Hydrological Characteristics of Surface Water and Groundwater in Hanoi Capital City, Vietnam

I. Literature review
II. Introduction
III. Method and Objectives
IV. Results and Discussion
V. Conclusion

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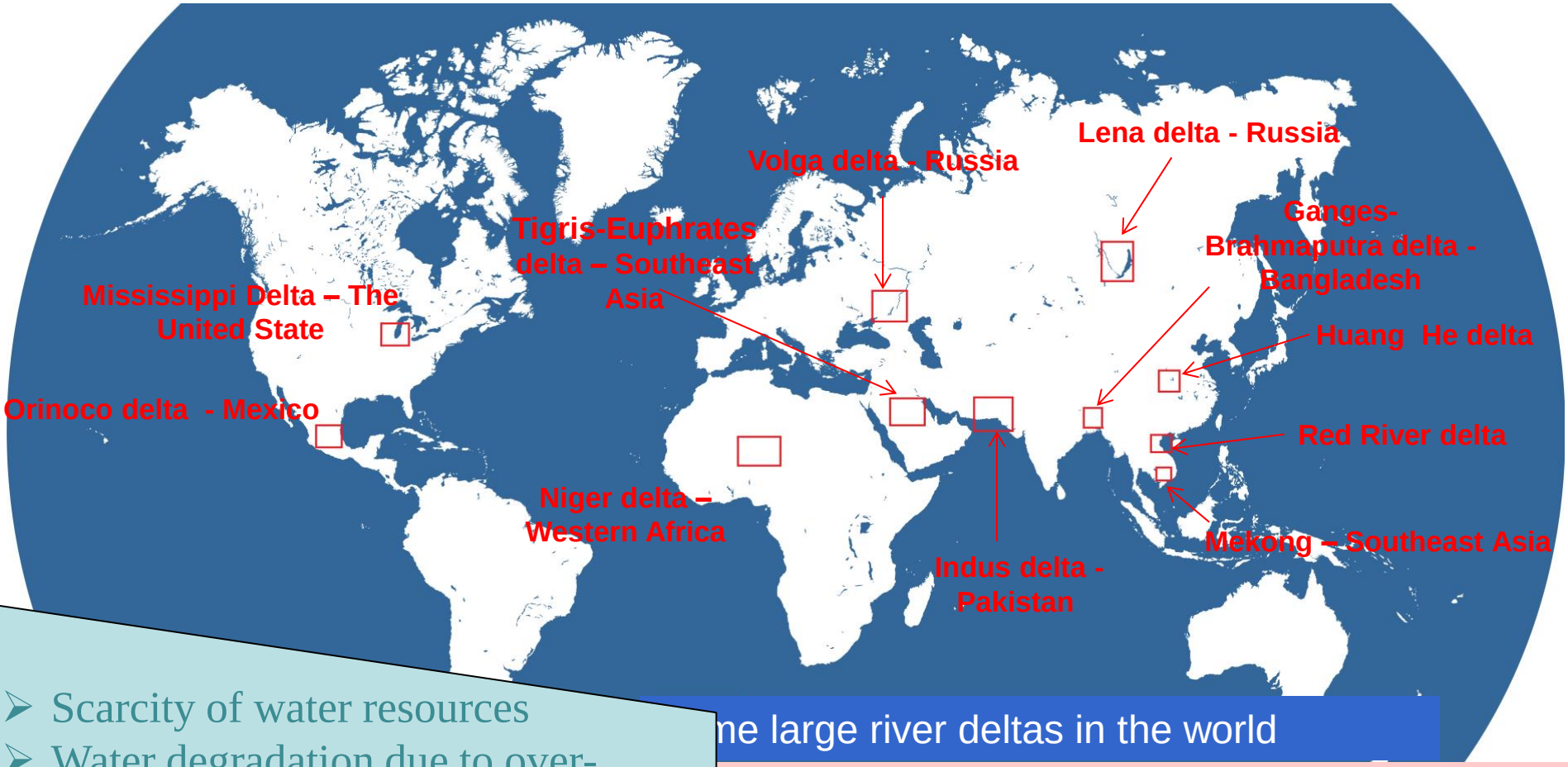
I. Literature review:

Water resource issues of river deltas in the world



me large river deltas in the world

- Scarcity of water resources
- Water degradation due to over-exploitation and contamination
- Water table depletion
- Sea water intrusion
- Land subsidence
- Transboundary water management

Abundant water resources and favourable conditions in the river deltas in the world

→ They are facing to international water issues

→ Water resource in the river deltas should be systematically studied

I. Literature review :

Vietnam and the Red river delta water resource issues

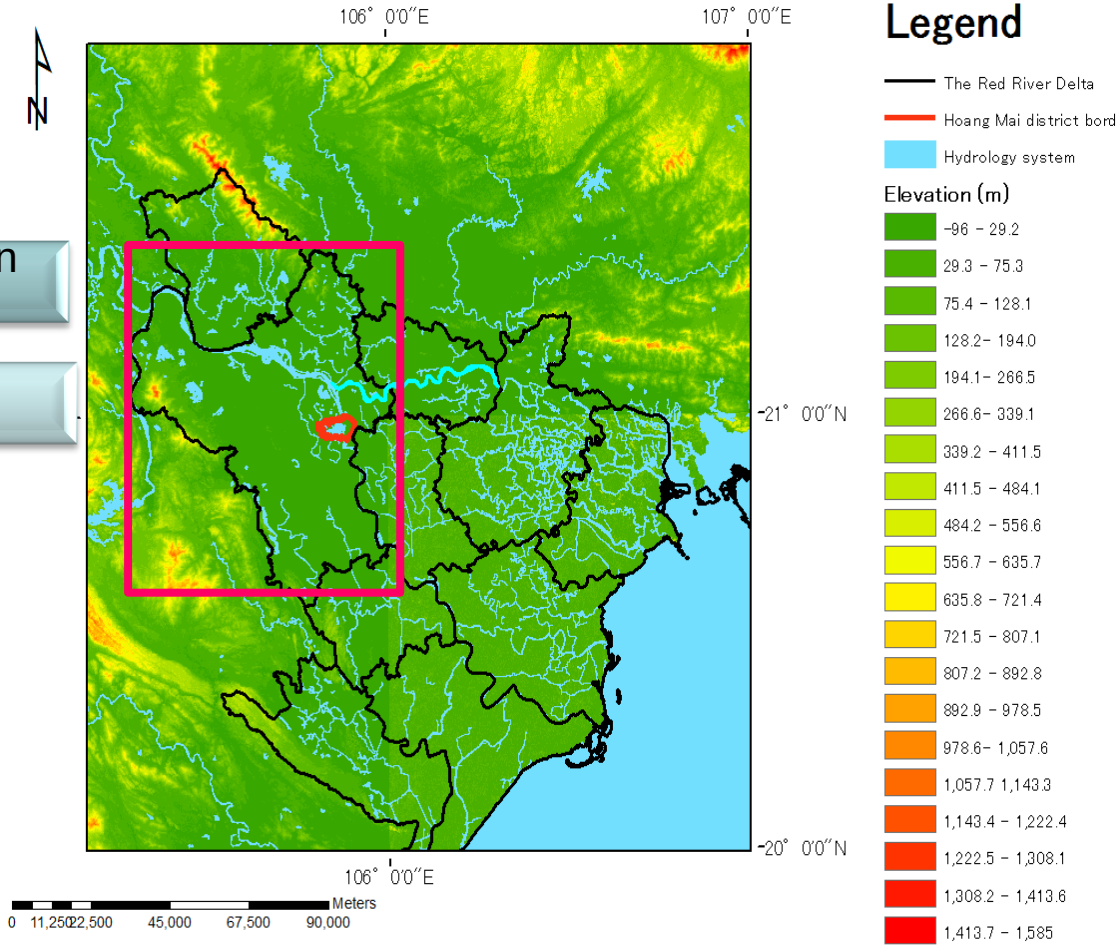
- Groundwater is a main source of the water supply in Hanoi. (Tong, 2000).

