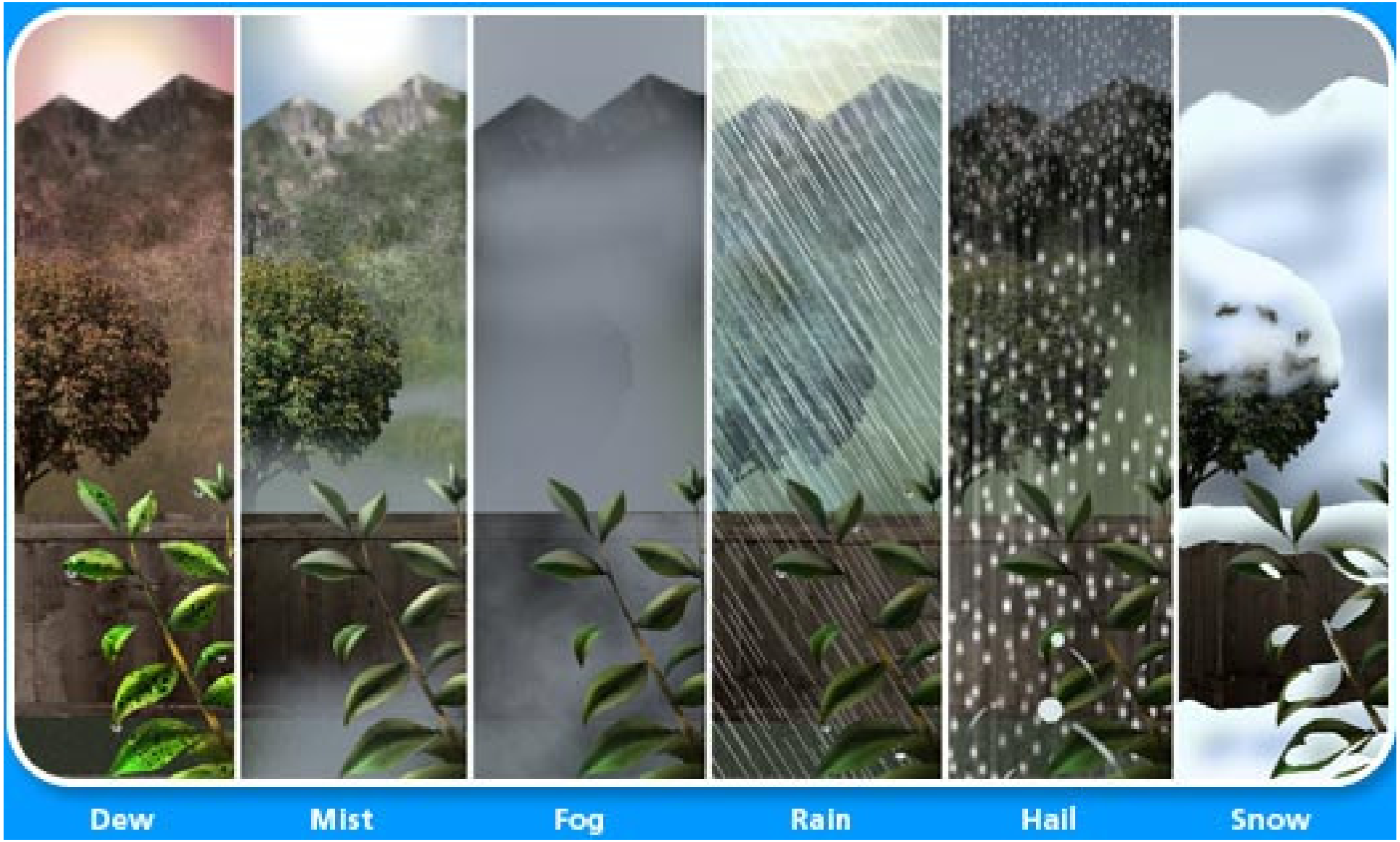
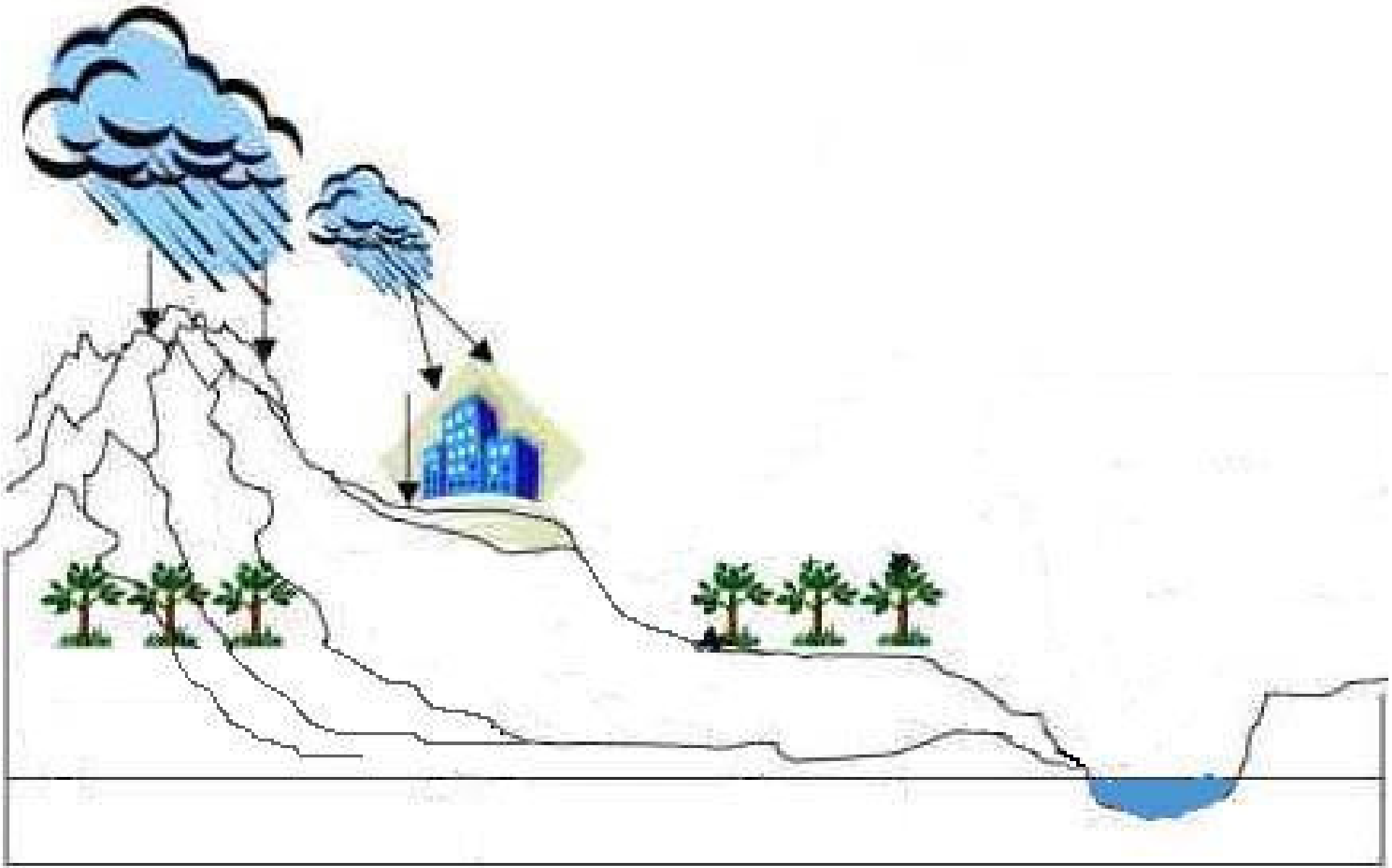
From falling rain to watershed study

Nicole HERMAN
Applied Physics teacher
Lycée Roosevelt
Reims - France

Precipitations


Dew
Mist
Fog
Rain
Hail
Snow

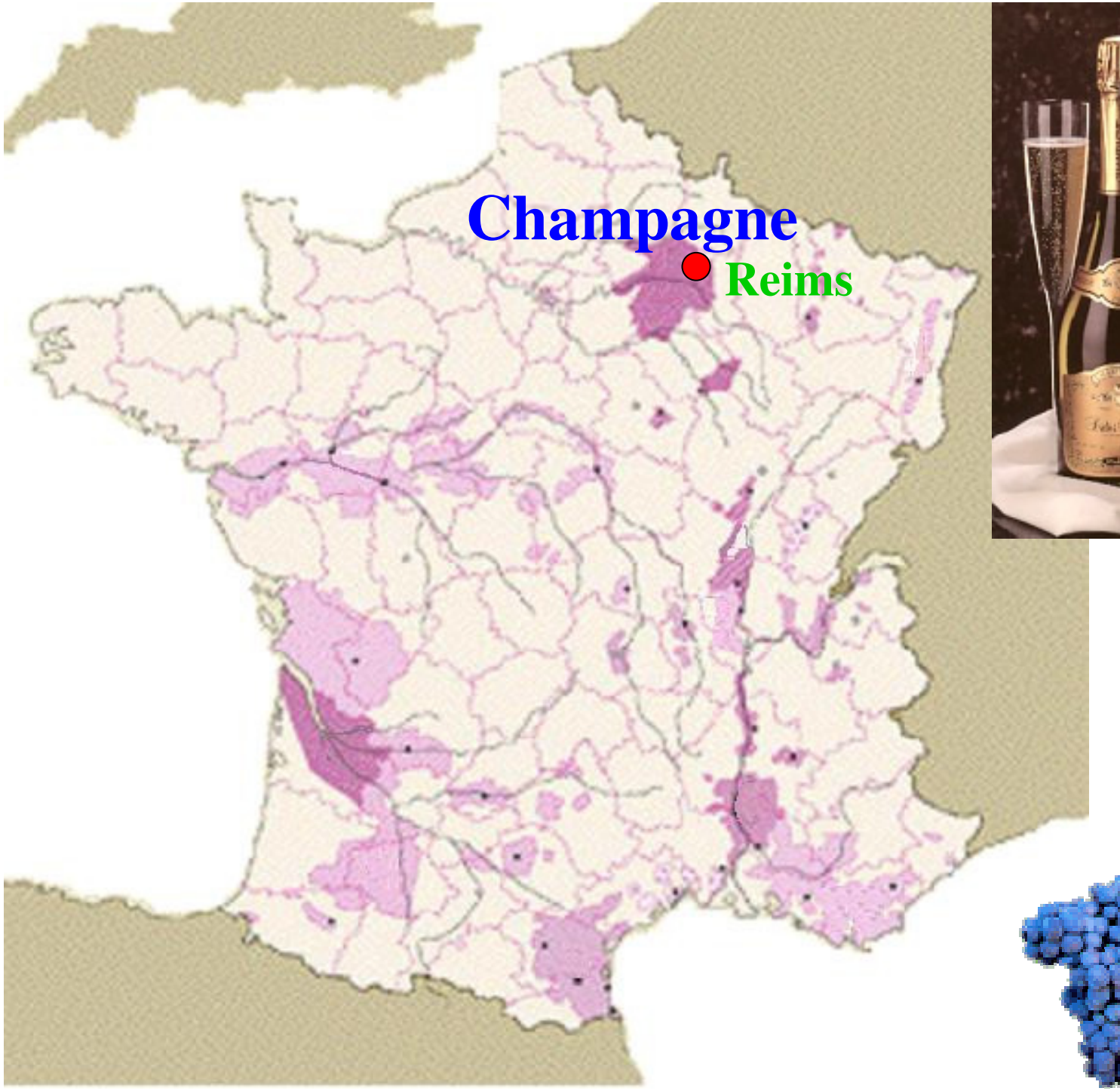


Where is that water going ?

Where is that water coming from ?

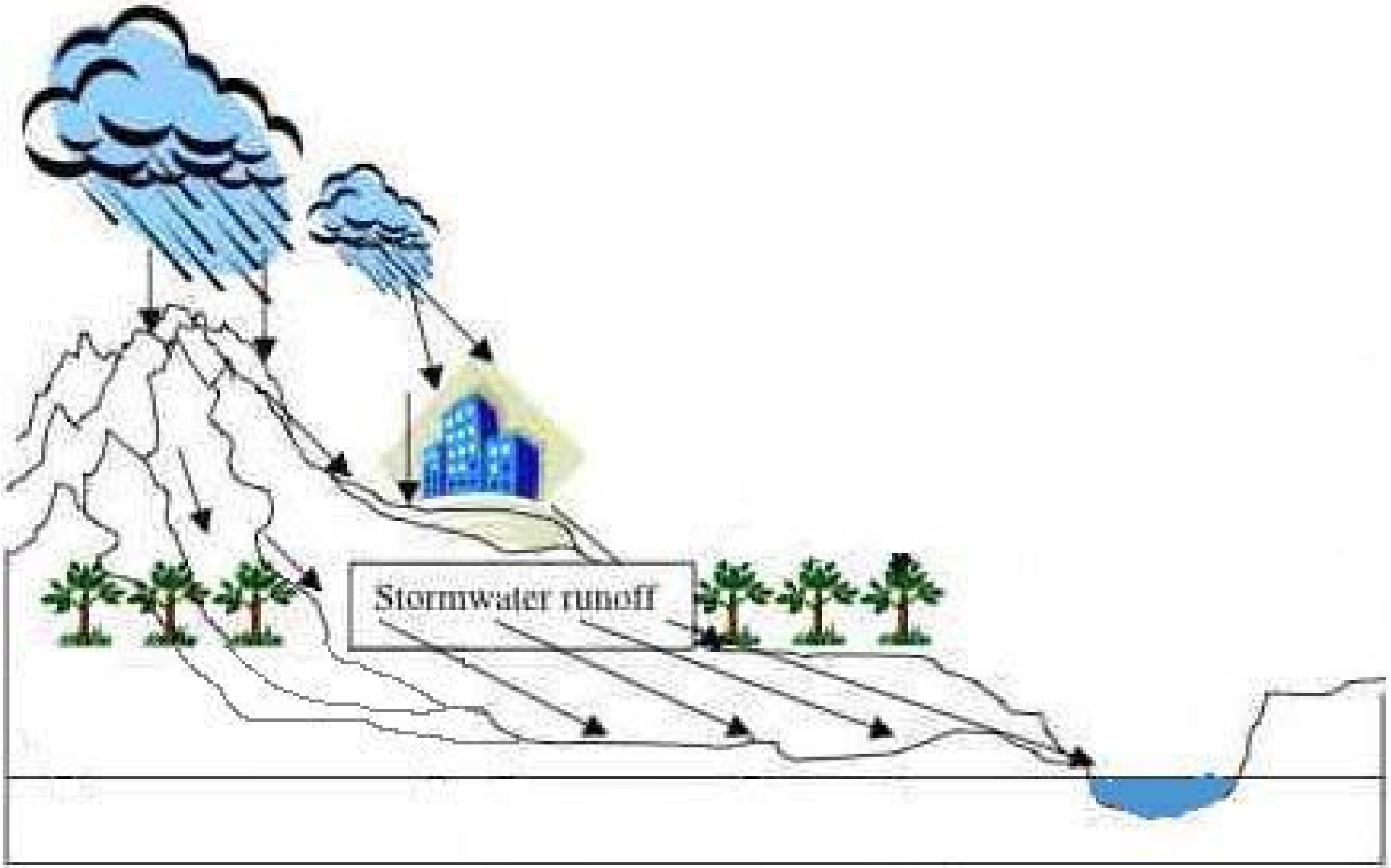
Rain falling into water

Rain falling on land

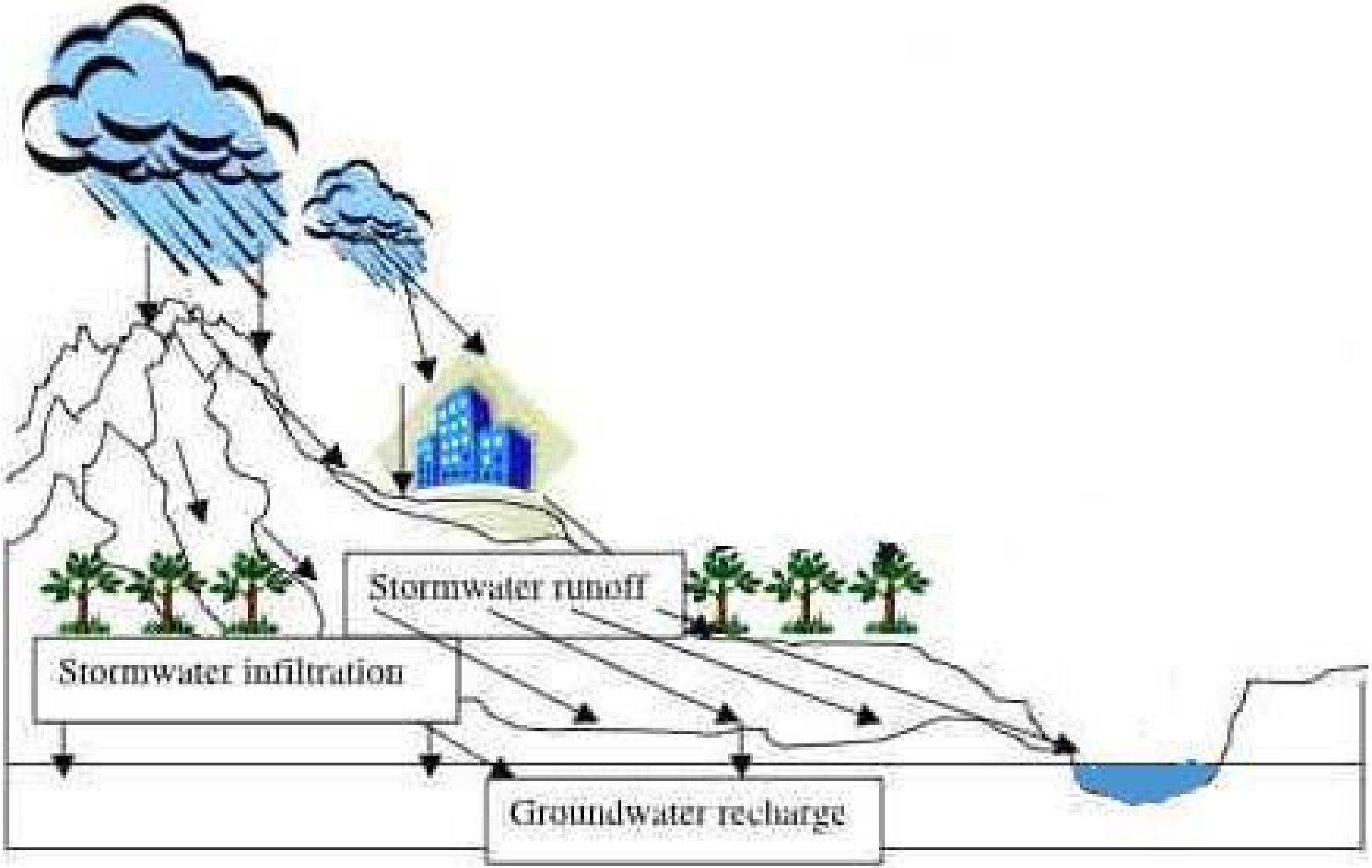

Champagne
Reims

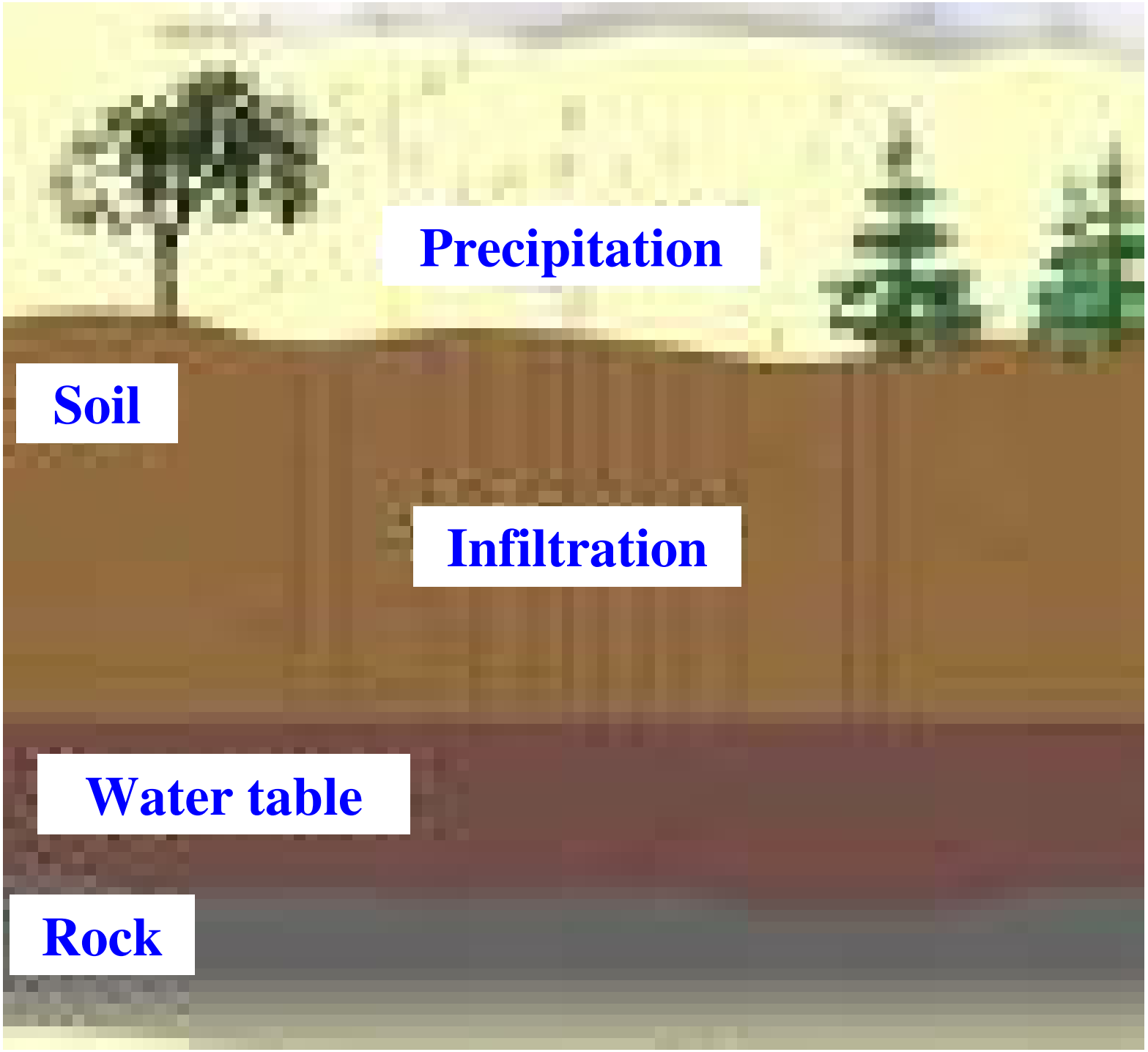

KIRIN
KIRIN

Runoff


Stormwater runoff

Infiltration


Stormwater runoff
Stormwater infiltration
Groundwater recharge


Precipitation
Soil
Infiltration
Water table
Rock

Rain falling on urban zones

Wetlands

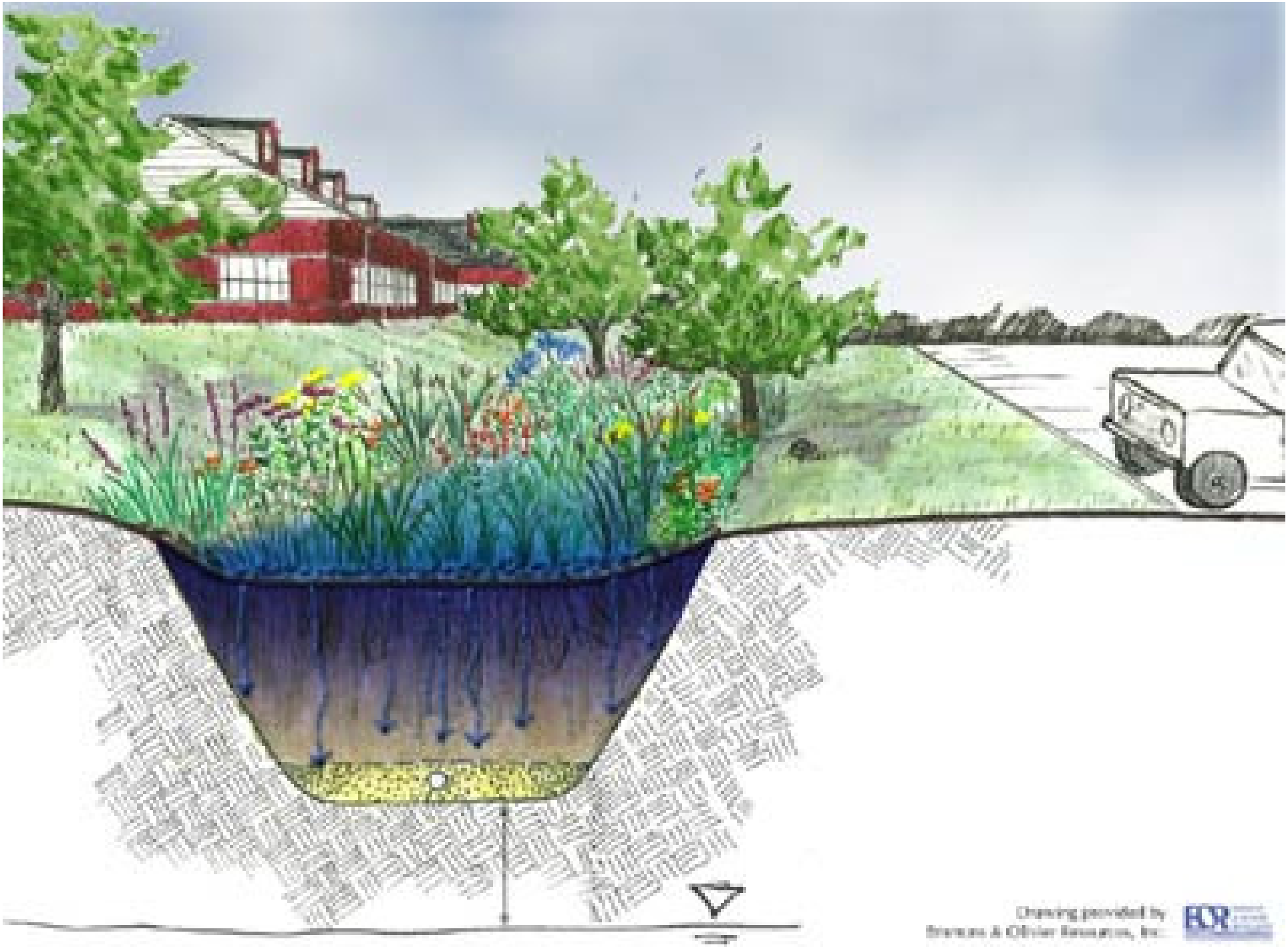
Drawing provided by
Emmons & Oliver Resources, Inc.

Marsh Marigold

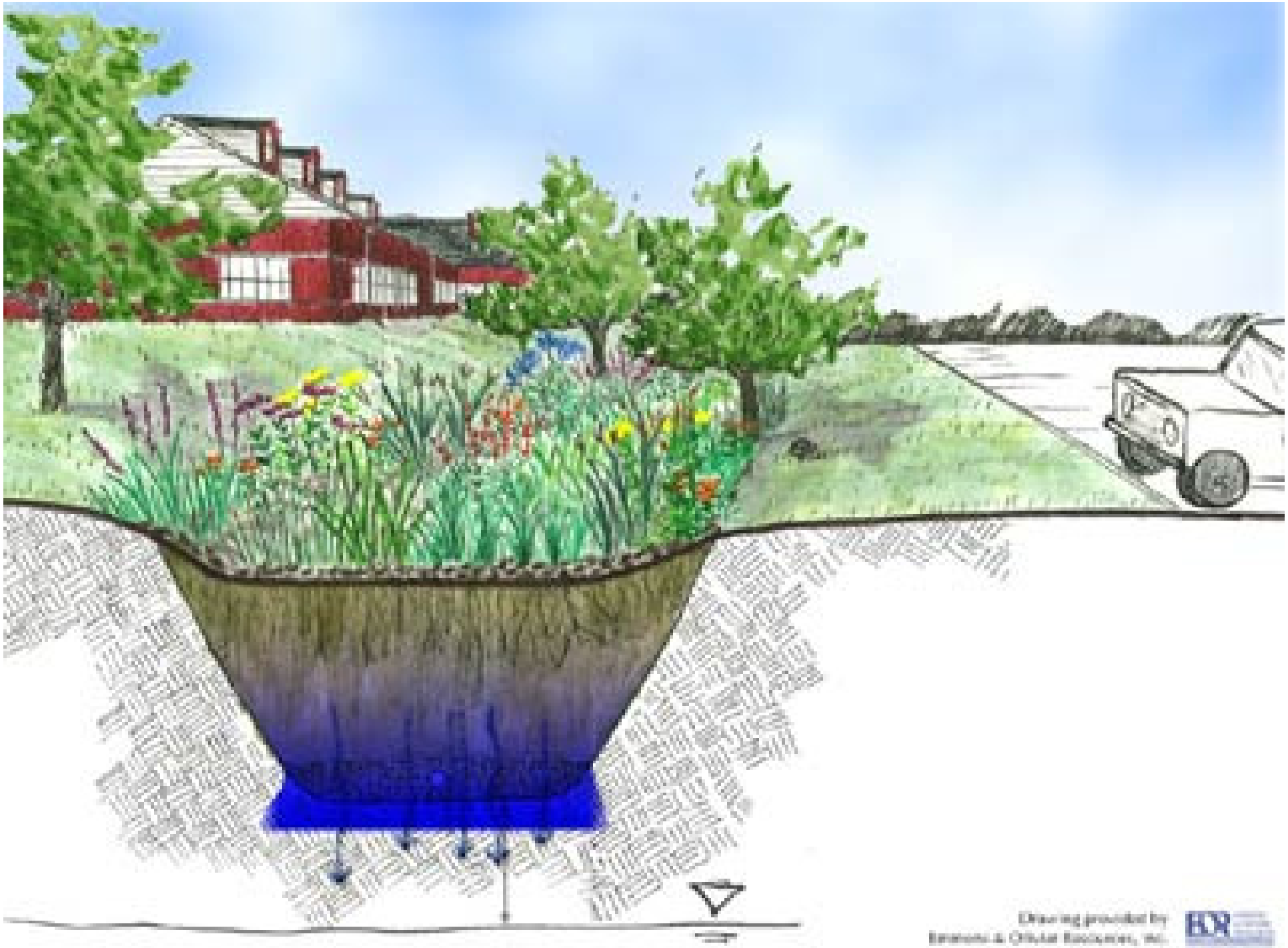
Characteristics of Marsh Marigold

Common Name:	Marsh Marigold
Scientific Name:	Caltha palustris
Appropriate for:	Raingardens Native Gardens , Shoreline Stabilization
Height:	18 Inches
Type of plant:	Flower/Forb
Color of bloom:	Yellow
Blooms from:	May to June
Sun Exposure:	Full sun to full shade
Soil	Wet to partial

