TERRECO-Workshop,
Bayreuth, 04/11-14/2010

Complex Terrain and Ecological Heterogeneity
(TERRECO) *Project 13*

NO_3, DOC and P Export from a Catchment under Monsoonal Climate Conditions

- The Case of the Haean Catchment, South Korea -

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Structure

1. **Research goal, hypothesis, main objectives**

2. **Methods**

- Identification of sink and source areas of nitrate, DOC and Phosphorous
- Characterization of the discharges within the catchment
- Characterization of river-/aquifer interactions and the riparian zone

3. **First results 2009**

4. **Additional Research in 2010** based on the results from 2009

Research Goal

Investigate the effect of how landuse and changes in landuse affect the NO_3, DOC and P export from catchments under monsoonal climate conditions

Hypotheses

1. river-aquifer exchange
   → significantly affect nutrient retention and transformation

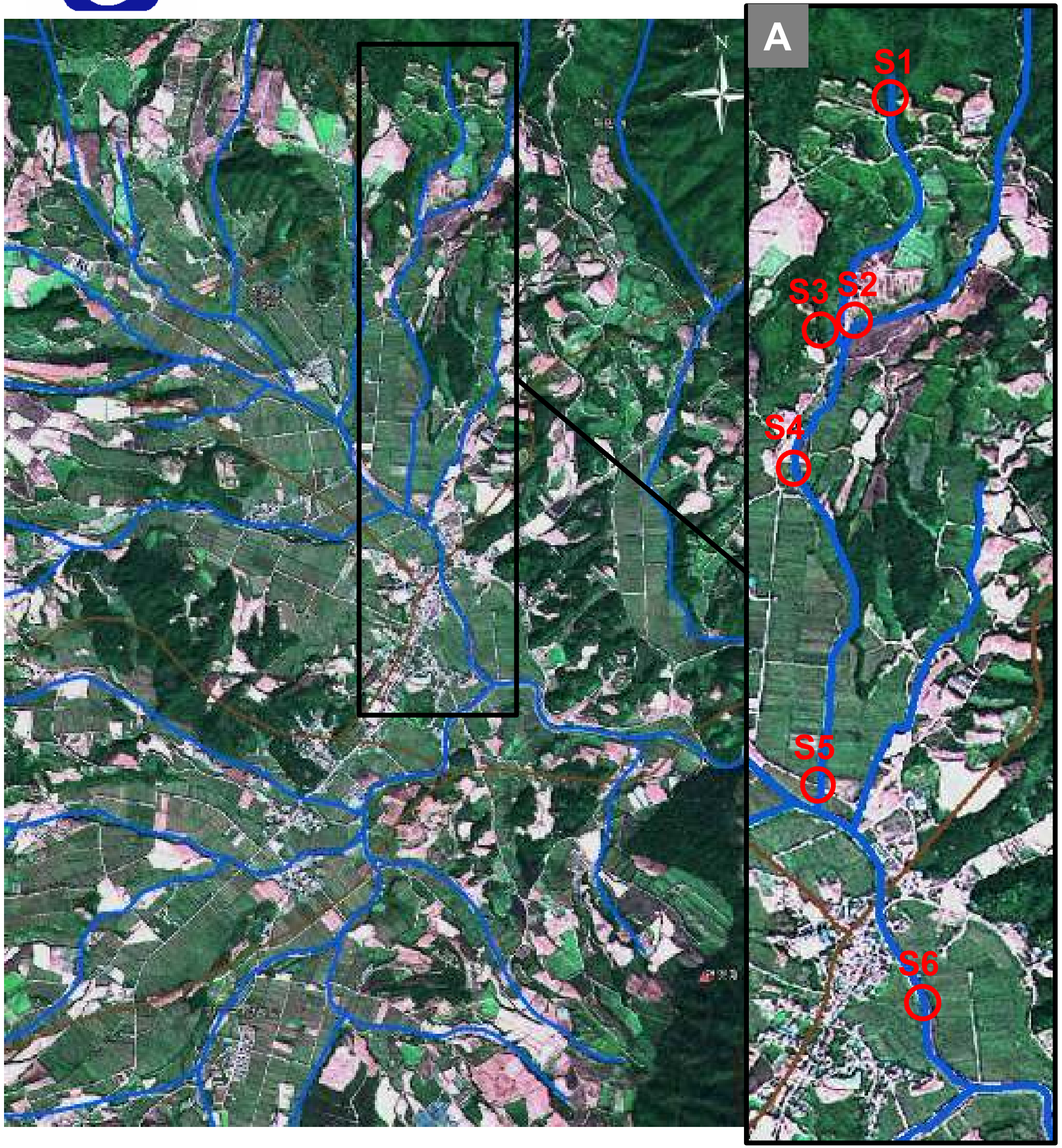
2. the export of NO_3, DOC and P from the catchment
   → variable in time driven by the hydrologic dynamics

Main Objectives

1. identify sink and source areas and transport pathways of NO_3, DOC and P

2. assess interactions between groundwater and the river

3. quantify NO_3, DOC and P export focusing on temporal dynamics and spatial patterns in surface waters and the hyporheic zone



*S*ubcatchment and Site Selection

S1: naturally vegetated forest area
S2 and S3: dry land farming (radish, potato, cabbage)
S4: dry land farming and rice paddies
S5: (subcatchment outlet): mainly rice paddies
S6: (not in the subcatchment): mainly rice paddies

