

Application of Variable Infiltration Capacity (VIC) Model to Support Water Resources Management in Tanzania

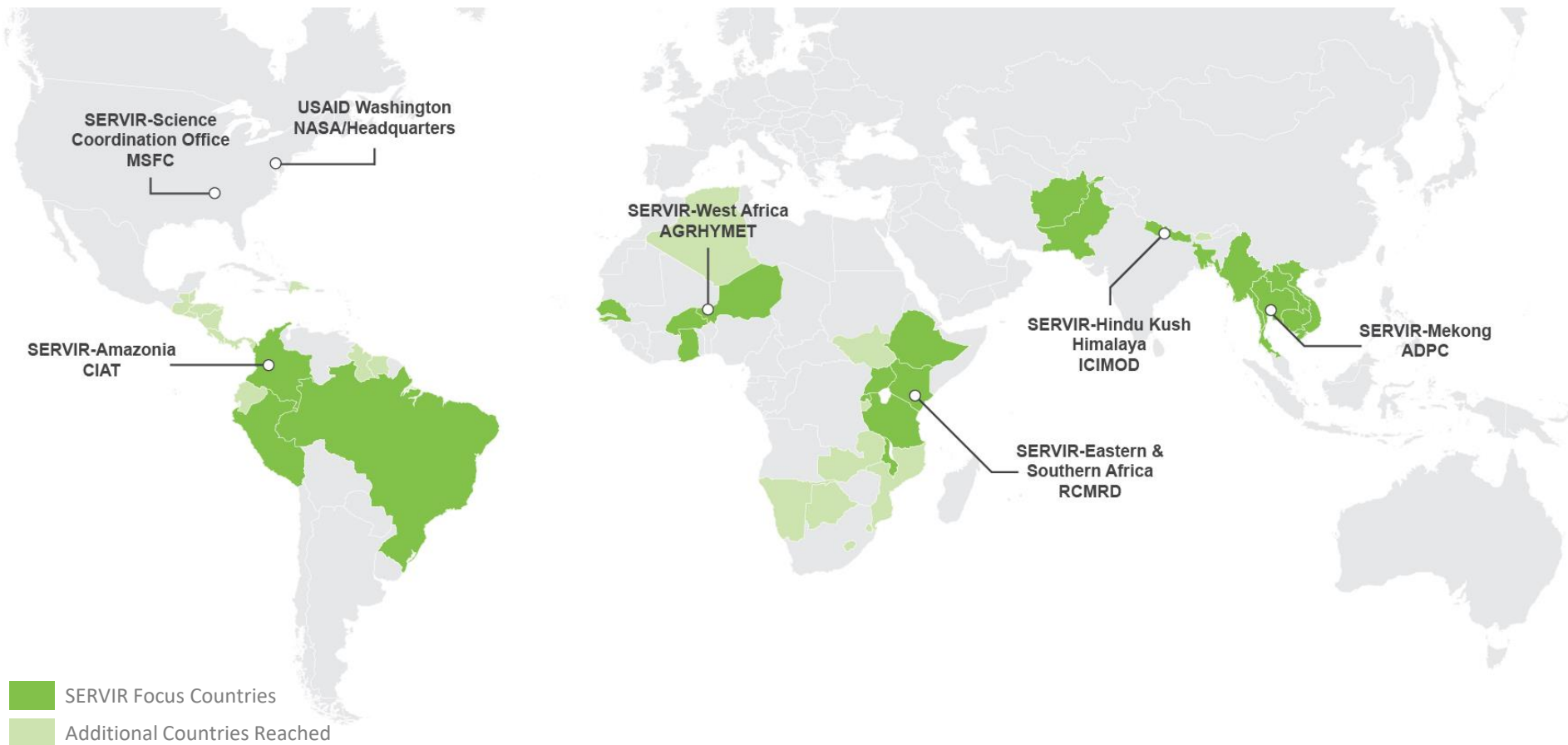
RCMRD/SERVIR-Eastern & Southern Africa
Nairobi, Kenya



Presenter: Kasiti Felix



SERVIR Focuses on Countries in Asia, Africa, and the Americas



SERVIR Eastern & Southern Africa Services



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AGRICULTURE AND FOOD
SECURITY



