Les changements globaux et le cycle des éléments nutritifs

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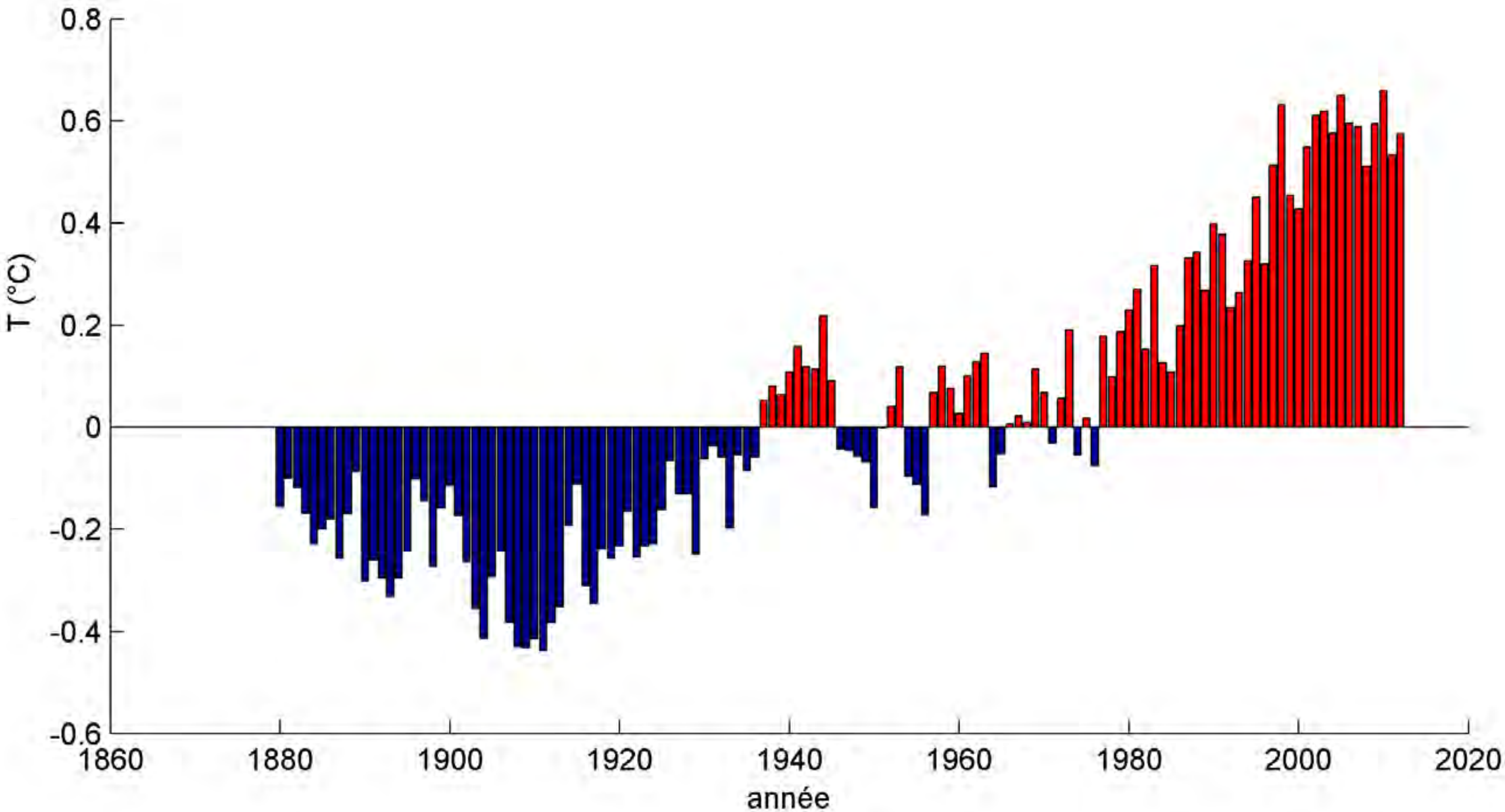
Ouranos

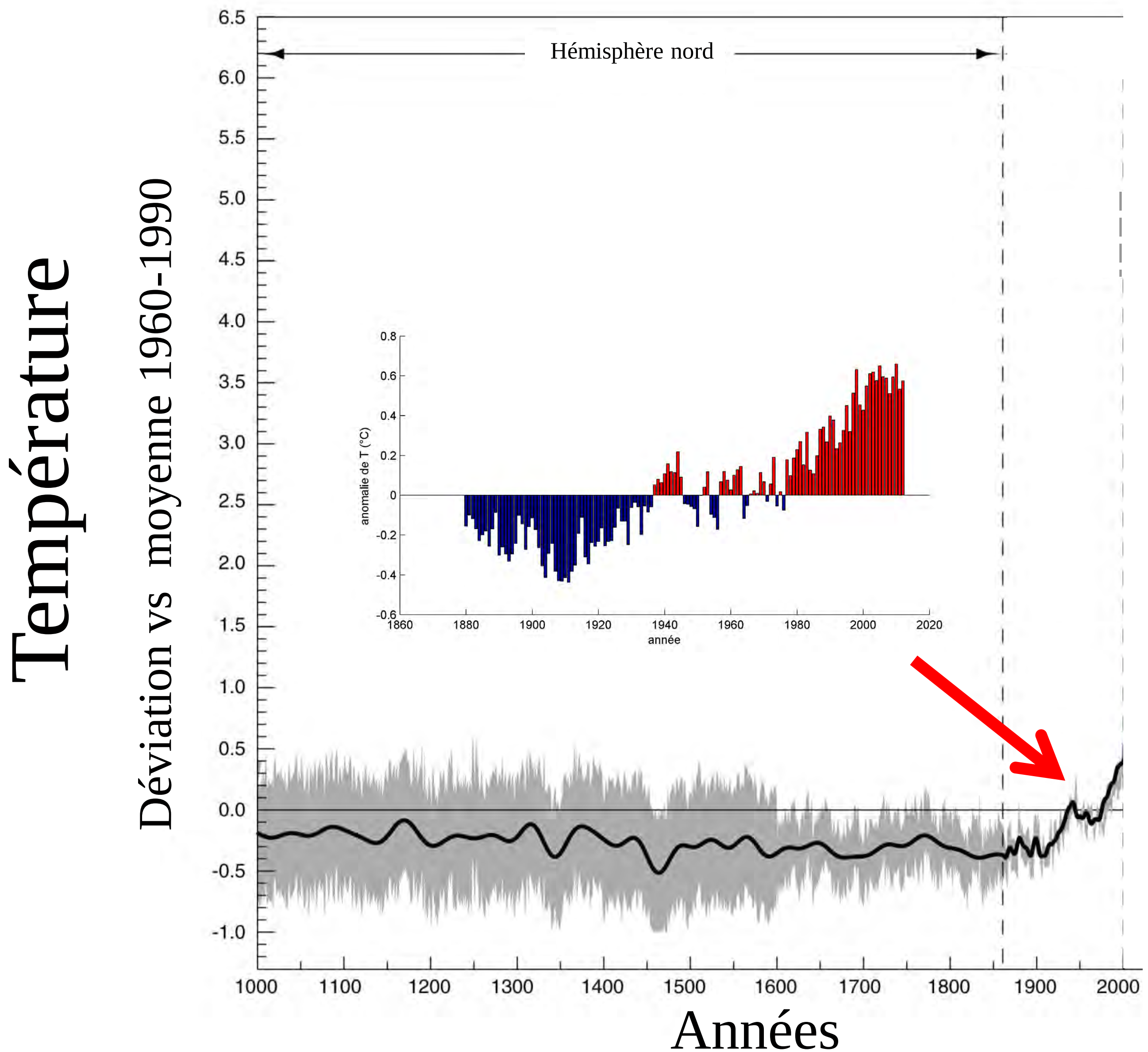
Évolution des températures globales depuis 1880