Methods

Identification of sinks and sources areas of nitrate, DOC and P

A)Surface water sampling:

- at all selected sites, with a higher frequency during storm events
- samples are analyzed on **nitrate, ammonium, DOC, TP, phosphate, turbidity**, **SSC**
- in situ parameters: **Temperature, O_2- saturation, electric conductivity, pH-value**

B) Groundwater sampling:

- out of the wells of the piezometer transects
- samples are taken once a week and before and after storm events
- two wells will be additionally equipped with an ISCO Autosampler
- samples are analyzed on **nitrate, ammonium, DOC, TP, phosphate**
- in situ parameters: **Temperature, O_2- saturation, electric conductivity, pH-value**

Methods

Characterization of the discharges within the Catchment

1.Method:

Sharp crested v-notch weir: The weir in combination with continuous measured water levels upstream the weir offers continuous discharge data

2. Method:

Stage-discharge relationship: Water level monitoring via pressure transducers in combination with current meter measurements at different water levels offer continuous discharge data

3. Method:

Float method: A floating body (orange) will be placed at the start point in the middle of the stream and the time until the floating body reaches the finish point will be measured via stopwatch.

Methods

Discharges measurement sites and used methods

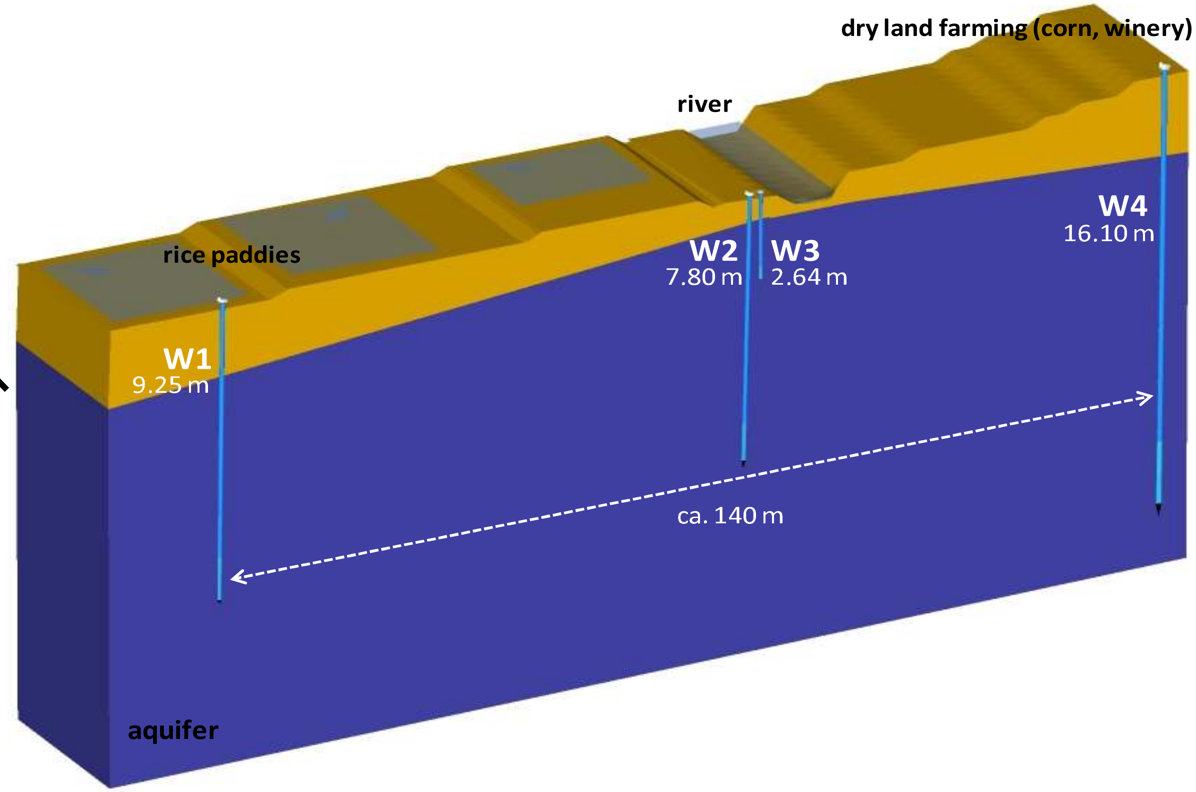
- **S1 and S4a:** sharp crested v-notch weir
- **S3 and S5:** stage-discharge relationship
- **S6:** float method and current meter measurements

