Observations of Lake Victoria Water Surface Temperatures and Use with Models

EarthTemp Network Workshop in
Karlsruhe, Germany
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Presentation Outline

- **Background: Regional social economic significance of Lake Victoria Basin; Lake basin climate drivers**
- **Significance of lake surface temperatures (applications, numerical models)**
- **Hydroclimate Project for Lake Victoria Basin (HYVIC) – SEE HANDOUT**
- **HYVIC observational plan (under development)**
- **HyVic Coordination Network**

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Significance of Lake Victoria Basin

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

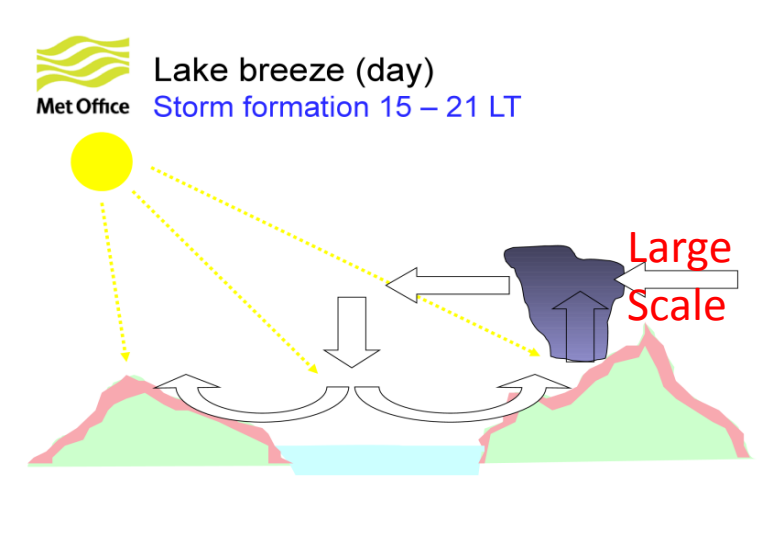
- Mainly rain fed agricultural economy with LV supplying <u>fish as a major part of the diet</u>

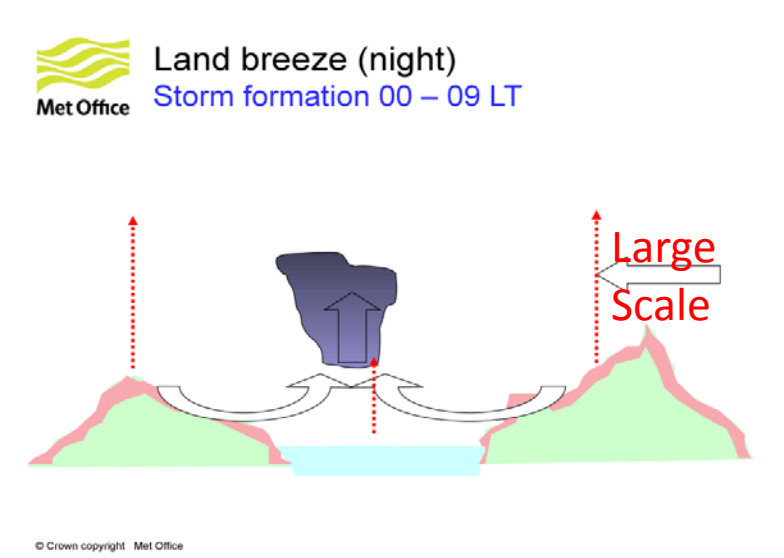
- Lake Victoria also provides <u>hydroelectric energy</u> and relatively inexpensive form of transportation

- Geopolitical significance of LVB as the <u>source of the White Nile</u>

Primary Weather/Climate Drivers

1





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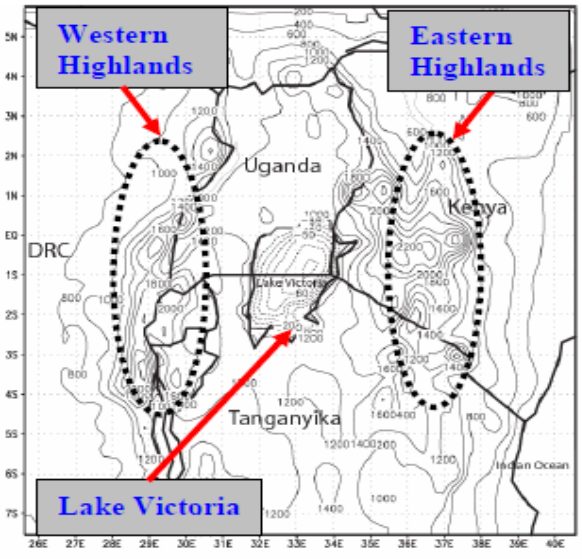

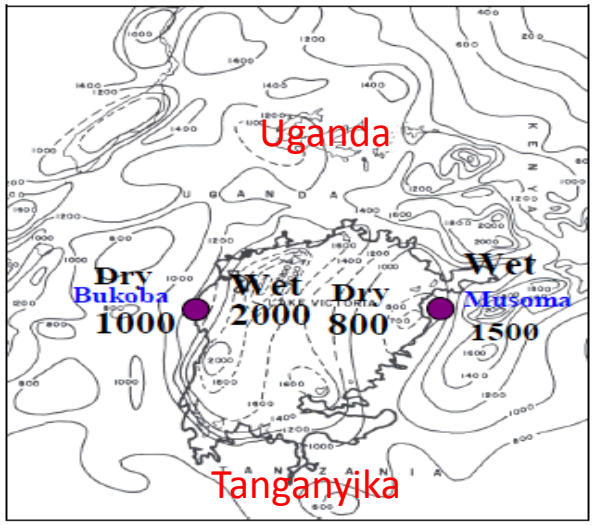

Fig.3: Observed Annual Rainfall (mm)

4

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Regional WRF Model (not coupled)

