Filling the Grand Ethiopian Renaissance Dam:
Implications for Riparian Countries

XVth IWRA World Water Congress
Edinburgh Scotland
May 2015

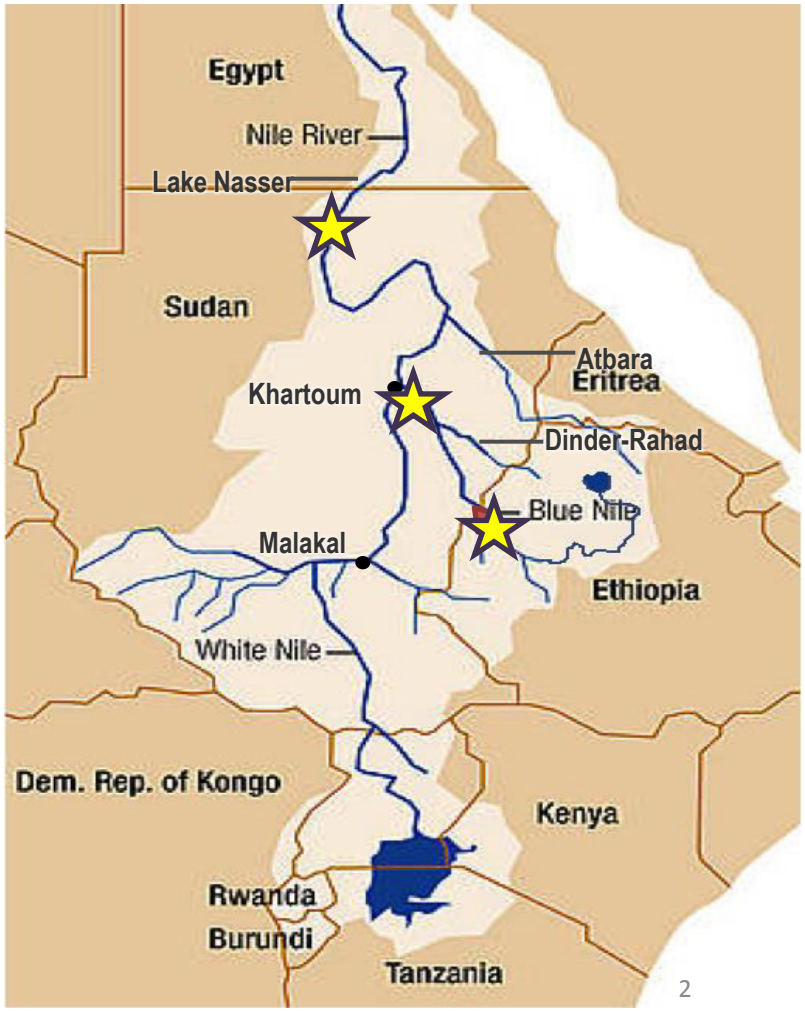
Paul Block
University of Wisconsin – Madison, USA

What is the Effect of the Reservoir Filling Rate?

