Development of Measured Data Based Nomograph for Flood Warning System of Small Streams

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2021. 11. 30.

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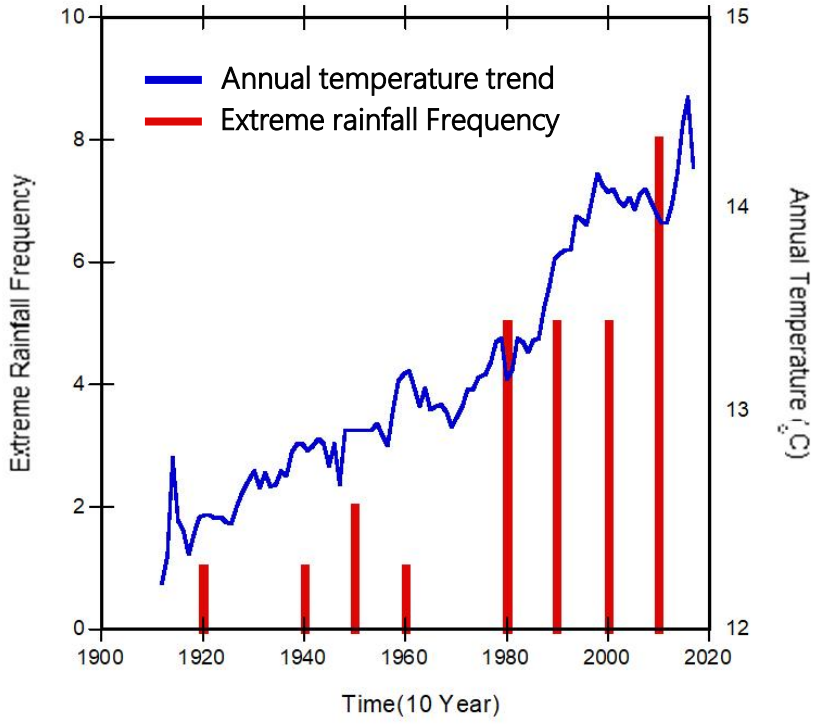
Backgrounds

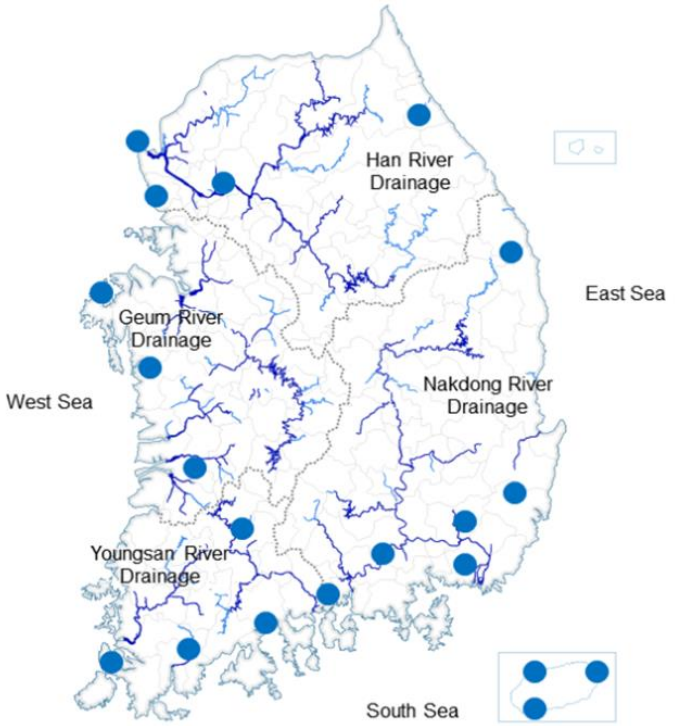
1 Backgrounds

Extreme rainfalls (>100mm/h) is increasing due to climate change

- Frequency and occurrence area of extreme rainfalls are increased during 92 years (1927~2019)



Trend of extreme rainfalls frequency



Distribution of extreme rainfalls occurance area

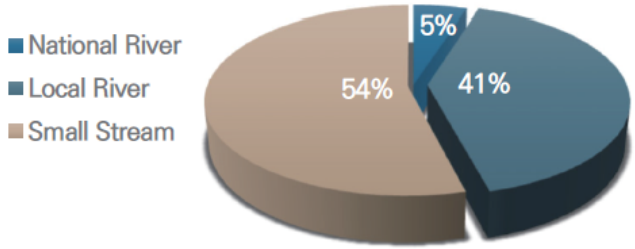
1 Backgrounds

Flood impacts is changing by extreme rainfalls

- Extreme rainfalls formed by localized heavy rainfall increasing flood damages in the small streams

Damages(M$)	Total	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rivers and Small Stream	6,841	938	577	2,266	1,458	413	1.05	3.28	621	299	271
Small Stream	2,896	431	262	878	661	237	0.42	2.48	165	146	113
Ratio (%)	42.3	45.9	45.4	38.7	45.3	57.4	40.0	75.6	26.6	48.8	42.0

- Rivers & Small Stream: 26,754 (65,549km)
- Small Stream: 22,823 (35,324km)

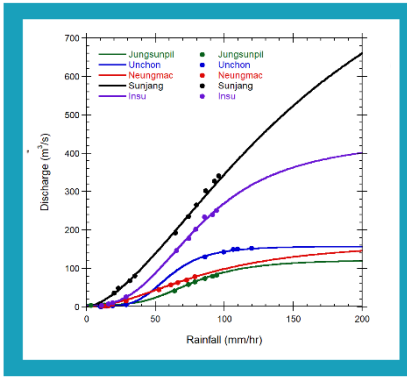


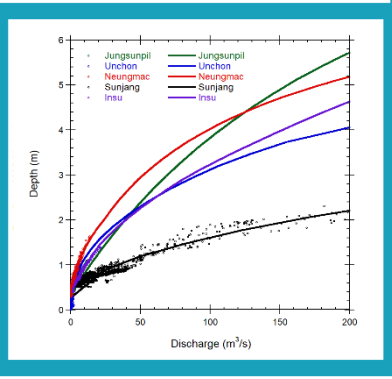
1 Backgrounds

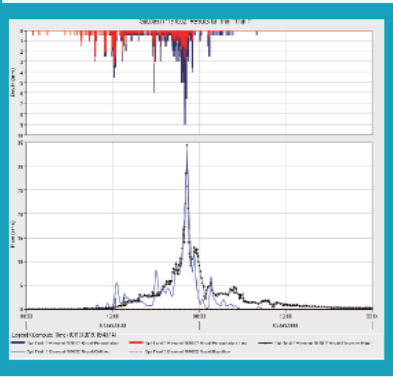
Development of small stream disaster risk reduction technology

