PhD Thesis Proposal:

Title: Scaling of hydrological processes and modeling a processes based approach to quantify land use change management in the Blue Nile Basin

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WOTRO

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1. Background

➤ Originates from Lake Tana Ethiopia
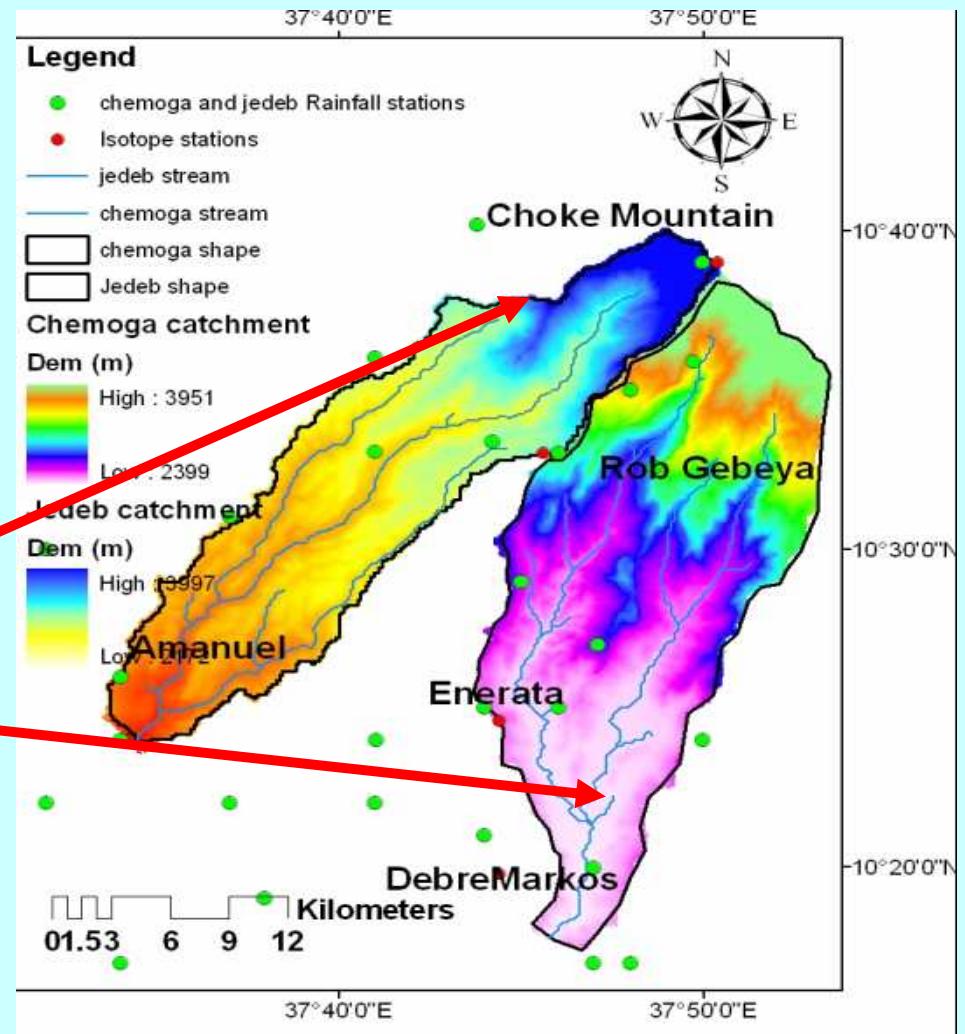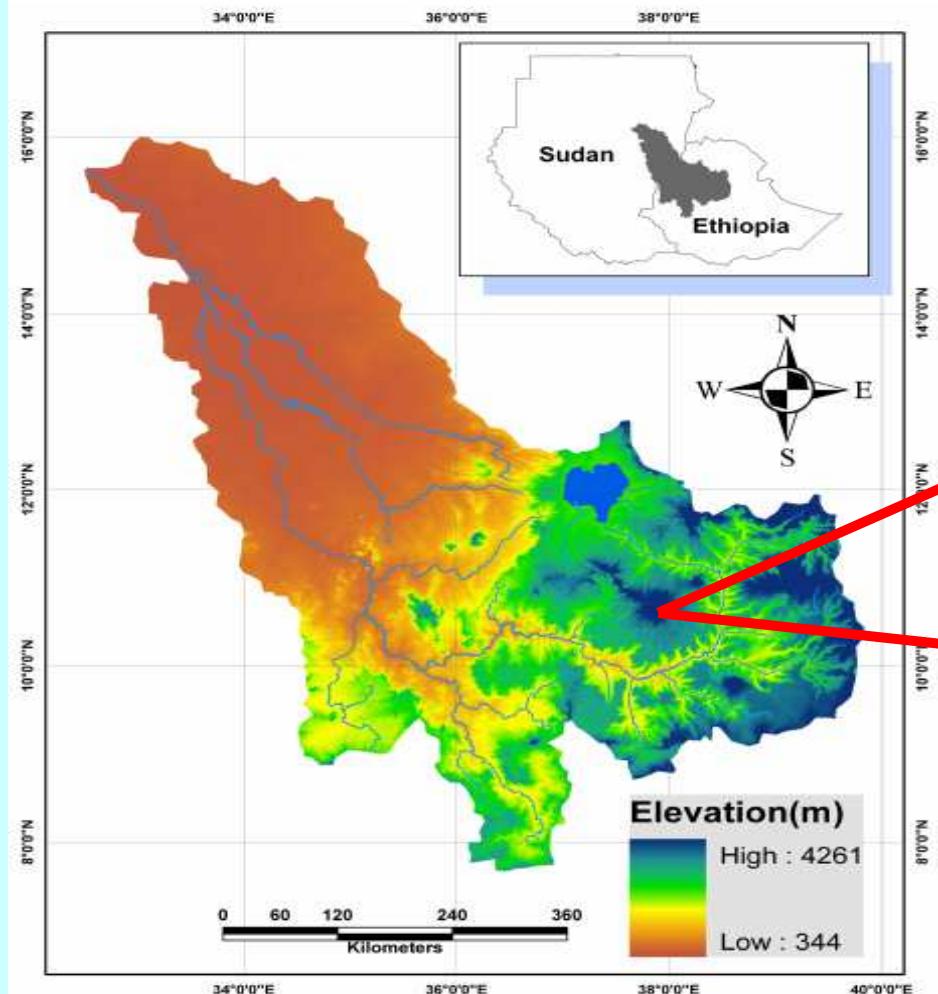
Background