Déviations de la température annuelle par rapport à la moyenne de 1901-2000

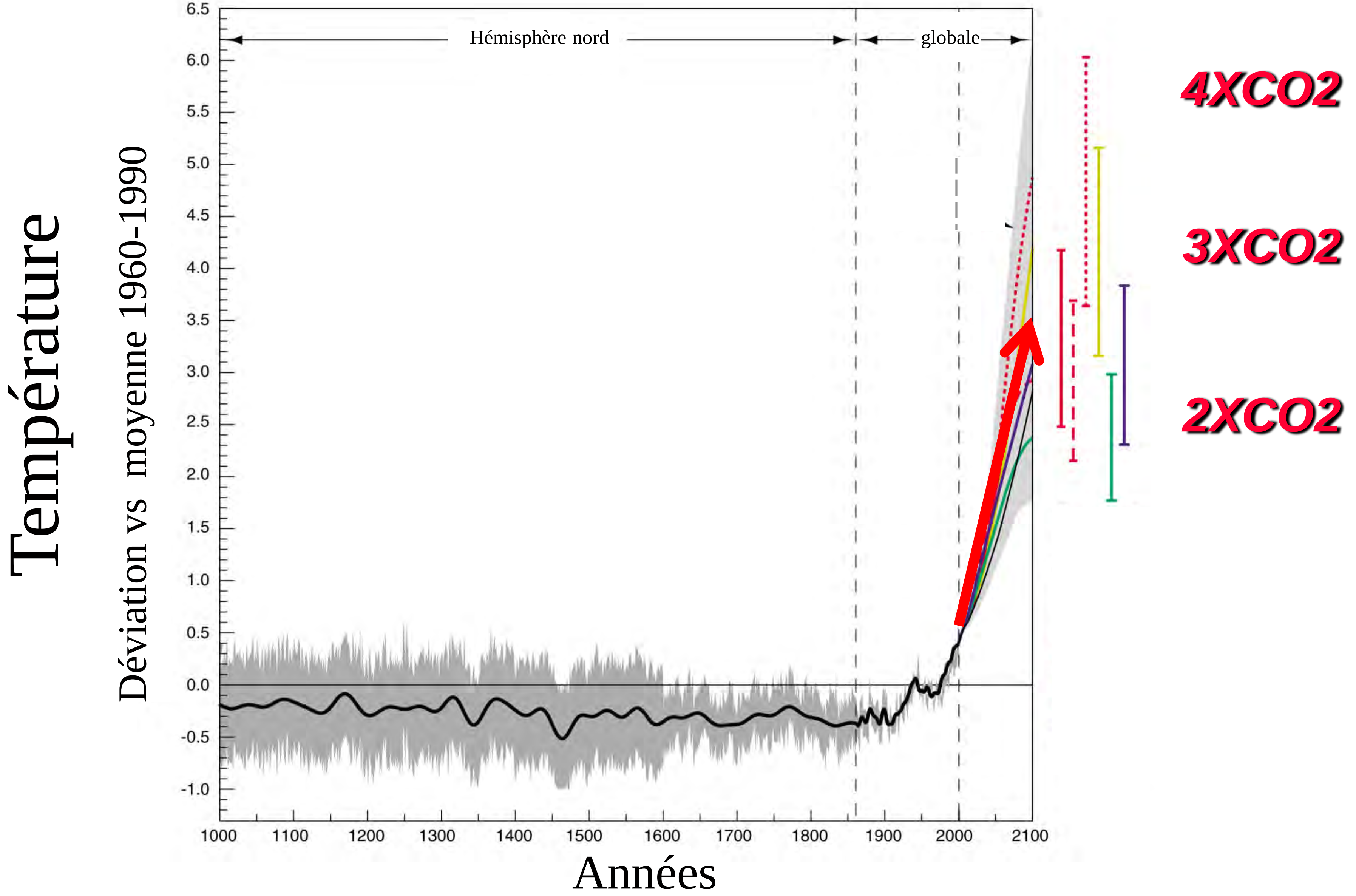


Source des données: NOAA

Tendance récente



Scénarios envisagés

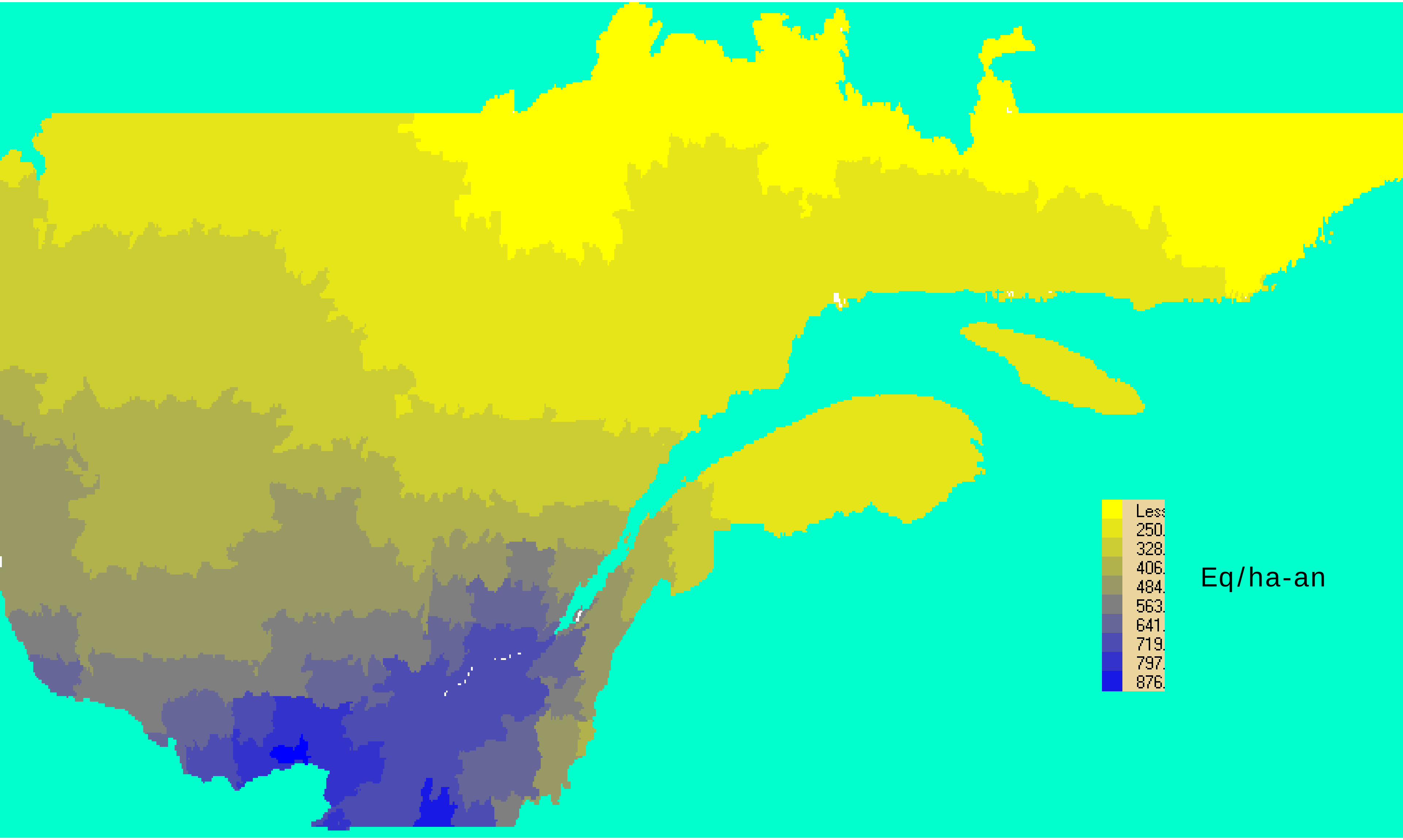


Précipitations acides

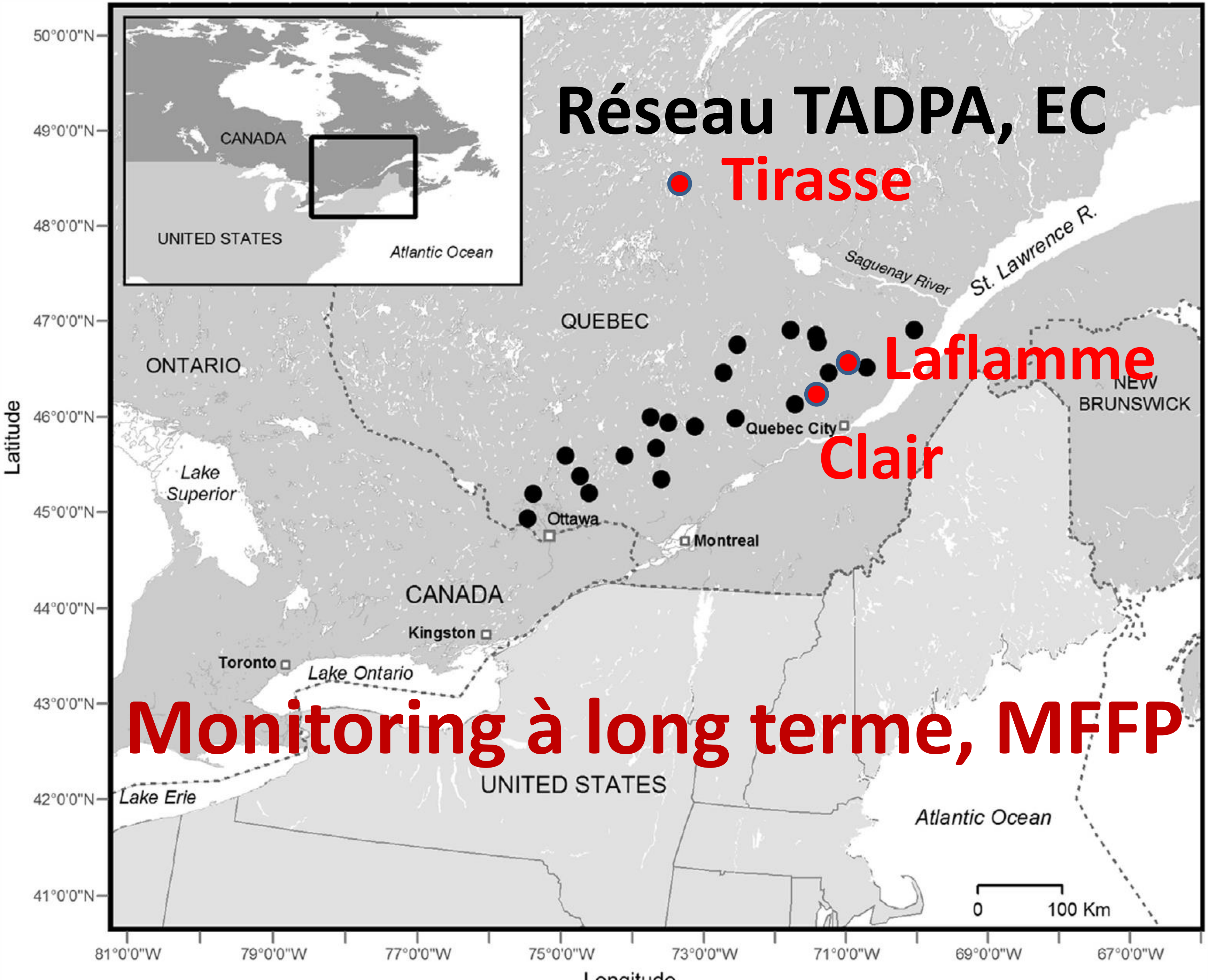
dioxyde de soufre (SO_2): **H_2SO_4**

oxydes d'azote (NO_x): **HNO_3**

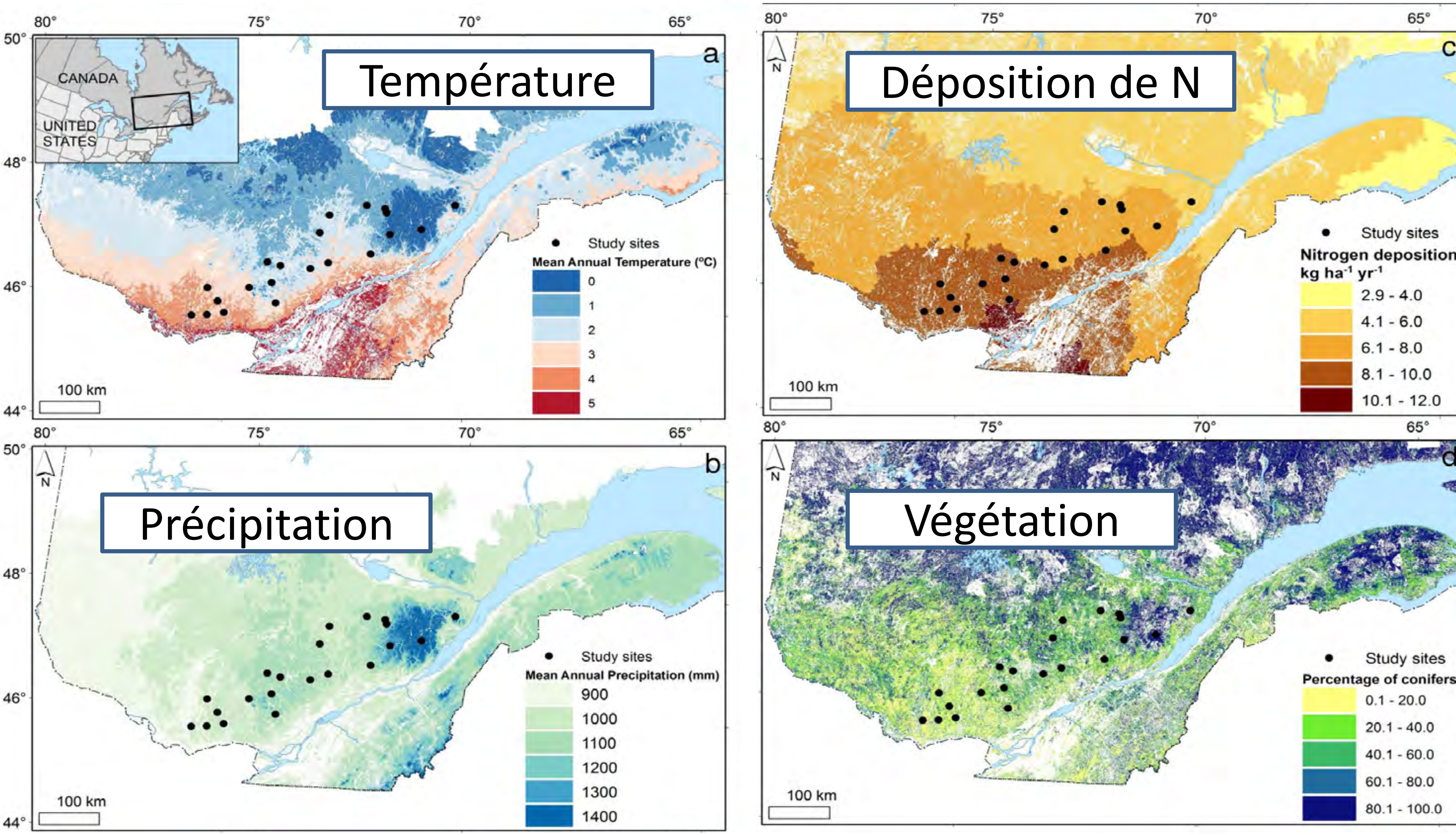
Dépôts humides de N (NO_3+NH_4)



