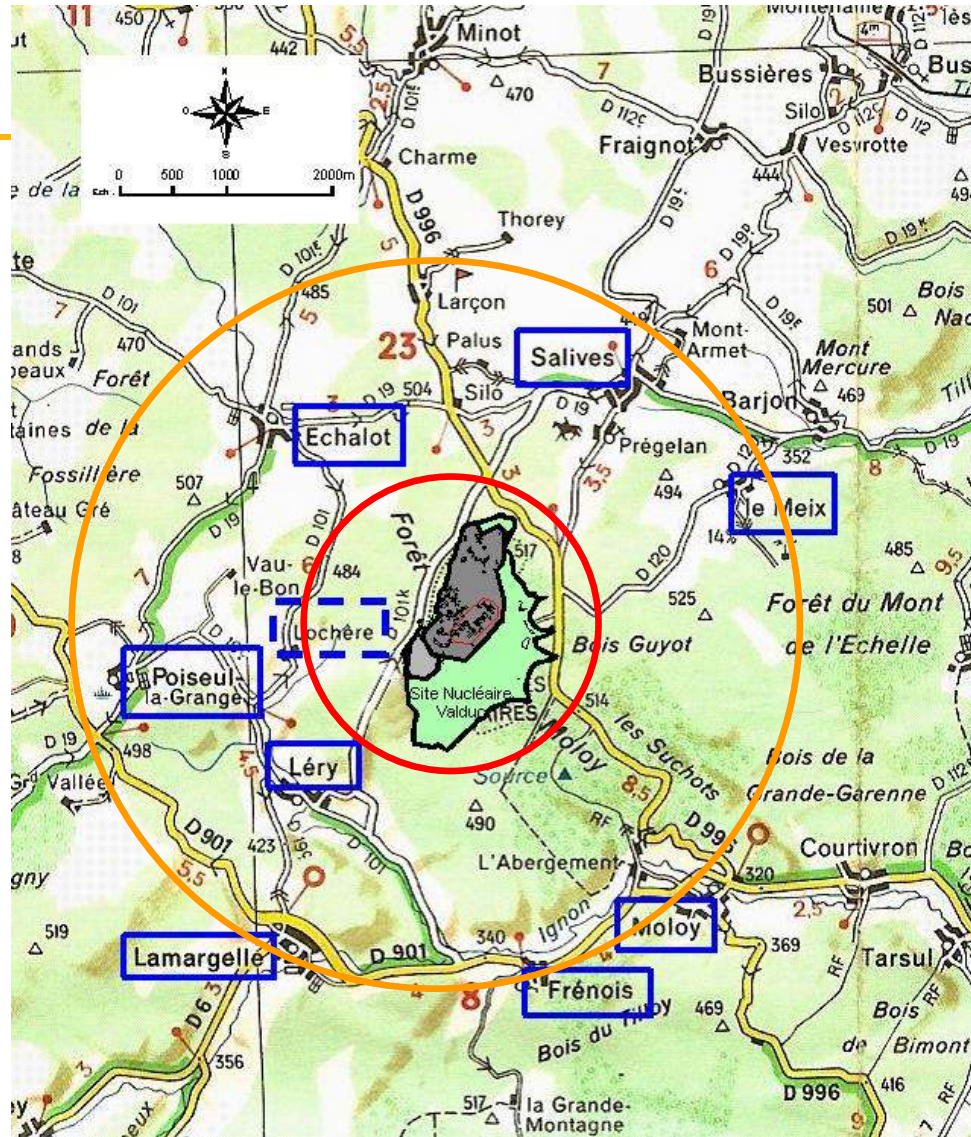


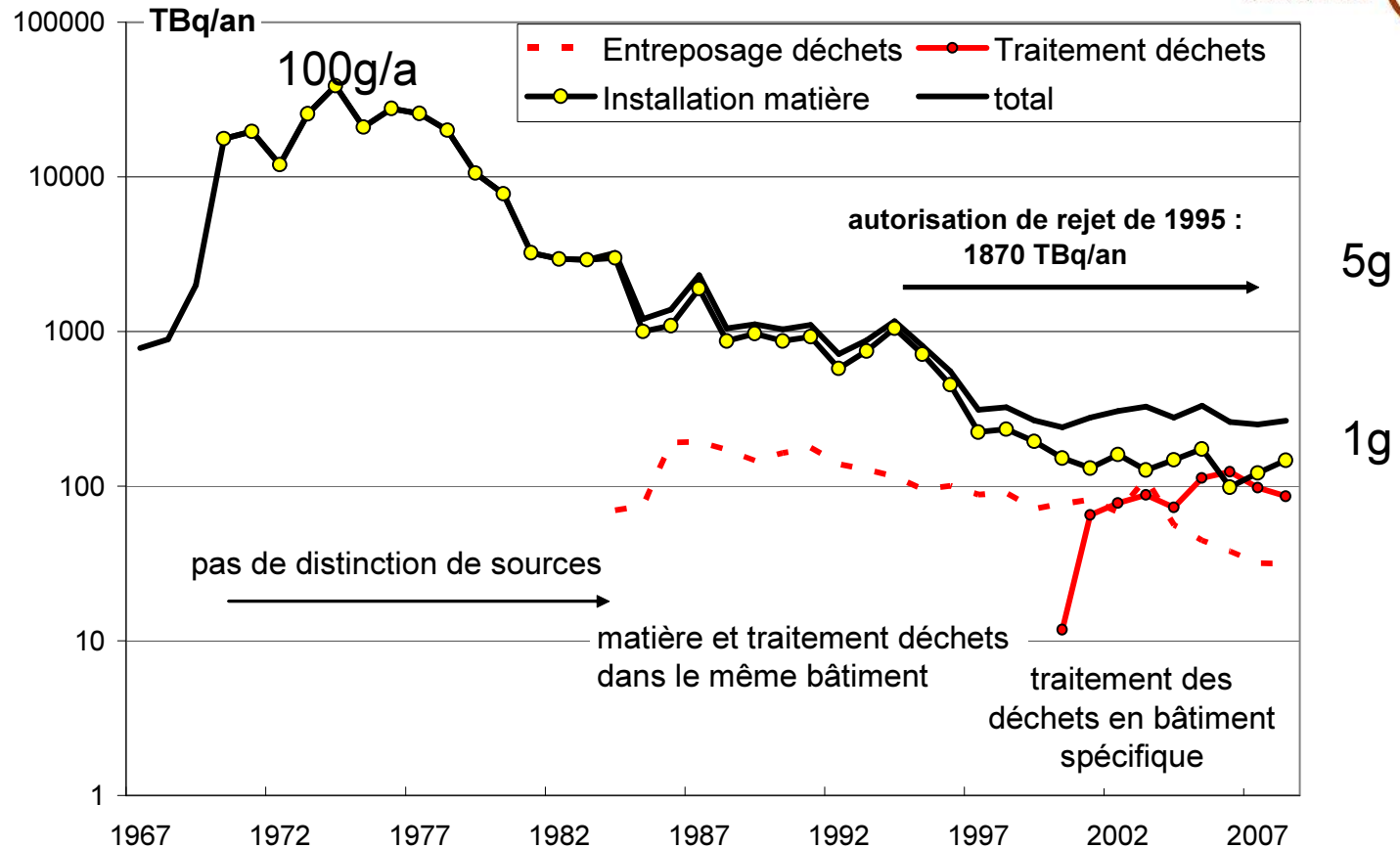


Contribution of  
CEA-Valduc centre  
on knowledge about tritiated water  
transfers in the different compartments of  
the environment from survey data, with  
atmospheric releases.

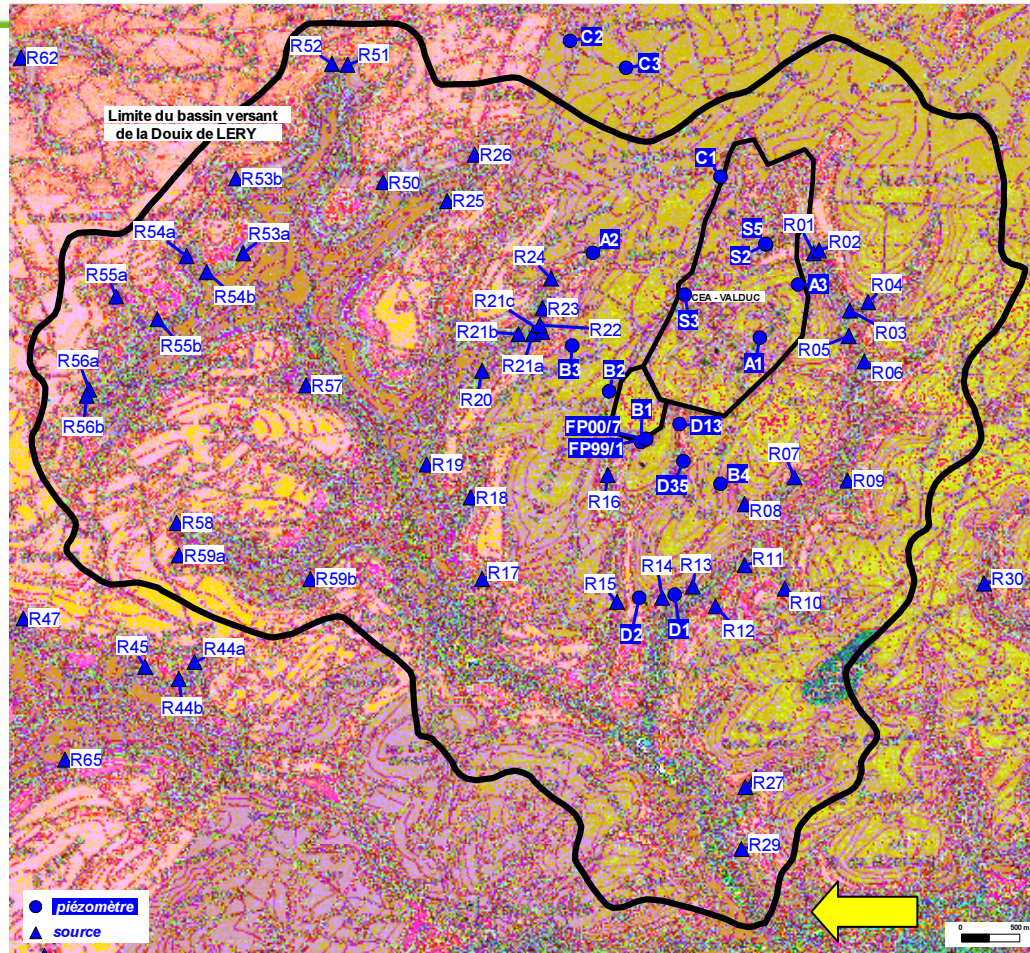
CEA France



# Atmospheric Release : Tritium



Constant annual Release for 10 y : about 1 gramme (358TBq)



