Interactive Wetlands/Lakes in CLM-RTM and Impacts in Nile Basin

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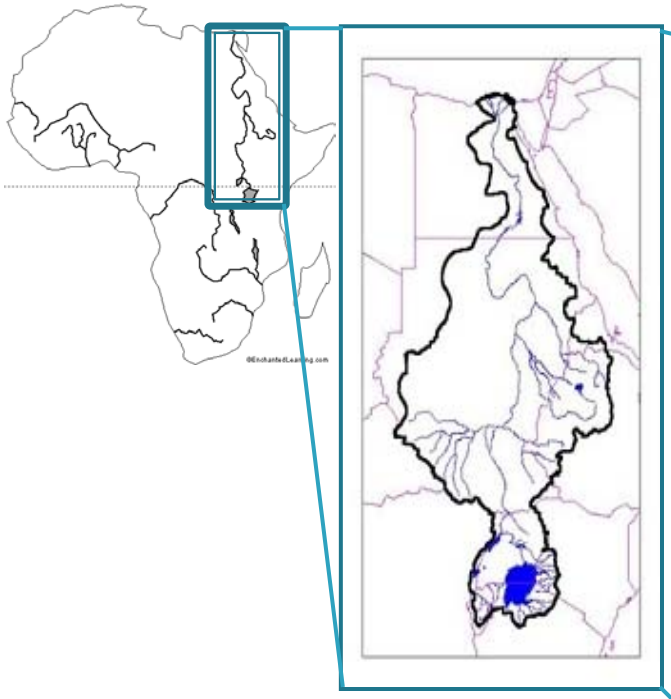
Motivation for Research

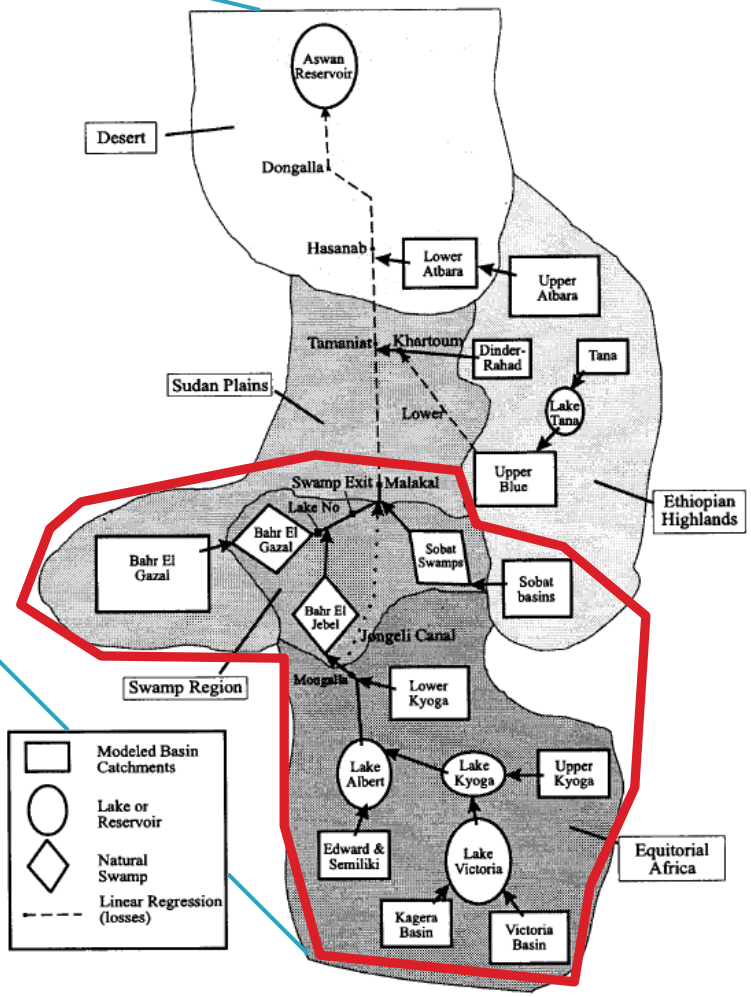
- In CLM, runoff from wetland/lake landunits, runoff as remainder of landunit's fluxes and constant water content

$$Q_{RGWL} = Prec - Evap - \frac{(WB_{end} - WB_{beg})}{dt}$$

  - Constant lake depth, volume
  - Constant wetland area, volume
  - Runoff at each cell computed independently
- RTM collects and routes runoff
- Reflected in outflow values

