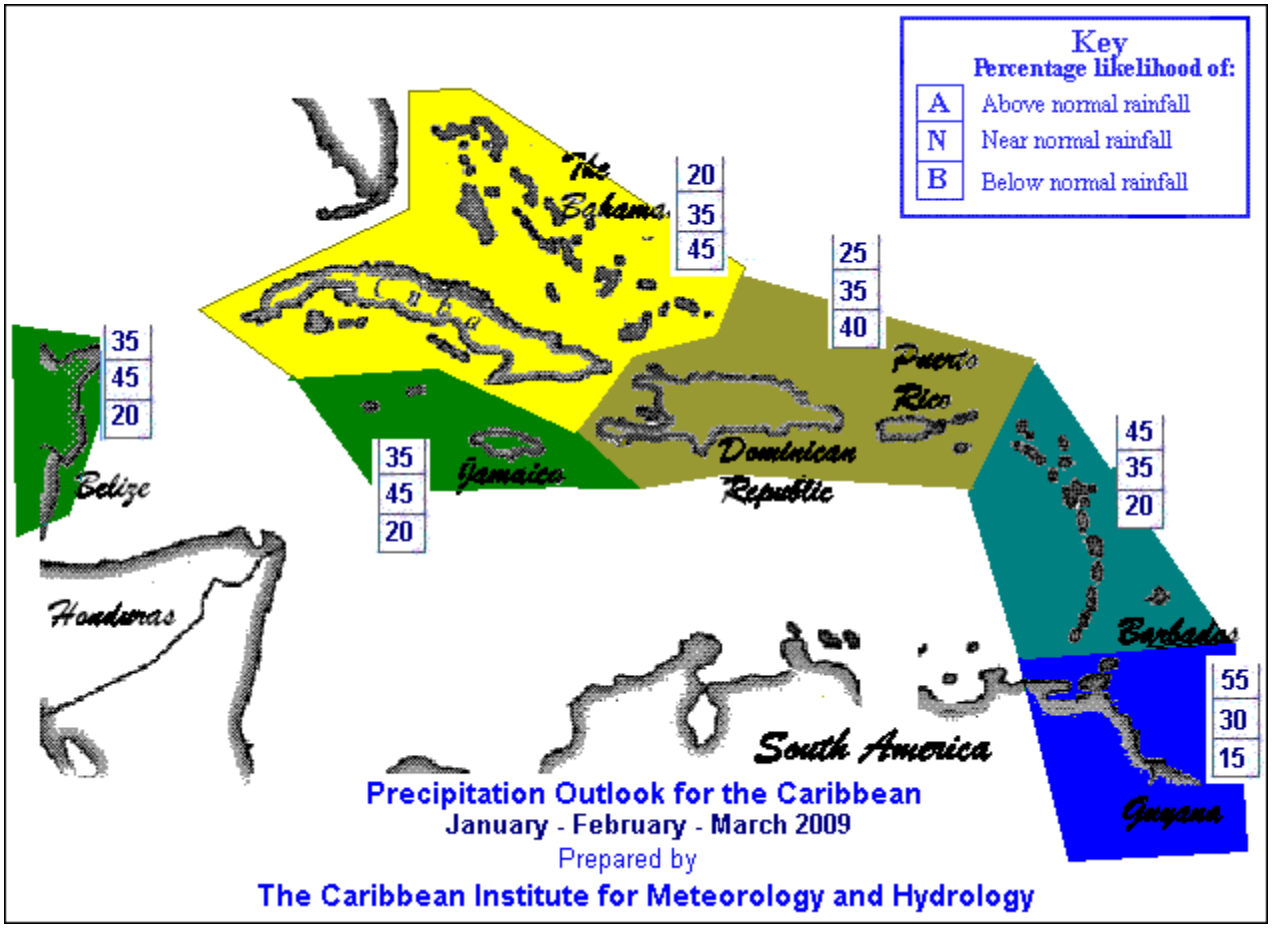
Monitoring stations

- One hydrological and meteorological monitoring station will be installed in each partner country
- The pilot communities for the three countries are

