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国際共同研究 中間報告 （ 課題番号：30W-01）

課題名： Integrated management of flash floods in wadi basins considering sedimentation and climate change

　　　　　（土砂堆積および気候変動を考慮したワジ流域のフラッシュフラッド統合管理）

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研究場所：Oman

共同研究参加者数： 12 名（所外 4 名，所内 8 名）

　　・大学院生の参加状況： 5 名（修士 4 名，博士 1 名）（内数）

　　・大学院生の参加形態　［ 現地調査への参加，論文執筆 ］

平成 30 年度　実施状況（FY2018）

　　The main goal is to uniquely combine assessment the sedimentation with wadi rainfall-runoff models considering the Climate Change (CC) impacts, therefore, the project objectives are:

1. To couple both field investigation and numerical modeling to predict water discharge and sediments transport.
2. To study the impact of climatic change on increasing WFFs extreme events in arid regions.
3. To study the impact of sedimentations on the dam reservoir and infiltration process.
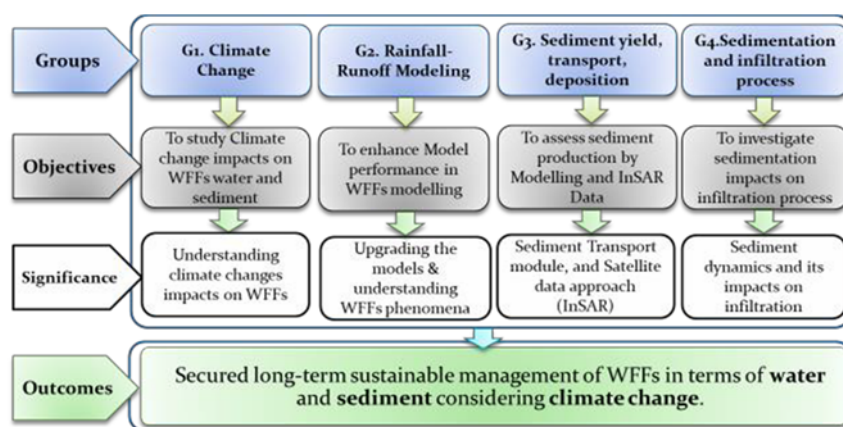

Fig. 1 An integrated Approach for sustainable management of water and sediment conceding the climate change.

Approach and Project Design:

The research project includes three groups (Fig. 1): **G1. Rainfall-runoff modeling, G2. Climate Change impacts, and G3. Sedimentation**. The first group has been already achieved and the second is ongoing work and the third one is the main focus of this project:

平成 30 年度　実施結果（FY2018）

　　In the first year , we have conducted the following topics.

1- Collecting the data for modeling (e.g. rainfall, flow discharge, sediments data, etc).
2- Summarizing our previous efforts especially about rainfall runoff modeling.
3- Using Climate Circulation Models to conduct the climate change scenarios in order to know future situation of extreme flash floods events at Wadi basins.

4- Developing the sediment transport module to be combined with the existing models (RRI and HydroBEAM).

5- Evaluate the sedimentation impact by models and field investigation on the dam efficiency and infiltration.

First, the hydrological models have been already developed for flash floods forecasting, and currently, developing sediment transport models are still in progress. Second, conducting detailed field investigations and sediment monitoring are the most important work for model validation and deep understanding for the physical process of sedimentation and its impacts. Two field investigations on Dec 2017 and Sept, 2018 were conducted at Wadi Mijlas and Samail in Oman. Some measures have been conducted including (wadi channel leveling, sedimentation Pedon analysis, detecting of flash floods marks, drone survey, infiltration tests, and field questionnaire about flash floods).

