HyVic and Ubuntunet Networks Partnership to Build Resilience to Climate Change in Eastern Africa

UbuntuNet-Connect 2013, Lemigo Hotel, 14-15 November 2013, Kigali, Rwanda

Hydroclimate Project for Lake Victoria Basin (HYVIC)

Fredrick Semazzi – HyVic International Planning Committee (Chair)

Rosalind Cornforth, University of Reading, Helen Houghton-Carr, CEH/NERC, Caroline Bain, UKMO, Richard Anyah, U. of Connecticut, Rita Roberts, NCAR/UCAR, Lian Xie, North Carolina State University, Laban Ogallo, Climate Prediction and Applications Centre (ICPAC), Pascal Waniha, Tanzania Meteorology Agency (TMA)Andrew Githeko, Kenya Medical Research Institute, Felix Mutua (Jomo Kenyatta University of Agriculture and Technology) – HyVic International Planning Committee (Members)

Presentation Outline

1. Background & Motivation for the Hydroclimate Project for Lake Victoria Basin (HYVIC)
2. Proposed HYVIC project
3. HyVIC Functional Components
4. HyVic and Ubuntunet Networks Partnership
5. HyVic Planning Timeline

Lake Victoria Basin

- LVB is the social-economic nerve center for EA (Burundi, Rwanda, Kenya, Tanzania, Uganda) – 30 to 40 million

- Mainly rain fed agricultural economy with LV supplying fish as a major part of the diet

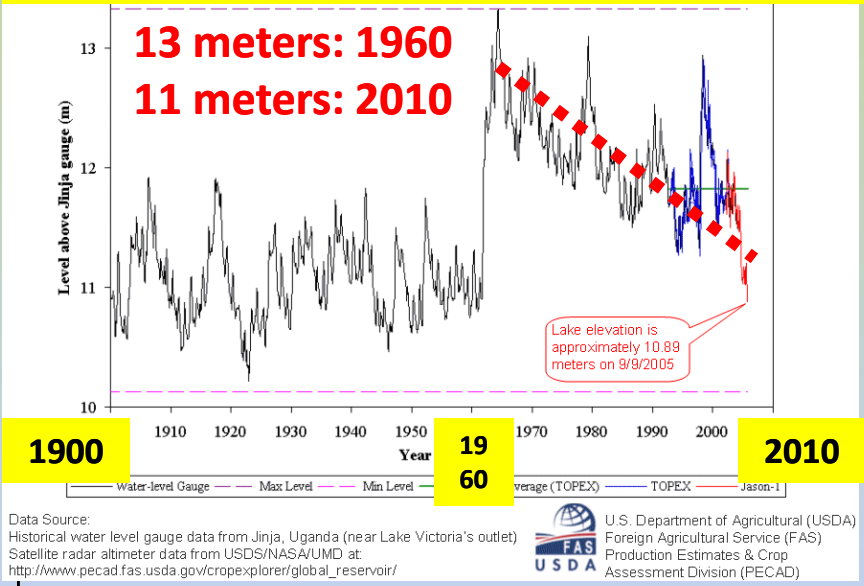
- Lake Victoria also provides hydroelectric energy and relatively inexpensive form of transportation

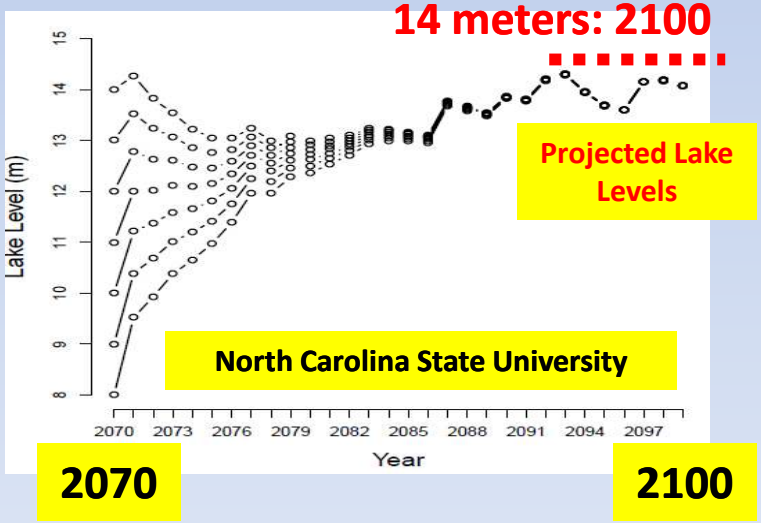
- Geopolitical significance of LVB as the source of the White Nile

Past & Projected Climate (lake levels)

- Persistent past decline & projected reversal and increase
- This phenomenon is the Eastern-Central African climate change paradox – **'Lake Victoria Basin Climate Change Paradox'**
- Likely to have profound implications on LVB sustainable development for more than 35 - 40 million people

