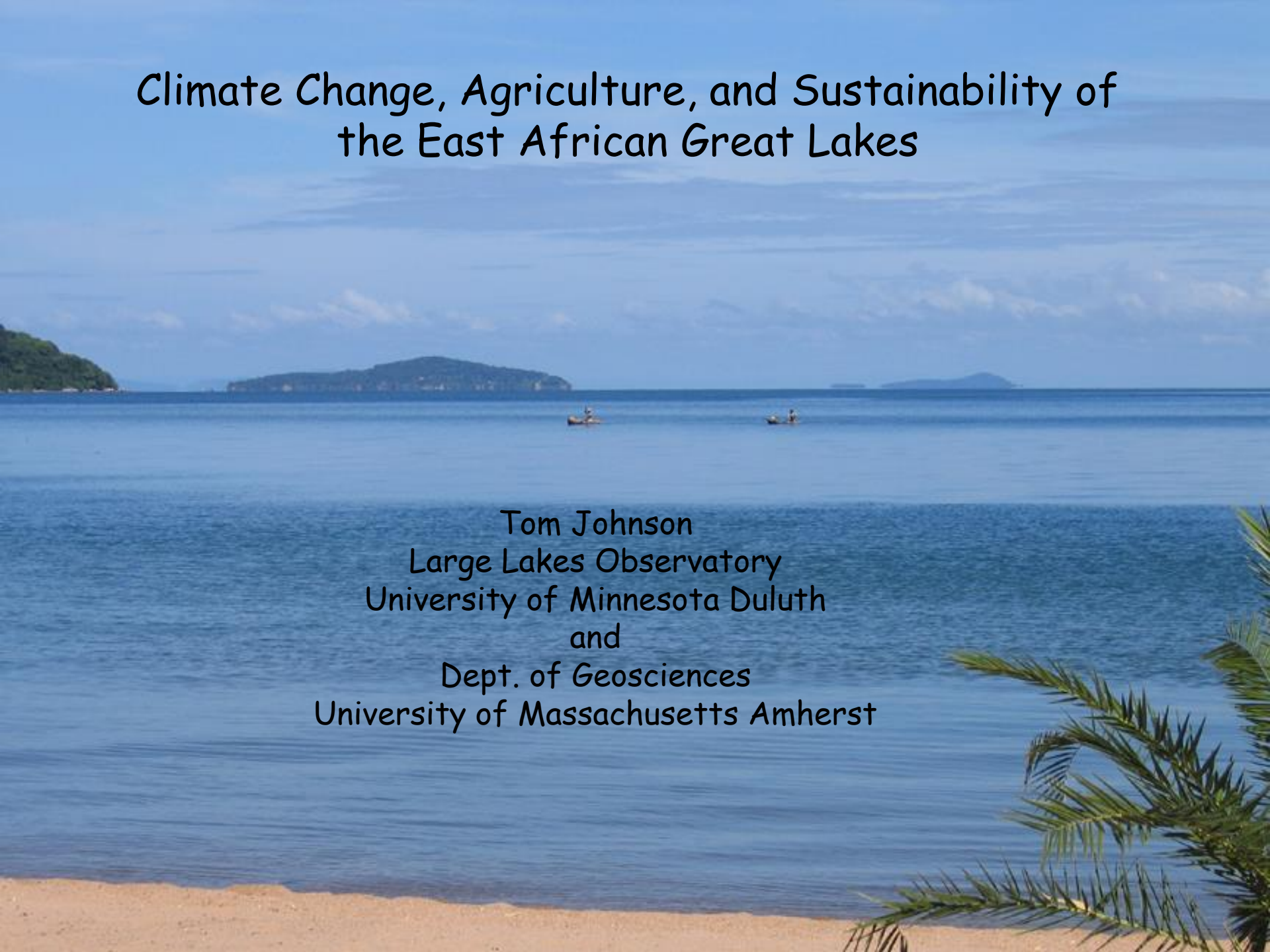
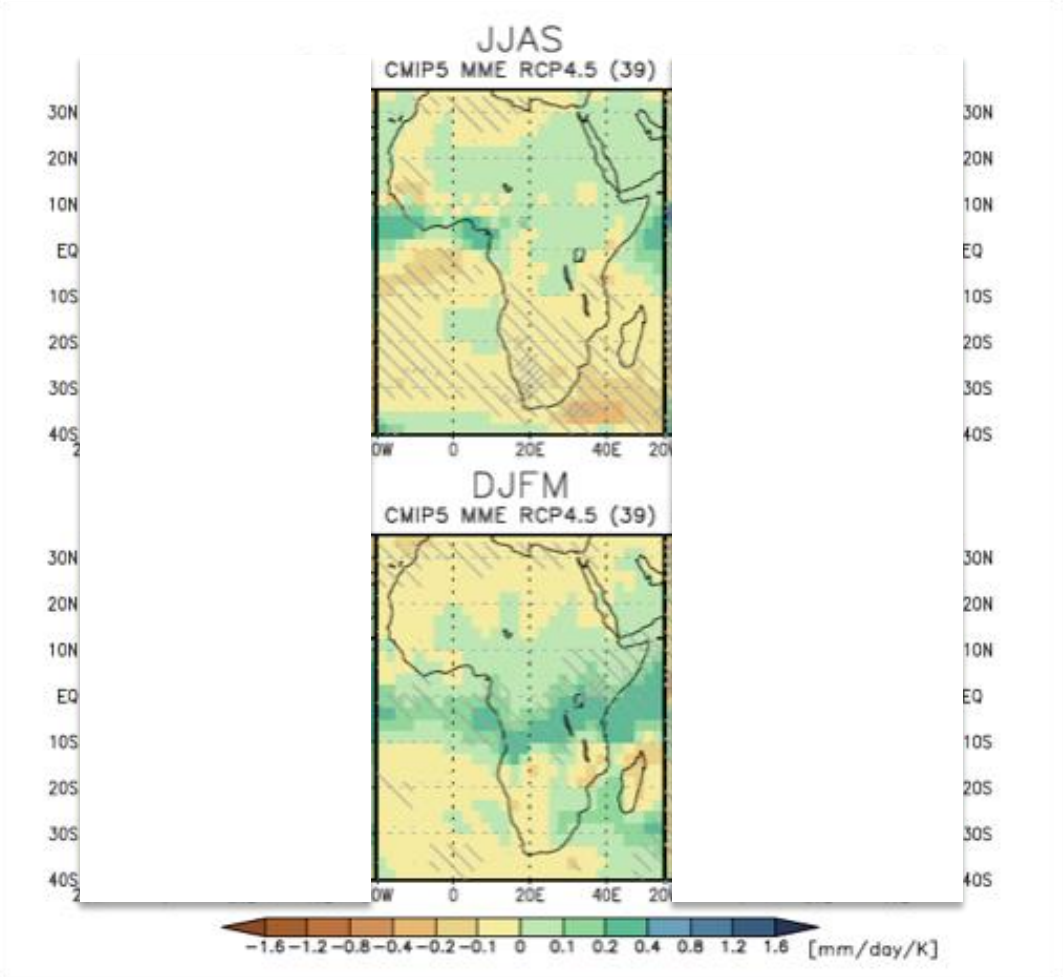
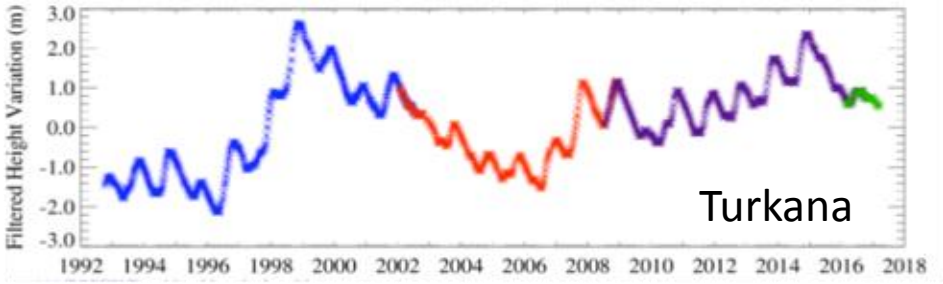
Climate Change, Agriculture, and Sustainability of the East African Great Lakes



