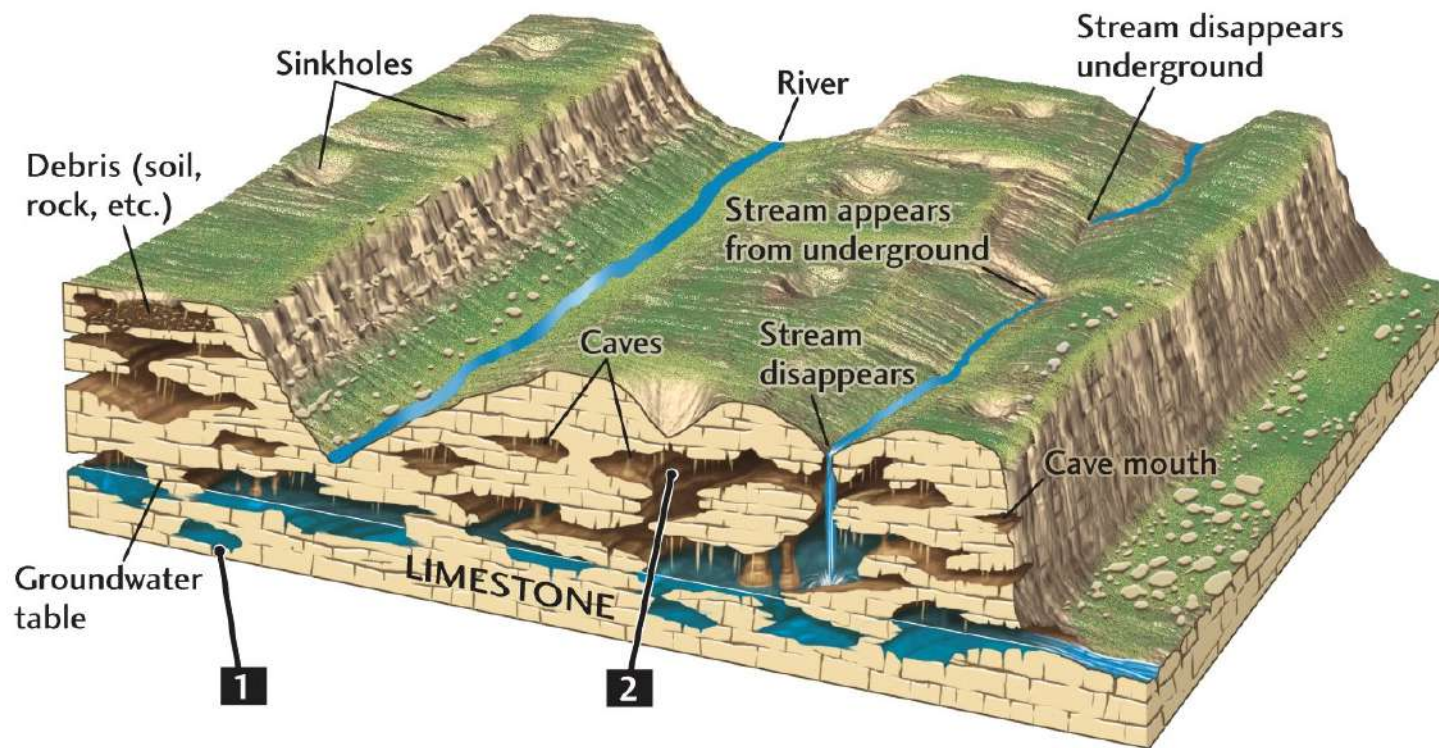


# Robotique d'Exploration Karstique

Architecture Robotique 2023,  
Luc Jaulin & Lionel Lapierre

# KARST : DEFINITION

- A topography formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum,



- Characterized by **underground drainage hydrosystems** with sinkholes and caves.

# KARST : GROUNDWATER RESERVOIR



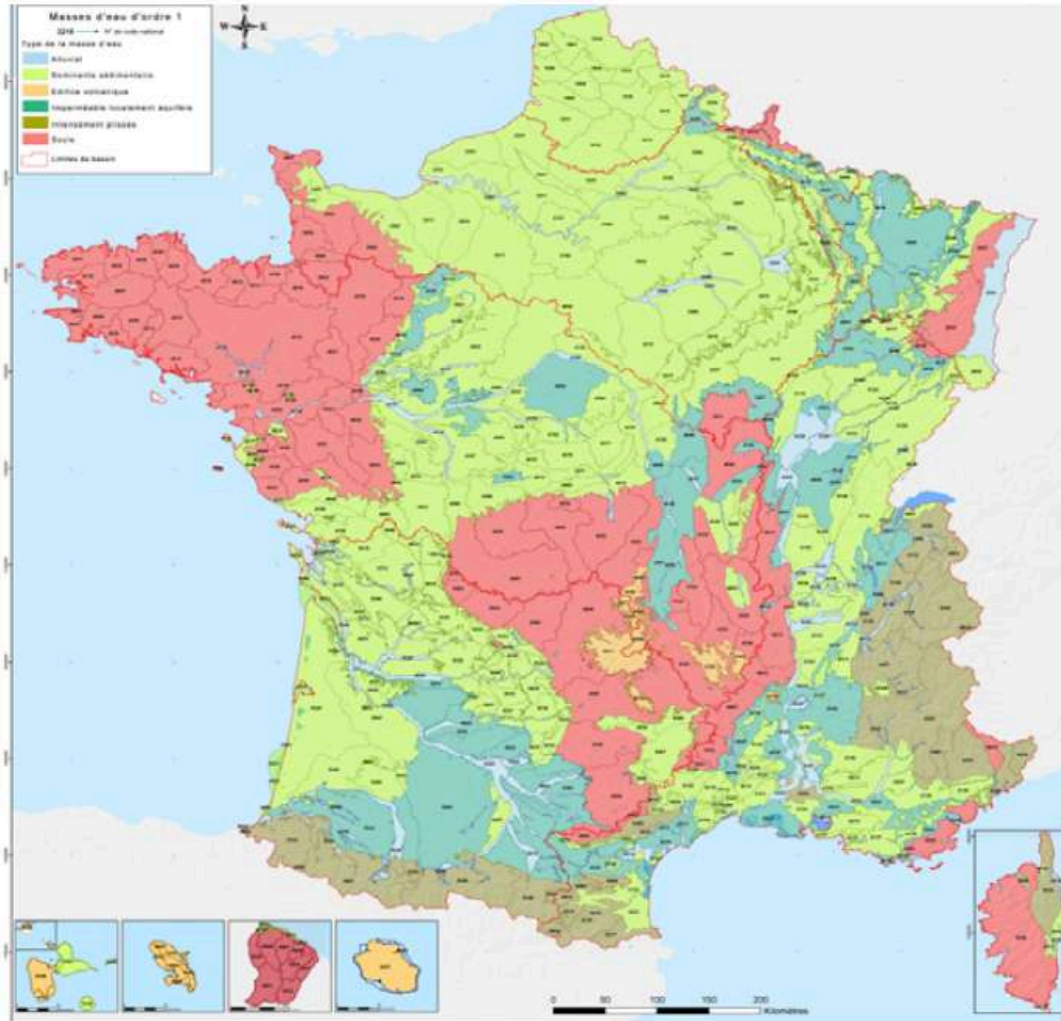
*Eclairage : Cédrik Bancarel  
Dominique François  
Photo.: Frank Vasseur*

