Assessment of Climate Change Impacts on Water Quality Loads in the Beasley Lake Watershed, MS

L.M.W. Yasarer[1], R.L. Bingner[2], J.D. Garbrecht[3], M.A. Locke[4], R.E. Lizotte[5], H.G. Momm[6], P.R. Busteed[7]

Managing resilient agroecosystems requires a long-term approach, which includes the assessment of future climate impacts and an evaluation of adaptation strategies and conservation practices to reduce impacts. One of the first steps in developing agroecosystem resiliency is to conduct watershed-scale assessments to evaluate potential climate change impacts that would alter regional hydrology and water quality. This study focuses on the Beasley Lake watershed (Figure 1), which is located in an agriculturally intensive area of the Lower Mississippi River Alluvial Plain (i.e. the Mississippi Delta). The Beasley Lake watershed has been a part of the USDA Conservation Effects Assessment Project (CEAP) since 1994; therefore, historical and current management practices and water quality conditions have been well documented. Using the Beasley Lake watershed as a case study, climate change impacts on watershed hydrology and water quality loads were evaluated through application of the USDA Annualized Agricultural Non-Point Source (AnnAGNPS) pollution model (Bingner and Theurer, 2001).

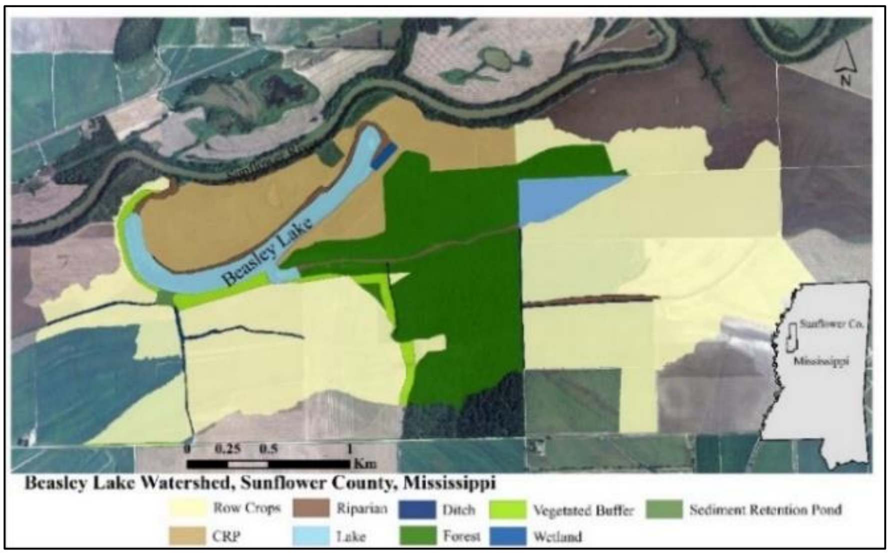

Figure 1. Beasley Lake Watershed, Sunflower County, Mississippi.

Fifteen global circulation models (GCMs) from the Coupled Model Intercomparison Project (CMIP5) forced with the Representative Concentration Pathway (RCP) 8.5 were bias corrected and spatially downscaled to a 12 by 12 km grid (Maurer et al., 2007) and temporally downscaled to a daily time step using the USDA Synthetic Weather Generator, SYNTOR (Garbrecht and Busteed, 2011). These downscaled climate data were then used in the AnnAGNPS model to simulate water, sediment, and nutrient loads produced from the watershed (Figure 2). Comparisons between baseline conditions and those influenced by projected climate changes will be presented. This information will help elucidate the impacts of possible climate change on watershed water quality that is needed for long-term conservation management planning.

[1]Lindsey M.W. Yasarer, Postdoctoral Research Associate (Research Hydrologist), USDA-Agricultural Research Service (ARS) National Sedimentation Laboratory (NSL), Oxford, Mississippi, USA; [2]Ronald L. Bingner, Agricultural Engineer, USDA-ARS NSL, Oxford, Mississippi, USA; [3]Jurgen D. Garbrecht, USDA-ARS Grazinglands Research Laboratory (GRL), El Reno, Oklahoma, USA; [4]Martin A. Locke, Research Leader, USDA-ARS NSL, Oxford, Mississippi, USA; [5]Richard E. Lizotte, Jr., Research Ecologist, USDA-ARS NSL, Oxford, Mississippi, USA; [6]Henrique G. Momm, Asst. Professor, Middle Tennessee State Univ., Murfreesboro, Tennessee, USA; [7]Phillip R. Busteed, Hydrologist, USDA-ARS GRL, El Reno, Oklahoma, USA. Corresponding author: Lindsey Yasarer, email: lindsey.yasarer@ars.usda.gov.