Source : Environnement Canada



Réseau TADPA, EC
Tirasse
Laflamme
Clair
Monitoring à long terme, MFFP
CANADA
UNITED STATES
Atlantic Ocean
QUEBEC
ONTARIO
Lake Superior
Saguenay River
St. Lawrence R.
NEW BRUNSWICK
Quebec City
Ottawa
Montreal
Kingston
Toronto
Lake Ontario
Lake Erie
0 100 Km
Latitude
Longitude
50°0'0"N
49°0'0"N
48°0'0"N
47°0'0"N
46°0'0"N
45°0'0"N
44°0'0"N
43°0'0"N
42°0'0"N
41°0'0"N
81°0'0"W
79°0'0"W
77°0'0"W
75°0'0"W
73°0'0"W
71°0'0"W
69°0'0"W
67°0'0"W



Gradients environnementaux

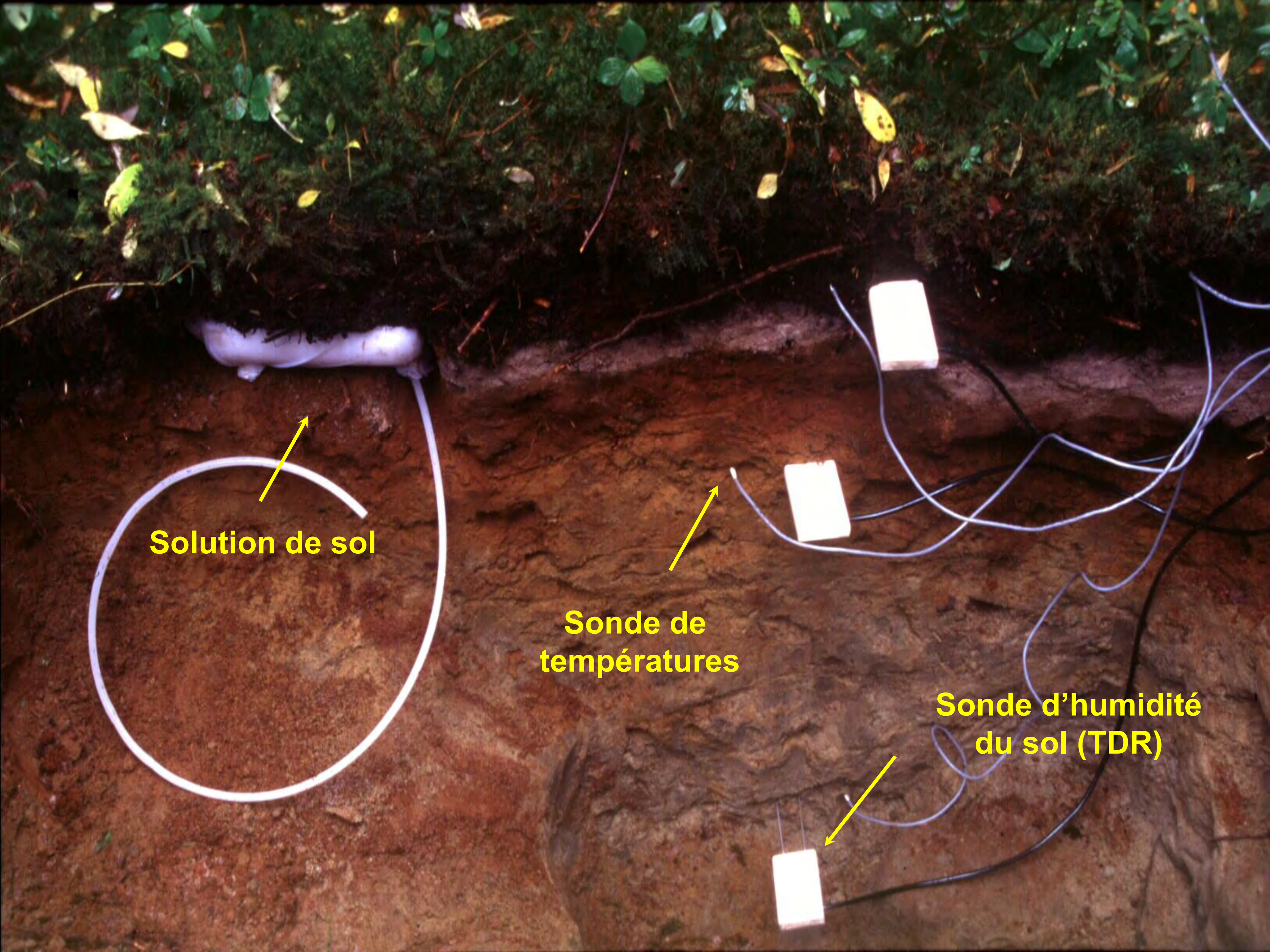
Monitoring à long terme


2501


2008
2008


10
1-0

Sapin baumier au lac Laflamme

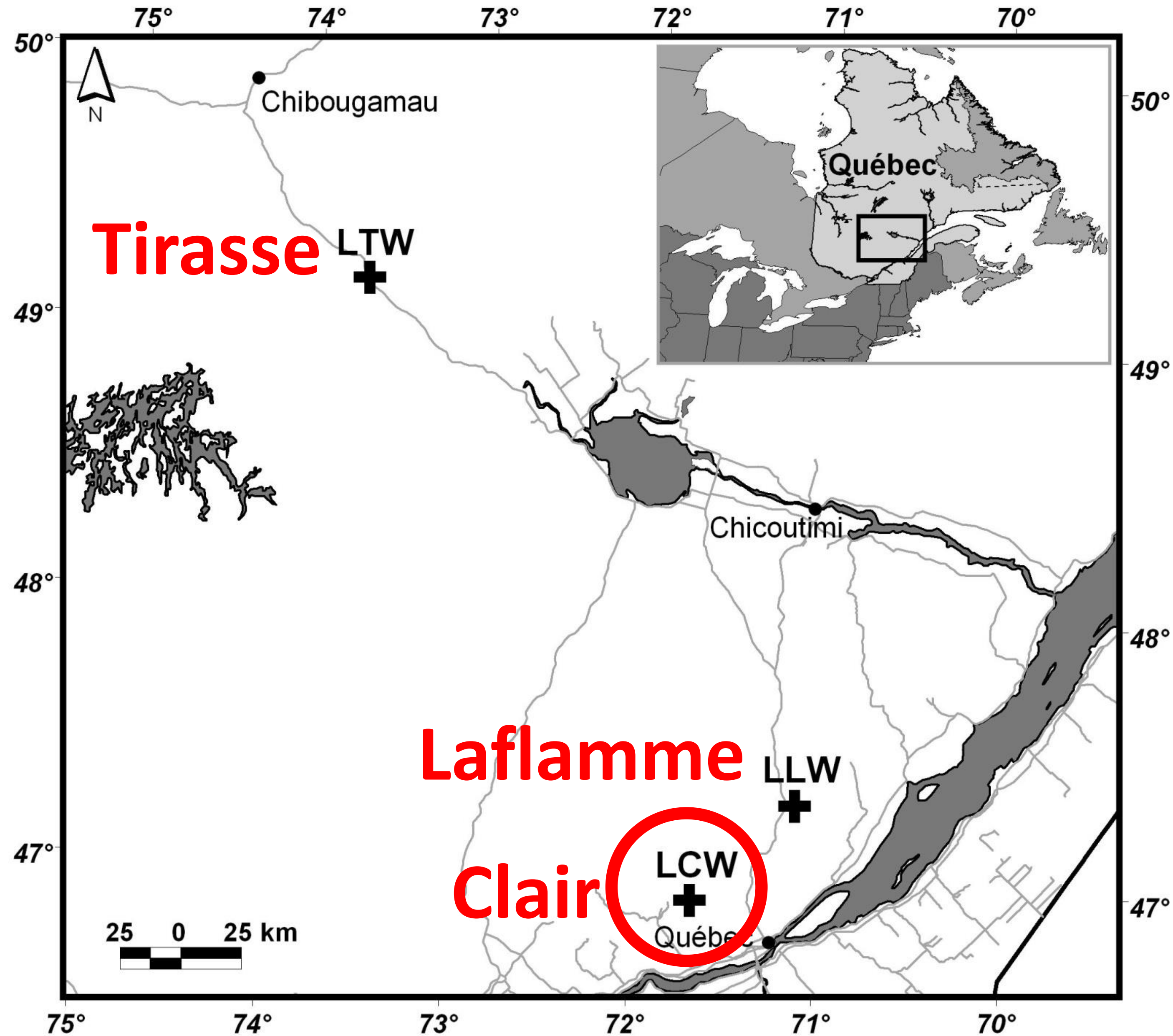

Solution de sol
Sonde de températures
Sonde d'humidité du sol (TDR)


Exutoire

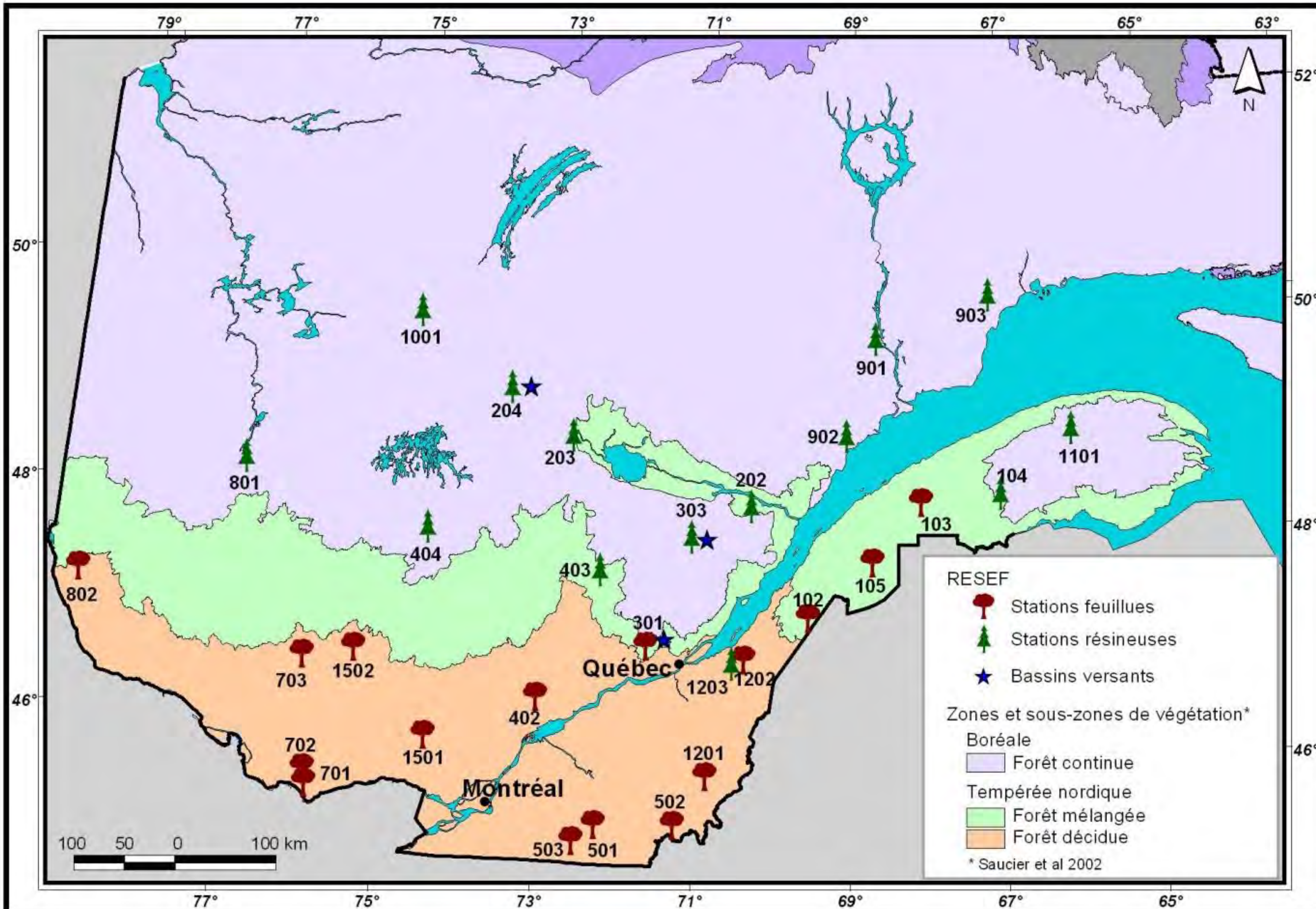
Thèmes et sujets

- Réservoirs de N et C dans les sols
- Isotopes ^{15}N et ^{13}C : turnover
- $^{34/32}S$-$^{18/16}O_4$, H_2-$^{18/16}O$
- Altération des minéraux
- $^{87}Sr/^{86}Sr$