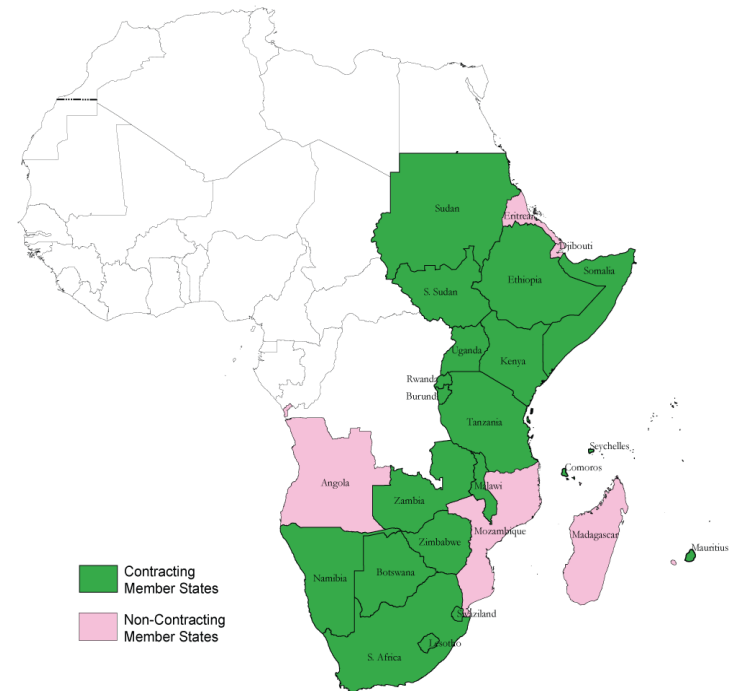
WEATHER AND CLIMATE



WATER AND WATER RELATED
DISASTERS



LAND ADMINISTRATION
& MANAGEMENT

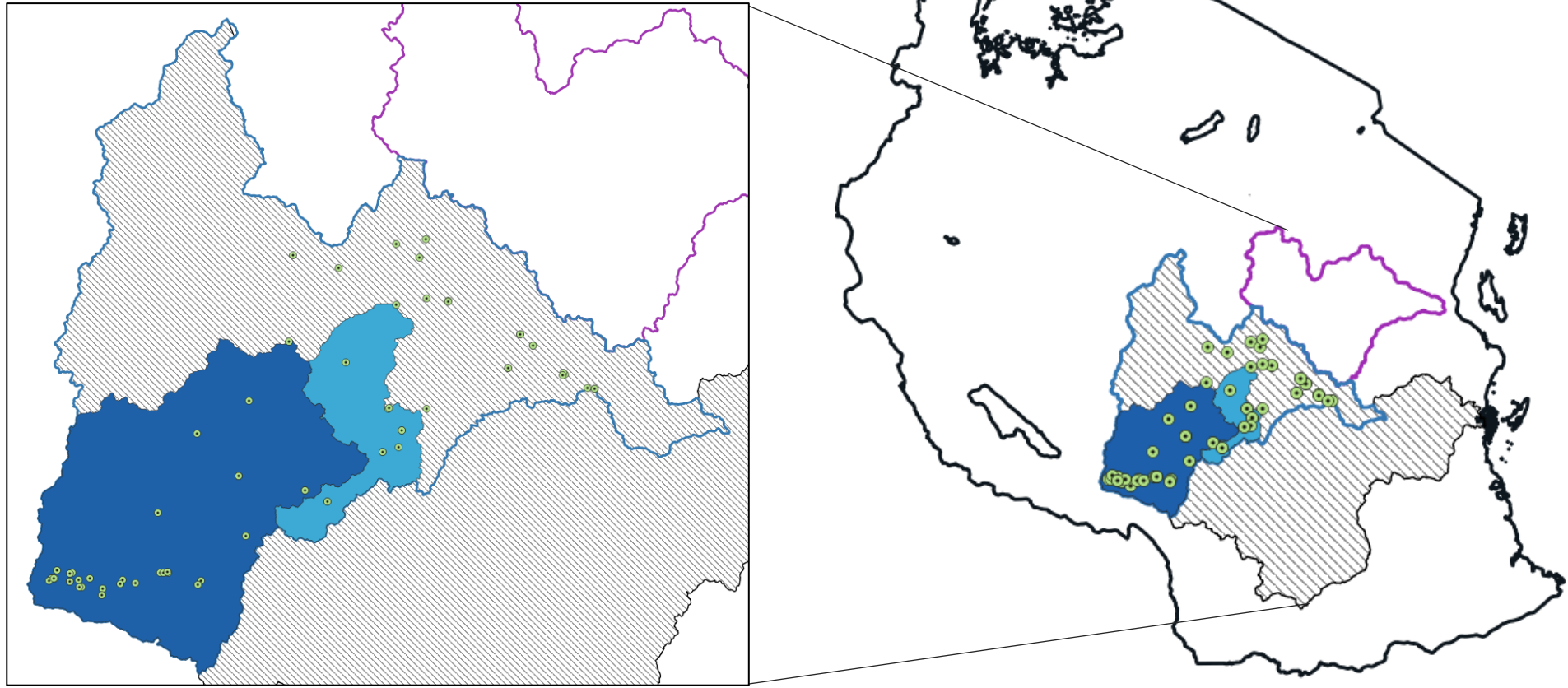