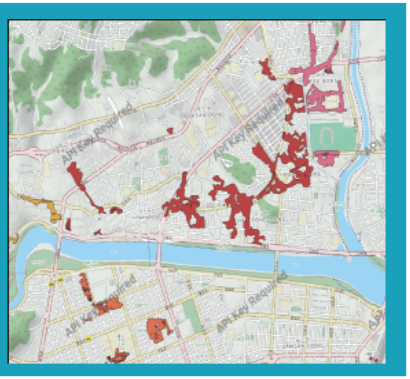
- Three key technologies solving the most pressing issues facing the climate changes

- Flood Warning System Related Technologies : nomograph, function etc.
- Design Codes Related Technologies : numerical, statistical models etc.
- Legislations Related Technologies : assessment, determination etc.









Nomograph | Function | Numerical Model | Assessment


Data Based FEWS

2 Data based flood early warning system

Enhancement of small stream flood early warning system (SSFEWS)

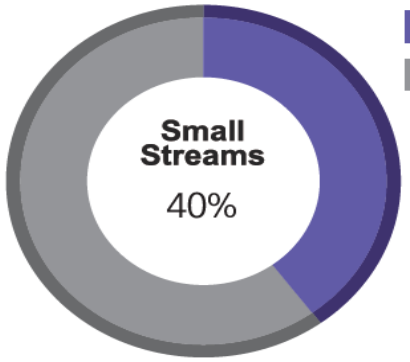
- Ministry of Interior and Safety developed the system during 5 years (12~16), NDMI evaluates it

2 Data based flood early warning system

Issues for collecting measured data to enhance the SSFEWS

- There are no measurement data in small streams for the following reasons

Damages Ratio



Depth Gauges

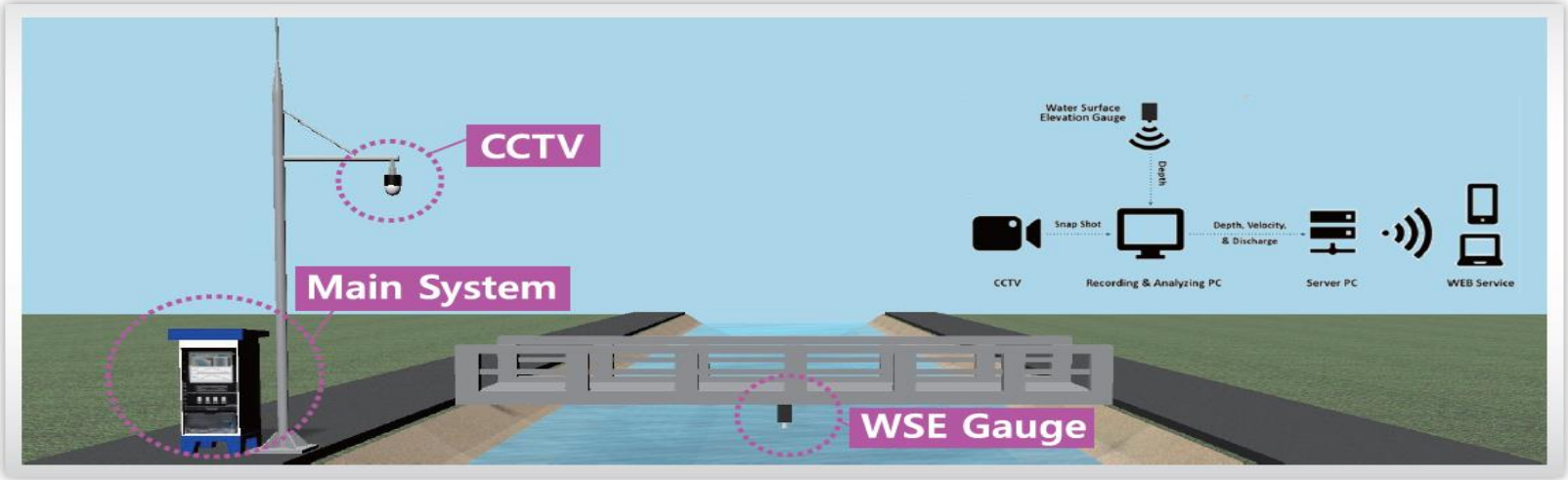
Discharge Gauges

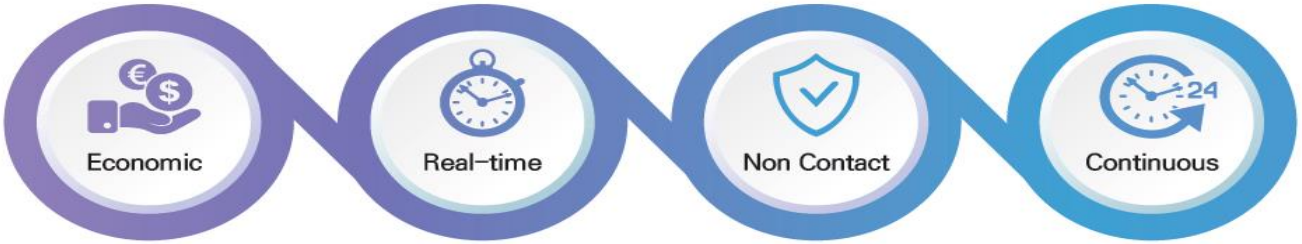
Inefficient Officials	Dangerous Field works	Rapidly Changing Flow
➤ National, local : 3,835 ➤ Small Streams : 22,823	➤ Deep & Fast Velocity ➤ Low Measuring Points	➤ Rapid Depth Increasing ➤ Difficult Peak Measure

