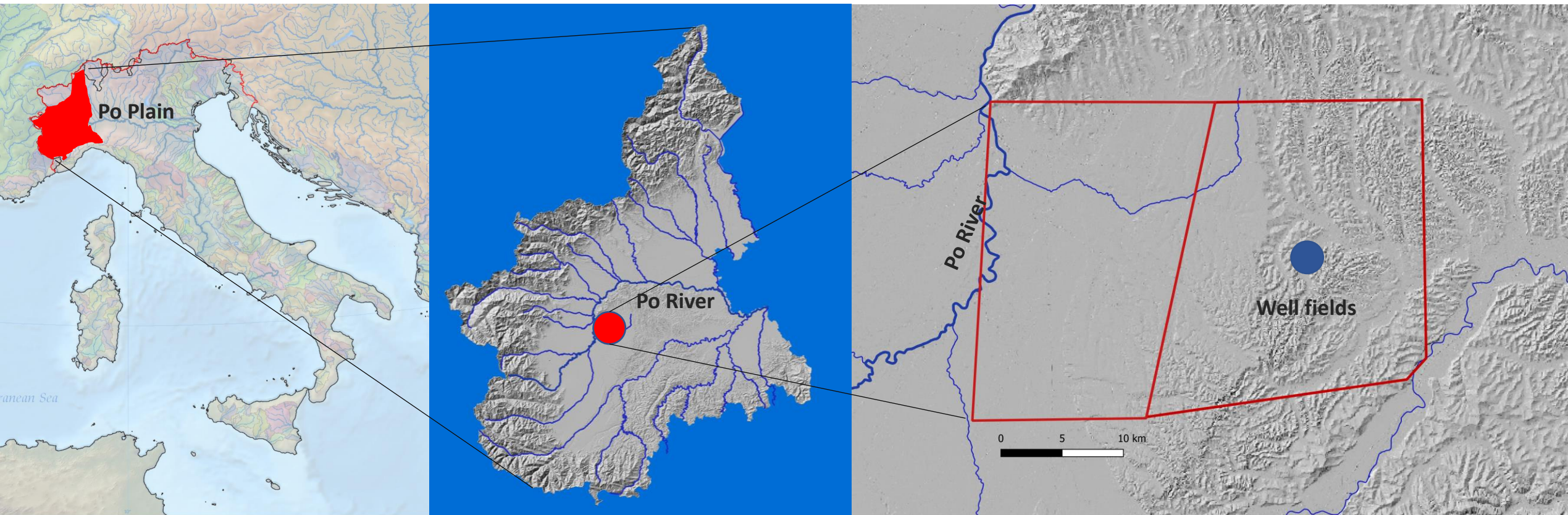


HYDROCHEMICAL AND ISOTOPIC STUDY OF MAGGIORE VALLEY DEEP AQUIFERS (NW ITALY): EVALUATION OF THE INTERACTIONS WITH THE PO RIVER



Daniele Cocca, Marta Moriondo, Manuela Lasagna, Domenico Antonio De Luca
Department of Earth Sciences, University of Turin
daniele.cocca@unito.it

Study area



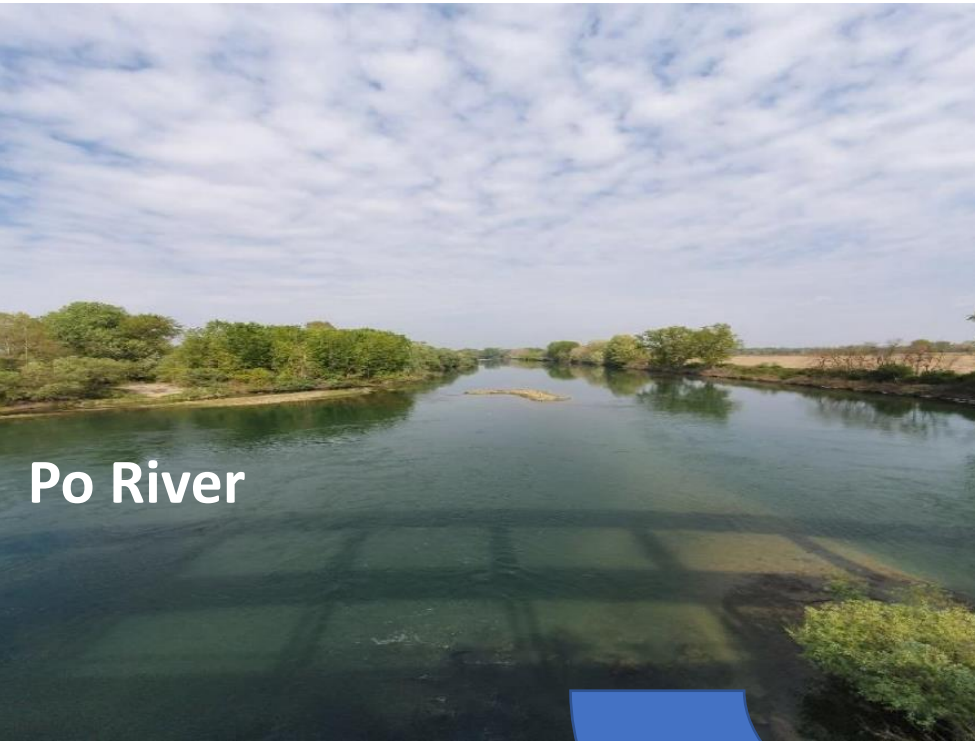
Italy

Piedmont Region

Study area

Introduction

Does an interaction between the Po River and the unconfined and confined aquifers?



Po River



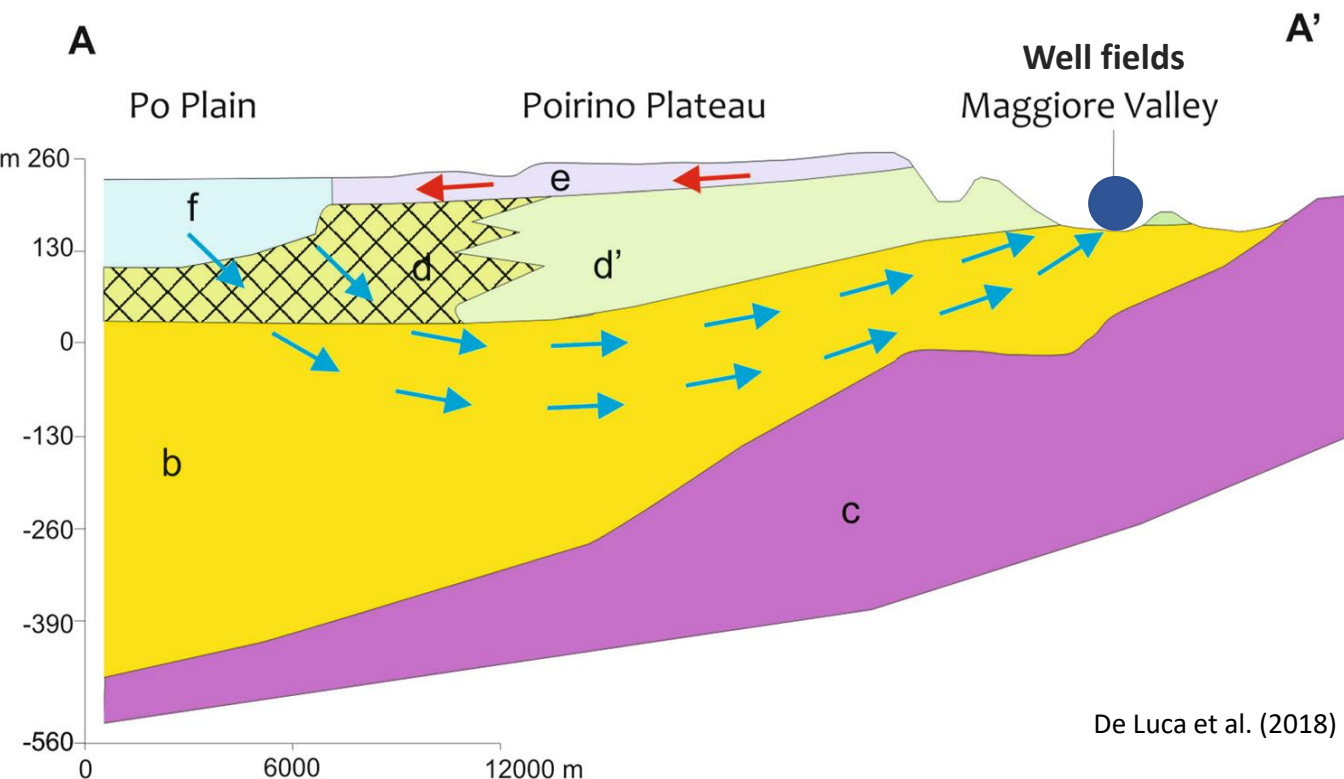
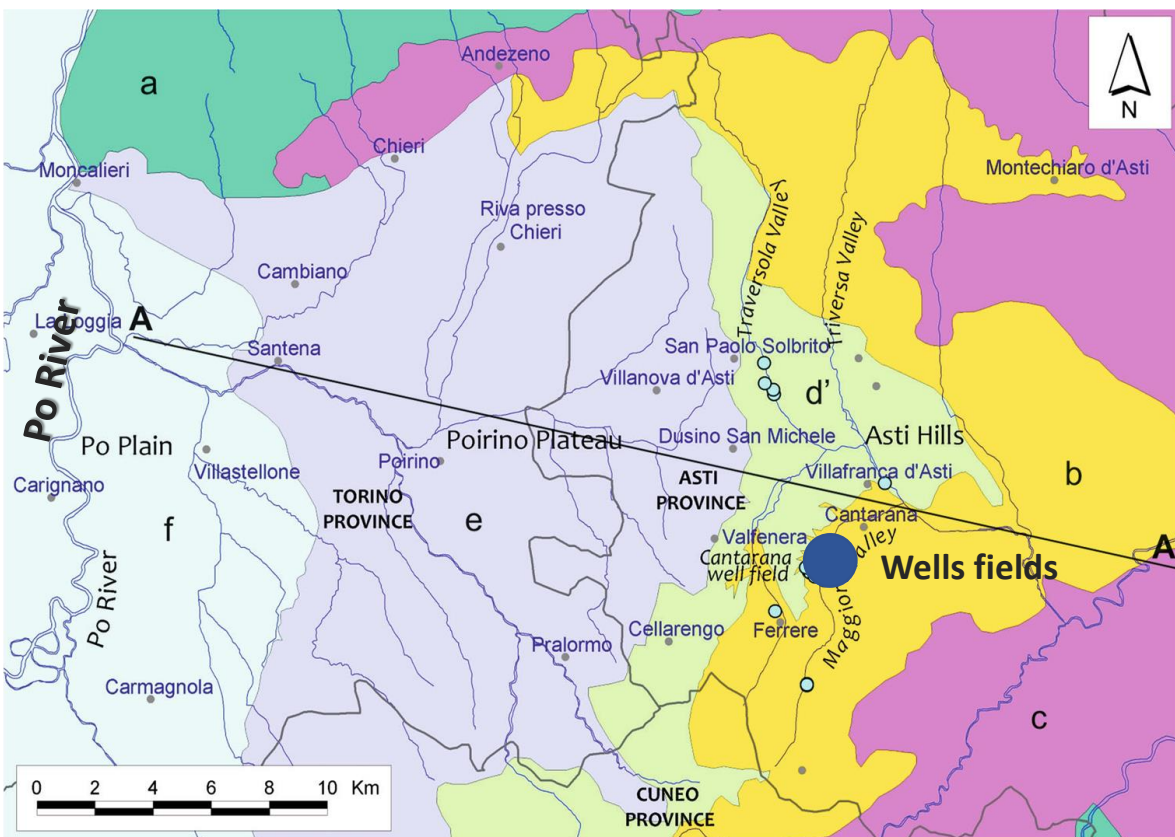
Wells fields













