

Project Reference

# Construct tide observation record DB

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\_\_\_Contents ;



# I. Overview

1. Korean Tide Observation
2. Background and purpose
3. Scope and Schedule

# II. DB construction Steps

1. DB Construction Processes
2. Step 1 : Scanning
3. Step 2 : Digitizing
4. Step 3 : Inspection

# III. Achievements



[Fig.1] National Marine Observation Network

## ❖ Tide observation status

- ✓ Mokpo is the first tidal station built in 1952 (in Korean war), and now 44 tidal stations are in operation
  - West coast : 19 (Mokpo, Daeheuksando, Youngkwang etc.)
  - South coast : 17 (Busan, Kaduckdo, Masan, etc.)
  - East coast : 8 (Sokcho, Mukho, Ullengdo etc.)
- ✓ Both analog and digital tide observation equipment are in use complementary since 2003 at every tidal station.
- ✓ Tidal Data can be accessed on the web and the ARS

### ❖ Purpose for the Project

- ✓ Construct the basis of various utilization on the tide observation record
- ✓ Digitize One minute value from analog tide record paper

### ❖ Background of the Project

- ✓ Needs for a permanent preservation of historical tidal records by Digitization
- ✓ Needs for a historical tide level data Service to the public and the organization.
- ✓ Needs for precise back data for the statistics to trace Sea Level Changes
- ✓ Needs for improved utilization of tide level data

## ❖ Scope of the project

### ✓ Record amount

Coast	No. of Station	Amount		Digitized Data Count
		Books	Pages	
West Coast	14	254	83,666	120,479,040
South Coast	17	393	134,131	193,148,640

- ✓ 31 Tidal Stations produced 647 books, 217,797 pages(days) of tide records were found
- ✓ Total 1 min. Data : 313,627,680

## ❖ Project Terms

- ✓ July 2009 ~ Dec. 2009 (6 Months)

**\_\_\_Contents ;**

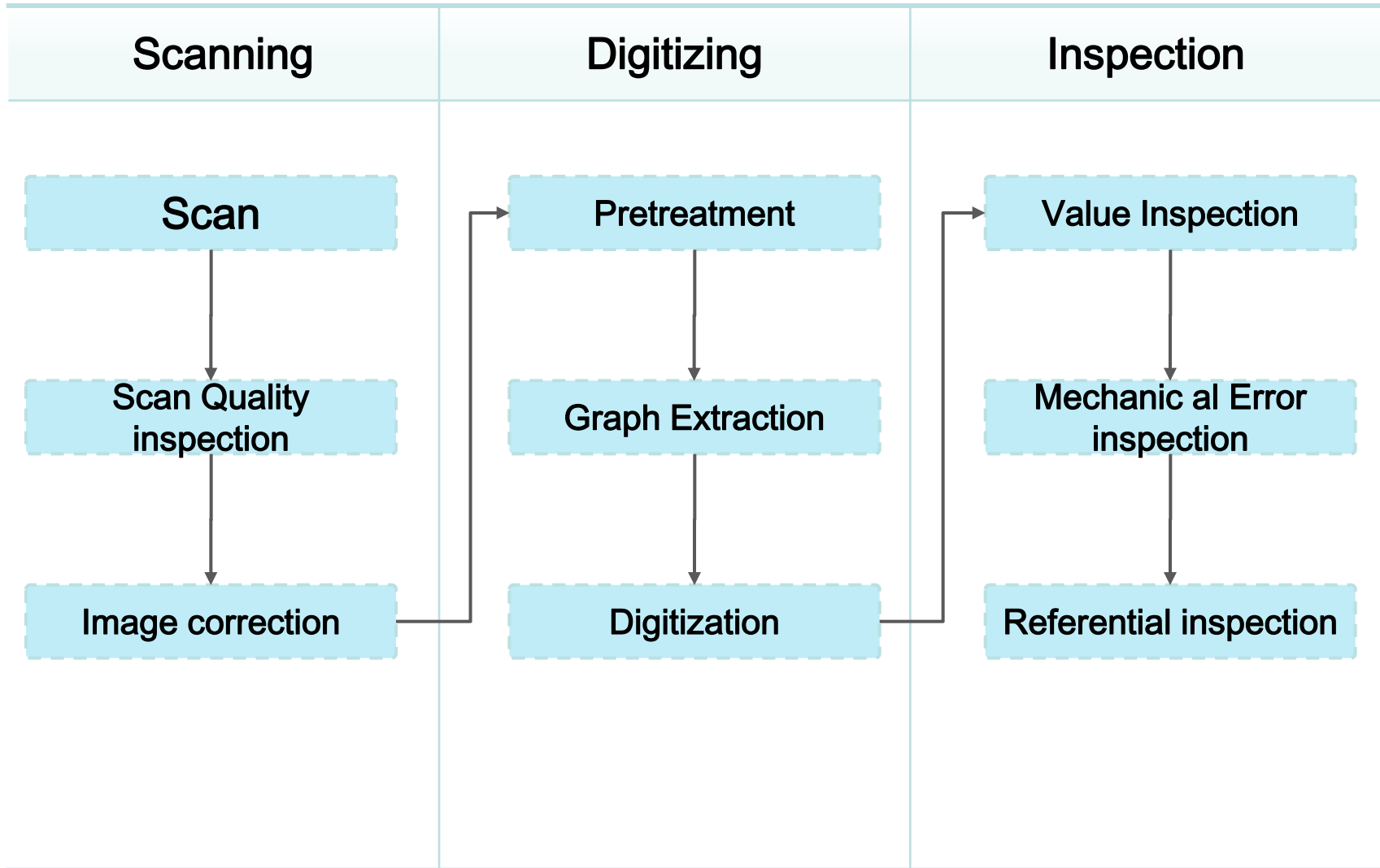
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## ❖ Preparation of scanning

## ✓ Classification by Paper Size

34 types of paper size were classified by the specification of recording paper.

Code	Size	Code	Size	Code	Size	Code	Size	Code	Size	Code	Size
<b>A0</b>	1189 X 841	<b>A7</b>	509 X 130	<b>B4</b>	378 X 248	<b>C1</b>	291.8 X 118	<b>C7</b>	35.6 X 23	<b>D4</b>	36 X 25
<b>A1</b>	841 X 594	<b>A8</b>	26 X 11.5	<b>B5</b>	335 X 216	<b>C2</b>	291.8 X 126	<b>C8</b>	34.32 X 24.52	<b>D5</b>	36.22 X 24.54
<b>A2</b>	480 X 350	<b>A9</b>	299.5 X 140	<b>B6</b>	36.22 X 24.54	<b>C3</b>	291.8 X 130	<b>C9</b>	37 X 65.5	<b>D6</b>	29.18 X 13
<b>A3</b>	480 X 250	<b>B1</b>	570 X 332	<b>B7</b>	26.84 X 18.22	<b>C4</b>	300 X 115	<b>D1</b>	26 X 18	<b>D7</b>	36.22 X 24.54
<b>A4</b>	297 X 210	<b>B2</b>	499.5 X 310	<b>B8</b>	49.5 X 24.5	<b>C5</b>	300 X 120	<b>D2</b>	35 X 24.54		
<b>A6</b>	509 X 186	<b>B3</b>	290 X 150	<b>B9</b>	36.22 X 24.54	<b>C6</b>	304 X 120	<b>D3</b>	45 X 78		

