Study of nitrate transfer in the unsaturated zone of two agricultural plots (northern France)

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AGRICULTURES & TERRITOIRES CHAMBRE D'AGRICULTURE AISNE

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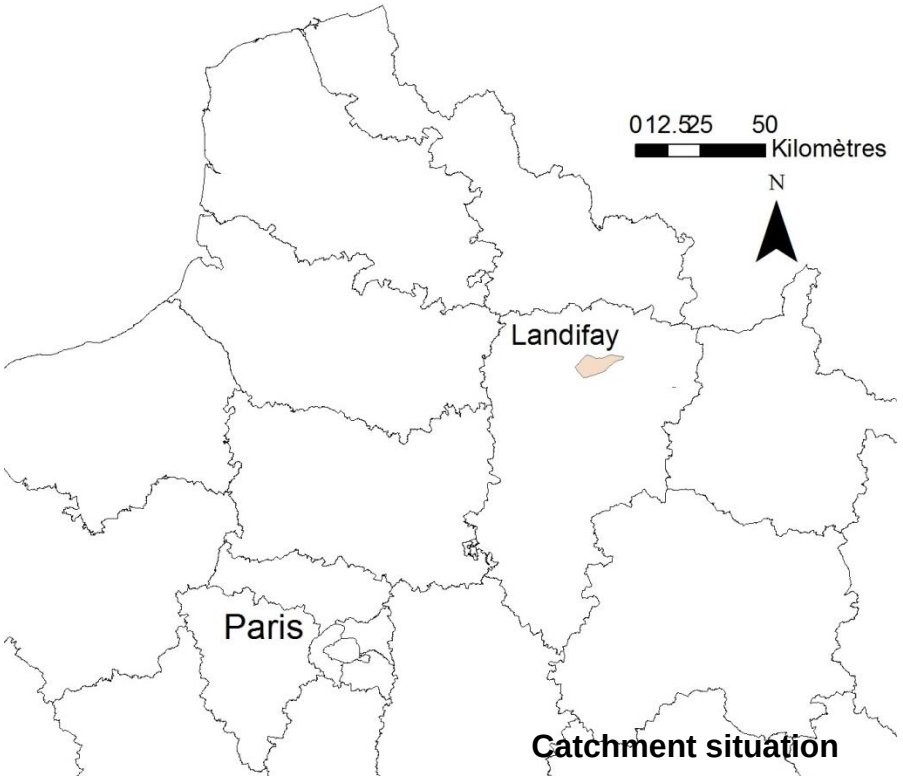
Backgroung

- The impact of fertilization in water quality trough the unsaturated zone is difficult to predict because several processes are occurring.
- These processes are not only linked to agricultural practices but also to climatic and geological environment.
- The forecasts are also made complex because these processes vary with time.
- Concentrations in the unsaturated zone and in groundwater are the result of the practices of several years or even more

Aim of the study

> Determine the transfer speed of water and nitrates in the unsaturated zone (i.e. soil and subsoil up to the groundwater)

> Catchment of Landifay in North of France
  - Chalky aquifer
  - Agricultural area