Due to the lack of other relevant sources of drinking water in this part of Piedmont region, this well field represents a drinking water reserve of regional importance.

Study area

Geological-Hydrogeological framework



De Luca et al. (2018)

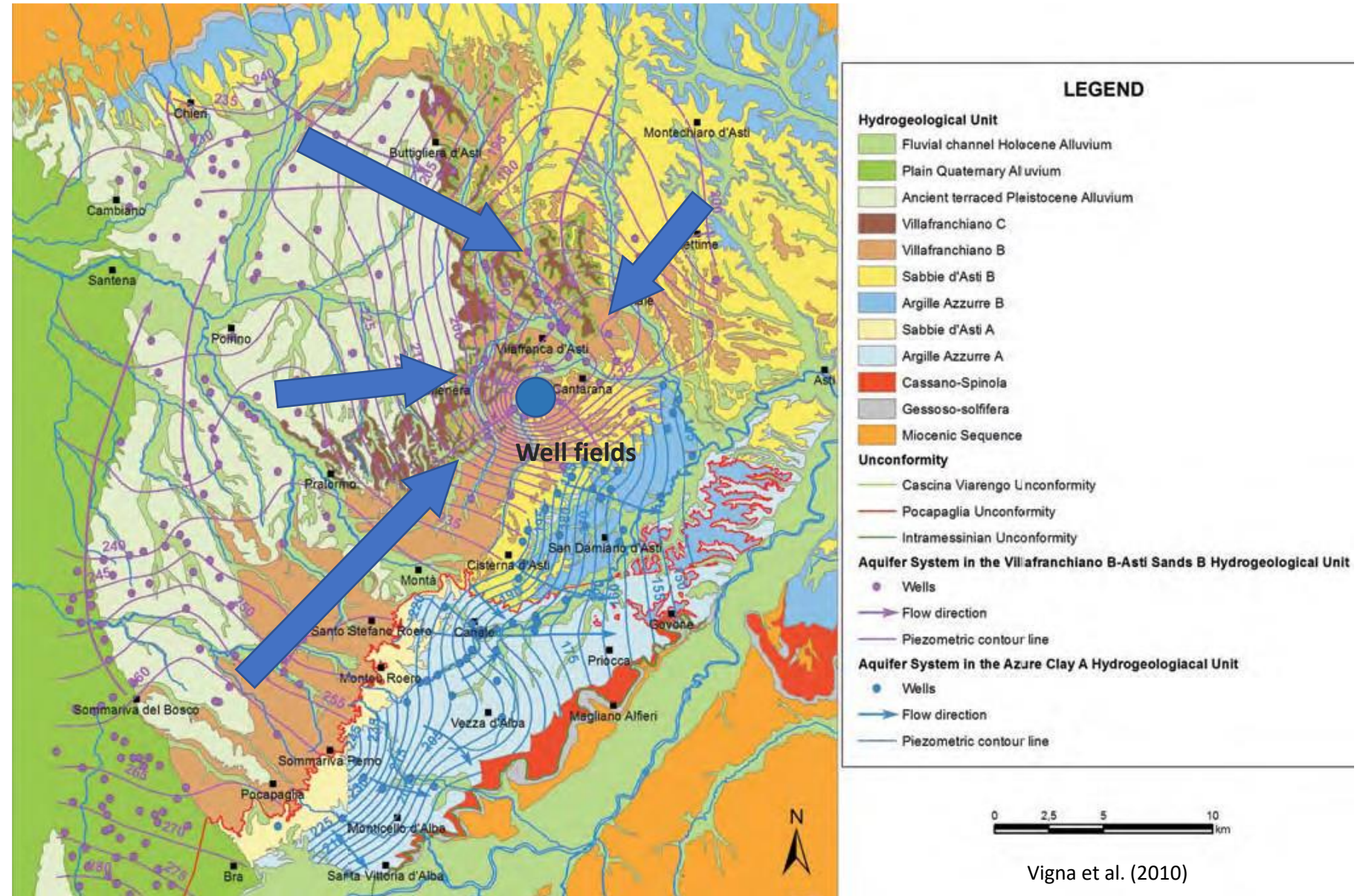
- DESCRIPTION**
-   groundwater flow direction
 -  water well
 -   Middle Pleistocene - Holocene alluvial complex (e = Porino Plateau deposits; f = Po Plain deposits)
 -   Middle Pliocene - Lower Pleistocene villafranchian transitional complex (d = gravel and sand; d' = silt and clay)
 -   Pliocene marine complex (b = Asti Sands; c = Lugagnano Clay)
 -  Pre-Pliocene marine complex

Study area

Geological-Hydrogeological framework

Deep flow converging to the well field area due to the withdrawal.

Excessive withdrawal has created a piezometric level decrease of 60 m in a century



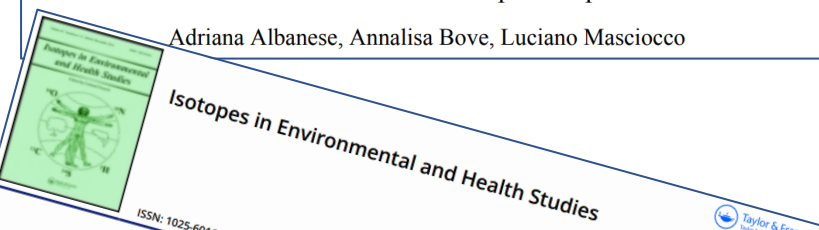
Previous studies

Chemical studies

Giornale di Geologia Applicata 2008, 8 (1) 41-48 - doi: 10.1474/GGA.2008-08.1-04.0199

Differenziazione idrogeochimica e isotopica dei circuiti idrici sotterranei nel settore sud-occidentale della pianura piemontese

Adriana Albanese, Annalisa Bove, Luciano Masciocco



Isotopes in Environmental and Health Studies

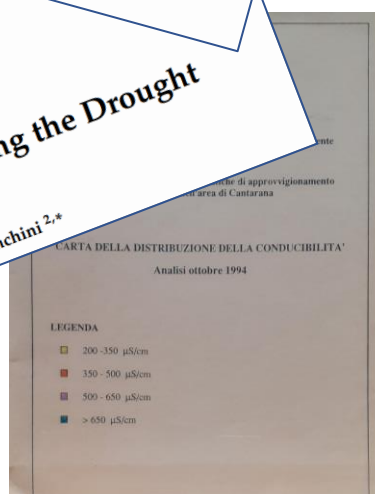
ISSN: 1025-6016 (Print) 1477-2639 (Online) Journal homepage: <http://www.tandfonline.com/loi/gleh20>

Natural and anthropogenic variations in the Po river waters (northern Italy): insights from a multi-isotope approach

Chiara Marchina, Gianluca Bianchini, Kay Knoeller, Claudio Natali, Maddalena Pennisi & Nicolò Colombani

water
Article
The Po River Water Isotopes during the Drought Condition of the Year 2017

Chiara Marchina¹, Claudio Natali² and Gianluca Bianchini^{2,*}



Other studies

Environmental Earth Sciences (2018) 77:19
<https://doi.org/10.1007/s12665-017-7218-0>

ORIGINAL ARTICLE



Effectiveness of geophysical surveys for water wells relocation in overexploited aquifers (the example of Maggiore and Traversola Valleys, Northwestern Italy)

Domenico Antonio De Luca¹ · Cesare Comina¹ · Manuela Lasagna¹ · Enrico Destefanis¹ · Luciano Masciocco¹ · Alberto Godio² · Stefano Stocco³

Bull Eng Geol Environ (2014) 73:341–355
DOI 10.1007/s10064-013-0500-9

ORIGINAL PAPER

Simulation modelling for groundwater safety in an overexploitation situation: the Maggiore Valley context (Piedmont, Italy)

Manuela Lasagna · Caterina Caviglia · Domenico Antonio De Luca



CONVENZIONE
TRA IL DIPARTIMENTO DI SCIENZE DELLA TERRA
DELL'UNIVERSITÀ DEGLI STUDI DI TORINO
E L'AUTORITÀ D'AMBITO N°5 ASTIGIANO MONFERRATO