2 Data based flood early warning system

Development of technology for measuring data in small streams

- CCTV based Automatic Discharge Measurement Technology (CADMT) based on SIV

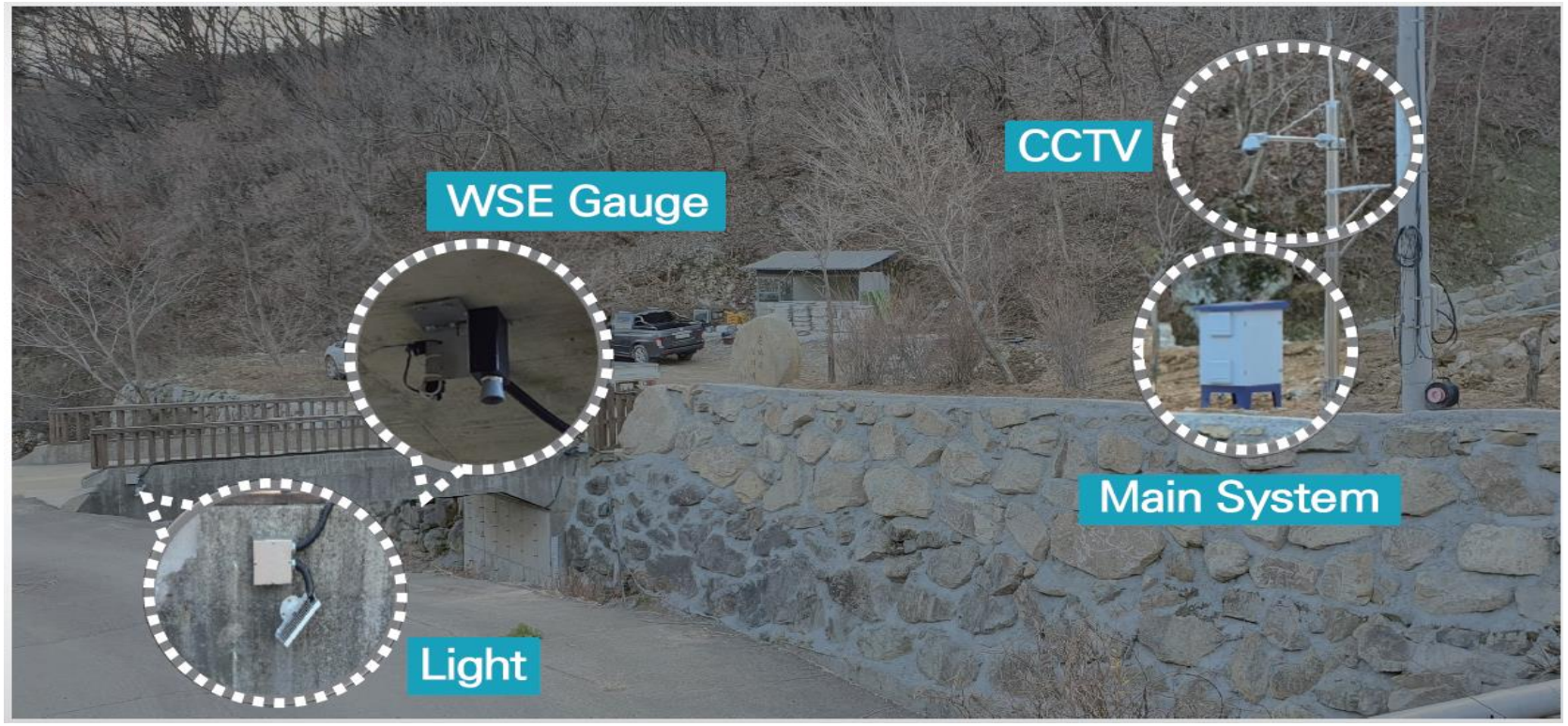




2 Data based flood early warning system

Establishment of technology for measuring data in small streams

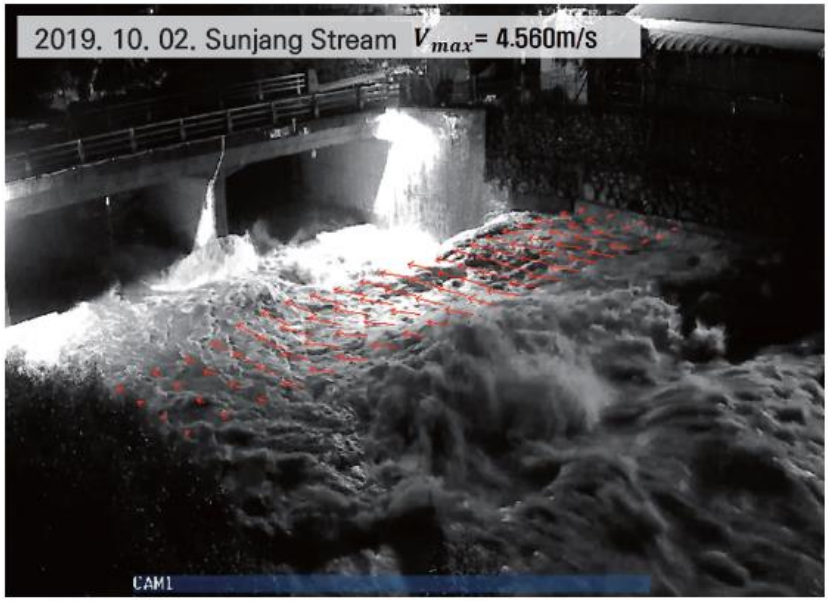
- The CADMT was established in Jungsunpil stream



