The 5th Session of WMO RA-II WGHS



Hydrometric Measurements in both Quality and Accuracy

26~28th Nov., 2018

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- In order to improve accuracy of the hydrological measurement, it is necessary to improve relevant techniques and use of adequate instrument and analysis method for specific flow conditions.
- Both of Application of advanced techniques and improvement of existing method(measurement, analysis and procedure, QC, data assessment) are equally important.
- The main objectives of action plan were to provide technical reports or guidance about three parts of hydrological observation techniques
 - Automatic discharge measurement system (IRDIMS, Integrated Real-time Discharge Measurement System)
 - Sediment measurement by new techniques
 - Development of rating curve



- Providing guidelines for application of automatic discharge measurement system and development of new measuring technique
 - Providing guidelines for application of IVM and operation of IRDIMS
 - Specific and detail guideline for all procedures from installation to operation of the measurement system using IVM
 For standardization on use of IVM by systematic procedures(using S/W tools)
 - Development of new measuring technique to be applied to the IVM and IRDIMS
 - Applicability analysis on new equipment such as surface velocimetry
 - Operation of test bed to analyze new technique Technical report based on results of test bed for new application



Improvement of sediment measuring techniques

- Development of method to estimate SSC using ADVM
- Develop technique to estimate concentration of suspended sediment(SSC) through analysis on the variation of Signal Intensity (SI) of the ADVM with SSC using data from the IRDIMS stations

Technical report on applicability of new technique by field test

Improvement & development of systematic procedure for use of rating curve

- Providing specific guidelines for development of rating curve
- Development of software tools to calculate discharge(including post processing and data QC) and develop rating curves

Guidelines and software tools for all procedures to develop rating curve

2. Work Plan for 2017~2020



Deliverables	Activity	Outputs	Resources	Milestones	Linkages	Progress
1. Improvement in hydrometric measurements in both quality and accuracy	 a) Providing guidelines for application of real-time measurement system and development of new measuring techniques Providing guidelines for application of IVM and IRDIMS Development of new measuring techniques to be applied to the IVM and IRDIMS 	 Guidelines related to IRDIMS Installation and operations Maintenance Development of index ratings Technical report on new applications of IRDIMS New application using surface velocimetry Case studies using test bed 	Republic of Korea (ROK)	 Guidelines by Dec 2020 Construction of test bed by Dec 2017 Technical Report by Dec 2019 	CHy ROK	 Writing guideline of installation and discharge calculation Operating test bed for surface velocity meter Analyzing data to calculate discharge using surface velocity
	 b) Improvement of sediment measuring techniques Development method to estimate suspended sediment using ADVM 	 Technical report on estimation of suspended sediment using ADVM 	Republic of Korea (ROK)	• Technical report Dec 2020	CHy ROK	 Case study from existing sample data of IRDIMS station
	 c) Improvement and development of systematic procedures for use of rating curve Providing specific guidelines for development of rating curves (for all procedures) Development of software tools to calculate discharge (including post processing and data QC) and develop rating curves 	 Guidelines on development of rating curves (from field measurement to assessment of rating curves) Software tools Discharge calculation for all kinds of instruments Development of rating curves 	Republic of Korea(ROK)	 Guidelines Dec 2018~ Dec 2020 Software tools Dec 2018~ Dec 2020 	CHy ROK	 Korean Guidelines have been finished and are in translation to English Development of Calpad and its manual is being writing

2. Work Plan for 2017~2020



Deliverables	Activity	Outputs	Resources	Milestones	Linkages	Progress
2. Global application of software tools and methods for measuring discharge	 (a) Assessment of applicability of software tools Request CHy to review and test software tools Request RA II members to test software tools and report to WGHS Chairperson Improvement of software by considering results of the testing 	Software tools and methods for measuring discharge including backwater and tidal influence	 Republic of Korea (ROK) CHy AWG RA II Members 	 Request test and review by Dec 2018 Development of Ver 2.0 Dec 2019 Development of Final ver. Dec 2020 	CHy RA II	(Development of Ver. 1.0 has been completed in 2016) Upgrading to Ver. 2.0 (debugging problem of lower version)



Fechnical Report of Construction & operation of IRDIMS

- Introduction of IRDIMS, ADVM(Spec., installation)
- Discharge calculation (IVM, VPM)
- Case studies on various conditions(Tidal effect, backwater etc.)