PROSECUZIONE, INTEGRAZIONE ED APPROFONDIMENTO DELLO STUDIO DELLA
FALDA IDRICA SOTTERRANEA DI VALLE MAGGIORE (CANTARANA) PER LA
DEFINIZIONE DELLE AREE DI SALVAGUARDIA DELLE CAPTAZIONI
ACQUEDOTTISTICHE E PER LA RAZIONALIZZAZIONE DEI PRELIEVI
IDROPOTABILI
Relazione sul primo anno di attività

Relations between stratigraphy, groundwater flow and hydrogeochemistry in Poirino Plateau and Roero areas of the Tertiary Piedmont Basin, Italy
Rapporti tra assetto stratigrafico, idrogeologia e idrogeochimica nel settore compreso tra l'Altopiano di Poirino e il Roero (Bacino Terziario Piemontese, Italia)

Mem. Desc. Carta Geol. d'It.
XC (2010), pp. 267-292,
figg. 16

VIGNA B. (*), FIORUCCI A. (*), GHIELMI M. (**)

Unpublished groundwater isotopic data

Franchino 2014

Sangiovanni 2016

Data

Sampling March 2021 and June 2021

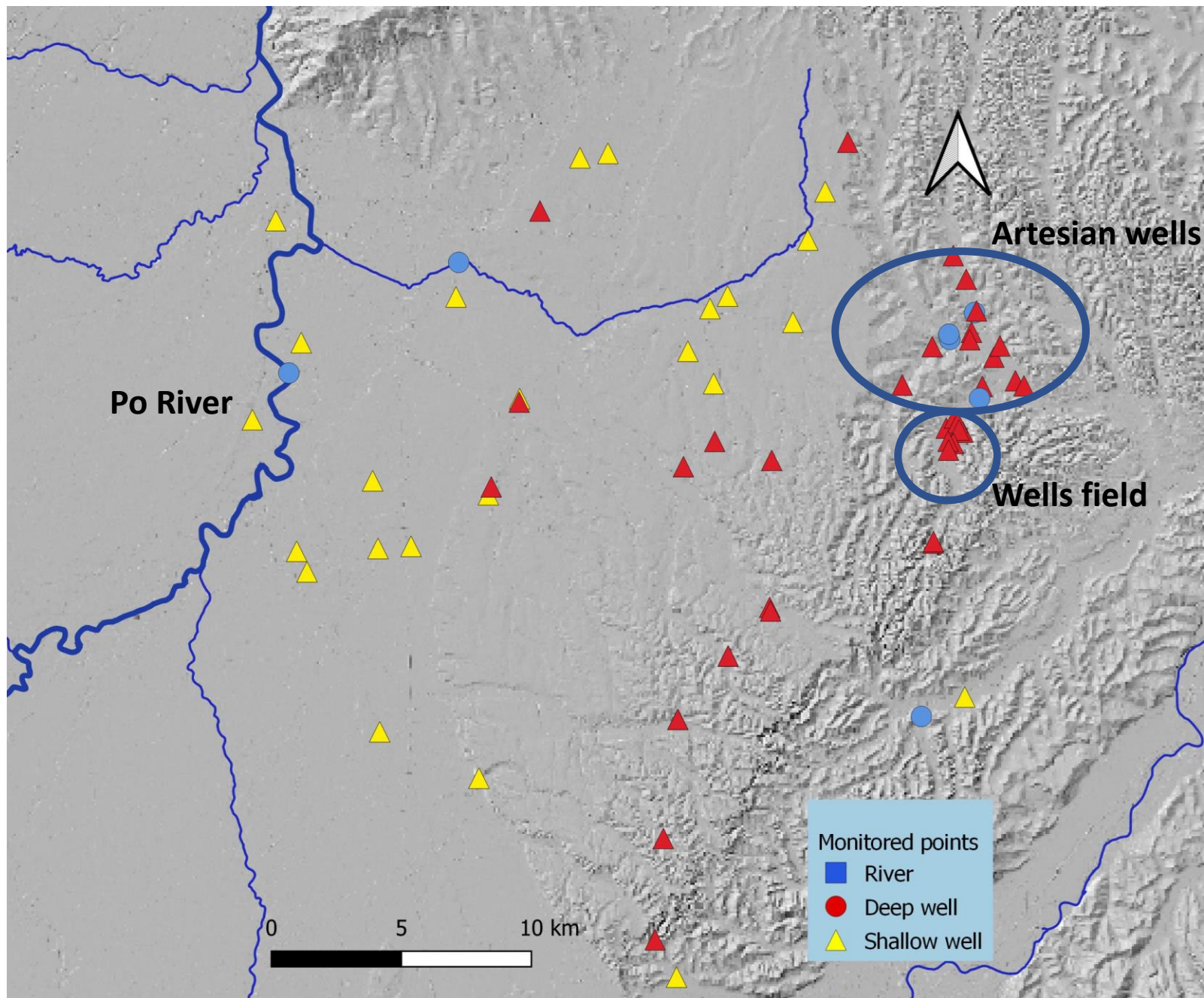
128 chemical analyzes

Chemical monitored points

Shallows wells

Deep wells

Rivers



Data

Sampling March 2021 and June 2021

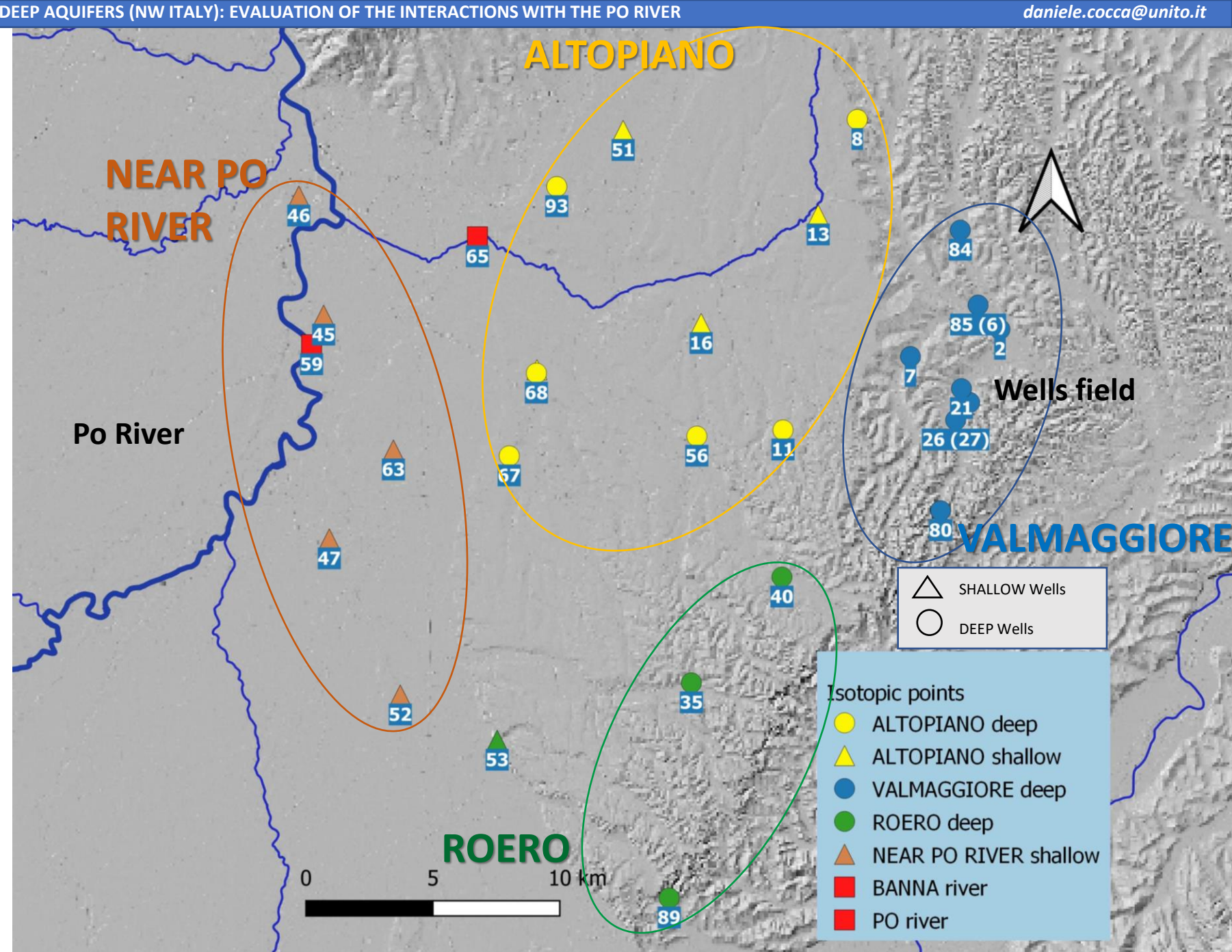
50 isotopic analyzes ($\delta^{18}\text{O}/\delta^2\text{H}$)

