MS THESIS DEFENSE

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CIVIL AND ENVIRONMENTAL ENGINEERING
TENNESSEE TECHNOLOGICAL UNIVERSITY

BY

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"Error Budget Analysis of Hydrologic Models: Understanding Applications for Satellite Rainfall Data"

Thursday, APRIL 05, 2007
3.30 – 4.30PM
PRESCOTT HALL ROOM 225

When the absence of an adequate ground-based rainfall network hinders the operative use of hydrologic models, satellite-based rainfall estimates become the natural alternative. However, the rainfall data obtained from space-borne platforms are prone to errors. An error budget analysis of hydrologic models was performed to understand the behavior of error in rainfall as it propagates from input (rainfall) to various outputs. It was hypothesized that error in rainfall input is a conservable quantity for hydrologic models that honor the principle of conservation of mass. Based on this hypothesis, a hydrologic model's accumulation of error from input to the simulated components of the hydrologic cycle was monitored as a conservable quantity. Two types of errors were considered – i) systematic and ii) random. Four hydrologic models of varying levels of complexity were studied. Systematic error and random error in input were found insensitive to the relative accumulation of error in the simulation of stream flow and evapotranspiration (ET) for the simplest statistical model. As systematic error increased in rainfall, error accumulated relatively more in stream flow for a linear storage-discharge model while proportion of error in ET decreased. This increase was observed to be linear. A linear increase in random error in rainfall on the other hand appeared to induce a non-linear (exponential-type) increase in error in stream flow. Additive random error penalized more than the multiplicative random error in the simulation of outputs. Hence, the assumption of error variance being independent of the mean is an important criterion in our understanding of the progression of error from input to output. Overall, a general observation is that rainfall error has a natural affinity to accumulate more in stream flow simulation as the complexity in model structure increases. Identification of the relative level of accumulation of input error among various simulated variables should facilitate the choice of models based on satellite rainfall over ungauged regions where both systematic and random errors are known to persist in the data.