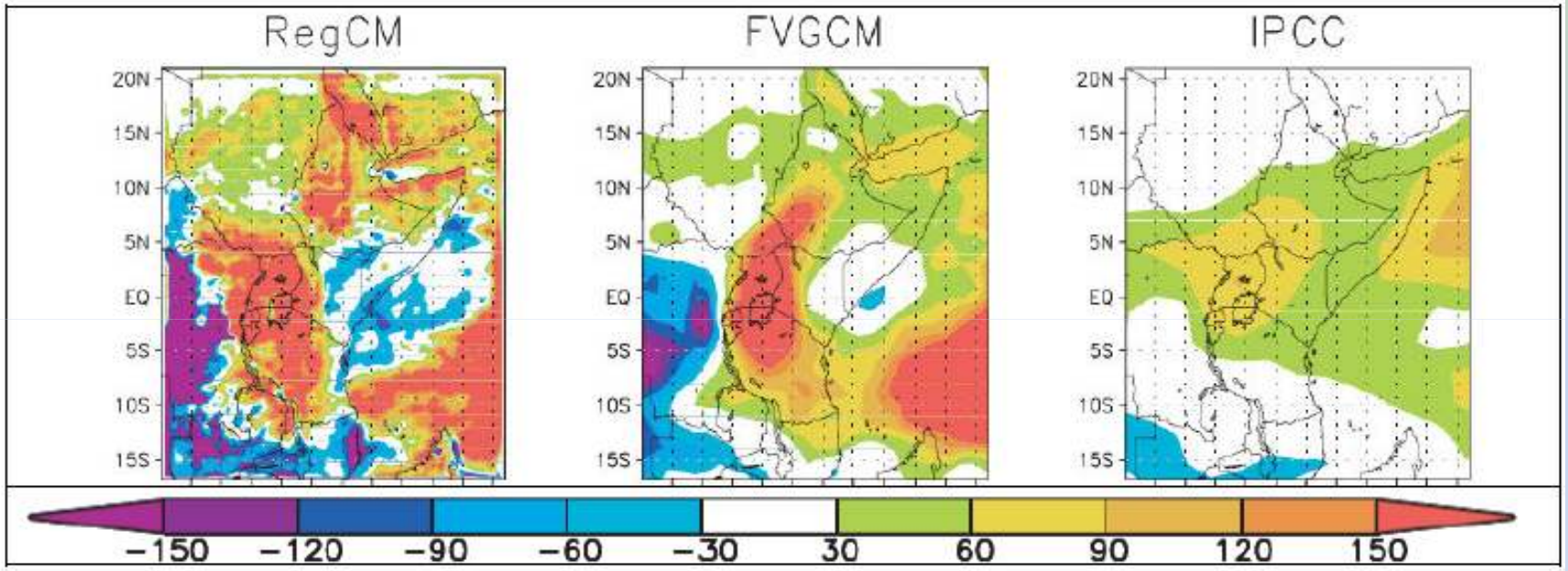
Past & Projected Lake Victoria Levels





RegCM downscaled rainfall for **2071-2100** used as input for the Tate et al (2004) WBM to compute the LL. (Smith, 2011**); evaporation is 13.5% above present level based on A2 scenario. Thus projection is 2 meters above present lake levels. (Kara et al, 2013)**

Regional Climate Projections



Rainfall projections (A2: 2071-2100 average) minus (RF: 1961-1990 average) for the Oct-Dec short rains: (left) RegCM3 (40 km grid); (centre) 2-member FvGCM ensemble average; (right) eight IPCC GCM super ensemble average. Units, mm.

Overarching Science Questions

Considering important factors that have not been considered before, in order to reduce the present high levels of climate model uncertainty in the projections of the changes in the hydrological cycle over Lake Victoria basin to determine,

(i) whether the hypothesized reversal in the availability of water resources will occur during the next few decades,
(ii) the timing of when it will occur, and
(iii) these two factors can be estimated at sufficient levels of confidence to address applications sector-specific policy and management questions

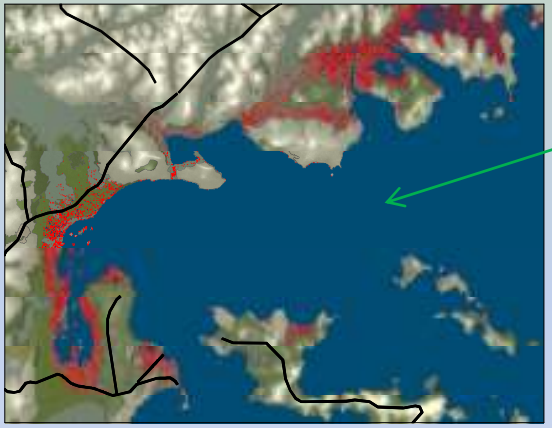
HYVIC Information Stakeholders

Infrastructure & Construction

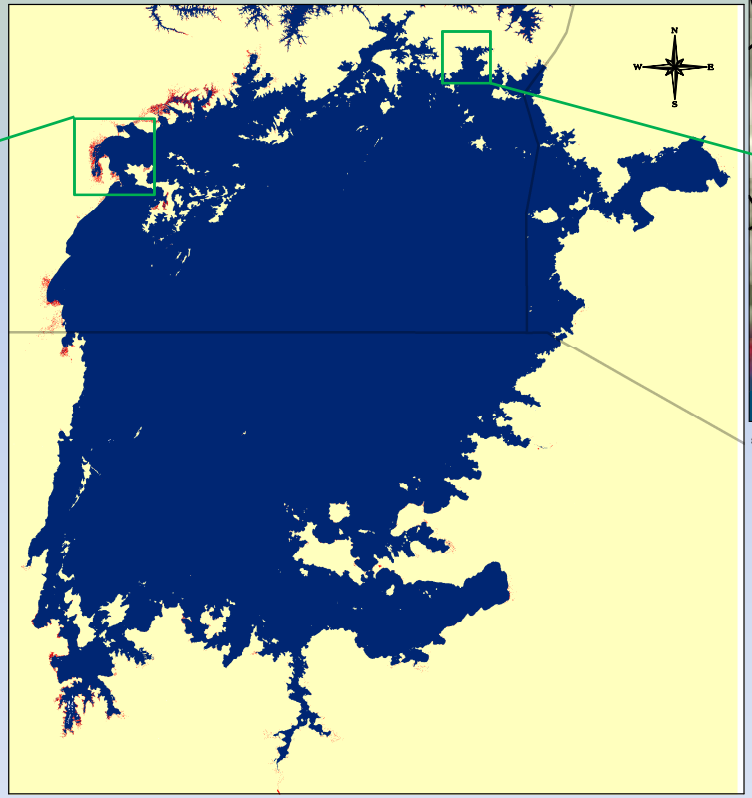
Projected Lake Flood Zone Mapping

(red dots are flooded locations; black lines are road infrastructure)

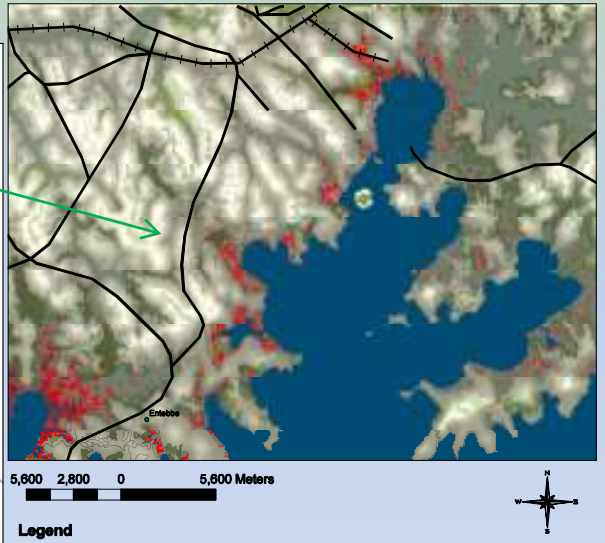
Flooding around northwest side of Lake Victoria