Ethiopia → Hydropower generation

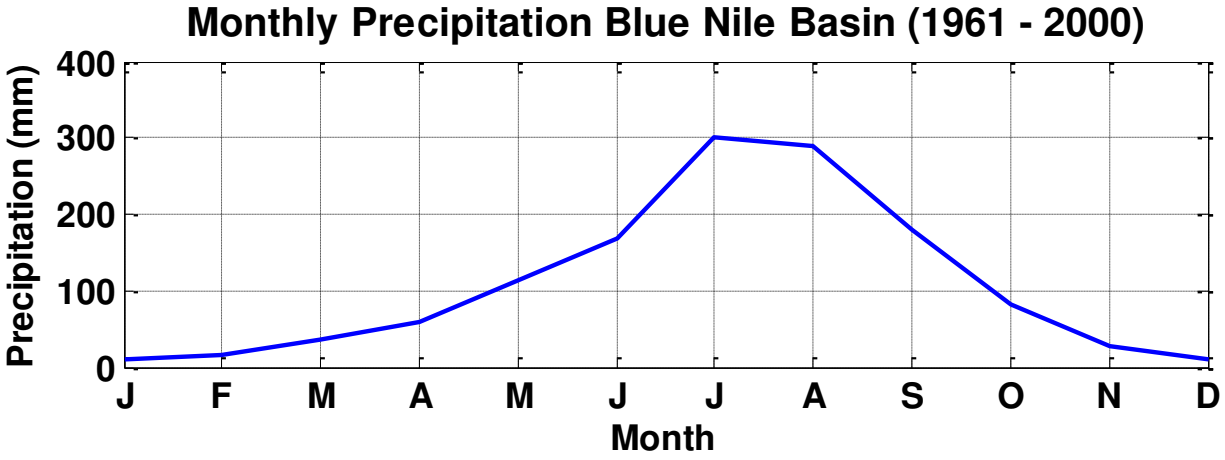
Sudan → Irrigation water

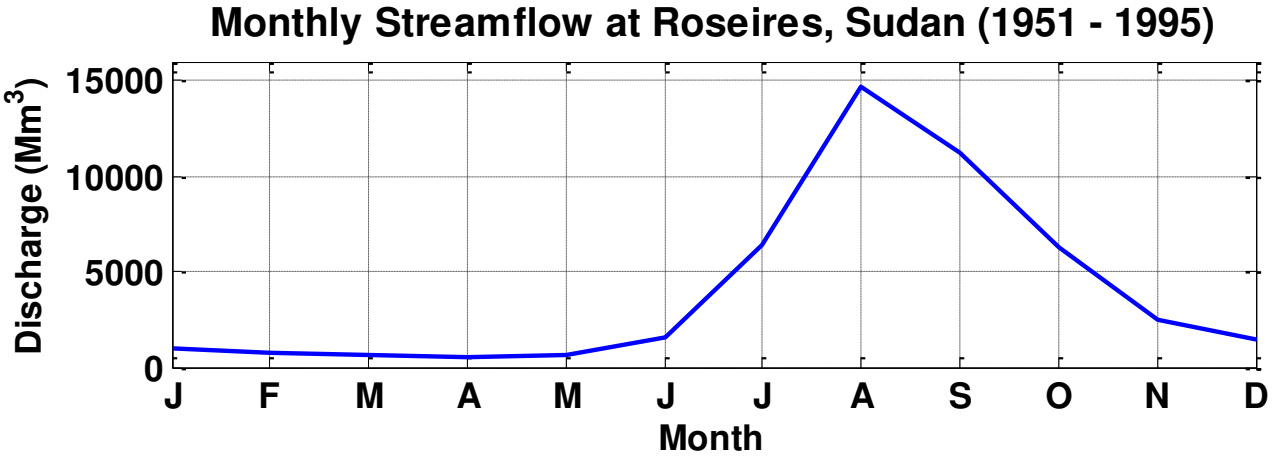
Egypt → Inflow to Lake Nasser



Zhang and Block, 2015

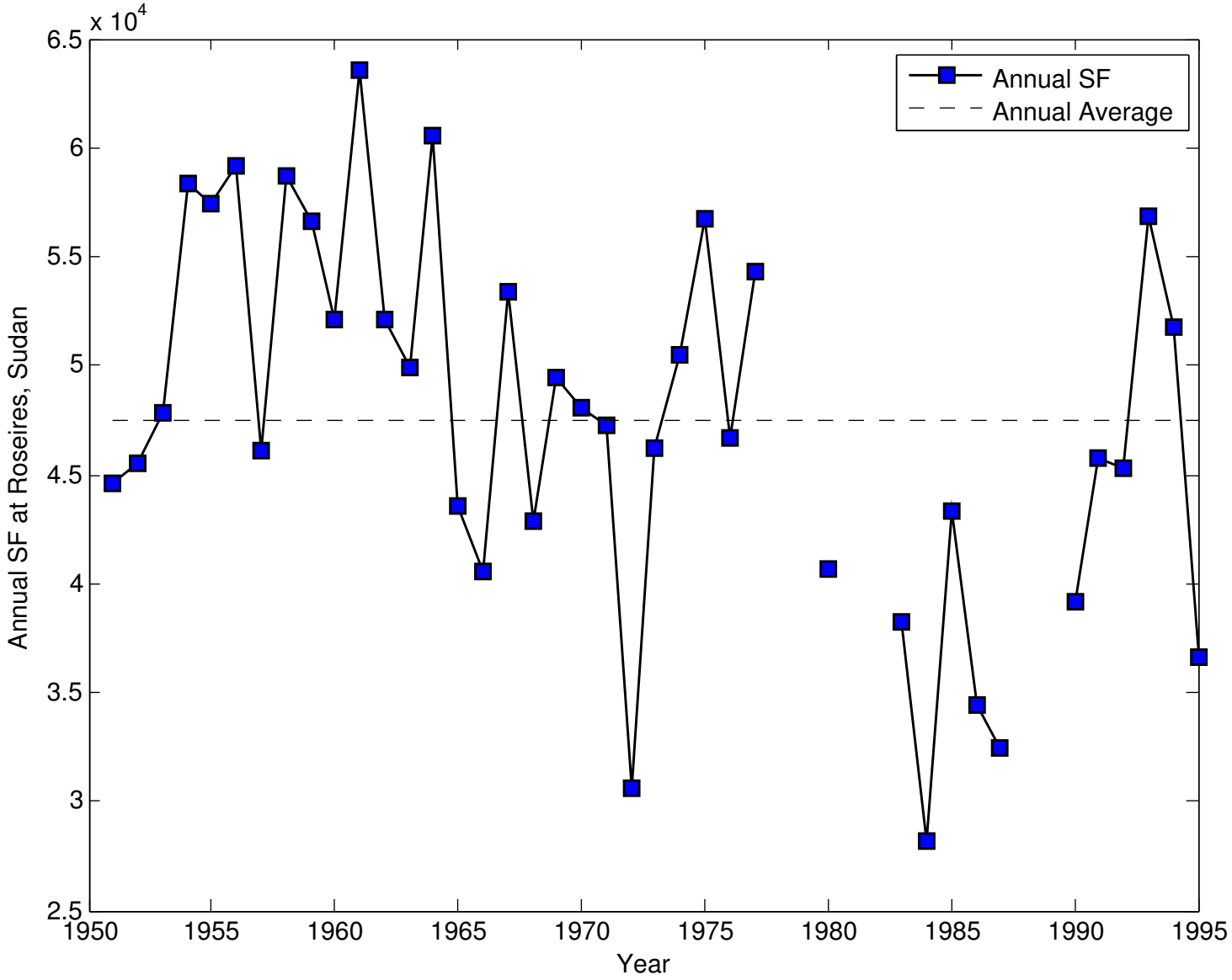
Blue Nile River Characteristics





King and Block, 2014

Blue Nile River Characteristics



King and Block, 2014

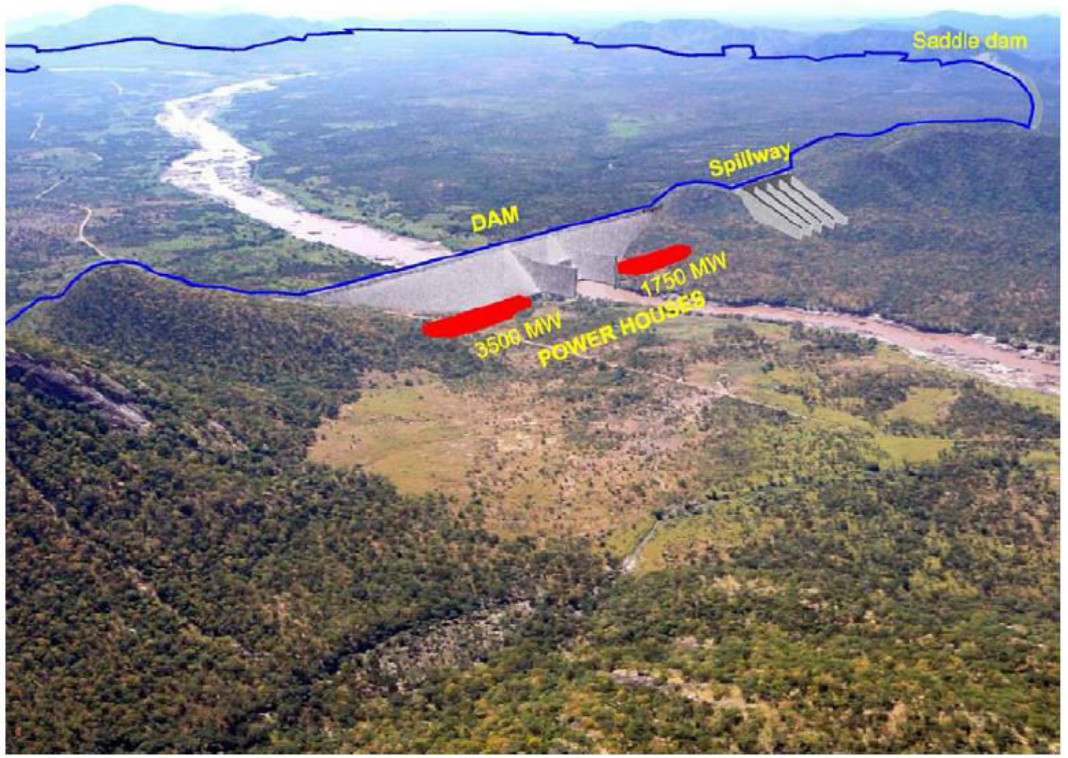
Relevant GERD Characteristics