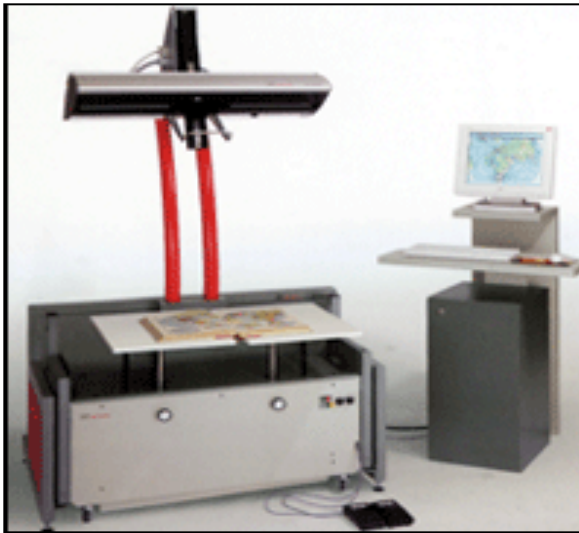


## ❖ Type Reclassification by Properties

- Most used types are A2, A3 (continuous type)

Type classification	Code	Digitizing method	number of type	Amount(day)	%
Large type	A0, A1	<ul style="list-style-type: none"> <li>Digitize after downsizing scan file size as the original is too big.</li> </ul>	2	6,688	3.1
continuous type	A2, A3, A4	<ul style="list-style-type: none"> <li>Digitize after securing 24 hours of tide record are included in each page</li> </ul>	3	145,219	66.7
Individual type	A5, A6, A7, A8, B1, B2, B4, B5, B6, B7, B8, B9, C7, C8, C9, D1, D2, D3, D4, D5	<ul style="list-style-type: none"> <li>Digitize after assigning the code on handwritten scale and record starting time by pages</li> </ul>	20	55,183	25.3
Y-axis curved type	A9, B3, C1, C2, C3, C4, C5, C6, D6	<ul style="list-style-type: none"> <li>Digitize after reconstructing rectangular coordinates by curvature correction of Y-axis curve.</li> </ul>	9	10,107	4.9
Total			34	217,797	100.0

- ❖ Scanners Used
- ✓ 3 types of scanner were used to handle various paper type
- ✓ Overhead, flatbed, Wide format scanner were used



