Flooding Monitoring and Flood Inundation Analysis using UAV

2019. 01. 23

Mikyoung Choi[a], Gunsang Lee[b], Kwansue Jung[c]

a International Water Resources Research Institute, Chungnam National University
b Department of Cadastre and Civil Engineering, Vision college of Jeonju
c Department of Civil Engineering, Chungnam National University

CNU 충남대학교

International Water Resources Research Institute

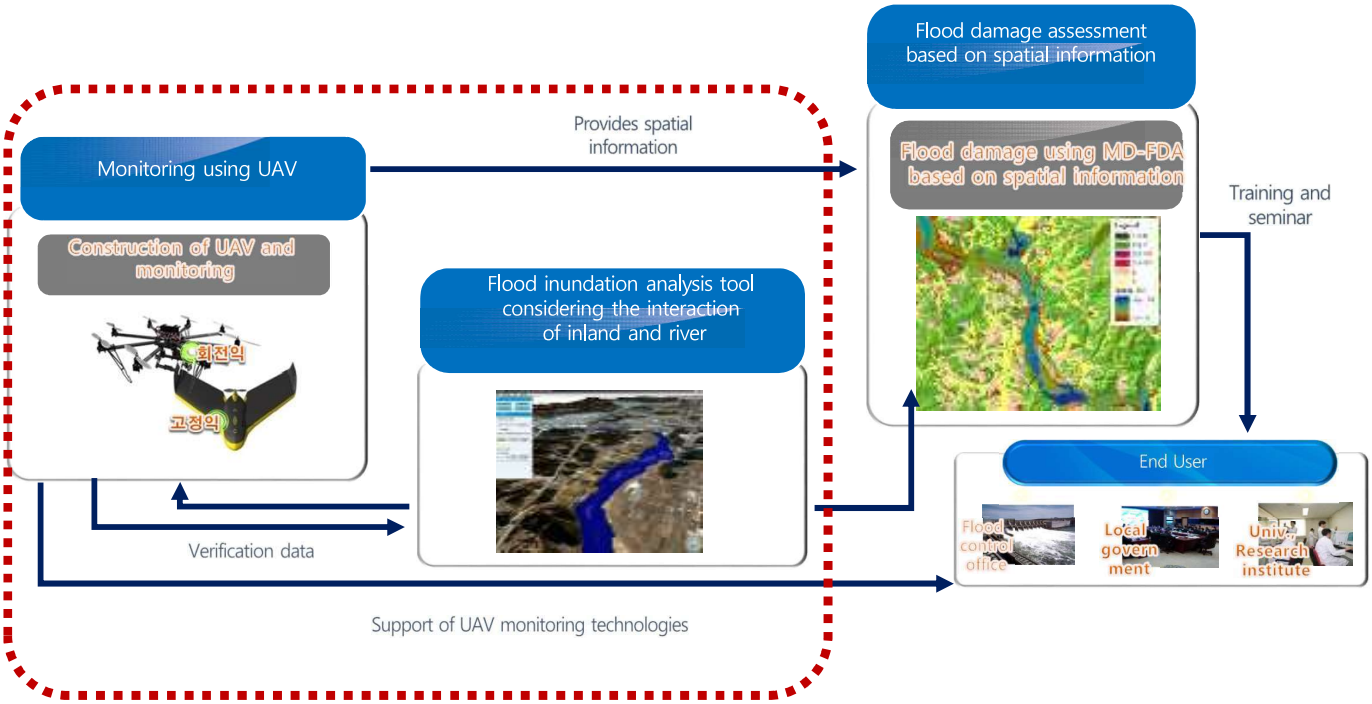
THA 2019 International Conference on Water Management and Climate Change towards Asia's Water-Energy-Food Nexus and SDGs
23-25 January 2019, Swissôtel Bangkok Ratchada, Thailand

01 Objectives



- The flooding monitoring using UAV have the significant advantages in terms of providing prompt flooding information or river conditions.
- It is necessary to establish processes such as flight plan, image processing, and application of images.
- This study suggests the methods of flooding monitoring and application to inundation anaylsis.