- Catchment area $= 324,530$ (km)^2

- Annually contribute 60 % of the flow to the Nile River   ⟶   (Conway, 2005; UNESCO ,2004)

- Mean annual discharge 48 BCM/year period (1912-1997)   ⟶   (Conway, 2000)

- Annual rainfall ranges 1200-1600 mm/year

- Mean annual temp. 18.3 0c

- Mean annual evapotranspiration 1100 mm/year   ⟶   (Kim et.al,2007)

Background contd..

Land cover Map (BCEOM,1999)
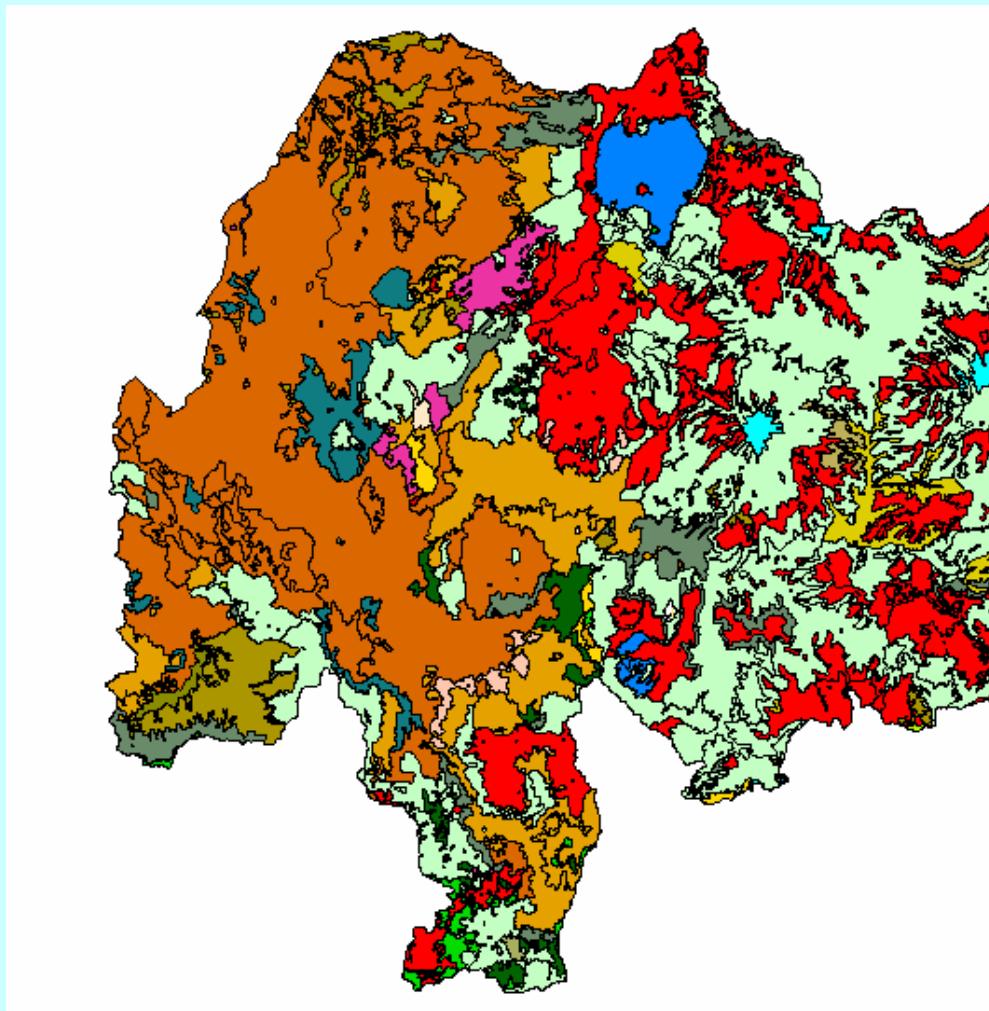
Landcov.shp
- A: Afro alpine
- B1: Bushland
- B2: Bushland
- BA1: Bamboo
- C1: Dominantly cultivated
- C2: Moderatly cultivated
- C5: Irrigated
- C6: Perenial crops
- F2: Forest
- F3: Forest
- G1: Grassland
- G2: Grassland
- H1: water body
- H2: Swamp
- P1.1: Plantations
- R: Rockland
- S1: Shrubland
- S2: Shrubland
- SF: State farm
- U: Urban
- WD: Woodland dense
- WO: Woodland open
- WR: Woodland riparian

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Background contd…

Soil Map (BCEOM,1999)

Soils.shp
- Calcic Vertisols
- Cambic Arenosols
- Chromic Luvisols
- Dystric Cambisols
- Dystric Leptosols
- Eutric Cambisols
- Eutric Fluvisols
- Eutric Leptosols
- Eutric Regosols
- Eutric Vertisols
- Haplic Nitisols
- Haplic Acrisols
- Haplic Alisols
- Haplic Arenosols
- Haplic Luvisols
- Haplic Nitisols
- Haplic Phaeozems
- Lithic Leptosols
- Marsh
- Rendzic Leptosols
- Rhodic Nitisols
- Urban
- Vertic Cambisols
- Water
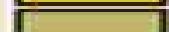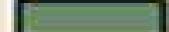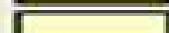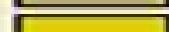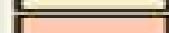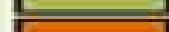
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2. Problem Definition