Construction Plan
2011 – 2017/2018

Generating Capacity
6,000 MW (5,250 MW)

Reservoir Size
74 B m^3 (63 B m^3)

Minimum Operating Level
590 masl



http://seeker401.wordpress.com/2011/10/01/the-grand-ethiopian-renaissance-dam/

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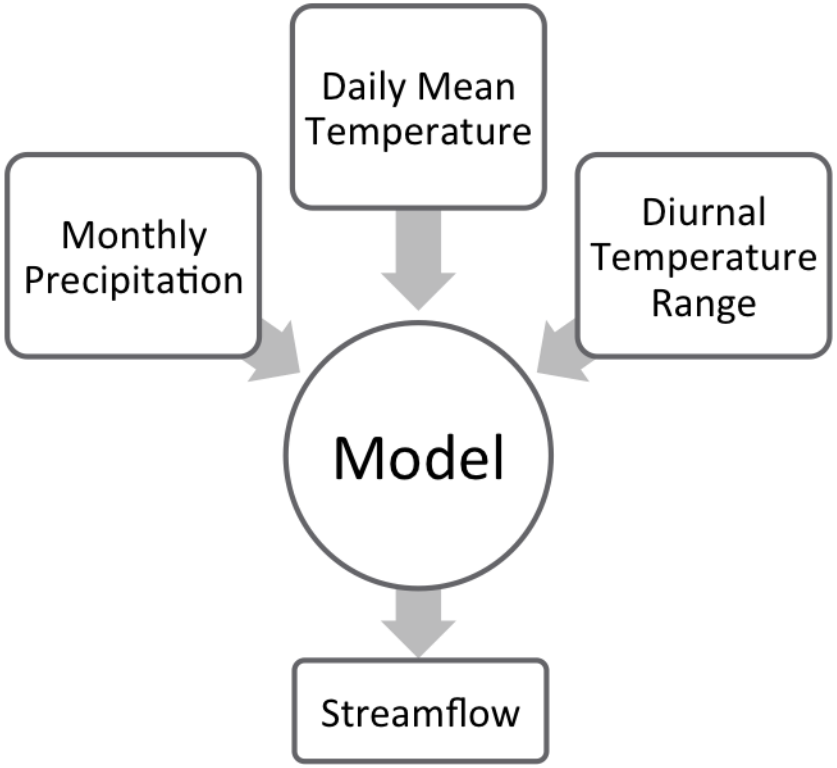
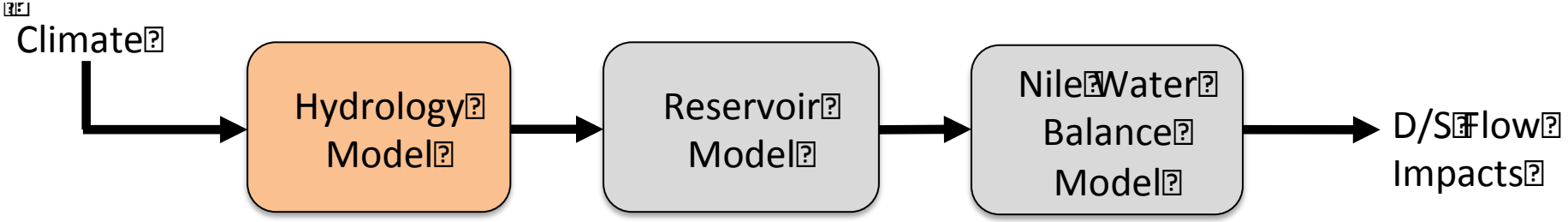
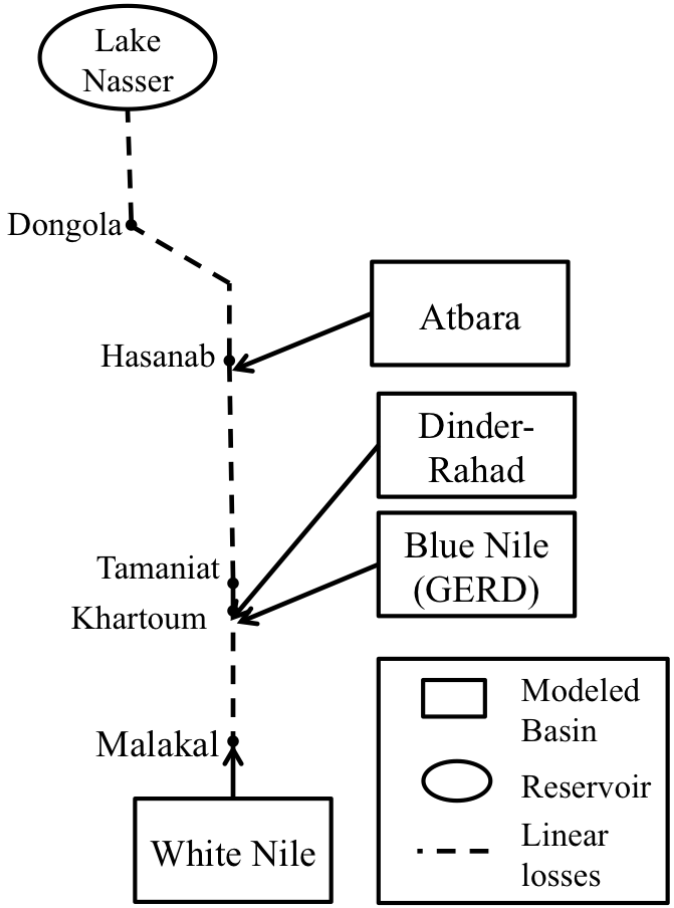
Hydrology Model