few piezometers but a lot of costless informations by the springs,

Un closed basin with one exutory : La douix in Moley,

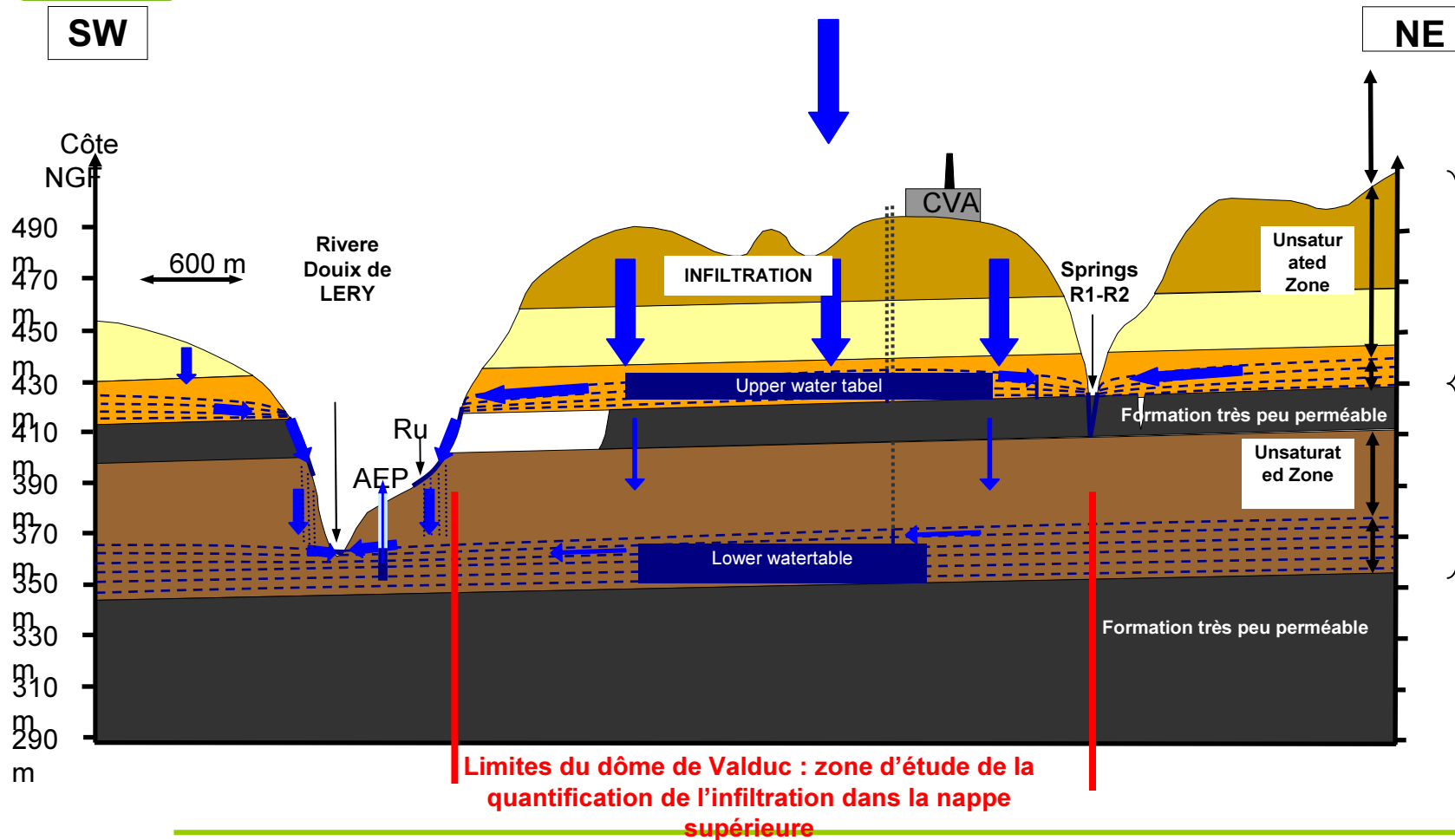
So possibility to balance

# in vertical : 2 watertables

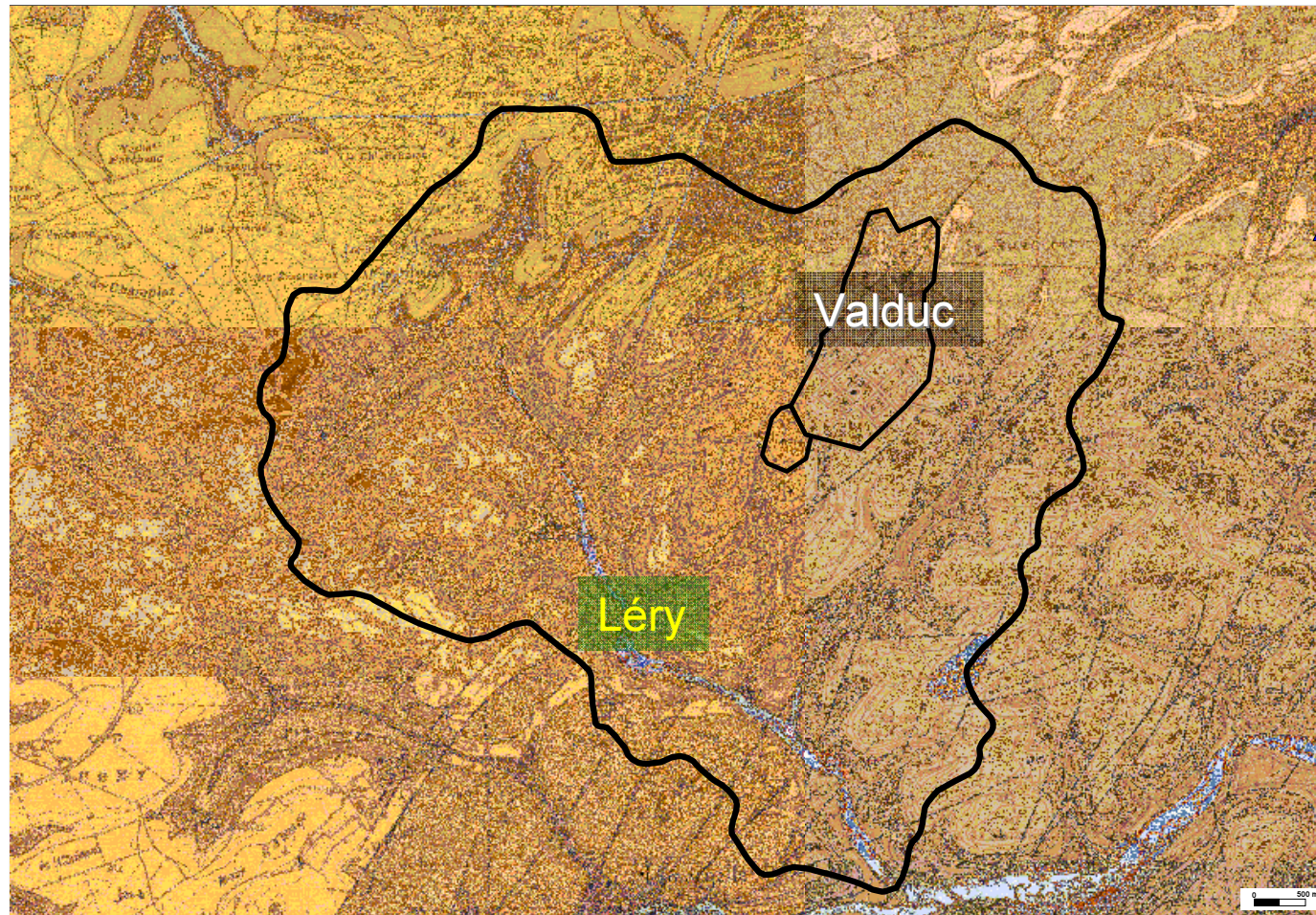
PRECIPITATION

SW

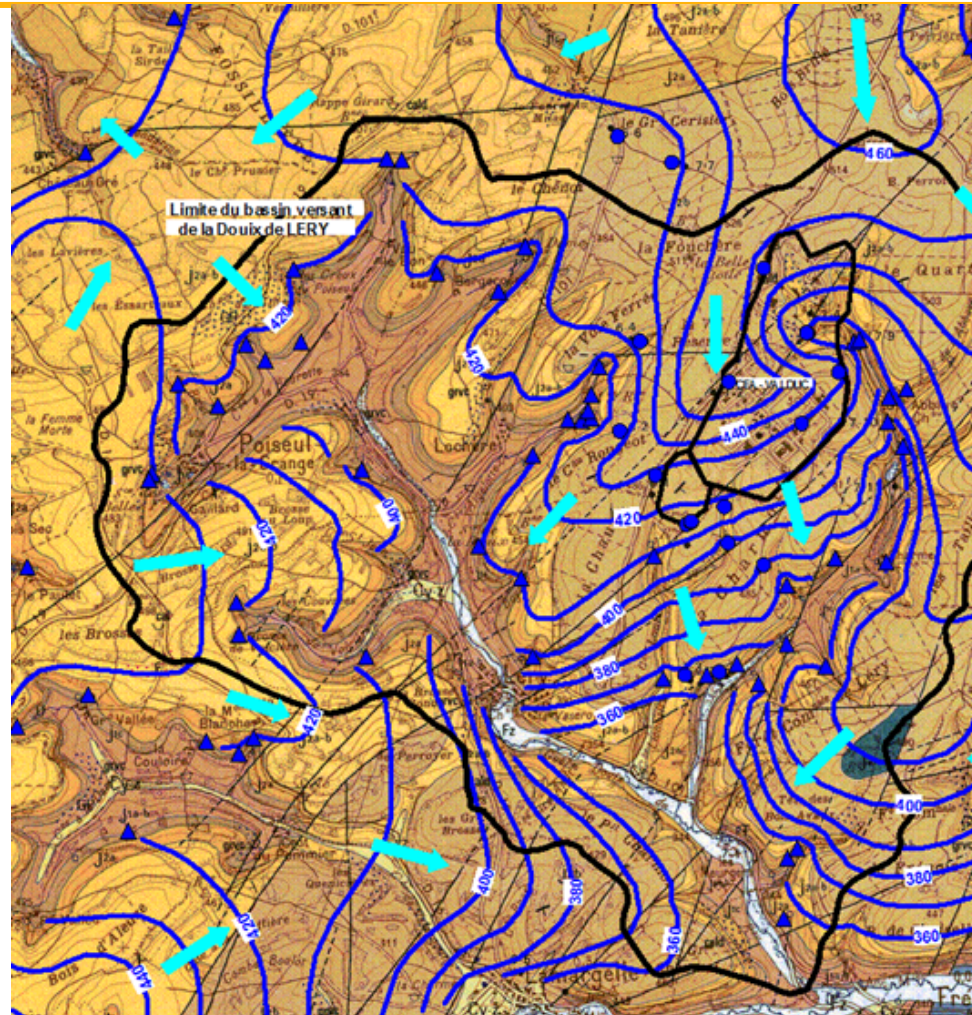
NE



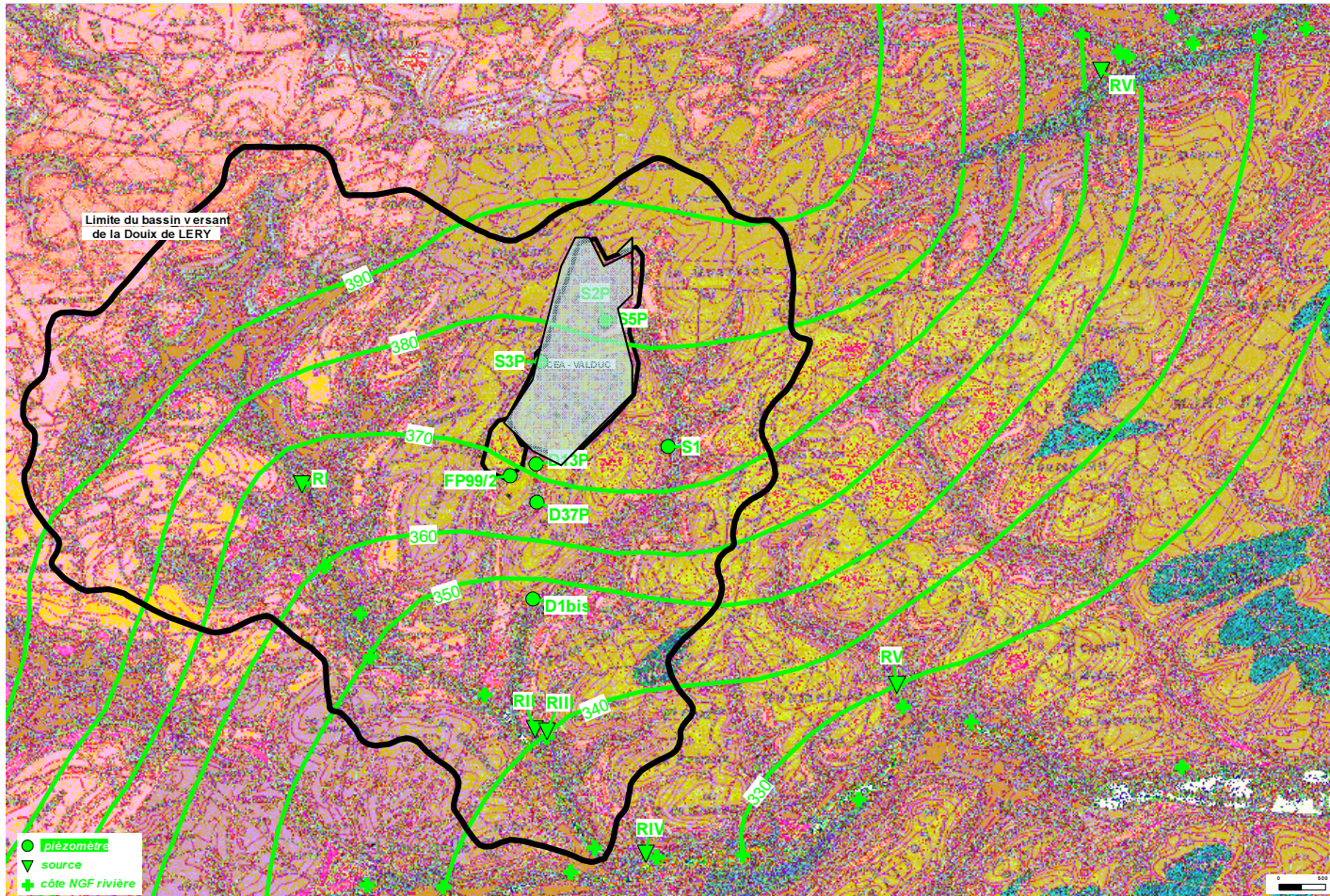
# Bassin Versant de la Douix de Léry



# Upper watertable

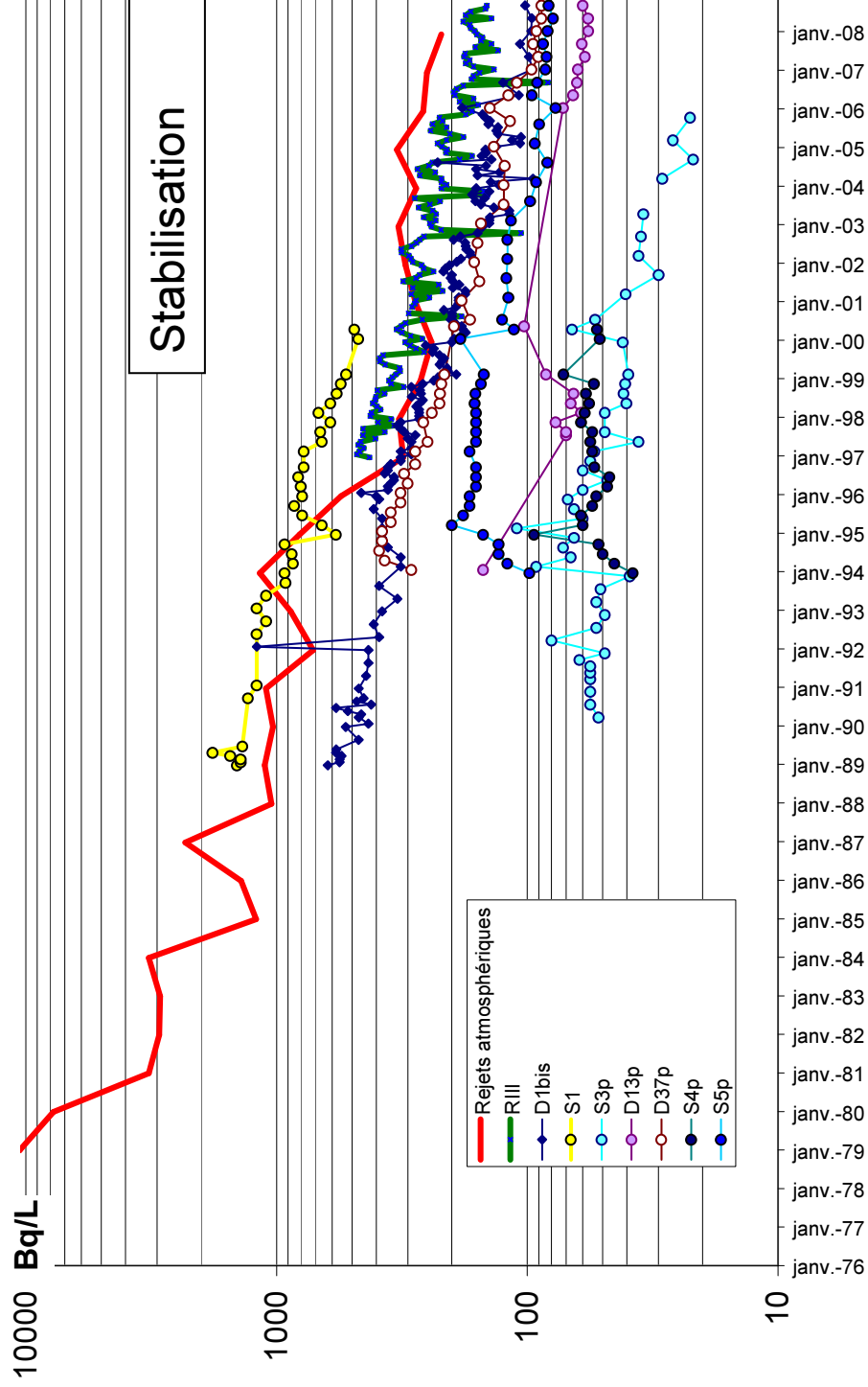


# Water flow of lower watertable





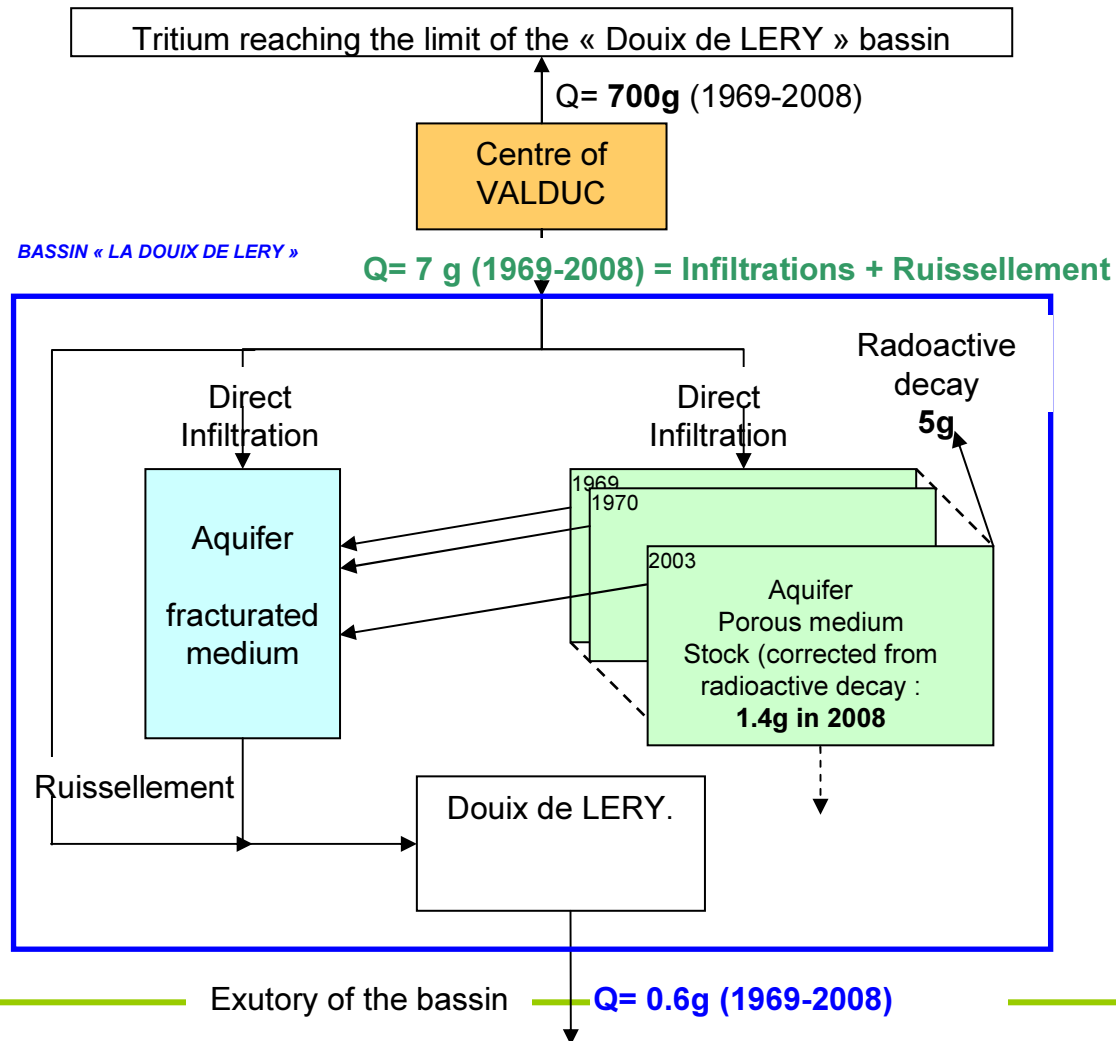
# Lower watertable activity



# Tritium Balance in the bassin Valduc



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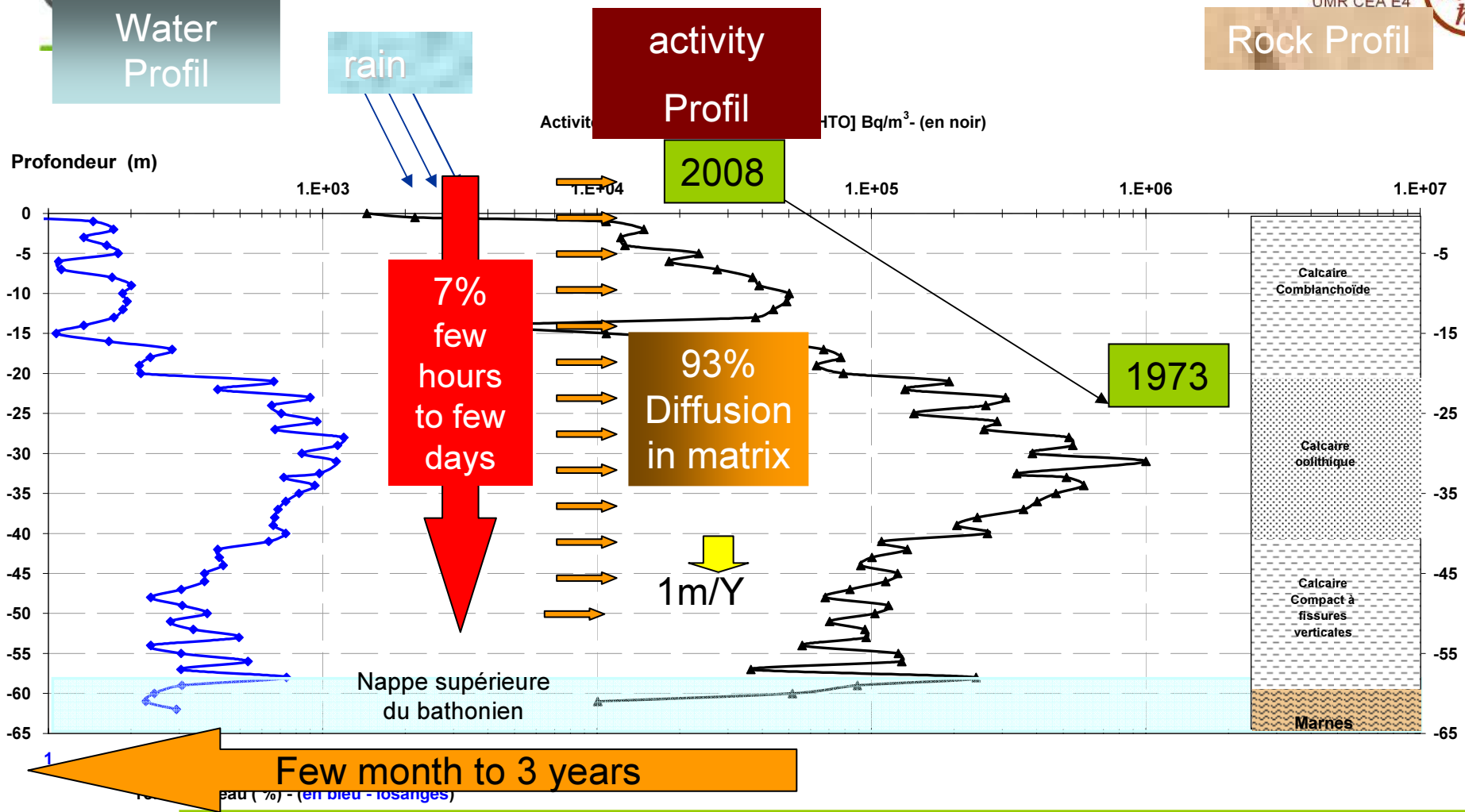
