Hydro-Meteorology and Sustainable Development in the Caribbean

David A. Farrell, Ph.D., P.G.

Principal
Caribbean Institute for Meteorology & Hydrology
Husbands, St. James
Barbados

Inputs from
Christopher Cox (Ph.D.)
Caribbean Environmental Health Institute

&

Adrian Trotman (M.Sc.)
CIMH

We plan our lives and activities around weather and climate. Where we live, how we live and what we do.

Hence, timely information on weather and climate is essential for our livelihood and way of life.

Our future is uncertain due uncertainties in future weather and climate.

Reducing these uncertainties is a major priority if we are to attain our socio-economic goals.

Every year, our global and national economies are negatively impacted by weather and climate events.

To reduce losses our economies need to become more climate and weather resilient through actions that increase adaptation. This can be achieved through improved targeted forecasting, early dissemination of accurate and easily understandable information, delivery of data, services and products that are easily integrated into the processes of downstream users.

Characteristics of the Caribbean

- Most are Small Island Developing States (SIDS) and countries with large low-lying coastal areas that are vulnerable to flooding;
- Significant coastal socio-economic development with most major cities, capitals and financial centres located in coastal areas;
- Mostly agricultural and service based economies with few exceptions;
- National and inter-related regional economies that lack significant diversity;
- Complex inter-related environmental hazards (e.g., flooding, drought, wind, earthquake) and highly vulnerable populations & ecosystems;
- Youthful populations with high expectations;
- Acutely susceptible to climate change and climate variability;
- All countries trying achieve the UN Millennium Development Goals and sustain or enhance future development.

Climate Related Risks Challenge Sustainable Development

- Over the last 3 decades, the Caribbean has suffered direct and in-direct losses estimated at between USD 700 – 3,300 million due to extreme weather events (Inter-American Development Bank, 2007);
- Cumulative annual impact of future climate change on all CARICOM Member and Associate Member States by ca. 2080 will be about USD 11.2 billion or 11.3 percent of the projected annual GDP (World Bank, 2009):
  - Most significant contributors to the future annual losses are expected to be direct losses due to climate related disasters:
    - USD 2.6 billion due to wind damage;
    - USD 363.2 million due to flood damage;
    - USD 3.8 million due to drought;
    - USD 447 million due to loss of tourism revenues;
- **Role for hydro-meteorology in sustainable development.**

Climate Related Risks Challenge Sustainable Development

- Actions Required to Reduce Climate and Disaster Risks
  - Quantification of risks related to climate related hazards;
  - Development of human and technical capacity to convert data to information that can be used to inform adaptation strategy and prioritization of the implementation process;
  - Integrated, proactive and creative approaches:
    - Science, engineering and social sciences will have to work in concert to define adaptation parameter space;
    - Integrated multi-sectoral interventions (water, agriculture, tourism etc) at the regional, national and local levels to implement risk reduction and risk transfer strategies that support and facilitate adaptation;
  - Challenges can be overcome if we have a common goal and work together in good faith!!!

Hydro-Meteorology & Climate/ Disaster Risk Reduction Requirements

- Timely provision of information on critical climatic parameters:
  - Precipitation, temperature, relative humidity, wind speed and direction etc (when, where, how much, seasonal trends etc);
- Data quality is important if risk reduction is to be achieved
  - Measurement networks must exist, be appropriate to the scale of the problem, and work for long periods of time
  - Adequate investment key to network performance & sustainability
  - Data quality assurance and quality control are important
- Products and information derived data must be transferred to stakeholders in a form that can be readily used … needs and capabilities of downstream users must be understood.
- **Systemic institutional failures across most of the region in 2009-2010 exacerbated drought impacts.**

Hydro-meteorology, Risk Reduction and Adaptation

- Hydro-meteorology data and products are essential for adaptation in the following sectors:
  - Water Resources Management;
  - Agriculture & Food Security
  - Energy (hydro-electric, solar and wind)
  - Health (vector borne diseases, heat stress & respiratory among others);
  - Manufacturing;
  - Tourism;
- Presentation focuses on first two.

Hydro-meteorology & Water Resources Management

FAO Country Profiles, 2000: Fernandez and Graham

Country	Water Availability ($x10^6$ m^3/yr)		Water Supply ($x10^6$ m^3/yr)		Desalination Plants
	Aquifer	Surface	Aquifer	Surface	
Antigua & Barbuda	4.6		4.6		2
Barbados	76	6.3	> 76	> 6.3	1
Belize	N/A	N/A		3.1	1(?)
Dominica		26		>16	

Hydro-meteorology & Water Resources Management

FAO Country Profiles, 2000: Fernandez and Graham

Country	Water Availability ($x10^6$ m^3/yr)		Water Supply ($x10^6$ m^3/yr)		Desalination Plants
	Aquifer	Surface	Aquifer	Surface	
Jamaica	3419	666	850	76	
Nevis		3.02		1.82	
St. Kitts	6.63	3.32		5	
St. Lucia	N/A	N/A			9
St. Vincent	N/A	95 (est	N/A	N/A	

Caribbean Meteorological Organization

OBJECTIVE

"The Organization shall have as its objectives the promotion and co-ordination of regional activities in the field of Meteorology and allied sciences."

The Caribbean Meteorological Organization

Functions of the Organization:

- Provision of meteorological services to civil aviation ;
- Co-operation with other services to provide an efficient hurricane warning system;
- Provision of meteorological information and advice to Member States ;
- Collection and analysis of all relevant meteorological data available and publication of results;
- Co-operation with meteorological services;
- Execution of basic scientific observations in keeping with its objectives;
- Participation in the work of the appropriate international organizations particularly the World Meteorological Organization and the International Civil Aviation Organization ;
- Participation in work in applied meteorology, agricultural meteorology, hydrology and associated research of direct interest to the Region
- Co-operation with all relevant scientific institutions