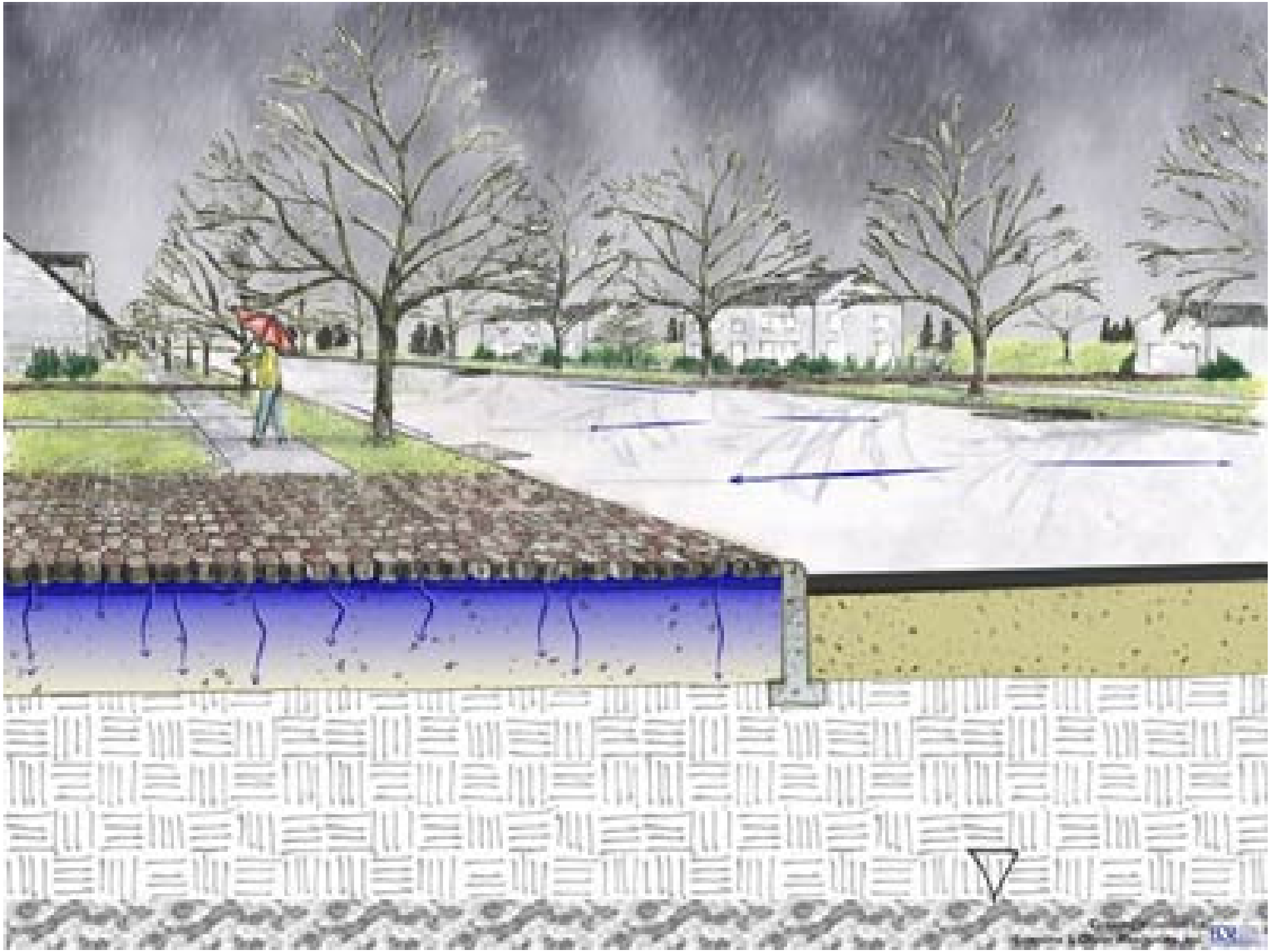
Marsh Marigold

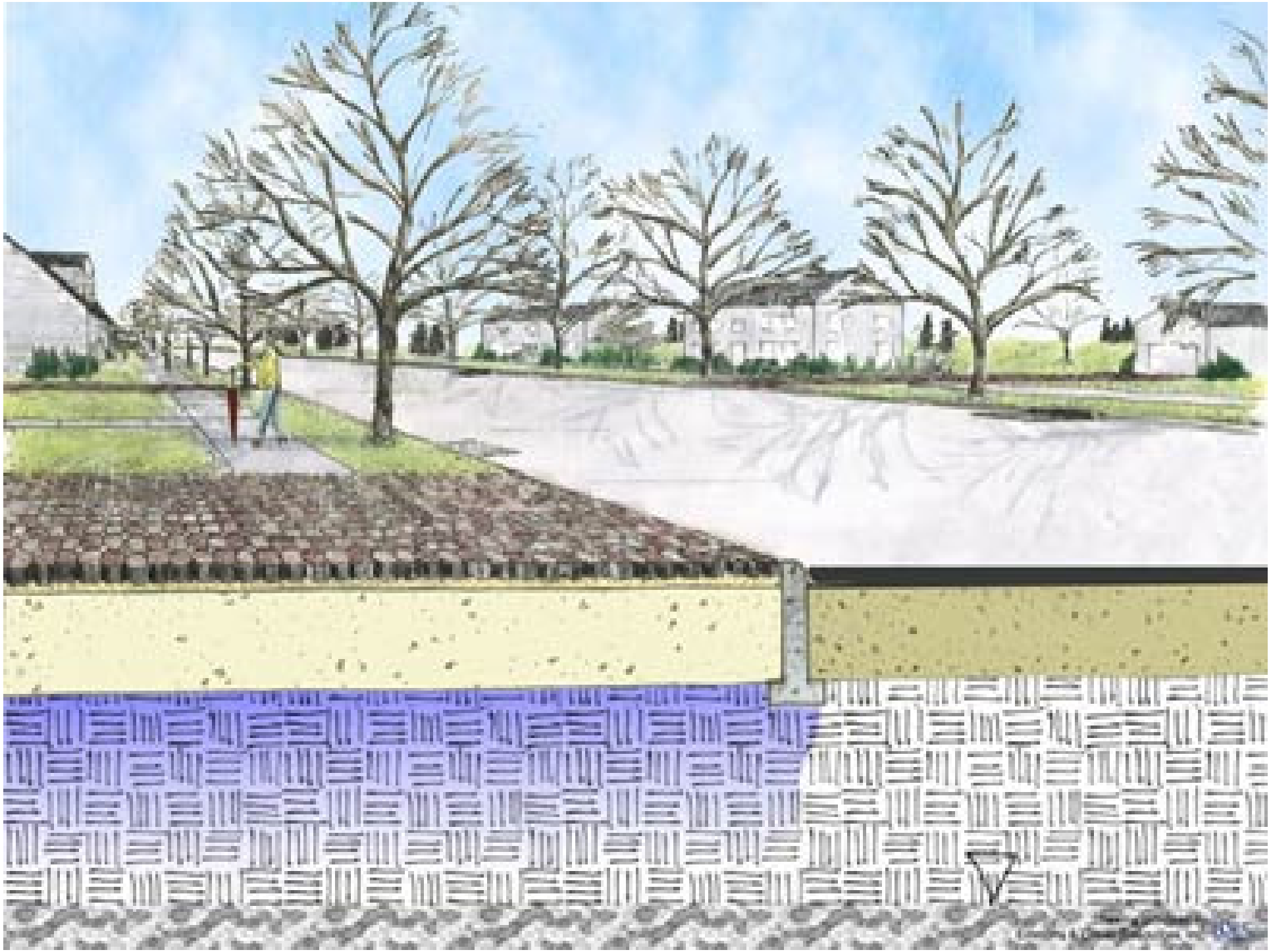


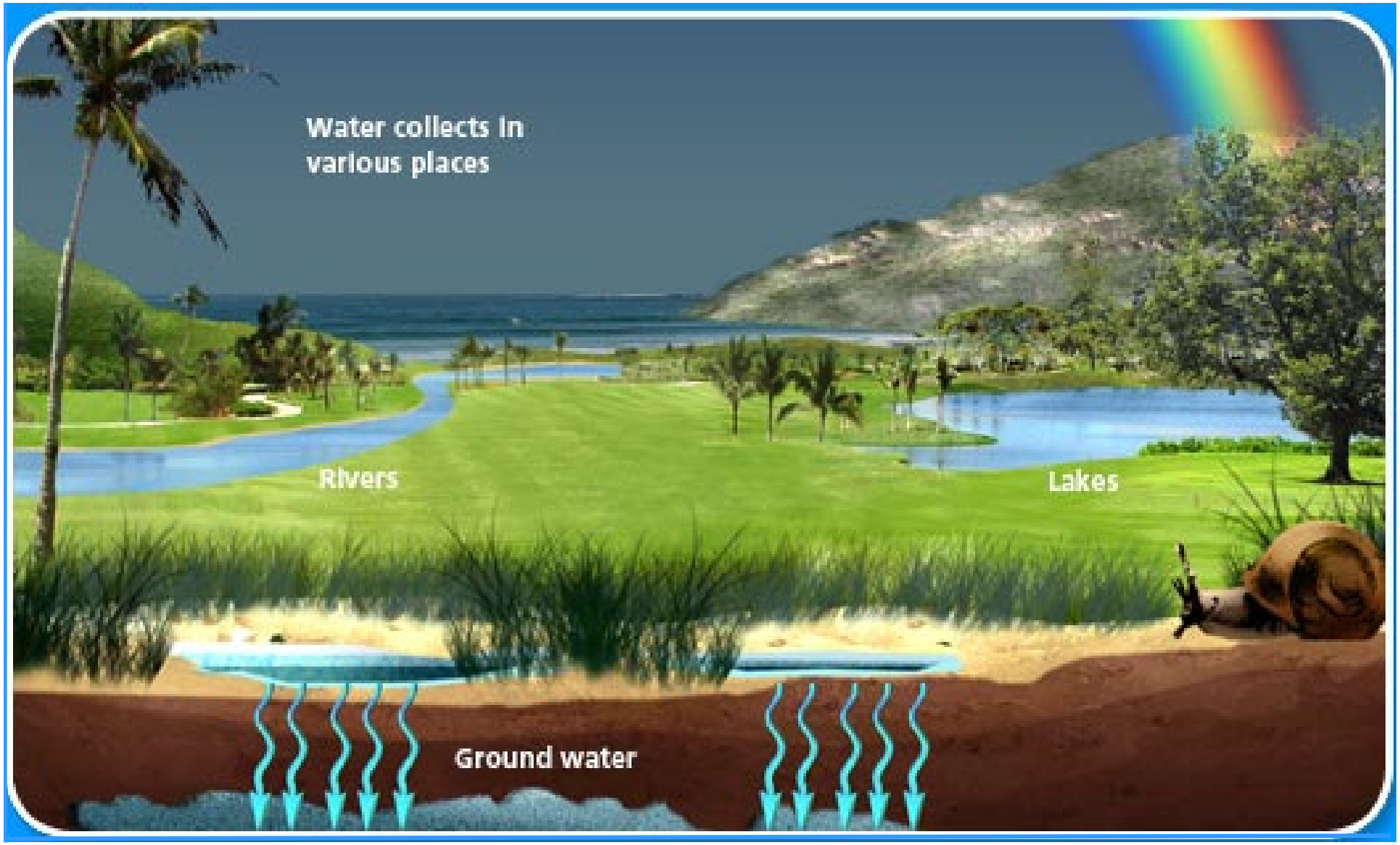
Drawing provided by
Frances A Olivier Resources, Inc.



Drawing provided by
Bennett & Orbital Associates, Inc.

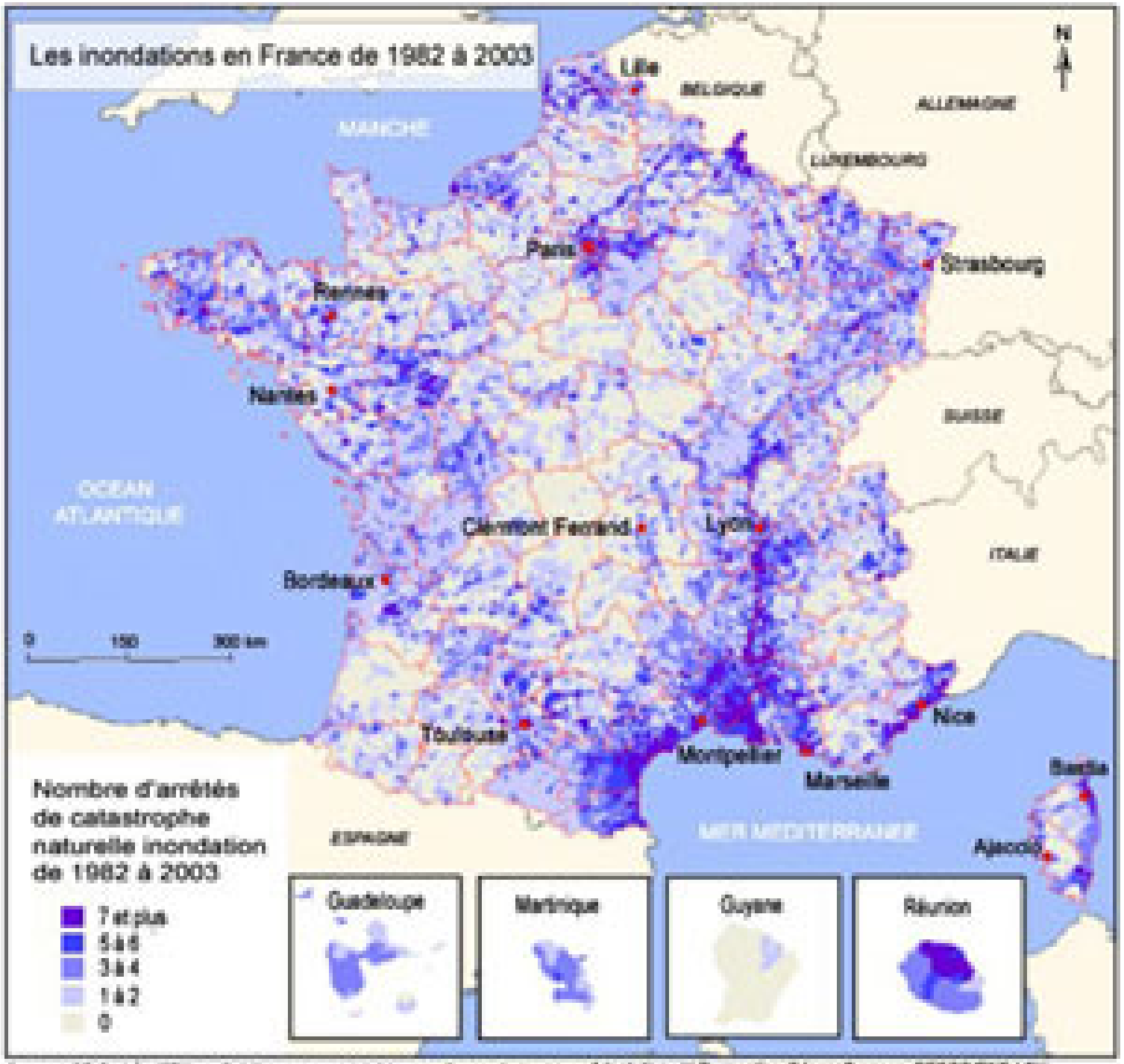





Water collects in
various places
Rivers
Lakes
Ground water

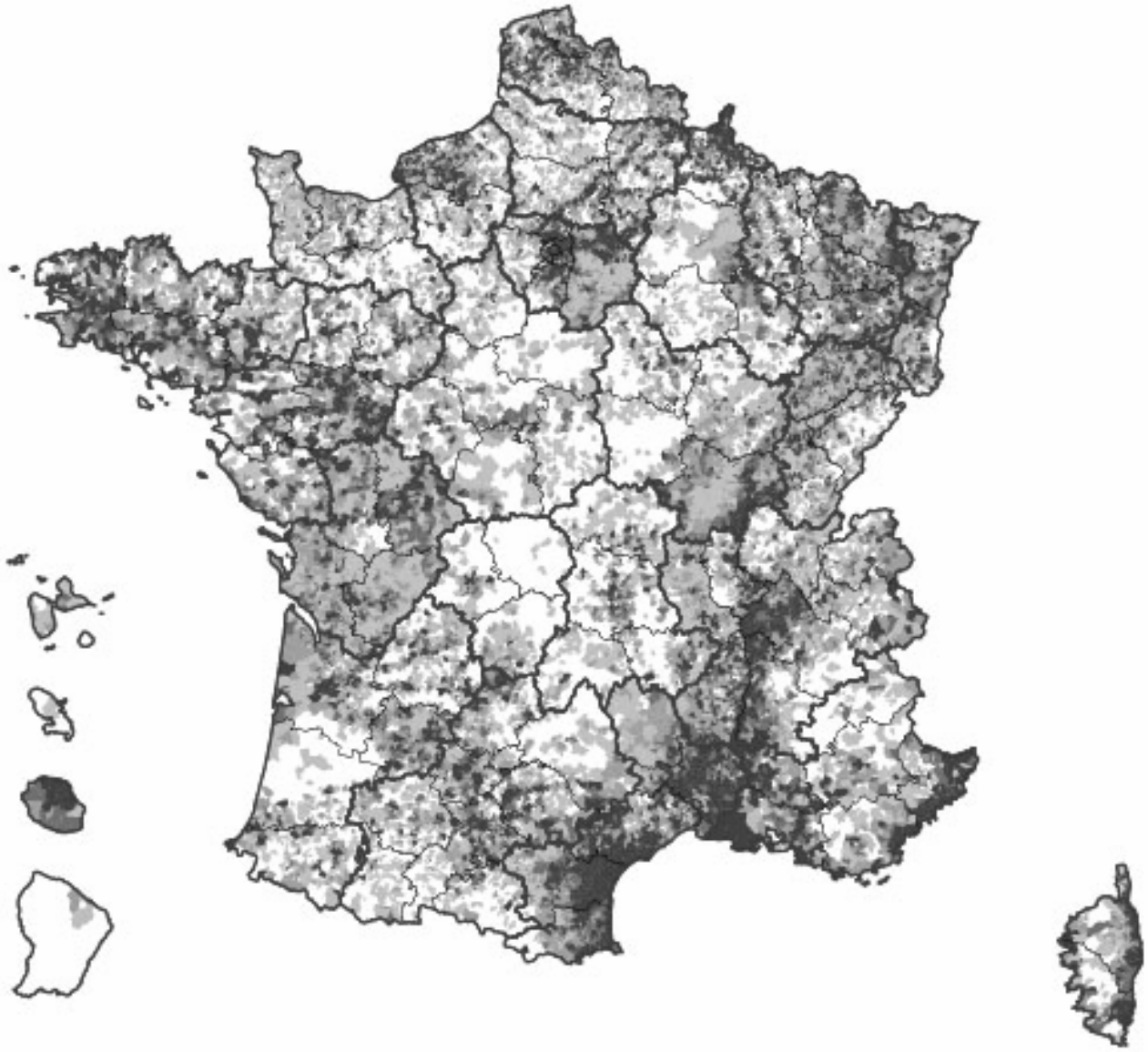
Everything seems perfect !

BUT…



Source : BD Comlp, IFEN - Crédit : www.ens-lsh.fr/geoconfluences/index.htm - Adaptation : H.Parmentier, Géoconfluences, DESCOEAS-LSH

Arrêtés de catastrophe naturelle "inondation et coulée de boue" de 1982 à août 2003



Arrêtés "inondation et coulée de boue"

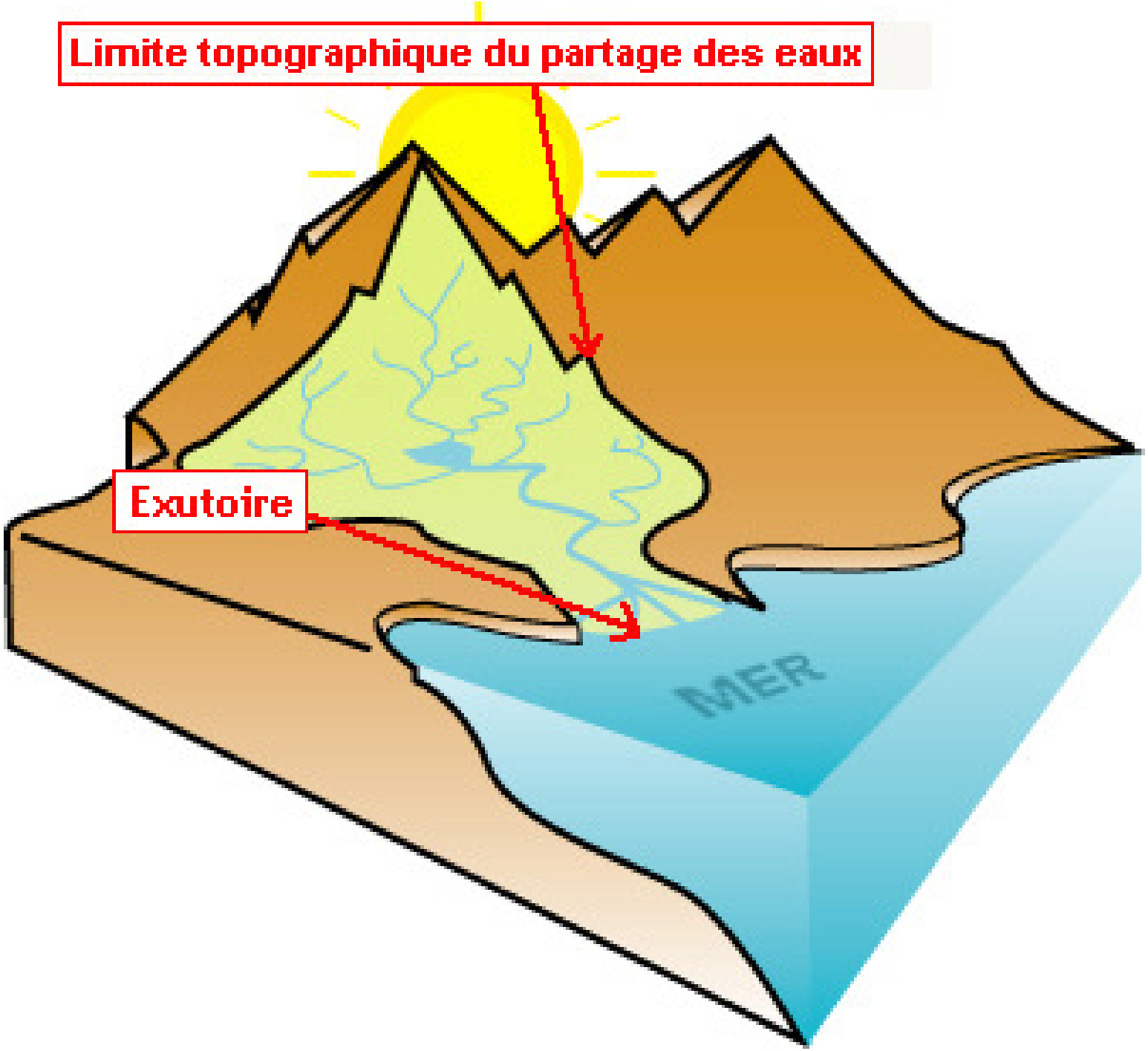
- 5 arrêtés et plus (4199)
- 4 arrêtés (3581)
- 3 arrêtés (6188)
- 2 arrêtés (9980)

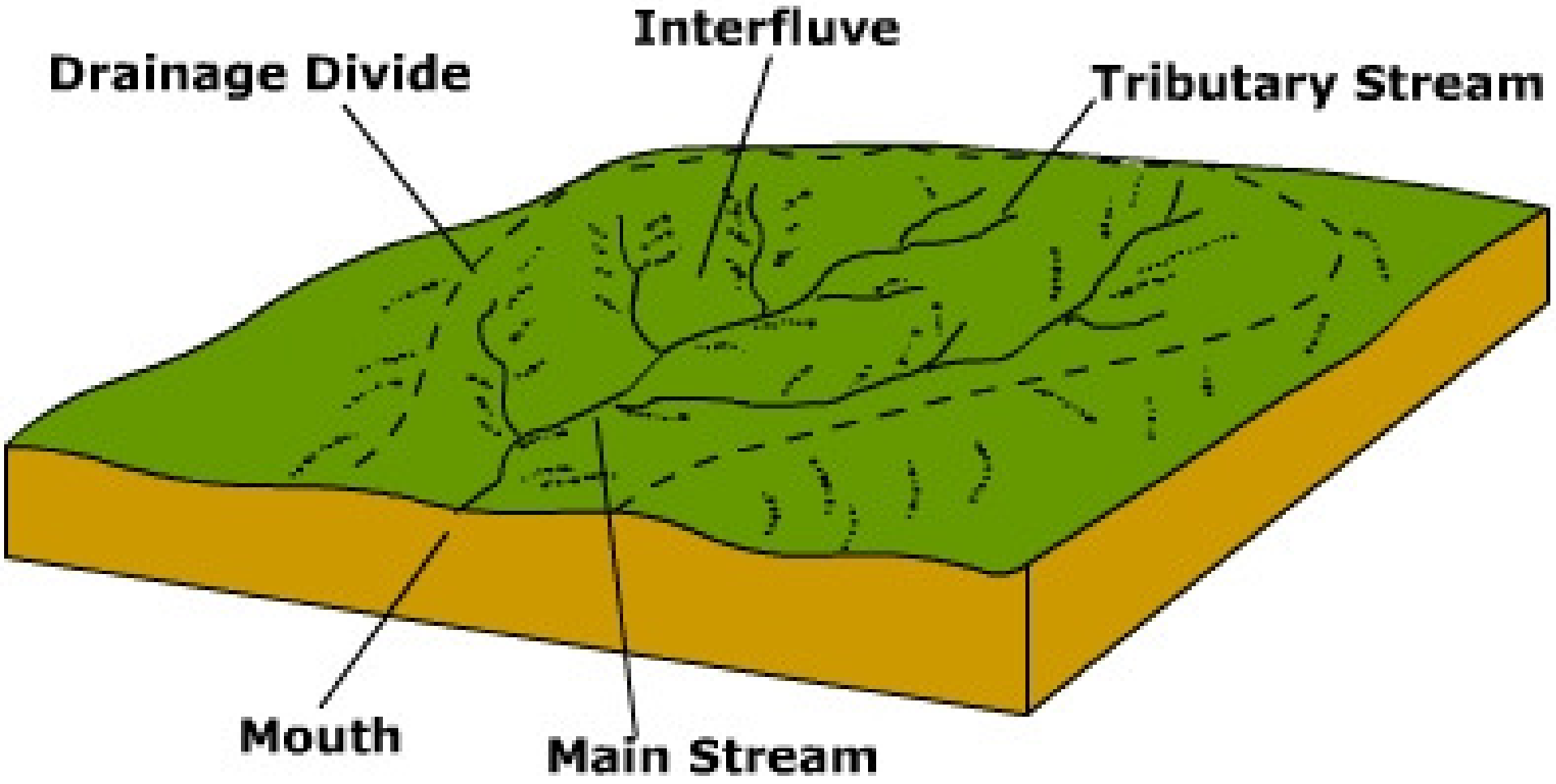
MEDD / DPPR / SDPRM 14/10/03

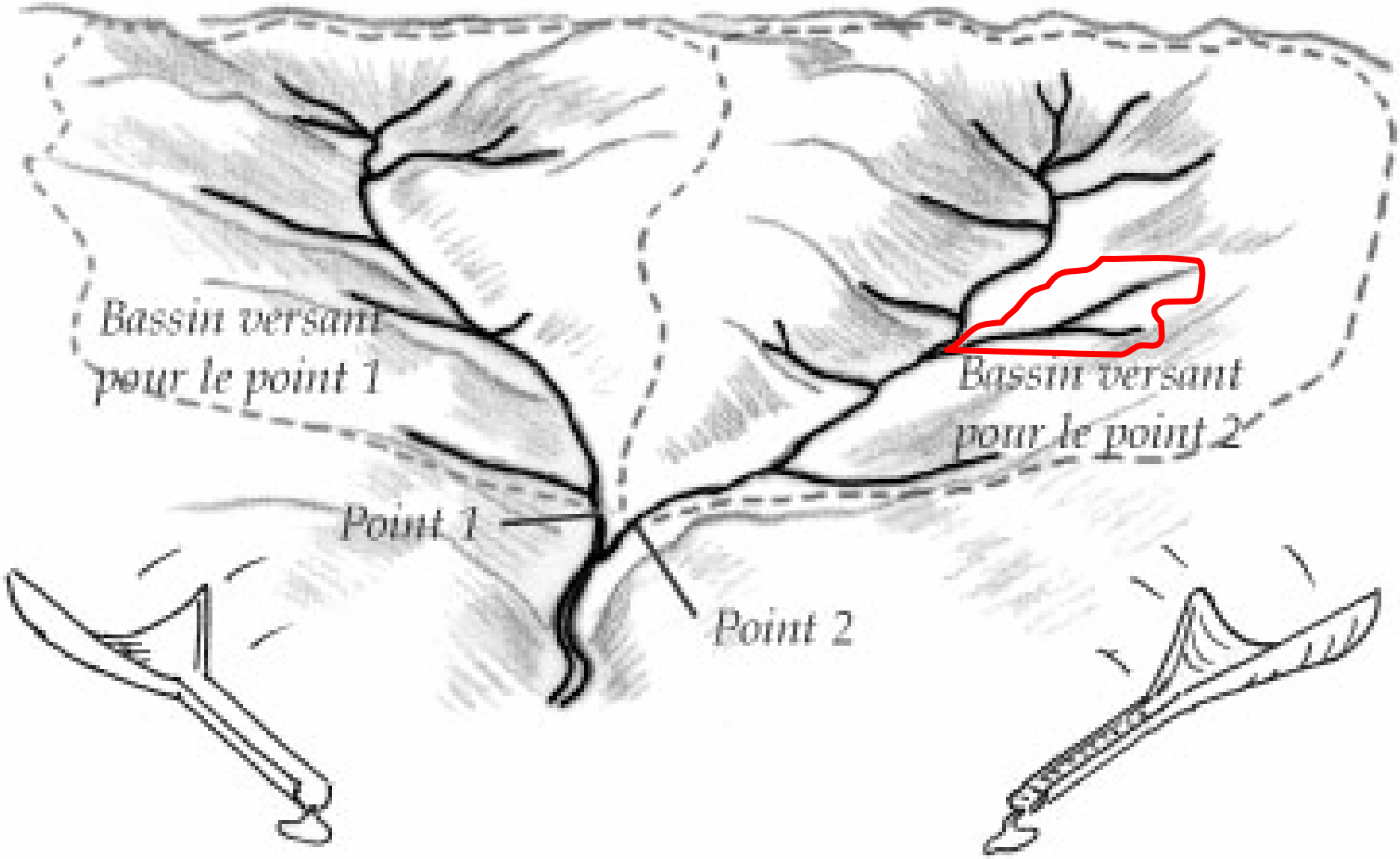
Some people can be very affected by too much rain

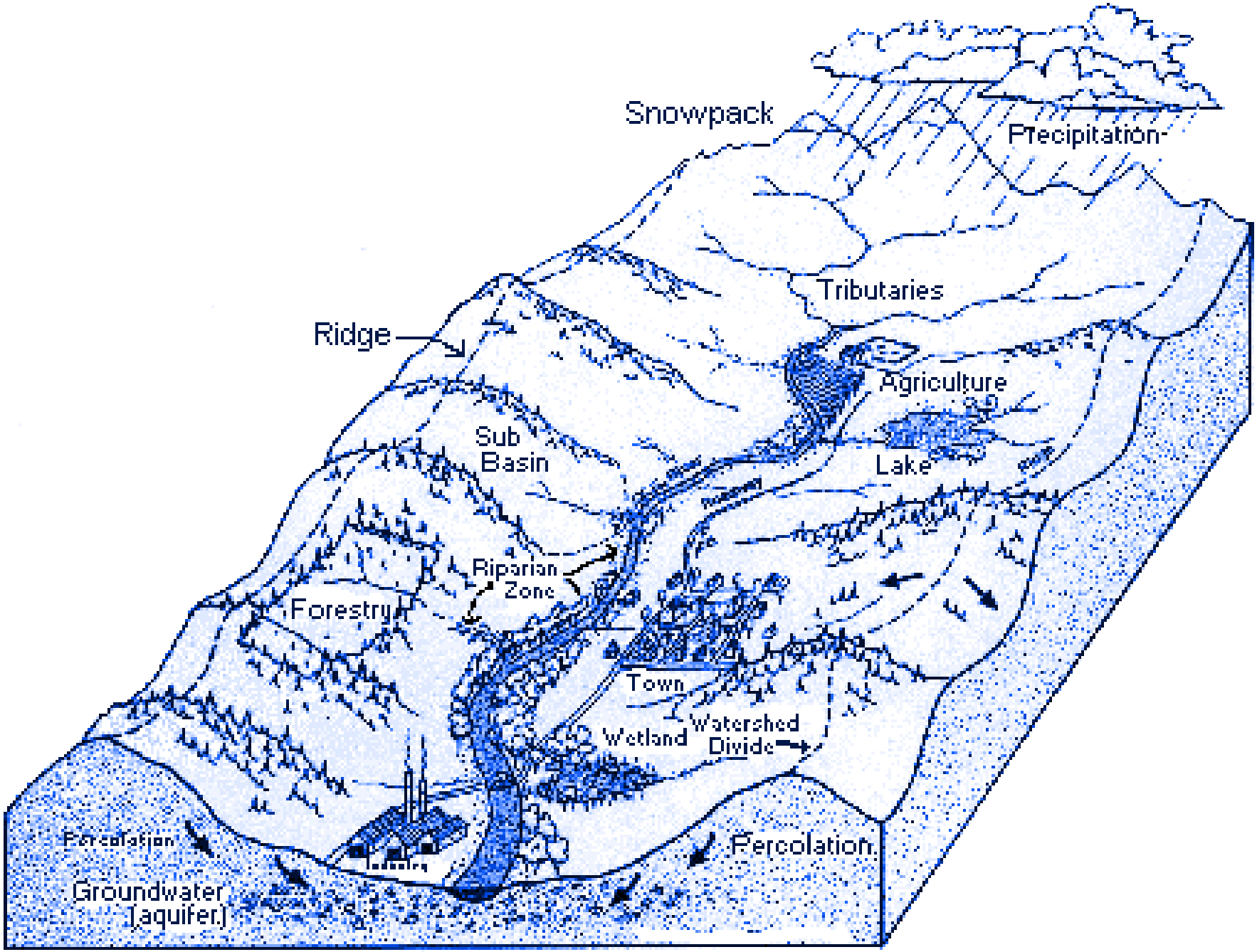
Some people can be affected by too much rain falling far from where they are living

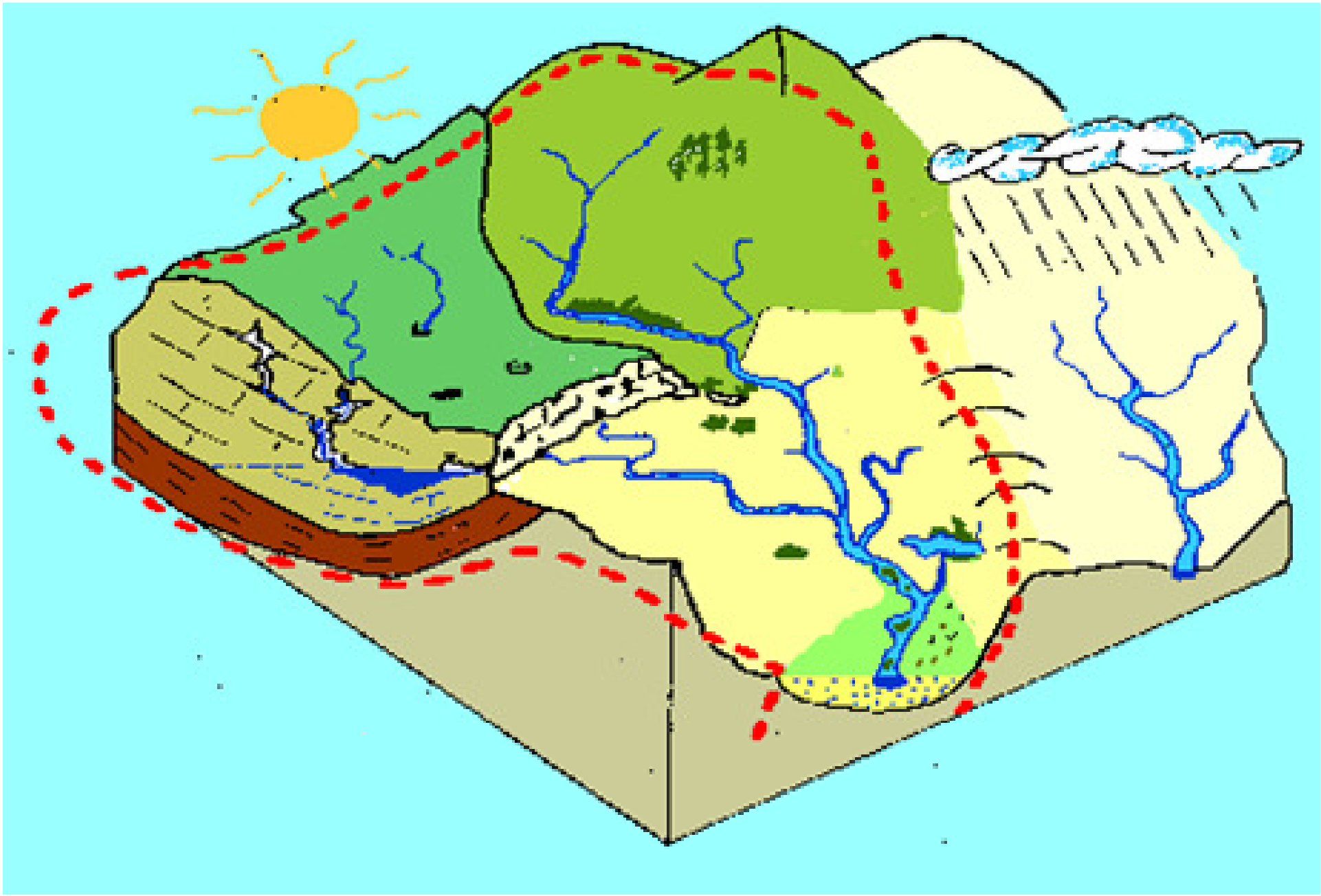
Watershed


Limite topographique du partage des eaux
Exutoire
MER

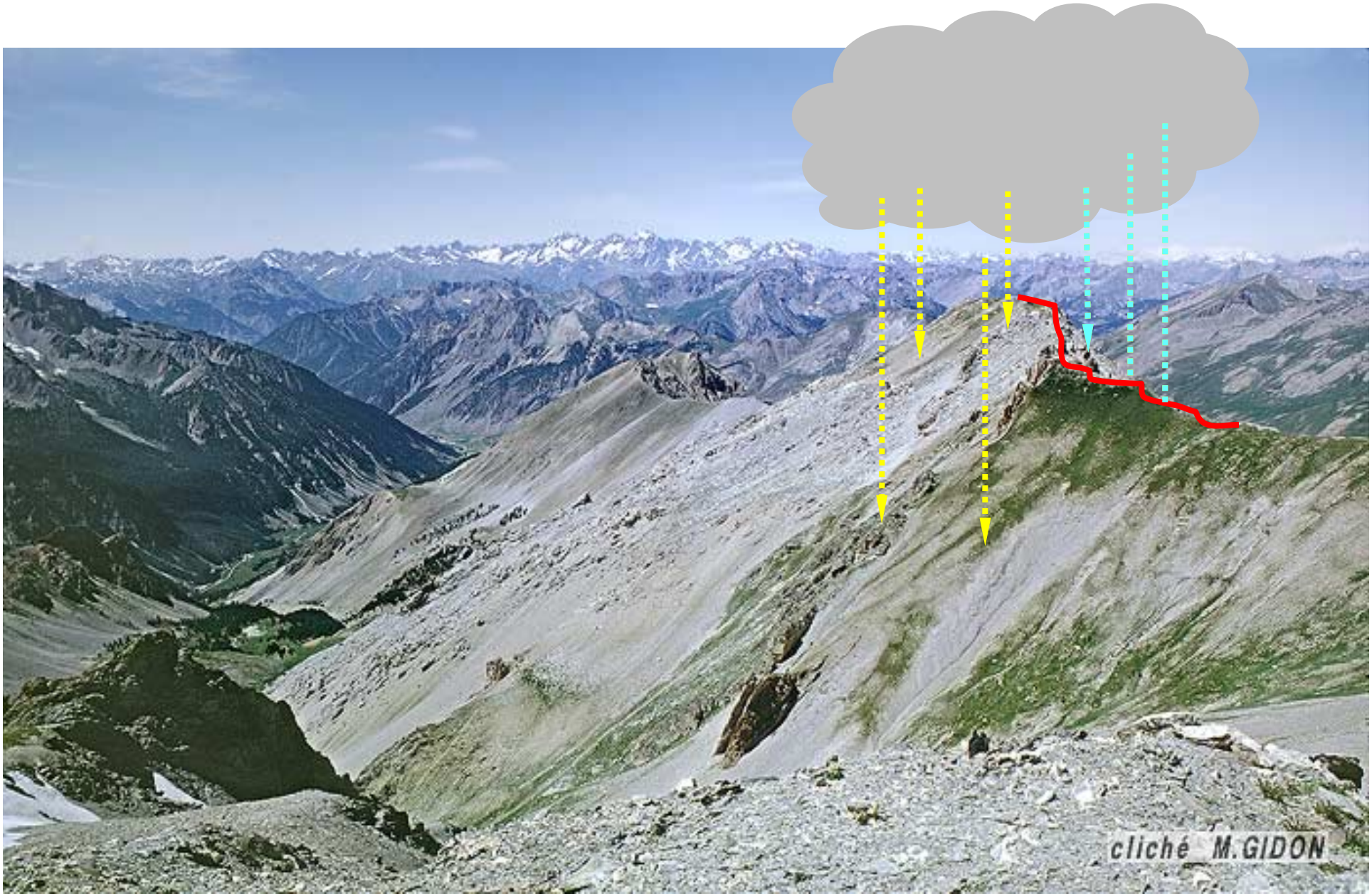

Drainage Divide
Interfluve
Tributary Stream
Mouth
Main Stream


Bassin versant
pour le point 1
Bassin versant
pour le point 2
Point 1
Point 2


Snowpack
Precipitation
Tributaries
Ridge
Agriculture
Sub
Basin
Lake
Riparian
Zone
Forestry
Town
Wetland
Watershed
Divide
Percolation
Percolation
Groundwater
(aquifer)