# Infiltration mechanism



LCPR-AC  
UMR CEA E4



Rock Profil





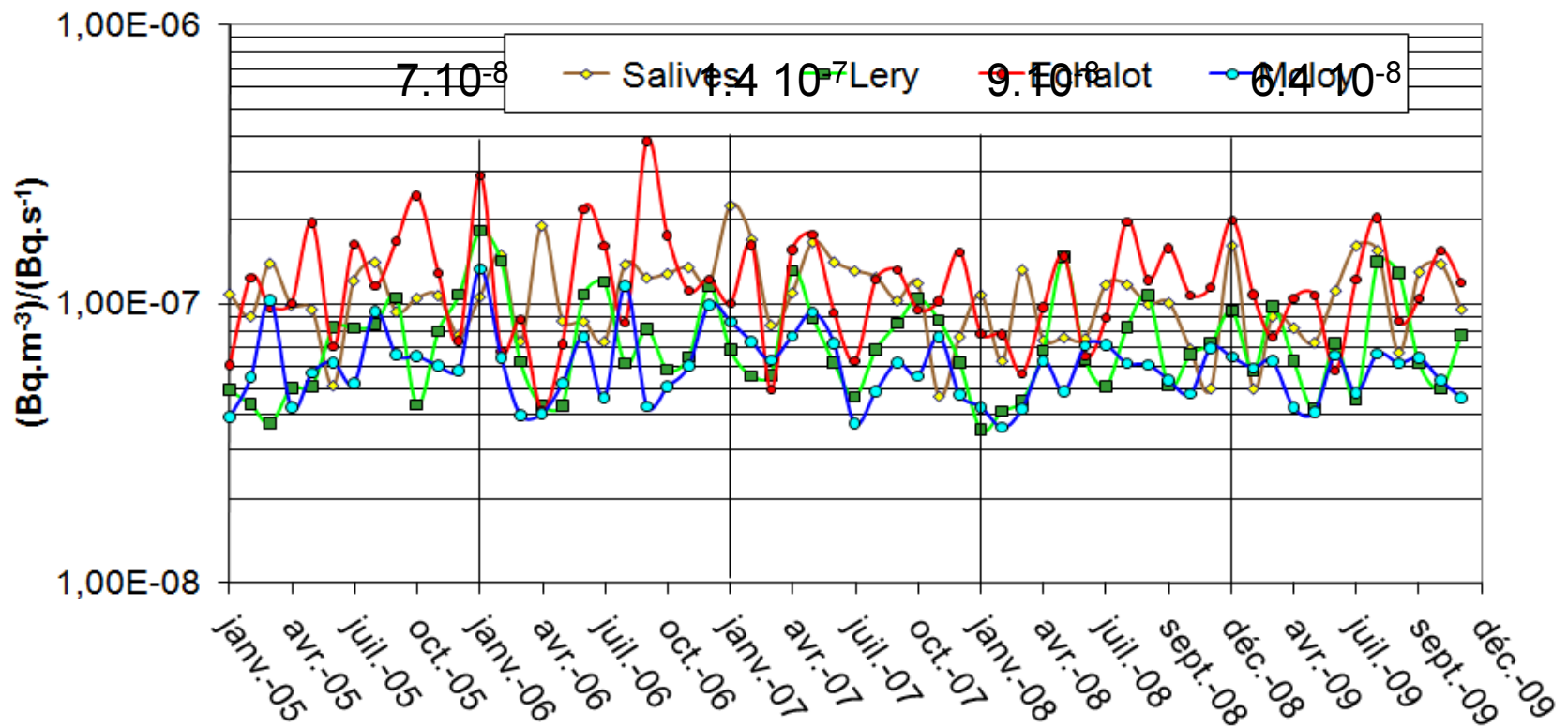
# atmospheric Transfers

## Measures and assessments

# atmospheric Transfer measures and assessment



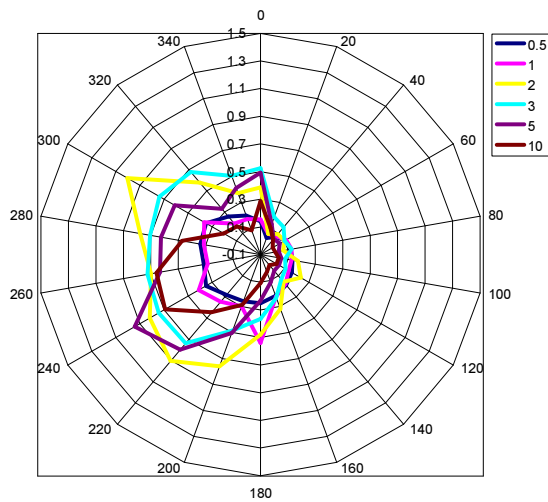
monthly average atmospheric transfer coefficient moyen mensuel  
to external survey stations (4 to 5 km)



# Wind roses 2005-2008

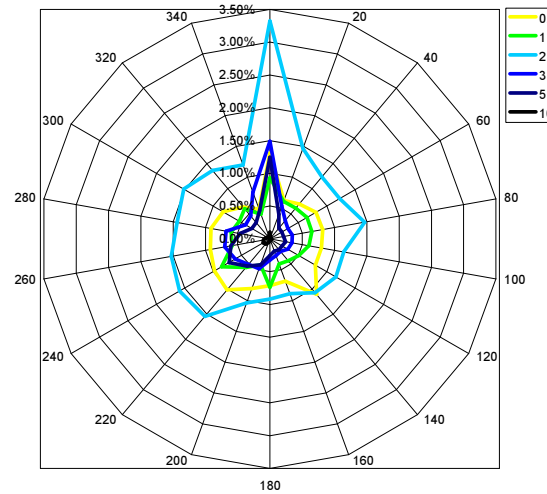


Origine des vents par temps de pluie de mars 2005 à mars 2008



rain

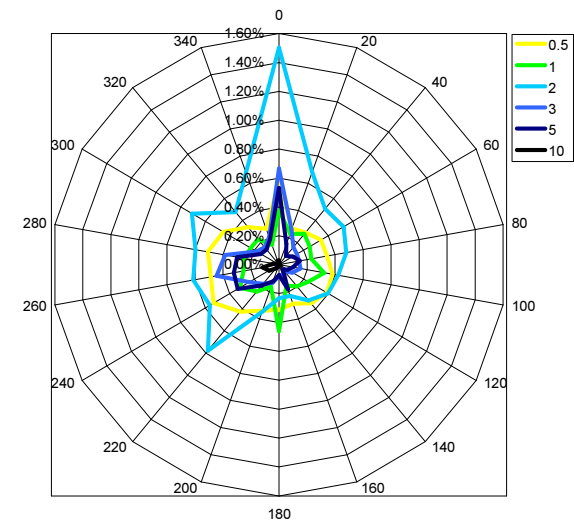
Rose des vents en diffusion normale sans pluie d'avril 05 à mars 08



dry

Instable and  
neutral

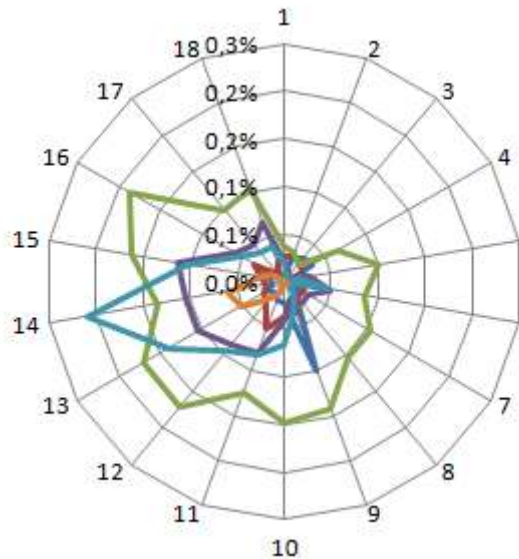
Rose des vents en Diffusion Faible sans pluie d'avril 05 à mars 08



