9th International Conference on Urban Drainage Modelling, Belgrade (Serbia), September 2012

Measurement of discharge by the ultrasonic (transit-time) method in “degraded mode” using computational fluid dynamics and data analysis

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Projects COACHS and MENTOR-2015

Outline

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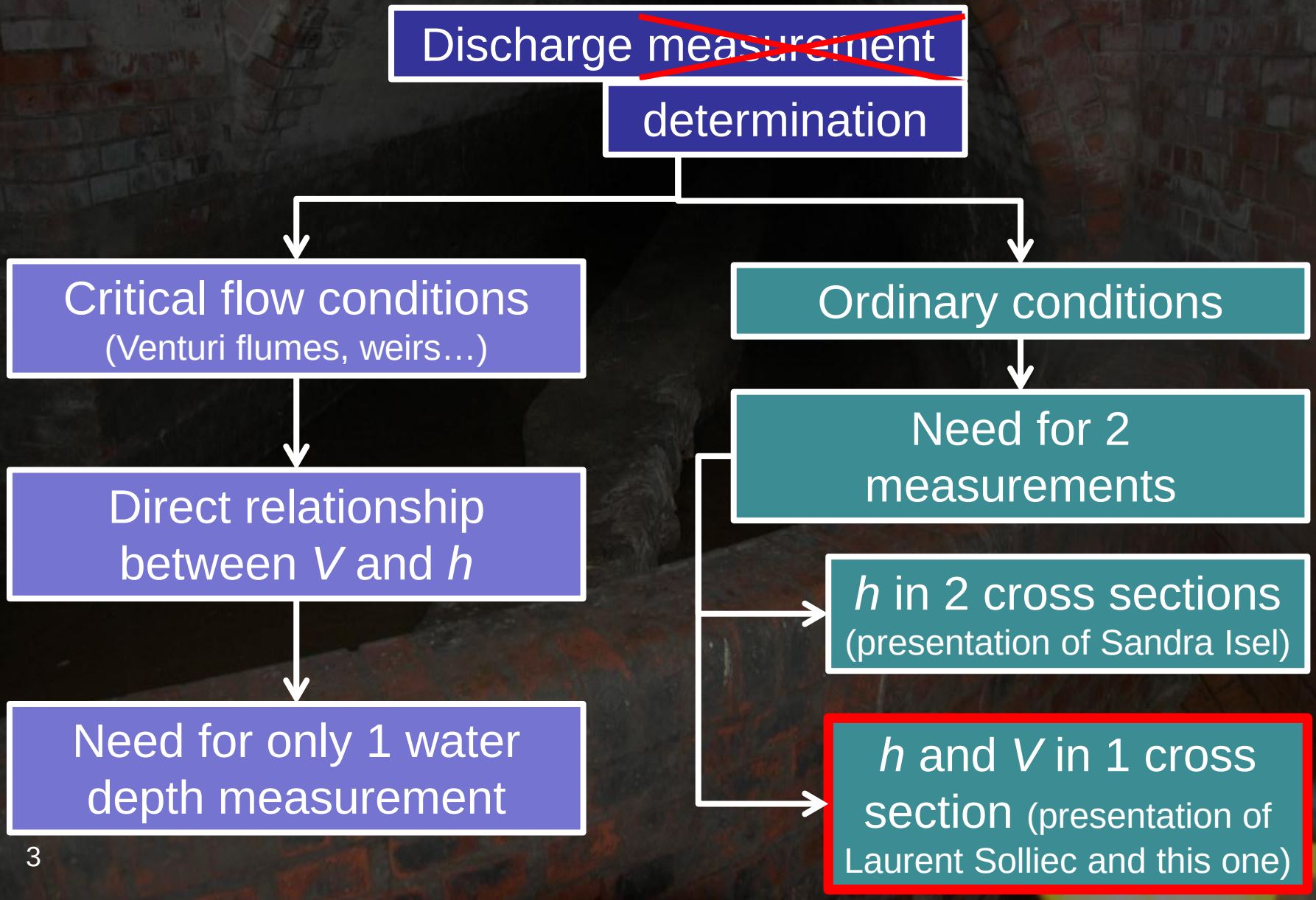
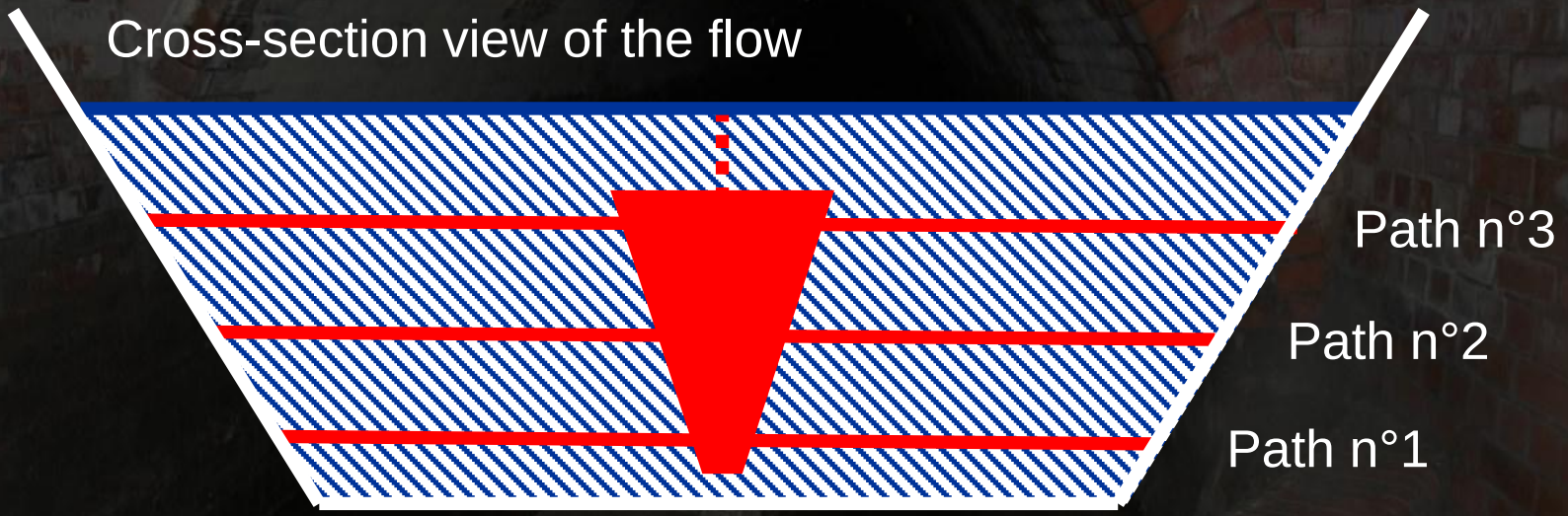
1. **Context and objectives**
2. Methodology:
   a. Discharge determination
   b. Degraded conditions
3. Conclusion