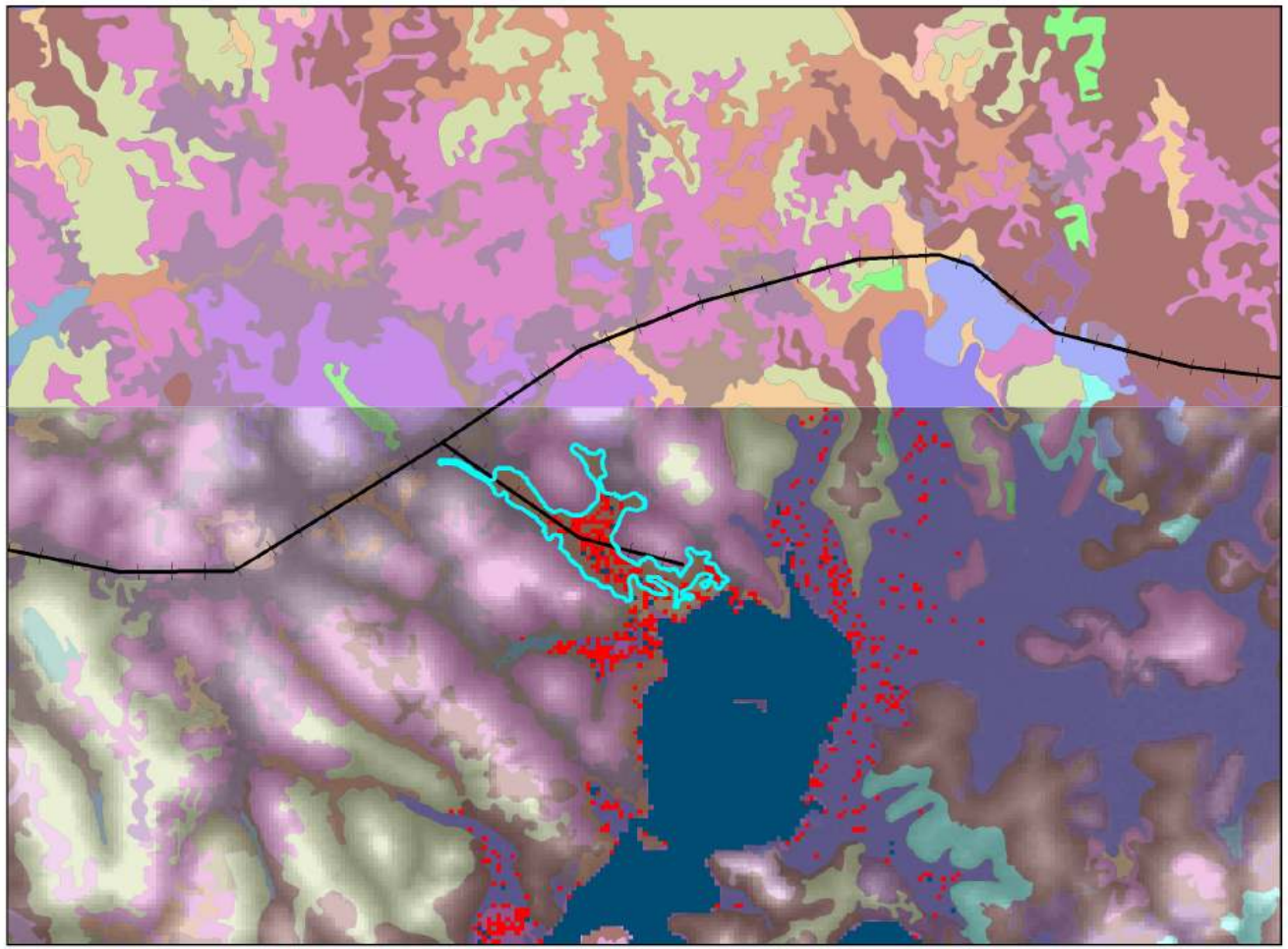
Potential Flooding Around Lake Victoria



Flooding near Kampala, Uganda



Kampala Flood Zone



4,000 2,000 0 4,000 Meters

Coastal Erosion

Adaptation Options to (IPCC/CZMS, 1990)

Adaptation strategies

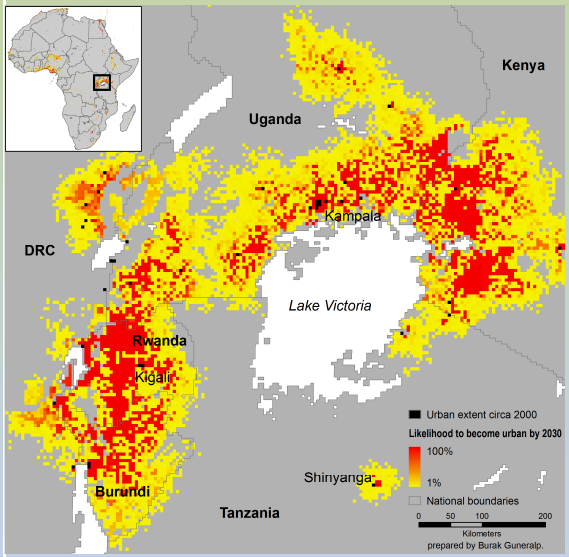
Potential Major Sources of Uncertainty in Current Climate Models

1. Climate projections not adequately take into account land cover changes (due to urbanization) influence on regional climate

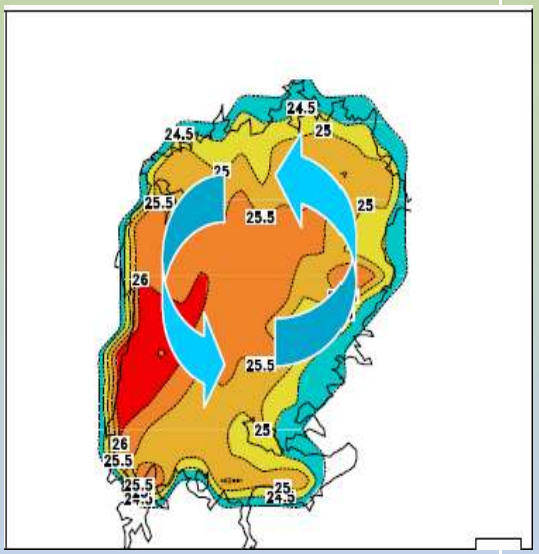
2. Climate models do not have realistic representation of lake 3D hydrodynamics interaction with regional climate

