

**ChloroKarst project : Interest of chlorophyll-a survey in karst-river relation: a case study in karstic limestones of Ouche valley, Burgundy (France).**



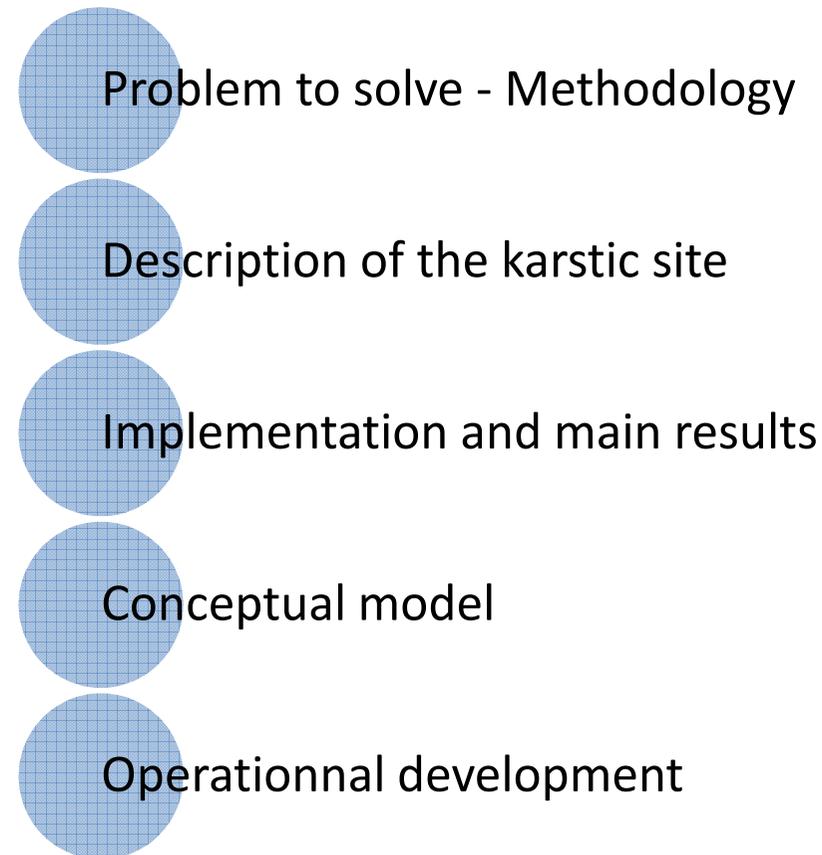
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N. Jozja, CETRAHE  
C. Brossard, HYDREKA  
J. Morris, VALEPORT**