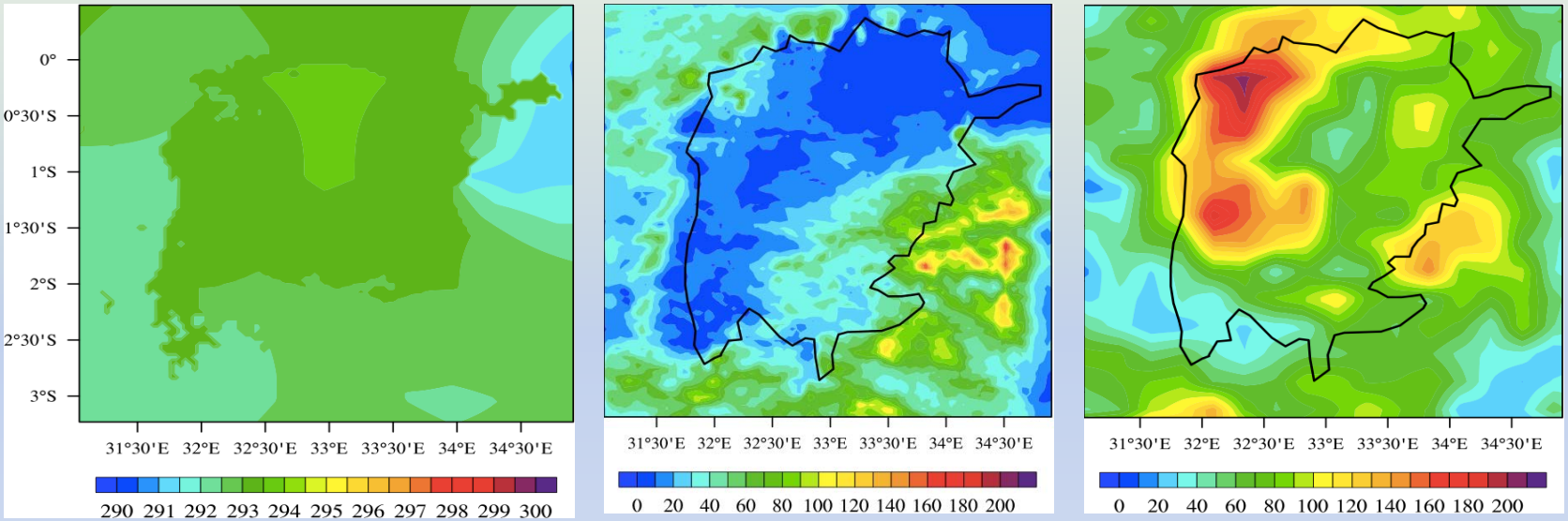
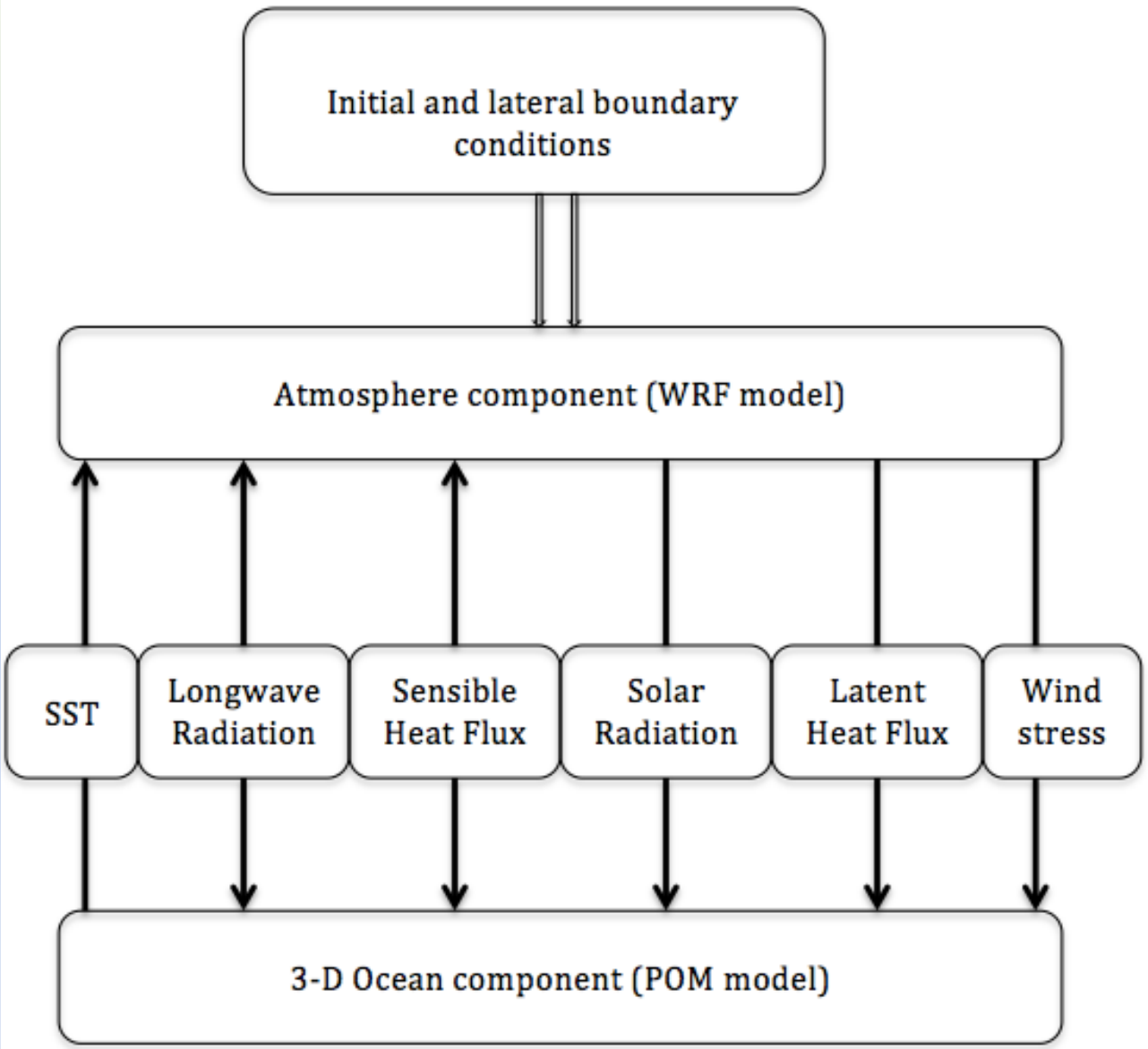


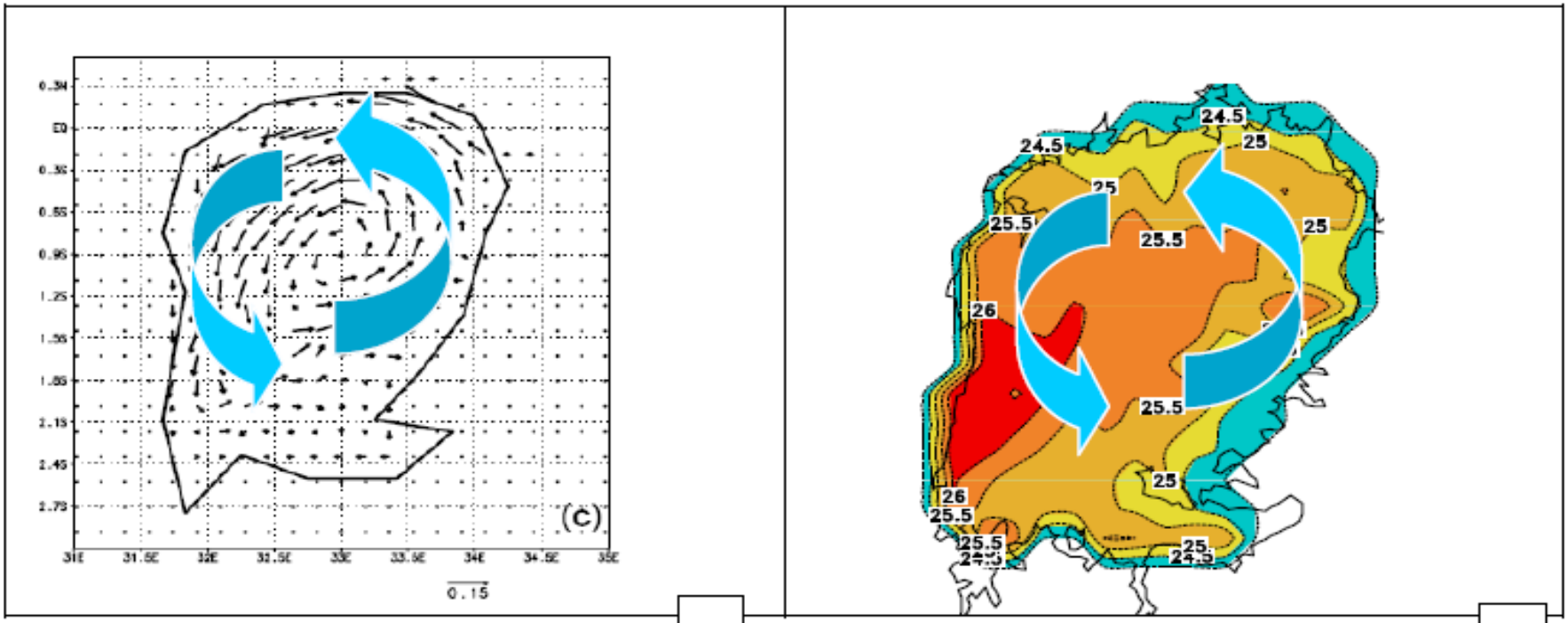
Fig.3 (a) The pattern of averaged default LST, (b) corresponding precipitation from control run, (c) five-day total rainfall of TRMM data from November 26, 1999

