국립환경과학원
National Institute of Environmental Research

Operational Water Quality Forecasting for the Four Major Rivers in Korea

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I. About NIER

National Institute of Environmental Research

rganization of NIER

esident

esearch Support Division

esearch Strategy & Planning Division

nvironmental Health Research Departr

Environmental Health Research Divisi

Biosafety Research Team

Risk Assessment Division

Chemicals Registration & Evaluation

Chemicals Research Division

limate & Air Quality Research Departm

Air Quality Research Division

Climate Change Research Division

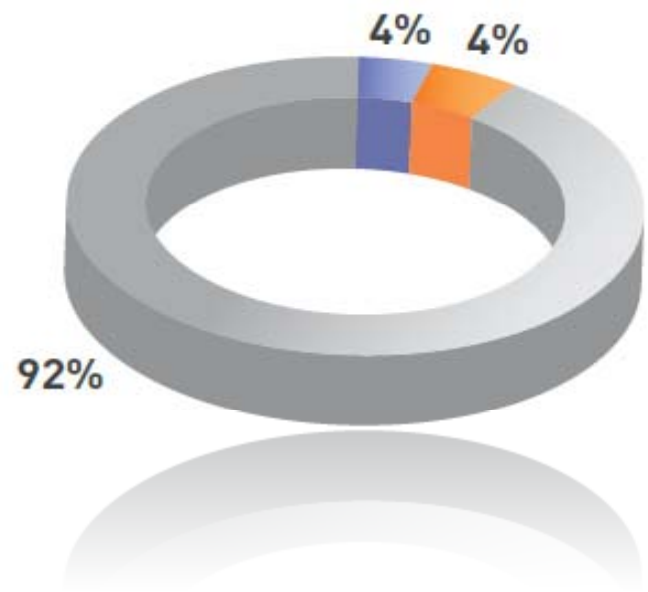
Air Pollution Engineering Division

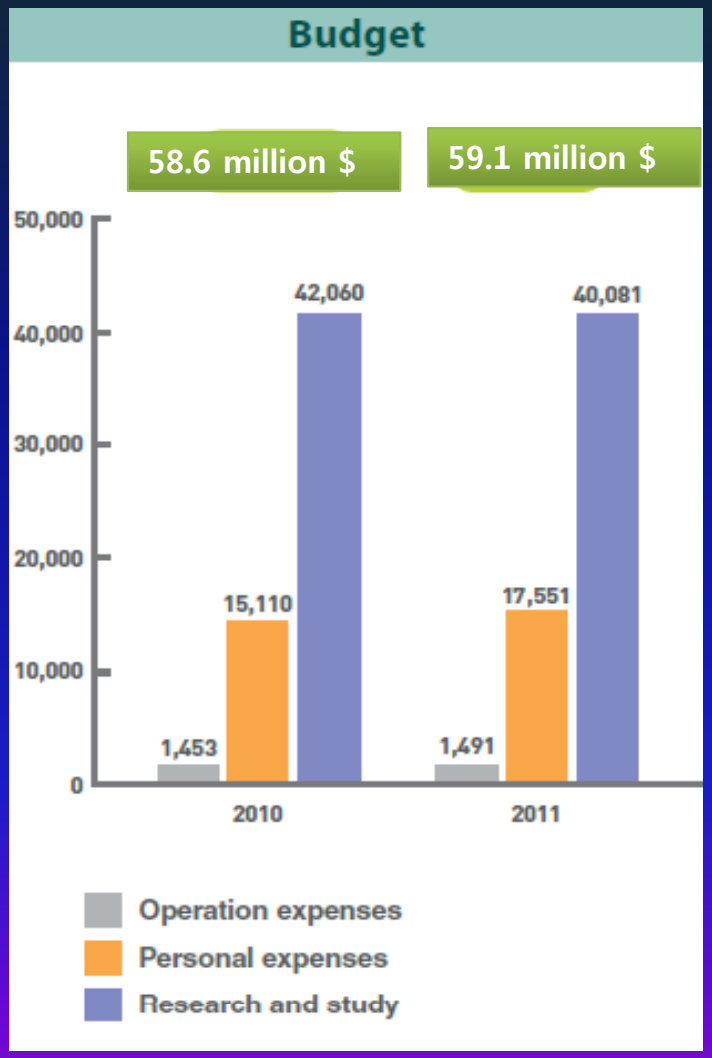
ter quality control center

edict long- and short-term water quality through water quality modeling
pread of toxic substance to cope with pollution accidents. We also operate
al/automatic water quality monitoring network and assess water quality,
g to establish the information system for integrated water quality control.

Manpower and Budget of NIER

Total workforce	855
Researcher	786 (92%)
Technical / Administrative staff	37 (4%)
Technical Assistant	32 (4%)





II. Operational WQ forecast

ckground – Water Quality (WQ) Forecasting

perational WQ forecasting in river systems?

