SD-BD-03 CLANIMAE *'Climatic and Anthropogenic Impact on African Ecosystems'*

Report on the meeting of the project follow-up committee

Ghent University, Gent, May 14th 2009

Participants:

Project members: Prof. Dr. Dirk Verschuren (UGent), Prof. Dr. Grégory Mahy (FUSAGx), Dr. Pierre-Denis Plisnier (MRAC-Tervuren), Bob Rumes (UGent), Vanessa Gelorini (UGent, secretary), Julie Lebrun (FUSAGx), Harold Hughes (MRAC-Tervuren)

Follow-up committee members: Dr. Sophie Verheyden (BelSPO), Dr. Kees Klein Goldewijk (PBL-NL), Pieter Decruynaere (FRDO-CFDD)

External project partners: Prof. Dr. Donald Gabriëls (UGent), Mary Mugide (UGent)

Excused:

Project members: Prof. Dr. Luc André (MRAC-Tervuren), Dr. Christine Cocquyt (NBG-Meise)

Follow-up committee members: Marc Depoortere (FRDO-CFDD)

Agenda:

9:00-9:30 Welcome and Introduction to the project (Dirk Verschuren, UGent)
9:30-10:00 Physical limnology and water-quality data (Pierre-Denis Plisnier, MRAC)
Coffee break
10:15-11.00 Summary of aquatic and terrestrial biological studies (Dirk Verschuren, UGent)
11:00-11:30 Si isotopes as aquatic productivity tracer (Harold Hughes, MRAC)
Coffee break
11:45-13:00 Feedback from follow-up committee on project strategy and focus
Lunch
14:00-16:00 Feedback from follow-up committee on technical issues
Meeting closure and Coffee break
16:15-17:00 Post-meeting discussion among project members

1. Introduction

The CLANIMAE project aims to produce the urgently needed long-term perspective to today's climate-environment-human interactions in tropical East Africa, by coupling high-resolution reconstructions of past vegetation and water-quality changes to existing and new information on decadal to century-scale climate variability, preserved in lake-sediment records covering the climatic gradient from (sub)-humid western Uganda to semi-arid eastern Kenya. This will allow the CLANIMAE researchers to 1) separate the influences of natural climate variability and human activity on East African terrestrial ecosystems, 2) determine the exact timing and relative magnitude of indigenous (pre-20th century) anthropogenic land clearance compared to recent landscape alteration, 3) determine the severity of lake water-quality losses due to siltation and excess nutrient input directly linked to deforestation and agriculture, compared to those associated with natural long-term hydrological change, and 4) assess the resilience of African ecosystems, and the prospects for restoration of disturbed ecosystems if human pressure were to be reduced or mitigated.

The follow-up committee meeting was convened to report on the progress of project activities towards its main objectives, with special attention to targets and deliverables related to the Belgian Federal Science Policy programme on 'Science and Sustainable Development'. The one-day meeting at Ghent University included summary presentations on project interim results (as presented in the interim report produced in July 2008, plus recent results), followed by discussion of the data themselves and of the success of general project strategy to deliver research data useful to various categories of potential local and governmental stakeholders. This document briefly summarizes the discussions and presents the comments and recommendations by the follow-up committee.

2. Transcript of selected discussion topics

Question Sophie Verheyden: Is this paleoecological method to separate human impact from natural change method applicable to other regions?

Response Dirk Verschuren: In principle yes, but for example in northwestern Europe human impact since 6000 BP may have been relatively strong while temperature and moisture-balance changes were relatively modest; in the (drier) tropics climate at the relevant time scales has been highly dynamic, thus exerts a clearer signature. Successful application to other tropical regions depends on the local availability of continuous lake-sediment records (and/or other paleoenvironmental archives) preserved through time.

Question Donald Jacobs: Are local rainfall data available at the micro-scale (for individual basins) ? If so we can predict erosion patterns based on rainfall patterns over several years.

Response Pierre-Denis Plisnier: Mostly not; there are only a handful of meteo stations in the region, and we placed temperature loggers near several lakes but no rainfall gauges.

Comment Pieter Decruynaere: You need to find a way to communicate your results to local communities, so that they can make correct policy decisions. Also you have to show that at a certain speed or magnitude of ecosystem change no return to normal ecological functioning is possible. You have to raise awareness. Furthermore, you have to link the CLANIMAE sustainable-development goals with the potential of local ecosystem services (hot topic on international level; biodiversity is a very important issue this year). You have to help local communities to defend themselves against, and to find solutions for, environmental problems.

Question Pierre-Denis Plisnier: Do you mean we need to produce a list of scenarios how people have to work ?