Tom Johnson
Large Lakes Observatory
University of Minnesota Duluth
and
Dept. of Geosciences
University of Massachusetts Amherst

IPCC 5 precipitation forecast for 2080-2099 (with modest warming)

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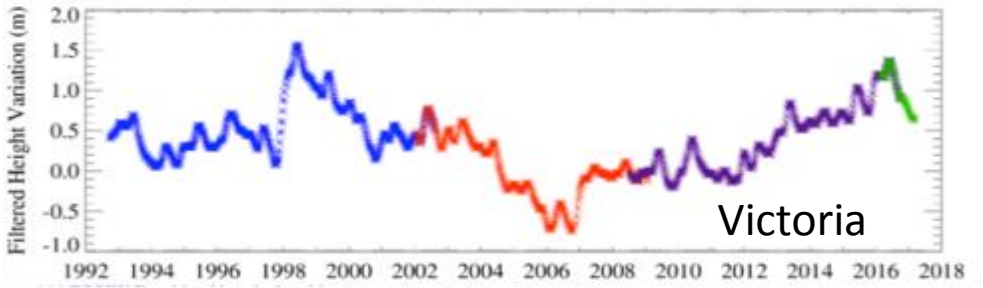
1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Turkana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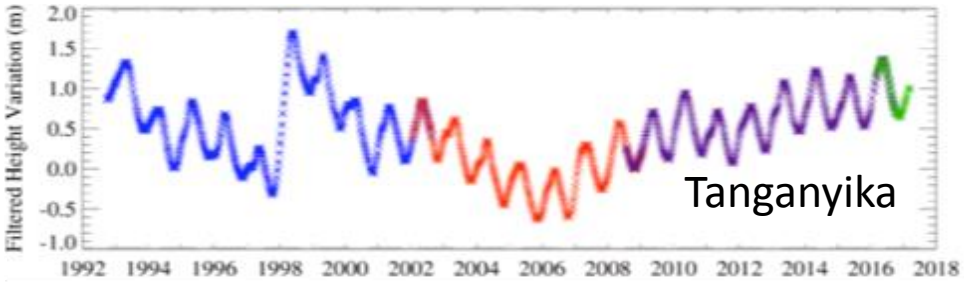
Victoria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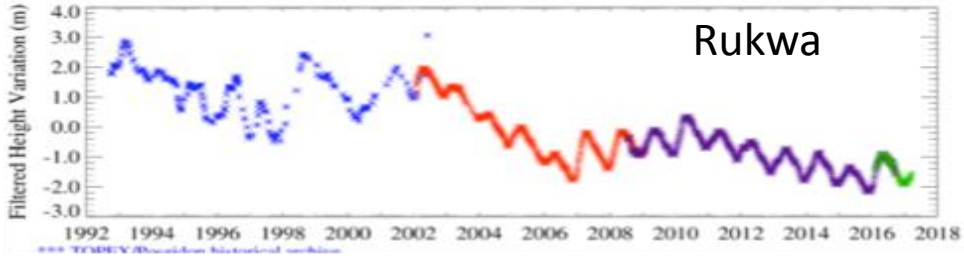
Tanganyika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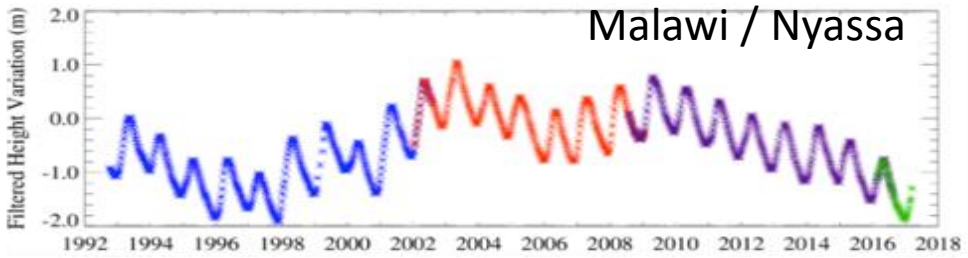
1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Rukwa