# KARST : GROUNDWATER RESERVOIR



Pedro Balordi and Guenter Essig, Gourneyras, France, July 2015

# KARST : GROUNDWATER MANAGEMENT, A NATIONAL ISSUE

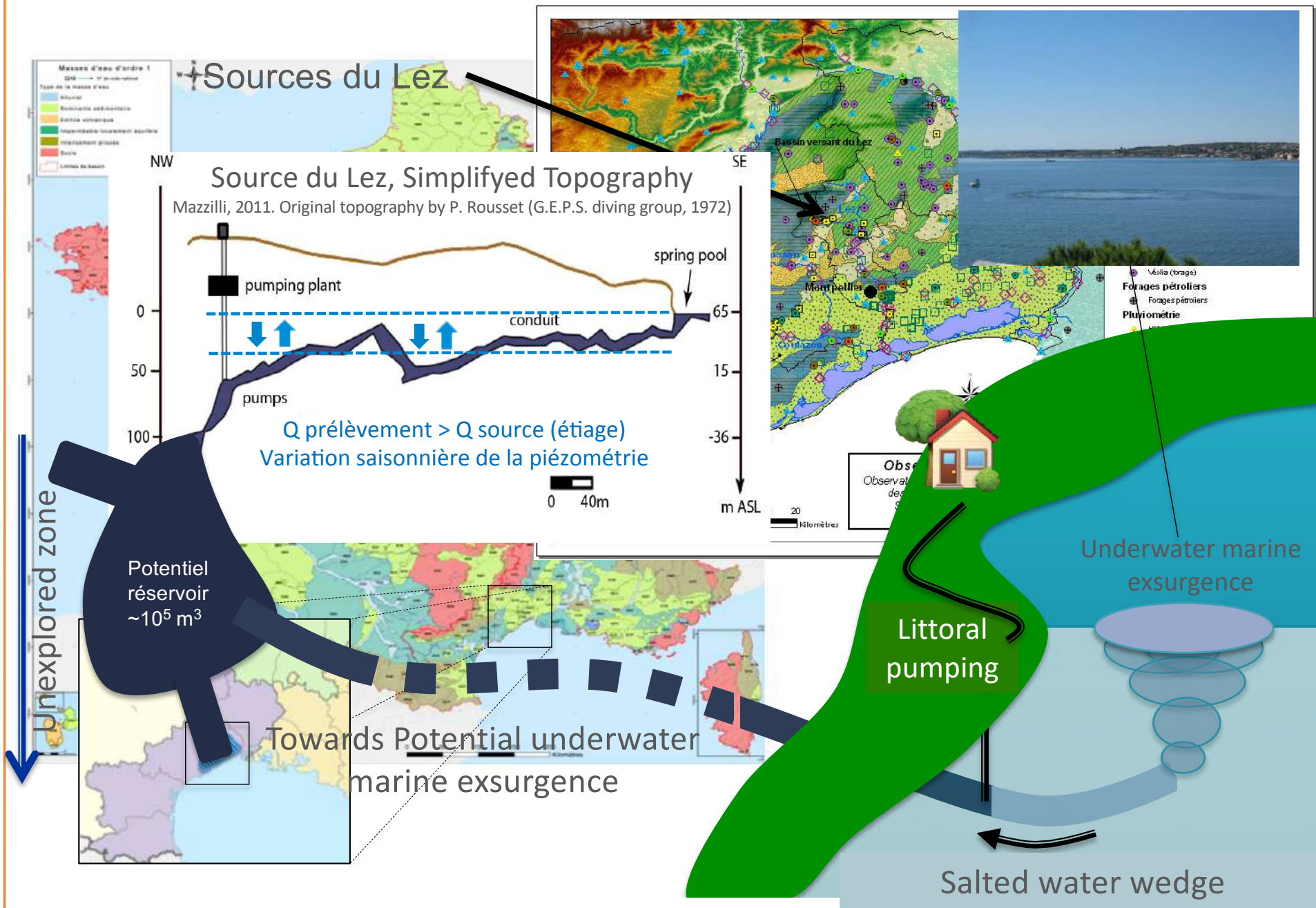


+ 50% of Drinking Water Supply

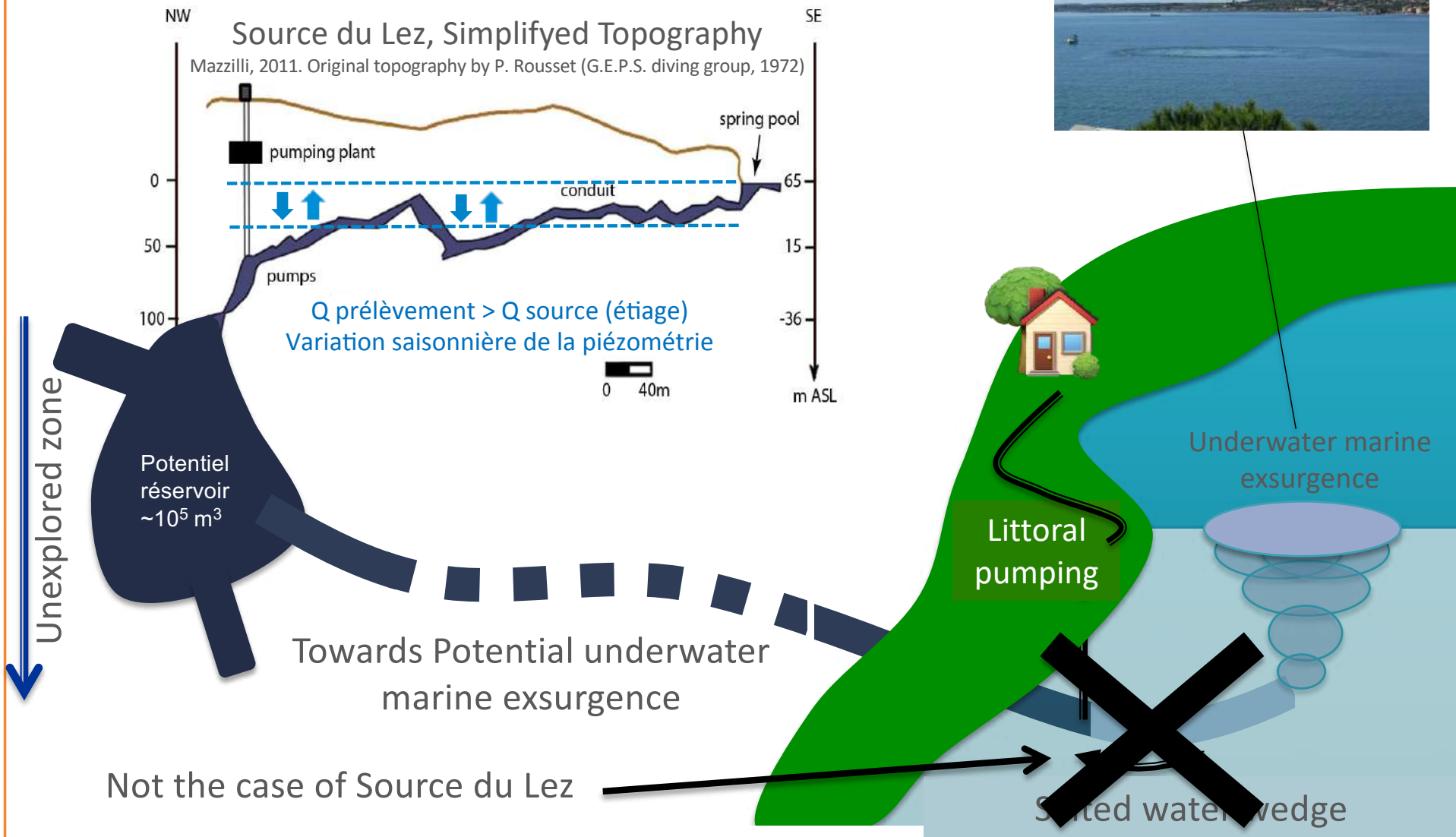
Service National d'Observation  
du KARST,  
SNO INSU/CNRS  
OSU OREME (UM)  
Coordinator H. Jourde



# SOURCES DU LEZ : A SEMINAL CASE STUDY

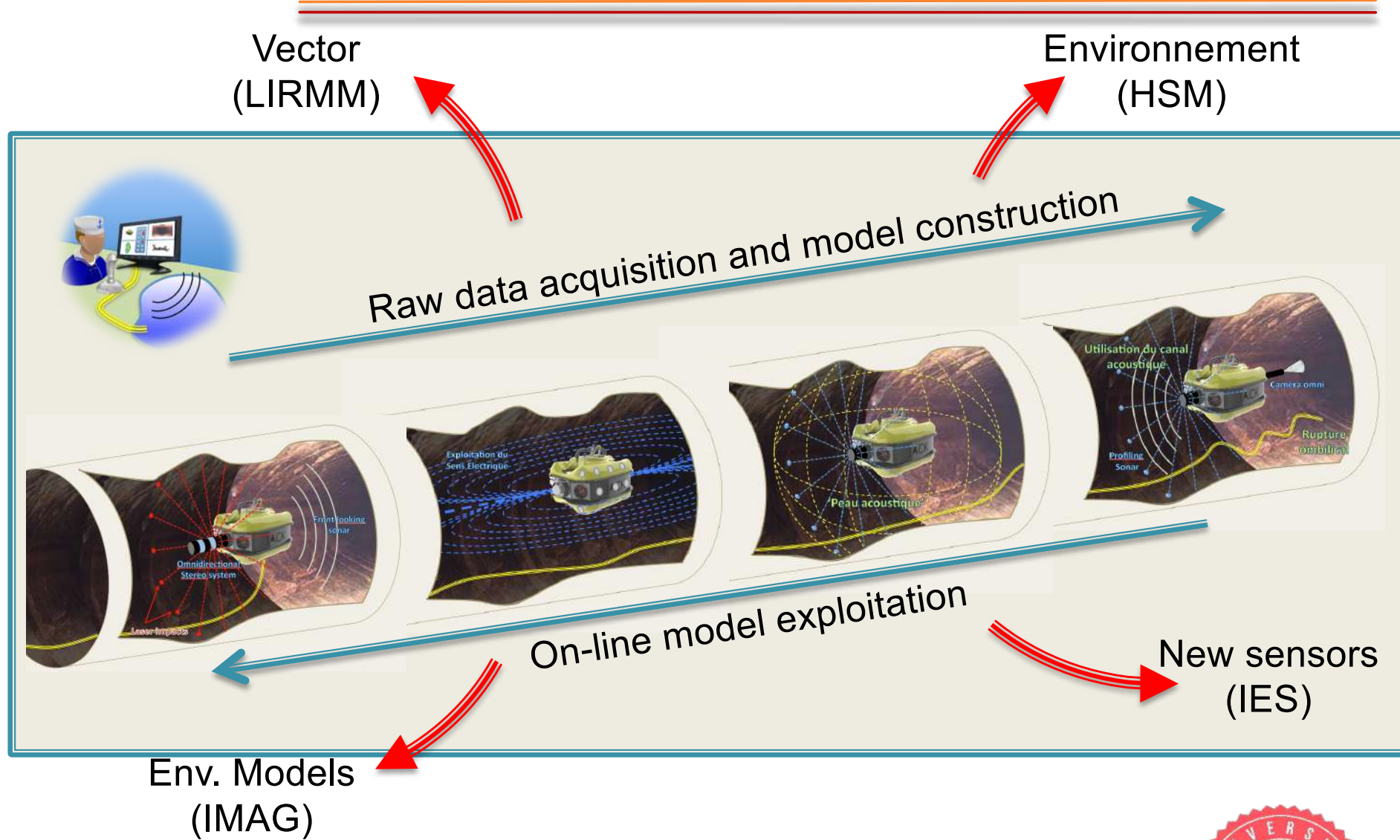


# SOURCES DU LEZ : ACTIVE MANAGEMENT OF GW RESOURCE





# RKE : GLOBAL PRINCIPLES



# THE RKE INITIATIVE : THE CHALLENGES

---

## ○ New Sensors Development

- Acoustic Skin
- Active Umbilical

## ○ Navigation

- Glob. Nav. System
- n-D Acoustic SLAM
- Vacancy Evidence Grids

## ○ Guidance

- Autonomous Centring
- Autonomous Targeting
- Env. Models inclusion

## ○ Control

- Robustness
- Co-control
- Open-loop stability

## ○ Actuation

- Reactive redundant A.S.
- Variable Geometry A.S.