Response Sophie Verheyden: Sustainable-development strategy is important in the sense that you need to communicate your results in scientific papers but also in simplified reports (or an executive summary) for use by the stakeholders. On the other hand, the link with social consequences is not the primary focus of the project. You have already done a lot of work and there is still a lot of work to do; it will be rather ambitious to include this in the ongoing project. What is important is that data already available need to be communicated to the local people. Maybe aided by didactic material, such as a film with CLANIMAE results, and flyers with possible scenarios to solve real environmental problems.

Remark Dirk Verschuren: We will organise a travelling tour of 'town-hall' meetings in Uganda and Kenya in April next year, visiting universities (Nairobi, Kampala, Mbarara), government research institutes (KWS, NAFIRRI, NARO), and local communities near the lakes.

Remark Kees Klein Goldewijk: Maybe you can make use of land-cover modelling to produce vegetation maps for select time slices in the past ?

Response Dirk Verschuren: To do this properly, we would first need to determine the relationship between modern-day pollen spectra (in lake surface sediments) and present-day biome distribution across the landscape, which would in turn allow translating specific changes in fossil pollen spectra into past shifts of vegetation ecotones across the landscape. This is not currently in the CLANIMAE work programme, but realizing its value we are trying to obtain additional funding in order to sponsor an African palynologist to do this work.

Remark Kees Klein Goldewijk: In South America, Richard Navel is working on such a modern calibration of paleoecological data, maybe he can help to translate your data.

Question Sophie Verheyden: Are there significant other data still missing ?

Answer Dirk Verschuren: Additional field data from the wet season would be useful to better constrain seasonal variability in lake behaviour; these are planned to be collected in April 2010. Besides this there is still significant work to do in extracting biological data from lake surface-sediment samples and cores, but we are on track to complete this work on schedule.

Remark Pieter Decruynaere: Maybe you can contact Luc Hens (VUB) and Jean Bugier, who have been developing a toolkit for ecological assessment, to help you make the first steps towards environmental management.

Remark Sophie Verheyden: What about the link with archaeology in the project?

Response Dirk Verschuren: We discuss with archaeologists through the EAQUA (East African Quaternary Association) community of regional archaeologists and paleoecologists, but they are not directly involved in the project at this time.

3. Summary of discussion and feedback

One of the most intriguing research challenges in our understanding of past environmental change in tropical East Africa is to clearly distinguish climate-driven environmental changes from anthropogenic vegetation disturbances. CLANIMAE project will definitely contribute to this research question by compiling already available and new proxy data of 8 study lakes, situated along a climate gradient from sub-humid Uganda (L. Kanyamukali, L. Katinda, L. Chibwera, L. Kacuba, L. Wandakara) to semi-arid Kenya (L. Bogoria, L. Simbi) and Tanzania (L. Duluti). Reconstruction of past terrestrial vegetation dynamics is based on analyses of fossil plant pollen and phytoliths, plus the fossil spores of fungi living on the excrements of large domestic animals, as indicators of lake use by pastoralists. The evolution of water quality through time is reconstructed using paleoecological analyses of aquatic insects, fossil diatoms and aquatic macrophytes, following calibration of the species distribution against lake trophic status and turbidity in the modern-day regional lake gradient.

Physical and chemical data from the Uganda study lakes relate water quality (lake trophic status) to basin morphometry and mixing processes. Our first results indicate that anthropogenic impact on water quality is mainly observed in the shallower lakes, since these lakes mix more often to the bottom and thus regenerate more nutrients to the surface waters to sustain phytoplankton blooms. The available chemo-physical data also support the hypothesis that most Uganda crater lakes mix entirely at least occasionally, however the deeper lakes with a frequency of perhaps once every 10 to 20 years.

The first comprehensive results of silicon-isotope studies indicate a strong dependence of the silicon-isotope composition of deepwater dissolved silica in the Uganda lakes (averaging the composition of local diatom algae, which after death largely dissolve during descent through the water column) as a temperature proxy across the range of temperatures attained by low- and mid-elevation African lakes. This is a promising result for development of silicon isotopes in diatoms as a proxy for past temperature change.