Filtered Height Variation (m)
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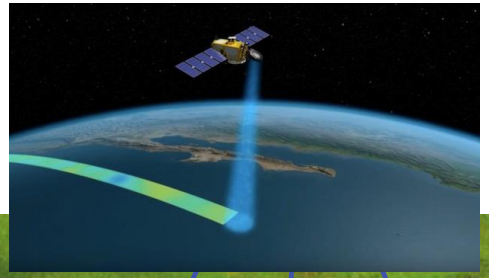
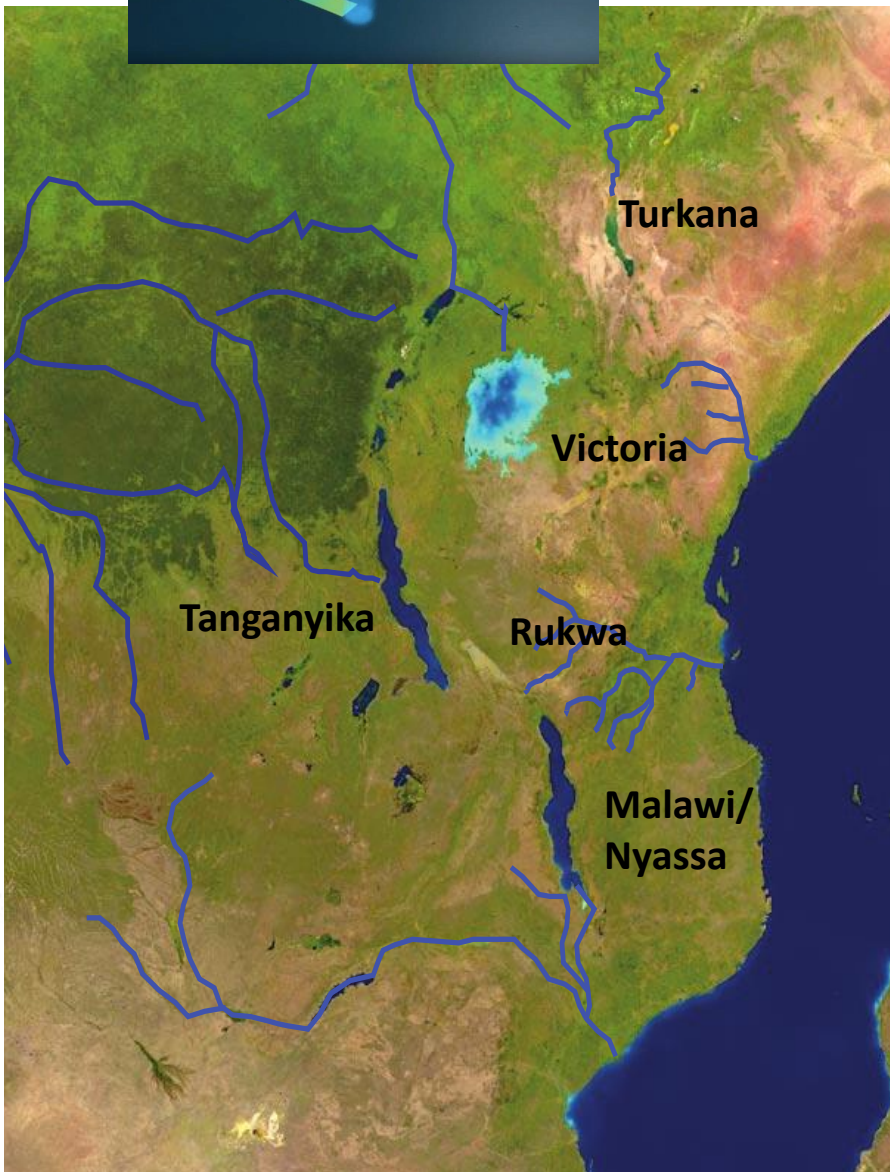
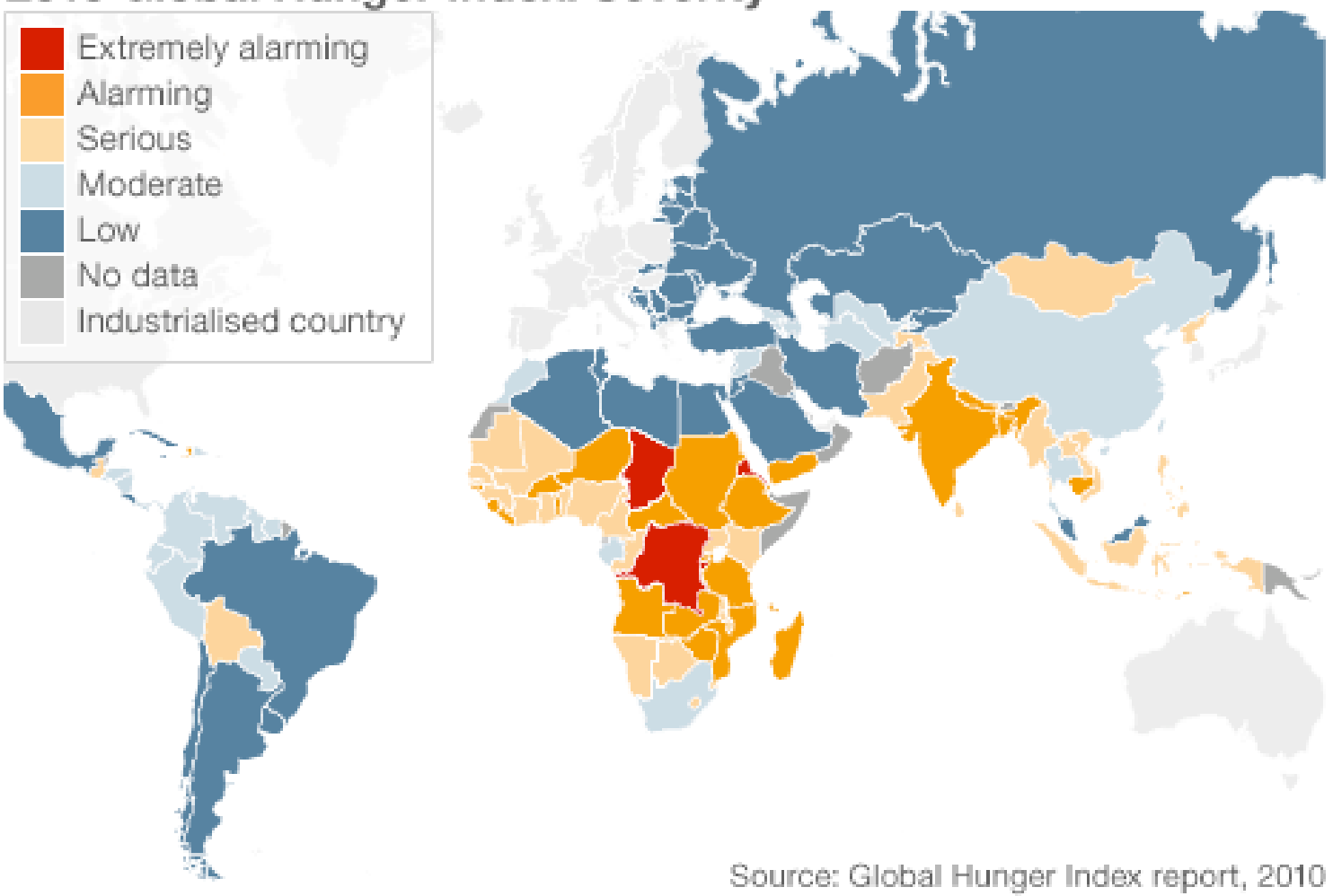
1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Malawi / Nyassa



