



**COLLEGE OF ENGINEERING
AND COMPUTER SCIENCE**
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Hao Chen

for the degree of Doctor of Philosophy (Ph.D.)



“Influences of Climate Change and Variability on Baseflows”

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Engineering West, Room 101
777 Glades Road
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ABSTRACT OF DISSERTATION

Influences of Climate Change and Variability on Baseflows

Baseflow is the portion of the streamflow that is sustained between precipitation events, fed to streams by delayed pathways. Baseflow estimation and evaluation are two critical and essential tasks for water quality and quantity, drought management, water supply, and groundwater protection. In this research study, the influences of climate change and variability on baseflow derived from hundreds of watersheds in the continental United States are evaluated. Baseflows are estimated using streamflow data from these watersheds that are least affected by anthropogenic influences. In the initial phase of the study, an exhaustive evaluation of four different baseflow separation methods is carried out using streamflow data at several sites from the South Atlantic-Gulf region which includes a geographical region comprising of nine states in the southeastern U.S. Baseflows are estimated at different temporal scales and are used to assess the performances of different methods over a 44-year period starting from the year 1970 and the best method among these methods is selected for further analysis. Assessment of climate change influences on baseflows is then carried out using two nonparametric statistical trend tests (viz., Spearman's Rho (SR) and Mann-Kendall (MK)). Trends in baseflows are evaluated at 574 sites located within the watersheds in the U.S. that are known to be least impacted by human influences. Trends were determined for annual

maximum, mean, and median baseflows for the period 1970-2013. Spatially non-uniform trends and changes in characteristics of baseflows and strong influences of past precipitation events on the baseflow extremes were noted across the continental U.S. Some regions have shown decreasing baseflow trends and these are cause for concern and have severe implications for drought mitigation plans and low-flow management strategies in several watersheds in the U.S. In the final phase of the study influences of climate variability on baseflow manifested through different phases of individual and coupled oceanic and atmospheric oscillations are evaluated. Baseflows at 574 sites separated by temporal windows that coincide with two or more phases of different decadal, quasi-decadal and multi-year oscillations (viz., Pacific decadal oscillation (PDO), North Atlantic oscillation (NAO), Atlantic multidecadal oscillation (AMO), and El Niño-southern oscillation (ENSO)) are evaluated for statistically significant changes using nonparametric statistical hypothesis tests. Results from the study indicate that unlike climate change influences, climate variability effects are noted only in few specific physiographic regions of the U.S. This study documents an exhaustive and comprehensive assessment of changes in baseflows due to changing climate and results from this work can aid in short- and long-term management of low flows at a regional level that supports sustainable aquatic environment and handle droughts effectively.

BIOGRAPHICAL SKETCH

Born in Wenzhou, Zhejiang, China

B.S., Nanchang University, Nanchang, Jiangxi, China, 2012

M.S., Florida Atlantic University, Boca Raton, Florida, 2019

Ph.D., Florida Atlantic University, Boca Raton, Florida, 2019

CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2015 - 2019

Qualifying Examination Passed: Fall 2016

Published Papers or presented:

- Chen H and Teegavarapu RSV. "Spatial and Temporal Baseflow Trends in the United States." American Geophysical Union Fall Meeting, Washington DC, 2018. <http://adsabs.harvard.edu/abs/2018AGUFM.H51L1457C>
- Chen H and Teegavarapu RSV. "Spatial and Temporal Baseflow Trends in the Continental United States." World Environmental and Water Resources Congress, Pittsburgh, 2019. <https://www.eventscribe.com/2019/ASCE-EWRI/fsPopup.asp?Mode=presInfo&PresentationID=482562>
- Chen H and Teegavarapu RSV. "Relationship between Ocean-Atmospheric Variability and Regional Baseflow of the Continental United States." Proceedings of World Environmental and Water Resources Congress 2019: Groundwater, Sustainability, Hydro-Climate/Climate Change, and Environmental Engineering, pp. 296-302. Reston, VA: American Society of Civil Engineers, 2019.
- Chen H and Teegavarapu RSV. "Spatial and Temporal Variability in Baseflow Characteristics across the Continental United States." Theoretical and Applied Climatology, 2019 (Under Review)
- Chen H and Teegavarapu RSV. "Oceanic-Atmospheric Variability Influences on Baseflows in the Continental United States." Water Resources Management, 2019 (under submission)
- Chen H and Teegavarapu RSV. "Comparative Analysis of Four Baseflow Separation Methods in South Atlantic-Gulf Region of the U.S." Hydrological Sciences Journal, 2019 (under submission)