The Caribbean Academy of Sciences



18th General Meeting and Conference

"Hazard Mitigation: Protecting Caribbean Infrastructure – Securing Caribbean Communities"

Conference Proceedings

Bridgetown, Barbados 2nd - 4th November 2012

Mission Statement

- To be an authoritative voice on science and technology in the Caribbean region
- To promote the development of all branches of science and technology for the Caribbean Region
- To strengthen the status of the scientific professions and act as a resource base for scientific information, expertise and policy analysis
- To increase the public understanding and awareness of the impact of science and technology on the development of society
- To develop and promote alliances and partnerships in support

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The Caribbean Academy of Sciences 18th General Meeting and Conference

Held in collaboration with THE UNIVERSITY OF THE WEST INDIES - CAVE HILL



Bridgetown, Barbados 2nd - 4th November 2012

"Hazard Mitigation:



Protecting Caribbean Infrastructure – Securing Caribbean Communities"











Prize for best Oral Presentation

Plan early for the

2014 Conference

Prize for best Poster Presentation

Studentships will be available



Important Dates for 2012 Conference:

CAS General Meeting (members only) — 2nd November 2012 » 1.30 pm to 4.00 pm Grand Opening Ceremony — 2nd November 2012 » 7.00 pm CAS Council Meeting — 3rd November 2012 » 7.00 pm to 9.00 pm

foreword

The area known as the Caribbean is a developmental laboratory. Within a relatively small geographic space there are societies which encompass four major languages and developed out of four different colonial experiences, systems and cultures. Within this space is one of the least developed economies of the world, juxtaposed with some which have been "graduated" to the global economic "middle class". The Island and Low Lying Coastal States of the region are characterized by very special eco systems and biological diversity; environmental fragility and heightened vulnerability to natural disasters and economic shock; and an endemic shortage of trained human resources. All of that existing in a physical environment which the rest of the world equates with "paradise"!

Under the Law of the Sea, Caribbean Island States are among those which have become responsible for Exclusive Economic Zones (EEZ) which are many multiples of their land masses. How therefore are Caribbean States to manage and exploit their EEZs when there is already a deficit of human resource to develop the even smaller land mass?

All of the above are intended to highlight, not crisis but opportunity. Opportunity that exists for research and the application of science including social science, and technology towards understanding the basis of the problems and proposing solutions for the benefit of Caribbean societies.

The Conferences of the Caribbean Academy of Sciences is one of the vehicles of response to that opportunity. It also needs to be said that the opportunities exist not only for Caribbean expertise but as well for global minds which want to be challenged.

Over the past twenty plus years of the Academy's existence we have focused in these Conferences on a wide range of Themes. This 2012 Conference follows that pattern in that, while the Theme is "Hazard Mitigation: Protecting Caribbean Infrastructure – Securing Caribbean Communities" papers have been included in other areas of the Natural and Social Sciences and in Technology. An eclectic mix of the submissions has been accepted, to be enhanced by the discussions and interactions of the Conference itself.

I welcome all the participants to the Conference and "thank you for choosing us"! I know that the visitors will enjoy their stay in Barbados!

On behalf of the Members of the Academy and the participants, I want to especially thank the Conference Coordinator- the Academy's PRO- Dr. Trevor Alleyne, the Organizing and Scientific Committees, our very kind sponsors and collaborators and all who have worked assiduously to bring us this event. These abstracts represent a sampling of the menu. Enjoy the feast!

Eng. Hollis Charles PRESIDENT Caribbean Academy of Sciences

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executive committee and chapter presidents



Eng. Hollis Charles, PRESIDENT CAS



Professor Tara Dasgupta, FOREIGN SECRETARY & PRESIDENT, JAMAICA CHAPTER



Professor Gosett Oliver SECRETARY



Dr Trevor Alleyne, PUBLIC RELATIONS OFFICER



Professor Jonas Addae TREASURER



Professor Winston Mellowes, PRESIDENT, TRINIDAD CHAPTER

Other Chapter Presidents



Professor Jean Louis Mansot PRESIDENT, GUADELOUPE CHAPTER



Dr Jorge Mereno PRESIDENT, ANTIGUA AND BARBUDA CHAPTER



Professor Neela Badrie CHAIR

Scientific Committee



Dr Mark Wuddivira MEMBER



Dr Raymond Jagessar MEMBER



Dr Diane Ignacio MEMBER

conference committees

| Steering Committee | Local Organizing Committee |
|---|--|
| Dr Trevor Alleyne – <i>Chair</i> Mr Peter Gibbs Eng Hollis Charles Dr Andrea Sealy Professor Winston Mellowes | Mr Peter Gibbs – <i>Chair</i> Ms Natasha Corbin Dr Andrea Sealy Ms Patricia Hackett-Codrington Ms Linda Christian-Clarke |
| Mrs Carol-Ann Crossley | Ms Cheryl Alleyne |
| Scientific Committee | Comerence Secretariat |
| Professor Neela Badrie – <i>Chair</i> | Ms Carol-Ann Crossley – <i>Chair</i> |
| Professor Robert Lancashire | Mrs Wilma Charles |
| Dr Mark Wudivera | Ms Natasha Corbin |
| Dr Trevor Alleyne | Professor Jonas Addae |
| Dr Diane Ignacio | Mr Dexter Superville |
| Dr Raymond Jagessar | Mr Michael Khan |

addresses of head office and chapters

| Head Office and Office of Trinidad Chapter | Jamaica Chapter |
|--|--|
| Faculty of Engineering | Englebert Davis |
| Block 13 Room 1 East | 2 Plymouth Crescent |
| The University of the West Indies | The University of the West Indies |
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| Trinidad and Tobago | Tel/Fax: 1-876-977-7764 |
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| Guyana Chapter | Guadeloupe Chapter |
| c/o Office of the Dean Faculty of Natural Sciences, University of Guyana | Professor Jean-Louis Mansot Caribbean Academy of Sciences UER Sciences Exactes et Naturelles |
| Box 10-1110, Georgetown, Guyana | Universite des Antilles et de la Guvane |
| iccaesar@vahoo.com | Campus de Fouillole, BP 250 |
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| Antigua and Barbuda Chapter | Barbados Chapter |
| Dr Jorge A Moreno | Dr Andrea Sealy |
| American University of Antigua School of Medicine | Caribbean Institute for Meteorology & Hydrology |
| St. John's | Husbands, St. James |
| Antigua | Barbados |
| Tel: 1-268-725-4335 | Tel: 1-246-425-1362/1363 |
| jmoreno@auamed.net | asealy@cimh.edu.bb |

conference timetable (nov 2012)

| Early Registration Thursday | November 1, 2012 | 3.00 pm – 6.00 pm | Registration at Divi Southwinds Beach Resort |
|-------------------------------------|------------------|--|---|
| Conference Day 1 Friday | November 2, 2012 | 11.00 am – 2.00 pm | Registration at Divi Southwinds Beach Resort |
| Conference Day 1 Friday | November 2, 2012 | 1.00 pm – 3.00 pm | Hotel Manager's Welcome Cocktail |
| Conference Day 1 Friday | November 2, 2012 | 1.30 pm – 4.00 pm | CAS General Meeting (members only) Divi Southwinds Beach Resort |
| Conference Day 1 Friday | November 2, 2012 | 7.00 pm - 10.00 pm (<i>Transport leaves DSBR</i> <i>hotel at 6.00pm</i>) | Opening Ceremony & Cocktail Reception (<i>Free to all Conference Participants</i>) EBCCI, Cave Hill Campus |
| Conference Day 2 Saturday | November 3, 2012 | 8.45 am - 5.15 pm (<i>Transport leaves DSBR</i> <i>hotel at 8.10am</i>) | Registration begins 8.15 am Main Conference: 8.45 am – 5.15 pm Oral and Poster Presentations RMTC, Cave Hill Campus |
| Conference Day 2 Saturday | November 3, 2012 | 7.00 pm - 9.00 pm | CAS Council Meeting Divi Southwinds Beach Resort |
| Conference Day 3 Sunday | November 4, 2012 | 8.45 am - 3.15 pm (<i>Transport leaves DSBR</i> <i>hotel at 8.10am</i>) | Registration – 8.15 am – 8.55 am Main Conference: 9.05 am – 3.20 pm Oral and Poster Presentations RMTC, Cave Hill Campus |
| Conference Day 3 Sunday | November 4, 2012 | 3.30 pm - 4.15 pm | Reports / Prize Giving / Closing RMTC, Cave Hill Campus |

publication policy

All Abstracts accepted for the Conference will be published in the CAS e-Journal. CAS is also extending an invitation to authors to have their full papers published in the CAS e-Journal. Note however that CAS reserves the right to reject any paper it deems unsuitable for publication in its journal. The deadline for the submission of full papers for the 2012 conference is November 30, 2012.

Persons wishing to have their full papers published should upload manuscripts directly to the CAS e-Journal; to do so please follow the instructions for preparation and uploading at: http://www.caswi.org.jm/ejournal.

Those without UWI Mona accounts will need to create a free account to log in.

| For further information contact | | |
|---------------------------------|------------------------|----------------------|
| Professor Robert Lancashire | Professor Neela Badrie | Dr. Mark Wuddivira |
| rjlanc@caswi.org | neela.badrie@yahoo.com | wuravnakka@yahoo.com |

scientific programme in brief

| TIME (Nov 3rd) | (Bus leaves Hotel DSW at 7:50am) | | | |
|------------------|---|--|---------------------------------------|--|
| 8.00 – 8.40 am | REG | ISTRATION - | - The Secretaria | at |
| 8.45 – 10.00 am | Welcome Address (10 min); 1 st Plenary Speaker – Dr D Farrell (25 min) Plenary Session 1 Feature Speaker – Dr G Holland (30 min) (QUESTIONS 10 Min) Venue: LT2 | | | |
| 10.00 – 10.15 am | | BRE | EAK | |
| 10.20 – 11.20 am | Plenary Session 2 Prof R Reddock, Dr A Cashman (25 min x2) (QUESTIONS 15 Min) Venue: LT2 | | | |
| 11.25 – 12.20 pm | Session 1A – Hazard / Disaster (18 min x3) (LT2) Session 1B – Applied Science (18 min x3) (LT3) | | | |
| 12.20 – 1.00 pm | LUNCH | | | |
| 1.05 – 1.15 pm | GROUP PHOTO SESSION | | | |
| 1.20 – 3.20 pm | Session 2A – Hazard / Disaster cont'd (20 min x6) (LT2) | Session 2B – Microbes G (20 min x6) (LT3) | | Group Meeting of Women's Forum (LR1) / Hazard Experts (LR2) |
| 3.20 – 3.35 pm | B R E A K | | | |
| 3.35 – 5.15 pm | Session 3A – Water (20 min x5) (LT2) | Session 3B (20 mir | – Soil / Energy n x5) (LT3) | Group Meeting of Women's Forum (LR1) / Hazard Experts (LR2) |

| TIME (Nov 4th) | (Bus leaves Hotel DSW-7:50am) | | | |
|------------------|--|--|-------|---|
| 8.30 – 10.00 am | Mr J Collymoore, Dr P Fraser-Abder (25 min x2); Young Scientist (20 min) Plenary Session 3 (QUESTIONS 15 Min) | | | |
| 10.00 – 10.15 am | | | BREAK | |
| 10.15 – 11.35 am | Session 4A (20 min x4) (LT2) Session 4B - Bio-active Extracts (20 min x4) (LT3) | | | |
| 11.40 – 12.15 pm | POSTER SESSION | | | |
| 12.15 – 1.10 pm | LUNCH | | | |
| 1.15 – 3.15 pm | Session 5A - Education (20 min x6) (LT2) | Session 5B – Bio-active Extracts cont'd (20 min x6) (LT3) | | Group Meetings of Women's Forum (LR3) / Hazard Experts (LR4) |
| 3.15 – 3.30 pm | B R E A K | | | |
| 3.30 – 4.15 pm | Report of Hazard Experts (15 min) and Report of Women's Forum (15 min) (LT2) Award of prizes for best Presentation & Poster (10 min) Close | | | |



TWAS/ CAS 2010 Young Scientist Award winner, Ms. Jo-Anne Sewlal is congratulated by The Honorable Prime Minister of Antigua & Barbuda, Mr. Baldwin Spencer. Professor Tara Dasgupta (right) and Professor Winston Mellowes look on.

CAS-TWAS Young Scientist Award

The Caribbean Academy of Sciences – Third World Academy of Sciences (TWAS), Young Scientist Award.

Applications are invited for the CAS-TWAS Young Scientist Award for 2013. The Award is worth US\$2000. The following conditions apply:

- 1. The Award shall be given to the individual who has done the most to advance the progress of Scientific research as judged by the quality of his/ her publications and /or patents in one of the following fields: Chemistry, Mathematics, Life Sciences, Physics and Engineering.
- 2. The age of the Applicant must not exceed 40 years during the year of the award. He/She must be a resident of the Caribbean region and most of the work for the Award must also have been done in the Caribbean region. An individual can only receive one such award.
- 3. The recipient of the Award will be expected to make a Scientific Presentation at the 19th Meeting of the Academy.
- 4. Nominations for the 2013 Award (on the required forms) should have reached the Office of the CAS Secretariat between 1st March and 31st August 2013. (Visit the CAS website at http://www.caswi.org for forms).



TWAS/CAS 2008 Young Scientist Award winner, Dr Michael Taylor (far right) is congratulated by The Honorable Prime Minister of Grenada, Mr. Tilman Thomas (centre).

Looking on From Left: Professor Emeritus Winston Mellowes, Professor Tara Dasgupta and Professor Ewart Thomas.

introduction

The 18th General Assembly of the Caribbean Academy of Sciences (CAS) was held in the beautiful island of Barbados. The 2012 Conference was co-hosted by The University of the West Indies - Cave Hill and supported by National Institute of Higher Education, Research, Science and Technology (NIHERST). The Biennial Conference commenced on the evening of November 02, 2012 with an impressive Opening Ceremony in the Walcott Warren Theatre in the Errol Barrow Centre for Creative Imagination. Nobel Laureate Derek Walcott delivered the feature address.



The Walcott Warner Theatre

The renowned Barbadian folk singer, Gabby, provided the entertainment. The unvailing of the TWAS-CAS Young Scientist Recepient and the inauguration of the Barbados Chapter of CAS were two other highlights.



The Errol Barrow Centre for Creative Imagination

The theme of the Conference was "Hazard Mitigation: Protecting Infrastructure Caribbean Caribbean Securing Communities". One of the main objectives of the Conference was to bring together international and regional natural scientists. social scientists, engineers, health experts, agricultural experts and the private sector to deliberate and focus their thoughts on the diverse implications of natural hazards, so that they could develop strategies to meet regional challenges.

A second major objective of the Conference was to provide an opportunity, via parallel scientific sessions, for experts from the region's Universities, Research Centres and Industry to come together to present their research, industrial and development findings for critical analysis.

The scientific programme consisted of seven plenary lectures by invited experts, fortyeight short papers of 20 minutes duration by participants and thirteen posters. The short papers were in areas of natural and social science, including, but not limited to: Agriculture, Medicine, Physiology, Chemistry, Biochemistry, Biology, Biotechnology, Energy, Food Science, Physics, Engineering, Education, Economics, Sociology, Historical and Environmental Science, Mathematics and Computer Sciences. The relevant abstracts can be found on pages 29 through to 72.

hotel accommodation

The Divi Southwinds Beach Resort was the hotel of choice for the CAS 2012 conference. Special concessionary rates applied to all registered conference participants.

The resort is located on St. Lawrence Main Road, Christ Church, Barbados.

All suites offer private balconies with scenic views of the ocean or poolside and gardens.



Also, all suites carry fully equipped kitchens, bedrooms with King-sized beds and spacious sitting rooms with sofas that convert to Queen-size sleepers. Other amenities include air-conditioning and flat screen TV with satellite reception. Hi-Speed wireless internet access is available in-room for US\$10.95 per day.



The strategic lay out of the hotel offers patrons three options. Patrons may relax in the quiet ambience or play a round of Mini-golf at Divi Southwinds (north): Others may opt for the action of the world-famous St. Lawrence Gap, a vibrant, throbbing entertainment precinct which separates the north section of the hotel from the south section. Finally Divi (south section) offers patrons a sample of the crystal clear waters and white sandy beaches of Barbados.





Ask for the Special Conference rates.

Single occupancy US\$130.00 Double occupancy US\$170.00

Tel: 1-246-418-7300, Fax: 1-246-420-2673 Website: www.divisouthwinds.com

TRANSPORT from Divi Southwinds to and from the Conference venue was provided.

Additional Enhancements

All confirmed guests are preregistered and pre-keyed for speedy Check-in.

Official Check-In time: 4.00 pm Earlier Check-In is possible. Check-Out :11.00 am

Free luggage storage and use of hospitality room while awaiting check in

Rates are inclusive of taxes and include breakfast. Rates apply up to 5 days before and 5 days after the conference.

conference venue

The University of the West Indies, Cave Hill Campus, Barbados will be the venue of the conference. The Opening Ceremony will be held at the Errol Barrow Centre for Creative Imagination (EBCCI) while the Scientific Lectures and the Poster Display will be held at the Roy Marshall Teaching Complex (RMTC).

about Cave Hill campus (a CAS partner)

The University of the West Indies has campuses at Cave Hill in Barbados, St. Augustine in Trinidad and Tobago and Mona in Jamaica with a total student body of approximately 24,300 distributed amongst nine faculties.

The Cave Hill Campus began in 1963 as the College of Arts & Sciences in temporary quarters at the Bridgetown Harbour (then familiarly known as the Harbour site). In August, 1967, the College moved to its present site at Cave Hill. With the establishment of the Faculty of Law in 1970, the name of the College was changed to the Cave Hill Campus of the University of the West Indies. The main Campus is currently located on 47 acres of elevated land overlooking the island's capital and principal commercial centre, Bridgetown, which is just five miles away.

Originally designed to accommodate about 500 students, the present enrolment is approximately 8,900. Despite its expansion in recent years, the campus maintains much of its original architecture of simple, low-rise buildings. The Campus has five Faculties, namely, Law, Humanities & Education, Science and Technology, Social Sciences and Medical Sciences. The scenic attractiveness and relatively small size of the university community creates an inviting, intimate and friendly atmosphere for studying. Looking for a great student-experience, Cave Hill is probably the place for you.