Transform meteorology data → streamflow data



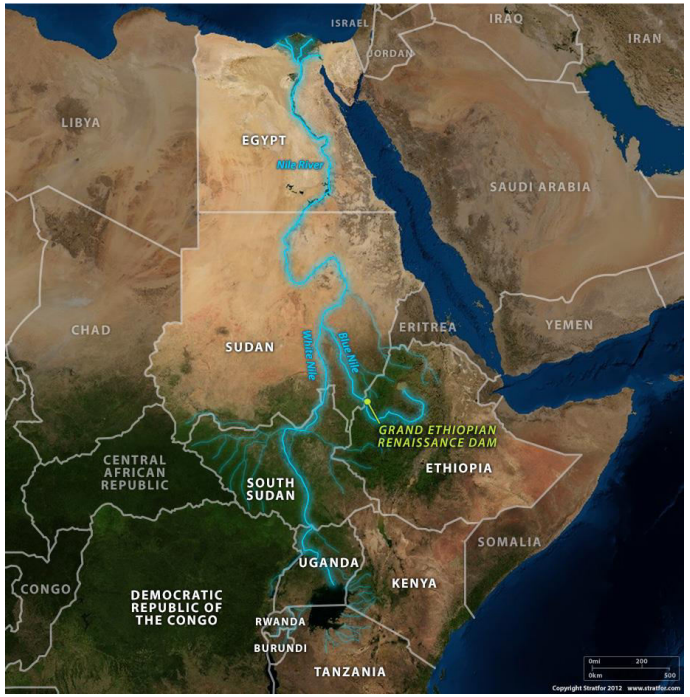


Water Balance Model

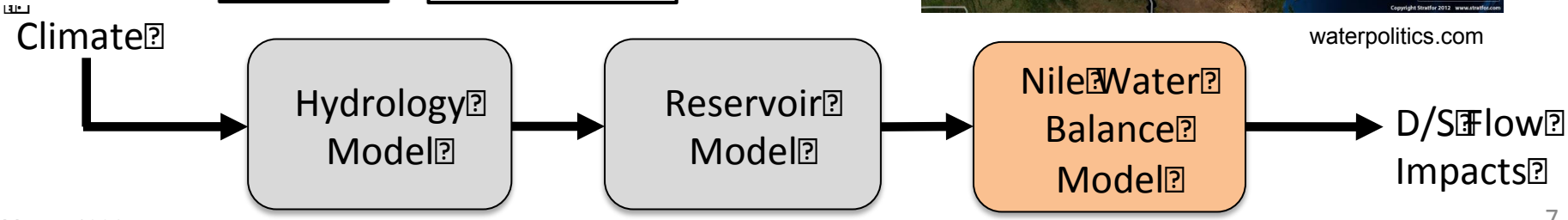


Major tributaries

Spatial/temporal coherence



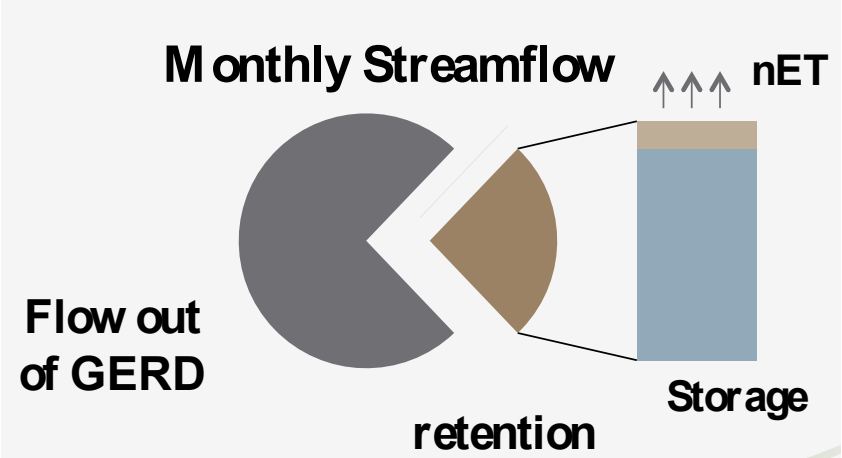
waterpolitics.com

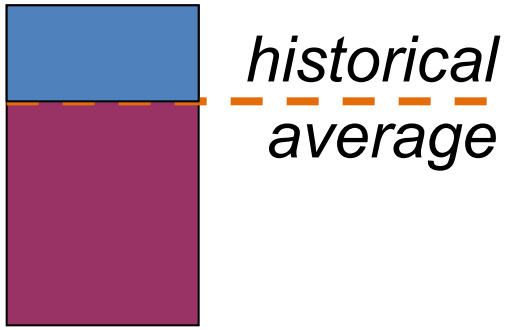


Yates, 1996

Reservoir Model

Filling Policy



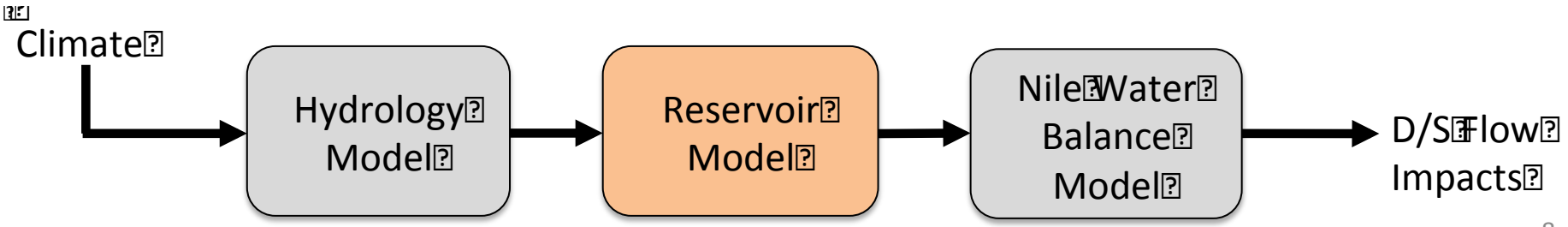


Fraction of Monthly SF

5%, 10%, 25%, etc

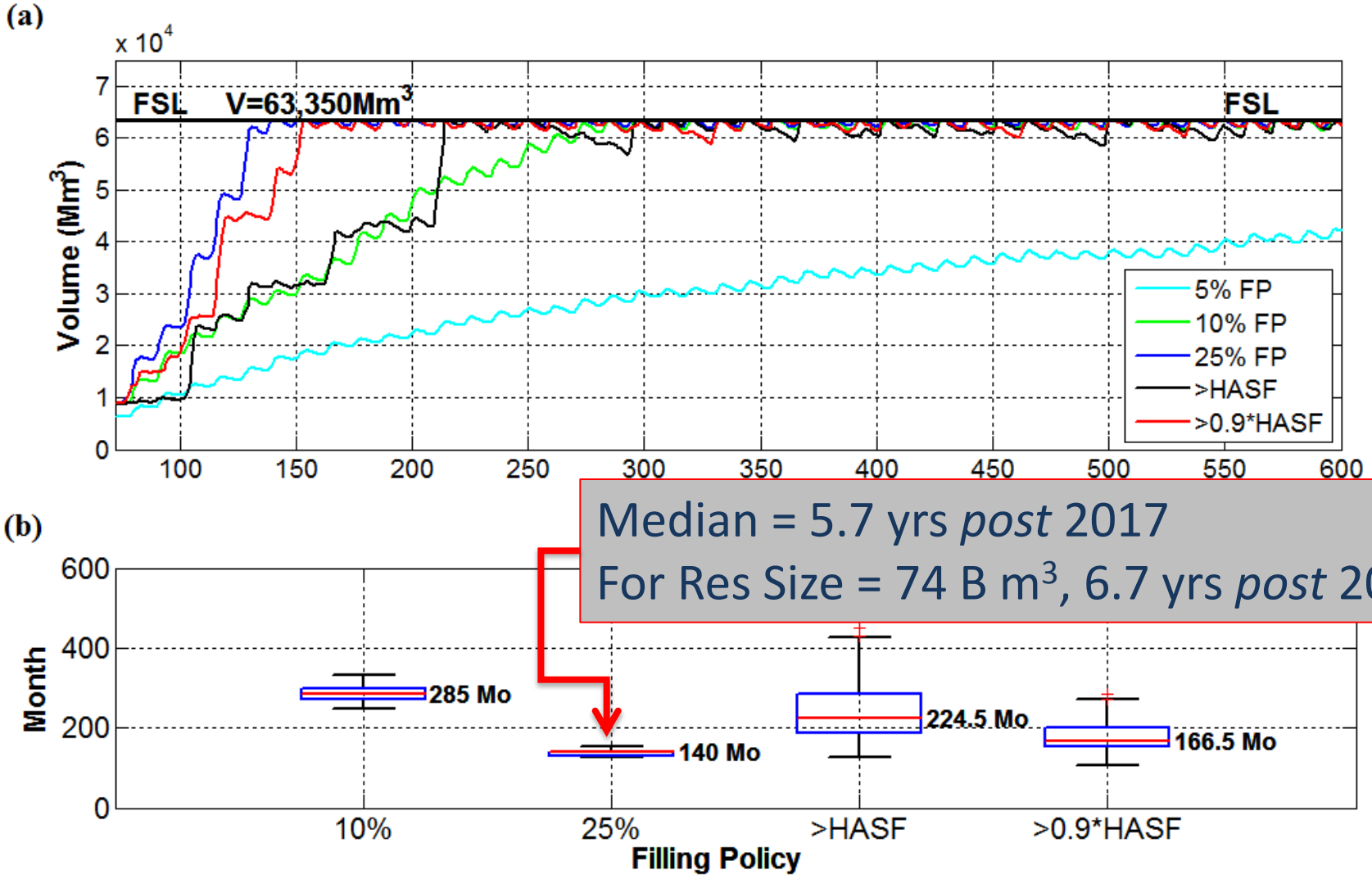
Volume > Historical Average SF

Hist Avg, 90% of Hist Avg, etc.



