Hydrochronological Approach for Extreme Flash Floods at Wadi Systems in Arid Regions

○Mohamed SABER・Sameh KANTOUSH・Tetsuya SUMI・Mohammed ABDEL-FATTAH・Tahani ALHARRASI・Takahiro KOSHIBA・Yusuke OGISO・Mahmood ALMAMARI

Introduction

Wadi system is characterized by several characteristics including drought, flash floods, water resources scarcity, and lack of monitoring data. Basically, in order to overcome such challenges, proposed sustainable strategies based on physical based hydrological models are totally needed. we believe that the missing of powerful hydrological models is due to the lack of observational data, therefore, improving the data availability are the optimal way to overcome such problems. The main goal of this paper is to propose a new hydrochronlogical approach of extreme wadi flash floods in arid regions. Chronology is a series of events with explanation in the order in which they happened. The original concept of the hydro-chronology was used by the British hydrological society (BHS)[1]. In this study, the hydrochronological approach is used for the first time for Wadi Flash floods (WFFs) at wadi systems in the Arab region which are suffering from data scarcity to develop database and to study WFFs events. The main objectives are summarized in three stages to identify: 1. Paleo-WFFs using satellite data and field investigations, 2. Recent-WFFs from historical records and satellite data, and 3. Future-Wadi FFs using global climate change models.

Approach and methods

The proposed Hydro-Chronological Integrated Approach (**Fig. 1**) includes chronological stages:1) Paleo-WFFs, 2) Recent-WFFs, and 3) Future-WFFs. Paleo extreme WFFs events will be assessed based on analyzing the satellite remotes sensing images in order to identify spatiotemporal changes along wadi channels due to erosional and depositional processes caused by the extreme flash floods. Channel geometry changes and sediment deposits will be also investigated in the filed for validation. Recent extreme WFFs will be collected from the recent historical records and monitoring observations. Satellite rainfall data such as GSMaP will be also used to fill the missing of such data. Future extreme WFFs will be identified using the Global Climate Models (GCM) with addressing different future scenarios of WFFs. Integration of the three stages will be conducted. Then, hydro-Chronlogical modeling will be used to simulate the extreme flash floods along the entire identified records to understand spatial-temporal variability of WFFs, and the climate changes in terms of intensity, magnitude and disaster impacts of WFFs.

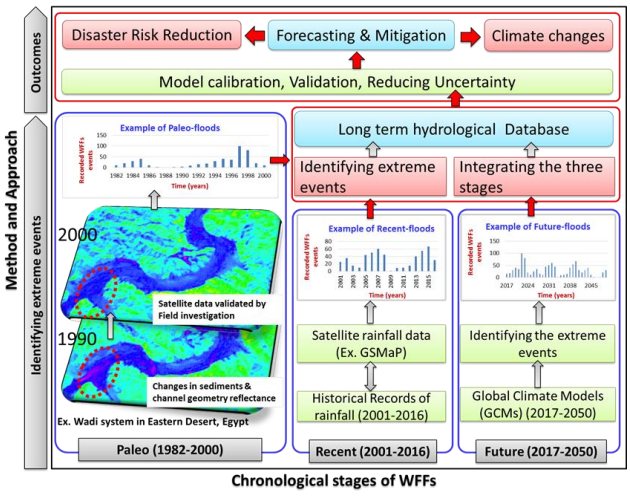

Fig. 1 Hydrochronological approach for wadi system (DRPI project 2017).

Results

In order to identify Paleo-extreme floods, field survey was conducted on Dec. 2017 at Wadi Mijlas in Oman (**Fig. 2**). Several field investigations (**Fig. 3**) have been implemented such as (wadi channel leveling, sedimentation Pedon to study the vertical layers of sedimentation at the reservoir by collecting sediments samples for further lab analysis, and detecting of flash floods marks).

To identify the recent flash floods events, Global Sattelite Mapping of Precipitation (GSMaP data) was used to analyze the extreme rainfall events in both space and time over the Arab Region. The results show high spatiotemproal varibailty with increasing the trend of extreme events (Fig. 3).