2 Data based flood early warning system

Measurement of hydraulics data by using the CADMT

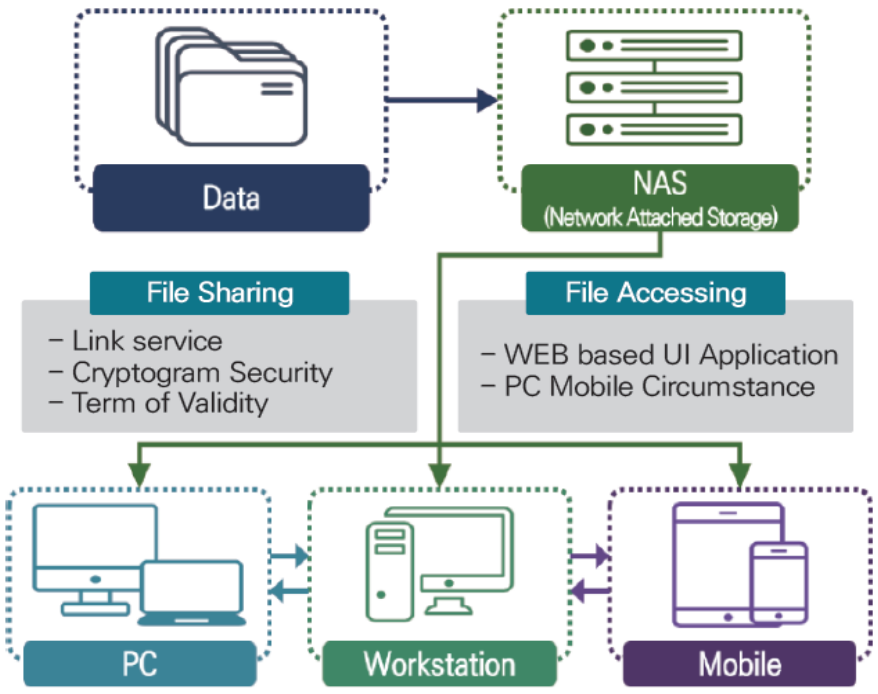
- The CADMT represent high velocity small streams flow well in flood season

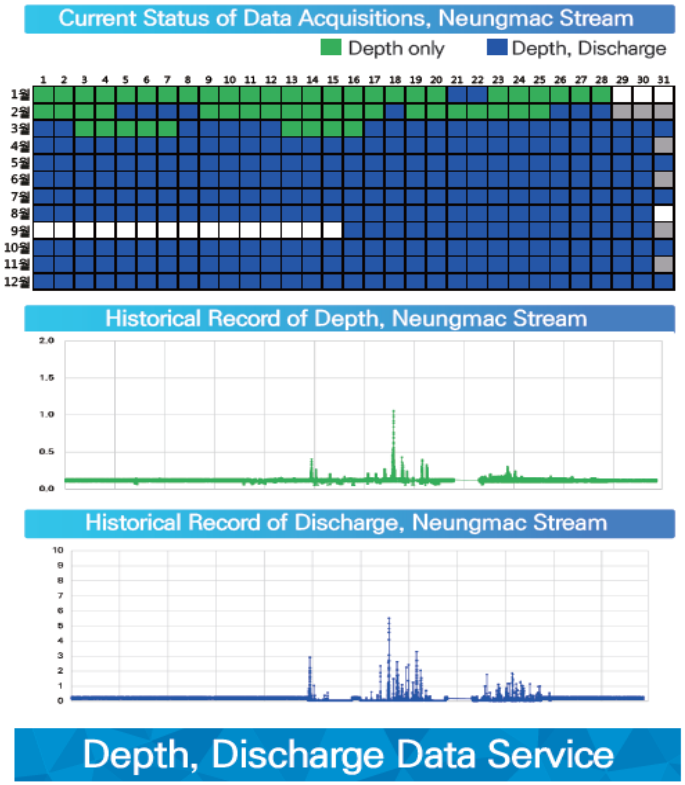


2 Data based flood early warning system

Data acquisition and sharing system

- The web based system was developed to develop technologies and share measured data



