Grotte des Chamois

(Alpes-de-Haute-Provence, France)

Flooding in epiphreatic passages

Analysis of the 4-5 Nov. 2011 flood

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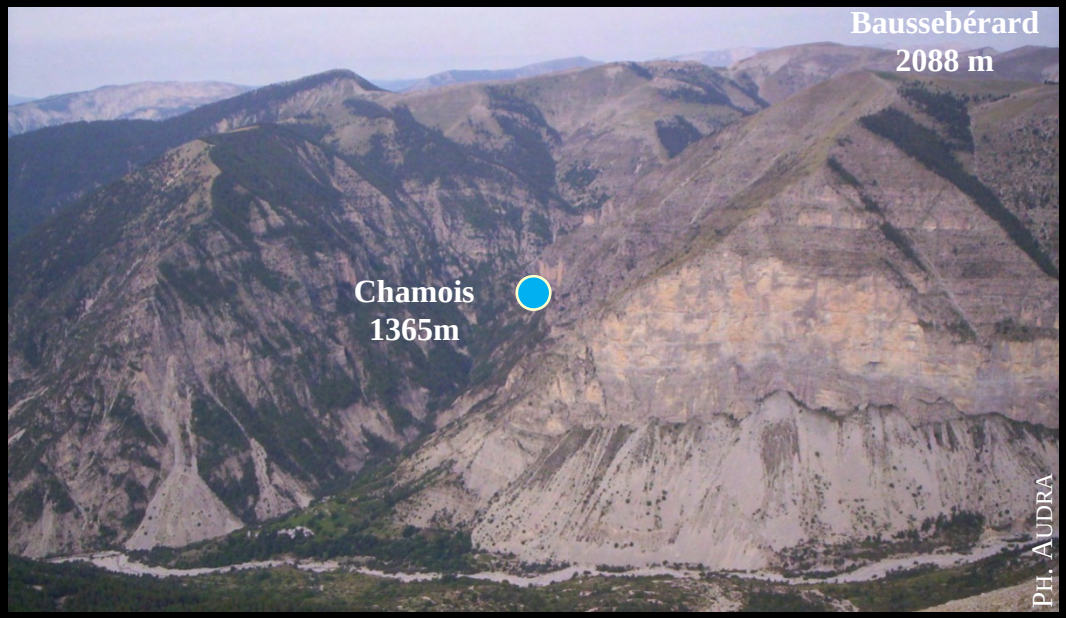
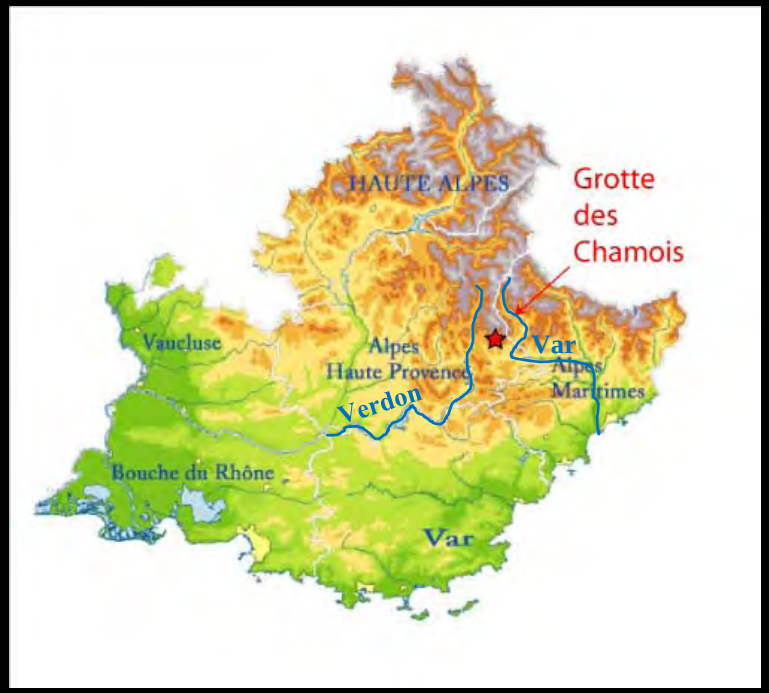
13th National Caving Congress
Muotathal, Switzerland

