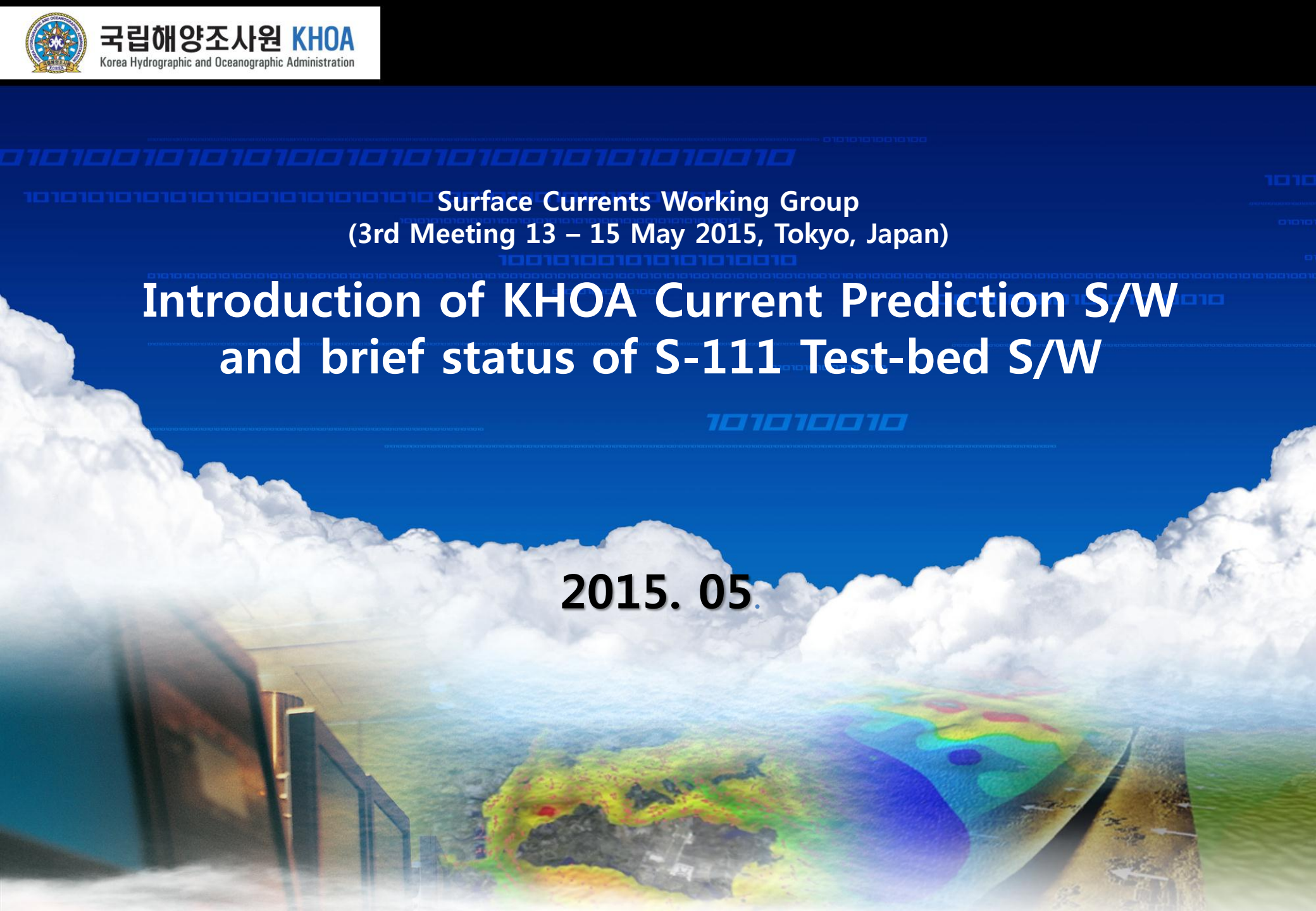
국립해양조사원 KHOA
Korea Hydrographic and Oceanographic Administration

Surface Currents Working Group
(3rd Meeting 13 – 15 May 2015, Tokyo, Japan)

Introduction of KHOA Current Prediction S/W and brief status of S-111 Test-bed S/W

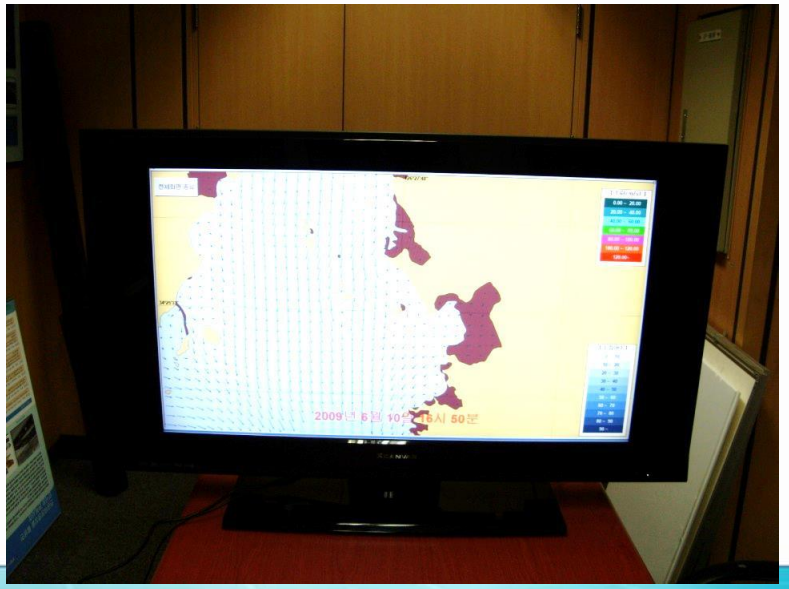
2015. 05.



Contents

❖ Introduction

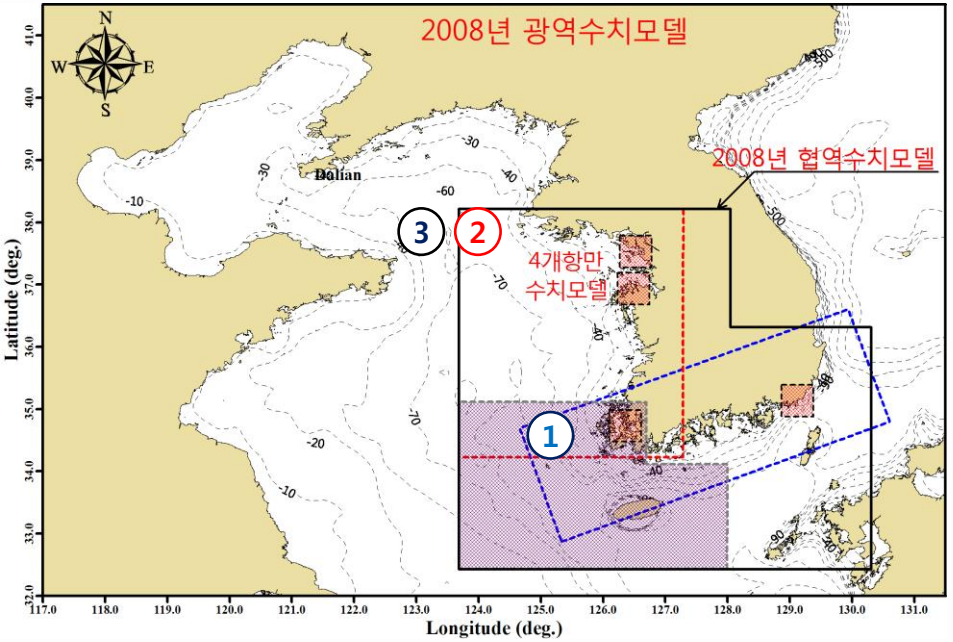
- Concept
  - ✓ Replace the paper for tide and tidal current chart
  - ✓ Distribute 'e- tide and tidal current chart' for public user
- Expanded Utilization
  - ✓ Prevention marine accident
  - ✓ Support rescue, management of facilities and VTS activities
- Expected User
  - ✓ Military part of Navy
  - ✓ Rescue part of Coast Guard
  - ✓ Marine science research
  - ✓ Fisheries, shipbuilding and leisure(Yacht)



❖ History

➢ Numerical Model & Program

Numerical Model Area



① South, Some of East, Some of South West coast(2006)

② West coast(2007)

③ West, South, East and South West coast (2008)

Numerical Model Properties

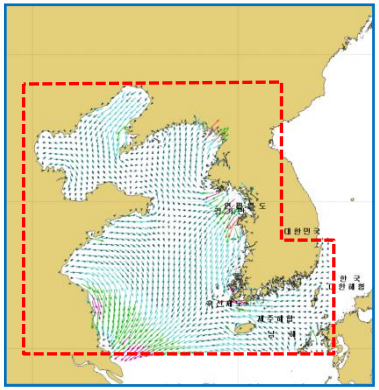
Section	2006	2007	2008
Area	South, Some of East, Some of South West coast	West coast	South, Some of East, Some of South West
Grid Resolution	500 m	500 m	200 m ~ 1 km

2008 Numerical Model configuration

Model	Area(km)	Grid Resolution	Area #
Open Sea	1100 × 960	2.0 km	1
Near Sea	530 × 630	200 m ~ 1.0 km	1
Port Area	-	50 m	4

❖ History

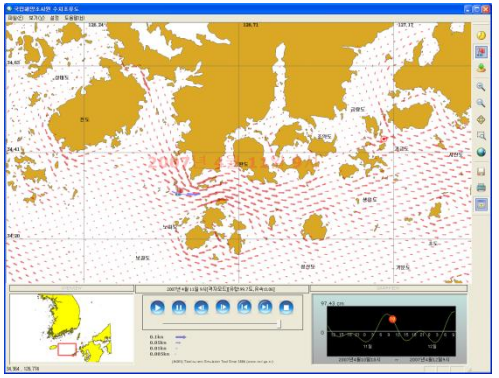
2009 Numerical Model Area(Grid size 1km~50m)