Time to Fill the Reservoir

Can vary options; 2014 start year

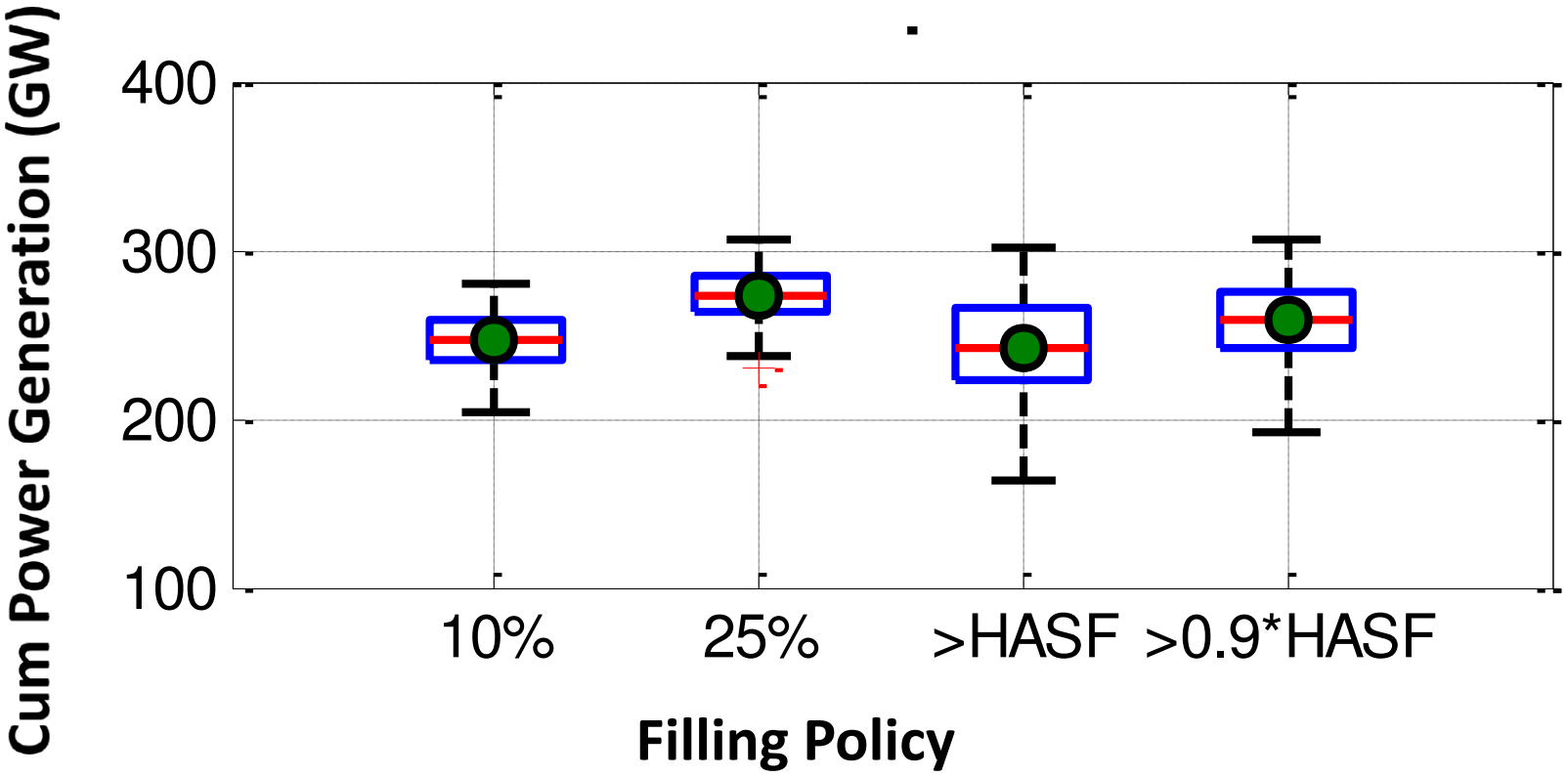


Median = 5.7 yrs *post* 2017

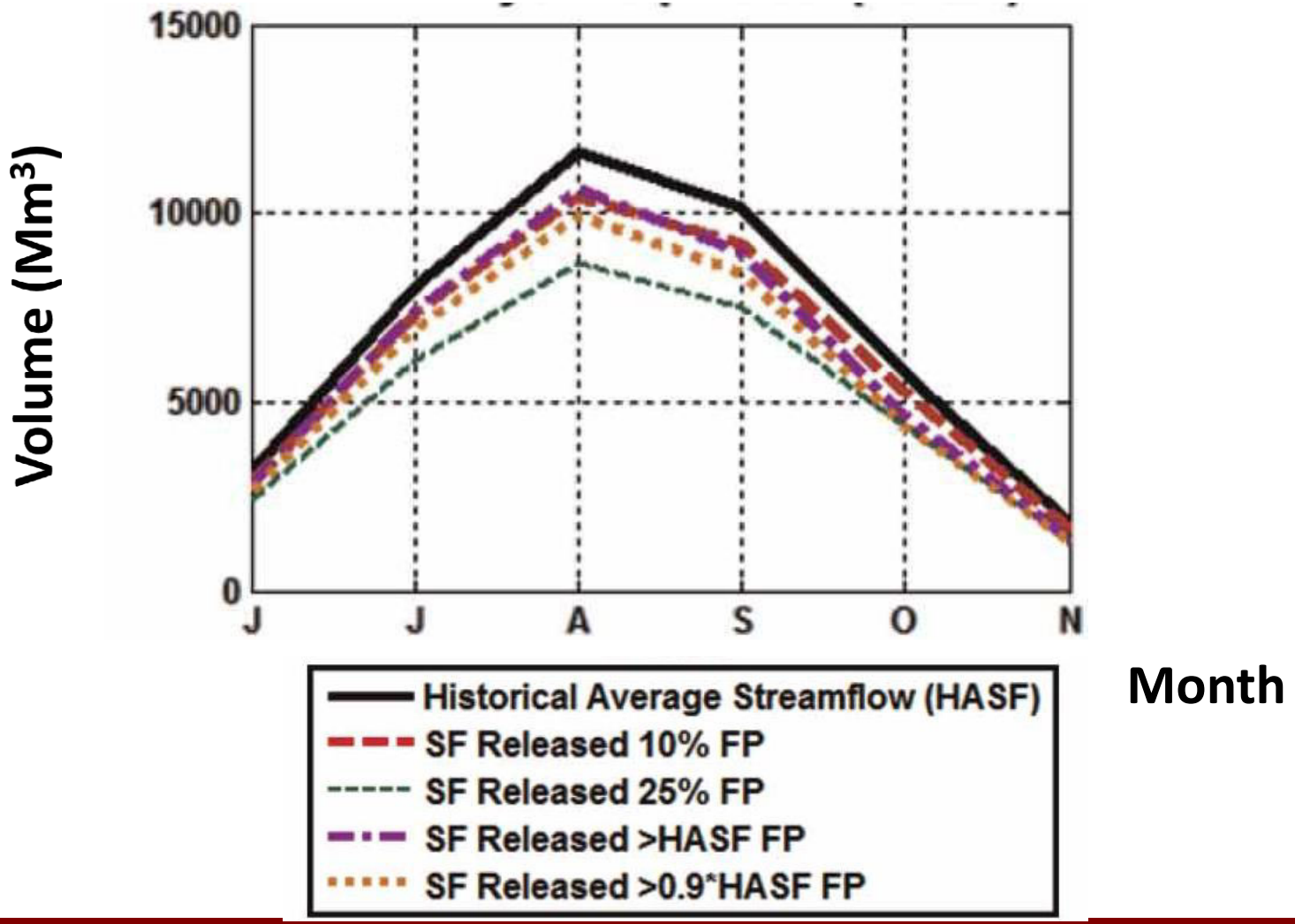
For Res Size = 74 B m^3, 6.7 yrs *post* 2017

GERD Hydropower Generation

2014 – 2031

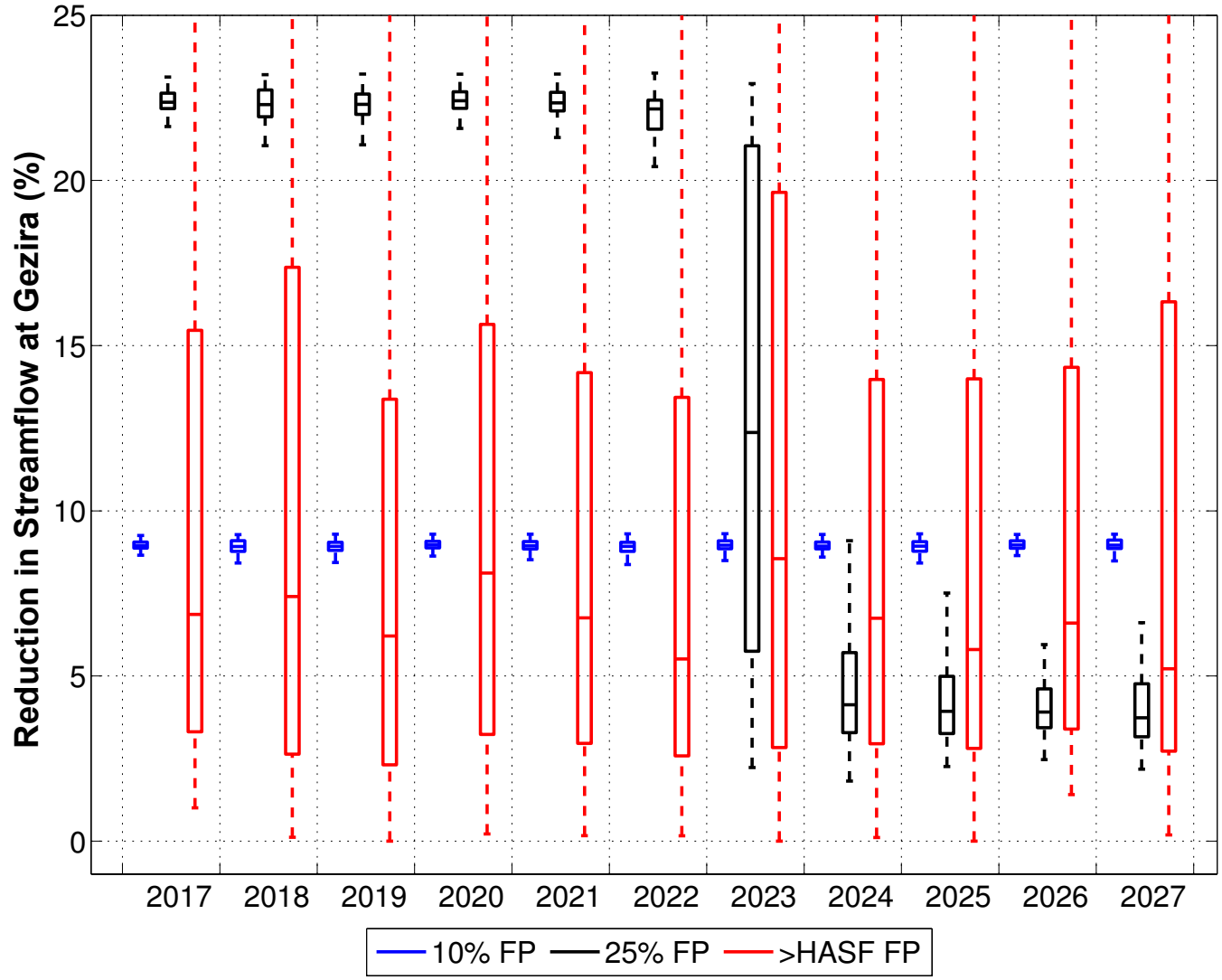


GERD Releases



Downstream Flows

Sudan (Gezira Irrigation Scheme, GERD = 74 B m^3)



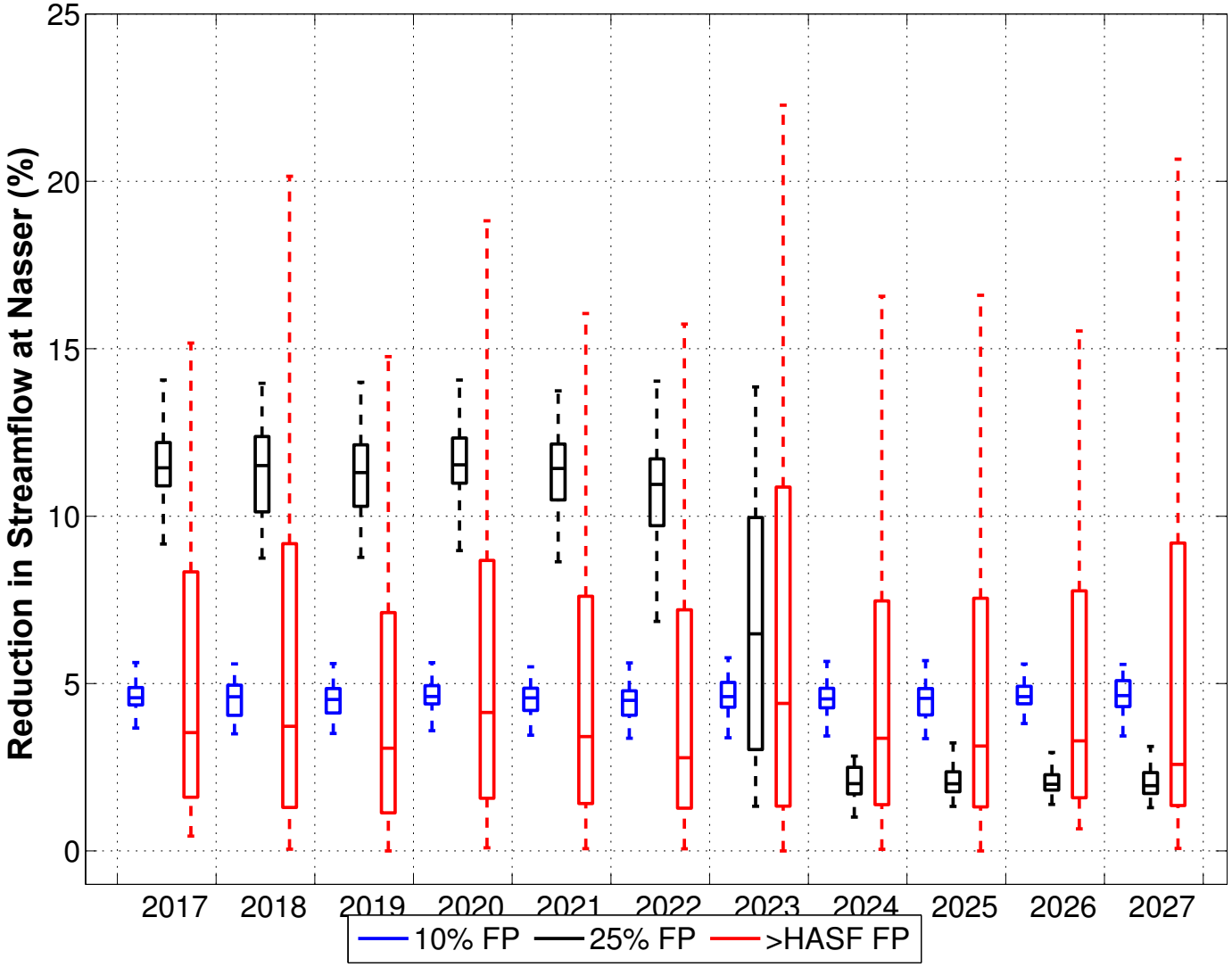
10% FP
stable reduction (9%)