Methods

Characterization of river-/aquifer interactions and the riparian zone

First main methods: <u>Installations of piezometer transects</u>

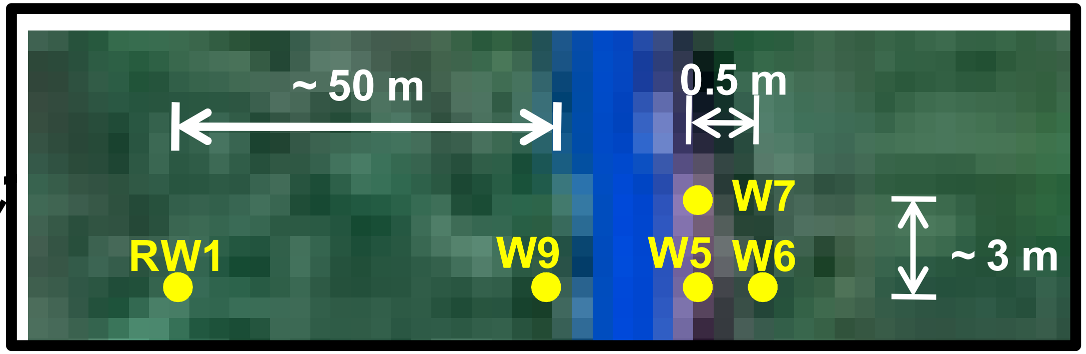
Piezometer transect 2009



Methods

Characterization of river-/aquifer interactions and the riparian zone

Piezometer transect 2010



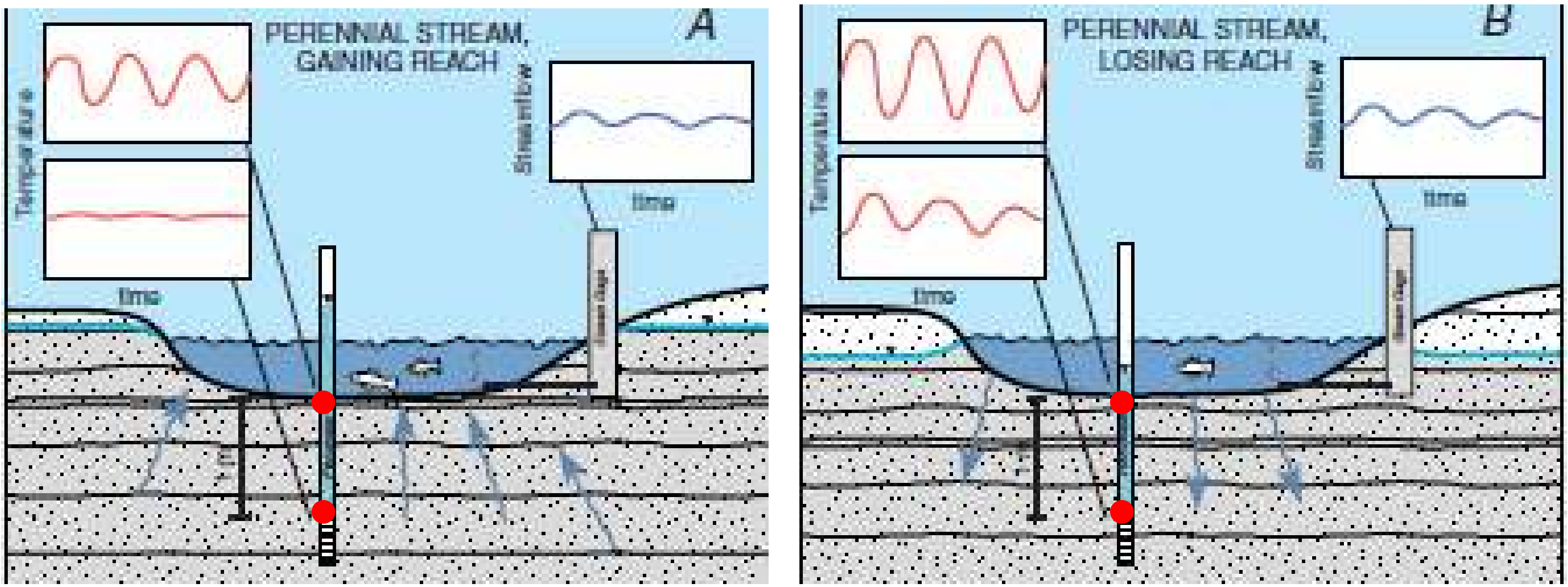
- depths of the wells: between 3.50 m and 6.50 m
- two nested wells
- all wells are equipped with pressure transducers
- **W7**: sample well equipped with an ISCO Autosampler
  - → same distance to the river as W5
  - → Information about how nutrient concentrations are related to the groundwater level fluctuations

