Understanding the relationships between climate variability and the Human Health.

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Abstract:
The objective of this conference describes the possible climate change impacts on human health in Cuba, as part of the assessment developed under the auspices of the First National Communication. Ortiz's methodology is applied for seven very significant diseases: acute respiratory infections (ARIs), acute diarrhoeal disease (ADDs), viral hepatitis (VH), varicella (V), meningococcal disease (MD) and malaria borne Plasmodium falciparum and Plasmodium vivax. It is shown that all diseases are sensitive to variations and climate change. A progressive increase or decreases in the case number more frequent epidemic outbreaks, the displacement of disease seasonal patterns are the principal responses observed. The researches demonstrate that the climate impact on the human health are multiple and complex for any region and disease, including the costs of the impacts and its reduction by the application of adaptation measures. Have been identified that the incidence of climate variability on health is stronger than climate change. Finally, bioclimatological warning systems among other measure are proposes for the adaptation. This system uses the signs of anomalies of the following variables: maximum and minimum temperatures, atmospheric pressure, relative humidity, water vapor pressures, rainfall, ENOS influence, and other climatic variables are integrating in one index.

Bioclimatological monitoring system is used in the climate surveillance and disease forecast. This measure, as well as the implementation of the control programs for diseases sensitive to climate, is successfully applied. These measures contribute to enhancing the preparedness and improve the human health in broader sense, with or without climate change.

Key Words: Climate change and variability. Impact on human health. Adaptations Bioclimatological monitoring system.

Presentación en forma Oral.

INTRODUCTION.

The relationship between climate and human health have been much attention, however theses studies not included in general the effects and relationships between climate and diseases vector ecological, social and epidemiological the form integrate.

Predictive models use for health impacts of climate change has been limited. However the models of physical systems and physiologic are well established. So many aspects of the human systems are not amenable readily to modelling.

Other problem in these studies is taking the climate as a synthesis of the conditions, reduced the study of the precipitation and temperature, e.g. however, rainfall effects on overall diarrhoea are non-linear, and can not easily be extrapolated to other regions. Today, it is a non-solve problem, because approach of lineal association between two variables, e.g. correlation between the precipitation or index SOI with number of case one diseases.

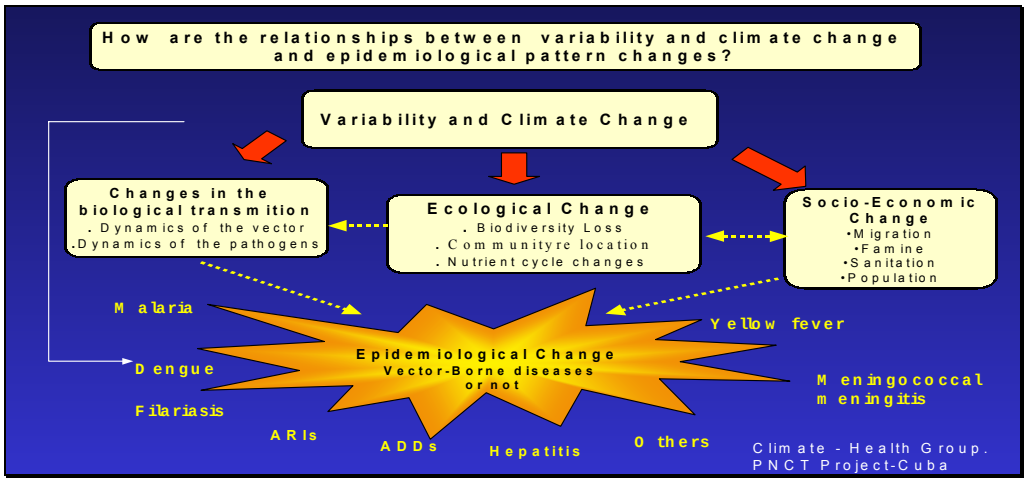


Figure 1. **Methodological approach for the study between climate and health**

The climate processes interact with human activities and the resources on which those activities depend. Then climate problems have been generated not only changes in rainfall, temperature, pressure or wind, but also by change in human activities. The increment of the climate variations can also generate ecological and socio-economic changes and it can increases or decreases the incubation period and transmission of the pathogen organisms. They are extremely sensitive to climatic fluctuations.