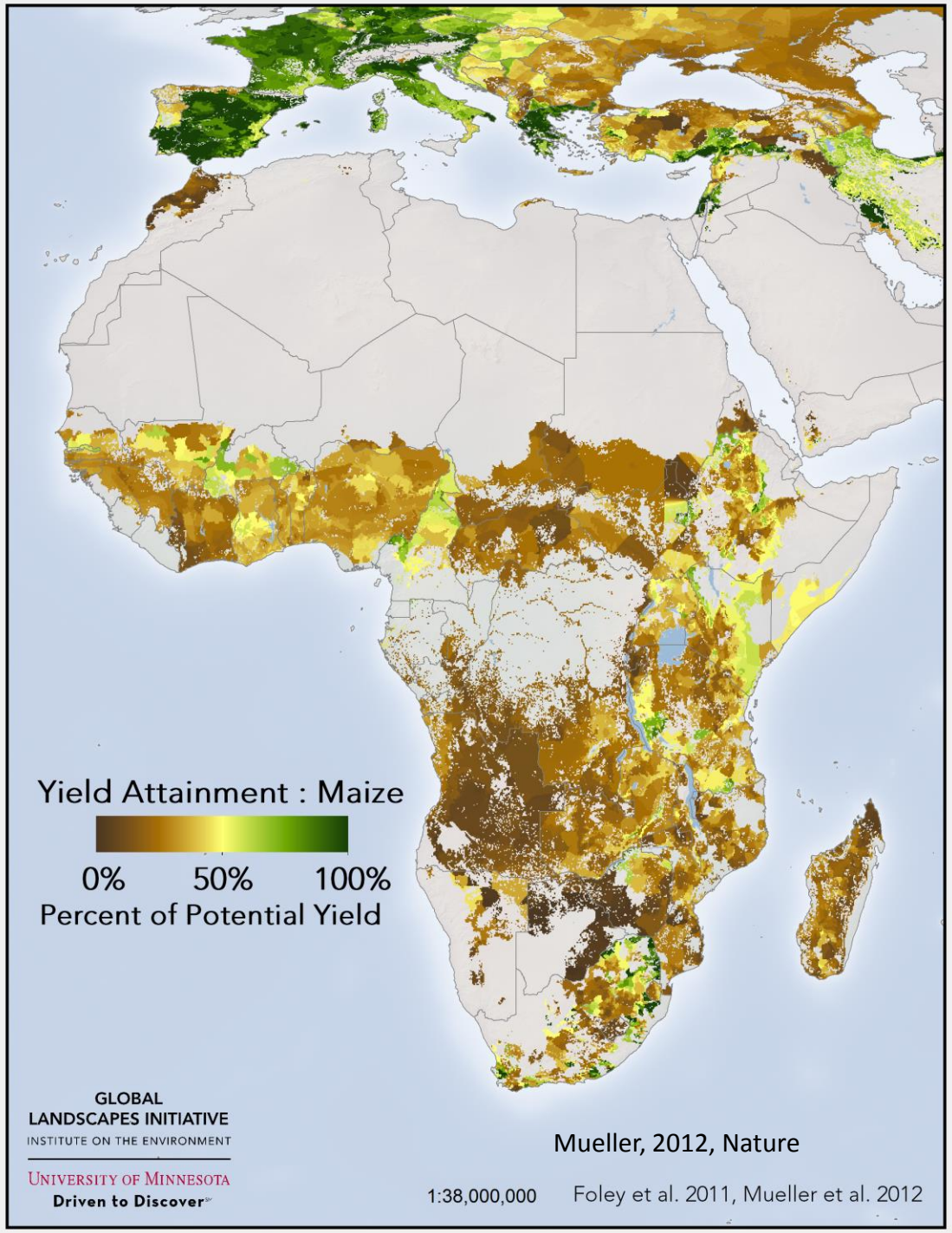

Turkana
Victoria
Tanganyika
Rukwa
Malawi/
Nyassa

2010 Global Hunger Index: Severity

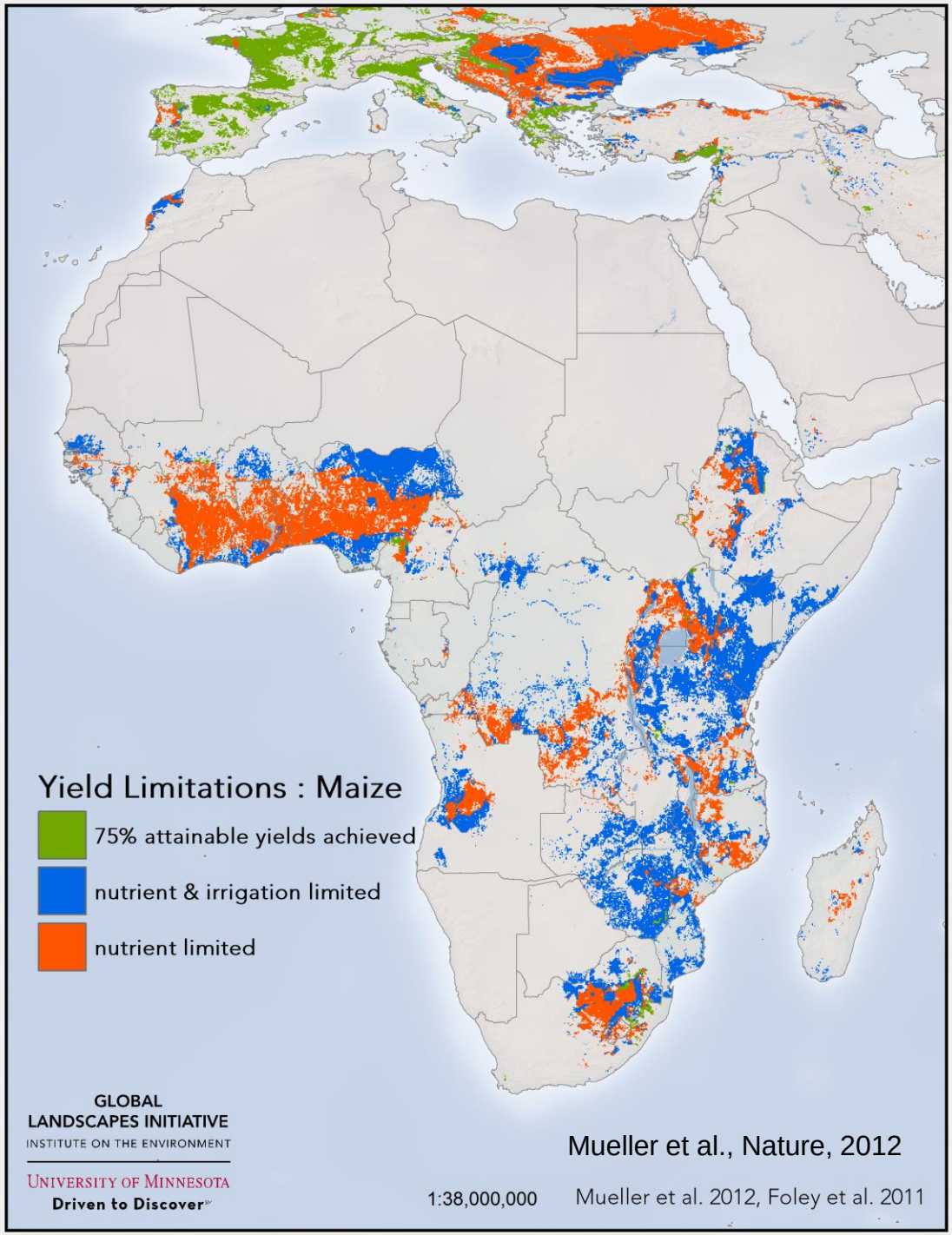


Source: Global Hunger Index report, 2010

Slope farming in northern Malawi along the South Rukuru River



Maize production could increase substantially!