The problem



The site



Implementation and results



Conceptual model

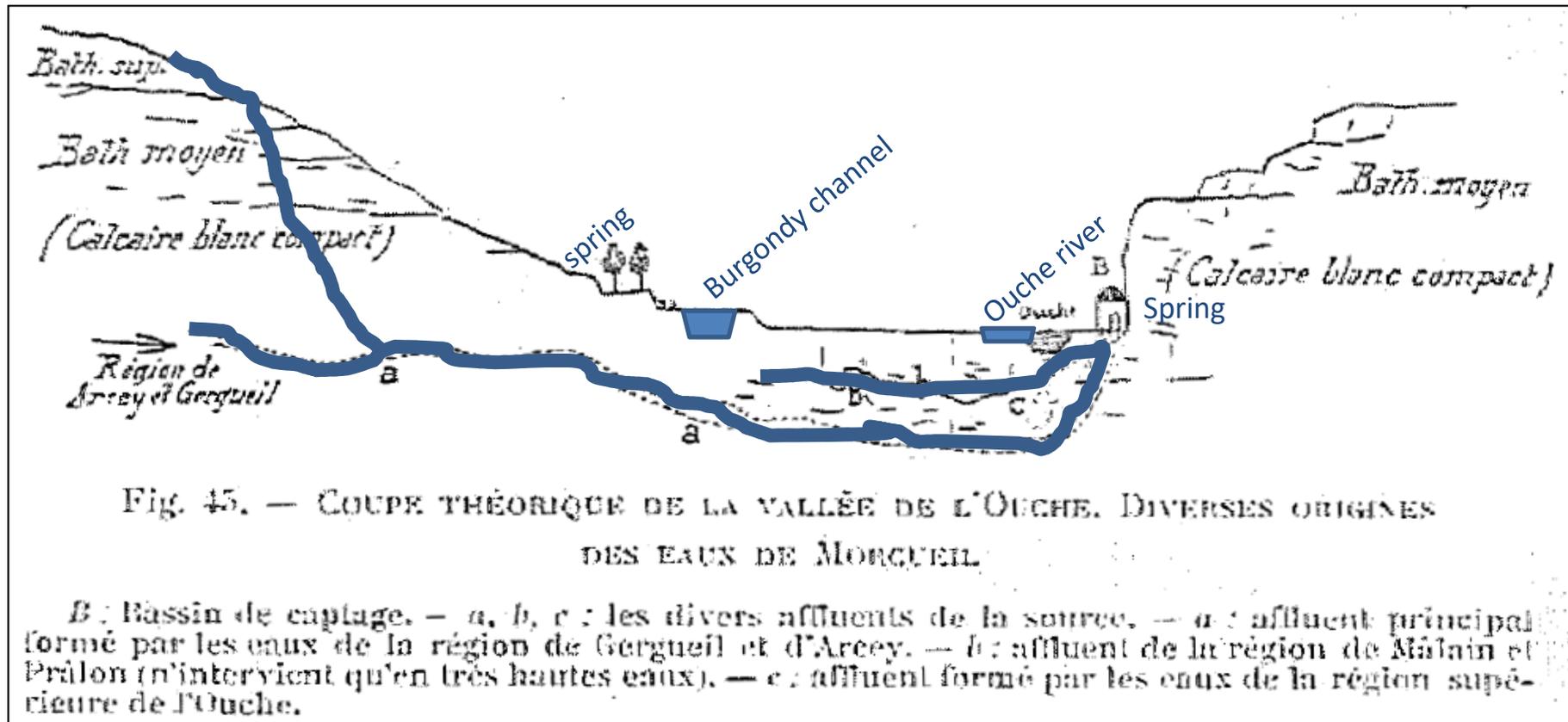


Operational development

## At the beginning : an old hydrogeological problem to solve

- How to highlight mass transfert between surface water and groundwater

Ouche valley karst, from Curtel, 1912





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# Mixed water : obviousness from hydrochemical facies

Water springs have commonly an intermediate facies between river and limestones :

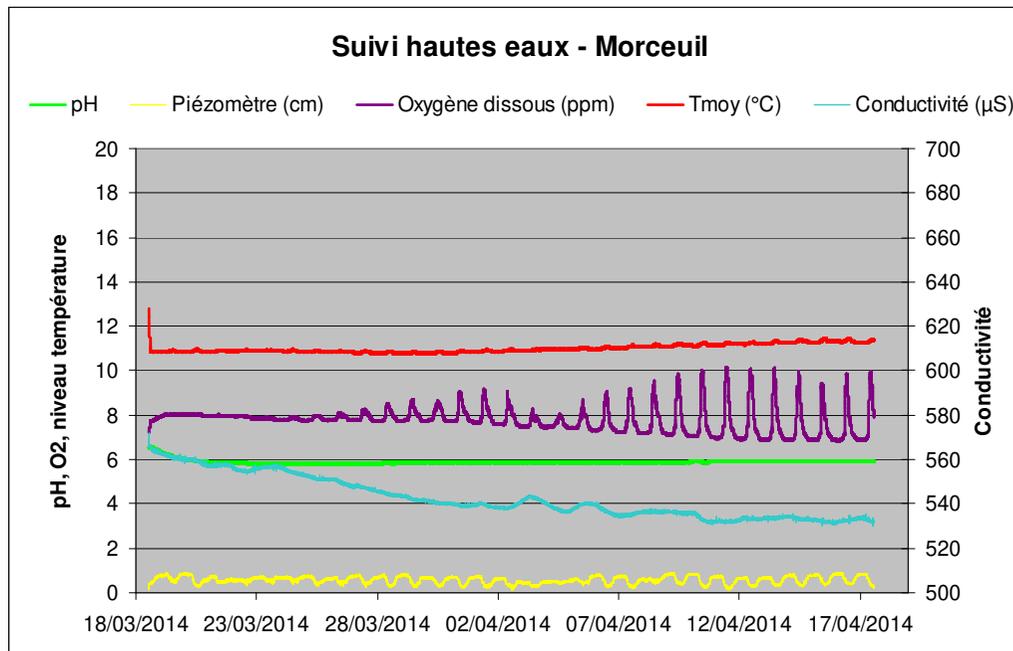
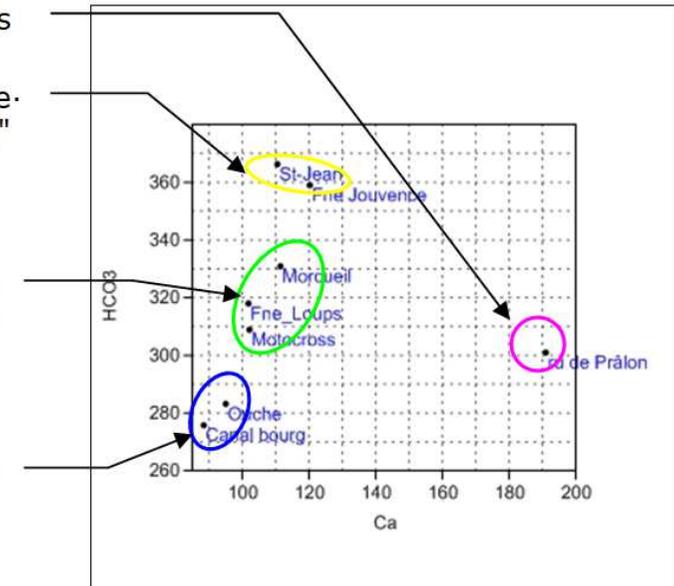
- With day/night variations
- Ch-a : no evidence from a first test