Overall a very substantial body of research data has been collected during the first phase of the CLANIMAE project, and first results of their analysis look very promising from a scientific point of view. However, the link to sustainable-development strategy will need to be better defined and integrated into the project aims by structuring the results for optimal communication to local communities and stakeholders; and by raising awareness about the severe social-economic and ecological consequences of climate variability and human pressure on East African aquatic and terrestrial ecosystems. When properly informed, local people will realize that beyond a certain threshold of disturbance, ecosystem recovery is much more difficult, hence correct policy decisions have to be made sooner rather than later. CLANIMAE's sustainable-development strategy needs to establish a link with the services provided by ecosystems to local communities to eventually work out procedures for (agro)-ecological restoration, and produce a list of different scenarios with practical solutions for environmental problems. The very first objective in reaching sustainable-development goals, however, is communication to stakeholders at the local scale. Furthermore, by producing a project report specific for stakeholder use, besides the scientific papers, policy makers can be better mobilized for the cause of sustainable ecosystem exploitation and environmental restoration. These first steps towards environmental sustainability may lead to a change of perception and attitudes among local people regarding climatic and human-induced ecological problems, which may motivate them to actively participate in the restoration of disturbed ecosystems. The explicit social dimension of human-ecosystem interactions is not currently a focus of the CLANIMAE project, but may be of interest for future research applications.

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Report on the final meeting of the project follow-up committee

National Botanic Garden, Meise, November 3, 2010

Participants:

Project members: Prof. Dr. Dirk Verschuren (UGent), Dr. Pierre-Denis Plisnier (MRAC-Tervuren), Dr. Christine Cocquyt (NBG-Meise), Vanessa Gelorini (UGent), Els Ryken (UGent, secretary), Julie Lebrun (ULg-Gembloux), Harold Hughes (MRAC-Tervuren)

Follow-up committee members: Dr. Kees Klein Goldewijk (PBL-NL), Jan Mertens (FRDO-CFDD)

Excused:

Project members: Prof. Dr. Luc André (MRAC-Tervuren), Prof. Dr. Grégory Mahy (FUSAGx), Bob Rumes (UGent)

Follow-up committee members: Marc Depoortere (FRDO-CFDD), Peter Wittoeck (FOD VVVL)

Agenda:

9:30-9:45 Welcome and Introduction to the project (D. Verschuren, UGent)
9:45-11:00 Summary of project phase 2 results (D. Verschuren, UGent)
11:00-11:15 Silicon isotopes as temperature/productivity tracer (H. Hughes, MRAC)
Coffee break
11:15-13:00 Feedback from follow-up committee on project strategy and focus
Lunch
14:00-16:00 Post-meeting discussion among project members

1. Meeting objectives in relation to the scope of the project

The CLANIMAE project aims to produce guidelines for sustainable management of land and water resources in tropical East Africa through comparative study of pristine and disturbed ecosystems in the modern landscape and by reconstructing the long-term historical perspective to today's climate-environment-human interactions affecting those ecosystems. This 'the past is the key to the future' approach is developed by coupling paleoecological data of past vegetation and water-quality changes preserved in lake-sediment records to existing and new information on decadal to century-scale climate variability across the climate gradient from (sub-)humid western Uganda to semi-arid eastern Kenya. This methodology allows CLANIMAE to 1) separate the influences of natural climate variability and human activity on East African terrestrial ecosystems, 2) determine the timing and relative magnitude of historical (pre-20th century) ecosystem disturbances by indigenous people compared to recent landscape alteration, 3) determine the severity of lake water-quality losses due to siltation and excess nutrient input directly linked to deforestation and agriculture, compared to those associated with natural long-term hydrological change, and 4) assess the resilience of

African ecosystems, and the prospects for restoration of disturbed ecosystems if human pressure were to be reduced or mitigated.

This third and final follow-up committee meeting was convened to report on the results of project activities during phase 2, with special attention to targets specified in the Belgian Federal Science Policy programme on 'Science and Sustainable Development'. The one-day meeting at the National Botanic Garden of Meise included an introduction to the project for committee members not present at earlier meetings, two presentations summarizing project results. This was followed by discussion of the data themselves and of the success of general project strategy to deliver research data useful to various categories of potential local and governmental stakeholders. This document briefly summarizes these discussions, with a transcript of comments and recommendations made by the follow-up committee.

2. Transcript of selected questions and discussion topics

Kees Klein Goldewijk: Could the survey of crater basin topography and fractional land cover be improved with remote sensing methods?
Response: In principle, yes. Some years before the CLANIMAE project we supervised a UGent MSc thesis in Geography classifying 6 major types of land use around three Uganda crater lakes in the Kanyamukali area, on the basis of ASTER satellite images supported by ground-truthing. This classification can be directly applied to lakes originally situated in the sub-humid woodland savanna region. Expanding this to include all study lakes from the dry savanna to the forest region would multiply the number of land use types to be distinguished, and represent a study in its own right.

Kees Klein Goldewijk: Are oral histories reliable?
Response: Individually their chronology is uncertain, but as a group they contain evidence of widespread climate-related hardship during certain episodes that match our paleo-environmental data.