Regional Coupled WRF-POM Model



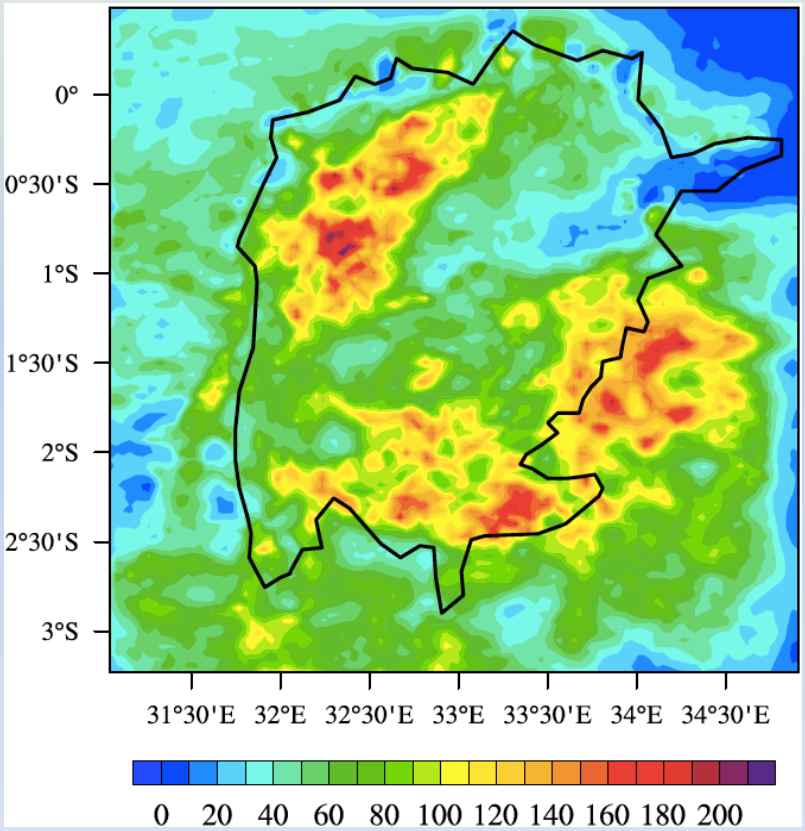
Lake Water Currents & Temperature Patterns

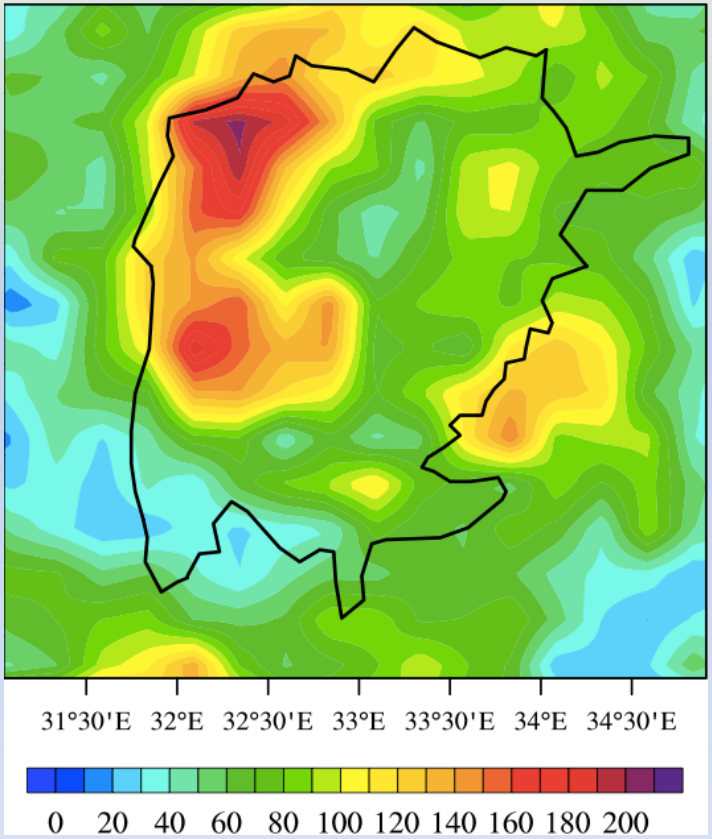
(complex water currents and LST gradients that may be related to navigation safety)



RegGCM3-POM simulation in December 1988 average over Lake Victoria. (a) 850mb wind at 6UT, and (b) lake surface temperature

Total precipitation distribution for five-day with lake surface temperature pattern from coupled model