Mueller et al., Nature, 2012

More irrigation and fertilizer required

MALAWI

Green Belt Initiative Taking Shape

By Charles Mpaka

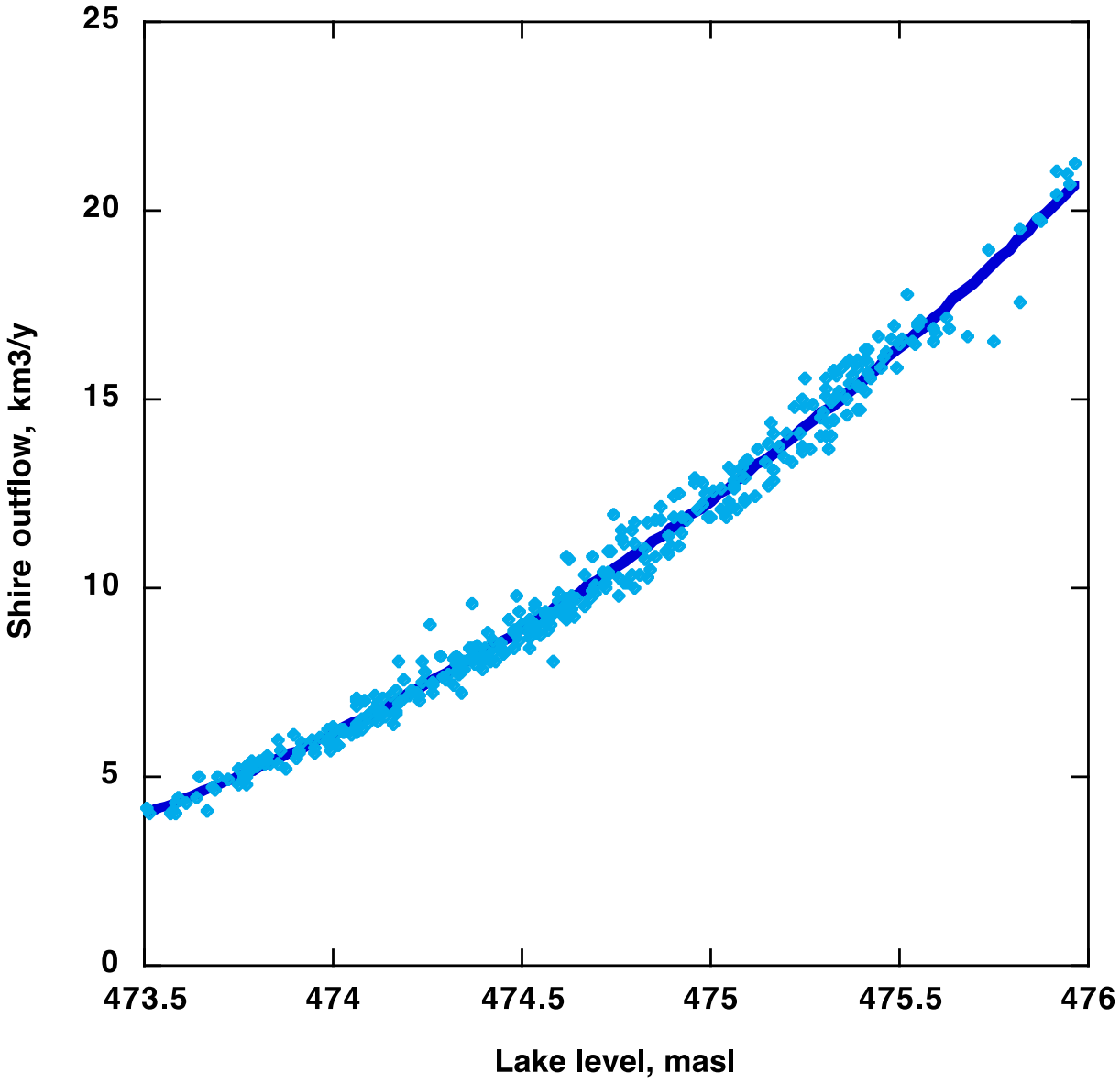
BLANTYRE, Jan 11, 2010 (IPS) - Let the rains fail, even for several successive seasons, and Malawi should still be able to produce enough to feed itself.

