ACF RIVER BASIN: CLIMATE AND DEMAND CHANGE IMPACTS AND MITIGATION MEASURES

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Abstract. This article presents the potential impacts of climate change on the Apalachicola -Chattahoochee-Flint (ACF) river basin (Figure 1) in the southeast US. The long term future basin inflow sequences corresponding to A1B and A2 climate change scenarios were used to drive a water resources model that incorporates the river network, all storage projects and hydroelectric facilities, water withdrawals and returns, instream flow requirements, and management procedures. The assessment criteria of impacts include reliability of water supply for municipal, industrial, and agricultural users with current demand level (year 2007) and future projection (year 2050); lake levels; environmental and ecological flow requirements; and hydropower generation. Results indicate that, under the climate change scenarios and with the current management procedures, the system will experience severe adverse water resources impacts such as extended reservoir drawdowns (Figure 2), water supply deficits (Figure 3), and frequent violations of instream flow requirements. Adaptive management procedures and modified operation rules are proposed and tested to mitigate the impacts of climate changes. The results indicate that such measures can significantly reduce adverse climate and demand change impacts (Figure 4 and Figure 5), but they need to be institutionalized as part of state and federal agency policies.

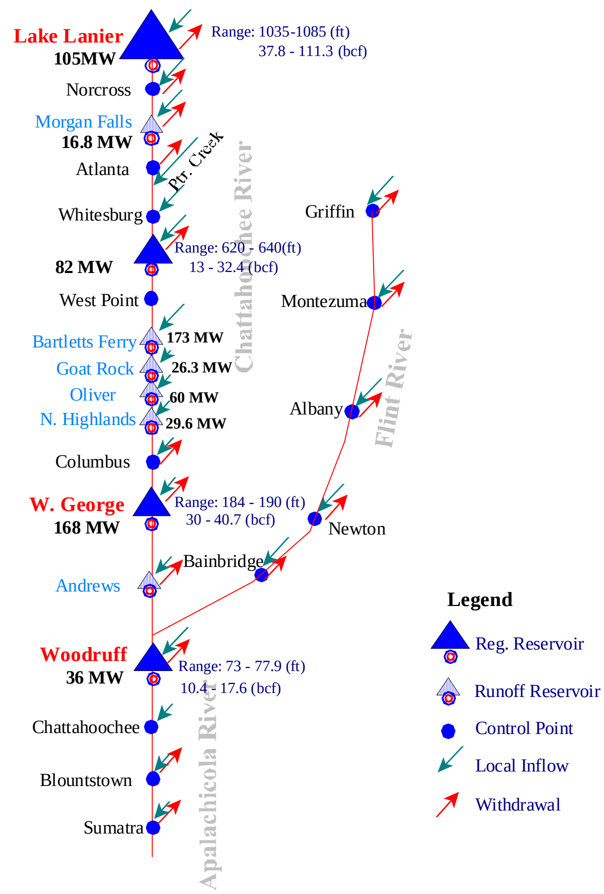

Figure 1. ACF basin schematic with indicated components of regulated reservoirs, runoff reservoirs, interested river control point, local inflows, and withdrawals. Installed hydropower capacities are shown in Megawatts (MW). The elevation and storage ranges of regulated reservoirs are shown in feet (ft) and billion cubic feet (bcf).