Nile Basin – White Nile

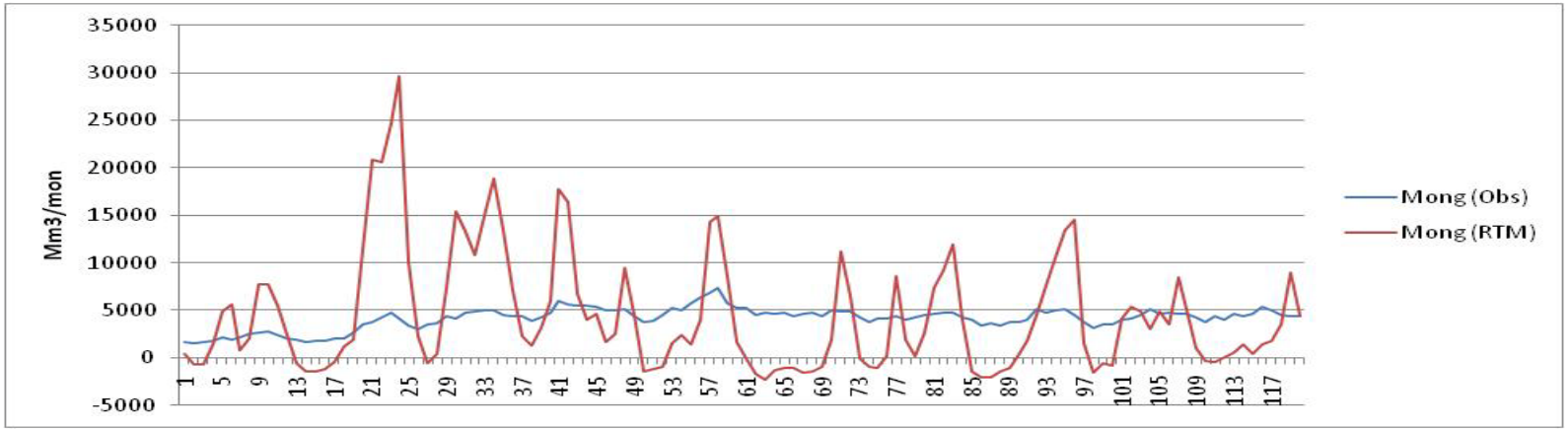




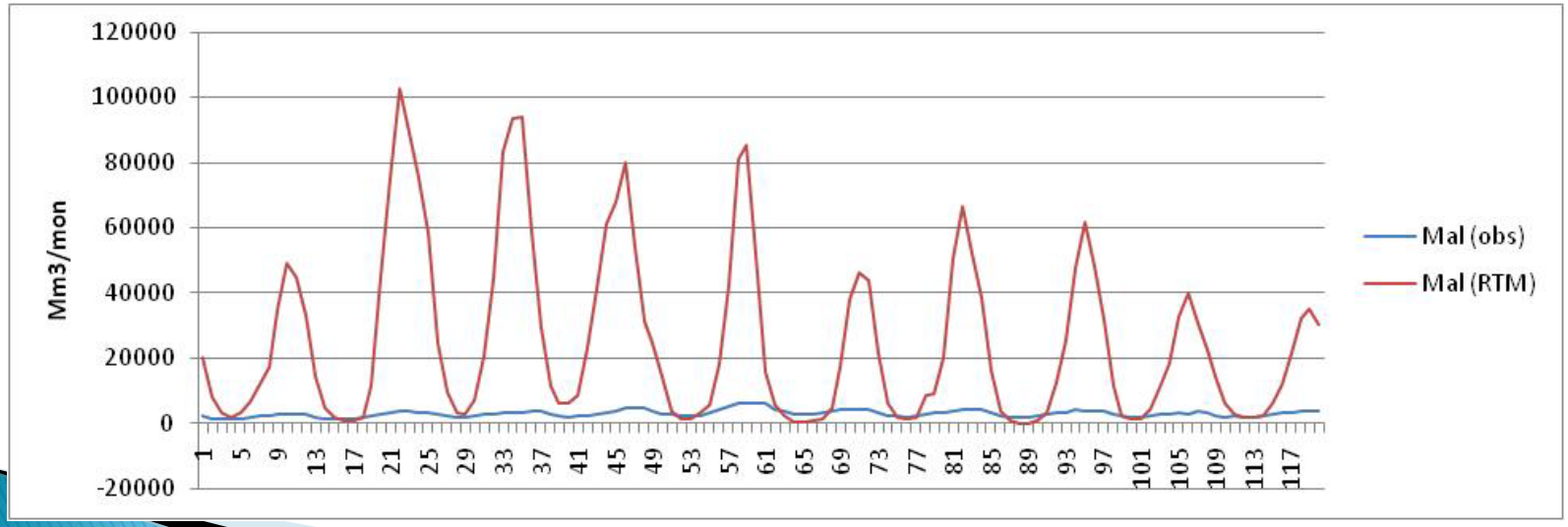
From Strzepek and Yates, Journal of Hydrologic Engineering, 1998

6 sub-basins:
- Lake Victoria
- Lake Kyoga
- Lake Albert
- Sudd Wetland
- B. el Ghazal Wetland
- Sobat Wetland