Context

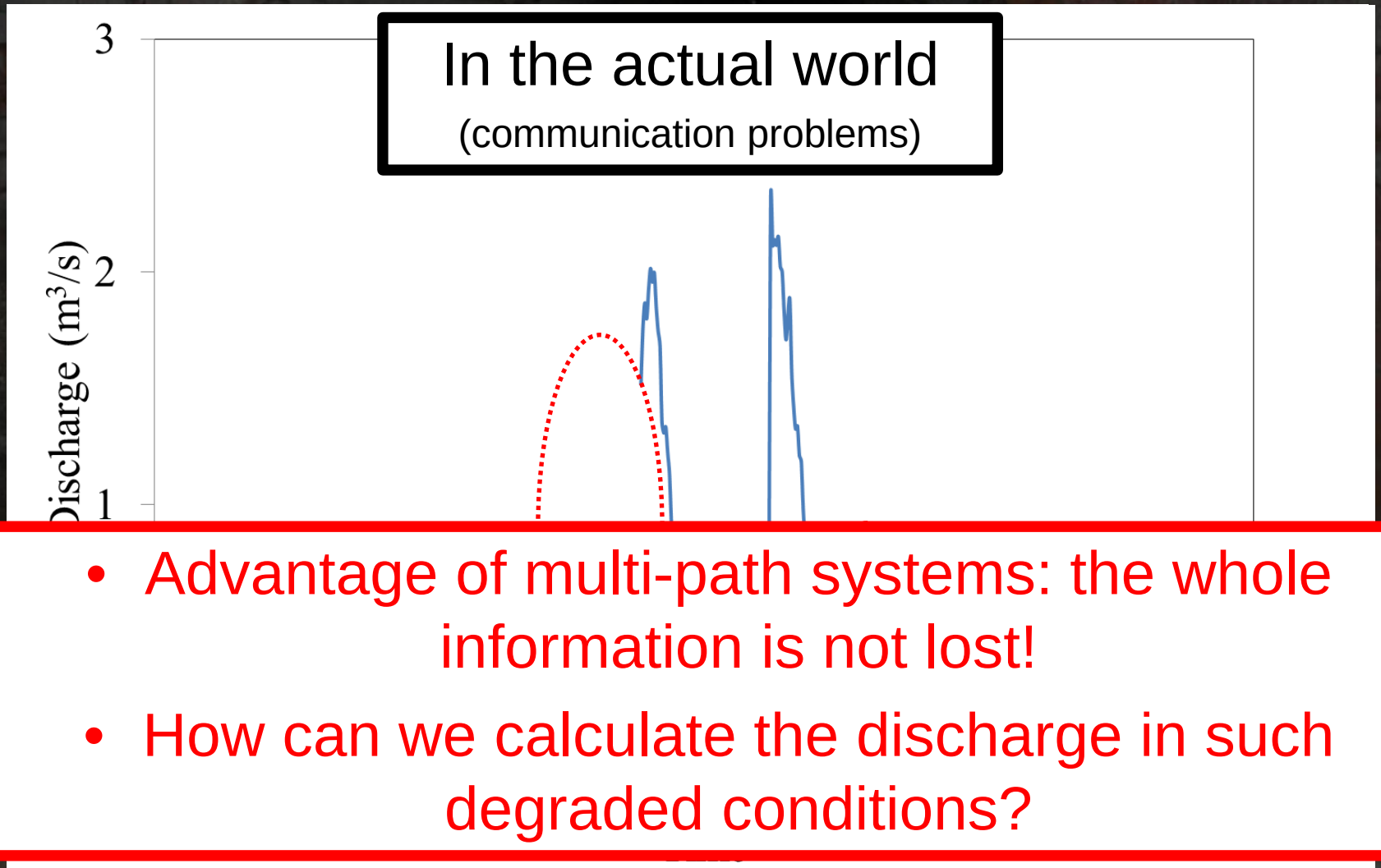

Discharge measurement determination
Critical flow conditions (Venturi flumes, weirs…)
Direct relationship between V and h
Need for only 1 water depth measurement
Ordinary conditions
Need for 2 measurements
h in 2 cross sections (presentation of Sandra Isel)
h and V in 1 cross section (presentation of Laurent Solliec and this one)

Context



- Main difficulty = the link between the measured velocity (local variable) and the mean velocity (needed for the determination of the discharge)?
- In particular for non-standard gauging stations (complex geometry with singularities)!

Context



- Advantage of multi-path systems: the whole information is not lost!
- How can we calculate the discharge in such degraded conditions?

(About 15% of loss for the dataset used in this study)

Objectives

- Objective: make discharge determination with ultrasonic transit-time method more reliable
  - Objective n°1:
    - Development of a methodology for discharge determination for non-standard gauging stations
  - Objective n°2:
    - Development of a methodology in degraded conditions