Administration Building, UWI Cave Hill, Barbados

registration

Registration for CAS Conferences can be done by E-MAIL or FAX on the Official Registration Form. Note that registration will only be considered as complete on receipt of the appropriate fee.

| Registration Fees for 2012 Conference | | | |
|---------------------------------------|------------------------------|-----------------------------|--|
| (Payable in US Dollars) | Before June 30, 2012 US\$ | After June 30, 2012 US\$ | |
| Members | \$200 | \$250 | |
| Non-members | \$250 | \$300 | |
| Students | \$100 | \$150 | |

Method of Payment:

Payment can be made by US Dollar Money Order or Bank Drafts payable to The Caribbean Academy of Sciences. Persons holding Trinidadian Accounts may pay the US Dollar equivalent by cheque. ****US\$1.00 equivalent to TT\$6.50.**

entitlements of fee-paying participants

All fully registered participants are entitled to attend the gala opening ceremony of our conferences. In addition they are entitled to all Conference Literature and to lunch and snacks served during the refreshment breaks of the Conferences.

contact information

The Conference Secretariat

c/o Dr. Trevor Alleyne Unit of Biochemistry Faculty of Medical Sciences The University of the West Indies Mt. Hope Trinidad and Tobago, WI

| Tel: | 1-868-662-1873/662-9294 | |
|---------|--------------------------------|---|
| or | 1-868-645-2640-9 Ext: 4642/464 | 3 |
| or | 1-868-360-0565 | |
| Fax: | 1-868-662-1873 | |
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CAS Secretariat

c/o Mrs. Carol-Ann Crossley Room 1 East Block 13 Faculty of Engineering The University of the West Indies St. Augustine Trinidad and Tobago, WI

| Tel: | 1-868-662-2002 Ext. 4469 |
|--------|--------------------------|
| or | 1-868-793-2351 |
| E-Mail | : secretariat@caswi.org |

For Conference updates, visit the CAS website: http://www.caswi.org

history of CAS

The idea of establishing a Caribbean Academy of Sciences (CAS) was informally proposed at the General Assembly Meeting of the International Council of Scientific Unions [ICSU] in Bern, Switzerland in September 1986. Among the ICSU members supporting the suggestion were: Nobel Laureate Sir John Kendrew - President of ICSU; Professor MGK Menon - Presidentelect of ICSU; Professor Raimundo Villegas - later Chancellor of the Latin American Academy of Sciences; The Swiss Academy of Science; the Third World Academy of Science; the International Foundation for Science; the US National Academy of Science; the Royal Swedish Academy; the African Academy of Sciences; the Israel Academy of Science and the Royal Nepal Academy of Science and Technology. Hollis Charles, the Caribbean member on the ICSU Committee for S&T in Developing Countries [COSTED] was mandated to raise the idea within the S&T community in the Caribbean and to support efforts to found a Caribbean Academy. Mr. Charles who was then the Director of the Caribbean Industrial Research Institute [CARIRI] assigned CARIRI Dep. Director - Dr. Desmond Ali, the task of promoting the Academy and COSTED Caribbean provided financial support for the activities leading to the formation of the Academy, including the inaugural seminar.

The next step was taken by the Physics Department of the University of the West Indies, St. Augustine, Trinidad and Tobago and subsequently by the Natural Sciences Faculty Board. They endorsed the idea and a small group of senior faculty members was asked to form a subcommittee to address all matters associated with the establishment of an Academy of Sciences for the Caribbean Region. It soon became apparent to the subcommittee that because of the relatively small size of the region and in particular the need to have a critical mass of scientists for the Academy to be an effective regional force for science, it was necessary to include not only natural sciences, but also the agricultural sciences which have an excellent track record for scientific research in the region, the engineering sciences which have and continue to play an important role in the development of an industrial base in the society and the medical sciences which have an excellent record of scholarship and the development of medical institutions in the region. At a later stage, after much and sometimes painful debate, the Social Sciences were included. It was in addition, decided that the Academy would not restrict itself to reside within the walls of The University of the West Indies, but should embrace scientists working outside the university environment. It was also agreed that appropriate resources of the Trinidad and Tobago Science Association (TTSA) which was established in 1983, should be utilized.

| In October 1987, a nine-man steering committee was formed to plan the inauguratio | n of CAS. | The |
|---|-----------|-----|
| members of the committee were: | | |

| Prof. Ramsey Saunders, Faculty of Natural Sciences | Dr. Winston Suite, Faculty of Engineering |
|---|---|
| Dr. Roman Antozewski, Faculty of Natural Sciences | Dr. Dennis Irvine, UNESCO |
| Dr. Harold Ramkissoon, Faculty of Natural Sciences | Dr. Julian Duncan, Faculty of Agriculture |
| Prof. George N. Melville, Faculty of Medical Sciences | Dr. Desmond Ali, President TTSA |
| Dr. Compton Seaforth, Faculty of Natural Sciences and Member of the TTSA | |

The steering committee organized the inauguration of the CAS at an international seminar on "Science, Development and Society" at the Central Bank Auditorium in Port of Spain, Trinidad on 16th and 17th May 1988. Regional dignitaries attending the inauguration included Sir John Compton, the then Chairman of the Commonwealth Caribbean Heads of Government, Senator Michael Williams, President of the Senate of Trinidad and Tobago and Honourable Winston

Dookeran, Minister responsible for Science and Technology in Trinidad and Tobago. Academies of Sciences worldwide either sent representatives or messages of congratulations to the Academy. The seminar itself was a resounding success. The keynote address was given by Professor W J Whelan of ICSU who represented Professor M G K Menon. Feature addresses were given by Professor Lalor who spoke on behalf of the disciplines of Natural Sciences; Professor H. Phelps who spoke on behalf of the Engineering Sciences; Professor Rolf Richards who spoke on behalf of the Medical Sciences; Mr. Frank Barsotti, a leading regional economist who spoke on behalf of the Social Sciences; Dr. Hayden Blades of CARICOM who spoke on behalf of the Agricultural Sciences and Dr. C H D Madagza, the representative of President Odhiambo of the African Academy of Sciences who spoke on "Some Experiences of the African Academy of Sciences".

Strong support for the seminar was provided by the Carnegie Foundation of New York and the private sector of Trinidad and Tobago. During the business session of the seminar, an Interim Executive Committee of the CAS was formed and Professor Ramsey Saunders named Interim President. The Interim Executive Committee was mandated to:

- Invite suitable persons for membership of the Academy
- Prepare and publish the Proceedings of the inaugural meeting
- Revise the draft constitution of the Academy on the basis of reports of working groups
- Organise and call the First Annual General Meeting

The objectives of the CAS were established in the early days of the Academy, and are as follows:

- To provide a forum for interchange of ideas among scientists on important issues related to the application of Science and Technology
- To serve as a source of advise to regional governments and regional governmental and non-governmental organizations in scientific and technological matters.
- To facilitate cooperation among scientists and promote the execution and coordination of scientific research in all its aspects
- To liaise with relevant research organisation and assist in facilitating their mutual interaction
- To recognise and reward outstanding performance and achievement within the region in the fields of Science and Technology
- To undertake, and collaborate in, the collation and publication of results of scientific research
- To raise the level of scientific consciousness in the region, and increase the public understanding and appreciation of the importance and potential of Science and Technology in human progress
- To establish and maintain high standards of ethics in all scientific endeavours

CAS in an effort to maintain its objectives strives to publish all scientific proceedings of the Annual General Meetings and a bi-annual newsletter which is distributed throughout the academy membership and elsewhere. In 2007 it launched an on-line e-journal for publication of proceedings of conferences and seminars.

Linkages have been established with the The Academy of Sciences for the Developing World (TWAS), who together with CAS, sponsors an annual scientific award to a young scientist; with the International Council for Science (ISCU) and with COSTED.

CAS is also a member of the Inter Academy Panel (IAP) which addresses international scientific issues. Regionally, CAS has formed close ties with the University of the West Indies (UWI) and Universities des Antilles et de la Guyane.

The Jamaica Chapter of CAS is the International Union of Pure and Applied Chemistry (IUPAC) National Adhering Organisation (NAO) representing Chemists.

Current membership stands at over 200 members, including scientists from the Englishspeaking Caribbean, Guadeloupe, Cuba, Guyana and Suriname. It is an independent, non-governmental body aiming to: provide a forum for interchange among scientists on important issues related to the application of science and technology to development; serve as a source of advice to regional, governmental and non-governmental organizations in scientific and technology matters; facilitate cooperation among scientists and promote the coordination and execution of scientific research in all its aspects; liaise with relevant research organizations and assist in facilitating their mutual interaction; recognize and reward outstanding performance and achievement within the region in the fields of science and technology; raise the level of scientific consciousness in the region and increase the public understanding and appreciation of the importance and potential of science and technology in human progress; establish and maintain high standards and ethics in all scientific endeavor.

Every two years CAS hosts a major Conference and General Meeting while local chapters host small conferences and frequent public panel discussions during the course of each year. In the last four years CAS has facilitated the training of dozens of science teachers via regional science workshops and visits of regional teachers to Canada.

The CAS Executive 2010 - 2012

| President | - | Eng. Hollis Charles (Trinidad and Tobago) |
|--------------------------------|---|---|
| Secretary | - | Professor Gossett Oliver (Jamaica) |
| Treasurer | - | Professor Jonas Addae (Trinidad and Tobago) |
| Public Relations Officer | - | Dr. Trevor Alleyne (Trinidad and Tobago) |
| Foreign Secretary | - | Professor Tara Dasgupta (Jamaica) |
| Chairman of T&T Chapter | - | Professor Emeritus Winston Mellowes |
| Chairman of Jamaica Chapter | - | Professor Tara Dasgupta |
| Chairman of Guyana Chapter | - | Mr. John C. Caesar |
| Chairman of Guadeloupe Chapter | - | Professor Jean-Louis Mansot |
| Chairman of Antigua Chapter | - | Dr. Jorge A. Moreno |

Former Presidents

| Prof. Ramsey Saunders | 1988 – 1992 | Prof. Winston Mellowes | 2002 – 2004 |
|-------------------------|-------------|------------------------|-------------|
| Prof. Ramsey Saunders | 1992 – 1996 | Prof. Winston Mellowes | 2004 – 2006 |
| Prof. Harold Ramkissoon | 1996 – 1998 | Prof. Tara Dasgupta | 2006 – 2008 |
| Prof. Harold Ramkissoon | 1998 – 2000 | Prof. Tara Dasgupta | 2008 - 2010 |
| Prof. Willie Chan | 2000 – 2002 | Eng. Hollis Charles | 2010 - 2012 |

CAS Meetings and Conferences

| Year | Country | Year | Country | Year | Country |
|------|----------|------|------------|------|---------------------|
| 1988 | Trinidad | 1996 | Tobago | 2002 | Jamaica |
| 1990 | Trinidad | 1997 | Barbados | 2004 | Trinidad |
| 1991 | Jamaica | 1998 | Guadeloupe | 2006 | Guadeloupe |
| 1992 | Barbados | 1999 | Suriname | 2008 | Grenada |
| 1993 | Trinidad | 2000 | Cuba | 2010 | Antigua and Barbuda |
| 1994 | Guyana | 2001 | Guyana | 2012 | Barbados |

about NIHERST (a CAS partner)





The National Institute of Higher Education, Research, Science and Technology (NIHERST) is a statutory body established in 1984 to promote science, technology and higher education in Trinidad and Tobago consistent with national development goals.

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on Transition of



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pictorial highlights 2010 conference

Conference speakers in scenic Antigua







pictorial highlights 2010 conference



THE CARIBBEAN ACADEMY OF SCIENCES (A) 17th General Meeting and Biennial Conference November 12th, 2010, Royal Antiguan Beach and Tennis Resort



CLIMATE CHANGE *Implications for Caribbean Health, Agriculture, Ecology, Industries and Building Codes

ANTIGUA & BARBUDA

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pictorial highlights 2008 conference

The Prime Minister (centre) with (from left) Tara Dasgupta, Winston Mellows, Ewart Thomas (feature speaker), Hollis Charles and Trevor Alleyne.











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We thank them all.

CAS also thanks the participants as well as all of those whom have contributed or assisted in any way in putting this conference together. In particular CAS extends special thanks to the Barbadian team of Dean Peter Gibbs, Ms Natasha Corbin, Dr Andrea Sealy and Ms Cheryl Alleyne. Finally, CAS thanks its secretary Ms Carol-Ann Crossley, Professor Neela Badrie and the Scientific Committee and graphic artist Mr Michael Khan for their tireless efforts.

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detailed scientific programme

| SATURDAY 03 NOVEMBER 2012 | | | |
|--|--|---|--|
| PLENARY SESSION 1: VENUE: LT 2 | | | |
| | Chair: Eng Holli | is Charles | |
| 8.45 – 8.53 a.m. | Honourable Ronald D, Jones MP Minister of Education and Human Resource Development | Welcome | |
| 8.55 – 9.20 a.m. | Dr. David Farrell Director, Caribbean Institute of Meteorology and Hydrology (CIMH), Barbados | The Role of CIMH and the Academic Community in Disaster Risk Reduction in the Caribbean | |
| 9.22 – 9.52 a.m, | Dr. Greg Holland Director, National Center for Atmospheric Research, USA | Extremes and Climate Variability/Change | |
| 9.52 – 10.00 a.m. | | QUESTIONS | |
| 10.00 – 10.15 a.m. | REF | RESHMENT BREAK | |
| | PLENARY SESSION 2 | 2: VENUE: LT 2 | |
| 10.10 10.10 a.m. | | GIDDS | |
| 10.18 – 10.19 a.m. | INTRODUCTION Drofossor Phodo Poddock | Do wa nood Conder Applysis in Natural Hazard | |
| 10.20 – 10.45 a.m. | Deputy Principal, UWI, St. Augustine | Mitigation? | |
| 10.47 – 11.12 a.m. | Dr. Adrian Cashman UWI, Cave Hill Campus, Barbados | Threats to Water Infrastructure from Natural Hazards and Climate Variability | |
| 11.12 – 11.20 a.m. | | QUESTIONS | |
| SESSION 1A – HAZARDS/DISASTERS – Venue: LT 2 Chair: Professor Gosett Oliver | | | |
| 11.25 – 11.43 a.m. | Dr. Frederic Dondin UWI, St. Augustine | Numerical Modeling of Volcanic Landslide-generated Tsumani Source: Comparison Between TOPICS and VolcFlow | |
| 11.44 a.m. – 12.02 p.m. | Dr. Lloyd Lynch The University of Guyana | An Appraisal of the Seismicity and Seismic Hazard of Guyana | |
| 12.20 – 1.00 p.m. | LUNCH | | |
| 1.05 – 1.15 p.m. | GROUP PHOTO | | |
| | | | |
| | SESSION 1B – APPLIED SCIENCES – Venue: LT 3 Chair: Dr Jorge Mereno | | |
| 11.25 – 11.43 a.m. | Dr. Thierry Cesaire University of French Guyana, Guadeloupe | Study of KA, the Traditional Drum from Guadeloupe: Preliminary Results on Wood Quality and Special Characterization | |
| 11.44 a.m. – 12.02 pm | Dr. Laurence Romana University of French Guyana, Guadeloupe | Investigation of Nanomechanical Behaviour of Strombus Gigas, Conch Shell by means of Nanoindeentation Techniques | |
| 12.02 – 12.20 p.m. | Professor Jean-Louis Mansot University of French Guyana, Guadeloupe | Archometry Applied to the Determination of the Origin of Underwater Discovered Ceramics | |
| 12.20 – 1.00 p.m. | | LUNCH | |

| 1.05 – 1.15 p.m. | GROUP PHOTO | | |
|------------------|---|--|--|
| 1.20 – 3.20 p.m. | WOMEN'S FORUM – Venue LR 1 | | |
| 1.20 – 3.20 p.m. | HAZARD EXPERTS – Venue LR 2 | | |
| | | | |
| | SESSION 2A – HAZARDS/DISASTERS – VENUE: LT 2 Chair: Professor Winston Mellowes | | |
| 1.20 – 1.39 p.m. | Mr. Keron Bascombe UWI, St. Augustine | The Effectiveness of a Learning Object in Disaster Risk Management | |
| 1.40 – 1.59 p.m. | Dr. Reynold Stone UWI, St. Augustine | Global Warning – How Reliable are the Surface Air Tem- perature Data? | |
| 2.00 – 2.19 p.m. | Ms. Joanne Chin Sang NIHERST | Public Dissemination of Spatial Information: A Case Study for Sea Level Rise in Tobago | |
| 3.20 – 3.35 p.m. | REF | RESHMENT BREAK | |
| | | | |
| | SESSION 2B – MICROBES, INSECTS, ANIMAL STUDIES – VENUE: LT 3 Chair: Dr. Mark Wuddivira | | |
| 1.20 – 1.39 p.m. | Ms. Jo-Anne Sewlal UWI, St. Augustine | Orb-weaving Spiders of the Eastern Caribbean | |
| 1.40 – 1.59 p.m. | Dr. Subramanian Gomathinyagam University of Guyana | Survey and Identification of Microbial Populations in Sugarcane Estate Soils | |
| 2.00 – 2.19 p.m. | Mr. Phillip Da Silva Guyana | Nurseries and Conservation of Mangroves: A Preliminary Survey of Insect Pests in Mangrove Nurseries in Guyana | |
| 2.20 – 2.39 p.m. | Dr. Emguerran Grandchamp University of French Guyana, Guadeloupe | Study of Housing Patterns Incidence on Dengue Transmission in Guadeloupe using Remote Sensing and Geographic Information Systems | |
| 2.40 – 2.59 p.m. | Dr. Srinivasa R. Popuri UWI, Cave Hill Campus | Solvent Effect on the Antibacterial Activity of Chitosan Microfiltration Membranes | |
| 3.00 – 3.20 p.m. | Professor Jonas Addae UWI, St. Augustine | Ethylemediamine Prevents Seizure and Anxiety in Animal Models | |
| 3.20 – 3.35 p.m. | REF | REFRESHMENT BREAK | |
| 3.35 – 5.15 p.m. | WOMEN'S FORUM (optional) – Venue LR 1 | | |
| 3.35 – 5.15 p.m. | 5 – 5.15 p.m. HAZARD EXPERTS (optional) – Venue LR 2 | | |
| | | | |