Area of Interest

Great Ruaha River Basin

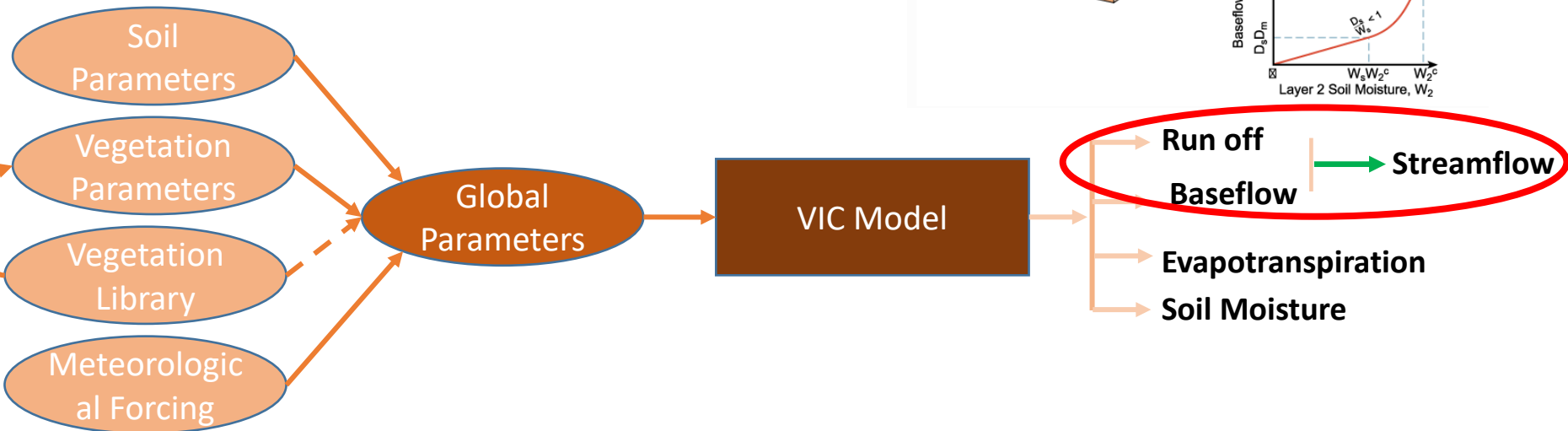
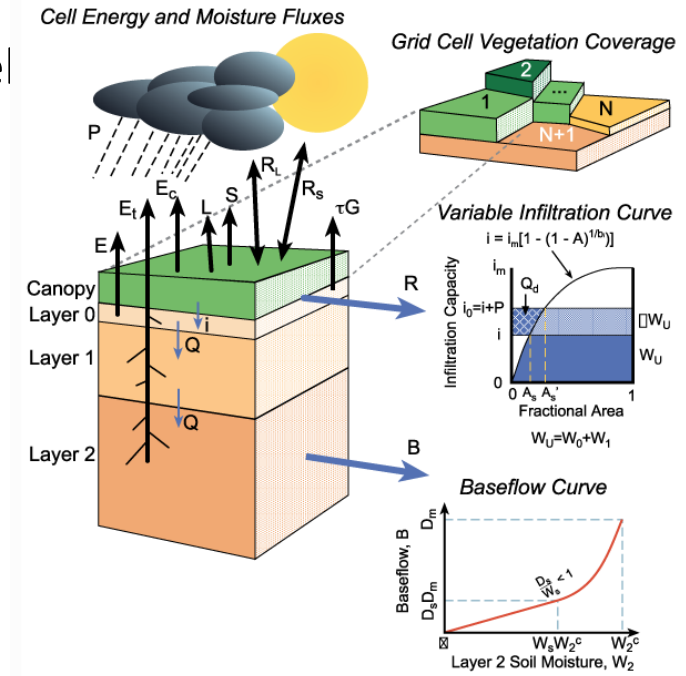
83,970 sq. km. (32,421 sq. mi.)