Isotopic monitored points

Shallows wells

Deep wells

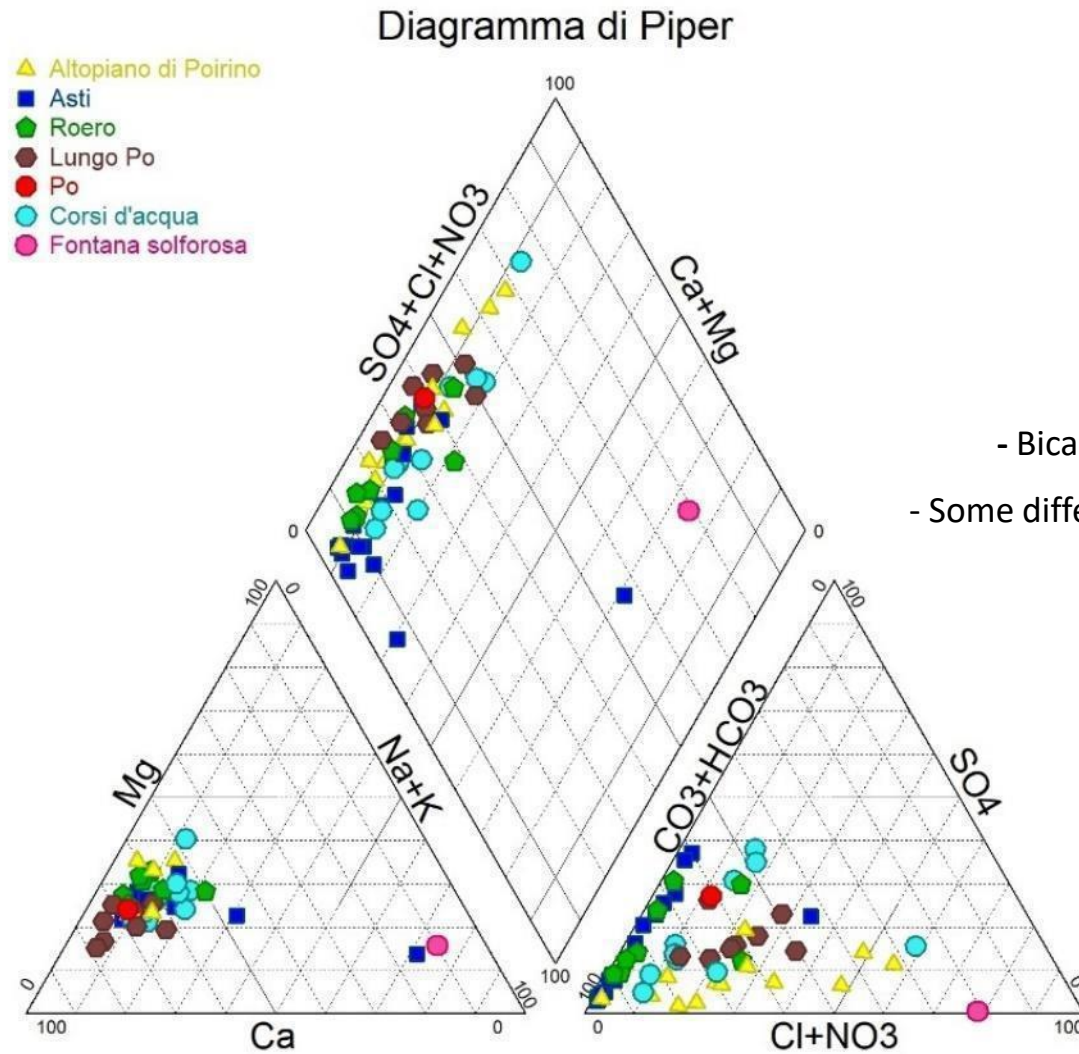
Rivers



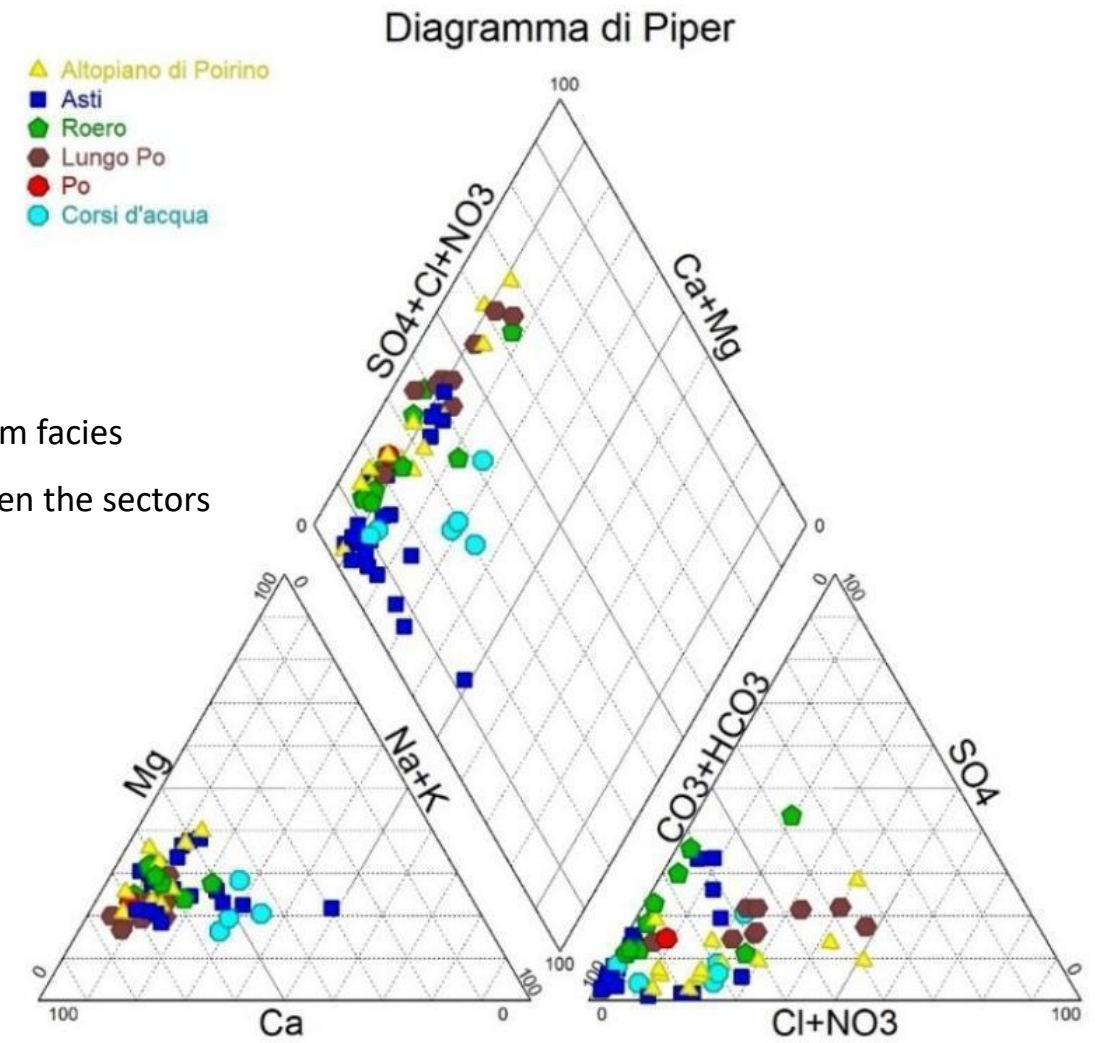
Chemical results

Piper

I campaign (March 2021)



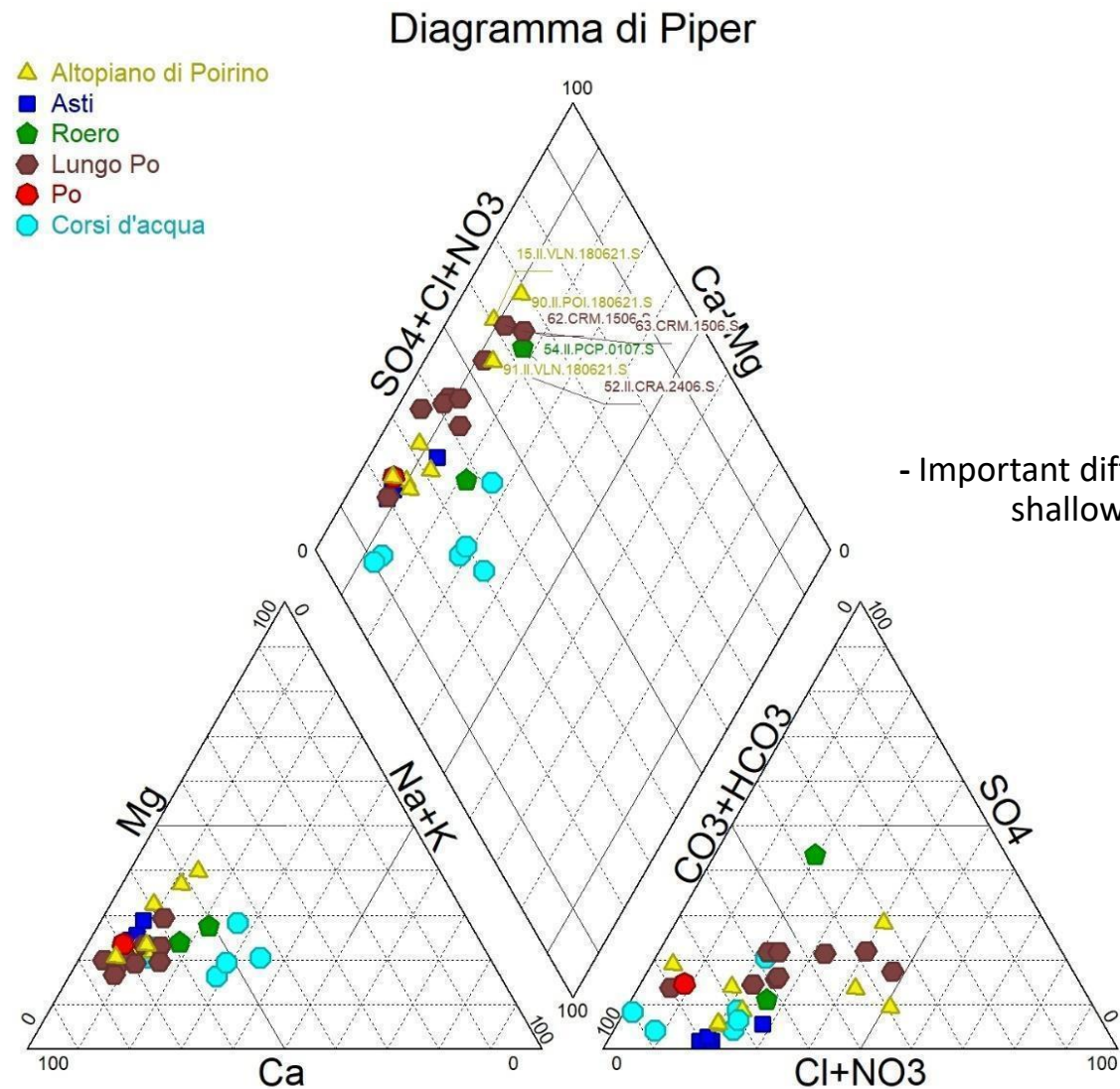
II campaign (June 2021)