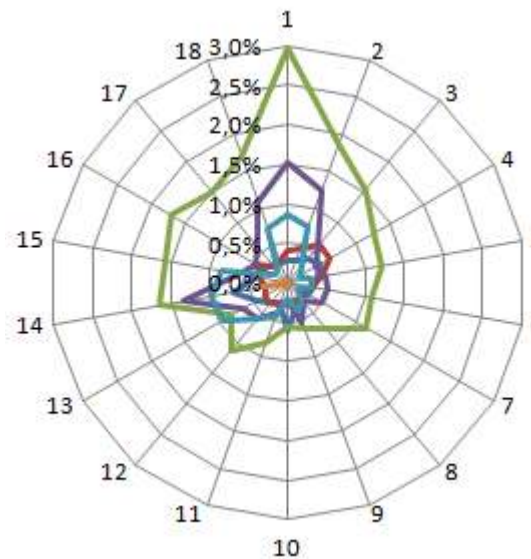
dry

stable

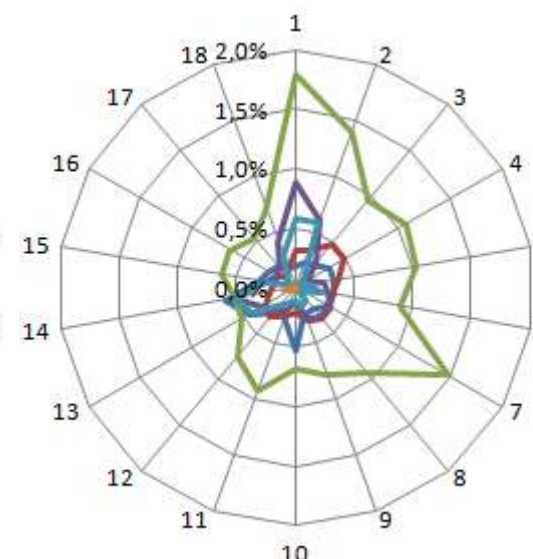
# Wind roses 2009



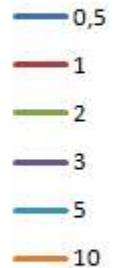
pluie



dry  
Instable

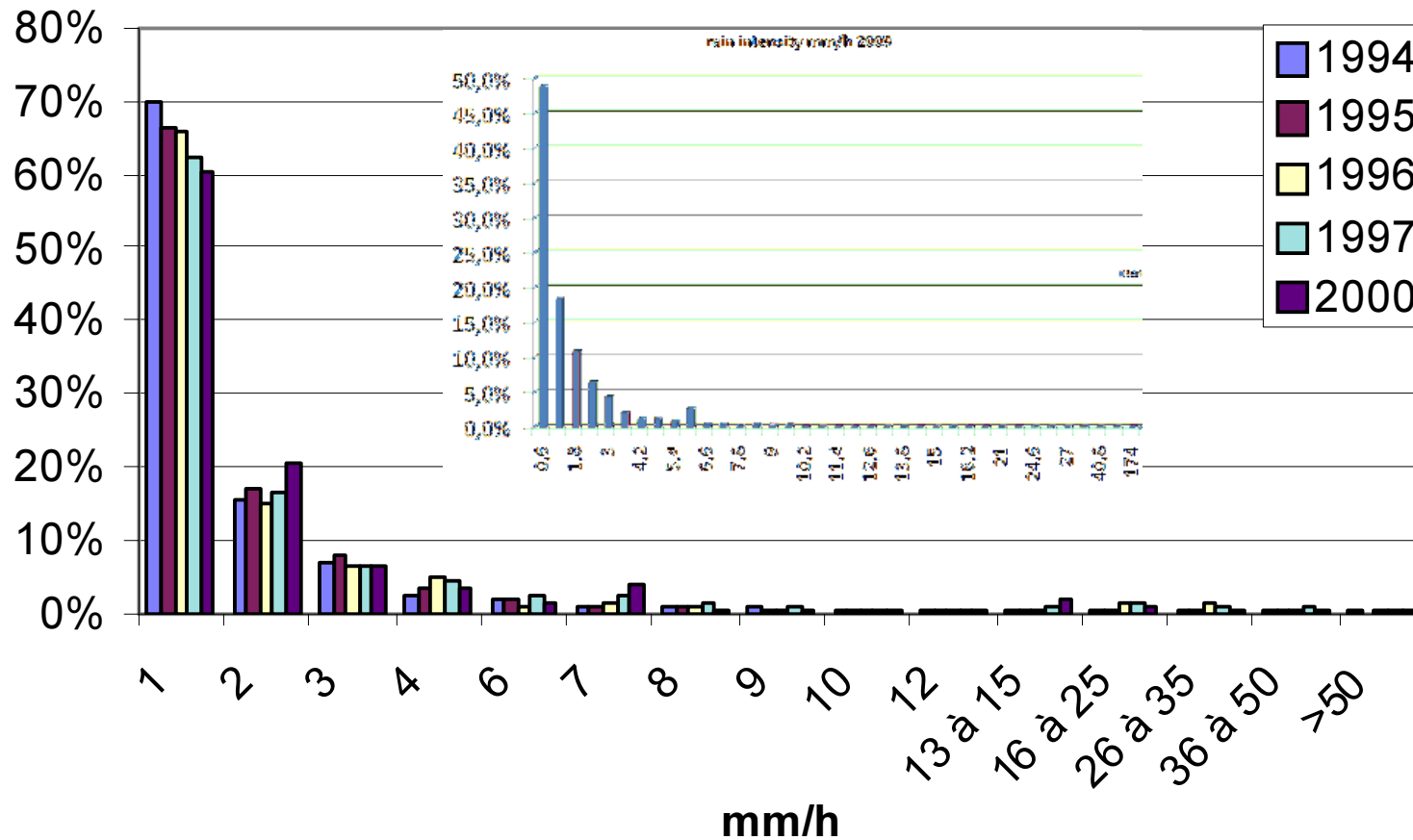


dry  
stable



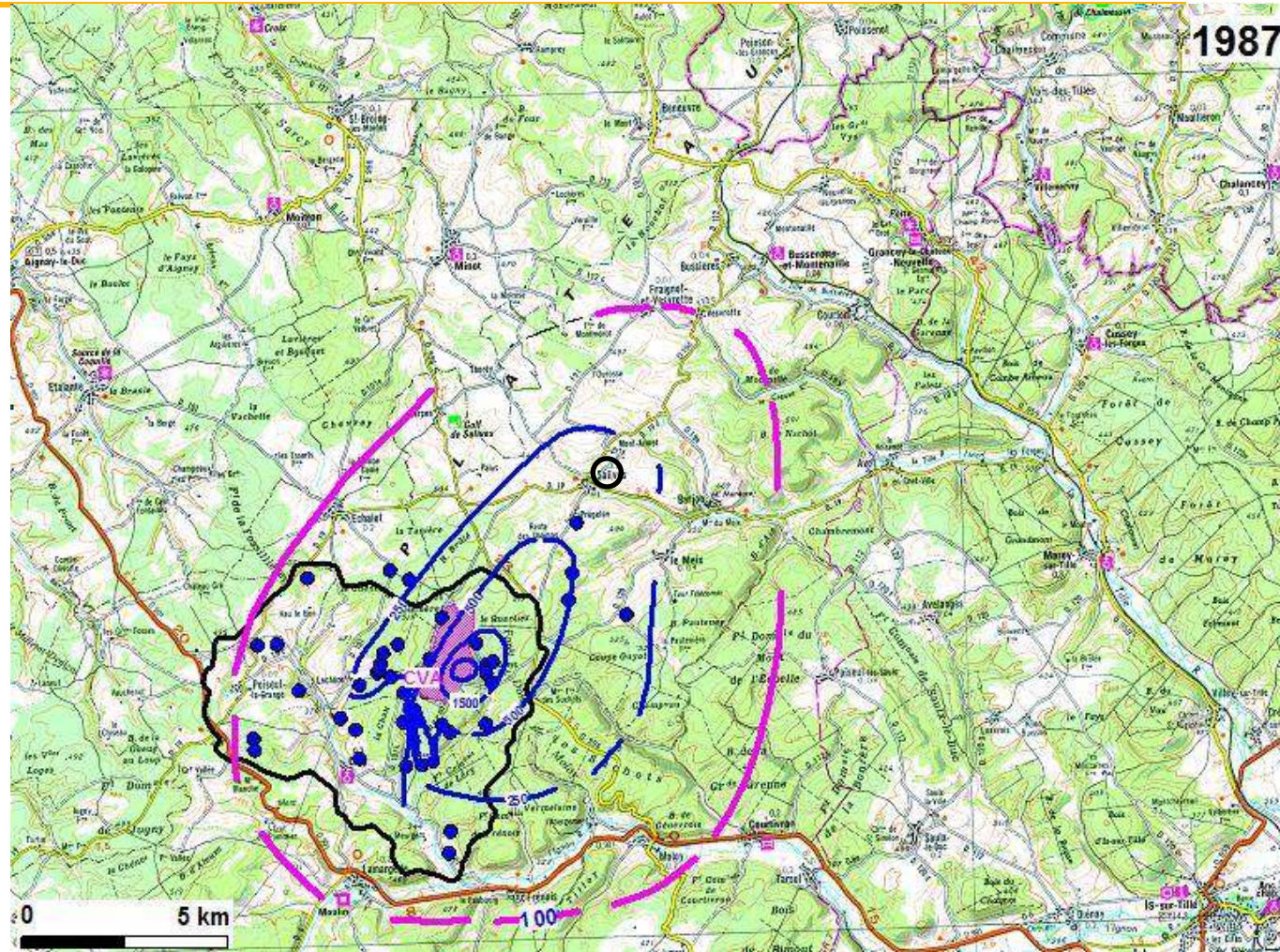
# Rain intensity distribution

Répartition des intensités de pluies (% annuel)

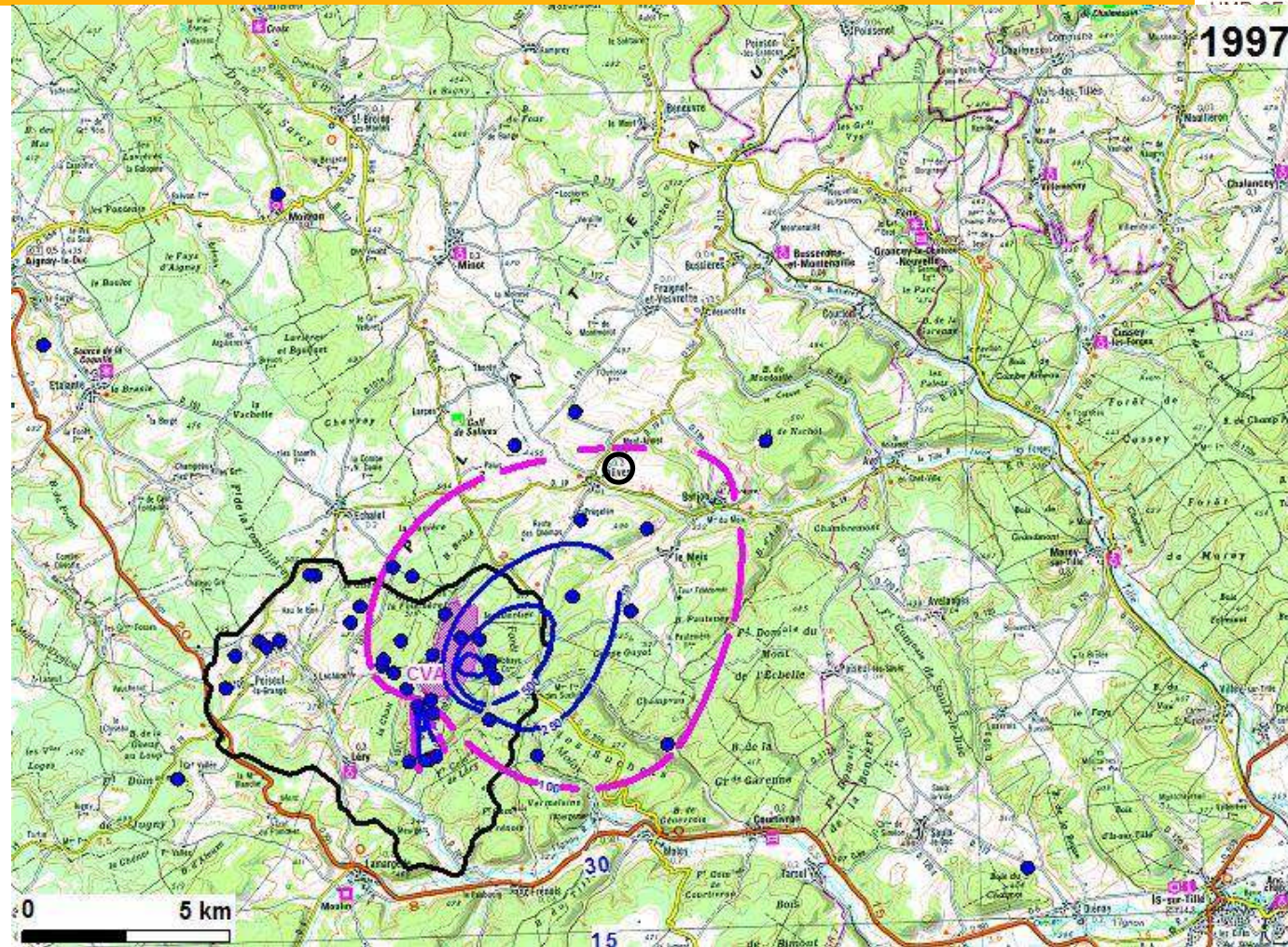




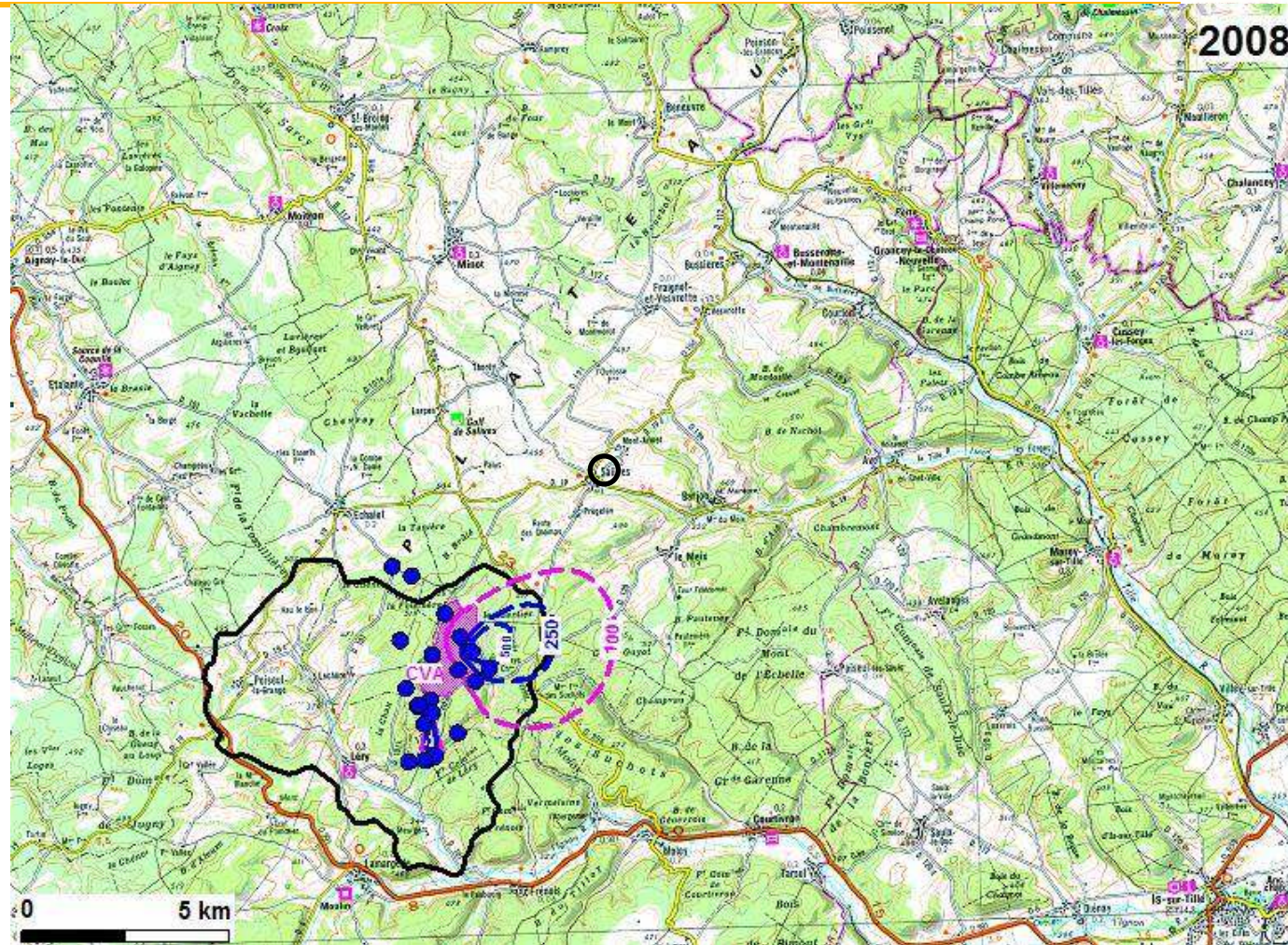
# Concentrations in tritium of the upper water table 1987



