EXPLANATION OF THE WATER MONITORING WATER TIME SERIES DATA IN SCHOHARIE CREEK, NY

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INTRODUCTION

Flooding in the rivers in upstate New York is an event that occurs mostly either due to rainfall (tropical storms) or due to ice jams (Johnston and Garver, 2001; Lederer and Garver, 2001; Sheller et al., 2002; Garver and Cockburn, 2009; Marsellos et al., 2010a). In case of flooding, it has been observed a higher level in the water discharge of the Mohawk river and Schoharie Creek (e.g., Marsellos et al., 2010b). In this study, we analyze the time series of the daily water discharge data from the Schoharie Creek for the period of 2005-2013. In particular, we investigate the association of flooding with the climatic variables as well as the water underground level time series data derived from the same location and during the same time period.

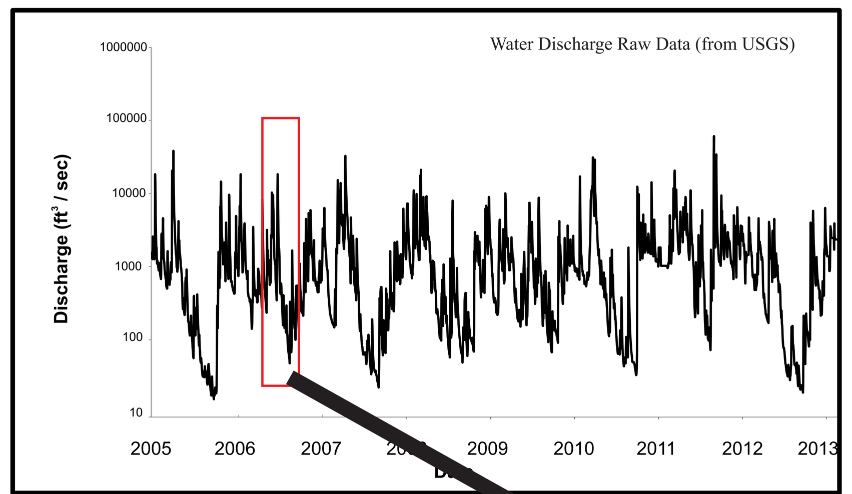
DATA

Daily time series of the water discharge, precipitation, temperature, water level (underground), wind speed, and tides measured at Schoharie Creek were obtained during the period of January 2005-February 2013. The data have been obtained from National Oceanographic and Atmospheric Administration (N.O.A.A.) and United States Geological Survey (U.S.G.S.).