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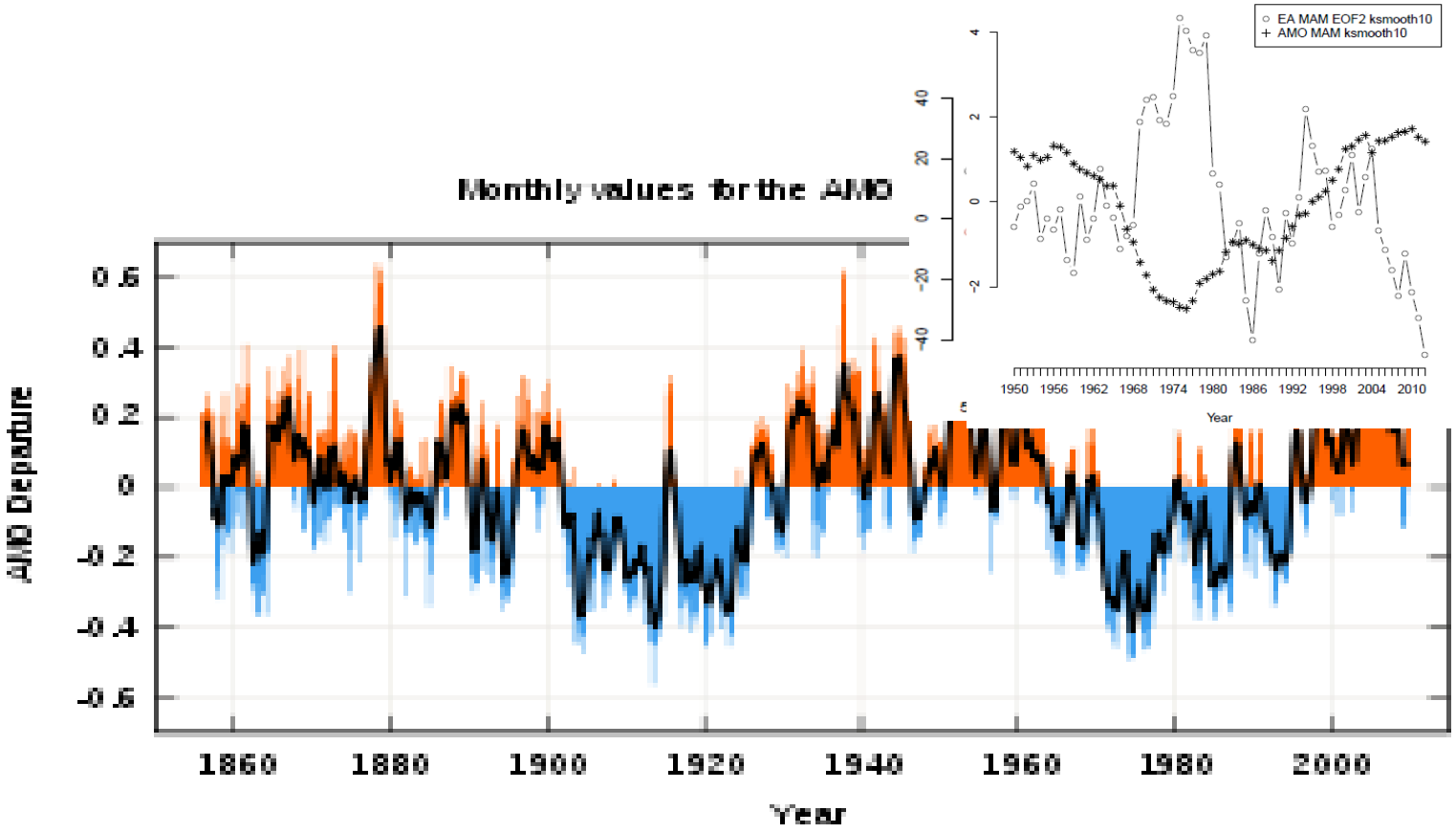
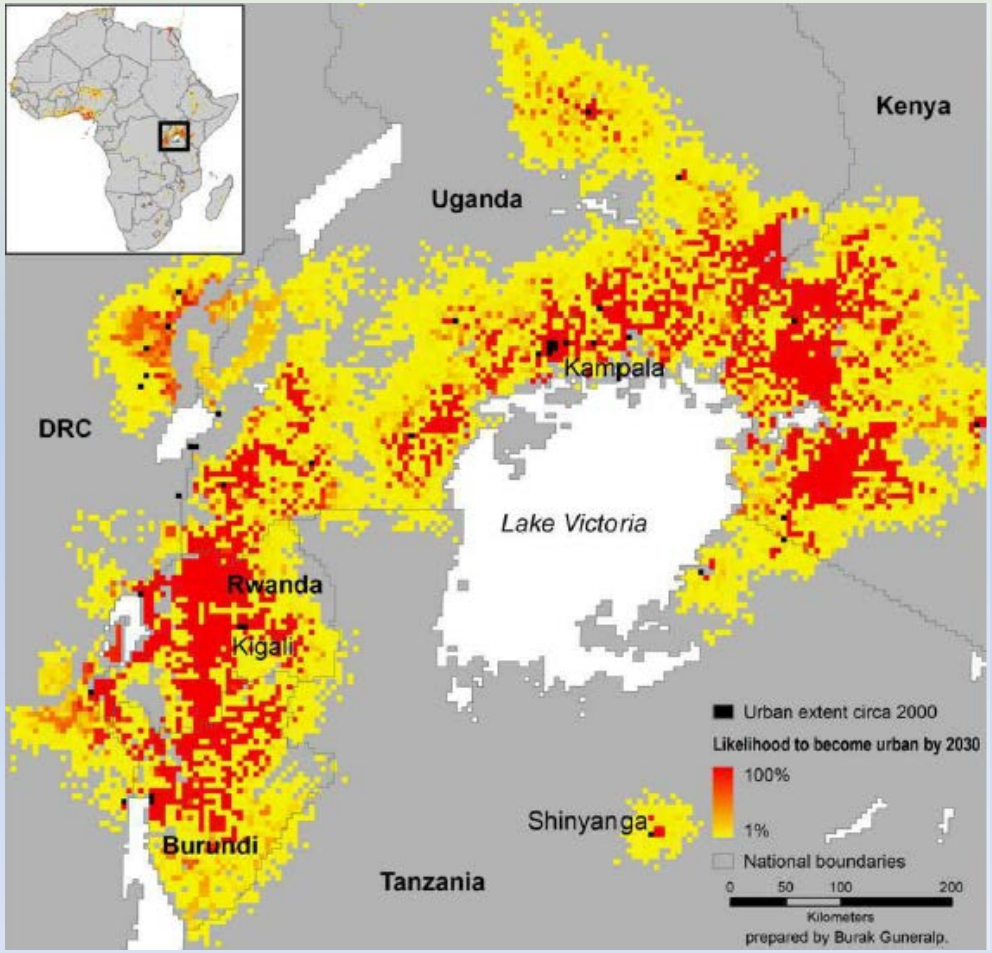
Natural decadal variability (NDV) Driver