Rapid urbanization, high population density

Many craft villages manufacture

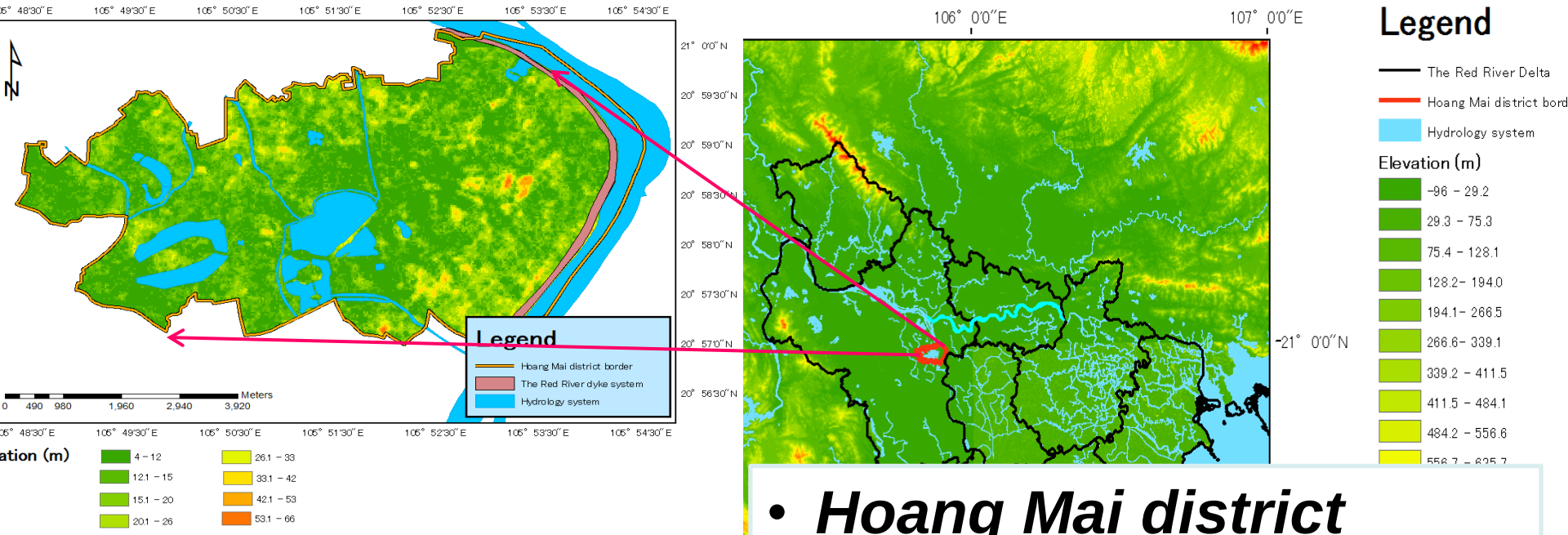
- Hanoi caused some serious problems, such as:

✓Groundwater level decline
✓Groundwater pollution
✓Land subsidence
(Tong, 2000)



The Red river delta topography map

II. Introduction: Study site



Climate: humid subtropical

Temperature: 2.7 - 40.4 ° C

Average rainfall per year: 1,676.2 mm

Average rainy days per year: 144.5 days

(Source: Annual statistic report of Hoang Mai district)

- ***Hoang Mai district***
- ***Area: 4,032.3878 ha (annual statistic 2010)***
- ***Population: 370,652 people (2013)***

(Source: Annual statistic report of Hoang Mai district)

II. Introduction: Two field surveys

III. Method and Objective

Method

Field survey

- Water samples
- Water temperature
- pH
- DO
- EC
- Statistic ground water level

Laboratory analysis

- Stable isotopes (^{18}O, D) by Mass spectrometry
- Inorganic solute with IC and ICP

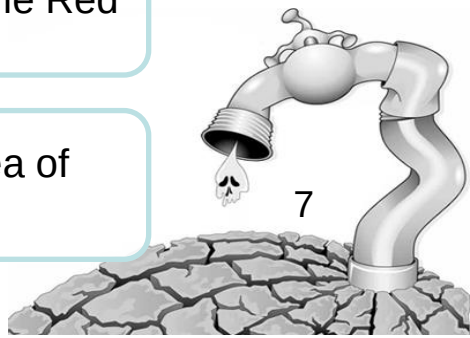
III. Method and Objective

Unsolved issues

1	Unclear discharge and recharge mechanism of surface water in lakes, channels and shallow groundwater
2	Limited information of recharge process between the Red river and groundwater in the area nearby the rivers
3	A decrease of area of hydrological network due to urbanization effects on water resource

Objectives

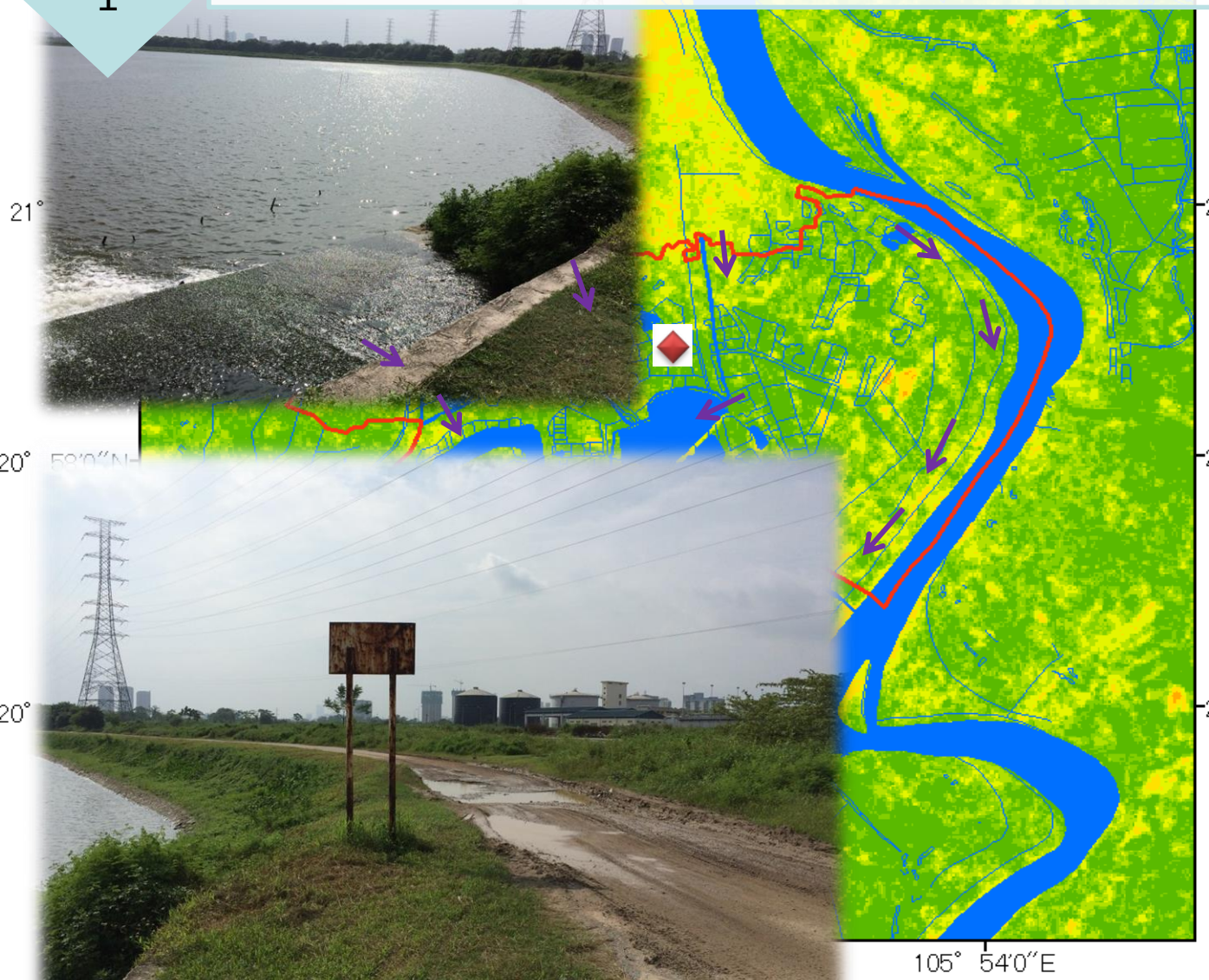
1. To identify interaction between surface water of lakes, river and channels and groundwater of house hold wells in the shallow aquifers
2. To investigate guaranteed water supply sources for economic and social development from the Red river and groundwater in the area nearby the Red rivers
3. To assess rapid urbanization effects on water supply resource and area of hydrological network