3. Climate models do not have realistic formulation of ground water hydrology influence on regional climate

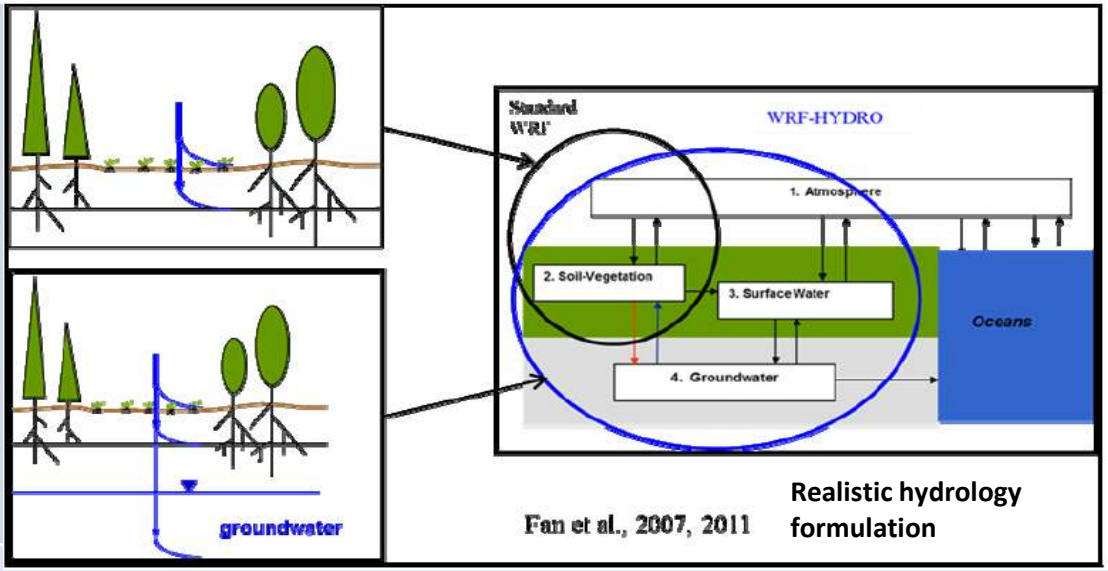
4. Climate models do not have sufficient spatial resolution to resolve critical climate change interactions



Forecast of urban expansion around LV by 2030 (Seto et al., 2012,*PNAS*)



Lake circulation & surface temperature (Semazzi et al., 2012)



Fan et al., 2007, 2011

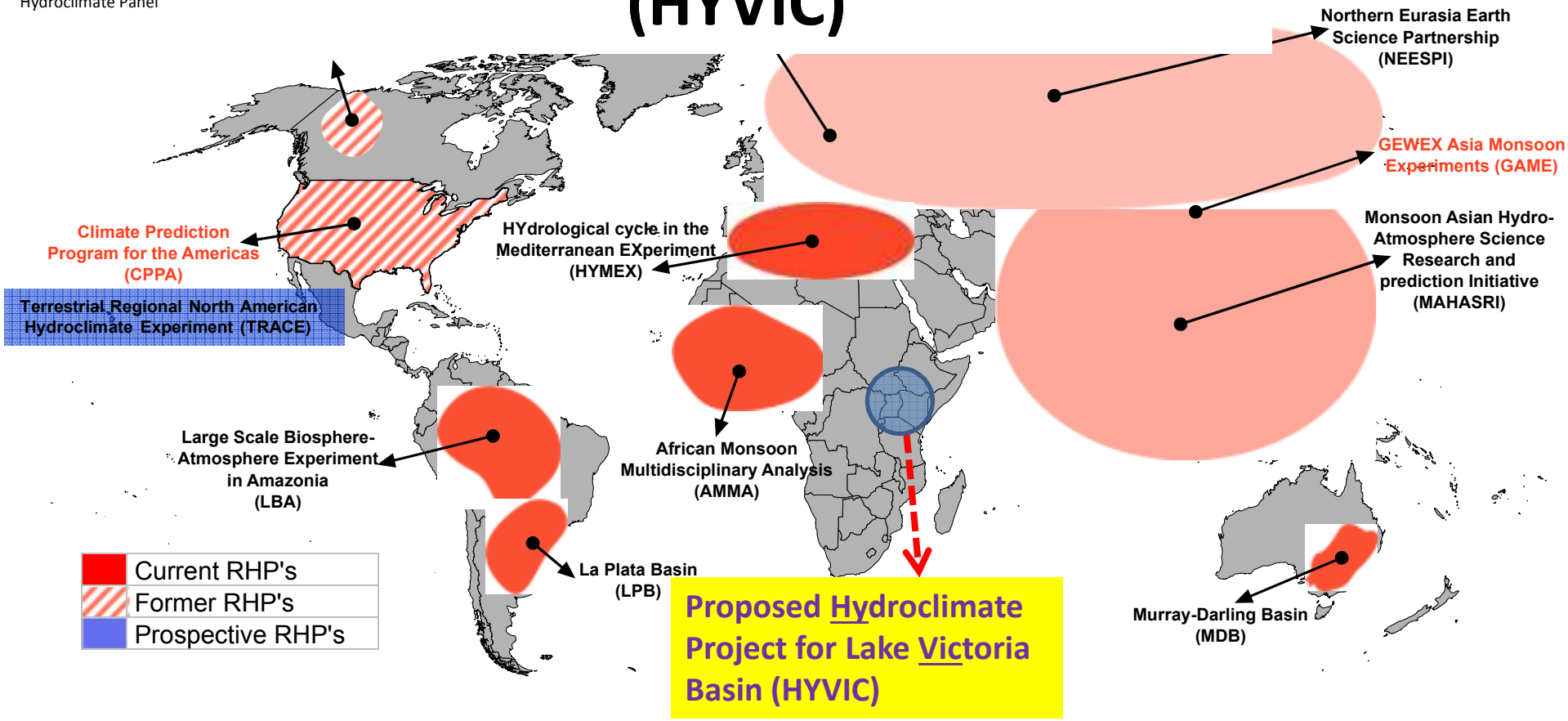
Realistic hydrology formulation

Any of these factors could change the climate projections

Proposed GEWEX GHP Hydroclimate Project for Lake Victoria Basin (HYVIC)