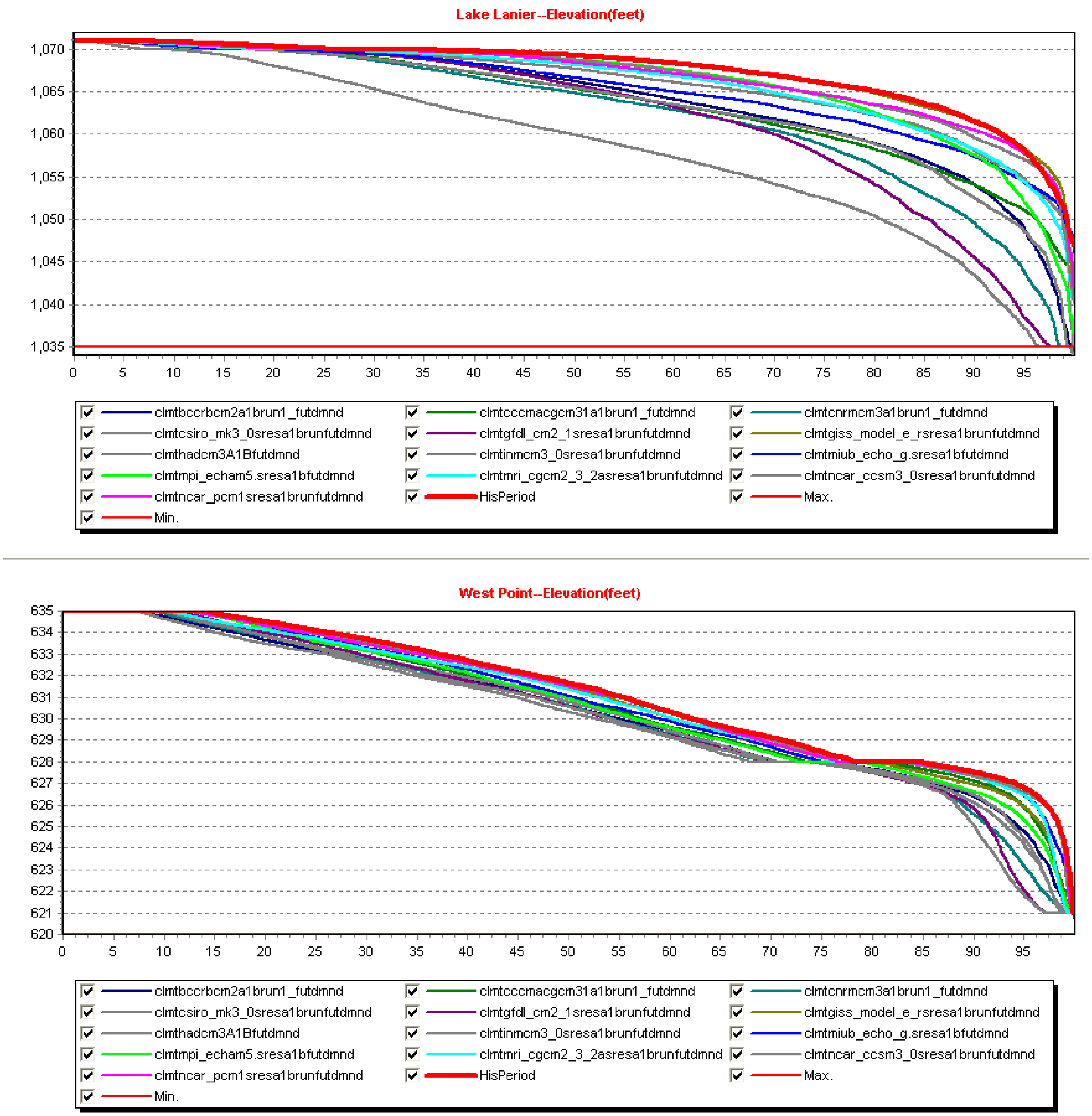

Figure 2. Reservoir elevation frequency curves for Lake Lanier and Lake West Point under A1B climate change scenarios, future demands, and current reservoir operation policy (Revised Interim Operation Plan—RIOP). The horizontal axis represents the probability of exceedance, the vertical axis represents the reservoir elevations. Thick red lines represent historical climate response, while thinner lines represent the lake response under 13 future climate scenarios (A1B type). The figure shows that the historical lake levels are clearly higher than those projected under the future climate scenarios.