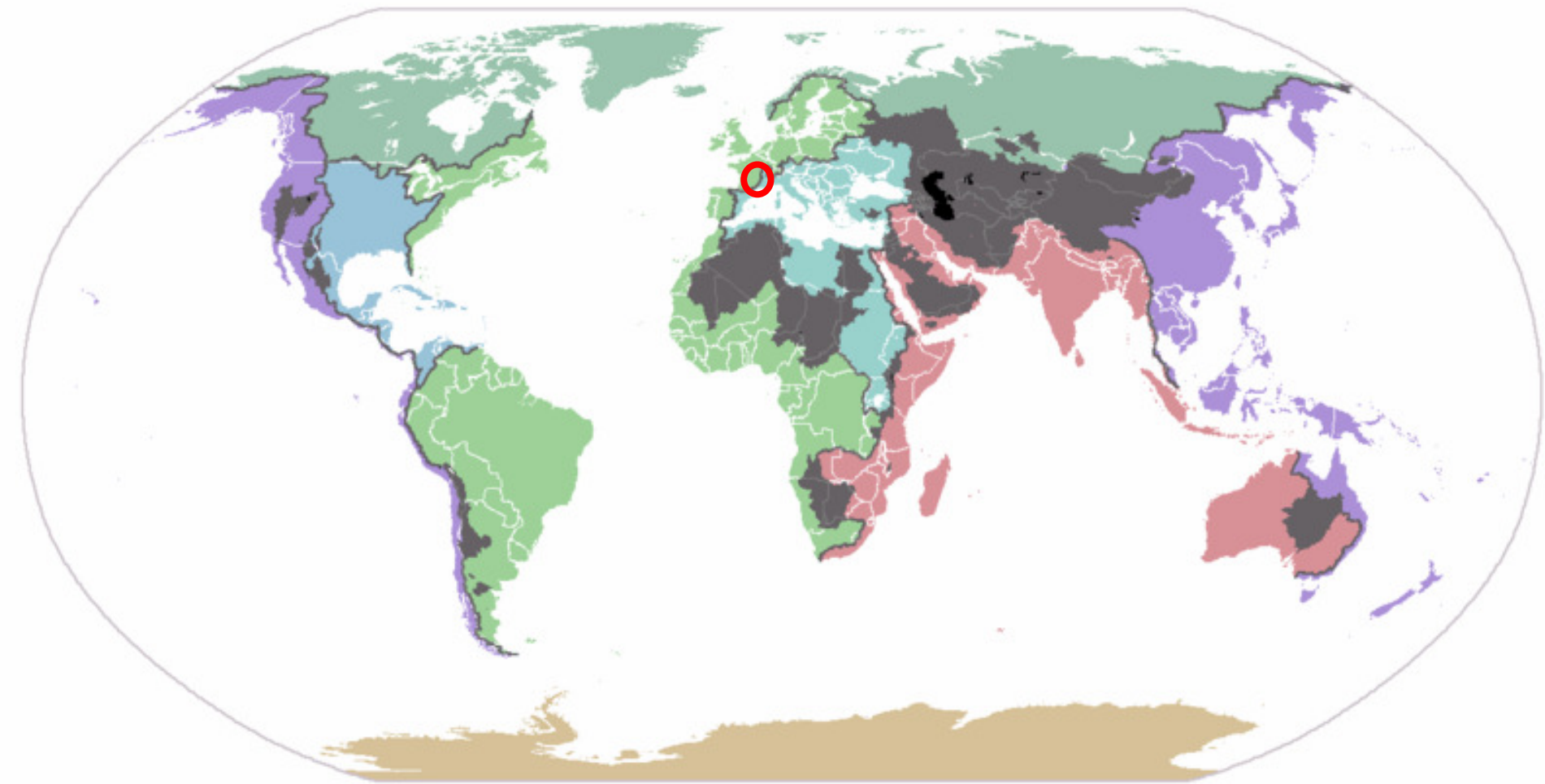


Watershed divides

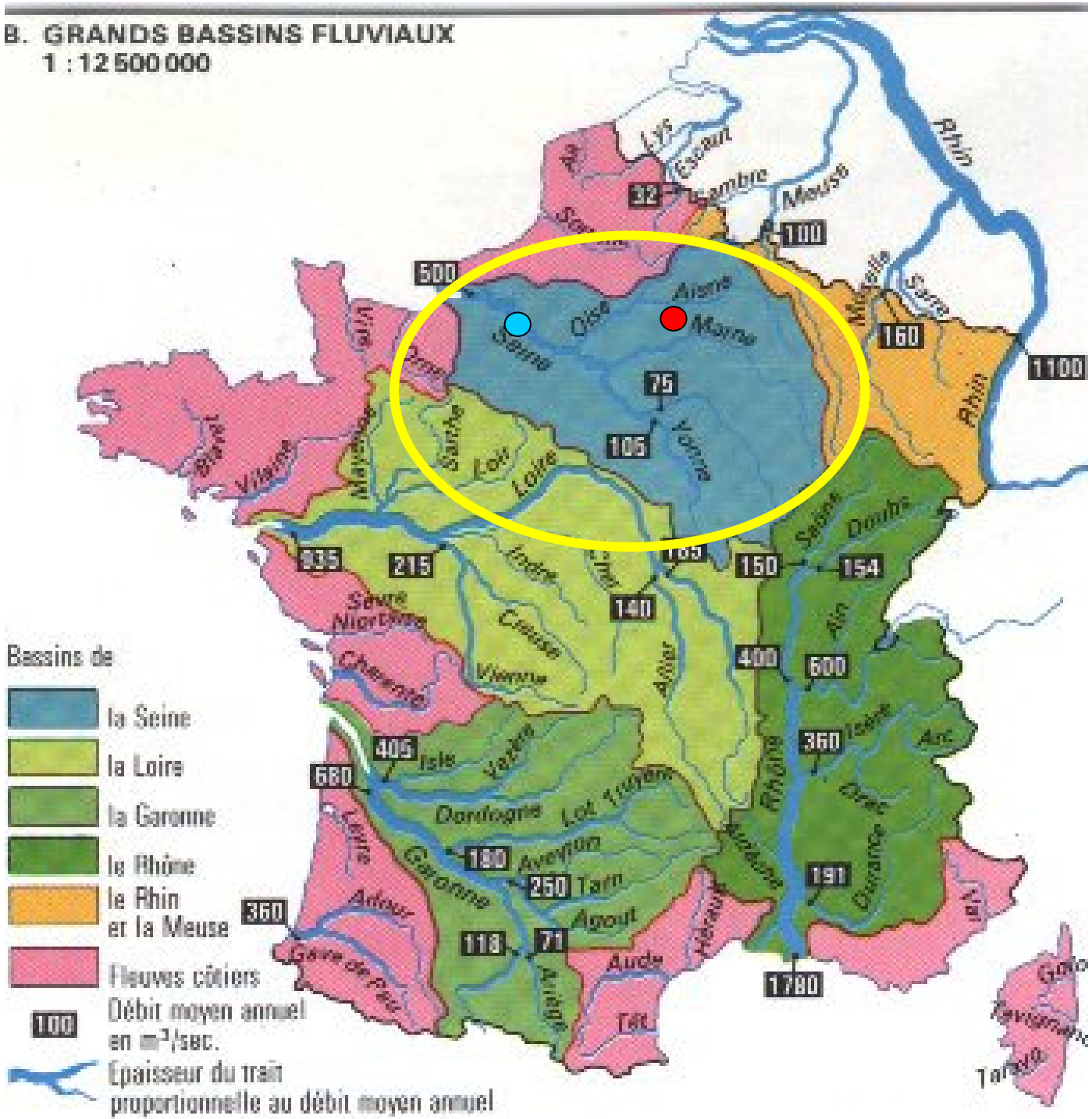

cliché M.GIDON


CONTINENTAL DIVIDE
MUDDY PASS
ELEV 8772 FT
PACIFIC
WATERSHED
ATLANTIC
WATERSHED

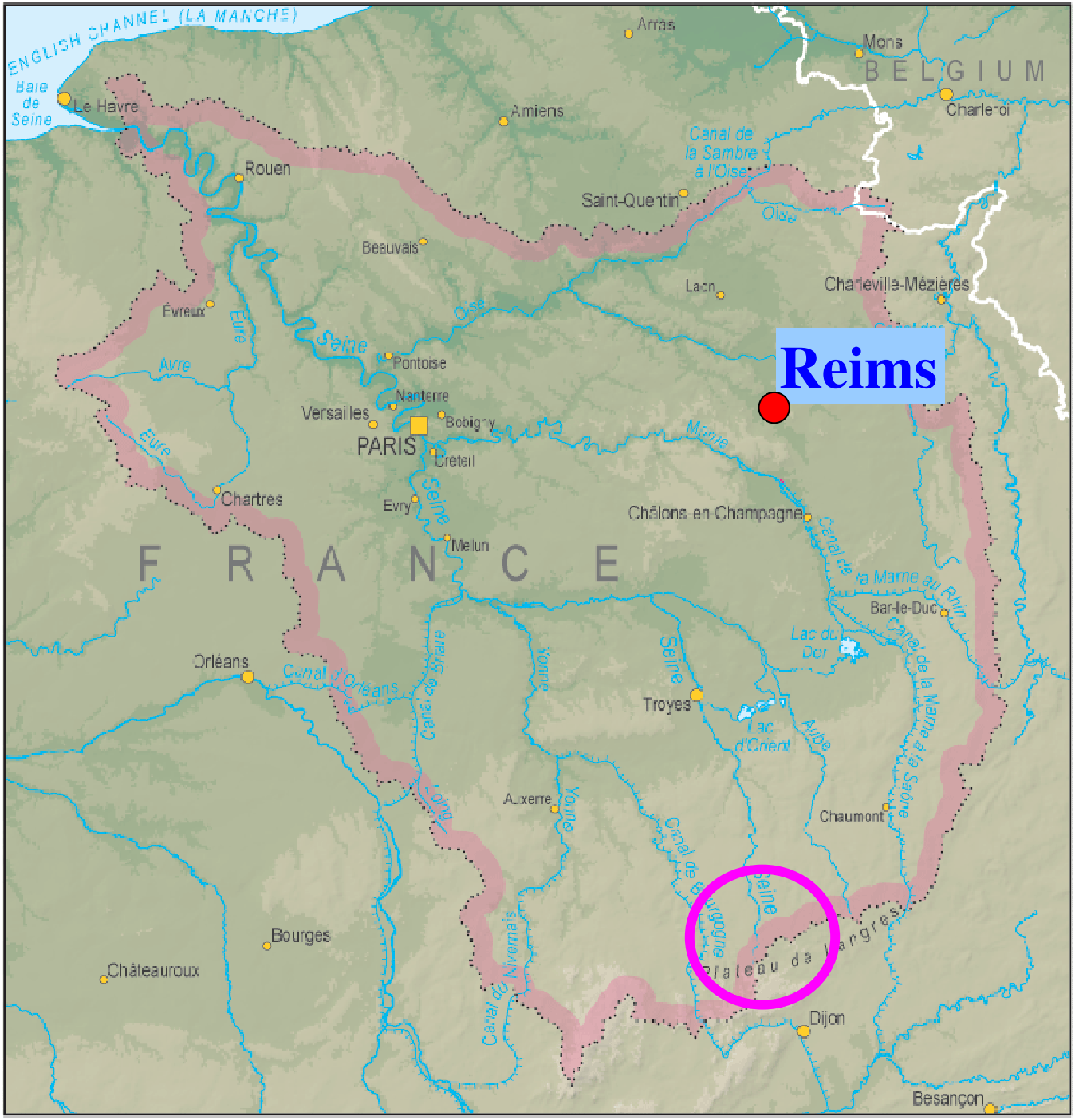

Ligne de Partage des Eaux
Méditerranée
Atlantique

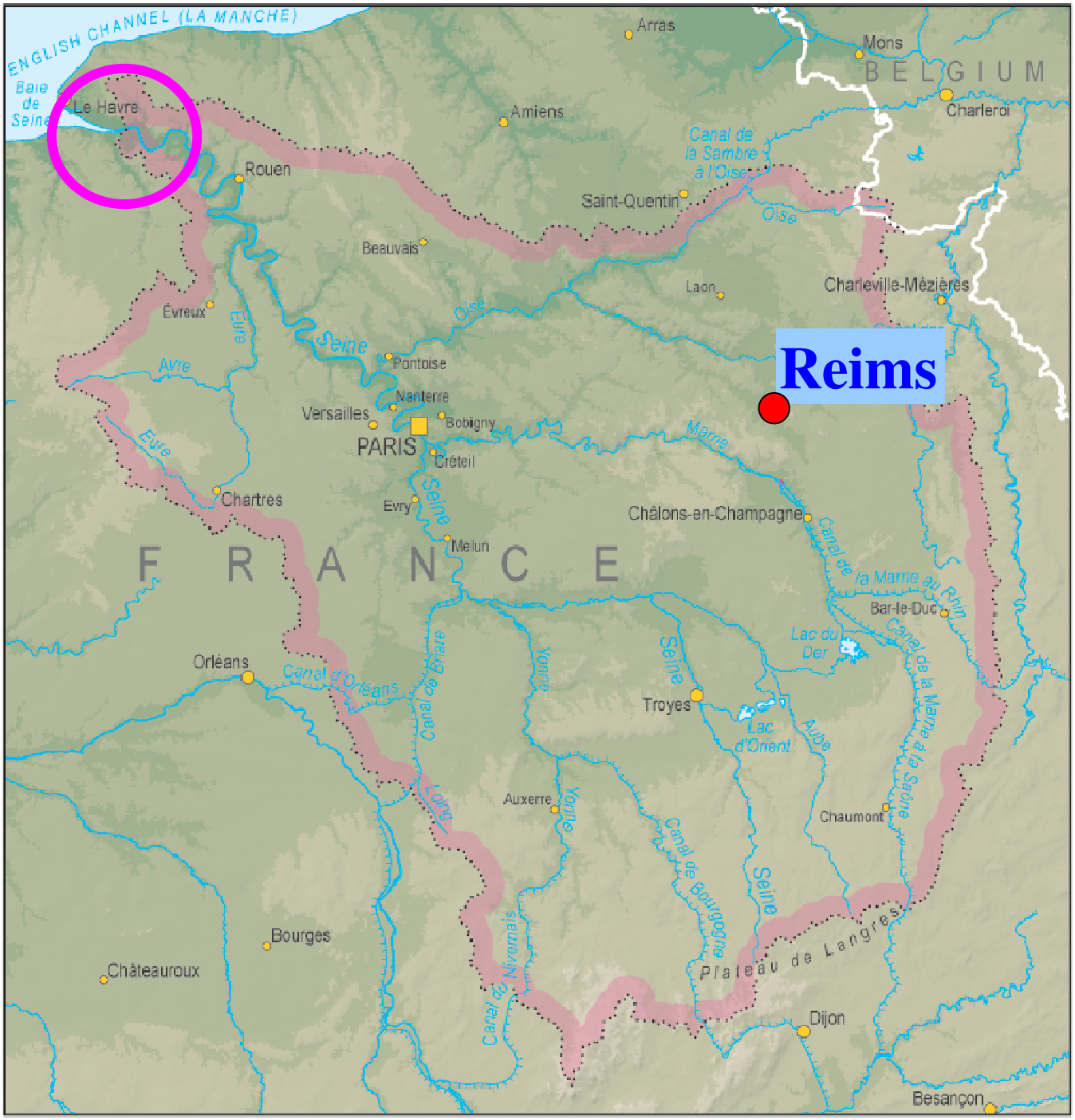


In our region


B. GRANDS BASSINS FLUVIAUX
1 : 12 500 000
Bassins de
la Seine
la Loire
la Garonne
le Rhône
le Rhin et la Meuse
Fleuves côtiers
100 Débit moyen annuel en m³/sec.
Epaisseur du trait proportionnelle au débit moyen annuel
500
75
105
160
1100
935
215
140
150
154
400
600
360
680
405
180
250
360
118
71
191
1780
Rhin
Meuse
Seine
Oise
Aisne
Marne
Loire
Vienne
Creuse
Allier
Saône
Doubs
Rhône
Isère
Durance
Dordogne
Lot
Tarn
Aveyron
Garonne
Adour
Ariège
Aude
Hérault
Var


ENGLISH CHANNEL (LA MANCHE)
Baie de Seine
Le Havre
Rouen
Évreux
Eure
Avre
Eure
Chartres
Arras
Amiens
Mons
BELGIUM
Charleroi
Canal de la Sambre à l'Oise
Saint-Quentin
Oise
Beauvais
Laon
Charleville-Mézières
Oise
Seine
Pontoise
Nanterre
Versailles
PARIS
Bobigny
Créteil
Evry
Seine
Melun
Reims
Marne
Châlons-en-Champagne
Canal de la Marne au Rhin
Bar-le-Duc
Lac du Der
FRANCE
Orléans
Canal d'Orléans
Canal de Briare
Loing
Yonne
Auxerre
Yonne
Seine
Troyes
Lac d'Orient
Aube
Canal de la Marne à la Saône
Chaumont
Canal de Bourgogne
Seine
Plateau de Langres
Bourges
Châteauroux
Canal du Nivernais
Dijon
Besançon
Scale 1 : 3 000 000
Kilometres 0 25 50 75 100 125

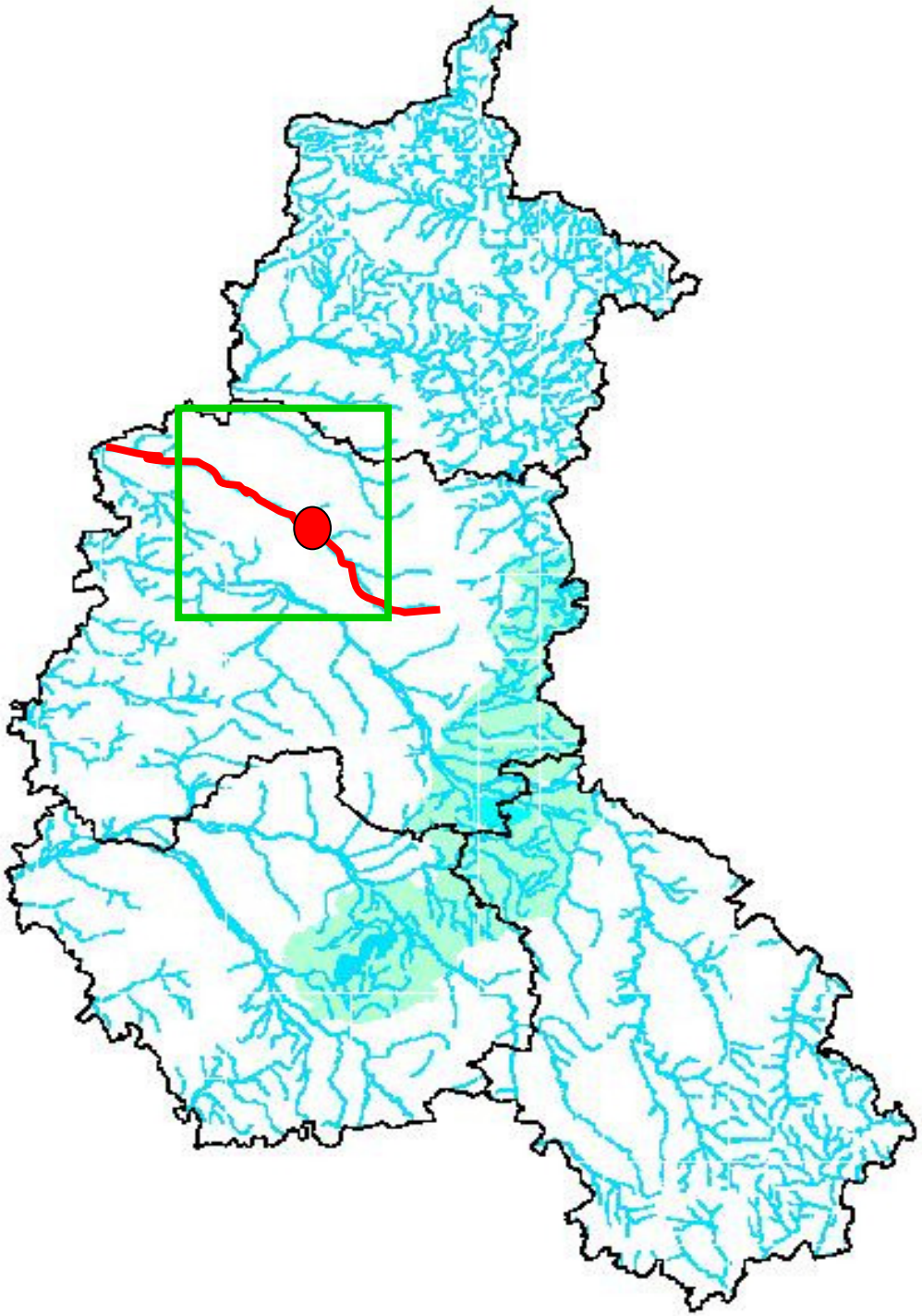

ENGLISH CHANNEL (LA MANCHE)
Baie de Seine
Le Havre
Rouen
Évreux
Eure
Avre
Eure
Chartres
Arras
Amiens
Mons
BELGIUM
Charleroi
Canal de la Sambre à l'Oise
Saint-Quentin
Oise
Beauvais
Laon
Charleville-Mézières
Oise
Seine
Pontoise
Nanterre
Versailles
PARIS
Bobigny
Créteil
Evry
Melun
Seine
Marne
Reims
Châlons-en-Champagne
Canal de la Marne au Rhin
Bar-le-Duc
Lac du Der
Seine
Troyes
Lac d'Orient
Aube
Canal de la Marne à la Saône
Chaumont
Orléans
Canal d'Orléans
Canal de Briare
Loing
Yonne
Auxerre
Yonne
Canal du Nivernais
Canal de Bourgogne
Seine
Plateau de Langres
Bourges
Châteauroux
Dijon
Besançon
FRANCE
Scale 1 : 3 000 000
Kilometres 0 25 50 75 100 125

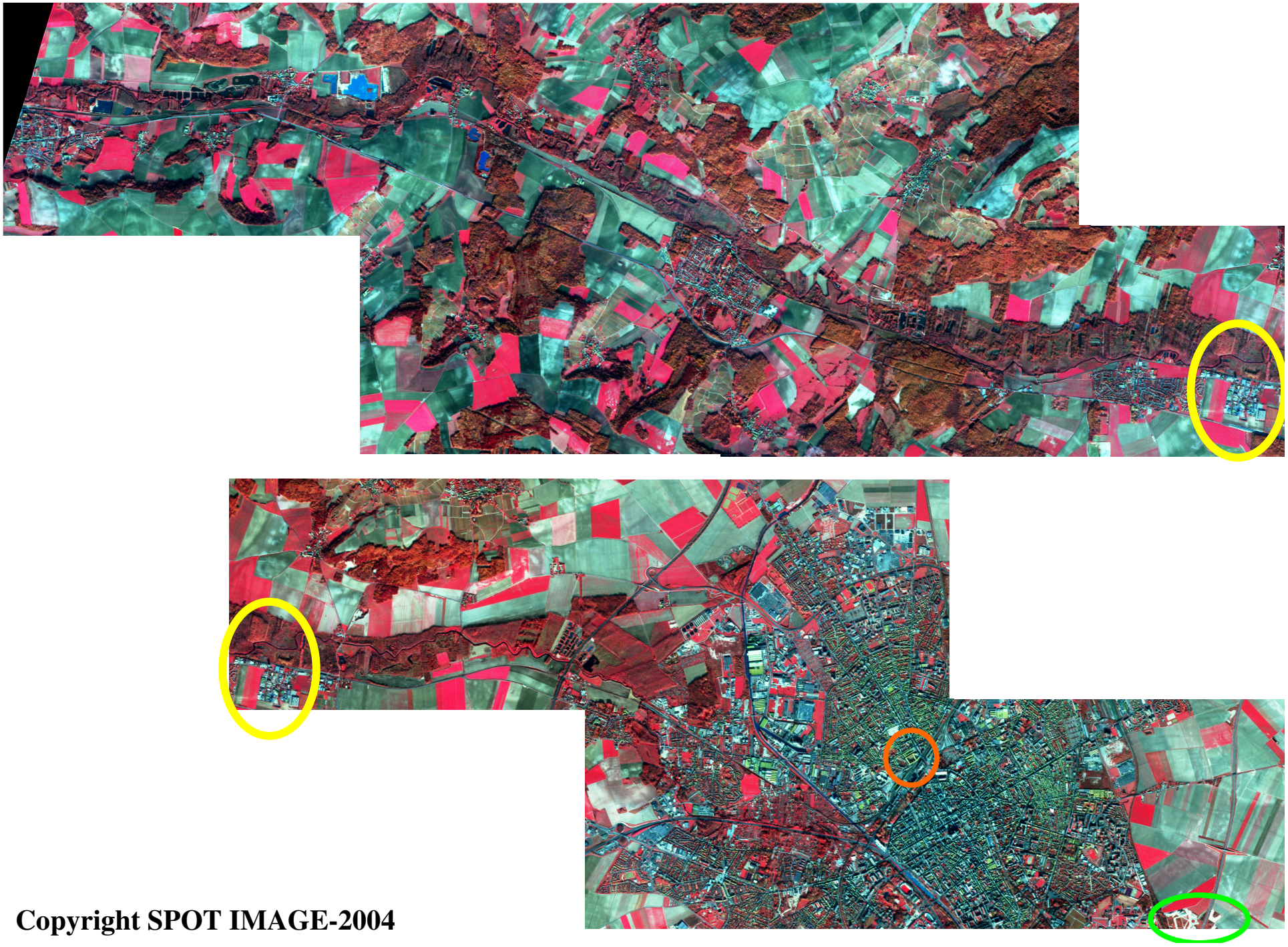

ENGLISH CHANNEL (LA MANCHE)
Baie de Seine
Le Havre
Rouen
Arras
Amiens
Mons
BELGIUM
Charleroi
Canal de la Sambre à l'Oise
Saint-Quentin
Oise
Beauvais
Laon
Charleville-Mézières
Évreux
Eure
Seine
Oise
Pontoise
Reims
Avre
Nanterre
Versailles
Bobigny
PARIS
Créteil
Marne
Eure
Chartres
Evry
Seine
Châlons-en-Champagne
Melun
FRANCE
Canal de la Marne au Rhin
Bar-le-Duc
Lac du Der
Orléans
Canal d'Orléans
Canal de Briare
Yonne
Seine
Troyes
Lac d'Orient
Aube
Canal de la Marne à la Saône
Auxerre
Loing
Yonne
Chaumont
Canal de Bourgogne
Seine
Bourges
Châteauroux
Canal du Nivernais
Plateau de Langres
Dijon
Besançon
Scale 1 : 3 000 000
Kilometres 0 25 50 75 100 125