Pôle-Prâlon-Trias

Pôle-  
"Comblanchien"

Pôle-  
intermédiaire

Pôle-rivière





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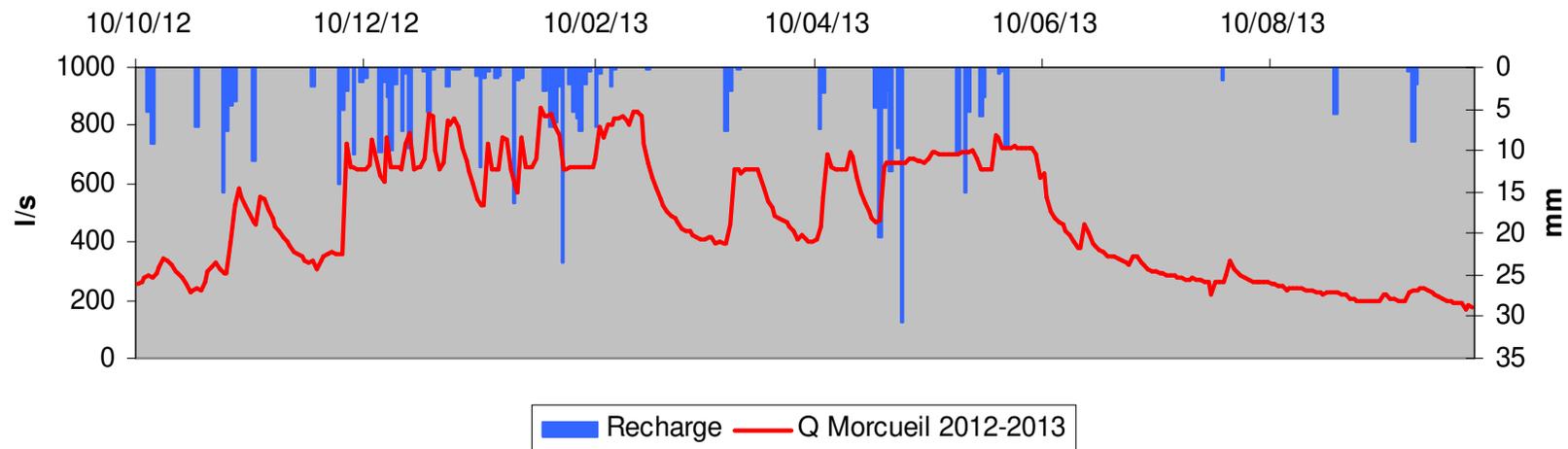
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## No evidence of inversac phenomena from level monitoring

- Pressure variation, karst by-pass, very low hydraulic gradient





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## ChloroKarst project



1- local site : surface water with high Ch-a concentration



2-Local site : karst system with conduit and annex system (SAD)



3-Test a chlorophyll-a probe in groundwater and surface water



4-Evaluation of « inversac » risk



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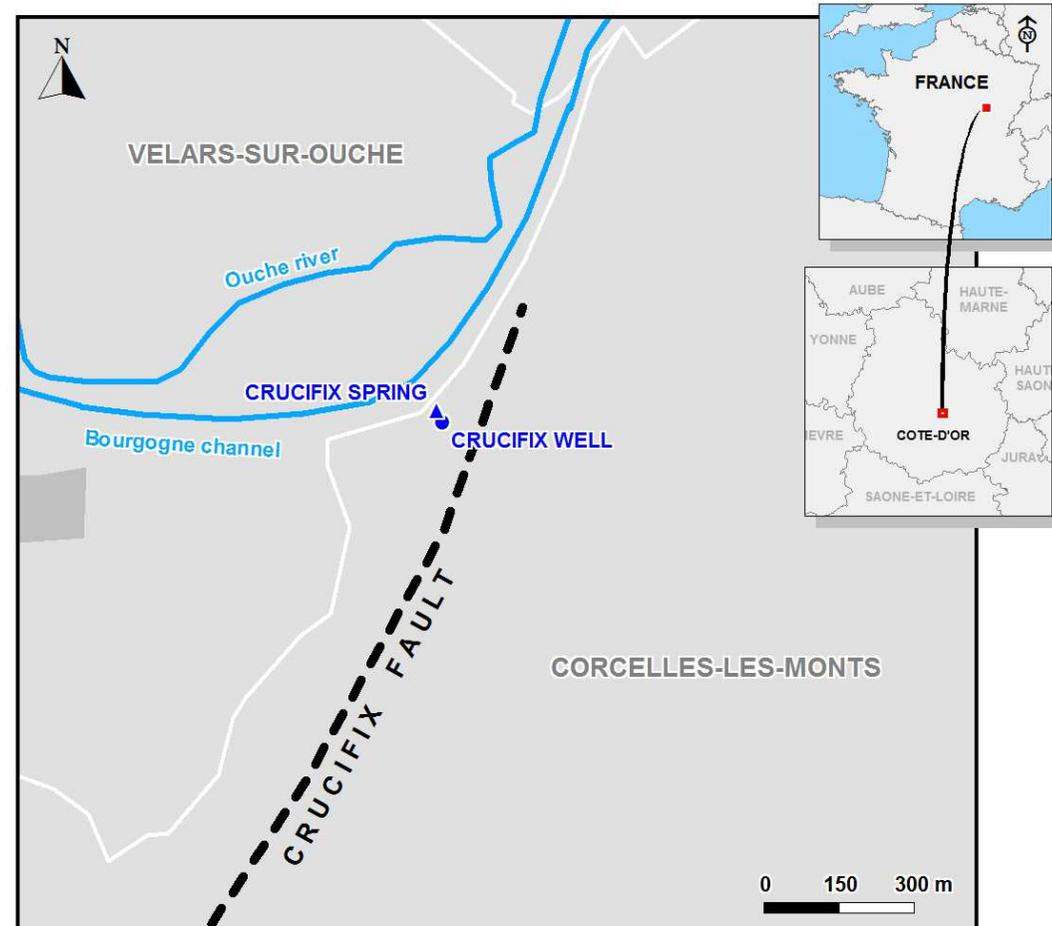
Operational development