## ○ Software Architecture

- Management of sensors recruitment (acc. jamming)
- Adaptive Autonomy
- Dependability & GoP

## ○ Models

- Multi-modality & Scalability
- Uncertainty Consideration

## ○ Technology

- Active Truncanner, NRJ opt.

## ○ Economic

- Evangelization of a Blue Ocean

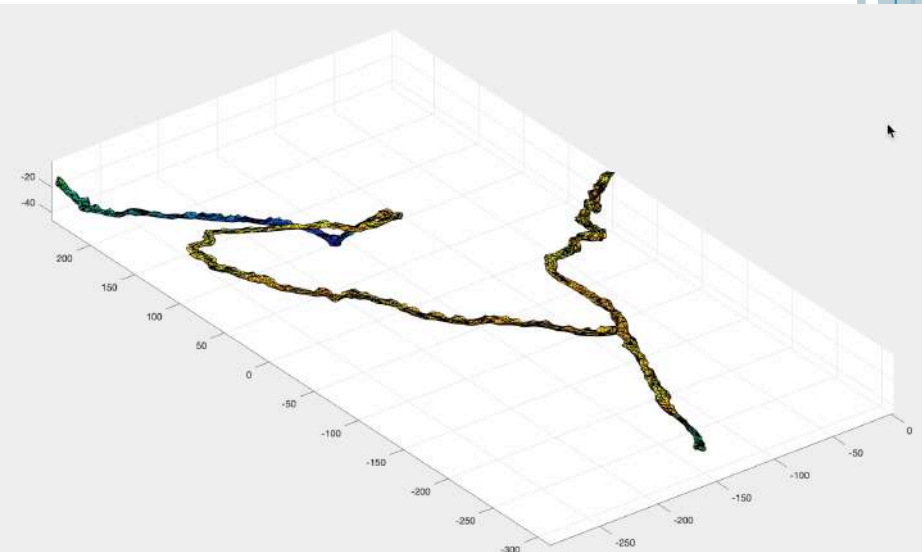
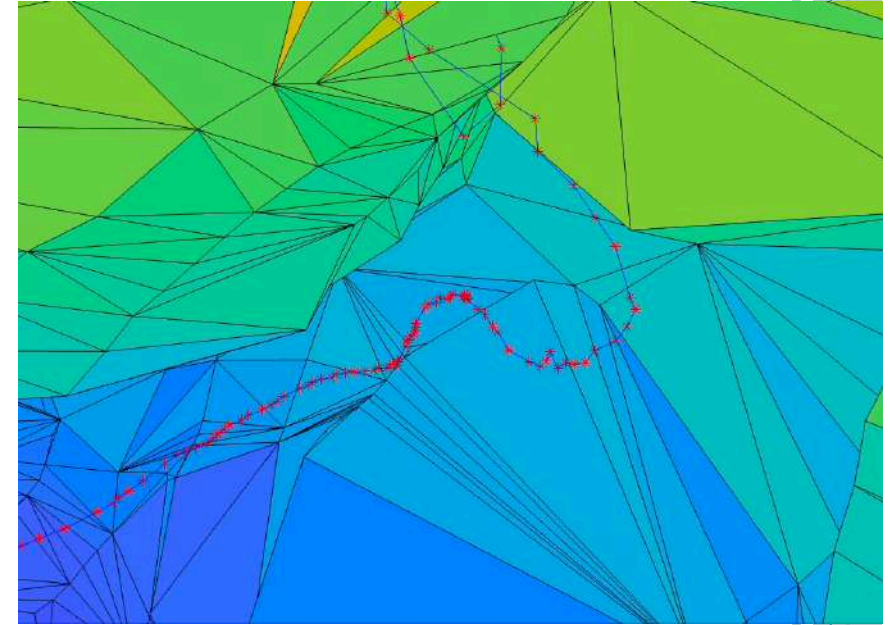
# TERRAIN RESULTS: FONTAINE DE NÎMES, 8/03/2023



