IMPACT OF SUMMER MONSOONS ON A RESERVOIR IN EAST ASIA

Daehyok Shin, Bomchul Kim, and Lawrence E. Band*

ABSTRACT: The Asian monsoon is the most powerful hydrometeorological event on Earth, and dominates the climate of the most densely populated region on the planet. Every year, a long dry period is followed by a short but very wet season. The societies and ecosystems in the monsoon region experience a dramatic change of behavior driven by this annual cycle.

Reservoirs in East Asia are significantly influenced by the monsoon; torrential rainfalls during summer rainy seasons – called *Changma* in Korea, *Baiu* in Japan, and *Mai-yu* in China – impact reservoirs with excessive sediment and nutrient export from watersheds. The 10-year measurement on the Soyang Reservoir, the largest reservoir in South Korea, showed that more than 60% of annual precipitation occurred during rainy season, and it exported more than 80% of the annual suspended sediment and 70% of the annual phosphorus loads. The massive loading created 40 m-thick turbid layers with up to 140 *mg-SS/l* and 500 *μg-P/l* in the metalimnion. The layers were sustained over the entire monsoon season of three months, and occasionally produced severe algal blooms in late summer and autumn.

Heavy rainfalls during the summer monsoon are transformed through watersheds into massive sediment and nutrient loads that essentially break the causal relationship between the nutrient state pre-monsoon and the biologic response post-monsoon, which reduces the predictability of water quality. As a consequence, in East Asia we cannot predict the intensity of algal blooms during summer by measuring phosphorous concentration at spring turnover, which is a typical management practice in North America and Europe.

Combined with heavy rainfall, the high temperature of summer plays a critical role in determining the dynamics of the reservoir. It strongly stratifies the reservoir, and confines the turbid inflow to the metalimnion, buffering the instantaneous influence of the strong monsoon storms' meteorological signal to the biologic response in the epilimnion. However, the algal blooms were occasionally observed following heavy rainfall events. This implies the existence of additional mechanisms that supply nutrients in the turbid inflow to the epilimnion in certain conditions.

Major loading in North America and Europe often occurs during spring and fall, when reservoirs mix vertically. In contrast, the peak loading in East Asia occurs during summer, when metabolic processes are most active both in reservoirs and their watersheds. Exploring the dynamics of reservoirs in these two situations can provide new insights on the interactions between meteorological forcing, watershed conditions, and reservoir dynamics.

*Respectively, Ph.D. student, Geography Department, University of North Carolina at Chapel Hill, CB#3220 Saunders Hall, Chapel Hill, NC 27599 (919-843-9707; Fax: 919-962-1537, Email: sdhyok@email.unc.edu); Professor, Environmental Science Department, Kangwon National University, 192-1 Hyoja-Dong, Chuncheon, Kangwon 200-701, South Korea (82-33-250-8572; Email: bkim@kangwon.ac.kr); and Professor, Geography Department, University of North Carolina at Chapel Hill, CB#3220 Saunders Hall, Chapel Hill, NC 27599 (929-962-3921; Fax: 919-962-1537; Email: lband@email.unc.edu).