- Not common in the world yet compared to flood forecast.
- The needs and usefulness are getting more attention.
- It requires multiple technologies including real-time hydrologic and WQ monitoring, data transfer and storage, advanced computing, and multi-dimensional, spatially distributed hydrodynamic and WQ modeling.

forts for operational WQ forecasting in Korea

- Goal: *to shift the water quality management paradigm into more advanced level through preventive actions such as pollutant source control and dam water flushing!*

- Water Quality Control Center was established in NIER in July 2010.
- A WQ forecasting system for the four major river basins was developed for the effective WQ management (Aug. 2011).
- Preliminary WQ forecasting (Aug. 2011 to Dec. 2011).
- Official WQ forecast service started in the four major river basins (Jan. 2012 ~ present).

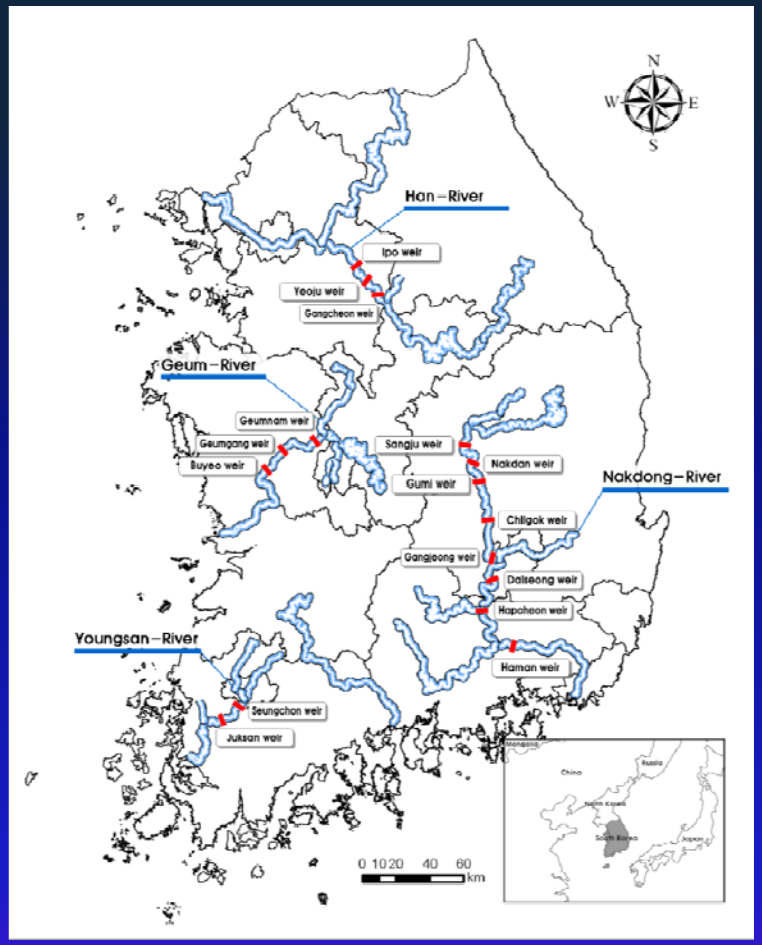
verview of Operational WQ Forecast (1)

outline of 7-days WQ forecast

recasting areas:
e representative upstream areas of
e 16 weirs in the four major Rivers (Han,
kdong, Geum, and Yougsan River basins)

recasting contents:
ter temp. and Chlorophyll-*a* level
will be extended to other WQ
ariables in the future (e.g., TOC & SS)

recasting model:
coupled HSPF-EFDC model developed
the four watersheds



recasting report: A 7-days WQ forecast are officially announced on every Monday
d Thursday and circulated to water management via a dedicated website
qcast.nier.go.kr:8080).

erview of Operational WQ Forecast (2)

procedure of 7-days WQ forecast

er data

ther observation data
ther forecasting data
-Regional / UM-Global)

ogic data

& stage monitoring data
water release data & plan

quality data

ual WQ monitoring data
matic WQ monitoring data
monitoring system (TMS) data

Data Preprocessing

DA

Watershed modeling (HSPF)

Update ICs & BCs

HSPF model run

Predict Flow & WQ

Validate the prediction

River WQ modeling (EFDC)