1 Layer

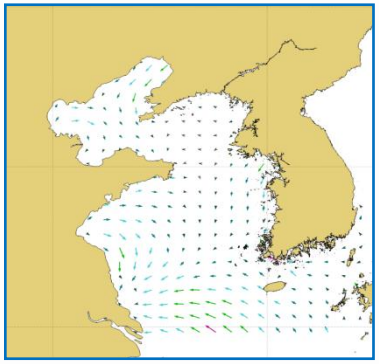
Grid size
- Open Sea 1km
- Near Sea 500m
- Port Area 200m

2007 Numerical tidal current program

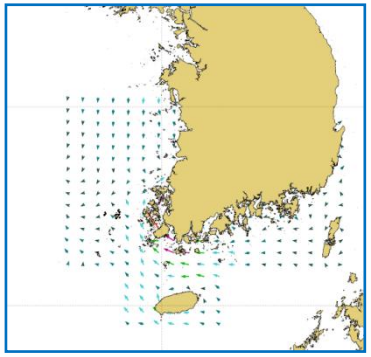


Basic Functions only
- Prediction
- Simulation

2013 Numerical Model Area(Grid size 1km/500m/250m)



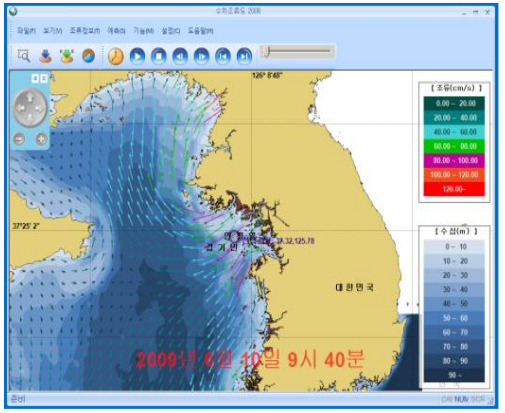
Model Area(1km/500m)



Model Area(250m 1of3)

Numerical Model size was increased
(about 30Mbyte -> 2Gbyte)

2009 Numerical tidal current program

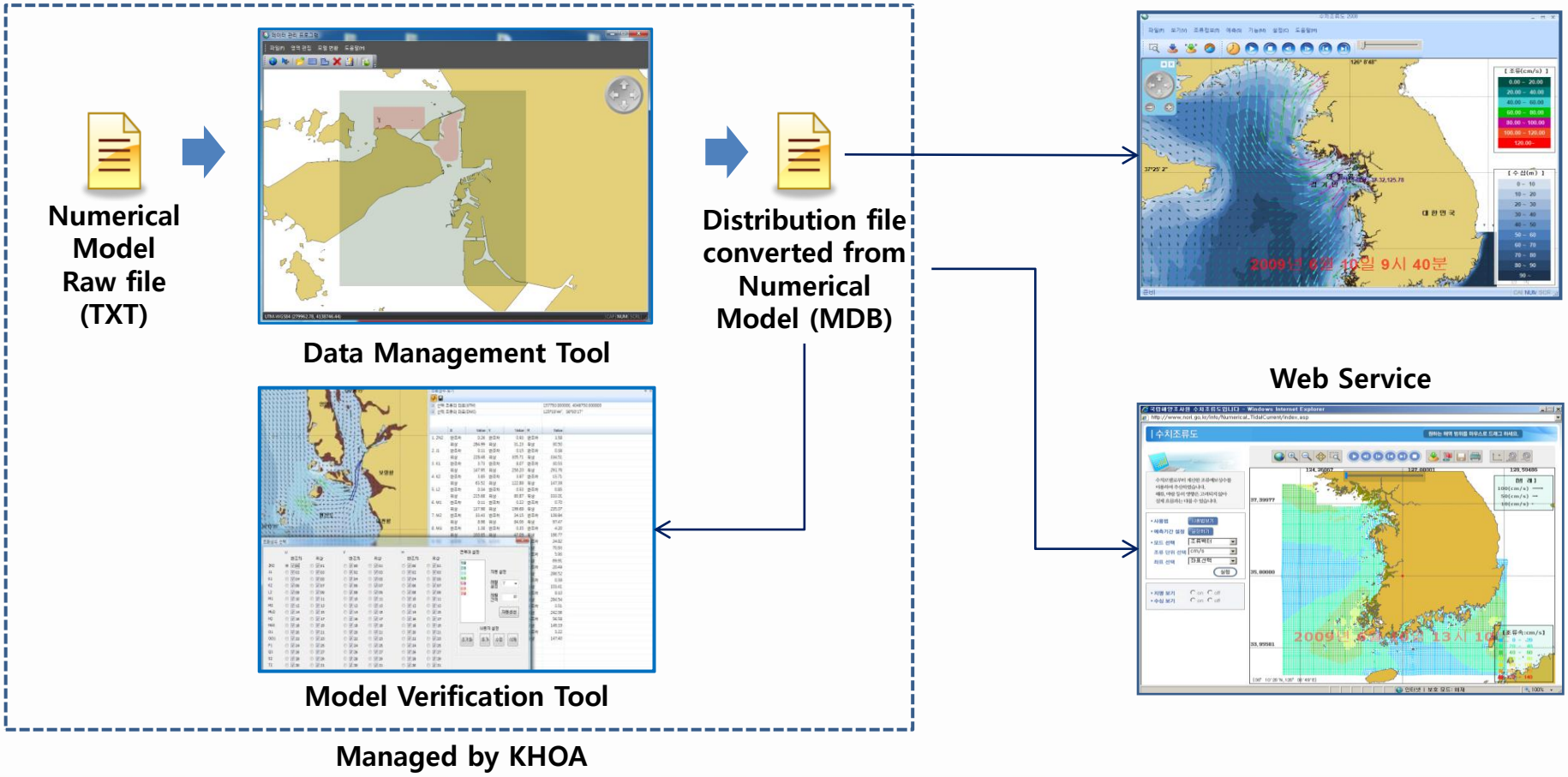


Added Functions
- Tracking drift
- Estimating Optimal time for Departure of Ship
- Etc...

Complexity of Software was increased

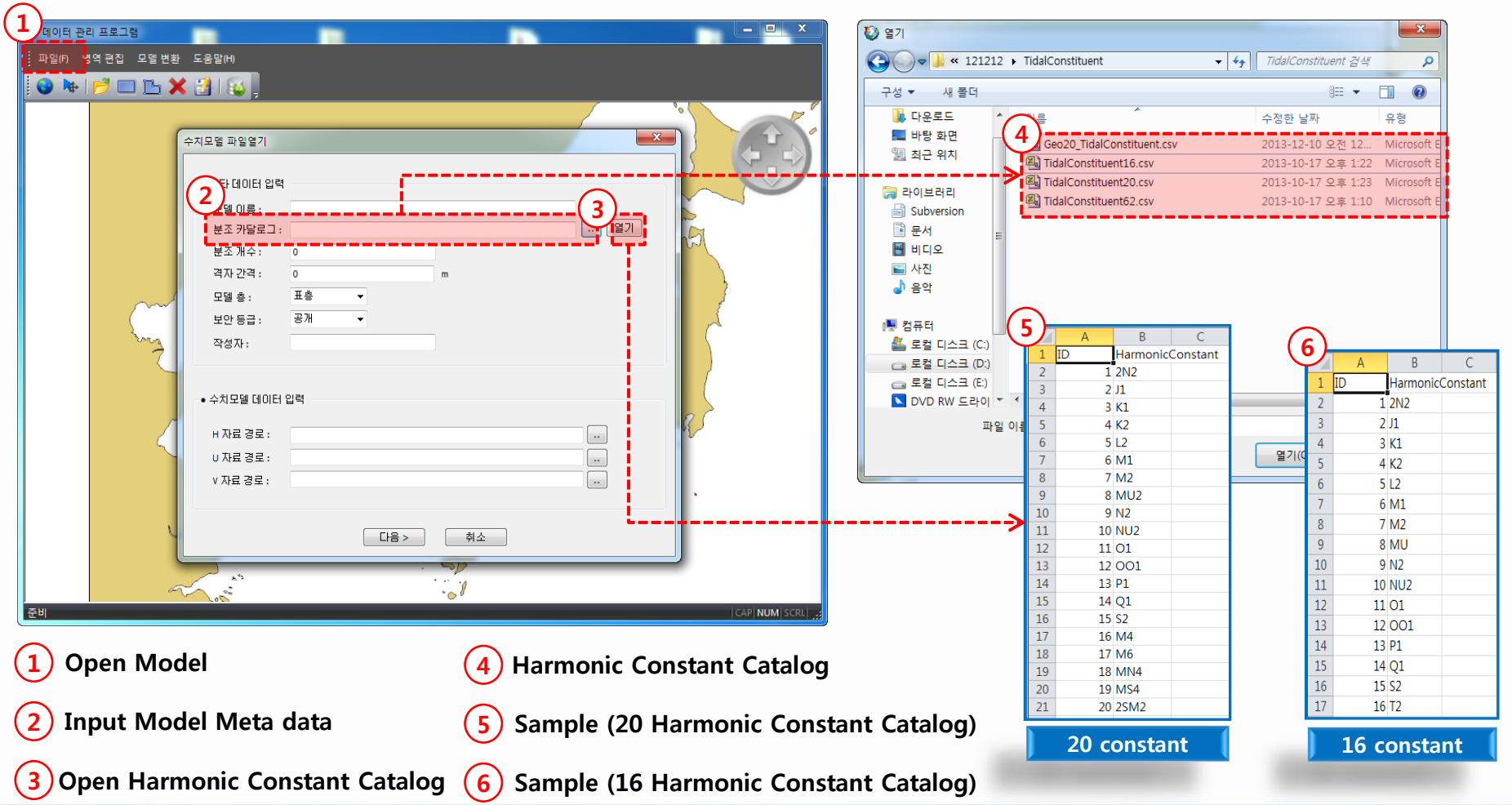
❖ Software Configuration

- ➢ Data Management Tool, Model Verification
- ➢ Distribution Program, Web Service