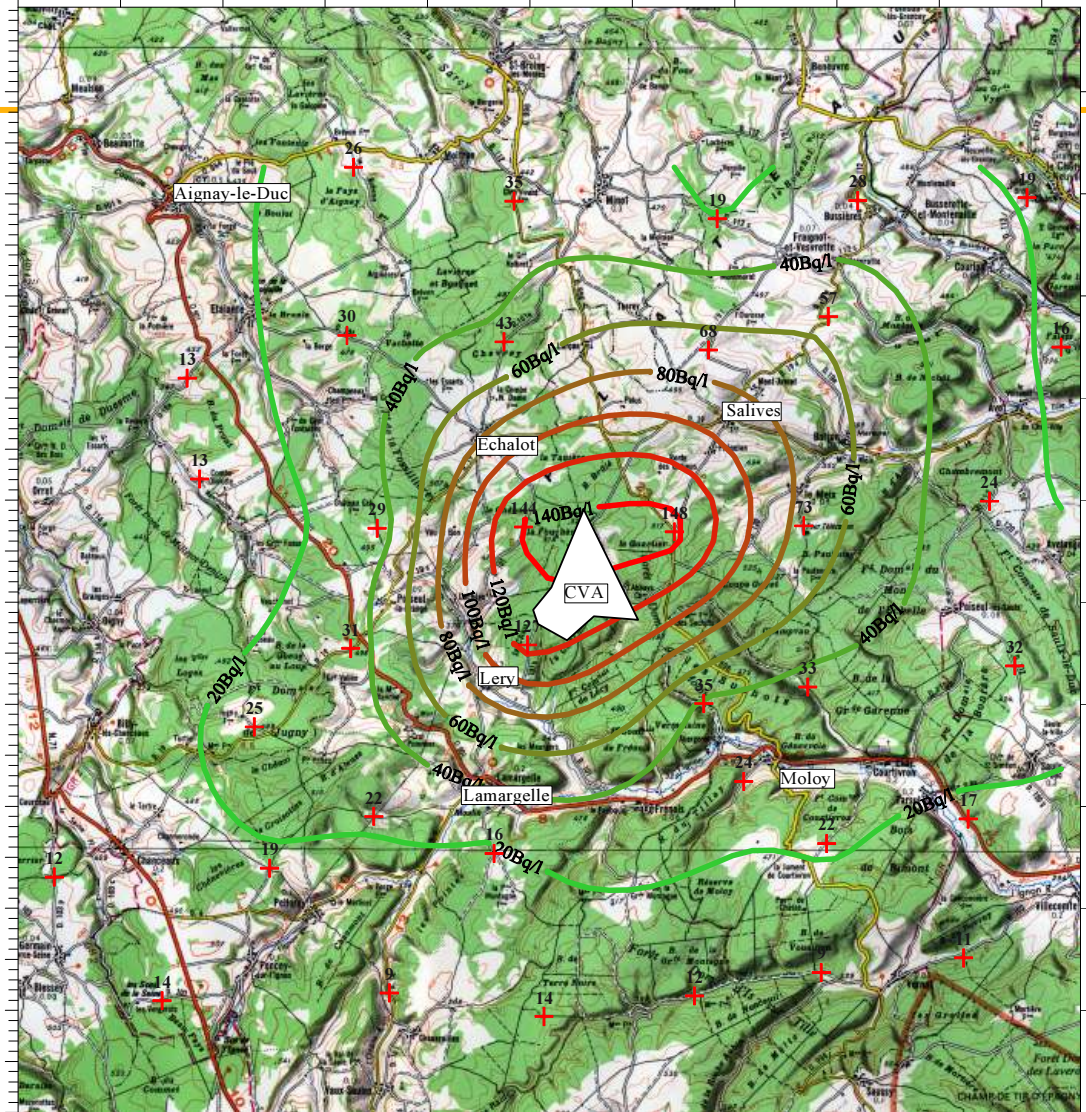
# Concentrations in tritium of the upper water table 1997



# Concentrations in tritium of the upper water table 2008



# OBT in oak leaves 1998



SFRP Paris

4 km

20

Isoconcentrations en tritium (OBT) en Bq/l

# When rain deposition small, vapor deposition can be seen



Station on site	South	North-East	Nord-West
HTO air vapor w (Bq/l) <sup>1</sup>	<b>142</b>	<b>243</b>	<b>236</b>
HTO rain (Bq/l) <sup>1</sup>	<b>36</b>	<b>238</b>	<b>100</b>
HTO soil (Bq/l) <sup>2</sup>	<b>69</b>	<b>231</b>	<b>132</b>

Average of monthly measurements in 1999-2000 1 : continuous , 2: points

- 700 L / year of rain

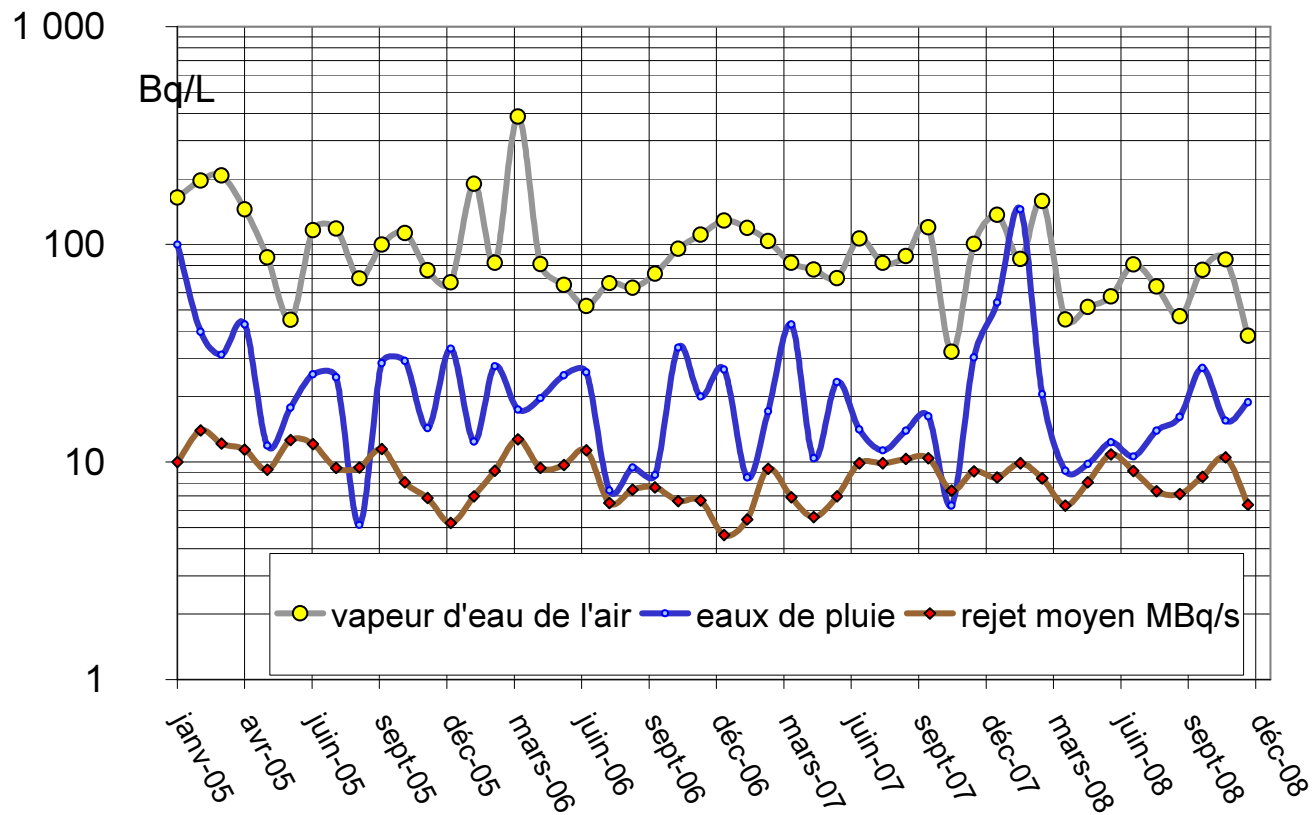
HTO soil (Bq/l) <sup>2</sup>	<b>69</b>	<b>231</b>	<b>132</b>
HTO soil (Bq/l) $0.3 A_{\text{vap}} + 0.7 A_{\text{rain}}$	<b>68</b>	<b>239</b>	<b>140</b>

300 L.y<sup>-1</sup> of dry vapor / 8 g.m<sup>-3</sup> . => **1.2 10<sup>-3</sup> m.s<sup>-1</sup>**

# Free waters

## Data of environmental survey

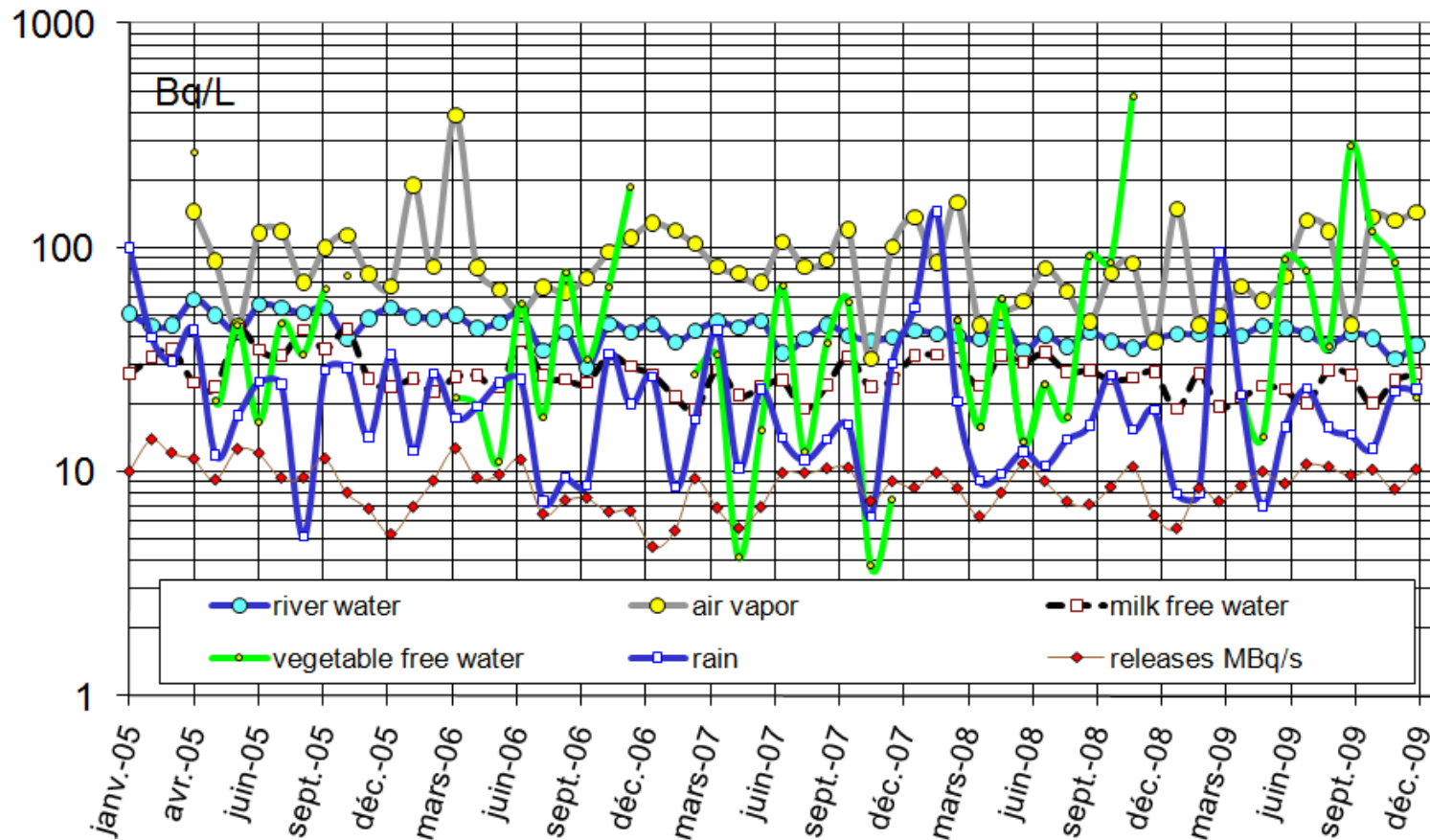
# rains less tritiated than air water vapor