Overhead scanner  
For continuous type

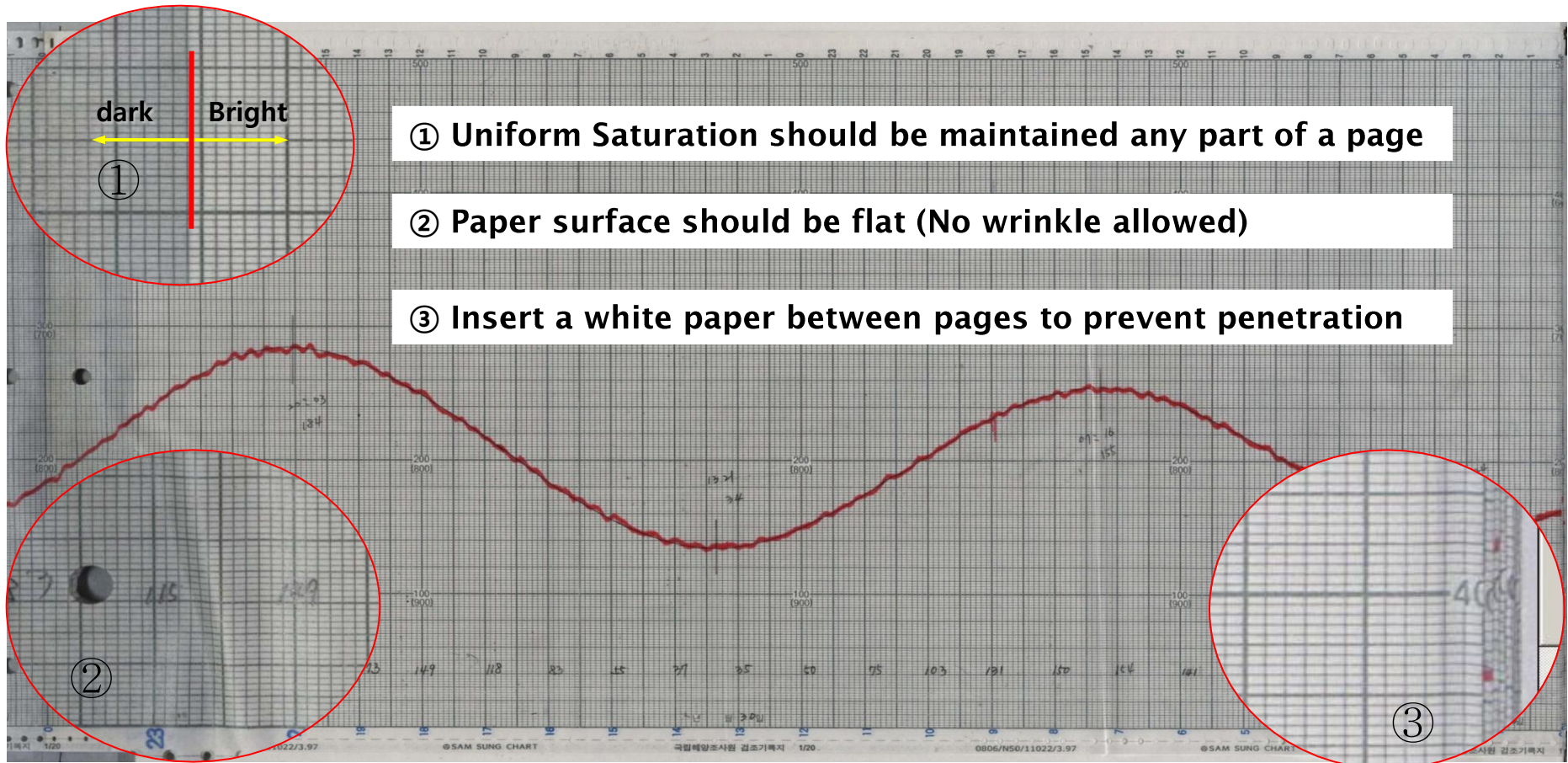


Flatbed scanner  
for individual type

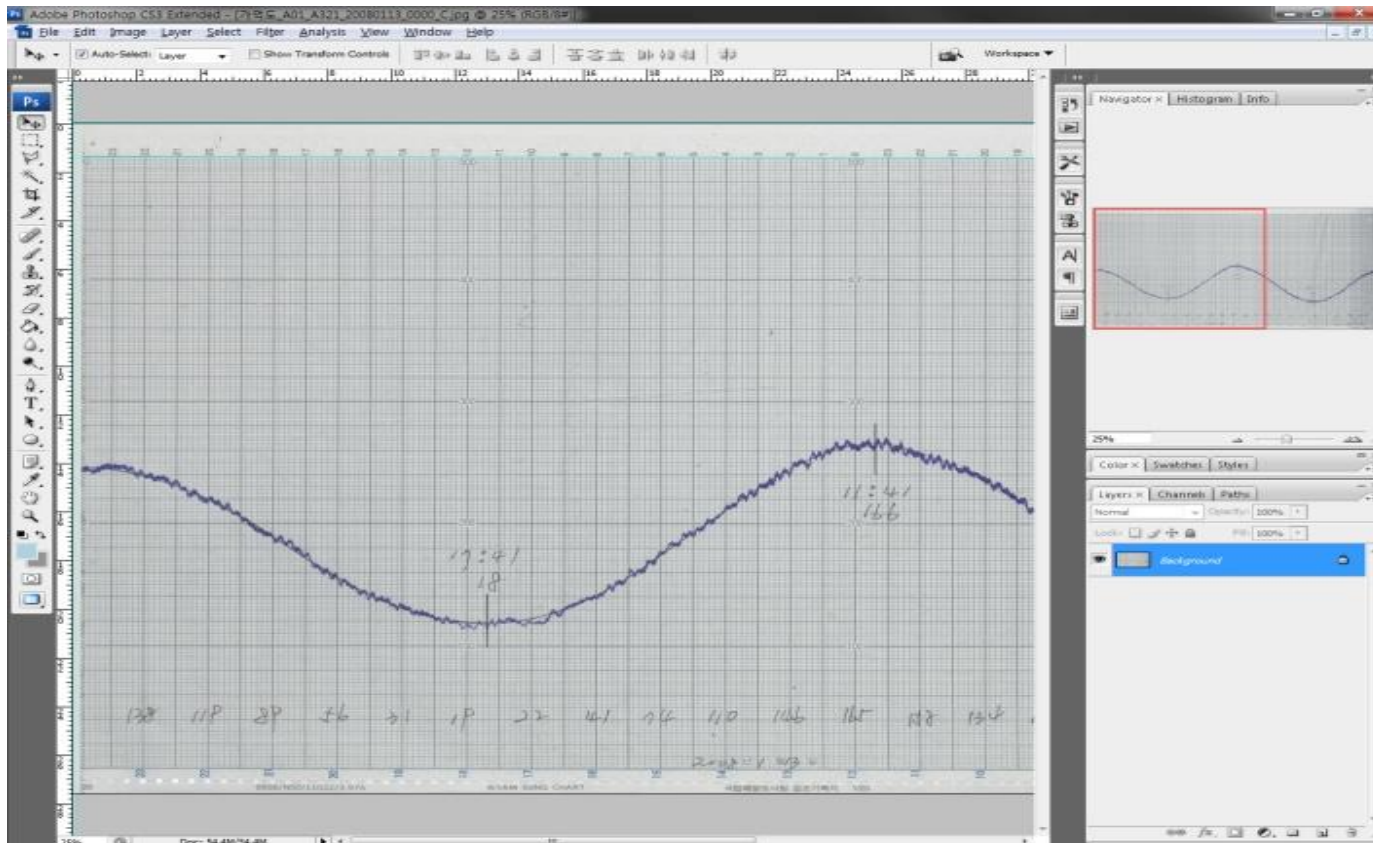


Wide format scanner  
For large type

- ❖ Scan Quality inspection
- ✓ Checking Resolution, Scan Range, whether Partial Stain contains



- ❖ Image correction
  - ✓ According to the scan quality inspection, correct image through Photoshop when needed
  - ✓ If correction unavailable, send back to Scan



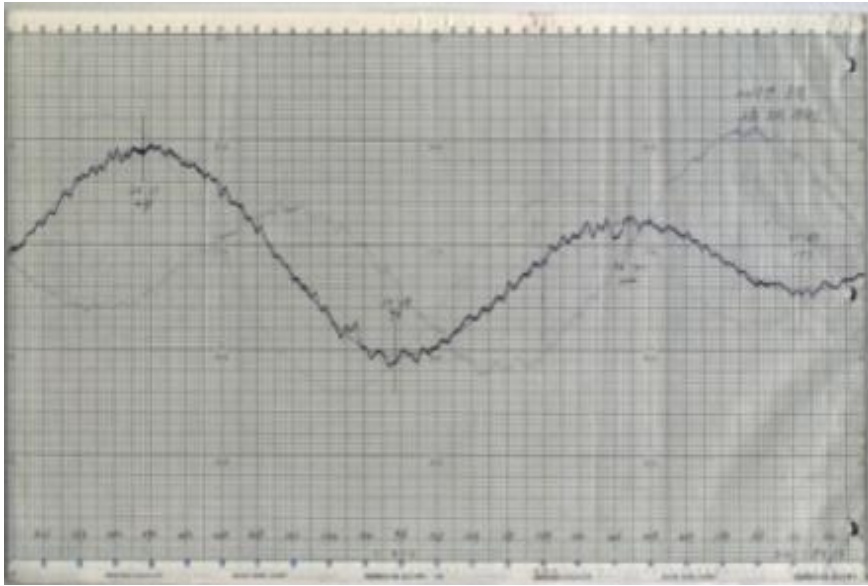
## ❖ Assigning image file name

- ✓ File name includes : Station name, image rating, error status, paper type code, recording direction, scale, date recorded, recording time begins, etc.
- ✓ Meta data can be extracted systematically from the assigned image file name

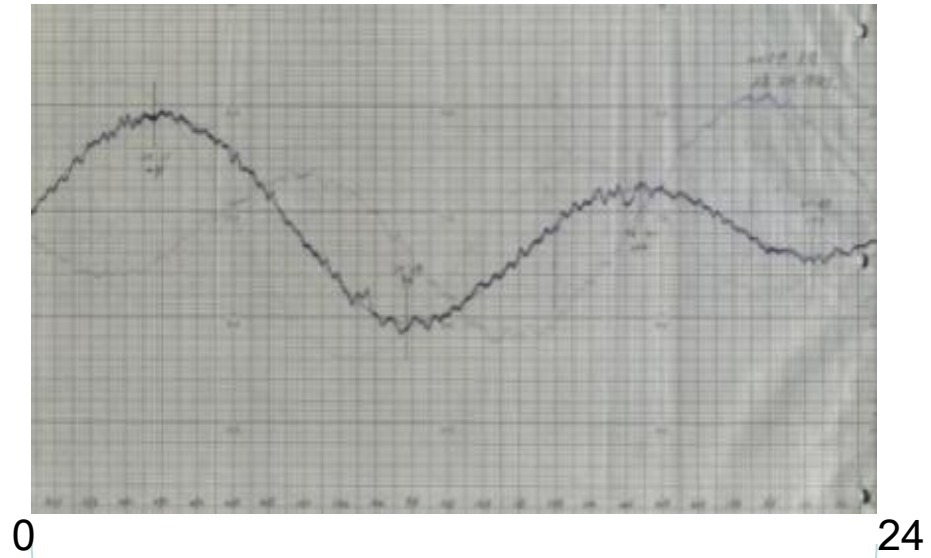
Goheung	_	A 00	_	A3 2 1	_	20041229	_	0000	_	C
tidal station name	-	File rating + error status	-	Paper type code + Recording direction + Scale	-	YYYYMMDD	-	Record time	-	Zero point

