Progress Report – AIACC SIS06 Project, The Threat of Dengue
July - December 2003

Summary
During the last 6 months the SIS06 project achieved most of its objectives. Outstanding activities not completed are the convening of the 2nd planning and consultation meeting, collection of current climate data and the generation of climate scenarios using SRES greenhouse scenarios. The interactive climate database is being tested in preparation for implementation. All retrospective data have been collected and analyzed for correlations with climate data. Analysis continues since it is felt that more information can be extracted from the data. Three papers based on the retrospective analysis have been prepared for the Caribbean Health Research Council 49th Annual Scientific Meeting to be held in Grenada, April 22-24, 2004. Prospective surveillance data for dengue fever and vector were gathered for Barbados, Jamaica, St. Vincent and the Grenadines and Trinidad and Tobago. Analysis of the prospective data has been slowed by the lack of current climate data. Socio-economic data which have been collected from records and interviews and entered in a database, are now being analyzed. A draft questionnaire for the KAP survey has been compiled and a training process for the interviewers has been initiated. An application was made, and approved, for a supplemental grant to build capacity in the use of epidemiology models. In the coming 6 months we hope that all outstanding items will be taken care of and that all scheduled activates will be completed on time. In particular we will introduce an epidemiology modeling component into the project and will start working on the design of a pilot project for early warning of dengue outbreaks.

Description of tasks performed and output produced

Climate Data Base

As envisioned, the Caribbean Climate Interactive Database (CCID) will house precipitation, maximum, minimum and mean temperatures for stations of the Caribbean, in addition to other variables extracted for the region from commercially available global datasets. CCID will also allow for the easy selection of data according to temporal and spatial characteristics specified by the user, as well as simple statistical manipulation of the data. As mentioned in the previous report, emphasis has shifted to building the database (the second of three tasks envisioned in the creation plan for CCID). A preliminary version of the database has been created using data from only a few stations, and is currently being tested for robustness and ease of manipulation. The prototype database allows for storage and retrieval of Caribbean station data based on queries by name of station, country, or station ID. It also includes procedures for performing simple statistics (correlations, mean, creating anomalies, climatology, etc.) and for writing the manipulated data to disk.

Epidemiology database

During the period July – December, 2003, Dengue Fever (DF) and DF Vector Prospective Surveillance data were gathered for the following countries: -

- Trinidad and Tobago
- Barbados
- St Vincent and the Grenadines
- Jamaica.

Data were gathered in the form of:-

- Monthly Breteau indices (BIs) of Aedes aegypti
- Dengue Fever cases reported to the Caribbean Epidemiology Centre by the Ministries of Health of the respective countries. In the case of Trinidad, instead of BIs, Ae aegypti ovitrap data were surveilled, since this was felt to be an even more precise tool.

Downscaling

The results of a preliminary execution of SDSM using the readily available output of the 1st generation Couple General Circulation Model developed by the Canadians (CGCM1) were analyzed. The results showed that no significant changes in temperature were expected over the next 80 years. To determine if these results could be accepted as 'valid' outputs from SDSM, analyses were started to determine if the predictor and predicatant data were properly processed and the SDSM model properly executed. Unfortunately the analyses ran into a snag and another student, Ms. Cassandra Rhoden, was taken onto the project to help with the processing of the data. In addition a SDSM expert from Canada, Dr. Gary Lines, was invited to Jamaica, through the courtesy of the Canadian ACCC project, to instruct the students in the use of SDSM at a workshop scheduled for early January 2004.

Retrospective study

Dengue patterns and the association between the climate variables (rainfall and temperature) and epidemics were studied. A distinct seasonality of the epidemics in the Caribbean region was evident. The epidemics appear to occur in the latter half of the year after warming and rainfall. The higher incidences of dengue in the **nineteen nineties** can be associated with less abundance in rainfall and higher temperatures in this period as revealed by the pattern of precipitation and temperature anomalies. The patterns were pronounced in Trinidad and Tobago, and Barbados. Three papers on the findings have been submitted for presentation to the Caribbean Health Research Council at its 49th Annual Scientific Meeting to be held in Grenada, April 22-24, 2004. Paper abstracts/actual papers are attached. Ms. Roxann Stennett was recruited as a graduate student to assist in the retrospective study.

Prospective study

Prospective studies initiated by Dr. Samuel Rawlins are under way in Trinidad and Tobago, Barbados, St Vincent and the Grenadines and Jamaica. St. Vincent and the Grenadines will replace St. Kitts as one of the 4 target countries of SIS06 for reasons explained below. Relevant epidemiology data are being routinely collected. However the progress of analysis has been slowed by the gathering of current climate data which is needed for correlation studies.