Deforestation → Soil erosion

Improper farming practices → Soil erosion

Soil erosion → Loss of fertile soil & crop land

Soil erosion → High runoff

High runoff → Less base flow

➢ Most catchments are ungauged → Hydrologic responses of the catchments not well understood
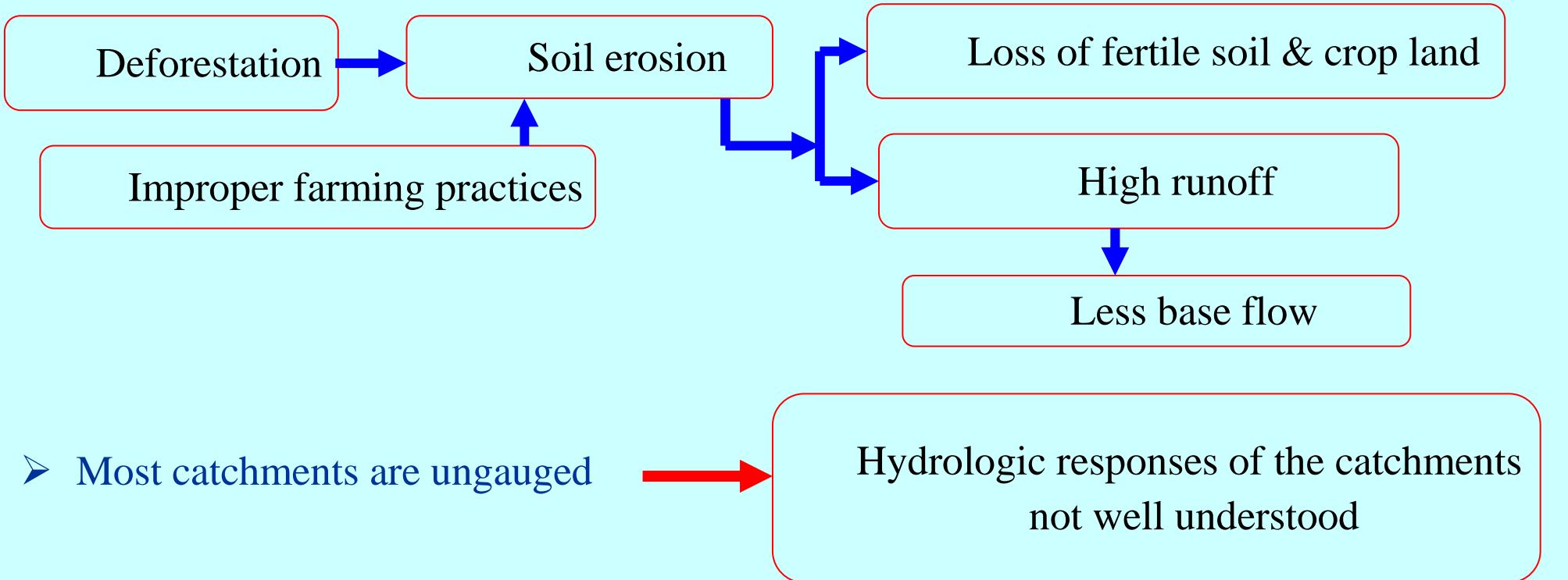
➢ Major bottlenecks for water resources planning and management in the basin

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3. Research Questions

1. What is the dominant hydrological processes, which controls the runoff generation processes in a nested micro-catchments and meso-catchments in Choke Mountain area?

2. What is the hydrological response and residence time in these catchments?

3. Can we observe the impact of land use change on hydrology of the Choke mountain area in the past decades ?

Research Questions contd...

4. How do we develop the appropriate conceptual hydrologic models, which simulate the observed stream flow for the right reason at various spatial and temporal scales in the Blue Nile River Basin?

5. Which hydrological processes are dominant where in the Blue Nile River Basin?

4.   Research Objective

- The main objective of this research is to understand, characterize and quantify hydrological variability of Blue Nile River Basin at various temporal and spatial scales.

Specific objectives

1. Investigate runoff generation process in headwaters of the Blue Nile River Basin called Choke mountain area.

2. Developing top-down model development approach for the Blue Nile River Basin, with the objective to achieve a parsimonious conceptual model

Specific objective cntd..

3. Classify catchments, which behave similarly in their hydrologic response with in the Blue Nile River Basin.

4. Regionalization of the information gained in gauged catchments to ungauged catchments with minimum uncertainty.

5. Estimation of the water balance components in different space and time scales within the Blue Nile Basin.

■ **Data availability**

Climatic data

Number of years	Number of stations
below 10	72
10 to 14	45
15 to 19	24
20 to 24	17
25 to 29	5
30 to 34	6
35 to 39	2
40 or more	2