  - Great River (Grenada)
  - St. Cuthbert's Amerindian mission (Guyana)
  - Mile Gully/ Warwick Castle (Jamaica)

- The CDPMN will afford an opportunity for a participatory process, between CIMH, national and local governments and pilot communities, to propose new *community water strategies* which consider the extremes of drought and flood for water resource management

Precipitation Outlook for the Caribbean



Outcomes of the CDPMN

1. Through the hydrometric stations and sensor data, monitor hydrological indicators, climate indicators...
2. Projection of future status (using precipitation forecasts and drought indices
3. Early warning information through CIMH website and networking with key agencies, governments
4. Build adaptation and response strategies to drought and flooding events – collaboration with a network of communities, researchers and decision makers

Drought and Flood Planning

- Data collection, monitoring and dissemination
- Integrating climate indices and other indicators into routine decision making processes
- Determining existing needs, scientific knowledge gaps
- Forecasting, predicting, strengthening infrastructure
- Establish monitoring systems and early warning systems
- Information can then be used by decision makers at community level and national level to improve livelihoods
- …All toward MANAGING RISK

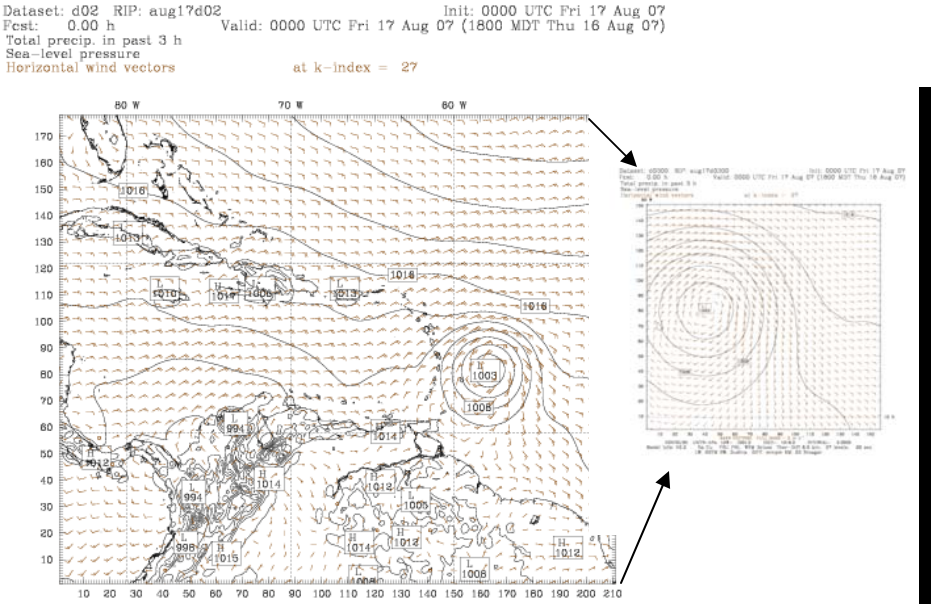
Figure 3. The 10-Step planning process.

CDPMN Status

- This network is in the start-up phase
- Hosted at CIMH, will be web-based
- Workshop on June 24 on WIS in Grenada
- Completely operational by 2010