- Tidal station name : the station where tide recorded
- File rating : A (Good, Auto digitization), B(Normal, Manual Digitization), C(Bad, Digitization Impossible)
- Error status : Cautions and notifications code have to be considered in Digitization
- Paper type code : 34 Classifications of paper size
- Recording direction : recording direction of time (Left to Right, Right to Left)
- Scale : Assigned code of the cell(grid) size
- Zero point : Location of the value Zero on Y-axis

- ❖ Pretreatment (= Normalization)
  - ✓ Identifying specification and quality condition of scanned images and cut the image precisely fit for digitization (Exactly 24 hours, both tractor area (upper and lower) removed)
  - ✓ Width for the image includes exact 24-hour and Length includes just cell(grid) area of the recording paper.
- ❖ General Normalization



[before] Original image

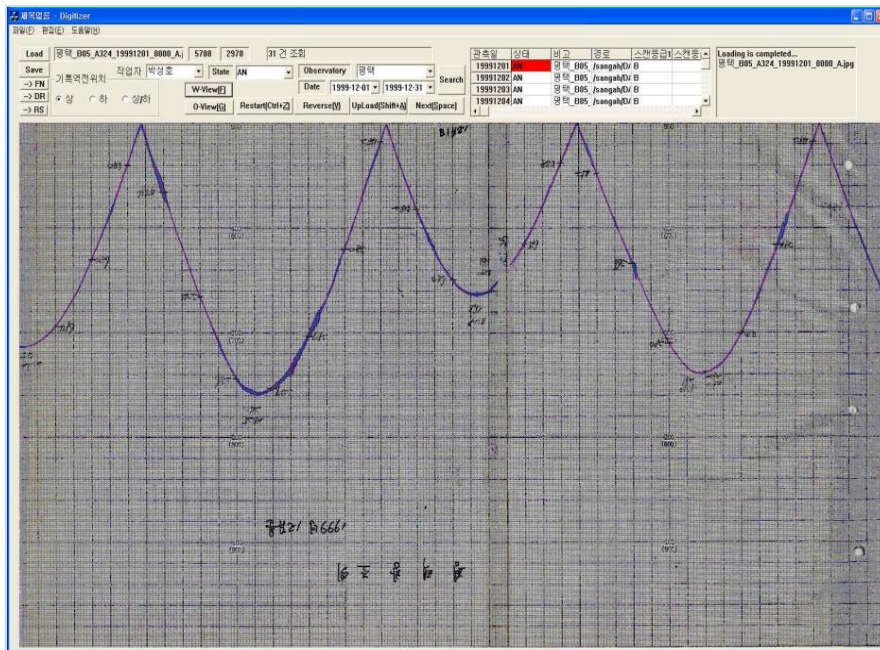


[after] Normalized image

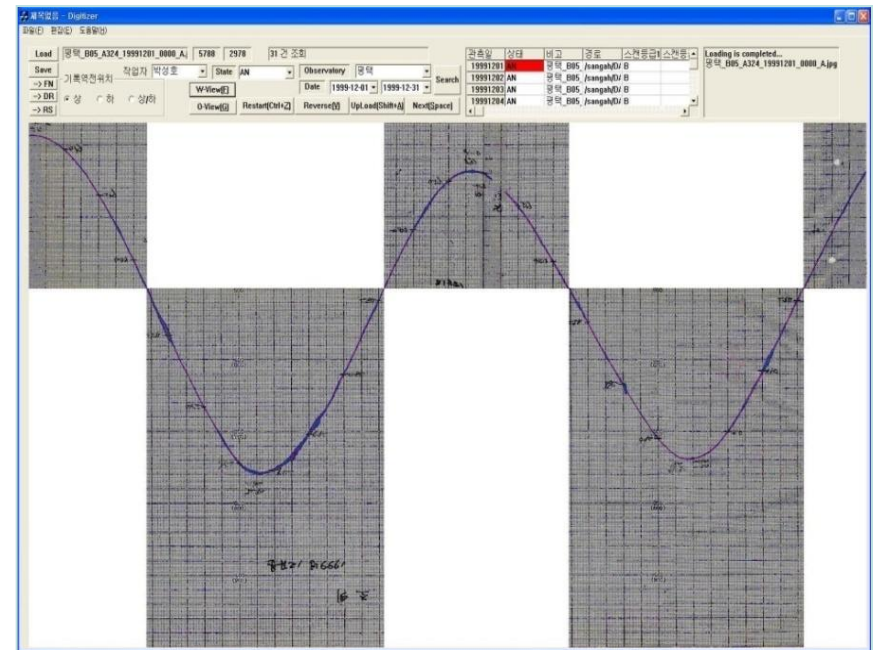
### ❖ Special Normalization

#### ✓ Reverse record normalization

- Manually convert the reversed graph area to normal direction shown below
- Three types of reverse direction records , upper , lower , upper and lower  
(Converting task performed on the normalization system we own made)



