# Developing the critical loads and target loads for watersheds of the Great Smoky Mountain National Park

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Critical loads and target loads were calculated for 12 watersheds in the Great Smoky Mountain National Park, Tennessee using the hydrochemical model PnET-BGC. The 12 sites were chosen based on a block design and have different watershed characteristics with acid neutralizing capacity (ANC) values ranging from to -14 μeq/L to 60 μeq/L. Some of the watersheds have no prior land disturbance history such as Left Prong Anthony and Walker Camp Prong, while others have been affected by the human settlement, diffuse disturbance, logging or exotic insect infestation. The model is run from 1000 year to 1850 as a spin- up period. 1850 to 2010 is a hindcast period in which stream chemistry is simulated based on reconstructions of historical changes in acidic deposition and land disturbance. From 2010 to 2200 year the model is run under a range of future scenarios of decreases in $SO_4^{2-}$, $NH_4^+$ and $NO_3^-$ deposition to estimate target and critical loads. Our results show that the model simulations of long-term stream data match well with the observed data. We find that most of the $SO_4^{2-}$ from atmospheric deposition is adsorbed by soil, and most of the stream output of $Ca^{2+}$ is the result of desorption from the soil exchange complex. The results show that the historical acidification has a similar pattern across the watersheds in which the ANC was decreased significantly since the industry time-1850. The results also show that decreases in $NO_3^-$ deposition are much more effective in achieving increases in stream ANC than decreases $SO_4^{2-}$ deposition. These results are markedly difference that the results of previous simulations conducted for northern forest sites. Decreases in $NH_4^+$ and $SO_4^{2-}$ deposition had comparable and but small effects on increasing stream ANC.

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