The scope of the work of our graduate student, Karen Polson, has been extended. The University of the West Indies agreed to our requests made to recognize the progress for Karen's program to be re-registered from an M Phil to a PhD research program. Karen's program on "Climate Change factors impacting on Dengue Fever and its transmission in Caribbean Countries", is continuing to make progress.

Vulnerability Studies

The aim of this sector is to analyse the vulnerability of Jamaican communities to the increased transmission of dengue that should result from climate change. The strategy adopted is to measure the adaptive capacity of the country both at the level of the generic and the specific. This involves an analysis of the capacity to adapt to changes in general as well as to the challenges that would be presented by the increased transmission of dengue.

To achieve these ends secondary sources were explored to analyse social, economic and political trends in the country. Expert interviews have been conducted with officials in the public and private sectors. In addition, three communities were selected on the basis of their experiences in

the 1998 outbreak of dengue and a questionnaire survey conducted among a sample of the residents. The questionnaire solicited information on a range issues which would be used to assess vulnerability; the factors associated with this condition; the modifications that might be effected to bring about change and the interventions that could be encouraged and supported.

Data entry (SPSS) has been completed and a start has been made on the analysis of the data.

Knowledge Attitudes and Practices (KAP)

A draft design of the KAP questionnaire has been prepared. The KAP survey was initiated by the training of medical students at the Mount Hope UWI campus to investigate a preliminary survey in Trinidad. This will be a forerunner of a survey to be executed in 4 countries in early 2004.

Proposal for Capacity building in the use of epidemiology model

A proposal for a supplemental grant from AIACC was submitted and approved. The specific aim of this proposal is to build capacity in

(i) modeling the epidemiology of dengue fever, including the environmental and global change effects;
(ii) determining the more productive breeding containers responsible for transmission of dengue by means of a pupal/demographic survey in Jamaica and Trinidad.

Description of difficulties encountered and lessons learnt

Climate database

We continue to experience difficulties in sourcing current climate data from stations in the Caribbean. An attempt will be made to source the data through the Caribbean Community (CARICOM) Secretariat.

Epidemiology database

No serious problems were encountered in this area.

Downscaling

Lack of computer programming skills on the part of one of the students working on the SDSM model was one of the reasons for the slow progress in statistical downscaling. Just before the start of the SIS06 project, the person originally offered the position to do statistical downscaling opted out and the present student was taken on because of his background in meteorology. A second student has been taken on to try to speed up the process.

Prospective Study

Analysis has been hampered by the lack of current climate data, as discussed in the climate database section above.

The St Kitts Ministry of Health did not present us with the monthly vector BIs, but instead sent the routine three monthly surveillance data, though the monthly data were promised on numerous occasions. At the same time, there were very few DF cases reported from this very small community. For these reasons we selected St Vincent and the Grenadines as an alternative site for our studies.

Last year we mentioned that Michelle Spencer, a graduate student is Social Sciences, would be taken on to supervise and analyze the KAP survey as part of her graduate degree program in the Faculties of Medical Science and Social Science at UWI, St. Augustine, Trinidad. Unfortunately Ms. Spencer changed her mind on joining the program in and we are trying to recruit another student in her place.

Description of connection with the national communications under the UNFCCC
The national focal point for Jamaica, Mr. Jeffery Spooner, has been made aware of our project and our ability to make an input into the 4th assessment.

In addition to the memorandum of understanding signed with the Caribbean Community (CARICOM) to cooperate in generating climate scenarios for the Mainstreaming Adaptation to Climate Change (MACC) project, a second memorandum has been signed to provide assistance in the analysis of data collected by the Caribbean Environmental Health Institute.

Description of tasks to be performed and difficulties anticipated in the next eight-month period

Climate database

Work to be completed in the upcoming months include (i) the further "in-house" testing of the database, (iii) the inclusion of all station data amassed to date (iii) the testing of the database by potential users. The gathering of current data will continue to be a problem.

Epidemiology database

No further work need be done

Downscaling

As stated in the previous report, scenarios up to 2090 will be generated for 4 target countries (Barbados, Jamaica, St. Kitts and Trinidad & Tobago) using HadCM3 outputs, which have just now become available for SDSM use.

Retrospective Study

Study on the association of dengue and climate is being continued. Correlation studies have been started to obtain more robust correlation coefficients and significant levels of the associations that exist between dengue and climate variables. More attention shall be focused on lag correlation studies.

Prospective Study and KAP Survey

We will finalize the prospective dengue fever and vector studies. The KAP studies should be launched on a local and regional basis early in 2004. Data analysis of prospective surveillance and KAP studies will be done. Recruitment of student(s) to take part in the KAP survey during the school year may pose a problem.

Vulnerability

Analysis of data in the SPSS database will continue. Some preliminary findings should be available by the end of March 2004

Planning and Evaluation Meeting

The 2nd planning and evaluation meeting scheduled for June to December 2003 will take place.