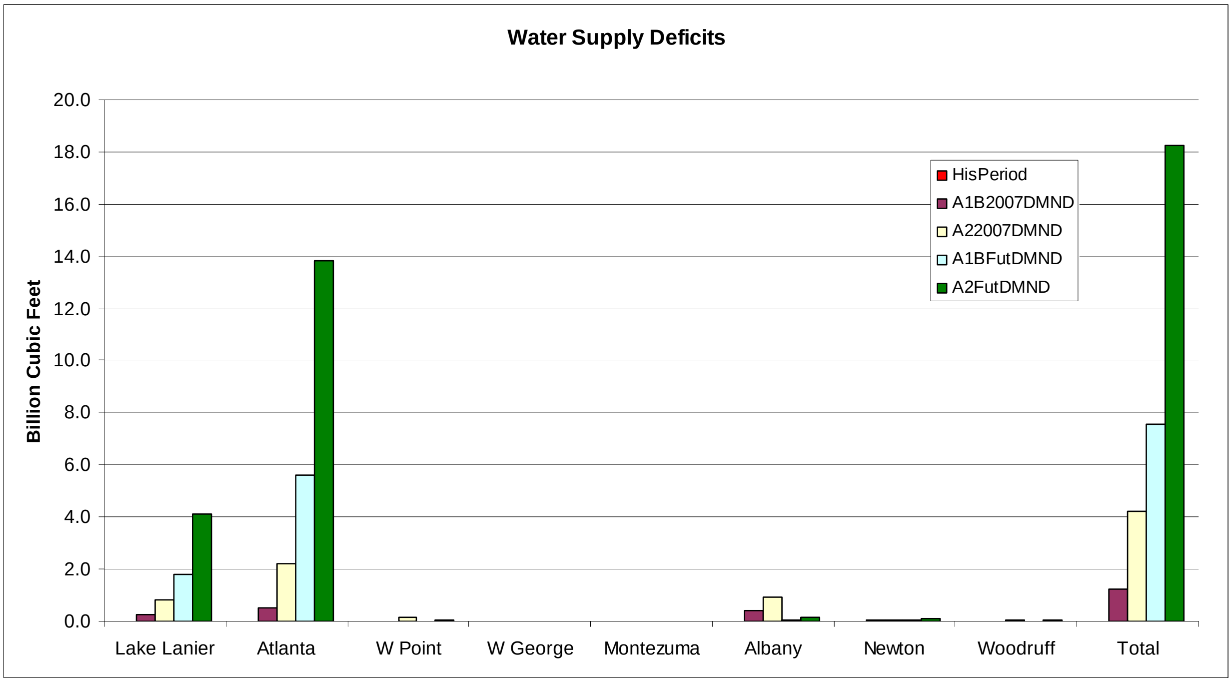

Figure 3. Water supply deficits (cumulative over the assessment horizon) at various ACF nodes under (1) historical period (HisPeriod), (2) A1B future climate scenarios with 2007 water demands (A1B2007DMND), (3) A2 future climate scenarios with 2007 water demands (A22007DMND), (4) A1B future climate scenarios with 2050 water demands (A1BFutDMND), and (5) A2 future climate scenarios with 2050 water demands (A2FutDMND). All cases are simulated with RIOP reservoir management policy. Results show no deficits for the historical period. The highest deficits occur under A2 climate scenarios and 2050 demands in the upper Chattahoochee (Lanier and Atlanta). The deficits under the A1B climate and 2007 demand scenarios are approximately half of the A2/2050 deficits.