Associated with AMO

Comprehensive analysis of leading Cis will be investigated

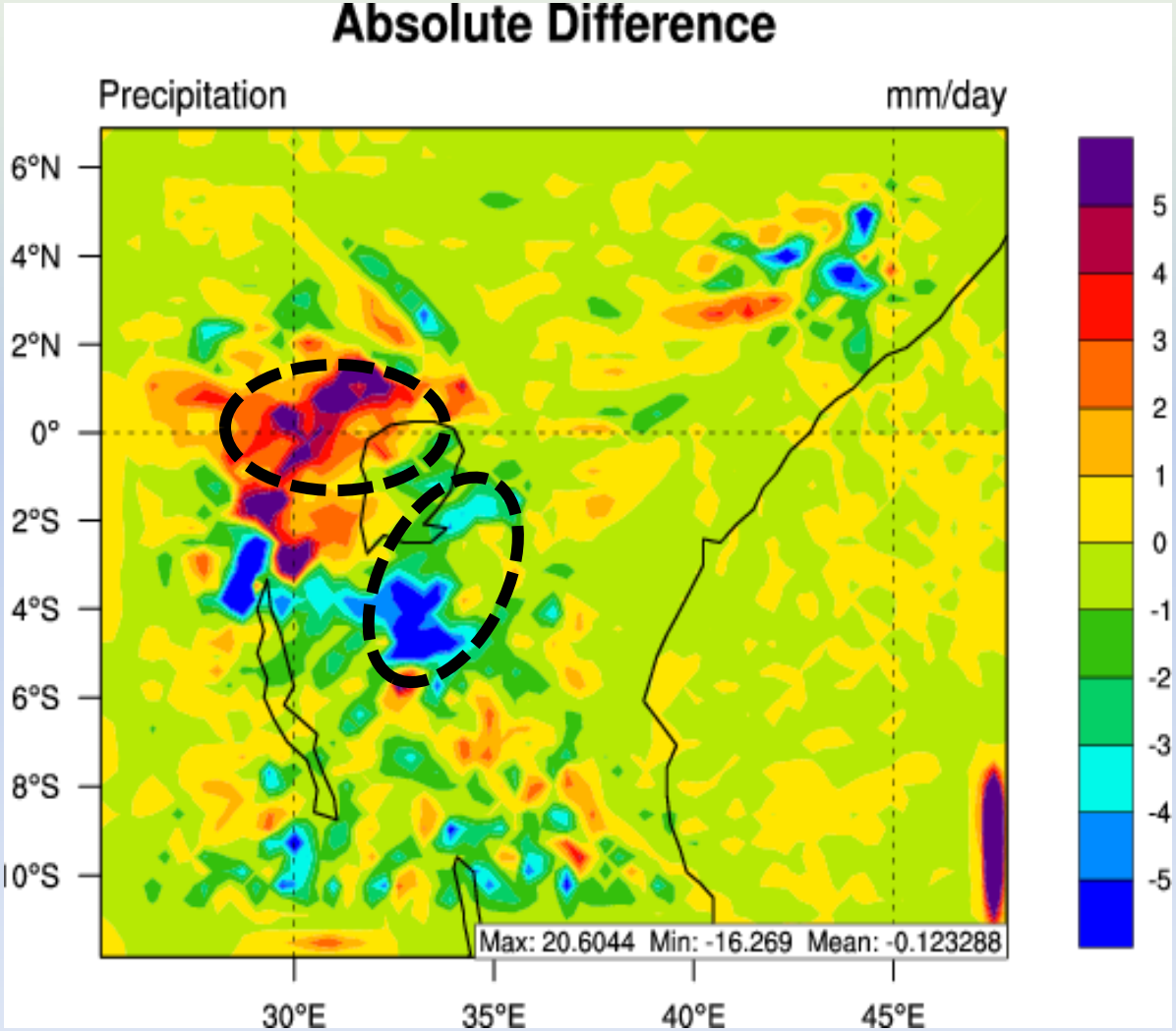


Projected Urbanization

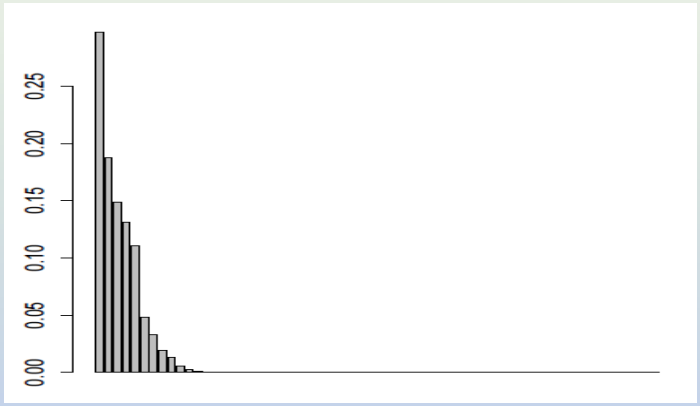


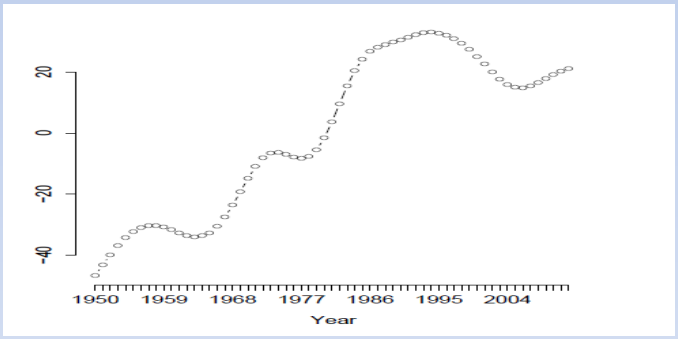
- Current population of the Basin is 30-40 million
- The UN projects the increase of population in East Africa to be from 56 million to 157 million in 2030
- Seto et al., (2012) projects that the northern part of the basin will have one of the highest urbanization regions

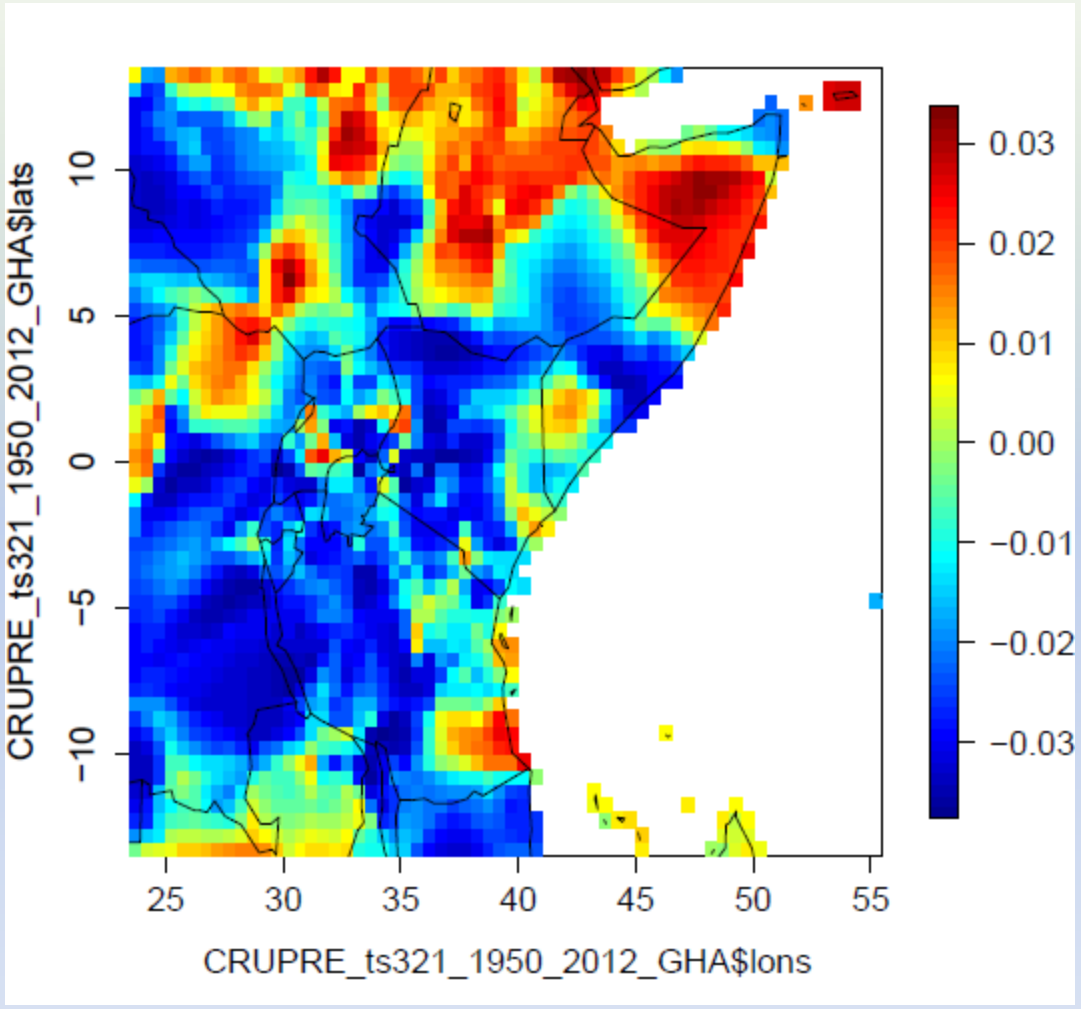
Simulated Impacts on Rainfall Due to Urbanization