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- 1. Introduction
- 2. Measurement by ADVM
- Discharge calculation and data processing
- Results of discharge measurement by IRDIMS
- 5. Conclusion

APPENDIX

- Introduction of softwares
- User guide of EDPad & MCDPad

Technical Report of Construction & operation of IRDIMS

- Introduction of IRDIMS
- ADVM(installation considering spec. and flow conditions etc.)
- Discharge calculation (basic theory of IVM, VPM and the procedure)
- Case studies on various conditions (Tidal effect, backwater etc.)





4 Software Tools to develop index rating for IRDIMS

- EDPad to data extracting from ADVM
- It is useful to data handling of index velocity measured by ADVM

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201607010040	2,122	1	-48	26	154	143	2	64	-32	138	133
201607010050	2,121	1	-5	-29	154	144	2	-30	-43	137	132
201607010100	2,12	1	32	-6	154	145	2	83	-22	140	133
201607010110	2,118	1	-21	-10	157	145	2	54	-41	140	134
201607010120	2,115	1	5	-21	157	145	2	67	-22	140	135
201607010130	2,113	1	29	-6	158	146	2	106	-58	141	134
201607010140	2,111	1	(-19	154	146	2	-31	13	137	137
201607010150	2,108	1	21	-11	156	146	2	17	-32	139	136
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201607010520	2,101	1	-14	14	156	148	2	34	15	142	134
201607010530	2,102	1	-24	36	157	145	2	101	-76	136	134
201607010540	2,105	1	-14	9	160	146	2	-15	-3	142	136
201607010550	2,112	1	-60	22	156	149	2	50	-27	140	134
201607010600	2,117	1	52	-6	157	147	2	25	-20	138	135
201607010610	2.118	1	5	1	157	145	2	44	-32	136	136



4 Software Tools to develop index rating for IRDIMS

- MCDPad to develop index rating
- Providing all procesures for developing index rating and discharge calculation







4 Software Tools to develop index rating for IRDIMS

- Userguide of software tools was included in Appendix of the technical report
- 2 software tools and source code will be provided (* source code will be provided to only user who request to use it for feedback)





This sheet of figure A-S is to organize data set of manual measurements to get mean velocity. In HSC, all measured data are managed by this sheet called DBPad. All information of individual discharge measurement data are organized in this theet, including code(DM No.), date and time, water height, width, area, mean velocity, discharge, measuring instrument, start & end time of measurement, water

However, even though user does not have this type of data sheet, user can use MCDPad by input some information in the each cell of spreadsheet. To develop index rating through MCDPad, it is necessary to input water height, area, mean velocity, discharge, start & end time of measurement, water heights of start & end

KIHŠ

Development of new measuring techniques to be applied to the IVM and IRDIMS

Operating test-bed to surface velocity meter

Surface velocity meter(Sensoflow) has been installed and being operated to analyze applicability to be used for IRDIMS

Applying k=0.85 and IVM to estimate mean velocity from surface velocity





Applicable analysis on use of surface velocity meter

- Operating test-bed to surface velocity meter
 - Result by applying IVM showed good agreement with H-Q rating curve, whereas method using k=0.85 resulted in over estimation
 - However, it showed some different for low flow condition





Improvement of sediment measuring technique

- Development of the method to estimate suspended sediment using ADVM
- Development of technique to estimate suspend sediment using variation of SI of ADVM by SSC.
 - Comparison of SI of ADVM(fixed- and moving position) and SSC data sampled at the IRDIMS station
 Development of method to estimate SSC using ADVM