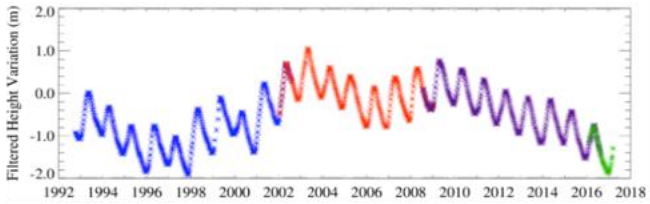
The plan is to protect the gains in food security, reduce vulnerability to drought and to boost production still further by irrigating a million hectares of land in a swathe lying within 20 kilometres of the country's three lakes and 13 perennial rivers.

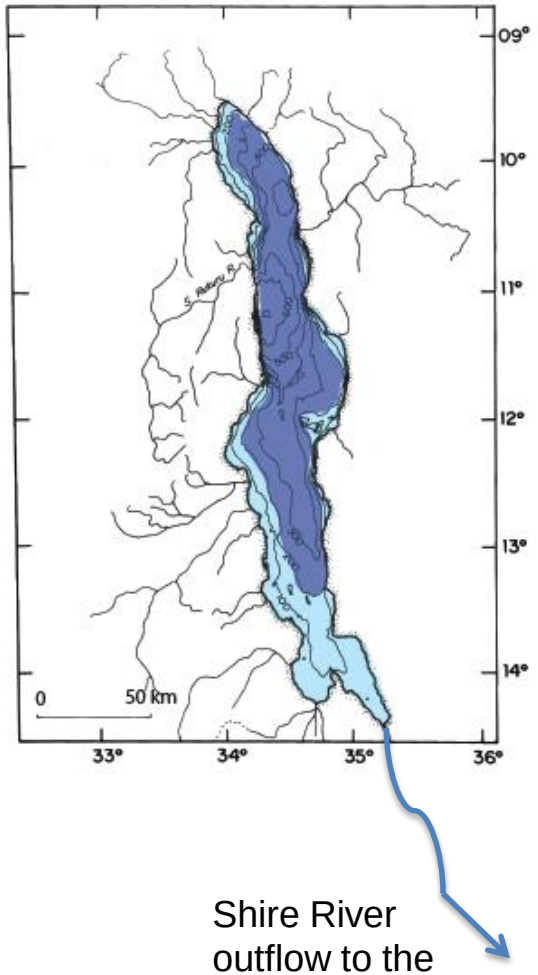
5000 m^3 water/ha y required for irrigation.
If applied to one million hectares, amounts to 5 km^3 water per year.

"Promoting Irrigated Agriculture in Malawi"