HASF FP
low average (6%)
high variance

25% FP
initially large (22%)
evaporation losses

Downstream Flows

Egypt (Dongola, surrogate for Nasser inflow, GERD = 74 B m^3)



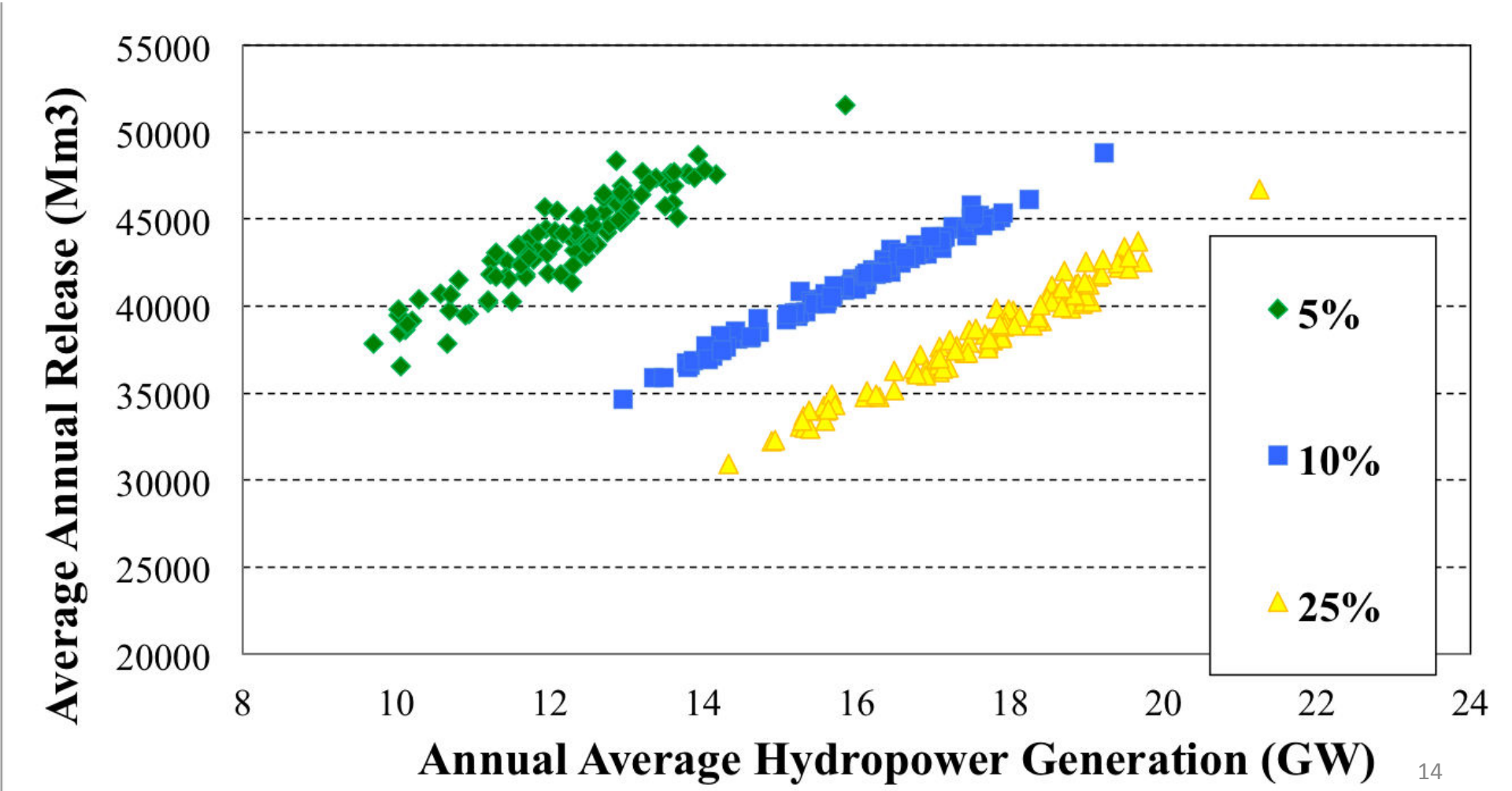
10% FP
stable reduction (5%)