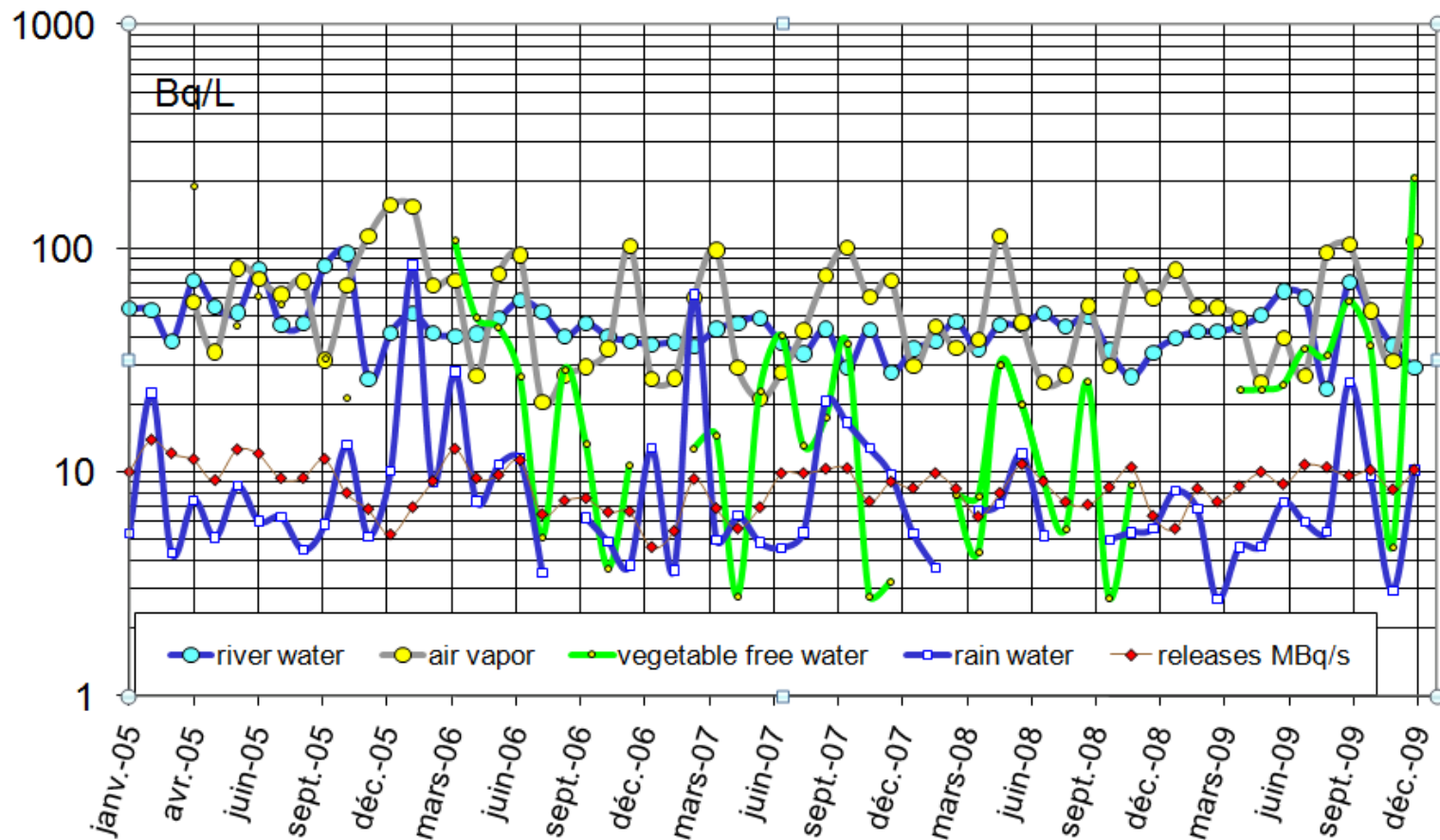
# Grass between air vapor and rain water

air vapor, rain water river Tille,  
vegetable and milk free water in Salives



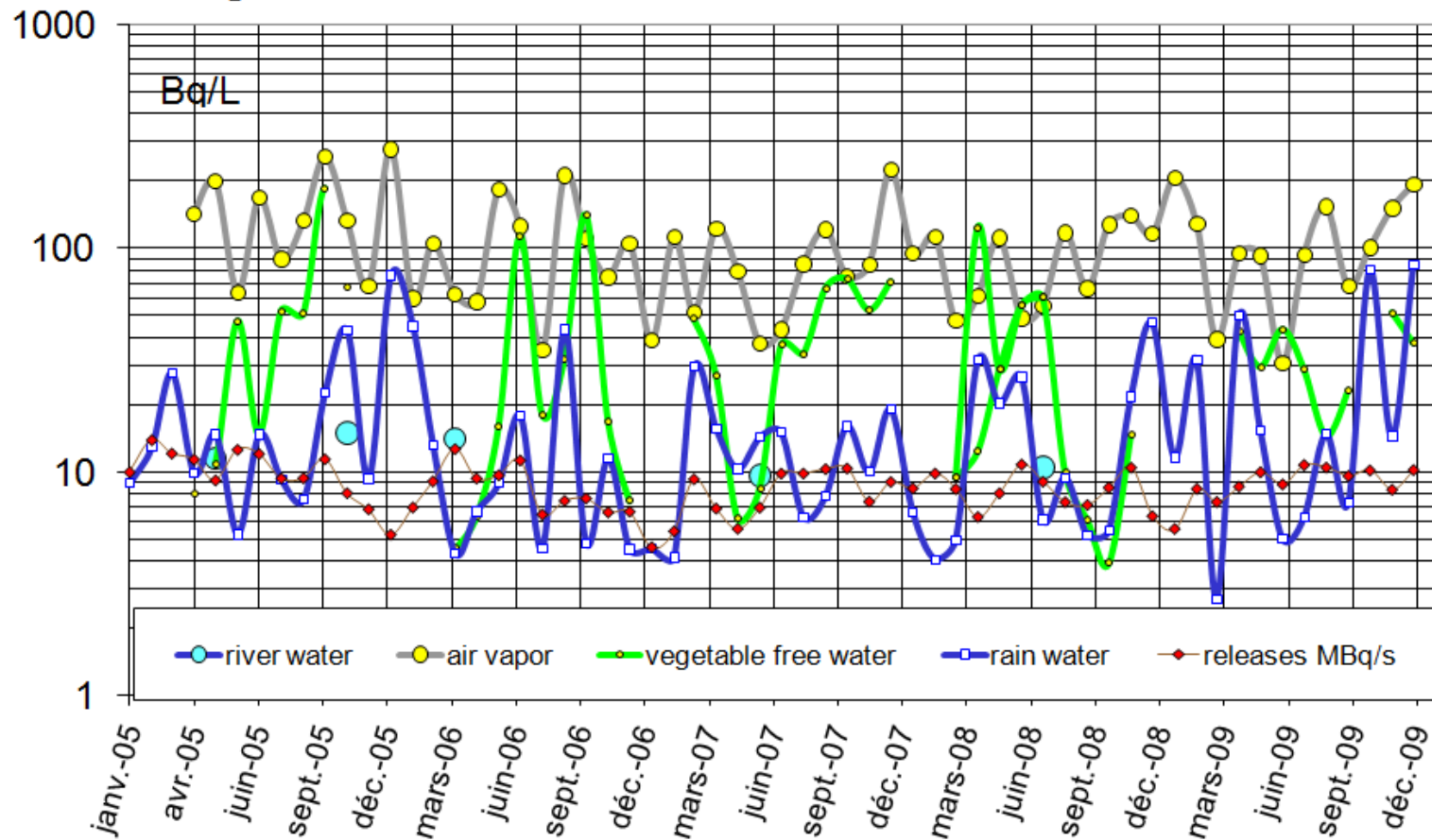
# Grass between air vapor and rain water

air vapor, rain water river Tille,  
vegetable and milk free water in Lery



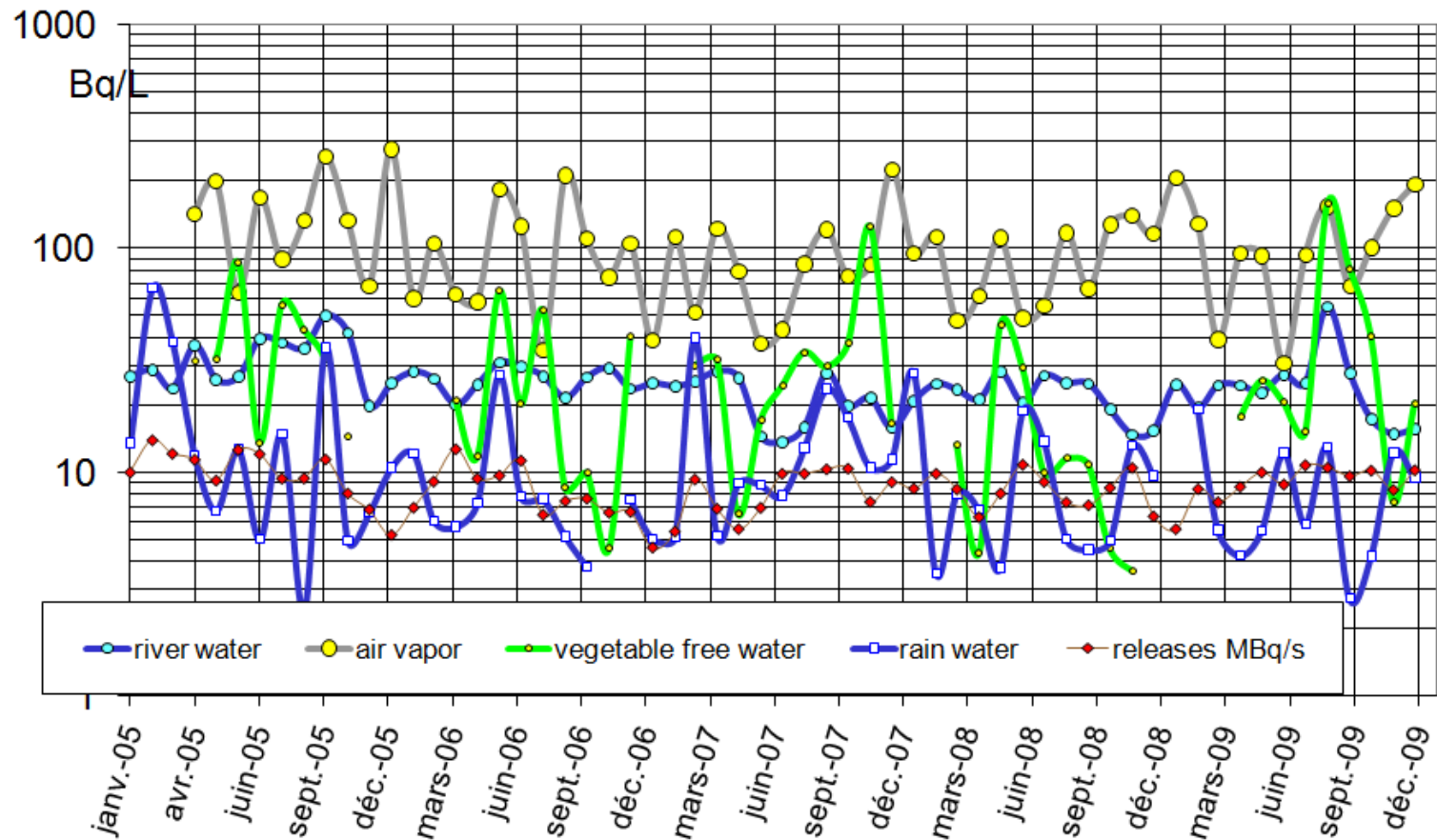
# Grass between air vapor and rain water

air vapor, rain water river Tille,  
vegetable and milk free water in Echalot



# Grass between air vapor and rain water

air vapor, rain water river Tille,  
vegetable and milk free water in Moly



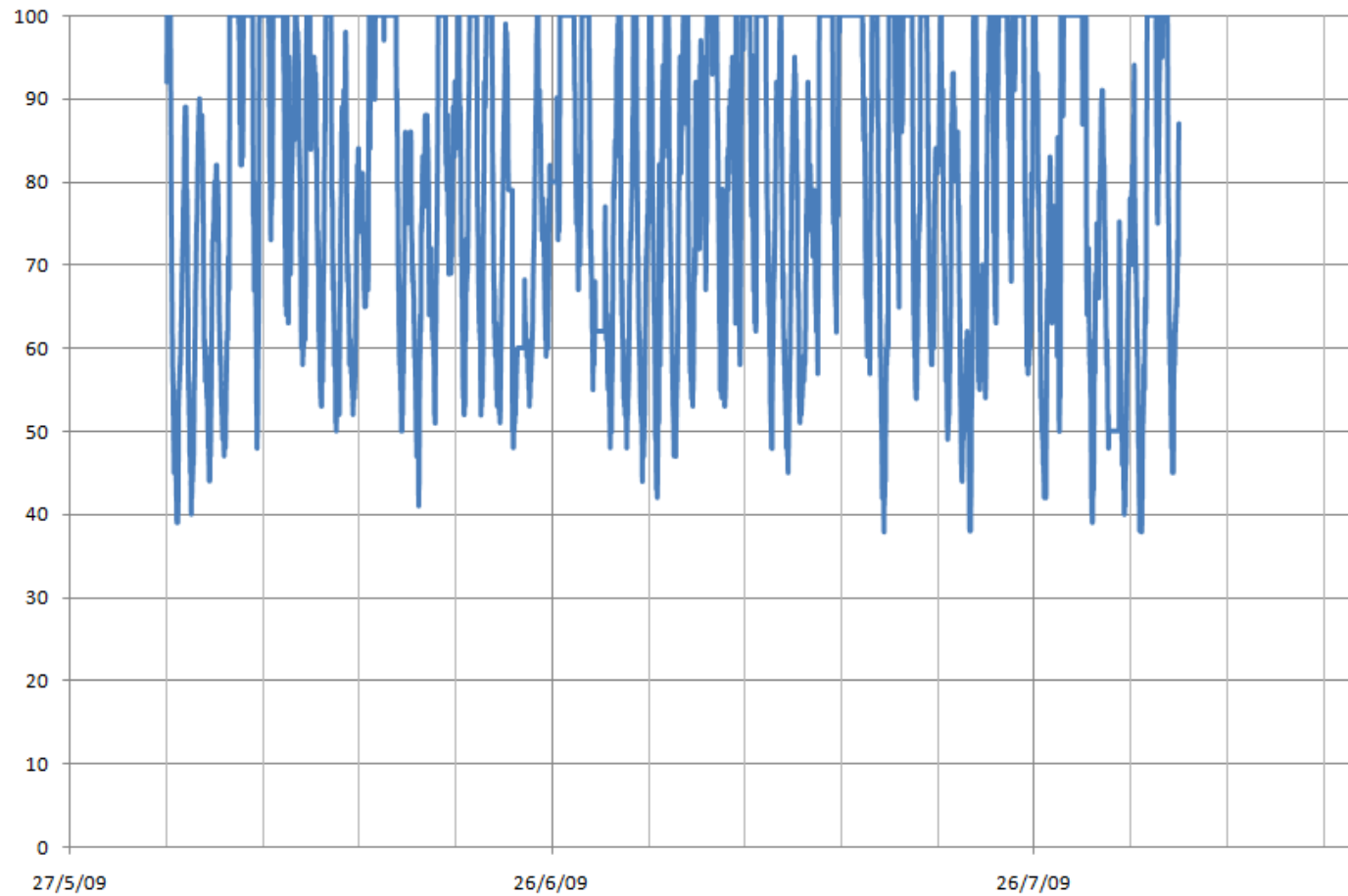
# Free water calculation

- $C_{\text{free veg w}} = H_r C_{\text{air}} + (1-H_r) C_{\text{sol}} ?$
- this means that free water activity is practically equal to air vapor activity