Outflow in Nile Basin



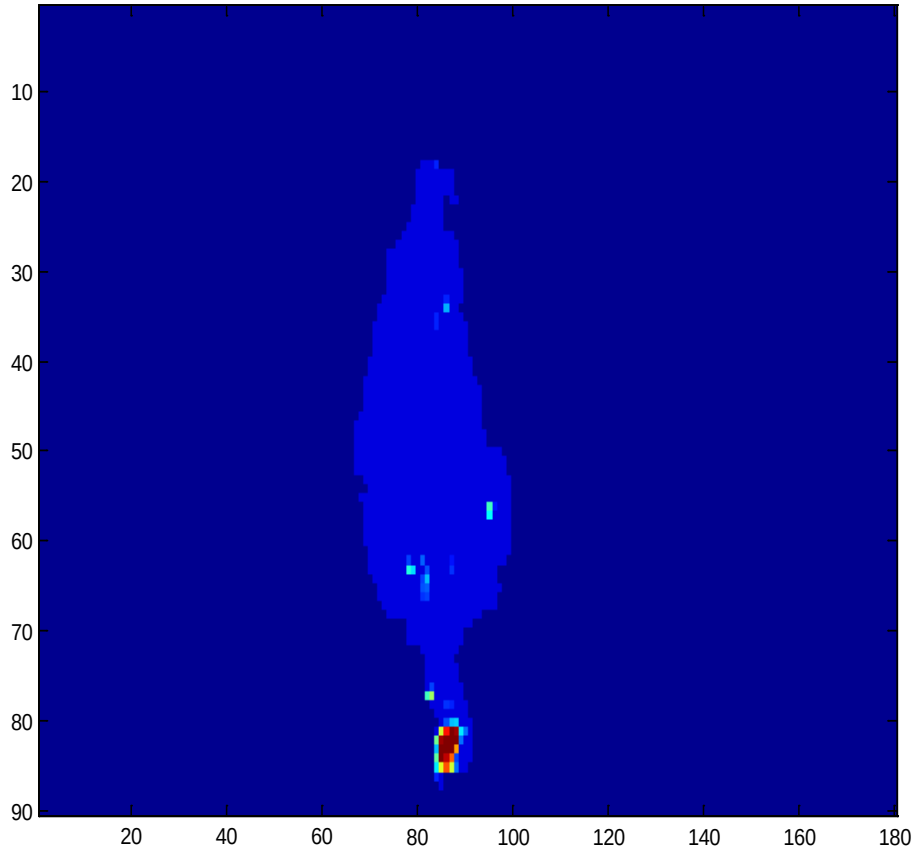
Outflow below 3 lake, 1960-1969



Outflow below all 6 sub-basins, 1960-1969

Research Methodology

- Recognizing when contiguous wetland/lake cells are part of the same unit
  - Use of structured arrays
  - Localize flow to form wetland/lake clusters
  - Single discharge cell



Grid cell lake, wetland cover, from CLM 3.5 database