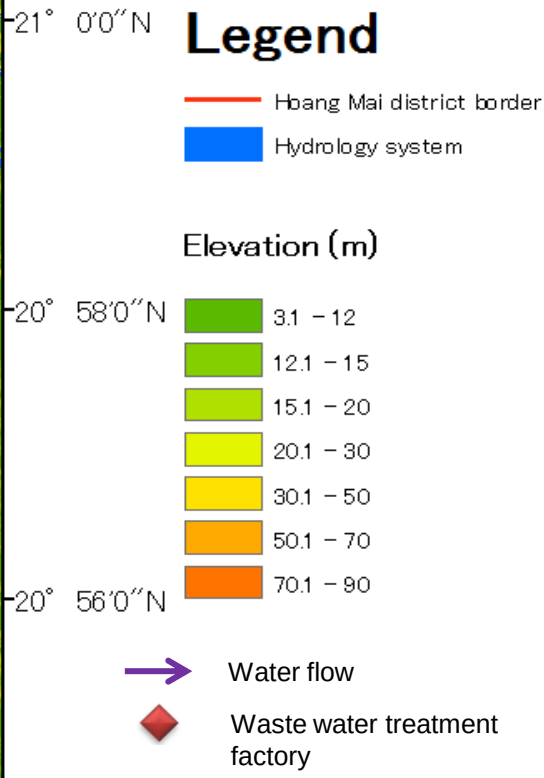


III. Method and Objective

Objectives 1

- Interaction between surface water of lakes, river and channels and ground water of house hold wells in the shallow aquifers

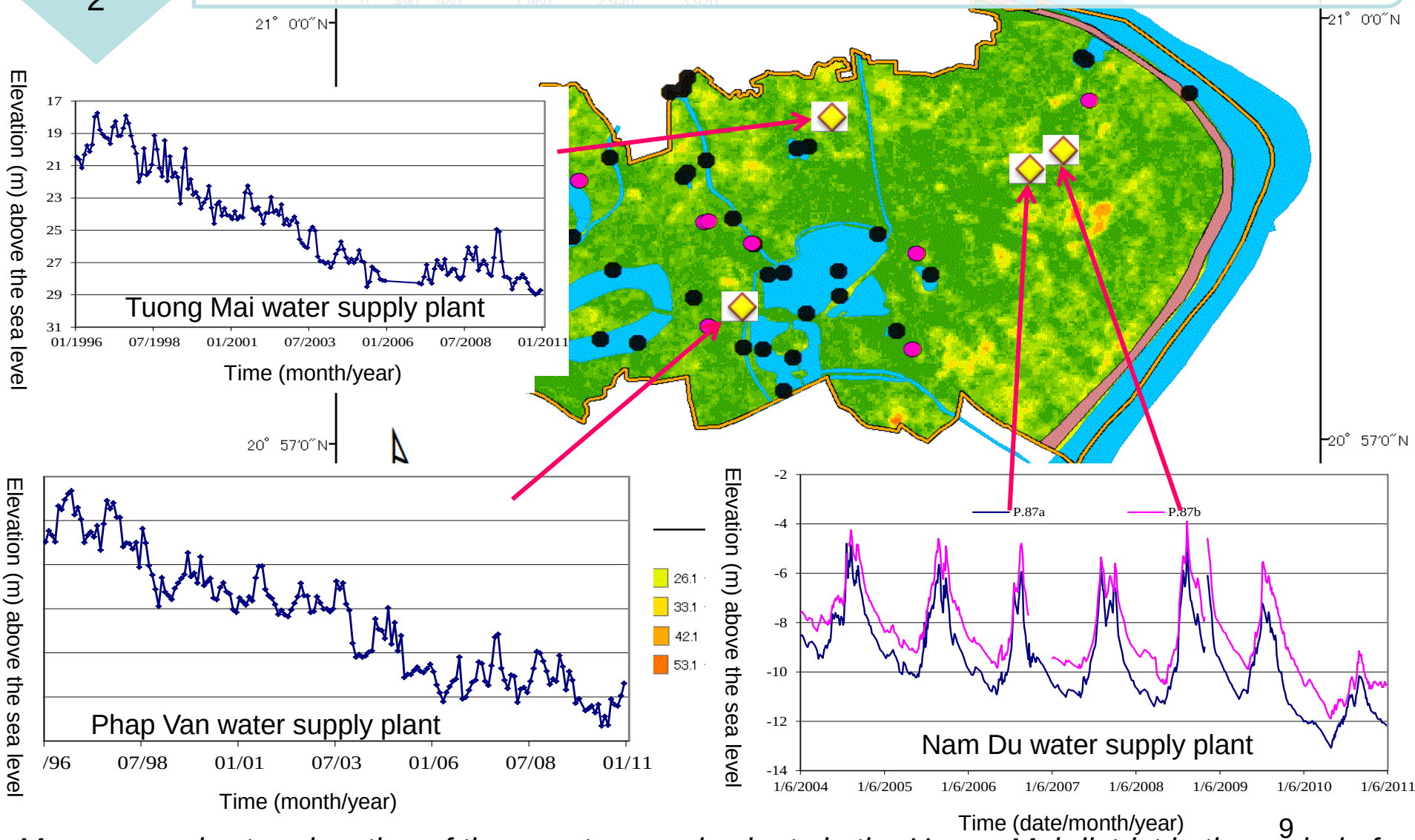




III. Method and Objective

Objectives 2

- Guaranteed water supply sources for economic and social development from the Red river and wells nearby the rivers