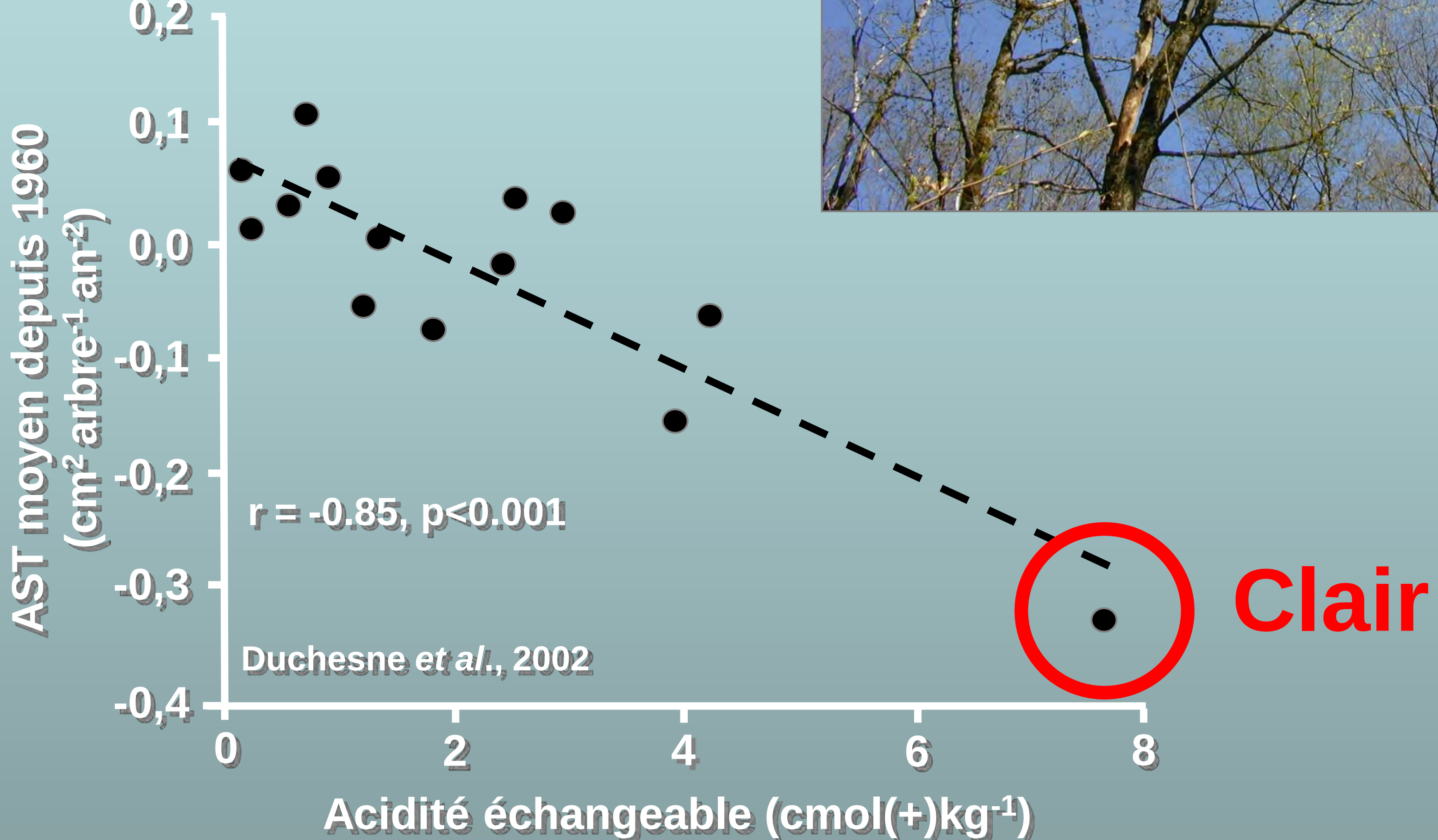
Monitoring à long terme



RESEF



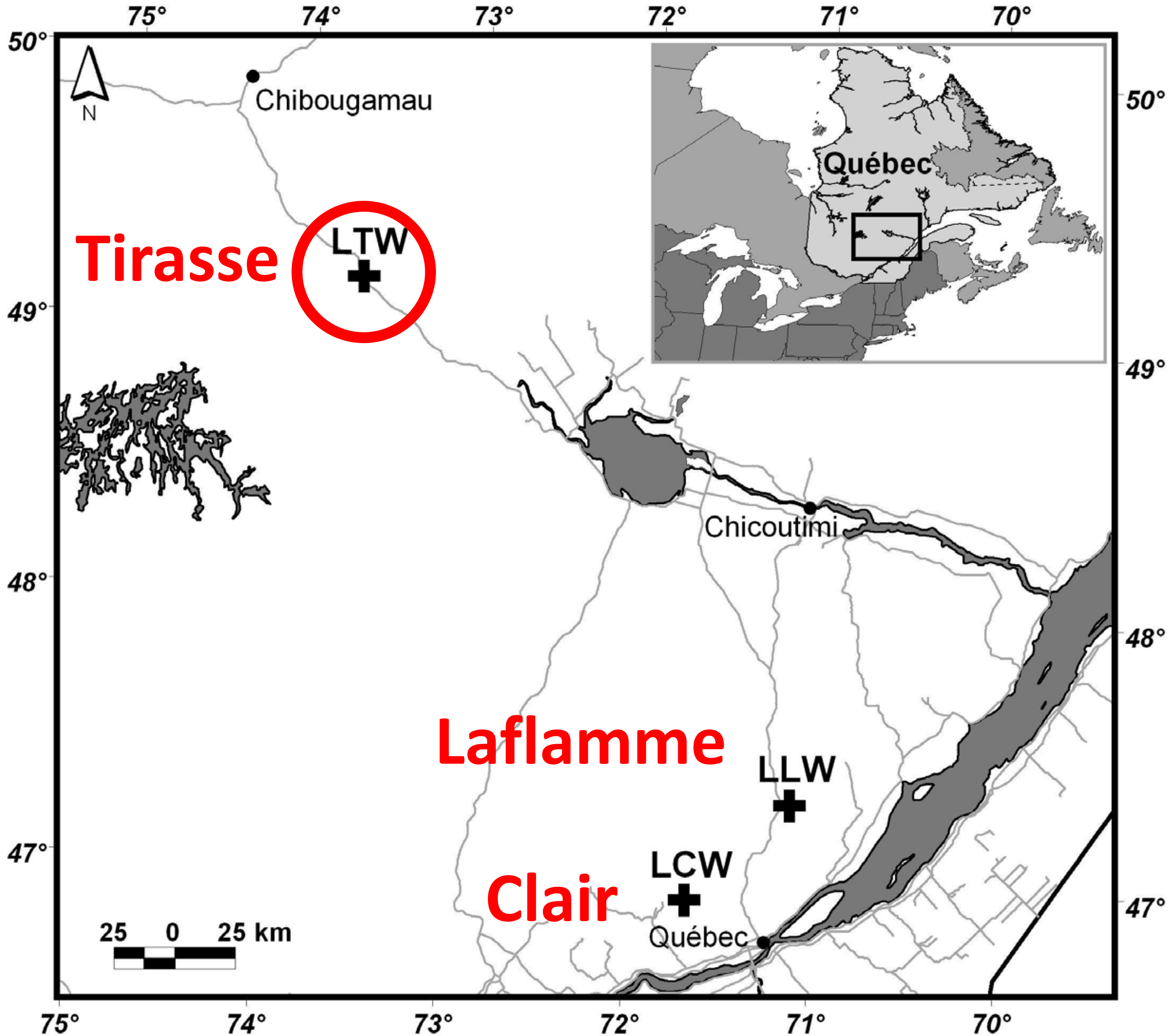
RESEF
Stations feuillues
Stations résineuses
Bassins versants
Zones et sous-zones de végétation*
Boréale
Forêt continue
Tempérée nordique
Forêt mélangée
Forêt décidue
* Saucier et al 2002
Québec
Montréal
100 50 0 100 km
1001
204
203
801
404
403
303
202
301
901
902
903
1101
104
103
105
102
802
703
1502
1203
1202
402
1501
702
701
1201
502
503
501


AST moyen depuis 1960
(cm² arbre⁻¹ an⁻²)
0,2
0,1
0,0
-0,1
-0,2
-0,3
-0,4
0
2
4
6
8
Acidité échangeable (cmol(+)kg⁻¹)
r = -0.85, p<0.001
Duchesne et al., 2002
Clair

Dépôts humides de N (NO_3+NH_4)

Le N : bon ou mauvais?

Source : Environnement Canada



75°
74°
73°
72°
71°
70°
50°
49°
48°
47°
N
Chibougamau
Tirasse
LTW
Québec
Chicoutimi
Laflamme
LLW
LCW
Clair
Québec
25 0 25 km

Ajouts mensuels de $^{15}NO_3$-$^{15}NH_4$

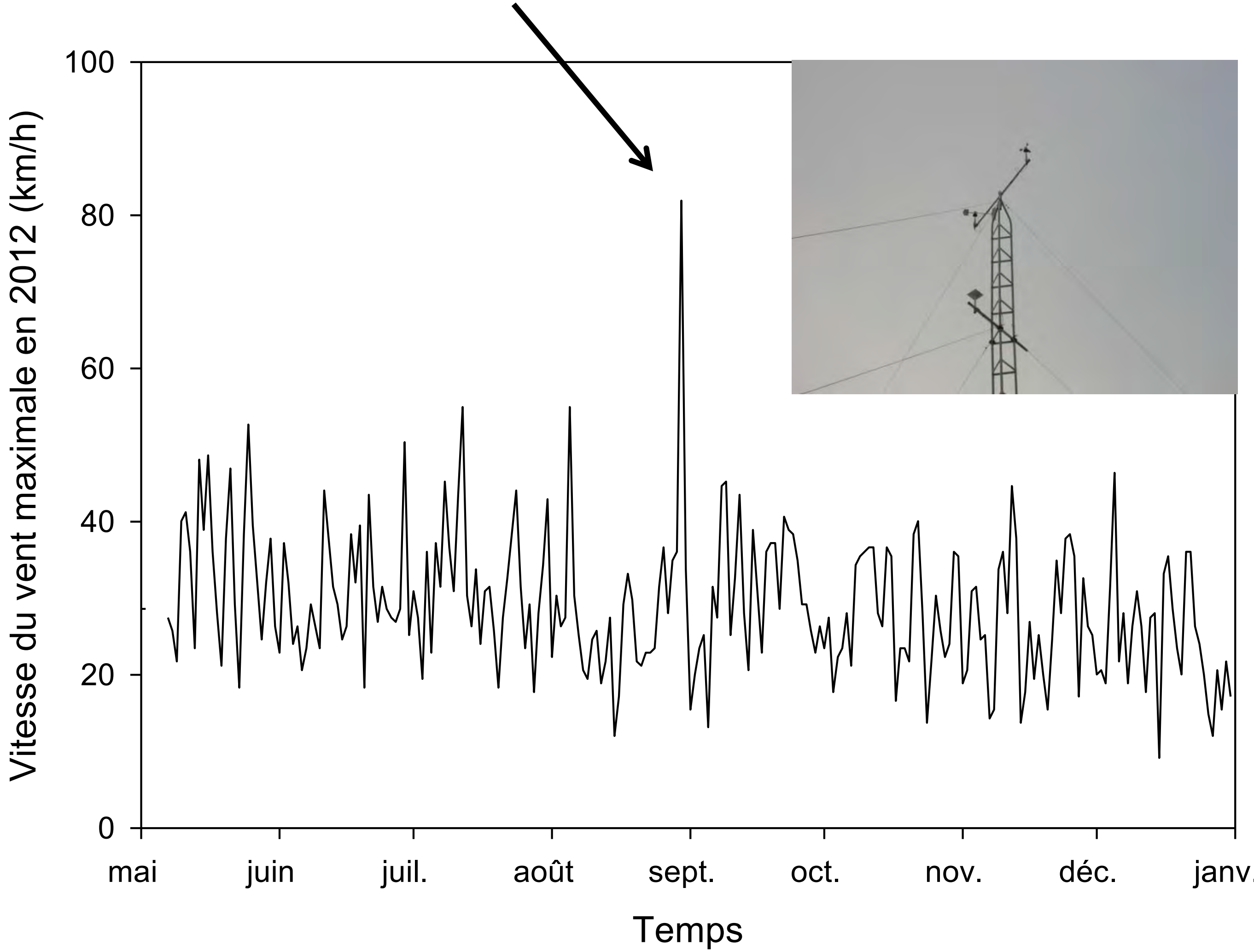
- Depuis 2001
- Témoins
- Low N : 3 fois les dépôts en N annuel
- High N : 10 fois les dépôts en N annuel
- ^{15}N **98%** a été ajouté aussi **sur les parcelles témoins (7% du N annuel)**

Aucune saturation en N après 150 ans de dépositions accélérées

Où va le N?