DA

Update ICs & BCs

EFDC model run

Predict WQ

Validate the prediction

Report forecasting results

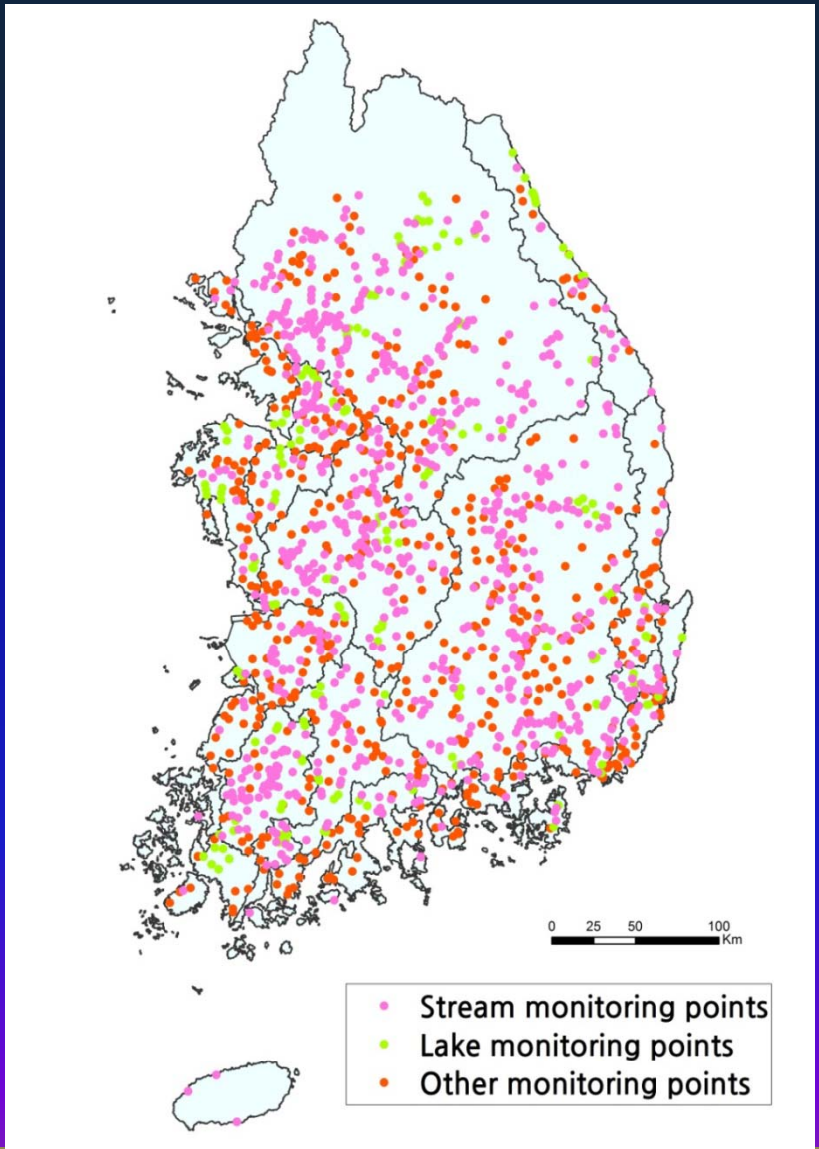
II. Monitoring System in Korea

tional Water Quality Monitoring Network (Manual)

al 1687 manual monitoring points (as
2012) cover most of the nation's
eams and lakes

npling interval differs from points but
stly monthly for a general purpose and
ekly for important points or specific use
h as TMDL and water quality forecast

npling variables include :
C, pH, DO, BOD, COD, SS, TN, TP, water
p., EC, NH_3N, NO_3N, DTN, DTP, PO_4P,
a, Phenols, heavy metals, VOCs, E-coli,
bidity



ational Water Quality Monitoring Network (Automatic)

al 67 stations are currently
operation nationwide
stalled near industrial
gions and important points
ch as the 16 weirs

easurement variables
Vater temperature, pH, DO,
C, TOC (default)
N, TP, NH_3N, NO_3N, PO_4P,
hl-a, Phenol, turbidity,
OCs, Cu, Pb, Zn, Cd,
elective)

Water Quality Tele-Monitoring System (TMS) Network

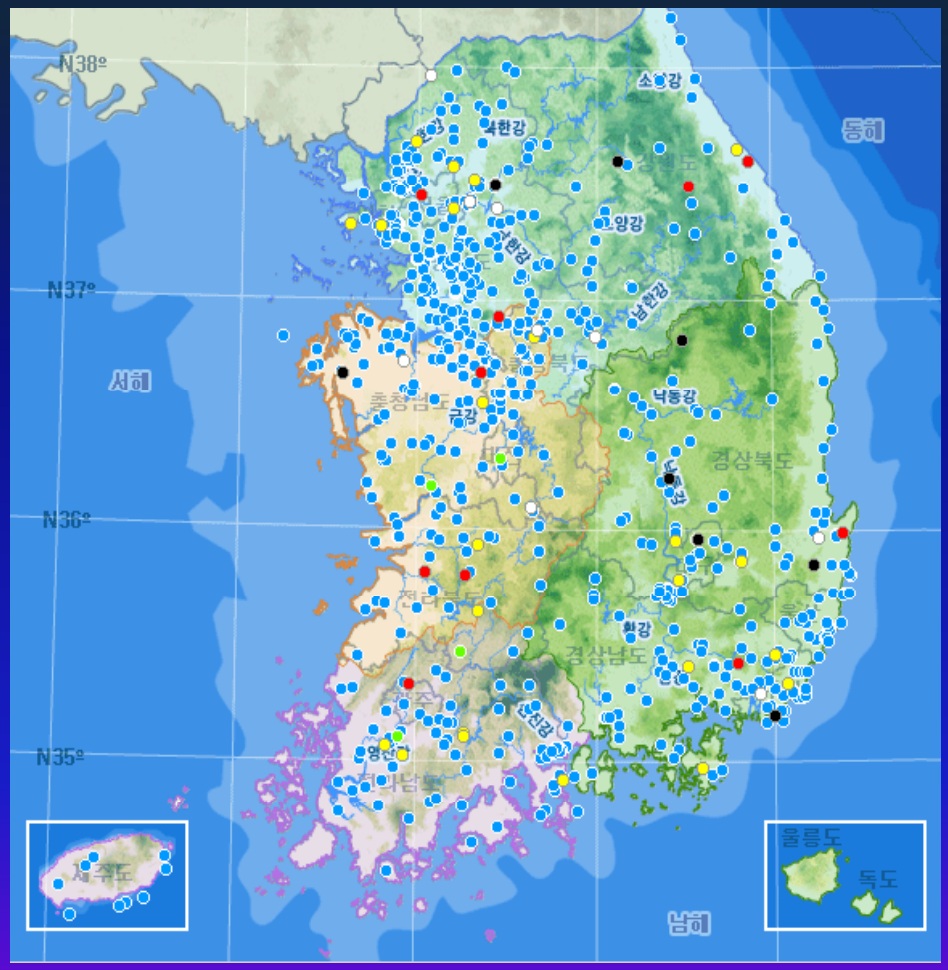
ter quality TMS is a remote water quality
nitoring system for which monitoring
tions installed at industrial and sewage
atment plants transmit data to a control
ter remotely.