Lake Malawi/ Nyassa

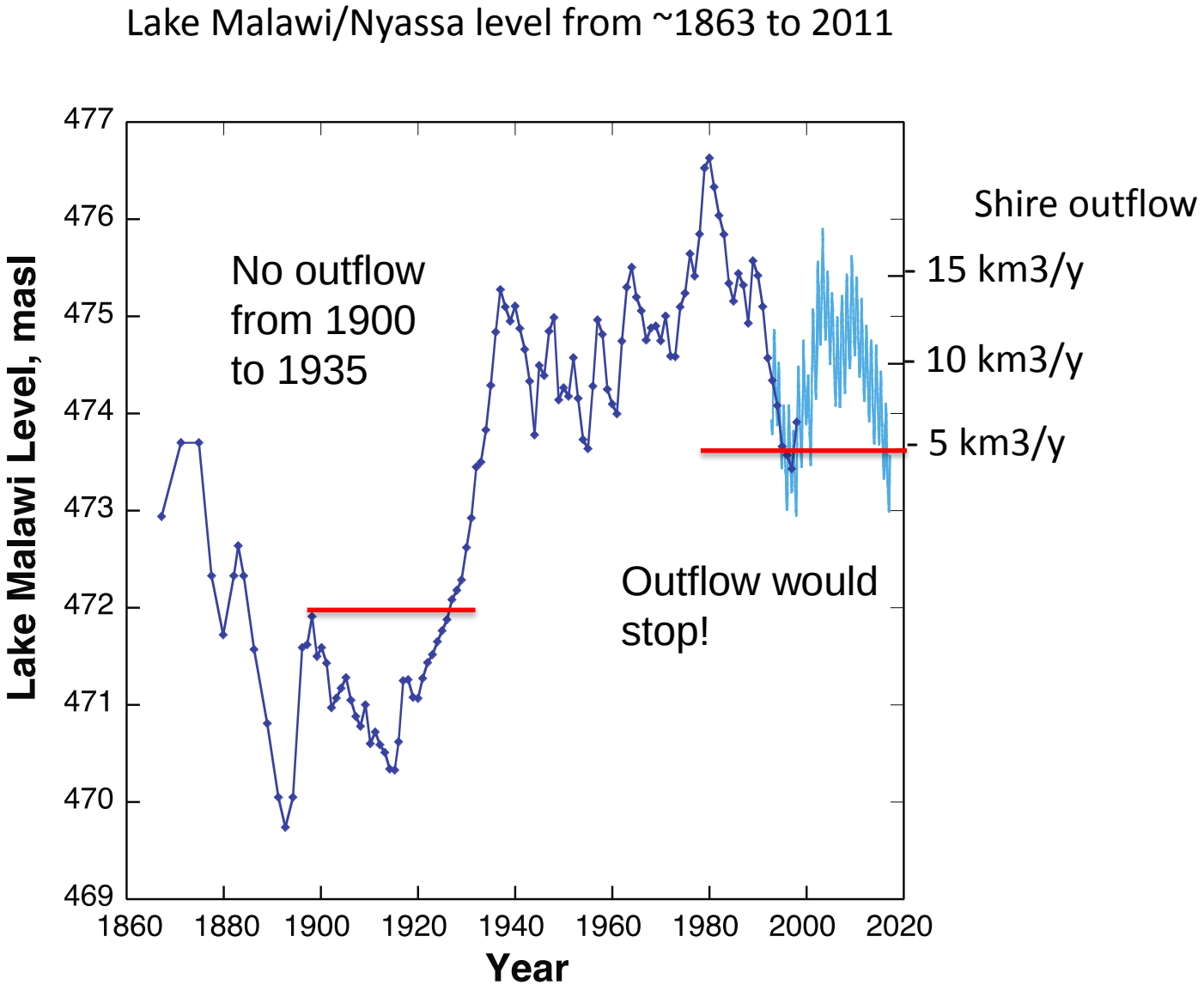




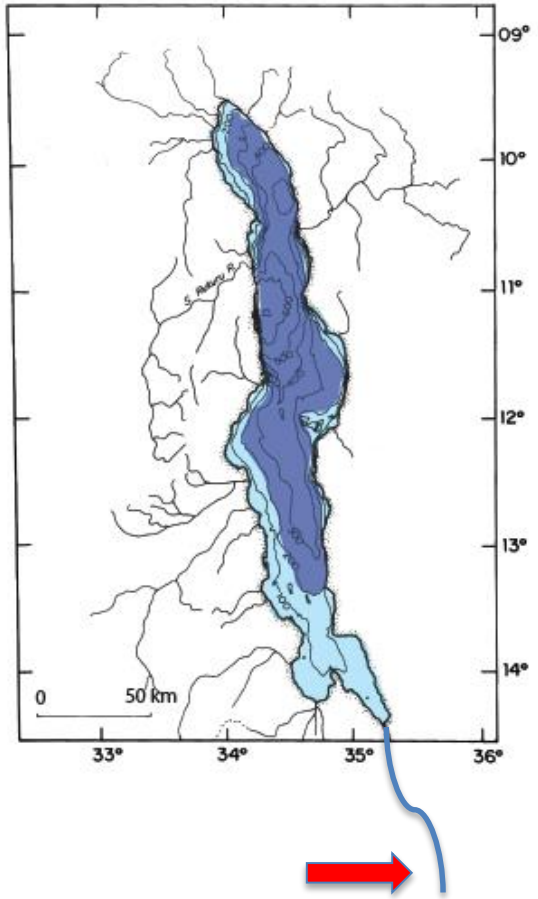


Shire River outflow to the Zambezi River

Lake Malawi / Nyassa:



Approximately 95% of Malawi's electricity is derived from four hydroelectric dams on the Shire River



Malawi to Get $350.7 Million Electricity Grant From Agency Created by Bush

By Indira A.R. Lakshmanan - Jan 5, 2011 3:28 PM CT

What should be done to save Lake Malawi/Nyassa?

Malawi Economy:

GDP - composition by sector:

agriculture: 29.4% (**accounts for 80% of exports**)
industry: 18.9% (beverages, pharmaceuticals, mining)
services: 51.7% (2006 est.) (tourism, retail, transportation, health, etc.)

Population below poverty line: 53% (2004 est.)

HOW CAN THE ECONOMY SHIFT AWAY
FROM AGRICULTURE?

In the case of MALAWI: A POSSIBLE FIRST STEP:

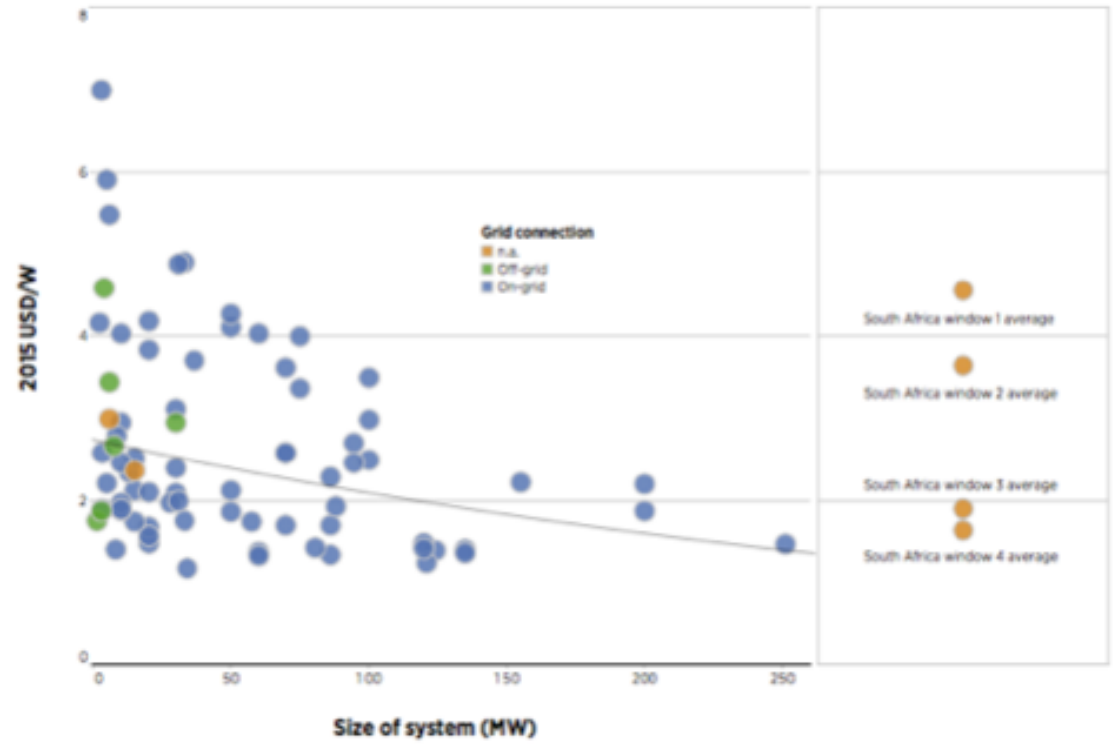
SHIFT FROM HYDRO TO SOLAR POWER

96 MW JASPER project in northern Cape Province, SA

IN THE CASE OF MALAWI:

- Present total power production is ~ 350 MW
- Services ~ 9% of the population
- Cost to completely shift to solar power ~$600 M