HASF FP
low average (4%)
high variance

25% FP
initially large (12%)
evaporation losses

Trade-offs: GERD Release & HP

2017 - 2027



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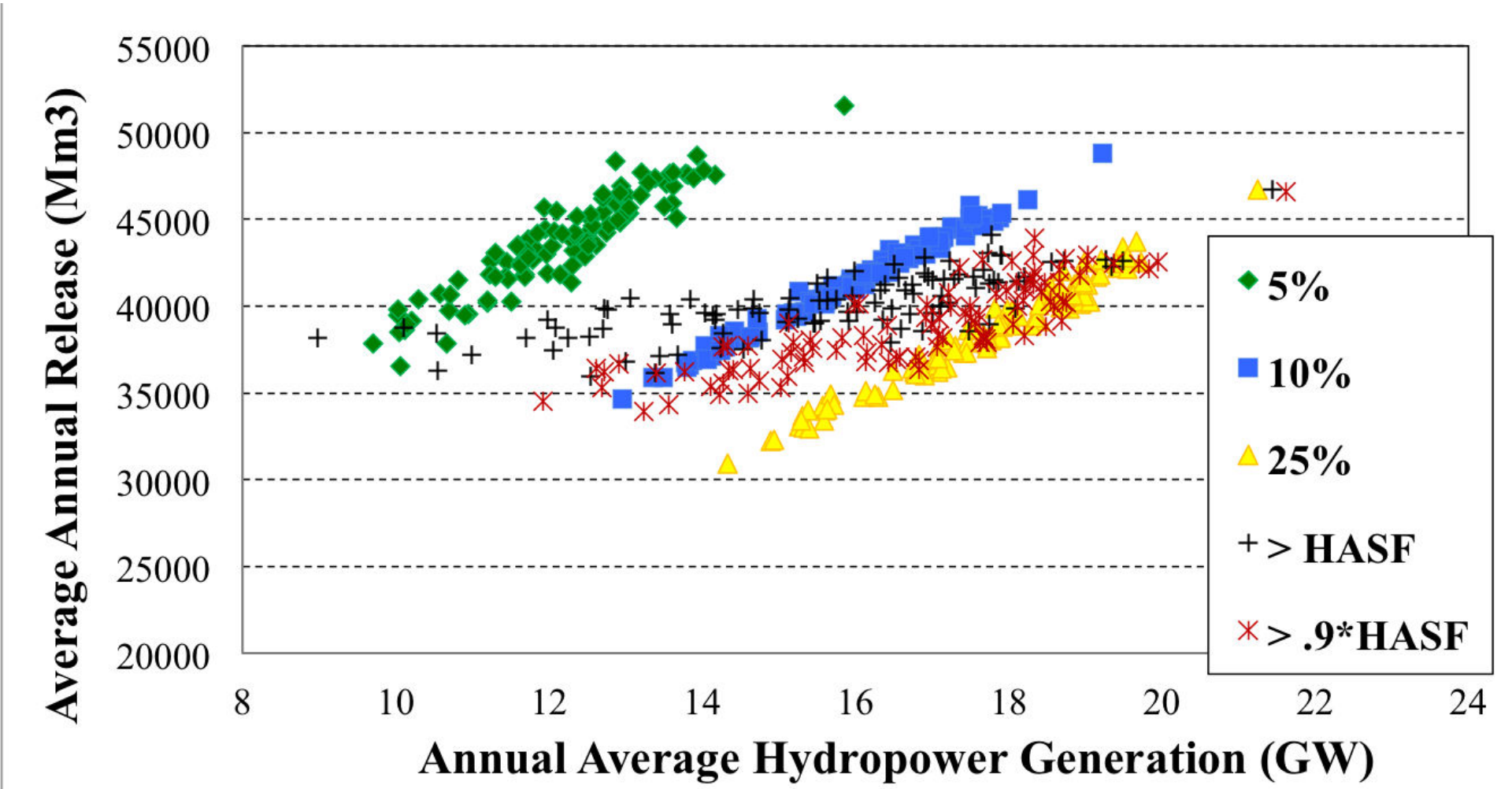
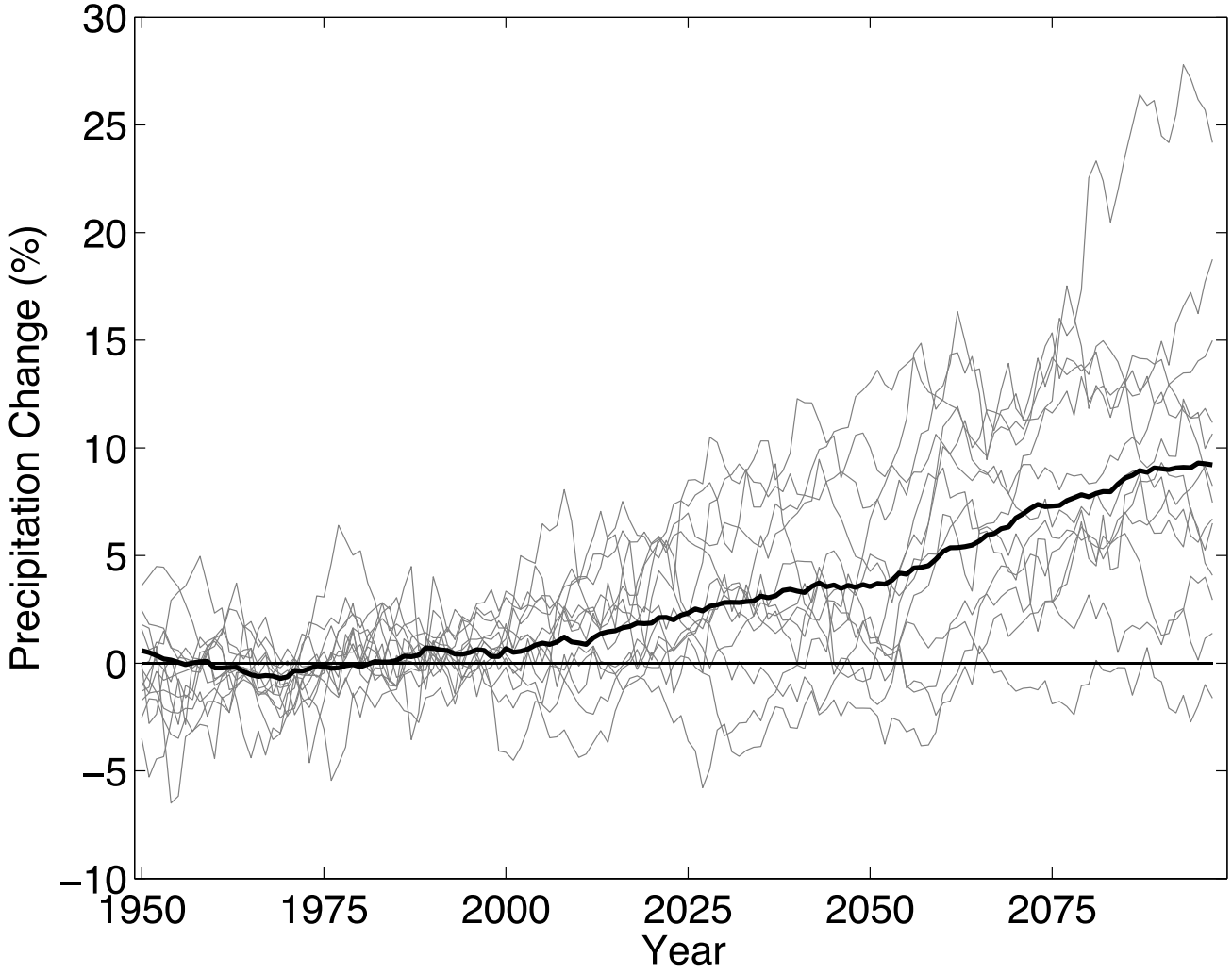
Trade-offs: GERD Release & HP