S master plan and the TMS control center
re established in 2004 and 2006
pectively

al 690 stations are currently in operation
ionwide

nitoring variables: BOD, COD, SS, pH, flow
T-N, T-P

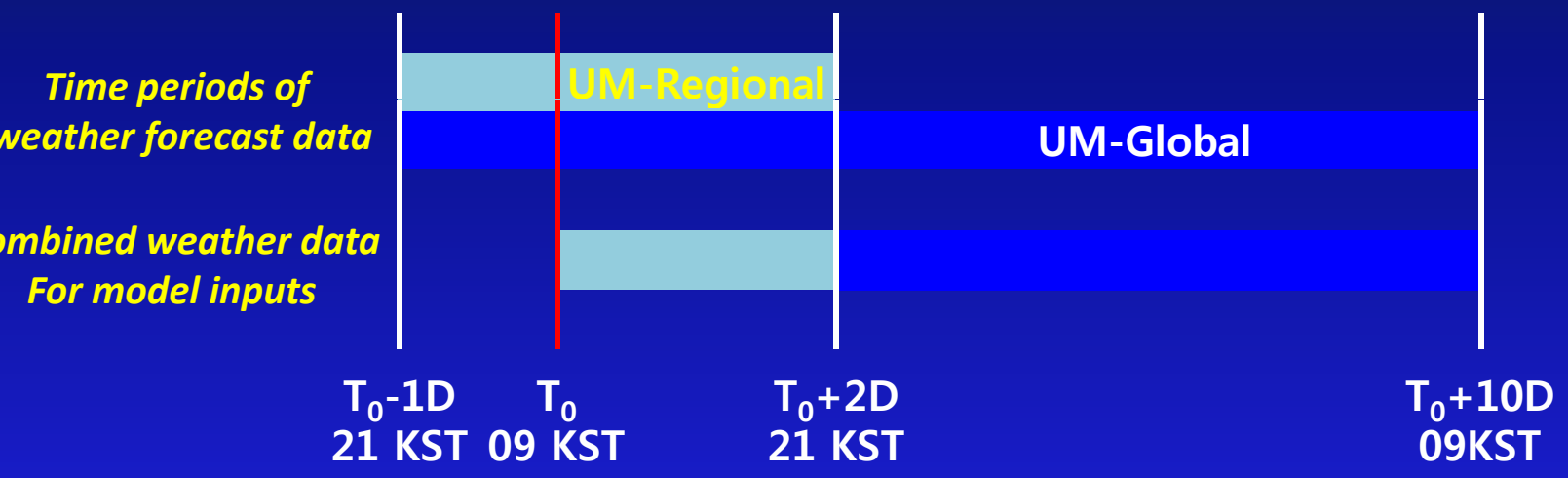
l time data collected at outlets of plants
transmitted to the TMS control center
l then distributed to other organizations
data analysis, issuing emission charge etc.



II. Operational WQ Forecasting Step

Q Forecasting Step: 1. Weather Forecasting

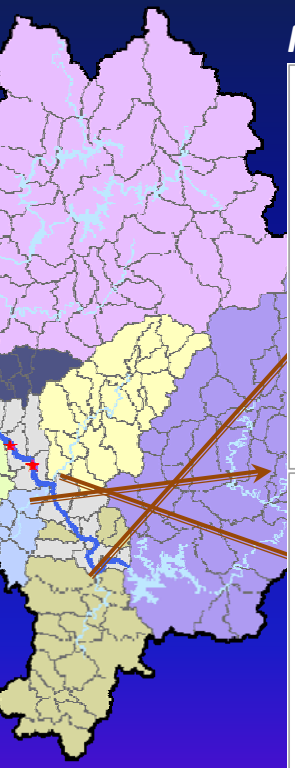
numerical weather prediction with **a merged dataset of Global and egional Unified Model (UM)** forecasting automatically fed from the Korea eteorological Administration serves as the atmospheric forcing in both odels.