Methods

Characterization of river-/aquifer interactions

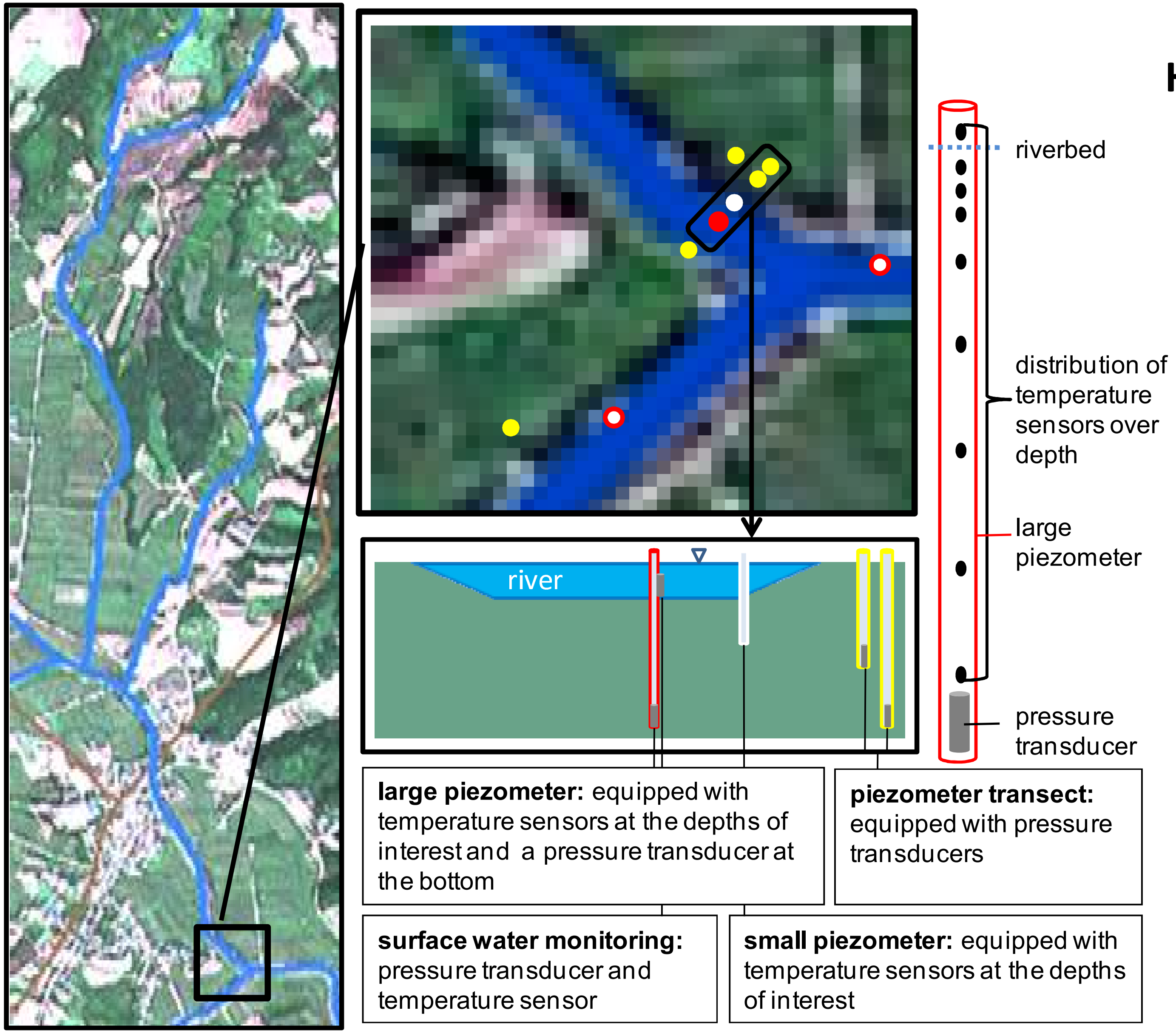
Second main methods: Using heat as natural tracer

•temperature time series from the river and piezometers can be analysed to evaluate exchange behaviour
•to estimate the water exchange fluxes based on the observed temperatures **VS2DH** (finite-difference model) will be used



Stonestrom and Constantz, 2003

Methods



Heat as natural Tracer
- Installations –

- ● 3.00 m deep under the riverbed, equipped with temp. loggers and pressure transuders
- ○ 1.60 m deep under the riverbed, equipped with temp. loggers and pressure transuders
- ○ 1.60 m deep under the riverbed, equipped with temperature sensors