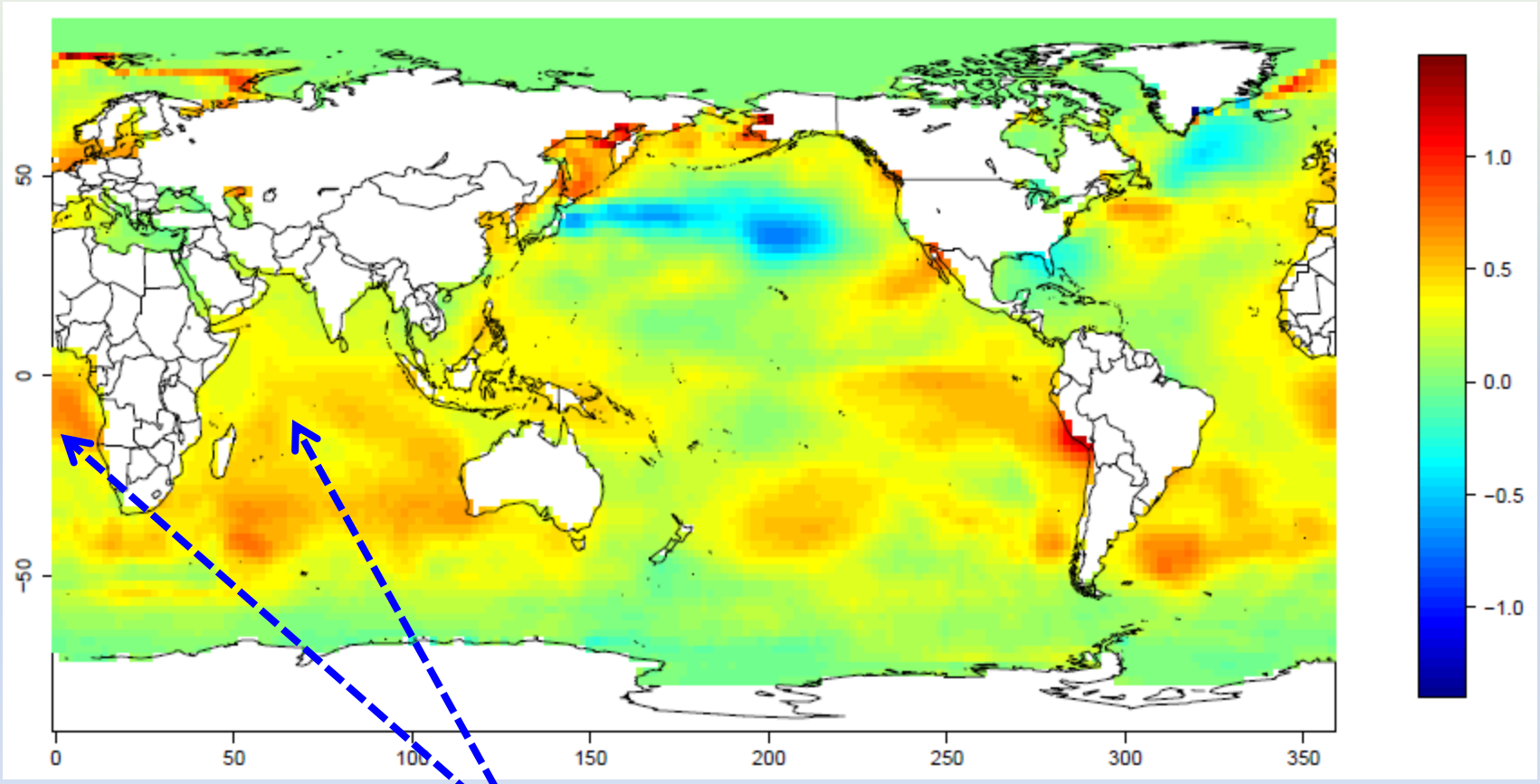
Global Warming Mode – EOF1 of March-April-May Rainfall (CRU)







SST Composite Corresponding to EOF1 March-April-May Rainfall (CRU)



Atlantic & Indian
Ocean Warming

Key Science Questions

- What is the Role of Atlantic & Indian Oceans Surface Warming Evaporation vs PGF Effects?
- What is the Role of Land Cover Change on surface temperature?
- What is the role of (i) upwelling, (ii) ocean currents, & (iii) stratus clouds in modulating Ocean surface temperature?

- What is the Role of Gill-Type Secondary Response
- What is the Role of Trapped Large Amplitude Rossby Waves-Response?

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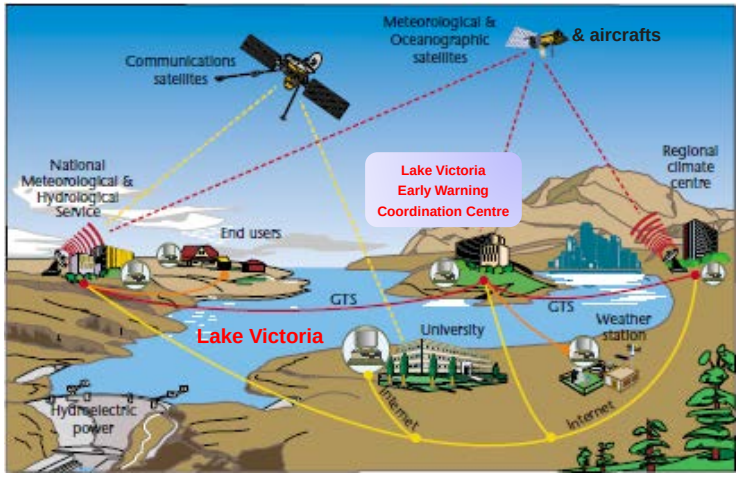
HyVIC Research Theme-5: Observation of the Hydroclimatological System

To understand and develop the variability of the hydrological components over Lake Victoria Basin this research theme will focus on observations

Atmospheric & Terrestrial Observations



Marine Observations for the 3-Dimensional Fluid System

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

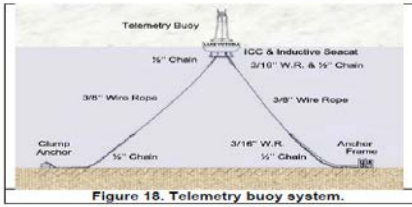
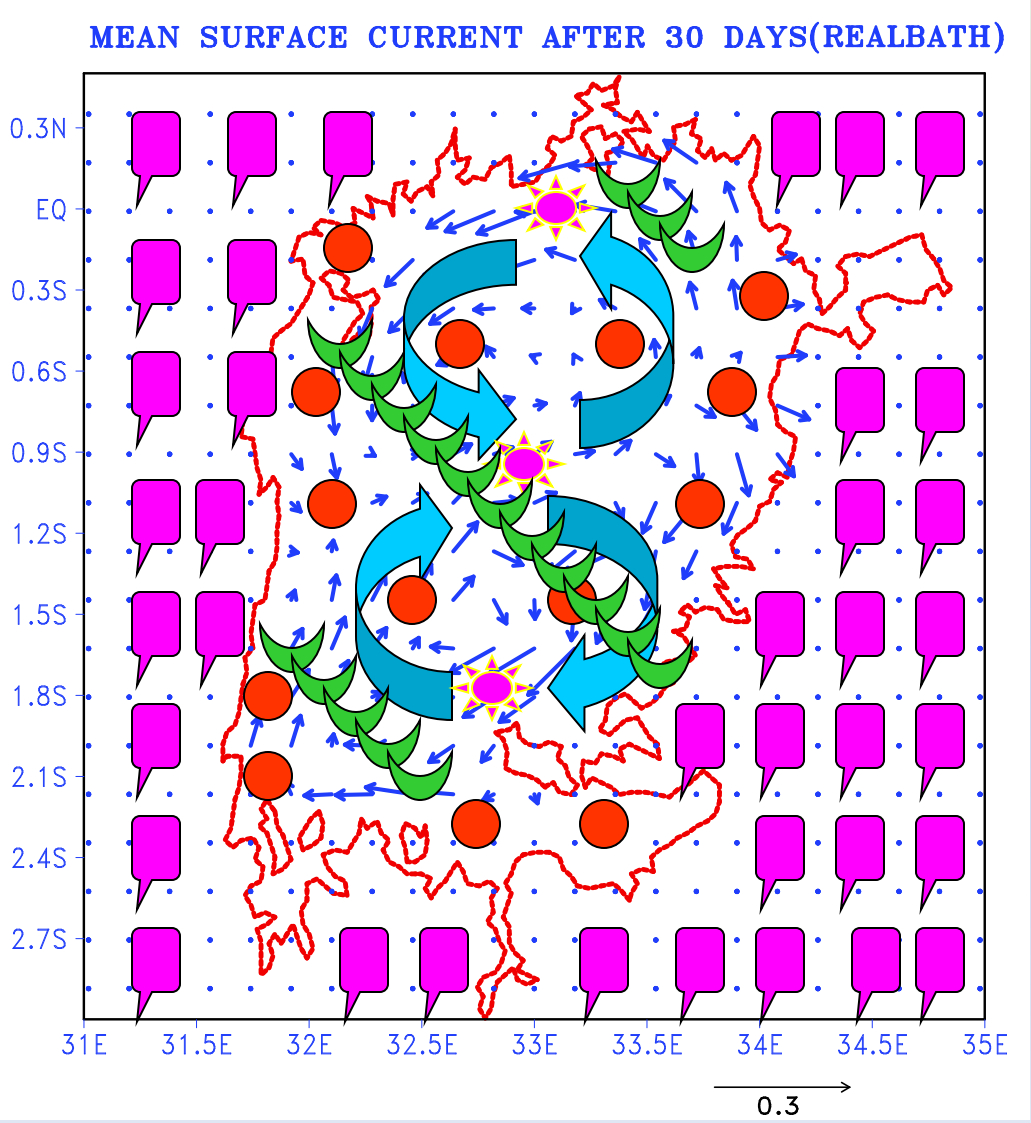


Figure 18. Telemetry buoy system.