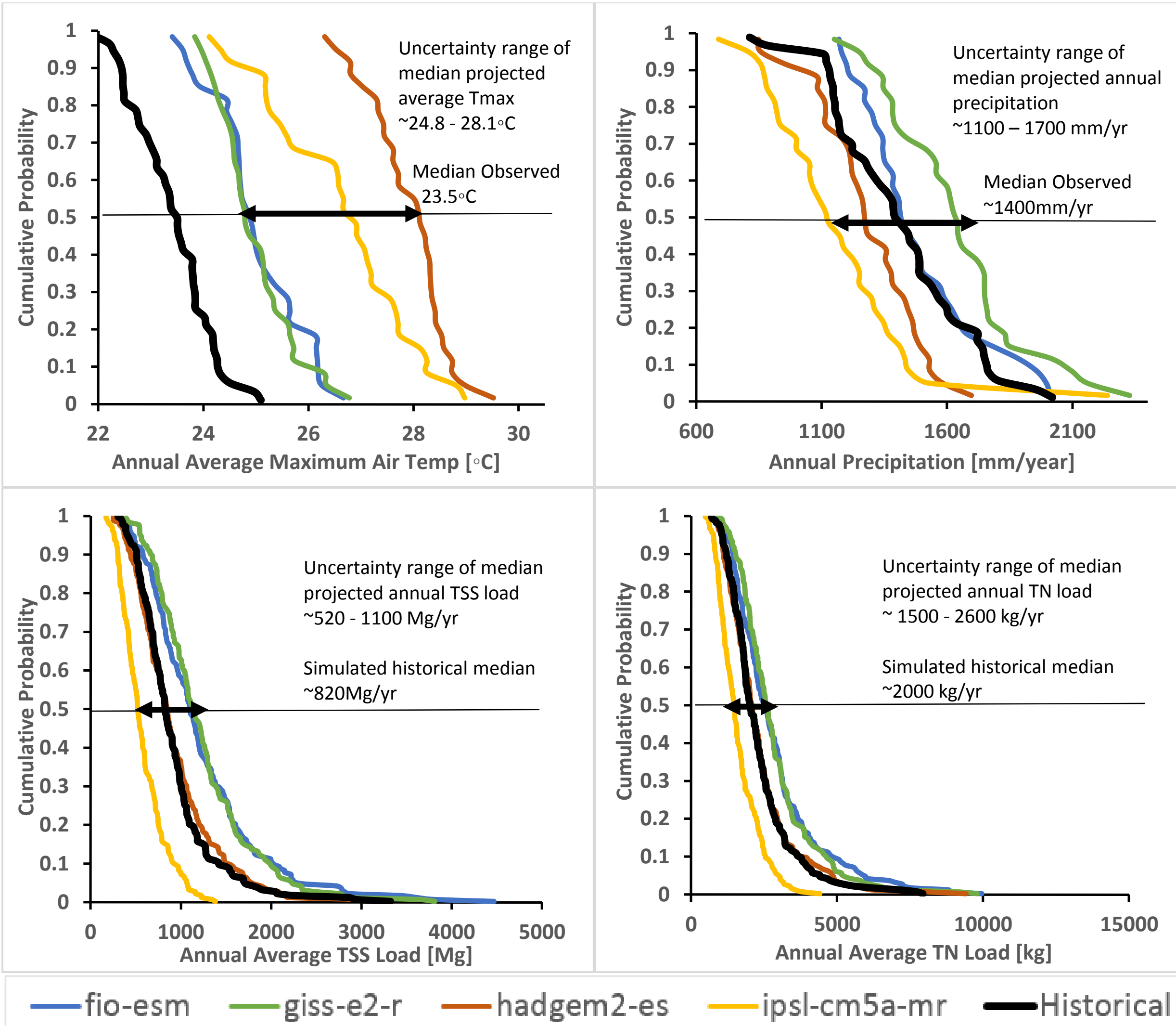

Figure 2. Cumulative probability plots of average annual maximum air temperature (top left), annual precipitation (top right), AnnAGNPS-predicted annual average TSS loads (bottom left), and AnnAGNPS-predicted annual average TN loads (bottom right) containing simulated results from 4 GCMs forced with RCP 8.5 for the 2041-2070 time period, as well as results representing the observed baseline climate (1971-2015). Selected GCM results shown represent the range in values generated from 15 GCM simulations.

References

Bingner, R.L., and F.D. Theurer. 2001. AnnAGNPS: Estimating sediment yield by particle size for sheet & rill erosion. In: Proceedings of the 7th Federal Interagency Sedimentation Conference, March 25-29, 2001, Reno, Nevada. pp. I-1 to I-7.

Garbrecht, J., and P. Busteed. 2011. SYNTOR: A Synthetic Daily Weather Generator Version 3.5 User Manual. Grazinglands Research Laboratory, GRL 1-11. USDA-ARS, El Reno, Oklahoma.

Maurer, E.P., L. Brekke, T. Pruitt, and P.B. Duffy. 2007. Fine-resolution climate projections enhance regional climate change impact studies. EOS, Trans. Am. Geophys. Union 88(47): 504.