Methods

Heat as natural Tracer – Installations

Methods

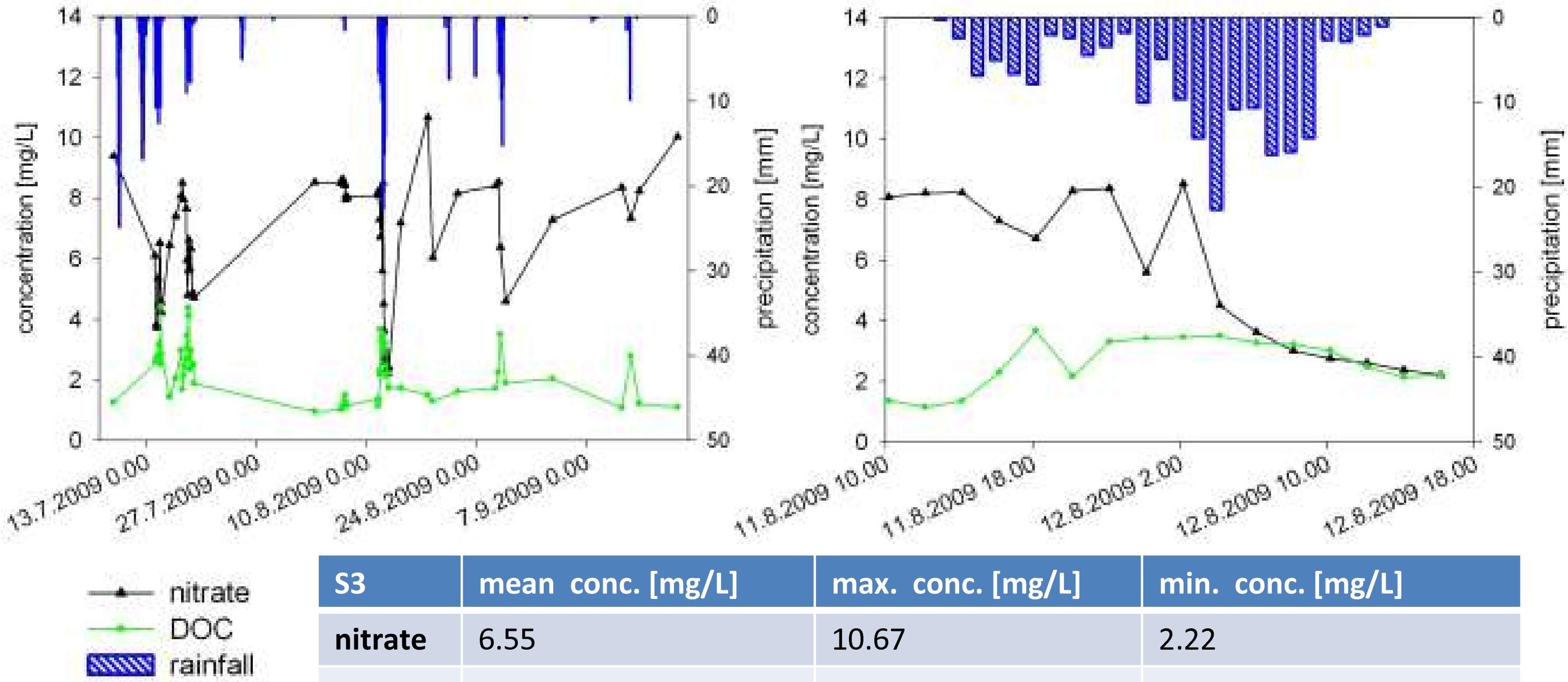
River-/aquifer interactions - Sites -

first-order-stream: using **stable isotopes ^{16}O, ^{18}O** for identifying the origin of the water

First Results 2009

General behavior of nitrate and DOC concentrations in the rivers

example: Site 3



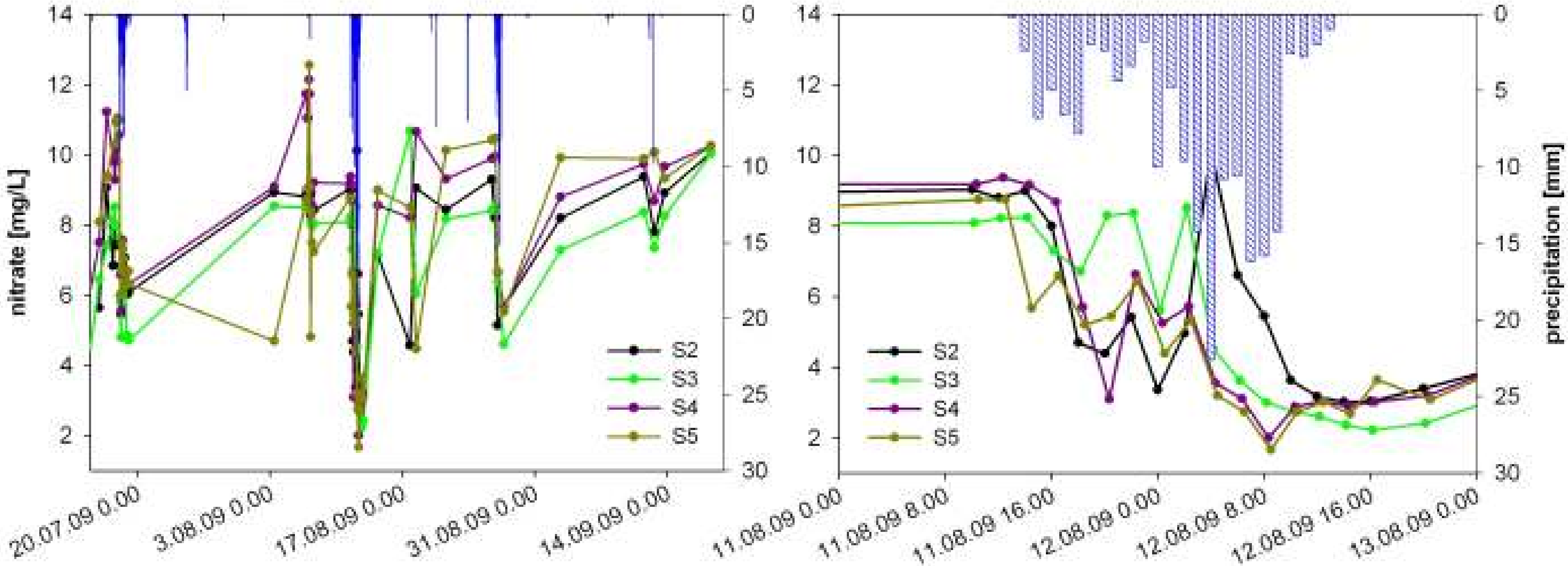
S3	mean conc. [mg/L]	max. conc. [mg/L]	min. conc. [mg/L]
nitrate	6.55	10.67	2.22
DOC	2.27	4.42	0.96

during storm events: DOC concentrations increase → surface runoff
Nitrate concentration decreases → river water dilution

under dry conditions: DOC concentrations decrease
Nitrate concentrations increase

First Results 2009

Nitrate concentrations in the rivers



	mean conc. [mg/L]	max. conc. [mg/L]	min. conc. [mg/L]
S2	6.82	10.12	3.02
S3	6.55	10.67	2.22
S4	7.54	12.49	2.00
S5	7.27	12.56	1.67