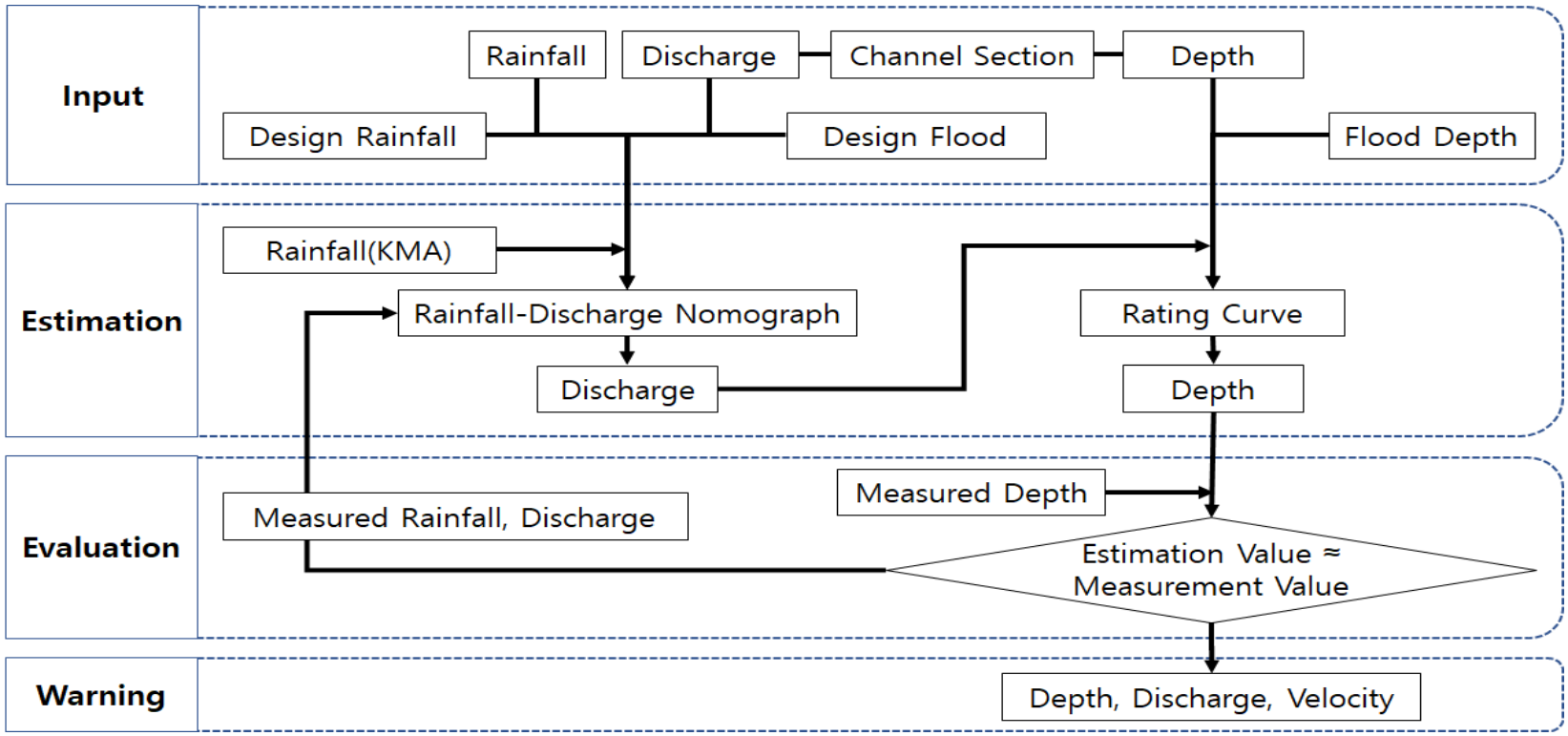


Flood Early Warning Framework

3 Flood early warning framework

Technology to enhance the small stream flood early warning system

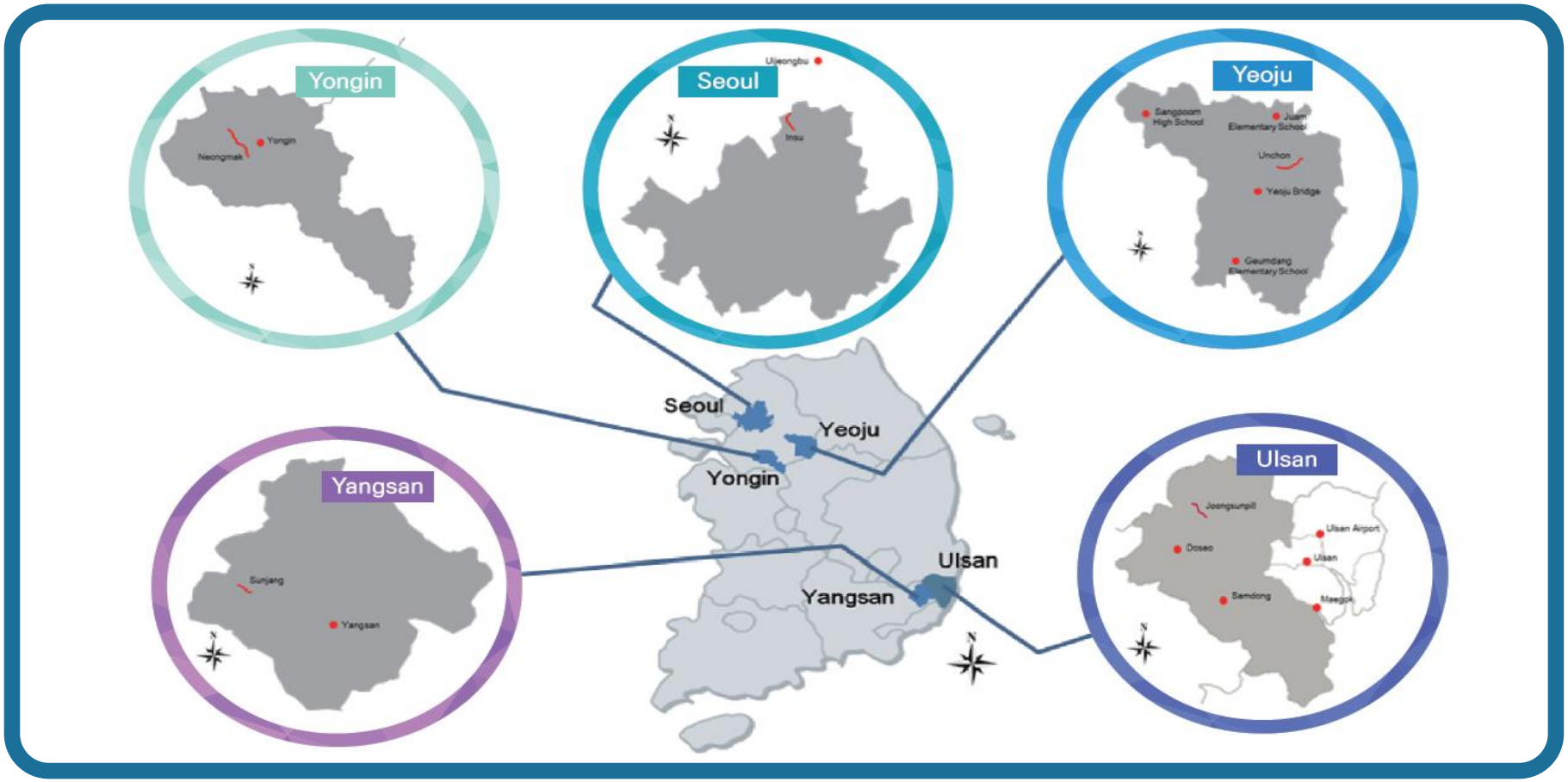
- Framework using both technologies of the rainfall-discharge nomograph and the rating curve