The Caribbean Meteorological Organization

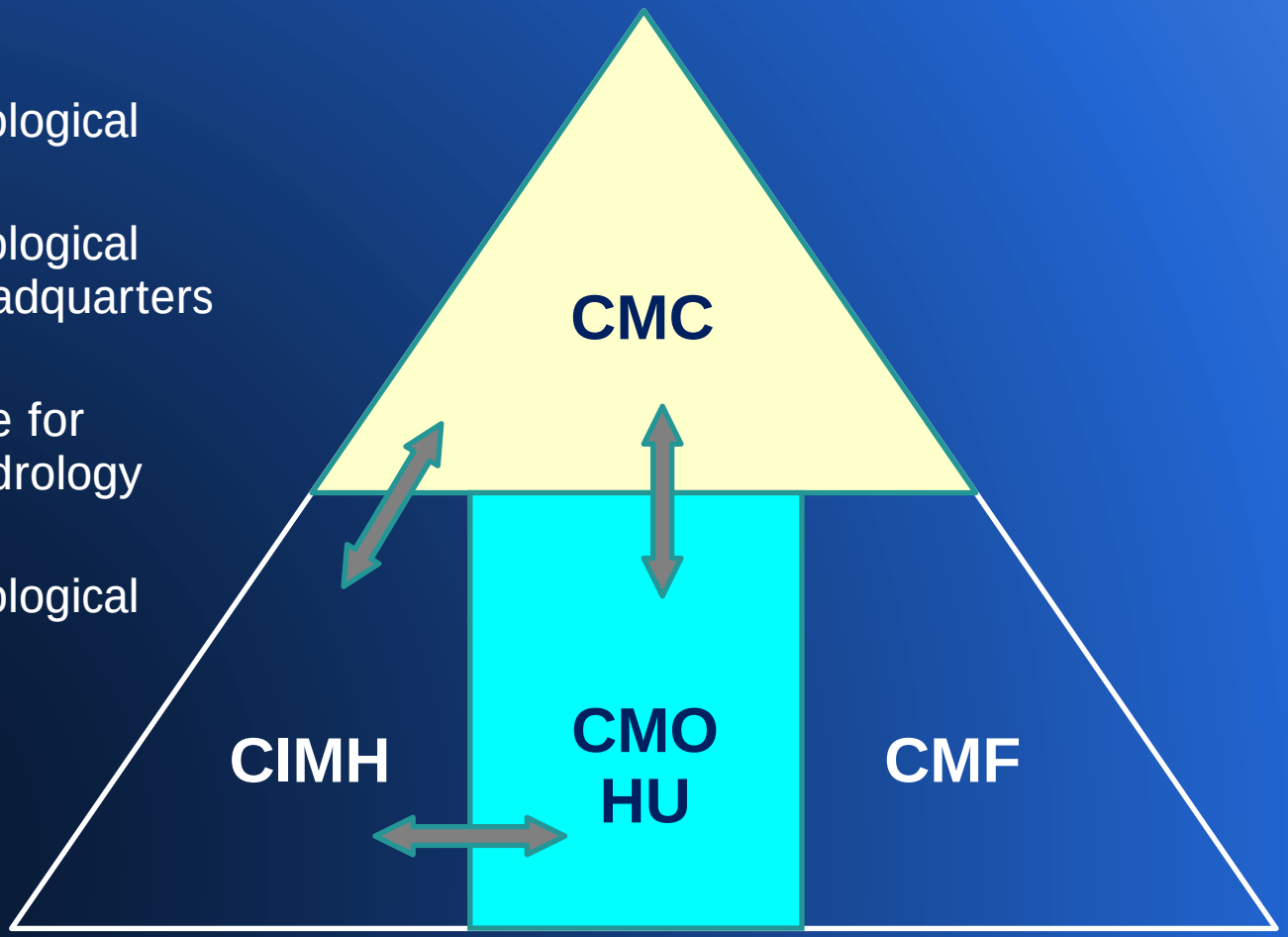
Membership

- Anguilla, Antigua and Barbuda
- Barbados
- Belize
- British Virgin Islands
- Cayman Islands
- Dominica
- Grenada
- Guyana
- Jamaica
- Montserrat
- St. Kitts/Nevis
- St. Lucia
- St. Vincent and the Grenadines
- Trinidad and Tobago
- Turks and Caicos Islands

Caribbean Meteorological Organization

Organs

- Caribbean Meteorological Council (CMC)
- Caribbean Meteorological Organization – Headquarters Unit (CMO-HU)
- Caribbean Institute for Meteorology & Hydrology (CIMH)
- Caribbean Meteorological Foundation (CMF)



Mandate of the Caribbean Institute for Meteorology & Hydrology

"... to assist in improving and developing the Meteorological and Hydrological Services as well as providing the awareness of the benefits of Meteorology and Hydrology for the economic well-being of the CIMH member states. This is ***achieved through training, research, investigations and the provision of related specialized services and advice***".

Brief History of the Caribbean Institute for Meteorology & Hydrology

- Caribbean Meteorological Institute (CMI) established August 23, 1967 under special funding from UNDP and WMO
  - 16 Caribbean States that comprise the Caribbean Meteorological Council were entrusted with the responsibility of managing CMI
- CMI becomes affiliated with UWI in 1973
  - B.Sc. in Meteorology established in Faculty of Natural Sciences
- CMI designated by WMO as a Regional Meteorological Training Centre in 1978 (new designation RTC)
- Caribbean Operational Hydrology Institute (COHI) established in 1982 and located at CMI ... COHI subsequently brought under CMI in 1987
- Name of CMI changed to Caribbean Institute for Meteorology & Hydrology in 1999
- CIMH designated an Institution of the Caribbean Community in the Revised Treaty of Chaguaramas (2001)

Functions of the Caribbean Institute for Meteorology & Hydrology

- WMO Regional Training Centre - Train various categories of meteorological and hydrological personnel
- Operate as a centre of research in meteorology, hydrology and associated sciences
- Regional Climate Data Centre - Data collection, storage, & dissemination
- Regional Instrument Centre – Develop, maintain, repair, and calibrate meteorological & hydrological instruments
- Regional Centre of Excellence for Satellite Meteorology
- Advisor to regional governments on matters related to meteorology, climate & hydrology
- Provide specialized services to industry

Meteorology Training

- WMO professional programmes
  - Entry Level Technician (6 months)
    - 2 courses conducted per year
    - 11 persons trained in 2006
  - Mid Level Technician (8 months)
    - 1 course per year
    - On-going course has 3 students
  - Senior Level Technician (18 months)
    - 1 course every two years
    - On-going course has 2 students
    - Next course starts in January 2008
  - *Applications of Meteorology*
    - Provides joint training in agrometeorology, hydrology, and climatology

Meteorology Training

- *B.Sc. Degree (joint with the University of the West Indies)*
  - Students in this programme are fully registered at the University but receive instructions in meteorology from staff of the Institute.

⑩ M.Sc. Natural Resource and Environmental Management specializing in Applied Meteorology *(joint with CERMES, University of the West Indies)*
  - The programme provides students with training in advanced techniques suitable for the analysis of meteorological and hydrological data and their application in various sectors of the regional economy.

Hydrology Training

- *Hydrological Observers*
  - Four week course designed to train technicians on applications of hydrology databases, basic hydrometeorology observation techniques, and field activities.
- *General Technicians*
  - Six month course with students being trained in the fundamentals of surface water hydrology and hydrogeology. The course also covers water quality monitoring, basics of surveying, and instrument maintenance.
- *Higher Technicians*
  - This is an eighteen months course and is designed to allow personnel with several years experience to gain further knowledge in hydrology
- M.Sc. Natural Resource and Environmental Management specializing in Water Resources Management *(joint with CERMES, University of the West Indies)*
  - The programme provides students with training in advanced techniques suitable for addressing a broad range of water resources issues.

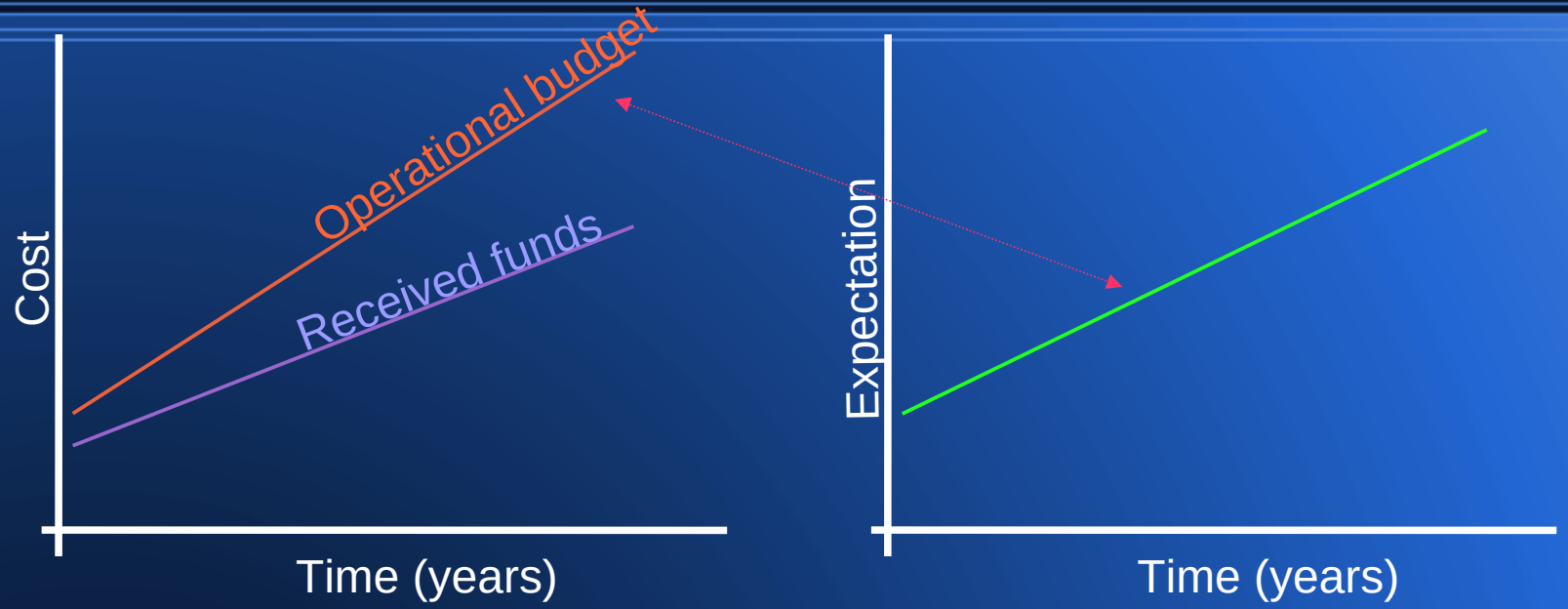
Regional Instrument Centre

- Regional Instrument Calibration Laboratory
  - Establishment of the instruments calibration lab established in 2007
- Sea Level Monitoring and Equipment Maintenance
  - CIMH currently involved in redevelopment of sea level monitoring stations across the Caribbean
  - CIMH will be responsible for maintenance of several of these stations
- Support for International Research and Development Projects (NASA, U. Miami, Max Planck Institute and CCCCC)
  - Instrument installation (lidar and small radar systems)
  - Monitoring and Maintenance
- Regional Instruments Maintenance/Support
  - CIMH continues to support requests from regional meteorological office and governments
- Research and Development
  - Developed a data-logger and rain gauge recording system (hardware and software customizable to client needs)

Regional Expectations & Challenges Facing CIMH

- As the region becomes acutely aware of the significant impact that climate, weather and water resources play on socio-economic development and attainment of national and international goals (e.g., UN Millennium Development Goals) national and regional institutions are being requested to develop more products and services to support current and future realities associated with climate change and climate variability that can enhance national and regional adaptation processes.
  - CIMH being the lead training institution and having significant expertise at it disposal is mandated to be involved
- However limited financial resources are being provided to support these requests ... budget currently frozen and not all member countries contributing.
- **Doing more with less ...**

Regional Expectations & Challenges Facing CIMH



- Expectations cannot be fully realized from funding received but nevertheless have to be met to sustain socio-economic development.
  - In the case of CIMH, annual realizable funding is generally between 50-70 percent of approved annual operational budget ... current funding received for 2010 is projected to be equivalent to 2005 approved budget.
  - Can't significantly rescope products to be delivered as it would unfairly punish those countries that contribute fully.
- How then to meet the expectations?