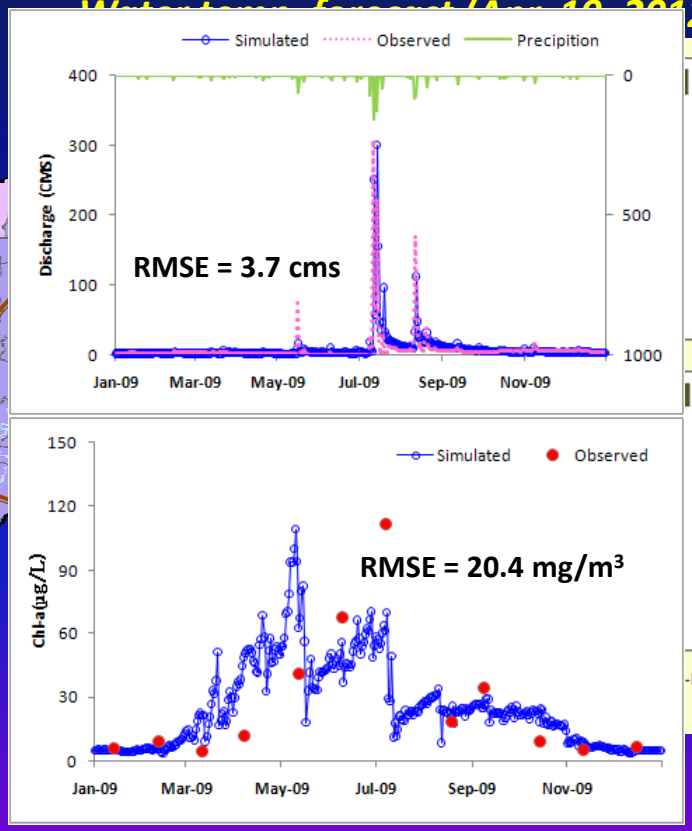
The latest data are available at 21 KST of the day before current day (T_o).
As UM-R data is available up to only 72 hours from 21 KST of T_o- 1D,
UM-G data is used after 21 KST of T_o+ 2D.

Q Forecasting Step: 2. Tributary Flow & WQ Forecasting

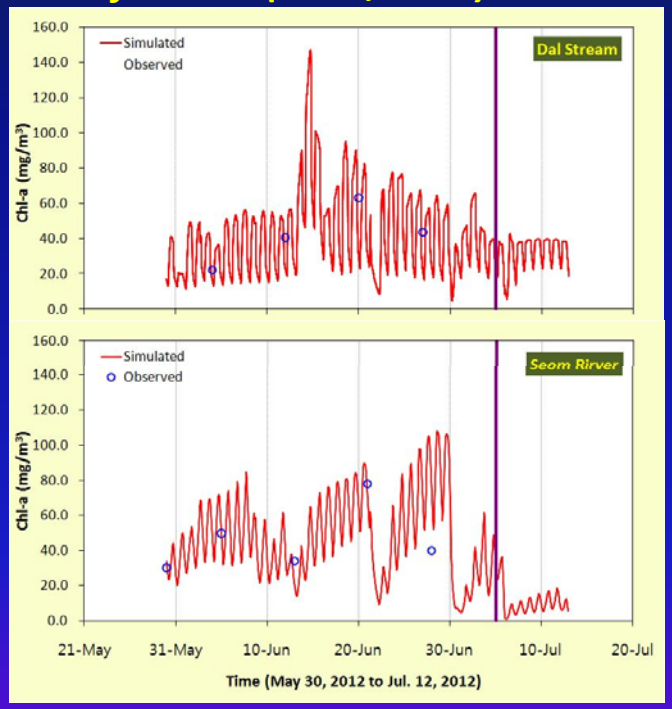
e HSPF model provides the flow and WQ forecasting data of major ibutaries as the boundary conditions of EFDC model.