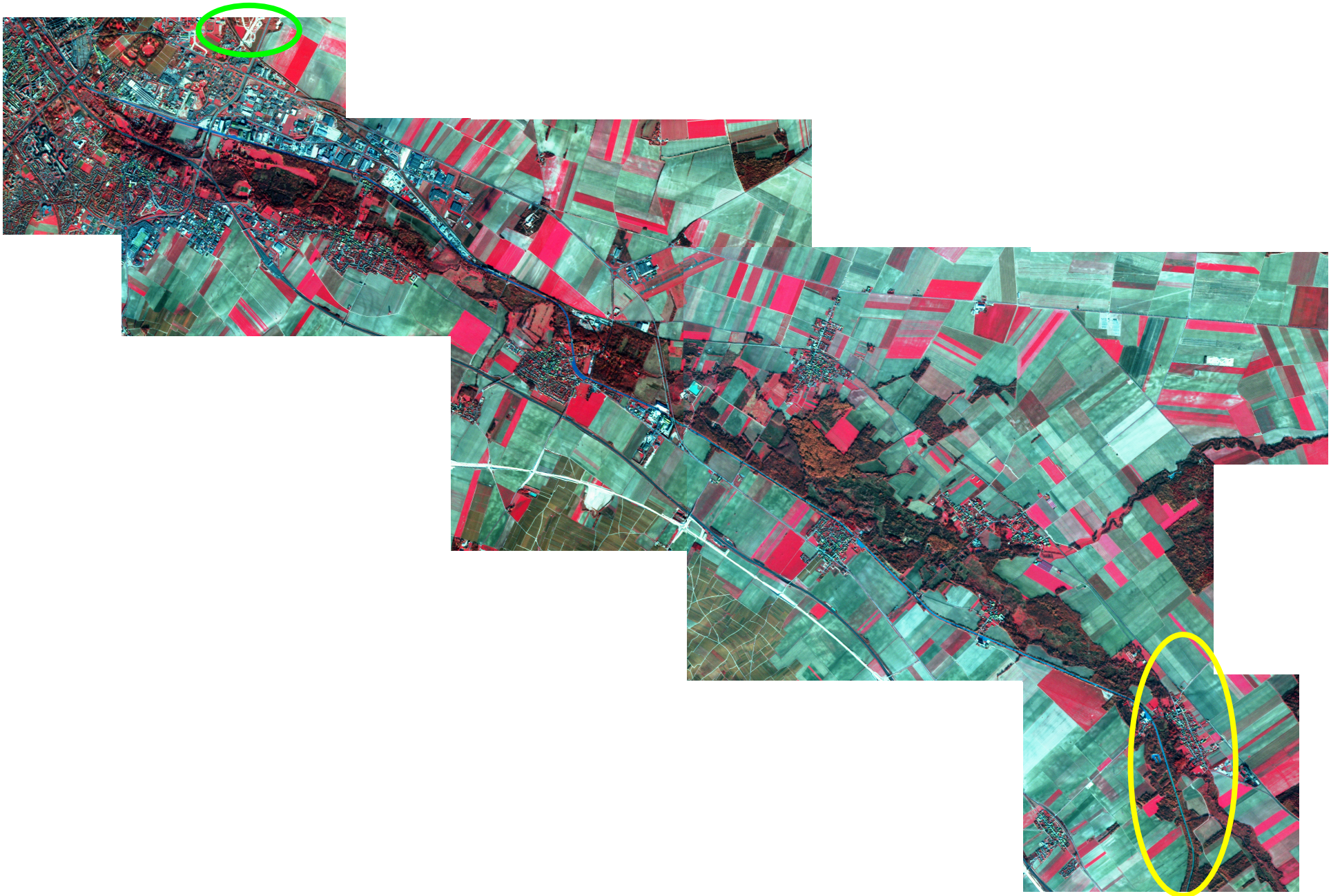

AMIENS
Reims
CHALONS-EN-CHAMPAGNE
METZ

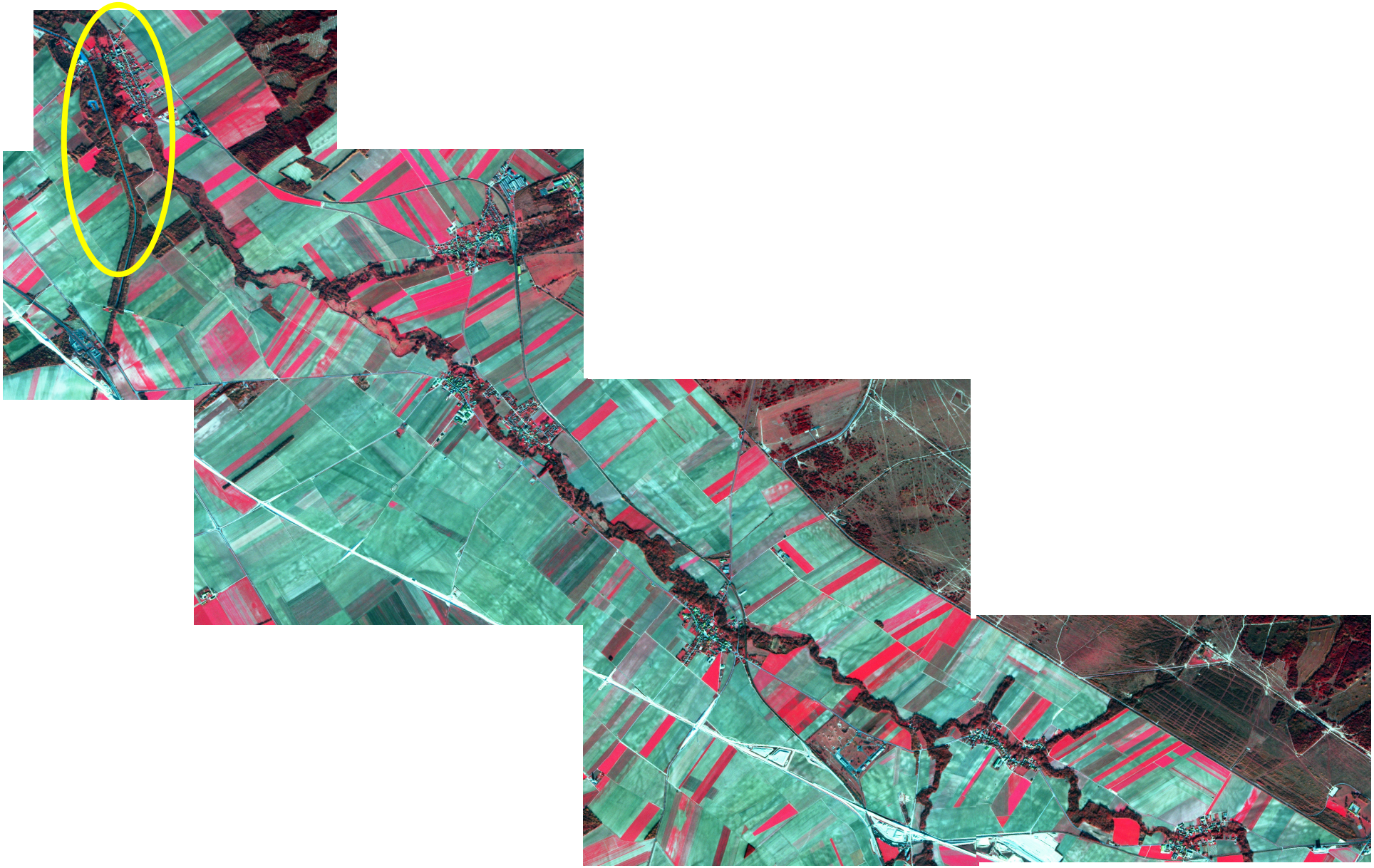
La Vesle

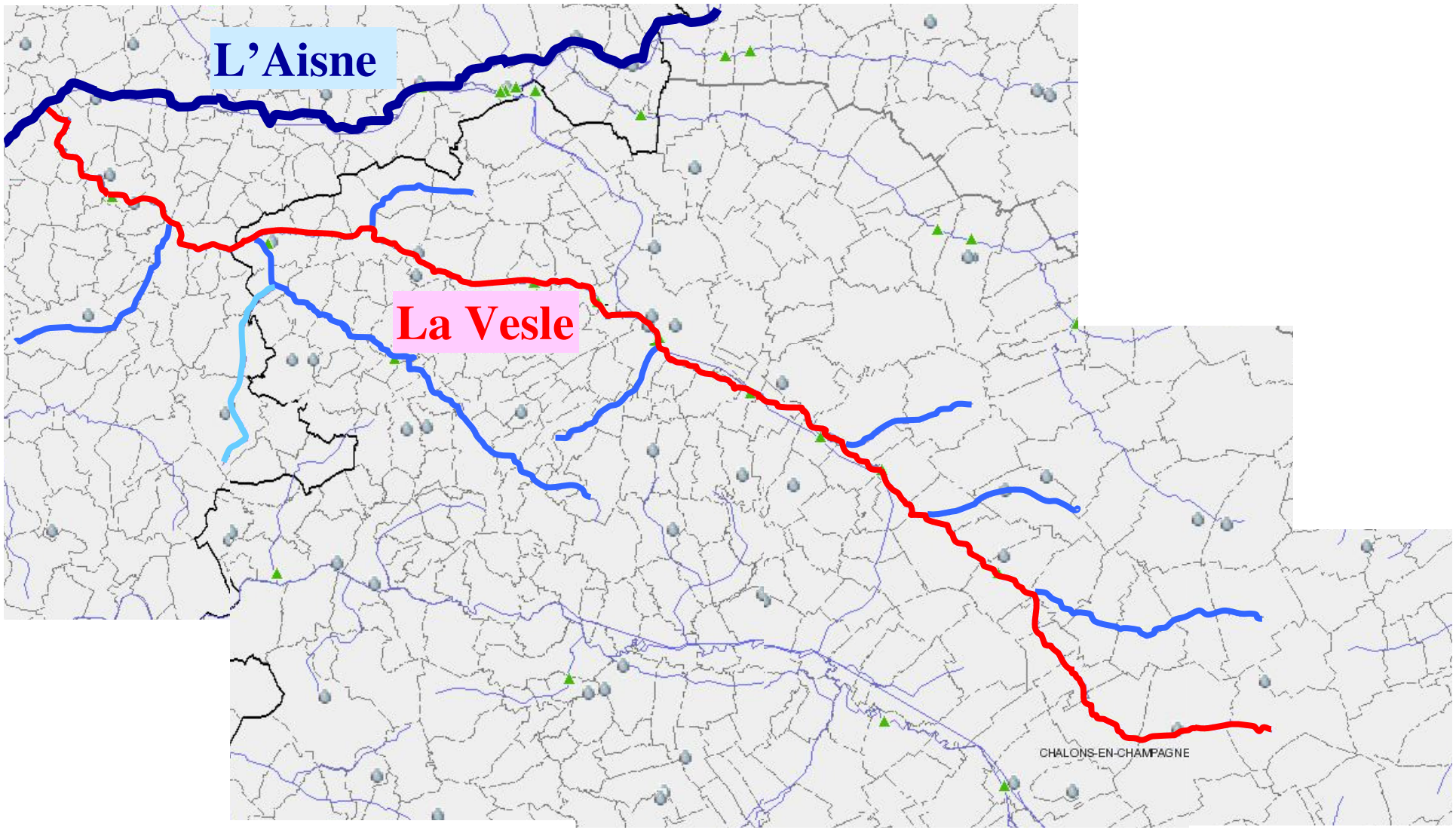
Length =130 km = 80 miles

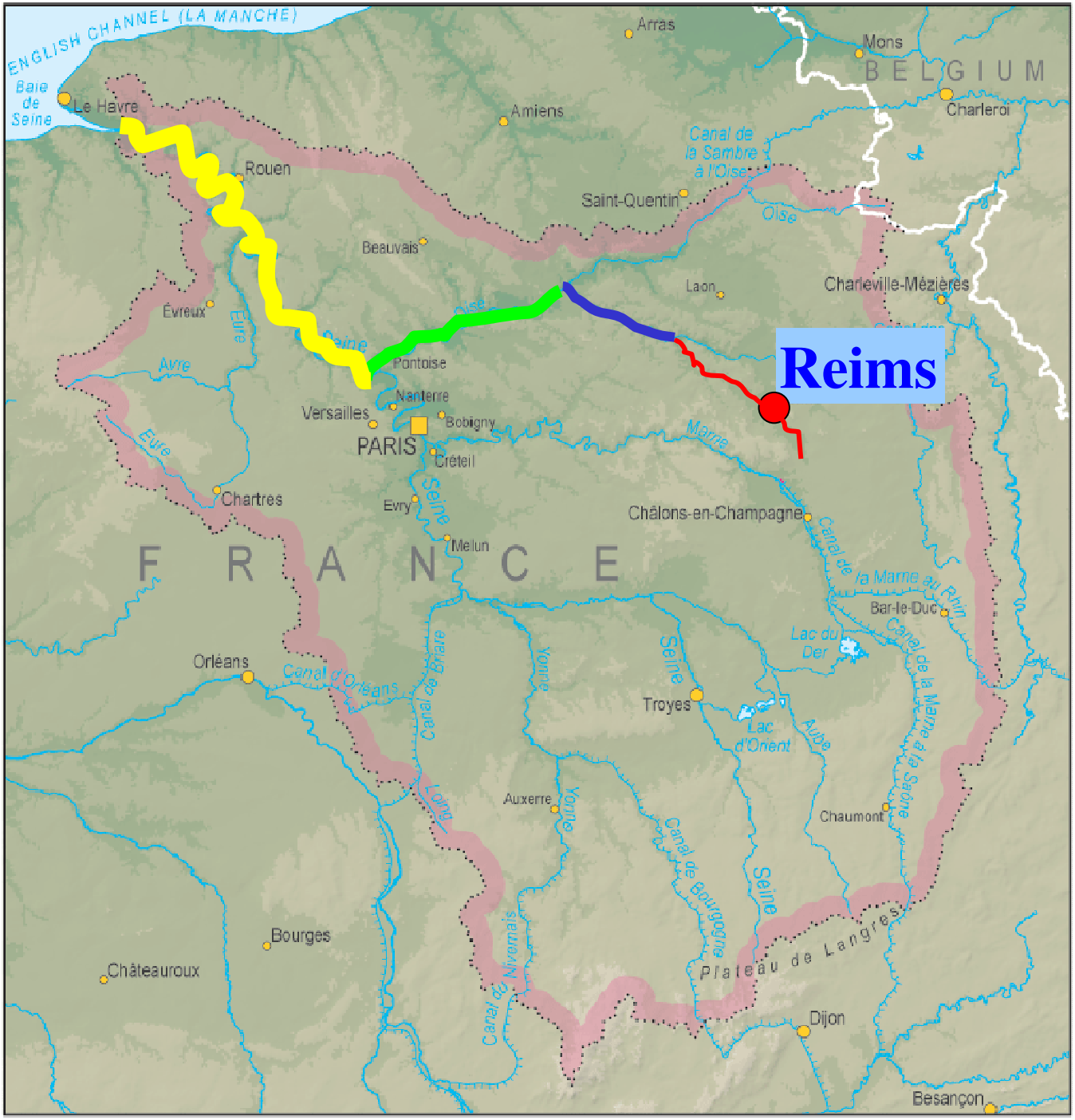


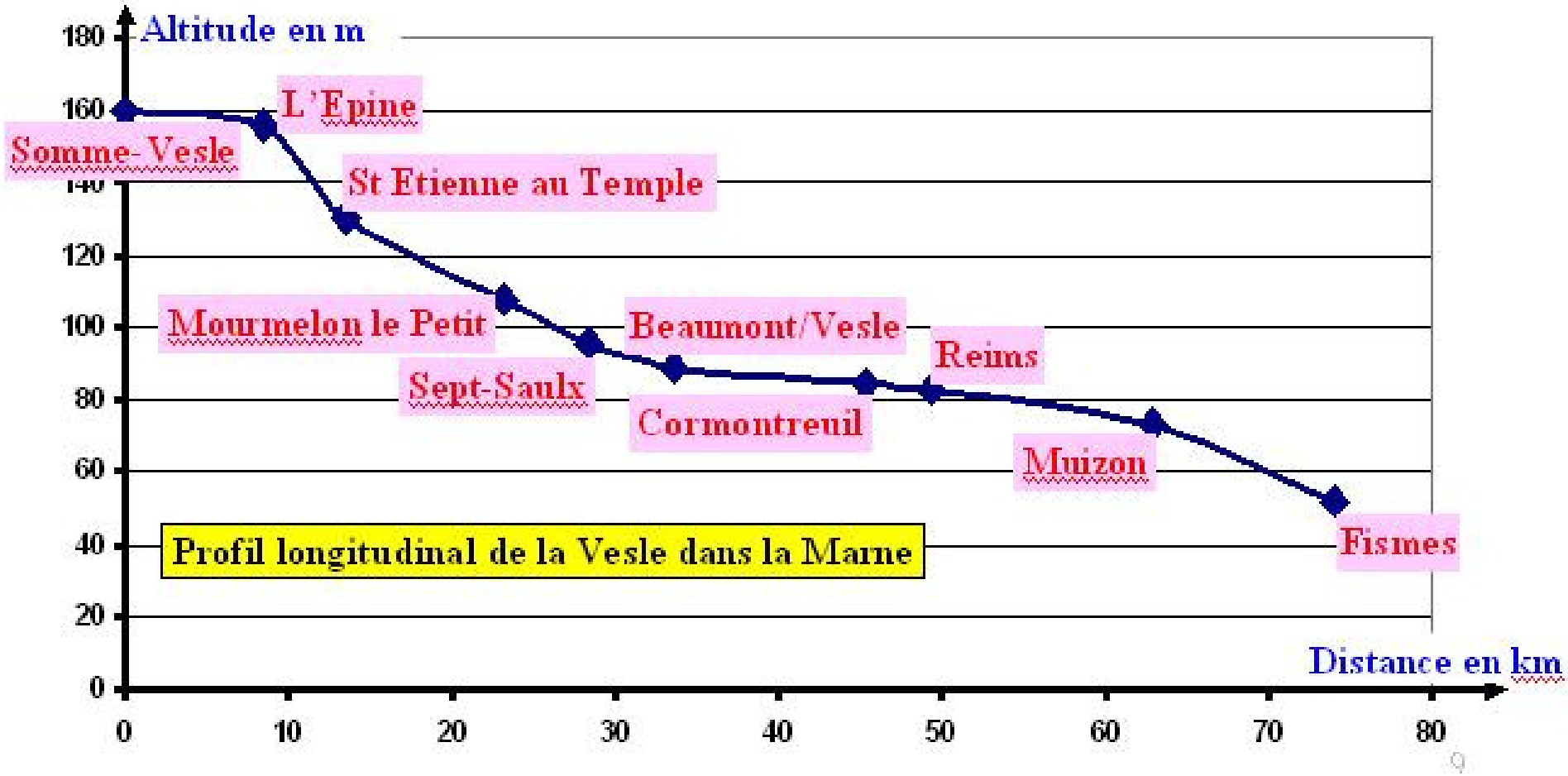







L'Aisne
La Vesle
CHALONS-EN-CHAMPAGNE


ENGLISH CHANNEL (LA MANCHE)
Baie de Seine
Le Havre
Rouen
Évreux
Eure
Avre
Seine
Oise
Pontoise
Nanterre
Versailles
PARIS
Bobigny
Créteil
Evry
Melun
Chartres
Arras
Amiens
Beauvais
Saint-Quentin
Canal de la Sambre à l'Oise
Laon
Mons
BELGIUM
Charleroi
Charleville-Mézières
Reims
Châlons-en-Champagne
Marne
Canal de la Marne au Rhin
Bar-le-Duc
Lac du Der
Troyes
Lac d'Orient
Aube
Canal de la Marne à la Saône
Chaumont
Canal de Bourgogne
Plateau de Langres
Dijon
Besançon
Auxerre
Yonne
Canal de Briare
Canal d'Orléans
Loing
Canal du Nivernais
Orléans
Bourges
Châteauroux
F R A N C E
Scale 1 : 3 000 000
Kilometres 0 25 50 75 100 125


Altitude en m
180
160
120
100
80
60
40
20
0
Somme-Vesle
L'Epine
St Etienne au Temple
Mourmelon le Petit
Sept-Saulx
Beaunont/Vesle
Cormontreuil
Reims
Muizon
Fismes
Profil longitudinal de la Vesle dans la Marne
Distance en km
0
10
20
30
40
50
60
70
80

GPS Measurement Protocol

Purpose

To determine the latitude, longitude, and elevation of your school and of all your GLOBE sites

Overview

The GPS receiver will be used to determine the latitude, longitude and elevation of your school or of your GLOBE sites.

Student Outcomes

Science Concepts

Earth and Space Sciences

- Earth materials have different physical properties (magnetism).

Physical Science

- Position of an object can be described by locating it relative to another object.
- Materials have measurable properties (magnetism).
- Magnets attract and repel each other.

Geography

- Tools and technologies have distinct characteristics and capabilities.
- Use appropriate geographic tools.
- Latitude and longitude may be displayed on maps.

Scientific Inquiry Abilities

- Using a GPS receiver to determine latitude and longitude
- Using a compass to determine true north and south
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.

Time

15 minutes to 60 minutes per site

Level

All

Frequency

Once per site

Materials and Tools

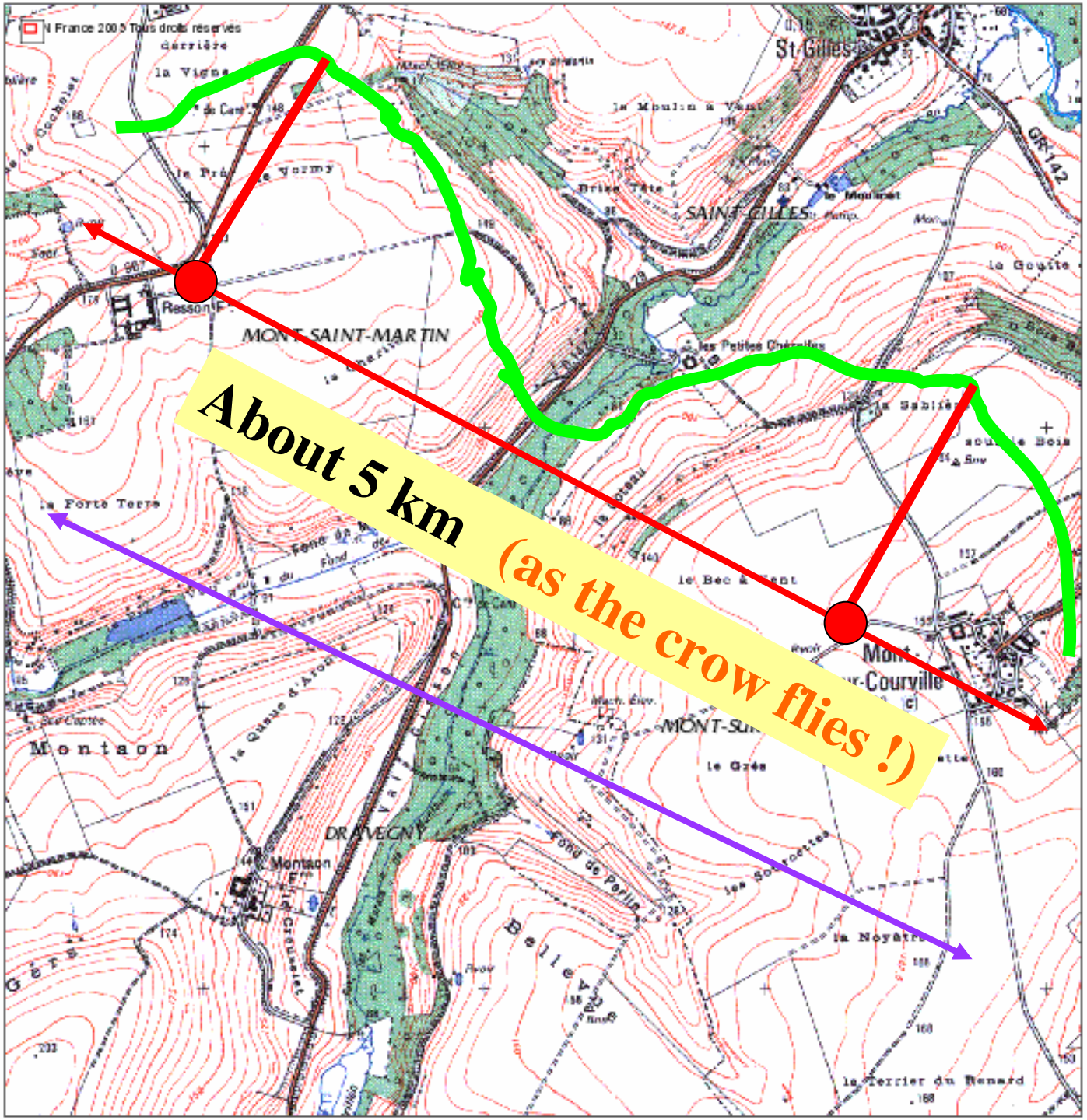
- GPS receiver
- Magnetic compass
- Tape measure
- Pencil or pen
- *GPS Protocol Data Sheet*
- *Offset GPS Work Sheet*

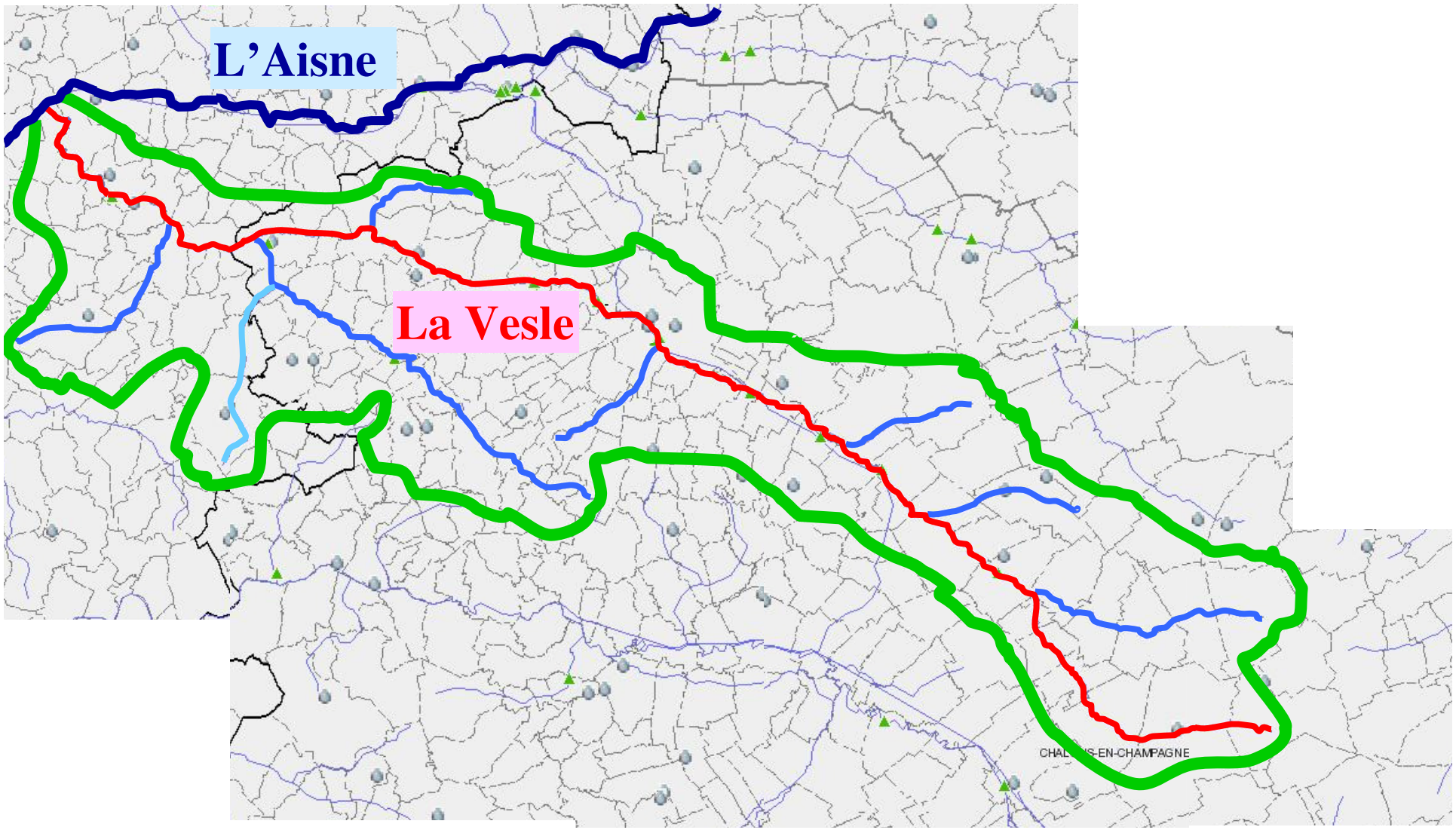
Preparation

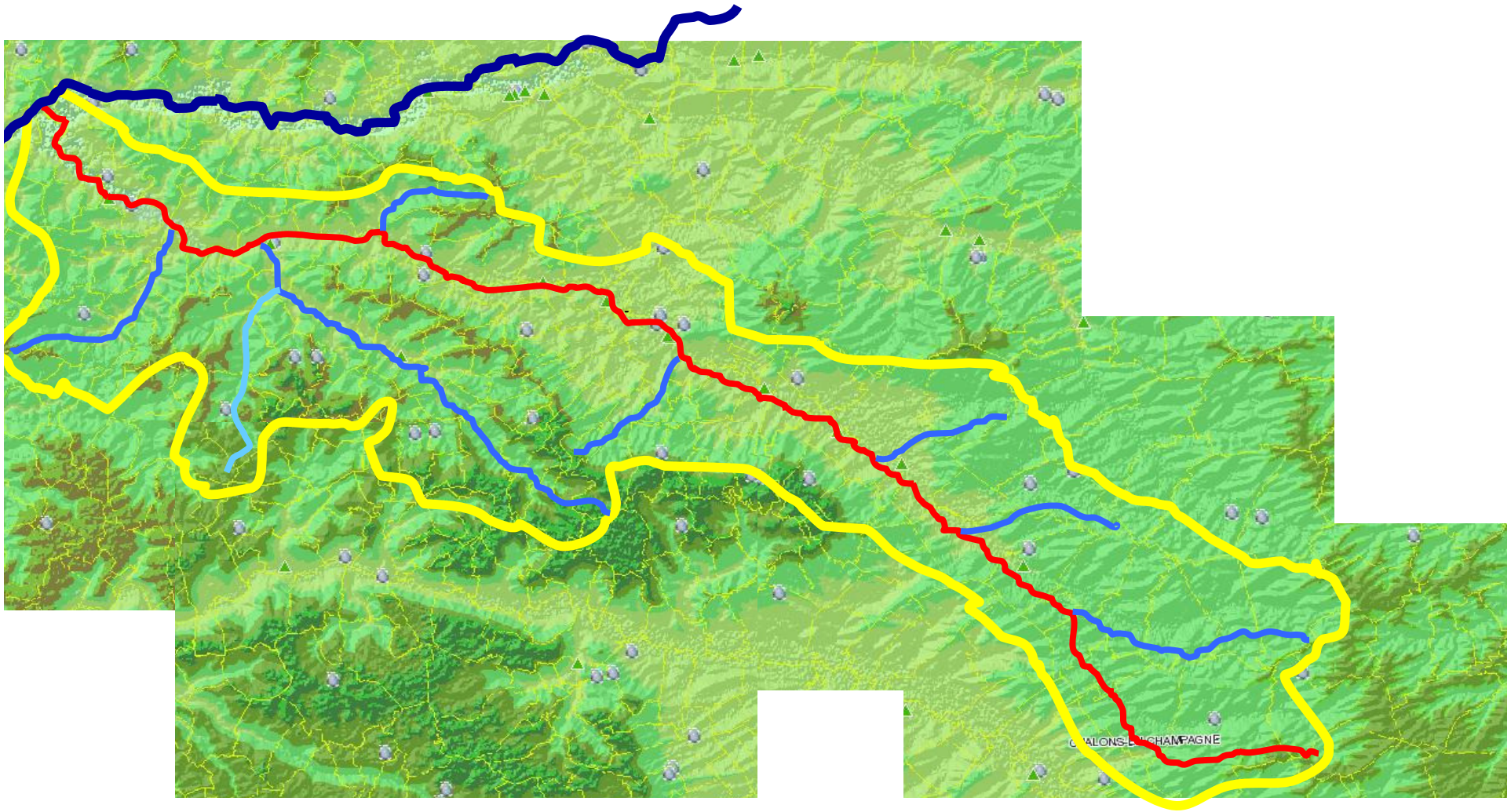
Determine locations to be visited. Bring GPS unit, data sheets, and pen or pencil to field sites. Identify sites where GPS location measurement is not possible because the signal is blocked. For there sites, compass, measuring tape, and *Offset GPS Data Work Sheet* should be also brought.

Prerequisites

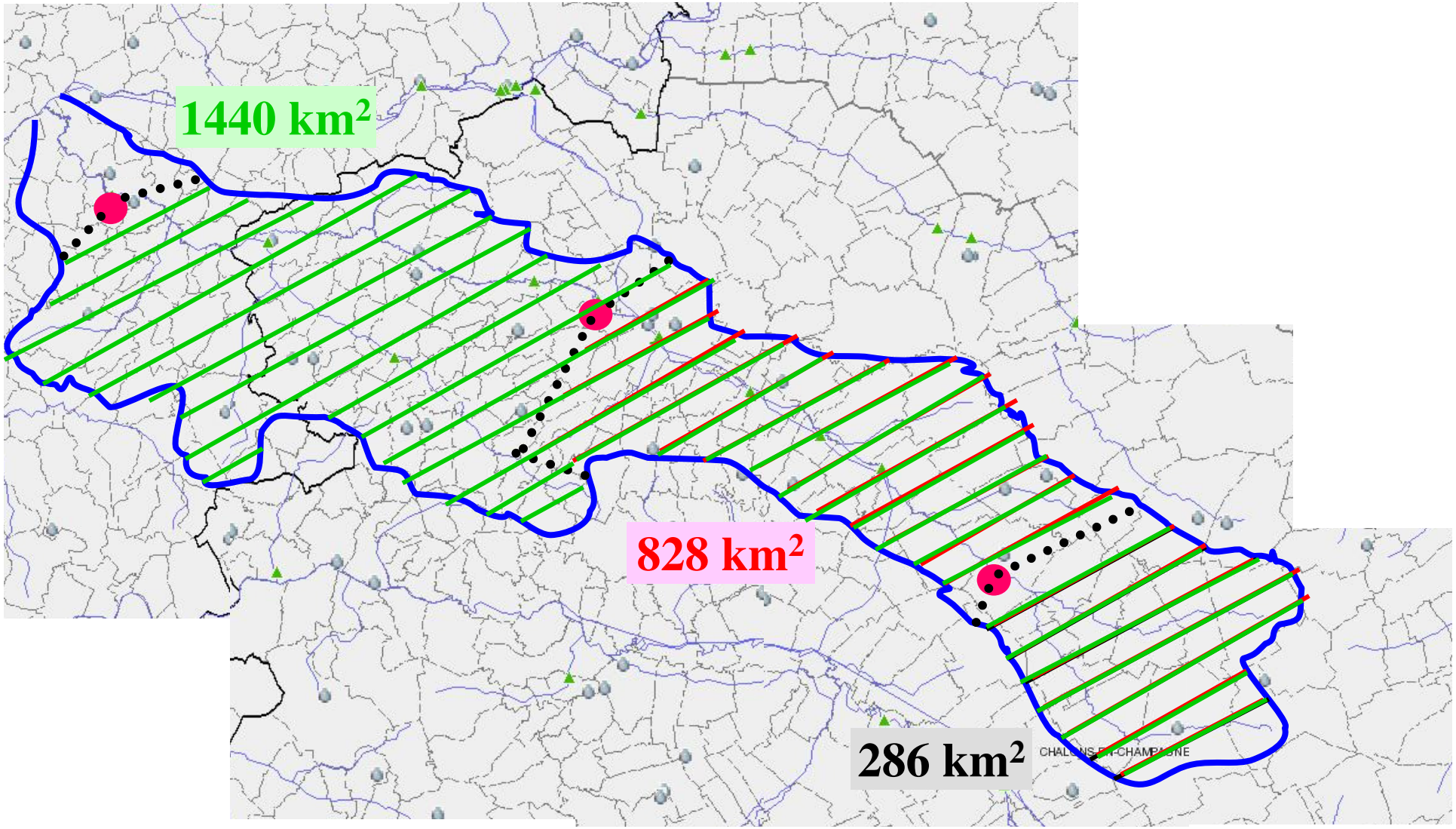
None


About 5 km (as the crow flies !)
MONT-SAINT-MARTIN
SAINT-GILLES
DRAVEGNY
Montaon
Ressont
St-Gilles
GR 142


L'Aisne
La Vesle


CHALONS-EN-CHAMPAGNE

Around 1500 km^2



Potamology

Precipitations

Precipitation Protocols

Purpose

To determine the amount of moisture input to the local environment by measuring rain and snowfall and to measure the pH of precipitation

Overview

Students use a rain gauge and a snowboard to measure the daily amount of precipitation that has occurred. Students measure the depth and rain equivalent of each day's snow and of the total snowpack. Special pH measuring techniques for precipitation are used to determine the pH of rain and melted snow.

Student Outcomes

Students will understand that precipitation is measured in depth and this depth is assumed to apply to a large area, that precipitation has a pH that can vary, and that snow is an input of water to the surface just like rain and each snowfall is equivalent to some amount of rainfall.

Science Concepts

Earth and Space Science

- Weather can be described by quantitative measurements.
- Weather changes from day to day and over the seasons.
- Weather varies on local, regional, and global spatial scales.
- Precipitation forms by condensation of water vapor in the atmosphere.

Physical Science

- Materials exist in different states.

Geography

- The nature and extent of precipitation affects the characteristics of the physical geographic system.

Scientific Inquiry Abilities

- Use a rain gauge to measure rainfall and rain equivalent of snow.
- Use pH paper, pen, or meter to measure pH.
- Use meter sticks to measure snow depth.
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Develop descriptions and explanations using evidence.
- Recognize and analyze alternative explanations.
- Communicate procedures and explanations.

Time

In the field: 5 minutes for rain,
10-15 minutes for snow
In the lab: 5 minutes for snow rain equivalent
5 minutes for pH
Maintenance: 10 minutes weekly for cleaning the rain gauge

Level

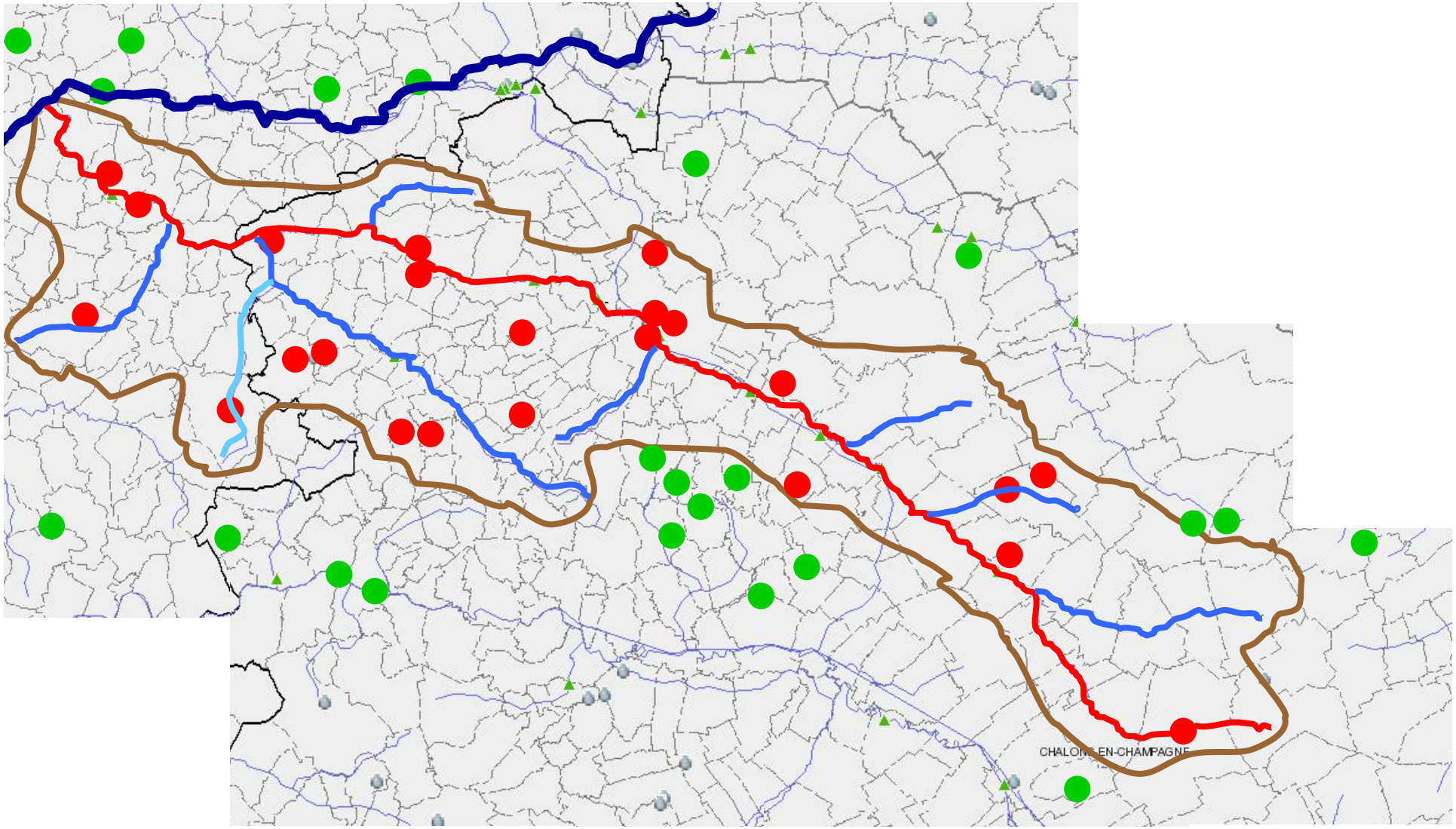
All

Frequency

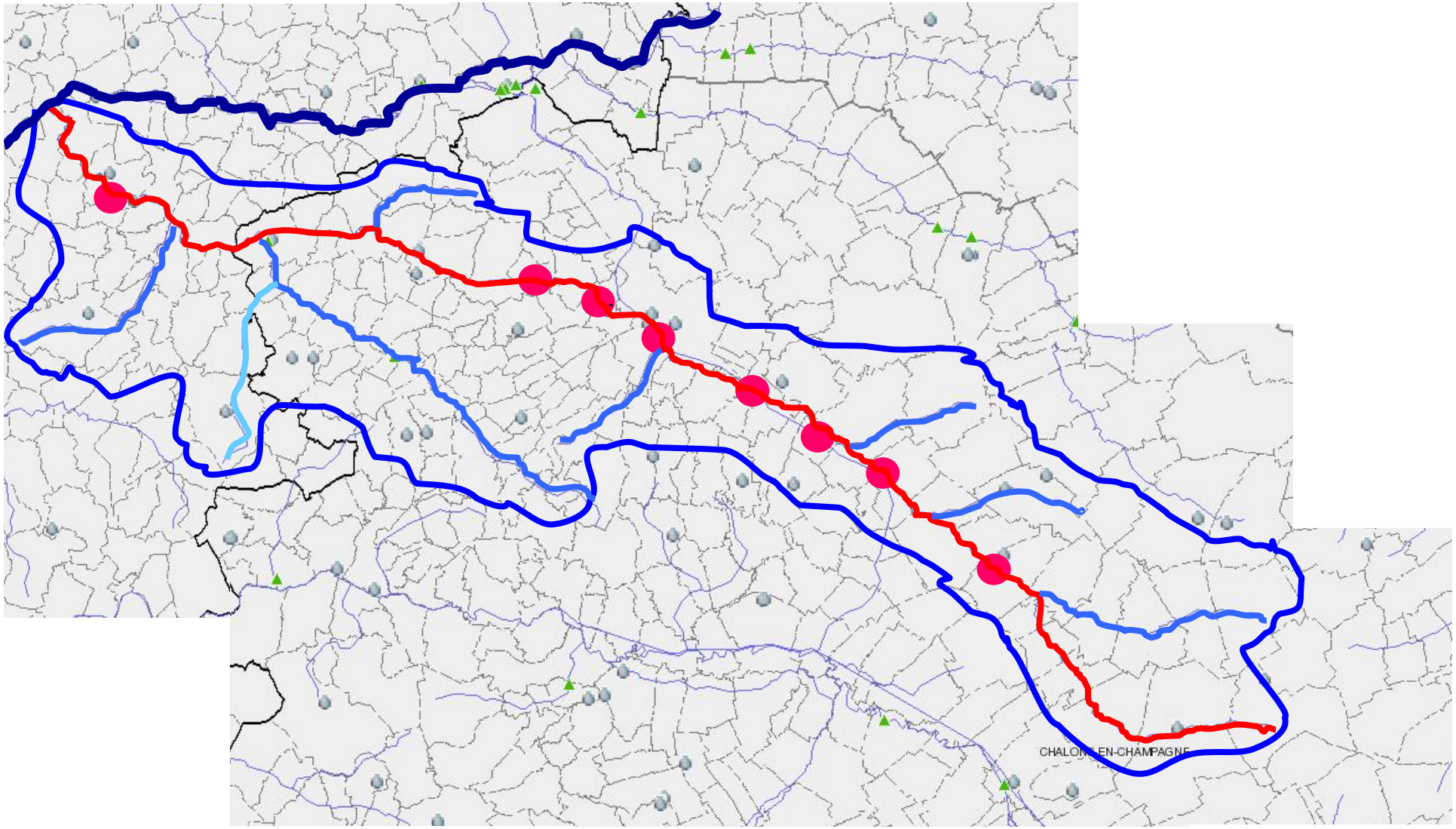
Daily within one hour of local solar noon