Summary of Expectations

- Training
  - Delivery of training services to National Meteorology and Hydrological Services (NMHSs) & the UWI
  - *Delivery of training services to non-NMHSs*
  - *Support continuous professional development to staff in NMHSs without having to leave the country (on-line training)*
  - *Training will be performed using the latest equipment and in modern infrastructure*

    If I don't utilize the service every year why pay every year ... it is expensive to travel in the Caribbean and to live in Barbados
- Deliver specialized products and services that support
  - *Disaster risk reduction*
  - *Adaptation to climate change and increasing climate variability*
  - Policy design and political decision-making (national and regional)

Need to demonstrate you can deliver a quality product before people will pay

Summary of Expectations

- Retain/Maintain a high level of staff competency & capacity
  - *Significant staff turn over in recent years in NMHSs and CIMH*
  - *New staff are young, lack significant experience and need to be trained and/or exposed*
  - *Existing staff need to maintain and/or enhance competency*

  Ability to demonstrate quality matters now more than ever ... people pay for quality ... poor quality high risks
- Meet the professional expectations of staff
  - People expect to have exciting dynamic careers
  - People expect to be fairly compensated

  Today's professional is a corporation ... they trade their services in a global market place ... can you afford to lose your investment
- Support global agenda and remain current through participation in global meetings

Who pays

Overcoming CIMH's Challenges

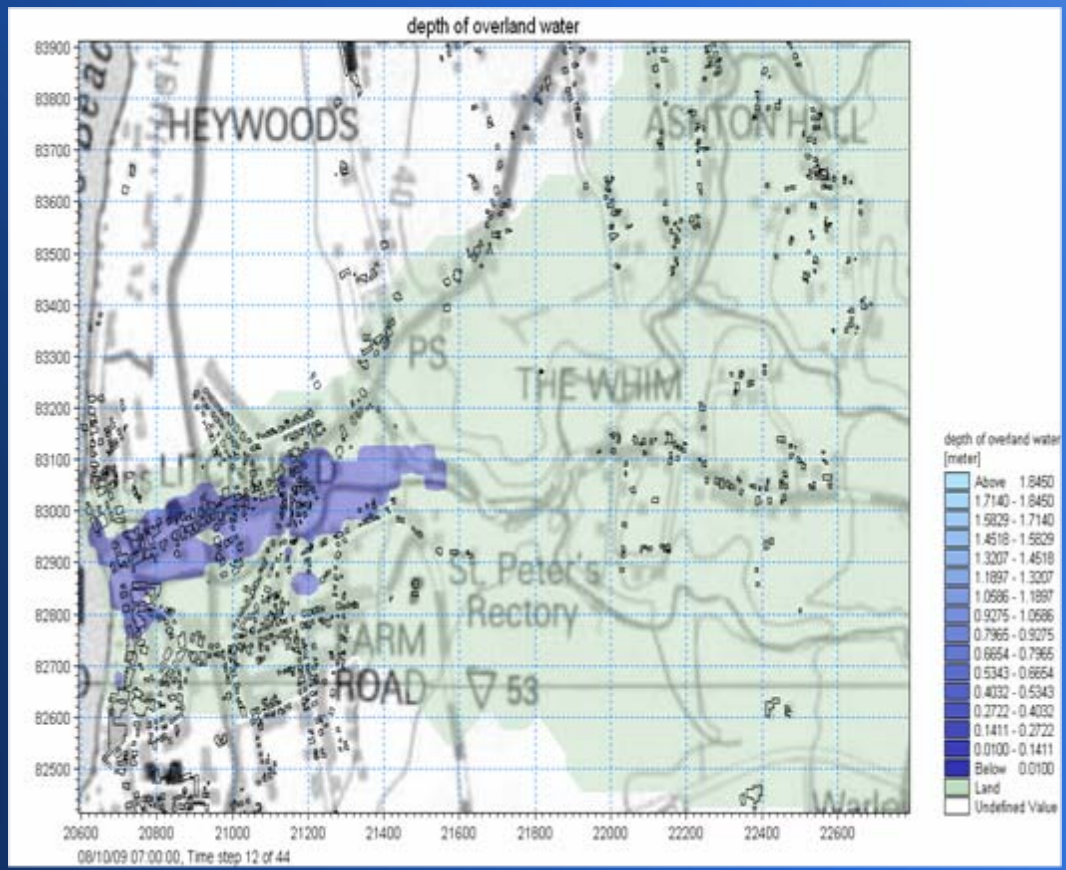
Challenges present opportunities for reassessment, re-organization and innovation

- Deliver specialized products and services
- CIMH Reorganized its internal structure to focus on the deliver of products and services
  - Changed the “Data Services” group to “Applied Meteorology and Climatology”
  - Mandate of the new group is to convert climate data to products (information) on climate change, climate variability and food security to support various socio-economic sectors
  - Hydrology group now supports a range of water resources and hydrometeorology initiatives that support disaster risk reduction
  - Interdisciplinary work between the Sections encouraged
  - **Over USD 1,000,000 in grants/contracts generated in the last 2 years**
  - **Donor agencies have been attracted by the products and the**

Research & Development

Flood Forecasting

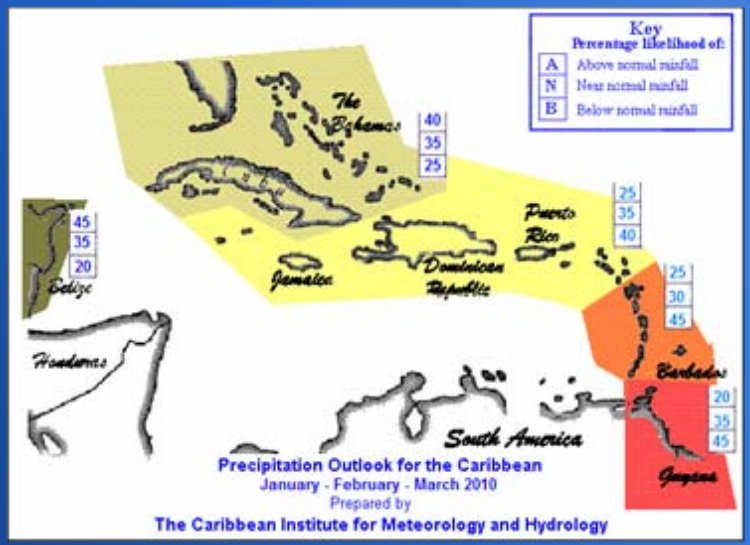
- Improved flood forecasting
  - Weather forecasting model (WRF)
  - Hydrologic model
  - 48hr rainfall forecast from WRF
  - SW flows and GW saturations simulated
  - Flood forecasts provided with significant lead times
  - Accuracy dependent on catchment characterisation (DEM, K's, etc.)
- Water resources management
  - Simulate impact of contaminant transport
  - Simulate sea level rise scenarios
  - Simulate impact of climate variability