| SESSION 3A – WATER – VENUE: LT 2 Chair: Professor Jonas Addae | | |
|--|--|---|
| 3.35 – 3.55 p.m. | Dr. Raymond Jagessar University of Guyana | Spectrophotometric Determination of Phosphates (PO43) Anion in Waste Water from Selected Areas of Coastal Guyana via Stannous Chloride/Moly date Calorimetronic Method |
| 3.56 – 4.16 pm | Dr. Martin Forde St. George's University, Grenada | Determining the Safety of Rainwater Harvesting Systems in the Caribbean |
| 4.17 – 4.37 p.m. | Dr. Abdullah Adil Ansari University of Guyana | Potential Use of Vermiwash Obtained from Different Sources in Hydroponics |
| | | |

| SESSION 3B – SOIL-ENERGY – VENUE: LT 3 Chair: Professor Jean Louis Mansot | | |
|--|---|---|
| 3.35 – 3.53 p.m. | Dr. Mark Wuddivira UWI, St. Augustine | Sustainable Use and Management of Slaking Sensitive Tropical Soils |
| 3.54 – 4.12 p.m. | Mr. Loic Louison University of French Guyana, Guadeloupe | Optimal Control for Nutrient Uptake Systems in Pol- luted Soils |
| 4.13 – 4.31 p.m. | Dr. Sally Radford Surrey, United Kingdom | Report on the UWI/BPTT Jubilee Conference on Revenue Management in Hydrocarbon Economics |
| 4.32 – 4.50 p.m. | Mr. Kiron Neale UWI, St. Augustine | Domestic Solar Energy: A Viable Alternative in Trinidad & Tobago? Case Study: Housing |

| SUNDAY 04 NOVEMBER 2012 | | | |
|----------------------------------|---|--|--|
| PLENARY SESSION 3: VENUE: LT2 | | | |
| | Chair: Dr Gail B | accus-Taylor | |
| 8.30 a.m. | INTRODUCTION | | |
| 8.32 – 8.57 a.m. | Mr. Jeremy Collymore The Caribbean Disaster Emergency Management Agency, Barbados | Resilient Development: Re-Framing the Disaster Risk Management Agenda | |
| 9.00 – 9.25 a.m. | Dr. Pamela Fraser-Abder Program Director, Science Education, New York University, USA | Perspectives on Preparing Students for Sustainability: Some Global Insights | |
| 9.27 – 9.47 a.m. | Dr. Aime Pelaiz Barranco Department of Physics Havana University, Cuba | Ferroelectric Materials | |
| 9.47 – 10.00 a.m. | | QUESTIONS | |
| 10.00 – 10.15 a.m. | R | EFRESHMENT BREAK | |
| | SESSION 4A – PESTICIDES-DUS Chair: Professor Ra | T-LIFE ORIGINS – VENUE: LT 2 amsey Saunders | |
| 10.15 – 10.34 a.m. | Dr. Ronald Ranguin University of French Guyana, Guadeloupe | Adsorption and Degradation of Chlorinated Pesticides, Chlordecone and Hexachlorocyclohexane by a Hybrid Material Activated Carbon Supported Vitamin B12 | |
| 10.35 – 10.54 a.m. | Dr. Arthur Potts The University of Trinidad and Tobago | Evaluating the Needs of the Fishing and Associated Livelihoods in the Coastal Fishing Sector of Trinidad and Tobago | |
| 11.40 – 12.15 p.m. | | POSTER SESSION | |
| 12.15 – 1.10 p.m. | | LUNCH | |
| | | | |
| | SESSION 4B – BIOACTIVE E | EXTRACTS – VENUE: LT 3 | |
| Chair: Professor Sean Carrington | | | |
| 10.15 – 10.34 a.m. | Dr. Raymond Jagessar University of Guyana | Phytochemical Screening, Isolation and Purification of Betulinic Acid and Trigonelline from Stems of Doliocar- pus denatus (Kapadulla) | |
| 10.35 – 10.54 a.m. | Dr. Mark Wuddivira UWI, St. Augustine | Influence of Environmental Factors on Biosystems, Profile and Biological Activity of Phenolic and Forage Plants | |
| 10.55 – 11.14 a.m. | Dr. Diane Ignacio UWI, St. Augustine | Muscadine Grape Skin Extract Inhibits Androgen-inde- pendent Prostate Cancer Cell Growth induces Cell Cycle Arrest and Decreases Migration by Targeting Heat Shock Proteins | |

| 11.15 – 11.35 a.m. | Professor Vishwa N. Verma University of Guyana | Photochemical Study of Flowers and Leaves of Pumpkin |
|--------------------|---|--|
| 11.40 – 12.15 p.m. | POSTER SESSION | |
| 12.15 – 1.10 p.m. | LUNCH | |
| 1.15 – 3.15 p.m. | WOMEN'S FORUM – Venue LR 3 | |
| 1.15 – 3.15 p.m. | HAZARD EXPERTS – Venue LR 4 | |
| | | |

| SESSION 5A – EDUCATION – VENUE: LT 2 Chair: Professor Winston Mellowes | | |
|---|---|---|
| 1.15 – 1.34 p.m. | Dr. Thierry De Lacaze University of French Guyana, Guadeloupe | Contextualising Teaching of Sustainable Development: Guadeloupe |
| 1.35 – 1.54 pm | Dr. Thomas Forissier University of French Guyana, Guadeloupe | Theoretical Background to Study Science Education Contents |
| 1.55 – 2.14 p.m. | Dr. Donielle Dundas University of Guyana | The Status and Potential of Free and Open Source Soft- ware (FOSS) in Guyana |
| 2.15 – 2.34 p.m. | Mr. Kemuel Gaffar University of Guyana | Mobile Learning Adoption and the UTAUT Model |
| 2.35 – 2.54 p.m. | Professor Sean Carrington UWI, Cave Hill Campus | EUCARINET Analysis of Science and Technology Research in the Caribbean |
| 3.15 – 3.30 p.m. | REFRESHMENT BREAK | |

| SESSION 5B – BIOACTIVE EXTRACTS – VENUE: LT 3 Chair: Dr. Sally Radford | | |
|---|---|--|
| 1.15 – 1.34 p.m. | Ms. Arlene Williams UWI, St. Augustine | Leonotis nepetifolia Extract: Potential to Protect the Liver from Harmful Effects of Acetaminophen |
| 1.35 – 1.54 p.m. | Mr. Sirpaul Jaikishun University of Guyana | Antimicrobial and Antifungal Activity of Vermiwash from Different Sources (Bagasse, Neem, Paddy Straw in Different Combinations) and its Effect on Fungal Diseases Affecting Tomato Fruit in Guyana |
| 1.55 – 2.14 p.m. | Dr. Sonia Peter Barbados Community College | The Application of HPLV ESIMS in the Comparison of the /aqueous and Methanoloic Extracts of a Caribbean Medicinal Plant |
| 2.15 – 2.34 p.m | Mr. Dunstan Arrindell UWI, St. Augustine | A Preliminary Evaluation of the Anti-Cancer Potential of Selected Caribbean Plants |
| 2.35 – 2.54 p.m. | Dr. Raymond Jagessar University of Guyana | Antimicrobial Potency of Aqueous Extract of Leaves of Terminalian catappa |
| 3.15 – 3.30 p.m. | .15 – 3.30 p.m. REFRESHMENT BREAK | |
| | | |

| | PLENARY 4 – VENUE: LT 2 Chair: Eng Hollis Charles |
|---|--|
| 3.30 – 3.40 p.m. | Report of Women's Forum |
| I.45 – 4.55 p.m. Report of Hazard Experts | |
| 4.00 – 4.10 p.m. Award of Prizes for the Best Oral and Poster Presentations | |
| 4.10 – 4.15 p.m. Closing of Conference | |

| POSTERS VENUE: LT FORECOURT | | |
|--|--|--|
| Dr. Raymond Jagessar University of Guyana | Phytochemical Screening, Isolation and Purification of Betulinic Acid and Trigonelline from stems of Doliocarpus denatus (Kapadulla) | |
| Dr. Raymond Jagessar University of Guyana | Antimicrobial Potency of Aqueous Extract of Leaves of Terminalian catappa | |
| Dr. Raymond Jagessar University of Guyana | Determination of Nitrate Anion in Waste Water from Nine Selected Areas of Coastal Guyana via a Spectrophotometric Method | |
| Ms. Phaedra Jaggernauth University of Trinidad & Tobago | The Application of Calcined Maristontion as a Catalyst in Biodiesel Production of High FFA Coconut Oil | |
| Ms. Ria Monbodh University of Trinidad & Tobago | Exploring the Potential of Microalgae3 as part of Renewable Energy Opportunities in Trinidad and Tobago | |
| Ms. Melissa Atwell UWI, St. Augustine | Assessing the Influence of Edaphic Factors on Tropical Wetland Vegetation Distribution Using Electromagnetic-induction | |
| Dr. Yves Mazabrand University of French Guyana, Guadeloupe | Hydrothermalism in the Lesser Antilles Volcanic System: A Natural Laboratory for Geothermal Research | |
| Dr. Eleonore Mira University of French Guyana, Guadeloupe | Differences in Leaf Traits (anatomy and morphology) of 13 Dominant Species in two Caribbean Forests: Tropical Rain vs Dry Forest | |
| Mr. Shawn Boyce CIMH, Barbados | Decision Support Tools for Flood Hazard Mitigation in the Caribbean | |
| K. Cadogan UWI, Cave Hill, Barbados | Estimating the Parameters of the Five Parameter Lambda Distribution | |
| Ms. Sunshine DeCaires UWI, St. Augustine | Assessing the Temporal Stability of Soil Apparent Electrical Conductivity in Cocoa Fields using Electromagnetic Induction | |

Abstracts Plenary

The Role of CIMH and the Academic Community in Disaster Risk Reduction in the Caribbean Dr. David Farrell

Caribbean Institute of Metrology and Hydrology

The Caribbean, which consists of many Small Island Developing States (SIDS), is widely recognized as one of the regions most at risk from natural disasters. These risks have been borne out over the years by a range of hydro-meteorological events that have produced significant losses. In recent, years Hurricane Ivan (2004) produced losses in Grenada equivalent to 200 percent of the island's Gross Domestic Product (GDP). In 2010, Tropical Storm Tomas produced losses in Saint Lucia equivalent to 60 percent of the island's GPD. In addition, the storm exposed previously undocumented risks in the island's water sector. The drought of 2009-2010, considered the worse drought on record in the region, also exposed the limited ability of the region to address risks associated with drought. These hydro-meteorological and climate related risks pose significant challenges to the sustainable development of Caribbean SIDS and especially given current predictions for increasing climate variability and future climate change.

The Caribbean Institute for Meteorology & Hydrology (CIMH) and some sections of the region's academic community have engaged in to varying degrees to addressing these problems. For example, the CIMH has been involved in (i) various aspects of hydro-meteorological training as well as training various stakeholders in the application of climate information to their respective sectors, (ii) provision of technical support in the areas of climate and hydrological products and services to regional governments and the private sector, (iii) research activities geared at the understanding climate and hydro-meteorological risks in the region and (iv) the development of new products and services to support adaptation to changing climate and hydro-meteorological realities. Similarly, the academic community has been involved in various research activities related to climate and hydro-meteorological activities in the region. Unfortunately, the integration between many of the activities in the region is lacking.

This presentation highlights some of the activities in the region and identifies (i) areas of current and future work where greater collaboration is required and (ii) new areas for research and development.

Extremes and Climate Variability/Change Greg Holland

National Center for Atmospheric Research

Understanding how extremes adapt to climate variability and change is an interesting challenge. We have difficulty in defining the extreme end of the spectrum in past data because of difficulty in measuring extremes and the relatively short periods of good records. Current climate model resolution also tends to truncate the distribution so that extremes can only be inferred. However, the statistics of extremes tells us that these will have an amplified response to any change in the overall distribution, which leads to the interesting possibility that the signal to noise ratio for extremes is actually better than for the population as a whole.

In this presentation, I will first demonstrate the amplified response of extremes from both a statistical and data perspective. Next I will discuss use of climate models for assessing future extremes, including some lessons learnt in our modeling work over the past several years. Finally, I will discuss both recent changes and predictions of future extremes using hurricanes as the canonical example.

Do we need Gender Analysis in Natural Hazard Mitigation? Rhoda Reddock

Gender, Social Change and Development, The University of the West Indies, St. Augsutine Campus

After close to four decades of inter-disciplinary and multi-disciplinary research, academic programming and development policy in the area of gender and gender analysis, there is still much skepticism, mistrust and actual resistance to this concept. Even for those who accept the social dimensions of many technological challenges, the gender aspects are more difficult to accept. This presentation will explore the existential dilemmas affecting the acceptance and integration of gendered knowledge into one's world view and practice. It also argues for the efficacy of integrating gender analysis into all aspects of natural hazard mitigation including research, pre-planning and actual implementation of mitigation strategies. The recent cases of Haiti, Grenada and brief mention of the recent flooding in North-West Trinidad will be used as cases to illustrate this.

Threats to Water Infrastructure from Natural Hazards and Climate Variability Adrian Cashman

University of the West Indies, Cave Hill, Barbados adrian.cashman@cavehill.uwi.edu

There is a consensus which believes that the impacts of climate change on society will manifest themselves principally through the medium of water. There is a growing understanding of how climate change is driving changes in global meteorological conditions such as temperatures and precipitation patterns. However, there is much less of an understanding, certainly in the Caribbean as to how those changes will be manifest through the hydrological cycle. Greater climatic variability will not only have an impact on existing water service infrastructure (water and wastewater services) but will also impact the water resources as well as the users of the water infrastructure. We are only just beginning to understand what some of the hazards might be, often through the experience of recent extreme events and the observation of the impacts. In the presentation I will consider some of the work that has looked at the impact of climate change on water resources in the Caribbean and the experience of extreme events to consider ways in which impacts might be mitigated or planned for. I will also consider how recent work that has looked at the integration of disaster risk reduction strategies and the mitigation of climate change impacts can contribute to protecting water infrastructure and thus securing services to communities even under challenging circumstances.

Resilient Development: Re-Framing The Disaster Risk Management Agenda Jeremy Collymore

The impact of natural and other hazards on Caribbean development is well ventilated, even in the absence of limited data. In the last three decades there has been a consistency in interventions designed to mitigate the hazard impacts and to build institutional capacity to manage the loss reduction processes.

These have been pursued as generally parallel tracks seldom aligned or harmonized around shared strategic goals. The increasing awareness and attention to climate change and adaptation has compounded this scenario.

Recent efforts to establish strategic frameworks and related prioritized programmes, Comprehensive Disaster Management (CDM) and Climate Change (CC), represent recognition of the need for a connection to a higher level strategic goal.

This presentation argues that this can be provided through the framing of the Disaster Risk Reduction (DRR) and Climate Change (CCA) agenda around "Resilience". In this milieu infrastructure, protection will have a critical space.

Perspectives on Preparing Students for Sustainability: Some Global Insights Dr. Pamela Fraser-Abder

Science Education, New York University pa1@nyu.edu

We are all global citizens living within different but interconnected fragile ecosystems. Only with the right tools can we be expected to interact with the environment with the appropriate level of treatment that it requires. The 'right tools' are the knowledge about sustainability and appropriate strategies for living a sustainable existence. This knowledge is acquired through our education systems and our culture. But what is sustainability? Who are we preparing and for what? How is education about sustainability being handled now and how could it be handled in the future? And what are the consequences for inaction?

This talk will use an operational definition for sustainability informed by the UN and discuss how sustainability is reflected in global curricula. We will also explore vision, strategies and resources for managing change as we move to sustainability. It is imperative that the next generation be educated about sustainability and that sustainability is not merely a topic within curricula, but that it is interwoven within every aspect of their lives.

Ferroelectric Materials A. Peláiz Barranco

Physics Faculty, Institute of Science and Technology of Materials, Havana University. San Lázaro y L, Vedado, La Habana 10400, Cuba pelaiz@fisica.uh.cu

Since the discovery of the phenomenon of ferroelectricity, the continuous development of materials and technology has provided an important number of applications. Ferroelectricity has been the heart and soul of several industries critical to the development of piezoelectric transducers, high dielectric constant capacitors, pyroelectric sensors, medical diagnostic transducers, radio and communication filters, electro-optical devices, ferroelectric random access memories, etc. The most striking properties of the ferroelectric materials are strong coupling effects, strong hysteresis in the field polarization response and high dielectric permittivity. For the development of new technology by using ferroelectric materials, considerable research has been carried out from the perspective of theory and of experiment. The research has provided revolutionary breakthroughs in the understanding of single crystals, ceramics, thin films and composites.

The present work shows a general overview of some research on ferroelectric ceramics and composites, which have been developed by the Group of Ferroelectric Materials at Havana University, Cuba.

The dielectric relaxation and the influence of the electrical conductivity on this phenomenon are analyzed in ferroelectric ceramics and composites. The doubly ionized oxygen vacancies are discussed as the most likely charge carriers operating in these materials.

The coexistence of antiferroelectric and ferroelectric phases is evaluated considering lanthanum doping for lead zirconate titanate ceramics. For these materials, the lanthanum doping disrupts the long-range dipolar order of the ferroelectric state, stabilizing an antiferroelectric state. Depending on temperature, the compounds exhibit different behaviours, from classical ferroelectricity to the superposition of ferroelectricity and antiferroelectricity. Ferroelectric domains are observed in the ferroelectric phase, and become decorated by nanodomains in the temperature region where an antiferroelectric contribution is evident in the hysteresis loops.

The piezoelectric behaviour in several ferroelectric ceramics is analyzed. A high electromechanical anisotropy is evaluated between the electromechanical coupling factors for the thickness and the radial vibration modes. Here we present a system, which has been developed to detect mechanical pulses by using a piezoelectric sensor. The system allows for detecting the pulses, which are generated by the piezoelectric material when a mechanical stress is applied.