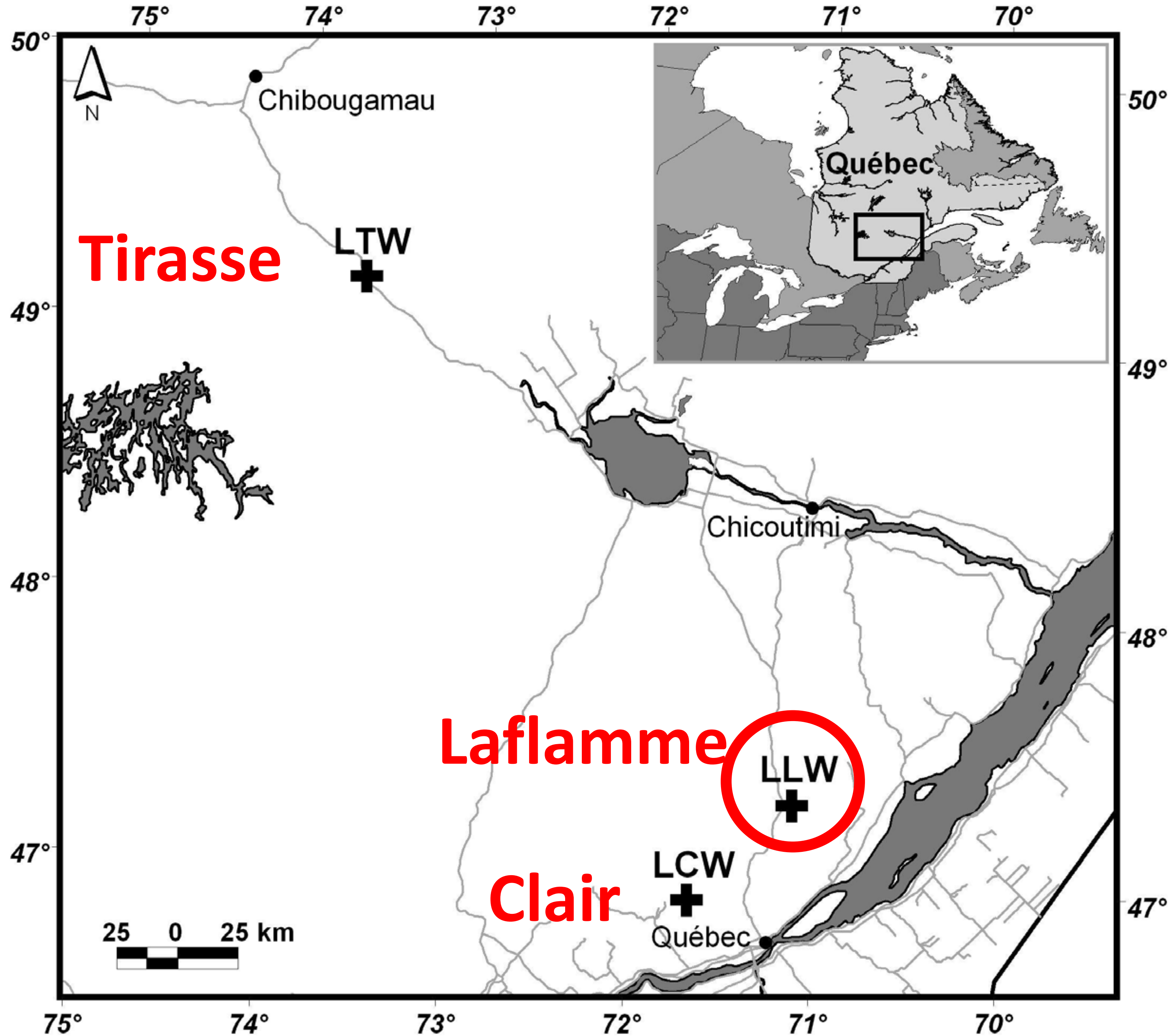
Échantillonnage foliaire

rafale soudaine de 82 km/hre le 30 août à 20 :27 heure normale de l'est

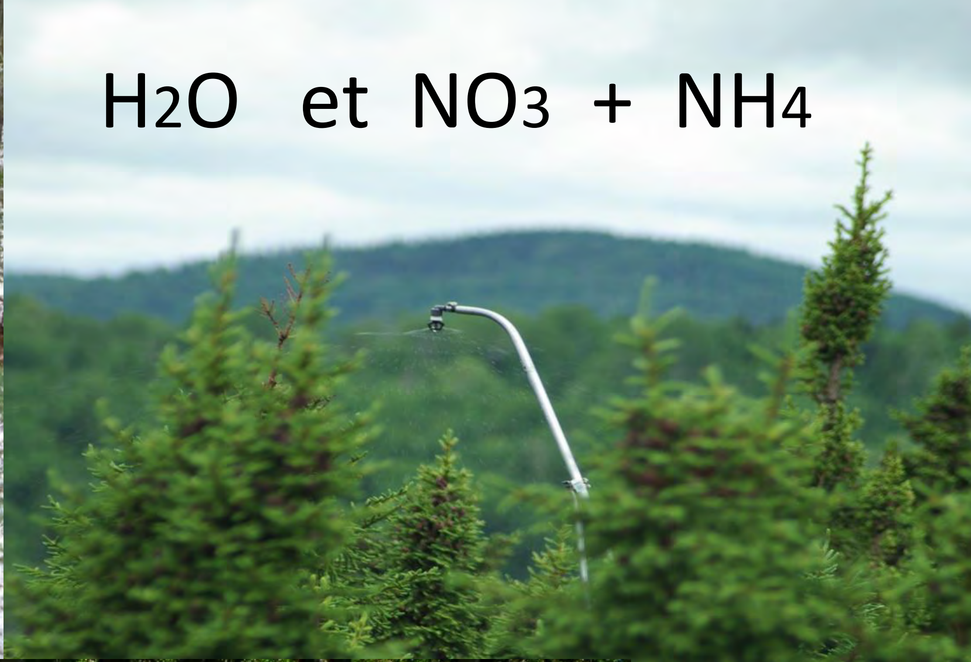



2012 9 5


11
N
2012 9 5



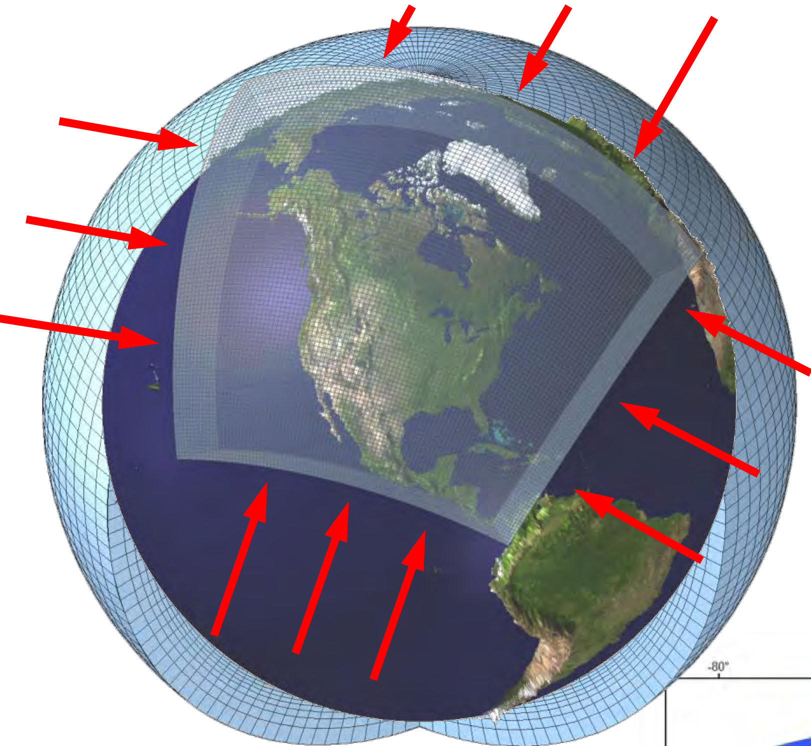
75°
74°
73°
72°
71°
70°
50°
49°
48°
47°
N
Chibougamau
Tirasse
LTW
Québec
Chicoutimi
Laflamme
LLW
LCW
Clair
Québec
25 0 25 km