Design of a Pilot Project

Using Knowledge gained from the retrospective, prospective and socio-economic studies, we will work on the design of a pilot project to use epidemiology surveillance and climate forecasts to provide an early warning system for dengue epidemic.

Inclusion of a dengue model in SIS06

A graduate student with computer competence and training in the life sciences will be recruited to work on the project. The student will be jointly supervised by Dr. Dwight Robinson, Department of Life Sciences, UWI, Mona, and Prof. Anthony Chen. Dr. Dana Focks, who will provide the epidemiology model, will conduct a one-week workshop and act in an advisory capacity. Dr. Samuel Rawlins who is the vector field coordinator for the AIACC project will work closely with Dr. Robinson in providing data for Trinidad, while the graduate student will source data for Jamaica. As in the case of the KAP survey, recruitment of a student in the middle of the school year may pose a problem.

Signed:

Anthony Chen

Samuel D. Rawlins

Appendices

CARIBBEAN HEALTH RESEARCH COUNCIL
49th ANNUAL SCIENTIFIC MEETING
APRIL 22 - 24, 2004, GRENADA

ABSTRACT FORM

Dengue Epidemics-its association with Precipitation and Temperature, and its Seasonality in some Caribbean Countries

AMD Amarakoon, AA Chen, SC Rawlins, MA Taylor
CSGM, Department of Physics, The University of the West Indies, Kingston, Jamaica and TheUniversity of the West Indies,St.Augustine, Trinidad

Objective: To study the association of dengue epidemics with precipitation and temperature and its seasonality in Trinidad and Tobago, and Barbados.
Design and Methods: The variability in the reported cases of dengue was studied along with the variability in precipitation and temperature. The data covered the period 1980 to 2000. Association of the epidemic with precipitation and temperature, and the seasonality of the epidemic were identified.
Results: The incidences of dengue in Trinidad and Tobago, and Barbados were higher in the last decade compared to that in the previous decade. The annual patterns of reported cases were nearly periodic and compared closely with the periodicity of ENSO events. The variability in the precipitation and temperature revealed that there was a tendency toward less abundant rainfall and higher temperatures in the last decade compared to the previous decade. Monthly/four weekly variability of the reported cases indicated a well defined seasonality in the epidemics.
Conclusions: Warmer temperatures and less abundance in rainfall appear to influence the epidemics. The epidemic patterns indicate a well defined seasonality. With improved predictability of ENSO events, temperature and precipitation, the observed seasonality could be a useful tool in the design of early warning systems for the prevention and control of dengue epidemics in our communities.

ABSTRACT

Climate Change and Health in Small Island States:
Issue of Climate Change/Variability affecting the Occurrence of Dengue Fever and its Vector, Aedes aegypti on St Vincent and the Grenadines: a Retrospective Study for the Period 1992 – 2002.

SC Rawlins, A Chen, M Ivey, D Amarakoon, K Polson & S Toney
The University of the West Indies (UWI), St Augustine, Trinidad; UWI, Mona, Jamaica; The Caribbean Epidemiology Centre, Port of Spain, Trinidad; The Ministry of Health, Kingstown, St Vincent and the Grenadines.

Objective: To determine from disease, vector breteau indices and climate retrospective data (1992 – 2002), any detectable association of dengue fever occurrence and varying climate conditions on St Vincent and the Grenadines, which may be characteristic of small island states.
Design and Methods: For the 345 sq km island group of St Vincent and the Grenadines (SVG), with 112,000 inhabitants, an analysis was made of the occurrence of reported dengue fever (DF), national vector breteau indices, actual climate events (rainfall and temperature) for designated (predicted) warm and dry (El Nino, EN), cool (La Nina, LN) and neutral (N) El Nino Southern Oscillation (ENSO) years. Non-parametric Kruskal-Wallis tests were used to examine for differences between ENSO events and Neutral (N) periods for the Caribbean region and SVG. Spearman's Rank coefficient was used to determine correlations between ENSO events and dengue fever (DF) cases and breteau indices (BIs) and DF cases. The level of statistical significance was set at $p<0.05$, and the data analysed using SPSS for Windows version 9.0.
Results: During 1992 – 2002 there were four years of DF epidemics – 1995, 1998 (EN+1), 1996 (N) and 2002 (EN). For the various ENSO years of 1992 – 2002, the order of total DF cases was: - EN+1 (575)>N(197)>EN(171)>LN(13); the order of the occurrence of cases/yr was similar:- EN+1 (287.5)> N (98.5)> EN (34.2) > LN (6.5). There was no statistical significant difference ($p<0.81$). Similarly, there was no association of BIs with case numbers or with ENSO events ($p<0.13$); the lowest annual number of DF cases occurred in the years with highest BIs. When the actual rainfall (RF) and temperature features of the 1980 – 2002 were compared with the predicted ENSO characteristics, EN and EN+1 designated years prove to be dryer than the Neutral base year, while the LN and N years proved to be generally wetter periods. Seasonal variation of DF cases of 1995, an EN+1 year, proved similar to other CMC data with 80% of the cases occurring in the last wetter quarter of the year ($p< 0.05$). In the other epidemic years there was no apparent seasonal correlation of DF cases.
Conclusion. These retrospective data are of limited value in that they show that the warmer EN and EN+1 years are associated with a greater risk of DF transmission. However, during the cooler, wetter La Nina and neutral periods, conditions are also appropriate for DF transmission, but less so than at EN and EN+1 times. This information could be useful to encourage adaptation by our communities to prevent DF transmission at these designated times. The retrospective BIs did not seem to correlate with ENSO periods or with DF cases, since at all times, they were high enough to permit disease transmission. Similarly, ambient temperatures only varied from 26.1 – 27.8 C, and there were no correlation of temperature with DF cases. Non-climate confounding features of DF virus in circulation, varying sensitivity of the human population and success in vector production mitigation, may still be having some effect on DF transmission as well.