Abstracts Hazards and Disasters (1A/2A)

Numerical Modelling of Volcanic Landslide-generated Tsunami Source: Comparison between TOPICS and VolcFlow F. Dondin¹, J.-F. M. Dorville²

> 1Seismic Research Centre, The University of the West Indies, St Augustine, Trinidad & Tobago 2Physics Department, Faculty of Sciences and Technology, The University of the West Indies, Mona, Jamaica. fredericdondin@gmail.com

Landslides (subaerial or submarine) are one of the principal causes of large tsunami. Landslide-generated tsunamis have generally a more local occurrence compared to earthquake-generated tsunami. The former produce usually higher run-up because they concentrate on a reduced area a large amount of energy due to the rapid impact of the landslide onto the water surface. These features are of major importance tsunami hazard-wise for the closest coasts from such tsunami sources. Therefore, in order to model landslide-generated tsunami and their tsunamigenic impact on coast, one has to put a particular attention on the source modelling.

In this study, we focus on the case of a large volcanic submarine landslide (Vcollapsed ~ 4, 4 km3; Dondin et al., 2012) that occurred at Kick'em Jenny volcano, a submarine volcano located 8 km north of Grenada in the Lesser Antilles Arc. We investigate the tsunami source generation caused by the volcano flank failure by comparing the tsunami source generated by two different numerical codes: (i) TOPICS, based on an empirical 3D source model that solves the conservation of mass; (ii) a bi-fluid version of VolcFlow, that uses a 3D model to assess the elevation of the water surface due to the landslide. Firstly, we focus on the 0 - 20 s window of the landslide's motion to analyze its dynamics on the source generation for both source models. Secondly, we propagate for each source in the Grenada Basin the tsunami waves generated using FUNWAVE, a fully nonlinear and dispersive Boussinesq wave propagation model. By doing so, we can compare the travel time, the waves characteristics (i.e. elevation; length; frequency) in the vicinity of the coast and evaluate the associated risk.

Keywords: Kick `em Jenny volcano; Lesser Antilles Arc; Volcanic submarine landslide; Landslide-generated tsunami; Numerical simulations; VolcFlow; Topics; Funwave.

An Appraisal of the Seismicity and Seismic Hazard of Guyana L.L. Lynch, W. Salazar; J.L. Latchman; O. Graham; A. Juman; and M. Johnson

Seismic Research Centre, University of the West Indies, St. Augustine Campus llynch@uwiseismic.com

Most of Guyana's landmass is located on the Guiana Shield, a stable continental region where the rate of production of earthquakes is far less than that of active plate boundary regions such as the Lesser Antilles Island Arc or the Andes Region of South America. Stable continental regions (SCRs) have been known to produce large earthquakes that have been quite devastating to the unsuspecting resident populations. Earthquakes in SCRs are believed to be triggered by low-strain rate reactivation of previous anisotropies and structures under the present stress regime after a long cycle of stress loading. Five likely zones for such reactivations are identified in the Guiana Shield.

Most of the earthquakes that have been felt in Guyana are of Caribbean or Venezuelan origin. Many of the destructive earthquakes that occurred from Guadeloupe to North-eastern Venezuela created much consternation among Guyana residents but caused little or no damage in the country. This has probably contributed to the local folklore thinking that the nature of the soil in the coastal regions renders earthquakes practically harmless.

We have reappraised the earthquake hazard exposure of Guyana and have arrived at the conclusion that Guyana is more vulnerable to earthquakes than previously thought. Our analysis of the historical earthquake catalogue, the seismicity of neighbouring areas in Brazil and the geology of the Guiana Shield reveals that Guyana could experience local earthquakes with maximum magnitudes in the range 6.5-7.0 but at considerably low probability of occurrence. Our analysis also shows that the coastal regions of Guyana are vulnerable to the effects of major earthquakes that can occur along the eastern and south-eastern boundary of the Caribbean Plate.

Currently, disaster management officials in Guyana do not rank earthquake as a major risk to the population. This policy could lead to the proliferation of buildings and infrastructure that will perform poorly in future earthquakes. The geodynamics of the shield is poorly studied and very little is known about the stress regimes in the region at this time. However, we have made preliminary estimates of the seismic hazard exposure from local and regional earthquake sources. The PGA (peak ground acceleration) with a 10% chance of exceedance in 50 years for the entire coastal plain region of Guyana should be no less than 3.0 ms-2 in order to mitigate the effects of future earthquakes.

The Effectiveness of a Learning Object in Disaster Risk Mitigation K. Bascombe; Dr. G.Seepersad

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In the provision of extension services there are a wide variety of techniques used to achieve instructional goals. A learning object is made up of combined portions of digital content that are used to accomplish a specific learning objective. The purpose of this study is to develop a learning object for use in Agricultural Extension as it relates to Disaster Risk Mitigation Practices and to ascertain its effectiveness. A learning video was created that combines text, audio and visual effects to stimulate the sharing of information with respect to the topic. In order to evaluate the effectiveness of the learning object, the methodology of the study involved the application of the Adapted Pedagogical Index (AdaPI). The method measured to what extent the learning object was effective in transferring knowledge from the object to the user. The process consisted of a number of components, all of which were under the purview of three separate dimensions; Interaction, Media and Learning Styles. To calculate the AdaPI a questionnaire consisting of closed type questions on a Likert scale, was created and averages were derived. A formula was then applied to the averages to determine the contribution of each component to the relevant dimensions. Results indicated that the dimension Media was the most important of the pedagogical process. Respondents reacted positively to Graphics used and the arrangement of material within the learning object. This was closely followed by the dimension Interaction. Many respondents indicated their willingness to revise and use the learning object in disaster risk mitigation management and training.

Key Words: Learning Object, Disaster Mitigation, Adapted pedagogical index

Global Warming – How Reliable Are The Surface Air Temperature Data? R. J. Stone

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Global warming is widely promoted by many climate scientists, environmental activists and politicians as the greatest threat facing humanity because it is believed to increase the intensity, frequency and duration of several natural hazards such as hurricanes, floods, droughts and heatwaves. To monitor and quantify the magnitude of global warming, the Climatic Research Unit (CRU), University of East Anglia, analyses

temperature data collected at weather stations worldwide. At the end of July 2011, after two years of denying requests made under the Freedom of Information Act for its temperature data, the CRU was legally forced by the United Kingdom Information Commissioner's Office to release the temperature data from over 5000 weather stations, including the Piarco Meteorological Station of Trinidad and Tobago (T&T), into the public domain. While nearly all countries were either indifferent to or gave permission for the release of their data, T&T asked categorically that its data be kept private. The reluctance to make its data available for public scrutiny naturally aroused suspicion that T&T may have something to hide. We investigated our suspicion by performing a routine homogeneity assessment of the CRU-T&T annual mean temperature time series data using a suite of statistical changepoint detection tests which identified the year 1979 as a statistically significant (P < 0.01) changepoint. We then compared the CRU-T&T data with the data obtained from the Piarco Meteorological Office which revealed that in 1980 the CRU-T&T temperature data series changed from being computed using hourly values to using daily maximum and minimum values until 1990 when it reverted to the use of hourly values. This finding implies that the CRU-T&T temperature data are unfit for use in the computation of the global annual mean surface air temperature and casts doubt and suspicion on the quality of data from other countries where proper quality control and homogeneity assessment procedures may also be lacking. We conclude that it is quite likely that a T&T official is aware of this glaring error and sought to hide it from the public. This investigation therefore underscores the need for careful quality assessment of all climate data used to quantify the occurrence and risk of climate hazards in the Caribbean region.

Public Dissemination of Spatial Information: A Case Study for Sea Level Rise in Tobago J. Chin Sang

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The purpose of this study was to determine the efficacy of geoinformatics visualisation tools in disseminating spatial information to public audiences. The potential impact for sea level rise (SLR) on the southwest coast of Tobago was the focus of this study, as it is presently an issue of significant concern to Small Island Developing States (SIDS) and there is need for education on the topic. The geographic elements involved in such an analysis could be easily undertaken using a geographic information system (GIS) such as ArcGIS – ArcMap and ArcScene. The SLR analysis was performed in ArcMap and a three-dimensional fly-through visualisation tool was developed in ArcScene. A session containing a sample of stakeholders from Trinidad and Tobago then evaluated the tool. The findings indicated that the tool was effective at disseminating spatial information to a small group of stakeholders. The multimedia method of visualising georeferenced data promoted personalised interest while engaging the audience through multiple senses. Although considered effective, some recommendations included the use of up-to-date data and appropriate symbology, customising material to target audiences and institutional implementation involving easy access to data. Based on the findings, it was concluded that the public dissemination of spatial information on sea level rise and countless other geographical topics, relating to hazard mitigation, is a noteworthy consideration for potentially long term benefits to SIDS such as Trinidad and Tobago. In addition, this study can guide and support the detailed planning of future educational spatial dissemination projects, the outcomes of which could be implemented by organisations with public education mandates such as NIHERST.

Keywords: Geoinformatics; Sea Level Rise; Small Island Developing States; Geographic Information Systems; ArcGIS

Abstracts Water (3A)

Spectrophotometric Determination of Phosphates (PO43-) anion in Waste Water from Selected areas of Coastal Guyana via the Stannous Chloride/Molybdate Calorimetric Method R.C. Jagessar*¹; L. Sooknana²

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Phosphate anion, PO43, an hypervalent molecule and salt of phosphoric acid, H3PO4, consists of one central phosphorus atom surrounded by four oxygen atoms in a tetrahedral arrangements. Phosphate ion is also the conjugate base of the hydrogen phosphate anion, HPO42-, which is the conjugate base of H2PO4-, the dihydrogen phosphate ion, is the conjugate base of H3PO4, phosphoric acid. Phosphates anion occurs in natural and wastewaters as Orthophosphates, Condensed or acid hydrolysed phosphates (Pyro-, meta-, and other polyphosphates), and organically bound phosphates. They occur in solution, in particles or detritus, or in the bodies of aquatic organisms. These forms of phosphate arise from a variety of sources. Phosphates may also occur in bottom sediments and in biological sludge. Phosphate ion concentration beyond the threshold value can cause Eutrophication which usually foster the growth of algae and other phytoplankton and deprives aquatic organism of oxygen. Profuse growth of phytoplankton blocks waterways and is an expensive endeavour to remove. Phosphate ion concentration in three selected areas of Coastal Guyana in the region of Berbice, Demerara and Essequibo was determined using the Stannous Chloride- Molybdate Calorimetric, Spectrophotometric method. The first step involves the conversion of condensed and Organically bound phosphate ion to soluble Orthophosphate by acid oxidation using H2SO4 and HNO3 and the second stage involves the spectrophotometric determination of phosphorus in the soluble Orthophosphate at 660 NM by the molybdenum (Mo) blue method using stannous (II) chloride as the reducing agent. The applicable range of this method is 0.01 to 6 ppm/L. Accordingly, the highest concentration of phosphate occurs at the Stabroek (Demerara), Ogle (Demerara), Skeldon (GUYSUCO, Berbice Estate) and Rosehall (Berbice) district. These areas registered values of 1.927 mg/L, 0.532 mg/L and 0.526 mg/L respectively. The lowest concentration of 0.085 mg/l, 0.115 mg/L and 0.148 mg//L was registered at Supernaam (Essequibo), Parika (Essequibo) and Good Hope (Demerara) respectively. The UK Standard and the Caricom (1981 draft) for Phosphorus in potable water is 2.2 mg/L. The European Union (EU) maximum admissible concentration (MAC) of Phosphorus in Potable water is 5 mg/l. The World Resources Instmution has indentified 375 hyponix coastal zones of which Guyana is not included. It seems that the selected Guyana's water is not polluted with Phosphate anion beyond the threshold limit but Guyana's water needs continual monitoring as development intensify.

Keywords: Phosphates, Orthophosphates, Condensed phosphates, Spectrophotometric, Berbice, Demerara, Essequibo, Maximum admissible concentration (MAC).

Determining the safety of rainwater harvesting systems in the Caribbean M. Forde¹; C. Cox²; N. Boodram²

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Rainwater harvesting (RWH) has been used in the Caribbean for at least three centuries. Currently it is estimated that approximately 500,000 people in the region at least partially depend on RWH systems.

Unlike municipal water supply systems, which are managed for maintenance of water quality, RWH systems are managed on-site at the discretion, capability and capacity of individual practitioners in a manner that might not ensure that the quality of water eventually consumed is safe. This study sought to determine the microbial quality of RWH systems in four Caribbean islands.

The water quality status of stored rainwater was determined by testing samples for three microbial indicators (E. Coli, Enterococci and Clostridium perfringens) taken from cisterns and storage vessels in four Caribbean islands. Findings revealed that captured rainwater was generally not safe for drinking according to World Health Organization guidelines for drinking water quality. Of the samples tested, only 49.9% from Carriacou, 20.0% from Barbuda, 3.3% from Antigua, and 2.8% from St. Lucia met WHO drinking water quality standards.

The proper management and promotion of RWH systems can play a significant role in hazard mitigation especially during the dry season or after hurricanes when there are more likely to be water supply challenges. Appropriate tools and practical approaches are need to promote the testing and proper maintenance of RWH systems. Additionally, local public health agencies need to increase their surveillance of RWH systems and place continued attention on public outreach related to safe water handling practices associated with RWH.

Keywords: stored water, microbial indicators, WHO guidelines, water quality

Potential Use of Vermiwash obtained from Different Sources in Hydroponics A. Ansari¹; M. Pereira² and S. Jaikishun³

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The chief economic activity of Guyana is agriculture. In the agricultural industries, the use of fertilizers for crop cultivation has become very prevalent and this has decreased crop quality over the years. The use of fertilizers accounts for about 75% of crop cultivation and quantity has basically become the major concern rather than quality. Proper organic waste management also results in issues and the process of recycling is of poor interest in Guyana presently. This project was carried out during the year 2011-2012 at University of Guyana with an objective to recycle organic waste using vermitechnology and simultaneously use vermiwash obtained from vermitech units to enhance crop production in Guyana by incorporating the modern agricultural technique "hydroponics". The present research indicated that chemical fertilizers improve quantity but not quality while organic fertilizers maintain both quantity and good quality of crops. The physico-chemical analysis of vermiwash showed the necessary elements for plant growth in sufficient quantity. T8 (neem+ rice straw+cattle dung) followed by T9 (neem+ rice straw+ bagasse+ cattle dung) and H (chemical treatment) were the most effective treatments in hydroponics compared to C (distilled water) and T1(cattle dung) that were minimally effective. This is substantiated by 2-factor ANOVA and composite index. Most plants grown using different organic wash (vermiwash) in hydroponics showed less moisture, better shoot and root growth, number of leaves, nodes and resistance to insect damage compared to plants grown with standardized hydroponic solution. Vermiwash obtained from vermitech units with combinations of organic matter generally produced better crops compared to the chemical wash used for hydroponics.

Keywords: vermiwash, hydroponics, shoot growth, root growth, physic-chemical analysis

Abstracts Pesticides, Dust, Life Origins (4A)

Adsorption and degradation of chlorinated pesticides, chlordecone and hexachlorocyclohexane, by a hybrid material, activated carbon supported Vitamin B12 Ronald. Ranguin¹, M.C. Ncibi1, T Cesaire², S. Gaspard¹

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The aim of this work is to develop a highly efficient mate rial to remediate the serious environmental problem related to water and soil contamination by chlordecone (CLD) known as Kepone. This organochlorinated insecticide, was used in the French West Indies to control the banana weevil Cosmopolites sordidus from 1972 to 1993. Due to its strong persistence in natural environments, its high resistance to chemical reactions and microbiological degradation, around 8 to 9 % of the cultivated areas of Guadeloupe contain CLD concentrations higher than 1 mg/kg in topsoil, and some banana fields exhibit CLD content higher than 9 mg/kg [1]. CLD may be bound to soils for several decades to half a millennium, depending on soil type [1]. To limit impregnation by this pesticide, in the polluted areas of Guadeloupe and Martinique, drinking water production plants were equipped with commercial activated carbon (AC) filters. After 18 months of treatment, AC are contaminated

The objective of this work is to produce a hybrid material with activated carbon (AC) as the solid sorbing support and vitamin B12 (VB12) as the degrading compound of chlordecone [2]. The activated carbons used are produced form locally available sugarcane bagasse. They have various porous structure but are mainly mesoporous, with surface areas (BET) ranging from 1 000 m2/g to 1500 m2/g. The tested ACs were "BagPilot" (produced under pilot conditions), BagP15 and BagP05 (produced after various acidic treatments).

The experimental results showed that BagP15 has a higher adsorption capacity due to its larger surface area. The binding of VB12 and bagasse derived AC is favored at high temperature, which suggests an endothermic process. The adsorption is optimal at pH around 6 at 25°C. A modelling analysis was performed on the kinetics and equilibrium data in order to understand the nature of physicochemical interactions between the two components of the material, AC and VB12. It was revealed that the dynamic behaviour follows the pseudo-second order model. The maximum adsorption capacity deduced from the Langmuir model was 422 mg/g, which revealed the high affinity between the two components of the hybrid material.

In order to study the stability of the prepared hybrid material, desorption of VB12 from BagP15 was also monitored in water and the related equilibrium results showed that the maximum desorbed amount reached almost 70 mg/g at 25°C, indicating that around 16.5% of the VB12, could be lost from the AC. The hybrid material was characterized by different methods, Fluorescence X, RAMAN spectroscopy. FTIR and TEM characterization are undergoing. The ability of the hybrid material to degrade chlorinated compounds hexachlorocychlohexane and chlordecone is tested. is.

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Evaluating the Needs of the Fishing and Associated Livelihoods in the Coastal Fishing Sector of Trinidad and Tobago Arthur Potts¹; Judy Rocke¹; Ben Maharaj²; Shanta Ramnath² and Lester Doodnath²

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This paper presents the results of a project undertaken to increase the understanding of the importance of the coastal and marine fisheries in Trinidad and Tobago. The authors administered 519 questionnaires to respondents and conducted thirteen focus group meetings in both islands. Among other things, stakeholders articulated their needs at each of the landing sites around the islands. Many different stakeholders with varying needs were encountered. The authors evaluated these needs by considering the government's priorities for the sector including profitability, governance and empowerment. Evaluation criteria were also applied namely: sustainability, representativeness, compliance and feasibility. Most of the fishermen and associated were operating without adequate networking while the businesses were well connected locally and internationally. Arising out of the study high impact recommendations were proposed for growth and development of the fishing sector of Trinidad and Tobago.