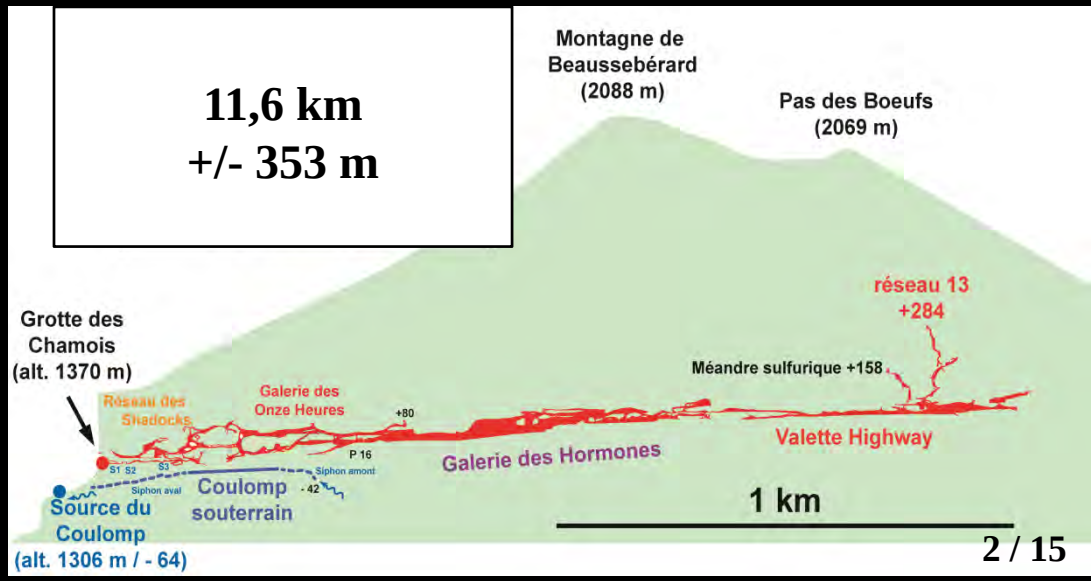
Location


Grotte des Chamois


Massif Armoricain
Bassin parisien
Vosges
Jura
Massif Central
Alpes
Bassin aquitain
Pyrénées
Altitudes
Grotte des Chamois


Baussebérard
2088 m
Chamois
1365m
Ph. Audra


HAUTE ALPES
Grotte des Chamois
Vaucluse
Alpes Haute Provence
Var
Alpes Maritimes
Verdon
Bouche du Rhône
Var


11,6 km
+/- 353 m
Montagne de Beaussebérard (2088 m)
Pas des Boeufs (2069 m)
Grotte des Chamois (alt. 1370 m)
réseau 13 +284
Méandre sulfurique +158
Réseau des Shadocks
Galerie des Onze Heures
+80
P 16
Galerie des Hormones
Valette Highway
S1 S2 S3
Siphon aval
Siphon amont
- 42
Coulomp souterrain
Source du Coulomp (alt. 1306 m / - 64)
1 km

Outline

1 - Problematic and methodology

2 – The 4-5 Novembre 2011 flood

3 – Flooding of the Shadocks series (Entrance)

4 – Draining of the Shadocks series

5 – Thermal dynamic

1 - Problematic and methodology

⇒ hydrodynamic of the Coulomp souterrain

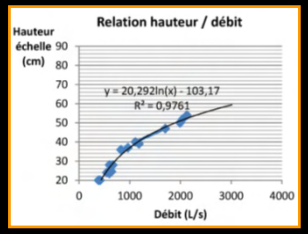
⇒ characteristics of flooding in the entrance (Shadocks series)

⇒ « bolt » for exploration (security)

⇒ gauging, gauging curve...

⇒ dataloggers:

- Schlumberger (Dive + Baro)
- Reefnet

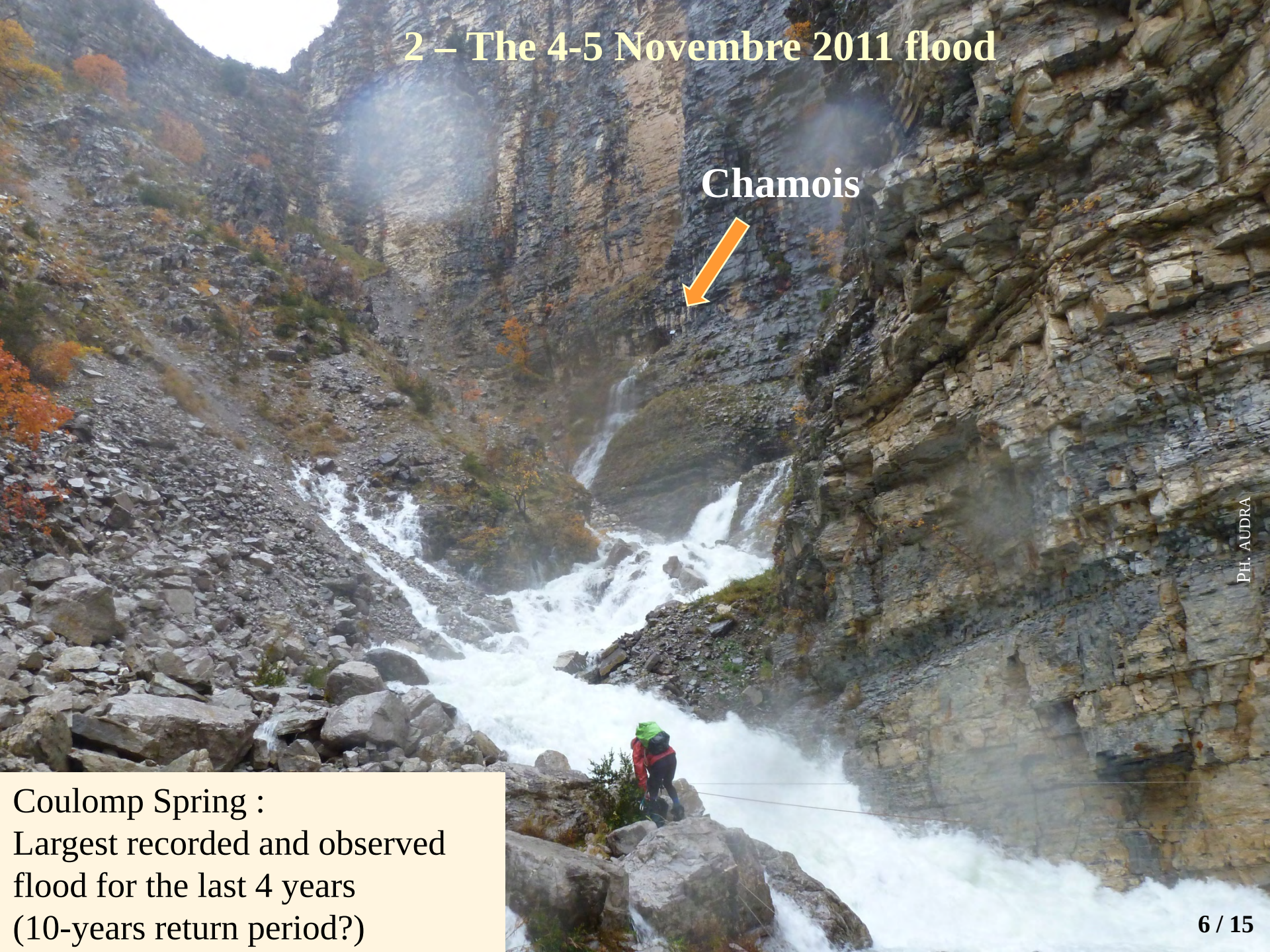


2 – The 4-5 Novembre 2011 flood

Var River : 1300 m^3/s

Flooding in Cannes
(Siagne River)

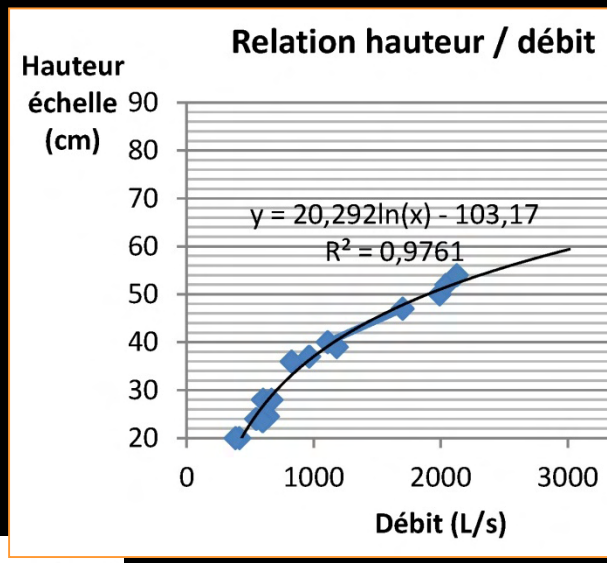
2 – The 4-5 Novembre 2011 flood

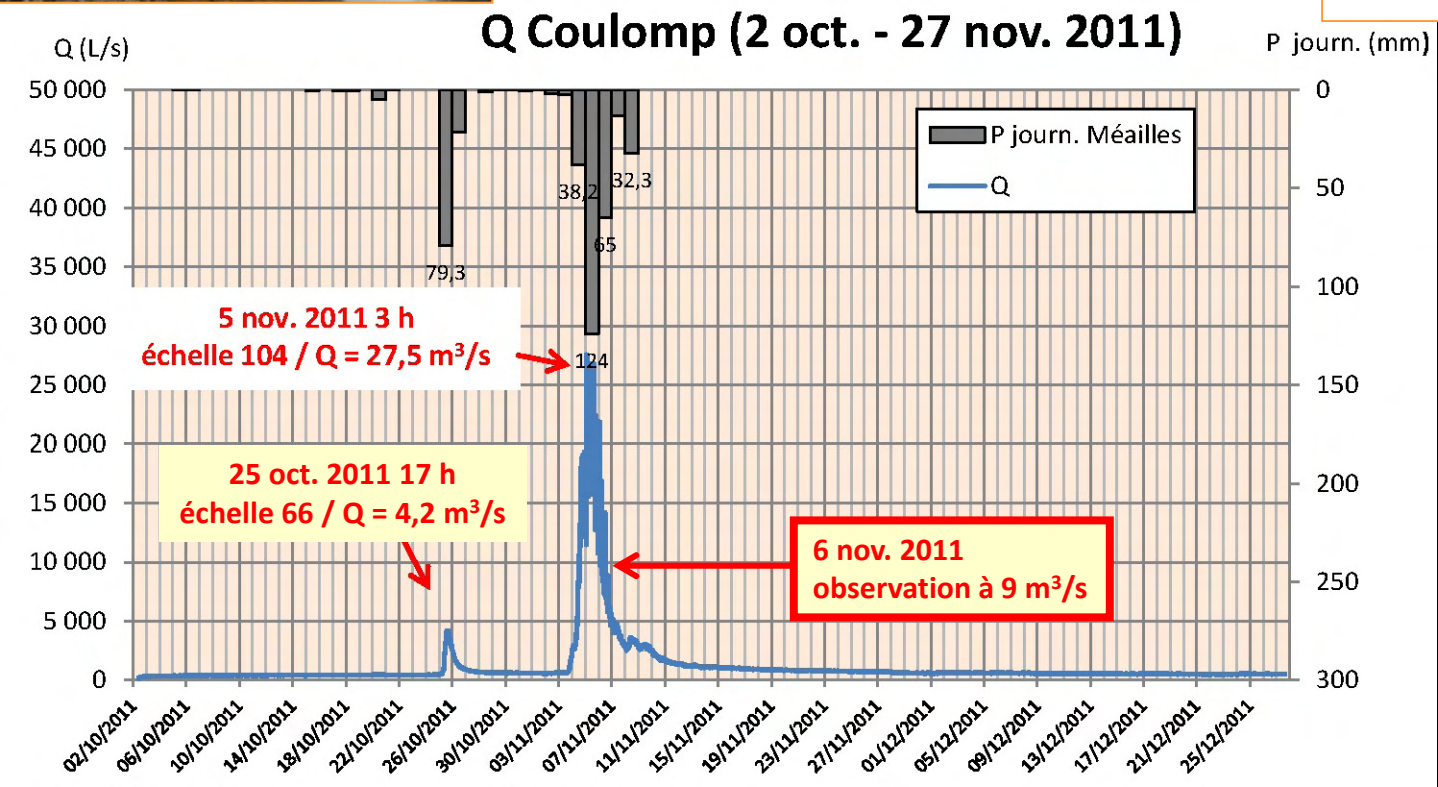


Coulomp Spring :
Largest recorded and observed flood for the last 4 years
(10-years return period?)