Source: BCEOM, 1999

Hydometric data
Around 102 gauging stations available but 25% abandoned
-most of the data are missed (Admasu, 1996)
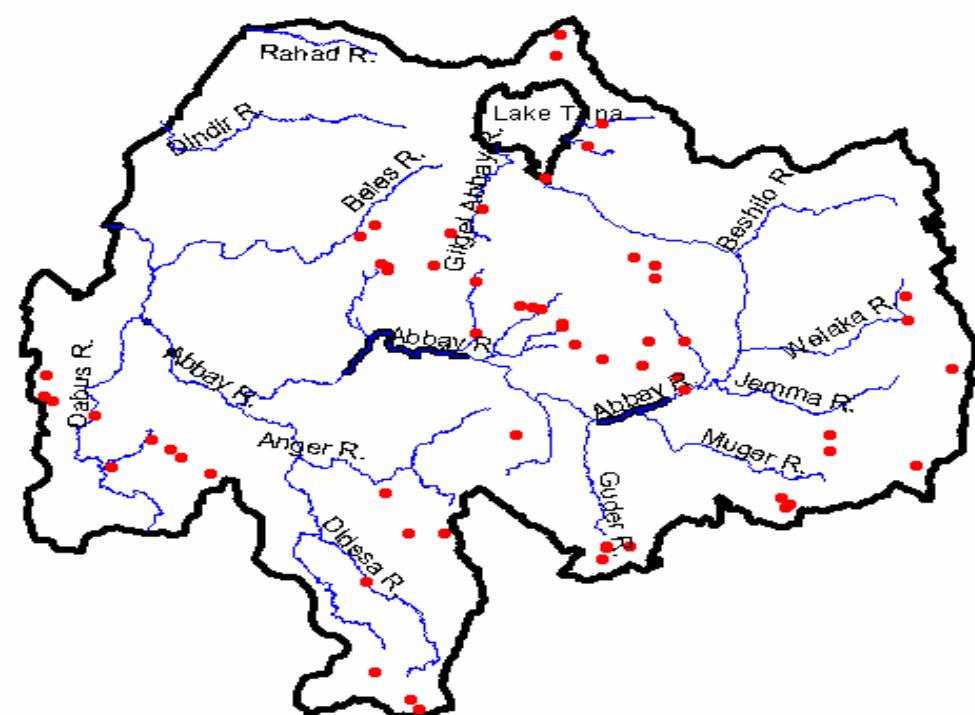
Stream gauging stations

Blue Nile at Kessie (1975-2002)