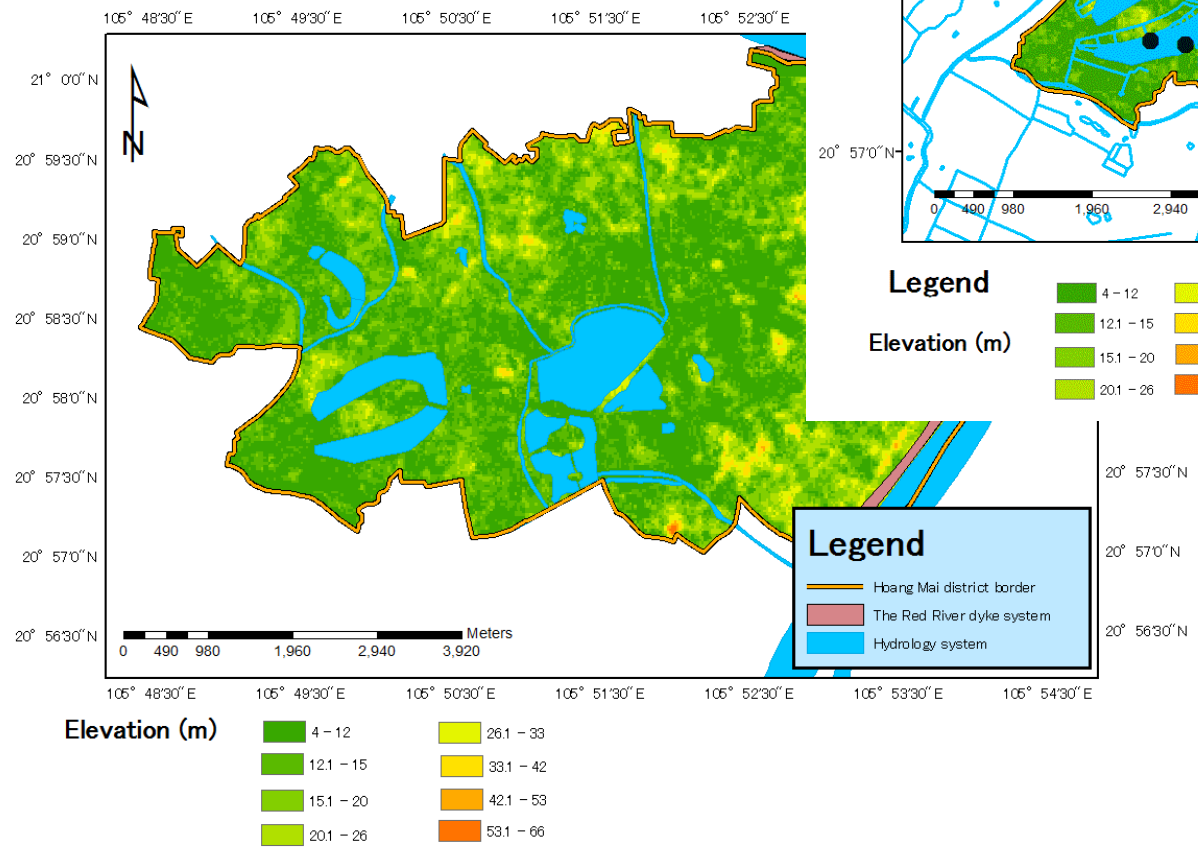


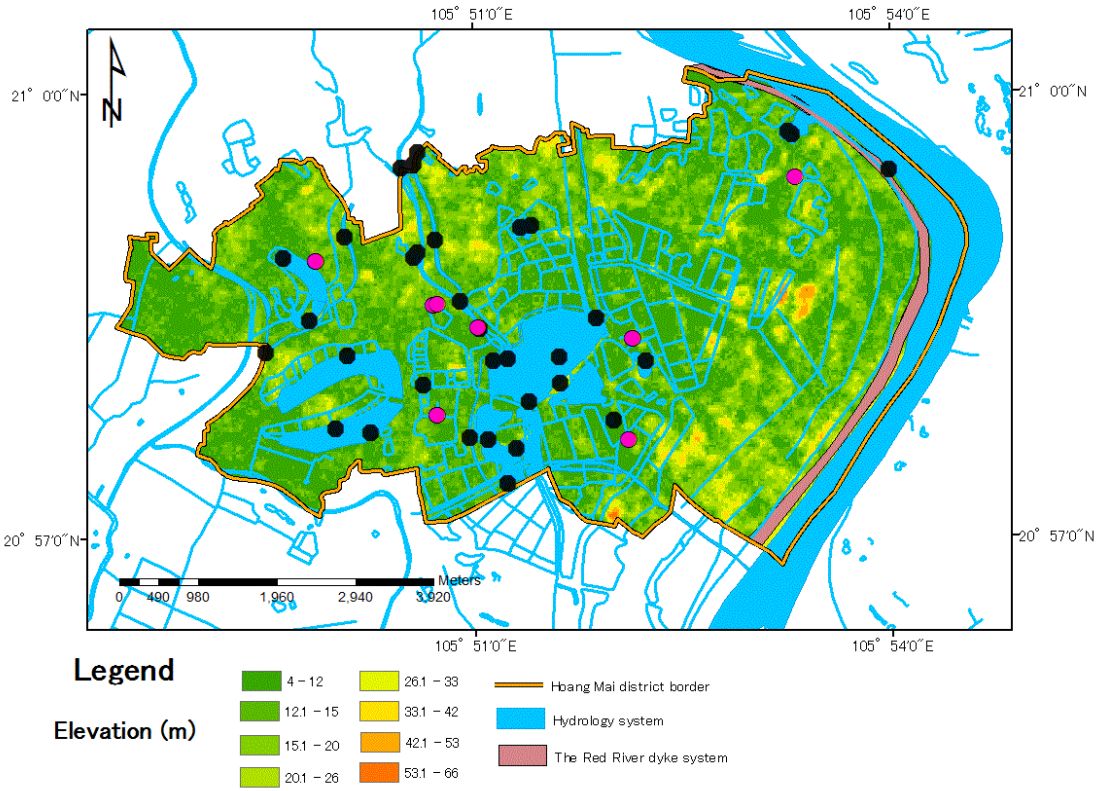
Mean groundwater elevation of three water supply plants in the Hoang Mai district in the period of time from 1996 to 2011 (Source: **Report of Northern division for water resources planning and investigation)**

Objectives 3

- Rapid urbanization effects on water supply resource and area of hydrological network