2 – The 4-5 Novembre 2011 flood

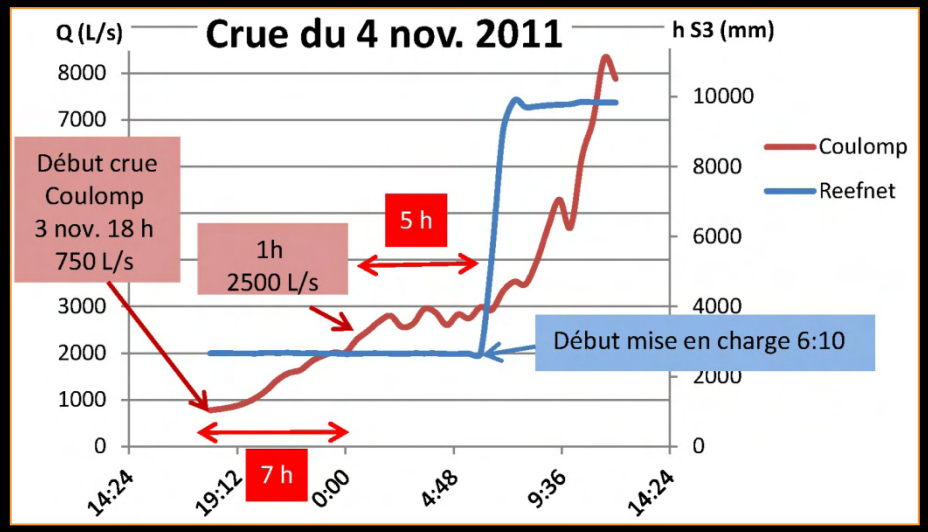
270 mm in 5 days
124 mm on 5th Nov.

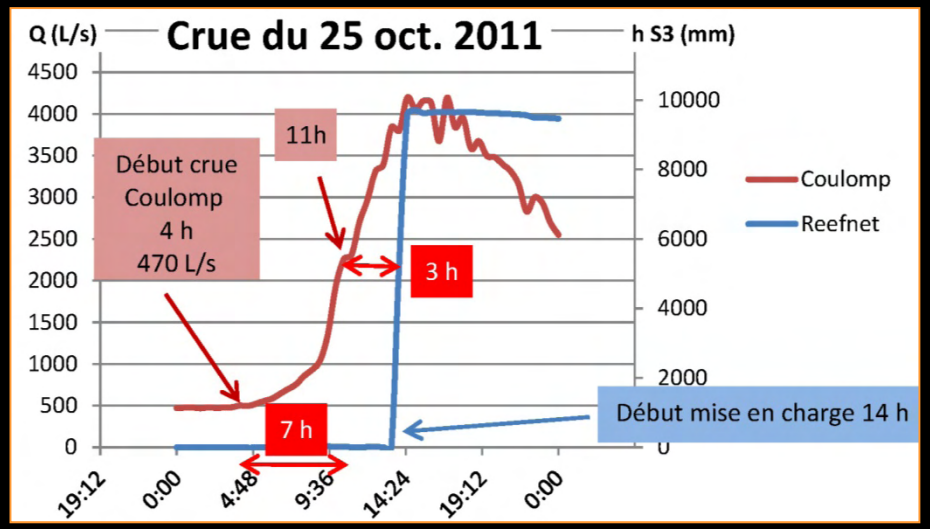




2 – The 4-5 Novembre 2011 flood

Beginning of the flooding
Comparison Spring – S3





- Rain event => flood beginning = 6 h
- Plateau at 2,5 m^3/s (pooring in galleries?)
- flood beginning => flooding of S3 = 12 h

Reaction time = 18 h

- flood beginning => flooding of S3 = 10 h (/ 12 h)

(more intense storm)