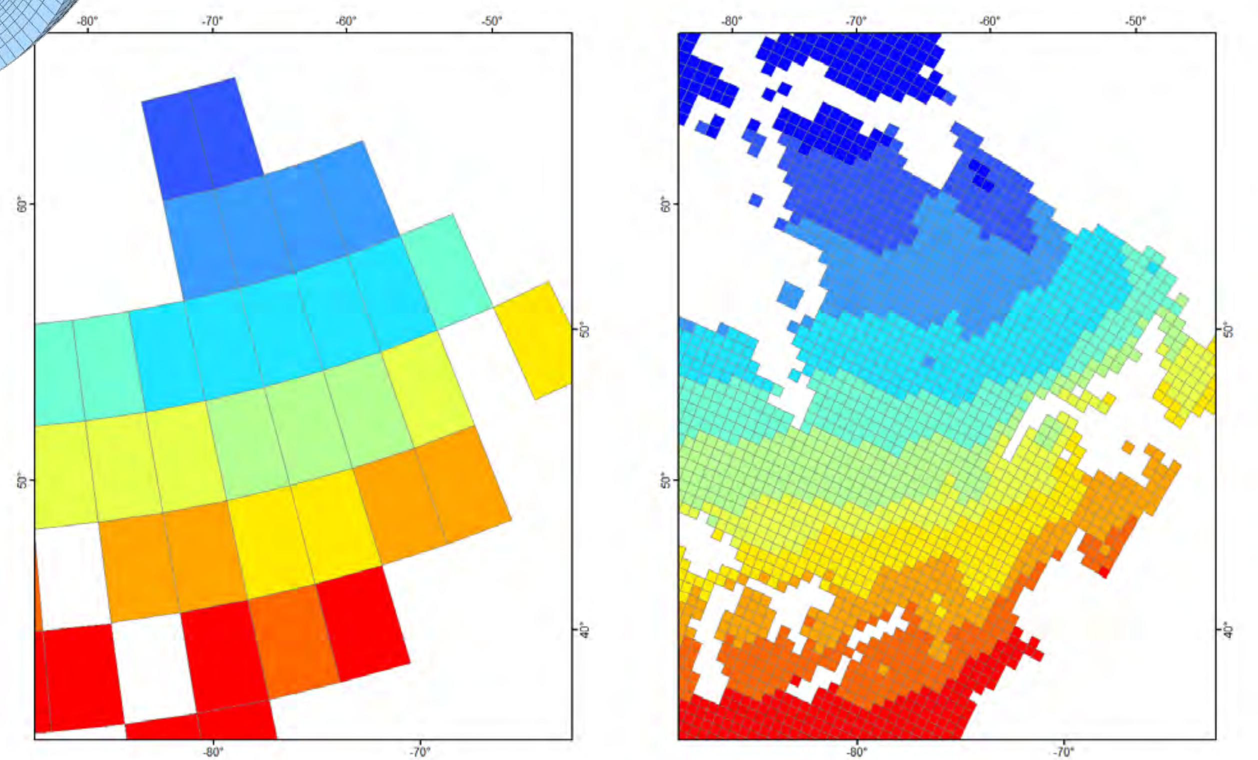


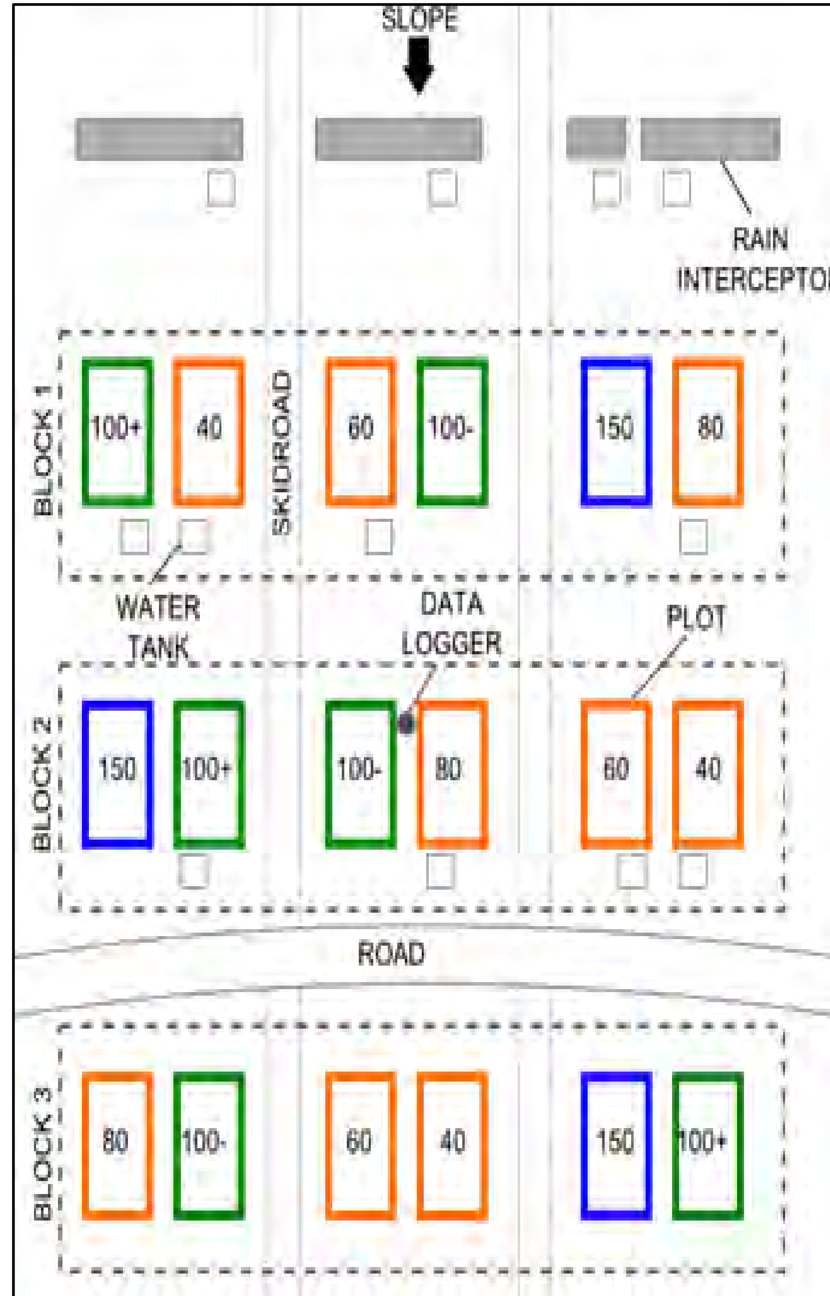
Forêt
chauffée
et
arrosée


Source : Richard Berthiaume

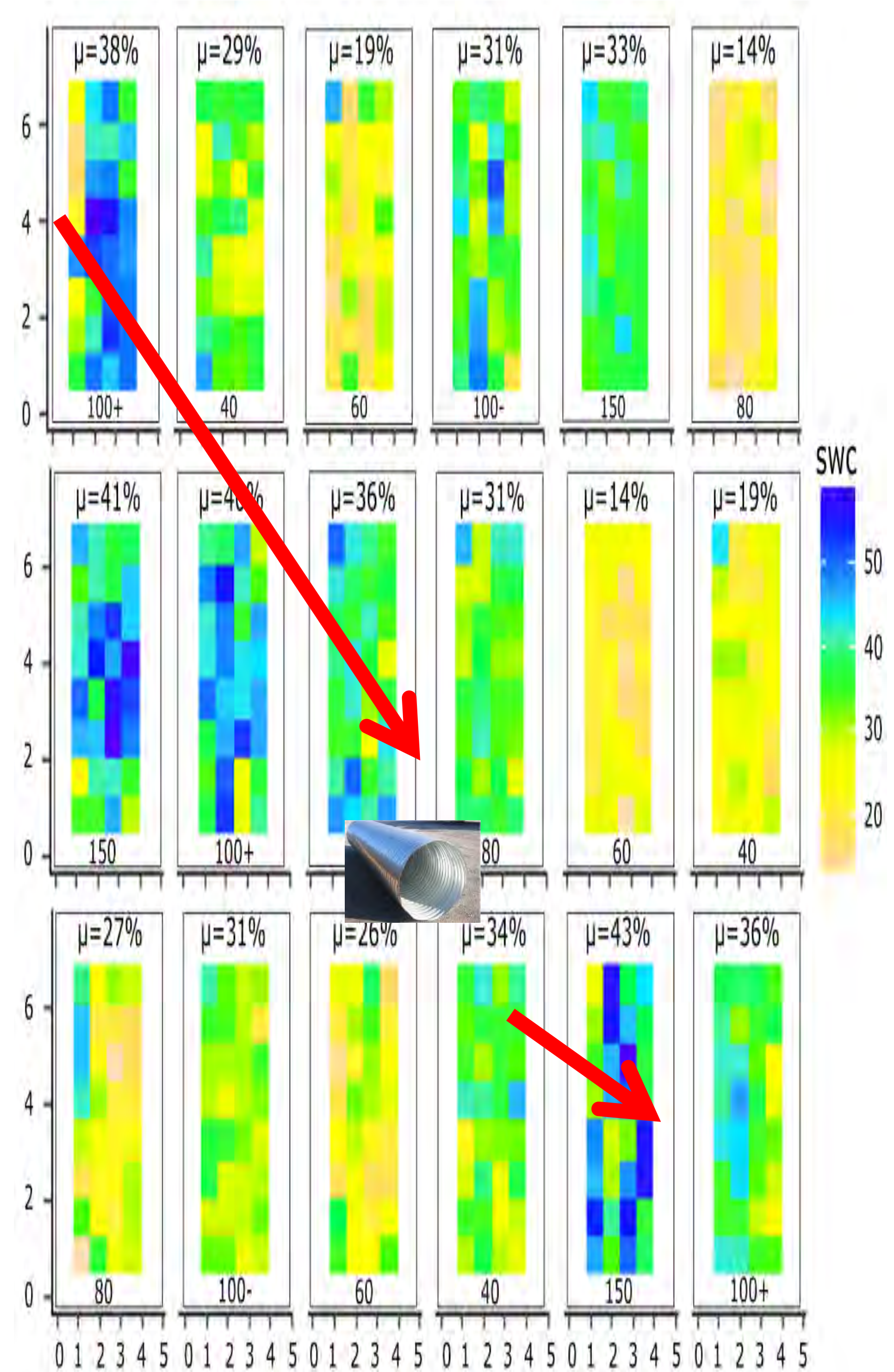
Modélisation régionale du climat



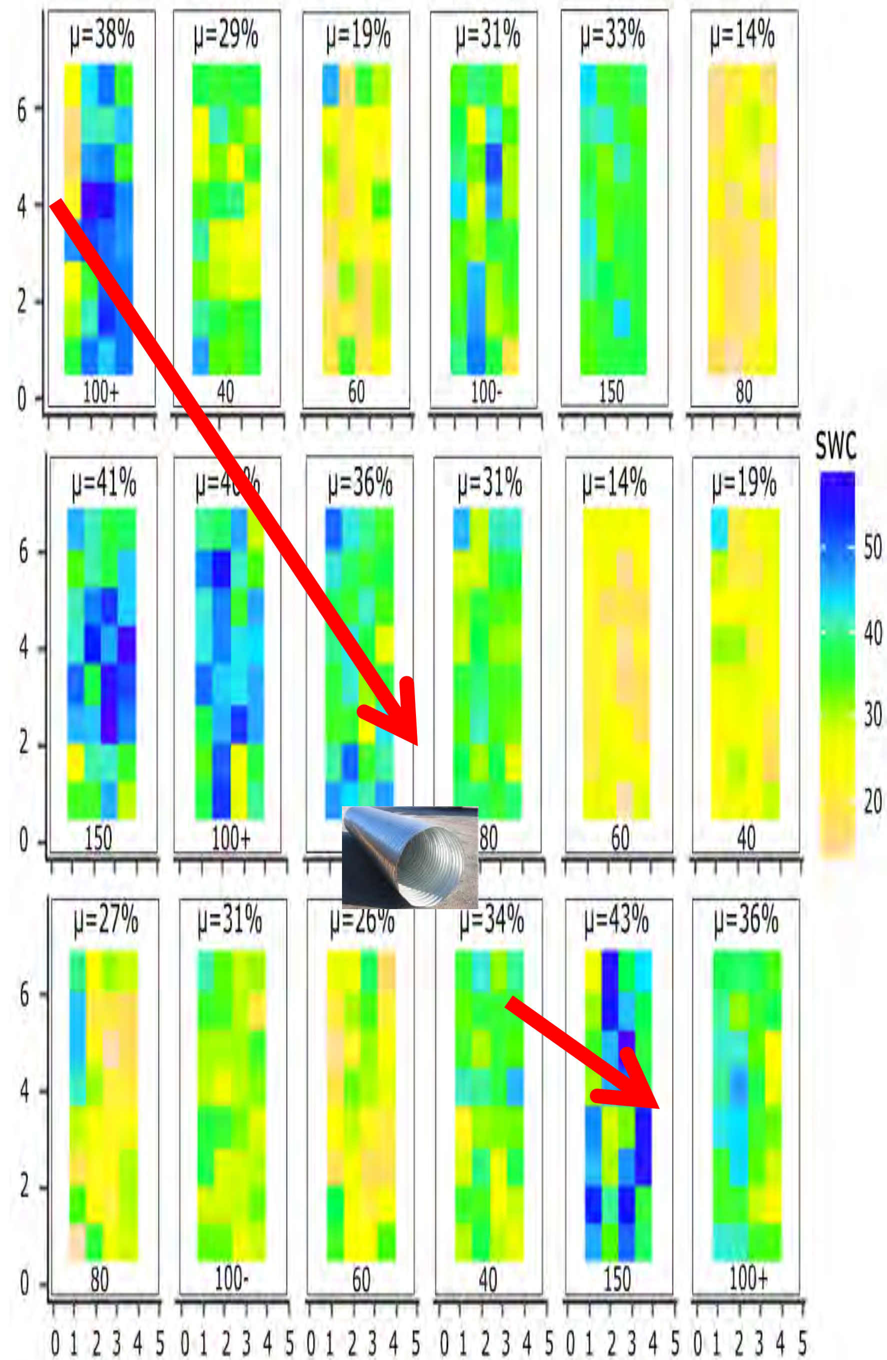




Disposition des parcelles



μ=38%
100+
μ=29%
40
μ=19%
60
μ=31%
100-
μ=33%
150
μ=14%
80
μ=41%
150
100+
μ=36%
μ=31%
80
μ=14%
60
μ=19%
40
μ=27%
80
μ=31%
100-
μ=26%
60
μ=34%
40
μ=43%
150
μ=36%
100+
SWC
50
40
30
20
0
2
4
6
0 1 2 3 4 5