Keywords: coastal fishing sector, government priorities, questionnaire profitability, empowerment

Abstracts Education (5A)

Contextualising teaching of sustainable development: Guadeloupe T. de Lacaze, T. Forrissier

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Guadeloupe has lived a major earthquake in 1843, a volcanic eruption in 1976 and many cyclonic events (for example in 1928, 1962 and 1989). Those disaster experiences have left psychological traces which could be helpful to redraw the vision of infrastructure in Guadeloupe. After Hurricane Hugo (1989), in one hand, the rebuilt have tried to take into account the climatic and geological thinking for better infrastructure. In another hand, it appears that education to environmental risk have to be more developed in Guadeloupe than in the rest of France.

More generally, the place of contexts in education to sustainable development is also questioned. This research is part of a PHD which aims to build an inventory of education for sustainable development in the particular context of Caribbean islands. Our study defines two different kinds of contextual specificities: the first are specificity of environmental problems link for example with island conditions or tropical latitudes, the second contain more educative dimensions like examples used in textbooks or teachers training in sustainable development.

This work roots in the fields of sciences and sustainable development education. To measure the place that sustainable development in Guadeloupe education system regarding to local specificities, we initially conducted a series of interviews with individuals involve in Education of sustainable development to characterize specificity of environmental problems. These are policies, association leaders, business leaders or from public institutions. What motivates their actions? Do they act adapting responses to local features? Is-there any questions on these tools? Do they use the tools developed in other contexts?

Initial results suggest that the role of schools should be strengthened and that the socio-cultural dimensions of sustainable development specificities seem important for the actors interviewed.

Theoretical background to study science education contexts T. Forissier

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Earthquake, volcanic eruption, cyclone, flood, tsunami, the Caribbean are particularly vulnerable to many natural hazards. Citizen Education to hazard mitigation is much more important in French West Indies than in Paris. With national, curriculum, evaluation and textbooks, how science education in French West Indies manage the challenge to take account this particularity of our territories?

Based on this example and others, the aim of this communication is to present a science education theoretical background focus on contexts studies. During science teaching, learning effects due to different context like social, cultural or language could be described as contextual effects. But others micro-didactic effects of contexts could also be identified as linked with specificity of natural environment. These effects manifest a strain between a goal of teaching or learning and its implementation, when this stain is due in the educational process in different contexts involved.

To ensure the quality of education, reference and quantify the effects of educational context seems to be necessary. it should be interested in the process leading to the emergence of these contexts. We propose a simplified model of these processes initially described as meetings of mechanisms operating within a network of transposition of designs. Then we question these processes by degree or forms of contextualization (low to high) and crossed these two approaches, giving an initial typology of contextualisation process. It then emerges the idea that these processes are constrained by resistances. We retain the following three: epistemological, social and educational. As these constraints are expressed in different ways according to disciplines, the data suggest the existence of disciplinary contextualization profiles. All these three approaches (network implementation, degree of contextualization, disciplinary profiles) are three tools for analyzing contextual phenomena which remain to test the robustness and operational character for the training analysis context.

The Status and Potential of Free and Open Source Software (FOSS) in Guyana D. Dundas¹; L. Singh²

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Free and Open Source Software (FOSS) is not used in Guyana when opportunities for using it exist. The absence of a model for the introduction and use of FOSS in the education system may be a key reason for this problem. In this study, we survey Information Technology (IT) professionals and educators on their use and perception of FOSS using a questionnaire. Further, we conducted several group experiments using self-selected volunteers to investigate the potential of FOSS to support two common IT activities – word processing and web development. Preliminary observations suggest that among the issues preventing the widespread use of FOSS were the prevalence of software piracy, contractual obligations, access to the software, lack of skills in using FOSS and the cost of switching. Despite barriers, most contacts are willing to switch to or adopt FOSS. Our experiment produced best results when Proprietary-only applications were used and least favorable results when a combination of both tools are used. However, on the survey of perception the FOSS/Proprietary group reported most favorably while the proprietary-only group reported least favorably. On both training and perception evaluation, the FOSS combined with training in the values and use of FOSS is critical for the successful adoption and implementation FOSS and for seamless transition from proprietary software to FOSS. Although there were reservations about FOSS, the survey suggested that users were open to FOSS as part of their software toolset. Our investigation suggests that software training can be successfully delivered using FOSS tools. However, simultaneous exposure to both proprietary and FOSS applications is essential for achieving best results. Additionally, careful selection of FOSS tools is likely to influence perceptions and use. A tentative model for the introduction of FOSS based on our preliminary investigation is presented.

Keywords: FOSS, Open Source Software, Proprietary Software, Education

Mobile Learning Adoption and the UTAUT Model T. Thomas; K. Gaffar; L. Singh

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The benefits of mobile learning in higher education are highlighted by many researchers and infrastructural development in the near future presents an opportunity for Guyanese education to benefit from mobile learning. However, to exploit the benefits to the fullest, it is necessary for educators and policy makers to be equipped with the right tools, knowledge and framework to ensure maximal returns. The UTAUT model which spun off from the Technology Acceptance Model (TAM) has been advanced as a general means of evaluating technology acceptance and has also been adapted to build a framework for m-learning. The current study evaluates the UTAUT model with ultimate endogenous factor

as behavioural intention (BI) on a sample of Guyanese university students. However, personal characteristics are also included as exogenous variables and both the psychometric and structural properties of the model are evaluated in a structural equations modeling framework. Preliminary results indicate that performance efficiency (PE), social factors (SF) and facilitating conditions (FC) exercise positive effects on both attitudes and behavioural intention (BI) while effort expectancy (EE) influences attitude and attitude in turn influences behavioural intention. Age and gender influences PE and age also affects EE. Ultimately, attitude, PE and SF exercise the greatest total effects on BI while PE and EE have the greatest influences on attitude. These findings bear several similarities with other findings and therefore also suggest that the UTAUT model is appropriate for the Guyanese setting. The findings also suggest that the adoption of m-learning among Guyanese students can be enhanced, most efficiently, by addressing both PE and EE.

Keywords: the Technology Acceptance Model, attitudes, behavioural intention

EUCARINET Analysis of Science & Technology Research in the Caribbean C.M. Sean Carrington 1, Charles Plaigin 2 & Gustavo Perez 3

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A bibliometric analysis of Caribbean publications for 1999-2009 was carried out using the Web of Science (WoS) © online database. The thirty-two countries/territories (excluding Puerto Rico and the US Virgin Islands) together published 12,817 papers, an estimated 0.08% of world publications for that same period. Just over half of these publications were produced by the Spanish-speaking Caribbean (mainly Cuba), about 32% by the Anglophone Caribbean, about 13% by the French Caribbean and less than 2% by the Dutch Caribbean, all sub-regions but the Dutch showing annual growth. Half the territories examined produced less than 50 publications in the 11 year period (together 1.7% of all publications) and were not included in further analyses. Cuba produced about half the publications while the remaining major producers were (with output in parentheses);- Jamaica (1465), Trinidad & Tobago (1353), Guadeloupe (818), Barbados (485), French Guiana (421), the Dominican Republic (276), Martinique (242), Bermuda (220), Haiti (149), Curacao (138), Guyana (135), Grenada (127), the Bahamas (102), and Suriname (83). Most of the publications from the region fell into three thematic domains - Agriculture, Biology & Environmental Sciences (28%); Biomedical Research (21%); and Clinical Medicine (18%) - and this trend is also evident on a sub-regional basis. Indicators were generated which allowed comparison of the relative visibility or impact of a country's publications based on whether papers of one country in a particular research area were more highly cited than the regional average. By this approach, Curacao then Belize had the highest visibility in the Agriculture/Biology/Environment domain. For Biomedical research, the top performers were Barbados followed by the Dominican Republic while for Clinical Medicine it was the Dominican Republic that lead followed by Haiti. For Chemistry, Jamaica was most visible followed by Trinidad & Tobago while for Engineering/Technology it was Guadeloupe first with Jamaica in second place. For Mathematics, Jamaica, Martinique and Guadeloupe were all top performers while in Physics the Dominican Republic and Guadeloupe out-performed other Caribbean territories. A specialisation index was also calculated to assess whether some countries tend to publish more in particular areas than the regional average and in most cases the research areas of specialisation or apparent focus was not necessarily those of high impact.

Abstracts Applied Science (1B)

Study of Ka, the Traditional Drum from Guadeloupe: Preliminary Results on Wood Quality and Spectral Characterization T. Cesaire ^{1*}, Y. Bercion ², K. Pitard ¹, F. Moeson ³, C. Barbin ⁴, F. Flauzin ⁵, F. Bade ⁶, J. L. Mansot ^{1,2}, S. Gaspard ³

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The drum, traditionally called "Ka" is the emblematic instrument of Guadeloupean culture. The "Ka" is composed of a single goatskin membrane mounted on one end of a wooden barrel, the other side remaining open. It is principally used in gwo-ka music, but in other forms of musical expression as well such as modern gwo-ka, zouk, hip-hop, and ragga.... Gwo-ka is becoming more and more popular and gaining interest among musicians from other countries. Nevertheless, the manufacturing of "ka" and its acoustic characterization are still traditional which lead to "unique instruments" which acoustic properties are slightly different from the others. A very important point is that the "ka" are built with temperature and moisture sensitive materials: goat skin and wood. This leads to significant variations of dimensions and mechanical properties and consequently acoustic answers. In order to standardize instrument acoustic properties and to reduce their sensitivity to environmental conditions it becomes necessary to have a better understanding of the mechanical behavior of the drum as a function of its constituents and their evolutions in various environmental conditions.

In order to select the wood species which would present the optimum stability when exposed to moisture, the hygroscopic characteristics of different wood species generally used in the manufacturing "ka" (Termina lia catappa, Swietenia macrophylla, odorata Linné and Tabebuia rosea) have been determined with a helium pycnometer for density determination, as well as volume and mass loss mesurements. A comparison of the data obtained allowed us to conclude that odorata Linné, presents the best characteristics. The acoustic answer of a "ka" was carried out by means of an experimental set-up composed by two microphones and a data acquisition system. The membrane was hit with a straight impulse, applied either with a hammer or with the operator's hand. The sound was recorded by the two microphones one located in front of the membrane the other behind the drum. The membrane was excited in different areas, with the drum standing up, lying down and with a drummer seated on it,. The signals collected by the microphones are analyzed by Fast Fourier Transform (FFT) to obtain the power spectra. The careful study of the spectra obtained for the different positions of the microphone, and also for the different positions of the drum and of the drummer allowed us to point out the influence of these various parameters on the acoustic answer of the "ka". Among the different studies carried out on drums. This study brings new and promising results on the instrument production and the musical practice of the Guadeloupean drum "ka".

Keywords: drum, Guadeloupe, wood species, acoustic, signals

Investigation of Nanomechanical Behaviour of Strombus gigas Conch Shell by means of Nanoindentation Techniques L. Romana¹; P. Thomas¹; P. Bilas¹; J.L. Mansot^{1, 2}; and D. A. Aranda³

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Amongst the seashells, Strombus gigas conch shell exhibits one of the highest level of organization with a crossed-lamellar structure made of micro crystals of aragonite (99,9% wt) embedded by organic layer (0,1% wt). This composite structure leads to remarkable macro mechanical properties compared to those of pure mono crystalline aragonite. Only few mechanical studies have been performed at the nano scale on seashells and none on the Strombus gigas conch shell. In this work, the hardness and Young's modulus of the biomaterial constituting Strombus gigas conch shells are measured by means of nanoindentation technique using the Continuous Stiffness Measurement mode. In addition a special attention is paid to the pop-in events, measured on the load displacement curves, which are related to the brittleness of the sample. The samples are prepared with surface orientations parallel or perpendicular to the growth axis of the conch shell. X-ray diffractometry performed on these two sets of samples clearly reveals a preferential crystallographic orientation during the bio mineralization process: aragonite crystallites are oriented with the c axis perpendicular to the growth axis of the conch shell. To separate the contribution of the anisotropic properties of the aragonite phase from those due to the micro architecture of the conch shell, the mechanical parameters measured on bio aragonite samples are systematically compared to those measured on mono crystalline standard samples with c axis parallel or perpendicular to the studied surfaces. The hardness and Young's modulus values measured on bio aragonite samples are close to those of the aragonite mineral standard indicating that H and E values are not related to the lamellar structure of the bio sample. However the nanocracks occurrence frequency is 5 times higher (3 times higher) for biological samples with c axis parallel (perpendicular) to the surface than for corresponding mineral standards. Such results clearly indicate that the micro architecture of the conch shell favors nanocracks initiation and propagation. The observations of the indent scars by means of scanning electron microscopy allow us to correlate the nanocracks events with the crossed-lamellar structure of the conch shell.

Keywords: Strombus gigas conch shell; hardness, Young's modulus, biomaterial, nanoindentation technique, Continuous Stiffness Measurement mode, X-ray diffractometry, crystallographic orientation, aragonite crystallites.

Archeometry applied to the determination of the origin of underwater discovered ceramics ¹R. Elias, ¹A. Vandermissen, ¹A. Sauldubois, ²B. Vicens et ^{1,3}J.L. Mansot

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During underwater archaeological explorations in the "Bay du Moule" in Guadeloupe, many pottery shards, dated from the high activity period of the Moule's harbor (end of the 18th century) were discovered. Two of these shards presenting some typological similarities with pottery pieces originating from Vallauris led to the conclusion that the discovered shards were parts of imported pottery pieces from Vallauris broken during transfer from the ship to the earth. This conclusion was supported by the fact that Vallauris dishes were commonly imported in the French West Indies during that period. The discovery of very similar pottery shards in the potter's workshop "Fidelin" located in the Guadeloupe neighboring island "Terre de Bas" and producing pottery pieces at the same period, introduced a doubt concerning the probable origin of the shards discovered in the Moule's Bay. The present work is concerned with the determination of the origin of these two shards. The chemical compositions of the discovered ceramic shards and of their coatings (glazes) are compared to the chemical composition of "standards" corresponding to well identified and dated ceramics shards from the potter's workshop "Fidelin" and from potter's workshops of Vallauris. The chemical compositions of the various ceramics and coatings were determined using X rays microanalysis coupled to scanning electron microscopy. Whereas the ceramic materials constituting the various shards, did not reveal significant differences, the analyses of the glazes allowed us to point out chemical and impregnation similarities between the discovered shards and Fidelin's ones. These results seem to support the conclusion that the pottery shards discovered in the "Bay du Moule" were part of potteries produced in a local potter'shop probably located in the "Terre de Bas island".

Abstracts Microbes, Insects and Animal Studies (2B)

Orb-weaving spiders of the Eastern Caribbean J. N. Sewlal

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The Eastern Caribbean represents a poorly studied region in terms of arthropods biodiversity in particular spiders. This study focused on the biodiversity of orb-weaving spider families on seven islands in the Eastern Caribbean, each sampled for two weeks during January 2006 to August 2010. Specimens were collected using two main methods; visual search and sweep-netting, and supplemented by material collected from the nests of the spider hunting wasp Sceliphron sp. Sampling efforts yielded 47 species distributed among six families.

Biodiversity was determined by examining the observed and estimated species richness, diversity indices, through multiple linear regressions, ANOVAs, species abundance models, and cluster analysis. Factors like geographic location and habitat classification were also examined in this study as possible factors influencing orb-weaver biodiversity.

Preliminary analysis showed that habitat type had no significant difference among the islands in terms of species richness. Anguilla was also shown to possess the most distinct orb-weaver species composition while St. Kitts and Nevis were closely associated as was that of Grenada and Montserrat.

Keywords: spiders, Eastern Caribbean, biodiversity, species, families

Survey And Identification Of Microbial Populations In Sugarcane Estate Soils Subramanian Gomathinayagam^{*1}, Rawl Phillips², and Murugesan Rekha³

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Microorganisms are a fundamental important component of the soils habitat; they play a key role in ecosystems through controlling nutrient cycling reactions essential for maintaining soil fertility and also contributing to the maintenance of the soil structure. The coastal region of Berbice where the majority of sugarcane production is carried out in Guyana. Scientist defines soil and water microorganism as any organism in the soil and water that requires a microscope to observe (Bollen 1959). It is said that these organism permeate the soil, water and air of our planet and Guyana is no exception. These microbes are recognized for vital role in which they play contributing to soil health and to a further extent to productivity of the ecosystem. This is so because they respond quickly to changes in the ecosystem and they have tightly coupled relations with their surroundings due to their high surface to volume ratio (Gershuny et al. 1995)

This research work was carried out during the period of September to December 2011 on survey and identification of microorganisms (bacteria and fungi) in the soils of the two estates (Rose Hall and Blairmount). In soil series 2, 7B, in Rose Hall estate showing more microorganisms pollutions both bacteria and fungus and this soil series has most beneficial fungus such as Trichoderma sp and Pseudomonas sp of bacteria. The rest of soil series has less microbial population and non harmful to crops.In soil series 32A, 1C and 43 at Blairmount estate has more

microbial population and 100% beneficial both bacterial and fungus such as Pseudomonas sp. and Trichoderma sp. remaining soil serious show less microbial populations. These microbes are recognized for the vital role in which they play contributing to soil health and to a further extent the productivity of the ecosystem.

This present study was carried out to survey and identify beneficial microorganisms in both estates in order to improve cane growth. The study conclusively proves that the agricultural soils support a healthy diversity of bacteria and fungi.

Key words: Microorganism, bacteria, Fungi, Estates, Soils

Nurseries and the conservation of Guyana's mangroves: A preliminary survey of insect pests in mangrove nurseries in Guyana. P. Da Silva¹; and S. Gillis²

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Mangrove ecosystems have long been recognised for their ecological, economic, social and coastal protection values. In Guyana mangrove ecosystems are now being recognised for their role in alternative livelihood options. In an effort to assist in combating climate impacts the Government of Guyana has embarked on a conservation project that seeks to rehabilitate coastal mangrove ecosystems and thus mangrove nurseries have been gaining recognition for its role in this process and also as an alternative livelihood option. In this regard mangrove nurseries have been established by private individuals who are contracted by the Guyana Mangrove Restoration Project (GMRP) to supply mangrove seedlings.