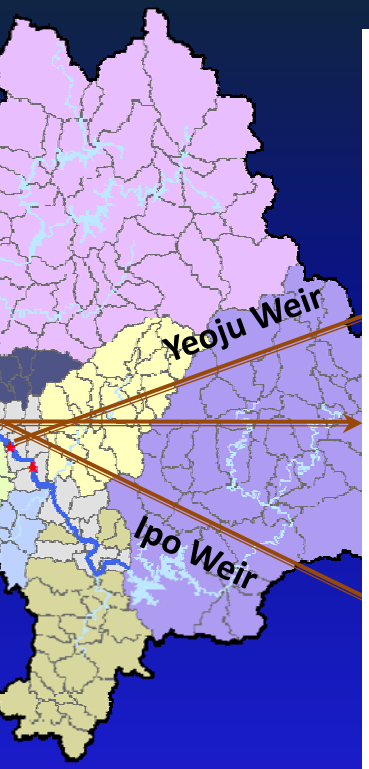
Model calibration

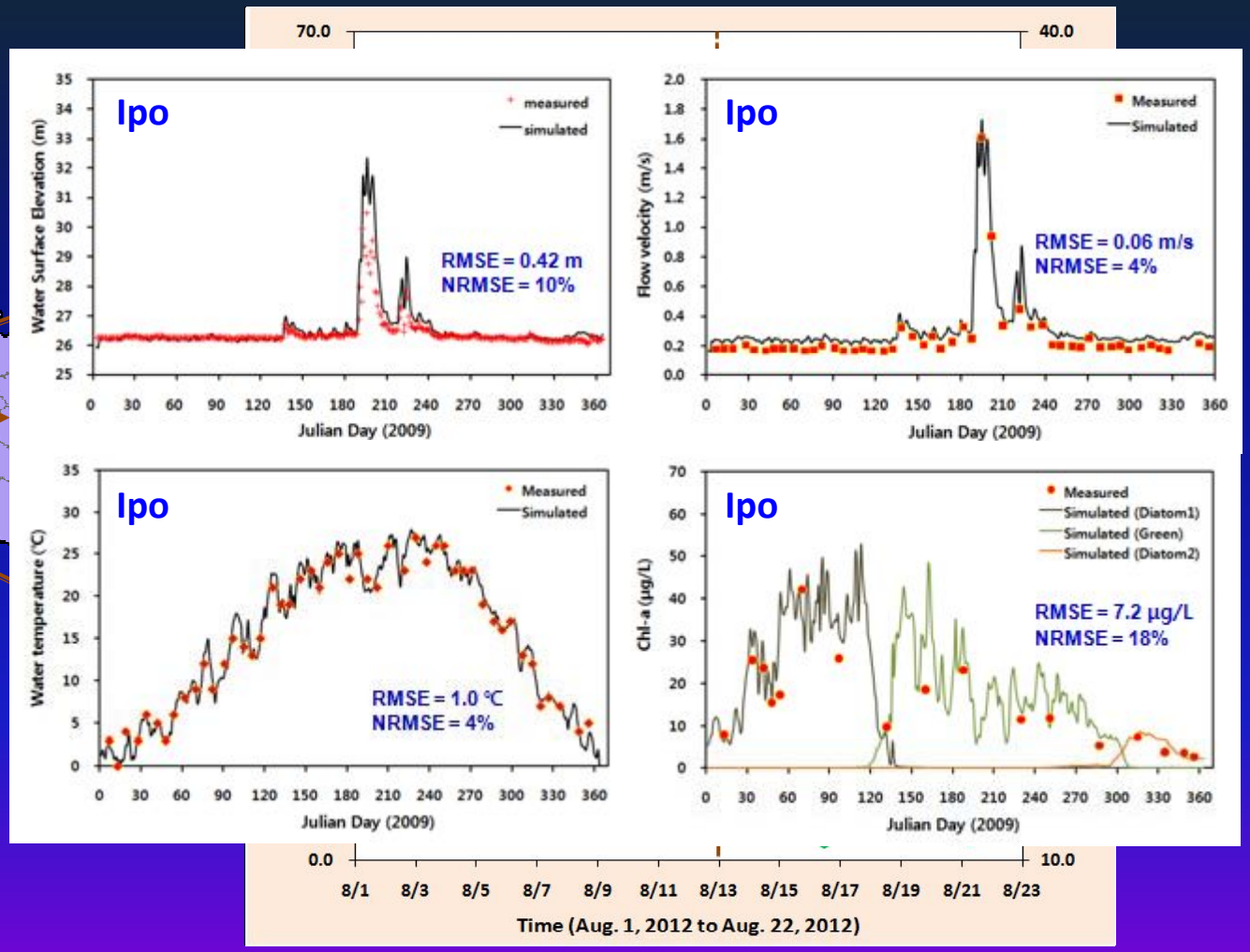


Chl-a forecast (Jul. 5, 2012)



Q Forecasting Step: 3. River WQ Forecasting



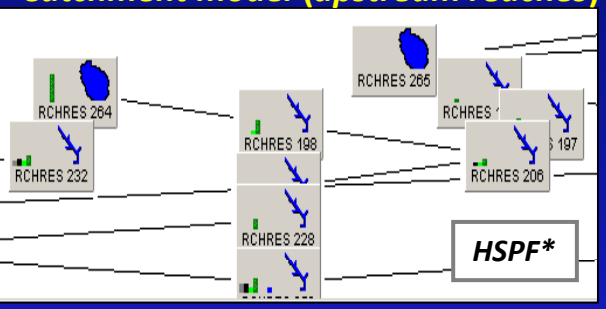


WQ Forecasting Step: Operational System (FEWS-NIER)

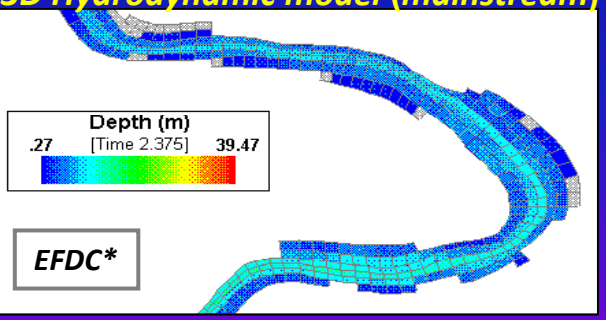
EWS-NIER: An operational forecasting system where all the tasks are heduled automatically…