❖ Data Management Tool

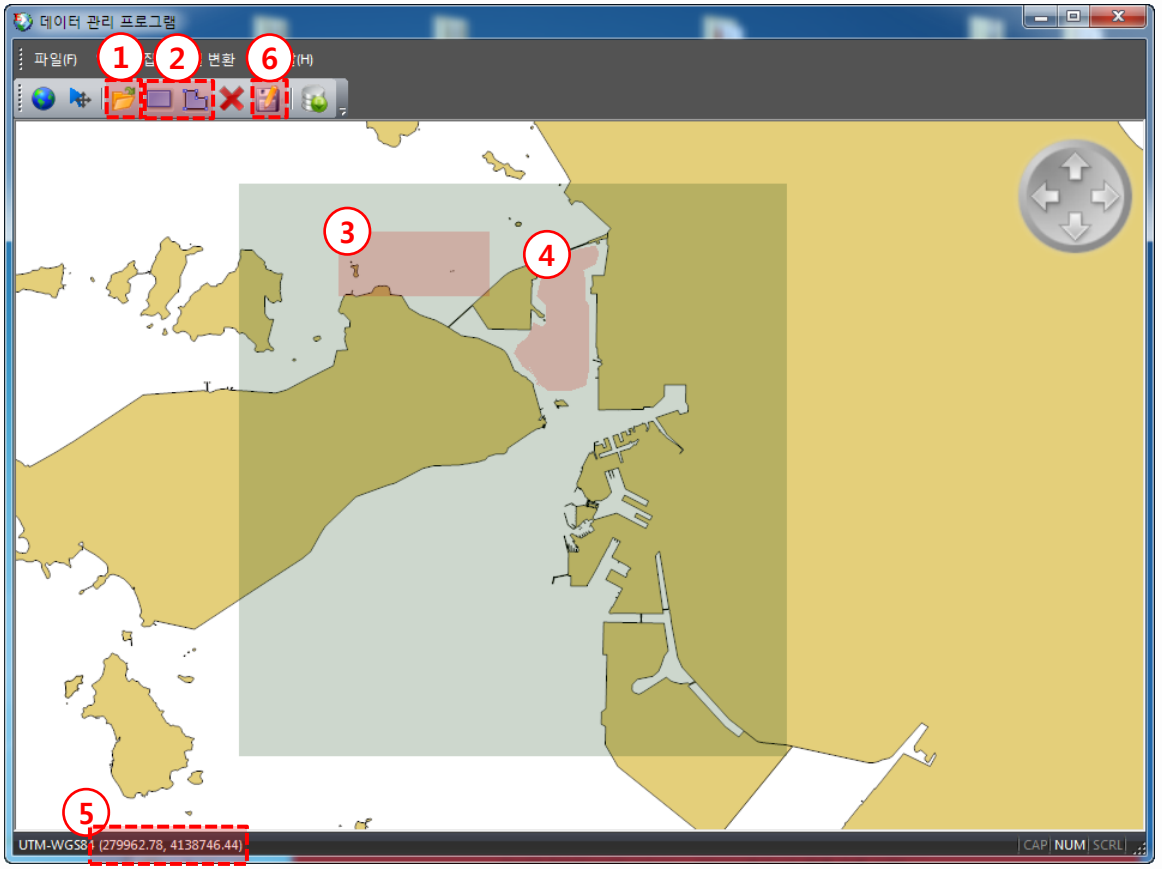
➢ Input Model Data & Meta Data(Model Name, Harmonic Constant Catalog, Grid Resolution, Layer and Security Class)



1. Open Model
2. Input Model Meta data
3. Open Harmonic Constant Catalog
4. Harmonic Constant Catalog
5. Sample (20 Harmonic Constant Catalog)
6. Sample (16 Harmonic Constant Catalog)

❖ Data Management Tool

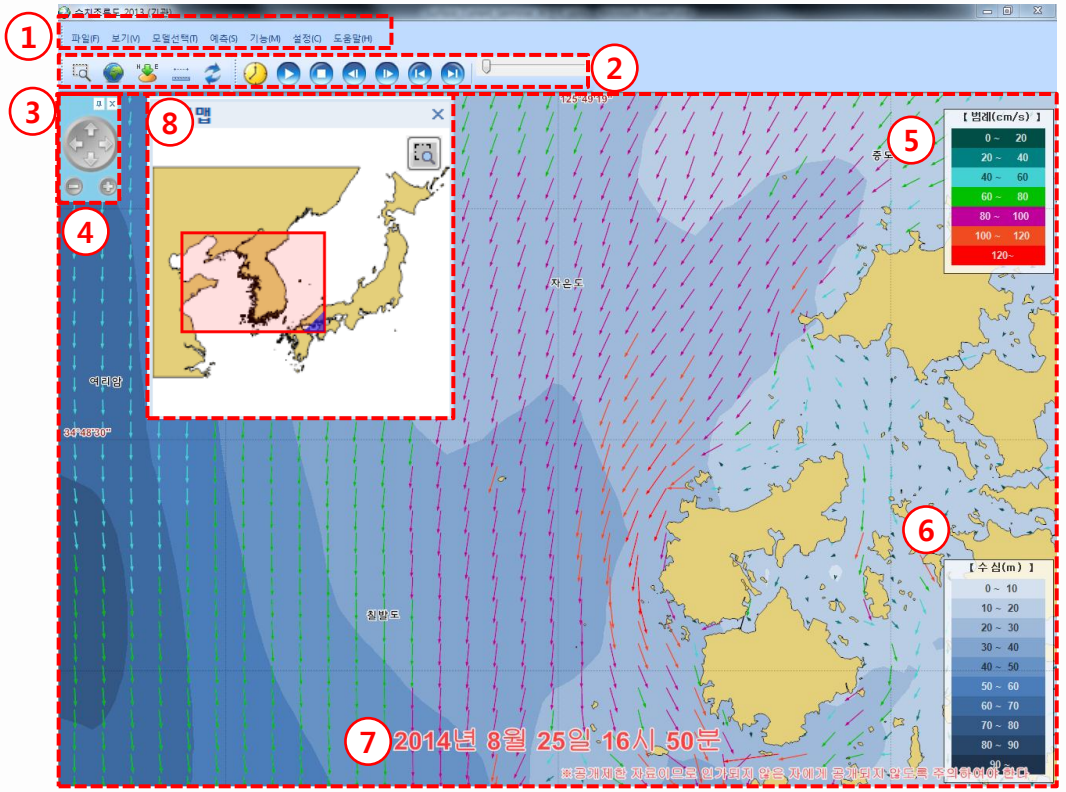
- ➢ Function for editing area
- ➢ Distribution, Treatment for security



1. Open adjust area saved
2. Adjust area(3 , 4)
3. Rectangle type
4. Polygon type
5. Check Coordinates
6. Save adjusted area (for next use)

❖ User Program

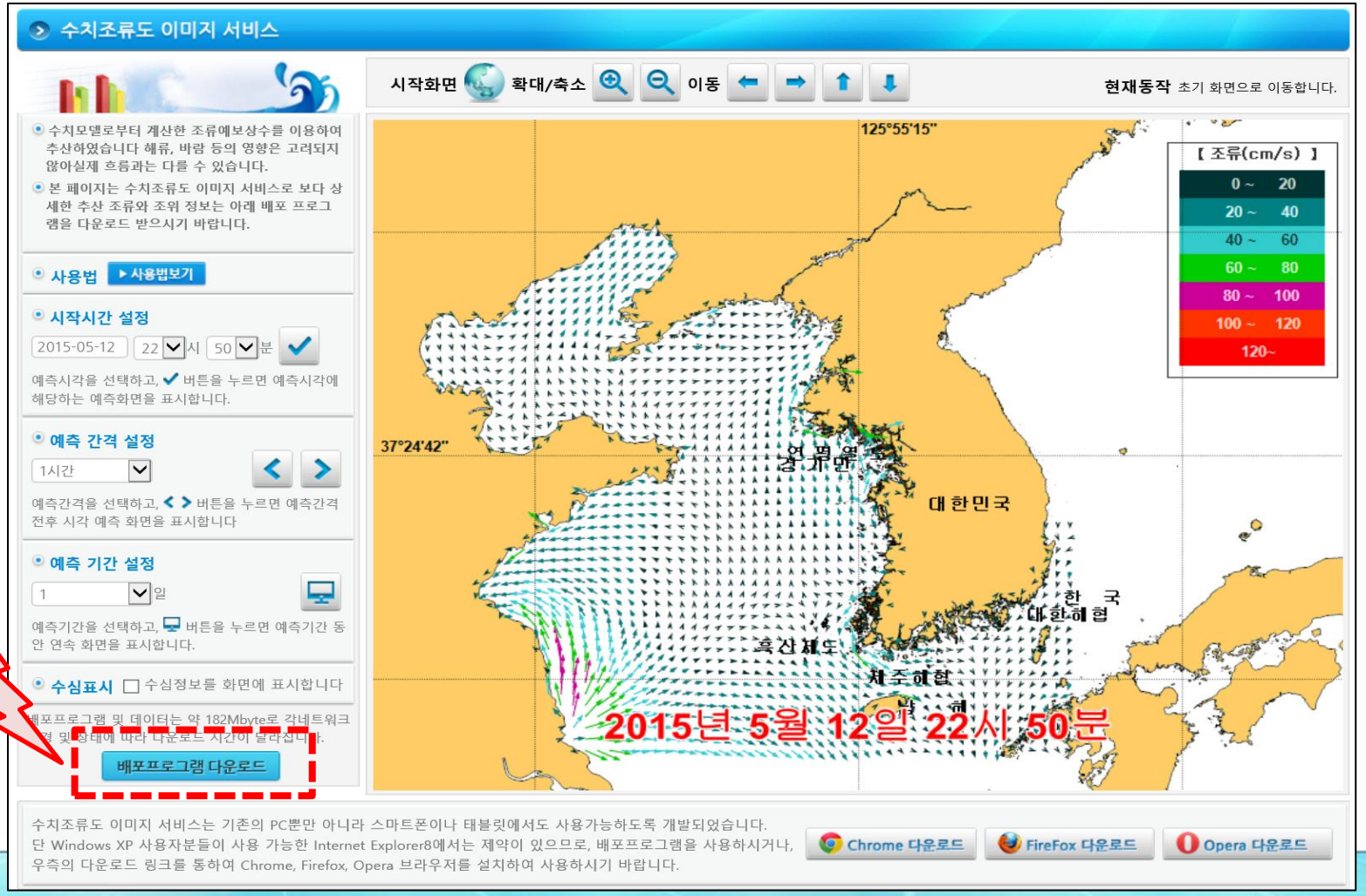
- ➢ Diverse version and UI for each user
- ➢ Menu, Tool bar, View Control and Main View
- ➢ Current Legend, Depth Legend, Current Time and Mini map