Wetland/Lake Models

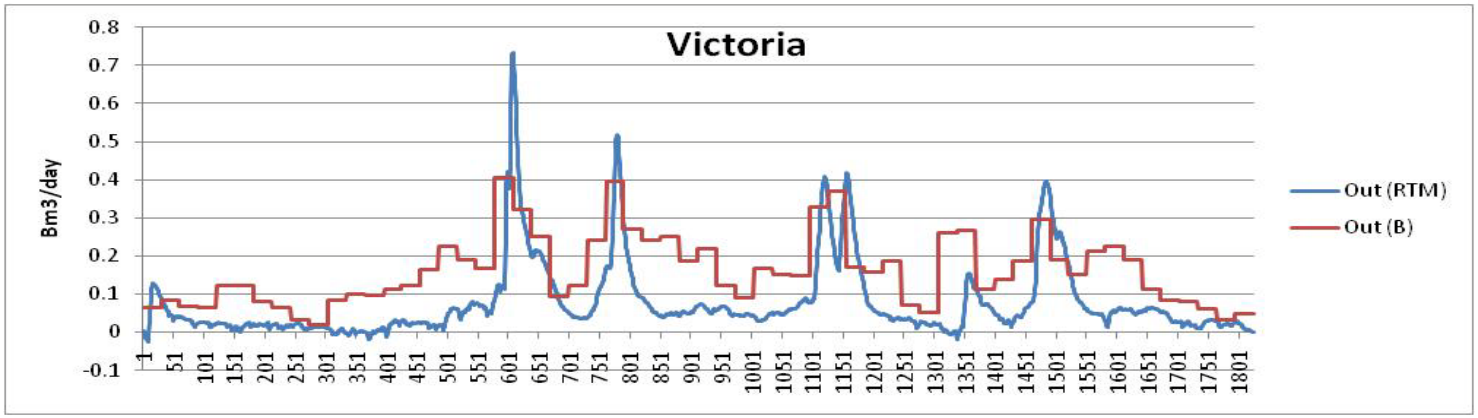
- Build in equations for calculating lake/wetland discharge
  - Collect all flows into lake/wetland clusters
  - Average P–E for group of cells
  - Variable Storage
  - Outflow function of volume, P–E, inflow, geometry
- Correct parameters for different RTM time steps (daily, monthly)