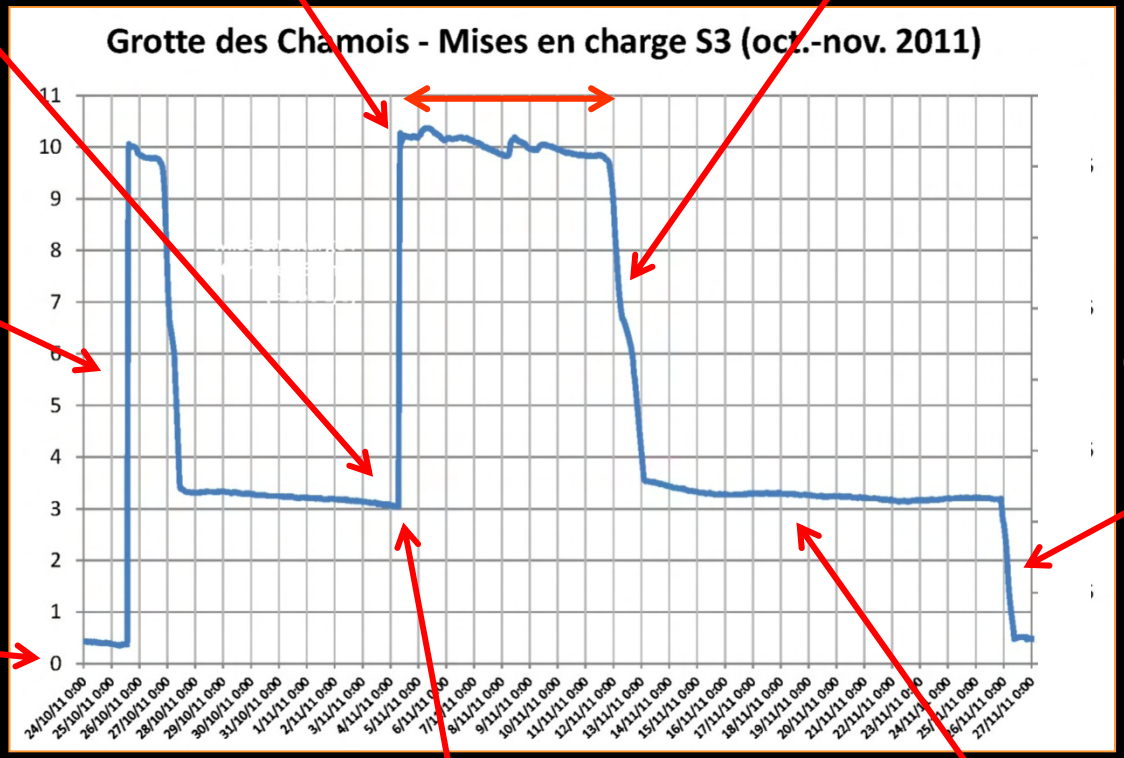
3 – Flooding of the Shadocks series

270 mm during 5 days,
From 4 Nov. in the morning

7:05
Siphon pours
out

Pouring out from
4 to 11 Nov.