1. **Program menu**
   - File, View, Model, Prediction, Function, Setting
2. **Tool bar**
   - Frequently used functions
3. **View Control**
   - Move, Enlarge, Collapse
4. **Main View**
5. **Current Legend**
6. **Depth Legend**
7. **Current Time**
8. **Mini map**

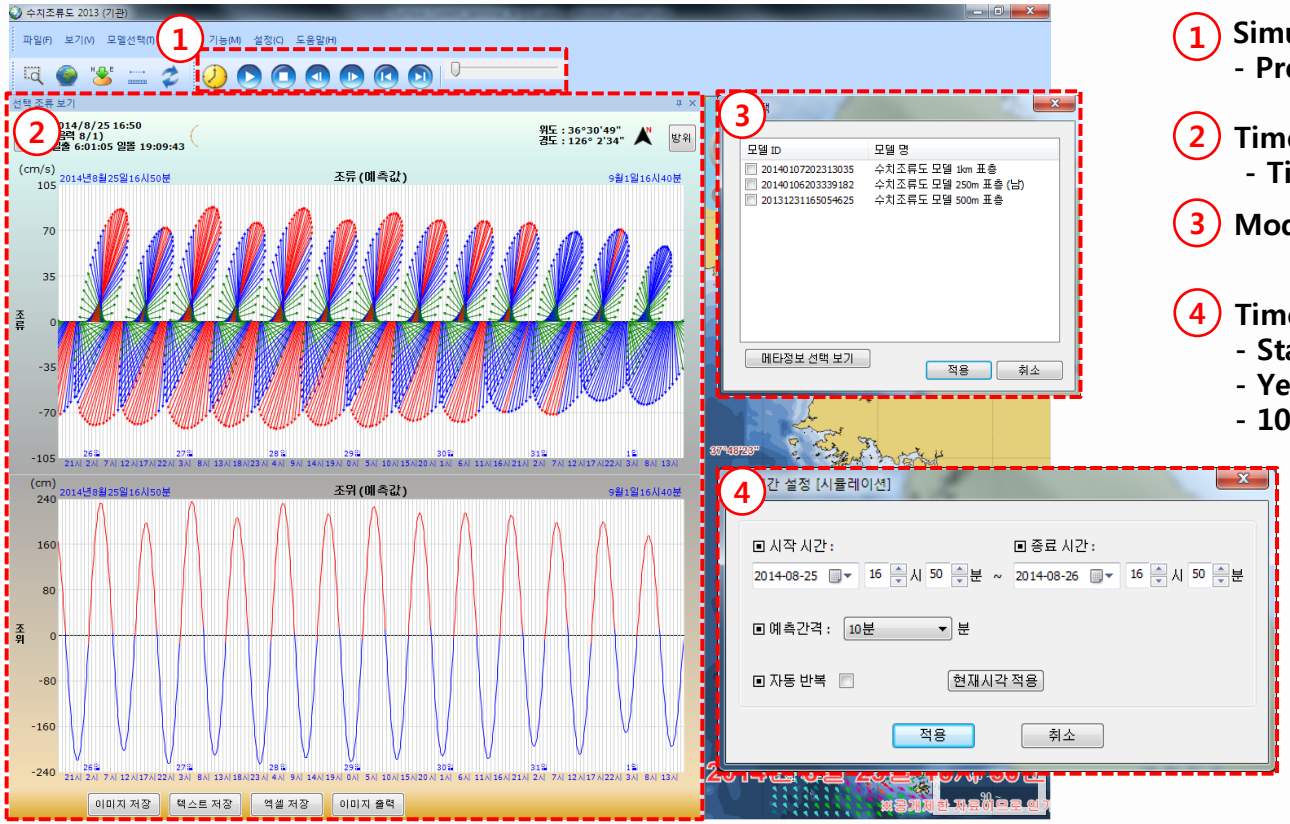
❖ User service (2 Methods)

- ➢ Web service (**http://www.khoa.go.kr/tdnet**)
- ➢ Stand alone User S/W



❖ Basic Functions

- ➢ Prediction
- ➢ Simulation
- ➢ Time series graph for a grid point



① **Simulation Control**
- **Pre, Forward, First time, Last time, Stop**

② **Time series graph for a grid point**
- **Tidal current, Tide**

③ **Model select**

④ **Time select**
- **Start time, End time, time interval**
- **Year, Month, Day, hour, minute**
- **10/30 minute, 1 hour**

❖ S-100/S-10X Test Bed of KHOA

PRELIMINARY LIST OF S-100 BASED PRODUCT SPECIFICATIONS

Research of S-100/S-10X Test Bed

Nautical Chart

Bathy Grid

Marine Observation

Nautical pub.

IHO: S-101 to S-199

IHO S-101 ENC

IHO S-102 Bathymetric Surface

IHO S-103 Sub-surface Navigation

IHO S-10x Tidal product for surface navigation

IHO S-111 Surface currents

IHO S-112 Real time tidal data transfer

IHO S-121 Maritime limits and boundaries

IHO S-122 Marine Protected Areas;

IHO S-123 Radio Services

IHO S-124 Navigational warnings

IHO S-125 Navigational services

IHO S-126 Physical Environment

IHO S-127 Traffic Management

IHO S-1xx Marine Services

IHO S-1xx Digital Mariner Routeing Guide

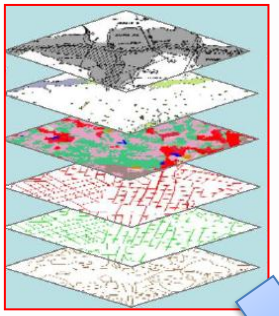
IHO S-1xx Harbour Infrastructure

IHO S-1xx (Social/Political)

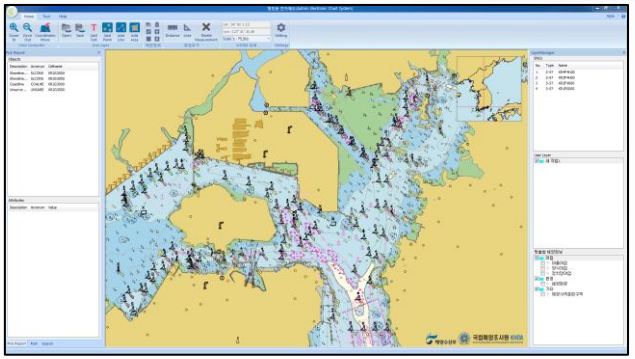
Dataset (8211/ GML/ XML/ HDF-5)

Feature Catalogue

Portrayal Catalogue



S-57/S-101 ENC Viewer



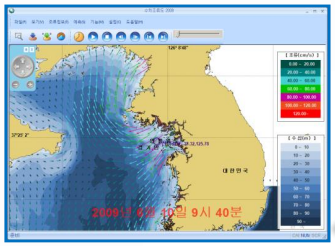
National GI (Geospatial Information) Registry of KHOA

Feature Catalogue Builder

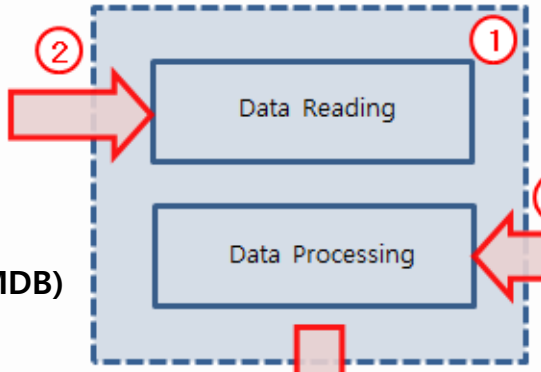
Portrayal Catalogue Builder

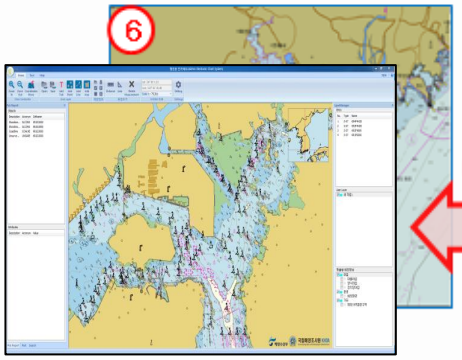
❖ Current Prediction Module used for S-111 Test Bed Research

- ➢ Use Current Prediction Module to support S-10X Test bed
- ➢ Library type of Current Prediction Module (.dll file)



Distribution file converted from Numerical Model (MDB)