Kees Klein Goldewijk: Has the exact number of people living within and near each lake basin been determined?
Response: No, demography has not been a focus of this project. We only consider relative population density as reflected in a limited or more intensive disturbance landscape, i.e. fractional land area occupied by anthropogenic land-cover types.

Kees Klein Goldewijk: The timing of exceptionally dry periods in the past are related to similar events in Finland. Has a comparison also been made with other distant regions?
Response: No; the Finland tree-ring based moisture reconstruction is relatively unique, and the reason for agreement with climate variability in Kenya is unclear at present. The explanation must be sought in a long-distance tele-connection involving the North Atlantic Oscillation.

Kees Klein Goldewijk: Why such a great variety of indicators among the reconstructions?
Response: Depending on site-specific processes influencing the recording of climate signals in lake sediments, different indicators will show the clearest signals. Pattern coherence among different independent indicators also enhances trust in the correctness of the reconstruction.

Kees Klein Goldewijk: I recommend that the final report includes a Table with an overview of all indicators used.

Jan Mertens: Recommendations for policy makers have to be more clear and detailed. The report is too scientific to be understood. It contains very useful information that can be used by stakeholders but they have to be simplified/vulgarized. Make a clear link between the scientific report and its relevance for sustainable development of these regions. How can the results be used by local decision makers?

Response: We need to ensure that the summary and policy recommendations of the project are understandable by all stakeholders, including local farmers and village people. We can provide a table classifying lakes according to their appropriate use: fishing, drinking water, recreation, agriculture/horticulture, fish farms, etc. This could be extrapolated to other lakes with a 'decision tree' that can help to decide what uses are possible taking into account the data collected during the project. For example: Is the lake fresh or saline? Is the lake deeper or shallower than 70m? We can also actively promote agroforestry and ecotourism as economically significant land uses with limited adverse impact on ecosystem functions.

Jan Mertens: How could this report be relevant for the Belgian development cooperation (DGCD)? Is the BTC active in this region? If not, could this study be replicated in another region where BTC is present and/or can its results be extrapolated to those other regions? Check the BTC website at www.btcctb.org for projects in Uganda; check the website of PROTOS at www.protos.be for water projects in Uganda; check www.4depijler.be for other Belgian organizations active in Uganda and Kenya who can use the data. Note that all future projects funded by BTC must be 'climate-proof'.

Jan Mertens: Could the results be used in developing adaptation measures? Could this project assist Belgium in deciding where to invest? The final report and associated knowledge transfer activities should lead to more active use of the pertinent information by different stakeholders.

Response: In September 2010 we organized a two-week CLANIMAE knowledge-transfer tour in Kenya and Uganda, with seven scheduled events (Taveta, Nairobi and Naivasha in Kenya; Jinja, Kampala, Kibale and QENP in Uganda) attended by a total of 143 people from diverse government agencies and ministries and a wide range of stakeholder groups; we also did a presentation at Kanyamukali parish for which no attendance list was made. Each event consisted of a formal Powerpoint presentation followed by a Q&A session; in Uganda we also showed a ~20-minute film showing the diversity of crater lake ecosystems, diverse types of human impact on those systems, and an overview of fieldwork methods. Further details will be given in the final report. However, in several venues the Q&A session evolved into lively debates between the stakeholder groups about preferred strategies for sustainable development of local water resources, which we can hope may develop into increased interaction between them and joint planning of their activities.

Jan Mertens: Can you calculate the 'ecosystems services' provided by each lake? Why it is economically interesting to restore/conserve/protect these ecosystems?

Jan Mertens: Can you project what will become of individual lakes in the future, under the dual stress of climate change and human impact?

Response: Allowing for the fact that annual rainfall projections for this region of equatorial Africa 10-20-50 years from now have high uncertainty (including conflicts of sign between individual model outcomes), and that consensus projections are thus based on ensemble model runs, it is possible to provide semi-quantitative estimates of future lake-level change for those lakes of which the 20th-century amplitude is documented. The magnitude of lake-level change will also greatly depend on how land-use evolution affects run-off delivery to the lakes. This must be modeled on a case by case basis, and evidently falls outside the scope of this project. However, by itself the hydrological sensitivity of individual lake basins to natural water-balance fluctuation should suffice to render strong policy recommendations about the need to adopt the precautionary principle to ensure a water-resource buffer against intermittent severe drought. In the case of Lake Naivasha, a previous study by CLANIMAE staff identifying a lake-level threshold below which a clear-water, healthy ecosystem state switches to a turbid state with poor water quality, has been taken up by the regional horticultural industry to set a concrete limit of maximum water extraction. The crater lakes of western Uganda, for their part, have value well beyond their own economic significance as ecological analogs for the contrasting large lakes Victoria and Tanganyika in their pristine, current and possible future state.