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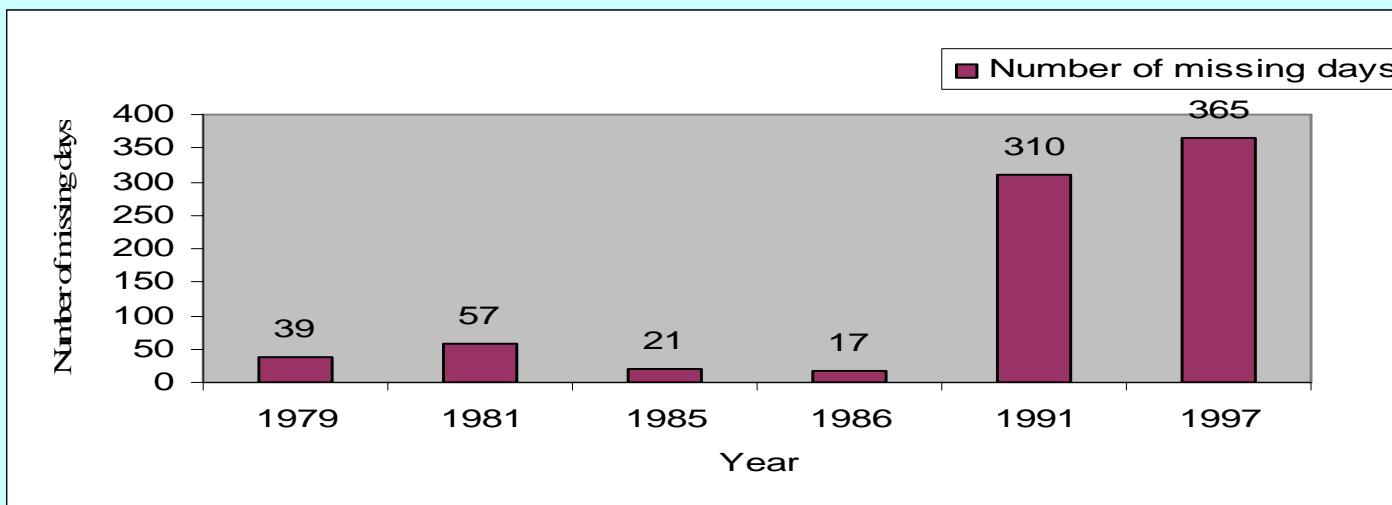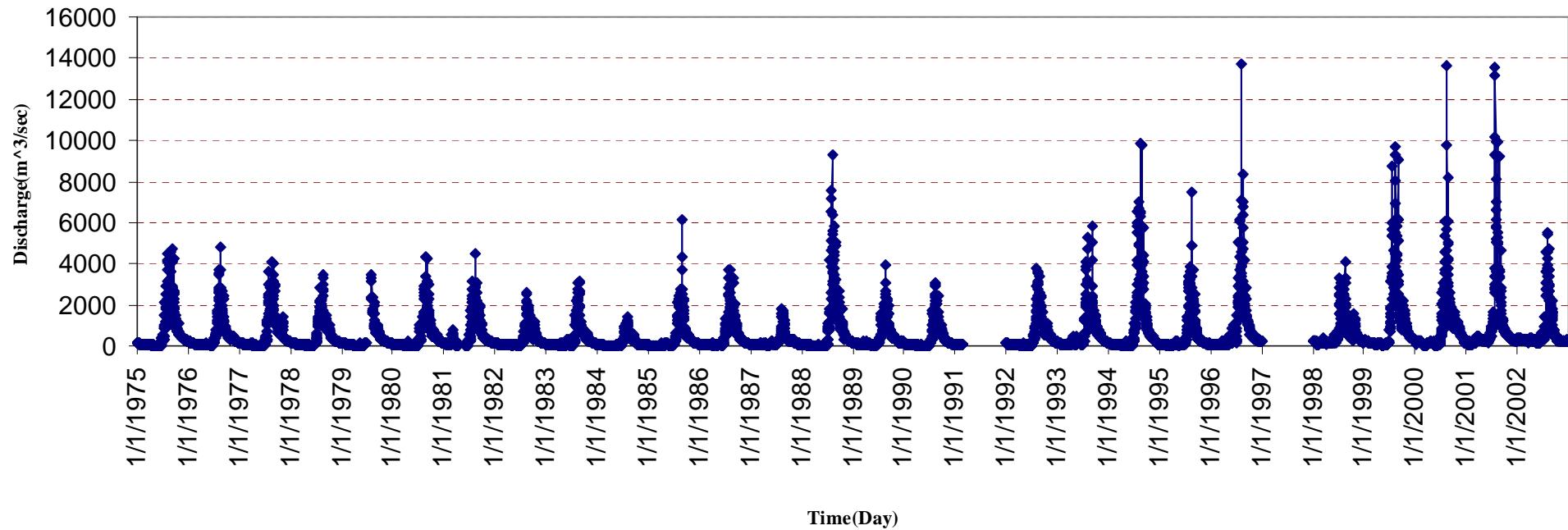
Daily discharge at Ethio-Sudanese Boarder (1975-2002)
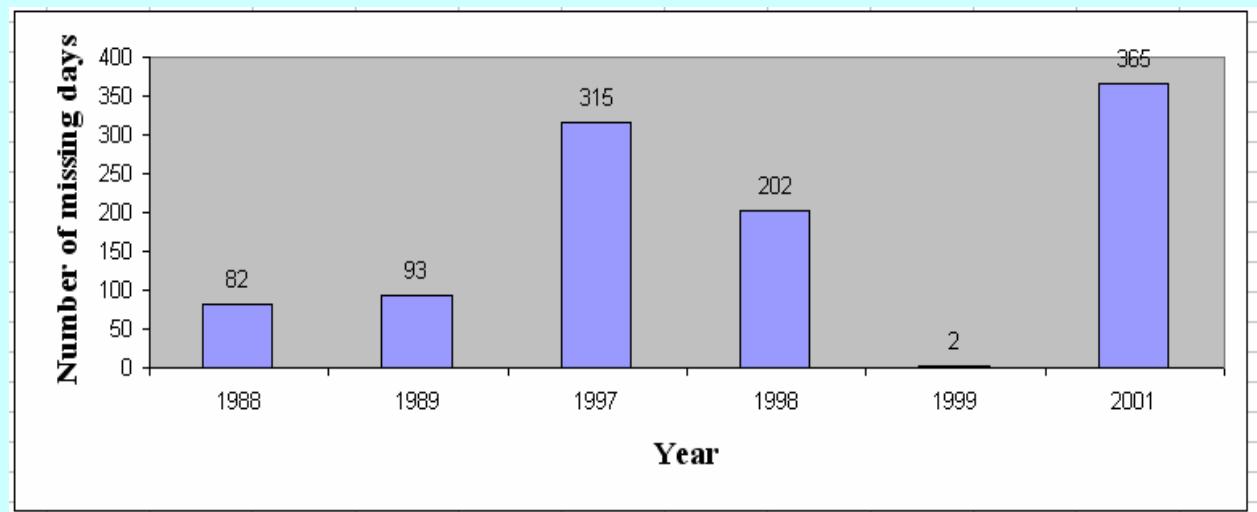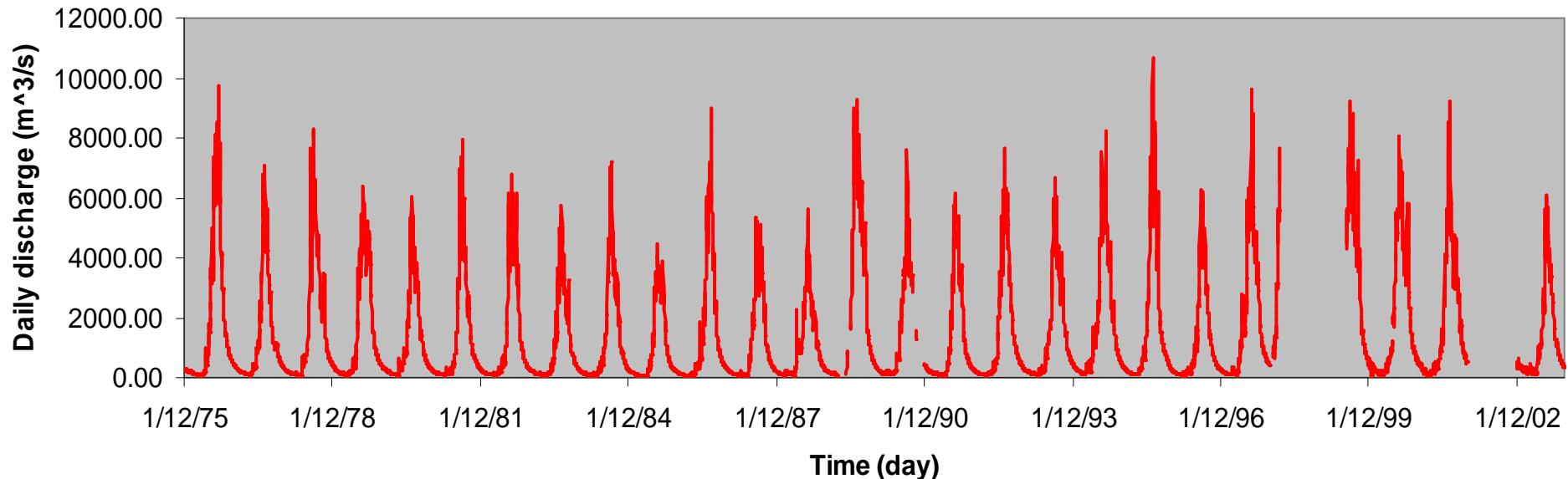
Fig Missing stream flow at El-Deim gauging station Ethio-Sudanese boarder (1975-2002)