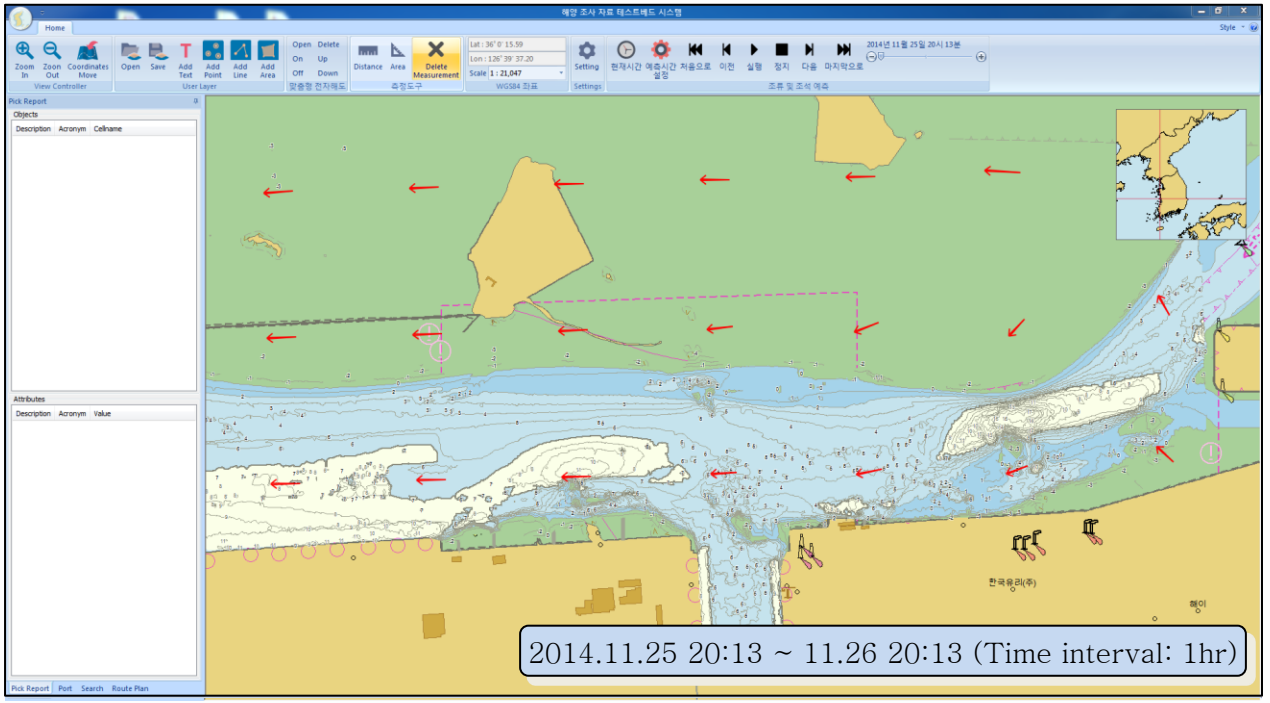




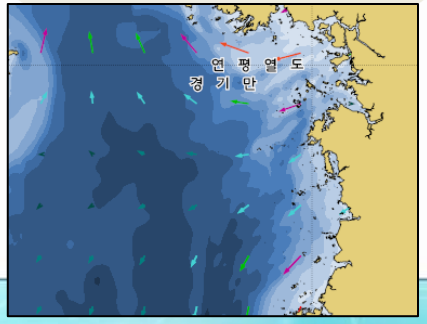
1. Tidal Prediction Module(dll)
   - Data Reading, Data Process
2. Input 'Numerical Model Converted file'
3. *I/F(API) of Control 'Prediction Data Processing'
4. Delivery 'Result of Processing'
5. Rendering I/F of S-10X Test Bed
6. Viewer of S-10X Test Bed

*I/F : Interface

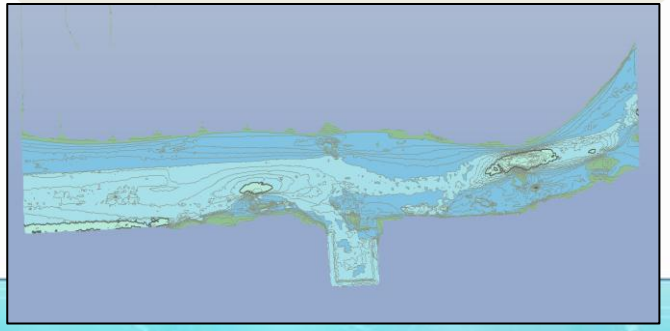
❖ ENC Viewer with Current Prediction Module (2014)



Numerical Model: 1km



High density ENC



Tidal Table

<TIDASIII - 조위예측극치자료>

대상조위관측소 : 군산(외항)
위도(WGS84) : N 35도 58분 32초
경도(WGS84) : E 126도 33분 47초
관측기간 : 2014-01-01 00:00:00 ~
2014-12-31 23:59:00

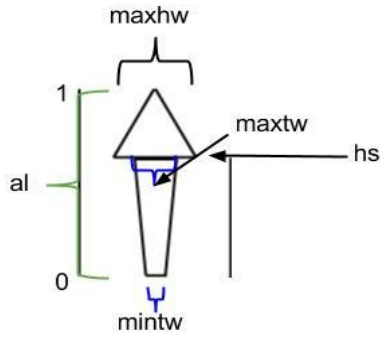
2014	01	01	02	25	MAX	590
2014	01	01	09	07	MIN	14
2014	01	01	15	06	MAX	698
2014	01	01	21	56	MIN	75
2014	01	02	03	15	MAX	615
2014	01	02	09	58	MIN	-10
2014	01	02	15	53	MAX	719
2014	01	02	22	44	MIN	54
2014	01	03	04	03	MAX	633
2014	01	03	10	47	MIN	-20
2014	01	03	16	39	MAX	726
2014	01	03	23	29	MIN	43
2014	01	04	04	50	MAX	640
2014	01	04	11	34	MIN	-14
2014	01	04	17	24	MAX	717
2014	01	05	00	13	MIN	44
2014	01	05	05	37	MAX	636
2014	01	05	12	19	MIN	9
2014	01	05	18	08	MAX	695
2014	01	06	00	56	MIN	57
2014	01	06	06	25	MAX	622
2014	01	06	13	03	MIN	47
2014	01	06	18	52	MAX	659
2014	01	07	01	39	MIN	79
2014	01	07	07	15	MAX	597
2014	01	07	13	49	MIN	98
2014	01	07	19	37	MAX	613
2014	01	08	02	23	MIN	108
2014	01	08	08	08	MAX	565
2014	01	08	14	40	MIN	154
2014	01	08	20	27	MAX	562
2014	01	09	03	15	MIN	139
2014	01	09	09	11	MAX	533
2014	01	09	15	43	MIN	206
2014	01	09	21	27	MAX	513
2014	01	10	04	17	MIN	163
2014	01	10	10	27	MAX	513
2014	01	10	17	05	MIN	237

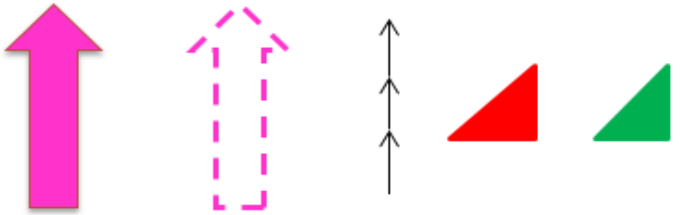
❖ Revision of S-111 Surface Current Product Specification

- ➢ Current version: Proposed Working Draft 1.5
- ➢ Major points: Portrayal, Data format, Metadata
- ➢ Data sources: Historical observation, Real-time observation, Astronomical prediction and Model-based prediction.

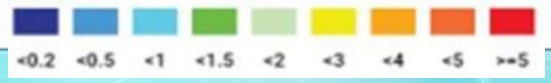
abbreviations
al = arrow length
mintw = min tail width
maxtw = max tail width
hs = head start
maxhw = max head width
minhw = 0
*note: the head narrows to a point where minhw = 0

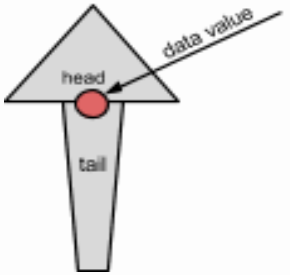
al = 1 unit of measure
mintw = al*.1
maxtw = 2*mintw
hs = al*.65
maxhw = al*.4





Step	Red	Green	Blue	Step	Red	Green	Blue
1	118	82	226	6	205	193	0
2	72	152	211	7	248	167	24
3	97	203	229	8	247	162	157
4	109	188	69	9	255	30	30
5	180	220	0				





Background	Alpha
Satellite	1.0
RNC	1.0
ENC Day	1.0
ENC Dusk	.4
ENC Night	.2

❖ Revision of S-111 Surface Current Product Specification

- ➢ Current version: Proposed Working Draft 1.5
- ➢ Major points: Portrayal, Data format, Metadata
- ➢ Data sources: Historical observation, Real-time observation, Astronomical prediction and Model-based prediction.

Metadata Block
Metadata for Time 1
Surface current speed at Time 1
Surface current direction at Time 1
Optional data at Time 1
Metadata for Time 2
Surface current speed at Time 2
Surface current direction at Time 2
Optional data at Time 2

N	DESCRIPTION	LENGTH	EXAMPLE
1	Country Code	2	CA
2	Geographic Designator	4	GSTL
3	First Valid Time (YYYYMMDD)	8	20140611
4	Data Source (O=Obs, F=Fcst, P=Pred)	1	F
5	Version (first=a1,second=a2, etc, up to z9)	2	a3
6	Extension	4	.sfc
	Total =	21	