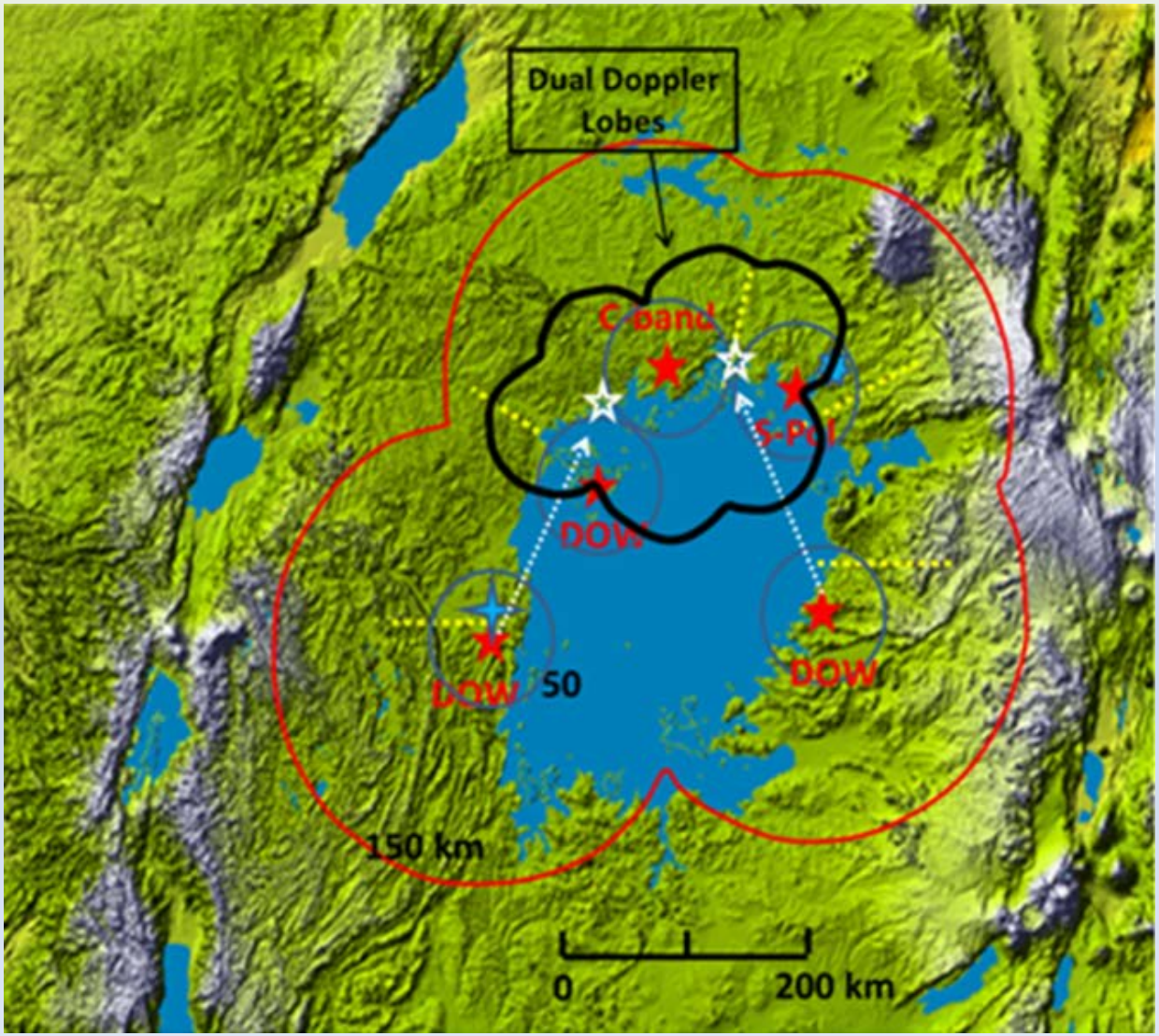
Figure19. Telemetry buoy sensors.

Proposed Observational Network



- Drifters for surface currents (@ 2k) + boats for relocation & synoptic measurements
- ADCP: Acoustic Doppler Current Profiles (3 @ $30K)
- CTD: Conductivity, Temperature and Depth (3 @ 10K)
- Ship transects
- Land-based temporary meteorological stations

The Field Project



- Meteorological Understanding
- Scientific Validation
- Statistical Verification

Red Stars – surveillance radar

White Stars – hi res radar, dual-doppler

Blue Star 6 – IOS

Blue Star 4 – Upper Air Station

Yellow – Met Stns

Caroline Bain, UKMO

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HyVic Network

Global Energy and Water Exchanges Project
GEWEX
WCRP

WCRP
World Climate Research Programme

NCAR/UCAR

GRACE

Curtin University Australia

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
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UbuntuNet Alliance
for Research and Education Networking

NSF Expedition

NC STATE UNIVERSITY

ICPAC-IGAD

CEH-UK

Centre for Ecology & Hydrology

AfClix

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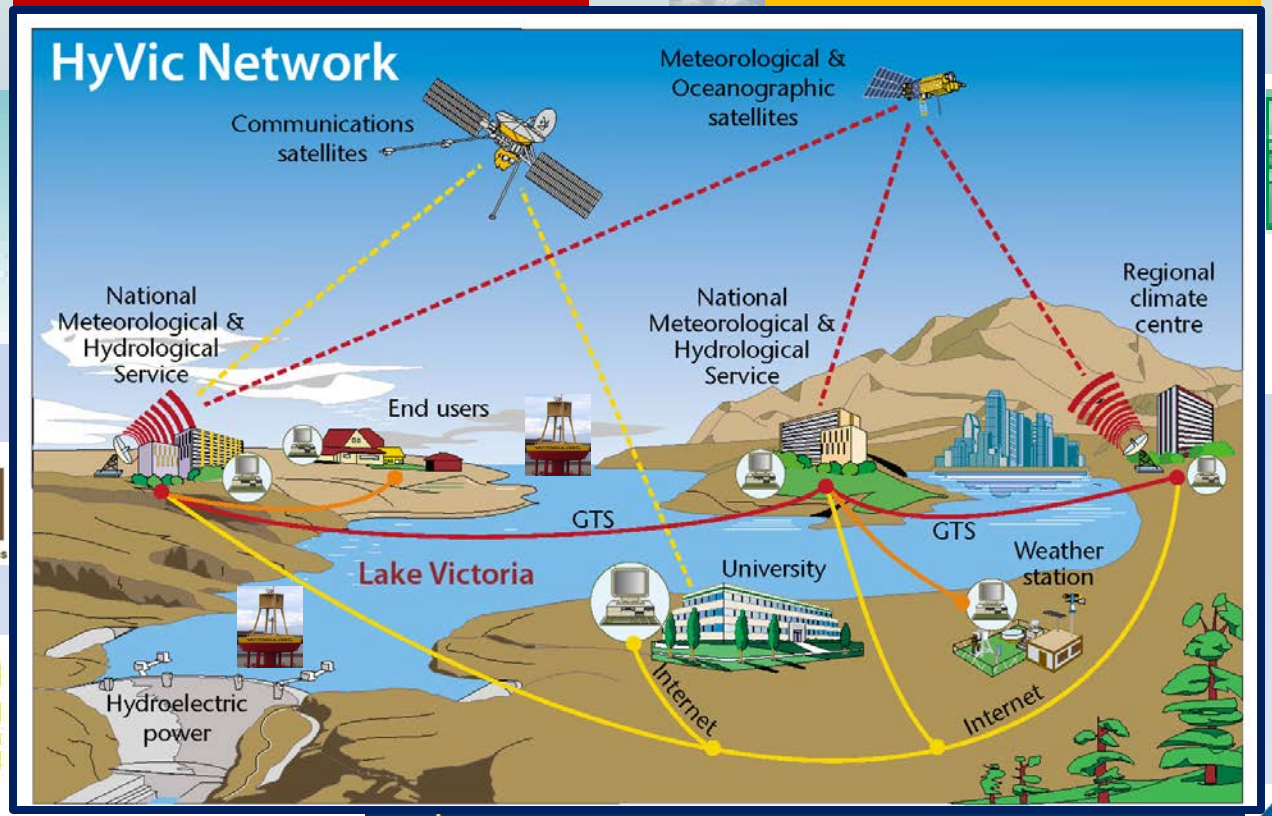
Africa Climate Exchange