[before] upper reverse record

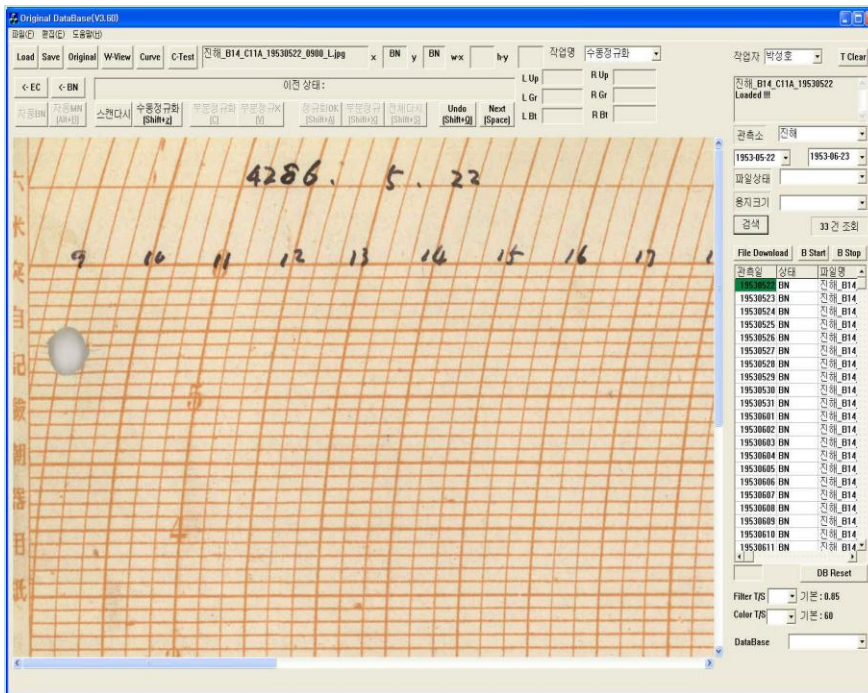


[after] convert to normal direction

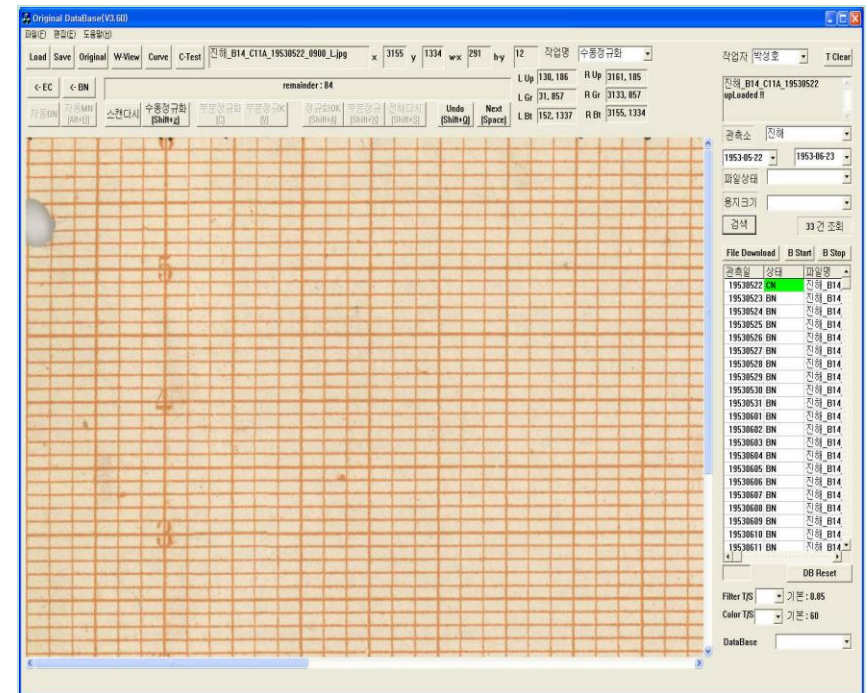
### ❖ Special Normalization

#### ✓ Curved Y-Axis type normalization

- Convert record to rectangular coordinates by curve rate correction
- Convert curve image to straight line image should be performed systematically by reading curve rate information of each paper.



[before] curved Y-Axis paper

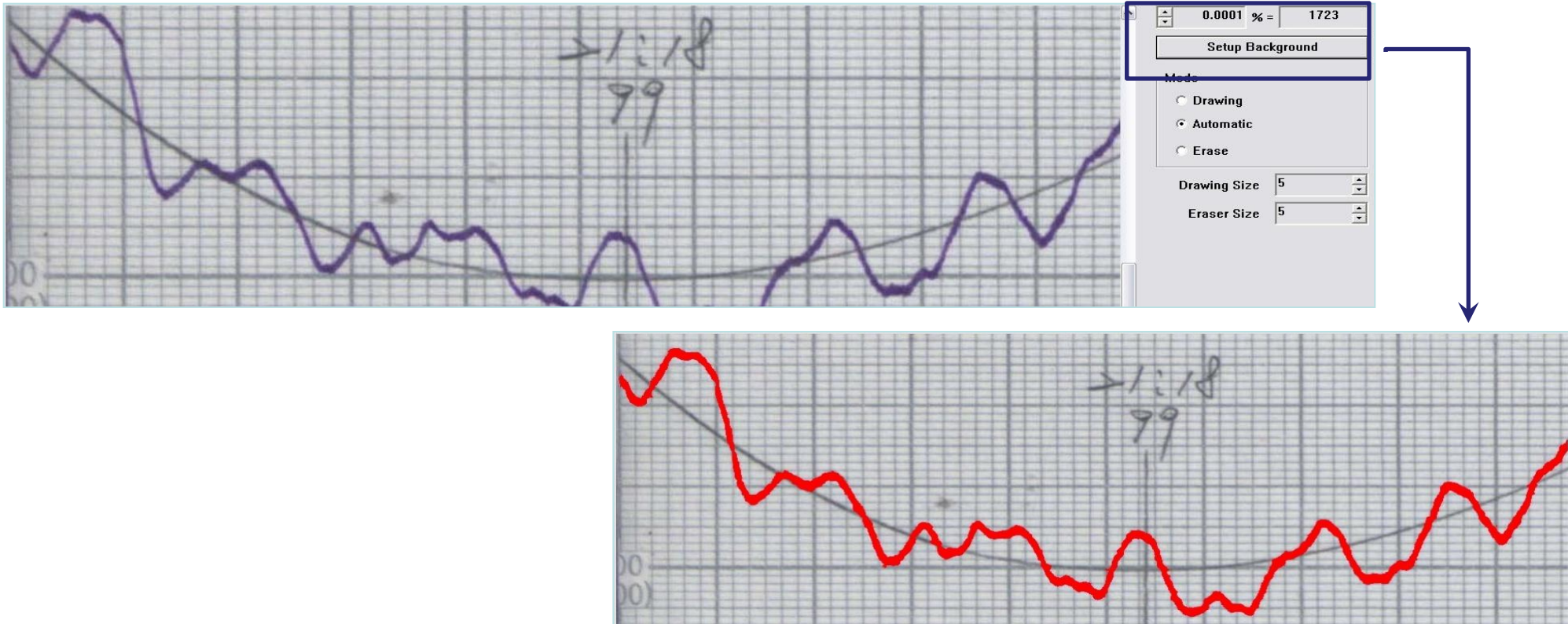


[after] Curve rate correction



## ❖ Graph Extraction

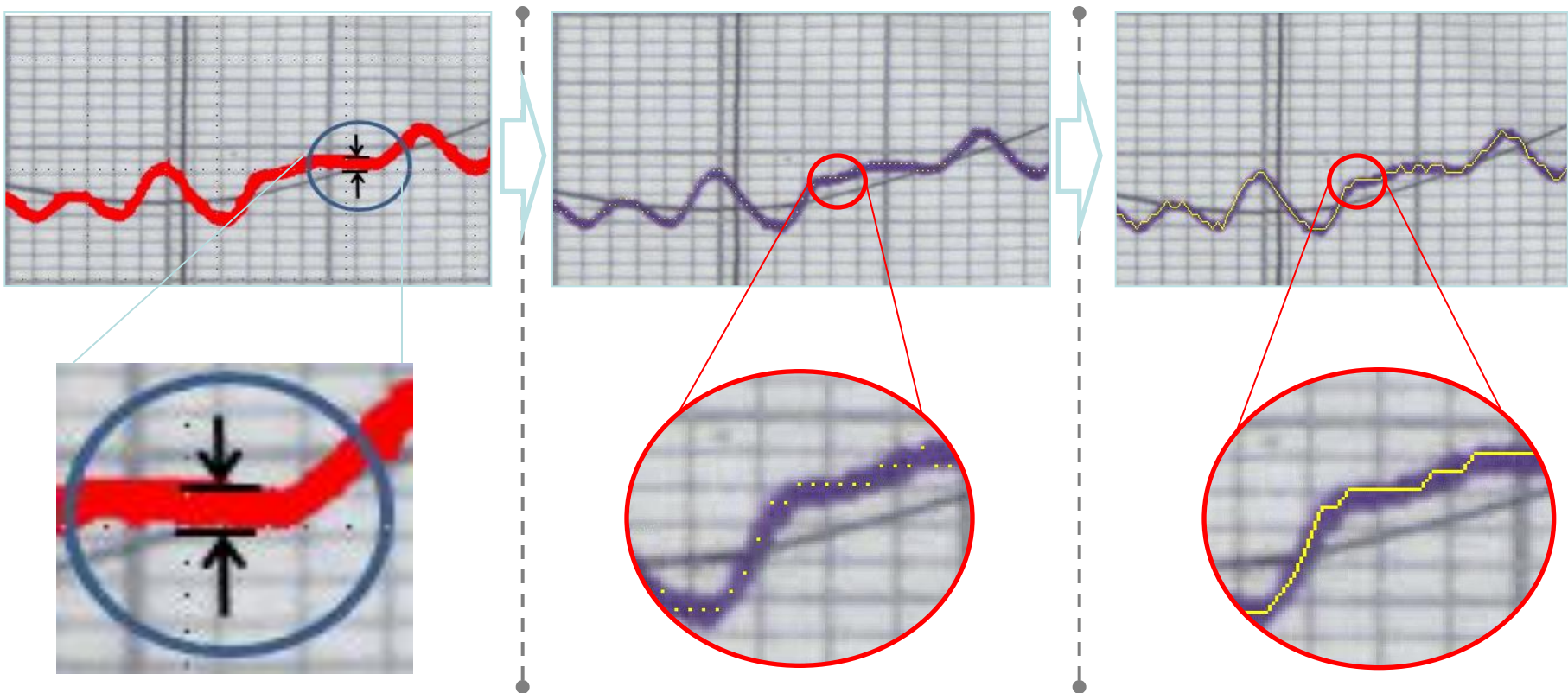
- ✓ Separate the graph from the background using color saturation difference in the image
- ✓ Background color saturation can adjustable from 1 % to 0.0001 %
- ✓ Extract the graph by clicking the graph line.