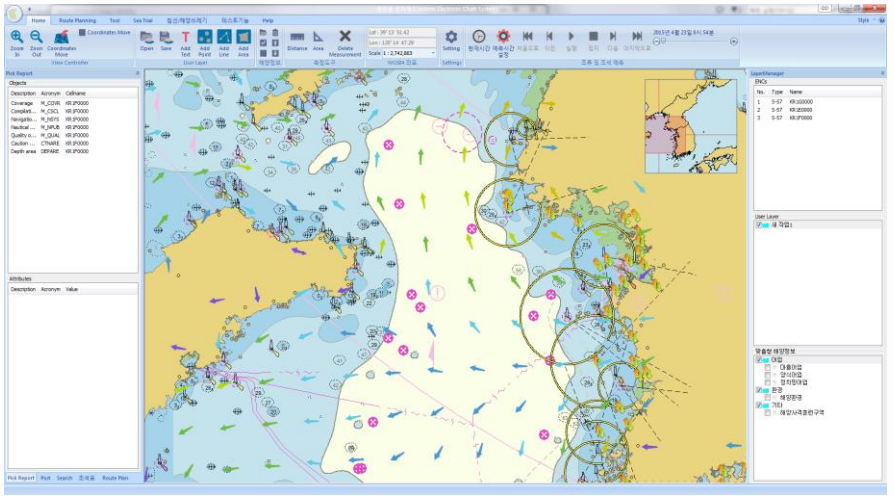
CAGSTL20140611Fa3.sfc

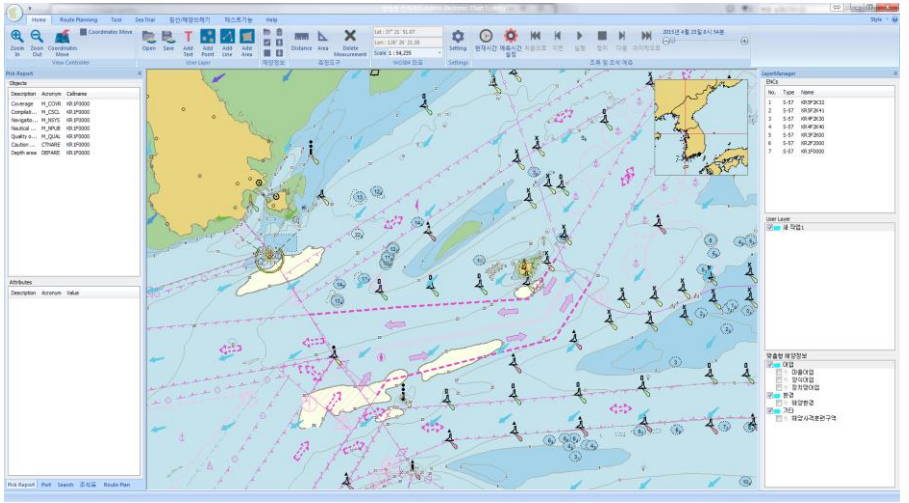
USTAMP20141202Fa2.sfc

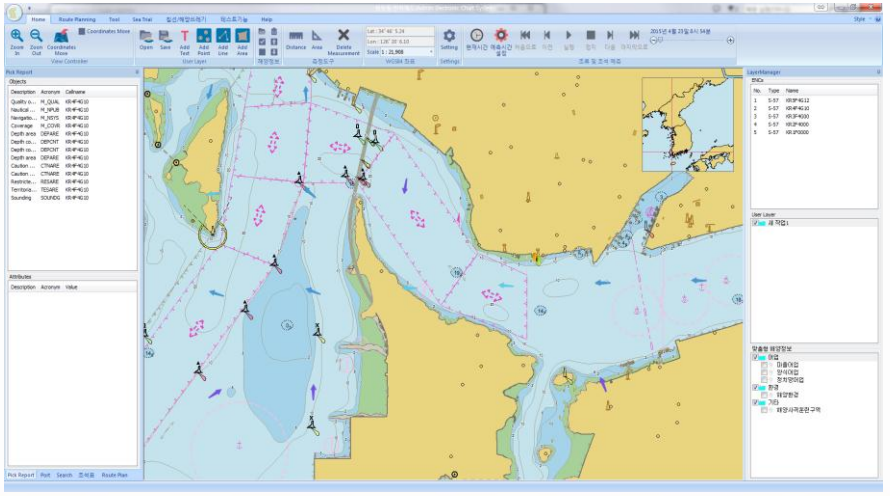
N	DESCRIPTION	UNITS	DATA TYPE	PROPOSED VARIABLE NAME
1	Country of Origin	NA	CodeList	Country
2	Primary Producing Agency Information	NA	CodeList	Producing_Agency
3	Secondary Producing Agency Information	NA	Text	Secondary_Agency
4	Name of Geographic Region	NA	Text	Geographic_Region
5	Name of Geographic Subregion	NA	Text	Geographic_Subregion
6	Minimum Longitude of Area	Arc Degrees	Real	West_Bound_Long
7	Maximum Longitude of Area	Arc Degrees	Real	East_Bound_Long
8	Minimum Latitude of Area	Arc Degrees	Real	South_Bound_Lat
9	Maximum Latitude of Area	Arc Degrees	Real	North_Bound_Lat
10	Time of Data Product Production	Y,M,D,H,M,S	Date-Time	T_product
11	Valid Time of First Value	Y,M,D,H,M,S	Date-Time	T_valid1
12	Valid Time of Last Value	Y,M,D,H,M,S	Date-Time	T_valid2
13	Number of Individual Time Values	None	Integer	K_Sets
14	Data Type (1=historical obs, 2=real-time observation, 3=astronomical prediction, 4=analysis, 5=hindcast, 6=forecast)	None	Enumeration	Index_Data_Type
15	Name of Station or Grid	NA	Text	-
16	Methodology: instrument or model	NA	Text	-
17	Grid Origin Longitude	Arc Degrees	Real	Origin_Longitude
18	Grid Origin Latitude	Arc Degrees	Real	Origin_Latitude
19	Grid Spacing Longitudinal	Arc Degrees	Real	Delta_Longitude
20	Grid Spacing Latitudinal	Arc Degrees	Real	Delta_Latitude
21	Land Mask/Missing Data Value (e.g., -1.0)	(Varies)	Real	Land_Mask_Value
22	Index for Layer Averaging or Depth of Current (1=layer, 2=depth below surf, 3=depth below fixed datum)	None	Enumeration	Index_Depth_Ref
23	Layer Thickness (if above index=1) or Depth of Current Below Datum (if above index=2,3)	Meters	Real	Surcur_Depth
24	Datum for Surface Elevation (if above index=3, then 0=unk, 1=LAT, 2=MLLW, 3=bottom, etc.)	None	Enumeration	Index_SurfDatum
25	Index for Surface Elevation (0=no,1=array)	None	Enumeration	Index_Surface_Elev
26	Datum for Surface Elevation (if above index=1, then 0=unk, 1=LAT, 2=MLLW, 3=bottom, etc.)	None	Enumeration	Index_ElevDatum
27	Horizontal Position Uncertainty	Meters	Real	Unc_Horizpos
28	Vertical Position Uncertainty	Meters	Real	Unc_Vertpos
29	Data Uncertainty Index (0=unk,1=const, 2=array)	None	Enumeration	Index_Data_Uncert
30	Speed Uncertainty Constant Value (Optional)	Meters	Real	Unc_Speed
31	Direction Uncertainty Constant Value (Optional)	Arc Degrees	Real	Unc_Direction