University of Reading



U Liverpool
Quantifying Weather & Climate Impacts
QWeCI
on health in developing countries

LVBC

CSRP

Met Office
Hadley Centre

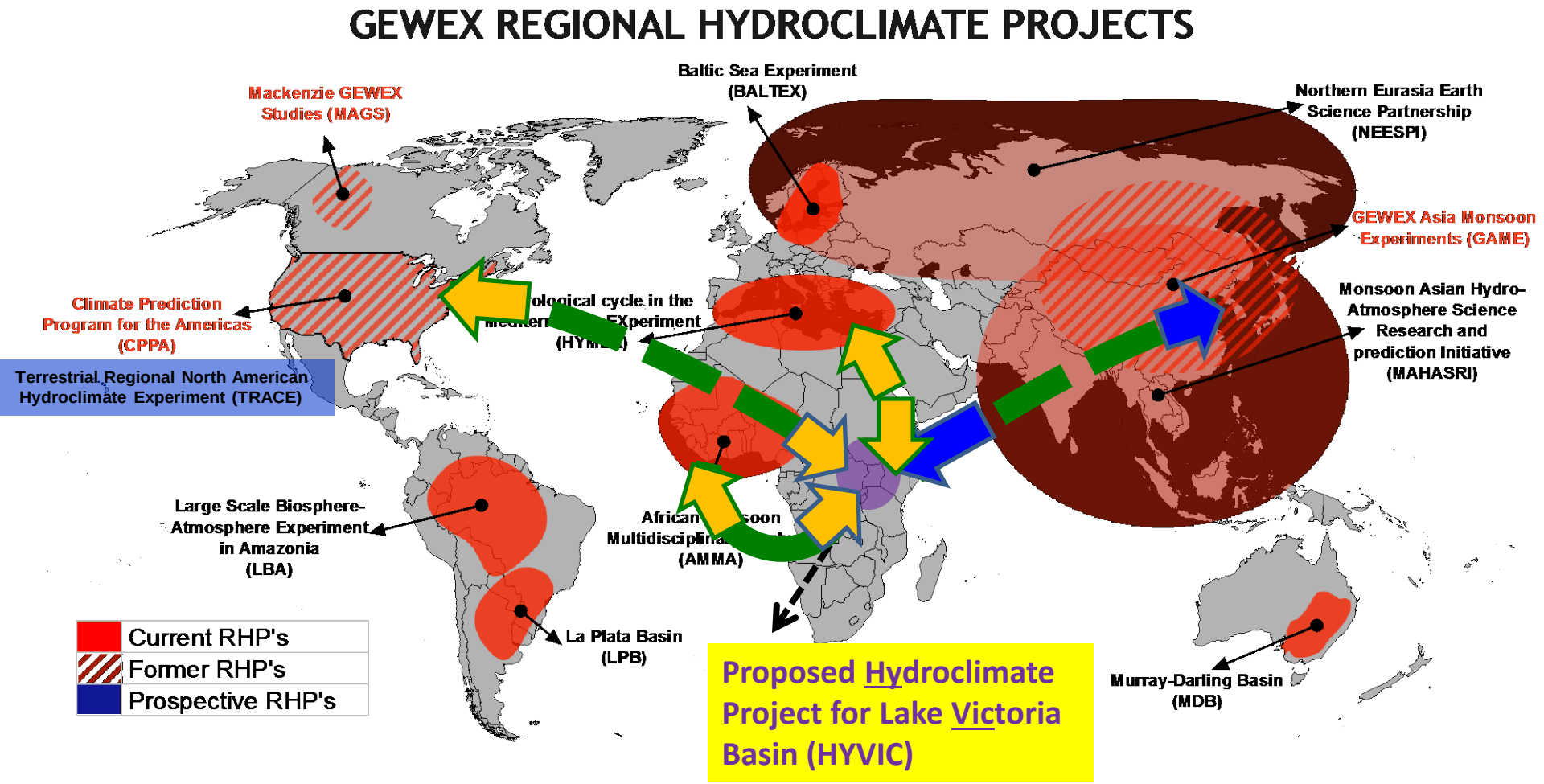
WWRP
WORLD WEATHER RESEARCH PROGRAMME

World Meteorological Organization SWFDP
Weather • Climate • Water

Stony Brook University

SoMAS
School of Marine and Atmospheric Sciences

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



Regional water cycles

HyVic Governance and Coordination

HyVic IPC: An international planning committee (IPC) for HyVic has been formed by GEWEX GHP to (i) update and finalize the science plan, (ii) set the overarching science questions to guide the project, (iii) prepare communication material for HyVic, (iv) coordinate partnerships with funding agencies & (v) coordinate proposal submissions to developmental partners.

LVB-HyNEWS: The LVB-HyNEWS Consortium (Lake Victoria Basin - HydroClimate to Nowcasting for Early Warning Systems) has been formed to enhance the coordination, visibility and sustainability of the HyVic, SWNDP (Severe Weather Nowcasting Development and Demonstration Project) and EAC NEWS (Navigation Early Warning System) for Lake Victoria projects. LVB-HyNEWS is governed by an Executive Council consisting of EAC/LVBC, Heads of NMHS with AMCOMET Secretariat as an invited observer. LVB-HyNEWS has a day-to-day coordinating team (LVB-HyNEWS Task Force) comprising of projects' PIs and the five NMHS technical contacts appointed by the NMHS directors.

Contact Information: Prof. Fredrick Semazzi (IPC Chair; fred_semazzi@ncsu.edu)

Potential Opportunities for Collaboration

- **Opportunity to perform two-way validation of satellite LST and numerical regional coupled model generated LST using information from lake surface temperature sensors fitted on boats. This information will also be used to design and implement an expanded LST boat network (eventually essentially crowd sourcing). The regional coupled model will also give us first guess of where best to focus the domain for the second boat, and later multiple boats, to maximize observational information content. Potential collaborators [EarthTemp, UKMO, NCSU].**

- Use of all-lake satellite LST to drive & validate weather and numerical models; and support planning of observational campaigns. **Potential collaborators [EarthTemp, HyNEWS Consortium, NCSU].**

- Understand the role of ocean currents (Benguela, Agulhas, Somali) as drivers for decadal climate variability over Eastern and Central Africa. **Potential collaborators [Marjolaine Krug?, NCSU].**

- Monitoring the impacts of LLC on surface temperature. [EartTemp, HyVic].


Thank You