Wami- Ruvu Basins

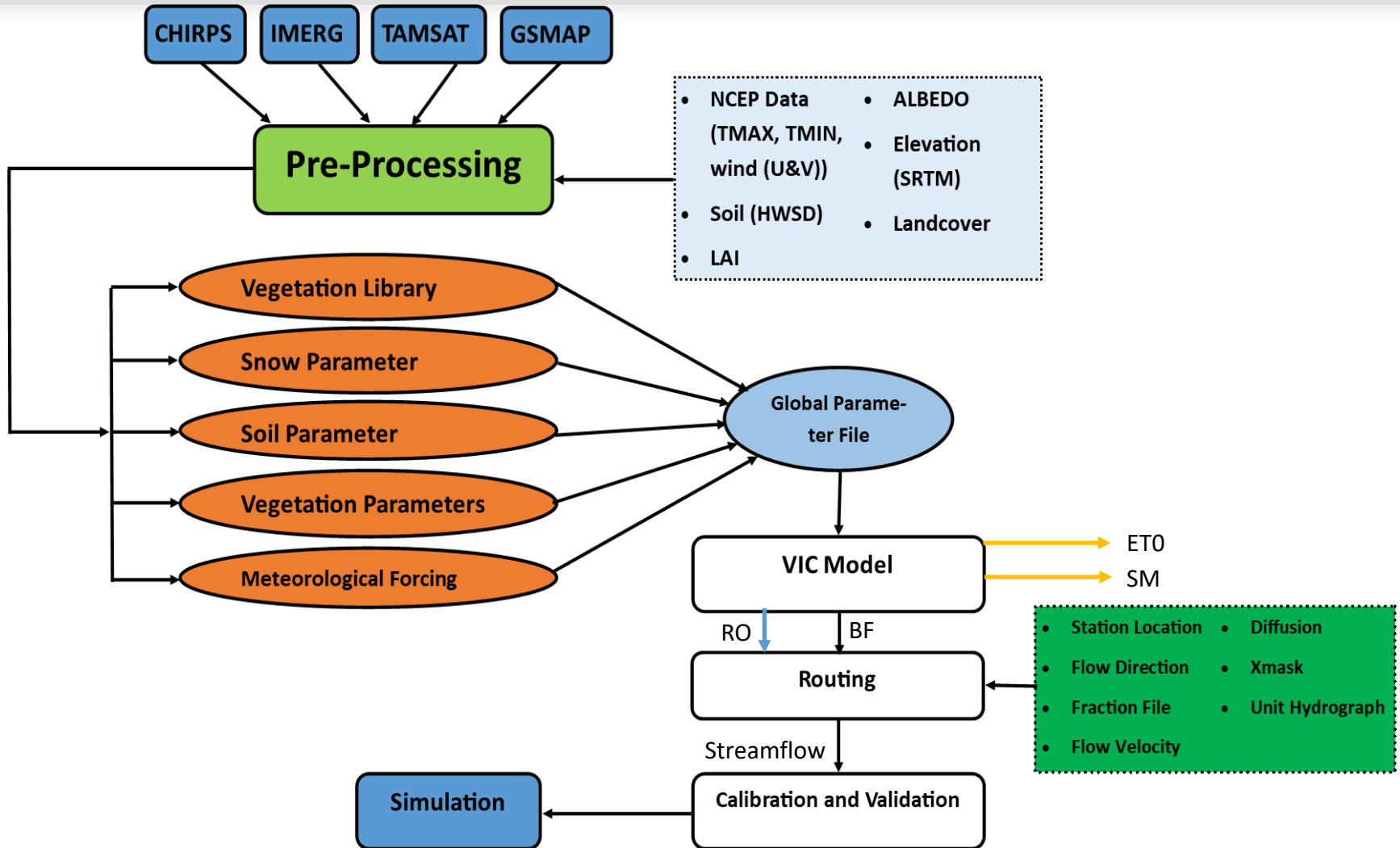


Variable Infiltration Capacity Model (VIC)

- Developed by Xu Liang at the University of Washington
- Semi-distributed macroscale hydrologic model
- Solves full water and energy balances
- Land Surface = >1KM grid cells