Chemical results

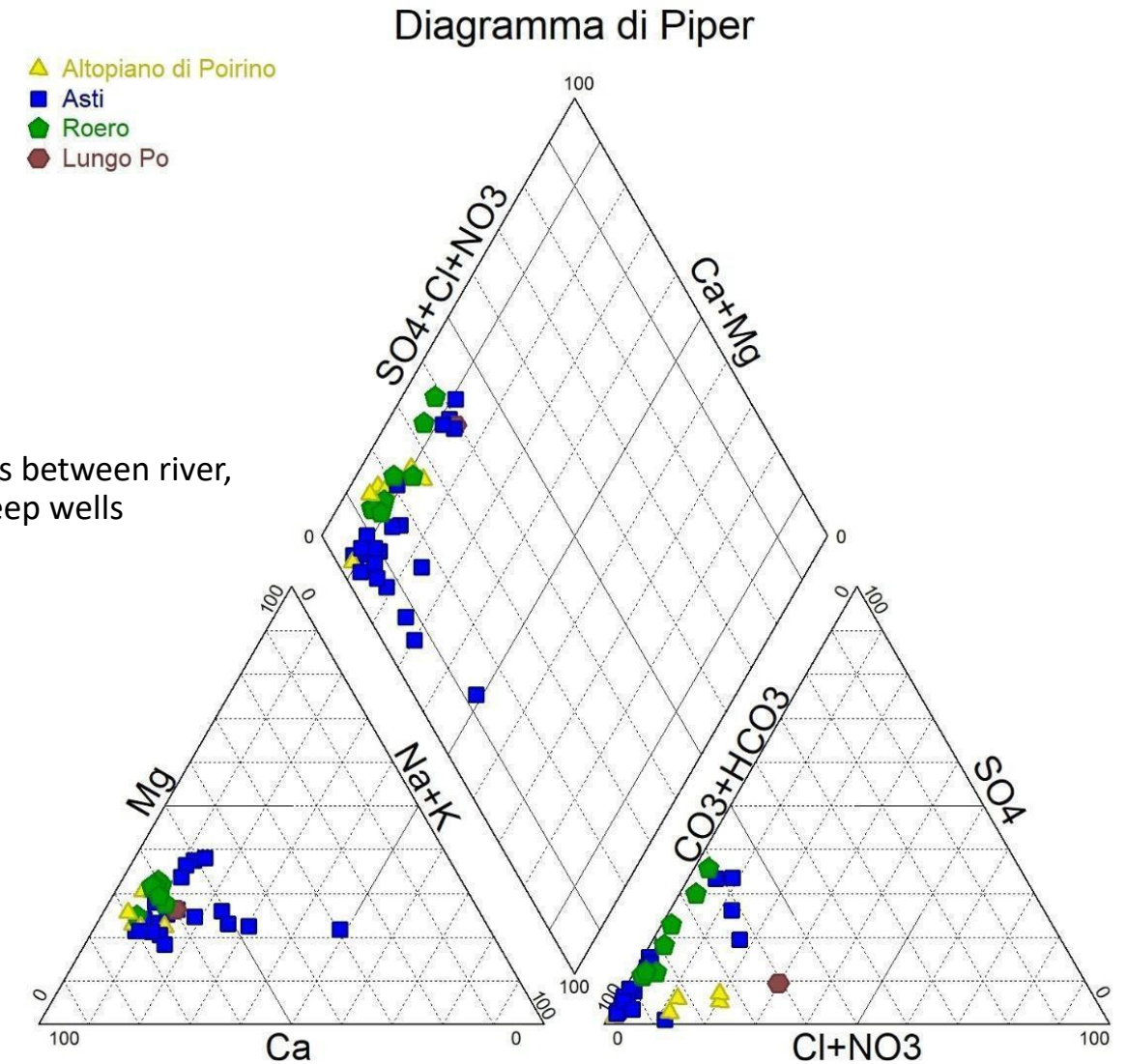
Piper

Shallow wells - River



- Important differences between river, shallow and deep wells

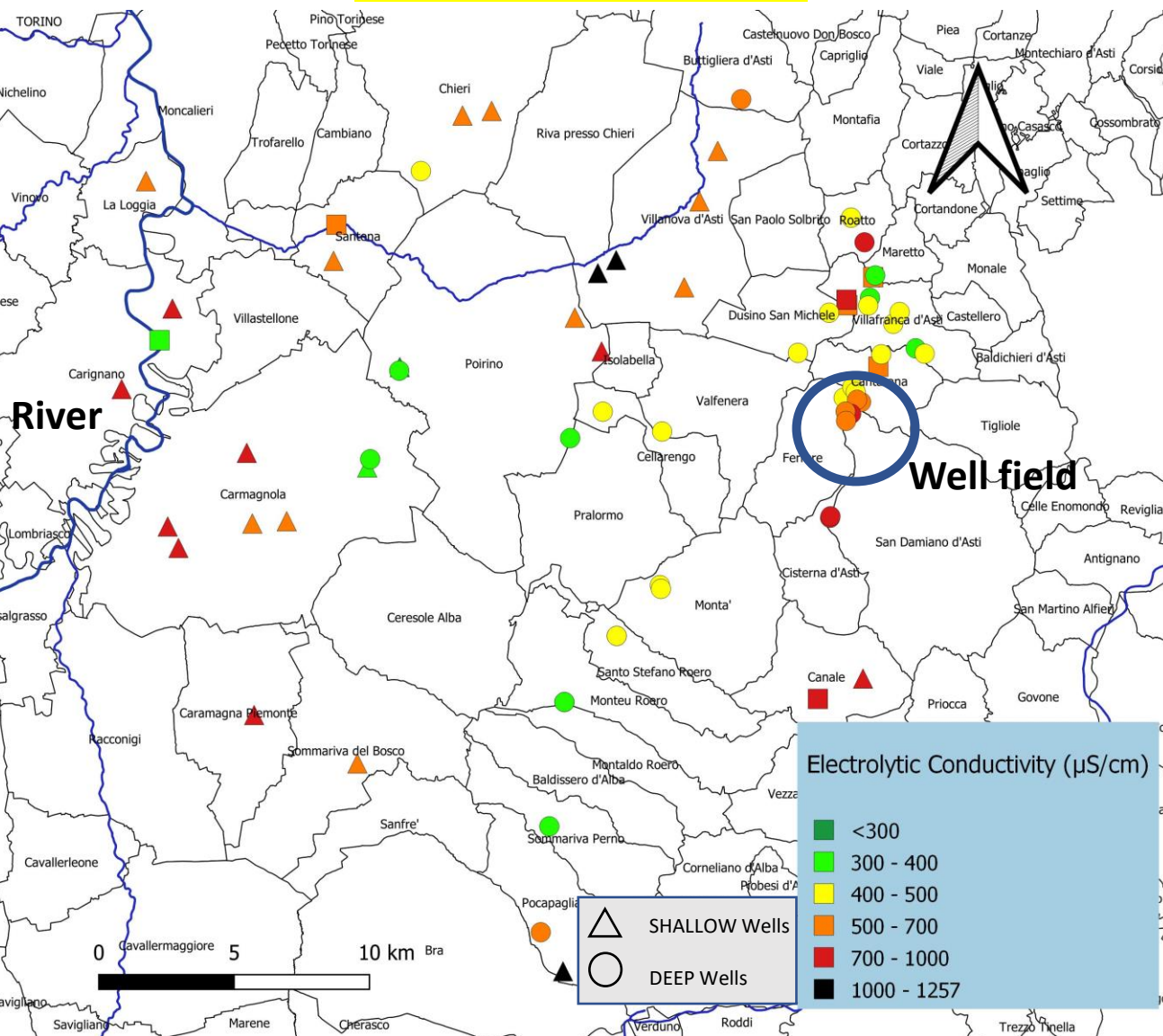
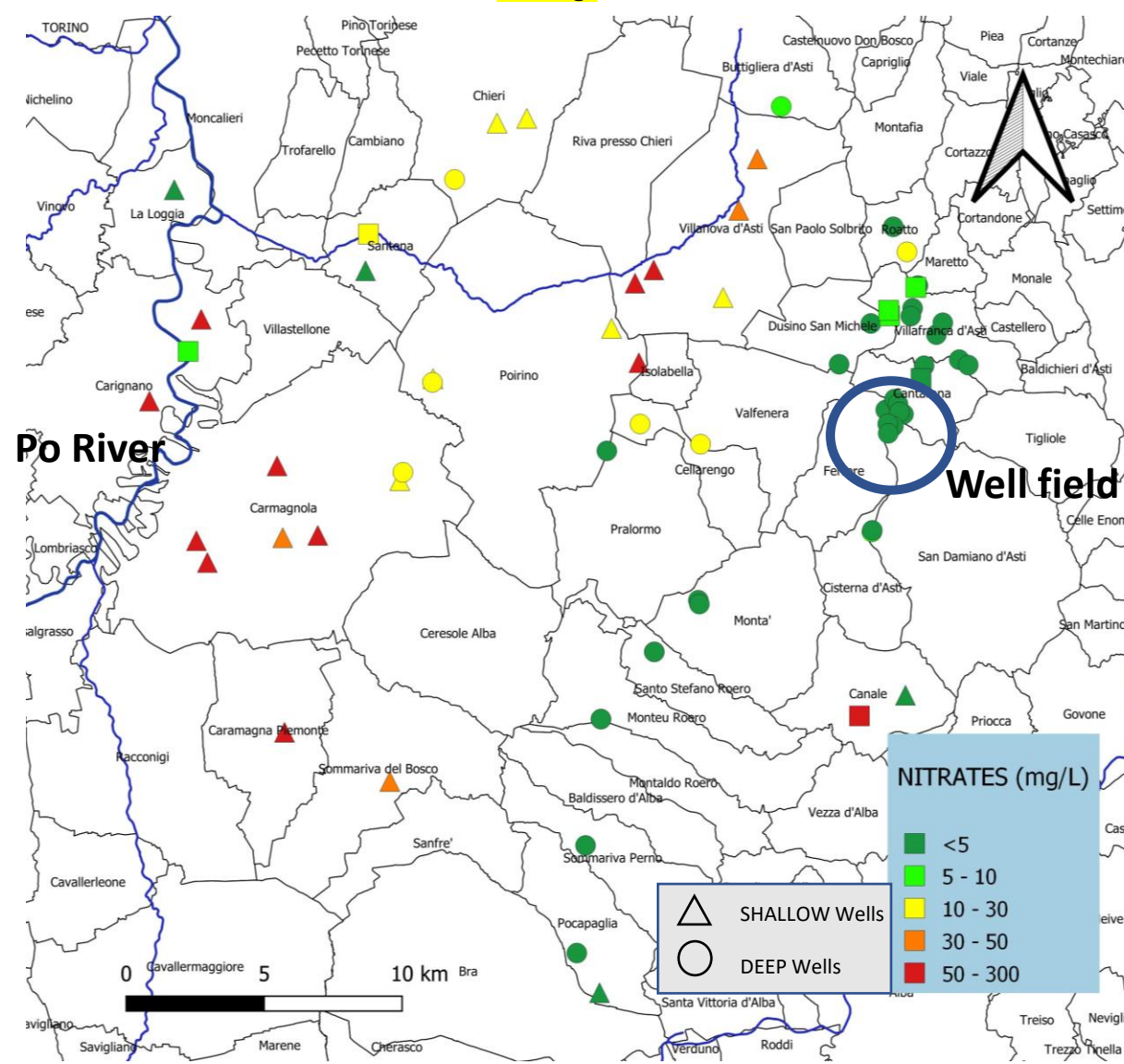
Deep wells