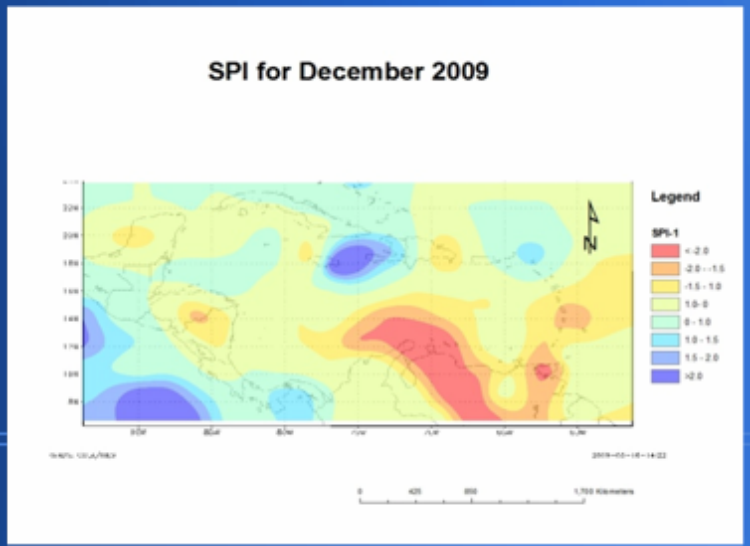


Research & Development

Applications of Meteorology

- 3-month Precipitation Outlook
  - Caribbean basin product produced using global databases and model outputs
  - Percentage likelihood for 3 scenarios provided (above average, average and below average rainfall)
  - Outputs useful for sectoral planning
  - Product being revised to improve usefulness
- Caribbean Drought and Precipitation Monitoring Network
  - Concept was borne out of the need to mitigate and respond to the creeping nature of drought the onset of which may go undetected
  - Regional and national monitoring scales
  - Several indices used SPI, Deciles, PDSI, CMI
- Monthly Weather Summary
  - Climate data for most Caribbean islands

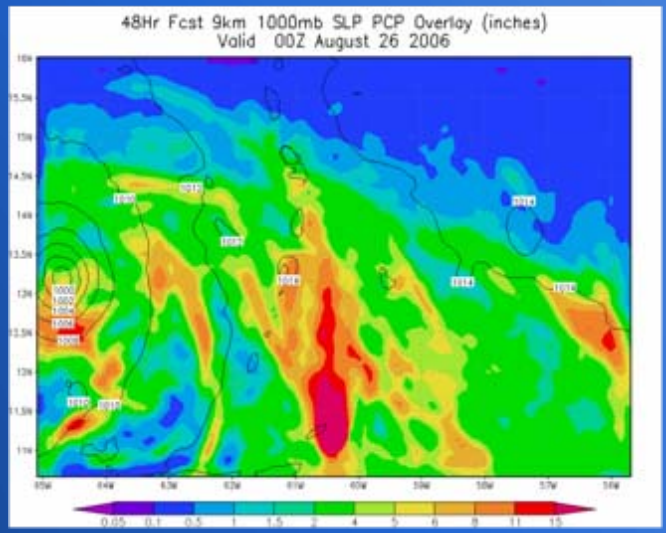


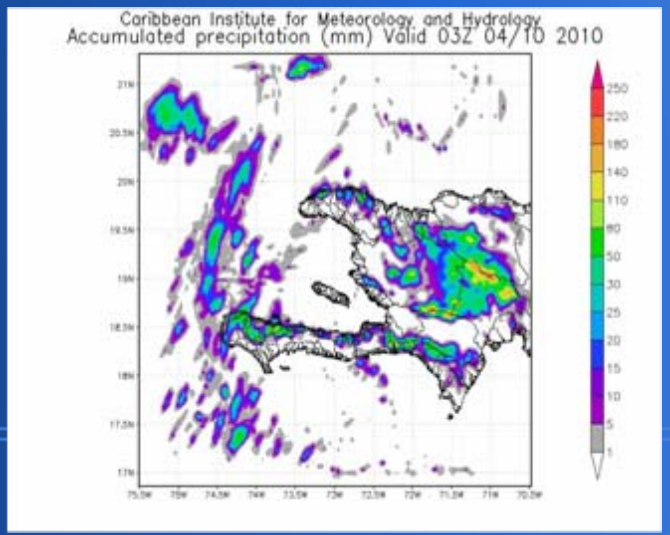


Research & Development

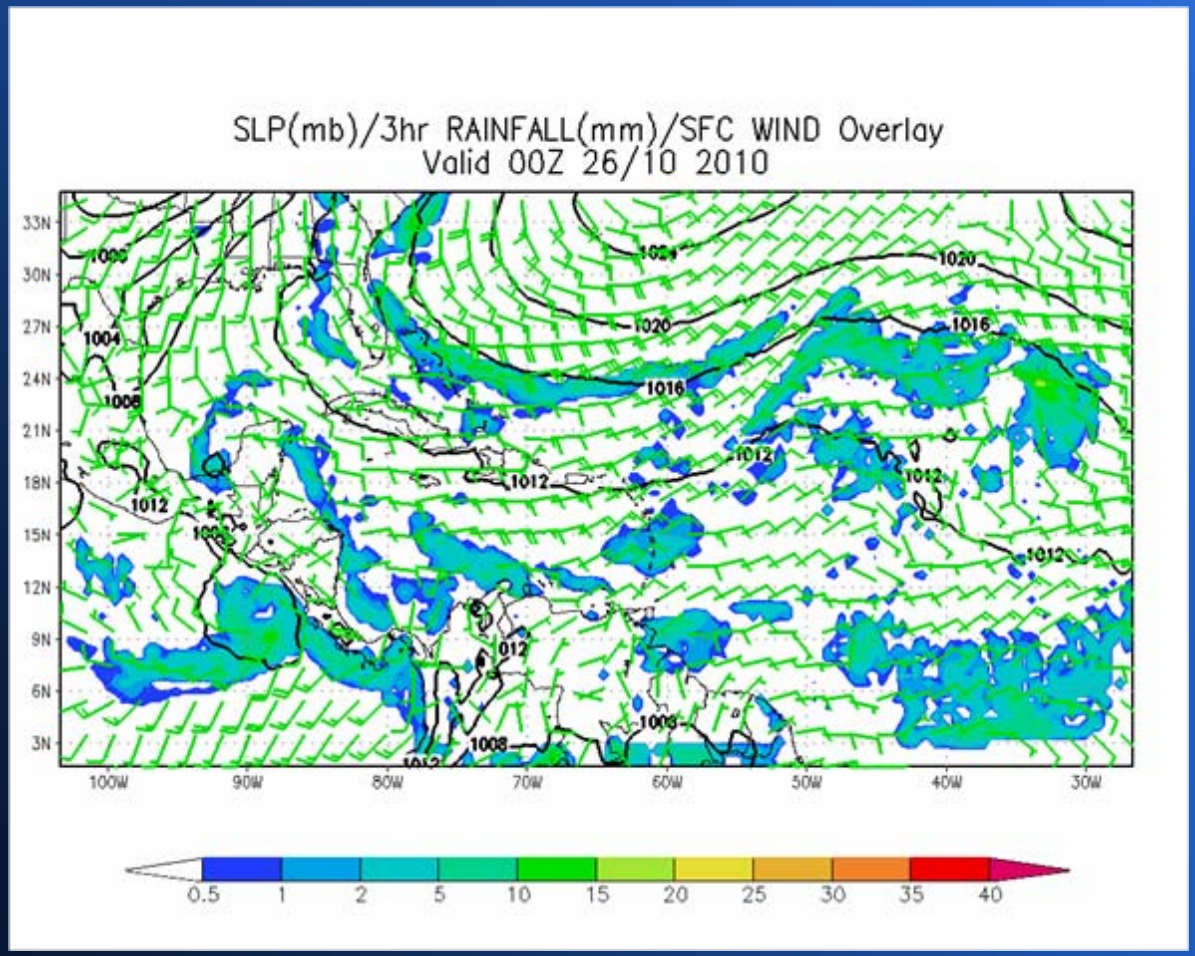
Computational Climatology

- Application of Mesoscale Models to Support Meteorological Forecasting and Disaster Risk Reduction
  - MM5V3 and WRF ver 2 & 3 used to support work
  - Model validation ongoing
  - Integration of modeling results into disaster management will commence this year
  - Student interns are involved in this activity
- Climate Change Modeling
  - Use of the PRECIS model to support analysis of climate change and climate variability across the Caribbean (MACC project)
  - Use of WRF to perform regional climate runs
  - Introduction of Max Planck's REMO model in 2010
  - Outcomes being used to support sectoral analyses (e.g., impact of climate change on agriculture)
  - Contribute to the efforts of the regional climate task team
- Support to Regional Post Impact Flood Assessment Teams & Risk Transfer Mechanisms
  - Convert data to products to assess flood return periods for regional catastrophe insurance organization





Research & Development



CIMH's regional numerical weather products used by NMHSs to support development of national forecasts

Overcoming CIMH's Challenges

- Training
- Enhanced existing training programmes by upgrading the teaching materials and working with UWI development of course develop strategies and improved delivery
- Focused on competency skills in most programmes and developed a 3-month competency development modules based on BIP-M for B.Sc. graduates who express a desire to seek work in aviation forecasting and who never took the Senior Level Meteorology Technician course (feedback from NMHSs very favorable ... model is transferrable)
- Provided on-demand specialized training to the disaster risk management community and the farming community (demonstrates the relevance and versatility of CIMH) ... grants and specialized agencies cover the cost)