Outline

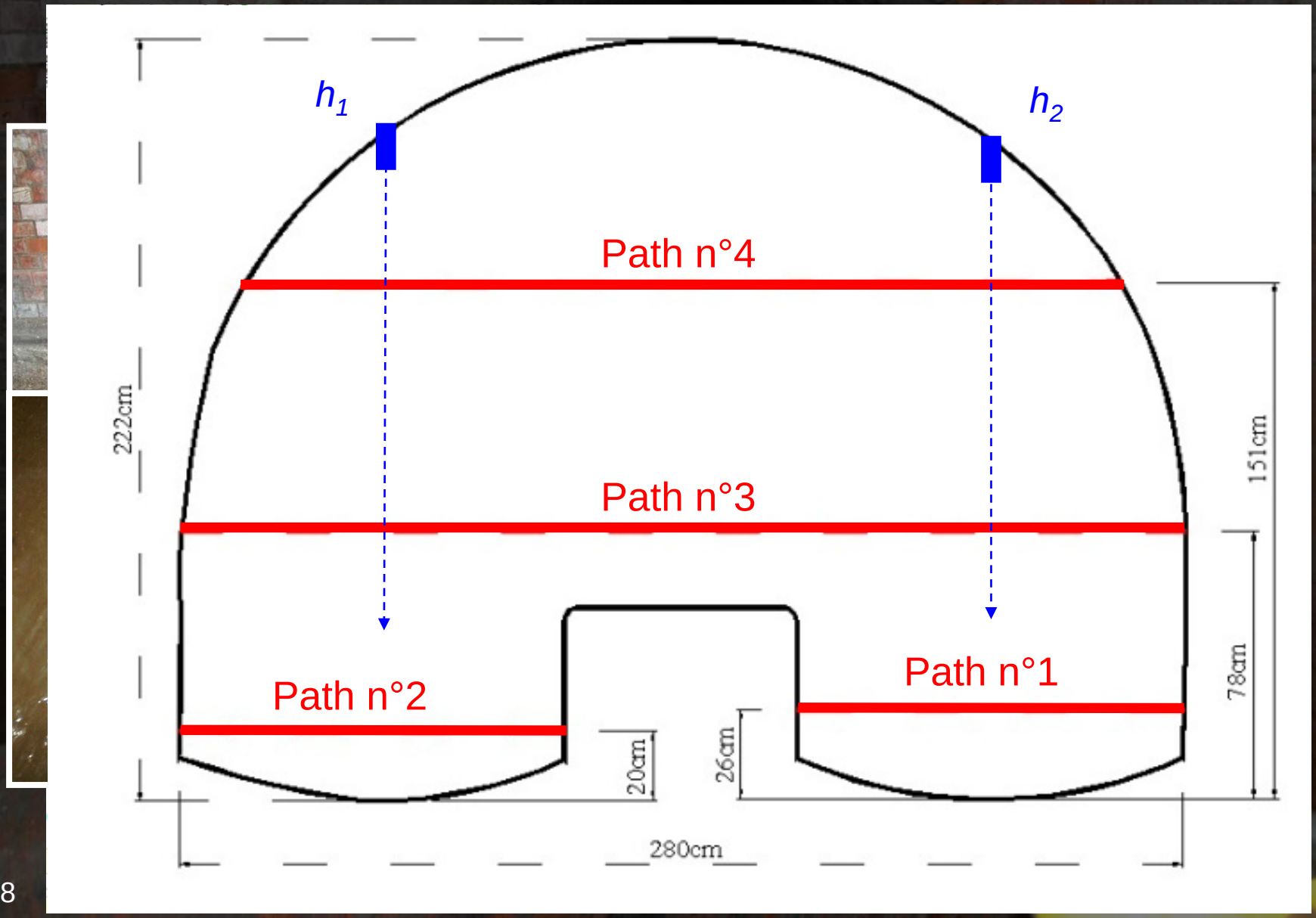
2

1. Context and objectives

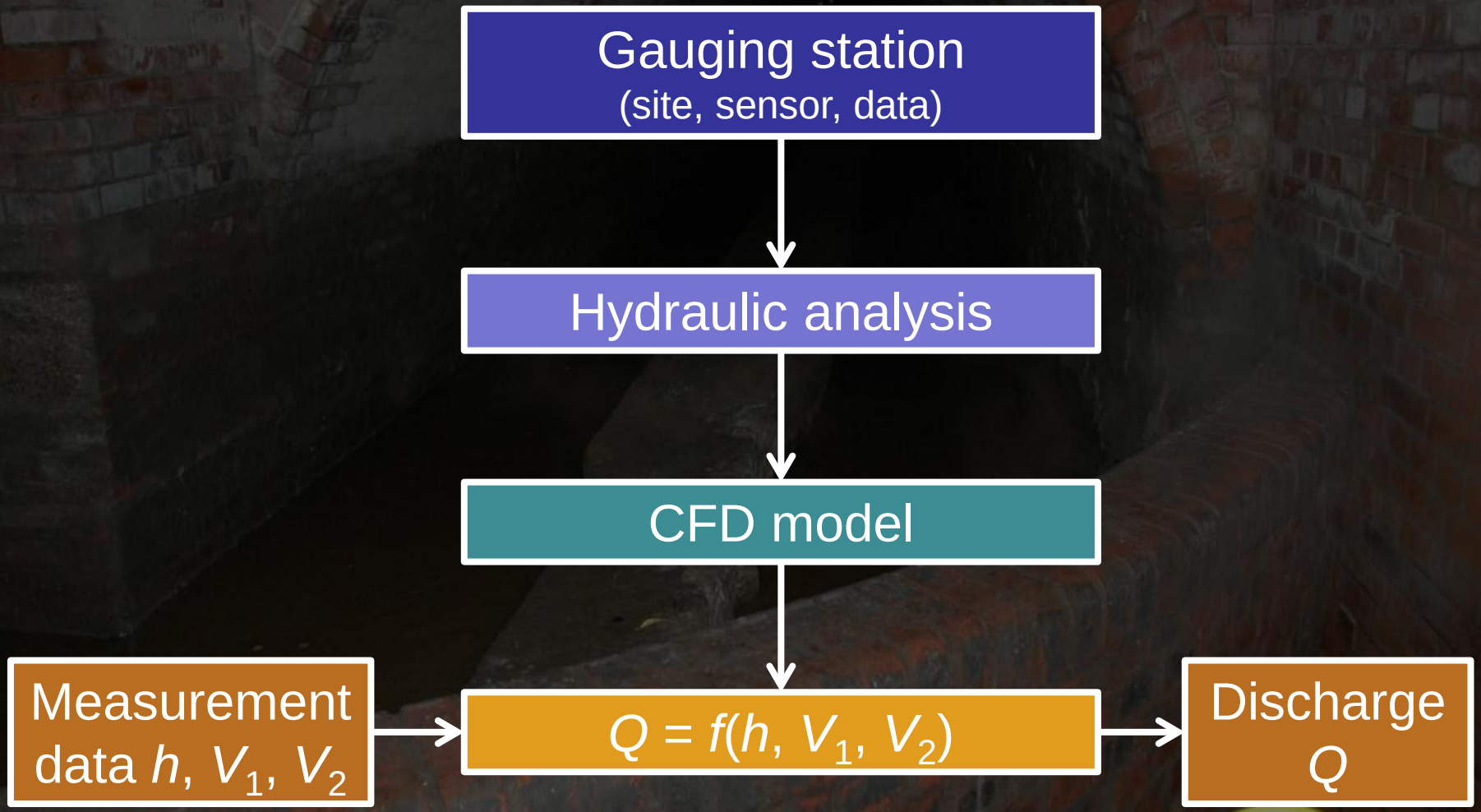
2. **Methodology:**
   a. **Discharge determination**
   b. **Degraded conditions**

Presented through one test-case: the gauging station ‘Milan’

Presentation of the gauging station Milan