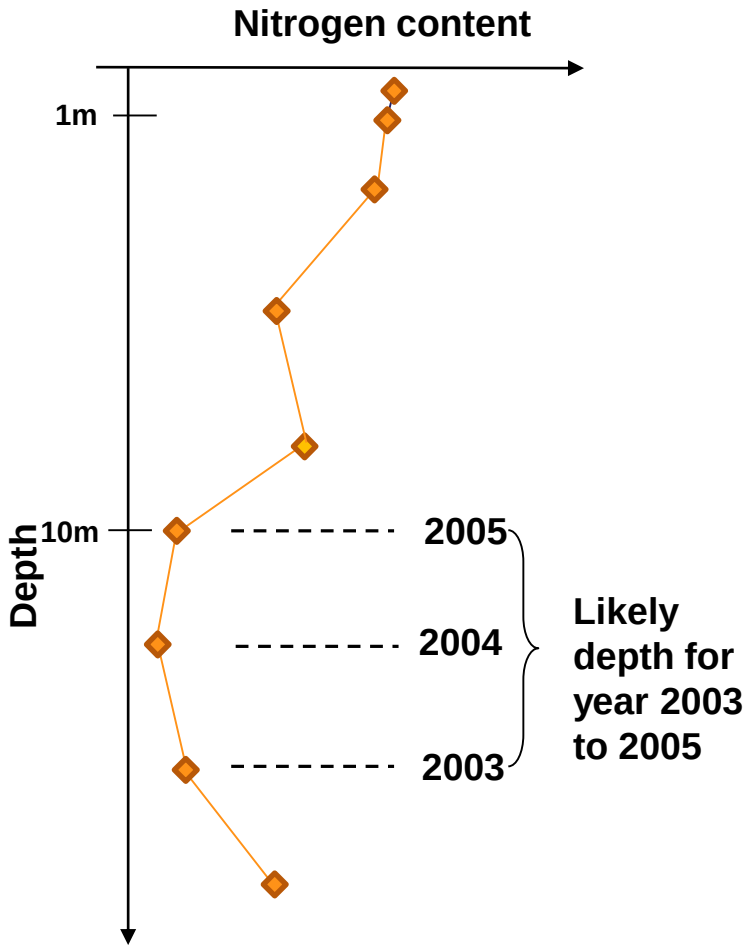


Catchment situation

Establishing nitrogen profiles in the unsaturated zone

Method:

- Profile in agricultural plot with an “agricultural marker" in the crop succession
  - “agricultural marker" = radical change of practice
- Nitrate concentration out of the agricultural marker is lower than the one out of conventional period
- it is possible to determine the fallow period depth thanks to the concentration