3 Flood early warning framework

Selection of five small stream for test bed

- Development and evaluation of the framework by using measured data from small streams



3 Flood early warning framework

Selection of five small stream for test bed

- Development and evaluation of the framework

Small Stream Basin Information

Stream	Latitude	Longitude	A_b (km²)	W_b (Km)	S_b	C_b	L_c (Km)	W_c (m)
Jungsunpil	35.65.17 N	129.13.17 W	5.09	1.60	0.058	0.50	3.18	14.00
Sunjang	35.24.04 N	128.55.49 W	13.63	2.17	0.053	0.34	2.14	33.50
Unchon	37.33.15 N	127.70.96 W	6.98	2.01	0.012	0.58	2.88	21.50
Neungmac	37.24.31 N	127.16.81 W	2.41	0.78	0.004	0.25	3.09	9.450
Insu	37.40.20 N	127.00.20 W	3.66	1.17	0.025	0.38	3.12	17.06

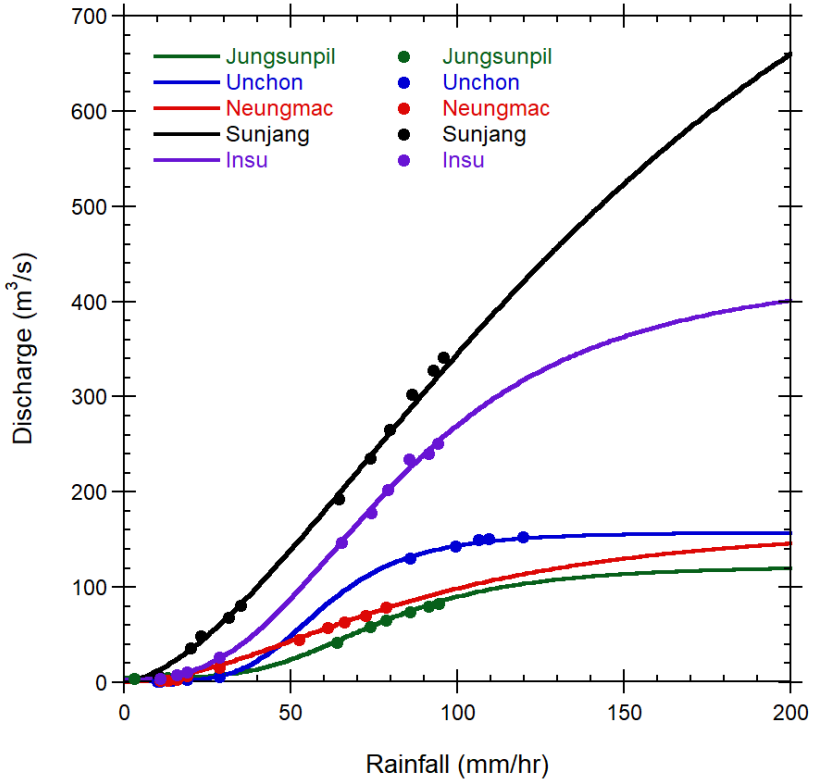
Rainfall Station Information for each small stream

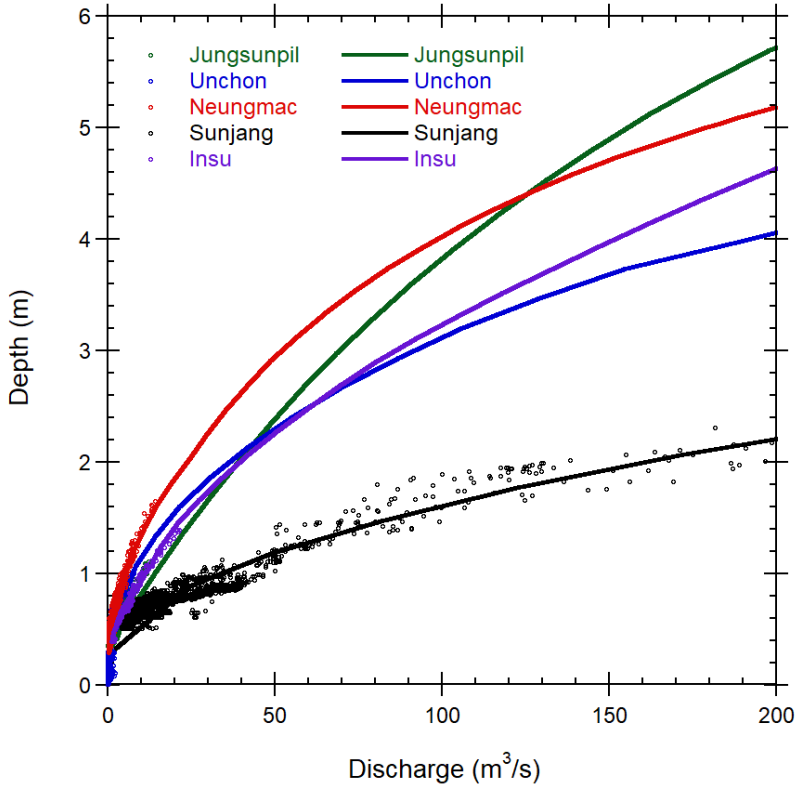
Station Name	Latitude	Longitude	Distance (km)	10 yrs. Average Total Annual Rainfall (mm)	Elevation (E L.m)	Start from
Doseo	35.62.03 N	129.14.35 W	183.1	1274.1	123.0	1991
Yangsan	35.30.74 N	129.02.01 W	9.86	1,588.20	6.29	2008
Yeojudaegyo	37.17.43 N	127.38.53 W	6.580	1180.1	51.5	1962
Yongin	37.27.01 N	127.22.18 W	5.830	1293.5	83.0	2005
Uijungbu	37.73.50 N	127.07.50 W	10.4	1544.50	72.0	2001