2017 - 2027



Climate Change – E. Africa



Giannini et al 2008

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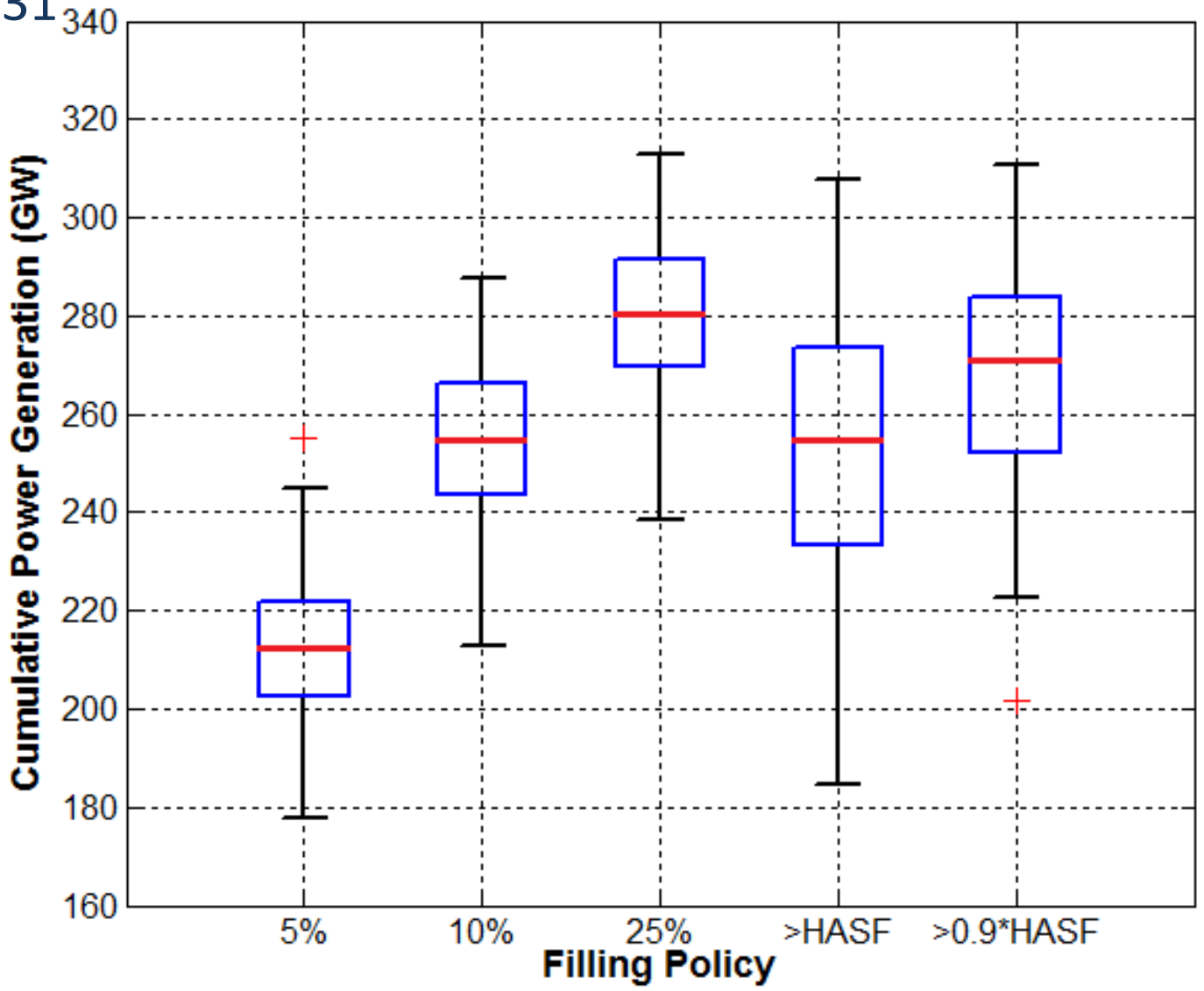
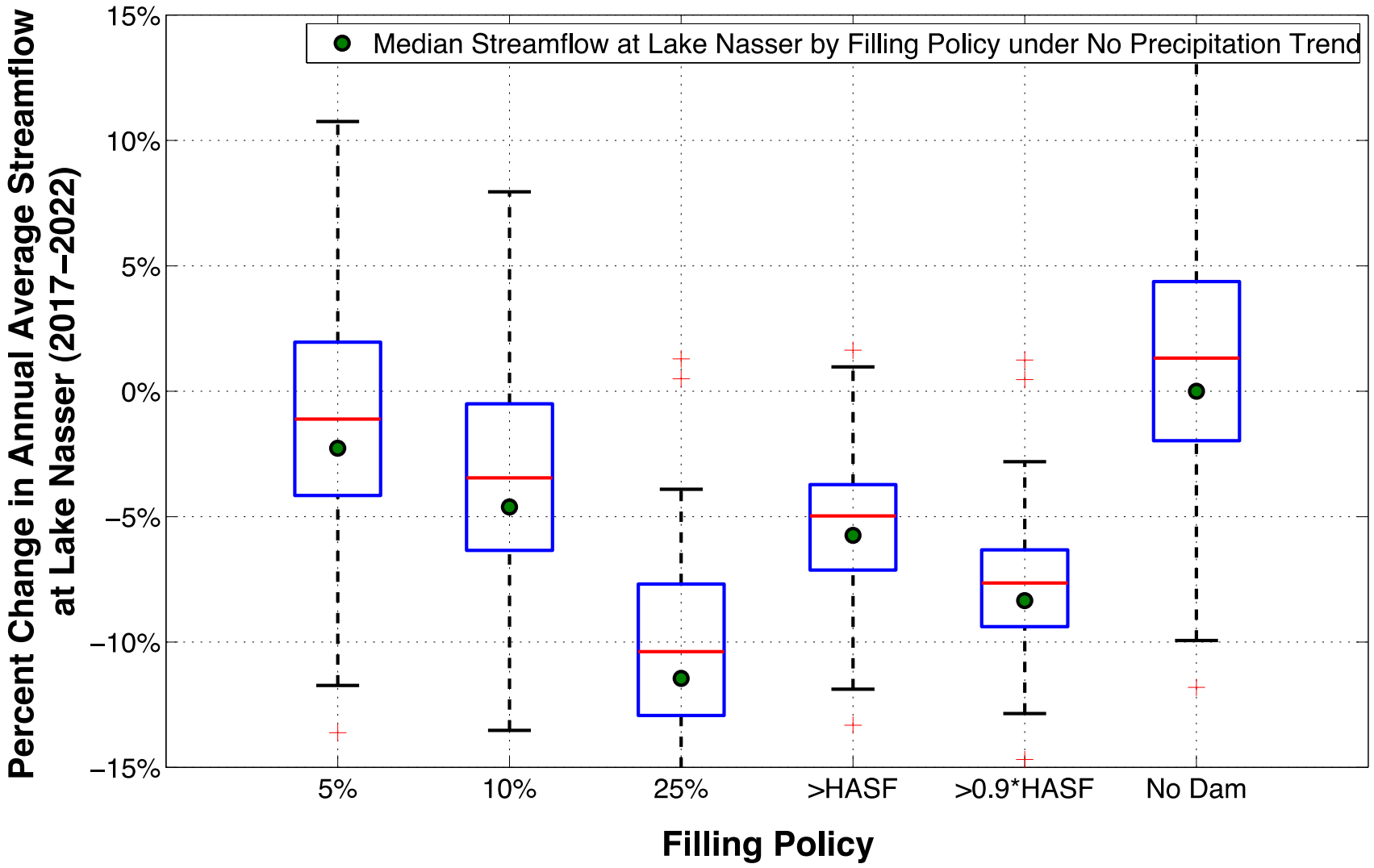
Hydropower Generation with CC

2014 - 2031

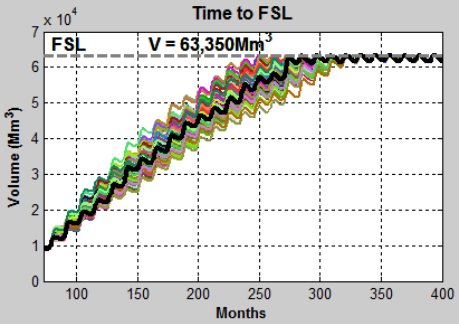


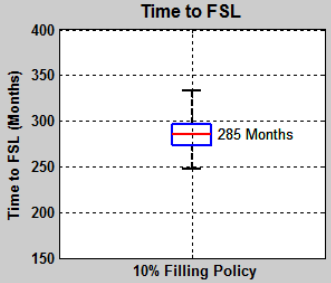
SF Reduction at Nasser with CC

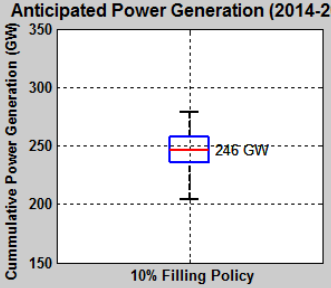


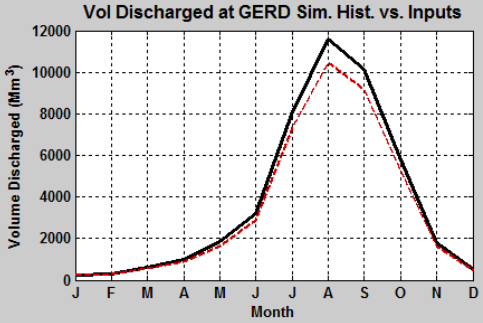
Tool

Resulting GERD Performance





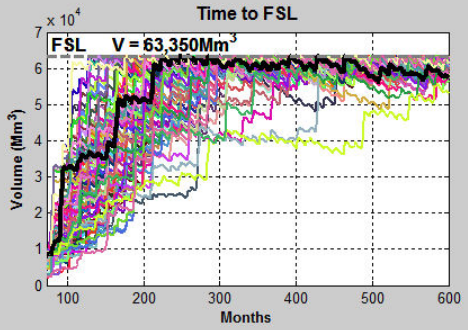


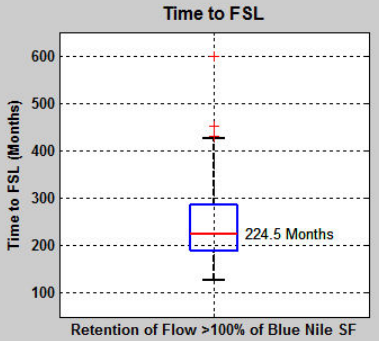


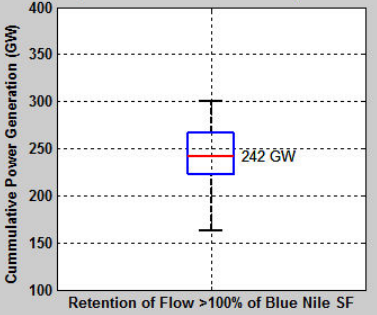
Results for Inputs of:

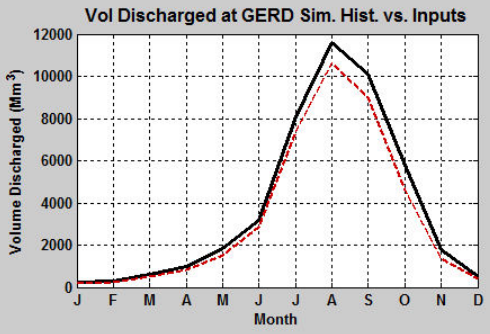
Power Gen. Capacity = 6.0 GW
Minimum Operating Level (MOL) = 590 masl
No Climate Change Trend
Filling Policy = Retain 10% of Blue Nile Inflow

Resulting GERD Performance









Results for Inputs of:

Power Gen. Capacity = 6.0 GW
Minimum Operating Level (MOL) = 590 masl
No Climate Change Trend
Filling Policy = Retention of Monthly Flow >100% of Simulated Historical Blue Nile Stream Flow

Thank You

Courtesy of Dorling Kindersley

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