Overcoming CIMH's Challenges

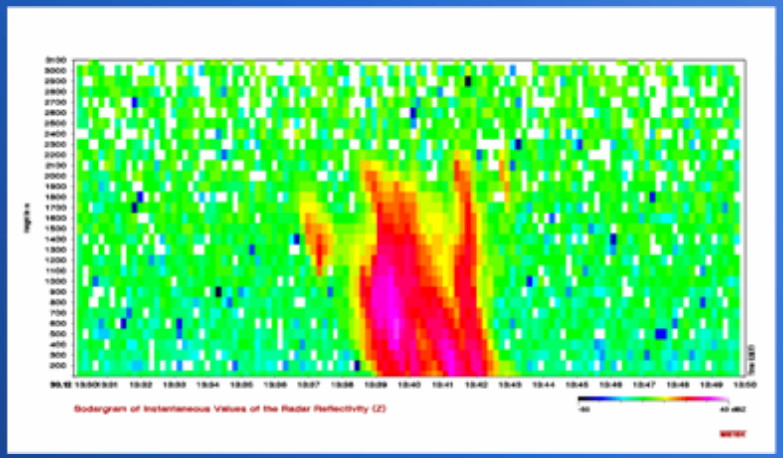
- Training ... cont'd
- Developing a cost-effective professional development programme for NMHSs
  - Cost of development and delivery is a challenge especially the latter as it may require travel and regular updating of material
  - Teaming with experts to support online development and delivery represents a viable option as going it alone represents an expensive proposition for CIMH
- Sharing resources online is financially beneficial for all as only one development cost is required and the cost of travel and accommodation is avoided (establish training consortia ... in discussion with COMET)
  - The contents of many courses are common across RTCs
  - Need to address language

Overcoming CIMH's Challenges

- Retain/Maintain a high level of staff competency & capacity while meeting the professional expectations of staff
- You have what I want ... I have what you want ... let's barter
  - Enter into sustainable joint research collaboration projects (research consortia) with well established programmes that are interested in doing work our region
    - Staff get exposure to new technologies and improve research skills
- Use revenue generated from the sale of products and services to support staff travel to meetings and workshops
- **WMO's help is still required to support staff development but is no longer the sole source of assistance**
- Summer research internship programme used to develop the next generation of climate, weather and hydrological scientists for the region and CIMH

Research & Development

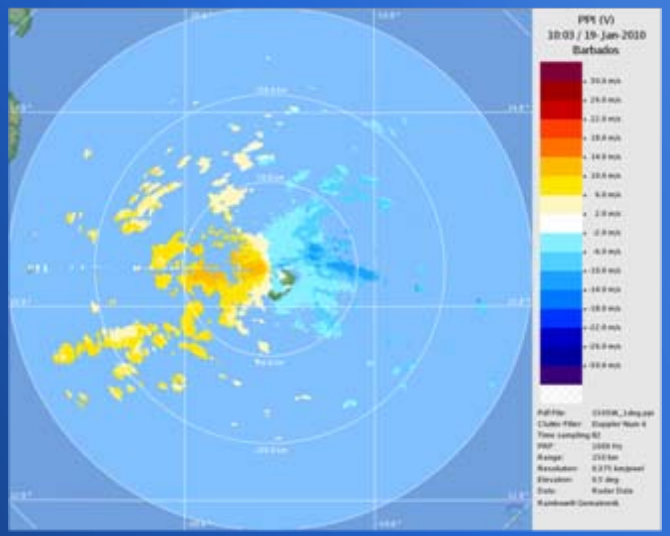
- Cloud Development and Rainfall Genesis Studies
  - International collaboration with the Max Planck Institute Hamburg (Meteorology Research Section) and the University of Miami
  - Cloud, rainfall and dust monitoring systems to be in place in 2010
- Aerosol Monitoring
  - Greater participation in the U. Miami aerosol monitoring programme along the east coast of Barbados (40-year aerosol and climate dataset acquired)
  - Participation in the new 2010 field campaign which will include aircraft flights
  - CIMH 2010 Atlantic dust transport modeling studies
- Remote Sensing
  - Utilization of satellite products to study atmospheric phenomena and to support monitoring and forecasting



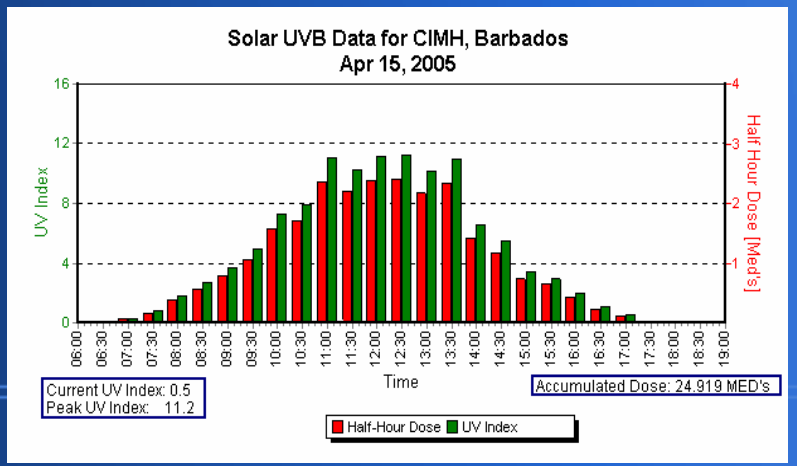
Research & Development

Physical Meteorology

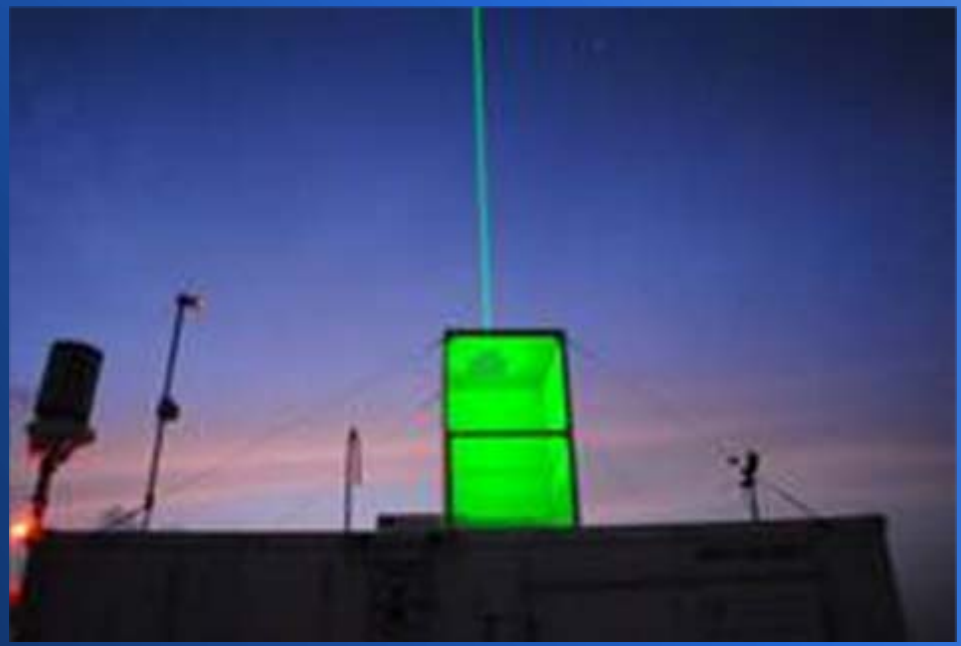
- Radar Meteorology
  - Access to outputs from the CMO Doppler Radar recently installed in the Caribbean
  - Access to data from a new Micro-Rain Radar installed at CIMH … additional systems to be installed across Barbados
  - Development of packages to support real-time and short-term forecasting
  - Integration of radar output with numerical modeling output to improve forecasts



- UV Studies
  - Supply of solar radiation data to the World Radiation Data Center, Russia
  - Measurement and analysis of UVB radiation levels for Barbados
  - Study of some of the factors which affect UV radiation levels