Methodology for discharge determination

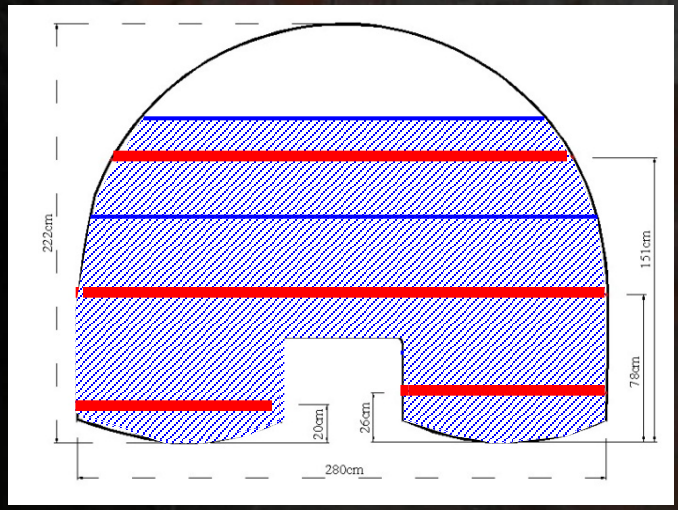


(methodology presented at ICUD 2011)

Methodology for discharge determination

- Two paths are immersed:

$$Q = 1.05 \times V_1 \times S_1 + 1.05 \times V_2 \times S_2$$



- Three paths are immersed:

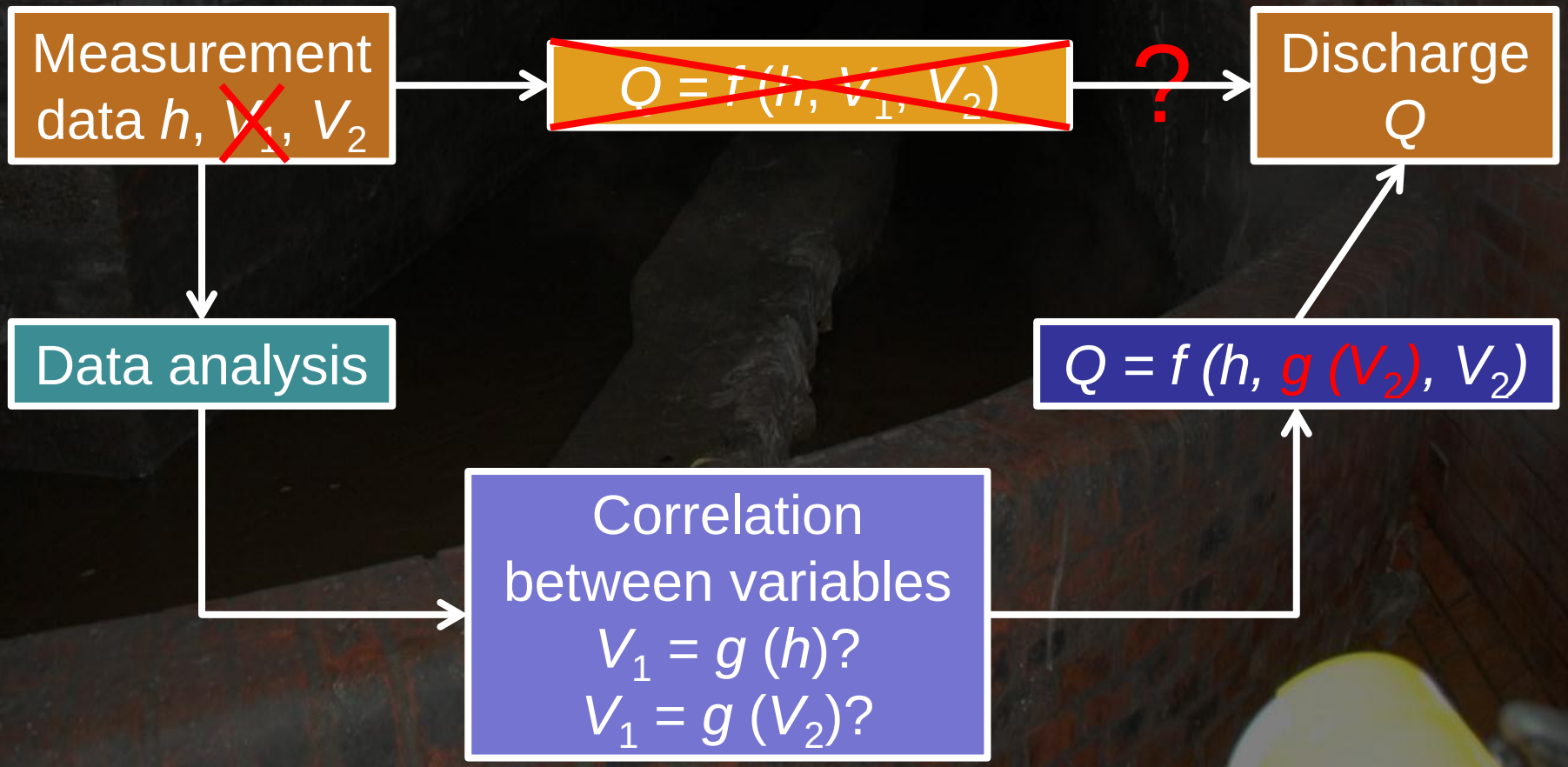
$$Q = 0.91 \times V_1 \times S_1 + 0.91 \times V_2 \times S_2 + 1.14 \times V_3 \times S_3$$

- Four paths are immersed:

$$Q = 0.91 \times V_1 \times S_1 + 0.91 \times V_2 \times S_2 + 1.06 \times V_3 \times S_3 + 1.10 \times V_4 \times S_4$$