METHODOLOGY

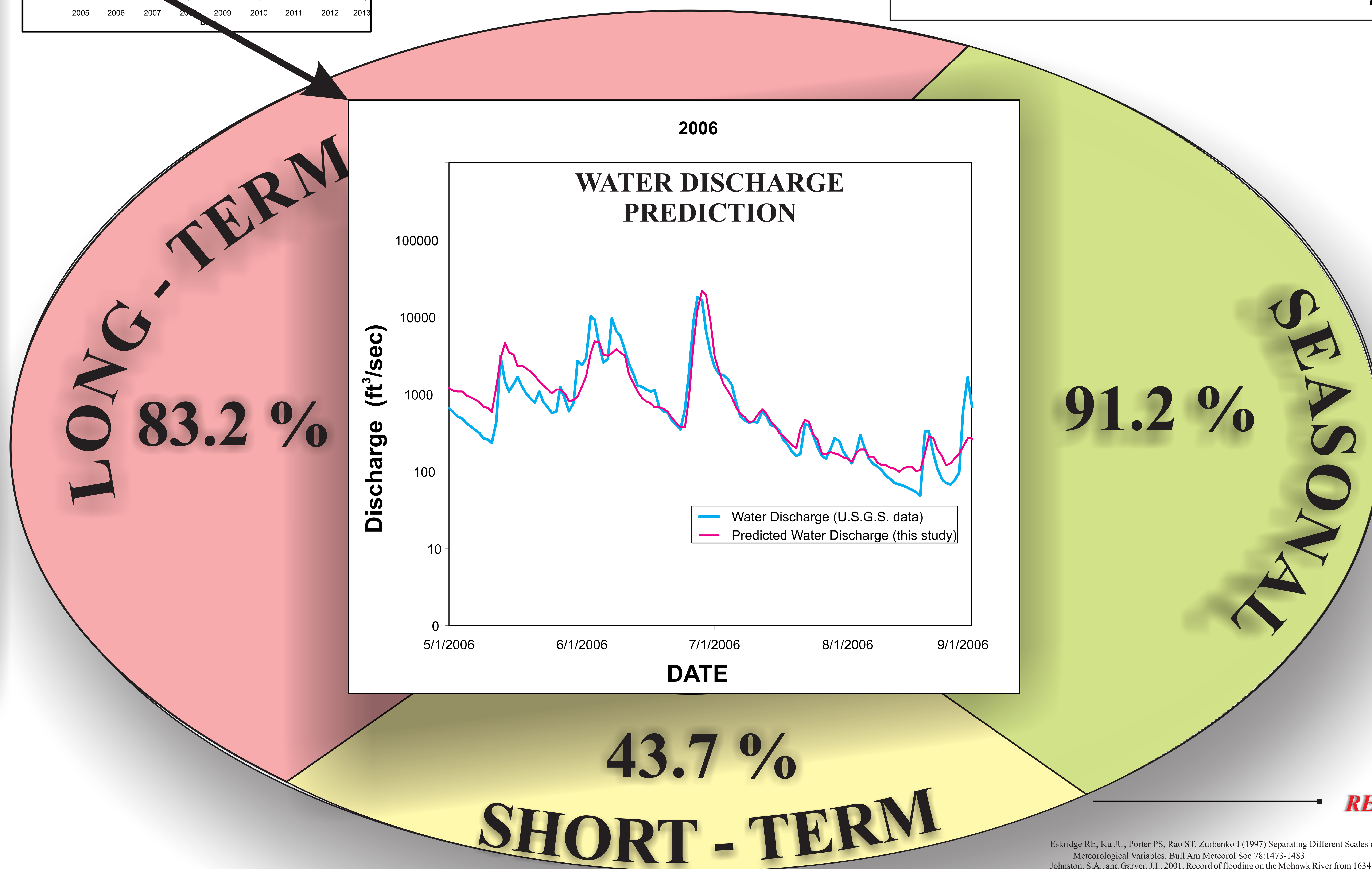
In several studies it has been proved that the separation of a time series into different components is necessary, to avoid contribution of different covariance structures between the components of the time series (Zurbenko and Sowizral 1999; Tsakiri and Zurbenko 2008; Tsakiri and Zurbenko 2009). For this reason, in order to examine the association of the time series of the water discharge with the climatic variables, we first decompose the time series of all the variables. A statistical methodology is presented for the decomposition of the time series into the long, seasonal and short term component of the variables. For the decomposition of the time series we use the Kolmogorov-Zurbenko filter (Zurbenko 1986). The Kolmogorov-Zurbenko (KZ) filter provides a simple design and the smallest interferences between the scales of a time series (Yang and Zurbenko 2010b). Moreover the KZ filter provides effective separation of frequencies and can be applied directly to datasets containing missing observations (Eskridge et al. 1997; Rao et al. 1997; Yang and Zurbenko, 2010a).

Daily underground water level time series data and daily climatic data have been analyzed for the same time period (January 2005 to February 2013) at the same location. After the application of the KZ filter, we analyze each component separately and we prove that the components of the water discharge time series can be explained by the climatic variables and the underground water level. This methodology can be applied for studying the water discharge time series in other locations, as well.



DECOMPOSITION

Decomposition	R2	Explanation
Long-term component	0.832	48.94%
Short-term component	0.437	10.18%
Seasonal component	0.912	16.31%
		75.43%



DECOMPOSITION OF TIME SERIES

Decomposition of time series into different components

$X(t) = L(t) + Se(t)+Sh(t)$

- X(t): original time series
- L(t): long term trend component which describes the long term variations
- Se(t): seasonal component which describes the seasonal variations
- Sh(t): short term component which describes the short term variations

Kolmogorov-Zurbenko Filter ($KZ_{m,p}$)

- For the decomposition of the time series we use the Kolmogorov-Zurbenko filter. The filter is defined by:

$$Y_t = \frac{1}{m}\sum_{j=-k}^{k} X_{t+j}$$

m=2k+1
X_t: original series
Y_t: filtered series
p: number of iterations

CONCLUSIONS

- It is difficult to explain and predict the time series of the water discharge because of the presence of the short term variations in the time series. For this reason, the decomposition of the time series of the water discharge as well as the climatic variables becomes essential for the interpretation of the water discharge time series.
- By using the Kolmogorov-Zurbenko filter, we can separate the time series of the variables into low frequency (long and seasonal component) and high frequency (short term component). After the decomposition, we can explain 76% of the water discharge time series by the climatic variables during the summer period.

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