Materials and Tools

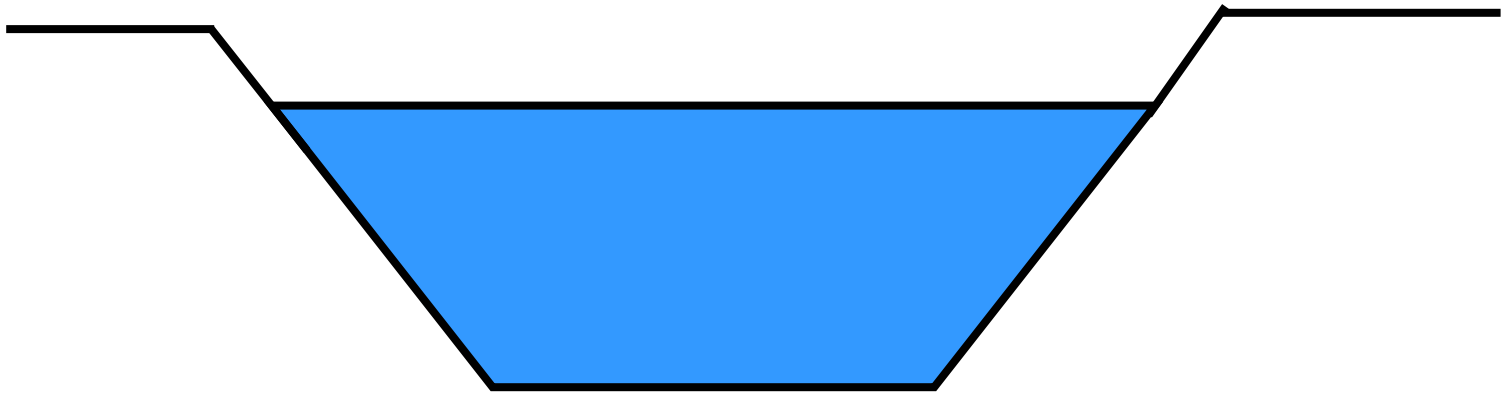
- Installed rain gauge
- Snowboard
- Clean containers for pH samples 100 mL or larger
- Two or three containers for snow samples
- Carpenter's level
- Meter stick
- pH paper OR meter and pH buffers
- Salt and salt card or tweezers
- Sampling jar with lid
- 300 mL beakers or cups
- Tweezers
- Stirring rods or spoon
- Latex gloves
- *Atmosphere Investigation Data Sheet*
- Distilled water for cleaning rain gauge

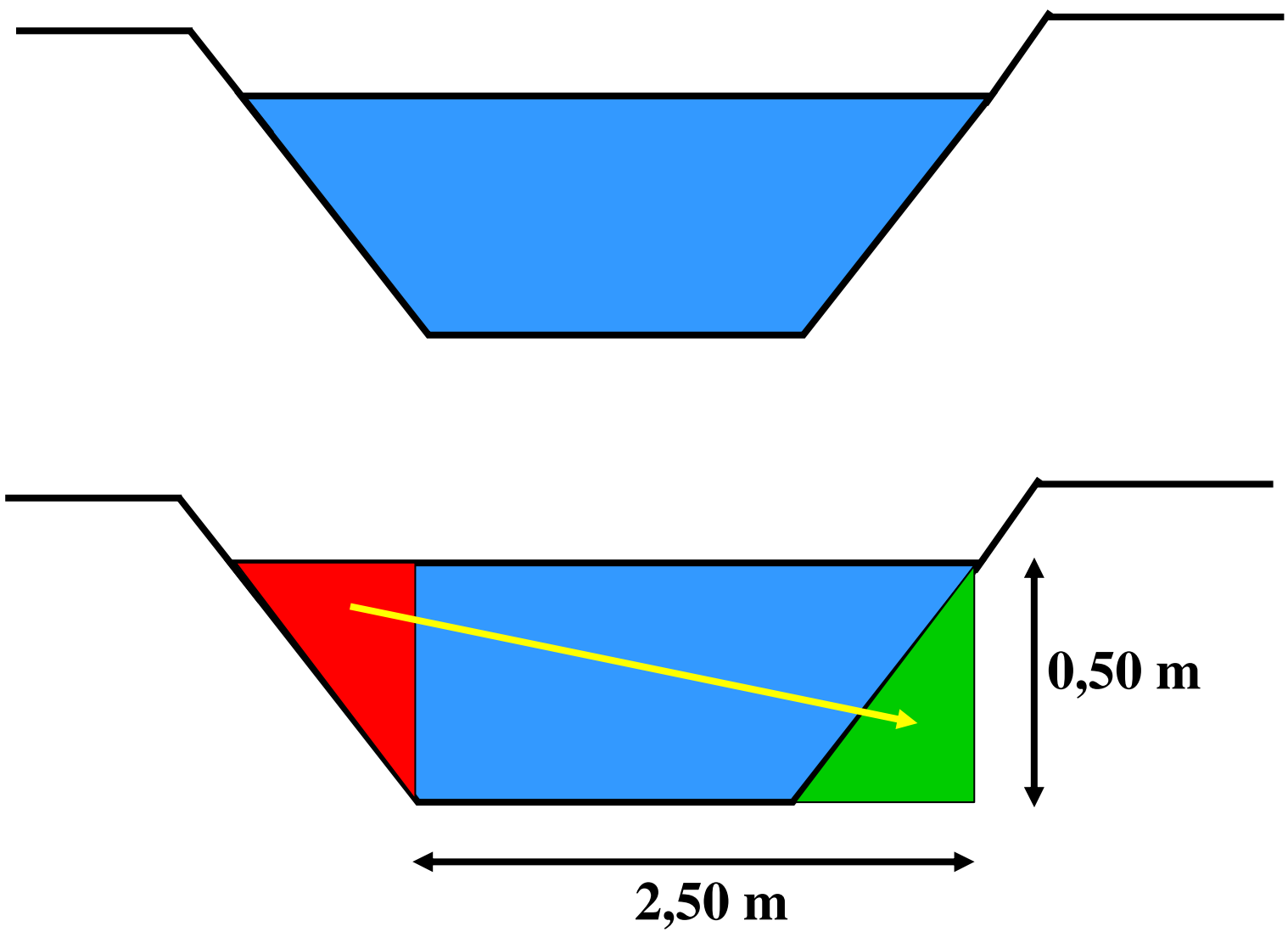

CHALONS-EN-CHAMPAGNE

Flow discharge


CHALONS-EN-CHAMPAGNE

Ce procédé est le plus simple de tous. On choisit une partie où la rivière est droite et régulière en largeur et profondeur, c'est-à-dire ayant l'aspect d'un canal. On s'assure de la section de cette rivière, c'est-à-dire largeur et profondeur d'eau.




0,50 m
2,50 m

Sur la partie droite de la rivière, on mesure une longueur de 10 à 20 mètres et la vitesse d'écoulement d'eau en y jetant un corps flottant, morceau de bois ou même, de préférence, une bouteille presque pleine de façon que ce flotteur plongeant dans I'eau donne la vitesse moyenne du cours d'eau et non pas la vitesse de la surface, supérieure à la vitesse moyenne.


10 m

Mais la vitesse de l'eau sur les côtés et au fond est inférieure à celle de la surface ou au milieu. Il faut donc répéter les essais de vitesse, ne jamais les faire dans un coude et prendre seulement 80% du résultat théorique.

Débit

=

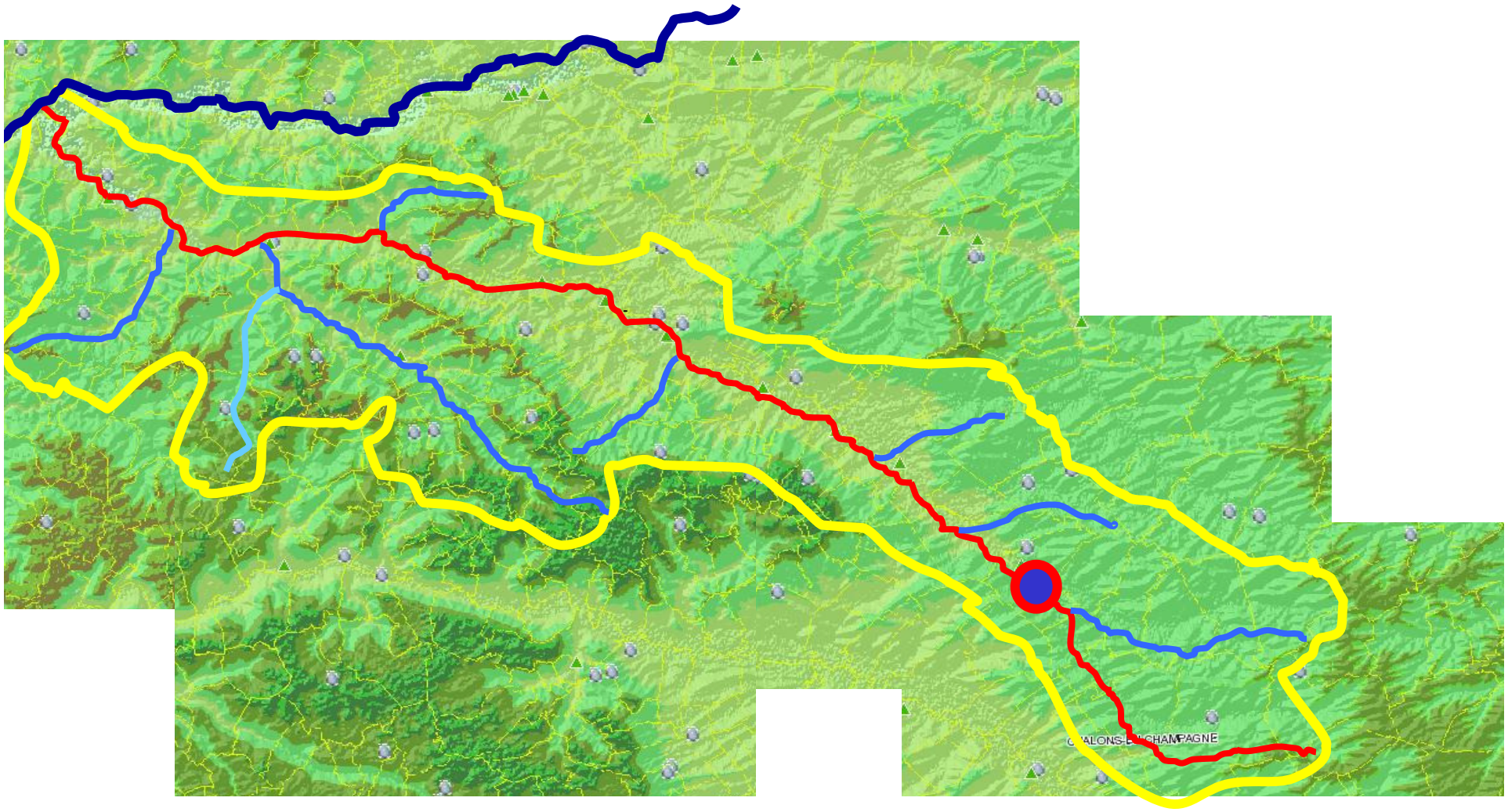
section de la rivière x vitesse mesurée x 80%

Exemple pour notre rivière : si le flotteur donne une vitesse de 0,80 m par seconde, on aura :

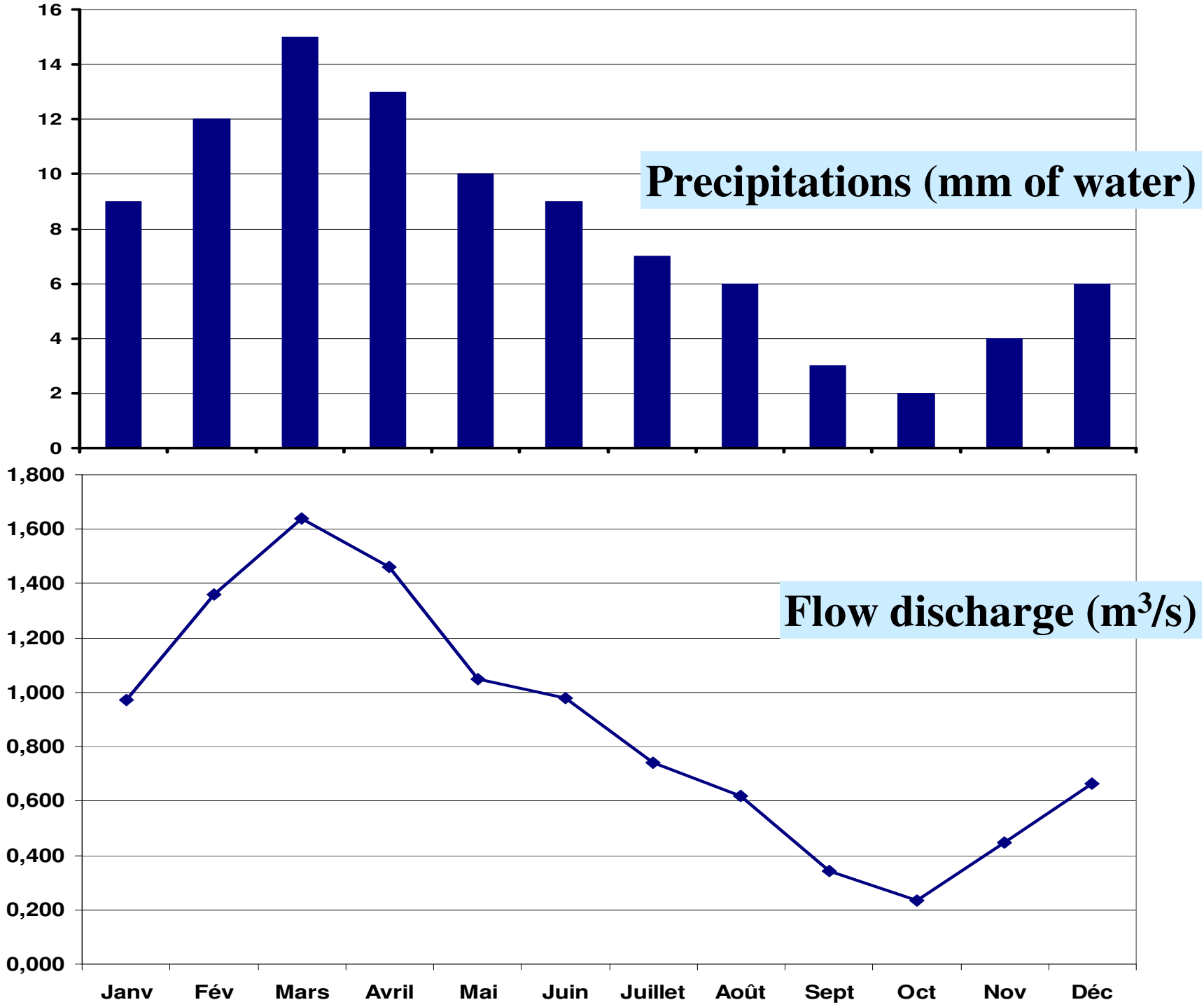
$$\text{Débit} = 2{,}50 \times 0{,}50 \times 0{,}80 \times 80/100$$

$$= 0{,}8 \text{ m}^3/\text{s}$$

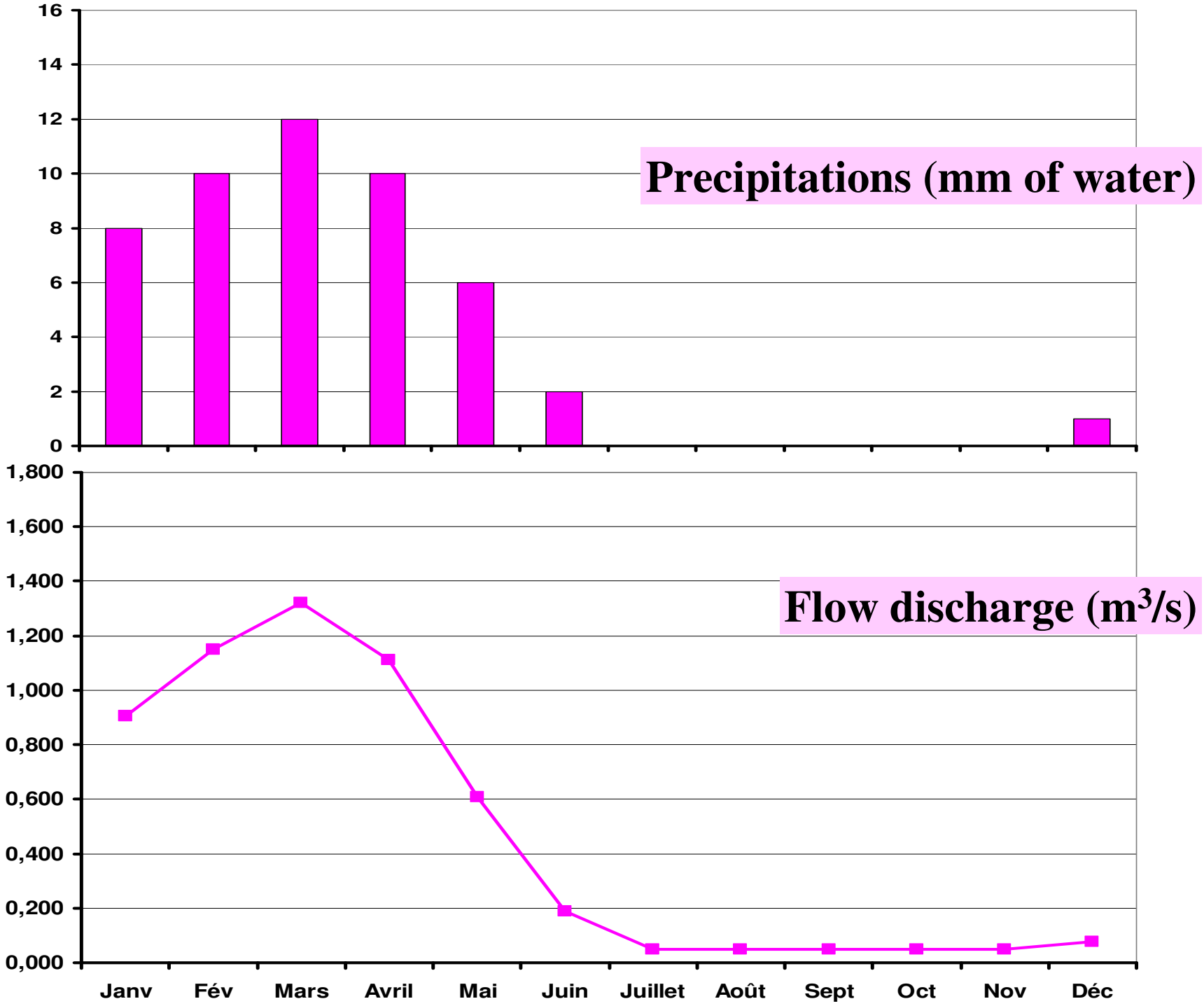
Flow discharge near the Vesle source

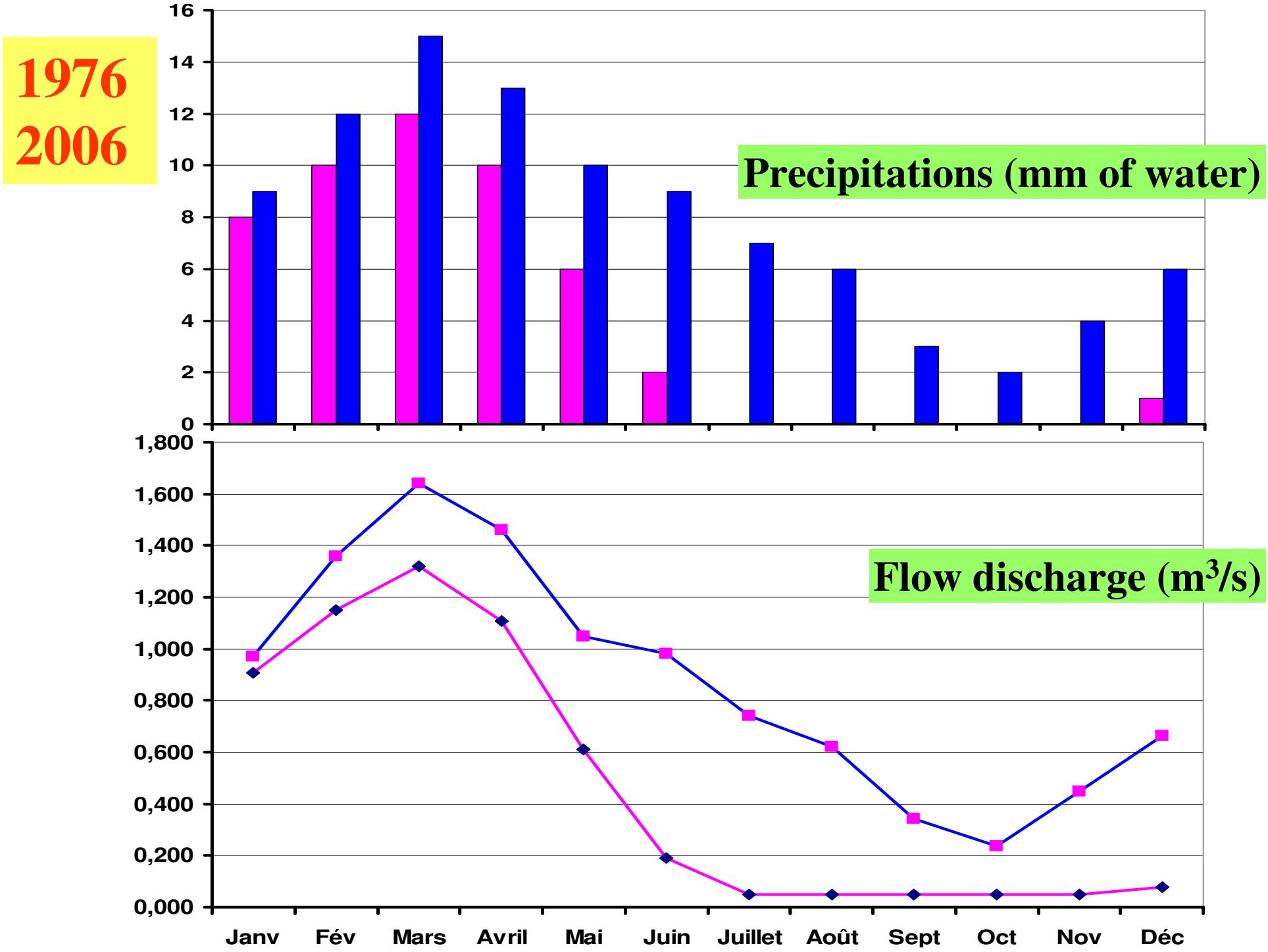


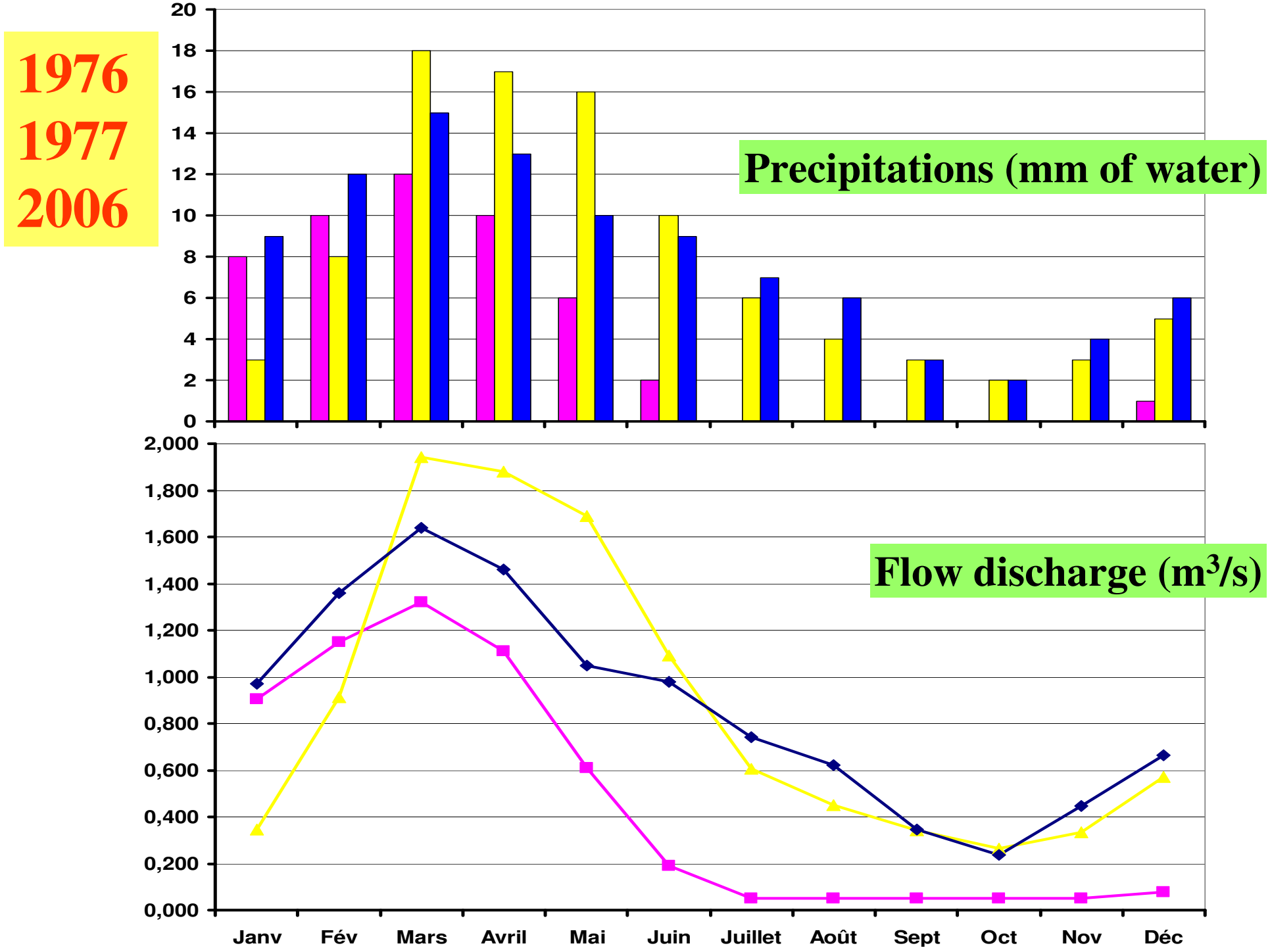
2006


Precipitations (mm of water)
16
14
12
10
8
6
4
2
0
Flow discharge (m3/s)
1,800
1,600
1,400
1,200
1,000
0,800
0,600
0,400
0,200
0,000
Janv
Fév
Mars
Avril
Mai
Juin
Juillet
Août
Sept
Oct
Nov
Déc

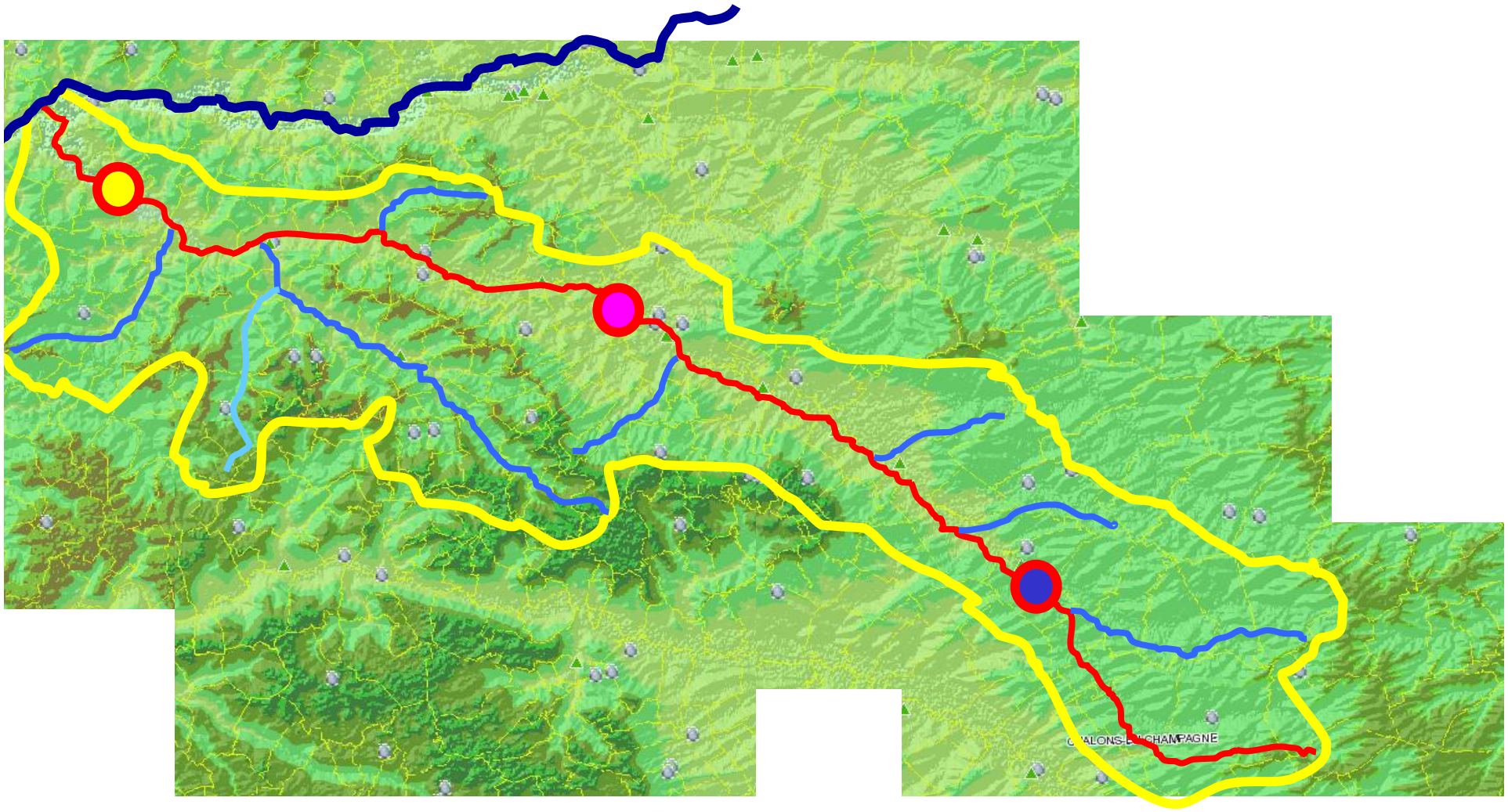
1976


Precipitations (mm of water)
16
14
12
10
8
6
4
2
0
Flow discharge (m3/s)
1,800
1,600
1,400
1,200
1,000
0,800
0,600
0,400
0,200
0,000
Janv
Fév
Mars
Avril
Mai
Juin
Juillet
Août
Sept
Oct
Nov
Déc

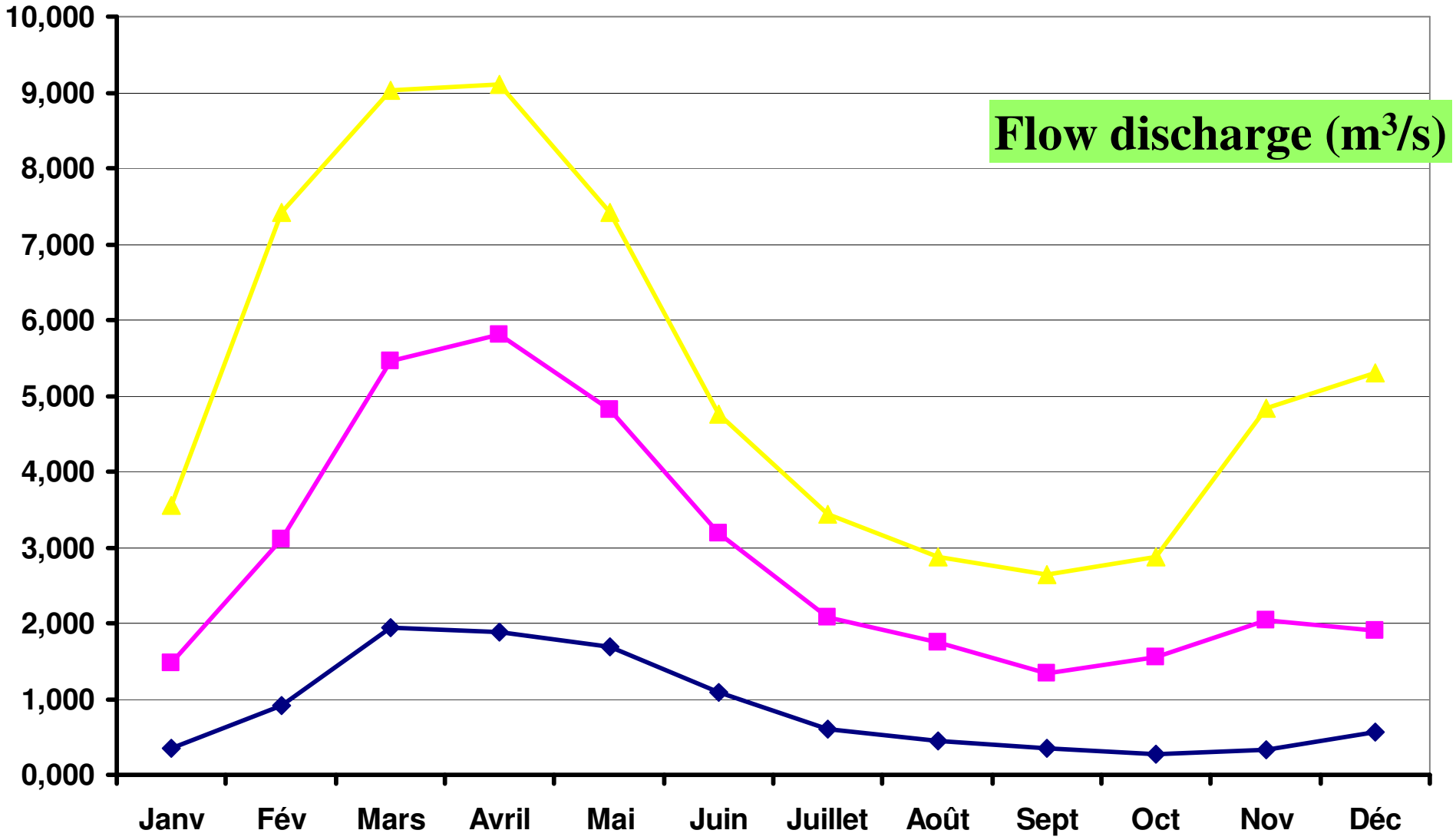

1976
2006
Precipitations (mm of water)
16
14
12
10
8
6
4
2
0
Flow discharge (m³/s)
1,800
1,600
1,400
1,200
1,000
0,800
0,600
0,400
0,200
0,000
Janv
Fév
Mars
Avril
Mai
Juin
Juillet
Août
Sept
Oct
Nov
Déc