Methodology for degraded conditions

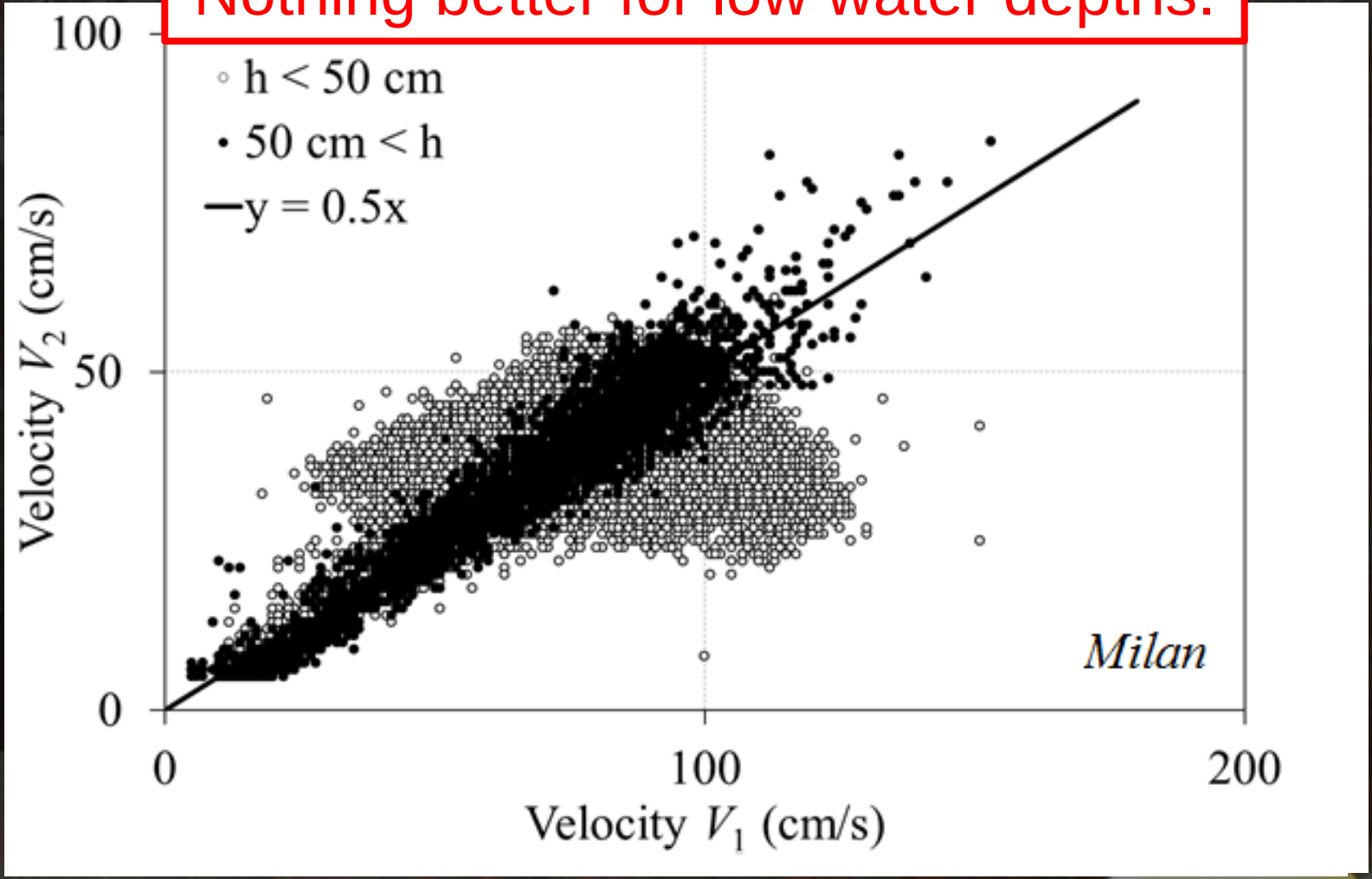
- Degraded conditions:
  - Example: path n°1 (V_1) is not working