Hydrology network map in 1993

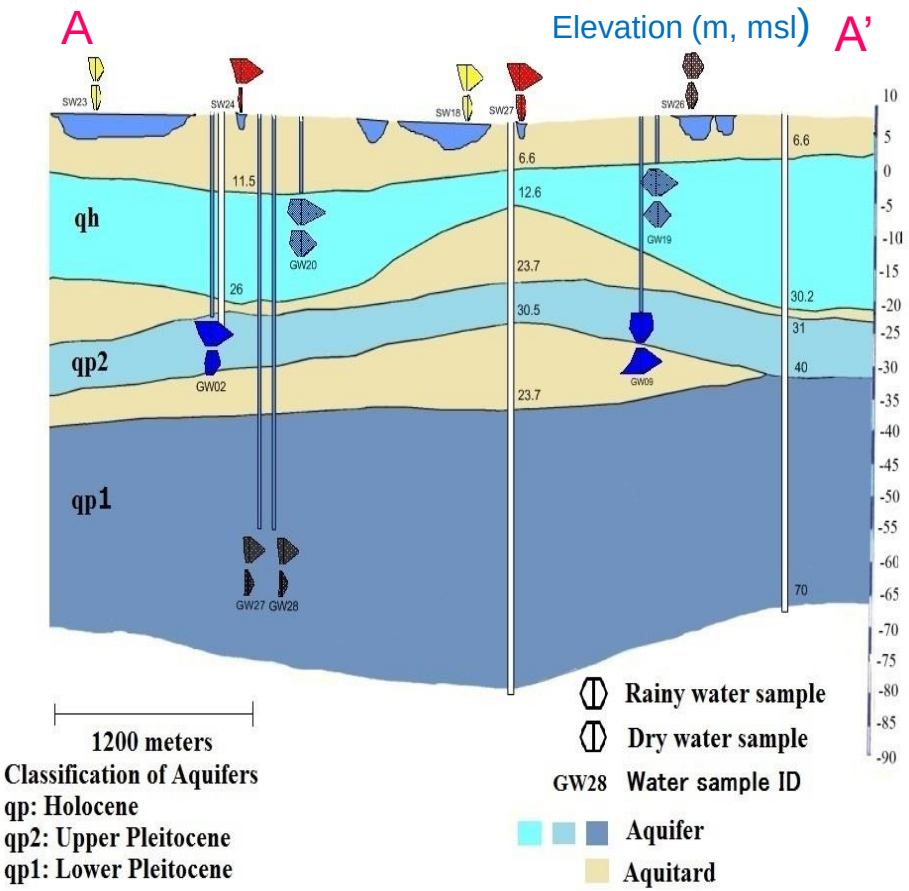


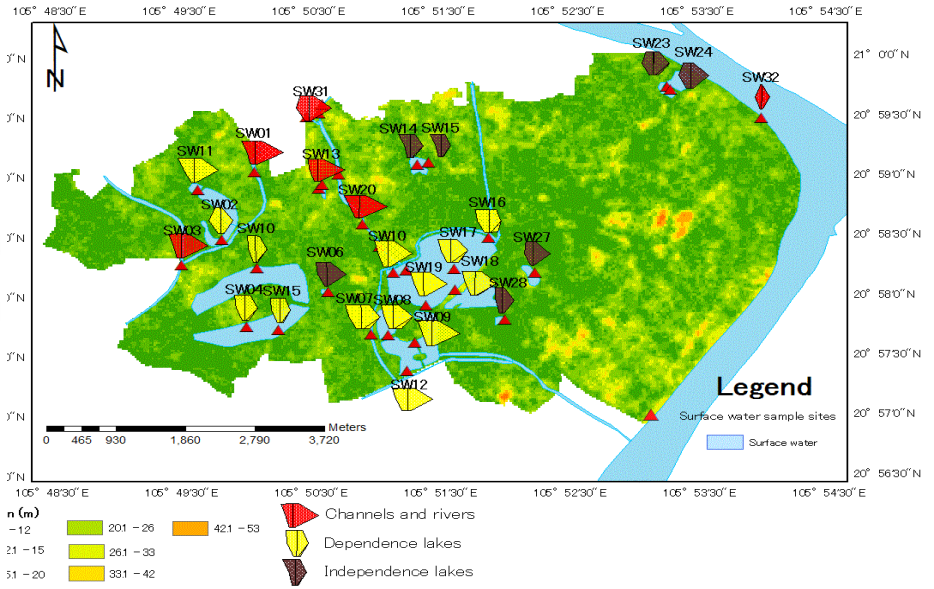


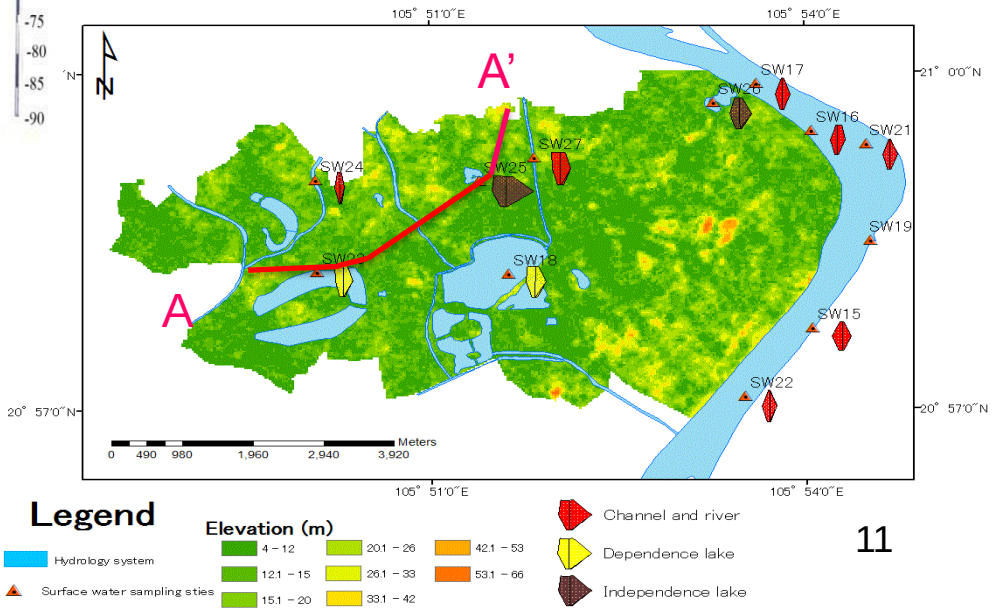
Hydrology network map in 2005

IV. Result and discussion

Geochemical characteristics: Seasonal variation of surface water





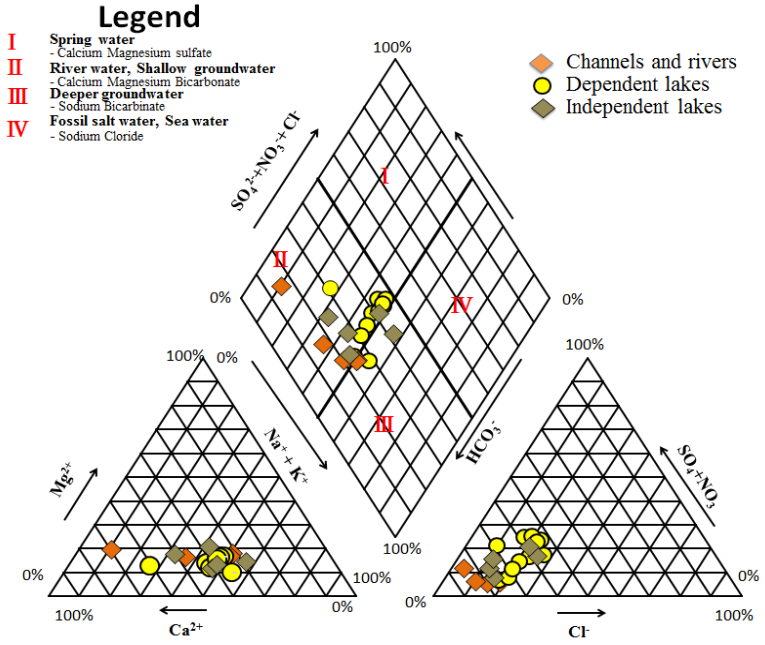


→ Major cation types are Ca^{2+} and Na^{+} and major anion types are $HCO3^{-}$. The composition is controlled by the impacts of alluvial sediments.

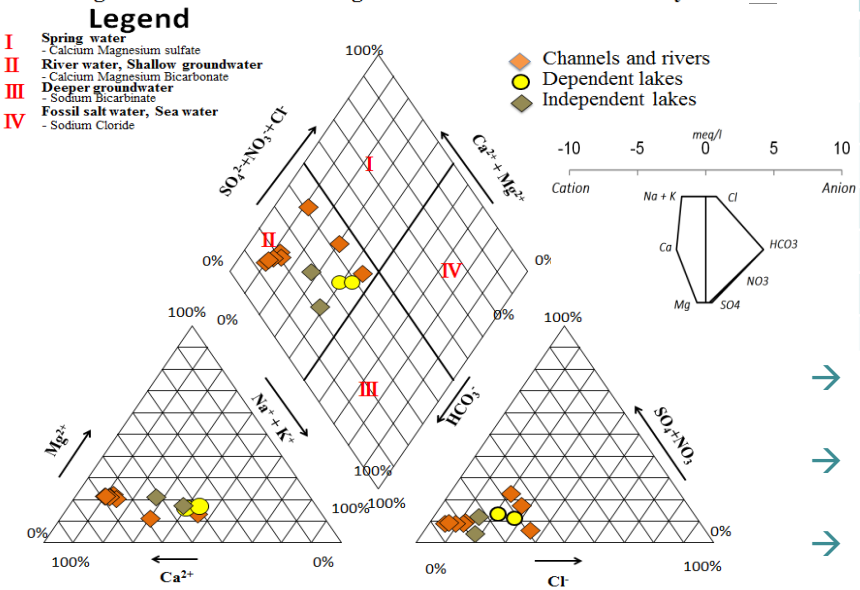
→ The $HCO3^{-}$ and Na^{+} concentrations of water samples in dry season is higher than those in rainy season

IV. Result and discussion

Geochemical characteristics: Regional variation of surface water



Hoang Mai district triliniar diagram of surface water in January 2014



Hoang Mai district triliniar diagram of surface water in August 2014

Mean ions concentrations of 33 surface water samples in the dry season and 12 surface water samples in the rainy season

Ions of surface water in Jan 14 (meq/L)	Channels and river	Dependent lakes	Independent lakes
Na^+	1.81	2.37	1.85
K^+	0.40	0.45	0.42
Ca^{2+}	2.00	2.33	1.98
Mg^{2+}	0.89	0.89	0.77
Cl^-	1.05	1.33	0.82
$HCO3^-$	5.61	4.12	3.40
SO_4^{2-}	0.36	0.50	0.43
NO_3^-	0.10	0.64	0.25

Ions of surface water in Aug 14 (meq/L)	Channels and river	Dependent lakes	Independent lakes
Na^+	0.32	1.36	1.19
K^+	0.10	0.26	0.24
Ca^{2+}	1.38	2.23	1.45
Mg^{2+}	0.44	0.90	0.58
Cl^-	0.34	0.84	0.72
$HCO3^-$	1.36	3.77	1.90
SO_4^{2-}	0.10	0.16	0.13
NO_3^-	0.12	0.38	0.23