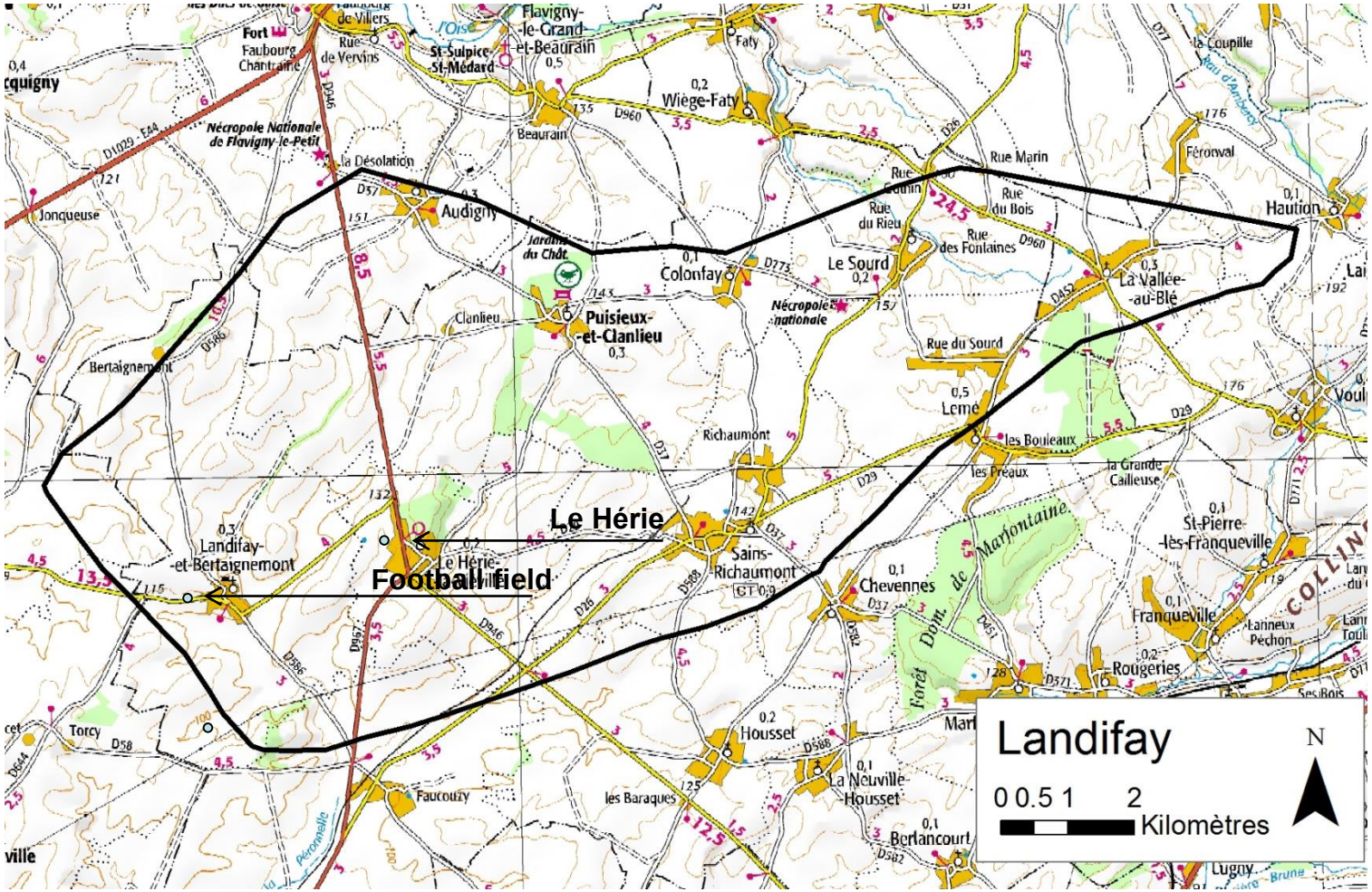


Nitrogen content profil in the unsaturated zone.
Marker = fallow between 2003 and 2005

Drilling and analyses

- Drilling and analyses were realized in september 2013
- Sampling every 25 cms (surface 0-6 m) then every 50 cms
- Measure of humidity and all the forms of nitrogen (nitrates, nitrites, ammonia) in soil