02 Framework



03 Construction of topography data using UAV

I Study area

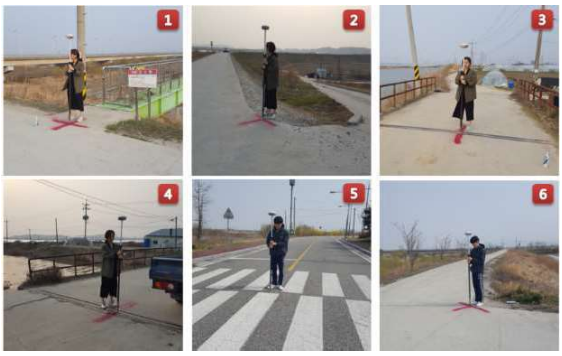
- The target area is about 1.0-km length of Nonsan River, a branch of Geum River

03 Construction of topography data using UAV

2 Ground control point (GCP) survey

- In order to match the coordinate system, GCP survey must be conducted.

(The captured image using UAV : WGS84 UTM coordinates, Korea : GRS80 TM coordinates)

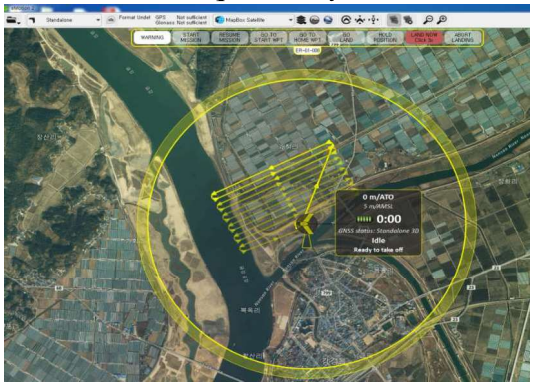


번호	X (East)	Y (North)	Elevation
1	201365.30	397081.54	10.90
2	200920.75	396790.45	11.00
3	200714.74	397096.84	5.09
4	201244.85	397492.12	4.51
5	201057.65	396414.61	7.26
6	201440.79	396736.70	10.74

03 Construction of topography data using UAV

3 Design of flight plan

- The UAV device for acquiring river terrain data was the eBee (SenseFly, Lausanne, Switzerland) was used.
- The flight plan was designed with eMotion software.
- Lateral and longitudinal overlaps were set to be 80% and 70%, respectively

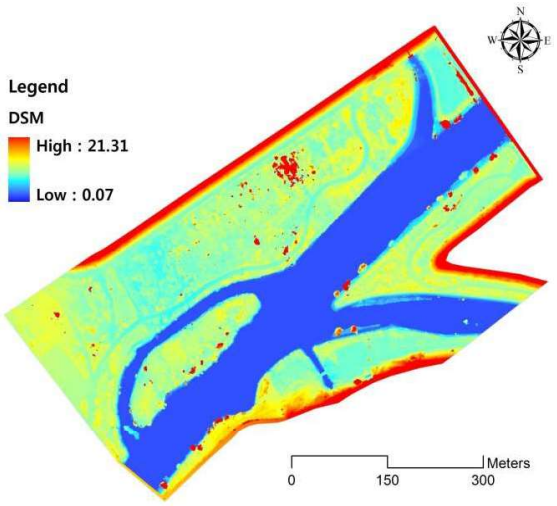


03 Construction of topography data using UAV

4 Creation of an Orthomosaic and a DSM

- Image mosaic processing used Pix4D software.
- The orthomosaic and Digital Surface Model(DSM) data was created.

Image mosaic processing with Pix4D SW



DSM

03 Construction of topography data using UAV

5 Creation of River Terrain Data

- Three-dimensional terrain data was created with virtual survey software using orthomosaic and DSM files.