Chemical results

Areal distribution

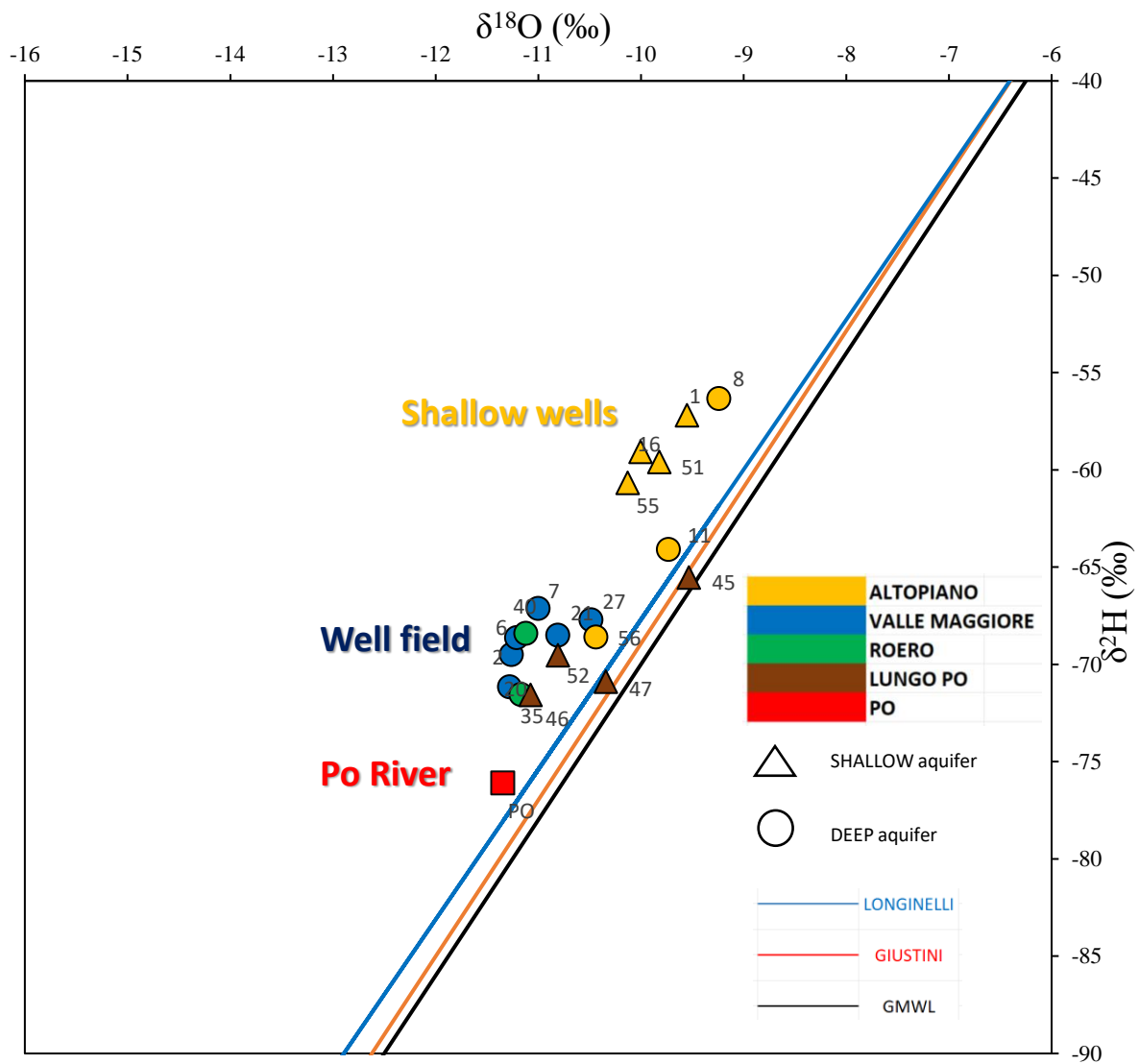
Electrolytic conductivity

 NO_3^- 

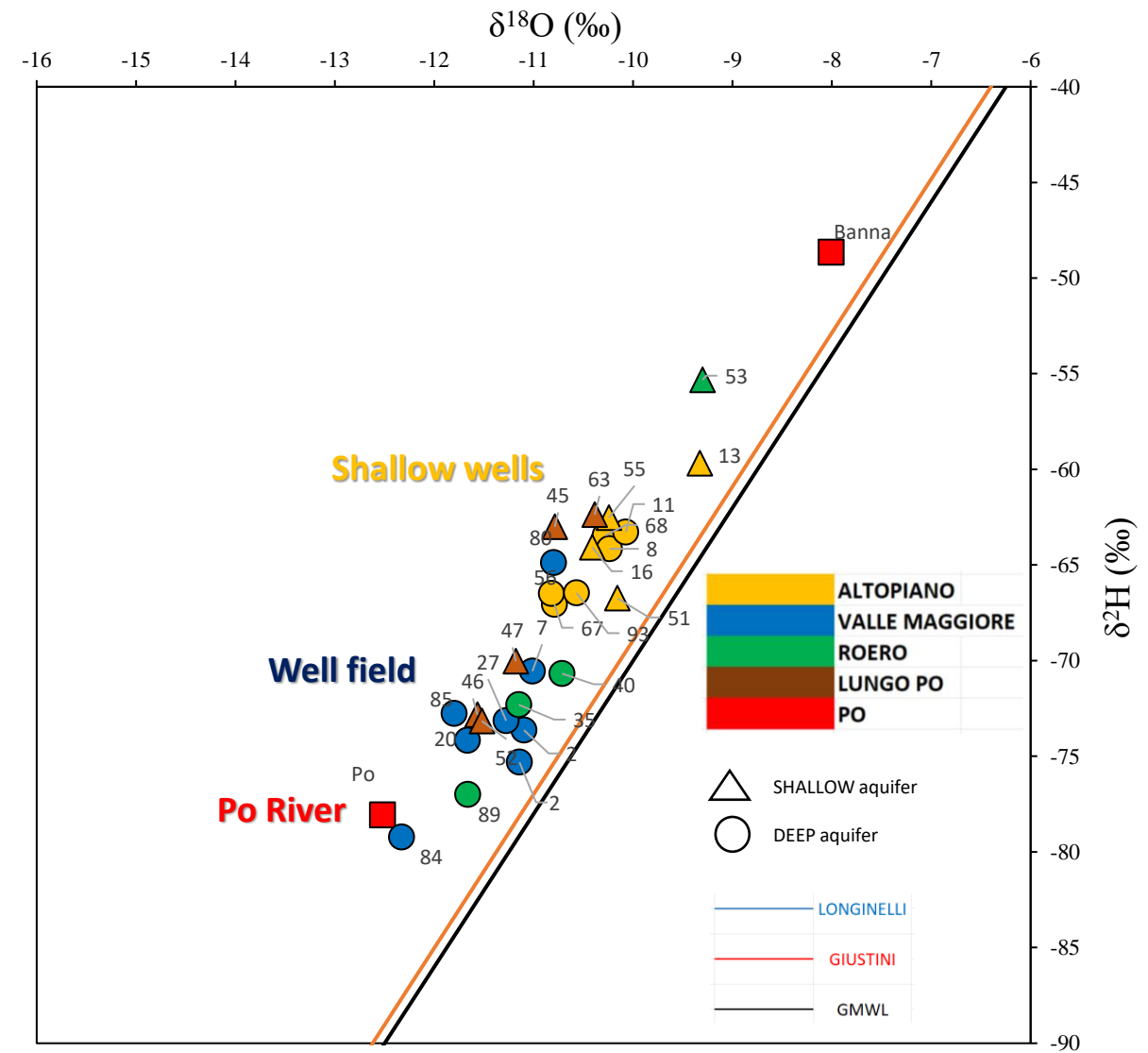
Isotopic results

 $\delta^{18}\text{O}/\delta^2\text{H}$

I campaign (March 2021)