The Ouche valley is exploited for drinking water supply,

Crucifix karst : an ideal site for the study of inversac

With :

- Canal de Bourgogne
- Karstic spring on the main conduit (Dijon Metropole resource)
- Waterwell on fissured system (SAD)





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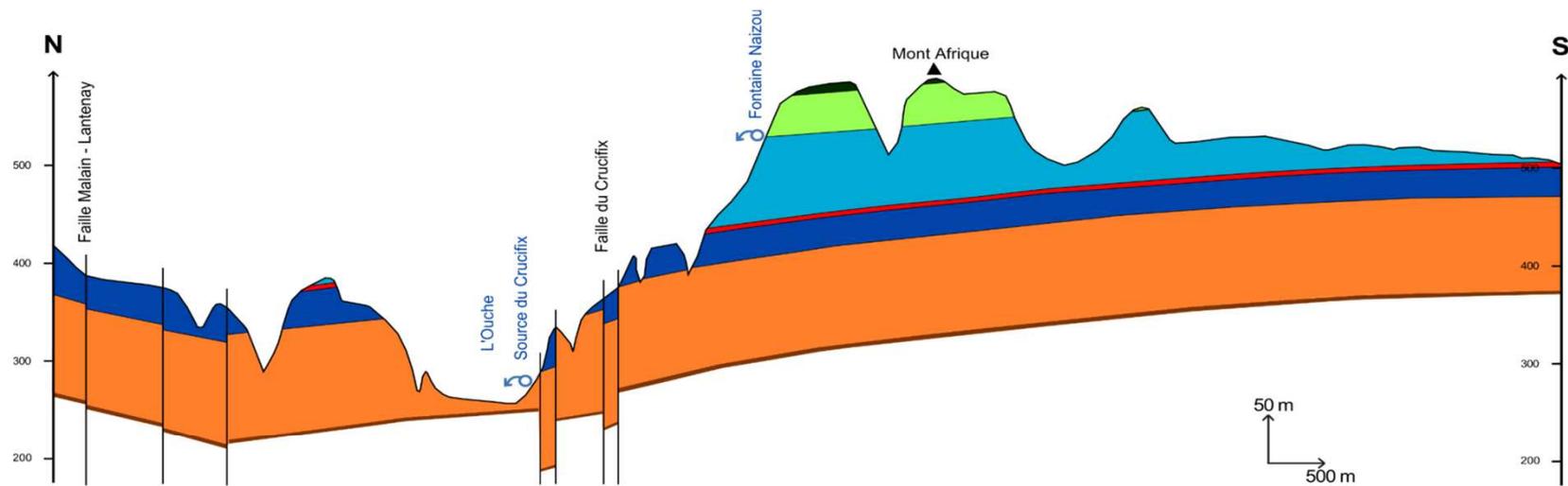
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Operational development

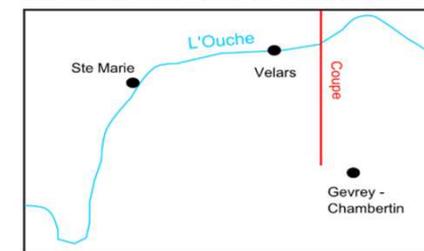
# Crucifix karst : an ideal site for the study of inversac

- Aquifer : Bathonian limestones (Comblanchien formation) covered by Oxfordian limestones
- Karstic circulation (from 10 to 50 m/h)
- Major anthropogenic construction : the Canal de Bourgogne supplied by dams