1976
1977
2006
Precipitations (mm of water)
20
18
16
14
12
10
8
6
4
2
0
Flow discharge (m³/s)
2,000
1,800
1,600
1,400
1,200
1,000
0,800
0,600
0,400
0,200
0,000
Janv
Fév
Mars
Avril
Mai
Juin
Juillet
Août
Sept
Oct
Nov
Déc

Flow discharge along the Vesle river

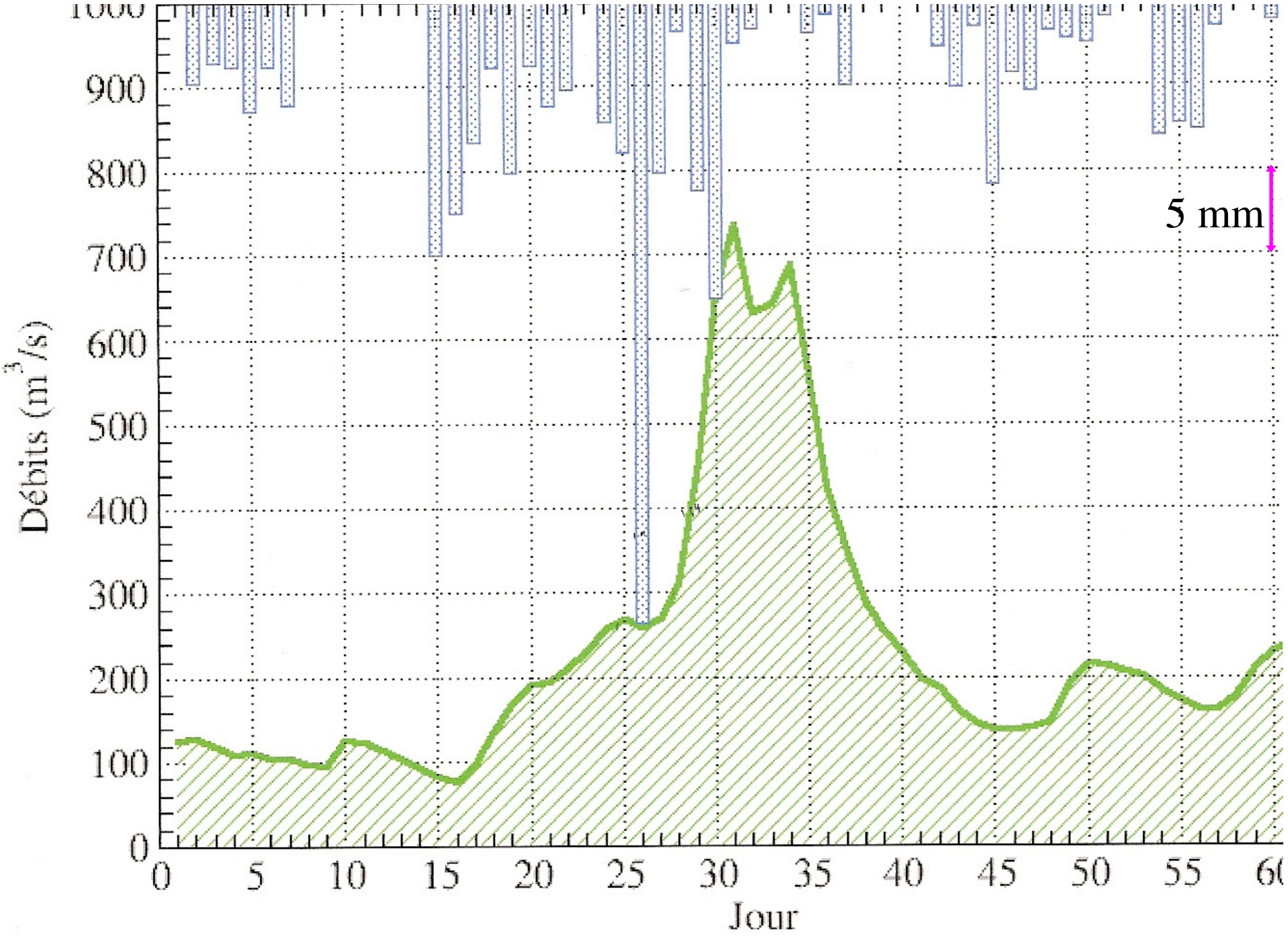


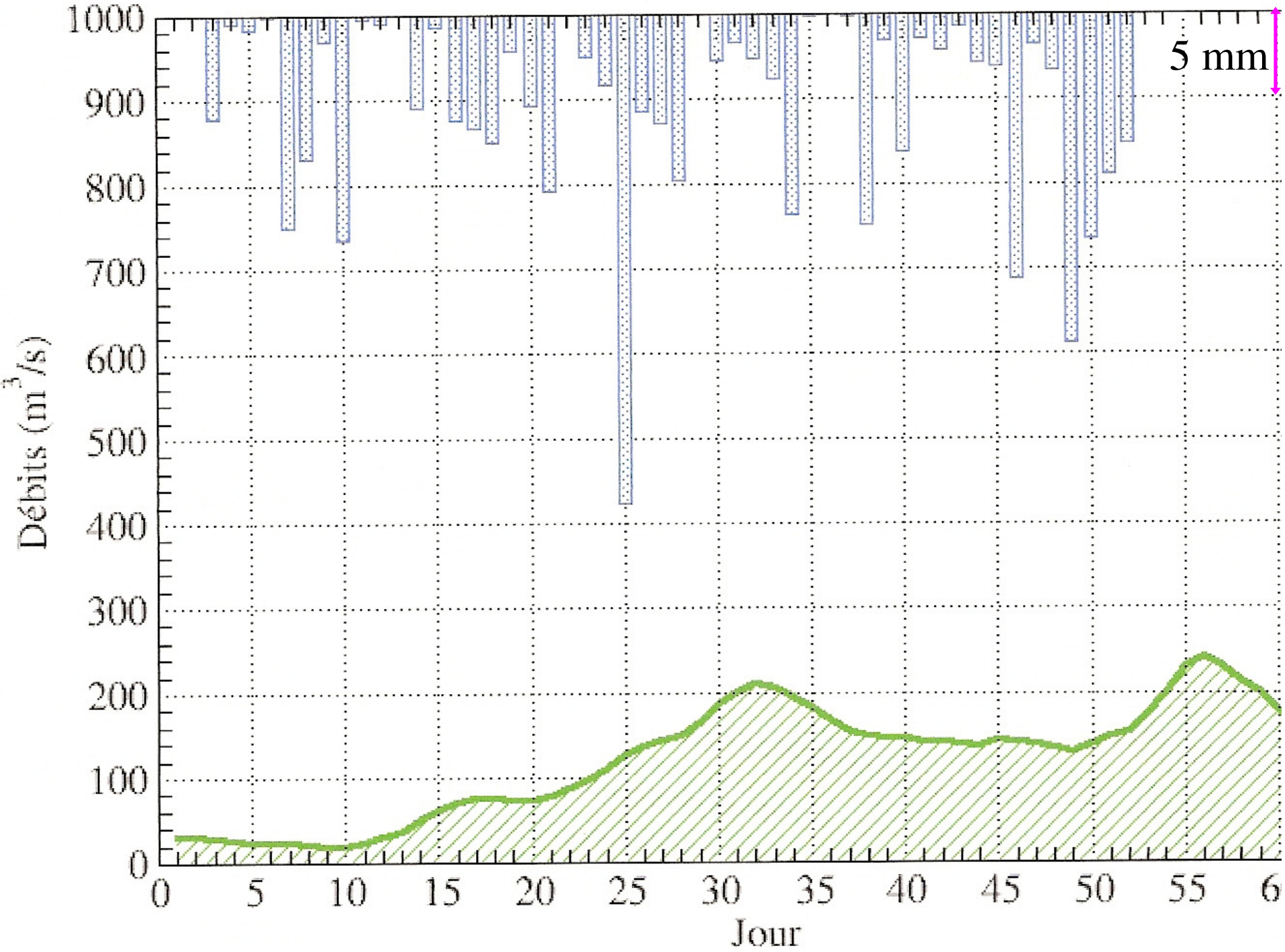
Along the Vesle river in 1977

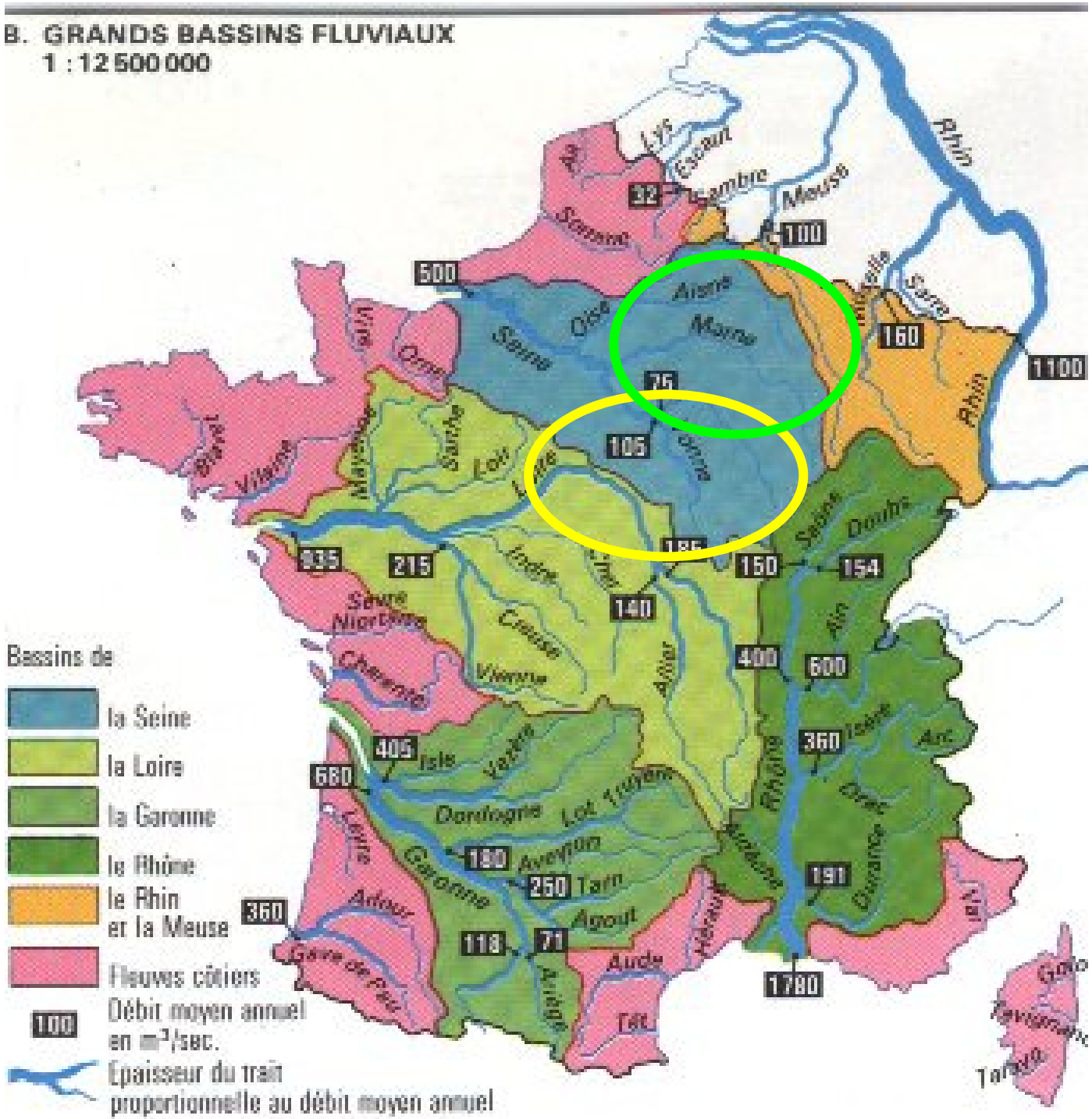


Trouble in a watershed

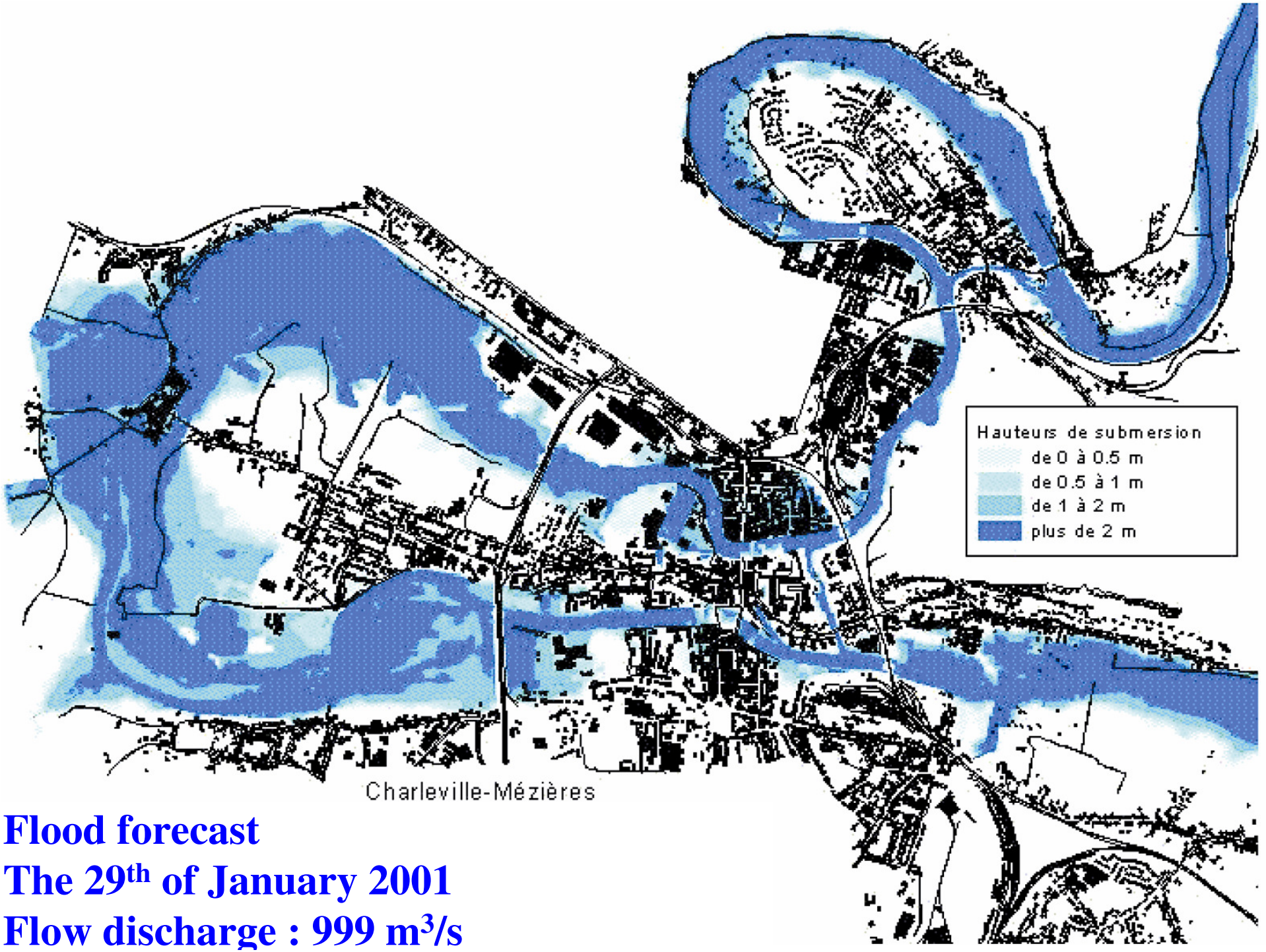
Floods


1000
900
800
700
600
500
400
300
200
100
0
Débits (m3/s)
0
5
10
15
20
25
30
35
40
45
50
55
60
Jour
5 mm


5 mm
Débits (m3/s)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
50
55
6
Jour

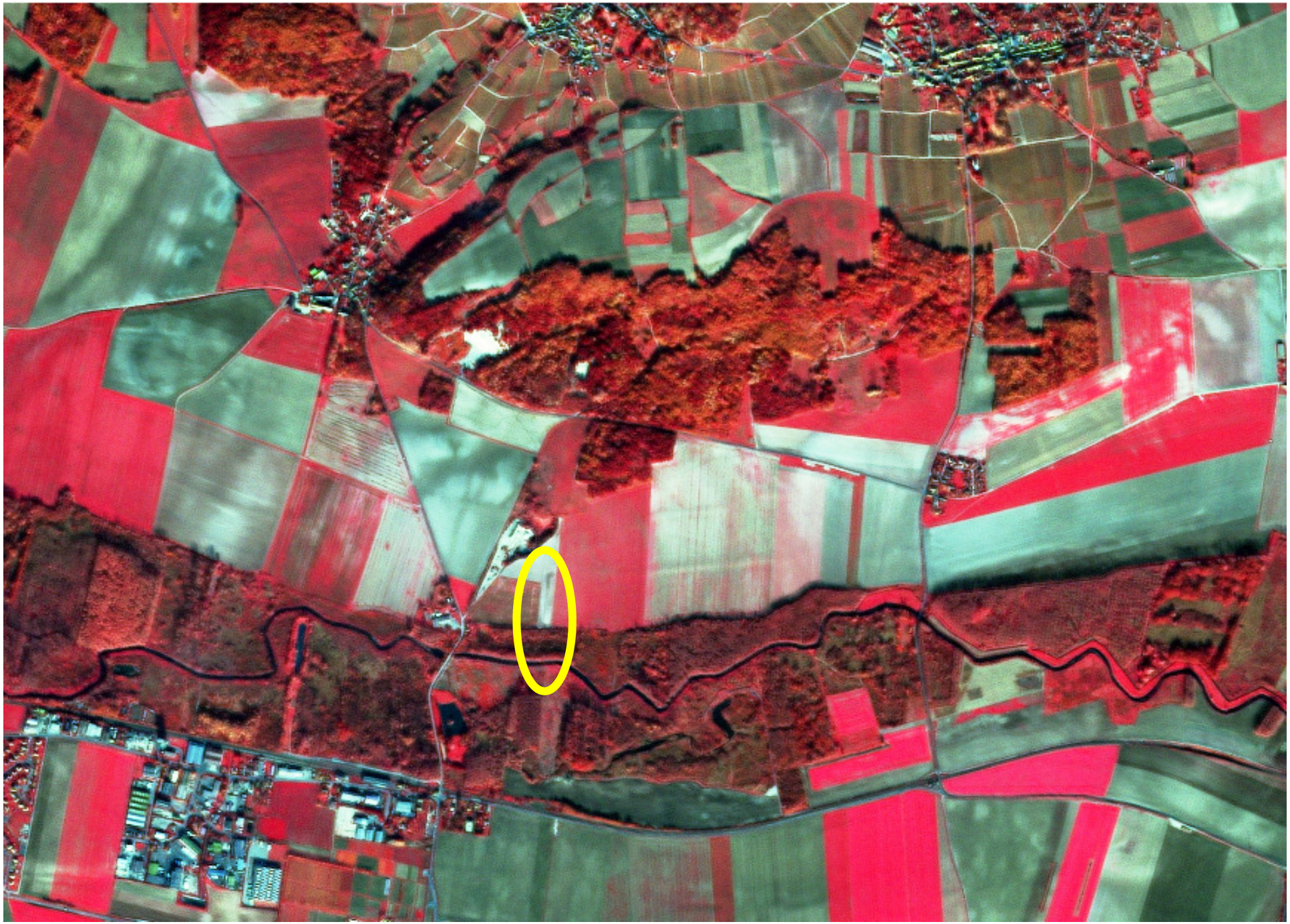

B. GRANDS BASSINS FLUVIAUX
1 : 12 500 000
Bassins de
la Seine
la Loire
la Garonne
le Rhône
le Rhin et la Meuse
Fleuves côtiers
100
Débit moyen annuel en m³/sec.
Epaisseur du trait proportionnelle au débit moyen annuel
Rhin
Meuse
Escaut
Lys
Somme
Seine
Oise
Aisne
Marne
Yonne
Loire
Allier
Cher
Indre
Vienne
Creuse
Sarthe
Mayenne
Loir
Vilaine
Blavet
Orne
Rhône
Saône
Doubs
Ain
Isère
Arc
Durance
Var
Gard
Hérault
Aude
Têt
Garonne
Lot
Tarn
Aveyron
Dordogne
Isle
Adour
Gave de Pau
Ariège
Agout
Charente
Sèvre Niortaise
Lèze
Tavignano
Golo
500
32
100
160
1100
75
105
185
150
154
140
215
935
400
600
360
405
680
180
250
360
118
71
191
1780

Hazard forecast

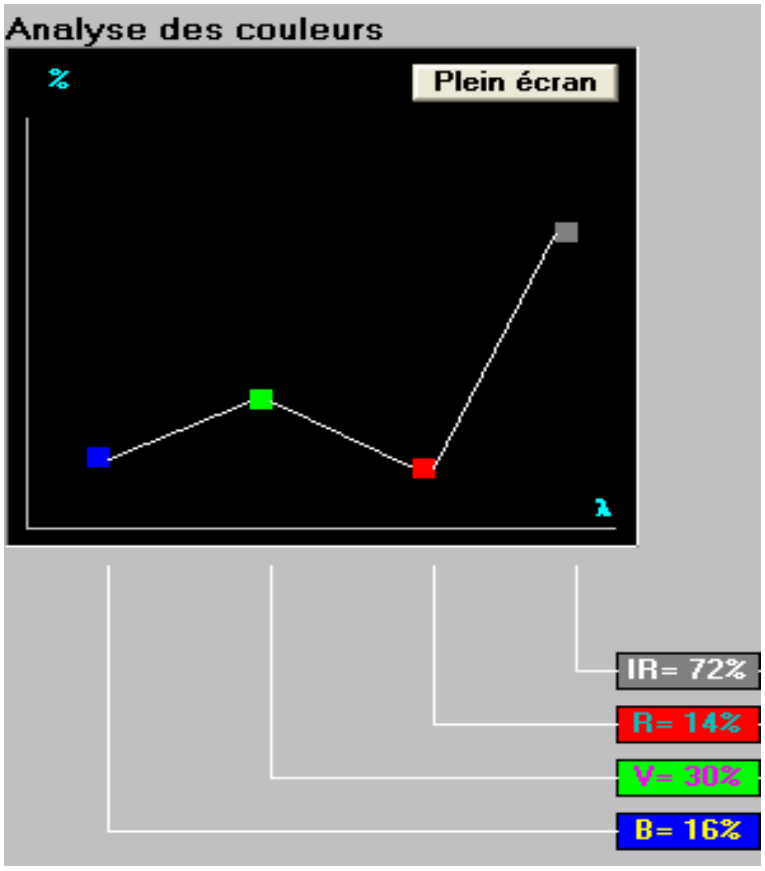


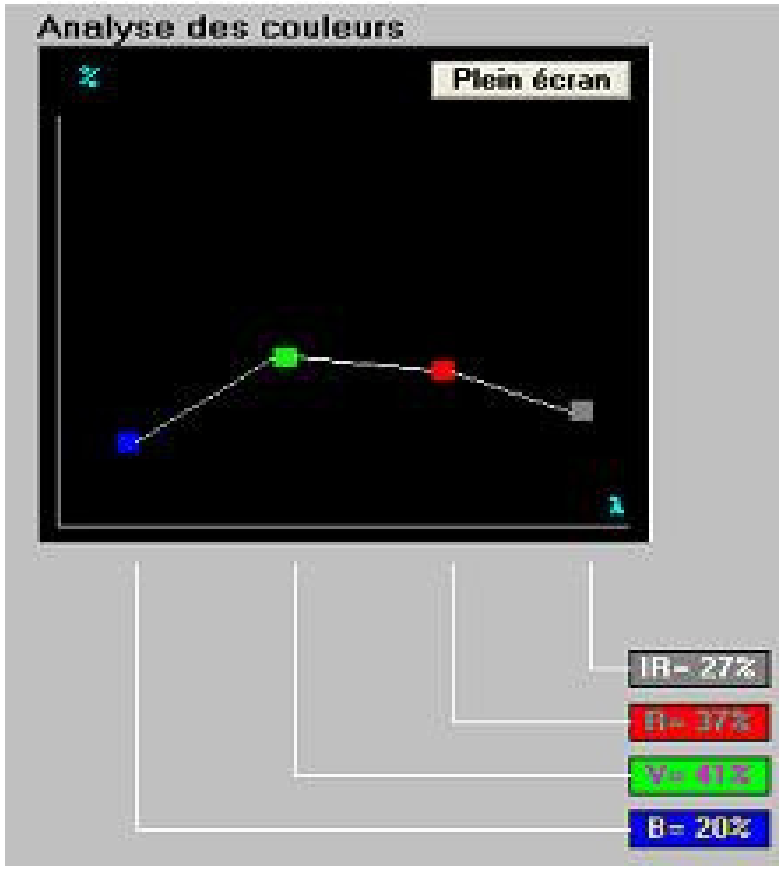
Flood forecast
The 29th of January 2001
Flow discharge : 999 m^3/s