Being a new venture in Guyana there was not much information on the potential challenges that could have been anticipated. This preliminary study sought to investigate and document the challenges faced by nursery operators in the production of Avicennia germinans seedlings. Specifically the investigation sought to document the types of insect pests that affected mangrove (Avicennia germinans) seedlings in established nurseries. The method entailed the use of a questionnaire and checklist and onsite observations to identify the various types of insect pests.

A number of challenges faced by nursery operators were identified. Insect pests from five (5) taxonomic orders and six (6) families were found to be common in the nurseries surveyed. These were observed in the growing seedlings at various leaf development stages. Representatives from the Order Lepidoptera and the Family Nymphalidae were most prevalent. Identification of these challenges and insect pests is an important step in the operation and management of mangrove nurseries.

Study of the housing patterns incidence on dengue transmission in Guadeloupe using remote sensing and Geographic Information Systems L. Girdary¹, E. Grandchamp²

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Dengue Fever (DF) is the most important mosquito-borne viral disease affecting humans worldwide. It is particularly widely spread and prevalent in tropical and subtropical areas, including all Caribbean countries, where tens of millions of cases occur each year. The DF epidemics scales are linked to environmental factors (temperature, humidity, etc.) which favour mosquito's development and also linked to

human activity and behaviour which expose them to infection risks. One of the contamination place is the human housing environment where favourable conditions can be present to increase DF transmission.

As all over the world, there is a lot of housing patterns in Guadeloupe and the incidence of each kind of patterns are different and depend on many factors (environment, social, etc.). The objective of this study is to classify and localize the housing patterns in Guadeloupe and to analyse their relation with dengue transmission. Information collected to classify the patterns includes environmental data, physical characteristics of the buildings and demographic variables. Remote-sensing has been used to collect information about buildings (size, localisation, etc.) and Geographical Information Systems (GIS) have been used to generate useful layers about urban, agricultural and natural areas. The GIS environment also allows modelling the phenomenon at the lowest administrative scale.

We analyse the evolution of the spatial distribution of the patterns between 1996 and 2004. For the first step of the analysis, an unsupervised raster classification (clustering) was used to select accurate information to identify and define the main classes of housing pattern. It included both a hierarchical classification and a Bayesian Discriminant Analysis. For the second step, a supervised raster classification and a supervised vector classification aim to define more precisely each class of pattern. It applies a learning procedure based on decision trees on labelled samples obtained at the first step. Eight classes of housing pattern are identified and defined. They allow the classification of the whole inhabited territory and show an evolution which is consistent both at the pattern's level and with the observed trend of urbanization during the period.

Then the incidence of the housing patterns is computed using clinically confirmed DF cases which are spatially localized. This allows identifying and localizing favourable patterns to schedule mosquito's eradication in exposed areas.

Solvent Effect on the Antibacterial Activity of Chitosan Microfiltration Membranes Elon I. Cadogan¹; Ching-Hwa Lee¹; Srinivasa R. Popuri^{2*}

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Chitosan is a commonly used biomaterial with respect to water treatment process notably in membrane technology. The ability to modify chitosan's chemical and physical properties has gained attention in microfiltration processes. In this study, we have synthesized chitosan membranes with various acid solvents such as acetic acid, ascorbic acid, citric acid, glycolic acid, maleic acid, oxalic acid and tartaric acid. Chitosan is obtained from deacetylation of chitin, which is isolated from locally available crab shell waste. The antibacterial trials show that the chitosan membranes have increased antibacterial activity compared to that of plane chitosan against Staphylococcus aureus and Eschercihia coli. The antibacterial activities of the chitosan membranes were determined against Escherichia coli and Staphylococcus aureus by enumeration of viable organisms at different incubation times. The interaction of the various acids with chitosan are characterized by Fourier Transform Infrared Spectroscopy-Attenuated Total Reflectance (FTIR-ATR) through the shift of the carbonyl, and the amine. Furthermore the resulted chitosan membranes were extensively characterized by Thermogravimetric Analysis (TGA), Static swelling, membrane thickness, tensile strength and antibacterial assays in order to investigate the various properties of the membranes. Swelling studies deduced that all membranes exhibited higher swelling than unmodified chitosan.

Key words: Chitosan membranes, deacetylation, antibacterial activity, acid solvents, thermogravimetric analysis

Ethylenediamine prevents Seizure and Anxiety in Animal Models J. I. Addae¹; K. Walkinsa; R. Cruickshanka and T. W. Stone²

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Ethylenediamine (EDA) is a small molecule diamine that forms a carbamate complex with bicarbonate in solution. The structure of the diamine-carbamate complex resembles that of the inhibitory neurotransmitter gamma amino butyric acid (GABA). Therefore we examined the actions of EDA on GABA receptors in the central nervous system. We also examined the potential of EDA to be used to treat various forms of epilepsy and anxiety – conditions that are traditionally treated with compounds that act on GABA receptors. We used established animal models to examine the mechanism of action of EDA and its effects on (i) topically applied bicuculline (a model of simple partial seizures), (ii) maximal electroshock (MES, a model of generalized tonic-clonic seizures), (iii) motor coordination using a rotarod treadmill, (iv) a model of anxiety using an elevated plus maze (EPM).

EDA inhibited neuronal excitation by both depolarizing and hyperpolarizing mechanisms. EDA at concentrations of 50 mM and above reduced the frequency of epileptiform spikes on an electrocorticogram in a concentration-dependent manner. EDA at 100 and 1000 mg/kg i.p. increased the threshold for inducing limb extension on MES. EDA did not affect the time spent by rats on the rotarod at 10 or 100 mg/kg, but significantly reduced the time spent at doses of 1000 mg/kg. In the EPM, EDA at 10 or 100 mg/kg significantly increased the frequency of entries and time spent in the open arms. We conclude that, in animal models, EDA prevented anxiety and both generalized (grand mal) and simple partial (petit mal) types of seizure at doses that do not affect motor coordination, and has the potential to be developed into a clinically useful GABAmimetic drug.

Keywords: Ethylenediamine, anxiety, electrocorticogram, neuronal excitation, animal models

Abstracts Soil and Energy (3B)

Sustainable Use and Management of Slaking Sensitive Tropical Soils M.N. Wuddivira¹; R.J. Stone¹; and E.I. Ekwue²

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Pressure build-up of entrapped air as a result rapid wetting and raindrop impact break soil aggregates and make them more erodible. Aggregate slaking due to pressure build-up of entrapped air aggravates soil aggregate break down by aiding the detachable power of intense rainfall of the humid tropics. We hypothesize that under high, energetic and erosive rainfall of the humid tropics, management for sustainable soil productivity and improvement of environmental quality are reliant on understanding the mechanism of soil slaking. We measured the aggregate stability of 23 humid tropical soils from Trinidad with varying clay content, mineralogies and organic matter content in the presence and in the absence of intense simulated rainfall. A slaking sensitivity model framework developed based on major soil factors (clay percentage, organic matter content, exchangeable sodium percentage and cation exchange capacity) affecting aggregate slaking, indicate that more than 80 % of the soils are highly sensitive to slaking. The implication of the study for soil management under agriculture and relevant soil management practices for sustainable productivity of these soils are presented.

Keywords: aggregate stability, aggregate slaking, humid tropics, intense rainfall, slaking sensitivity, sustainable management.

Optimal Control for Nutrient Uptake Systems in Polluted Soils L. Louison

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In addition to soil-plant interactions, biologists have proven the existence of a nutrient transfer between plants, and also between plants and mycorrhizal fungi, via the roots. This significant discovery represents a breakthrough in agroecology as it represents an alternative to the use of chemical fertilizers.

Experiments with isotopic markers are used by biologists, we propose in this paper a mathematical modelling and optimal control to examine the nutrient concentration uptake.

We used a slightly modified Nye-Tinker-Barber (NTB) model and added some control and pollution functions. Indeed, the soils are polluted in the lesser Antilles. We then focussed on resolving the problem of controlling the phenomenon of nutrient uptake by plants in contaminated grounds.

The control function corresponds to the nutrient transfer from the rhizosphere to the root plant. We used the technique of low-regret control which is well adapted to pollution problems. We proved the existence of the low-regret control and gave an approached optimality system. This work gives the possibility of future applications.

Keywords: nutrient uptake, polluted soils, mathematical modelling

Report on the UWI/BPTT Jubilee Conference on Revenue Management in Hydrocarbon Economies, 20-22 June 2012 Sally Radford, PhD, FGS, C.Geol.

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As a jubilee gift from BPTT to Trinidad and Tobago on the 50th anniversary of independence, the University of the West Indies organised the first forum on management of oil and gas revenue in the hydrocarbon-funded harbour venue.

N. Christie, president of sponsor BPTT opened the proceedings with praise for this significant event in the economic life of the republic as companies prepare for deepwater exploration. After investment over 50 years, BPTT is optimistic and committed to short-term and long-term development of the country, despite challenges to the gas business.

Feature speaker Professor R. Auty of Lancaster University in his presentation on Reformulating the Resource Curse- Policy implications for Trinidad & Tobago., surveyed the political basis of revenue deployment, resource curse to rent curse, theory of rent cycling and elite incentives and the political economy. Policy implications included windfall income from foreign aid and remittances, mineral rent curse, high rent distortion and low rent incentive, market repression, corruption, investment efficiency, GDP growth, social capital and social groups. Dutch Disease resulted from tropical extractive activity. Institutions are secondary to economic policy and accommodate elite aims. Rent streams replicate the curse. Rent cycle includes growth incentives, export industry, diversification driven by industrialisation, which removes surplus labour, accelerating demographic transition. Rapid, equitable growth and structural change proliferate self-reliant groups contesting power, strengthen taxation, urbanisation and a business lobby for safeguards to protect returns on investment. Low rent competitive industrialisation model is counterfactional for high rent solutions. Dutch disease cuts investment efficiency, slower GDP growth retards structural change, rent seeking consolidates patrimonial capitalism, slows demographic transition with rising saving rate, resists reform and retards change . Rent deployment is maladroit, concentrated and statist, with targeted expenditure on projects over universal public good. Incentives convert depleting assets to alternative forms of capital, to match rent absorption to domestic capacity in IMF sustainable fiscal policy. Governments absorb rent too quickly, igniting Dutch Disease which impedes diversification,. They subsidise fuel . Jobs in industry and bureaucracy grow from patronage not markets,. Workforce in high-rent economies are insulated from competitive pressure to boost productivity. Expanding rent is unsustainable, causing rent addiction as politicians compete to channel rent to voters to favour unions, consumers and business rather than shift to productivity-driven growth backed by the IMF, IDB and WB. Low rent absorption in an early reform zone builds a pro-growth coalition and a dynamic market economy. Managing hydrocarbon rent is difficult. Government can boost reliance on personal taxation, expand competitive firms in energy-related goods and services and transform large volatile rent flow to small, stable dispersed flow.

Professor Paul Stevens of the Royal Institute of International Affairs reported that while oil revenues should improve economic performance, 95 countries had a negative relationship between resource exports and growth. Markets and governments fail mysteriously according to the Law of Parsimonious Explanation.

Dr H. Monroe of the IMF in his contribution on Macroeconomic management in resource-rich economies noted their volatile revenues. Trinidad & Tobago has the highest dependence on resource revenue in the Hemisphere, with inflation and weak tourism as it seeks to consume, save or invest.

Valerie Blackman of the IDB compared tax regimes in hydrocarbon producers and discussed the value chain in sustainable energy, financial services, new global trade in Panama and private sector inclusion.

Dr. D. Driver of the Energy Chamber stated that fuel subsidies funded by levy on crude oil should end.

Minister of Planning Dr. B. Tewarie proposed more collaboration between UWI and Government for sustainable development, investment and diversification. The Ministry also presented ideas for diversification, the national innovation policy, research and intellectual property.

UWI contributed papers on regulation, fiscal regime local content, transformation and macroeconomic challenges including diversification, specialisation, social structure, environmental management and ethics. J. Downer explained royalty, profit tax and production tax.

Indera Alli of CCfC related the extent of state funding of 132 institutions and the paradox of poverty in plenty Revenue Watch Institute speaker M. Genasci and TTEITI emphasised transparency in Extractive Economies. S. Greenleaf of CIS and J. Ram of LSE described environmental and economic goals and challenges. The Central Bank , Environmental Management Authority, Ministry of Energy and Unions contributed valuable data and insights.

Local investors on a Panel on the History of the Petroleum Industry explored a century of activity from early drilling at seeps to development of a world-class downstream industry. NEC and UWI contributed to a Panel on Frontiers of Development in the Hydrocarbon Industry including corporate social responsibility.

A petroleum engineers conference the previous week and a gas conference next week may explain low attendance of the private sector and state companies. Abstracts should be published for the record. as presentations were comprehensive and consistent with valuable statistics. The Research Fund established by companies should be available to Caribbean Academy of Sciences to collaborate with universities in improving public understanding of the industry.

Domestic Solar Energy: A viable Alternative in Trinidad and Tobago? Case Study: HDC housing K. Neale

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In light of the climate change prospect for the world and more so, the profound implications expected for the Caribbean basin as a community of Small Island Developing States, the region's industrial capital, Trinidad and Tobago, seeks to embark upon a domestic alternative energy pilot project using solar water heating as its focus through the Government of Trinidad and Tobago's Housing Development Corporation (HDC). This intended initiative has stimulated a research concept of full scale solar arrays on these homes for electricity generation. In so doing, such an alternative energy scheme would open up avenues for CO_2 abatement, carbon trading, energy conservation and diversification; symbolizing a 'green' response by the nation in the face of environmental change. Using NASA solar insolation data, length of daylight, energy consumption records from the various homes as well as the efficiency of Sanyo and Suntech solar panels, a formula was developed to yield the area of solar panels a given home would require to meet its energy demand after which, the panel, maintenance and inverter costs were all assessed. Conventional electricity costs as well as CO_2 emissions and its stock market value were delved into to yield an economic comparison to the aforementioned solar alternative. From this single home context the findings were expanded to a theoretical national Phase 1 and 2 housing scheme inclusive of import scenarios for both natural gas and solar panels set in the context of our hydrocarbon reservoir lifetime. Trinidad and Tobago averages 6 KwH/m²/day showing an increasing trend in incoming climatic insolation where based on the calculations, panel areas needed can range anywhere from 90m² to 200m². The solar water heating showed marginal CO² abatement whilst its economics were seen to be out-competed by the domestic energy prices; the solar arrays however yielding payback periods of roughly 5 years with the potential to cut emissions by 350 Mg per home. As such, the insolation data reveals that the nation is in a geographically advantageous location for solar harvesting where the array's paybacks suggest viability for the moderate to high energy demanding homes. With this said, the prospective gas depletion that results in the purchasing and importing of extra-regional natural gas to satisfy energy needs, so too, was not as economical as proposed shipments of solar panels for the housing Phases. Given that CO² production was found to increase with energy consumption, the solar investment likewise marks a significant abatement project. However, such an economic environment that is increasing in its viability hints that national scale solar panel investments can present market domination by the foreign transnational manufacturers where any potential manufacture, marketing and distribution by local firms may stifled.

Abstracts Extracts With Bioactivity (4B/5B)

Phytochemical Screening, Isolation and Purification of betulinic acid and Trigonelline from Stems of Doliocarpus dentatus (Kapadulla) R. C. Jagessar^{1*}; A. R. Maxwell²; Ghansiam. Hoolas²

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The stems of Doliocarpus dentatus (Kapadulla), a plant of the Guyana (South America) flora were screened for natural products using solvents of varying polarity: C6H12, CH2Cl2, EtOAc, CH3CH2OH. Natural products are the secondary metabolites of plants and animals that are of restricted occurrence. They are non essential for the normal physiology and hence, survival of plants, in constrast to organic compounds in nature: sugars, amino acids, nucleotides etc. which are essential to the plant for survival. Phytochemical screening provides first hand knowledge of the chemical constituents of plants. Also, crude extracts can be subjected to chromatographic separation, leading to the isolation, purification and structural elucidation of new and unknown bioactive natural products/phytochemicals, whose medicinal activity can be investigated and correlated with the solvent type crude plant extract. Phytochemical screening revealed selective presence of natural products in different parts of the plant. C6H12 extracts revealed the presence of sterols, triterpenes, coumarins and reducing compounds. From the CH2Cl2 extract, a white solid crystallized. Phytochemical tests revealed it to be steroidal in nature. The white solid after further chromatographic purification and spectroscopic elucidation yielded the white lupine type pentacyclic triterpene, betulinic acid (betulinic acid (3-beta-hydroxylup-20-(29)-en-28-oic acid). The filtrate from recrystalisation was also steroidal in nature. Betulinic acid has been shown to exhibit a variety of biological activities such as the inhibition of human immunodeficiency virus (HIV) replication in H9 lymphocyte cells, blockage of HIV type 1 entry into cells, and inhibition of DNA polymerase β , anti-cancer, anti-protozoan effects over the years. The EtOAc extract showed the presence of emodols, tannins, flavones, reducing compounds and alkaloid salt. Flash column chromatography of the EtOAc extrract yielded Trigonelline as one of the major fraction. Trigonelline, an alkaloid which is widely distributed in terrestrial plants as well as in marine invertebrates has been previously isolated from the algae, Pterocladia capillacea. However, it has never been isolated from Doliocarpus dentatus. It is a zwitterion formed by the methylation of the nitrogen atom of niacin (vitamin B3) and is a product of niacin metabolism that is excreted in urine. It has been proven to have anti-diabetic activities. For the hydrolysed CH3CH2OH extract, positive tests were noted for anthrasenosides and coumarins. The non-hydrolysed CH3CH2OH extract revealed the presence of emodols, tannins, reducing compounds and flavones. The structure of isolated natural products was elucidated using 1HNMR,13 CNMR, DEPT-135, 1H-1H COSY, HMBC and HMQC. For Betulinic acid, the 1HNMR shows diagnostic peaks for the six methyls and these resonate at 0.647, 0.761, 0.865, 0.894, 0.929 and 1.643 ppm. In addition, multiplets are seen at 1.086-1.261, 1.237-1.396, 1.436-1.54, 1.802, 2.1, 2.2 and 2.948 ppm and these arise from either CH or CH2 protons. Two distinct broad doublets are seen at 4.69 and 4.56 ppm and these arise from terminal alkene protons H-30. 13C NMR spectrum revealed the presence of thirty signals, arising from 30 carbons of the triterpene. Dept-135 NMR indicates the presence of 11 CH2 signals and six CH signals which are consistent with the assigned structure.