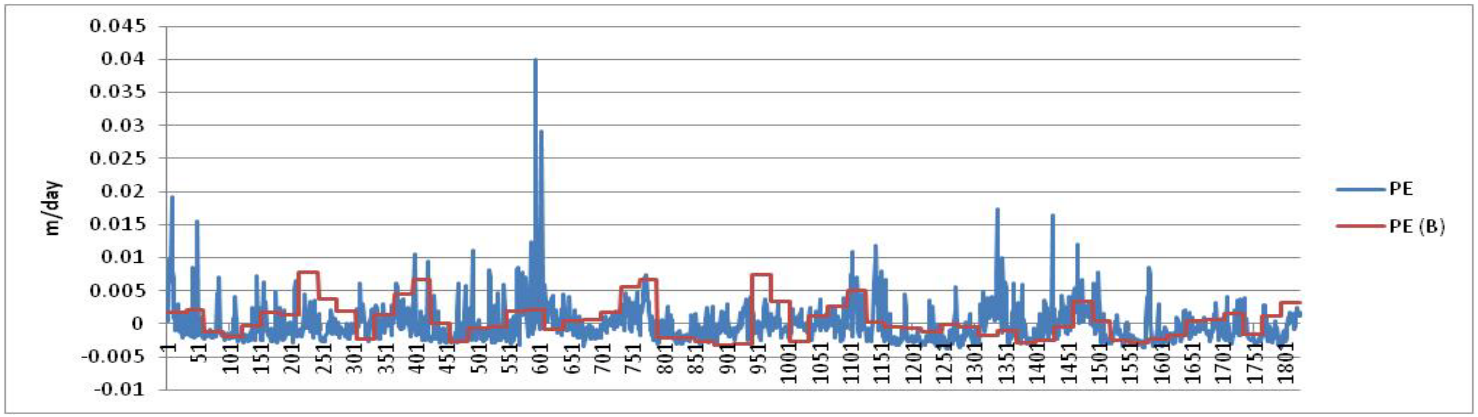
$$\frac{dV}{dt} = I + \left(P_{eff} - PET\right) \cdot \left(a_1 V^3 + a_2 V^2 + a_3 V\right) - \left(b_1 V^2 + b_2 V + b_3\right)$$ Lake Equation

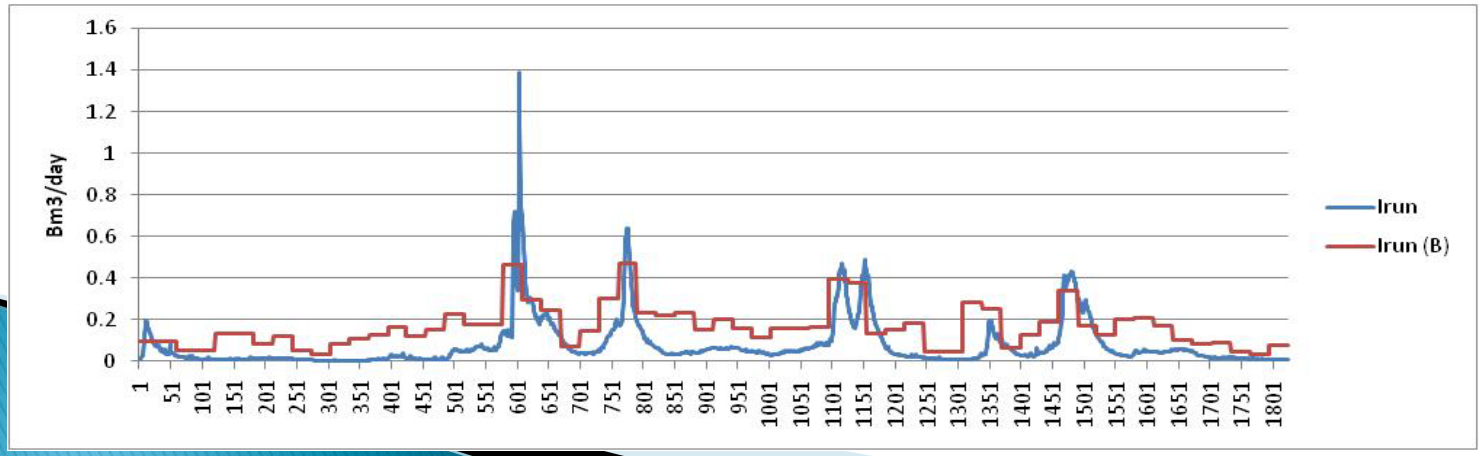
$$\frac{dV}{dt} = I + \left(P_{eff} - PET\right) \cdot \left(kV\right) - \left(bV^2\right)$$ Wetland Equation

(from Block and Rajagopalan, 2009)