Research & Development



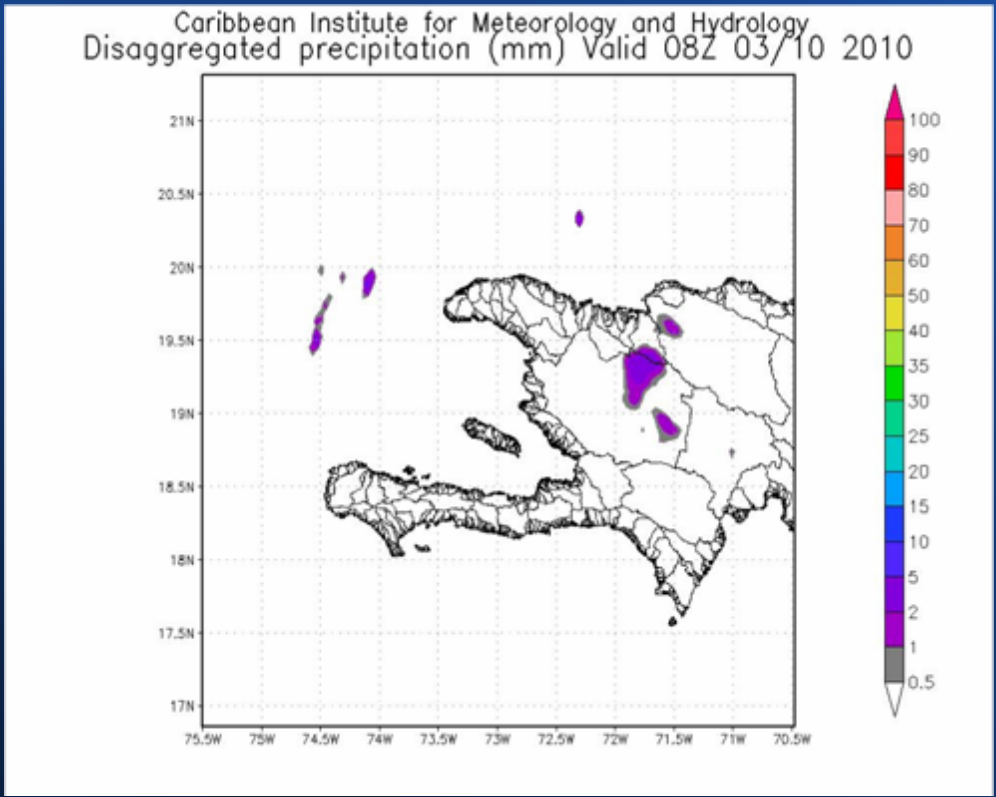
Max Planck Institute for Meteorology (Hamburg) research station on Barbados – Aerosol, Cloud, Precipitation and Climate Interactions in the Tropics Experiment

CIMH staff support the technical operations of the facility and as a result get exposed to cutting edge technology. In return, CIMH and regional climate modelers received training on MPI-M's Regional Climate Model (REMO). The model is being run on the CIMH computational cluster.

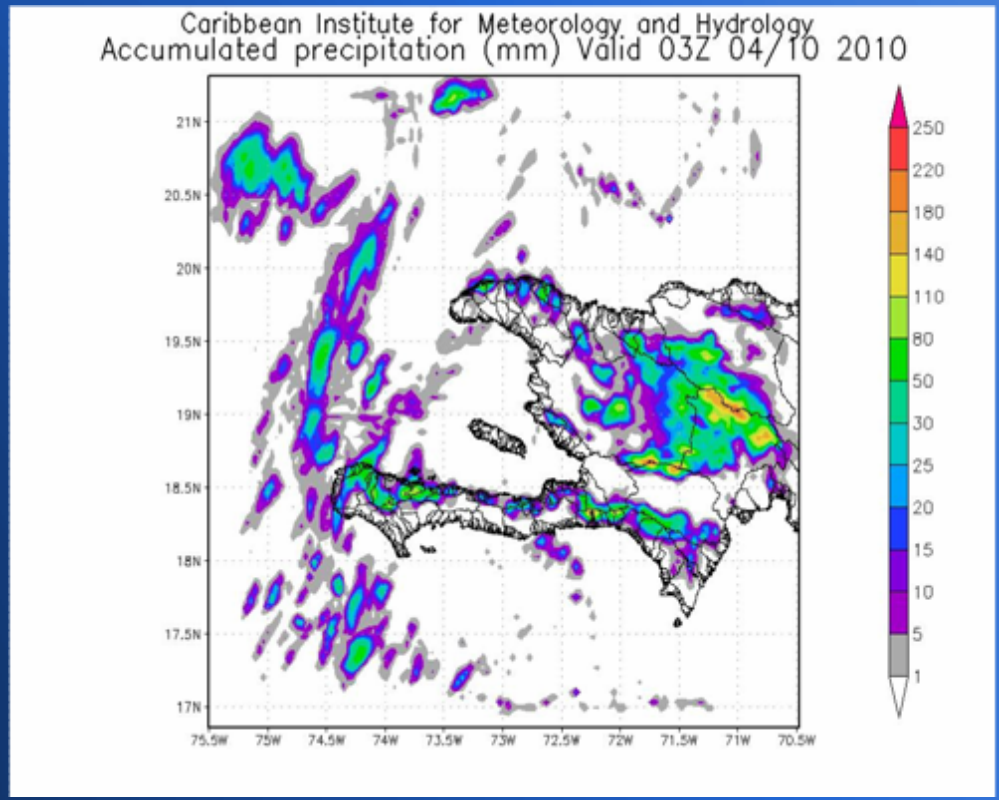
Caribbean Flooding

- Examples of recent severe flooding in the Caribbean (clockwise from top right):
  - Jamaica, Barbados and Haiti.
- Loss of life and property remains unacceptable high.
- Can this be improved?

Adaptation:
Advance Flood Forecasting: Haiti Pilot Project 2010



Hourly precipitation output from 48-hour high resolution (4 km) numerical weather prediction model run over Haiti watersheds. Ideal for forecasting the potential for flash flooding.



Running cumulative 48-hour precipitation output from 48-hour high resolution (4 km) numerical weather prediction model run over Haiti watersheds. Ideal for assessing the potential for flooding and landslides due to multiple precipitation evens over 48 hours.

Adaptation:
Advance Flood Forecasting: Haiti Pilot Project 2010

- Effort started January 13, 2010 with production of high resolution rainfall estimates after the earthquake;
- Development work subsequently financed by the CCRIF with the product being used by the international community;
- Flood forecasting based on explicit hydrologic model that uses rainfall predictions over watersheds;
- System to be implemented in watersheds in the Caribbean under a Japan-CARICOM funded project.
- Hydrometric data needed for robust model calibration.

Initial water depth in the watershed prior to the start of the rainfall event.

Adaptation:
Advance Flood Forecasting: Haiti Pilot Project 2010

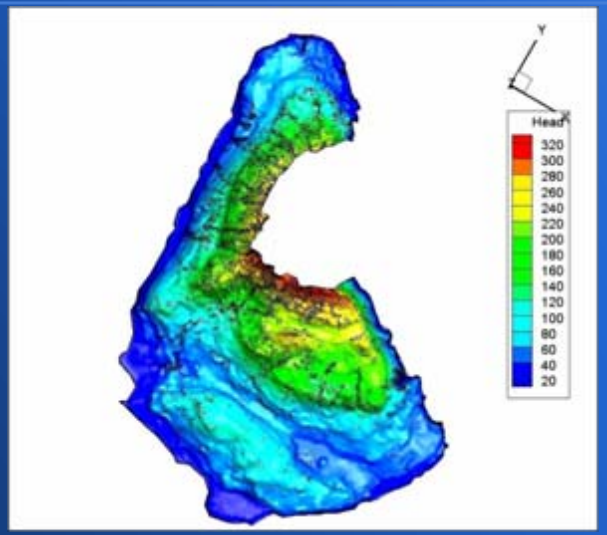
Modeled water depths across the watershed approximately 5 hours after the start of the event.

Modeled water depths across the watershed approximately 12 hours after the start of the event.

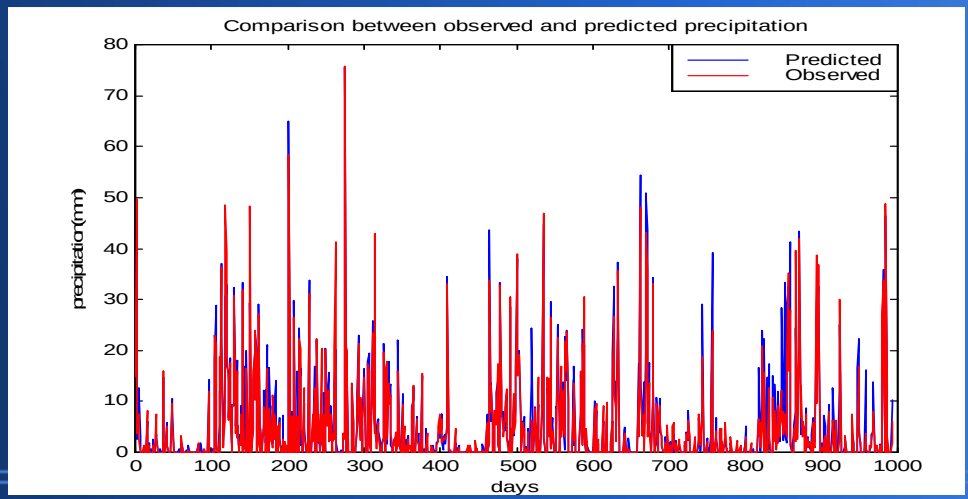
Hydro-meteorology & Water Resources Management

- Island scale and focused groundwater and contaminant migration modeling requires hydro-meteorological inputs:
  - Models support current management and future climate change adaptation assessments;
- Hydro-meteorological data often have gaps due to poor maintenance of the network or data stored in an unusable format;
- Missing data can be approximated using statistical algorithms;

Data rescue programme needed for most Caribbean islands!!!