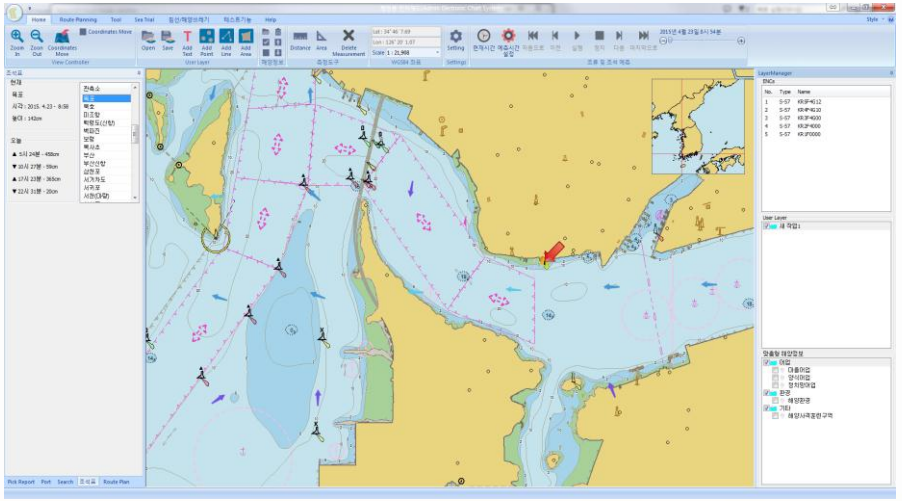
❖ Ongoing status of S-11 Test-bed S/W

- ➢ Portrayal results on the current version of S-111



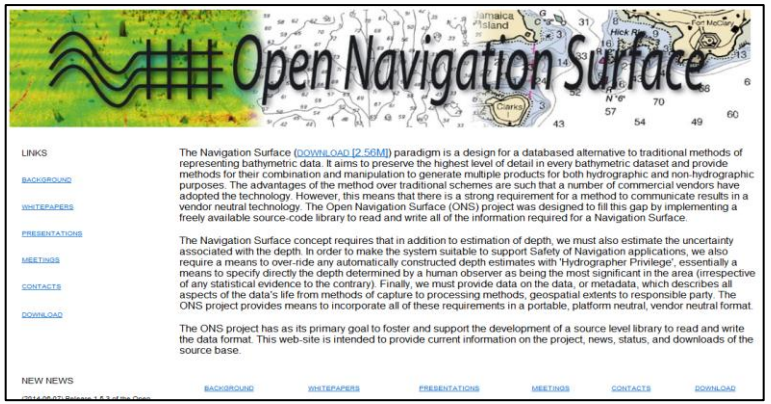


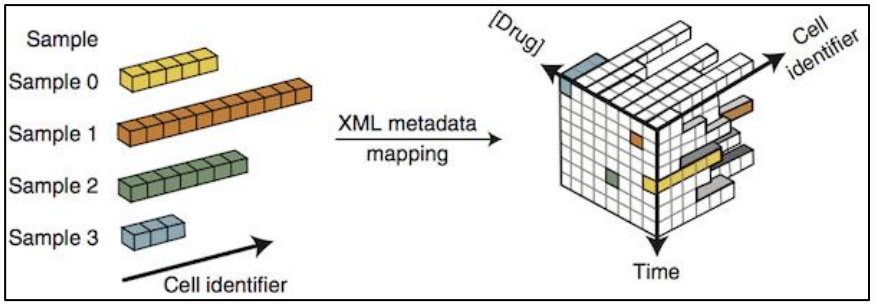


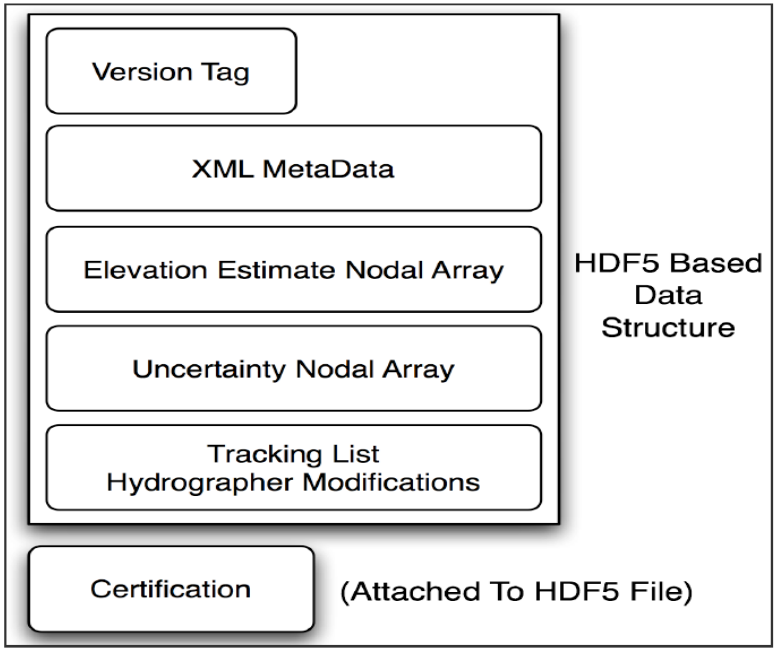


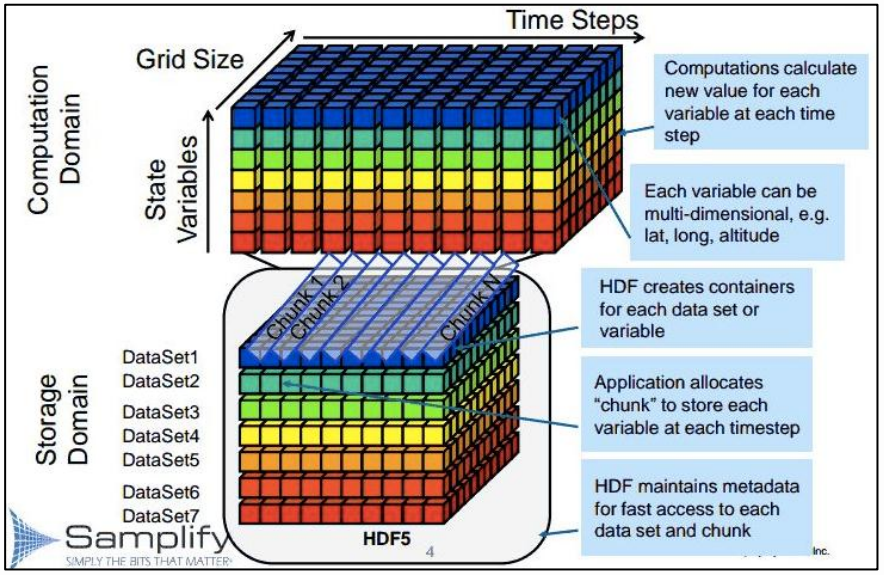
❖ Ongoing status of S-11 Test-bed S/W

- ➢ Data results on the current version of S-111





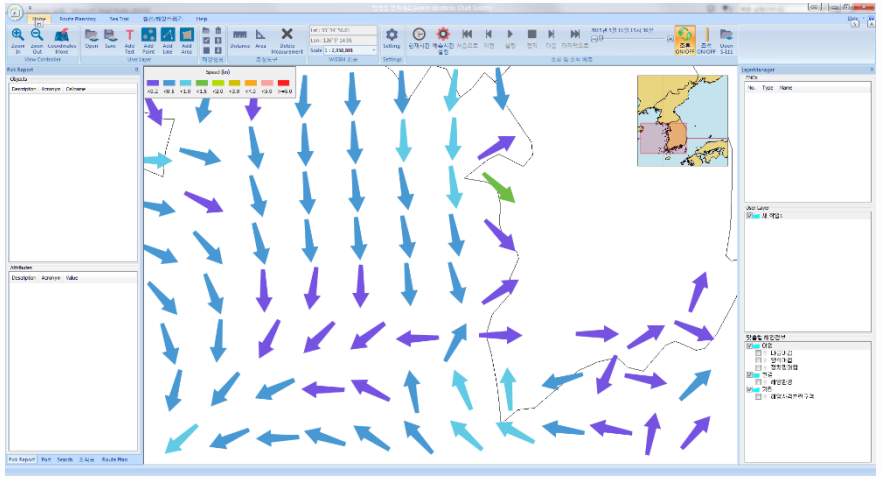


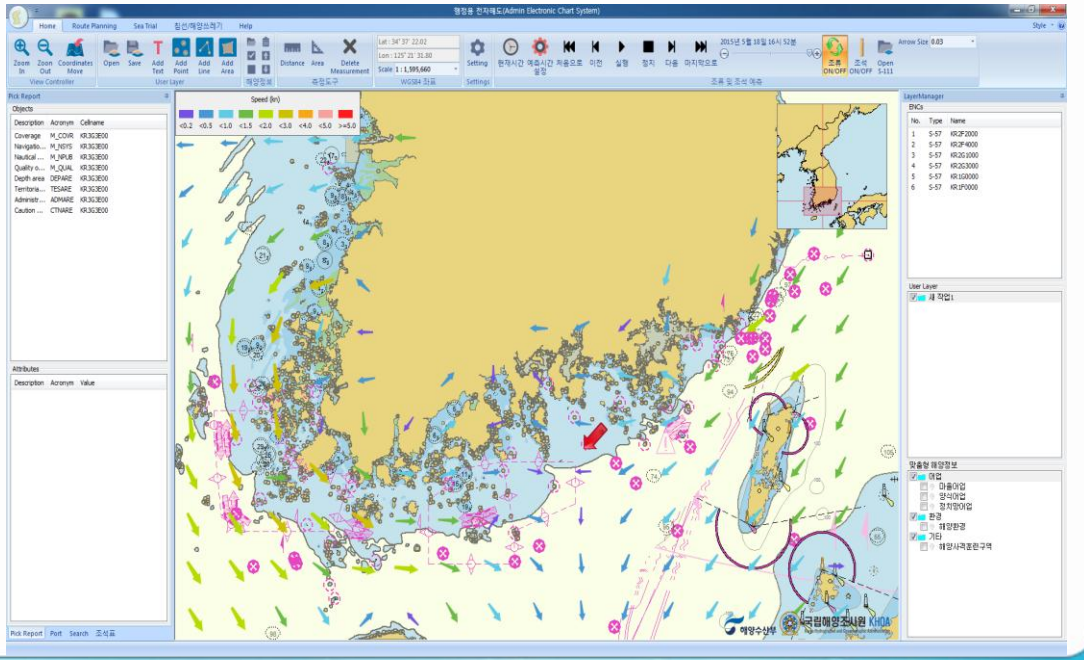


❖ Portrayal issue(1): Arrow size

- Max size of Arrow is calculated in the dataset → Different region has different arrow size
- Option 1 : S_{max} from datasets (Arrow size can be different per time or regions)
- Option 2 : Fixed S_{max} by S-111 (Arrow size is always same, can be less efficient)

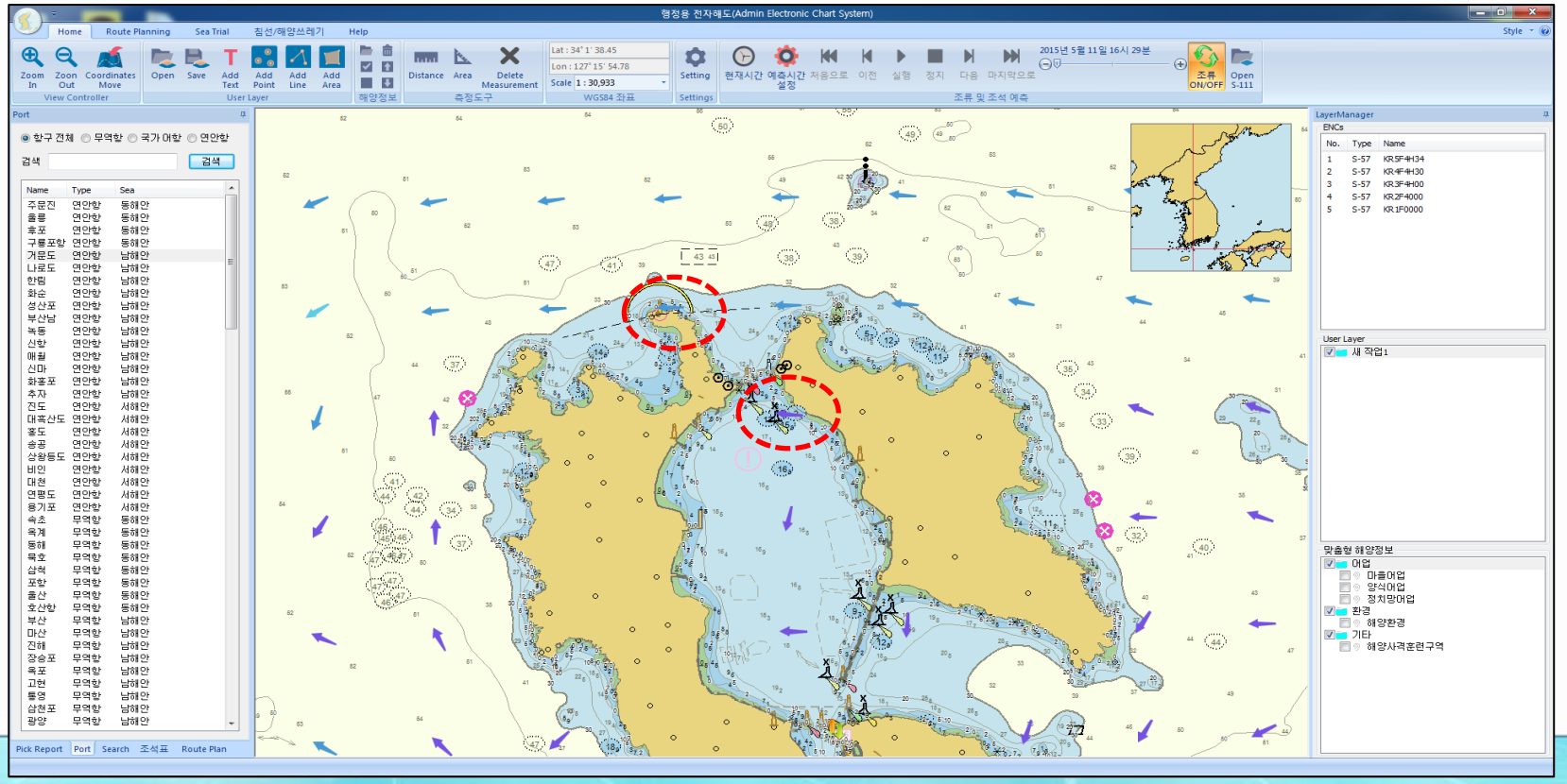
$$cS'_{max} = 0.05w, \quad c = 0.05w/S'_{max}$$