GEWEX is a core project of WCRP on Global Energy & Water Exchanges

GHP: A GEWEX Hydroclimate Panel



Regional water cycles

HyVic Network

GEWEX Global Energy and Water Exchanges Project — WCRP

WCRP World Climate Research Programme

NCAR/UCAR

GRACE

Curtin University Australia

UCONN UNIVERSITY OF CONNECTICUT

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
Setting Trends in Higher Education, Research and Innovation

UbuntuNet Alliance for Research and Education Networking

NSF Expedition

NC STATE UNIVERSITY

ICPAC-IGAD

CEH-UK

Centre for Ecology & Hydrology

AfClix

AfClix Africa Climate Exchange

University of Reading

U Liverpool

QWeCI

LVBC

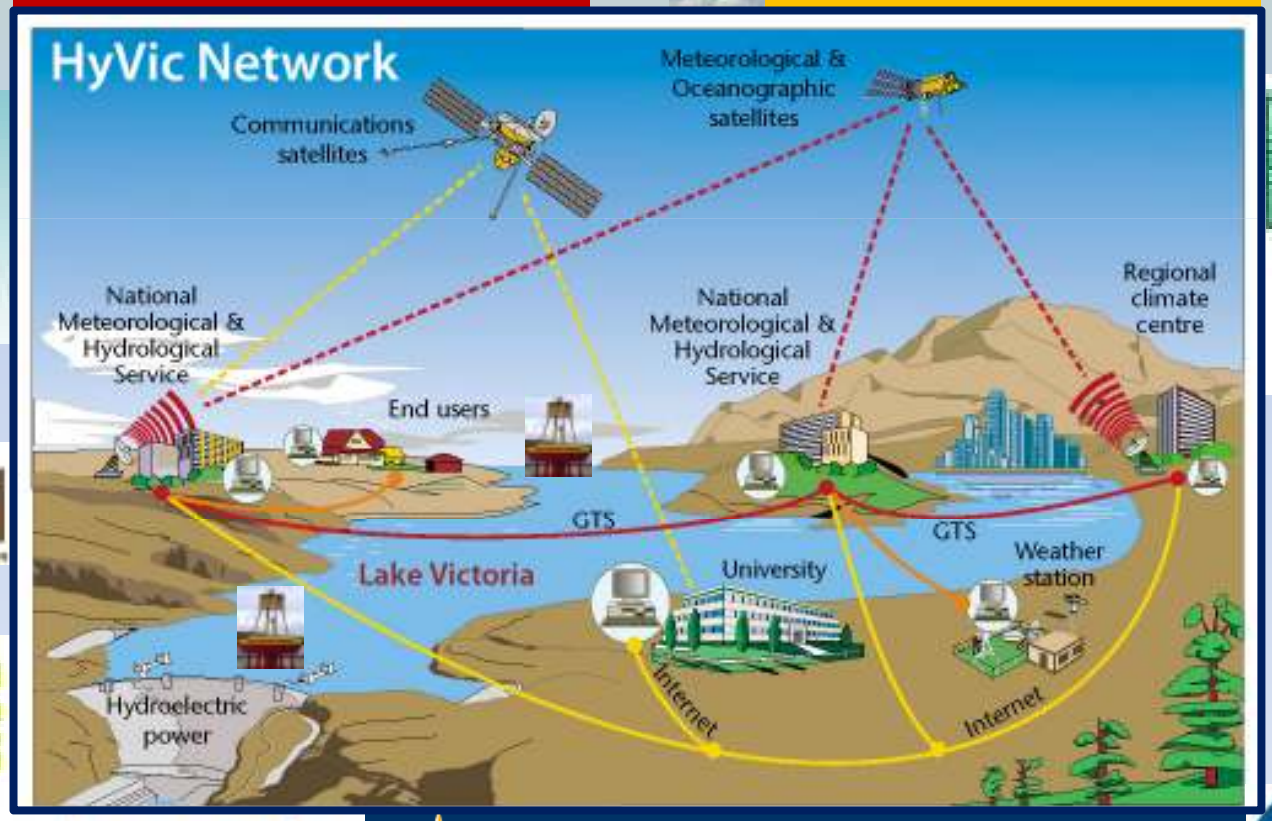
CSRP

Met Office Hadley Centre

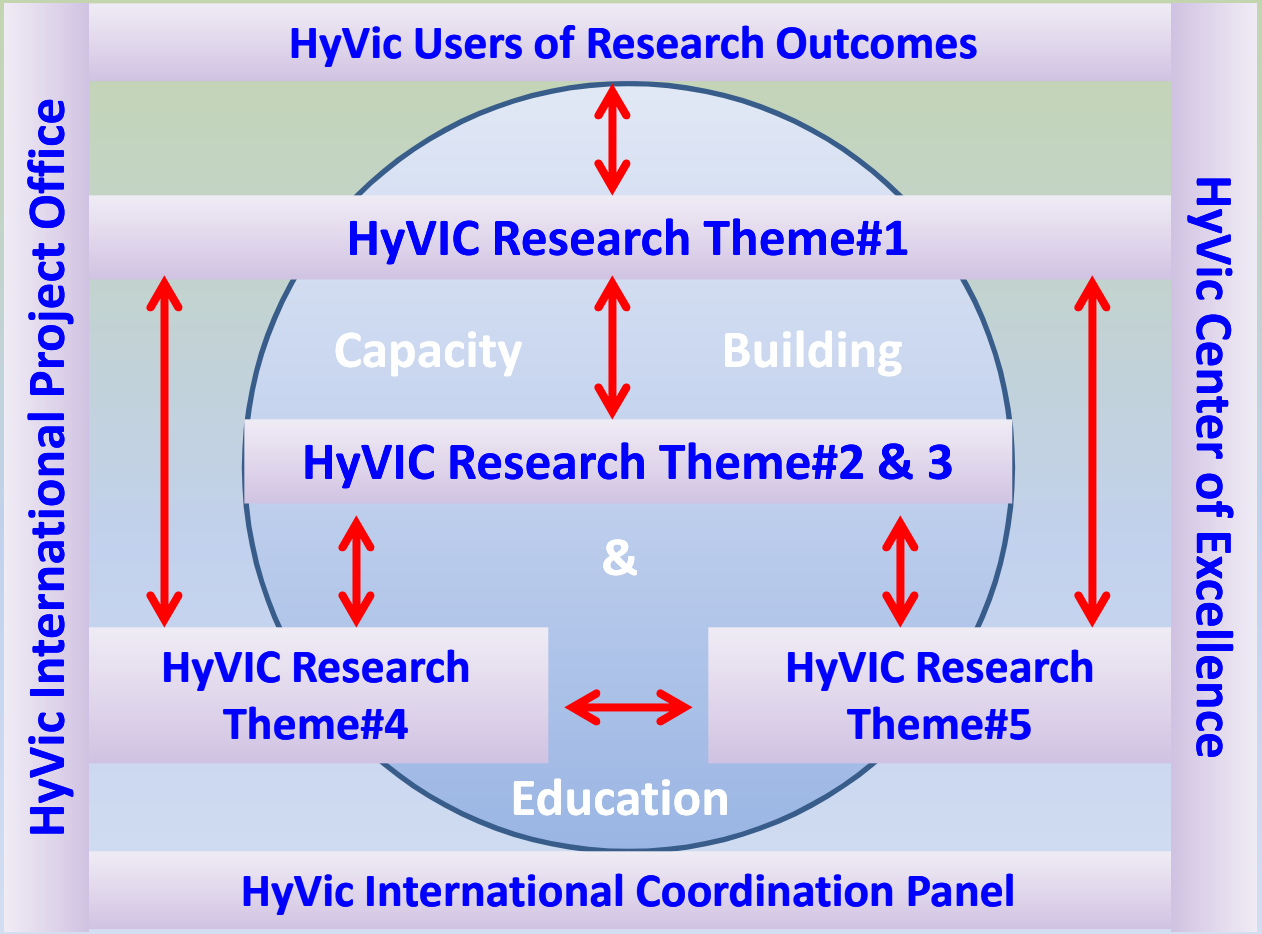
WWRP

World Meteorological Organization SWFDP
Weather • Climate • Water

Stony Brook University SoMAS School of Marine and Atmospheric Sciences



HyVIC Components