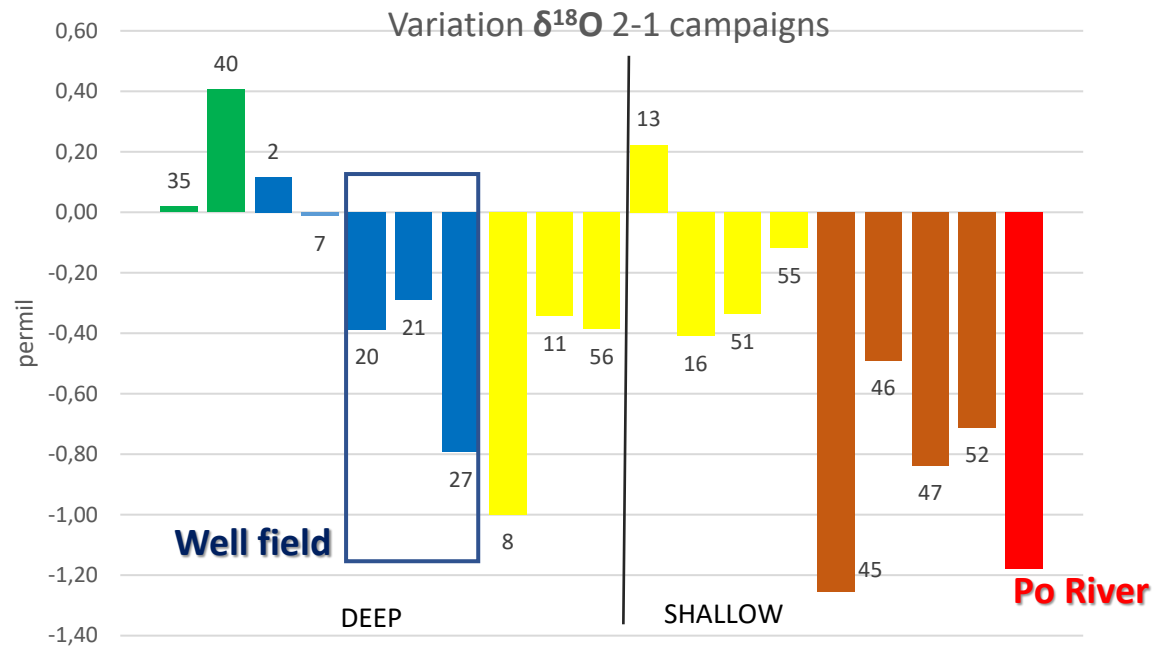
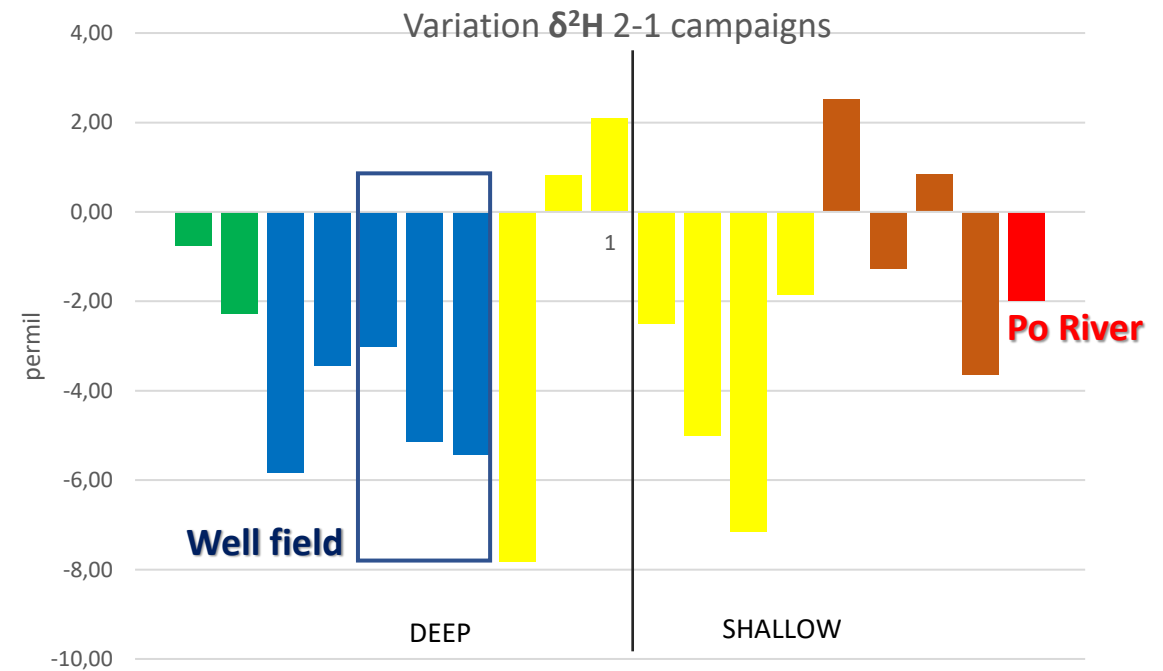
II campaign (June 2021)



- Important differences between river, shallow and deep wells

Isotopic results

Time variation

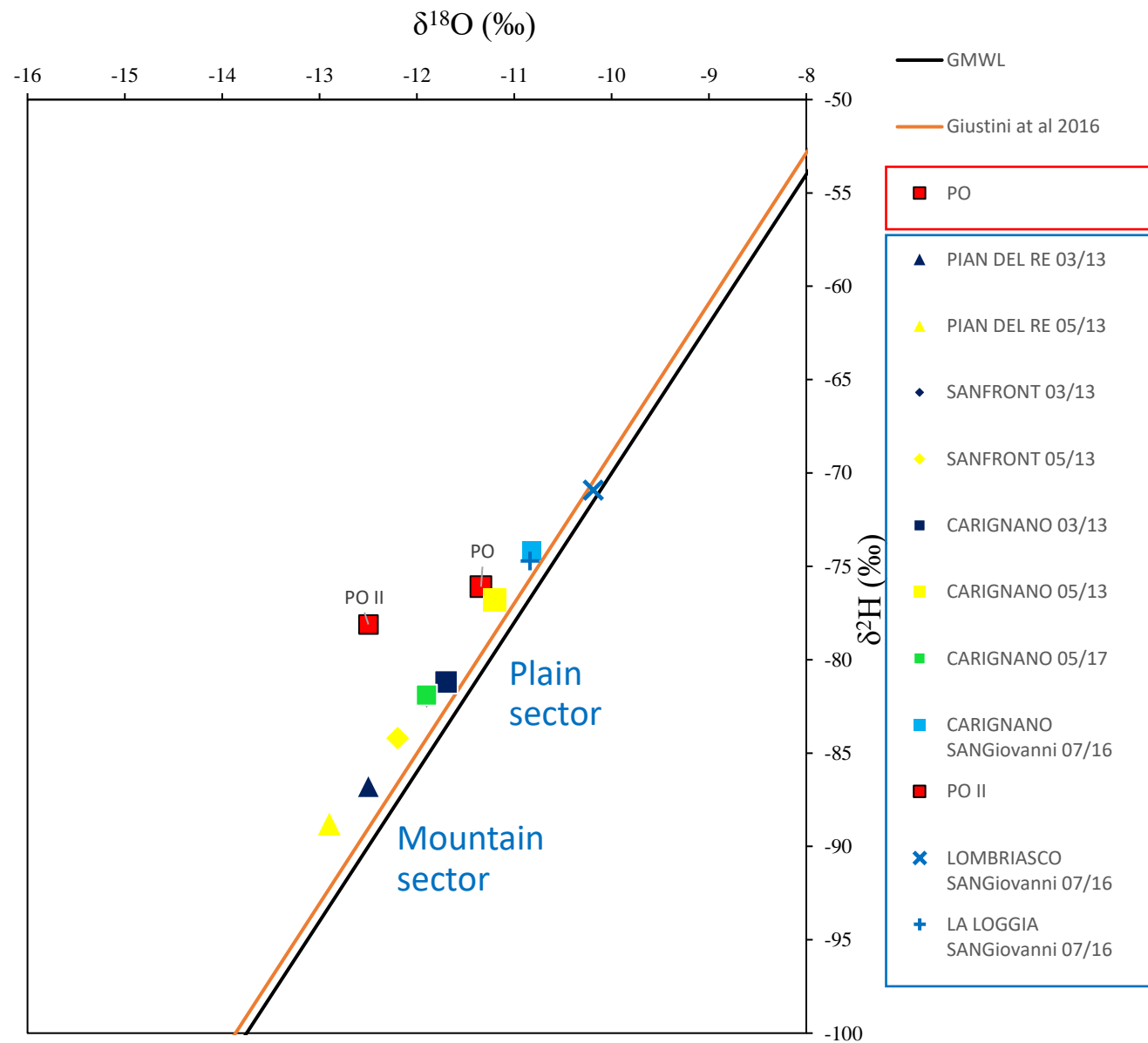
 $\delta^{18}\text{O}$

 $\delta^2\text{H}$


Isotope signal negativization in June compare to March (opposite trend to precipitation)

Po River similar to shallow wells

Isotopic results

Comparison Po River



Our data

Previous data

(Marchina et al. 2016,
Marchina et al. 2019,
Sangiovanni, 2016)

Isotopic results

Comparison Groundwater data

Deep confined aquifers

Progressive isotope signal positivization due to the interaction with the more positive shallow unconfined aquifer

1 VARIATION OF THE ISOTOPIC SIGNAL ALONG THE DEEP CONFINED WATER FLOW (MAX-MIN)

3 pozzi Superficiali
H -86,31 / -80,80
O18 -12,34 / -11,67

CUNEO

4 pozzi Profondi
H -82,30 / -74,86
O18 -12,06 / -10,93

FOSSANO - BENE VAGIENNA - GENOLA

2 pozzi Profondi
H -74,35 / -68,82
O18 -10,93 / -10,37

BRA - CAVALLERMAGGIORE - RACCONIGI



2 VARIATION OF THE ISOTOPIC SIGNAL ALONG THE DEEP CONFINED WATER FLOW (MAX-MIN)

H -77,0
O18 -11,66

POCAPAGLIA

H -72,3 (-71,54 | Camp)
O18 -11,1 (-11,17 | Camp)

