AR/04

CHOLTIC

Cholera outbreaks at Lake Tanganyika induced by climate change ?

DURATION OF THE PROJECT
15/12/2010 – 31/03/2015

BUDGET
797.413 €

KEYWORDS
Cholera, epidemiology, bacteriology, limnology, climate change, phytoplankton, zooplankton, numerical simulation, Lake Tanganyika, Africa.

CONTEXT

Cholera is one of the deadliest diseases in Africa. Cholera outbreaks reappeared in the area of the African Rift in the late 70's when strong signals of climate changes were noted. It is suspected that climate change has triggered cholera epidemics through a change of lake condition, biodiversity host organisms. The African Rift is pointed as an area of propagation-source of Cholera (Bompangue et al., 2008a). A link between cholera, phytoplankton blooms and copepods zooplankton was demonstrated in Asia. Great lakes such as Lake Tanganyika are suspected of playing a role as a reservoir of the cholera bacteria while human infection and movement propagate the disease inland.

PROJECT DESCRIPTION

This interdisciplinary project investigates the environmental factors favouring the reservoir-hosts as well as the outbreak and the spatial propagation of Vibrio cholerae for the first time in a freshwater environment. The possible links with climate change and global indices could help in designing early warning methods applicable to cholera outbreaks, a crucial health issue in Africa and for worldwide information.

Objectives

CHOLTIC aims to clarify the environmental factors favouring the emergence of cholera outbreaks and its persistence at Lake Tanganyika.

Methodology

(1) In situ monitoring: An integrated 3 years simultaneous field monitoring of meteorology, limnology, phytoplankton, zooplankton, fish abundances, fishermen and traders movements is necessary. Epidemiological statistics of cholera cases and fatalities added to a bacteriological monitoring (human, lake water and plankton) will be implemented.

(2) Remote sensing. Previous CLIMLAKE and CLIMFISH projects showed that remote sensing is an efficient tool to get spatial and synoptic limnologic information at Lake Tanganyika. We will produce time series of daily images of chlorophyll a (phytoplankton and indirectly zooplankton proxy), K490 (light attenuation coefficient) from MODIS-TERRA and AQUA and SST (lake surface temperature) from AVHRR satellites using validated procedures for the period 2000-2014. Medium resolution satellite images will allow the environmental study of cholera epidemics.

(3) Eco-hydrological modelling will investigate links between climate, upwelling of nutrient rich water and occurrence of plankton blooms at time of cholera outbreaks.

(4) Microbiology: microbiological confirmation will be performed in laboratories of INRB at Kinshasa.
(5) Genetic: characterisation and identification of cholera strains' genotypes and mass spectra phenotypes will be carried out at AP-HM (Marseille). This will be helpful to understand the pathways of cholera outbreaks.

(6) Data analysis: the spatio-temporal relationships between environmental factors and health data will be explored by multivariate statistics integrating spatial and time series analysis results. A geographical information system will contribute to the integration of interdisciplinary data. Correlation between climate, oceanic, limnologic and epidemiologic data will be investigated as they may contribute to early warning of cholera outbreaks.

(7) Epidemiological modelling: A feasibility study will be conducted, so as to determine whether elementary epidemiological models can be of use for representing past cholera outbreaks and, possibly, predict future ones.

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INTERACTION BETWEEN THE DIFFERENT PARTNERS

RMCA will develop a field environmental monitoring (limnology, fisheries, climate) in collaboration with research institutions in DR Congo and Zambia. This will be done in collaboration with ITM that will implement the field bacteriological survey and with NBGB that will take care of the phytoplankton investigation. The genetics of cholera strains will be analysed by our partner at AP-HM (Marseille). The phytoplankton component in the lake water will be compared and extended to the data provided by satellite images analysed by ULG while UCL will use field data to improve a model linking hydrodynamic and ecological information. An epidemiological survey in collaboration with DR Congo partners will be parallel to the environmental survey. Time series of cases and death cases by cholera will be used to analyse statistical relationships with environmental variables and population displacements in the region

EXPECTED RESULTS AND/OR PRODUCTS

- Interdisciplinary analyses concerning cholera outbreaks in relation with climatic and lake conditions.
- Recommendations for preventing decreasing cholera outbreaks and its propagation.
- Evaluation of possible methods to predict cholera outbreaks (early warning) according to different climate indicators and other potential environmental predictors.
- Databases (limnology, plankton, fisheries, epidemiology, bacterial identification, genetic).
- Eco-hydrological and preliminary epidemiological models
- Scientific publications

PARTNERS

RMCA - Royal Museum for Central Africa : Physico-chemistry of water, fish and fishermen survey, climate

ULG - Université de Liège: Remote sensing of surface planktonic dynamics

NBGB - National Botanical Garden of Belgium: Phytoplankton changes in abundance, identification of dominant taxa

ITM - Institute of Tropical Medicine: Capacity building and bacteriological monitoring and identification

AP - HM - Assistance Publique - Hôpitaux de Marseille: Microbiological genetic

UCL - Université Catholique de Louvain: Eco-hydrodynamic model and epidemiological model investigation

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Follow-up Committee
For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra

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