- j7a Kimméridgien inférieur : Calcaires oolithiques
- j6b Oxfordien supérieur : Calcaire compact à grain fin
- j5 Oxfordien moyen : Marnes et calcaires
- j4 Callovo-oxfordien : Couches calcaires condensées
- j3-2 Callovovien-barthonien supérieur : Calcaires "grenu" et de la "dalle nacrée"
- j2c Bathonien : Comblanchien
- j1b Bajocien supérieur : Marnes à *Ostrea acuminata*

Localisation : Carte de Gevrey-Chambertin



Réalisé par : C.Laffaille  
Date 13/07/2017



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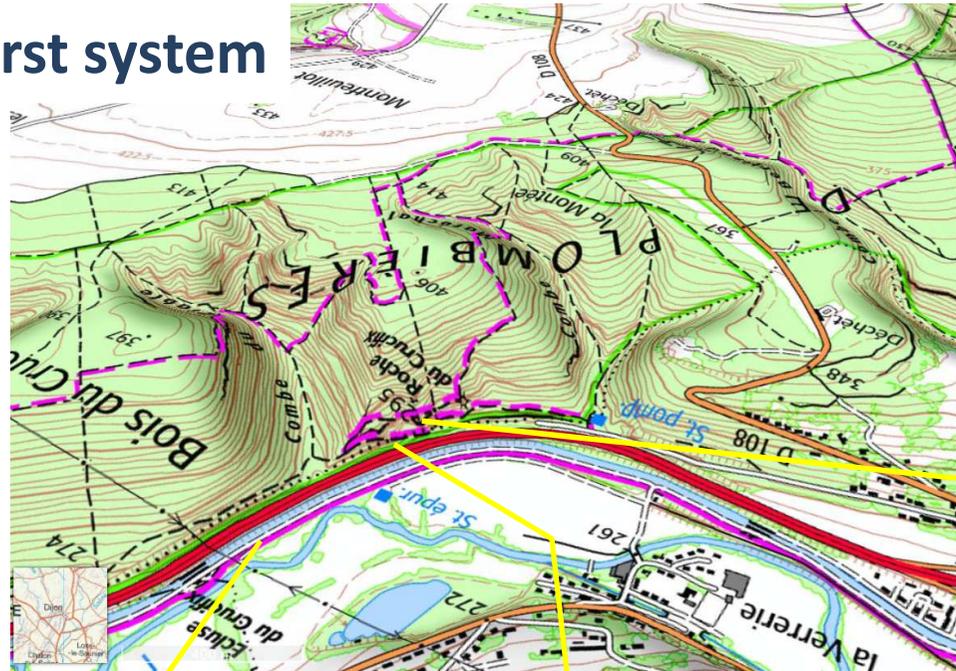


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Operational development

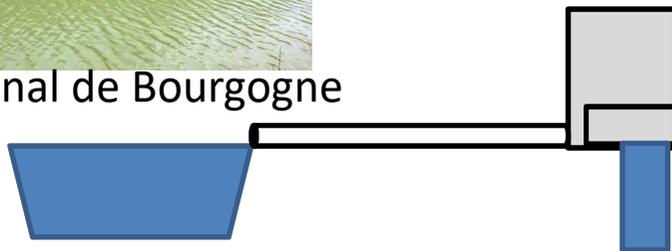
# The Crucifix karst system



Canal de Bourgogne

Crucifix spring

Water well





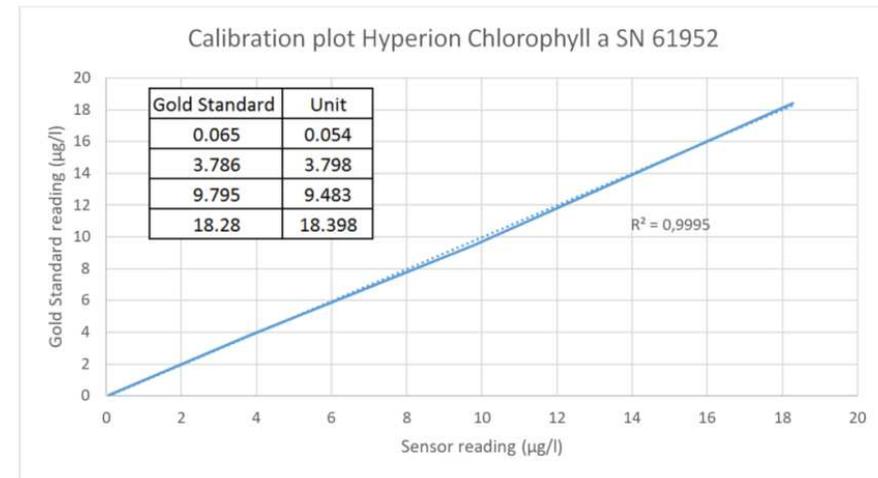
# Implementation : the Hyperion probe (Valeport)