Situation of drilling sites on the area of Landifay



Football field
6m deep drilling

Le Hérie
30m deep drilling and
two 6m deep replicates

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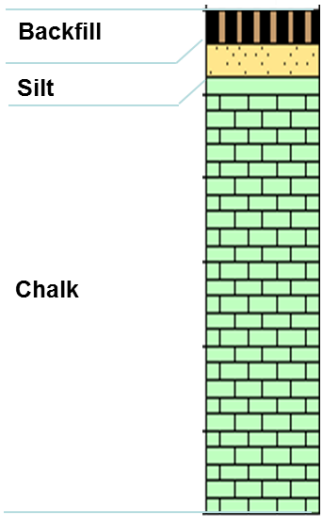
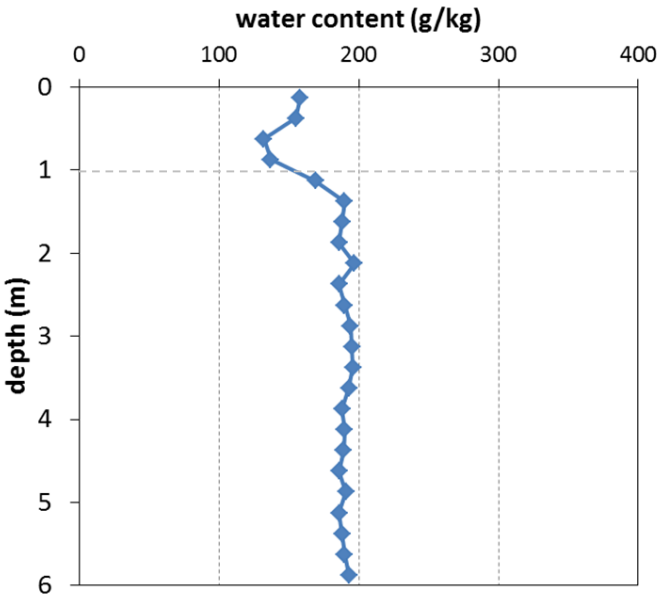
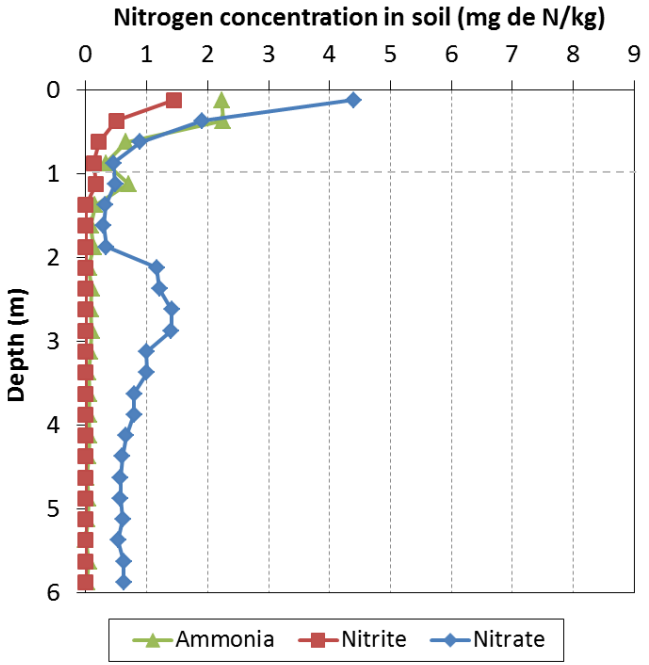
Profiles on the football field