Using satellite and radar high resolution data is still being processing to assess the sedimentation changes and also numerical models to estimate the sediment transport, then all these outcomes will be compared and validated by the field investigation findings. Such integrated approach, is important to understand deeply the sedimentation impacts on the reservoirs as well as infiltration processes in arid regions.
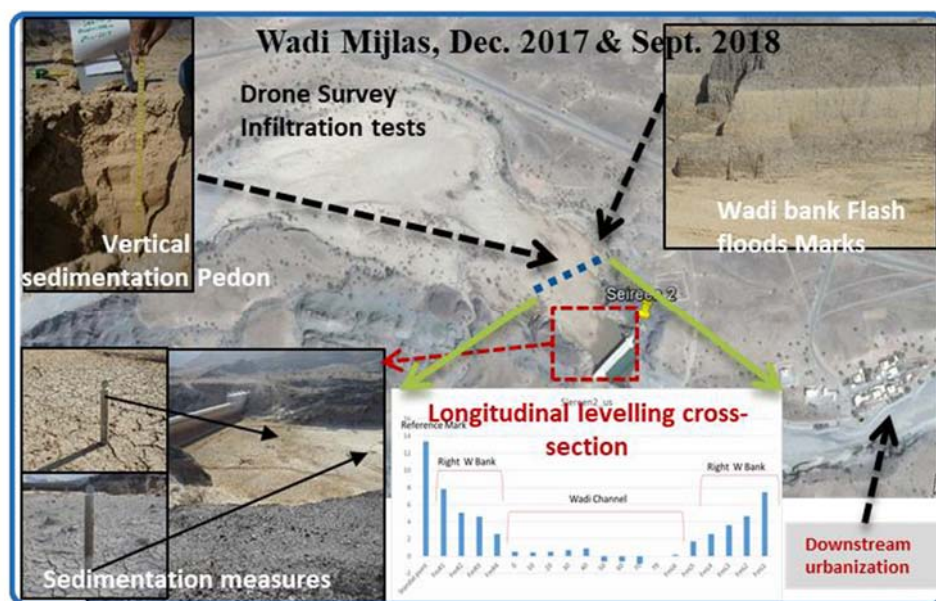

Fig. 2 Field survey at Wadi Mijlas, Oman (Dec. 2017, Sept. 2018).

Based on field survey and data analysis, the following results have been obtained.

(1) The field survey such as UAV survey, pedon analysis, soil sampling and infiltration test was conducted to understand sediment transport characteristic and infiltration process. The results of this field survey and its analysis revealed the following:

  1) Infiltration rate in the recharge dam is influenced much by its particle size distribution.

  2) Hydraulic conductivity of the original bed decreases much by fine sediment clogging inside the original bed soil.

(2) Rainfall-runoff simulation was conducted by using Rainfall-Runoff-Inundation (RRI) model. The purpose of rainfall-runoff simulation is to detect the flood events which caused sedimentation in Aserrin Up down and to use the outcomes discharge as input in TELELMAC model for sediment transport modelling. The results revealed the following:

  1) The distributed hydrological model such as RRI is applicable to arid regions which has unique characteristics such as the rapid increase in its discharge from its zero-flow status to the flood peak and the high spatial and temporal variability of the surface runoff. The model is calibrated and validated at Wadi Mijlas.

  2) Hydraulic conductivity and roughness coefficient control the peak of flood discharge

(3) We adopted a new method to estimate the transported sediment from the volume and distribution of accumulated sediment by calibration of sediment concentration with acceptable correlation of all events. Sediment transport simulation in Aserrin II dam was conducted by using TELEMAC- SISYPHE model. The results revealed the following:

  1) Sediment transport modeling in the recharge dam reservoir was conducted using TELEMAC-SISYPHE model in arid regions and calibrated by data of sediment deposition.

  2) Estimated sediment concentration is 34.45 (g/l), which means quite large volume of sediment is transported in arid regions.

(4) Infiltration simulation in Aserrin II dam reservoir was conducted using Hydrus-1d model. The purpose of this simulation is to assess the effect of the dam sedimentation based on the field survey data. The results revealed the following:

  1) The recharge volume decreases by about 10 percent due to the impact of sedimentation since the dam construction.

Based on the findings of the study, the following points are proposed:

  1) More detailed analyses of total sediment volume in the reservoir by continuous monitoring in order to derive the relation between sediment transport and discharge is still needed.

  2) Regular removal of sediment accumulated in the reservoir for recovery of infiltration rate.

  3) To increase monitoring stations such as rainfall, discharge and groundwater level to develop practical model.

令和 1 年度　実施計画（FY2019）

  Based on the first year results, we will continue our collaboration research as follows.

1- Validation of the developed model for sediment transport using the available observations and the field measurements.

2- Analyzing the extreme events that identified by GCM to understand the frequency and magnitudes changes of WFFs.

3- Testing the sedimentation effects on reducing water storage capacity and evaluate the degradation of groundwater recharge due to clogging of the fine sediments. This will be done by measuring the infiltration rates at different stages of sedimentation.

4- Evaluating the sedimentation impacts on the flash floods generation in terms of disaster.

5- Using Satellite data of InSAR to quantify sediment volume in Wadi basin, to determine the morphological changes in the Wadi Channel, and consequently to assess the trapping efficiency of existing structures.