## Chlorophyll-a proble in

- Canal de Bourgogne: beneath shady trees
  - Karstic spring : in the conduit (no light)
  - Waterwell : at the bottom
- 6 minutes period

## Other probes :

- Temperature and pressure every 30 seconds
- GSM monitoring



Performance	Chlorophyll a
Excitation:	470 nm
Detection:	696 nm
Dynamic range:	0-800 µg/l, 2 gain settings : 0-40 µg/l, 0-800 µg/l
Instrument detection limit	0.025 µg/l*
Linearity:	0.99 R <sup>2</sup>
Response time:	0.03 to 2 sec
Physical	
Materials	Titanium with glass window
Depth rating	6000 m
Dimensions	40 mm Ø x 179.5 mm (including connector)
Weight	0.5 kg
Operating temp	35°C max



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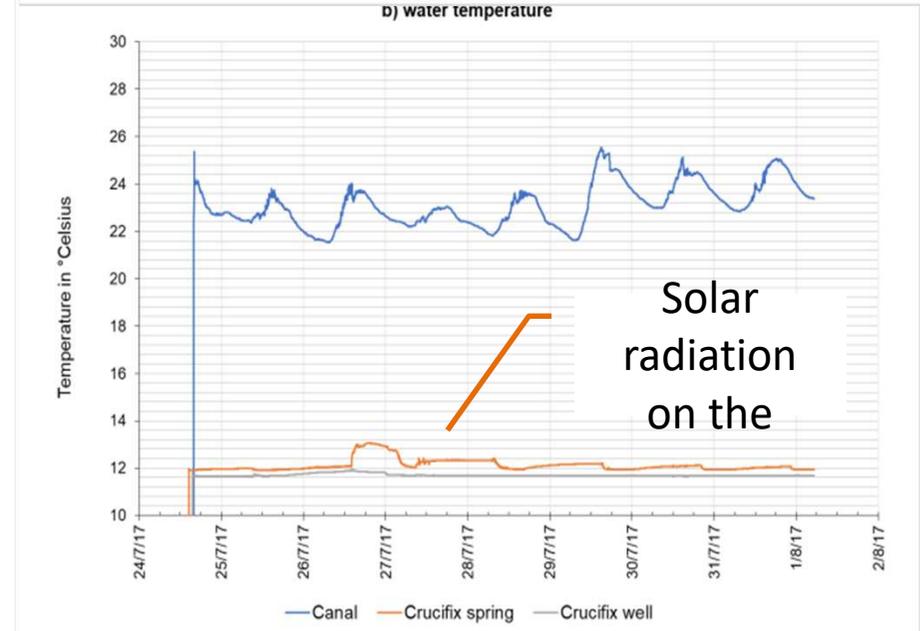
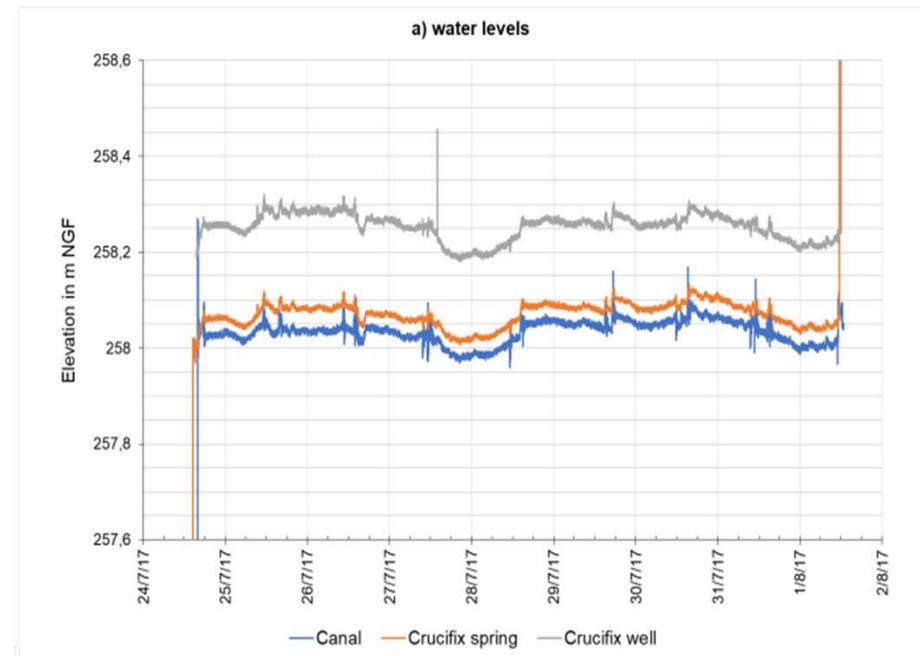
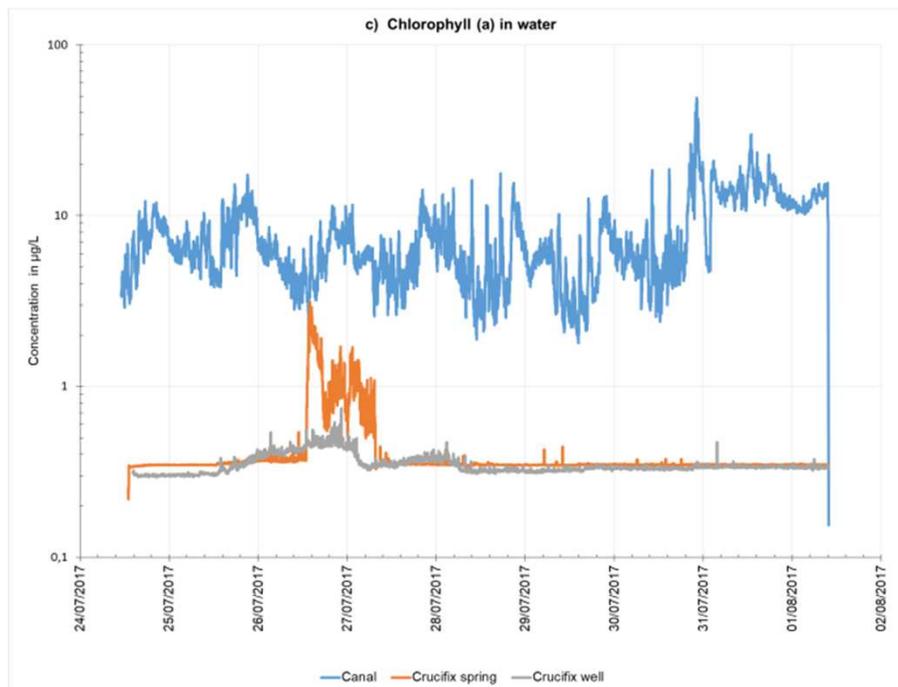
Operational development