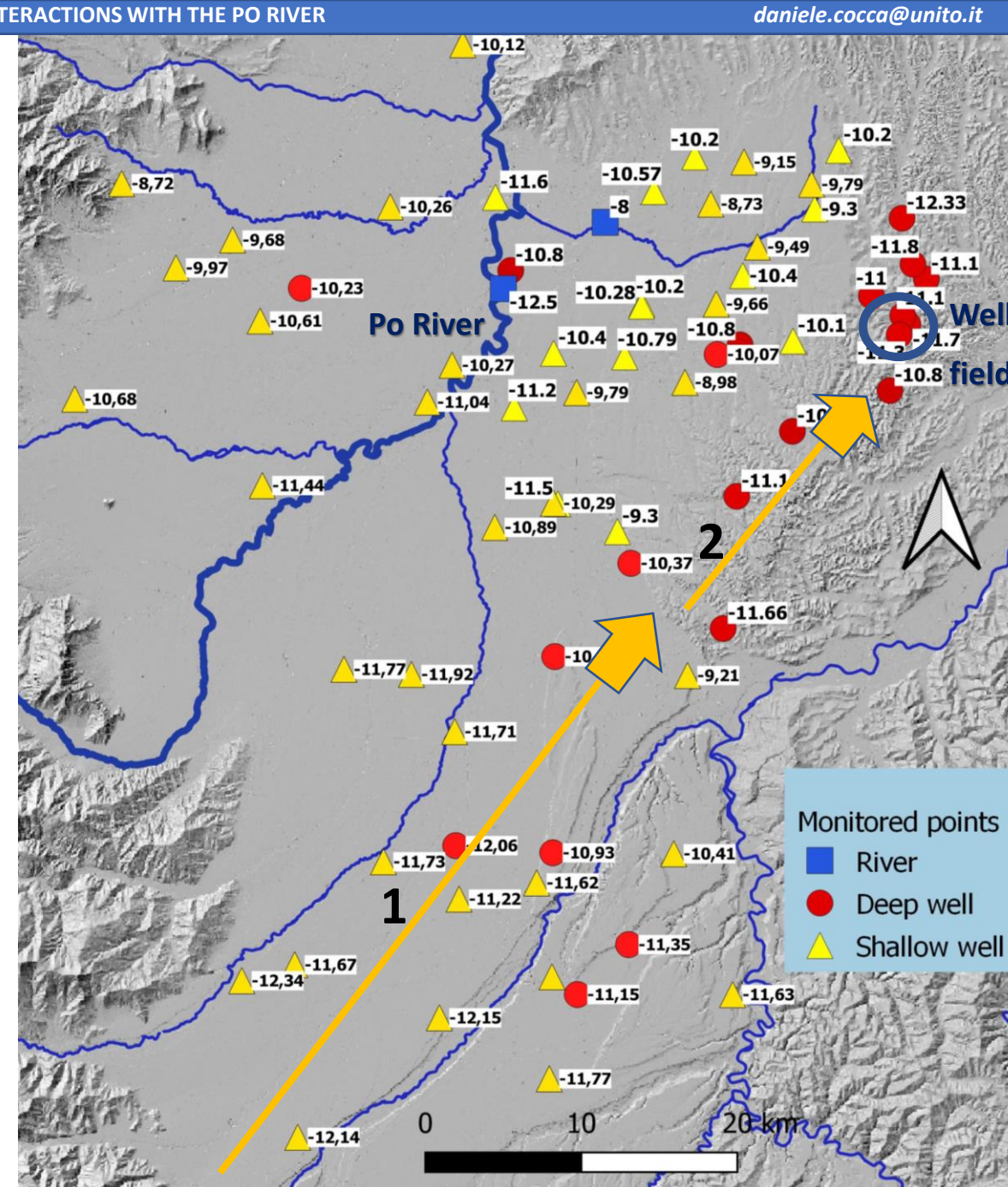
MONTEU ROERO

H -70,7 (-68,4 | Camp)
O18 -10,7 (-11,12 | Camp)

MONTA'

H -64,88
O18 -10,80

CISTERN D'ASTI



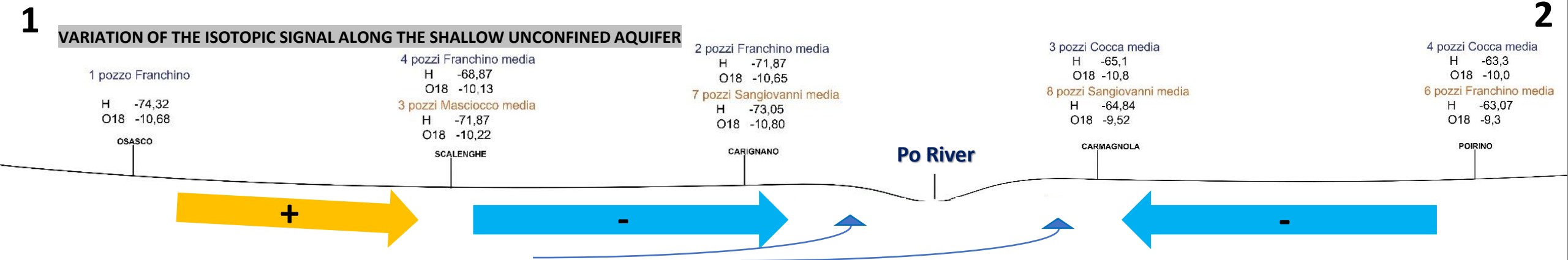
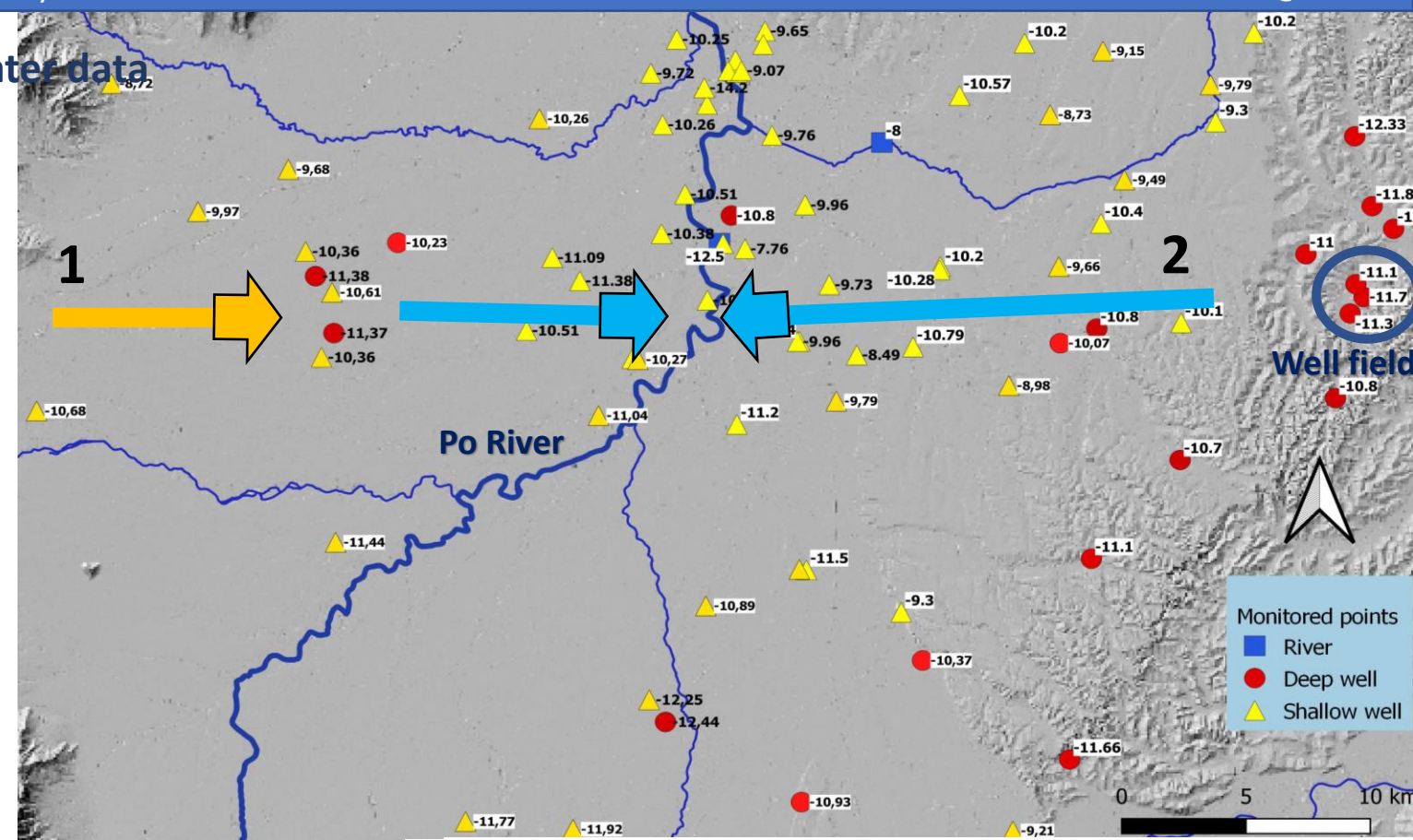
Isotopic results

Comparison Groundwater data

Shallow unconfined aquifers

Initial isotope signal positivization, subsequent negativization near to the Po River.

mixing with the deep aquifer groundwater under pressure due to the absence of impermeable levels separation



Conclusion

Does an interaction between the Po River and the unconfined and confined aquifers?

- Lack of evidence in chemical-physical analyzes (Electrolitic conductivity, Nitrates, Chlorides)
- Progressive isotope signal positivization of the deep confined aquifer linked to a interaction with the shallow aquifers
- Isotope signal negativization of the shallow aquifer in correspondence with the Po River connected to a dilution with the deeper aquifers under pressure, allowed by the aquicludes absence
- Although some wells in the well fields have isotopic signals similar to the Po River, it is hypothesized to be linked to mixing with very negative groundwater (high depths)

Po River

The interaction between the Po River and deep aquifers is possible due to the reduced difference in the isotopic signal between the two end-members.

The study provides an additional tool for a better groundwater management and protection of a regional importance drinking water reserve.



Wells fields





Thank you for the attention