Shaft rapidly drains
in 34 h



25 Oct.: 80 mm
Reaction time:
1/2 day

26 Nov.
Pumping,
draining of 2,7 m

Siphon empty

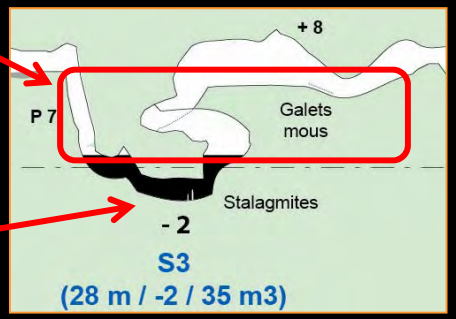
4 Nov. 6:10
Flooding begins

Siphon slowly lowers

3 – Flooding of the Shadocks series

200 m³

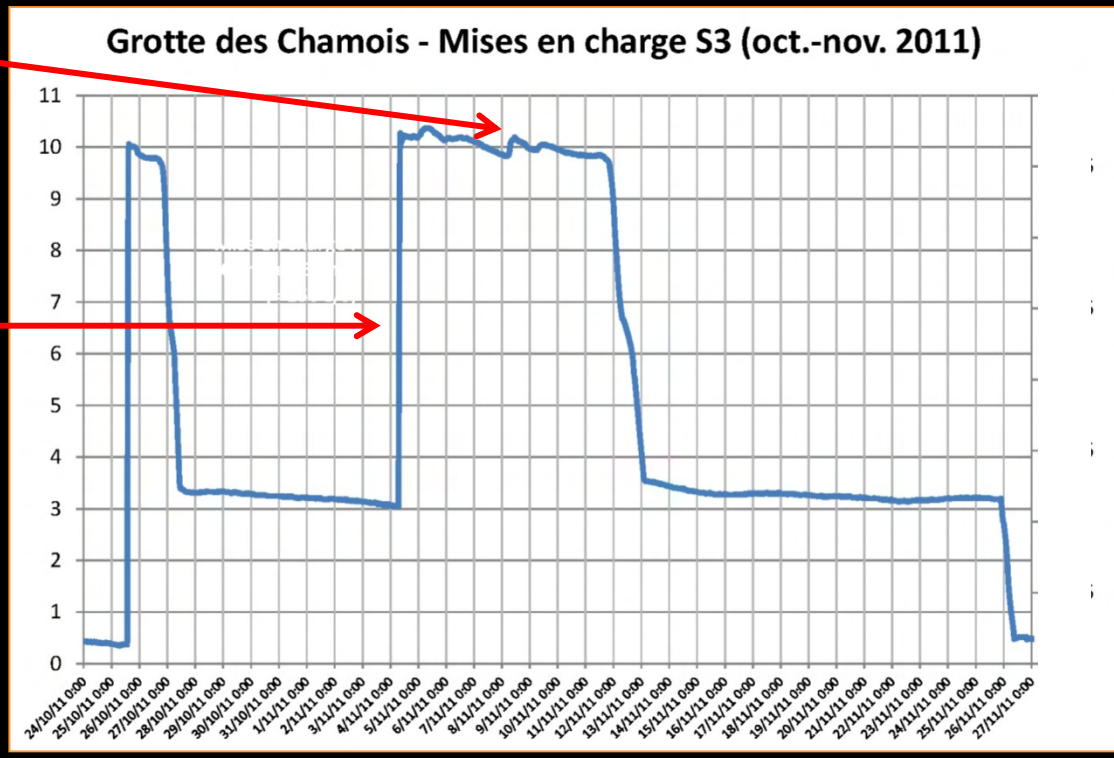
32 m³



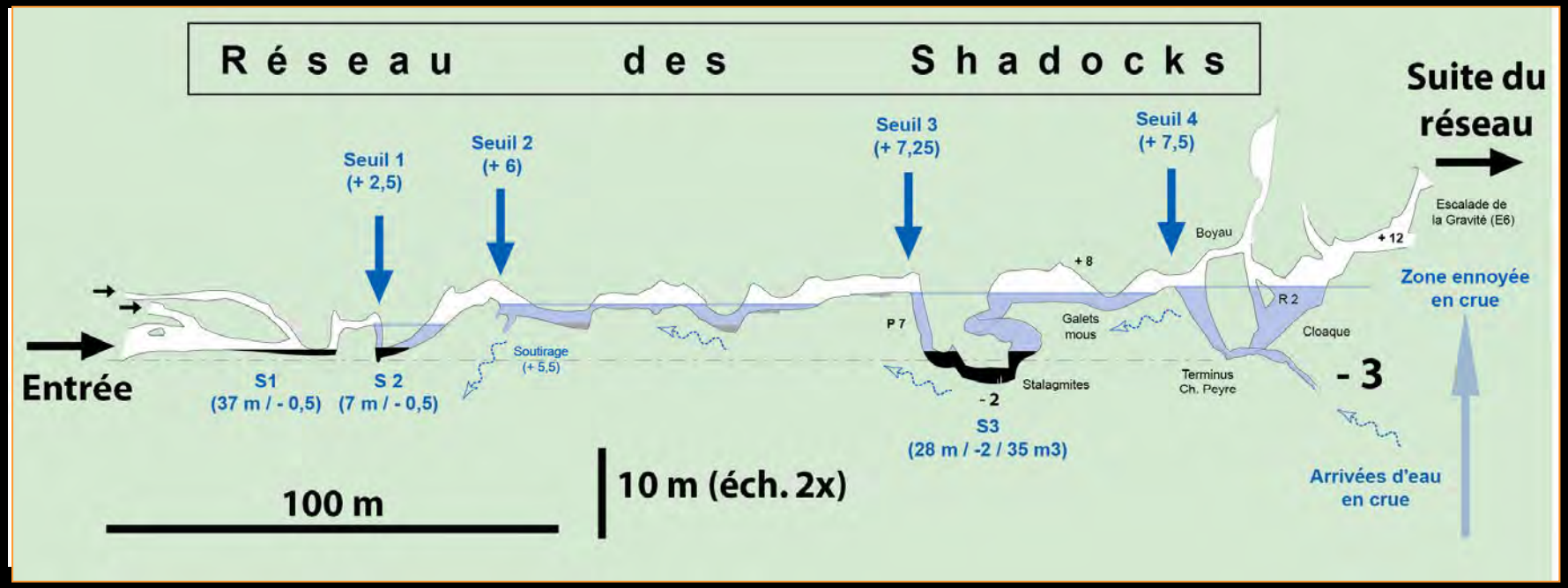
200 m³ in 55 mn => 60 L / s
=> Siphon closed in 1 mn !

Pouring out:
1 week

Flooding rise: 55 mn
(13 cm / mn)



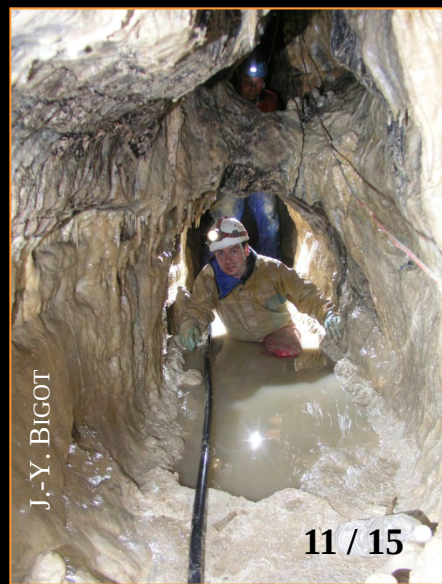
3 – Flooding of the Shadocks series



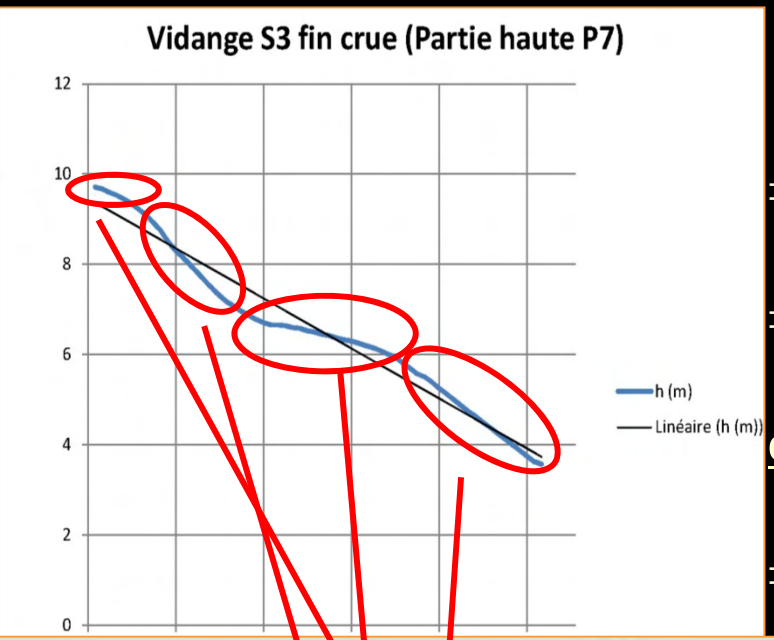
⇒ ropes turn back, washed areas, water level

