"Tales from East Africa"

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Or, the title I suspect you may be thinking:

“Yet Another Professor’s Willy Nilly, Irresponsible Expenditure of Federal Funds in Far-Away Lands”
The Great Lakes of East Africa

- Malawi
- Tanganyika
- Edward
- Albert
- Turkana
- Victoria
- Albert
- Edward
- Tanganyika
- Malawi
IPCC (IV) prediction of climate change during the 21st century
(average of 21 climate models)
“Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by --- low adaptive capacity.”

Intergovernmental Panel on Climate Change, AR4, 2007
Looking for patterns and connections in the global climate system
What role (if any) has climate played in the evolution of our species?
In the Sahara desert ----
Cave paintings from the Sahara
The “Paleoclimatologists”

Ocean drilling

Tree rings

Ice cores
Piston coring

On the ocean

On Lake Victoria
Finding the right place to core with seismic reflection profiling
Lake Tanganyika - 1982
Our second night out on Tanganyika ----
Adrift and out of fuel

A tow into the village of Nyanza Lac, Burundi
More than 4 km of sediment underlie the major rift lakes

Lake Tanganyika
Lake Turkana, Kenya - 1984
Looking at Lake Turkana, Kenya to determine the Nile’s past
Fossil diatoms indicate that an abrupt shift from freshwater to saltwater conditions happened 4300 years ago

The Old Kingdom of Egypt collapsed 4200 years ago
Exciting new developments ------
TEX86 – A proxy for past temperature based on tetraether compounds (GDGTs) from Thaumarchaea

Images courtesy of Johan Weijers
Lake Malawi

- >700m deep
- 4th deepest lake in the world
- ~600km long and average of 55km wide
- Anoxic below 200m
A 25,000 year history of temperature in the African tropics

Recent warming

5000 years ago – a surprisingly warm time in the southern African tropics

Significant cooling during the ACR and YD

The last glacial maximum

Powers et al., 2005
Temperature records from Lake Tanganyika show recent warming, much like the whole world.
Diatom silty clay

Laminated

Non-laminated

Calcareous silty clay - usually bioturbated
A 1.2 million year record of temperature in the Malawi basin
Hominin evolution extends back some 7 million years

We have only begun to recover the record of human evolution!
African Great Lakes in Peril:
Lake Malawi example
Lake Malawi has ~1000 species of fish: the most of any lake in the world.

99% of these species are endemic to the lake.

Ornamental fish trade serves as an important source of foreign exchange.

Fish provide 75% of the animal protein intake for the people of Malawi.
IPCC (IV) prediction of climate change during the 21st century
(average of 21 climate models)
2010 Global Hunger Index: Severity

Source: Global Hunger Index report, 2010
5000 m³ water/ha y required for irrigation. If applied to one million hectares, amounts to 5 km³ water per year.
Lake Malawi level from ~1863 to 2011

Shire outflow

No outflow from 1900 to 1935

Outflow would stop!
Approximately 95% of Malawi’s electricity is derived from four hydroelectric dams on the Shire River, which flows out of Lake Malawi.
Lake Malawi – the next Aral Sea?
Needs at the systems level approach
The Research Team Co-PIs

- **Climate** - Sharon Nicholson, Florida State Univ.; Bette Otto-Bliesner, NCAR
- **Lake Dynamics** - Jay Austin, Stephanie Guildford, Robert Hecky, Thomas Johnson, Joe Werne*, all at Univ. Minnesota Duluth
- **Human Dimension** – Asli Aslan, Tracy Dobson, Anne Ferguson, Craig Harris, Sieg Snapp*, Leo Zulu, all at Michigan State Univ.
- **Ecosystem Services, Economic Tradeoffs** – Stephen Polasky*, Univ. Minnesota Twin Cities

Proposal in Review at NSF ---
Unique complexities of the system:

- Data poor, underfed region of our planet
  - Poverty is prevalent
  - People are particularly vulnerable to the whims of climate
  - Expatriate pressure for agriculture development
Subsurface moorings in Lake Malawi

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