3 Flood early warning framework

Development of prediction technology for flood early warning

- Technologies were developed by using measured data from 2017~2020

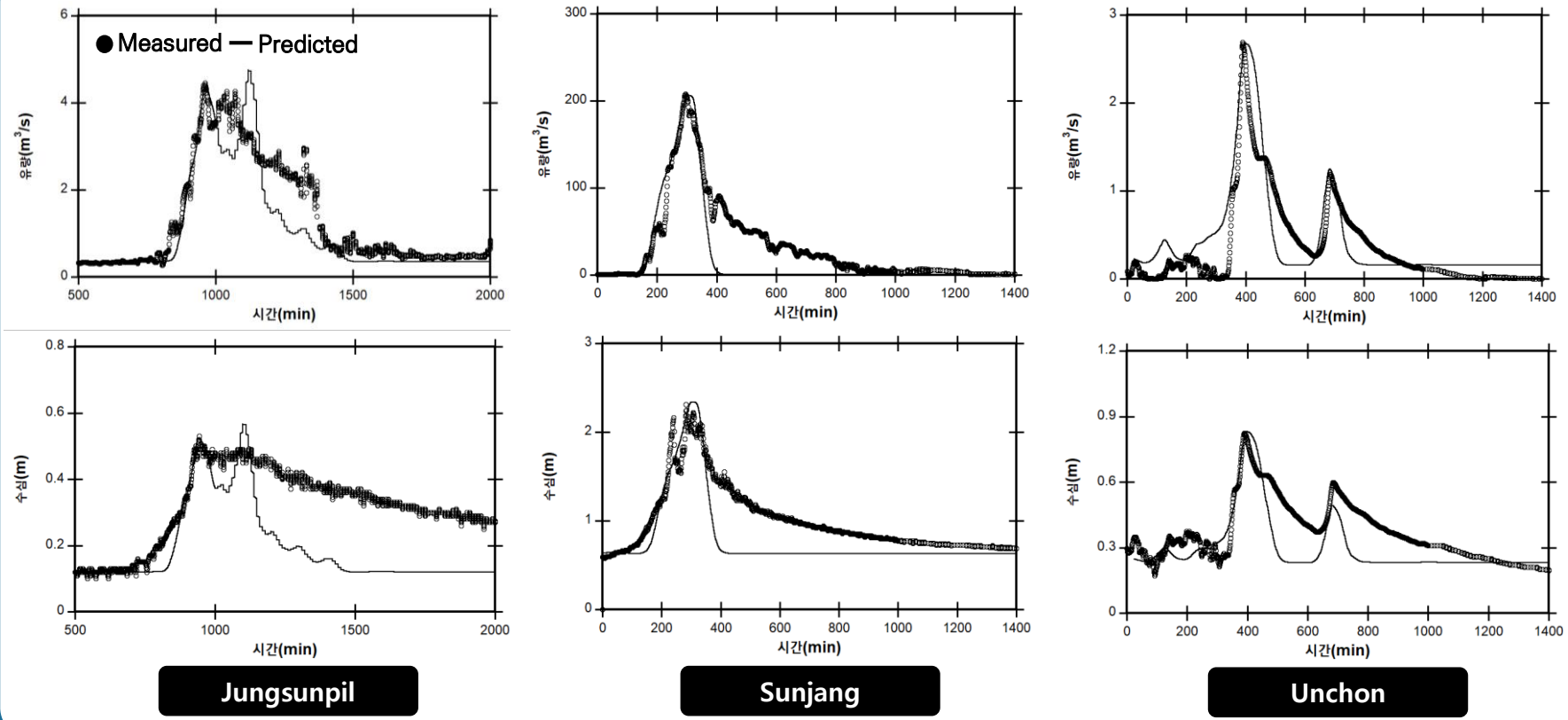




3 Flood early warning framework

Evaluation of prediction technology for flood early warning

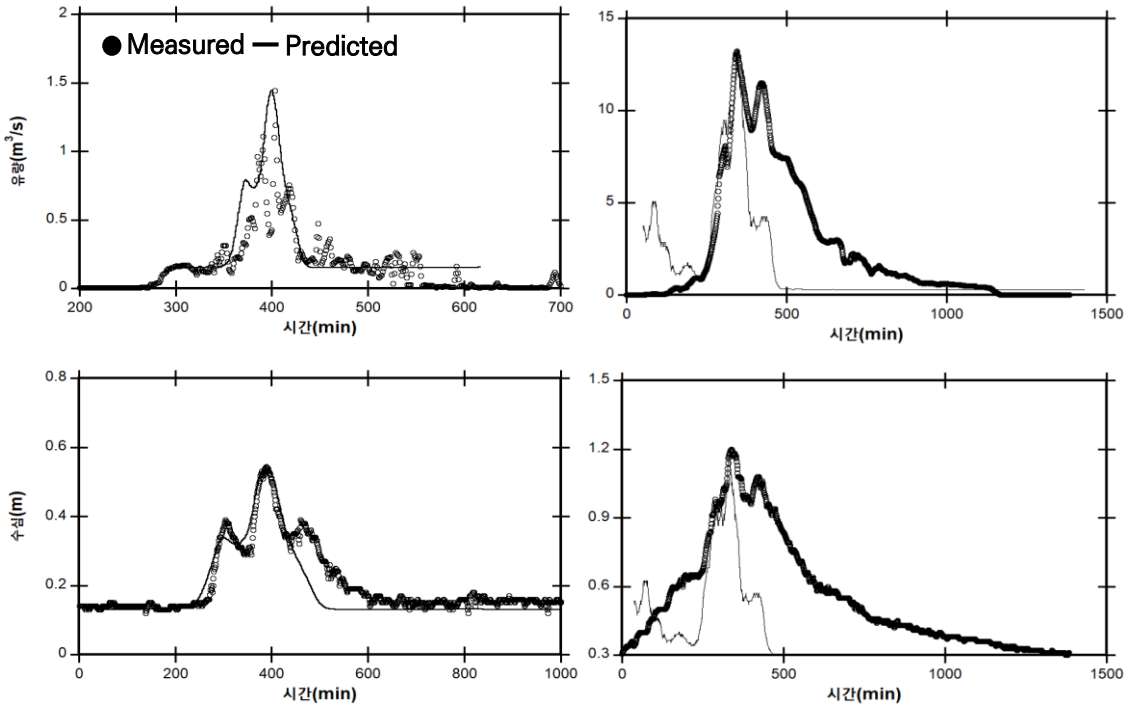
- Technologies were evaluated by using measured data from 2021