Groundwater model being developed for Barbados.



Estimating missing data using analytical neural network.

Examples of Ongoing & Planned Regional Projects

- CCRIF Excess Rainfall Parametric Insurance Product
  - Based on model outputs due to limted hydro-meteorological data to support a data-driven model.
- Caribbean Water Initiative (CARIWIN)
  - 6 year pilot project being implemented in Jamaica, Guyana and Grenada with McGill University through assistance with CIDA
  - Supports water resources management training from the national to community levels
  - Installation of hydro-meteorological equipment
- CADM Phase II (CDEMA & Japan International Cooperation Agency)
  - Supports flood risk management in 6 CARICOM Member States)
  - Supports upgrading of hydro-meteorological networks in participating countries

Examples of Ongoing & Planned Regional Projects

- Completion of the Caribbean Meteorological Organization (CMO) Doppler Radar Project
  - Provides information to support rainfall estimation and location as well as other meteorological variables
- UNDP/Italy Enhance Resilience to Reduce Vulnerability
  - Will be executed in Barbados and OECS
  - Implementation of a decision support system to reduce hydro-meteorological risk
  - Improvement of hydrometric networks and data real-time capture
- Expansion and enhancement of hydrometric networks in the OECS (USAID?)
- Completion of the Caribbean Sea Level Monitoring Network

Ongoing & Planned Regional Projects

- Carib-HYCOS (France & WMO)
  - Expansion of hydrometric networks and data capture in participating countries
  - Specialized water resources management training
- Capacity Building for Water Programmes in Higher Education in the Caribbean (CapCar) (EduLink)
  - Series of specialized short courses to support capacity building in water resources
- GEF Integrating Coastal Areas and Water Resources Management (GEF-IWCAM)
  - Capacity building in participating countries to implement an integrated approach to the management of watersheds and coastal areas.

Conclusions

- Sustainable development in the Caribbean is strongly dependent on weather and climate;
- Reducing the impacts that weather and climate have on the various socio-economic sectors requires significant interaction between the various disciplines;
  - Important lessons were learnt from the 2009-2010 drought;
  - Information must be shared in a timely manner;
  - A clear understanding of end-user needs is required.
  - Clear policies for such interactions is required;
- Many new initiatives are being enacted at the regional level that if sustained should improve disaster risk reduction and water resources management. Given recent history, are all of the efforts sustainable? How do we prioritize these efforts?

Conclusions

- Comprehensive education and training programmes may be required to support integration of disciplines

Regional Climate Data Archiving at CIMH

- Responsible for storing/archiving meteorological and meteorological data from CMC Member States
  - Not all Member States are currently utilizing CIMH's data archiving capabilities
  - Not all data collecting agencies in countries share data with NMHS … as a result, comprehensive data sets for most countries is not available
- CIMH can handle data in a range of formats including CLIDATA and CLICOM which are supported by WMO … hydrological database also present
- Quality Assurance checks performed by CIMH on the data received and archived
  - Monthly Weather Summaries prepared from meteorological data received (available in electronic format http://www.cimh.edu.bb)
- In the past, few data products produced from data collected (cost is expensive relative to revenue) … situation is changing
  - See Caribbean Agrometeorology Network (http://63.175.159.26/~monthly/CarAgMet2/products.htm)

Challenges to Data Archiving at CIMH

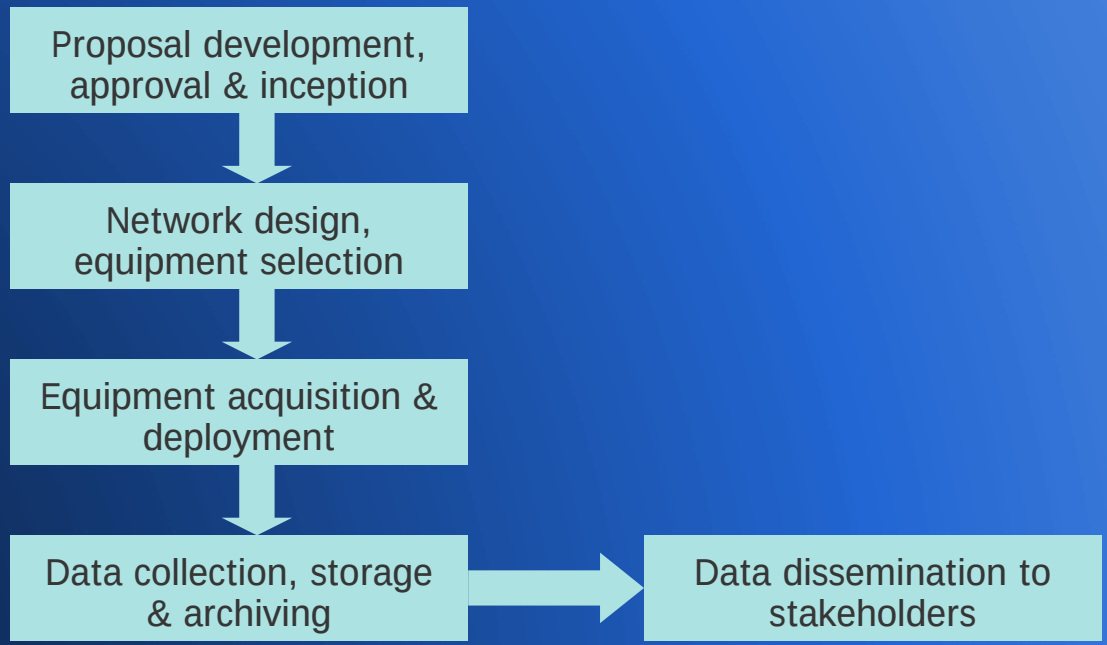
- Failure of several countries to archive data at CIMH
- Costs associated with data collection and archiving systems
  - Data collection, archiving and quality assurance at CIMH is approximately USD 250,000.00
  - Most of these costs are not recoverable
  - As more databases are added costs will increase
  - Sustainability of the system is susceptible to budgetary shortfalls at CIMH
- A more strategic approach to data collection, archiving and quality assurance at CIMH is required

Meteorological Data Archiving in the Caribbean

- Why collect and archive? What is the importance of archived data?
  - Better understand the climatology of the region to support sectoral planning (e.g., agriculture, water resources planning, insurance, etc)
  - Support for global climate databases (e.g., GCOS)
  - Support engineering designs (e.g., drainage design to support flood mitigation)
  - Environmental change detection
  - Supports design of alternative systems and energy mix