 - No communication between grid cells → Need to use a routing model
- Water can only enter a grid cell from the atmosphere
 - Does not account for non-channel flow



VIC Model Setup Workflow

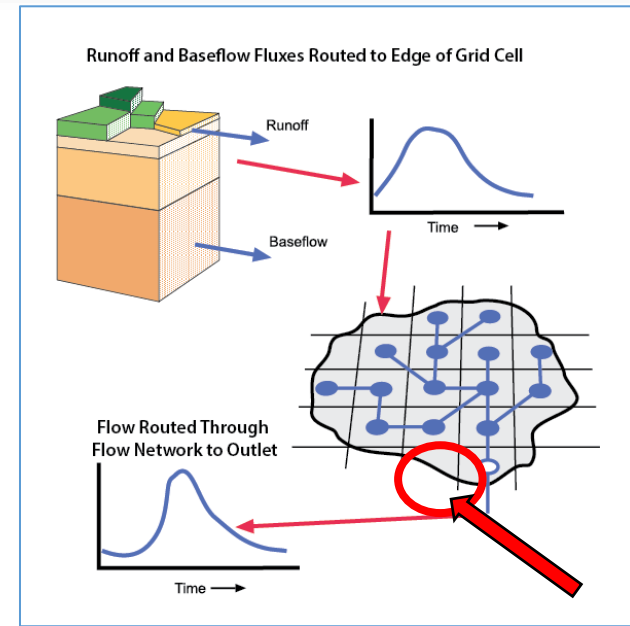
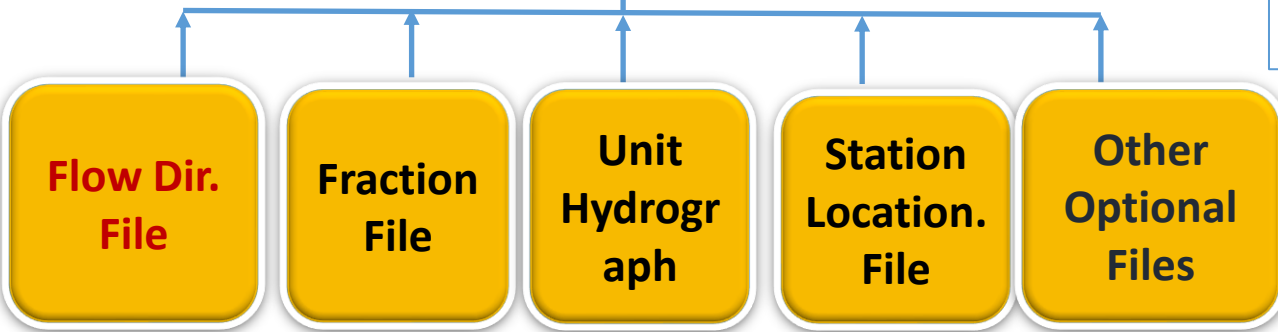
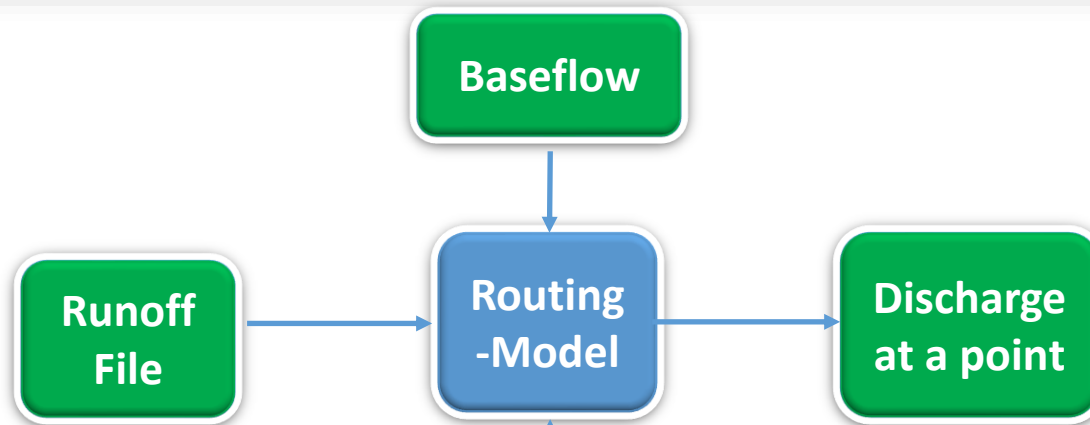