- **Import real-time data**
- **Pre-processing data**
- **Running models**

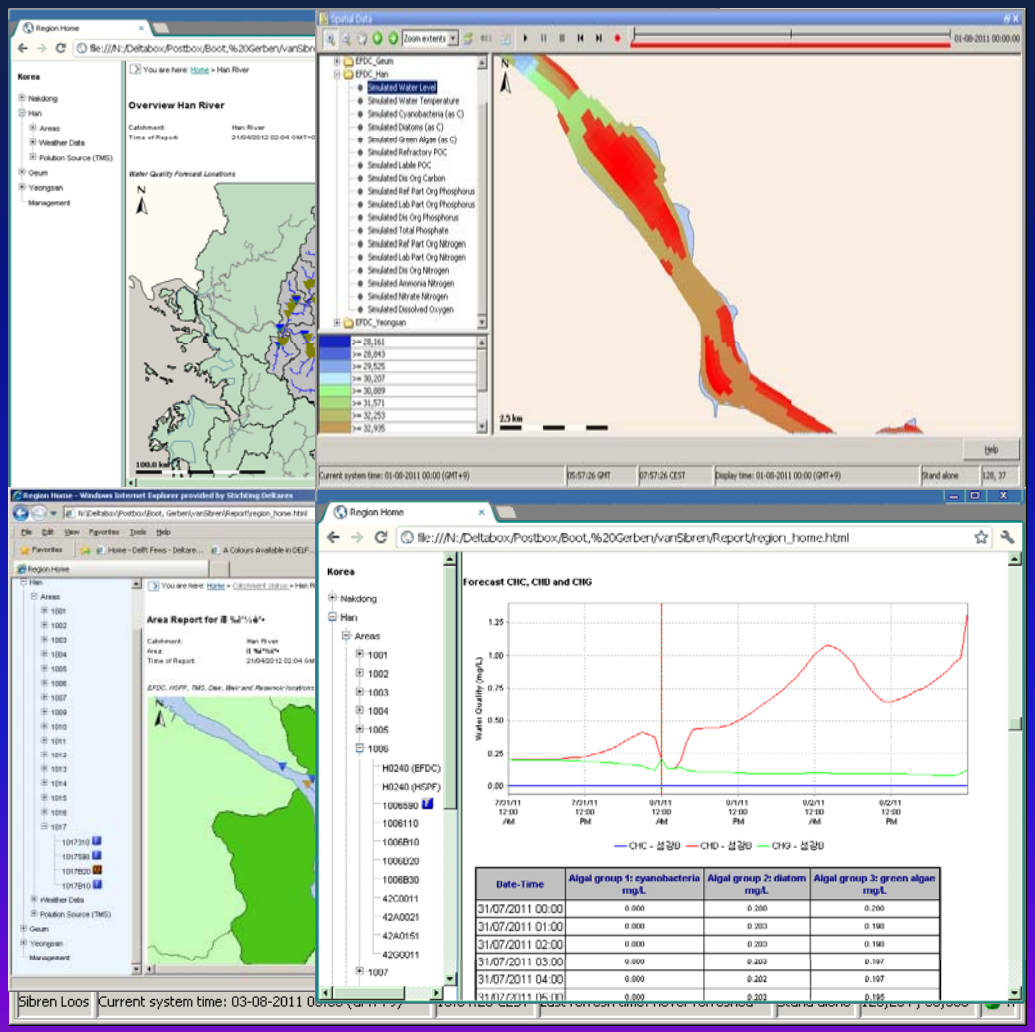
Catchment model (upstream reaches)



3D Hydrodynamic model (mainstream)



Post-processing data



ne Prevention and Control of Algal Bloom Based on the WQ Forecasting System

se Study : Algal control in Youngsan River (1)

ackground

Sever algal blooms occurred at one of the two weirs in Youngsan River in eptember 2011 after a long period of rainfall followed by hot and dry days Water temperature was over 30 ℃ and Chl-a conc. reached over 123.6 ug/L Water depth remained about 6~7m at Seongcheon weir and the gate of uksan weir was open

Vater temperature and Chl-a data at Seongcheon weir in Sept. 2011

Location		08-30	09-01	09-02	09-03	09-04	09-05	09-06	09-07
0m upstream eongcheon weir	Water Temp.	-	30.4	28.9	30.8	30.3	29.0	28.4	27.9
	Chl-a	-	22.7	54.5	44.9	64.9	**122.8**	**123.6**	-
m downstream eongcheon weir	Water Temp.	34.1	30.0	28.7	30.8	34.1	29.4	27.8	27.2
	Chl-a	124.9	32.8	35.8	67.0	58.5	**183.7**	**102.4**	-

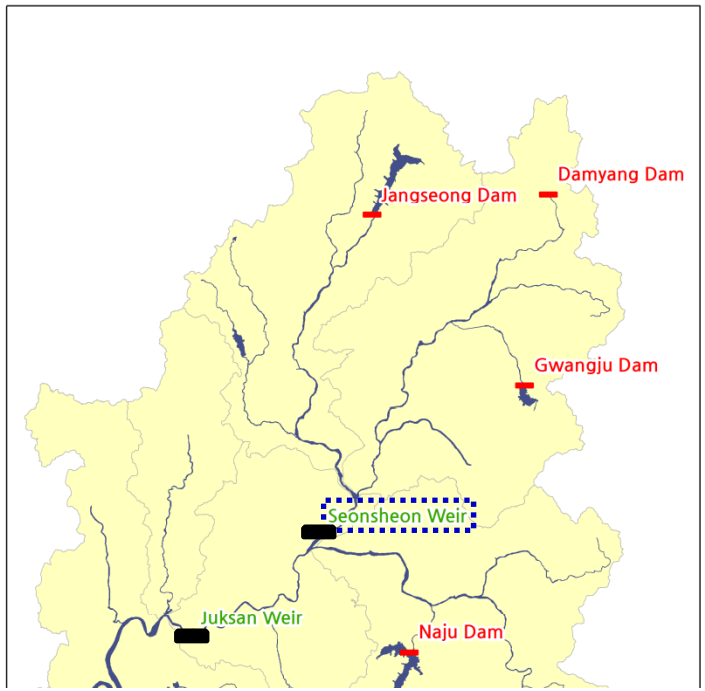
se study : Algal control in Youngsan River (2)