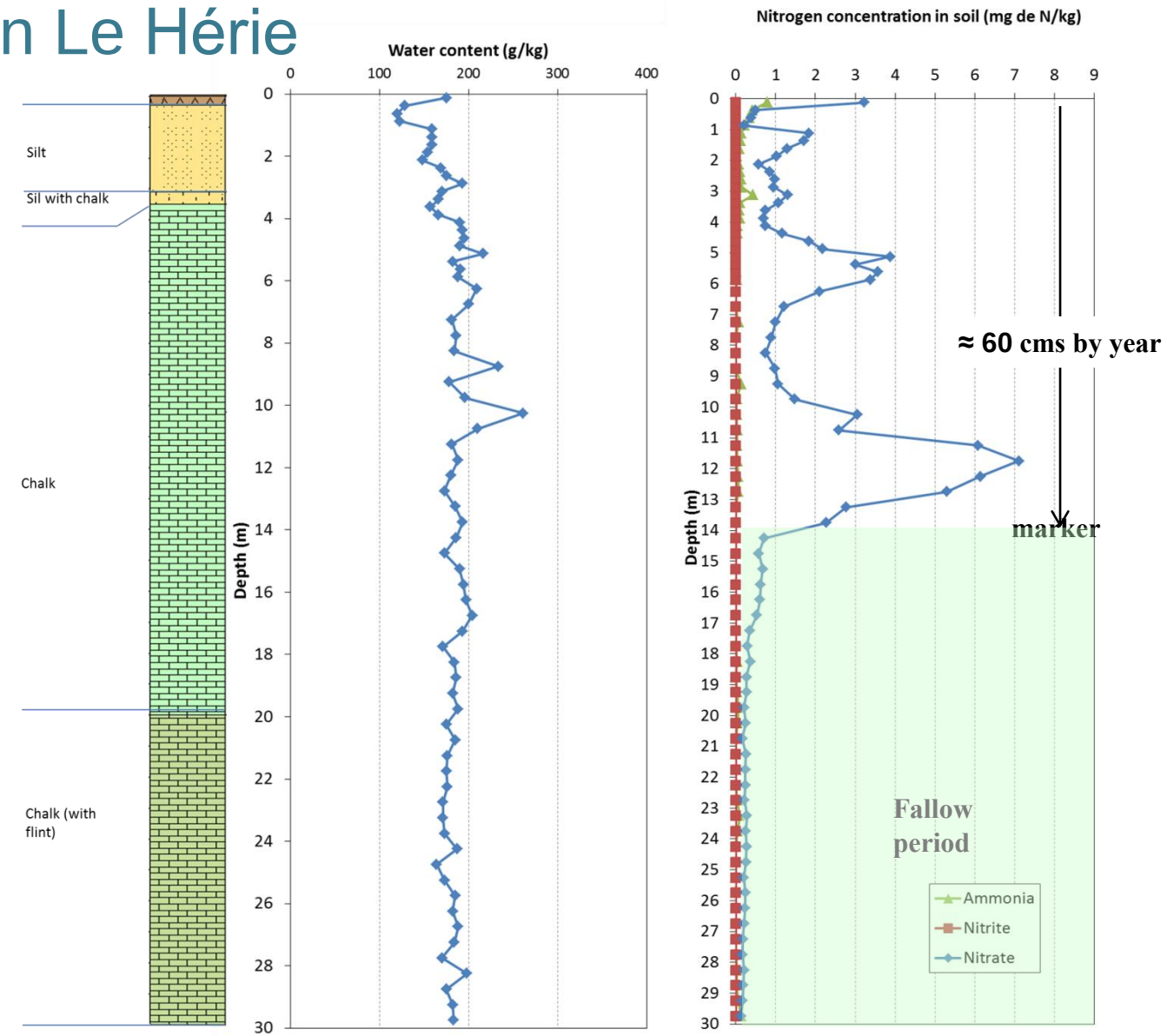


lower part
Water content -> stable
-> link to the geology

lower part
Nitrate content -> low and stable
Stability accentuated by geology

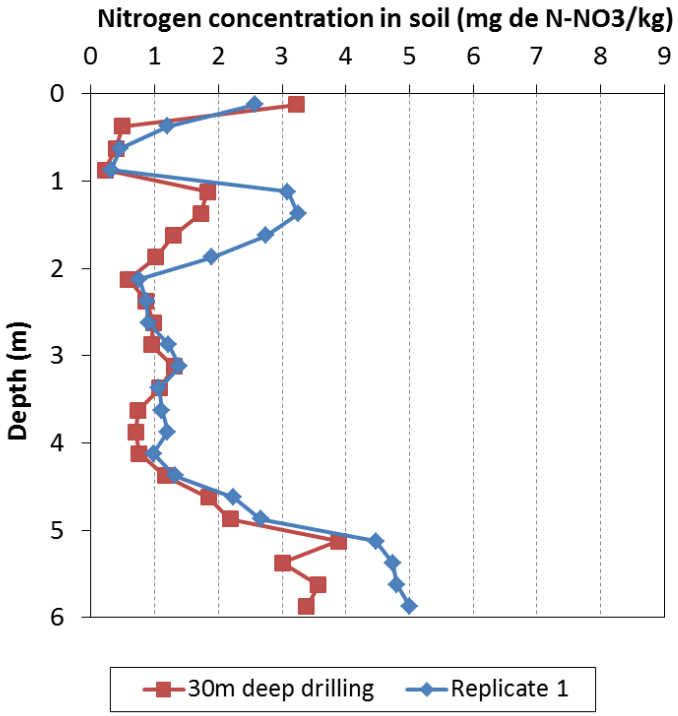
Plot without fertilisation - used as a reference