Runoff pollution
Leaching

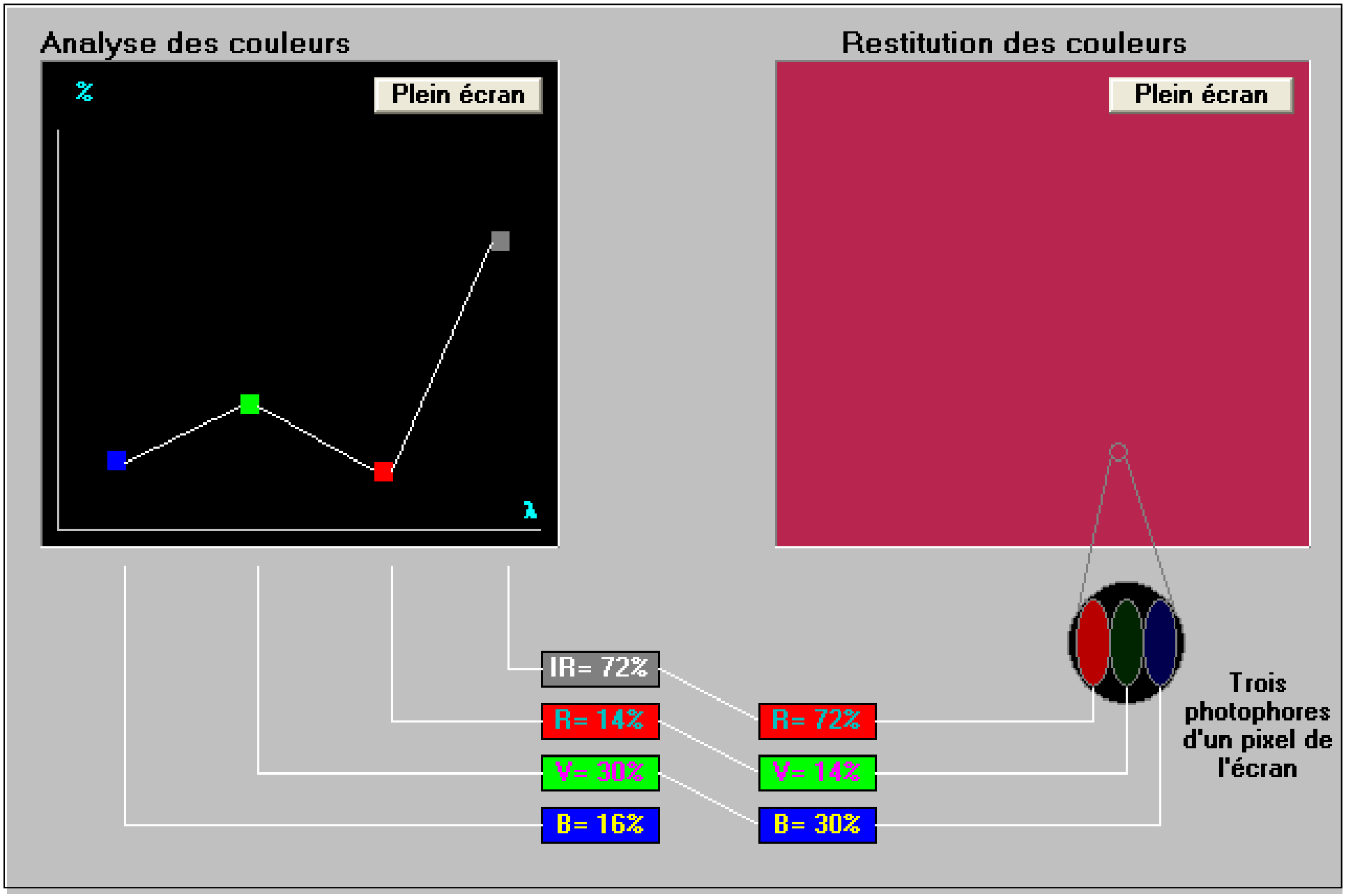


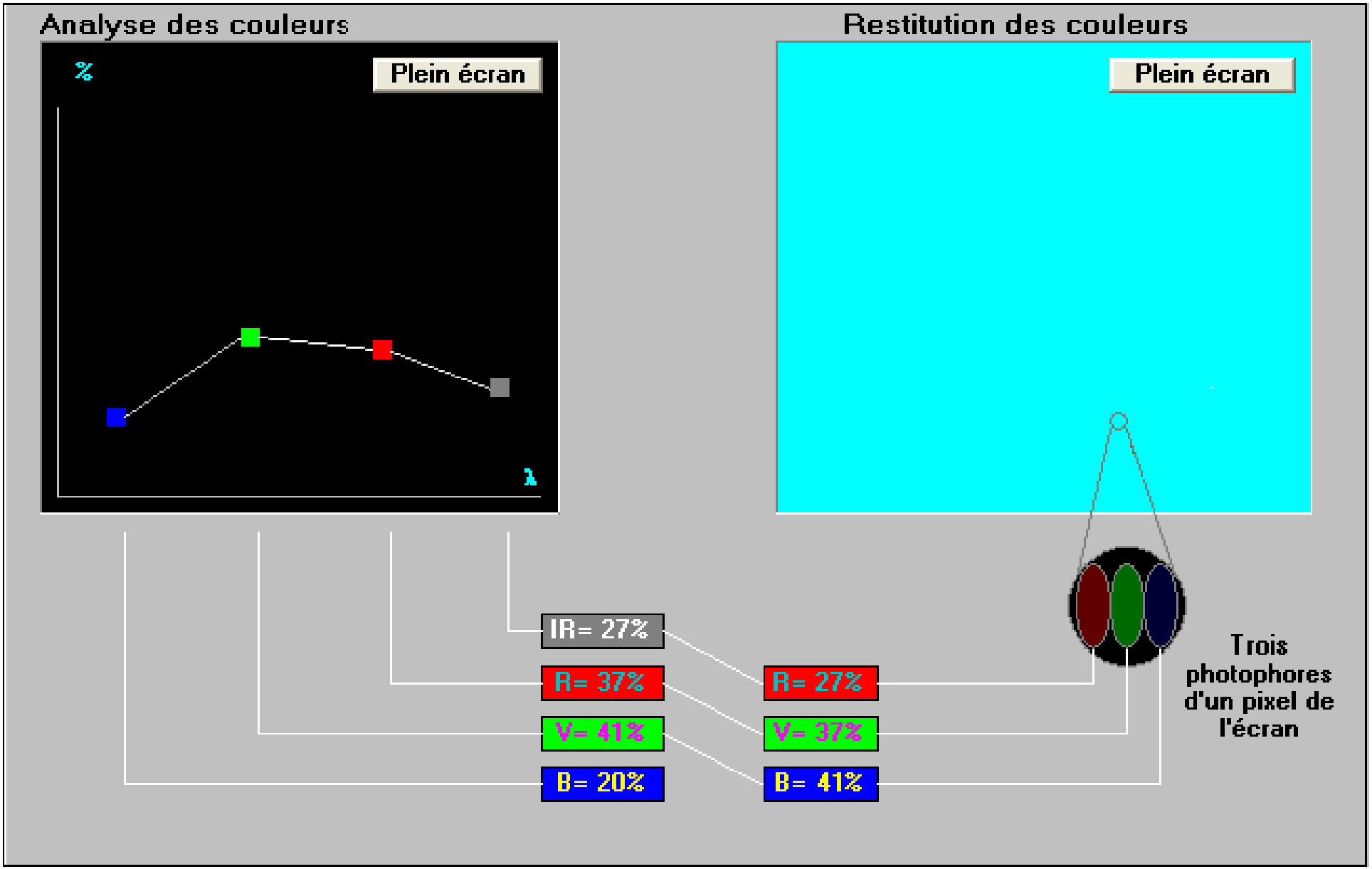
Acquisition of a satellite image

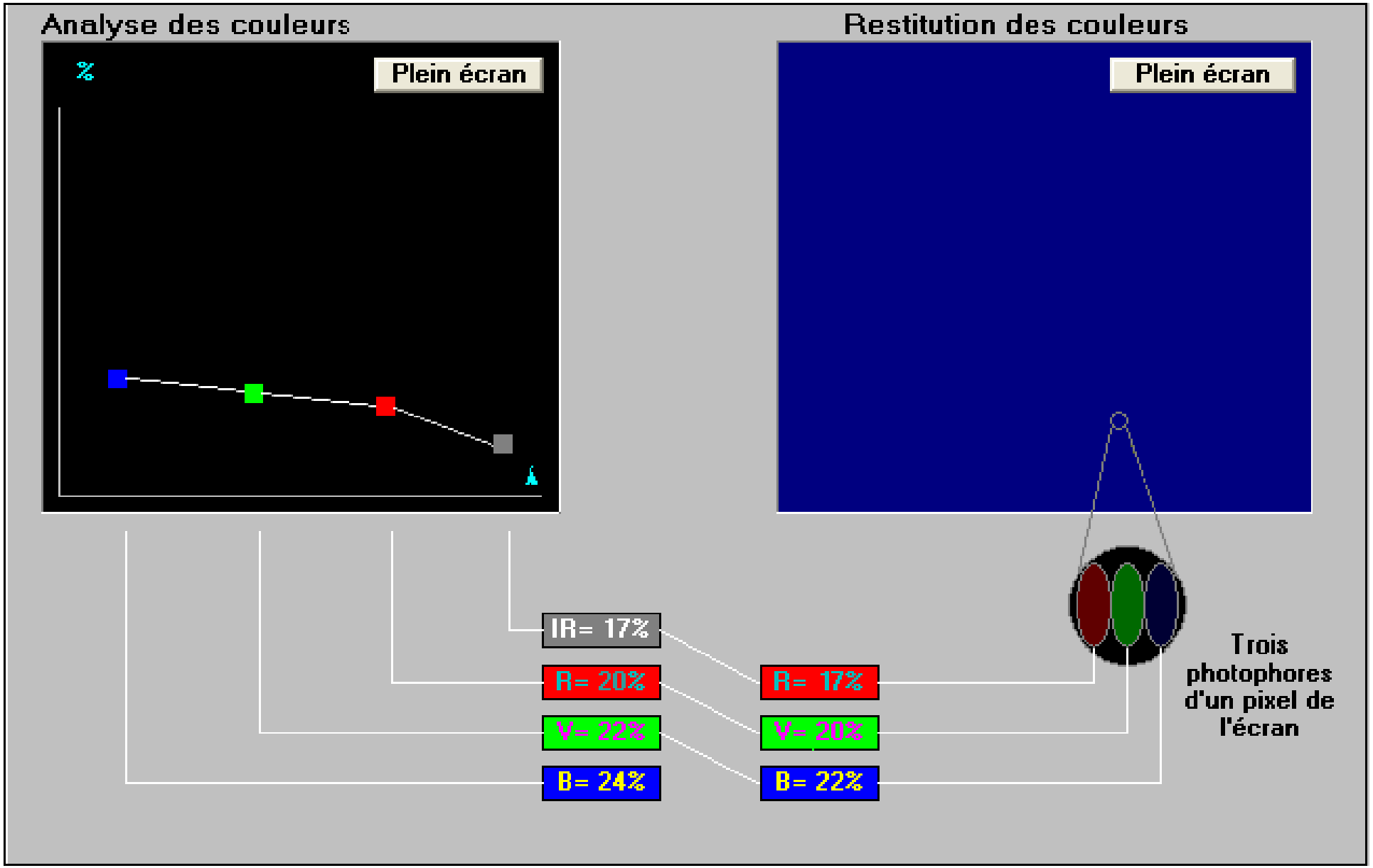

Analyse des couleurs
%
Plein écran
λ
IR= 72%
R= 14%
V= 30%
B= 16%

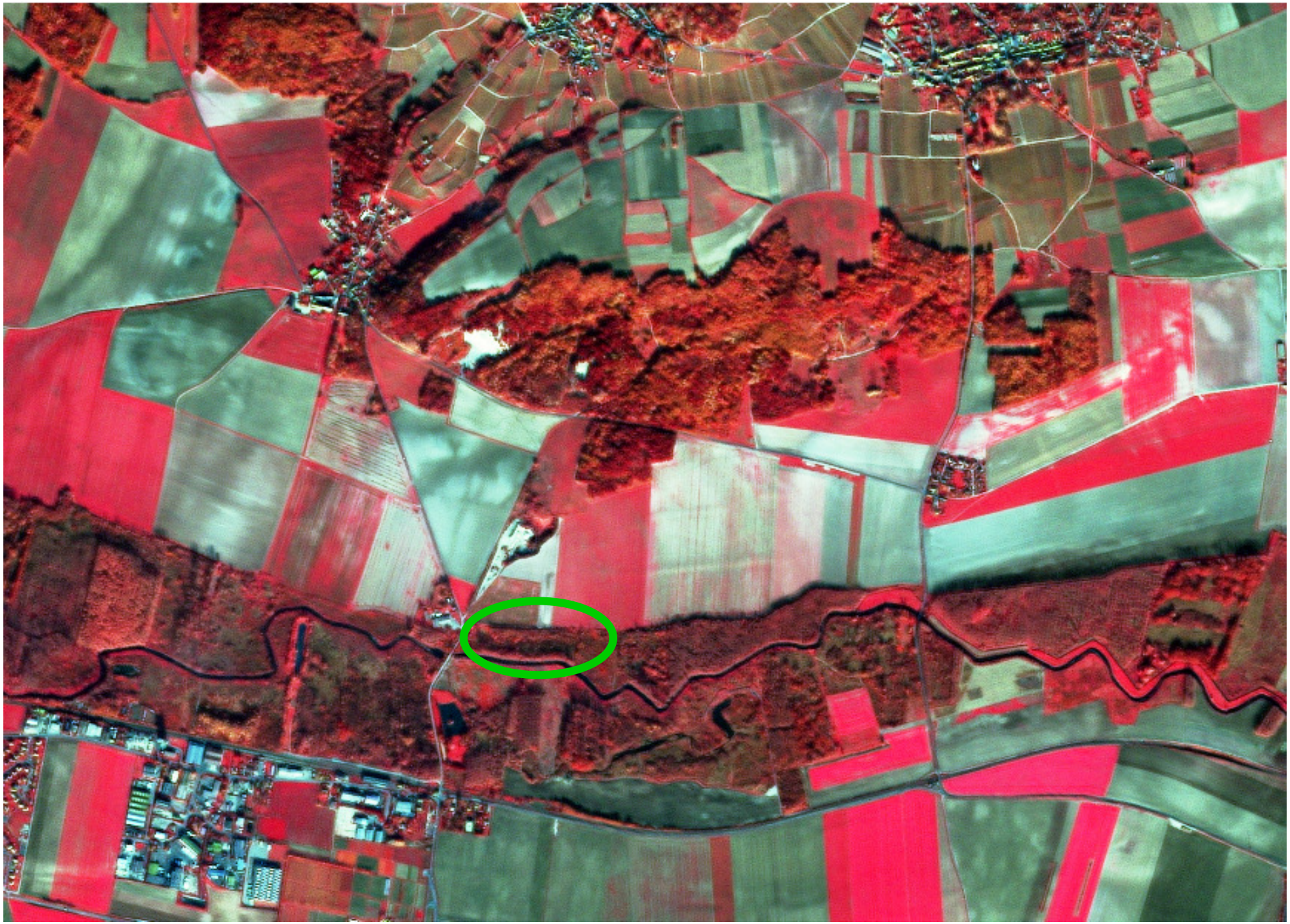

Analyse des couleurs
%
Plein écran
λ
IR= 27%
B= 20%

False colours

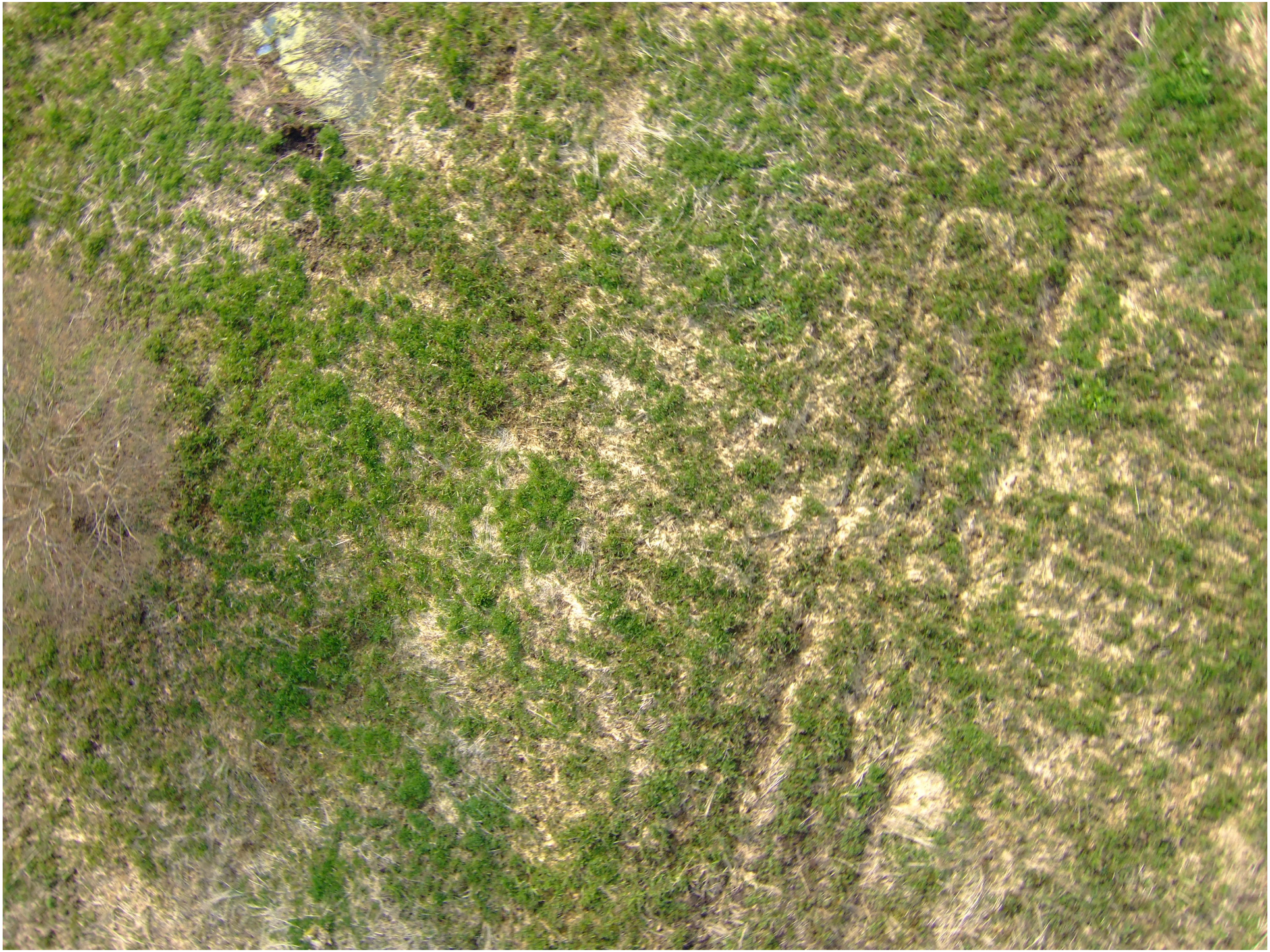

Analyse des couleurs
%
Plein écran
λ
Restitution des couleurs
Plein écran
IR= 72%
R= 14%
V= 30%
B= 16%
R= 72%
V= 14%
B= 30%
Trois photophores d'un pixel de l'écran


Analyse des couleurs
%
Plein écran
λ
Restitution des couleurs
Plein écran
IR= 27%
R= 37%
V= 41%
B= 20%
R= 27%
V= 37%
B= 41%
Trois photophores d'un pixel de l'écran


Analyse des couleurs
%
Plein écran
λ
Restitution des couleurs
Plein écran
IR= 17%
R= 20%
V= 22%
B= 24%
R= 17%
V= 20%
B= 22%
Trois photophores d'un pixel de l'écran




ENVIRONNEMENT

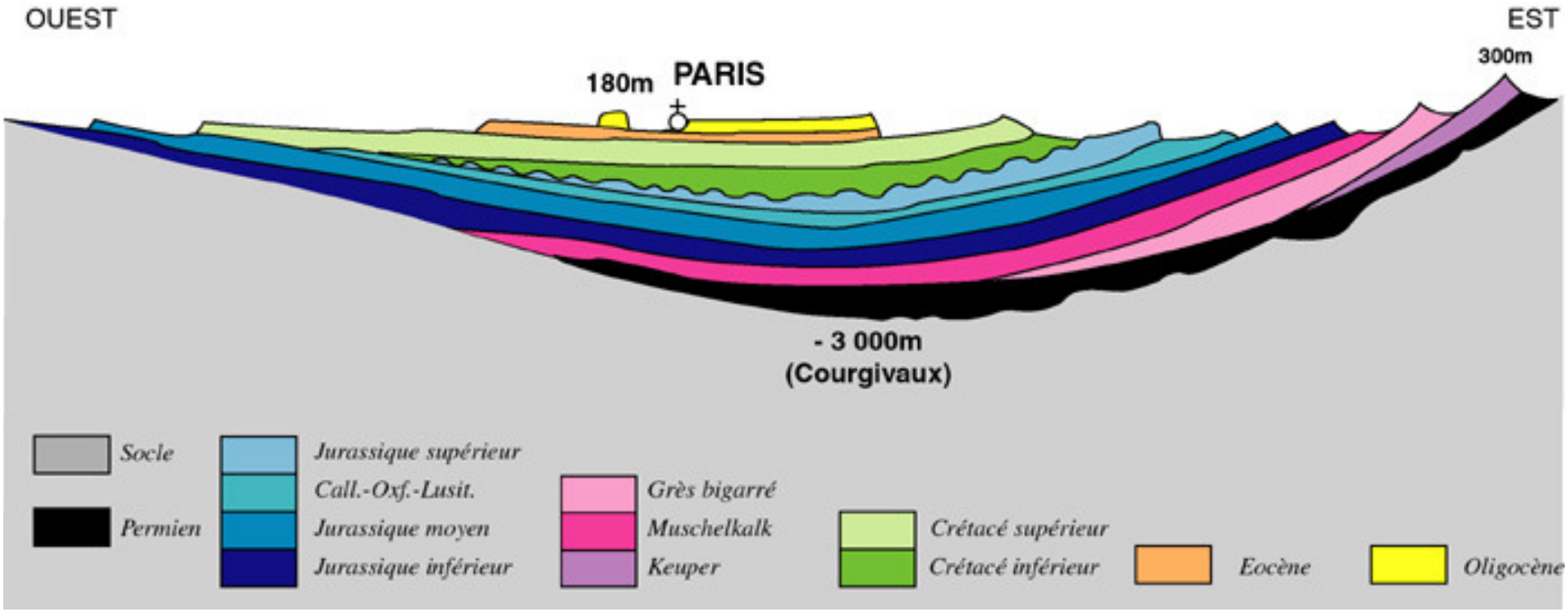


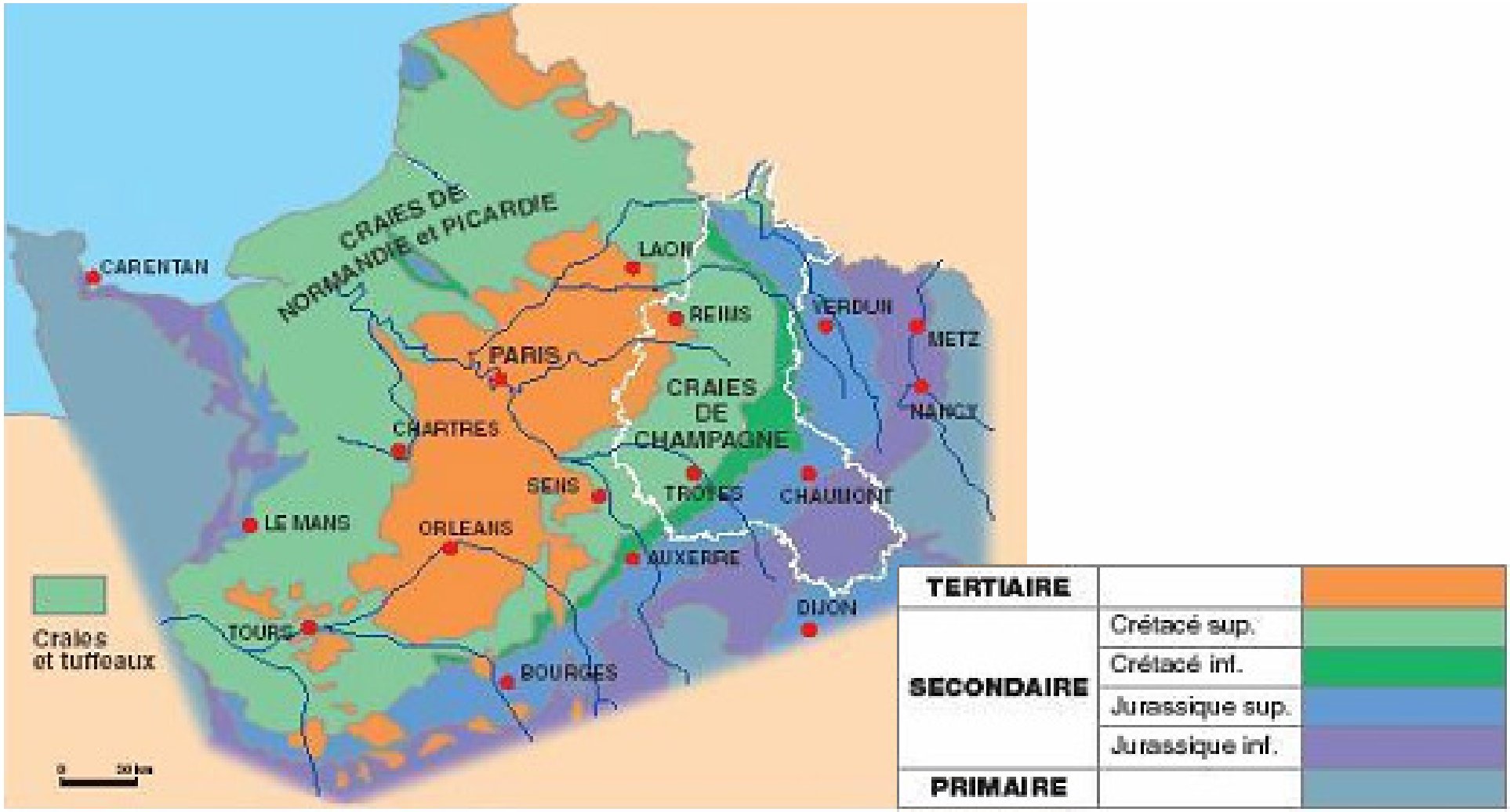

ATELIER ESPACE
ENVIRONNEMENT

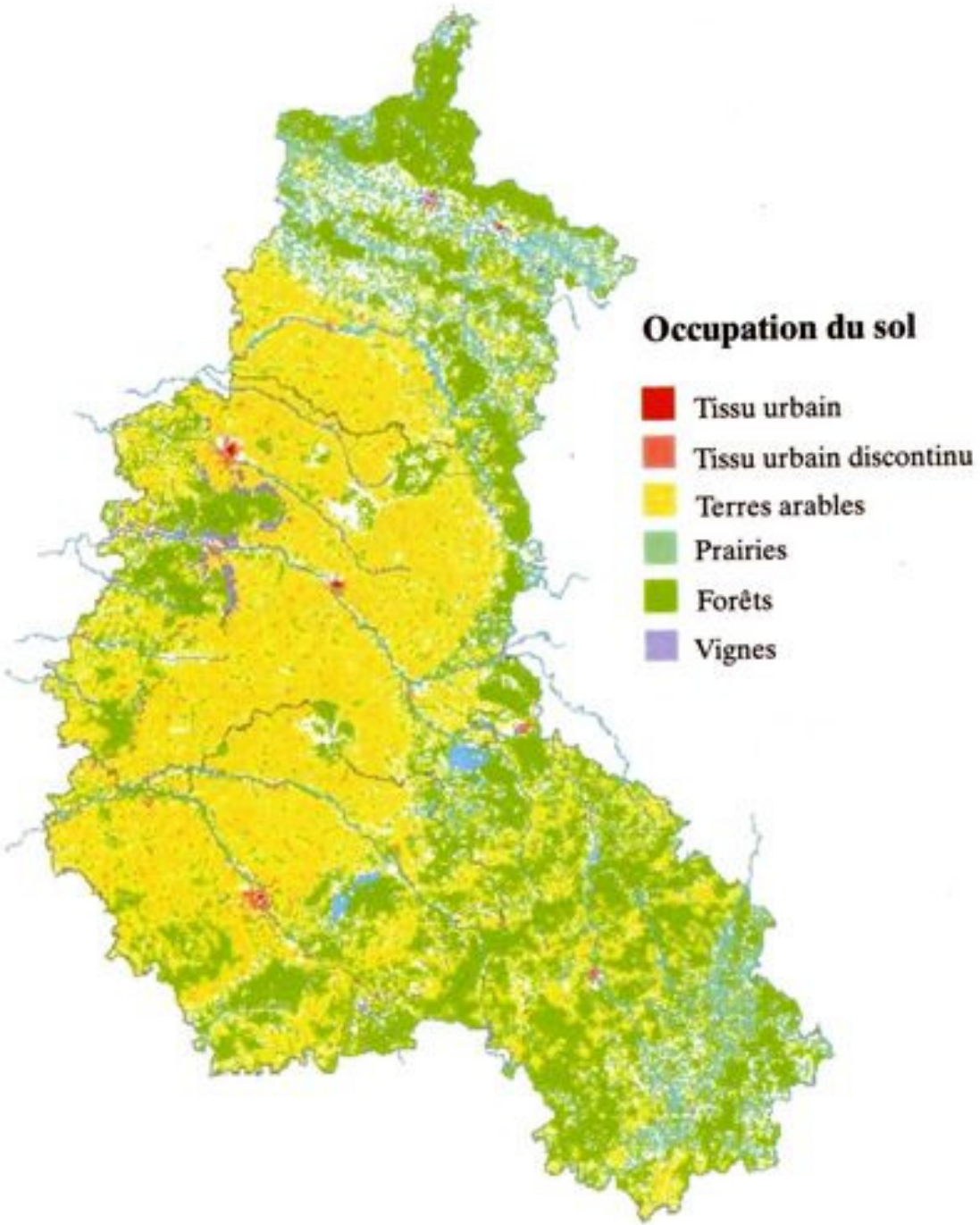
Champagne-Ardenne region

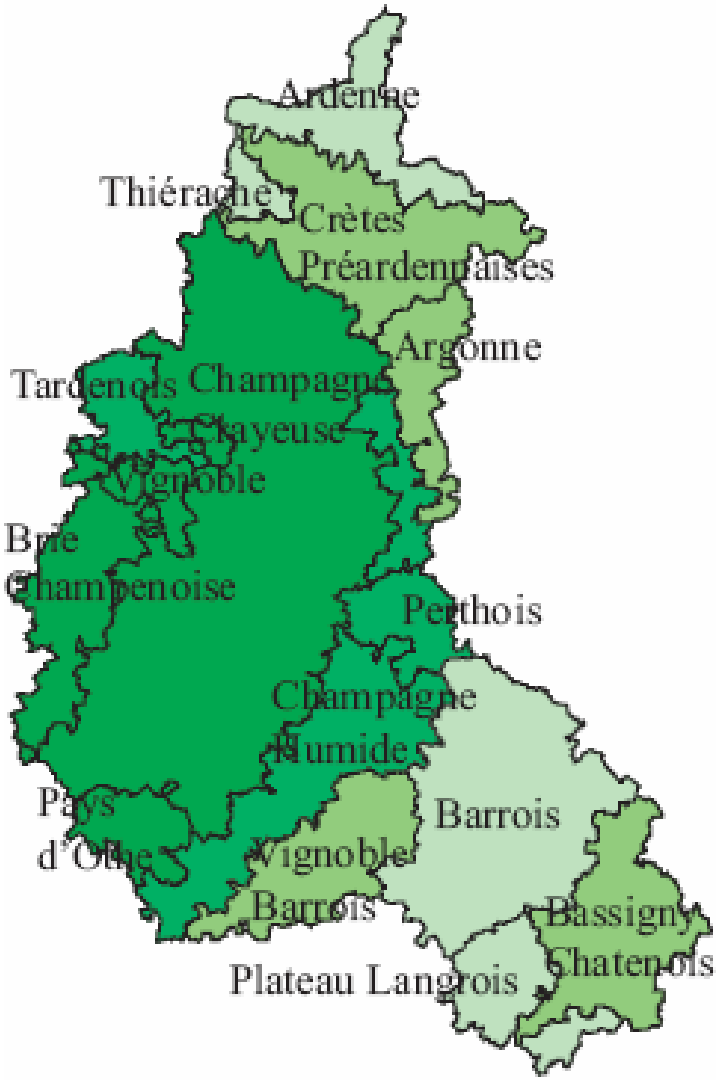
=

Arable farming region


OUEST
EST
180m
PARIS
300m
- 3 000m
(Courgivaux)
Socle
Permien
Jurassique supérieur
Call.-Oxf.-Lusit.
Jurassique moyen
Jurassique inférieur
Grès bigarré
Muschelkalk
Keuper
Crétacé supérieur
Crétacé inférieur
Eocène
Oligocène

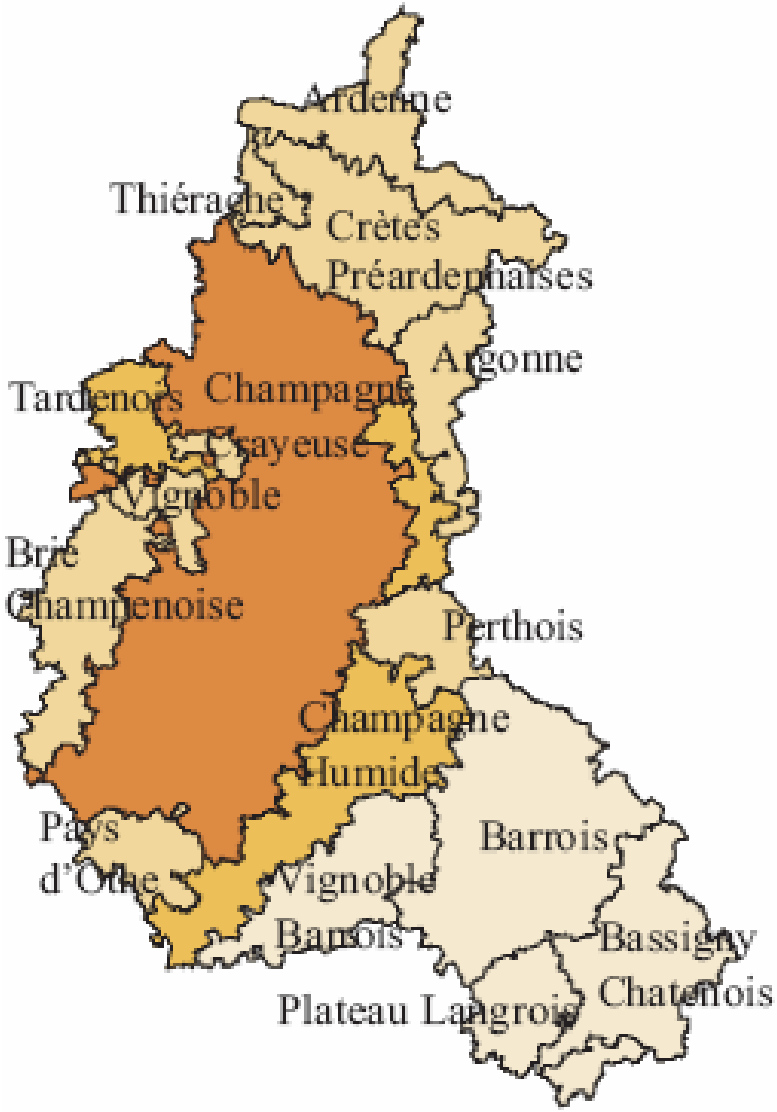

CRAIES DE NORMANDIE et PICARDIE
CARENTAN
LAON
REIMS
VERDUN
METZ
PARIS
CRAIES DE CHAMPAGNE
NANCY
CHARTRES
SENS
TROYES
CHAUMONT
LE MANS
ORLEANS
AUXERRE
DIJON
TOURS
BOURGES
Craies et tuffeaux
0
200 km
TERTIAIRE
SECONDAIRE
Crétacé sup.
Crétacé inf.
Jurassique sup.
Jurassique inf.
PRIMAIRE


Occupation du sol
Tissu urbain
Tissu urbain discontinu
Terres arables
Prairies
Forêts
Vignes



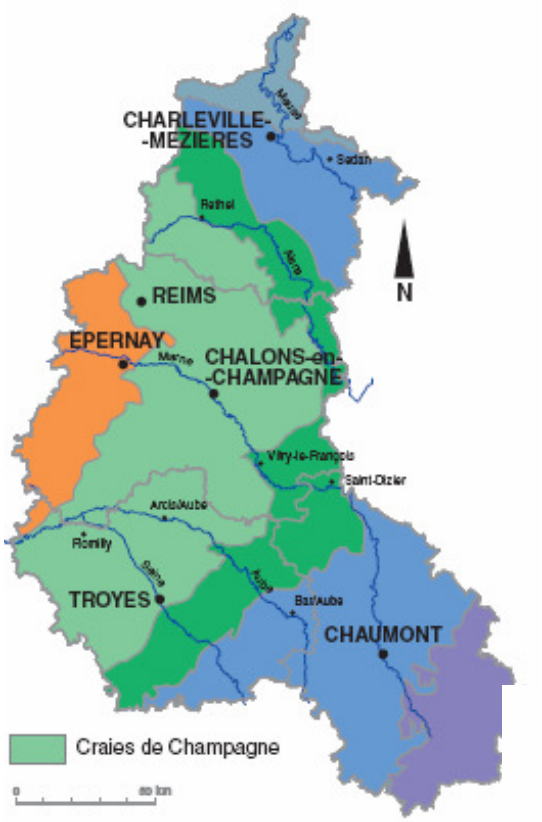
Rendement en blé tendre (qx/ha)

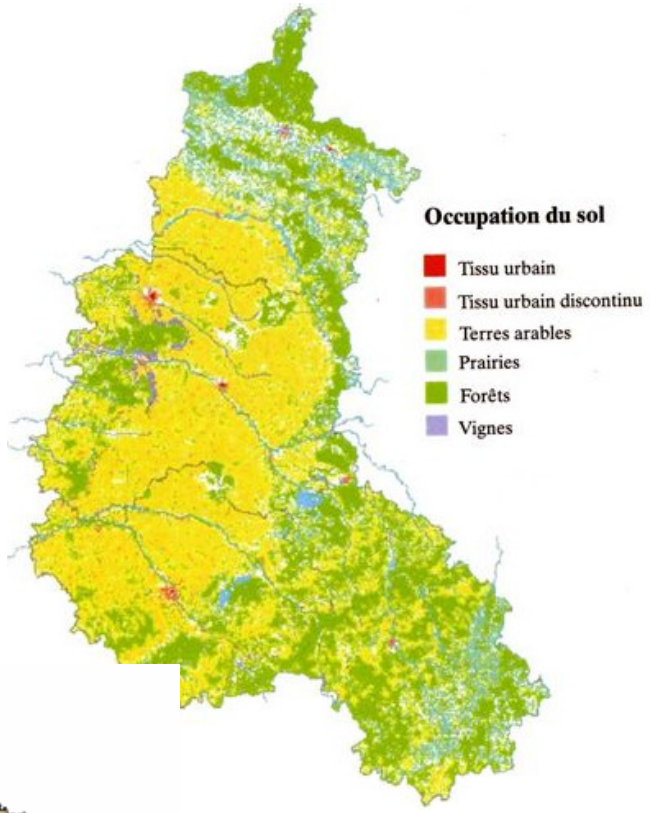
75
60
65

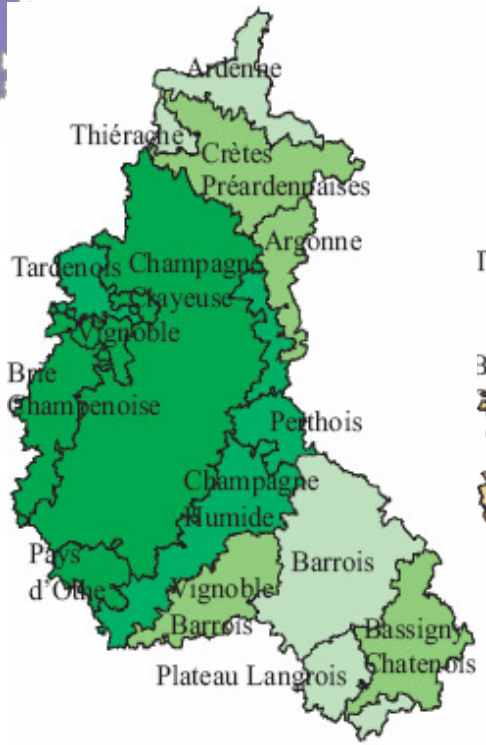


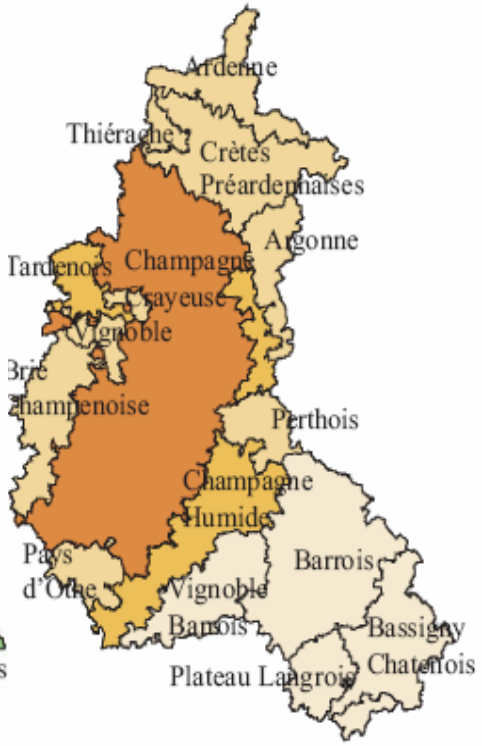
Rendement en orge de printemps (qx/ha)

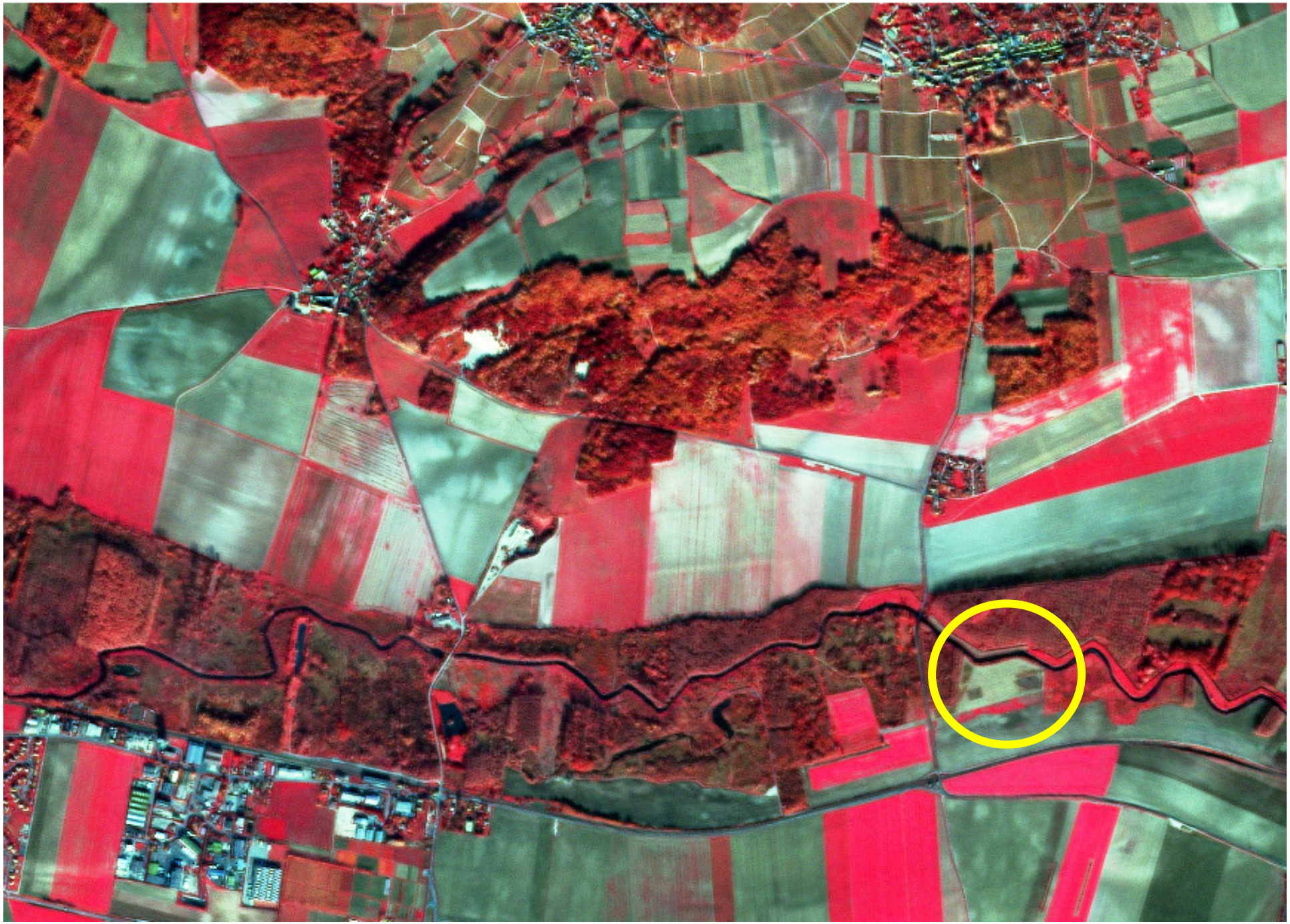
65
60
50


CHARLEVILLE-
-MEZIERES
Sedan
Rethel
Aisne
REIMS
N
EPERNAY
Marne
CHALONS-en-
-CHAMPAGNE
Vitry-le-François
Saint-Dizier
Arcis/Aube
Romilly
Seine
Aube
TROYES
Bar/Aube
CHAUMONT
Craies de Champagne
0
40 km


Occupation du sol
Tissu urbain
Tissu urbain discontinu
Terres arables
Prairies
Forêts
Vignes


Ardenne
Thiérache
Crêtes
Préardennaises
Argonne
Tardenois
Champagne
Crayeuse
Vignoble
Brie
Champenoise
Perthois
Champagne
Humide
Pays
d'Othe
Barrois
Vignoble
Barrois
Bassigny
Chatenois
Plateau Langrois


Ardenne
Thiérache
Crêtes
Préardennaises
Argonne
Champagne
Crayeuse
Vignoble
Perthois
Champagne
Humide
Barrois
Vignoble
Barrois
Bassigny
Chatenois
Plateau Langrois



Nitrate Protocol

Purpose

To measure the nitrate-nitrogen (NO_3-N) of water

Overview

Students will use a nitrate kit to measure the nitrate-nitrogen in the water at their hydrology site. The exact procedure depends on the instructions in the nitrate kit used.