**PLONGEURS**  
Frank VASSEUR  
Mathieu FOULQUIE  
Doriane MORATE  
Damien VIGNOLE  
Denis PAILLO

**Eq. TECHNIQUE**  
Lionel LAPIERRE  
Hervé JOURDE  
Pierre FISCHER  
Benoit ROPARS  
Mohammed ALIOUACHE

**MAIRIE DE NIMES**  
Guillaume PLA

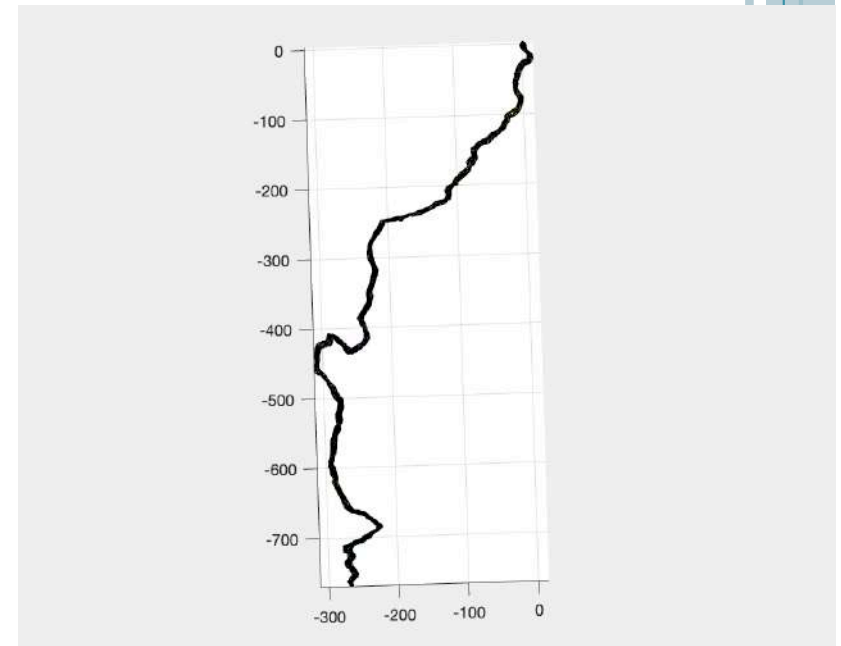
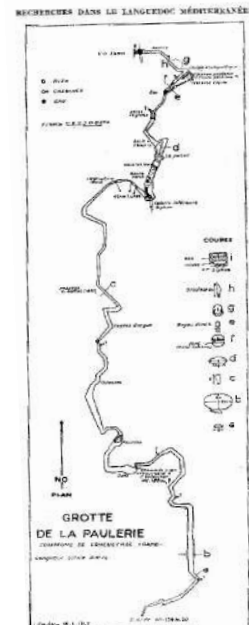
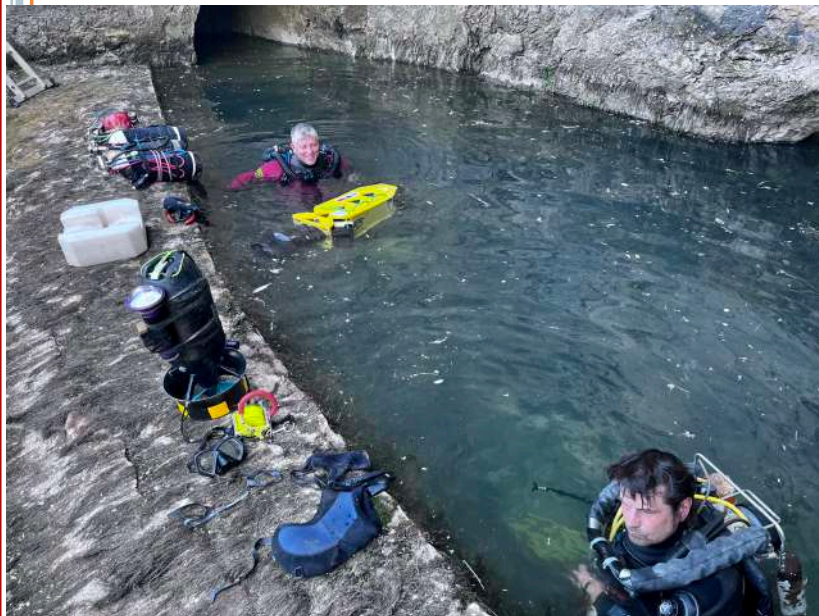
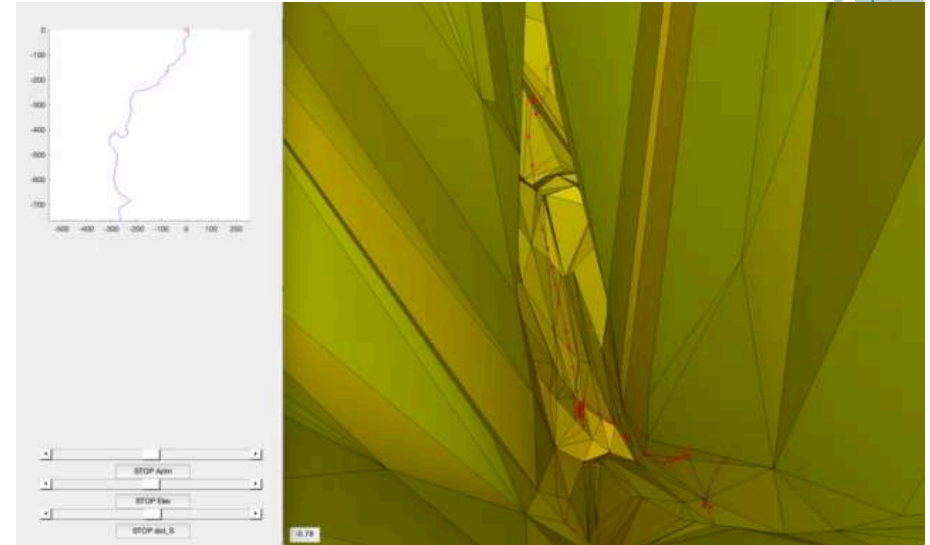


# TERRAIN RESULTS: FONTAINE DE SAUVE, 24/05/2023



**PLONGEURS**  
Frank VASSEUR  
Doriane MORATA  
Dominique VIGNOLE

**Eq. TECHNIQUE**  
Benoit ROPARS

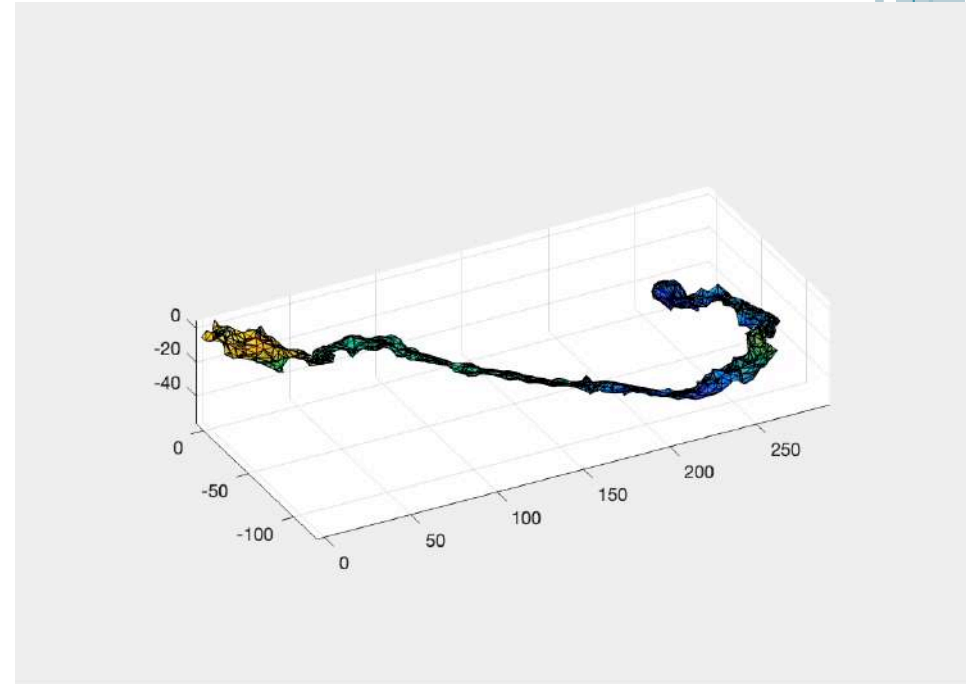
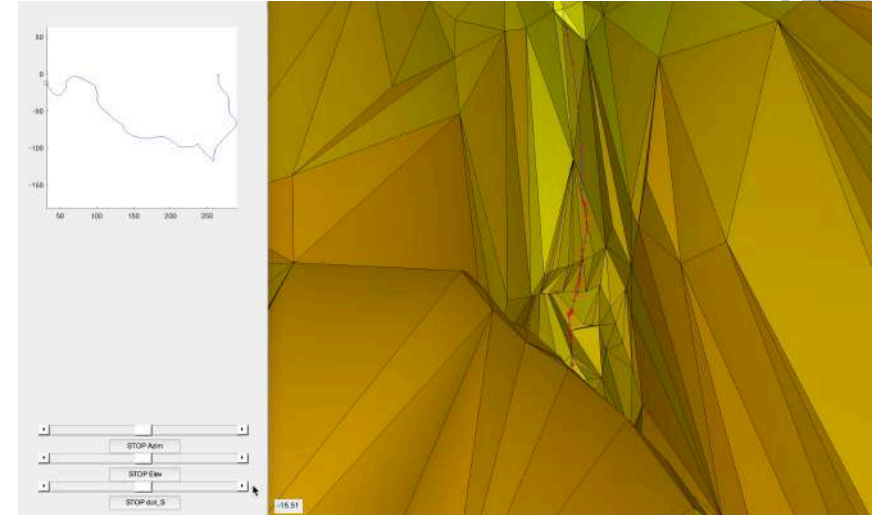