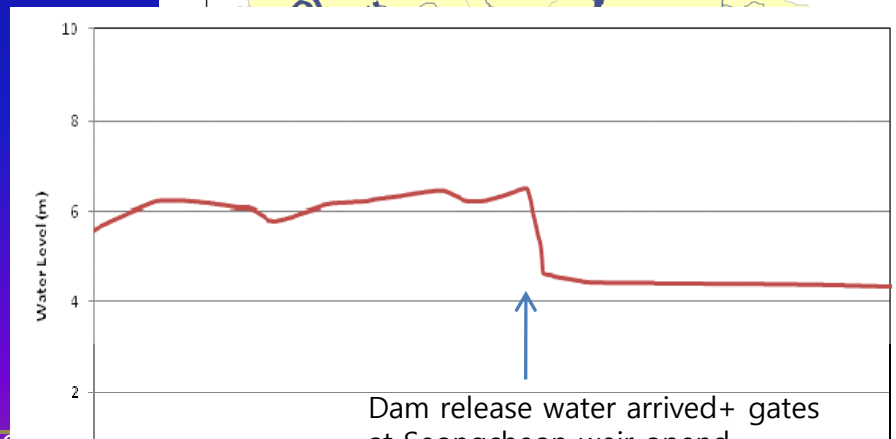
enario goal

To improve the water quality of Seongcheon weir by releasing water from upstream dams etc.

ushing measures

- Dam water release from three upstream agricultural dams 3.3% of total water of the dams were released from Sept. 9
- The gates of Seongcheon weir opened The gates were opened on Sept. 9, the water level decreased to 4.5m

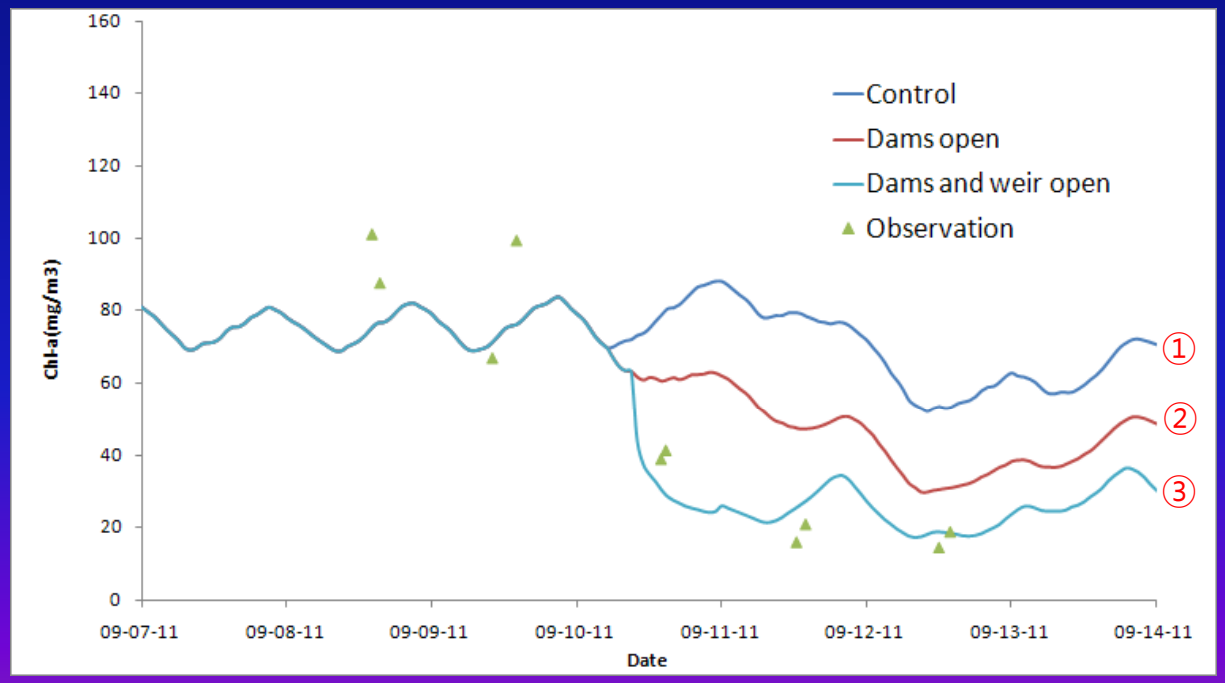




ase study : algal control in Youngsan River (3)

fect of flushing by dam water release from agricultural dams
About 37% reduction ② compared to no release case ①

fect of gate open of Seongcheon weir
Additional effect of the gate open was significant ③
Decreased dramatically up to 19 ug/L on Sept. 12 (prediction 20 ug/L)



Thank you for the attention!
Questions or Comments?

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