Long-term Research Visit (Project No.: 29L-03)

Project title: Hydro-Chronological Approach for Extreme Flash Floods: Case Study of Wadi Systems in Egypt
Principal Investigator: Mohamed Saber Mohamed Sayed Ahmed
Affiliation: Assistant Professor
Name of DPRI collaborative researcher: Associate Prof. Sameh Kantoush Name of visitor (Affiliation): Mohamed Saber Mohamed Sayed Ahmed Period of stay: June 1, 2017 ~ March 31, 2018
Location of stay: Kyoto city, Japan

Number of participants in the collaborative research: 5 (4provide numbers for DPRI and 1non-DPRI staff)
-Number of graduate students: Two PhD Students (Japan & Egypt), one Master Students (Japan), Two Masters (Oman)

(5)

- Participation role of graduate students [Supporting in field survey in Wadi Mijlas in Oman on December 2017, hydrological Modeling, and data analysis]

Anticipated impact for research and education

1- The research will be helpful for wadi flash floods forecasting and developing database for ungauged basins arid regions.

2- Involving Graduate students in the project could enhance their career and ability in academic research.

3- Presenting a new approach for hydrological application in Wadi system.

Research report
(1) Purpose
Ungagged Wadi basins are characterized by flash floods impacts, data scarcity, and missing of effective hydrological models for flood forecasting and disaster risk reduction. Therefore, the project aimed to develop Hydro-Chronological Integrated Approach for Paleo, Recent, and Future - Wadi Flash Floods (WFFs) in arid region in order to overcome such challenges.

(2) Summary of research progress
The main framework of the project are summarized in three chronological stages: 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. Several research activities have been done including rainfall analysis, field investigation and hydrological modeling. In order to understand the variability of extreme rainfall events which almost formulating flash flood, Global Satellite Mapping of Precipitation (GSMaP) was used to analysis and identify the recent extreme rainfall events over the Arab regions considering different thresholds in both space and time. The spatial variability, frequency, intensity, and duration of extreme events were addressed. Several field investigations have been implemented to understand the characteristics of wadi system, and also to identify the paleo-extreme events by analyzing the sedimentation history at Wadi Mijlas in Oman. Two field surveys were conducted by the PI and Graduate students from Oman and Japan: the first one was on Dec. 2017, the second one was on March 2018. To analyzing the future extreme events, the Global Climate Models (GCM) with addressing different future scenarios of WFFs is still ongoing.

(3) Summary of research findings

Three chronological stages for WFFs (Paleo, Recent, and Future) were developed for the extreme events responsible for the great disaster in Wadi system. 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 e rosional and depositional processes caused by the extreme flash floods. Collecting the samples and analyzing the historical data were successfully done, but further analysis for the data to identify the Pelo-floods is still in progress. Channel geometry changes, sediment deposits and erosion are important indicators to assess the flash floods impacts and could be used to detect the extreme flash floods throughout the field investigations for these features. Recent extreme WFFs were identified from the recent historical records and monitoring observations, along with using Global Satellite Mapping of Precipitation (GSMaP data) and Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN).

Systematic cycles of increasing the flash floods over the Arab region were identified during the time period from 1984 to 2017. The results show that there is high spatiotemporal variability of precipitation over the Arab region with increasing the trend of extreme events. Currently, interferometry Synthetic Aperture Radar (InSAR), for instance PALSAR data observed by JAXA is being used to analysis the sedimentation yield and also to assess the sedimentation erosion and deposition in arid regions. Future extreme WFFs identification is still in progress by using the Global Climate Models (GCM) with addressing different future scenarios of WFFs. The significance and contribution of this approach are summarized in developing hydrological database for WFFs (providing long term database for model calibration and validation), reducing uncertainty of hydrological models for mainly forecasting and disaster risk reduction, in addition to understanding the climate change impacts on WFFs, as well as the rainfall spatiotemporal variability of extreme events in arid regions.

(4) Publication of research findings

1. M. Saber, M. Abdel-Fattah, S. A. Kantoush, T. Sumi (2017). Extreme flash floods events in the arab region based on satellite data. December 2017, Conference: 3rd International Symposium on Flash Floods in Wadi Systems, Muscat, Oman. (**Abstract attached**).
2. Mohamed Saber, Sameh Kantoush, Tetsuya Sumi, Mohammed Abdel-Fattah, Tahani Alharrasi, Takahiro Koshiba, Yusuke Ogiso, Mahmood Almamari. 2017. Hydrochronological Approach for Extreme Flash Floods at Wadi Systems in Arid Regions. Annuals of the Disaster Prevention Research Institute, Kyoto University, (http://www.dpri.kyoto-u.ac.jp/hapyo/18/pdf/C28.pdf). (**Extended Abstract attached**).
3. Mohamed Saber, Sameh Kantoush, Tetsuya Sumi, Mohammed Abdel-Fattah, Tahani Alharrasi, Takahiro Koshiba, Yusuke Ogiso, Mahmood Almamari, Dina Elliethy, Kenji Tanaka. 2018. Long-Term Extreme Flash Floods Analysis Based On Hydrochronological Approach For Wadi Systems In Arid Regions. 12th ISE 2018, Tokyo, Japan (http://ise2018.com/). (**Extended Abstract attached**).
4- Mohamed Saber et al. 2018. Paleo-Recent-Future Extreme Wadi Flash Floods Analysis in Arid Regions: Hydrochronological Approach **(In preparation for International journal)**