## Two major events

- No detection by the level survey
- Minor temperature signal in spring (no signal on well)

## Chlorophyll-a signal is more significant

- Inversac on the spring : pronounced chl-a concentration
- Less contamination on the SAD





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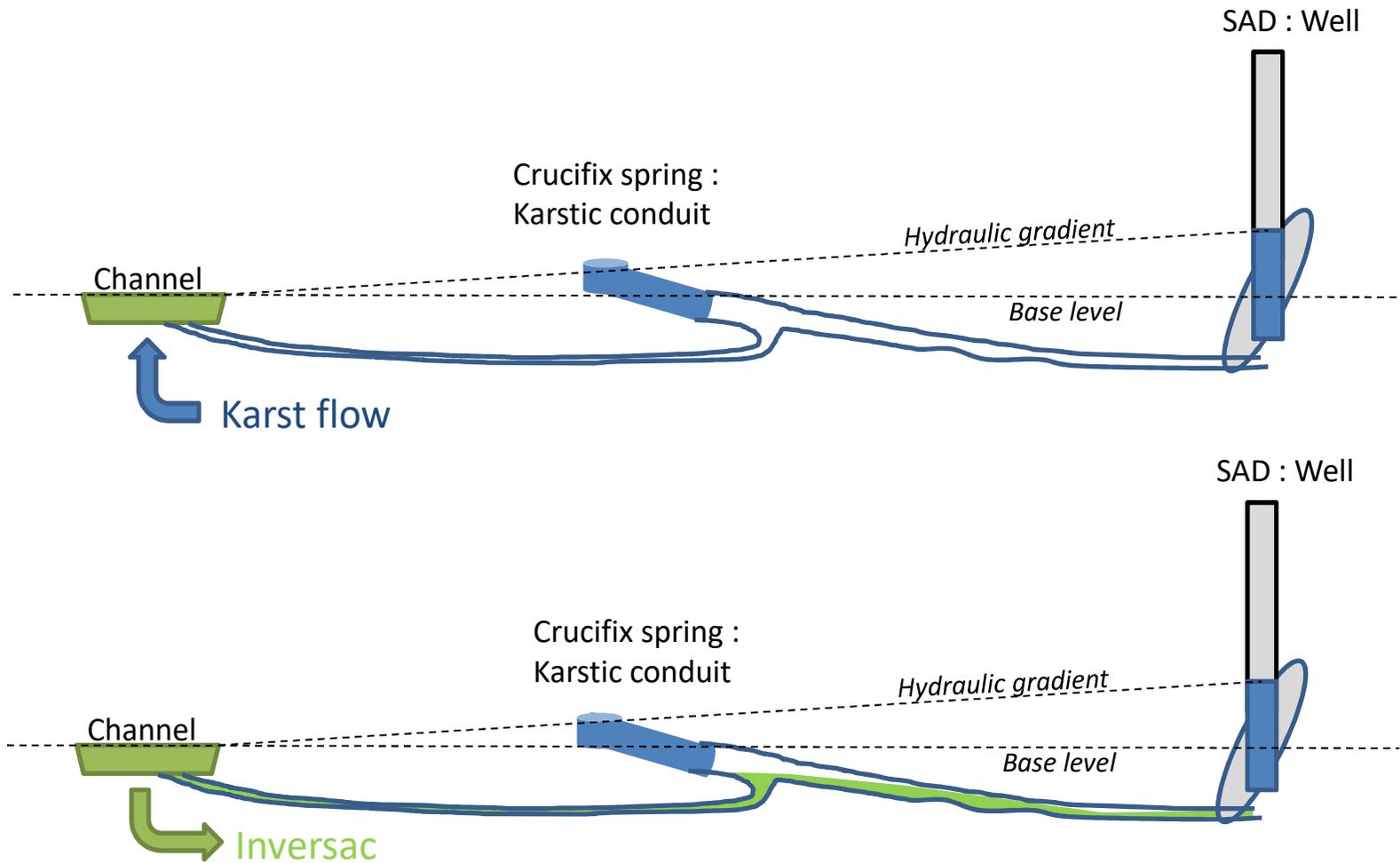