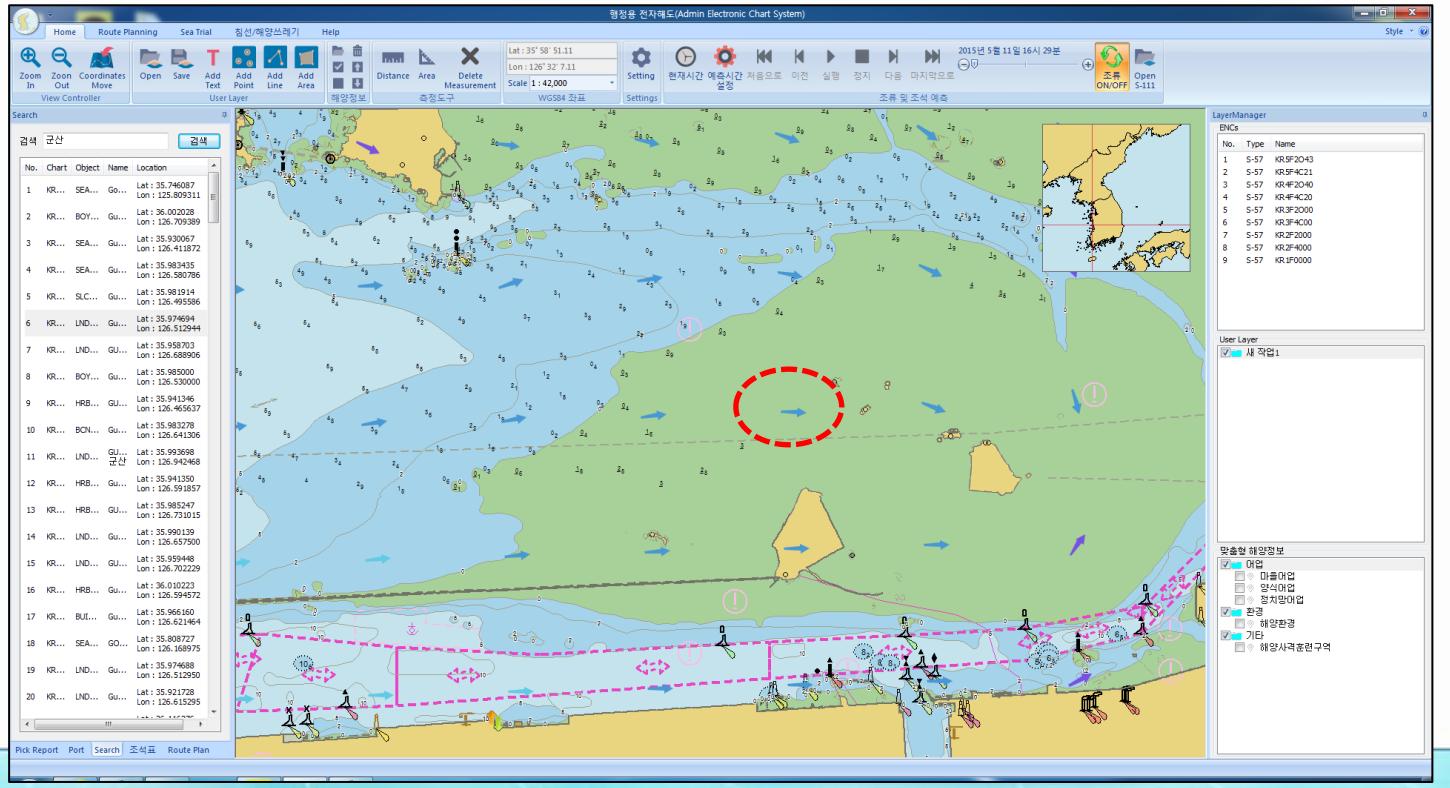
❖ Portrayal issue(2): Symbol Overlap between ENC and Surface Current

- ➢ ENC symbols and Surface current arrows can be overlapped at specific MSVS(Mariners Selected Viewing Scale)
- ➢ Overlapping avoidance algorithm or process needs to be considered to avoid overlaps in terms of datasets integration.



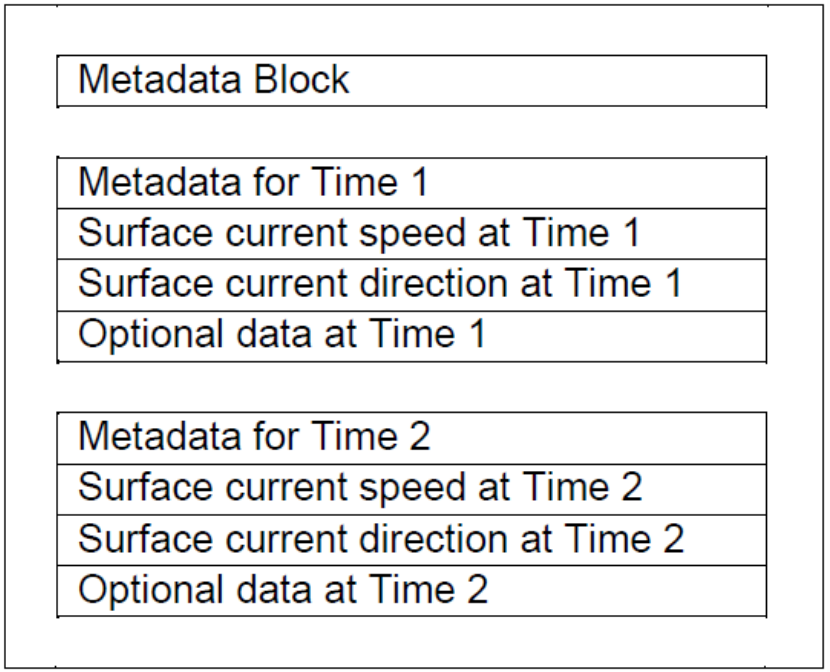
❖ Portrayal issue(3): Surface current symbol in the intertidal zone

- Surface current symbol by computational models can be always shown in intertidal zone. If there is not water in intertidal zone, surface current arrow is needed to be disappeared.
- Digital tidal table or dynamic water level can be considered to be used together



❖ Data format issue: Metadata Schema of Metadata block and Time block

- ➢ All metadata schema need to be provided to make S-111 datasets



N	DESCRIPTION	UNITS	DATA TYPE	PROPOSED VARIABLE NAME
1	Country of Origin	NA	CodeList	Country
2	Primary Producing Agency Information	NA	CodeList	Producing_Agency
3	Secondary Producing Agency Information	NA	Text	Secondary_Agency
4	Name of Geographic Region	NA	Text	Geographic_Region
5	Name of Geographic Subregion	NA	Text	Geographic_Subregion
6	Minimum Longitude of Area	Arc Degrees	Real	West_Bound_Long
7	Maximum Longitude of Area	Arc Degrees	Real	East_Bound_Long
8	Minimum Latitude of Area	Arc Degrees	Real	South_Bound_Lat
9	Maximum Latitude of Area	Arc Degrees	Real	North_Bound_Lat
10	Time of Data Product Production	Y,M,D,H,M,S	Date-Time	T_product
11	Valid Time of First Value	Y,M,D,H,M,S	Date-Time	T_valid1
12	Valid Time of Last Value	Y,M,D,H,M,S	Date-Time	T_valid2
13	Number of Individual Time Values	None	Integer	K_Sets
14	Data Type (1=historical obs, 2=real-time observation, 3=astronomical prediction, 4=analysis, 5=hindcast, 6=forecast)	None	Enumeration	Index_Data_Type
15	Name of Station or Grid	NA	Text	-
16	Methodology: instrument or model	NA	Text	-
17	Grid Origin Longitude	Arc Degrees	Real	Origin_Longitude
18	Grid Origin Latitude	Arc Degrees	Real	Origin_Latitude
19	Grid Spacing Longitudinal	Arc Degrees	Real	Delta_Longitude
20	Grid Spacing Latitudinal	Arc Degrees	Real	Delta_Latitude
21	Land Mask/Missing Data Value (e.g., -1.0)	(Varies)	Real	Land_Mask_Value
22	Index for Layer Averaging or Depth of Current (1=layer, 2=depth below surf, 3=depth below fixed datum)	None	Enumeration	Index_Depth_Ref
23	Layer Thickness (if above index=1) or Depth of Current Below Datum (if above index=2,3)	Meters	Real	Surcur_Depth
24	Datum for Surface Elevation (if above index=3, then 0=unk, 1=LAT, 2=MLLW, 3=bottom, etc.)	None	Enumeration	Index_SurfDatum
25	Index for Surface Elevation (0=no,1=array)	None	Enumeration	Index_Surface_Elev
26	Datum for Surface Elevation (if above index=1, then 0=unk, 1=LAT, 2=MLLW, 3=bottom, etc.)	None	Enumeration	Index_ElevDatum
27	Horizontal Position Uncertainty	Meters	Real	Unc_Horizpos
28	Vertical Position Uncertainty	Meters	Real	Unc_Vertpos
29	Data Uncertainty Index (0=unk,1=const, 2=array)	None	Enumeration	Index_Data_Uncert
30	Speed Uncertainty Constant Value (Optional)	Meters	Real	Unc_Speed
31	Direction Uncertainty Constant Value (Optional)	Arc Degrees	Real	Unc_Direction

Thank you