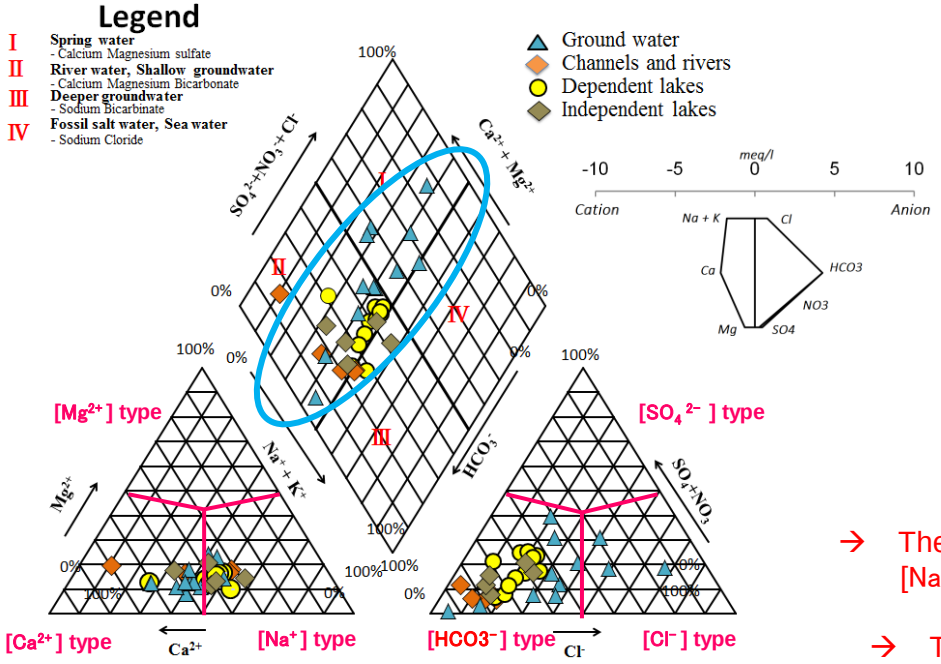
→ Surface water samples were identified as [Ca^{2+}], [Na^+] and [HCO_3^-]

→ Ions concentrations of dependent lakes, channels and rivers are closed thanks to connection and interaction between them

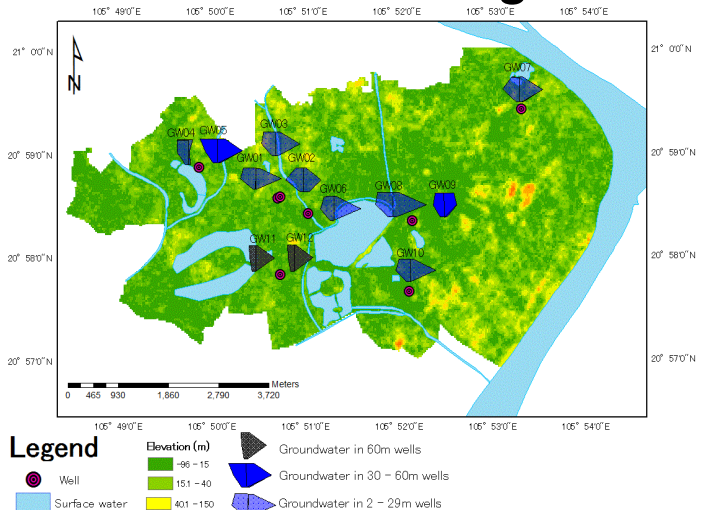
→ Ions concentrations of dependent lakes, channels and rivers are higher than those of independent lakes

IV. Result and discussion

Geochemical characteristics: Seasonal variation of groundwater

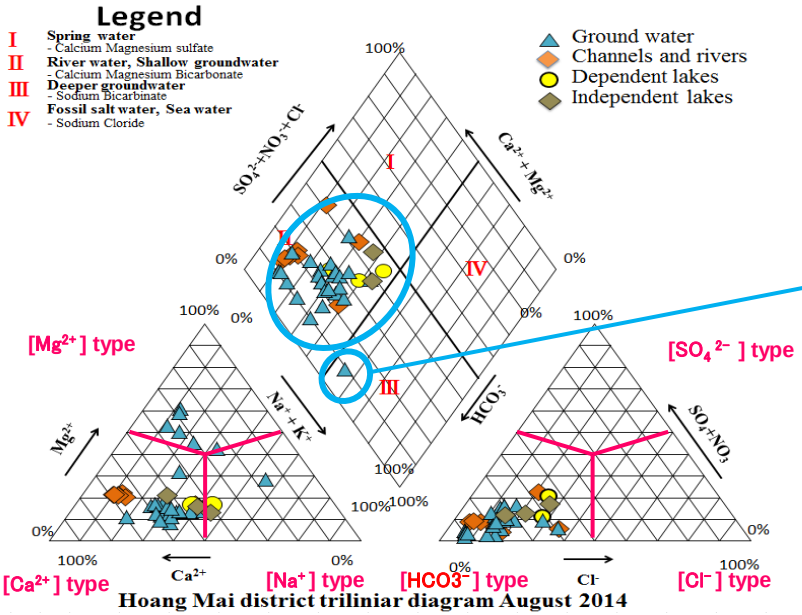


Hoang Mai district triliniar diagram January 2014

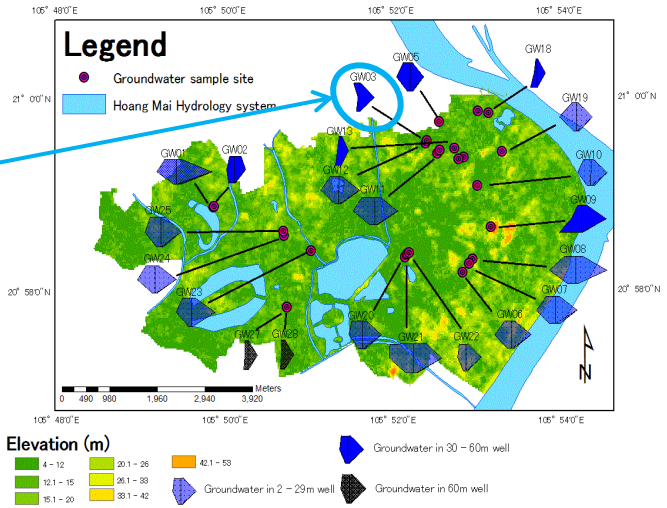


→ The 33 groundwater samples in the dry season were indicated as [Ca^{2+}] and [Na^{+}] type while 12 groundwater samples in the rainy season were indicated as [Ca^{2+}] and [Mg^{2+}] type . This may causes by dolomitization.

→ The 12 groundwater samples in the rainy season were indicated as just [$HCO3^{-}$] type while 33 groundwater samples in the dry season were dominated as [$HCO3^{-}$] and [Cl^{-}] type. Water sources may receive more [$HCO3^{-}$] from precipitation or more interaction with other water source