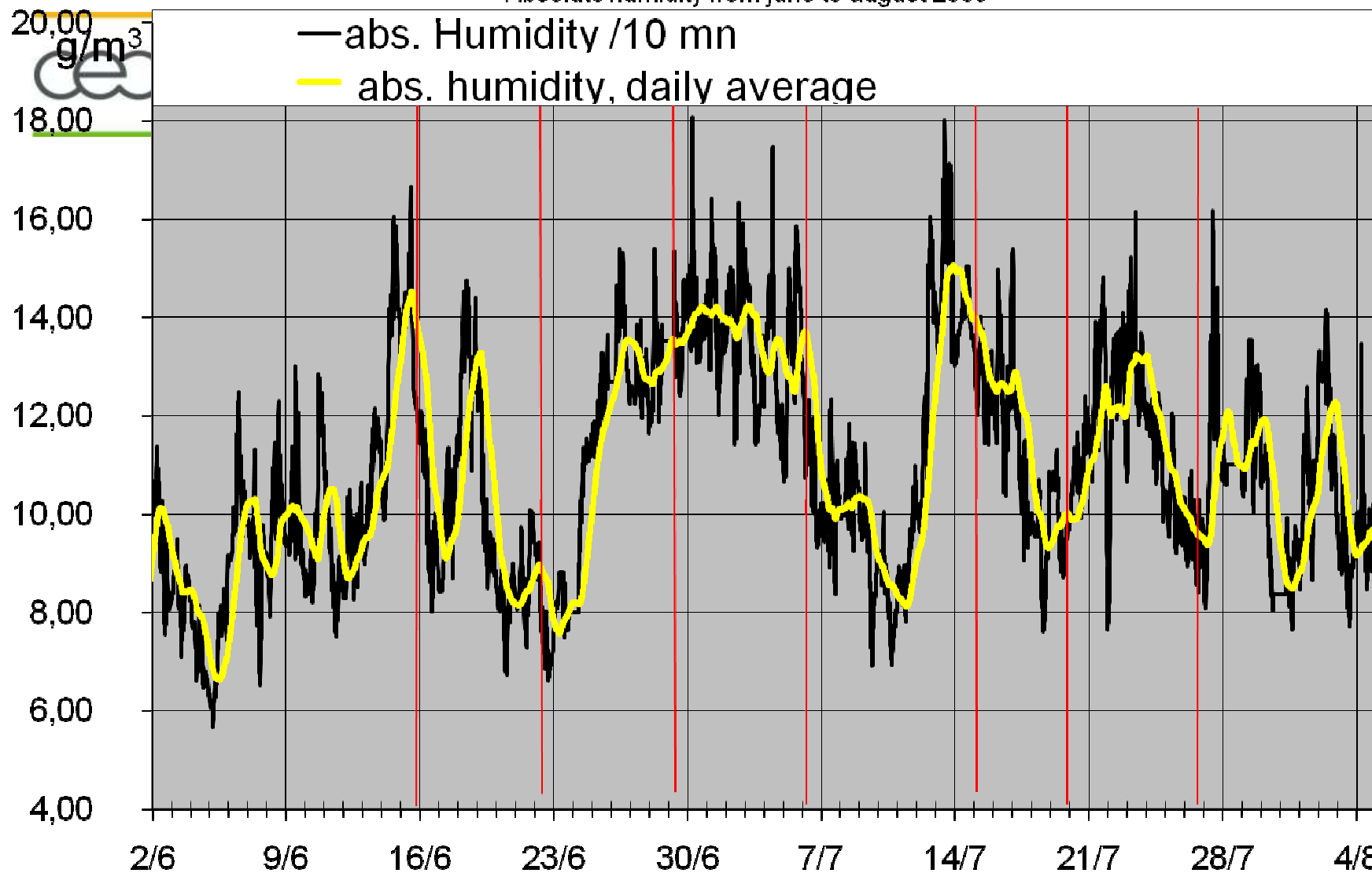
# Air relative humidity fluctuation



Hygrométrie



Absolute humidity from June to August 2009



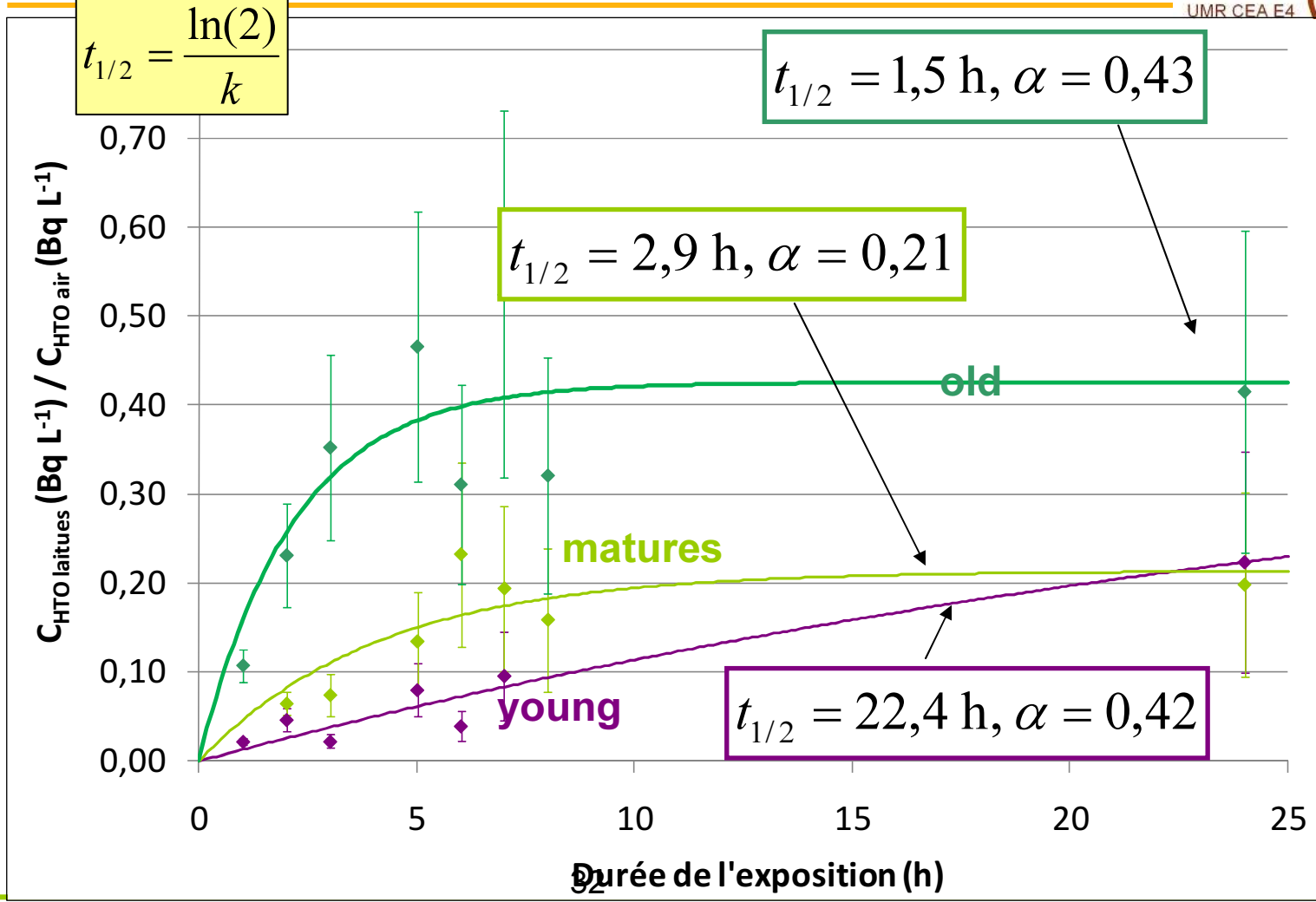
# Measures in Free water : light



$$C_{laitues}^{HTO} = C_{air}^{HTO} \times \alpha \times (1 - e^{-k.t})$$

$$t_{1/2} = \frac{\ln(2)}{k}$$

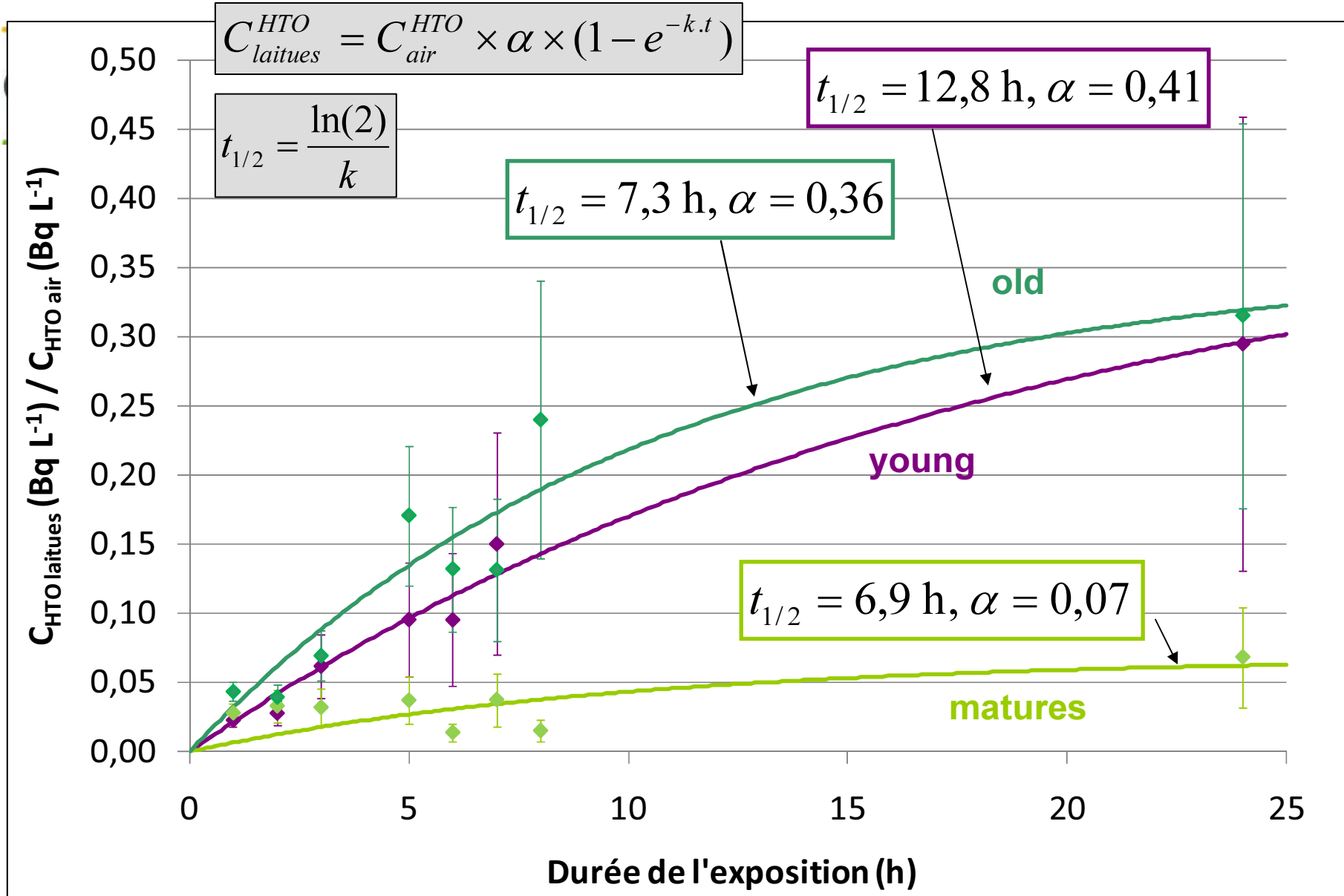
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Durée de l'exposition (h)