μ=38%
μ=29%
μ=19%
μ=31%
μ=33%
μ=14%
100+
40
60
100-
150
80
μ=41%
μ=36%
μ=31%
μ=14%
μ=19%
150
100+
80
60
40
μ=27%
μ=31%
μ=26%
μ=34%
μ=43%
μ=36%
80
100-
60
40
150
100+
0
2
4
6
0 1 2 3 4 5
SWC
50
40
30
20

nature plants

LETTERS

PUBLISHED: 28 NOVEMBER 2016 | ARTICLE NUMBER: 16187 | DOI: 10.1038/NPLANTS.2016.187

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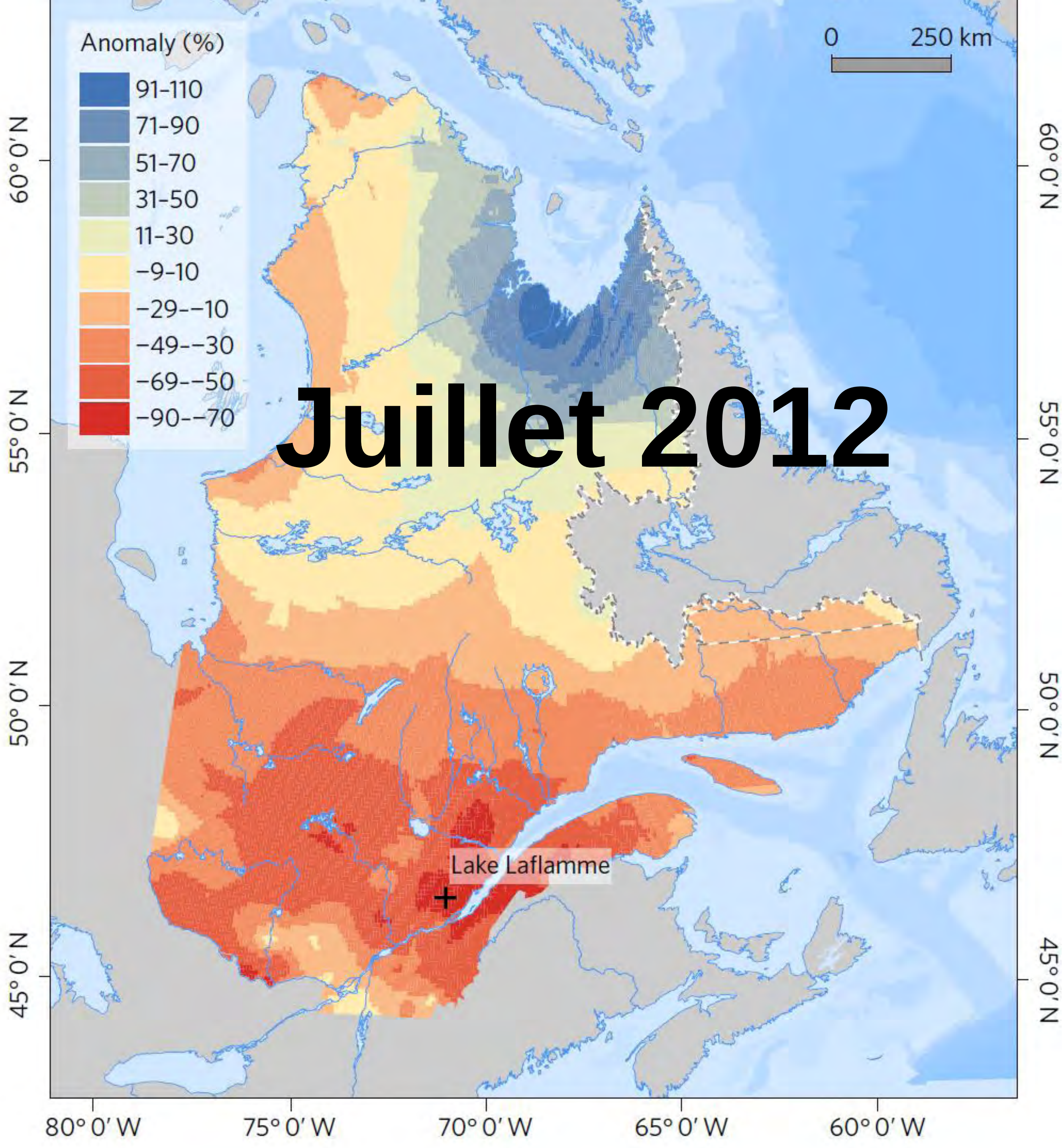
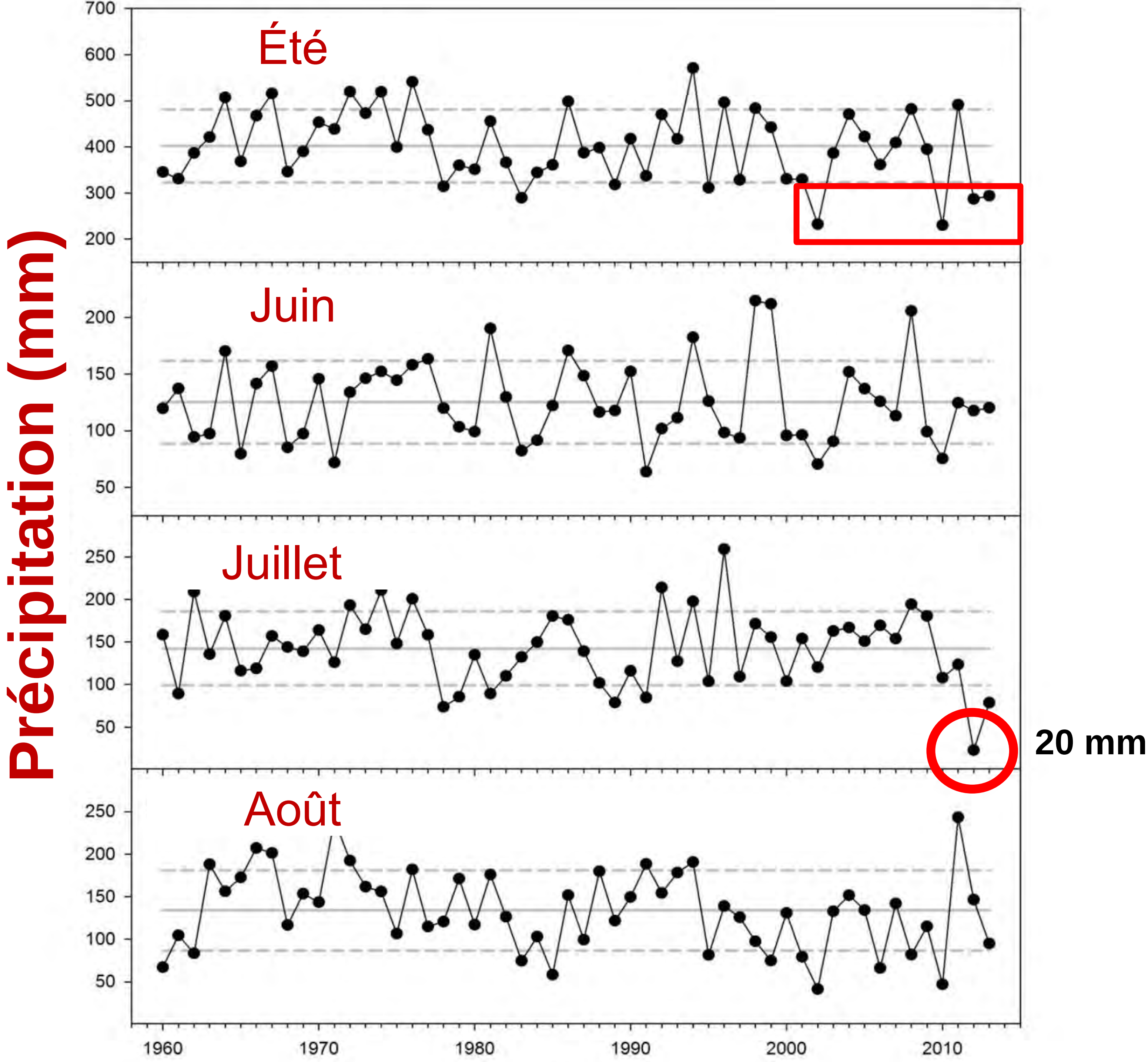
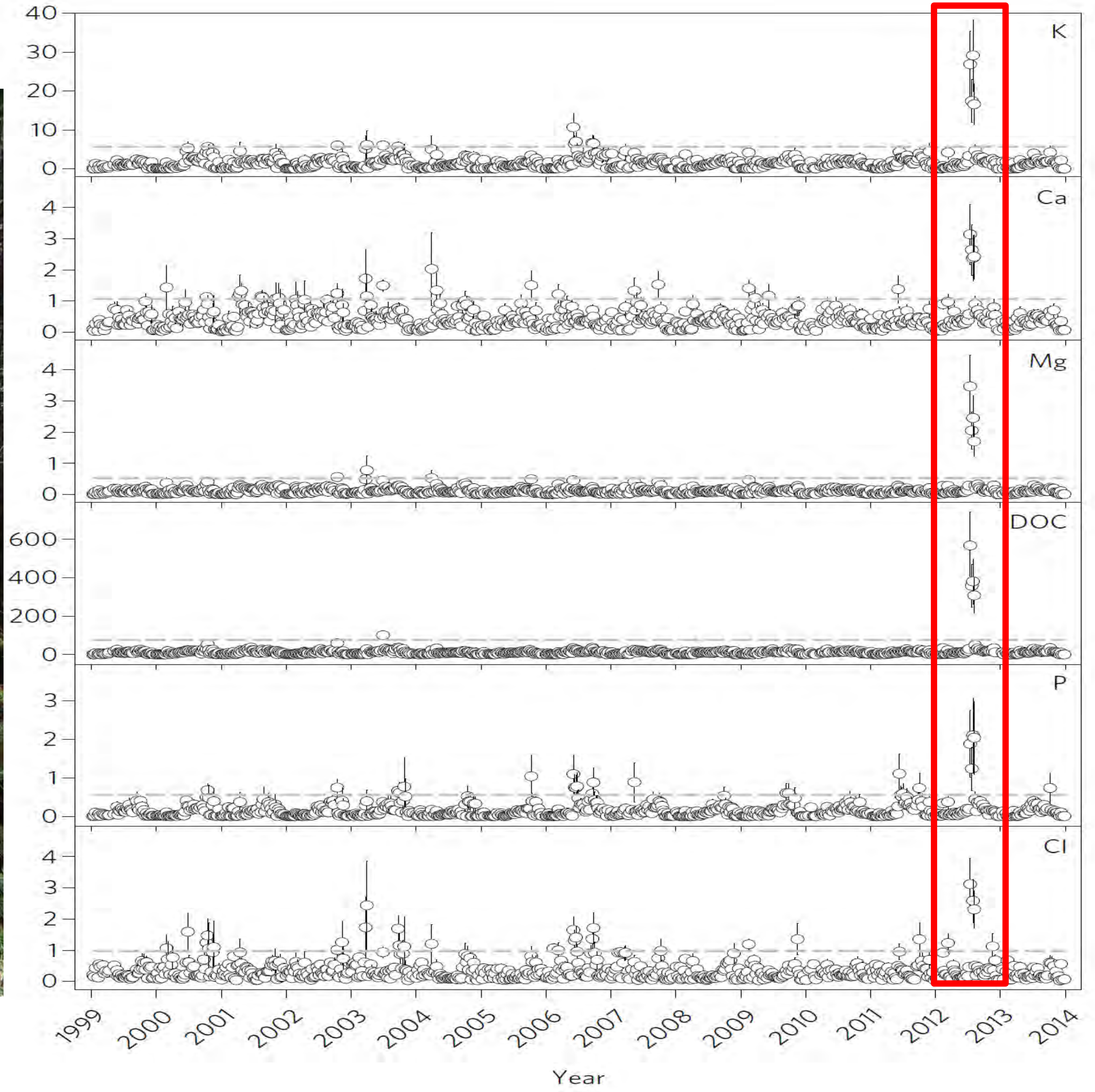