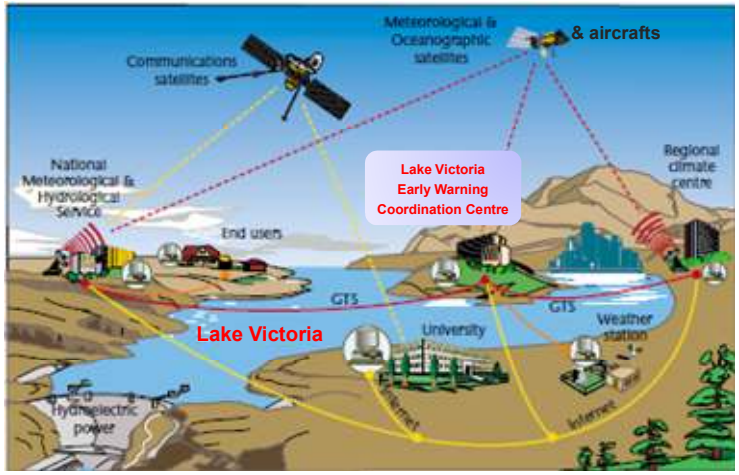
HyVIC Research Theme-1: Translational Research Interface with Applications
HyVIC Research Theme-2: Severe Weather and Water Currents (collaboration with WWRP-LVP)
HyVIC Research Theme-3: Lake Victoria Basin Water Budget
HyVIC Research Theme-4: HyVic Earth System Model (EaSM)
HyVIC Research Theme-5: Observation of the Hydroclimatological System

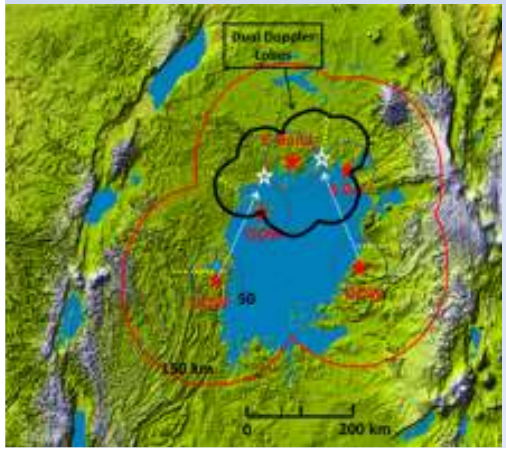
(Customized from GFCS)

Proposed HYVIC Monitoring

HyVIC Research Theme-5: Observation of the Hydroclimatological System

Atmospheric, Surface & Terrestrial Observations





Marine Observations for the 3-Dimensional Fluid System

Figure 17. Example of buoys being loaded onto the deck of deployment ship. The M/V Jumuiya and other vessels that EAC may have commissioned should be deployed for Lake Victoria.

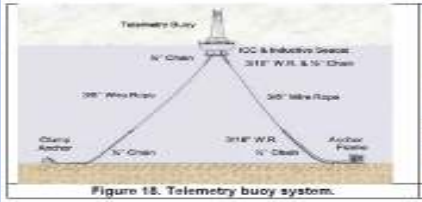


Figure 18. Telemetry buoy system.

Figure19. Telemetry buoy sensors.