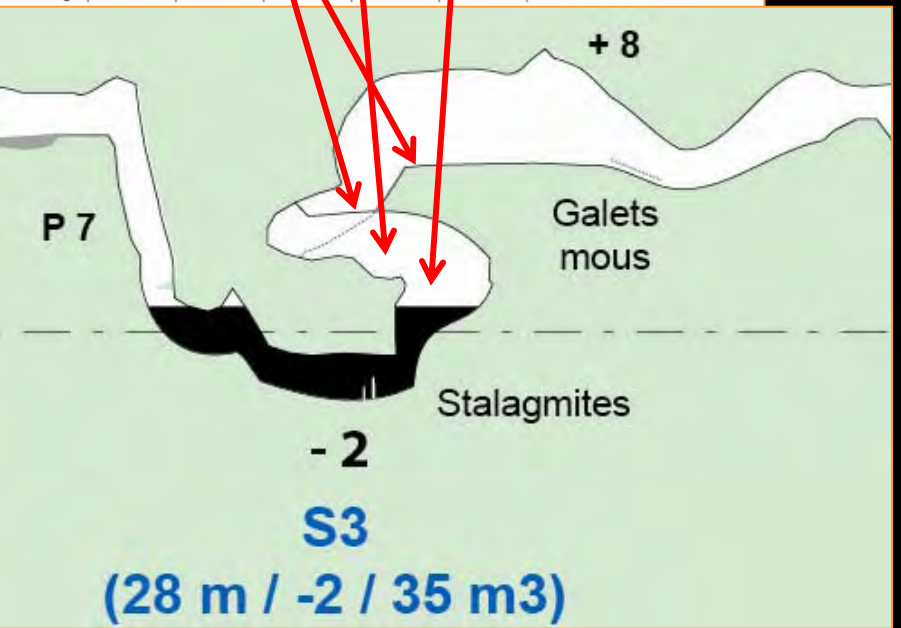
⇒ pouring out: 1 week (!)

⇒ Shadocks Series partly flooded (except highest parts)



4 – Draining of the Shadocks series





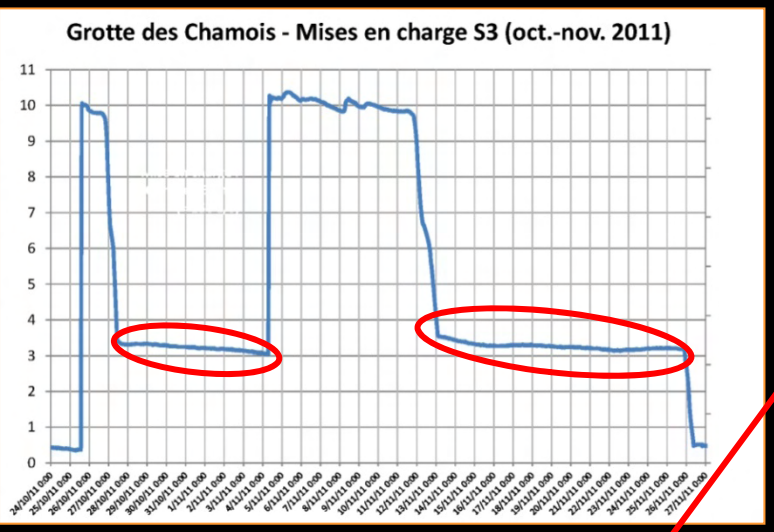
P7 shaft quickly drains

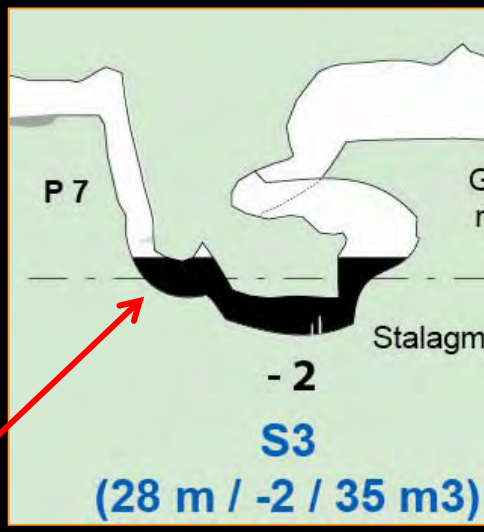
⇒ lowering 18 cm / h ; 200 m^3 / 34 h ≈ **1,5 L / s**