Keywords: Phytochemical screening, natural products, chloroform extract, non hydrolysed ethanol extract, hydrolysed ethanol extract, emodols, tannins, flavones aglycones, (anthracenosides aglycones), coumarins, coumarins lactone derivatives, tannins (gallic), reducing compounds, alkaloid salts, betulinic acid, spectroscopic method

Influence of Environmental Factors on Biosynthesis, Profile and Biological Activity of Phenolics in Forage Plants V. Mlambo; M.N. Wuddivira; G.D. Eudoxie; and C. Bowen O'connor

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Some secondary plant compounds, such as tannins and non-tannin phenolics, have been identified as beneficial bioactive chemicals in forages that can be used to reduce methanogenesis from rumen fermentation, prevent bloat in ruminants utilizing lush leguminous pastures with readily degradable protein, and reduce gastrointestinal parasites loads. In addition, some condensed tannins are also known to increase the levels of rumen by-pass protein resulting in improved animal performance. The attraction to these natural product remedies in livestock production is driven by consumer preferences for drug residue-free animal products, the need to protect the environment by reducing methane emissions, the rise in pathogen resistance to chemotherapeutic agents and the need to ensure sustainability and profitability of the livestock enterprise. Although the utility of phenolic-rich forages as herbal products for use in livestock production has been proven in some cases, it is common knowledge that the concentration, composition and hence, biological activity of phenolics varies widely. Apart from genetic differences, several biotic and abiotic factors influence the biosynthesis, profile and activity of secondary plant compounds of phenolic origin in plants. Indeed, a plant's growth environment has long been known to influence biosynthesis and profile of secondary plant compounds of phenolic origin. It is envisaged that commercial cultivation of phenolic-rich plants for use in livestock production systems will become widespread as the demand for plant phytochemicals increases. Transforming phenolic-rich forages into commercial commodities that can be traded requires the cultivation of plants with consistent and desirable effect on bloat, internal parasites, protein ruminal degradability or methane production. Environmental conditions modify the quantity and type of secondary plant compounds, thus it should be possible to optimize the biosynthesis of phenolic compounds by manipulating a plant's growth environment. For successful manipulation and enhancement of the biosynthetic process of secondary plant metabolites, a large number of biotic and abiotic factors that influence secondary plant metabolism as well as post-harvest storage and processing, would have to be considered, controlled and optimized. This paper examines the often contradicting and scattered hypotheses on how diverse biotic and abiotic factors may influence biosynthesis, profile and potency of phenolic compounds in different plant species.

Keywords: forage plants, phenolics, secondary metabolism, growth environment, carbon-nutrient balance, methane production.

Muscadine Grape Skin Extract Inhibits Androgen-independent Prostate Cancer Cell Growth, Induces Cell Cycle Arrest and Decreases Migration by Targeting Heat Shock Proteins D. Ignacio¹, K. Mason¹, E. Hackett¹, C. Albanese², L. Ringer², W. Wagner³, P. Wang¹, M. Carducci⁴, S. Kachhap⁴, C. Paller⁴, J. Mendonca⁴, Leo L.Y. Chan⁵; B. Lin⁶, D. Hartle⁷, J. Green⁸; T.Hudson^{1*}

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Previously we demonstrated that muscadine grape skin extract (MSKE), a natural product significantly inhibited prostate cancer cell growth by inducing apoptosis through the targeting of phosphatidylinositol 3-kinase-Akt and mitogen-activated protein kinase survival pathways in androgen-responsive transformed human prostate cancer epithelial cell lines. However, the preventive effects of MSKE on a more aggressive androgen-independent prostate cancer remain unknown. This study seeks to address this question by examining the effects of MSKE treatment using complementary human PC-3 prostate cancer cell culture and xenograft models. In cultured PC-3 prostate cancer cells, we found that MSKE inhibited prostate cancer cell growth. The growth inhibitory effects of MSKE appeared to be through the induction of cell cycle arrest. This induction is accompanied by reduction in protein expression of Hsp40 and the client proteins, cyclin D1, and NFkB p65 which are all involved in cell cycle regulation. In addition, MSKE induced p21 mRNA and wild-type p53 protein expression. Moreover, we demonstrated that MSKE inhibits cell migration in PC-3 prostate cancer cells. In our xenograft model we showed that administration of MSKE significantly inhibited PC-3 human prostate cancer cell tumor growth in vivo. Overall, the results show that MSKE inhibit prostate tumor growth, migration, and induces cell cycle arrest by targeting Hsp40 and its client proteins suggesting that MSKE may be important in treating aggressive forms of prostate cancer.

Keywords: muscadine grape skin extract, prostate cancer cells, protein expression, cell cycle arest

Photochemical Study of Flowers and Leaves of Pumpkin V. Mahabir¹; and V.N. Verma²

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There are a number of nutrient metals which are essential to keep body healthy. They are naturally found in a different forms in organic vegetables and other cereals. Pumpkin is a very common vegetable available mostly through out the year in all over the world. Different parts of pumpkin have different amounts of the metals. Our earlier study of the skin , flesh and seed of pumpkin has shown that K, Ca, Mg, P, Zn, Cu, Ni, Fe, Co, and heavy metals, Pb and Cd were present in different amounts. The present photochemical study was focussed on the flowers and leaves of pumpkin , because in many countries the people make use of the flowers and soft leaves of pumpkin as a vegetable. The samples were collected from different three plants directly from vegetable farm. The samples were digested by aqua regia method and then the flame atomic absorption spectroscopic method was used to investigate the presence of nutrients elements for each digested sample. Manganese (566ppm), zinc (1084ppm), nickel (33ppm), cobalt (19ppm), iron (13ppm), copper (116ppm), manganese (11074ppm) and potassium (362ppm) were found in flowers and manganese (533ppm), zinc (521ppm), nickel (22ppm), cobalt (7ppm), iron (833ppm), copper (26ppm), manganese (8668ppm) ,and potassium (548ppm) were found in leaves. Thus the manganese and zinc were found in very high amount in both cases. It is known that the zinc helps in preventing the growth of prostate cancer and thus the use of pumpkin's flowers and leaves as a vegetable will be a good source of zinc in our body to prevent the growth of prostate cancer.

Keywords: Photochemical, nutrient elements, pumpkin leaves, pumpkin flowers, absorption spectroscopic method

Leonotis nepetifolia Extract: Potential to Protect the Liver from Harmful Effects of Acetaminophen. A. Williams¹; Y.N. Clement¹, S. Nayak², A.V.C. Rao³ and E. Uchee Nwache⁴

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Leonotis nepetifolia extract was investigated pre and post treatment on an acetaminophen-induced toxic mouse model at four doses. In vivo study was done to determine the hepatic activity of both methanol and aqueous extracts of L. nepetifolia. Oven dried leaves of Leonotis nepetifolia were extracted in methanol or 0.9% warmed saline solution. Swiss albino mice (n = 4-6) were pre-treated orally with either methanol or aqueous extract at a dose of 250 to 1000 mg/kg for three days followed by a toxic non-lethal dose of acetaminophen, 550 mg/kg one hour before a single dose of extract. Negative (-) control normal saline, and the positive (+) control, a toxic non-lethal acetaminophen dose of 550mg/kg was used for

evaluation. Animals were fed ad libitum for 24 hours after the final dose was administered; serum alanine aminotransaminase (ALT), aspartate aminotransferase (AST) and histology were quantified. Acetaminophen-treated animals showed significant increase in serum ALT and AST levels in a dose dependent manner with the highest levels and survival at 550mg/kg. Histological assessment at this dose confirmed centrizonal necrosis indicative of hepatic damage. Pre and post treatments of Leonotis nepetifolia at all doses showed a complete reversal of this effect on acetaminophen toxicity with serum levels of ALT and AST closer to normal at a 95% confidence level, p < 0.05. Histopathology of the liver tissue showed that Leonotis nepetifolia attenuated the hepatocellular necrosis caused by the toxic dose of acetaminophen. Leonotis nepetifolia extracts in pre and post treatments can prevent acute liver damage induced by acetaminophen toxicity. We propose that hepatic protection of Leonotis nepetifolia leaf extract may be due to components of plant exhibiting a direct effect to reduce toxicity of acetaminophen metabolism. The active components of the Leonotis nepetifolia leaf extract responsible warrant further investigation.

Keywords: Leonotis nepetifolia, serum alanine aminotransaminase, aspartate aminotransferase, hepatocellular necrosis

Antimicrobial and Antifungal Activity of Vermiwash from Different Sources (Bagasse, Neem, Paddy straw, Different Combinations) and Its Effect on Fungal Diseases affecting Tomato Fruit in Guyana Jaikishun¹; N. Hunte² and A. A. Ansari³

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The demand for products and technologies based on plants to control plant pathogens has increased in recent years due to the concern about the use of hazardous pesticides. Present investigations were carried out during the year 2011-2012 at the University of Guyana, Georgetown focusing on recycling organic waste using vermiwash from vermitech unit in different combinations for exploring the effects on productivity of tomato plants and its ability to inhibit or kill microorganisms such as fungus causing fruit rot on tomato fruit in Guyana. Plant growth parameters and effect of different sources of vermiwash against tomato fruit fungus (Alternaria alternate) were monitored during the experiment. The study revealed that plants treated with vermicompost and vermiwash had greater influence on plant growth parameters compared with the control treatments. The average biomass of tomato (Lycopersicom esculentum) plants during the period of harvesting weight a maximum value of 103.50±28.70g as compared to the plants with control treatments: T1 and T2. The average weight of fruits extracted at the time of harvest revealed that those treated with T7 had a maximum of 41.9g as compared with control plant, T1 and T2, along with the other combination treatment. In terms of fruiting T7 had a maximum of 10.50±13.44 compared with control treatment. In terms of shoot length, T6 had a maximum of 40.33cm compared to control plant, control treatment: T1 and T2 as well as other treatment with T3 having a minimum value of 30.53cm. The value of T7 on the other hand was insignificant compared to the control treatments. Composite index was calculated based on each growth parameters and revealed that T4 ranked 1 followed by T6 and T7 (Rank 2) whereas T5 ranked least followed by control and T1 (Rank 7). The findings from this experiment generally indicated that vermiwash with combination of neem+earthworm+cattle dung such as T3, T6 and T7 are very effective depending on their concentration or percentage to get rid of pathogens and improve yield and growth parameters of tomato fruit. The treatment T1, T2, T6, T7, T8 and T9 at 10% dilution of vermiwash were effective against Alternaria alternata affecting tomato fruits.

Keywords: vermiwash, tomato, fungal diseases, biomass

The Application of HPLC ESI MS in the Comparison of the Aqueous and Methanolic Extracts of a Caribbean Medicinal Plant S. Peter¹ and J. Headley², K. Peru², B. Fahlman²

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The tradition of using plants for medicinal value is still of importance to peoples of the Caribbean. Medicinal plants are used for preventative health care and also for therapeutic value in the treatment of chronic diseases such as diabetes and hypertension. Documented usage suggests that the most popular mode of preparation involves water based decoctions or infusions of the fresh or dried plant material. In efforts to validate the value of the modality of usage, phytochemical analysis is employed to identify classes of natural products with relevant bioactivities. In most of these analyses the potential bioactive agents are extracted into an organic matrix for analysis unlike the standard mode of preparation in practicing the tradition. This study employed HPLC coupled with negative ion ESI MS/MS to compare the composition of the aqueous and methanolic extracts obtained from the medicinal plant Pluchea carolinensis (Jacq.) G. Don., of the Asteraceae family. In Barbados tradition this shrub is used for a variety of health management applications including colds, flu, jaundice and menopause. The leaves of the plant are used to make a medicinal tea either by decoction or infusion in water. The results of the analysis showed that there was significant similarity in the composition of the aqueous and methanolic matrices with mono-, di- and tricaffeoylquinic acids featuring prominently in the spectra. The aqueous extract showed slightly less complexicity in the number of conjugates. These results support the efficiency of a polar organic matrix for the qualitative analysis of bioactive phenolics in medicinal teas.

Keywords: Caribbean, medicinal plants, Pluchea carolinensis, methanolic extracts, mono-, di- and tricaffeoylquinic acids Key Words: Ethnomedicine, Phytochemistry, Mass Spectrometry

A Preliminary Evaluation Of The Anti Cancer Potential Of Selected Caribbean Plants Dunstan Arrindell¹, Sonia Peter², Trevor Alleyne¹ Diane Ignacio¹, Abayomi Odekunle¹, Yuri Clement¹ and Hubert Daisley¹

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Cancer may be defined as a class of diseases characterized by uncontrolled division of cells and the ability of these cells to invade other tissues. PAHO data suggest that in spite of continued advances in treatment the incidence of cancer continues to rise and that by 2030 cancer will become the major cause of death globally. Much of the hope for the reversal of this trend centers round the development or discovery of new drugs and tropical plants are believed to offer great possibilities in this search. In this study, we investigated the anti-cancer potential of extracts from the leaves of the Sugar Apple tree, Annona squamosa L.

Air dried leaves from the Sugar Apple tree, were crushed and extracted with methanol in a ratio of 1g/10ml of methanol. This total crude extract was reduced by 50% using rotary evaporation at 60 °C and extracted first with petroleum ether and then dichloromethane. All fractions were further reduced by rotary evaporation and four dilutions of each (100μ g/ml - 400μ g/ml) prepared. The anti-cancer properties of the extracts were tested on the MT-4 Leukemia cell line. At concentrations of 200 µg/ml and above the total methanol extract and the hexane fraction but not the dichloromethane showed anti-proliferative effects; both extracts elicited a 25% reduction in proliferation of MT-4 cancer cells.

Antimicrobial Potency of the Aqueous extract of leaves of Terminalia Catappa, R. C. Jagessar^{1*}; R. Allen²

*1Senior Lecturer and Supervisor, Department of Chemistry, University of Guyana, Faculty of Natural Sciences, Turkeyen Campus, South America; 2, Final Year Research student, 2010-2011, University of Guyana, Faculty of Natural Sciences.

There is an urgent need to intensify research in herbal medicines and drug discovery, considering the presence of incurable diseases such as HIV AIDS and the threat of new emerging disease such as SARS, bird flu etc. Over the years, crude and fractionated plant extracts have been a good source of herbal medicines and also natural products/ phytochemicals. Guyana has a rich biodiversified flora whose crude extracts, both organic and aqueous have been screened for their antimicrobial activity. Also, the specified plants parts fractionated or screened for natural products whose antimicrobial activity have been investigated and compared with that of the crude extracts. Following this, clinical trials of crude extracts and isolated natural products can result in the formulation of herbal plant creams or herbal medicines.

Terminalia catappa is a large tropical tree in the Leadwood tree family, Combretaceae. It grows usually to 35 metres (115 ft) tall, with an upright, symmetrical crown and horizontal branches. It has corky, light fruit that is dispersed by water. The leaves contain several flavonoids such as kaempferol or quercetin), several tannins(punicalin, punicalagin or tercatin), saponines and phytosterols. The leaves and also the bark are used in different traditional medicines for various purposes. For example, in Suriname, a tea made from the leaves is prescribed against dysentery and diarrhea. Antimicrobial efficacy of the aqueous extract of leaves of Terminalia cattappa was investigated against pathogenic Staphylococcus. aureus (gram (positive), E. coli, (gram negative), Klebsiella pneumonia (gram negative), Candida albicans strains using the Disc Diffusion assay. Pathogenic microorganism investigated were Escherica coli (EC), Staphylococcus aureus (SA), Klebsiella pneumoniae (KP) and C. albicans (CA). Escherica. coli can cause several intestinal and extra intestinal infections such as urinary tract infections, meningitis, peritonitis, mastitis, septicemia and gram-negative pneumonia. Staphylococcus aureus, the yellow type can cause furuncles (boils), carbuncles (a collection of furuncles). In infants, Staphylococcus aureus can cause a severe disease Staphylococcal scalded skin syndrome (SSSS). Staphylococcal endocarditis (infection of the heart valves) and pneumonia may be fatal. Staphylococcus aureus can cause food poisoning. Candida albicans is a diploid fungus (a form of yeast) and is a casual agent of opportunistic oral and genital infections in humans. It is responsible for the infectious disease, candidiasis, thrush etc. Klebsiella pneumoniae is a gram-negative, non-motile, encapsulated, lactose fermenting, facultative anaerobic, rod shaped bacterium found in the normal flora of the mouth, skin, and intestines. K. pneumoniae can cause the disease Klebsiella pneumonia. Based on the zone of inhibition, antimicrobial potency of the plant aqueous extract against the above pathogenic microorganism followed the sequence: Klebsiella pneumonia > Staphylococcus aureus > Escheria. coli > Candida. albicans. Antimicrobial potency was also found to be less than standard antibiotics: Ampicillin, Nystatin and Penincillin under standard conditions.

