Water Balance Study and Validation of Reservoir Releases for Merowe Dam

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Introduction

Merowe Dam constructed across the main Nile near the 4th cataract, is the largest dam in Sudan. The main purpose of the dam is power generation, agricultural and industrial development of the region. Accurate reservoir water balance is very important for proper operation of the dam and strengthening the water management decision-making.

Objectives:

The main objective of this study is to accurately validate all components of the water balance of Merowe reservoir, specifically:

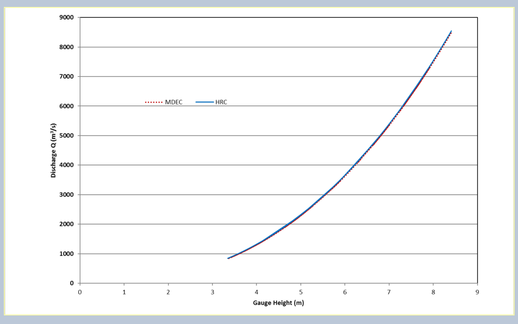
- Validation of reservoir inflows at Elkoro station and upstream stations Barbar, Tabya and downstream Girba dam;
- Validation of reservoir releases computed by gates' equations, against discharge measurements downstream at Elhesai station, and Dongola and Kedain stations.
- Water balance study using validated inflows releases, estimated evaporation and most recent bathymetric survey results.
- Development of a computer user interface UI for daily operation of the dam

Methodology :

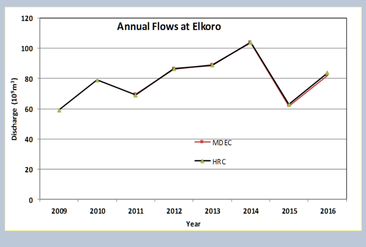
The methodology followed includes: collection of historical data, field visits and limited validation measurements. The collected data include hydrological, climatic, reservoir characteristics and operation data. Limited discharge measurements were conducted at Elkoro, Barbar and Elhesai stations for validation purposes. The water balance equation for the reservoir is given as:

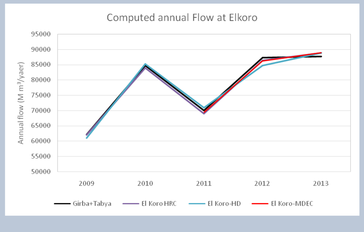
$$Q_{in} + R = Q_{out} + Abs + E + Seep + \Delta S$$

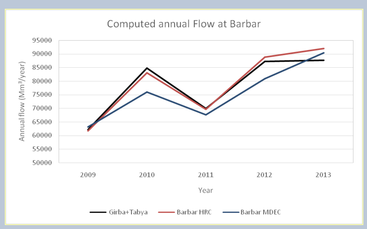
Where Qin = Inflow to reservoir, R= Rainfall on the reservoir (almost 0), Qout= Release from reservoir E= Evaporation losses, Abs =Abstraction by irrigation schemes upstream reservoir, Seep= Seepage losses, and Δs = change in the storage of the reservoir.



Results:







⇒ The discharge measurements, method of deriving rating curves of MDEC at Elkoro are correct and agree with those of HRC.

⇒ Computation has shown that there is no significant difference between MDEC and HRC computed discharges at Elkoro station for daily, 10-days and monthly discharges.

⇒ There are significant differences between computed discharges for Barbar station by Hydrology Department and HRC for daily, monthly and annual discharges.

⇒ Verification of discharge measurements at Elkoro and Barbar with upstream stations (Tabya + downstream El-Girba), has shown that the measured discharges at Elkoro are reliable.

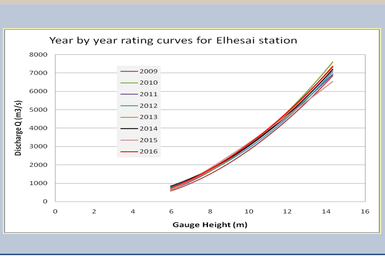
⇒ The average rating curve for Elhesai showed some scatter at high flows, while year by year rating curves are very good with R^2> 0.99.

⇒ There is a degradation of 10 -15 cm per year in Elhesai measuring satiation

⇒ The discharge measurements procedure at Elhesai agreed with those conducted by HRC.

⇒ The discharge series computed by HRC for Elhesai station were used for the water balance.

⇒ The developed user interface will facilitate the daily operation of the reservoir as it gives the water balance once the input parameters are updated.



Sponsor: MOWRIE, MEDC **Duration:** 2017 (6 Monthes)