## ❖ Digitization

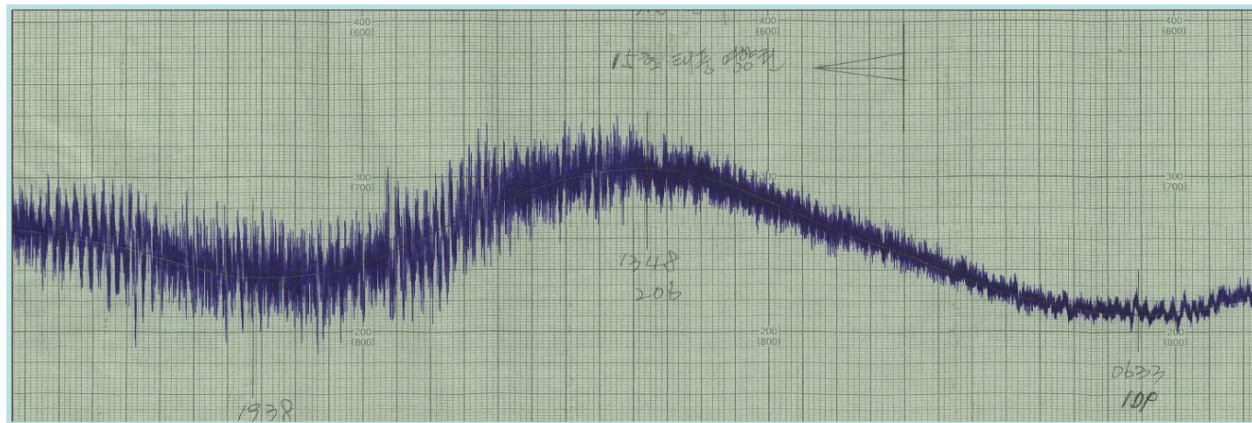
## ✓ Normal (=Meanline) Digitization

- Identify the area of extracted graph
- Digitize the center value from extracted graph for each 1 minute
- Display the digitized value as a line to see if correct

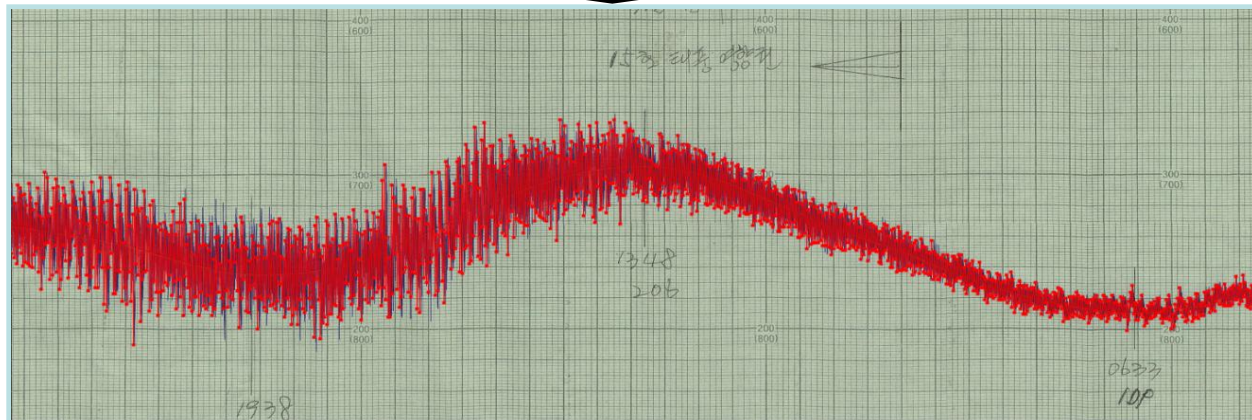


## ✓ Seiche(=Min-Max) Digitization

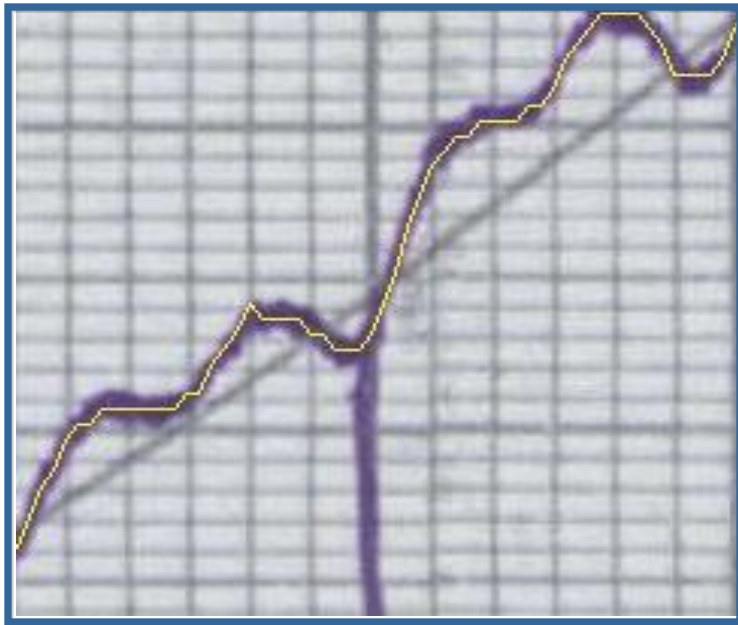
- Seiche's wavelengths are so big and terms are so short that unexpected values were digitized when applying Meanline digitization. Therefore alternative Min-Max value crossing method were developed.
- Digitize by crossing the maximum and minimum value alternatively for each 1 min.