04 Flooding monitoring

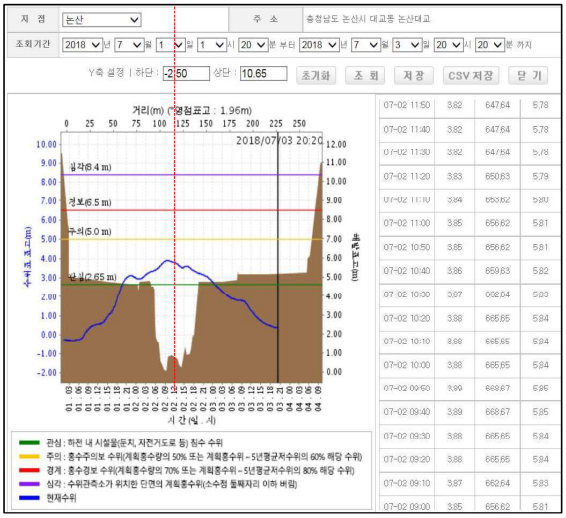
I Flooding monitoring in July 2, 2018

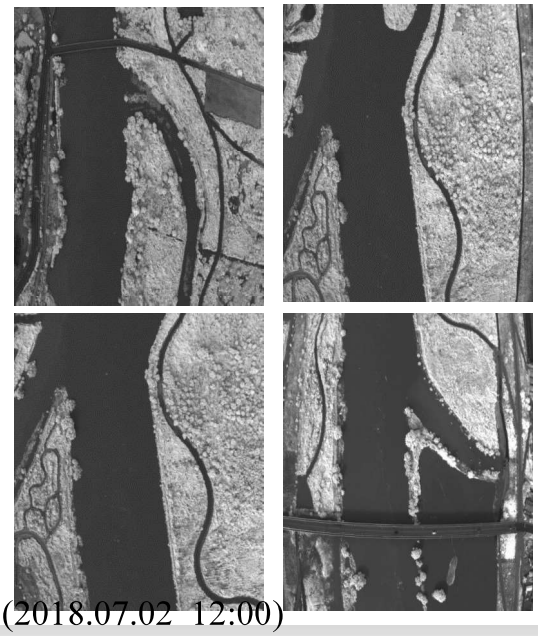
- Inspire UAV and Sequoir sensor was used to monitor flooding conditions in July 2.