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Mean monthly flow at kesie and border
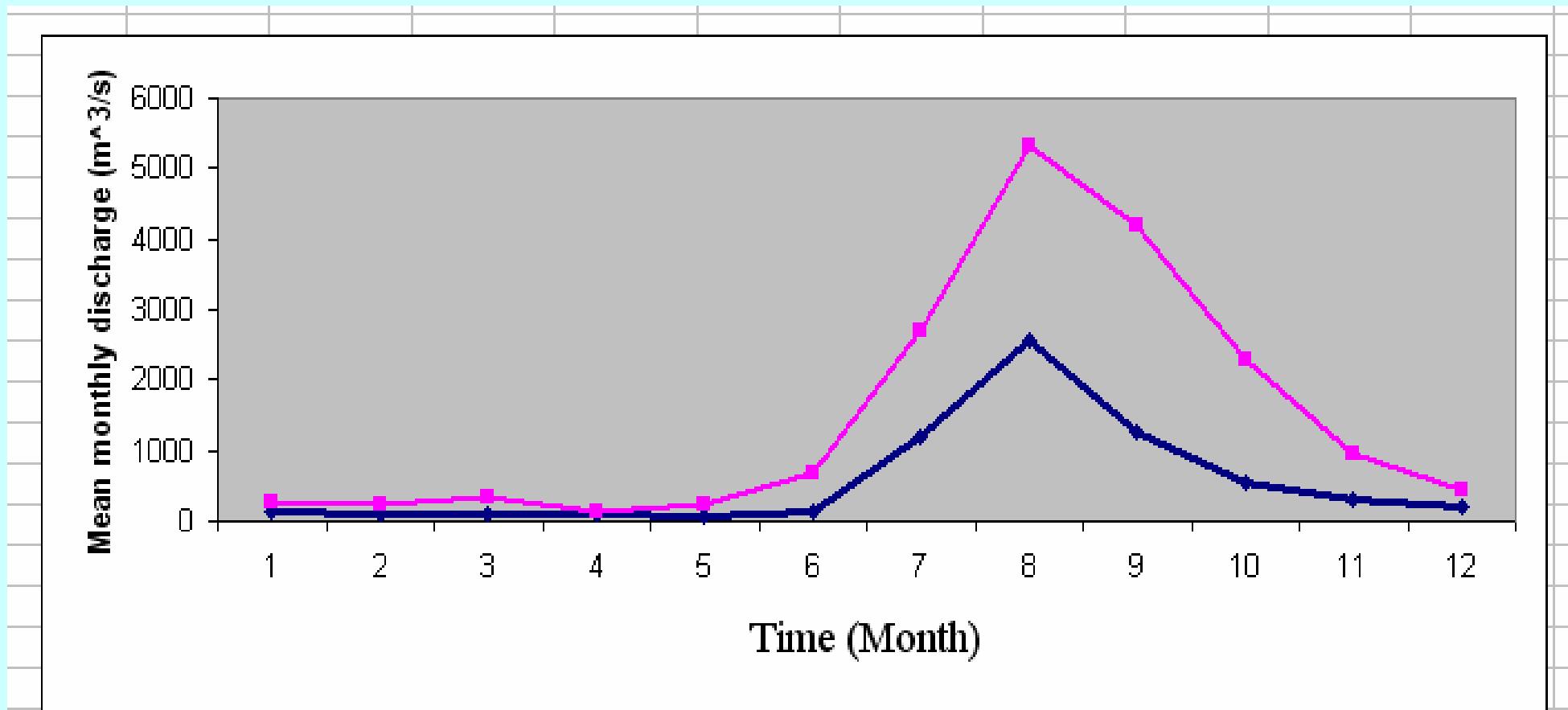
Mean Monthly discharge at Kesie station (Bridge) & at the boarder (1975-2002)
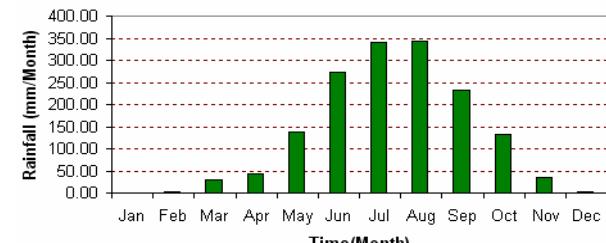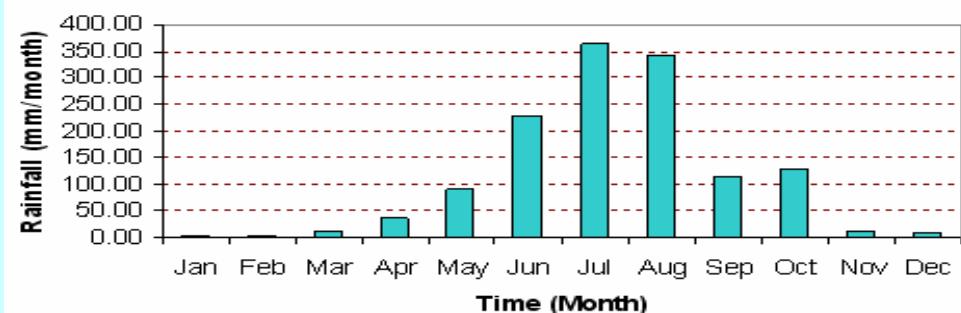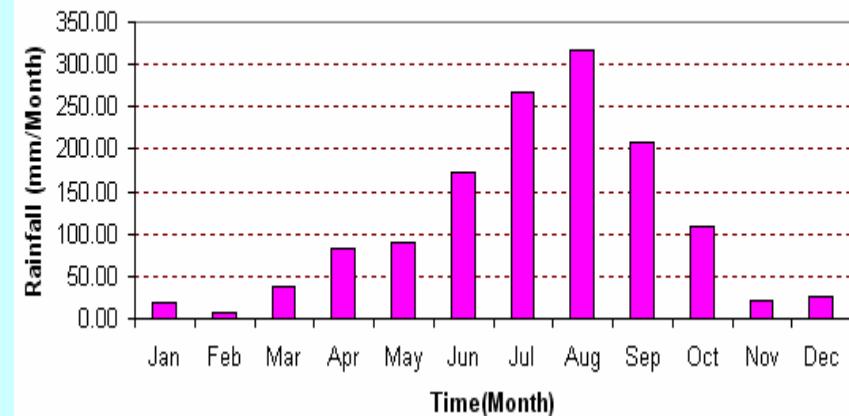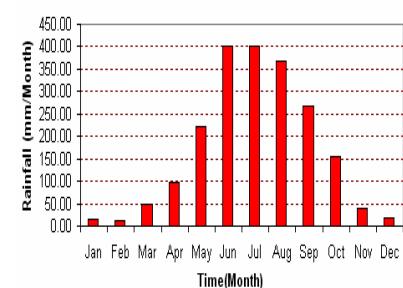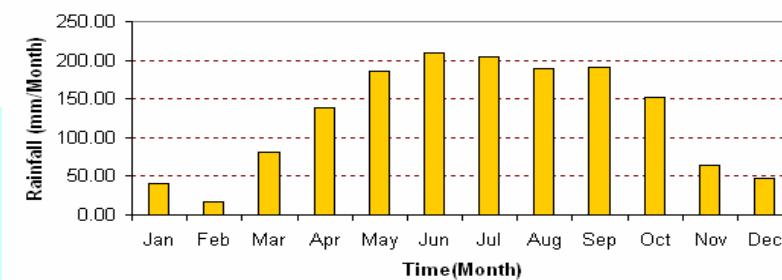
Climatic stations in Blue Nile River Basin