Proposed HYVIC EaSM

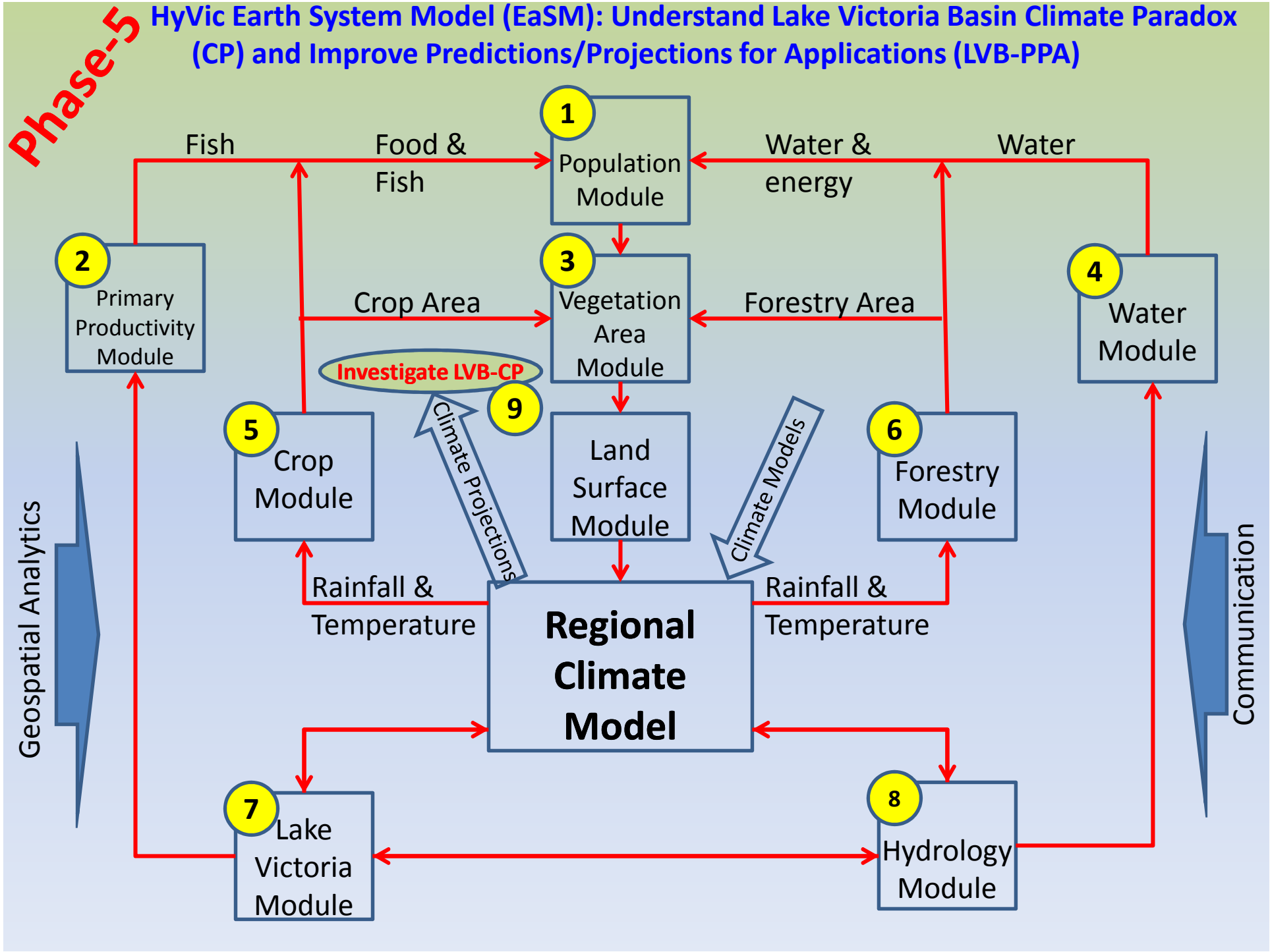
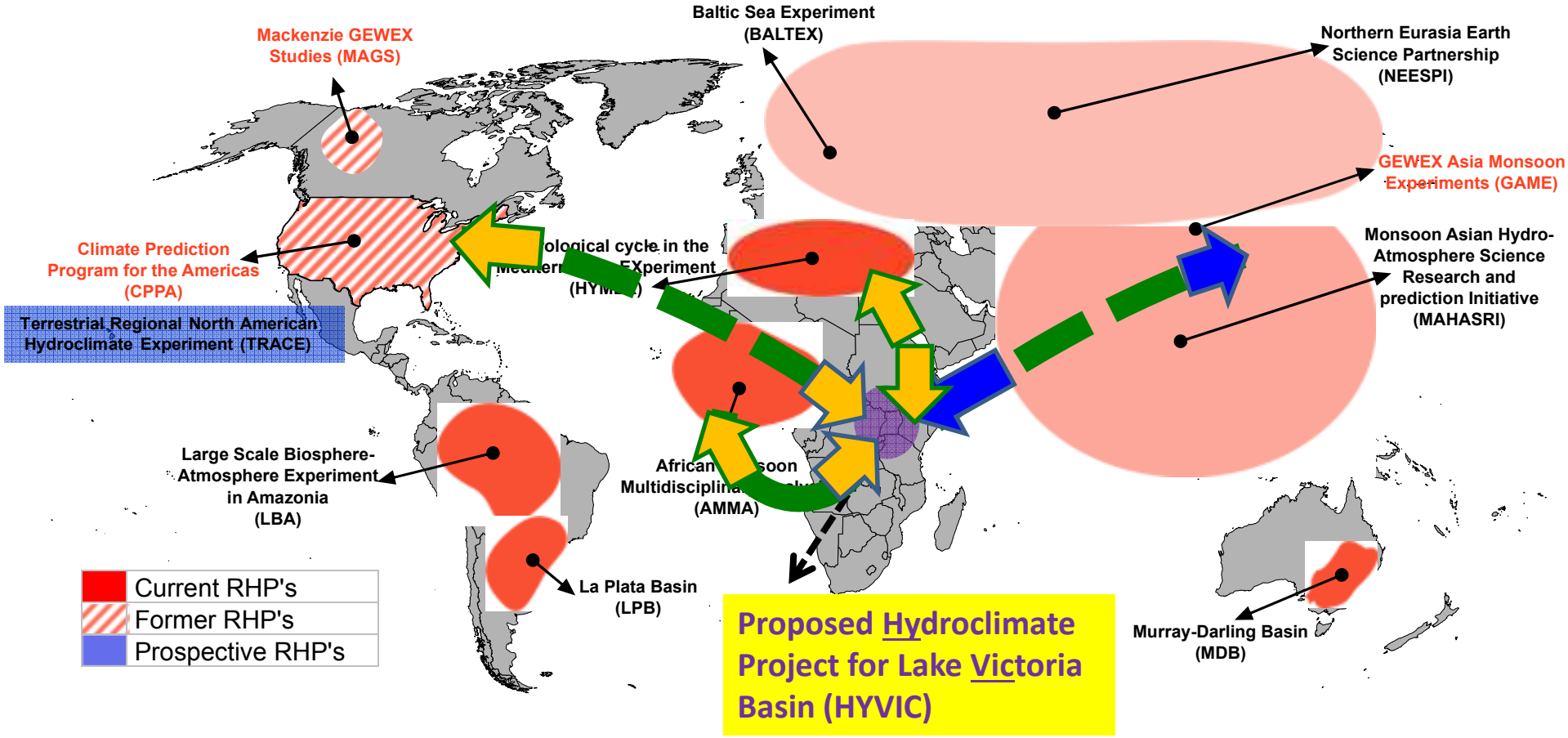