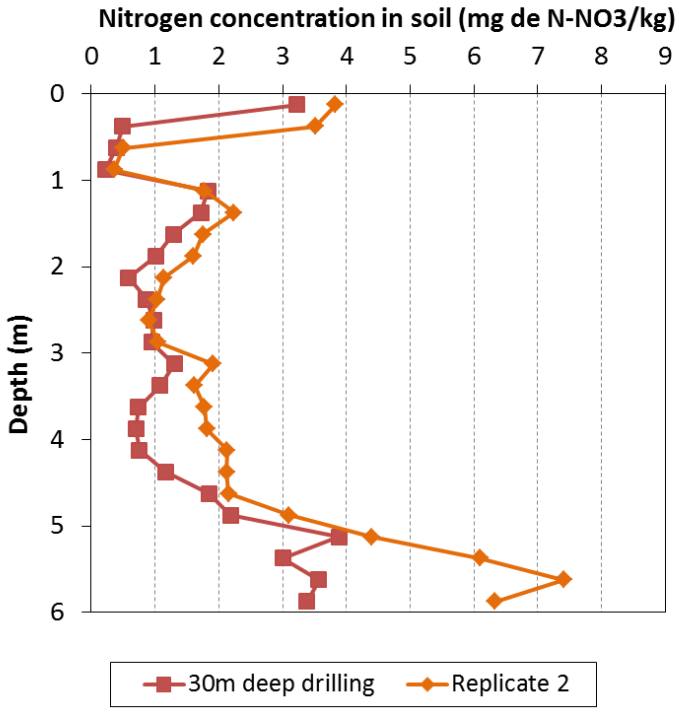
Profiles in Le Hérie



Water content -> stable
-> link to the geology

Le Hérie, comparison between the nitrogen contents in the three drillings





Good agreement between three profiles

->inputs do not create a random signal in the soil

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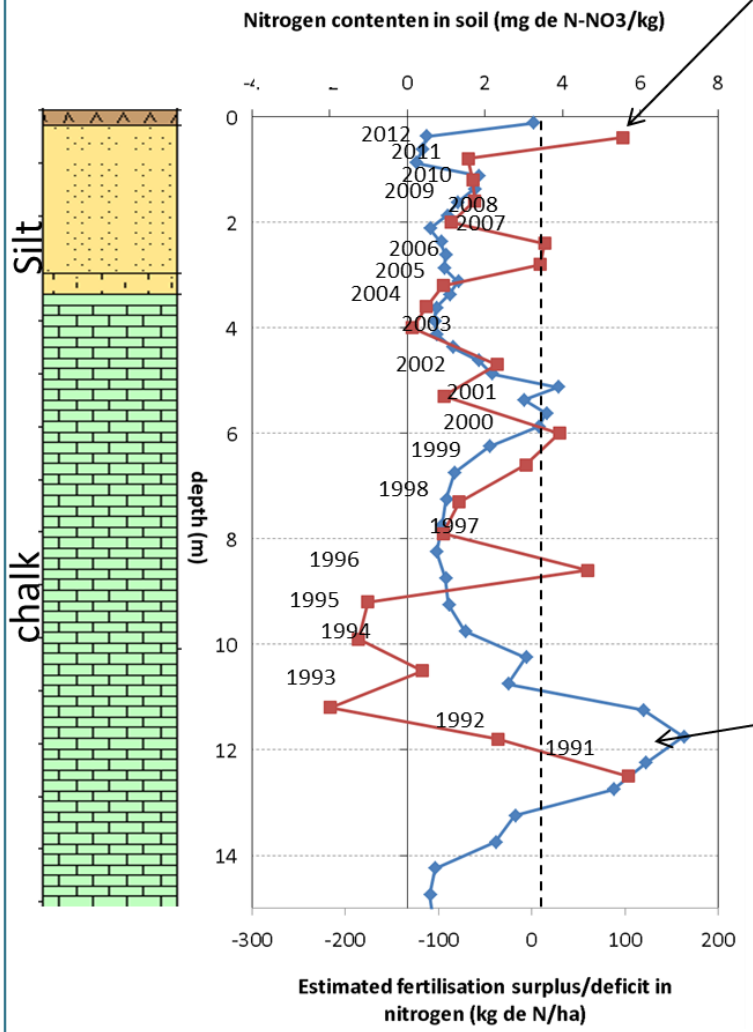
Le Hérie, comparison with the agronomic data