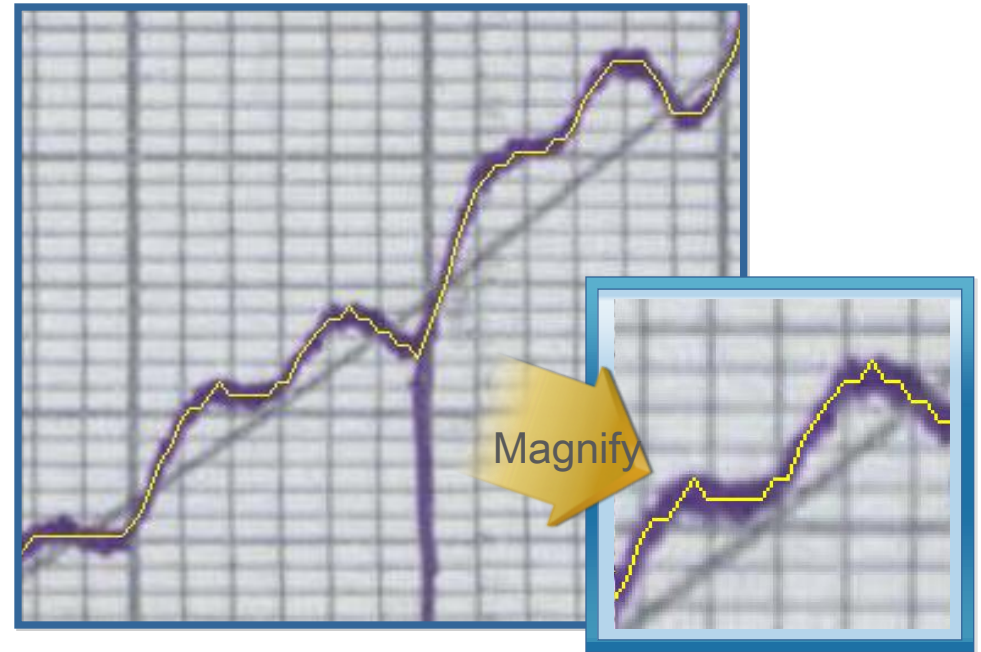
digitizing



- ❖ Value inspection
- ✓ Inspect if digitized values are exactly positioned on the center of their raw graph
- ✓ Retrieve digitized values overlaying with raw image file
- ✓ Check if the deviated parts from record line's trend were removed
- ✓ Modify micro errors by the manual operation