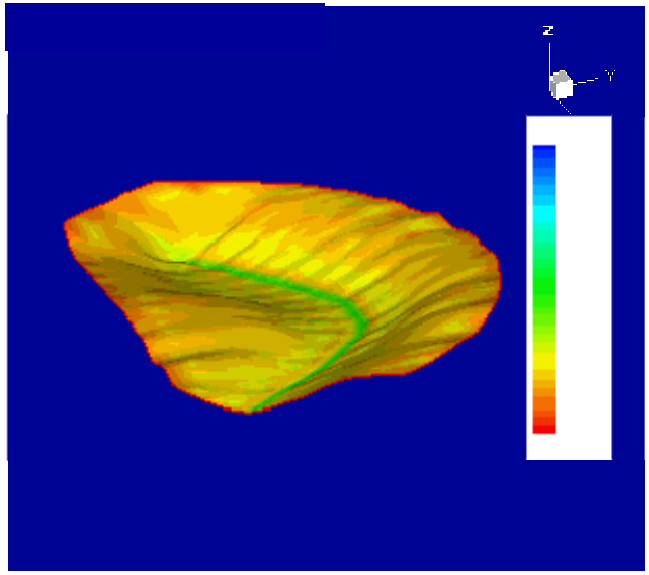
www.mcgill.ca/cariwin

The models



Weather Research Forecasting model

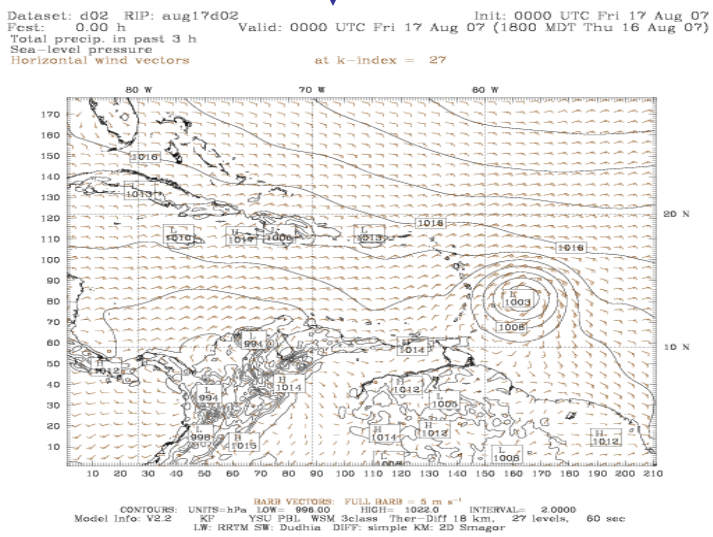
- Outputs: atmospheric variables at all levels of the troposphere; the state of the atmosphere at different times in the future
- Forecasting tool:
  - Provides simulations on different spatial scales
  - Real-time forecasting out a fortnight
  - Can be altered to better represent the tropical atmosphere
  - Regional climate scenarios

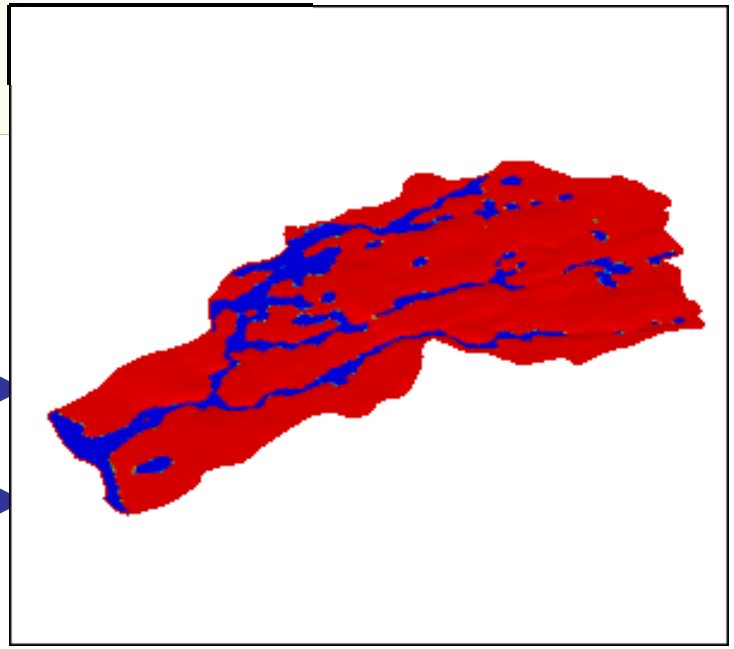


HydroGeoSphere (Hydrological Model)

- Outputs: Water depths; SW/GW flows; GW saturations; Concentrations
- Water resources management tool
  - Flood forecasting
  - Simulate impact of contaminant transport
  - Simulate climate change scenarios scenarios
  - Real time monitoring

Demonstration





CDPMN, Flood forecasting Precipitation Outlook

Genesis of a coordinated Weather Related early warning system for the region