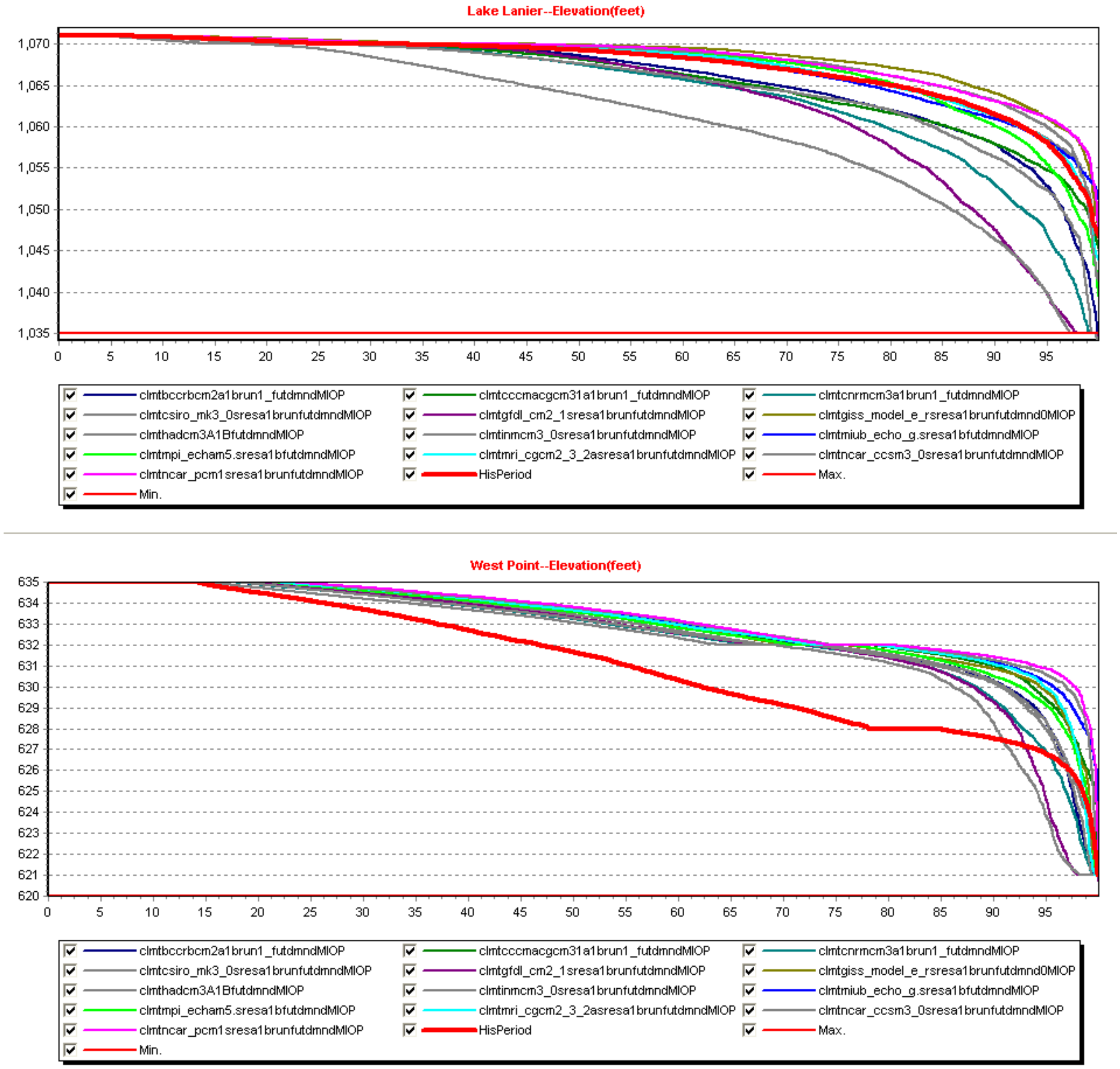

Figure 4. Reservoir elevation frequency curves for Lake Lanier and Lake West Point under A1B climate change scenario, future demands, and an adaptive reservoir operation policy (Georgia Tech Interim Operation Plan—GT-IOP). The horizontal axis represents the probability of exceedance, the vertical axis represents the reservoir elevations. Thick red lines represent historical climate response (as in Figure 2), while thinner lines represent the lake response under 13 future climate scenarios and the GT-IOP. The figure shows that the future lake levels improve in comparison to those in Figure 2, indicating that adaptive management policies mitigate the adverse impacts of climate change.

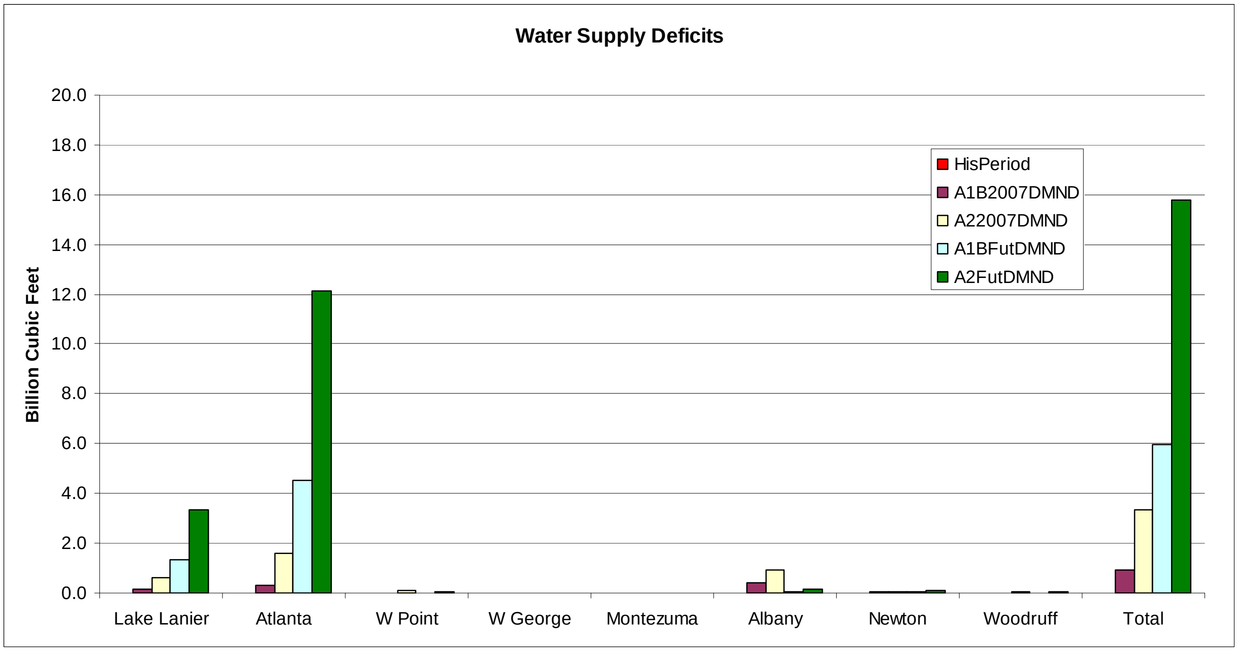

Figure 5. Water supply deficits (cumulative over the assessment horizon) at various ACF nodes under (1) historical period (HisPeriod), (2) A1B future climate scenarios with 2007 water demands (A1B2007DMND), (3) A2 future climate scenarios with 2007 water demands (A22007DMND), (4) A1B future climate scenarios with 2050 water demands (A1FutDMND), and (5) A2 future climate scenarios with 2050 water demands (A2FutDMND). All cases are simulated with GT-IOP reservoir management policy. Deficits at all locations are lower under the adaptive management policy compared to those of Figure 3 (RIOP).