ABSTRACT.

The Impact of Climate Change/Variability Events on the Occurrence of Dengue Fever in parts of the Caribb
Retrospective Study for the Period 1980 – 2002.

S.C. Rawlins, A. Chen, M. Ivey, D. Amarakoon, K. Polson
The Universityof the West Indies (UWI) St Augustine, Trinidad;The UWI, Mona, Jamaica;The Caribbean Epidemiology Centre, Port of Spain, Trinidad.

Objectives: A retrospective review of dengue fever (DF) cases (1980 – 2002) of CAREC Member Countries (CMCs) was done in relation to El Nino Southern Oscillation (ENSO) event show any association of designated (predicted) climate patterns and DF cases in CMCs. An attempt was also to demonstrate any seasonal influence of climate impacting on DF in 3 countries – Barbados (high), Jamaica (medium) and St Kitts/Nevis (low) - with varying history of the disease.

D**esign and Methods:** Retrospective data on DF cases (1980 – 2002) in all CMCs were studied in relation predicted climate ENSO conditions - warm (El Nino, EN), the second year of the EN (EN+1), cold (La Nina neutral (N). Non-parametric Kruskal-Wallis tests were used to examine for differences in the occurrence of cases during the ENSO events and neutral periods; Spearman's Rank coefficient was used to determine correlations between ENSO events and DF cases. In addition, the impact of seasonal/climate variation on DF with respect to rainfall/ temperature in the 3 CMCs with different histories of DF occurrence – Barbados(high Jamaica (medium) and St Kitts/Nevis (low) – in recent epidemic years. The patterns of the onset of DF in rel to rainfall were summarized.

Results: The pattern of DF in 1980 – 2002 suggested a varying relationship with ENSO events when viewed two and a part of decadal periods. In 1980 – 1999, EN events coincided with peaks in DF in 1982, 1986. In 1999, EN related DF was again dominant (1992, 1993, 1994, 1997), but EN+1 epidemics in 1995 and 1998 occurred. Since 2000, there have been DF epidemics in N, LN and EN years. There were significantly more in 1990-2002 ($p<0.001$) than in the previous decade; there was no significant difference, between cases in EN periods and those in neutral times ($p=0.935$). Overall, the occurrence of total cases for the 1980 – 2002 were order:- EN (21, 218)> EN+1 (12, 481)> N (9,418) > LN (8920). But cases / year changed the order to: - E (4,160)> N (2,355) > EN (2,122) > LN (1,487). There were differences in DF epidemics in 1990 – 2002 in t three countries. In Barbados (270,000) there were 9 epidemics> Jamaica (2.5m) 2 > St Kitts/Nevis (40,410) 13 years. In Barbados and Jamaica, EN+1 years experienced most cases, while in St Kitts/Nevis, the single epidemic occurred in an ENSO neutral year.

Seasonal variation (rainfall) of cases in the epidemic years showed a significant correlation ($p< 0.05$) with case loads (%) occurring in the high rainfall period of the last quarter of the year: Barbados (98.3%)> Jamai (89.8%) > St Kitts/Nevis (85.4%).

Conclusions: There were greater occurrence of DF cases in the warm dryer predicted (EN) period, but there was no evidence of the impact of temperature increases. Rather the impact of water storage in non-mosquito secure habitats in dryer periods may explain the EN and EN+1 related cases. It appears that all ENSO and neutral seasons are appropriate for DF transmission though EN and EN+1 seem more appropriate. Also in wetter parts of the year (wet season), the countries are of greater risk to DF transmission. It therefore seems appropriate for targeting planning vector mitigation programs at this time of year to reduce mosquito production and DF transmission.