Free & Open-Source Approach



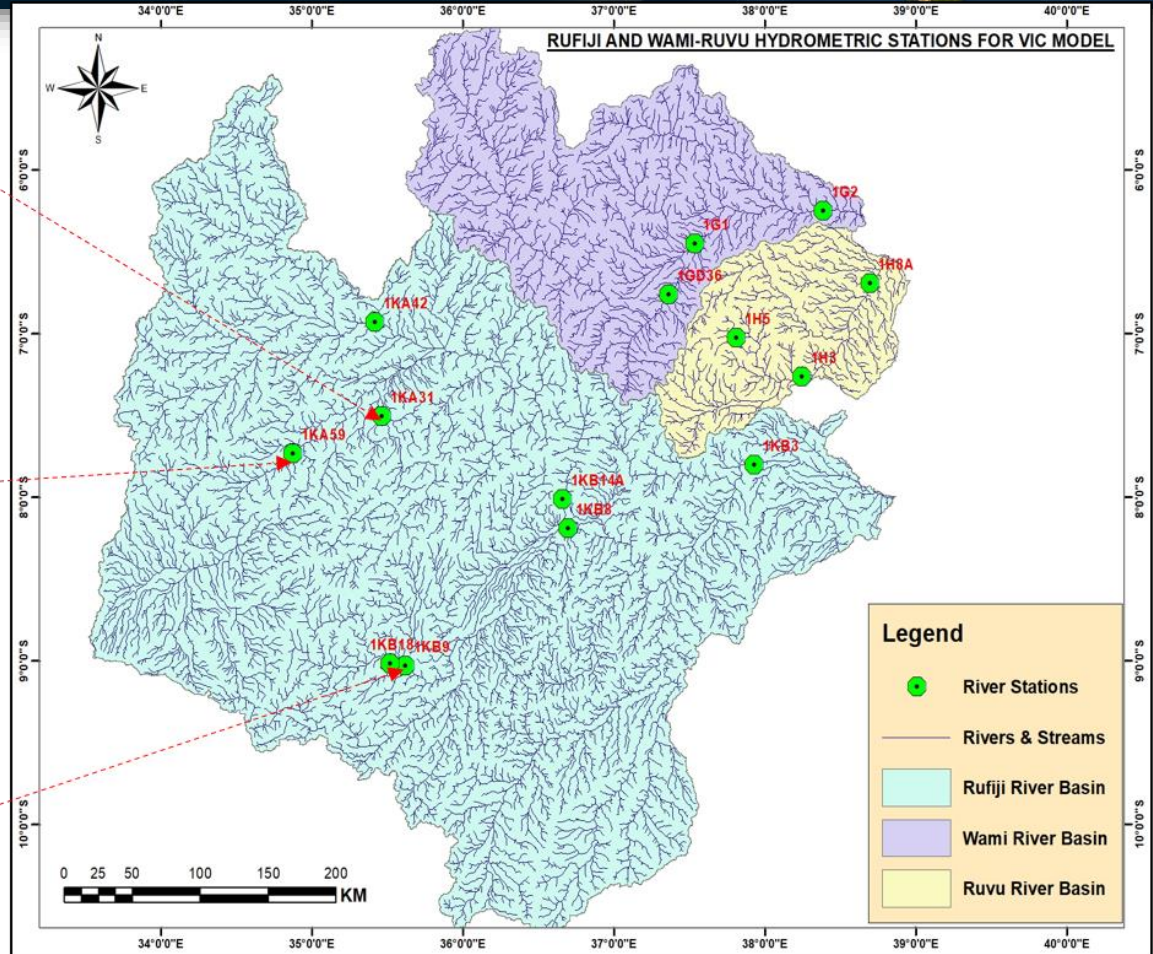
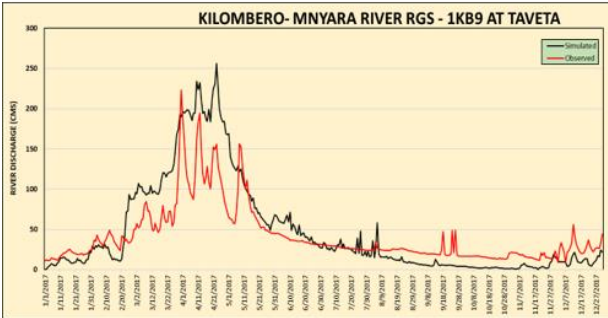
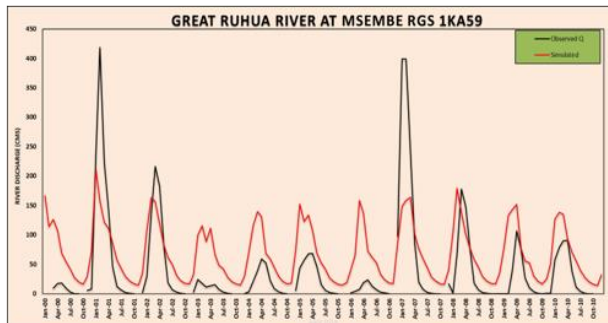
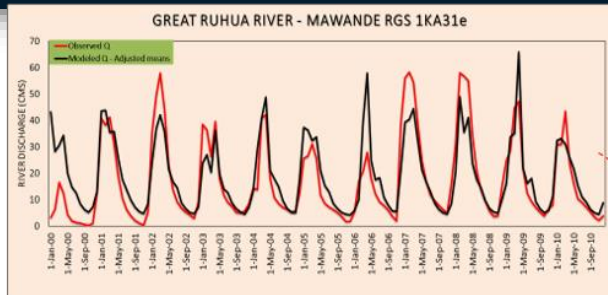
Dataset	Use	Source
SRTM DEM (30m)	Elevation Raster Slope Raster	NASA/ USGS via Google Earth Engine
MODIS Land Cover (MCD12Q1) (500m)	IGBP Classified Raster	NASA LP DAAC via Google Earth Engine
CHIRPS Daily Precipitation	Annual Precipitation Raster/ Forcings	UCSB-CHG via Google Earth Engine
WWF HydroSHEDS Drainage Direction (3 Arc Seconds)	Flow Direction Raster	WWF via Google Earth Engine
HWSD Soils MU Global – v 1.2 (30 Arc Seconds)	Classified Soils Raster	FAO SOILS PORTAL http://www.fao.org/soils-portal/en/
NCEP/NCAR Reanalysis 1	Forcings (Max Temp, Min Temp, Wind Speed)	https://psl.noaa.gov/data/gridded/data.ncep.reanalysis.surface.html
MERRA-2 Reanalysis Data Dailly	Forcings (Max Temp, Min Temp, Wind Speed)	NASA https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/
MODIS LAI/ FPAR 4-Day Global (500m) (MCD15A3H)	Monthly LAI Rasters for Period of Record	NASA LP DAAC via Google Earth Engine
MODIS BRDF-Albedo 16-Day Global (500m) (MCD43A2)	Monthly Albedo Rasters for Period of Record	NASA LP DAAC via Google Earth Engine