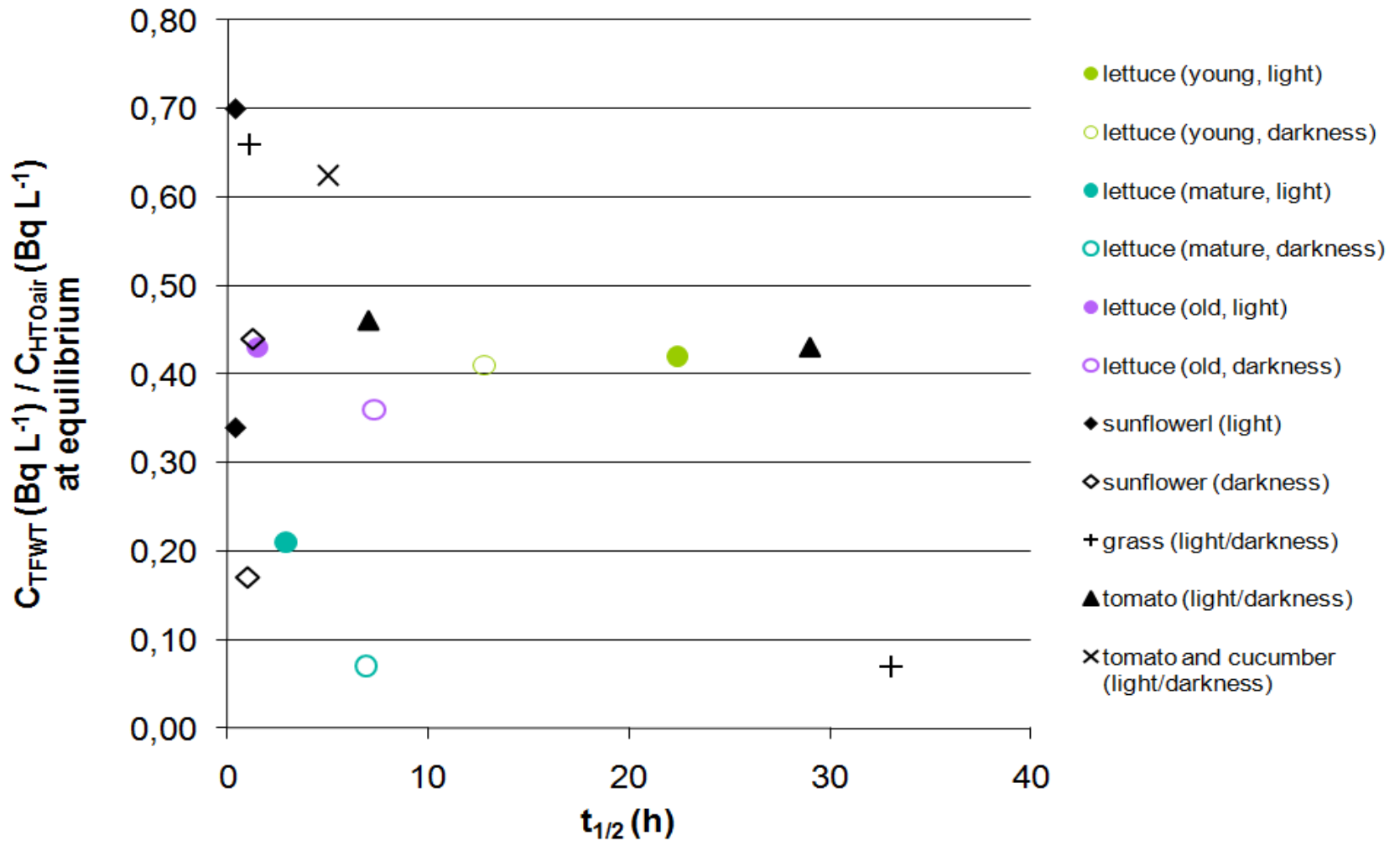


# Measures in free water: darkness

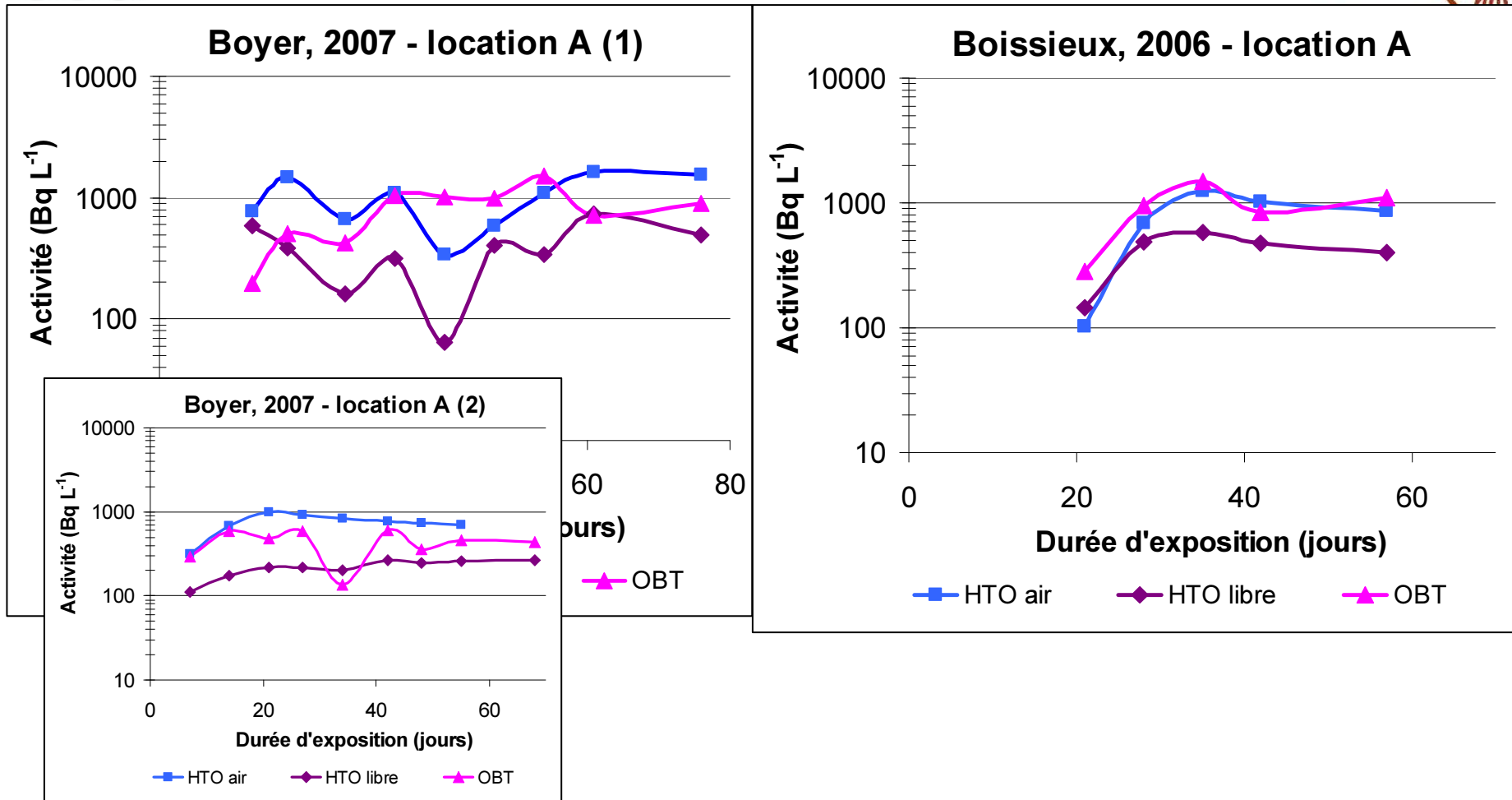


# Comparison with litterature

## ► Comparison with litterature data



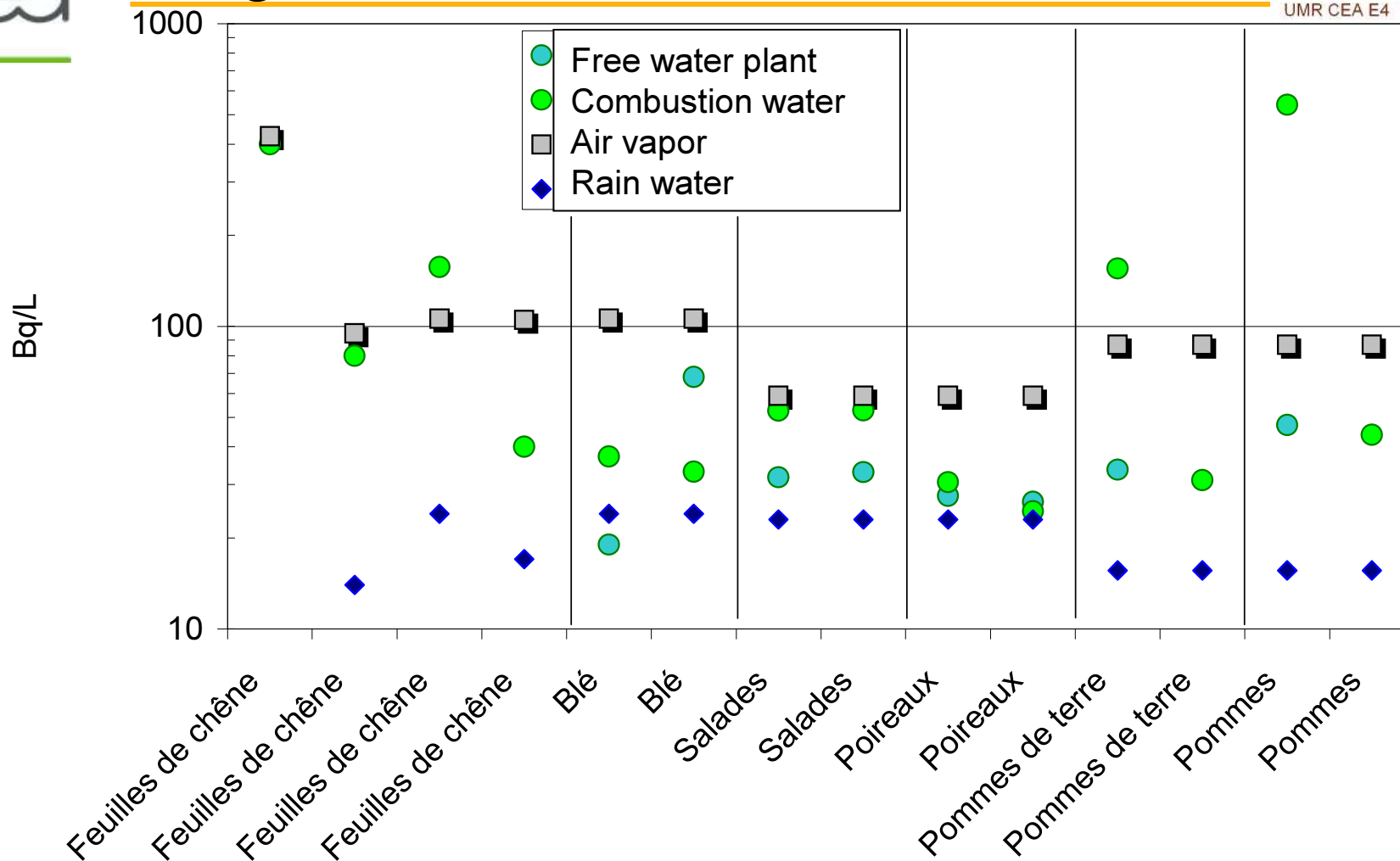
# Air Vapor, free water and combustion water



# Water concentrations in air, rain, and vegetables : free and combustion



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UMR CEA E4



$$C_{TFWT} = [RH \cdot C_{am} + (1 - RH) \cdot C_{sw}] / \gamma,$$

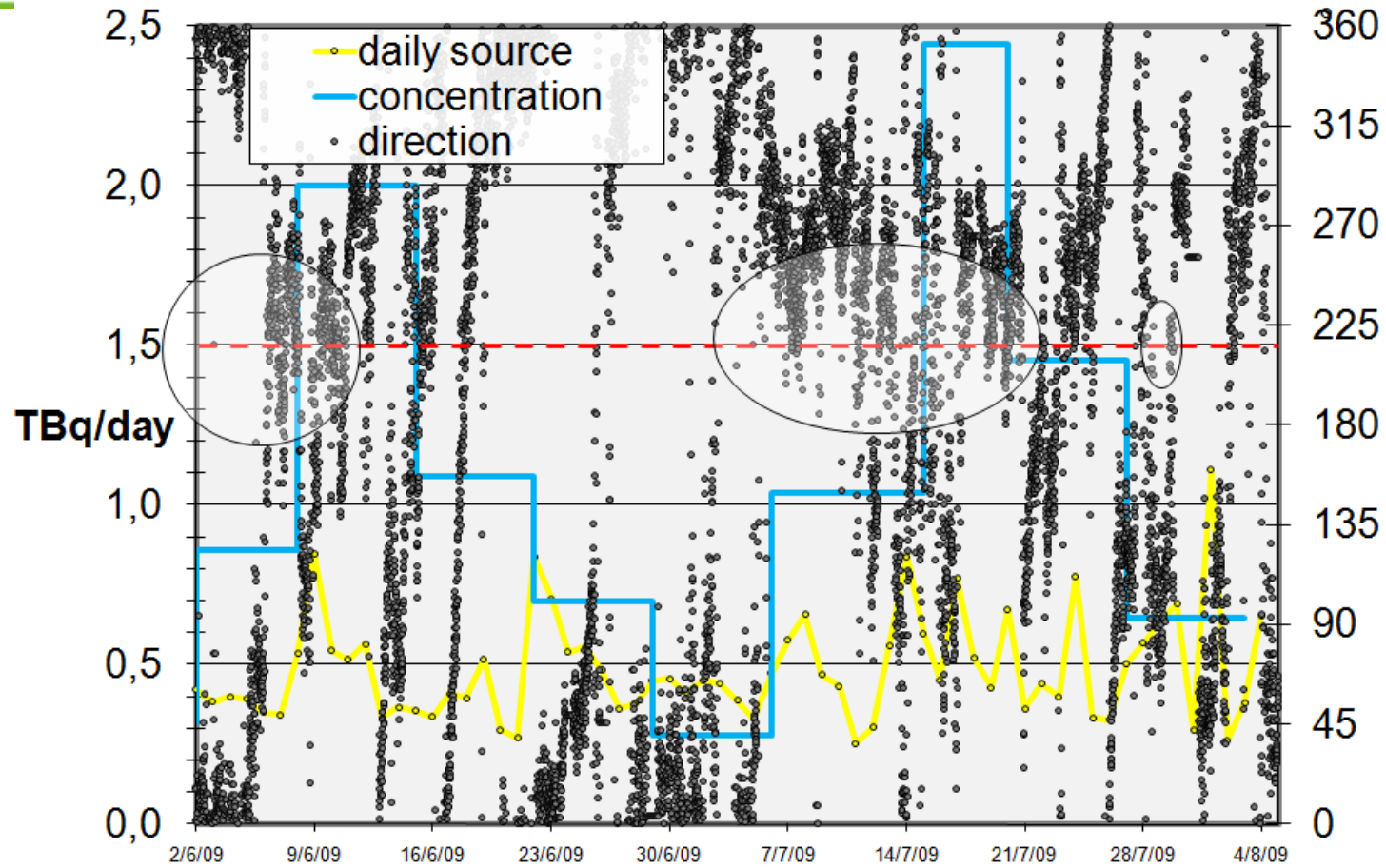
$$C_{pfw}^{OBT} = (1 - WC_p) \cdot WEQ_p \cdot R_p \cdot C_{TFWT},$$

$$C_{comb w} = WEQ_p \cdot R_p \cdot [RH \cdot C_{am} + (1 - RH) \cdot C_{sw}]$$

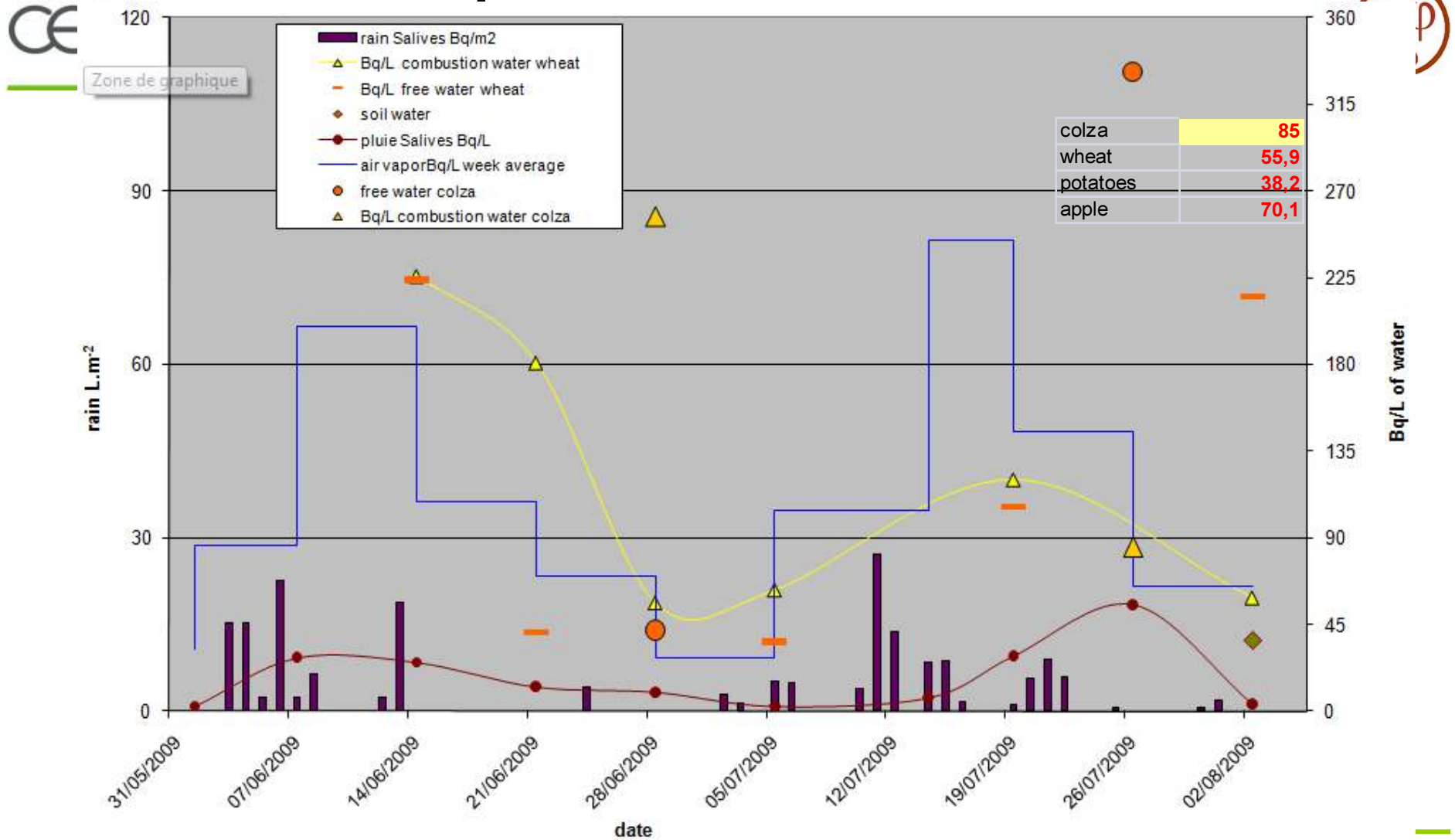
$$C_{free w} = [0.4 C_{am} + 0.6 \cdot C_{sw}]$$

$$C_{vegetable} = WC_p \cdot C_{free w} + (1 - WC_p) \cdot C_{comb x}$$

# Field experiment OBT 2009



# Field experiment OBT 2009



# Conclusions

- Effect of cuticles and efficiency of stomata, Particularly during the night
- Vegetable free water depends probably more on soil's water than we say, but (may be) not OBT.