Parrot

SEQUOIA

Flood Monitoring



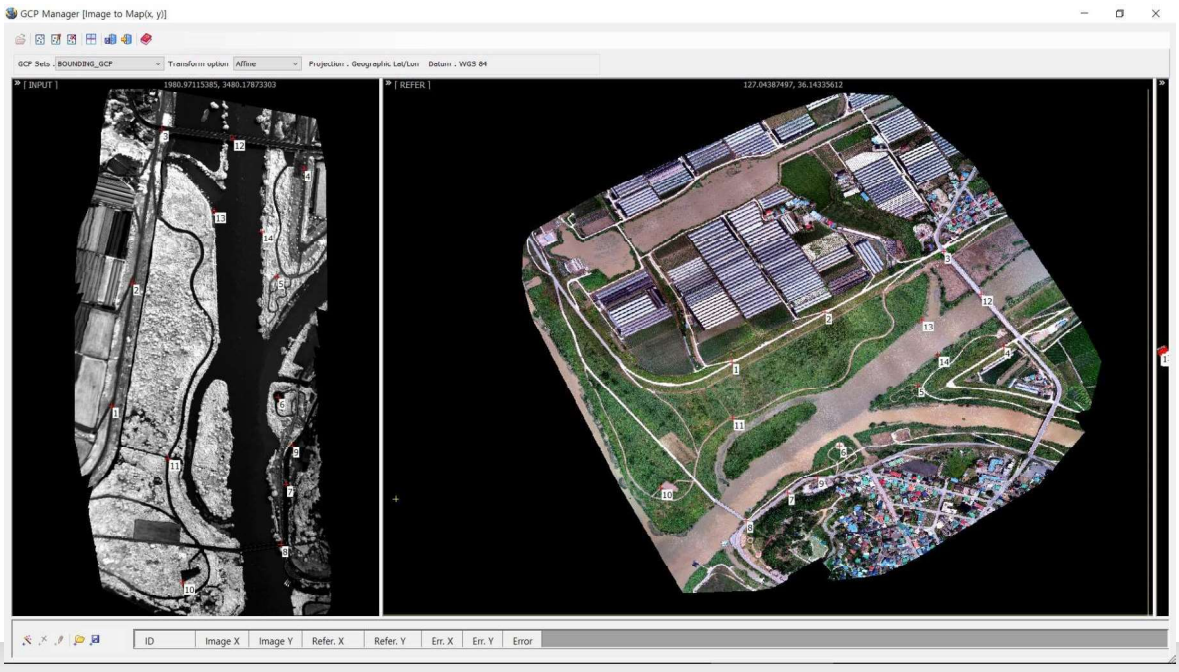


Flood Monitoring in Nonsan Area (2018.07.02 12:00)

04 Flooding monitoring

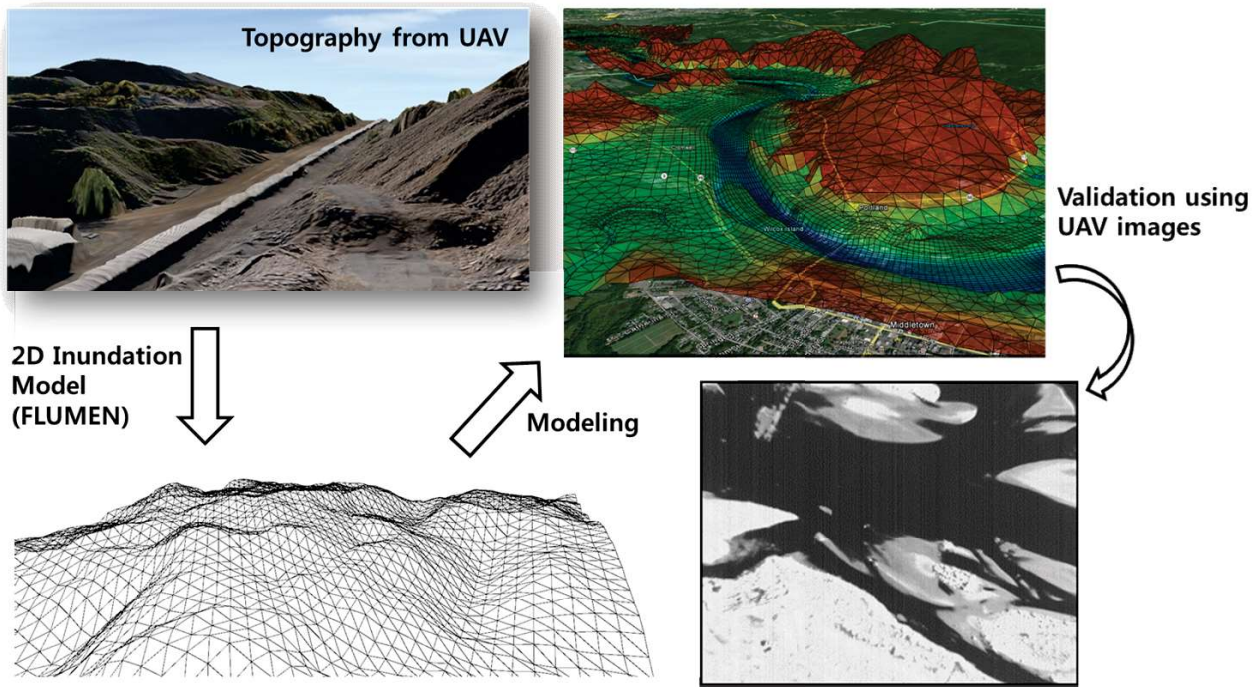
I Flooding monitoring in July 2, 2018

- Coordinate match by PG-Steamer software : NIR image → Three-dimensional terrain data



