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Assessment of Paleo-hydrology and Paleo-inundation Conditions: the Process

Pingping Luo[a,*], Kaoru Takara[a], Bin He[a], Weili Duan[b], Apip[a], Daniel Nover[c], Watanabe Tsugihiro[d], Kenichi Nakagami[e] and Izumi Takamiya[f]

[a]*Disaster Prevention Research Institute (DPRI), Kyoto University, Gokasho, Uji-shi, Kyoto 611-0011, Japan*
[b]*Department of Civil and Earth Resources Engineering, Graduate School of Engineering, Kyoto University, Kyoto, Japan*
[c]*AAAS Science and Technology Policy Fellow, U.S. Environmental Protection Agency, Global Change Research Program, Washington D.C., WA, USA*
[d] *Graduate School of Global Environmental Studies, Kyoto University, Sakyo-ku, Kyoto 606-8501 Japan*
[e]*Graduate School of Policy Science & College of Policy Science, Ritsumeikan University, Kyoto Japan*
[f]*Faculty of Literature, Arts and Cultural Studies, Kinki University, Osaka, Japan.*

Abstract

Paleo-hydrology is an important study which simulates the historical hydrology at the lack of observed period, calibrated at the present period and predicted the future hydrological condition. The study of paleo-hydrology is to obtain the historical evidence for the present hydrology and improve the accuracy of the statistical analysis and the prediction modeling assessment. Paleo-inundation assessment is the study of historical inundation under flood events which occurred prior to direct measurement of hydrologic parameters using modern methods. The ultimate objectives of this study were to estimate paleo-inundation under extreme floods using historical literature and incomplete data records. This paper focused on an application of estimating historical inundation conditions under paleo-floods using modern technologies at the river basin scale.

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* Corresponding author. Tel.: +81-774-38-4005; fax: +81-774-38-4130.
E-mail address:robertluoping@flood.dpri.kyoto-u.ac.jp.

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1. Introduction

Inundation simulation is an essential exercise for managing flood risk, as it provides tools necessary to reduce damage and economic loss while providing information for protecting human populations from the effects of floods. Paleo-inundation studies, a part of paleo-flood hydrology, attempts to estimate inundation conditions under historical events using a combination of historical information and modern methods. Paleo-inundation analysis plays an important role in reconstructing flood conditions, evaluating historical flood control policy, providing the experiences of historical escape technology and the method for evaluating the flood risk.

A great deal of researches has focused on hydrologic and paleo-hydrologic studies in the Nile river basin. Recorded flood levels in the Nile river at Roda island have been used to identify the multi-scale detection of abrupt climate change using the Mann-Kendall rank test[1,2]. Oscillatory modes have been used to extend the Nile river records from 622 A.D. to 1922 A.D[3]. Deep Mediterranean sediments have been examined to explore Nile flood records and provide a direct link between deep-marine sedimentary records and climate change[4]. Relationships between paleo-climate variability and paleo-flood have also been investigated[5,6]. It is important to simulate paleo-inundation conditions for paleo-hydrologic studies in the Nile river basin.

The main objectives of this study were 1) to develop the basic process for paleo-inundation reconstruction and paleo-hydrologic analysis in river basins that lack observed data, 2) to provide a case study for the paleo-inundation reconstruction assessment, and 3) to discuss the basic approaches to paleo-hydrology and paleo-inundation assessment.

2. Study Site

The Nile River is one of the longest rivers in the world with a length of 6740 km from the source to the sea. The Nile river basin extends from 4ºS to 32ºN and covers an area of 3 million km2.It includes two main branches (Blue Nile and White Nile), the mainstream and lakes (Victoria, Albert, Kayoga, Edward).The climate in the upstream of Nile river basin is tropical, and the climate in the downstream of Nile river basin is arid and semi-arid. The mean annual rainfall in the upstream is 1200 mm, but that in the downstream is less than 10 mm. In this study, we would focus on the main Nile river basin in Egypt. The main Nile river basin in Egypt includes one big dam called Aswan high dam which was constructed completely on July 21, 1970. A vast lake called Nasser Lake is located in southern Egypt and northern Sudan. According to an agreement between Egypt and Sudan (1959) the Nile water budget is 18.5×10^9 m^3 to Sudan and 55.5×10^9 m^3 to Egypt. The Nile river flood is an important nature cycle in Egypt since the ancient period. The flood inundation in Egypt used to happen every year, and it stopped until the Aswan high dam was completed. The detail location is shown in Figure 1.

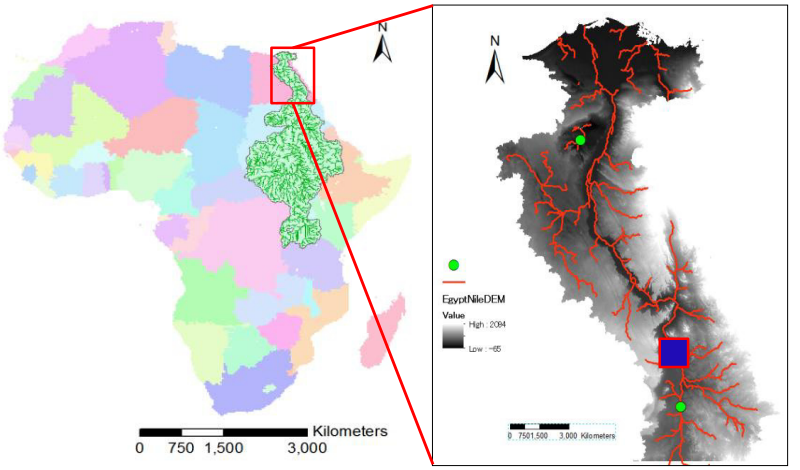

Fig. 1. Location of study area with the blue square in the left DEM map.