Phase-5
HyVic Earth System Model (EaSM): Understand Lake Victoria Basin Climate Paradox (CP) and Improve Predictions/Projections for Applications (LVB-PPA)
1
Population Module
Fish
Food & Fish
Water & energy
Water
2
Primary Productivity Module
3
Vegetation Area Module
Crop Area
Forestry Area
4
Water Module
Investigate LVB-CP
9
5
Crop Module
Land Surface Module
6
Forestry Module
Climate Projections
Climate Models
Geospatial Analytics
Communication
Rainfall & Temperature
Regional Climate Model
Rainfall & Temperature
7
Lake Victoria Module
8
Hydrology Module

Illustration of Simulation Dataset Sizes

Application	On-Line Data	Off-Line Data
FLASH: Buoyancy-Driven Turbulent Nuclear Burning	75TB	300TB
Reactor Core Hydrodynamics	2TB	5TB
Computational Nuclear Structure	4TB	40TB
Computational Protein Structure	1TB	2TB
Performance Evaluation and Analysis	1TB	1TB
Kinetics and Thermodynamics of Metal and Complex Hydride Nanoparticles	5TB	100TB
Climate Science	10-100TB	1.4PB
Parkinson's Disease	2.5TB	50TB
Plasma Microturbulence	2TB	10TB
Lattice QCD	1TB	44TB
Thermal Striping in Sodium Cooled Reactors	4TB	8TB
Gating Mechanisms of Membrane Proteins	10TB	10TB

Connect of HYVIC (via national RENs) with High Speed Research and Education Networks in USA (Internet2) ; South Korea; Africa; Europe

GEWEX REGIONAL HYDROCLIMATE PROJECTS



Proposed Hydroclimate Project for Lake Victoria Basin (HYVIC)

Regional water cycles

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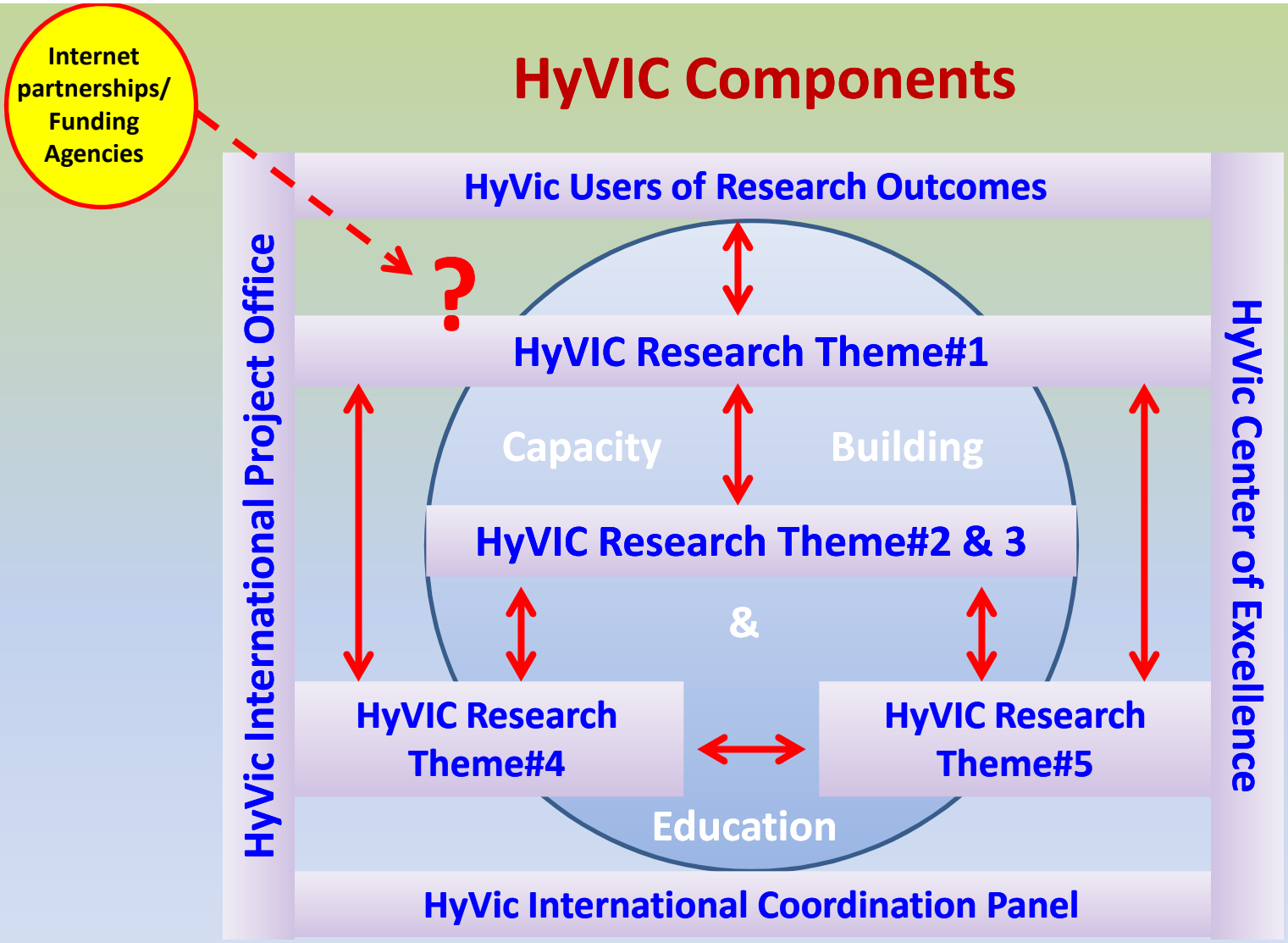
10. Richard Anyah, U. of Connecticut
11. Rita Roberts, NCAR/UCAR

HYVIC IPC Terms of Reference

– Update and finalize the science plan
– Set the overarching science questions to guide the project
– Prepare communication material for HyVIC
– Coordinate partnerships with funding agencies
– Coordinate proposal submissions to agencies

HyVIC Components



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(Customized from GFCS)

Perhaps we can put a smile on this man's face ….