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Data Requirement

- Climatic data collection (Precipitation, temperature, solar radiation, relative humidity, wind speed) → National Meteorological Agency

- Hydrological data: Daily stream flow data (Discharge) → Ministry of Water Resources

- Satellite Data: TRMM satellite Product

- Tracer data: Rainfall and stream flow samples

- DEM (SRTM, 90*90m)

- Land use and soil data

6. Research Methodology

A) Field work (in experimental catchments)

Establishment of meteorological stations (Automatic & manual for rainfall)

To measure P, Relative humidity, wind speed and solar radiation

- Manual rain gauge .

Measuring stream flow

   - Partial flume with the data

   logger at each nested catchments

B) Lab work (analysis of water sample for isotopic composition, cations and anions etc)
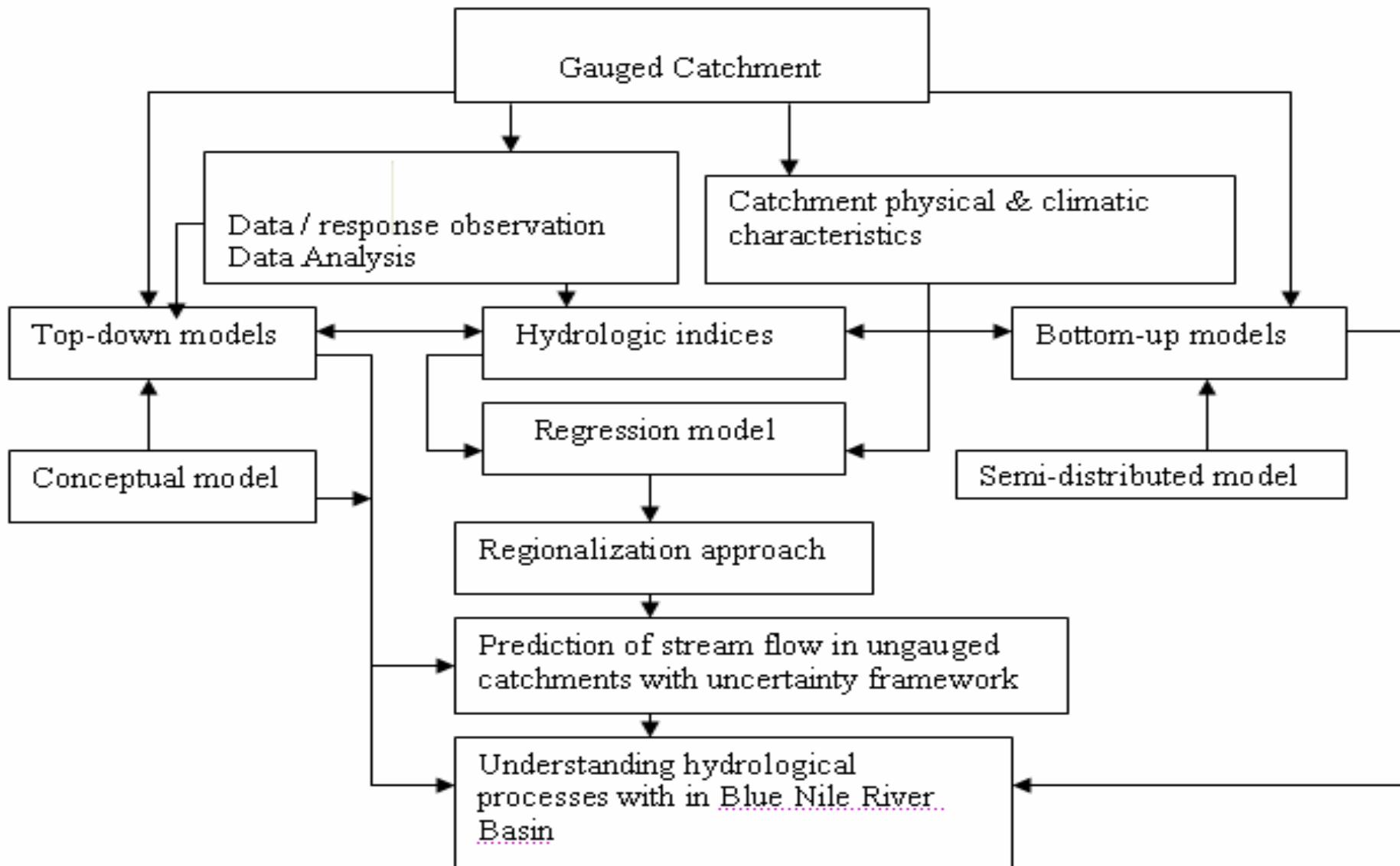
Methodological Frame-work proposed in this research

Linkage of this research to other hydro-solidarity research

- This research has linkage to project one ----extrapolating the hydrological impacts of improved farming practices around Choke Mountain area.

- Link with project three-----to study the relationship between stream flow and sediment load

- Link with project seven----- to study the impacts of past land use /cover change on the hydrologic response.