05 Flood inundation analysis

1 (FLUvial Modelling Engine) FLUMEN



05 Flood inundation analysis

2 FLUMEN (FLUvial Modelling Engine)

- FLUMEN is based on the depth-averaged shallow water equations:

$$\frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} + \frac{\partial G}{\partial y} = S$$

$$U = \begin{bmatrix} h \\ uh \\ vh \end{bmatrix},\ F = \begin{bmatrix} uh \\ u^2h + \frac{1}{2}gh^2 \\ uvh \end{bmatrix},\ G = \begin{bmatrix} vh \\ uvh \\ v^2h + \frac{1}{2}gh^2 \end{bmatrix},\ S = \begin{bmatrix} 0 \\ gh(S_{ox} - S_{fx}) \\ gh(S_{oy} - S_{fy}) \end{bmatrix}$$

h : flow depth t : time g : acceleration of gravity ρ : density of fluid

u, v : fluid's horizontal flow velocity, averaged across the vertical column

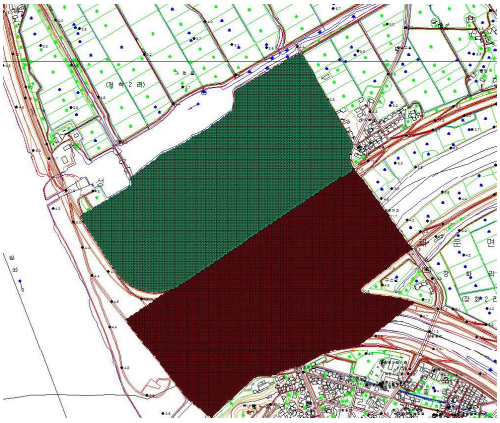
S_o, S_f : bed slope and friction slope

05 Flood inundation analysis

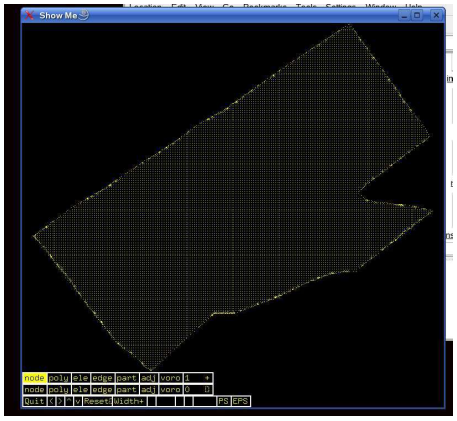
3 Input data I

- Topography Data

- DSM data by UAV



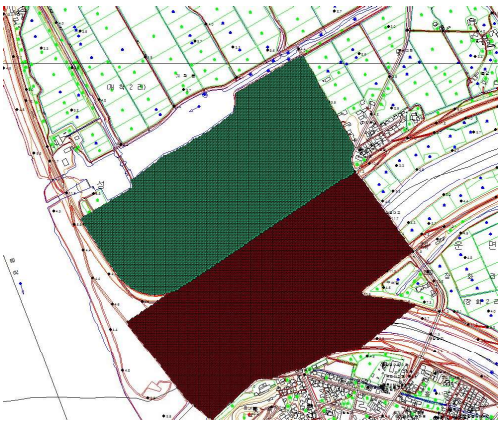
- Generation of calculation mesh with Fluviz