# TERRAIN RESULTS: SOURCE DU LEZ, 15/03/2023



**PLONGEURS**  
Frank VASSEUR  
Mathieu FOULQUIE  
Doriane MORATA  
Dominique VIGNOLE  
Denis PAILLO

**Eq. TECHNIQUE**  
Lionel LAPIERRE  
Hervé JOURDE  
Benoit ROPARS  
Mohammed ALIOUACHE

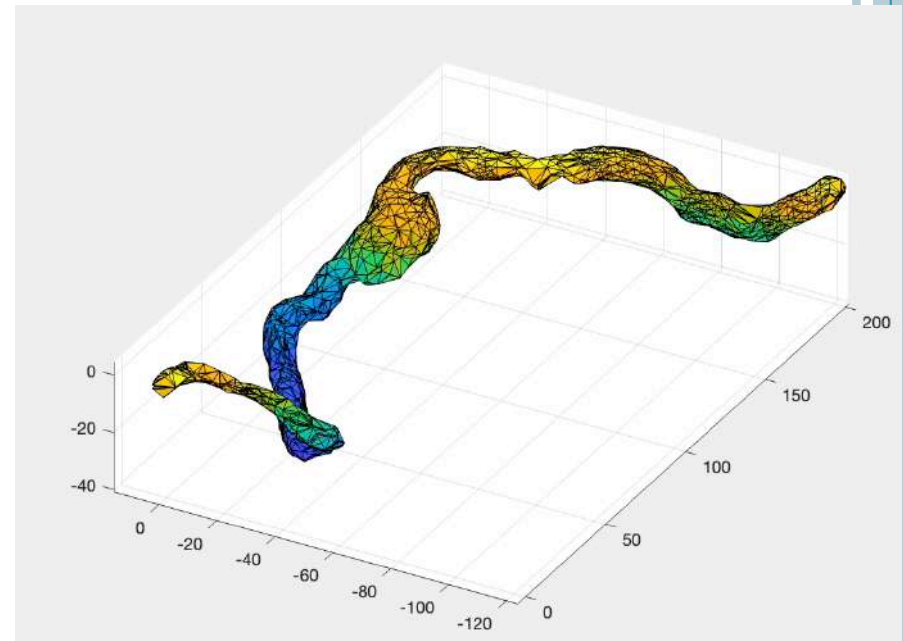
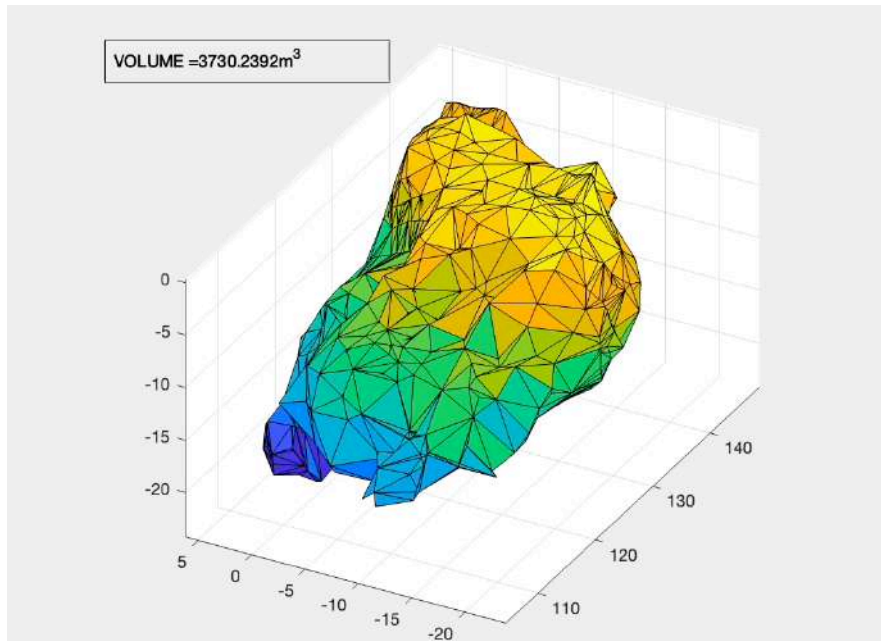
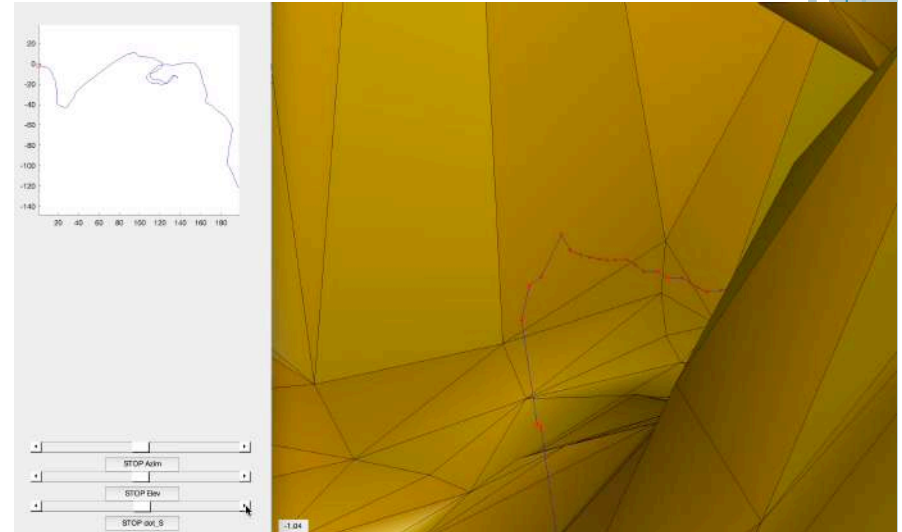