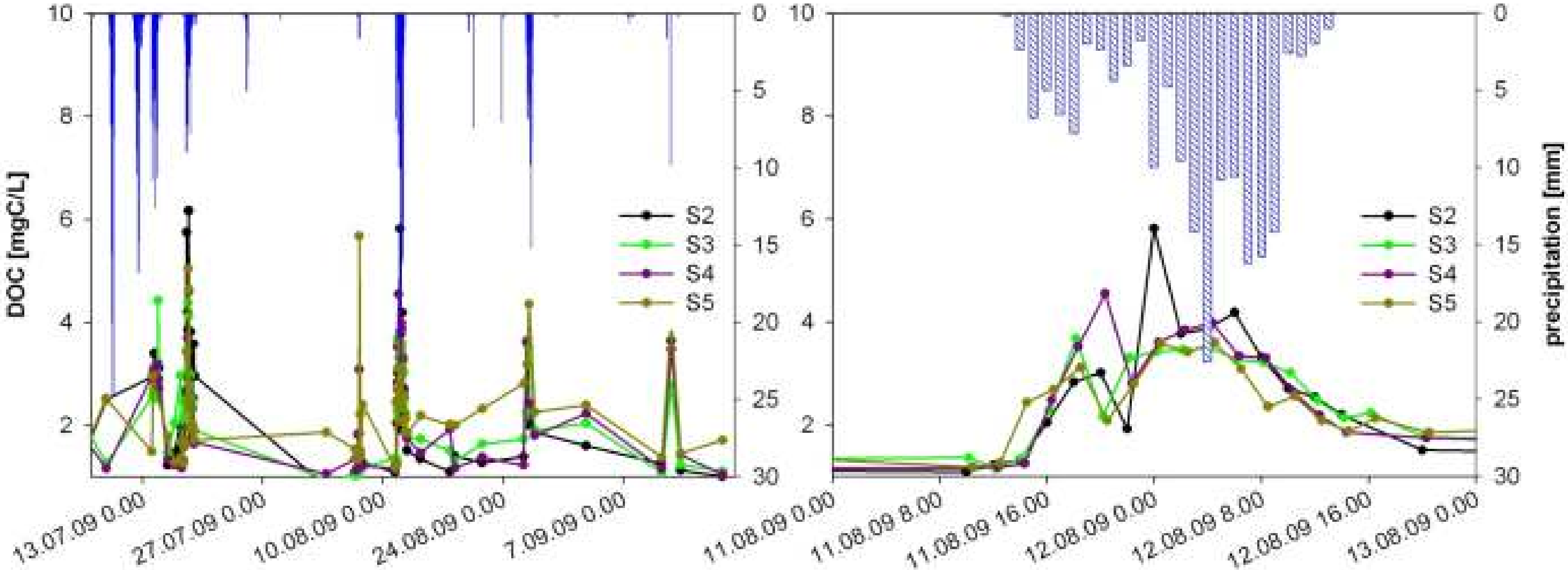
in general:
S4 and **S5** → highest conc.
S2 and **S3** →lowest conc. → close to the river source
during storm events:
S2 and **S3** → highest conc.
S5 and **S4** → lowest
→ higher discharges, water dilution

S5 → highest range, highest max. and lowest min. conc.

S2→ smallest range

First Results 2009

DOC concentrations in the rivers



	mean conc. [mg/L]	max. conc. [mg/L]	min. conc. [mg/L]
S2	2.37	6.17	0.82
S3	2.27	4.42	0.96
S4	2.18	4.6	1.04
S5	2.35	5.67	1.18

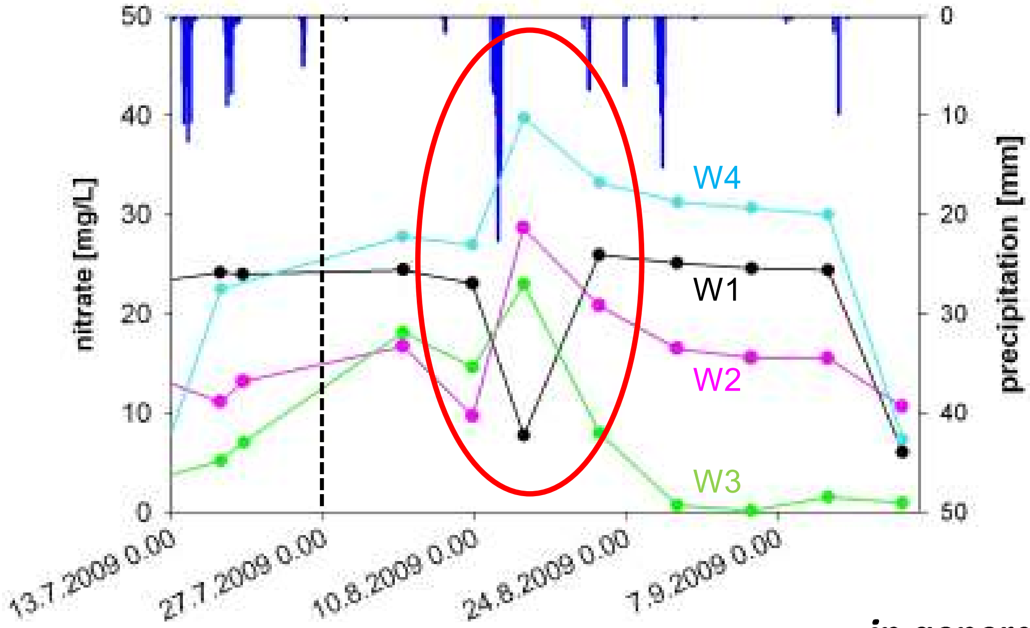
in general: low variability between the sites → around 2 mgC/L
S2 → highest range, highest max. and lowest min. conc.
S5 → smallest range