We have developed a new approach, which consider complex indexes to simulate and to explain the combinative actions of the processes and climate.

This index describes the climate anomalies, in different scales for example: Inter-annual, seasonal, and Inter-Seasonal variability.

Therefore for, the proposed indexes should describe the climatic anomalies. e.g, an effect of inter-annual climate variability is a prolonged drought, that affects the ecosystem dynamics.

Used variables for the formulate index according to methodology propose

Data set processing according to the methodology.

Global date:
Three variables were included for each month: Multivariate ENSO Index (MEI), Quasi-Biennial Oscillation (QBO), and North Atlantic Oscillation (NAO), values available since 1950 from Climate Diagnostic Center (CDC). These indices were considered as an expression of the forcing of the interannual and decadal variability's in the studies region.

Climate date:
Base meteorological data was obtained from the Climate Centre of Meteorological Institute, Cuba, available for 51 stations in all country. This base include monthly series of maximum and minimum temperature (XT, NT) in ^{0}C, precipitation (PP) in mm, atmospheric pressure (AP) in hPa, vapor pressure (VP)in mm of Hg, relative humidity (RH) in %, thermal oscillation (TO), day with precipitation (DP), solar radiation (SL) in MJ/m^{2,} and insolation (I)in HL, for the period 1961-1990 that constitute baseline climate, and 1991 to 2003 was used for the evaluated to conditional actuality.

Epidemiological date:
Epidemiological date was obtained from the department of statistical the Minister the health of Cuba. These base include the indicator of the cases number of acute respiratory infections (ARIs), acute diarrhoeal disease (ADDs), viral hepatitis (VH), varicella (V), meningococcal disease (MD) and malaria borne Plasmodium falciparum and Plasmodium vivax.

Ecological date:
Ecological database includes the following indicators: Larval density (LD) and biting density hour (BDH), and the number of positive houses as entomological indicative.

Socio-economic date:
Used variables such as % without potable water residences (PHD); % with soil floors (PHF); illiteracy rate (IR); monthly births (MB); and index of monthly infestation (IMI).

As result were obtained four indexes that describes the climate with trend and variations, e.g. some indexes interpretation:

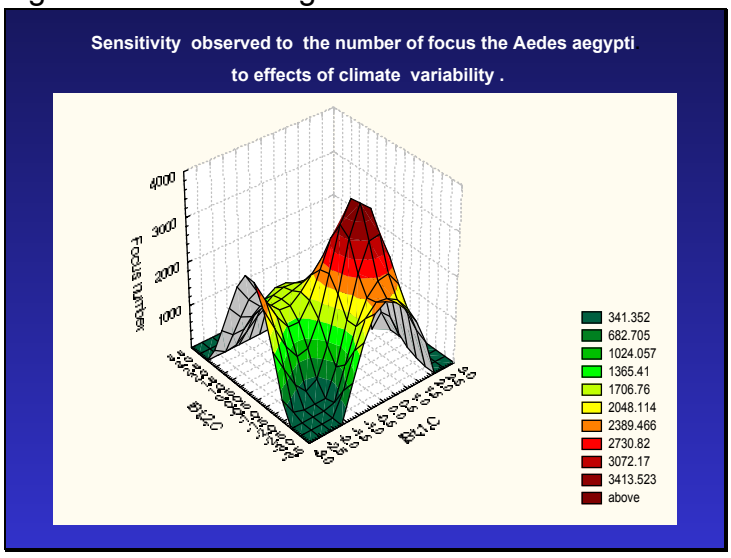
- The $IB_{t,1,p}$ describes inter month, seasonal and inter-seasonal variation for country. The data includes variables such as: maximum, mean, and minimum temperatures, precipitation, atmospheric pressure, vapour pressure, and relative humidity.
- The $IB_{t,3,p}$ describes the inter-annual and decade scale variation and uses the same climate variables as $IB_{t,1,p}$
- The $IB_{t,4,p}$ describes the variations about behavior of a group of socioeconomic indicators and their relationship**.** Therefore in the special case or individual of the economic index we interpret it as the factor of life quality and state of poverty the population's in the study region that they influence in the infestation risk or epidemic outbreak.

These proposed indexes have been used successfully in the studies of climate-health carried out in Cuba another countries of the tropical area. These indexes take those appropriately the variations of the climate in the different regions of the tropic. As well as the existent socio-economic conditions trend and variations, that influence join in the dynamics, abundance, geography distribution, and transmission the vector as well as in those diseases vector borne or not.

