**AWRA 2011 ANNUAL WATER RESOURCES CONFERENCE**
**Albuquerque, New Mexico**
**November 7-10, 2011** 

# CUMULATIVE SUM ANALYSIS FOR DETECTION OF SHORT-TERM TRENDS IN STREAM CHEMISTRY DUE TO ATMOSPHERIC DEPOSITION

David R. DeWalle *

**ABSTRACT:** Cumulative sum analysis can be used to detect short-term trends in stream chemistry data which are not easily discovered using nonparametric Mann-Kendall or ordinary least-squares regression methods. Cumulative sums of differences between water quality data and some expected value, such as the long-term mean or predicted values based on a long-term regression trend line, can be plotted over time to help identify existence and timing of short-term trends. Short-term trends in stream chemistry identified using cumulative sum analysis can then be compared to variations in suspected causal factors. The method is illustrated using cumulative sums of residuals from long-term trend lines for monthly stream nitrate and sulfate concentration data in Appalachian forest streams and monthly atmospheric wet deposition data at nearby CASTNET monitoring stations during 1988-2009. Even though stream concentrations, adjusted for effects of varying flow rates, showed significant long-term reductions due to long-term decreases in atmospheric deposition, subtle short-term, multi-year cycles in stream chemistry data were also detected which appeared to be a lagged response to short-term cycles in monthly atmospheric wet deposition. Cumulative sum analysis of residuals from a long-term trend line is a sensitive, easily-applied method for detection of short-term variations in time series data that may be particularly useful in illustrating how changing atmospheric deposition affects stream chemistry.

* Professor Emeritus, Penn State, Forest Resources, 516 Gregor Circle, State College, PA 16801 USA, Phone: 814-861-6449, Email: d9d@psu.edu