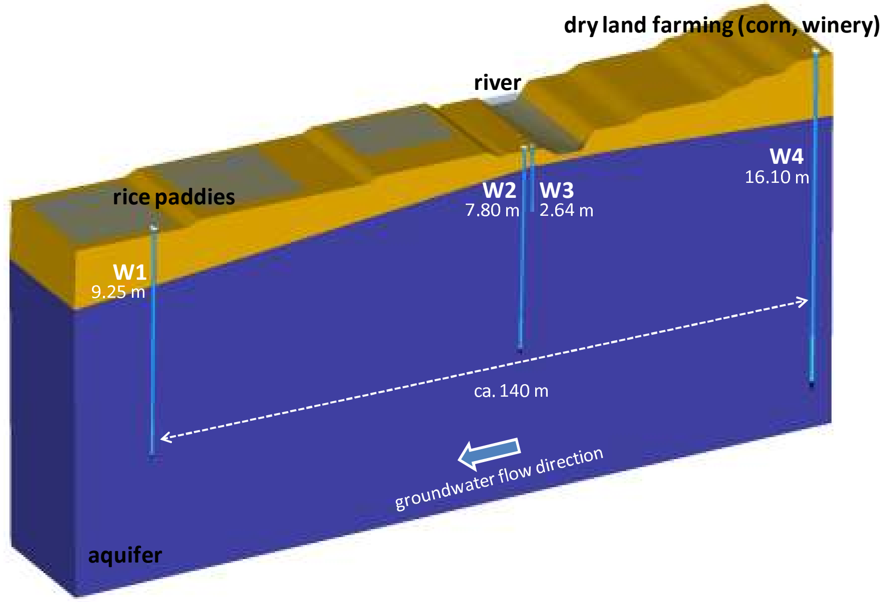
→contrasting behavior of nitrate and DOC

S4 → lowest mean conc. (dry land farming and rice paddies) **S2** → highest mean conc. (dry land farming, close to the river source

First Results 2009

Nitrate concentrations in the groundwater





in general

W4: highest nitrate values → dry land farming **W3, W2:** lowest values → river water dilution

during storm event

W2, W3 and W4: the nitrate concentrations increase by contrast **W1:** nitrate concentrations decrease

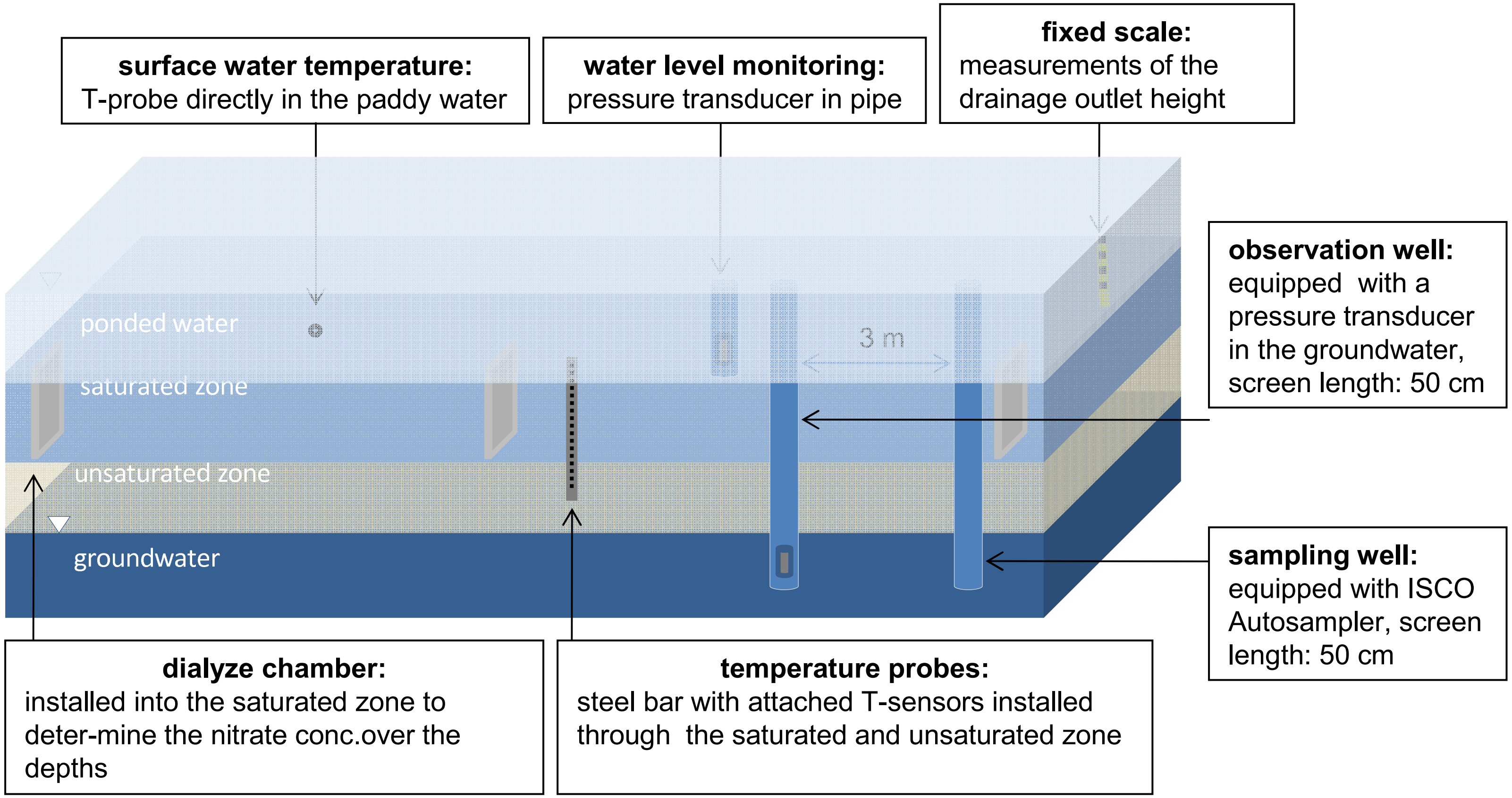
→denitrification processes in rice paddy soils?