Influence the climate variability in the health

Theses indexes give the regionalization possibility the country according to the climatic variations, also characterize, the variations north anomalies to south, and to be able to build the maps of climatic risks and the according to take values the range of exposition is determinate the period of high risk for the diseases.

Figure 2. Period of high risk with the values of the indexes



Economic impact due to variability and climate change.

The economic impact in the evaluation is another aspect to consider. It is very important to quantify the economic effects of the increase of the disease cases.

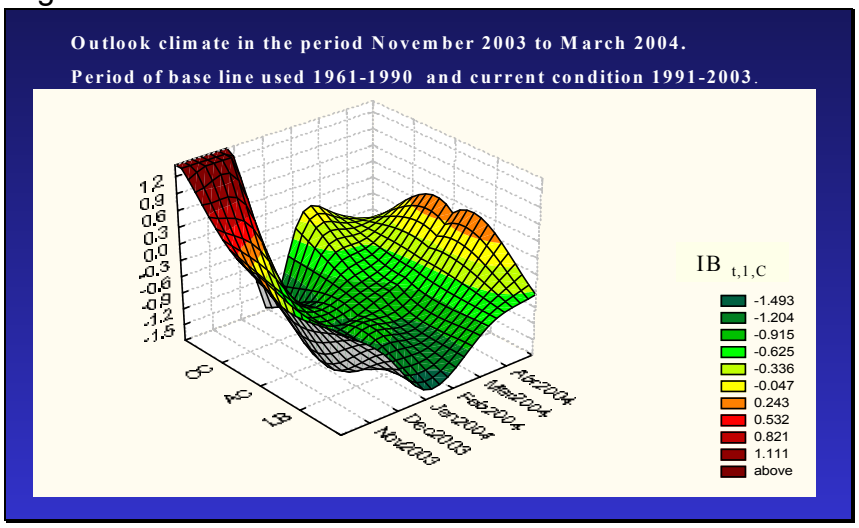
Table No.1. Economic effects attributable to the variability climate.

Diseases	Cost of attention	Cost of hospitalization	Restricted activity day	Treatment cost	Cost of service of urgency	Total Cost
HV	8 874.06	8 657.10	917 50.00	5 505.00	1 236.79	116 022.95
ADDs	373 073.6	175 067.95	547 059.20	76 064.60	36 463.4	1 207 728.75
Dengue Fiver	-	-	-	3 745 605.66		3 745 605.66
Meningitis by Neumococo*	-	231 318.00	-	-		231 318.00
Total Cost						5 300 675.36

* All cases of admission in hospitals.

The used the predictions model for the anticipatory adaptation.
Importance result of forecasting as anticipatory (or proactive) adaptation measure in the human health, as experimentation and analysis tool, for understanding, warning system and support tool for decision makers.
Then, It is important to note that is possible the forecasting of diseases from climate variability, e.g. for some diseases, changes in variability associated with climate change may be it is more important that changes in mean climate.

Figure 3. Outlook Climate for the next month.



The following impacts are prevented: The reduction of the cases number in winter, of bronchial asthma, more frequent epidemic outbreaks change of its seasonal distribution in case the ARIs, displaced epidemic outbreaks and increasing trend in winter in case the ADDs, more frequent epidemic outbreaks the VHs, displacing epidemic outbreaks the VAR, more frequent risk epidemic the MD and increased level infestation by Aedes aegypti.

Adaptation option for Island of Cuba according to impact.
To continue program of environmental education, to maintain the environmental reparation, improvement of the systems, of supply of water, to continue perfecting the epidemic systems of surveillance, (With the bioclimatic warning systems), developments, infrastructure specifically designed to reduce impact to climate variability, (programs of primary attention, organization community and civil defence), to continue strengthening the vaccination programs, in combined collaboration and investigation developments that help to the understanding of the problem climate variability and human health.

Conclusion.

The reached results corroborate that climate prediction can be used to prepare for the climate variability and extremes events. These results has been help a decision makers, this contribute to the estimate costs, to the planning in health and to perfect the systems of surveillance in health. Also it show one example of working interdisciplinary that possibility the interchange the information and methodological. experience between other sectors.