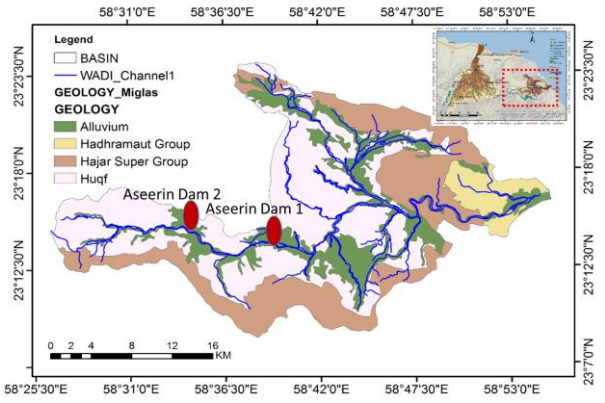

Fig. 2 Location map of the study area showing Wadi Samail and Wadi Mijlas in Oman.

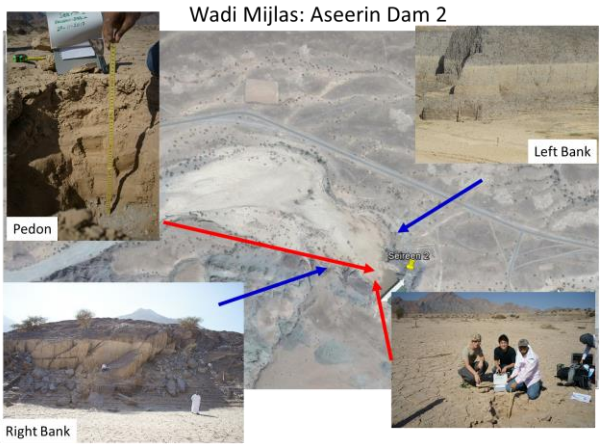

Fig. 3 Field Survey at Wadi Mijlas showing the pedon of the sedimentation at the reservoir (upper left), flood mark (top right) (photos was taken on Dec. 2017).

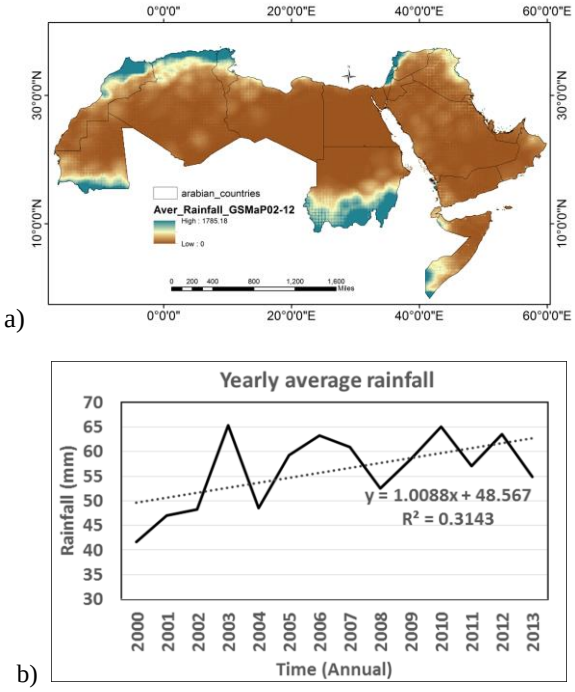

Fig. 3 GSMaP data analysis showing the spatial distribution (a) and temporal trends (b) of rainfall over the Arab region.

Conclusion

In this research, a new hydrochronological approach of WFFs in arid regions was proposed. This might be the best way to overcome the challenges of the ungauged wadi basins. The significance and contribution of this work are: 1) Developing hydrological database for WFFs in ungagged Wadis, 2) Reducing uncertainty of hydrological models for mainly forecasting and disaster risk reduction, and 3) Understanding climate change impacts & hydrological processes.

Acknowledgment

This paper is based on achievements of the collaborative research program of DPRI, Kyoto University, Project Number: 29L-03, 2017"

References

Andrew R. Black & Frank M. Law (2004) Development and utilization of a national web-based chronology of hydrological events. Hydrological Sciences Journal, 49:2, -246, DOI: 10.1623/hysj.49.2.237.34835.