→rice paddies sinks for nitrate?

but: not enough data

Additional Research in 2010

Transport pathways and transformations of nitrate in rice paddies

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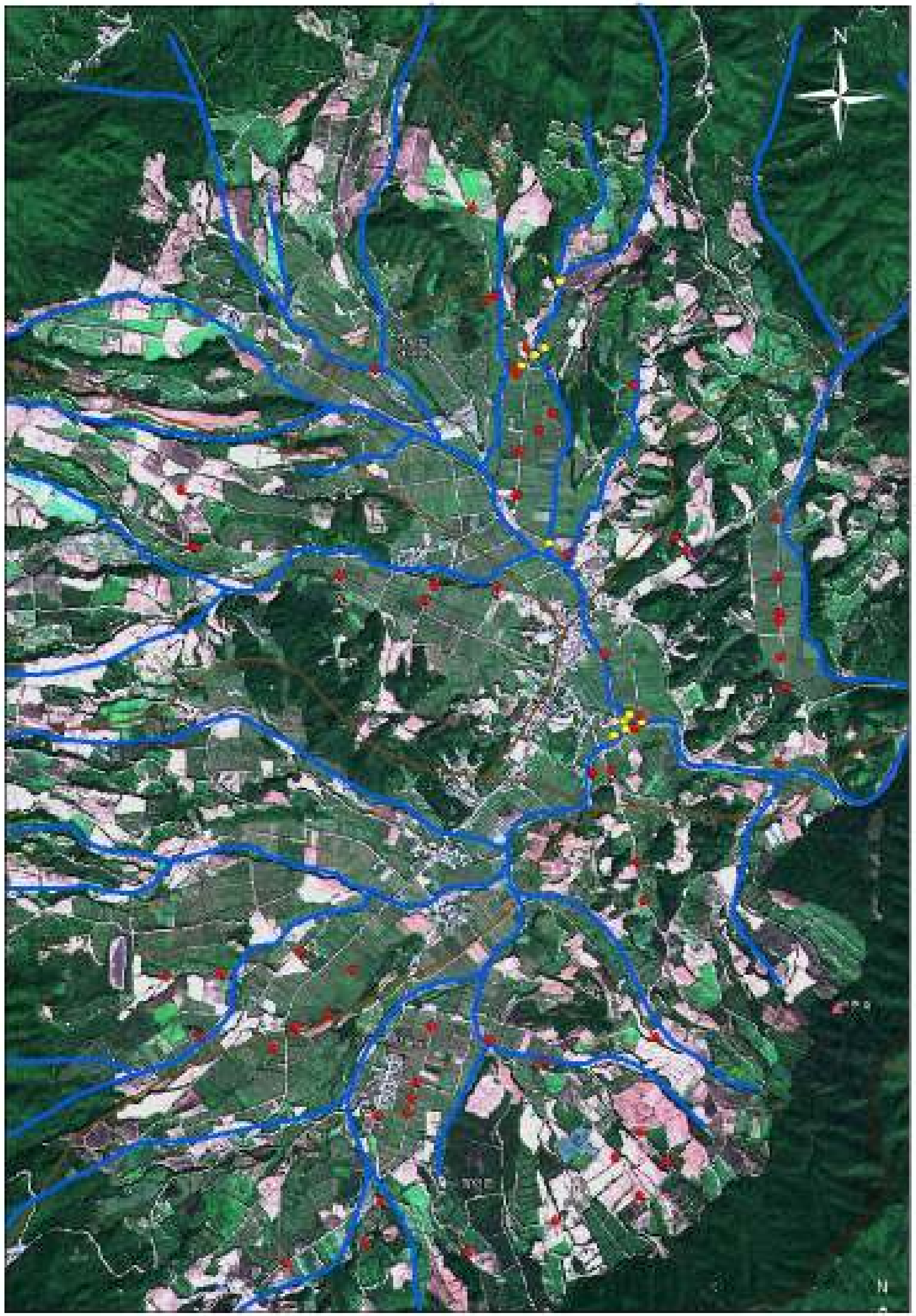
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