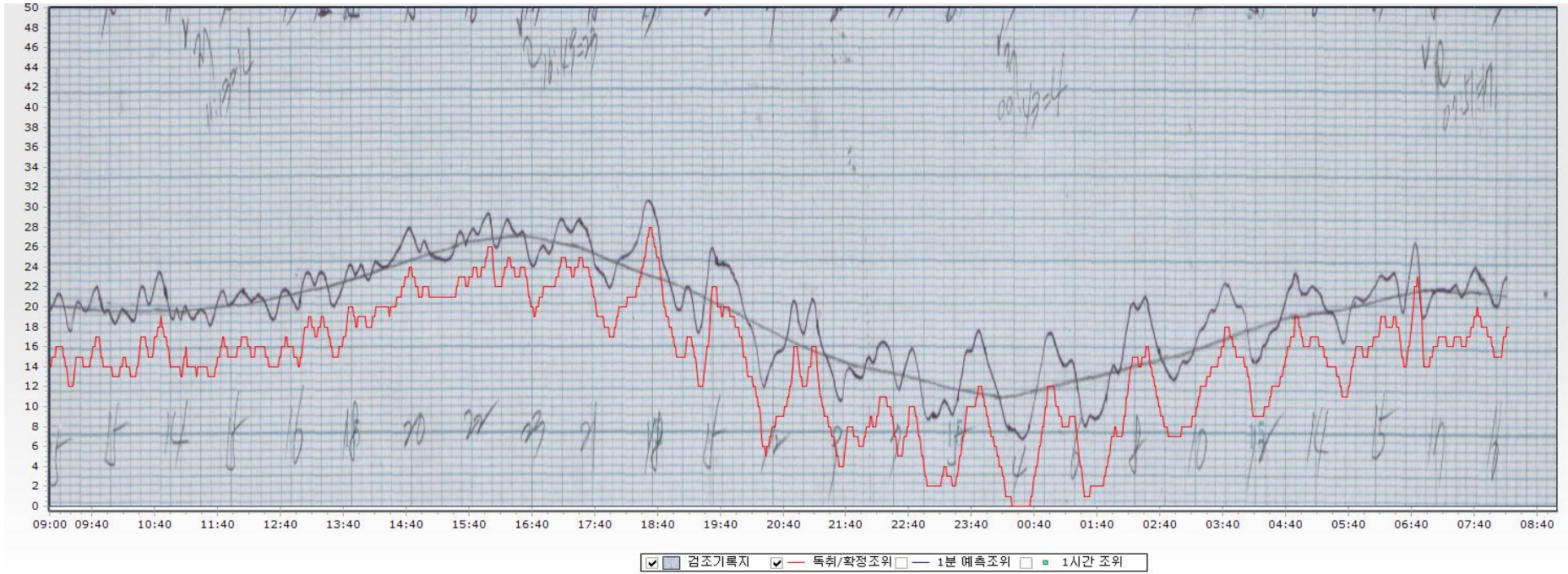


Overlay values on the raw image file



Modifying errors

❖ Value inspection



Discrepancy of raw graph and digitized value

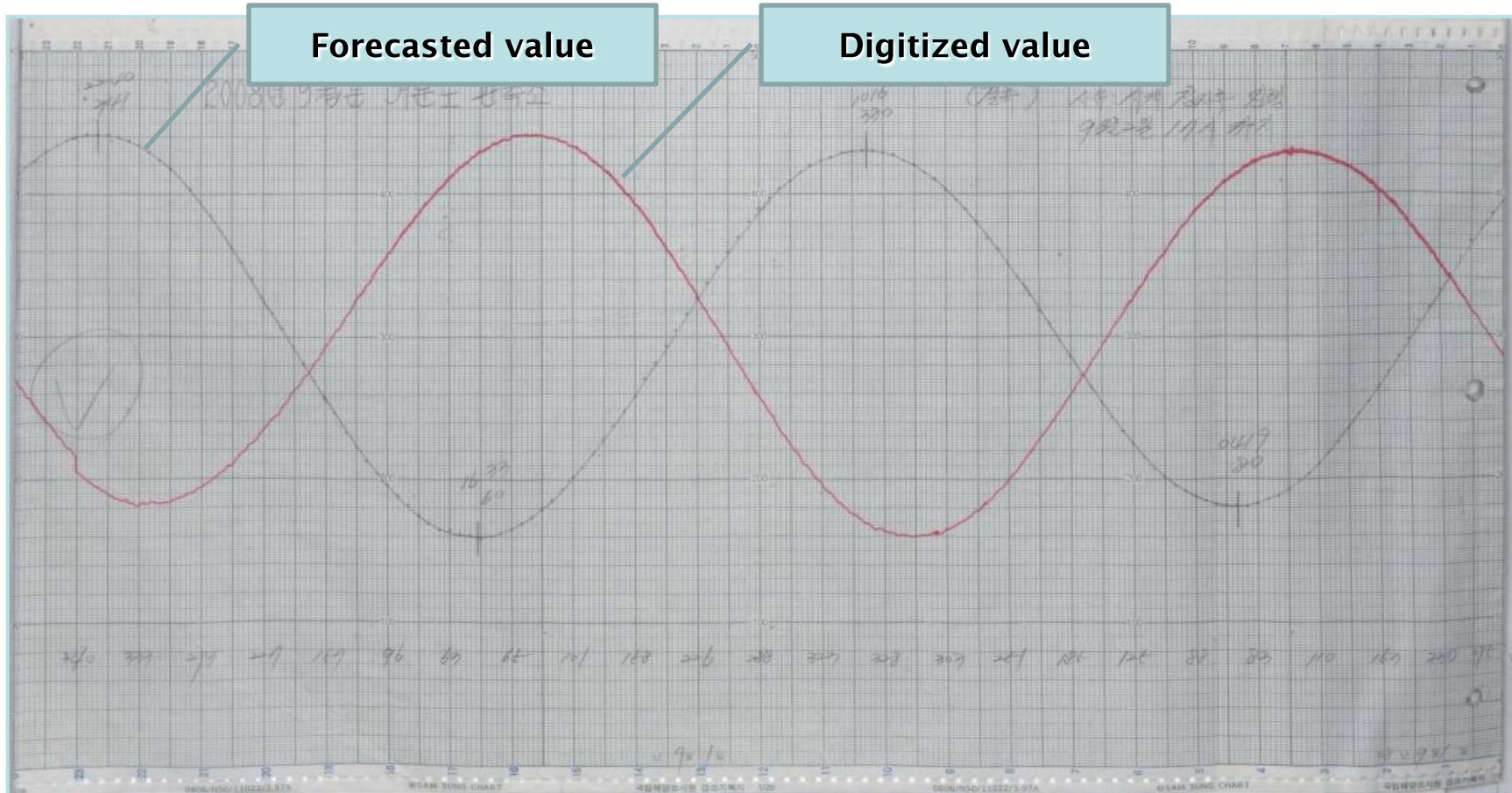
- ❖ Mechanical error inspection
  - ✓ Check if the record includes any mechanical error such as stop functioning or malfunctioning of the equipment
  - ✓ Tagging these errors on the meta data and verify the reason afterward



Short term stop functioning (absence of observation)

## ❖ Mechanical error inspection

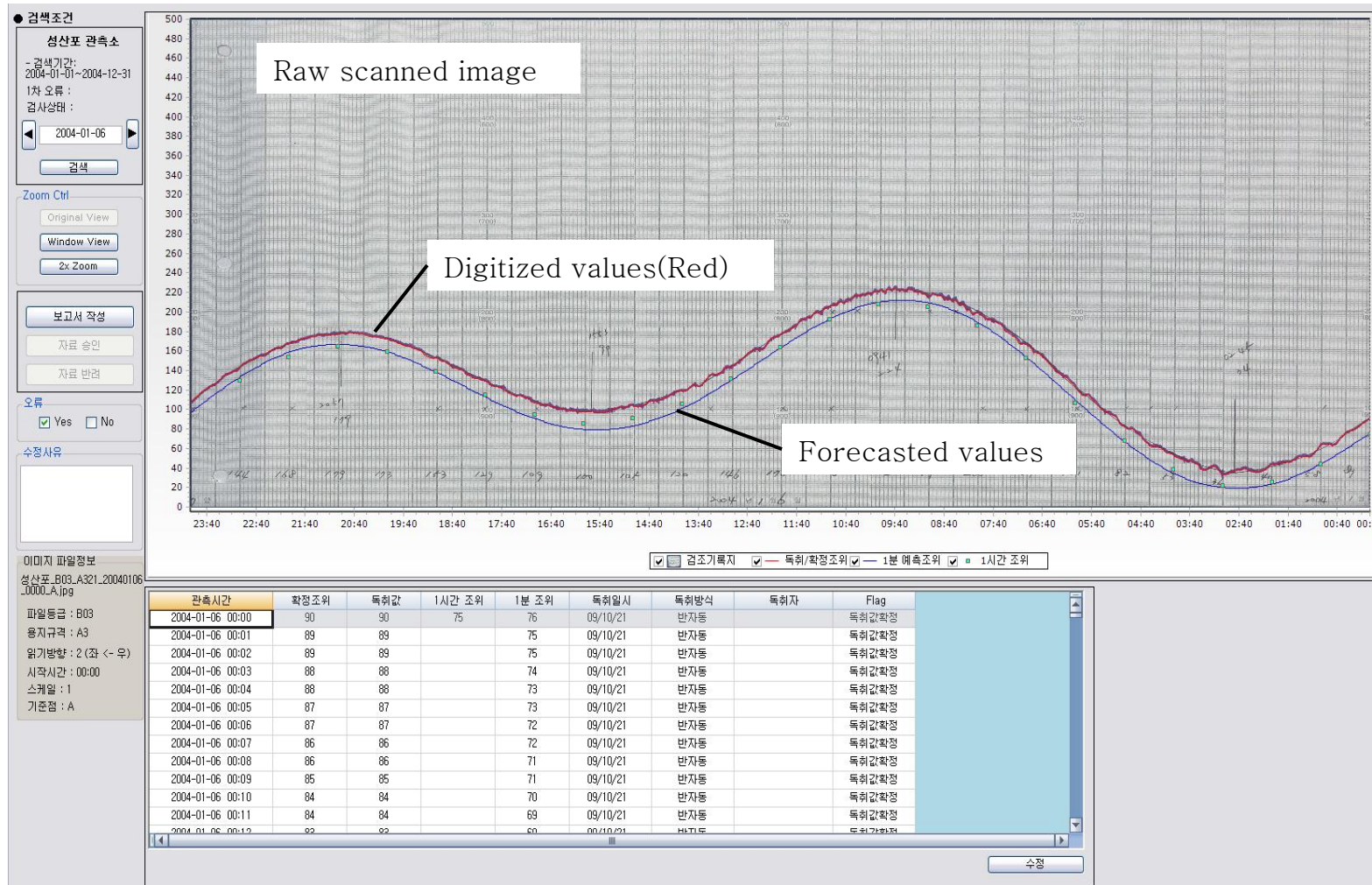
✓ Time shifting occurs when the clock gradually goes slow or fast



Time shifting

# ❖ Referential inspection

✓ Compare digitized data with forecasted data and existing hourly tide data





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### III. Achievements

- ❖ **Expand Coverage of Tidal Information Services**
  - ✓ Historical tide data is provided on the web
  - ✓ Expect significant savings of time and resources for Management , Search, analysis and statistics of tide information
  
- ❖ **Infra for Tidal data utilization constructed**
  - ✓ Expect Increased Information utilization through the Digitization of Analog Tide Records
  - ✓ Improve the accuracy of statistics and Tidal analysis Through the creation of 1 minute Tide Records
  - ✓ Expect an active exchange of information between Related agencies, academies and Research Groups

## ❖ Systematic Achievement

- ✓ Systematic Frame Constructed For digitizing analog Tide Observation Records
- ✓ Built an image processing technique for digitizing Tide Observation Records
- ✓ Secure digitizing methodology developed for the various types of recording paper and the type of errors

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**Thank You!**