# TERRAIN RESULTS: FONTANILLES, 15/03/2023



**PLONGEURS**  
Frank VASSEUR  
Mathieu FOULQUIE  
Doriane MORATA  
Dominique VIGNOLE  
Denis PAILLO

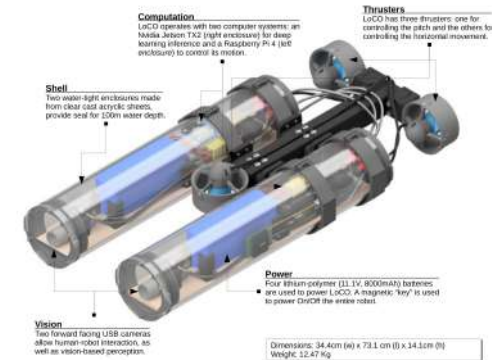
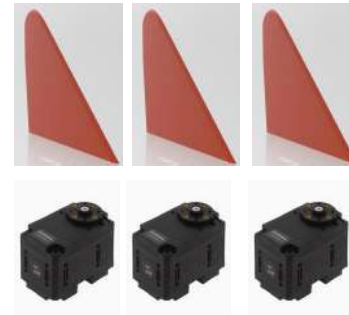
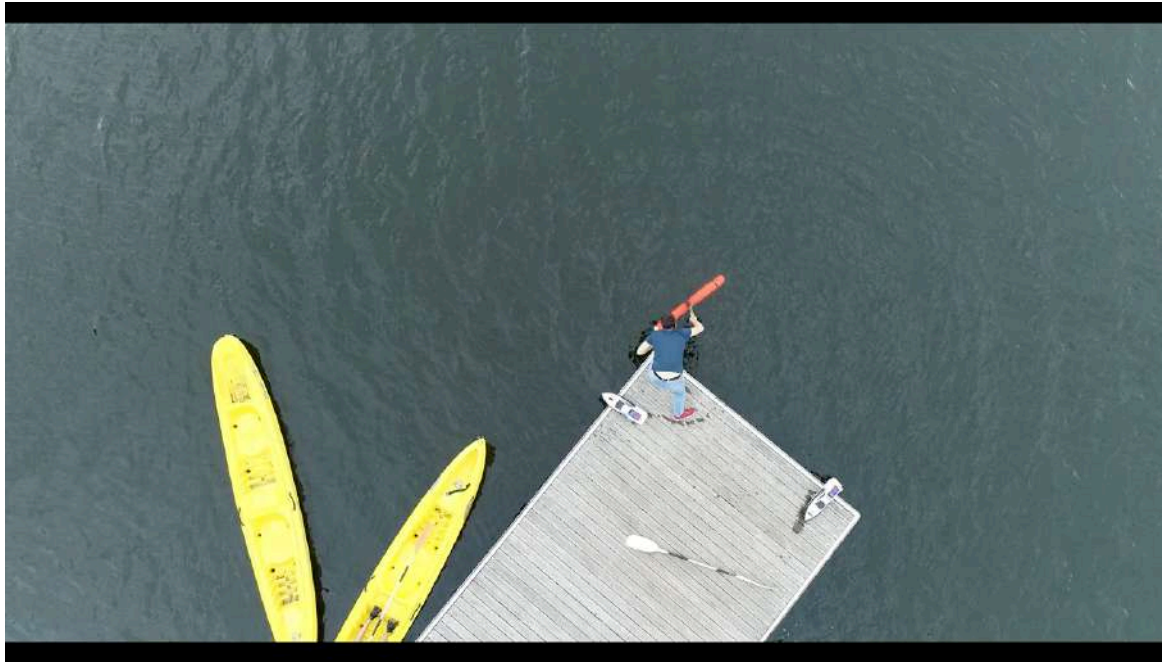
**Eq. TECHNIQUE**  
Benoit ROPARS



# RÉALISATION D'UN AUV : L'ANGUILLE

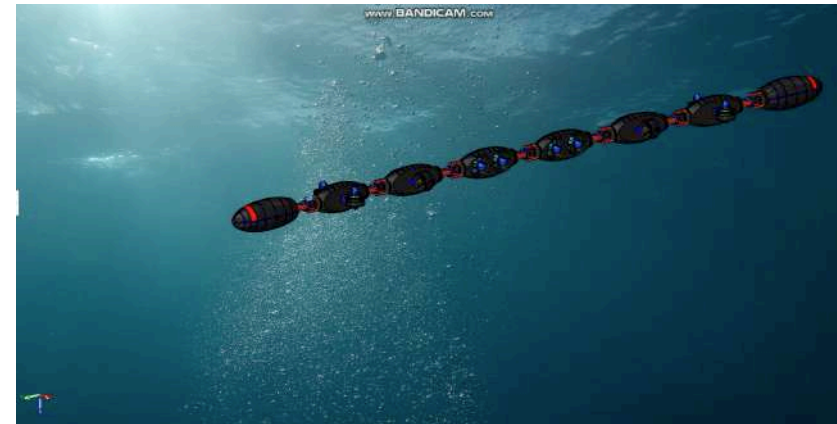


# RÉALISATION D'UN AUV : LA TORPILLE



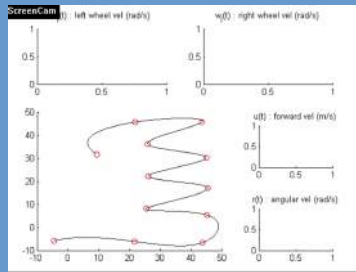


# RÉALISATION D'UN AUV : ELECTROKARST, SOLUTION HYBRIDE

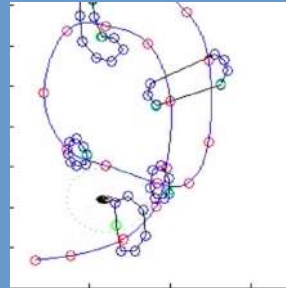




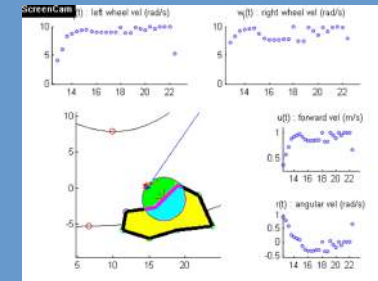
# RÉALISATION D'UN AUV: LA COMMANDE, ANALOGIE 2D AVEC L'UNICYCLE