Routing of flow



- Multi-gauge routing

Model Calibration & Validation



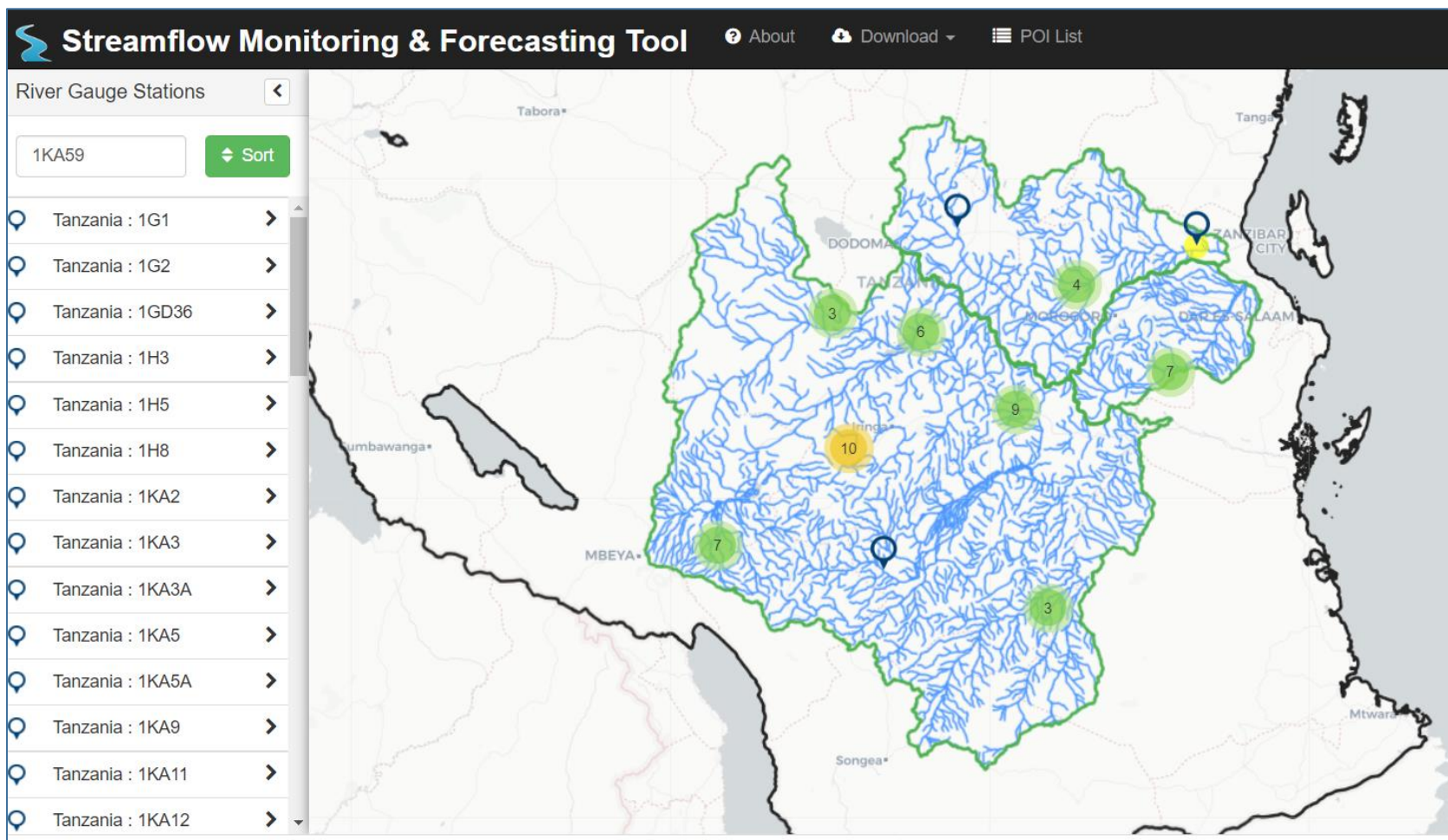
	CHIRPS	TAMSAT	IMERG	GSMAP
NSE	0.65	0.53	-0.71	-0.14
Bias	-6.63	-14.61	5.96	-26.54
RMSE	39.62	46.06	87.34	71.51

	CHIRPS	TAMSAT	IMERG	GSMAP
NSE	-2.78	0.15	-11.14	-0.14
Bias	69.67	-0.62	121.36	-27.56
RMSE	145.03	68.83	259.84	79.47

Product – Streamflow Monitoring Viewer



- ❖ Streamflow Monitoring and Forecasting for Data and Water Resources Planning, Allocation and Management addressing competing demands (<http://streamflowmonitor.rcmrd.org/>).