Hoang Mai district triliniar diagram August 2014



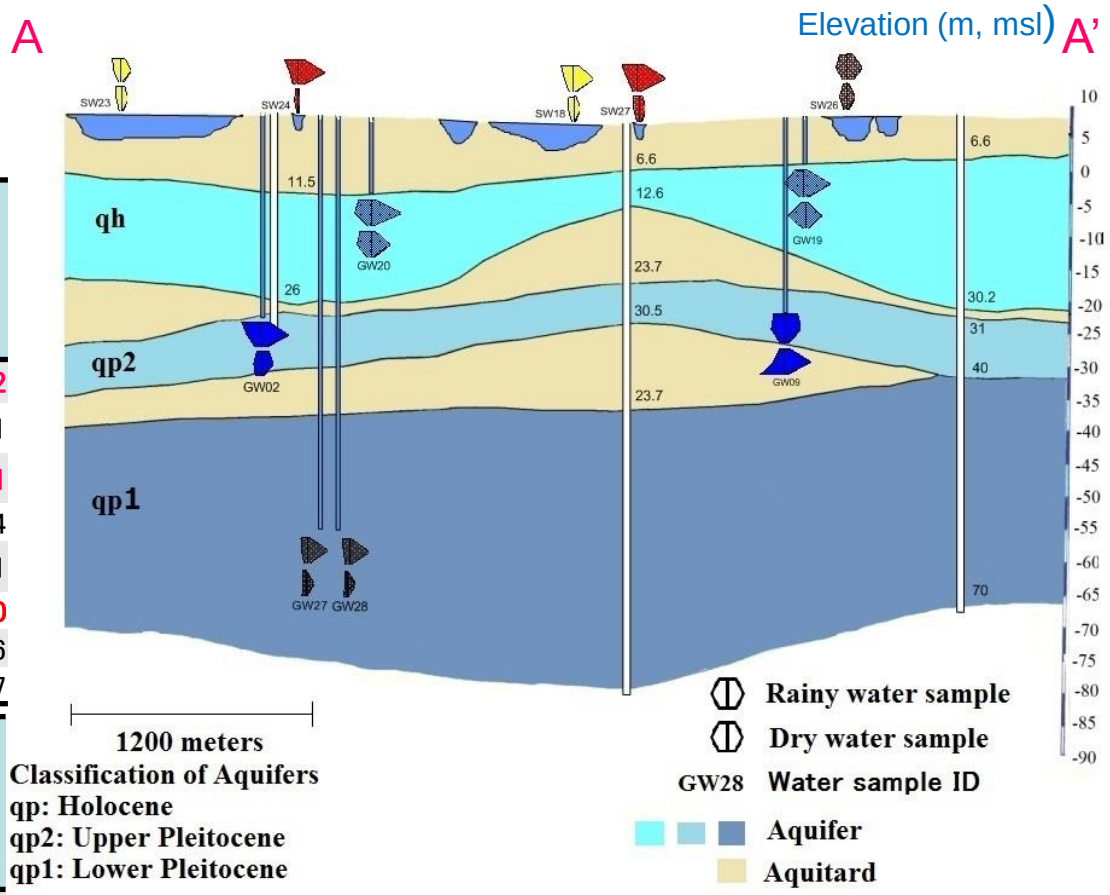
IV. Result and discussion

Geochemical characteristics: Seasonal variation of groundwater

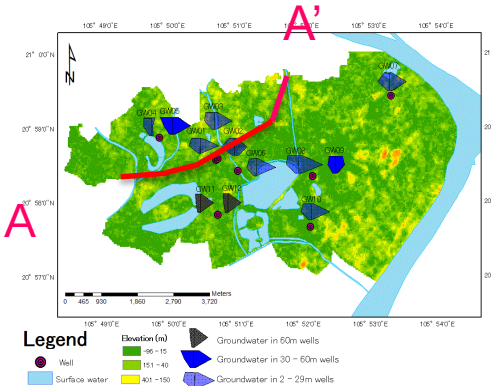
Mean ions concentrations of 12 groundwater samples in the dry season and 29 groundwater samples in the rainy season

Ions of groundwater in Jan 14 (meq/L)	Holocene well	Upper Pleistocene well	Lower Pleistocene well
Na^+	2.39	2.85	1.62
K^+	0.83	0.69	0.21
Ca^{2+}	4.52	3.61	1.51
Mg^{2+}	1.01	1.24	1.04
Cl^-	1.19	2.15	0.51
$HCO3^-$	1.66	3.03	5.00
SO_4^{2-}	0.69	0.25	0.06
NO_3^-	1.49	0.36	0.07

Ions of groundwater in Aug14 (meq/L)	Holocene wells	Upper Pleitocene wells	Lower Pleitocene well
Na^+	2.03	0.71	1.62
K^+	0.52	0.12	0.21
Ca^{2+}	4.44	1.23	1.51
Mg^{2+}	1.20	1.67	1.04
Cl^-	1.25	0.34	0.51
$HCO3^-$	5.47	2.79	5.00
SO_4^{2-}	0.28	0.07	0.06
NO_3^-	0.45	0.26	0.07



→ The concentrations of almost ions decrease from the dry season to the rainy season



IV. Result and discussion

Geochemical characteristics: Regional variation of groundwater

Ions of groundwater in Aug14 (meq/L)	Holocene wells	Upper Pleitocene wells	Lower Pleitocene wells
Na^+	2.03	0.71	1.62
K^+	0.52	0.12	0.21
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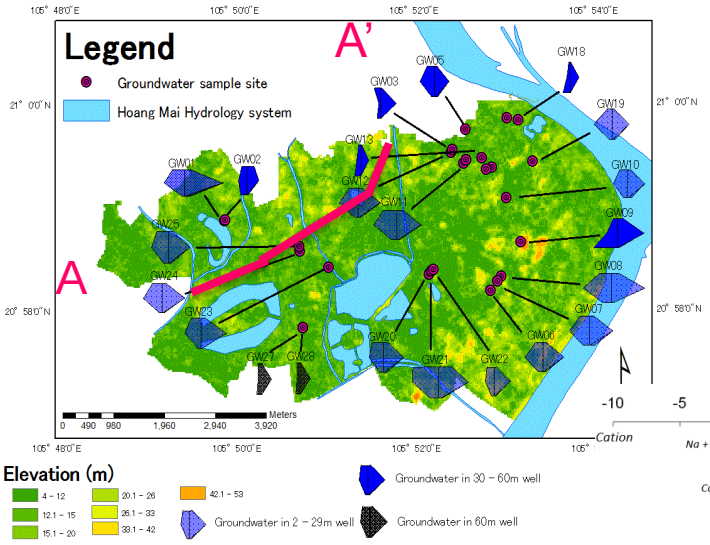
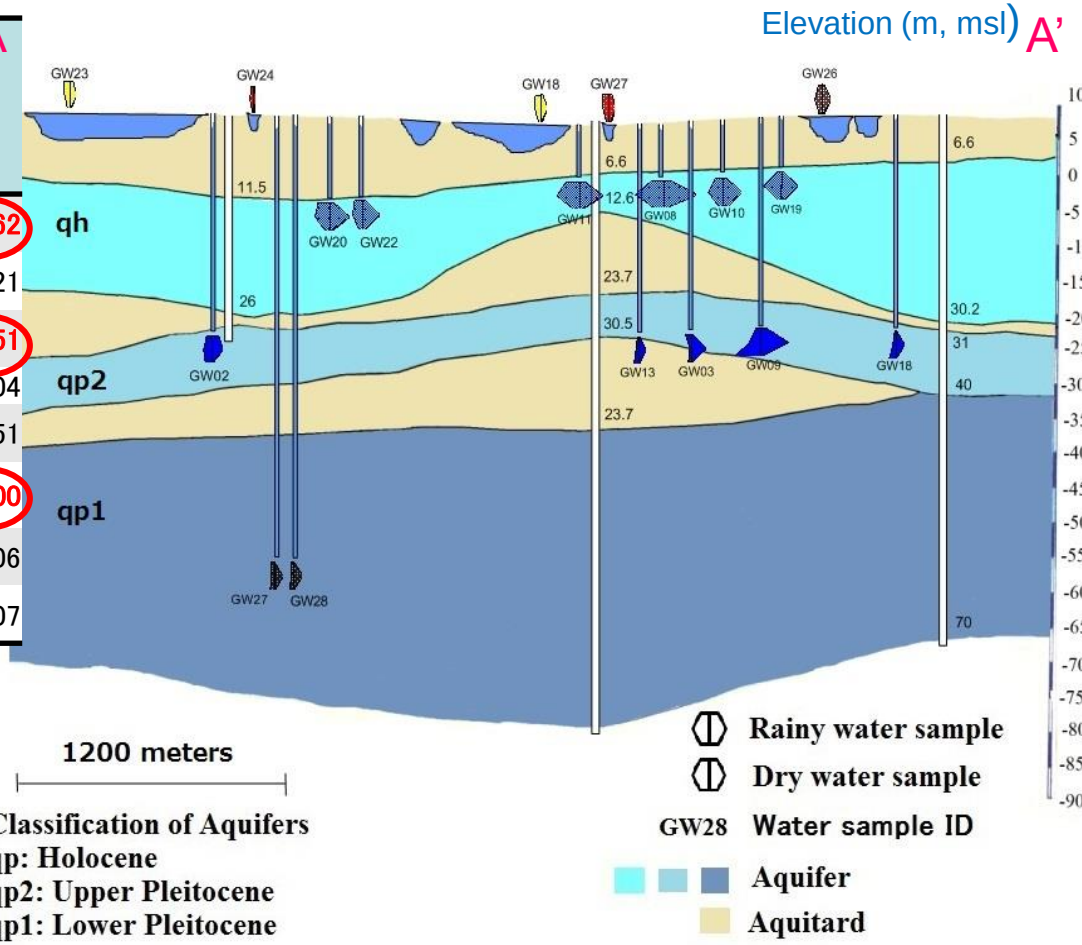
Mean ions concentrations of 29 groundwater samples in the rainy season