Co

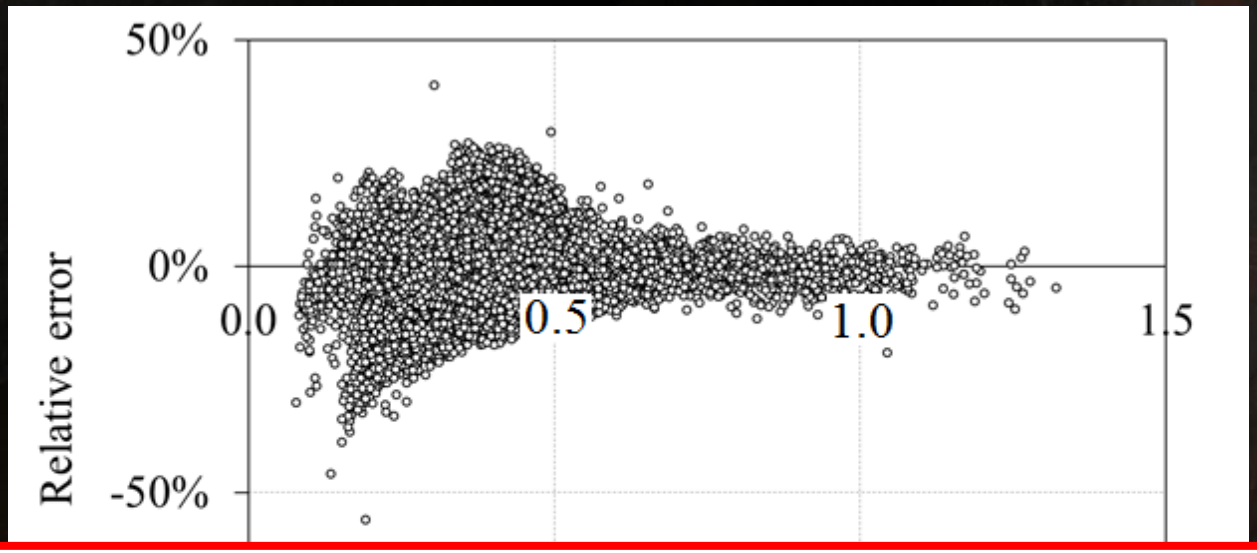
Good correlation between V_1 and V_2 for high water depths,

Nothing better for low water depths.



Results

- Comparison between optimal functioning and degraded mode (V_1 is not working)



Non-negligible error but:

- Better than loosing the data!
- Can be used for the management of the sewer.

Outline

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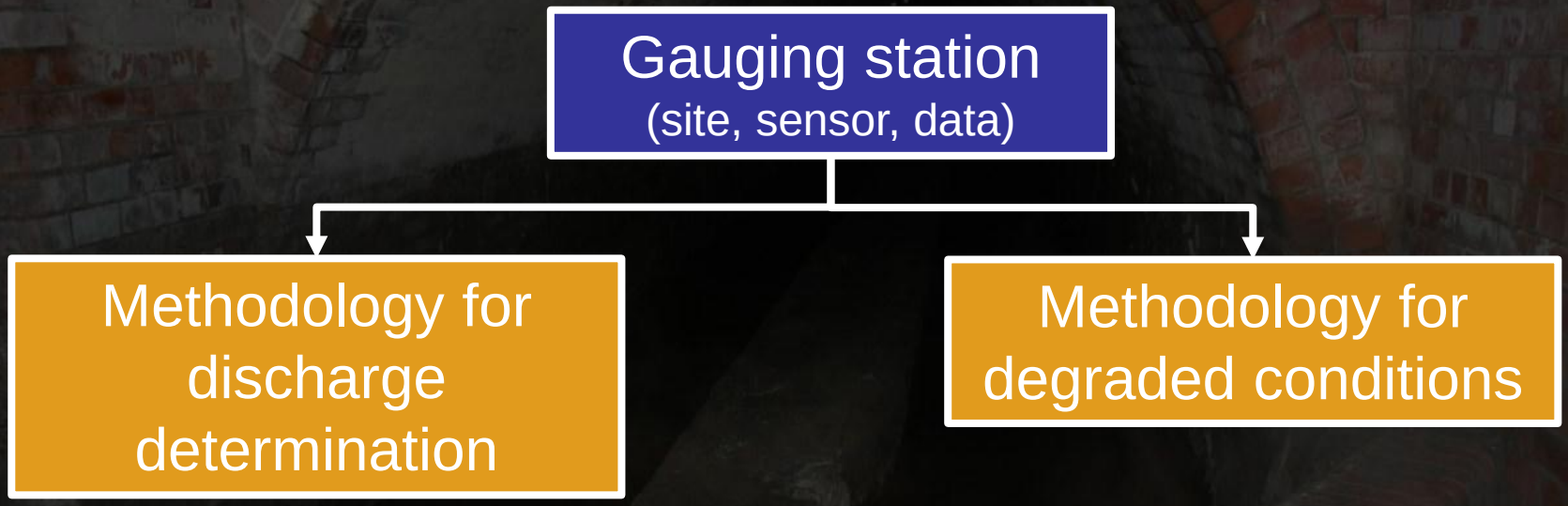
Conclusion



- Main goal: make the discharge determination more reliable.

- Two perspectives:
  - Improvement of the degraded relationships while the data are collected.
  - Investigation of more physical degraded relationships (velocity profiles…)

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