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7. Time schedule

Main Activities	Time in Months (Oct 2008 to Oct 2012)							
	6	12	18	24	30	36	42	48
Proposal Development	▬▬							
Time at IHE (Delft)	▬▬		▬▬		▬			▬▬
Fieldwork		▬▬▬▬		▬▬▬				
Data collection and processing		▬						
Lab. Work					▬			
Modeling work(Conceptual)			▬▬▬▬▬▬▬▬					
Interpreting results & writing papers			▬▬▬▬▬▬▬▬▬▬▬▬▬					
Modeling work (Semi-distributed)				▬▬▬▬▬▬▬				
Writing & compilation, public defense							▬▬▬	

# Thank you for your attention!

Chemoga daily stream flow

Missing stream flow data (1973-2002)
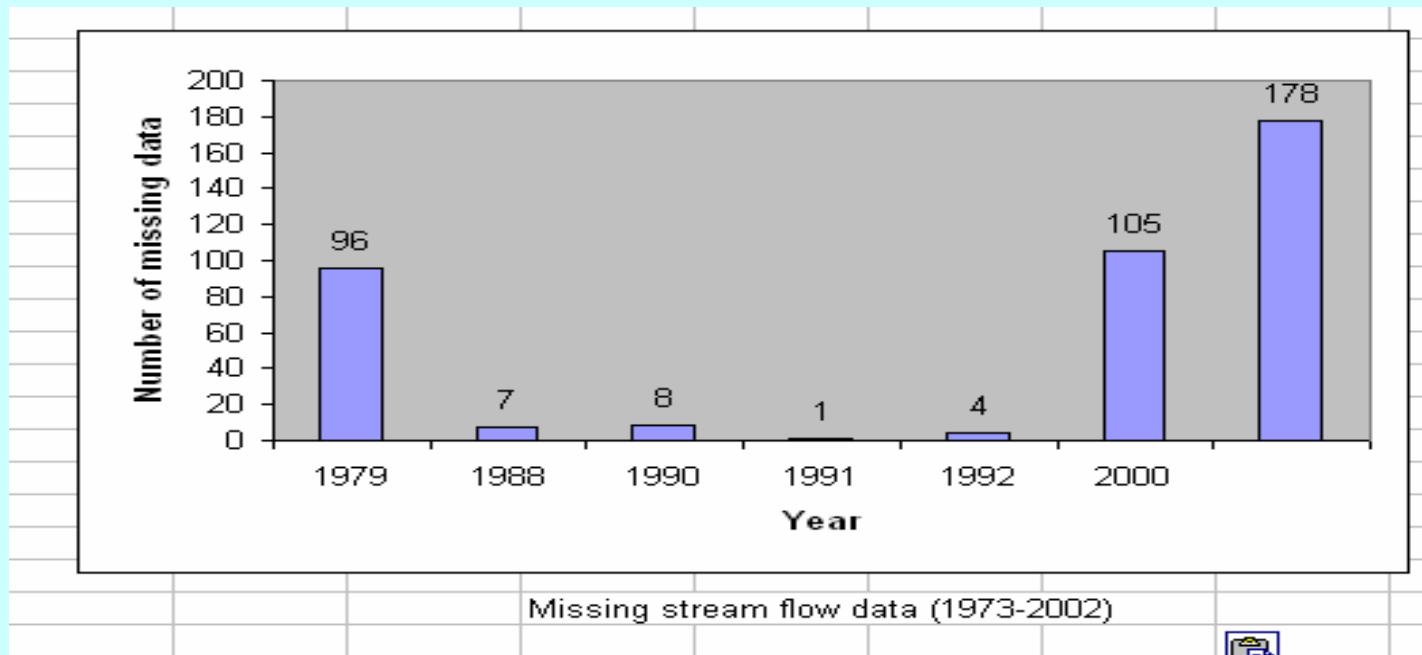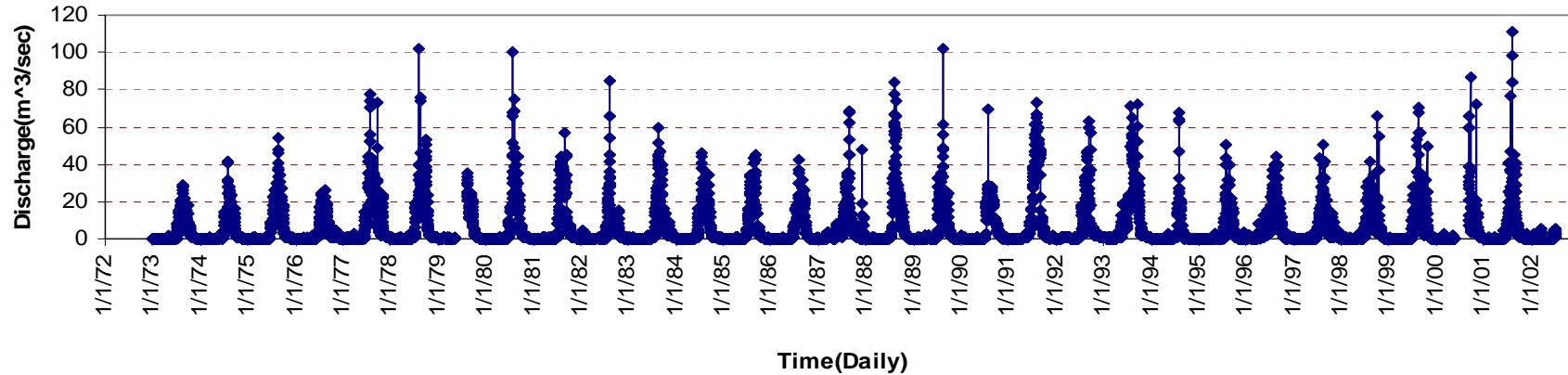
Jedeb catchment daily stream flow

Number of missed stream flow data in Jedeb catchment (1966-2000)