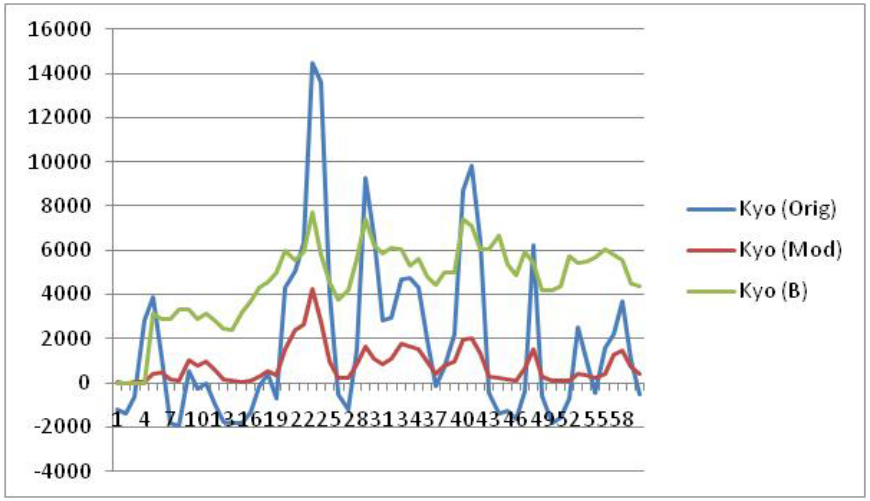
Lake Victoria Results

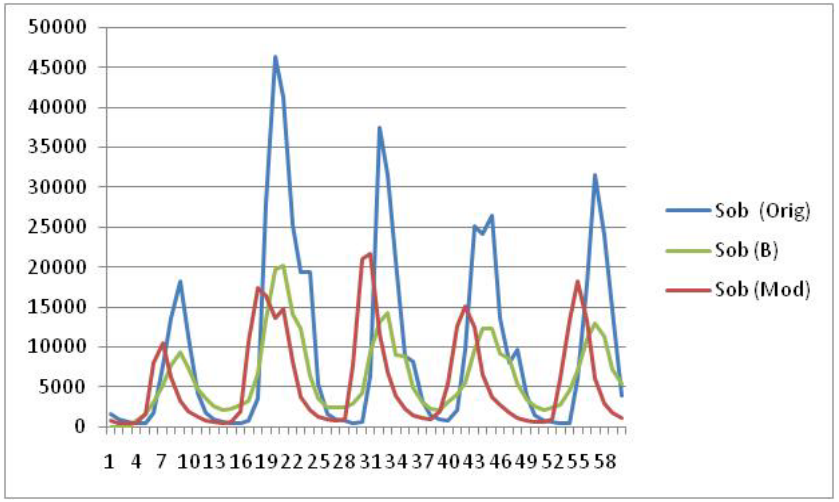


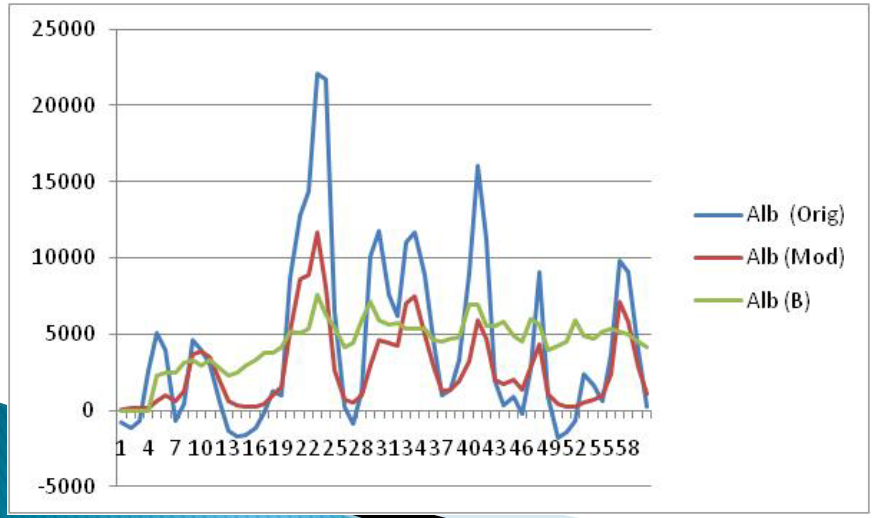


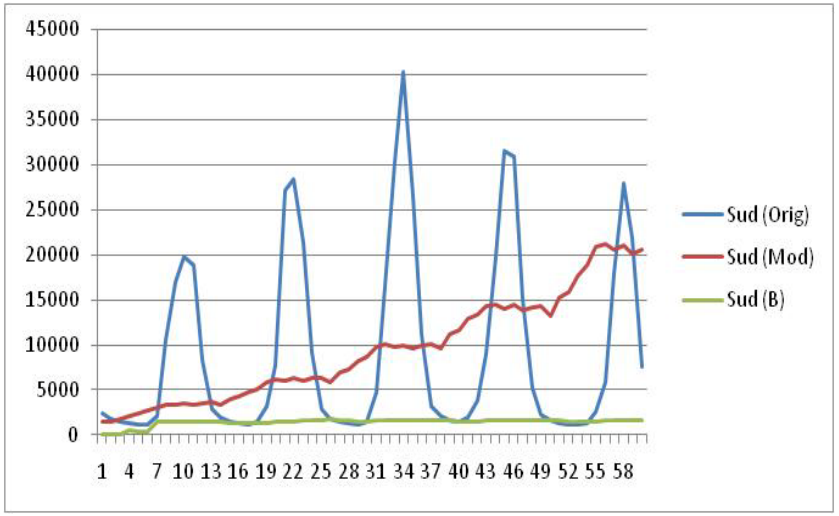


Model Results (outflow in Mm3/mon)



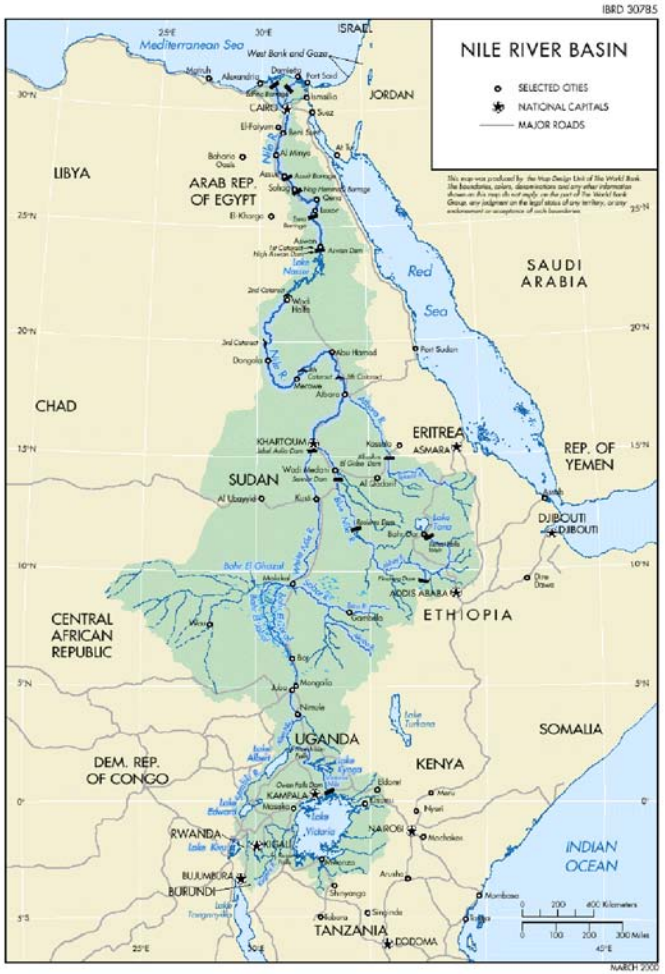






Current/Future Work

- Currently
  - Analysis of CLM/RTM input data (P-E, inflow) to observed
- Long term goals
  - Using modified RTM runoff for policy related research



Thank you.

- References

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