Keywords: Antimicrobial efficacy, Terminalia catappa, Disc diffusion, Staphylococcus aureus (gram positive), E.coli, (gram negative), Klebsiella pneumonia, Candida albicans

Abstracts Posters

Phytochemical Screening, Isolation and Purification of betulinic acid and Trigonelline from Stems of Doliocarpus dentatus (Kapadulla) R. C. Jagessar^{1*}; A. R. Maxwell²; Ghansiam. Hoolas²

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The stems of Doliocarpus dentatus (Kapadulla), a plant of the Guyana (South America) flora were screened for natural products using solvents of varying polarity: C6H12, CH2Cl2, EtOAc, CH3CH2OH. Natural products are the secondary metabolites of plants and animals that are of restricted occurrence. They are non essential for the normal physiology and hence, survival of plants, in constrast to organic compounds in nature: sugars, amino acids, nucleotides etc. which are essential to the plant for survival. Phytochemical screening provides first hand knowledge of the chemical constituents of plants. Also, crude extracts can be subjected to chromatographic separation, leading to the isolation, purification and structural elucidation of new and unknown bioactive natural products/phytochemicals, whose medicinal activity can be investigated and correlated with the solvent type crude plant extract. Phytochemical screening revealed selective presence of natural products in different parts of the plant. C6H12 extracts revealed the presence of sterols, triterpenes, coumarins and reducing compounds. From the CH2Cl2 extract, a white solid crystallized. Phytochemical tests revealed it to be steroidal in nature. The white solid after further chromatographic purification and spectroscopic elucidation yielded the white lupine type pentacyclic triterpene, betulinic acid (betulinic acid (3-beta-hydroxylup-20-(29)-en-28-oic acid). The filtrate from recrystalisation was also steroidal in nature. Betulinic acid has been shown to exhibit a variety of biological activities such as the inhibition of human immunodeficiency virus (HIV) replication in H9 lymphocyte cells, blockage of HIV type 1 entry into cells, and inhibition of DNA polymerase β , anti-cancer, anti-protozoan effects over the years. The EtOAc extract showed the presence of emodols, tannins, flavones, reducing compounds and alkaloid salt. Flash column chromatography of the EtOAc extrract yielded Trigonelline as one of the major fraction. Trigonelline, an alkaloid which is widely distributed in terrestrial plants as well as in marine invertebrates has been previously isolated from the algae, Pterocladia capillacea. However, it has never been isolated from Doliocarpus dentatus. It is a zwitterion formed by the methylation of the nitrogen atom of niacin (vitamin B3) and is a product of niacin metabolism that is excreted in urine. It has been proven to have anti-diabetic activities. For the hydrolysed CH3CH2OH extract, positive tests were noted for anthrasenosides and coumarins. The non-hydrolysed CH3CH2OH extract revealed the presence of emodols, tannins, reducing compounds and flavones. The structure of isolated natural products was elucidated using 1HNMR,13 CNMR, DEPT-135, 1H-1H COSY, HMBC and HMQC. For Betulinic acid, the 1HNMR shows diagnostic peaks for the six methyls and these resonate at 0.647, 0.761, 0.865, 0.894, 0.929 and 1.643 ppm. In addition, multiplets are seen at 1.086-1.261, 1.237-1.396, 1.436-1.54, 1.802, 2.1, 2.2 and 2.948 ppm and these arise from either CH or CH2 protons. Two distinct broad doublets are seen at 4.69 and 4.56 ppm and these arise from terminal alkene protons H-30. 13C NMR spectrum revealed the presence of thirty signals, arising from 30 carbons of the triterpene. Dept-135 NMR indicates the presence of 11 CH2 signals and six CH signals which are consistent with the assigned structure.

Keywords: Phytochemical screening, natural products, chloroform extract, non hydrolysed ethanol extract, hydrolysed ethanol extract, emodols, tannins, flavones aglycones, (anthracenosides aglycones), coumarins, coumarins lactone derivatives, tannins (gallic), reducing compounds, alkaloid salts, betulinic acid, spectroscopic method

Antimicrobial Potency of the Aqueous extract of leaves of Terminalia Catappa R. C. Jagessar^{1*}; R. Allen²

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Keywords: Antimicrobial efficacy, Terminalia catappa, Disc diffusion, Staphylococcus aureus (gram positive), E.coli , (gram negative), Klebsiella pneumonia, Candida albicans

Determination of nitrate anion in Waste Water from nine selected areas of Coastal Guyana via a spectrophotometric method R.C. Jagessar^{*1}; L. Sukundun²

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Globally, the presence of nitrate anions in water beyond the threshold limit can be deleterious to both flora and fauna life. Nitrates (NO3-), salts of HNO3 acid and triangular in shape have both positive and negative effects on man's livelihood. Nitrates are an important component of the nitrogen cycle. Most plants withdraw NO3- and NH4+ from the soil and then convert NO3- into more NH4+ which plants use to produce the amino acid glutamine and other essential compounds. Nitrates are responsible utimately for the growth of plants and also nitrogen

fixation. Nitrates are found in nature since they are the end product of the aerobic decomposition of organic nitrogenous matter as well as the decomposition of organic micro-organisms. High concentrations of NO3- in drinking water induce blood disorder in babies less than six months of age, a condition called the "Blue-Baby Syndrome". In infants intestine, Escherichia coli, reduce the nitrate ions (NO3-) to nitrite ions (NO2-). The nitrite ions are absorbed into the bloodstream where they oxidized iron Fe2+ in the hemoglobin to iron Fe3+. The presence of hemoglobin containing oxidized iron, known as Met-haemoglobin reduce the oxygen carrying capacity of the blood. This condition can ultimately lead to death. More Babies are more vulnerable to high NO3- levels than adults because their stomachs are less acidic. Guyana's waste and domestic water needs continual monitoring to assess the concentration of toxic anions and cations. Selected areas monitored along the coast were No. 58 Livehood Village, Rose Hall Town, Skeldon GUYSUCO Estate, Good Hope, Ogle, Stabroek, Parika, Supenaam, Spring Garden. The results showed that the concentrations of nitrates were not as high and are below the internationally accepted threshold value. The average concentration been 0.03mg/L, 0.06mg/L and 0.20 mg/L, 1.77 mg/L, 2.363 mg/L, 0.333mg/L, 0.17 mg/L, 0.19 mg/L, 0.18mg/L NO3- for the above several areas respectively. The results were accepted at the 95% confidence level using statistical analysis. The US public Health Service designated safe limit for nitrate in water as 45mg/L... The applicable range of concentrations using the above method is 0.1-2 mg/L NO3-.

A maximum level of 45 mg/L is established as worldwide guidance for nitrate concentration in water. In Europe, the maximum permitted levels of nitrate in potable water is 50.0 mg/L, while the US-EPA has established a guideline for the maximum level of nitrate-nitrogen of 10 mg/L. It can safely be informed that the nine selected areas choosen are not polluted with nitrate anion beyond the threshold value. However, our water needs continual testing as development intensify.

Keywords: Waste water, Nitrates, Nitrogen cycle, Blue Baby Syndrome, Met-haemoglobin, Threshold limit, US-EPA standard

The Application of Calcined Marlstones as a Catalyst in Biodiesel Production of High Free Fatty Acids (FFA) Coconut Oil P. Jaggernauth; E. John; P. Bridgemohan.

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Biodiesel is a renewable, available and environmentally attractive alternative to petroleum derived diesel. One of the major challenges to mass production of biodiesel is its high consumer price relative to petroleum diesel due to its higher production costs. Reduction of any production costs should therefore lower the biodiesel market price. An expensive process input that can impact on the lowered operational cost is the catalyst for the biodiesel reaction (or transesterification). This can potentially be accomplished by use of low cost, environmentally friendly catalysts such as calcined marlstones.

This research was aimed at investigating the catalytic potential of two types of calcined marlstones (red and white), and their optimum time/temperature calcination combinations, in the transesterification of high FFA non-edible coconut oil. A 3 x 3 experimental design with variables of temperature (700, 900 and 1000°C) and calcination time (1.5, 2.0 and 3.0 hours) was used for the calcination of the marlstones. The high FFA coconut oil required acid transesterification before use in the experiments. The experimental design for the base transesterification using the marlstone catalysts included two factors for catalyst wt% (5wt% and 15wt%), but constants of 2 hrs reaction time, 60°C reaction temperature, vigorous stirring, and a 6:1 methanol to oil molar ratio.

The catalyst, 15wt% generally produced a higher yield than 5wt% catalyst for both marlstones. The highest yield was 97% which was produced by 15wt% marlstones (white) calcined at 1000°C and 1.5 hrs. Yields of 94% were also obtained from use of 15wt% catalyst for the following: marlstones (red) calcined at 900 °C for 3 hrs; marlstones (white) calcined at 700°C for 2 hrs, 900°C for 1.5 hrs and 1000°C for 1.5 hrs. These yields indicate that calcined marlstones do have catalytic potential in the transesterification reaction.

Key words: Coconut oil, catalyst, calcined marlstones, biodiesel

Exploring the Potential of Microalgae as part of Renewable Energy Opportunities in Trinidad and Tobago Ria Manbodh; Ejae John; Puran Bridgemohan

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Trinidad and Tobago is increasing its focus on renewable energy alternatives. A range of research and development projects have been implemented at UTT, among them, the extraction of lipid from microalgae to produce biodiesel. Microalgae are presently widely researched for its potential as a source of biodiesel and carbon dioxide mitigation and because it is widely reported to be the most feasible source of biodiesel to meet present and predicted fuel consumption requirements. Trinidad and Tobago has entered the microalgae research field by establishing an inventory of indigenous microalgae and its growth and lipid production potential as part of the initial stages of exploratory work in this field. The study involved a series of steps including water collection at various sample locations, microalgae species isolation in the laboratory using agar and then transfer to liquid culture medium. Also a range of growth rate experiments were conducted. Unless otherwise stated, samples were grown in batch culture for 14 days under laboratory conditions. Freshwater media (5g/L Yara Mila Complex in distilled water) Nariva Swamp media (final salinity 1%),Caroni Swamp Media (final salinity 0.5%). Cell count under a microscope, pH and temperature were recorded every 24-48 hours. All experiments were done in triplicate. Microalgae samples were then harvested by centrifugation and lipid extracted using Folch's method. Fatty acid composition analysis was conducted on a GC-MS. The results indicated that freshwater microalgae samples showed better growth rates at lower salinities and the Mathura River microalgae samples displayed a higher growth rate and biomass content at lower nutrient levels when grown for a maximum of 15 days. These results indicate favourable results for microalgae growth under normal conditions and further work is being planned on scale-up outdoor experiments.

Keywords: renewable energy, fatty acid composition, microalgae

Assessing the Influence of Edaphic Factors on Tropical Wetland Vegetation Distribution Using Electromagnetic-induction M. Atwell¹; M.N. Wuddivira¹; D. A. Robinson²; J. Gobin³

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Coastal wetland vegetation ecosystems are important tropical habitats forming an interface and buffer between the land and ocean. Due to degradation, efforts to restore these systems require an understanding of the vegetation ecology as it relates to edaphic soil conditions. The edaphic characteristics of wetland soils typically occur in gradients and have been the focus of intensive research as it relates to vegetation zonation. Much of this research, however, has been focused in temperate regions with relatively little known about the importance of edaphic factors mainly salinity to the zonation of vegetation in a tropical wetland. By using geophysical imaging to quantify salinity, soil physiochemical properties and to compare plant community patterns within geophysical signals in the Godineau swamp, we were able to determine the major factors which influenced plant zonation within a tropical wetland. Analysis revealed that salinity which was most affected by clay, salts, elevation and tidal inundation corresponded with the existing vegetation patterns. Grasses thrived under higher elevations, lower clay and salt levels (2.57 dS/m) and sedges under lower elevations, higher clay and salt levels (2.00 dS/m). We conclude that with sea level rise and increased inland salinization, we stand the risk of losing valuable plant communities with increasing monocultures of invasive species in the wetland.

Keywords: Vegetation pattern, Electrical conductivity, Electromagnetic Induction, Geophysics

Hydrothermalism in the Lesser Antilles Volcanic System : A Natural Laboratory for Geothermal Research Y. Mazabraud

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The subduction of the Atlantic plate underneath the Caribbean oceanic plateau in the Lesser Antilles is at the origin of its well known arc magmatism. Indeed, partial melting of the earth's mantle generates ascending magma that, when cooling, will form igneous and volcanic rocks. Not only this phenomenon constructs the arc itself, it is also associated with heat transfer from the deep toward the surface. When interacting with meteoric or sea water, the heat will trigger convection of fluids within the rocks. These hydrothermal fluids bear an industrial potential for green energy. Indeed, 7% of the electricity in Guadeloupe is already produced by the Bouillante geothermal power plant. Other islands, such as Martinique and Dominica also have proven potential. In order to monitor the resource before and along its exploitation, we need to better understand the geologic frame. The work presented here focuses on the means to achieve geologic models in this context. It demonstrates the need to work at all scales and to study analogs at different structural levels. Then, a tectonic sketch of faults interaction, along with volcanism, is proposed to act as a key factor to geothermal body formation.

Keywords: earth's mantle, volcanic, geologic models, hydrothermal fluids, Lesser Antilles

Differences in leaf traits (anatomy and morphology) of 13 dominant species in two Caribbean forests: Tropical mountain rain vs dry forest E. Mira ^{1*}; O. Gros ²; M. Dulormne ¹

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The tropical dry and rain forests have an enhanced sociologic, economic and biologic role. Guadeloupe Forest presents a high specific biodiversity and this is one of the most important areas in the Lesser Antilles. The aim of this poster was to present the differences or similarity between 13 tree functioning strategies in two contrasted ecosystems of the Caribbean. For that, 13 leaf traits (morphologics, anatomics and chemical) allowed to determine this functional strategy. Both ecosystems are specific to extreme climatic conditions, (Dry forest, DF, 1 300mm of rain/year and mountain rainforest, MRF, 10 000mm of rain/year).

The results have shown significant differences in morphology, chlorophyll content and anatomic proprieties of leaf between DF and MRF. DF's species shows bigger leaves with higher specific leaf area, thinner cuticles and higher ratio of palisade parenchyma/spongy parenchyma (PP/SP) than those of MRF. These associated traits are known to allow a maximization of resource acquisition by plant during a rainy season. DF's species also have leaves with few stomata and numerous trichoms, both of these traits play a role in water economy strategy in plants of dry areas. MRF's species show more conservative traits: small thick leaves with high values of SLA, a set of traits often associated to nutrient conservation in low resources environment. However, wood density didn't vary in both forests, because each species can grow more or less quickly, independently of the ecosystem type.

Decision Support Tools for Flood Hazard Mitigation in the Caribbean S. A. Boyce¹; K. Whitehall^{1,2}

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The influences of weather and climate are often neglected during times of national non-hydrometeorological emergencies. However, these factors can significantly impact all phases of the disaster cycle. Weather, hydro-meteorological and climate information can be used to support (i) forecasting the spatial and temporal impacts to facilitate the issuance of early warnings, the mobilization of first responders and the redeployment of critical assets, (ii) search, rescue and evacuation activities and (iii) post-event long-term rehabilitation and relief efforts that are often necessary following major impacts.

Implementing effective flash flood warning systems is challenging in the Caribbean due in part to (i) the technical complexity of predicting deep localized convective events with appropriate accuracy and lead time especially in small watersheds and (ii) the lack of efficient data collection and monitoring networks. Among the three options for creating local or regional flash flood early warning systems described by UCAR (2010) is the use of atmospheric fine scale models coupled with distributed hydrological models. This option is viewed as important to the Caribbean due to the deficiencies of hydro-meteorological networks in the region and the fact that it provides disaster managers with significant lead time before the onset of the event when built with numerical weather prediction (NWP).

This concept forms the basis of the advanced flood forecasting research currently being conducted at the Caribbean Institute for Meteorology and Hydrology (CIMH) which includes the application of a distributed open source rainfall-runoff hydrological model to predict water depths in watersheds. This work showcases some of the forecast products under development at the CIMH and provides a typical application example aimed at demonstrating a flood forecasting concept for the Caribbean. In particular, we demonstrate aspects of the platform applied to Haiti immediately following the January 12, 2010 earthquake.

Estimating the Parameters of the Five Parameter Lambda Distribution S. Mahdi; and K. Cadogan

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With a flexible probability density function and five parameters at its disposal, the Five Parameter Lambda Distribution (FPLD) is suitable for distributional modeling. However, little research has been carried out on this distribution to date. And although the most recent published work focuses on how to apply newly developed estimation techniques, the literature does not address how to accomplish parametric estimation using existing well-established estimation methods. Hence, this research shows how to fit the FPLD using the methods of Moments, Probability Weighted Moments (PWMs) and Linear Moments (L-moments) with the specific goal of determining whether any one method outperforms the others. To demonstrate how to apply the proposed methods, the FPLD was fitted to two theoretical distributions, the Standard Normal distribution and the Standard Exponential distribution, as well as a sample of empirical data.

Our research shows that no fit can be obtained for the Standard Exponential distribution using the method of Moments. However, quantilequantile plots of the FPLD showed that both the PWMs and L-moments methods gave perfect graphical fits to the Standard Exponential distribution. This result was also reflected in extremely low numerical measures of the distance between the probability density functions. In comparison, the Standard Normal distribution was well approximated by the FPLD using all three estimation techniques. Similarly, viable fits of the FPLD were obtained for the set of real rainfall data analyzed. Overall, the methods of PWM and L-moments were deemed to perform better than the method of Moments despite the fact that neither exactly outperformed the other according to the goodness of fit tests.

Assessing the Temporal Stability of Soil Apparent Electrical Conductivity in Cocoa Fields using Electromagnetic Induction. Sunshine A. De Caires¹; Mark N¹. Wuddivira; Isaac Bekele¹

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Variation in soil properties is one of the major factors that cause crop yield decline. Cacao (Theobroma cacao L.) remains in the same field for decades, therefore, spatial and temporal patterns of soil properties can affect yields of cocoa estates. Identifying spatio-temporal patterns of soil properties and using them as a guide to making management decisions, can lead to improved input use with resultant increase in cocoa yields. In cocoa plantations, where delineated zones will facilitate management of inputs in the field for multiple years, greater emphasis should be placed on depicting temporal stability. Using electromagnetic induction (EMI) geophysical technique, a time-lapse approach was employed to investigate the temporal stability of apparent soil electrical conductivity (ECa) in cocoa fields. We made a total of nine multi-year (2008 to 2009) measurements of shallow (top 0.5 m of soil) and deep (top 1.5 m of soil) ECa from two blocks 6A (1.34 ha) and 6B (4.47 ha) of the five blocks of accessions in the International Cocoa Genebank, Trinidad (ICG, T). Shallow soil ECa values showed much stronger linear dependence between measurement days with Spearman's rank correlation coefficients (rs) ranging between 0.83 and 0.91 than deep ECa (rs, 0.66 – 0.85). We found that in our fields, shallow ECa measurements were more temporally stable than deep ECa suggesting that for this and similar non-saline systems, single ECa mapping should suffice to delineate management zones based on ECa without recourse to remapping.

Keywords: apparent electrical conductivity, temporal stability, management zones, cocoa field.

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