- Improvement and development of systematic procedure for use of rating curv
 - Providing specific guidelines on development of rating curve
 - Specific and detail guidelines classified by each procedure discharge measurement (using current meter, ADV, ADCP, Float rod, surface velocimetry) Maintenance and management of the measuring instrument Data processing and QC Development and assessment of rating curve for various conditions
 - Development of software tools
 - to calculate discharge for each instrument
 - to develop rating curve



4 Technical Repot on Development of H-Q Rating Curve

- Introduction of the procedure on development of H-Q rating curve and software tools used in KIHS
- Case studies on various conditions

(weir operation, vegetation growth, continuous bed change)

HYDROMETRIC
MEASUREMENTS with QUALITY
and ACCURACY in KOREA
(Focused on the development of rating curve)
By Eunjeung, Shim
Westward Survey Center Histophile of Kenter

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	Chapter 1 Introduction 1
	1.1 Introduction
	1.2 Definition of stage-discharge rating curve
	Chapter 2 Development of rating curve in Korea
	2.1 Status of development of rating in Korea
	2.2 The major procedure of development of rating curve
	2.3 Standard form for stage-discharge rating curve in Kosea
ing	Chapter 3 Discharge calculation and data processing
	3.1 Development of rating curve in weir operation effect
	3.2 Development of rating curve in said channel stream effect
	3.3 Development of rating curve in vegetation effect
	Chapter 4 Conclusion

- 1. Introduction
- Development of rating curve in Korea
- Case analysis on development of rating curve with various field conditions
 - weir operation
 - vegetation growth
 - continuous bed change
- 4. Conclusion

KIHŠ

4 Technical Repot on Development of H-Q Rating Curve

- Introduction of the procedure on development of H-Q rating curve and software tools used in KIHS
- Case studies on various conditions

(weir operation, vegetation growth, continuous bed change)





Figure 24 Sample of the site sketch

The dufts associated with vegetal growth are cyclic and therefore change with time. The provth increases as the proving season programs and declares during the documant season, but dufts may remain adaptify if the vegetation is walked out by a stream rate. In analyzing shifts there is no substitute for expenses with a given intense because the shift pattern can offen be interpreted logically in more than one says, (USGS, 1982).

As vegetation grows and disappents seasonably, the rating curve shifts to the left (negative shift) according to the vegetation growth, and then the rating curve shifts again reaches to the night (positive shift), and senam to the base rating without effect on vegetation.



Figure 25 Stage discharge rating curve shift (USGS, 1982)

The figure below shows an example according to the monitoring of vegetation growth and development of shaft rating curve by vegetation at Wicheon Museong

Table 3 Rating curve Equation (Gongpyeong , 2010)

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4.2 Development of rating curve in sand channel stream effect

In sund channel timmes, steps-divelvage relations are continuelly changing with true because of seques erosion and sedimentation changes in the configuration of channel bed. So in this condition, monitoring of rever bed changes before and after the flood is very important.

The most important thing is to get a picture that shows change in section and change in the flow of stream. On site photography at the same location can improve the quality of monitoring.



Figure 18 Field monitoring (Site photos) by period for 3 years



4 Software tool to calculate discharge(CalPad)

- Development of software tool to calculate discharge for all kinds of point velocitmetry (Price meter, ADV etc.) using midsection and meansection method



The 5th Session of WMO RA-II WGHS



4 Software tool to calculate discharge(CalPad)

- It provide functions not only to calculate discharge but also useful information to check whether data measured properly (velocity profile, uncertainty, max. ratio of subsections)

- It is available to use of digital field note with mobile equipment





4 Software tool to calculate discharge(CalPad)

- CalPad and its quick guide have been ready for providing

Standard Calculating Procedures

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4 Software tool to calculate discharge(ADCP)



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4 Software tool to calculate discharge(others)

Surface velocity meter and float rod



KIHŠ

4 Software tool to develop rating curve

- Data management for individual measurement data
- Development of H-Q rating curve





Thank You for Your Attention !