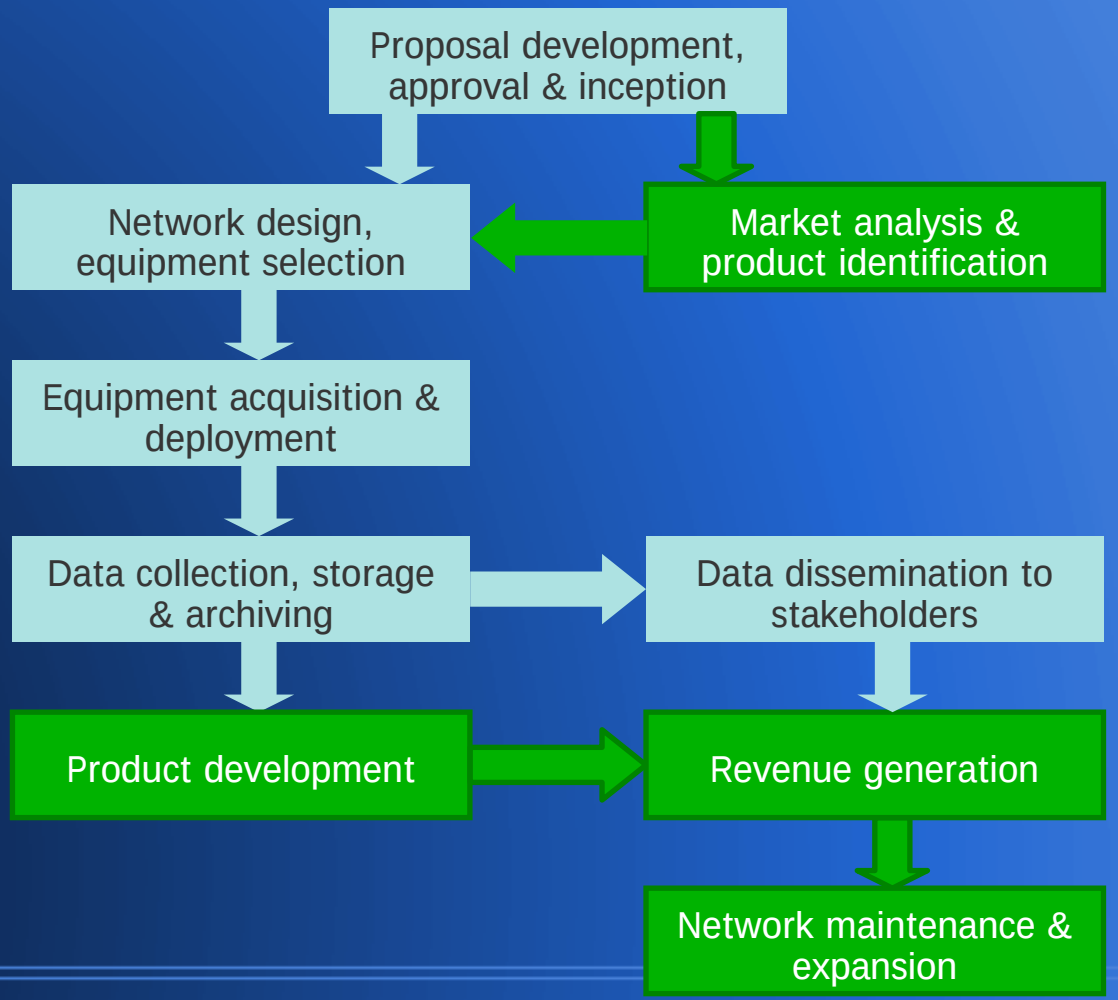
Project Cycle for Data Collection Projects

- **Challenges**
  - Limited sustainability as there is often little funding beyond the execution period
  - Often no product development from the data collected
  - How to address recurring costs
- **Enhancing sustainability**
  - Include a revenue generating model in the project design to address ***recurring costs***



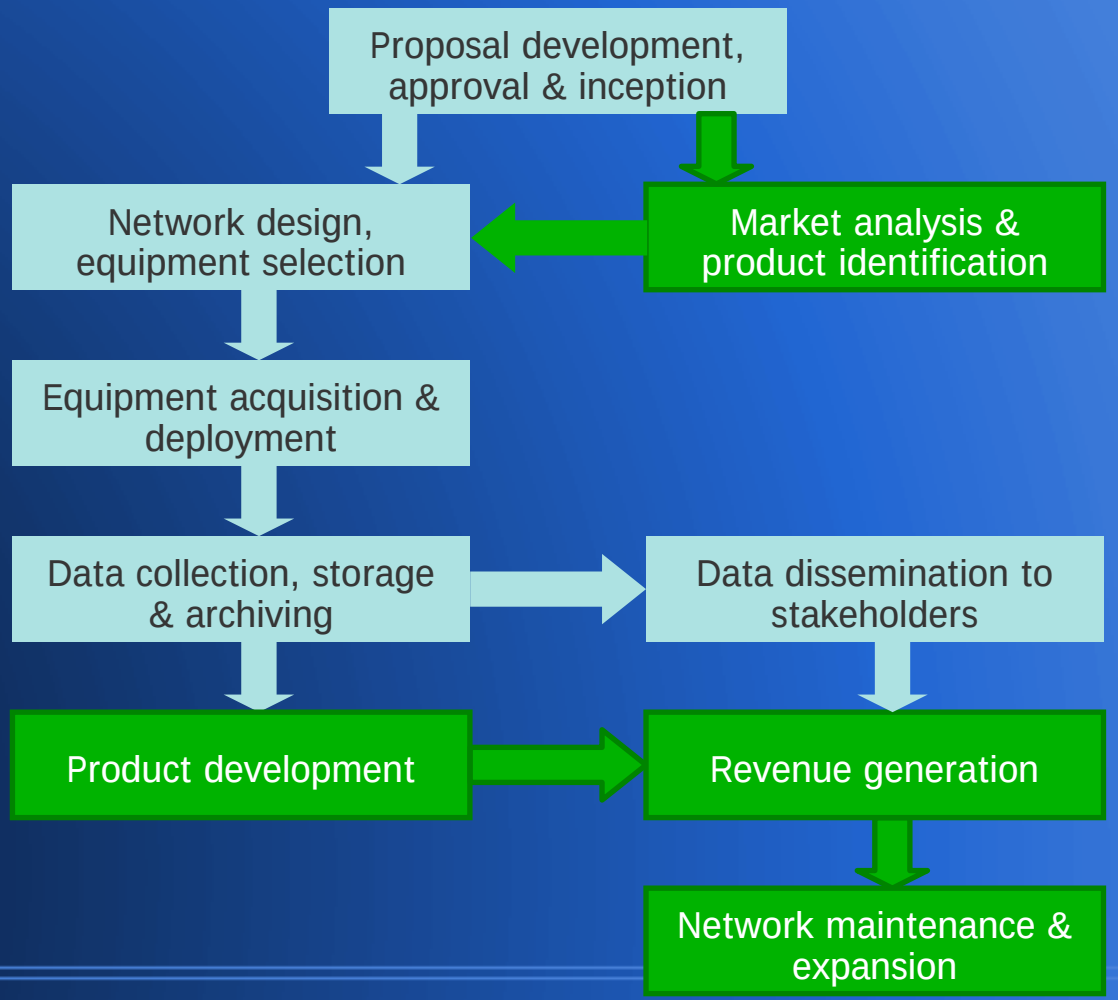
Modified Project Cycle for Data Collection Projects

- Market analysis and product identification
  - Customers and marketing strategy should be developed early in the project
  - Should be included early in the project cycle so that it is reflected in the equipment acquisition, network design and data collection and storage activities
  - Needs of the market may result in network design that may differ from that developed for the “traditional scenario”



Modified Project Cycle for Data Collection Projects (… cont'd)

- Product development
  - Can occur within regional organizations or as joint collaborations between the organization and the public/private sectors
  - Single or multiple products developed based on market demand and risk consideration
- Revenue generation
  - Sale of data to commercial entities
  - Sale of products and services developed from data collected and royalties



Revenue Generation Models

- Sale of data
  - Requirements:
    - Identification of appropriate pricing schemes
    - Development of appropriate agreements controlling the distribution of the data to third parties
    - Establishment of an appropriate system where royalties (or some equivalent) is paid to the data collector distributor for each unit of product sold for which the data is an important contribution
  - Pros:
    - For donor funded activities the cost and risk exposure is small for the implementing organization
  - Cons:
    - No incentive for capacity development leading to innovation is often missing
    - Revenue generated may be insufficient to cover recurrent costs associated with sustain the network … return to the donor community for financing to revitalize the network … removes money that can be applied to other important developmental activities

Revenue Generation Models
(… cont'd)

- Development of Products & Services … added value
  - Requirements:
    - Market research conducted early in the project development stage
    - Appropriate staffing and resources may need to be put in place
    - Establishment of appropriate pricing schemes for products and services
    - Public sector/Private Sector partnerships
  - Pros:
    - Donor assumes the initial risks by providing the seed financing
    - Revenue generated from the sale of products and services used to sustain the network … no need for further interventions from the donor community
    - Research (market and scientific) and product development supports capacity development, innovation and spin-off activities … organizational growth
    - Data dissemination objectives also achieved
    - Provides incentives for data collection
  - Cons:
    - Organization's risk exposure increased due to its need to invest in product development

Other Approaches to Achieving Sustainability of Data Collection Systems

- Exploitation of synergies between projects
  - Currently several projects are being initiated in the Caribbean that have data collection components. CIMH is working with the various implementing agencies. Long-term sustainability of these efforts can be achieved by:
    - Exploiting synergies across projects to reduce repetition of efforts
    - Using common instrument platforms to reduce the number of systems being deployed, managed and maintained
    - Utilization of common databases to reduce the costs associated with supporting multiple databases
    - Reinvesting cost savings from synergistic activities to support sustainability activities (equipment procurement, software updates and research and development activities)

Conclusions

- Saying we need a new network is not enough ... demonstrating a clear long-term management strategy is required
- There needs to be significant shift in the way we see data and demonstrate the importance of data to national development
- Business models should be built into proposals to support the sustainability of projects. Models should explore revenue generation based on resale of data and development of products from data. Revenue could support
  - Sustainability of networks
  - Innovation, research and development