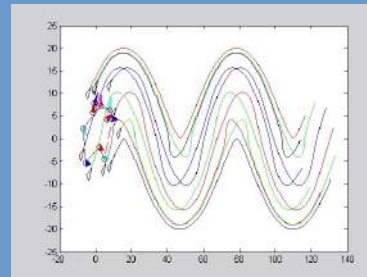
*Saturation Act<sup>o</sup>*



*Evitement Obstacles & suivi de chemin*



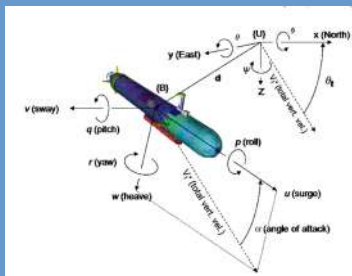
*Multi PF & CA*



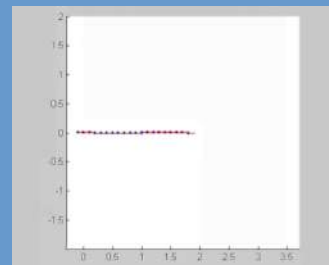
*Path-tracking*



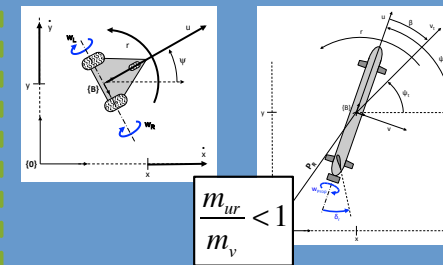
*Ombilical virtuel*



*Robustesse adapt.  
et commutée*

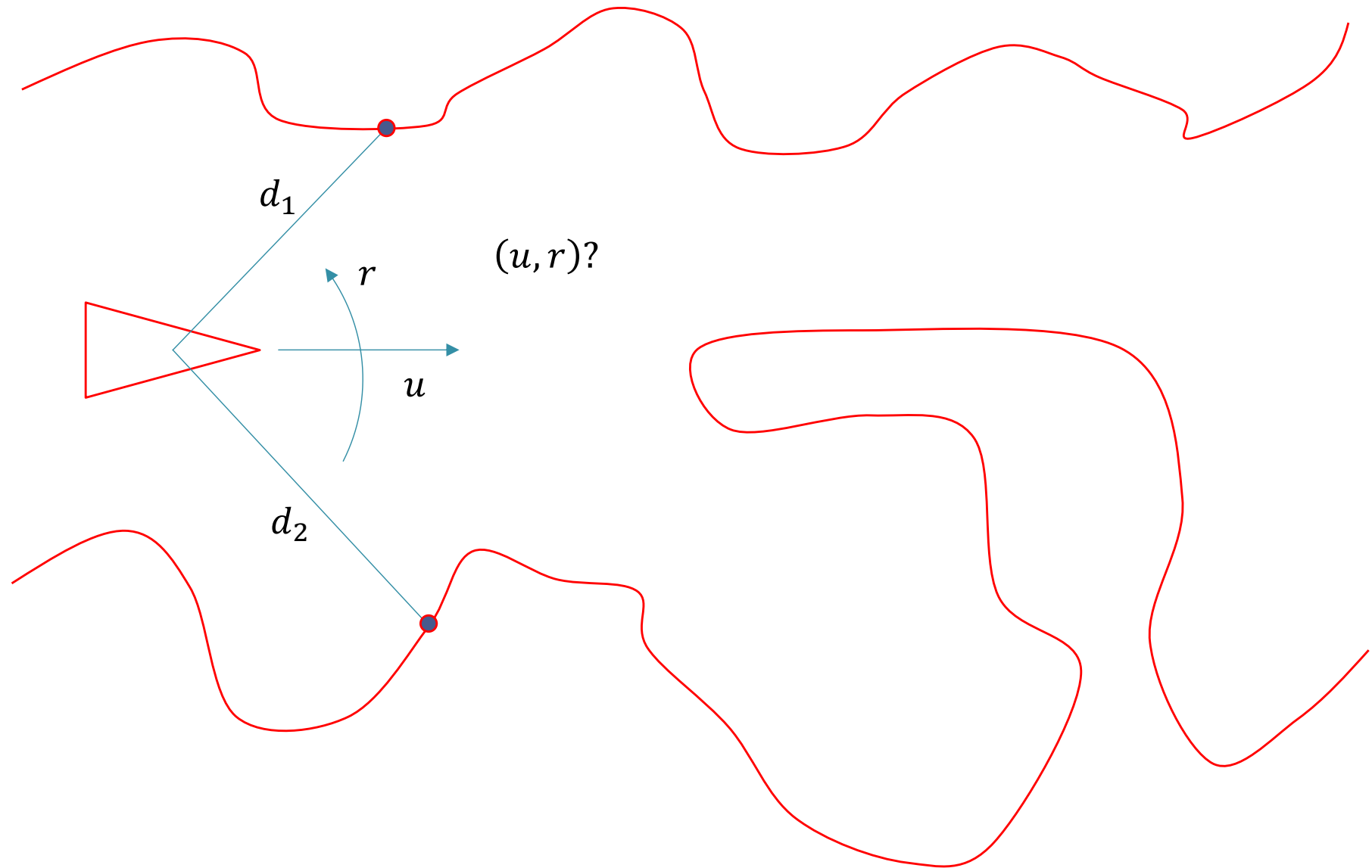


*Locomotion  
anguilliforme*



*Nonholonomie ->  
sous-actionnement*

# RÉALISATION D'UN AUV: LA COMMANDE, ANALOGIE 2D AVEC L'UNICYCLE



# RÉALISATION D'UN AUV

A vous de jouer !