Juillet 2012
Anomaly (%)
91–110
71–90
51–70
31–50
11–30
−9–10
−29–−10
−49–−30
−69–−50
−90–−70
0
250 km
Lake Laflamme
60° 0′ N
55° 0′ N
50° 0′ N
45° 0′ N
80° 0′ W
75° 0′ W
70° 0′ W
65° 0′ W
60° 0′ W

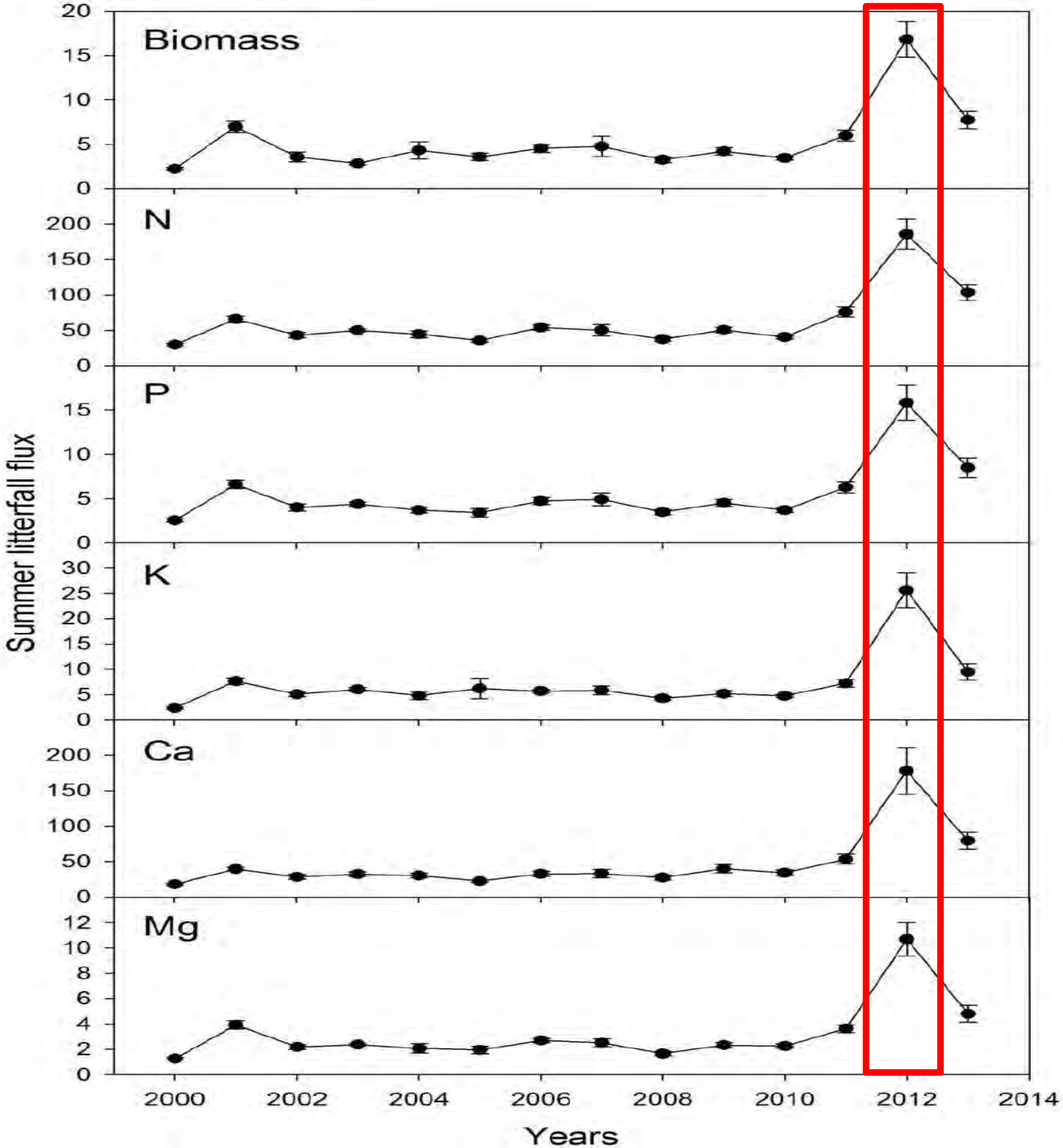


Précipitation (mm)
Été
Juin
Juillet
Août
20 mm
700
600
500
400
300
200
150
100
50
250
1960
1970
1980
1990
2000
2010

a

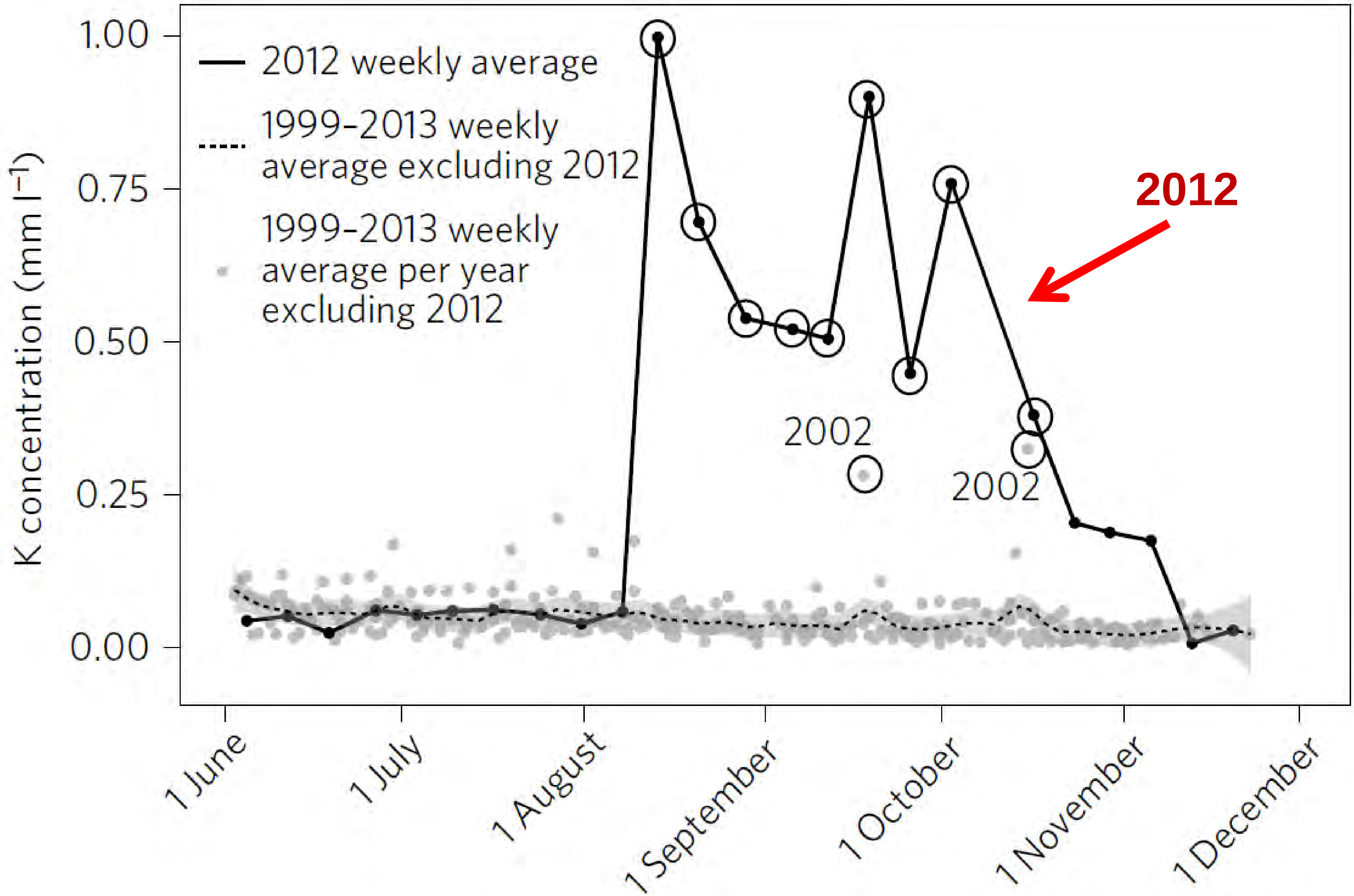

2501


K
Ca
Mg
DOC
P
Cl
40
30
20
10
0
600
400
200
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



Biomass
N
P
K
Ca
Mg
Summer litterfall flux
Years

Concentration de K dans la solution de sol



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LETTERS

PUBLISHED: XX XX 2016 | ARTICLE NUMBER: 16187 | DOI: 10.1038/NPLANTS.2016.187

Major losses of nutrients following a severe drought in a boreal forest

Daniel Houle[1,2*], Geneviève Lajoie[2] and Louis Duchesne[1]

Because of global warming, the frequency and severity of droughts are expected to increase, which will have an impact on forest ecosystem health worldwide[1]. Although the impact of drought on tree growth and mortality are increasingly documented[2–4], very little is known about its impact on nutrient cycling in forest ecosystems. Here, based on long-term moni- toring dat before, du During an throughfall of nutrient chlorine, pl fering by o term norm high throu at a depth ium conce deposition especially of net losses under 'normal' conditions. Our data show that droughts have unexpected impacts on nutrient cycling through impacts on tree canopy and soils and may lead to important episodes of potassium losses from boreal forest eco- systems. The potassium losses associated with drought will add to those originating from tree harvesting and from forest fires, and insect outbreaks[5–7] (the last two being expected to increase in the future because of climate change) and may con- tribute to reduce potassium availability in boreal forests in a

The net potassium losses (atmospheric deposition minus leaching losses) following the drought were especially important, being the equivalent of nearly 20 years of net losses under 'normal' conditions.

in photosynthetic activity, transpiration and growth, resulting in an increase in nutrient concentrations in the soil solution and higher risks of leaching losses[15]. Nutrients are also less likely to be made available for plant uptake during drought by impacting the health and activity of soil microbes responsible for enzyme production con- trolling nutrient availability[16]. Despite such valuable investigation of he mag- drought ved in a y losses solution es from n these ns and lsam fir severe osing a ts and account for their impact on ecosystem nutrient balance.

The summer 2012 was very dry for a vast portion of Eastern Canada and the United States[18,19]. At Lake Laflamme, located in the area where the drought was most intense in Québec (Fig. 1), July 2012 was the driest summer month ever observed throughout the 1960–2013 period ($n = 162$ summer months, Supplementary Fig. 1). In fact, only 23 mm of rain was received as opposed to the 143 mm long-term average. Although there were no significant tem- poral trends across the long-term record, four of the five driest

Perturbations


Merci!