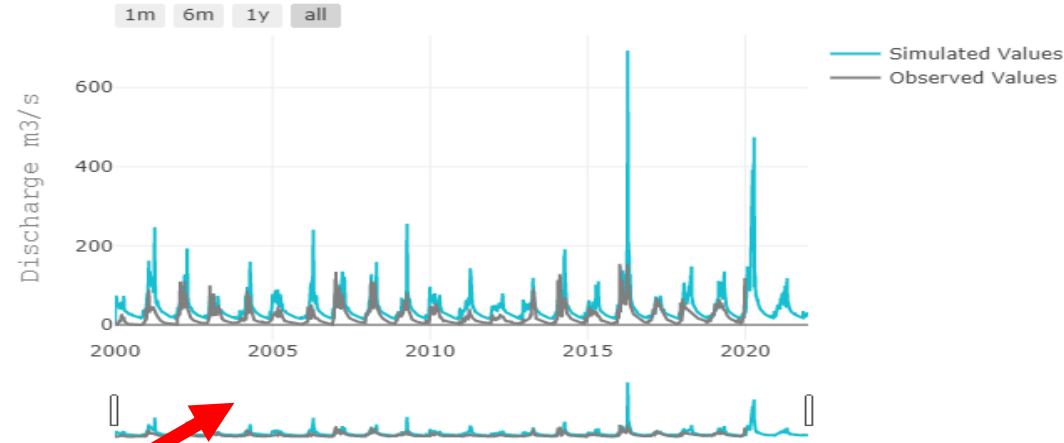


Operational Hydrological Model Tool



<http://streamflowmonitor.rcmrd.org/>

Streamflow Monitoring & Forecasting Tool - Time Series



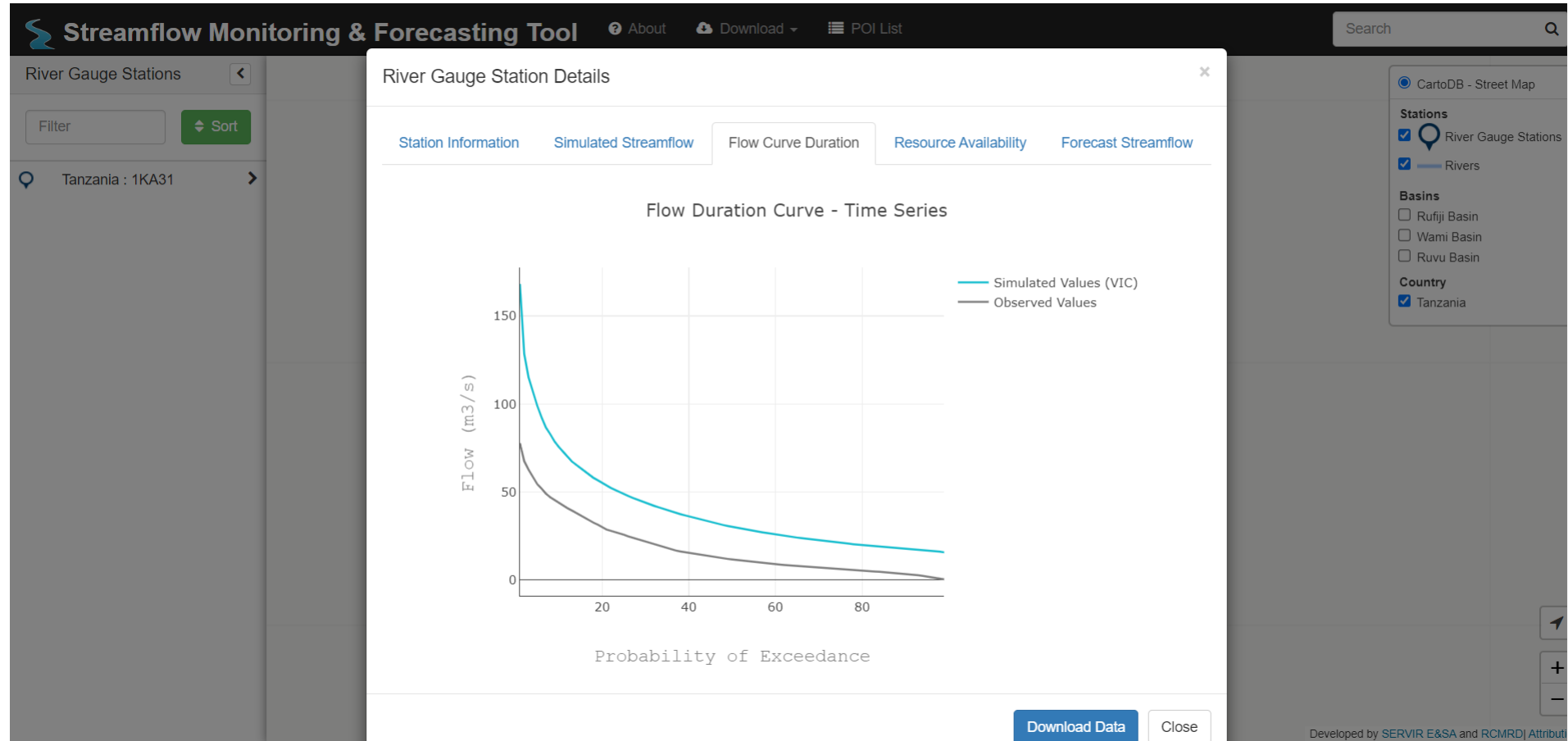
Streamflow Monitoring & Forecasting Tool About Download POI

River Gauge Stations

1KA59 Sort

- Tanzania : 1G1
- Tanzania : 1G2
- Tanzania : 1GD36
- Tanzania : 1H3
- Tanzania : 1H5
- Tanzania : 1H8
- Tanzania : 1KA2
- Tanzania : 1KA3
- Tanzania : 1KA3A
- Tanzania : 1KA5
- Tanzania : 1KA5A
- Tanzania : 1KA9
- Tanzania : 1KA11
- Tanzania : 1KA12

Streamflow Monitoring Viewer—Flow Curve



- ❖ Water Balance not closing – Uncertainty in the input, observed discharge & model error-structure

Streamflow Monitoring Viewer—Flow Indices **SERVIR**

River Gauge Stations

Filter Sort

Tanzania : 1KA31

River Gauge Station Details

Station Information Simulated Streamflow Flow Curve Duration Resource Availability Forecast Streamflow

Study Sub-Catchment Discharge		
Units	m ³ /sec	Million m ³ /day
Reserve / Environmental Flow	16.95	1.46
Normal Flow	19.98	1.73
Flood Flow	30.26	2.61
Flood Discharge (Allocation)	10.27	97.21

Study Sub-Catchment - Spring Flow Conditions		
Units	m ³ /sec	Million m ³ /day
Reserve / Environmental Flow	0	0
Normal Flow (Domestic Use)	0	0
Flood Discharge (Commercial Allocation)	0	0

Download Data Close

- CartoDB - Street Map
- Stations**
 - River Gauge Stations
 - Rivers
- Basins**
 - Rufiji Basin
 - Wami Basin
 - Ruvu Basin
- Country**
 - Tanzania

Thank You