FIGURE 33: TOTAL PROJECT COST OF OPERATING AND PROPOSED UTILITY-SCALE PV PROJECTS IN AFRICA, 2010-2018

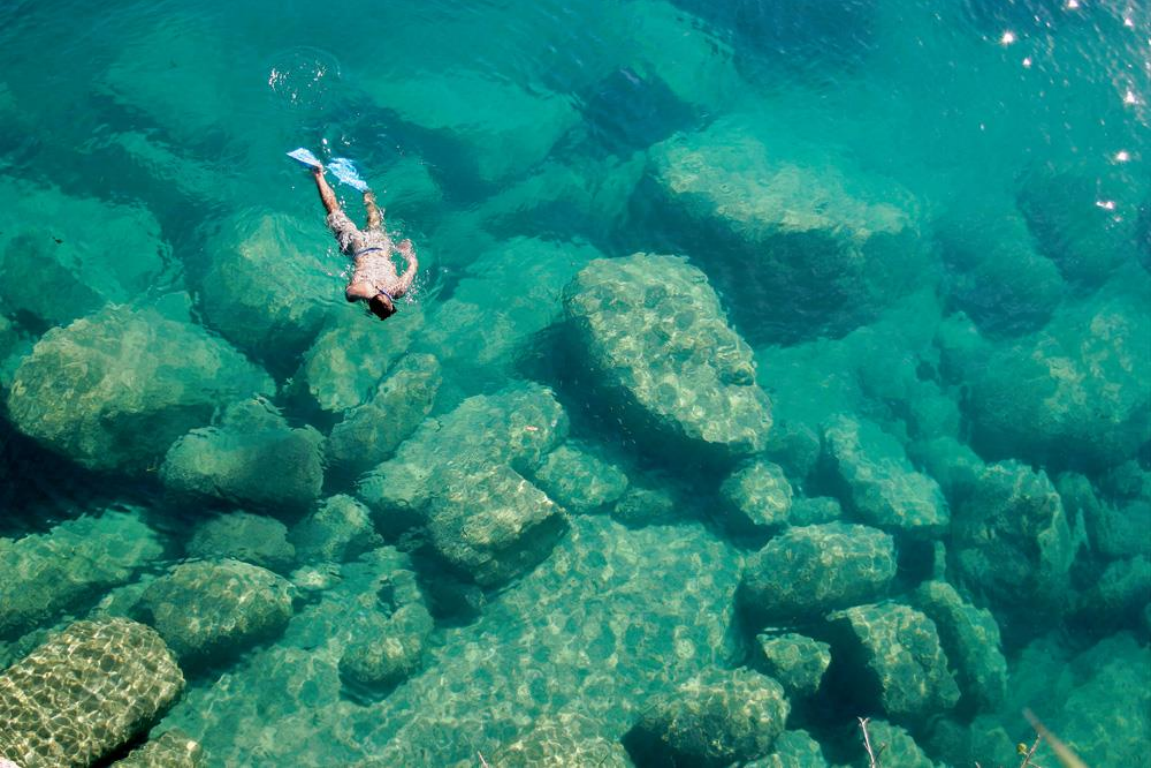


Source: Renewable Cost Database, 2016

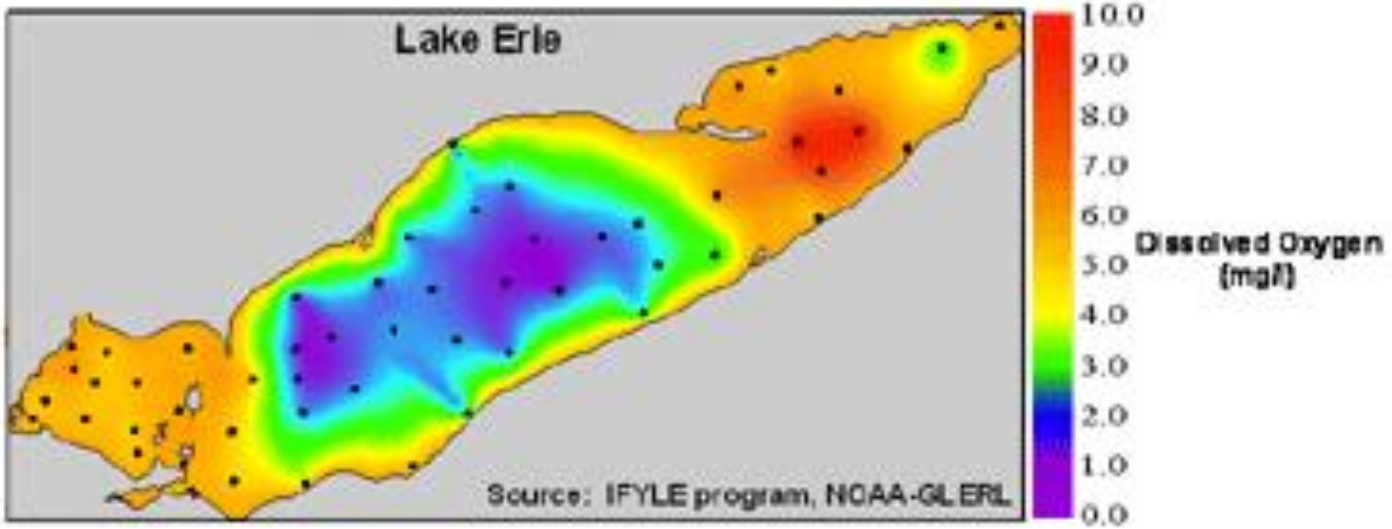
Gibe III dam in Ethiopia cost $1.2 B

CONCLUSIONS

- SUSTAINING THE GREAT LAKES OF EAST AFRICA WILL REQUIRE MAJOR CHANGES IN THE ECONOMIC STRUCTURE OF THE REGION
- AGRICULTURE WILL NEED TO BE REPLACED AS THE MAJOR ECONOMIC DRIVER IN THE REGION
  - If not, the hydrological budget of many of these lakes will shift to closed-basin status, with major drawdown and shifting shorelines.
  - Eutrophication will escalate, creating dead zones and toxic algae blooms.
- IN THE CASE OF MALAWI, A LOGICAL FIRST STEP WOULD BE TO SHIFT TO SOLAR POWER
  - Hydroelectric dams on the Shire River mayno longer have adequate flow to generate electricity.
  - Hydroelectric dams placed on rivers flowing into Lake Malawi/Nyassa will exacerbate the dropping lake level caused by climate change.
  - A shift to solar power would allow more growth in the industrial sector, given more reliable power; more people could hook into regional grids, reducing the demand for wood and charcoal (i.e, more sustainable forests)
  - LAKE MALAWI/NYASSA MIGHT BE SUSTAINED!



Lake Erie: Toxic algae blooms and “dead zones”



Gibe III Dam on the Omo River

- $1.2 B
- 1470 MW
- Online since October 2015