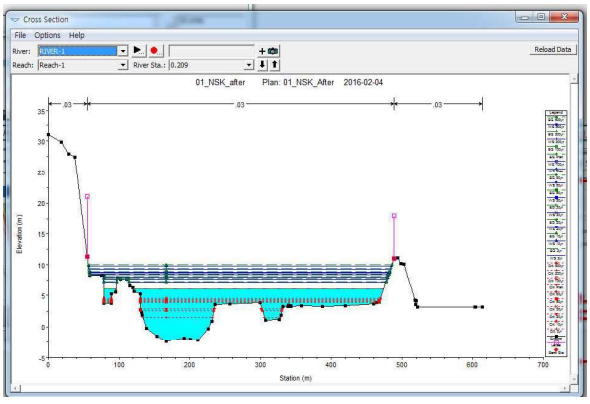


05 Flood inundation analysis

3 Input data 2

- Water condition data
  - Water level of outflow boundary, discharge of inflow boundary by HEC-RAS
  - Data was inputted during 12 hours

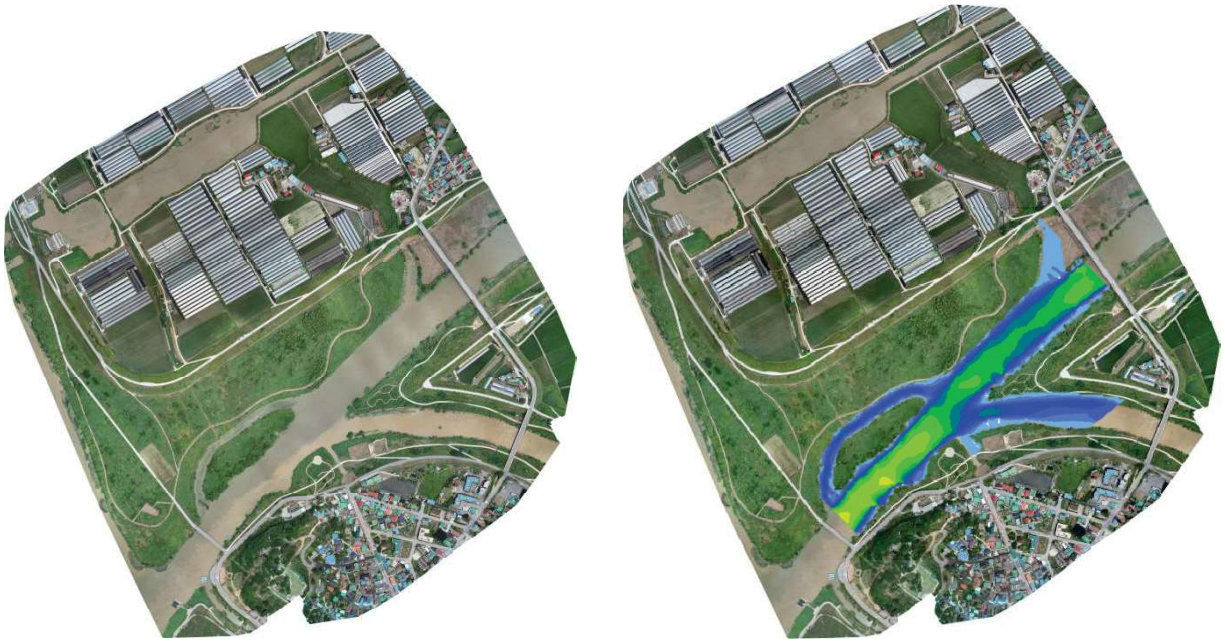




- Coefficient of roughness

05 Flood inundation analysis

2 Validation between inundation simulation and UAV-based topography data



Flood Monitoring in Nonsan Area (2018.07.02 12:00)

07 Conclusion

- Construction of river terrain data depended on the actual measurement (total station survey) or LiDAR measurement. This is take a lot of cost and times. In terms of this aspect, river terrain measurements using UAV have significant advantages.
- Also, the flood monitoring using UAV can provide prompt flood information.
- However, the images that are acquired using UAV exhibit a limitation, because UAV cannot obtain the accurate terrain with respect to the bottom of the water body.
- Although this study is just compared as plane shapes between flooding model and UAV-based on data, we will try to consider the flooding depth and the time of the rise and fall of water level.

Thank you for your attention!