		Crop yield (qx/ha)	Crop need (kg de N/ha)	Fertilisation (kg de N/ha)
		Provided		*Provided*
2013	Sugar Beet	82	164	222
2012	Winter Weat	90	270	192
2011	Winter Weat	105	315	242
2010	Oilseed Rape	44	286	205
2009	Winter Weat	93	279	203
2008	Sugar Beet	96T	192	166
2007	Spring barley	53	117	116
2006	Winter Weat	82	246	141
2005	Faba beans	46	153	0
2004	Winter Weat	106	318	180
2003	Oilseed Rape	38	247	190
2002	Winter Weat	86	258	174
2001	Sugar Beet	56	112	102
2000	Winter Weat	81	243	227
1999	Maize	125	275	177
1998	Winter Weat	90	270	185
1997	Sugar Beet	76T	152	192
1996	Winter Weat	105	315	149
1995	Protein peas	51	206	0
1994	Winter Weat	99	297	190
1993	Protein peas	56	236	0
1992	Maize	96	211	160
1991	Maize	80	176	170
1990				



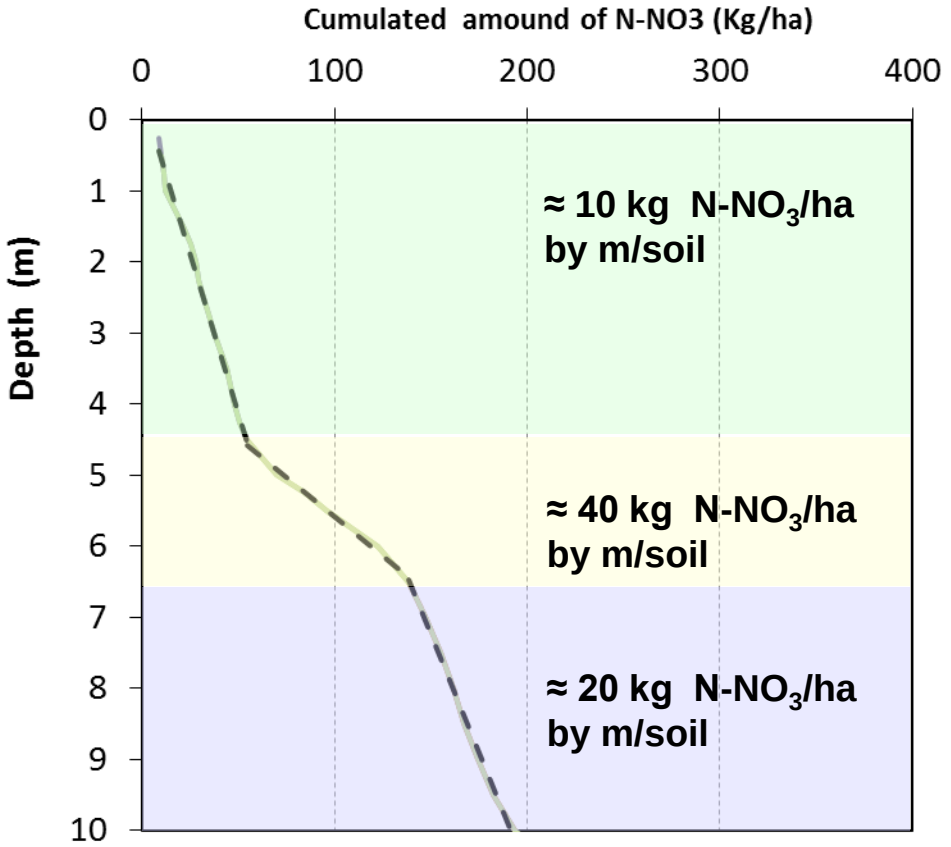
Estimated average speed: 0,40 m / year in silt

Estimated average speed: 0,65 m / year in chalk

Le Hérie, stocks trends

- Caculate the cumulated amound of nitrogen in soil was calculated in the 10 first meters deep

- Regression analysis was permormed on coherent segment



-> the most recent period create the least important stock augmentation

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Le Hérie, results

> **Calculated average speed:**
  - Approximately 0,60 m / year

> **Average thickness on the catchment:**
  - Approximately 30 m

> **Time of theoretical transfer from the surface to the top of the groundwater table:**
  - Approximately 50 years

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Conclusions

- **The results show improvements in the practices of these last years**

- **The results show a long time of transfer for nitrogen (several decades)**

- **The experimental phase :**
  - Allows to calculate speed transfer and stock
  - Allows to obtains very didactic results for farmers and stakeholders

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