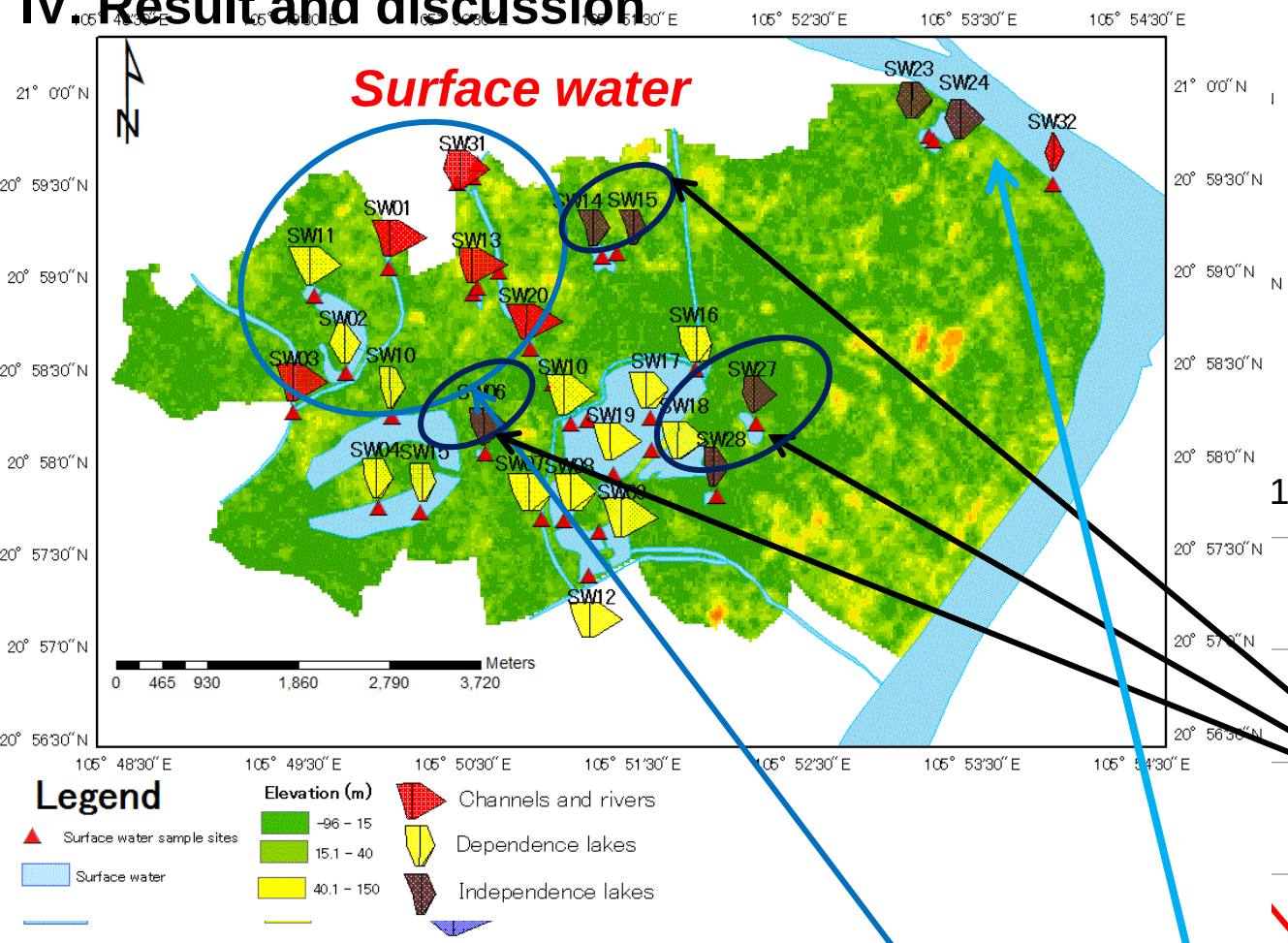




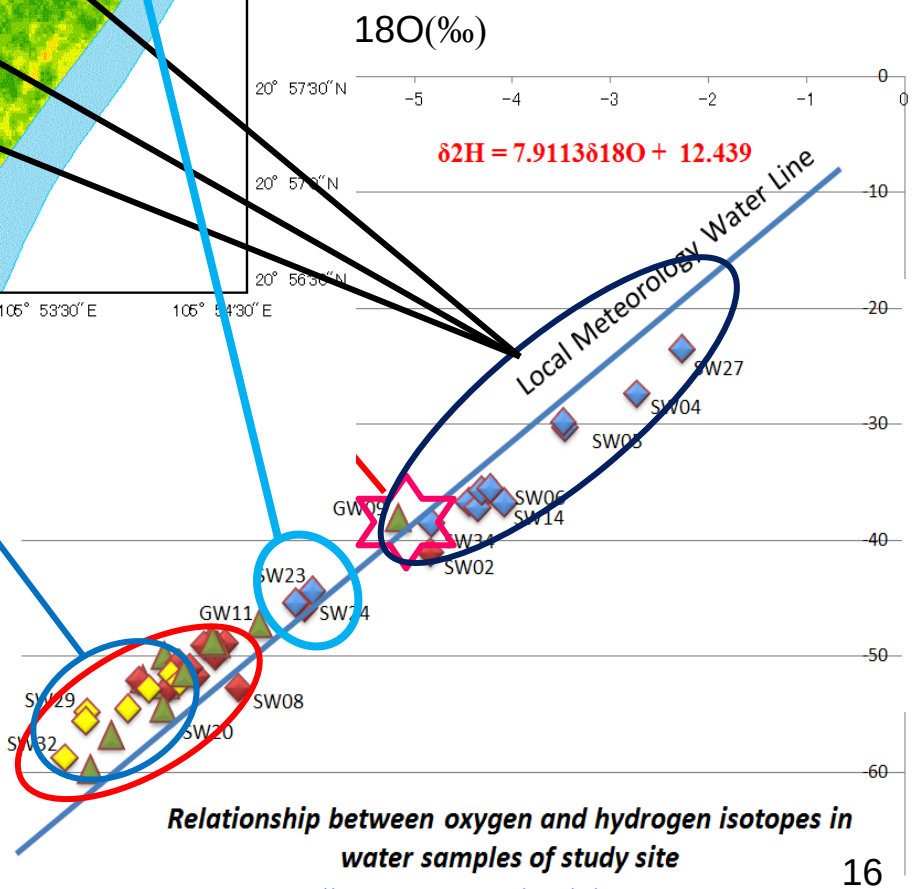
→ The concentrations of all ions reduce from the upper aquifer to the lower aquifers. This mainly come from the rock and soil weathering. I am studying more about that

→ The concentration of NO_3^- in the Holocene aquifer is the highest due to anthropogenic input

IV. Result and discussion



Relationship between oxygen and hydrogen isotopes in water samples of study site in January 2014



- ✓ There are many clues of interaction between dependent lakes, channel, rivers and groundwater of the Holocene aquifer
- ✓ Almost independent lakes samples isotopes values is totally heavier than the others. The indicated that the samples have been effected by atmosphere input or precipitation and less connection with another water sources

Source: http://www-naweb.iaea.org/napc/ih/IHS_resources_gnip.html

V. Conclusion

Objective	Conclusions
Surface water	✓ Thanks to the impacts of alluvial sediments of the Red river delta, major cation types are Ca^{2+} and Na^{+} and major anion types are $HCO3^{-}$ ✓ Ions concentrations of dependent lakes, channels and rivers are closed. That causes by connection and interaction between them. The ions concentrations of dependent lakes, channels and rivers are higher than those of independent lakes
Groundwater	✓ In seasonal variation, the concentrations of almost ions decrease from the dry season to the rainy season ✓ In regional variation, the concentrations of all ions reduce from the upper aquifer to the lower aquifers. This may come from the rock and soil weathering. ✓ The concentration of NO_3^{-} in the Holocene aquifer is the highest due to anthropogenic input
Interaction of surface water and groundwater	✓ A lot of clues show the interaction between dependent lakes, channel, rivers and groundwater of the Holocene aquifer ✓ Almost independent lakes samples isotopes values is totally heavier than the others. The indicated that the samples have been effected by atmosphere input or precipitation and less connection with another water sources

THANK YOU FOR YOUR ATTENTION!