Conceptual model



Operational development

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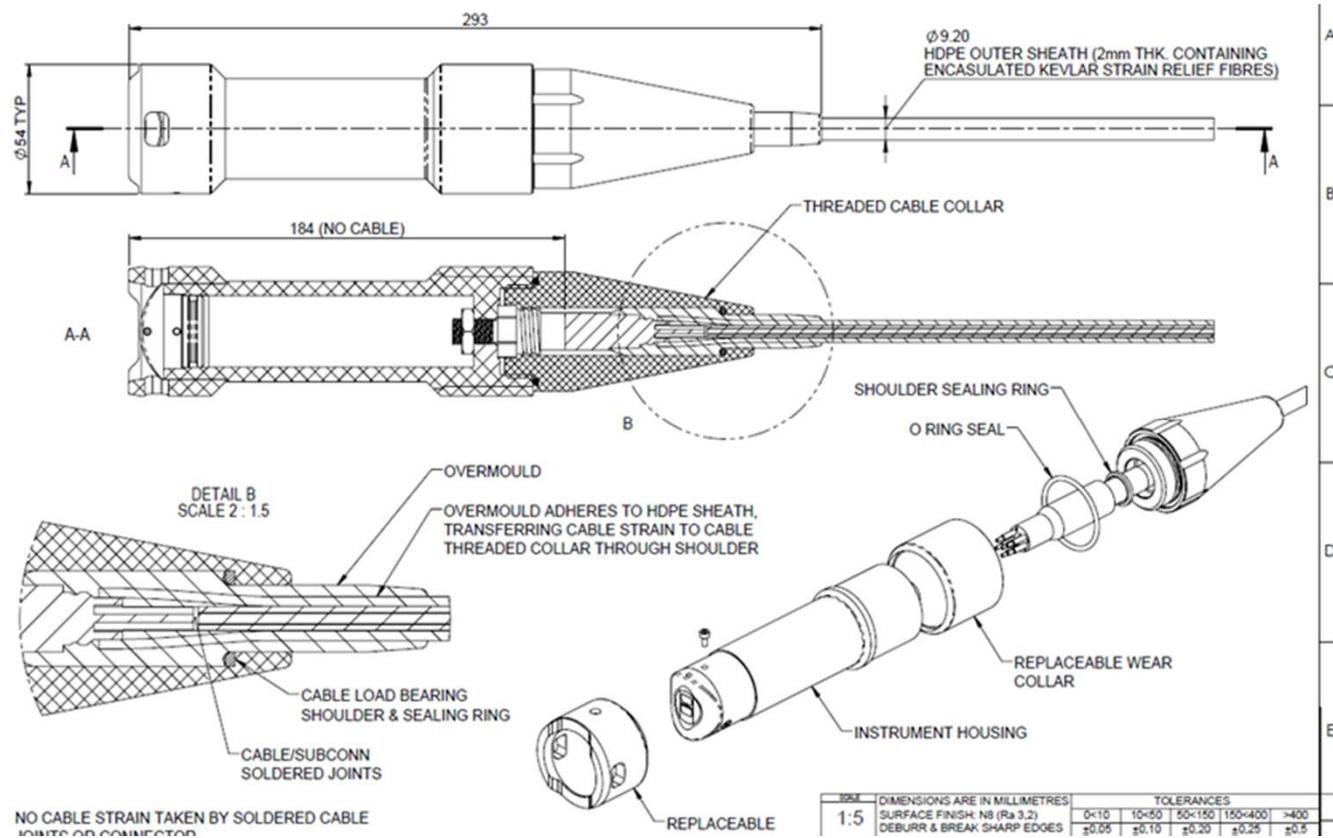
# Operational development

## Active management of karstic resource

- Chlorophyll-a survey
- Alert or pumping command

## Adaptation of the probe

- Graduation on the ruban
- Design
- Dye tracer development



**Thanks for your attention**

**T. Gaillard, CPGF-HORIZON**  
**26 juin 2018**