⇒ irregularities = chgt draining discharge / <u>section changes</u>

⇒downstream P7, regular section => upstream profil

4 – Draining of the Shadocks series

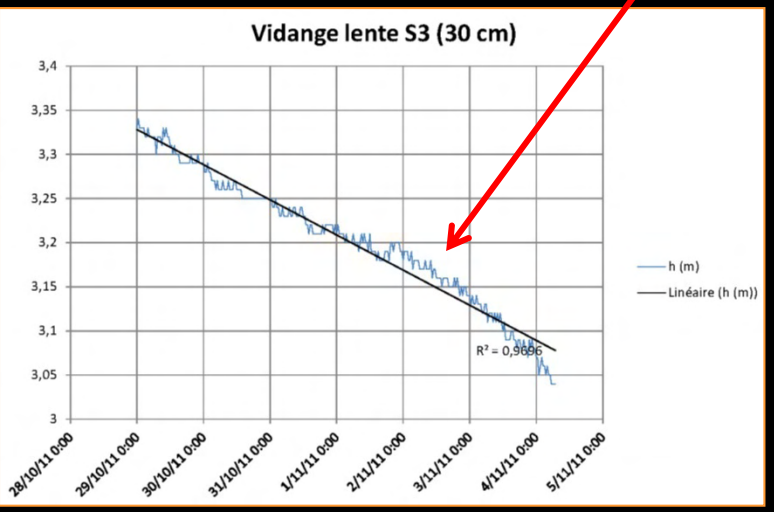




Slow draining of the S3

- 30 cm lowering
- Linear draining

- no section change
=> Q ct



$\Rightarrow$ 30 cm lowering = 5 cm / day

$\Rightarrow$ (compared to pumping) ≈ 4,5 m^3

$\Rightarrow$ Q draining ct ≈ **0,5 L / mn**

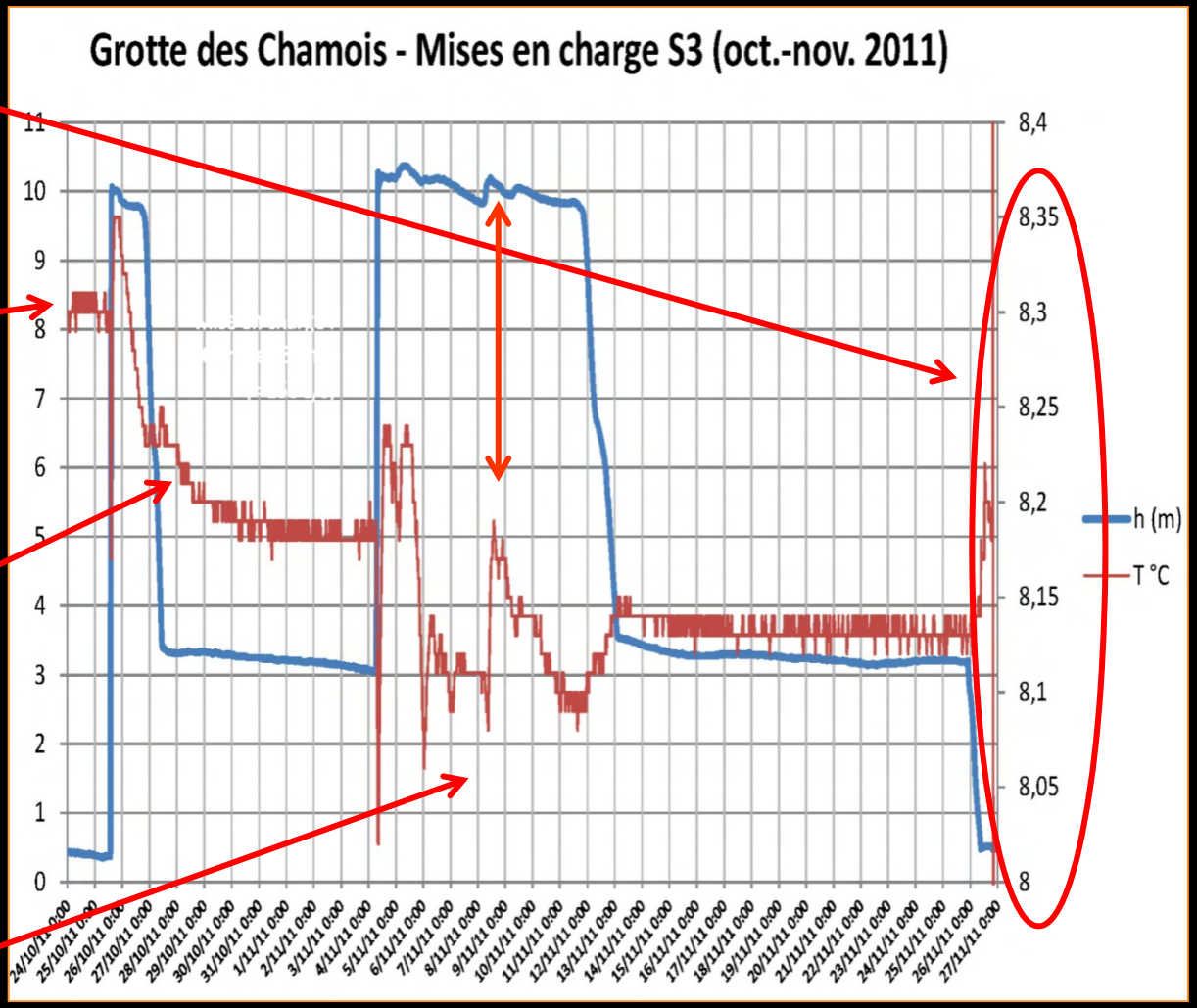
5 – Thermal dynamic

- T changes 8 – 8,35 °C

- Air T (siphon empty)

- water colder and colder
  (autumn rainfall)

- succession of rain showers
« cévenoles type »:
water first « warm »,
then pushed by colder rain water



Conclusion

- **Qmax peak ≈ 27 m^3/s**

  ⇒ **gauging with uranine at high Q**

- **Reaction time for flooding:**

  ≈ 18 h after rain (karst not saturated)

  ≈ 10-12 h after flood begins at the spring

  ⇒ **refining (saturated reserves / unsaturated); Hourly P**

- **High velocity, extent and lenght of flooding (security!)**

  ⇒ **« instantenous » closing of S3**

  ⇒**Shadocks is flooded (except highest parts)**

  ⇒ **lenght 1 week (+ draining time of the lower parts)**

- **quantification of draining Q S3 (1,5 L/s ; 0,5 L/mn)**

=> **Dataloggers are worthwile** (if data reduction are done!)