3 Flood early warning framework

Evaluation of prediction technology for flood early warning

- Technologies were evaluated by using measured data from 2021



Neungmac

Insu

Small Stream	Peak Discharge (m³/s)		Error
	Measured	Predicted	
Jungsunpil	4.46	4.74	0.280
Unchon	2.69	2.65	0.040
Sunjang	207.74	206.56	1.180
Insu	13.21	13.38	0.170
Neungmac	1.43	1.44	0.010

Small Stream	Peak Discharge (m³/s)		Error
	Measured	Predicted	
Jungsunpil	0.53	0.56	0.030
Unchon	0.82	0.83	0.010
Sunjang	2.31	2.34	0.030
Insu	1.20	1.18	0.020
Neungmac	0.54	0.55	0.010

Future Works

4 Future works

Expansion of the CADMT

- NOIS and NDMI will expand the CADMT to about 22,000 small streams (10%)

Risk Assessment (15%)
- All Basins
- Risk Level 1, 2

+

Needs Survey (15%)
- Disaster History
- Needs of Community

→

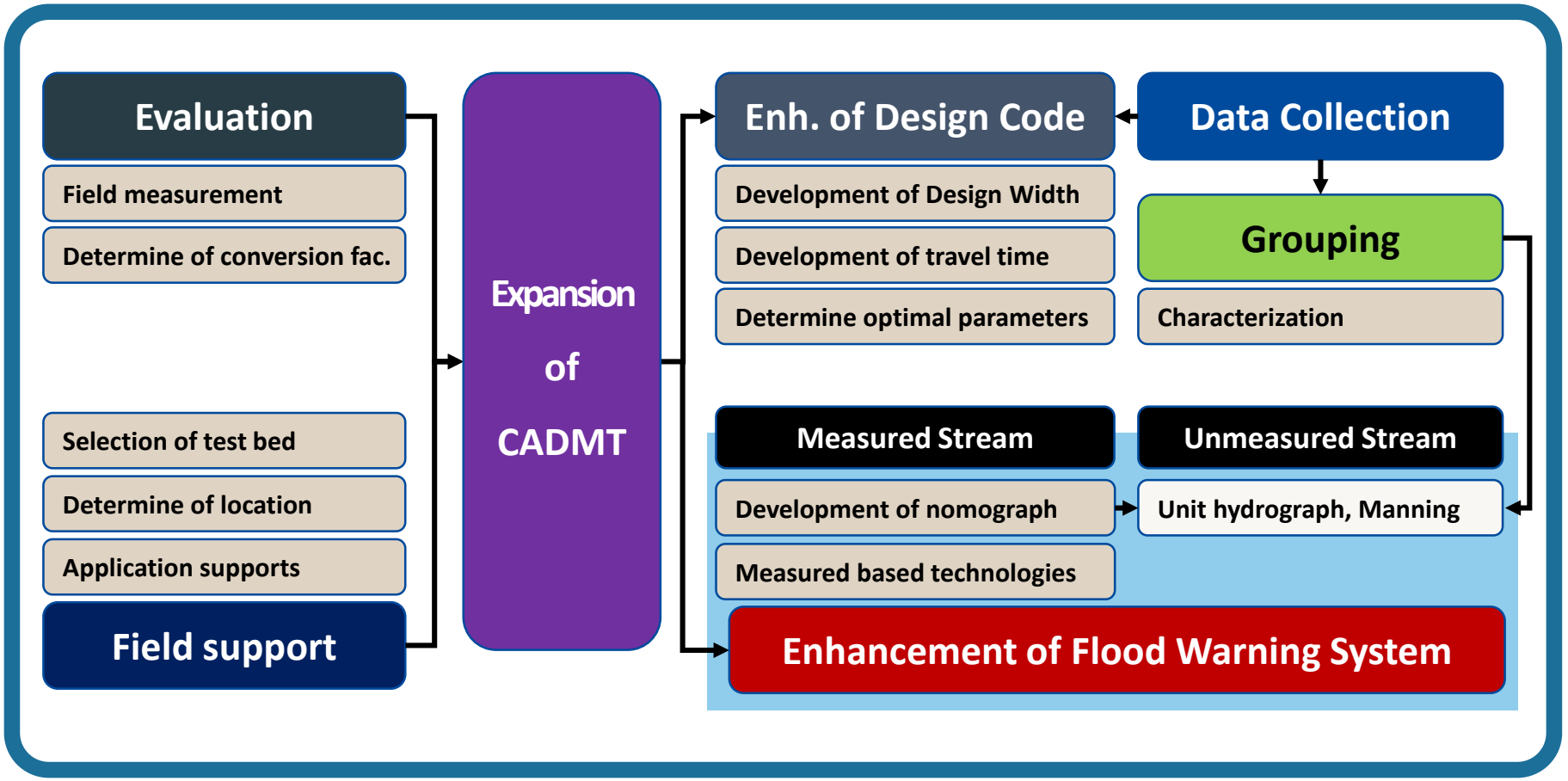
Determine Stream (10%)
- High Priority
- Availability for Establishment

2. Technology Simulation

4 Future works

Development of the DRR technologies based on measured data

- The DRR technologies development by classifying measured and unmeasured streams



Thanks for your attention

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