Student Outcomes

Students will learn to,

- use a nitrate kit;
- examine reasons for changes in the nitrate of a water body;
- communicate project results with other GLOBE schools;
- collaborate with other GLOBE schools (within your country or other countries); and
- share observations by submitting data to the GLOBE archive.

Science Concepts

Earth and Space Science

Each element moves among different reservoirs (biosphere, lithosphere, atmosphere, hydrosphere).

Earth materials are solid rocks, soils, water and the atmosphere.

Water is a solvent.

Physical Sciences

Objects have observable properties.

Life Sciences

Organisms can only survive in environments where their needs are met.

Earth has many different environments that support different combinations of organisms.

Organisms change the environment in which they live.

Humans can change natural environments.

All organisms must be able to obtain and use resources while living in a constantly changing environment.

Scientific Inquiry Abilities

Use a chemical test kit to measure nitrates.

Identify answerable questions.

Design and conduct scientific investigations.

Use appropriate mathematics to analyze data.

Develop descriptions and explanations using evidence.

Recognize and analyze alternative explanations.

Communicate procedures and explanations.

Time

20 minutes for nitrate test

Quality Control Procedure: 20 minutes

Level

Middle and Advanced

Frequency

Weekly

Quality control every 6 months

Materials and Tools

Nitrate Test Kit (if you have salt or brackish water, be sure to use an appropriate test kit)

Nitrate Protocol Field Guide

Hydrology Quality Control Sheet

Hydrology Investigation Data Sheet

Clock or watch

Latex gloves

Goggles

Surgical mask (if using powdered reagents)

Distilled water

For Quality Control Procedure, the above plus:

- *Quality Control Procedure Field Guide*
- *Quality Control Procedure Data Sheet*
- *Making the 2 ppm Nitrate Standard Lab Guide*
- Standard nitrate solution (1000 mg/L nitrate-nitrogen)
- Equipment depends on how the standard is made (see *Making the 2 ppm Nitrate Standard Lab Guide*)

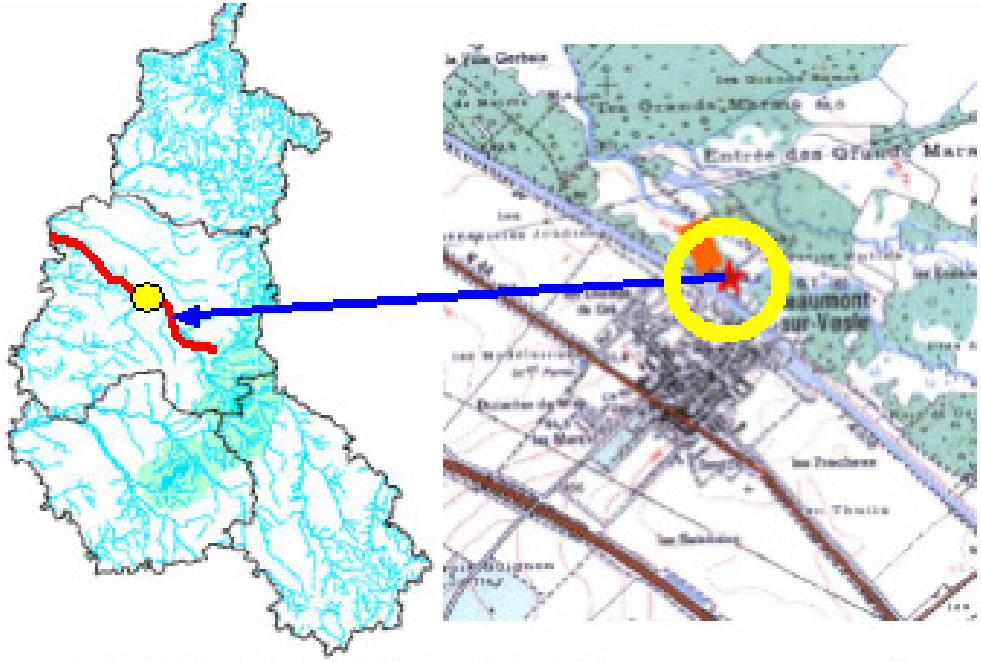
Preparation

Suggested activity: *Practicing Your Protocols, Nitrate Protocol (e-guide only)*

Prerequisites

Discussion of the differences among nitrate, nitrate-nitrogen, and nitrite

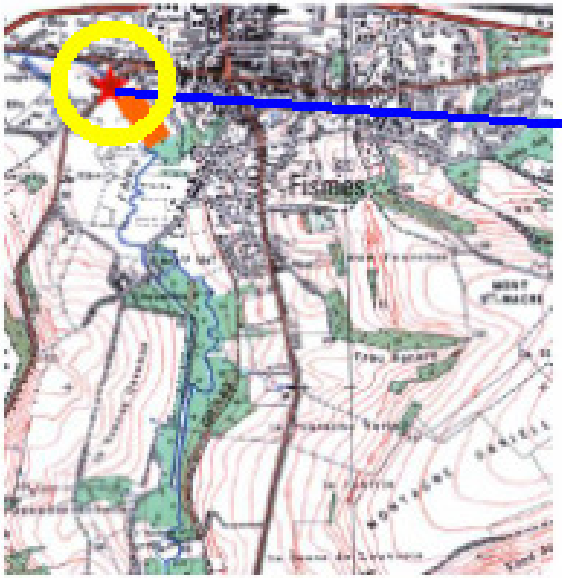
Discussion of safety procedures when using chemical test kits.



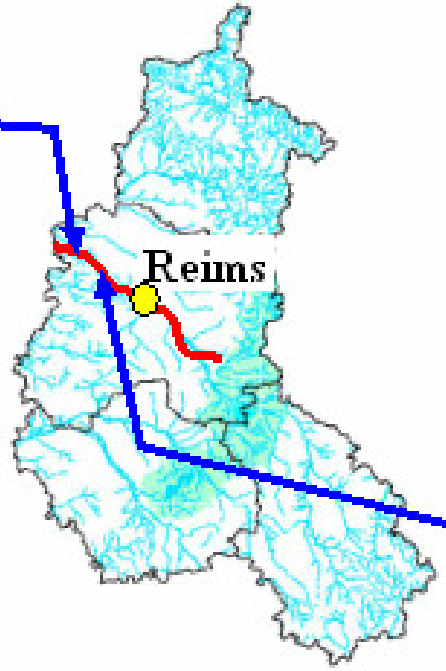
Nitrates : 35

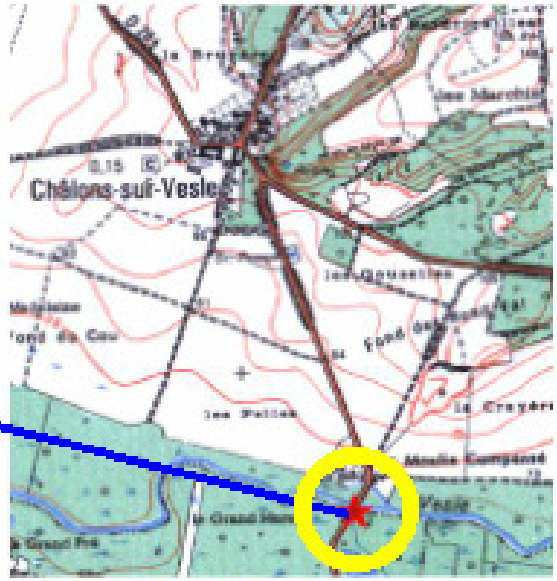
Echelle de qualité

- Très bon
- Bon
- Passable
- Mauvais
- Très mauvais



Nitrates : 38

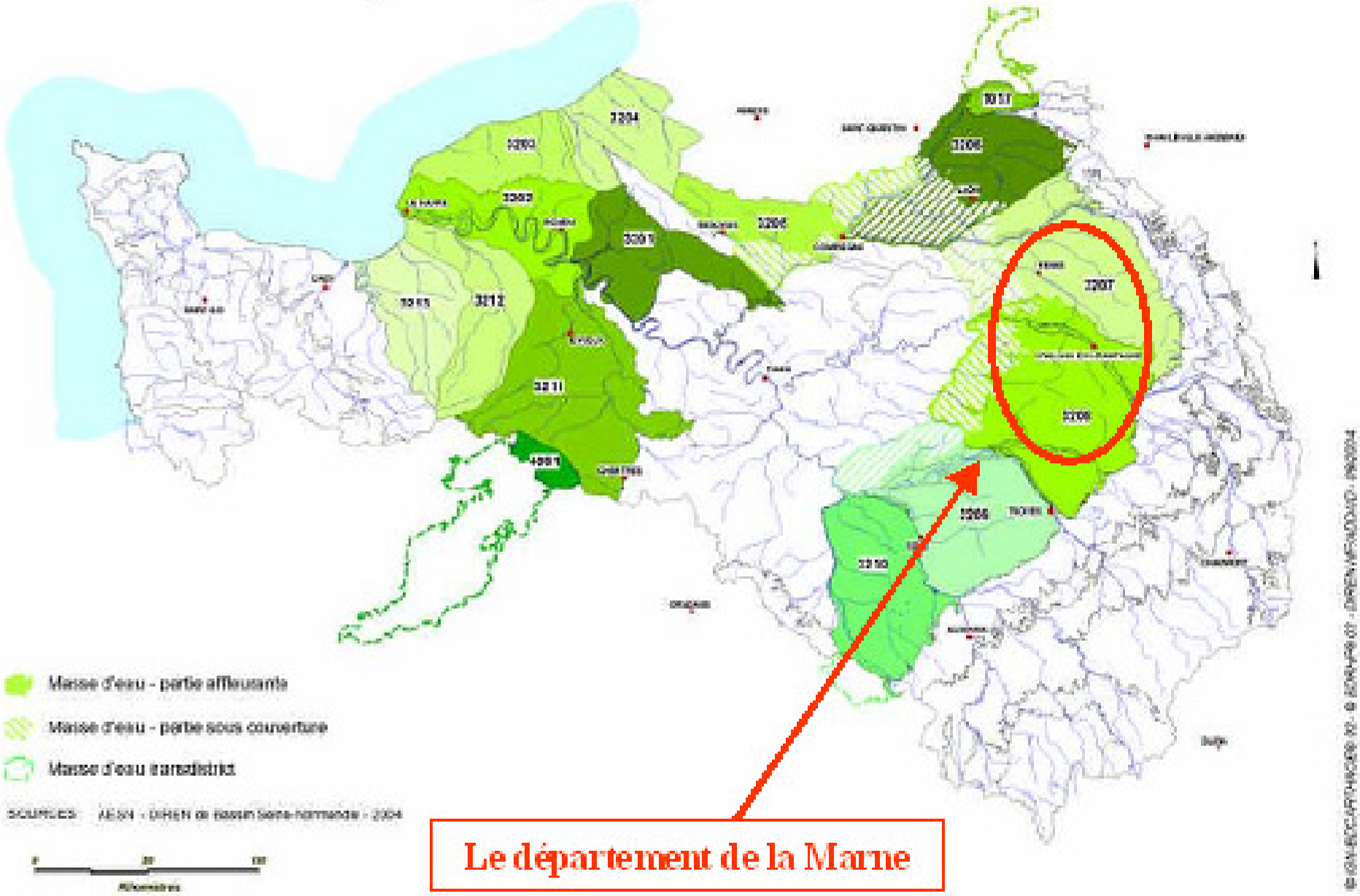


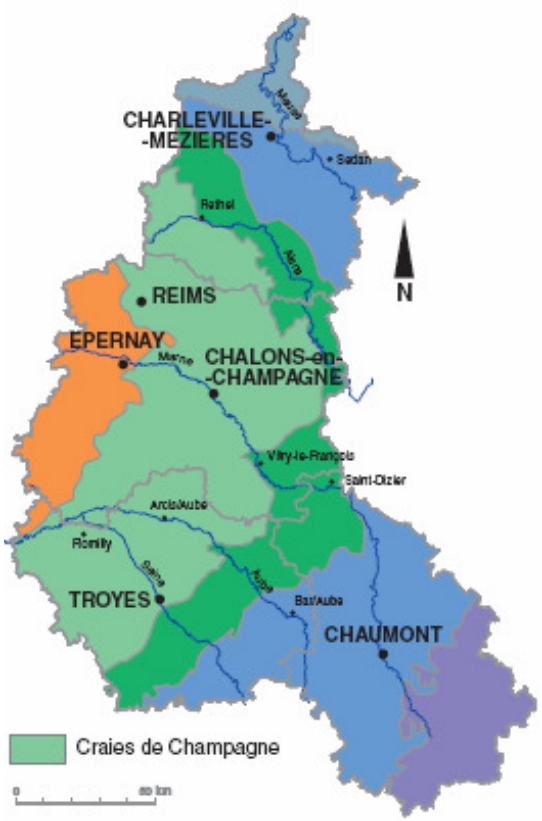


Nitrates : 35

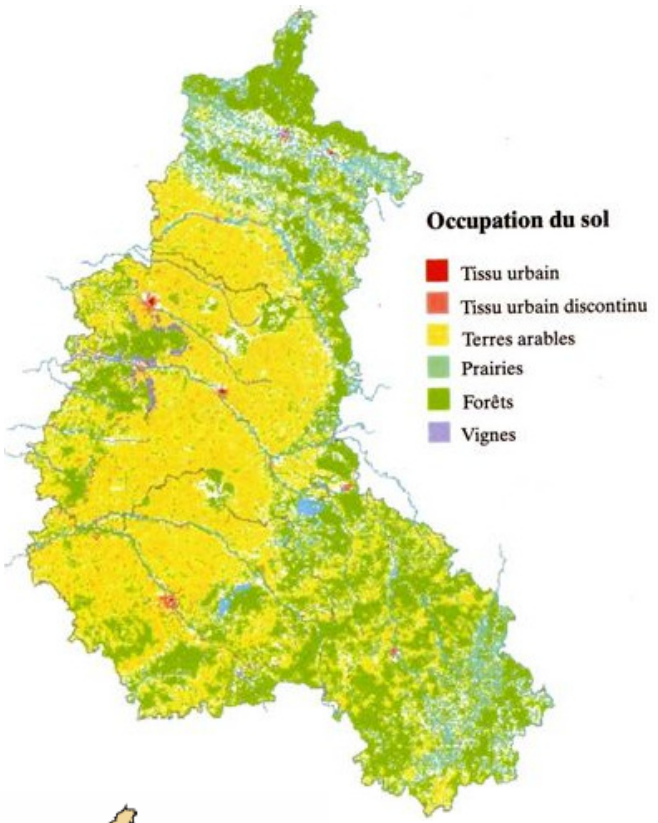
Groundwaters quality

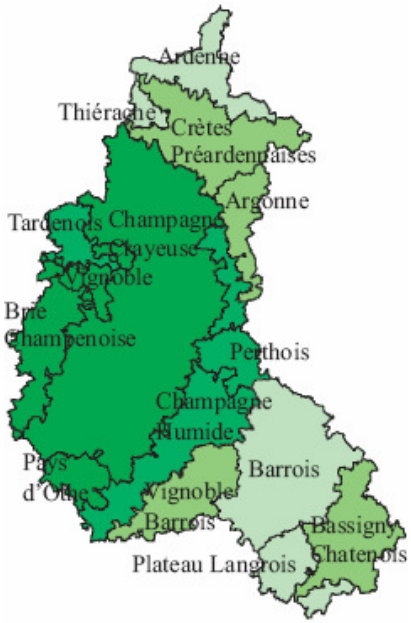
Masses d'eau de la craie (crétacé supérieur)

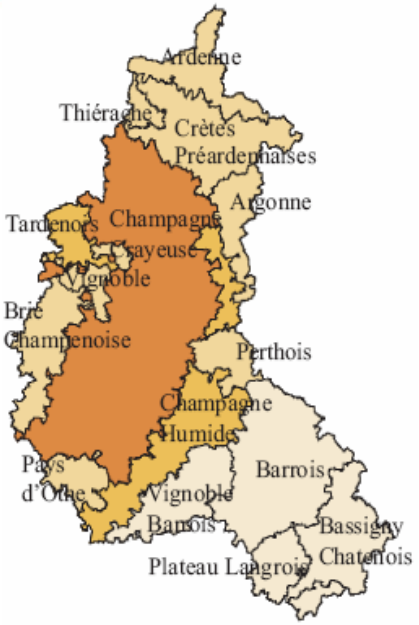


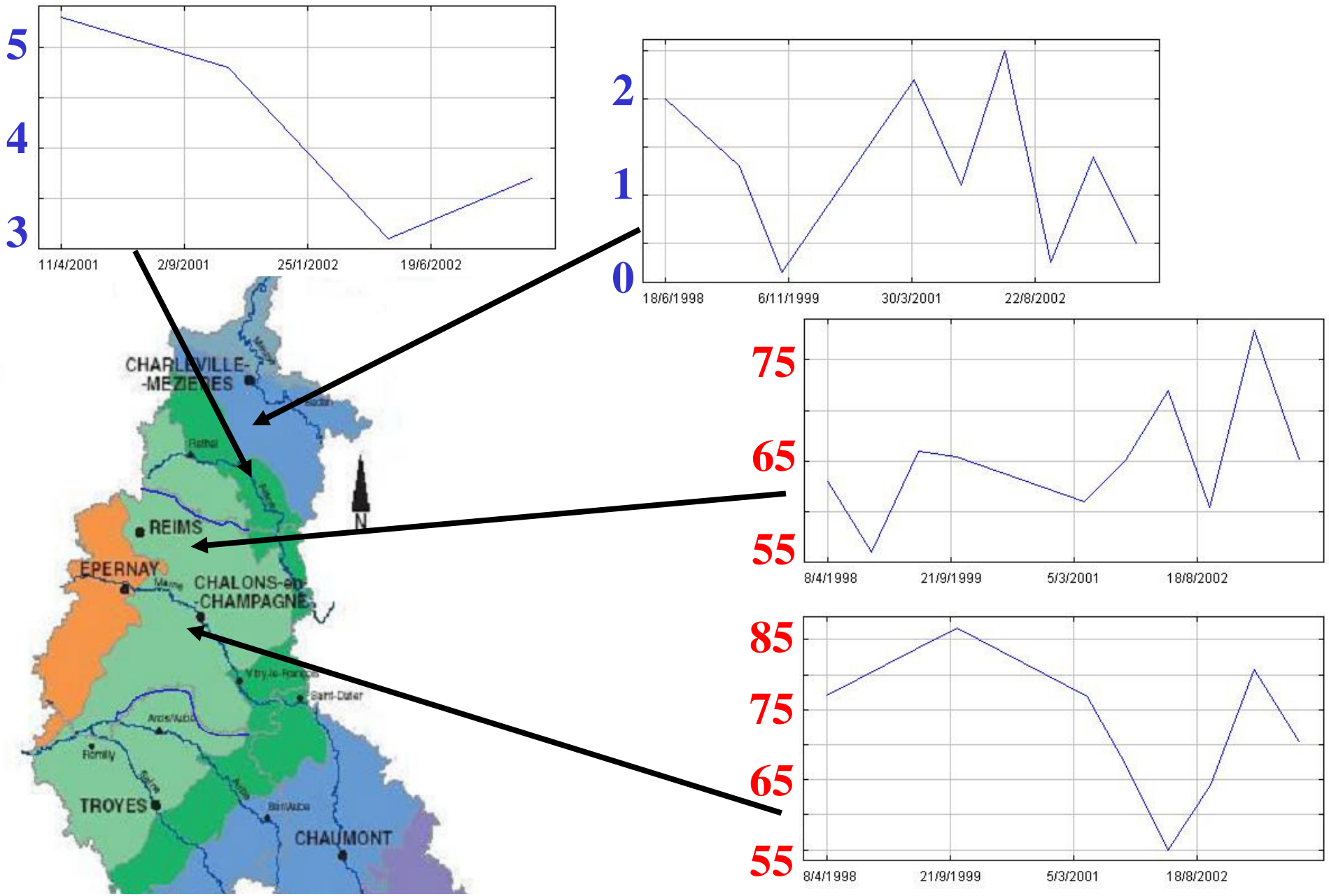

CHARLEVILLE-
-MEZIERES
Sedan
Rethel
Aisne
REIMS
N
EPERNAY
Marne
CHALONS-en-
-CHAMPAGNE
Vitry-le-François
Saint-Dizier
Arcis/Aube
Romilly
Seine
Aube
TROYES
Bar/Aube
CHAUMONT
Craies de Champagne
0
40 km


Nappe
de la craie
ARDENNES
MARNE
AUBE
HAUTE
-MARNE


Occupation du sol
Tissu urbain
Tissu urbain discontinu
Terres arables
Prairies
Forêts
Vignes

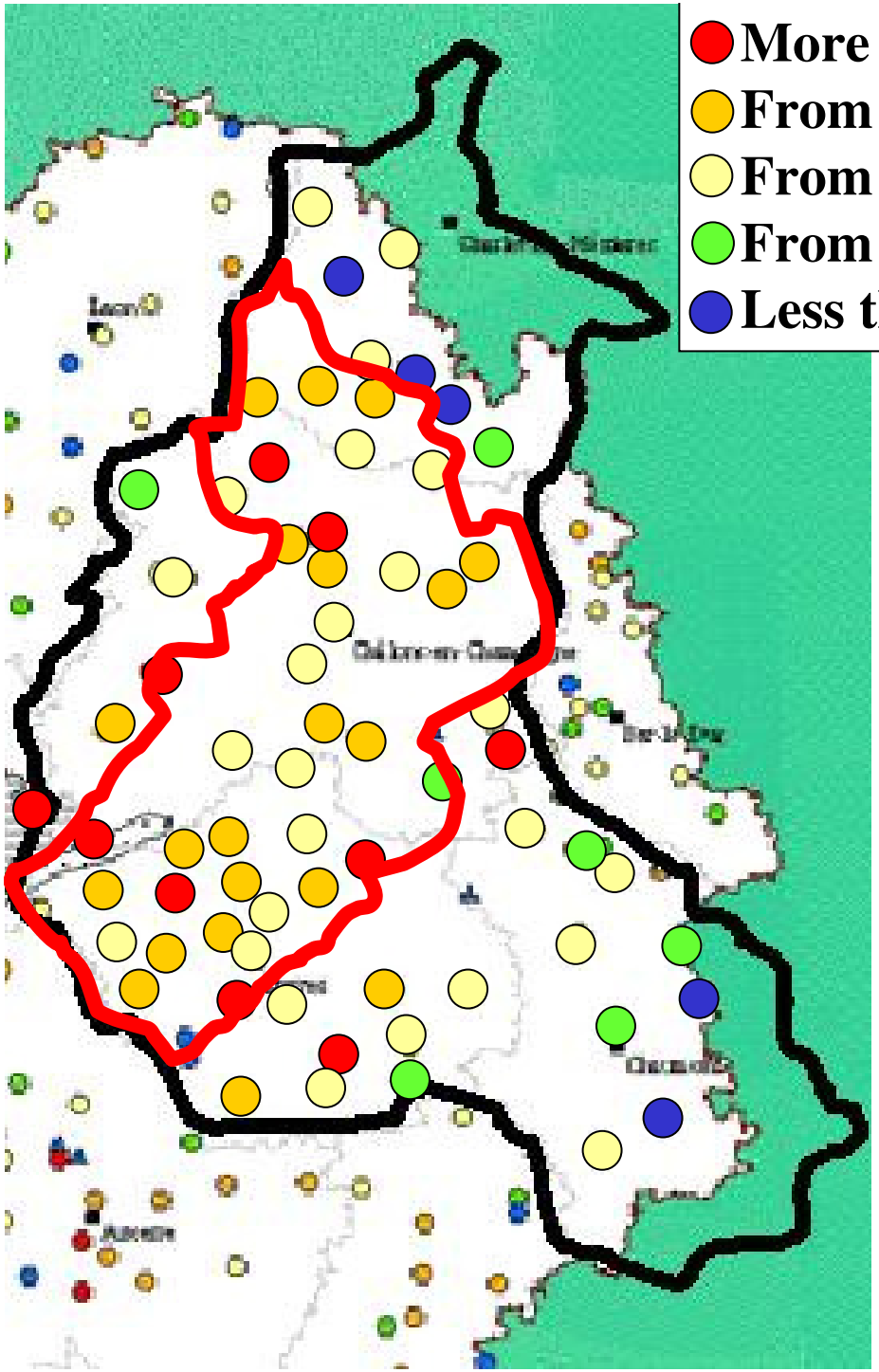

Ardenne
Thiérache
Crêtes
Préardennaises
Argonne
Tardenois
Champagne
Vignoble
Brie
Champenoise
Perthois
Champagne
Humide
Pays
d'Othe
Vignoble
Barrois
Barrois
Bassigny
Plateau Langrois
Chatenois

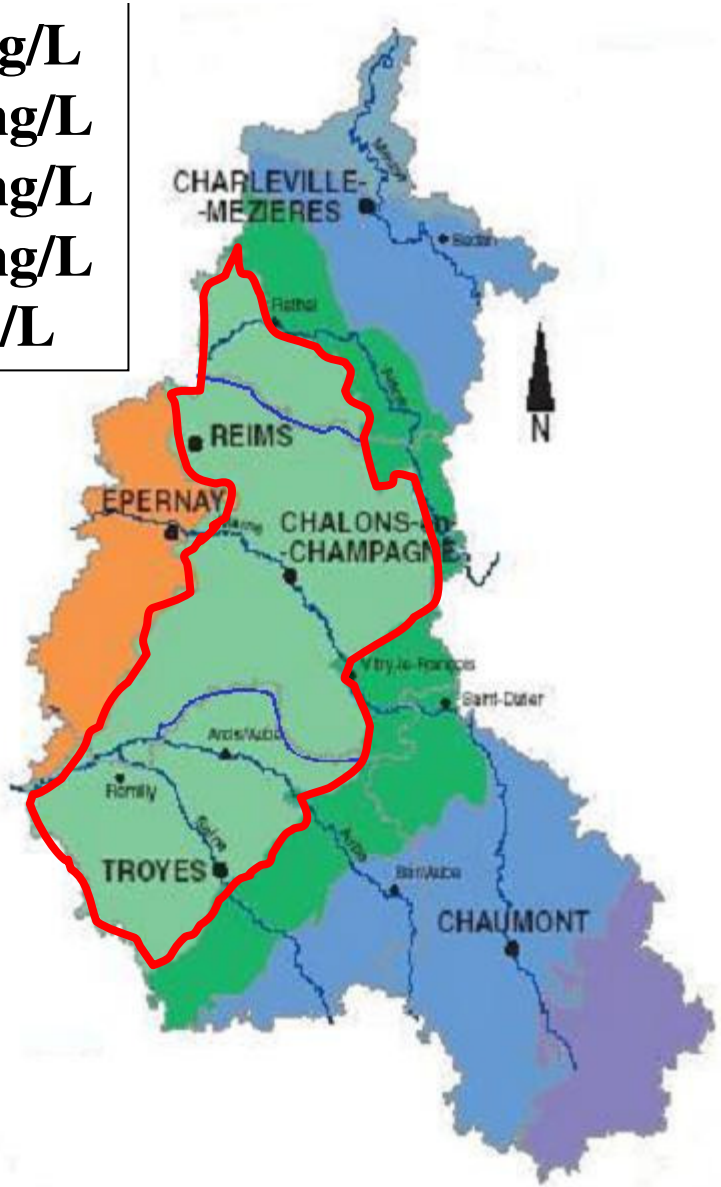

Ardenne
Thiérache
Crêtes
Préardennaises
Argonne
Tardenois
Champagne
Vignoble
Brie
Champenoise
Perthois
Champagne
Humide
Pays
d'Othe
Vignoble
Barrois
Barrois
Bassigny
Plateau Langrois
Chatenois

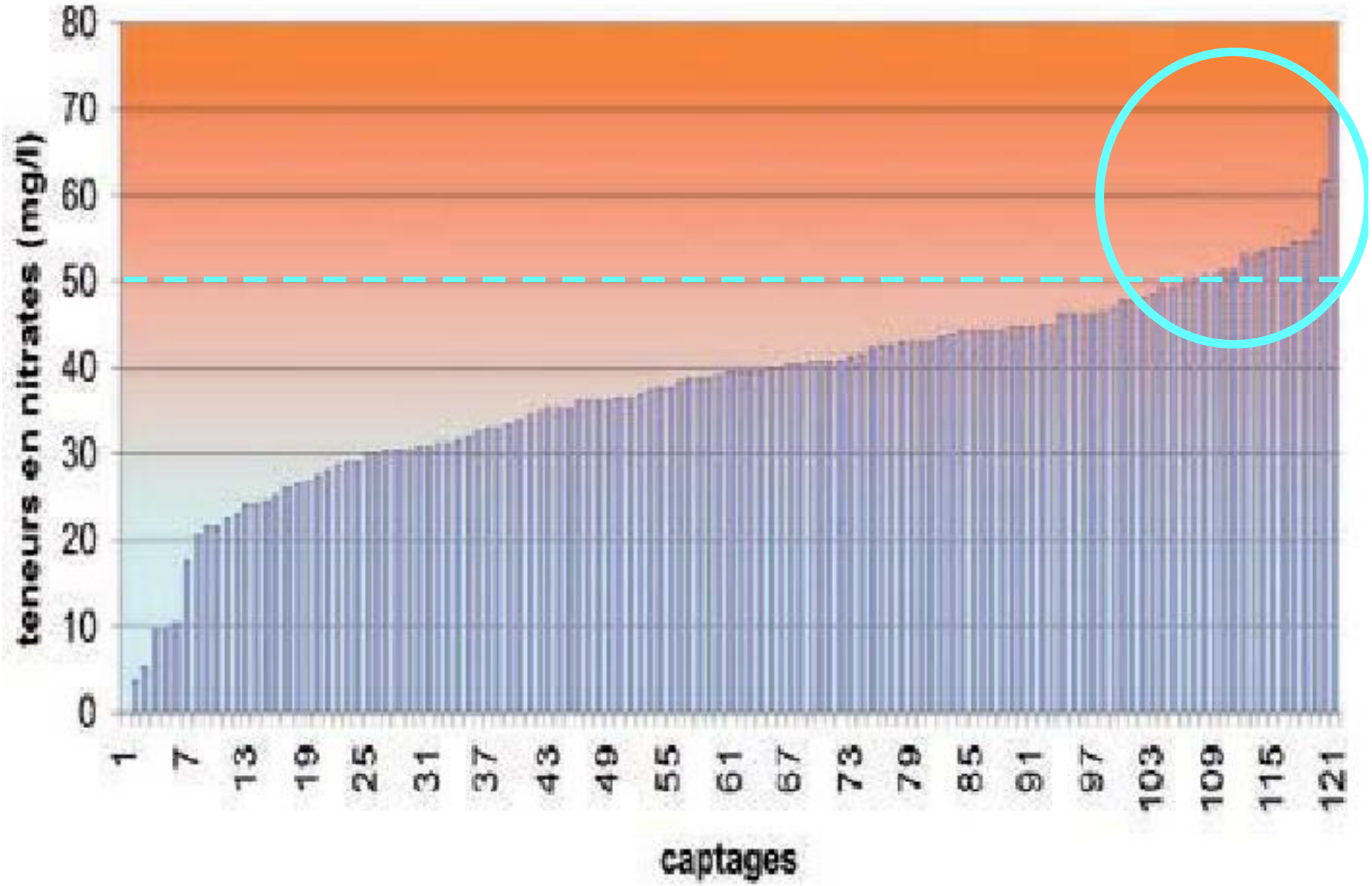


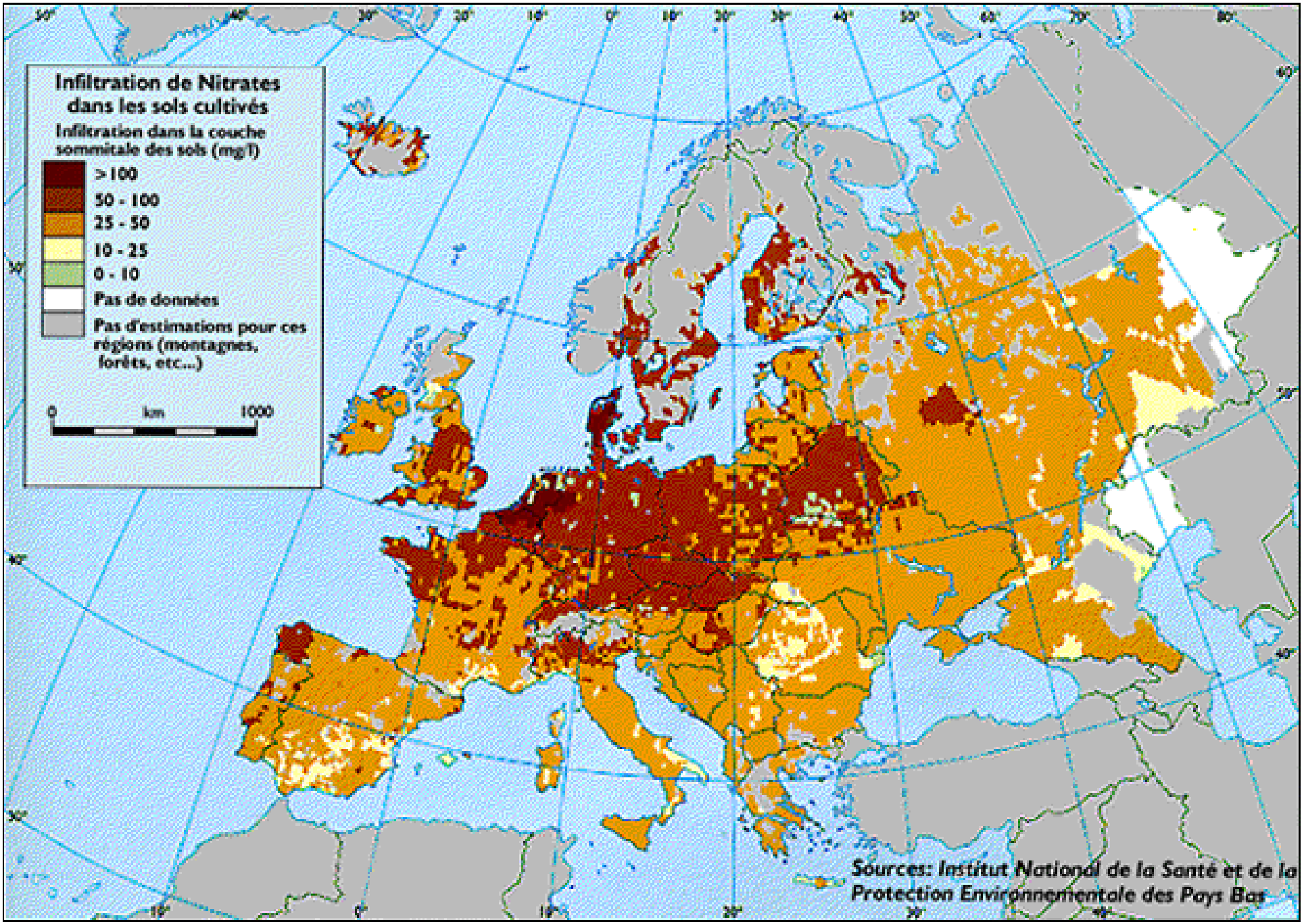
NO_3 en mg/L measured from 1998 untill 2003

European Community maximum value for drinking water: 50 mg/L

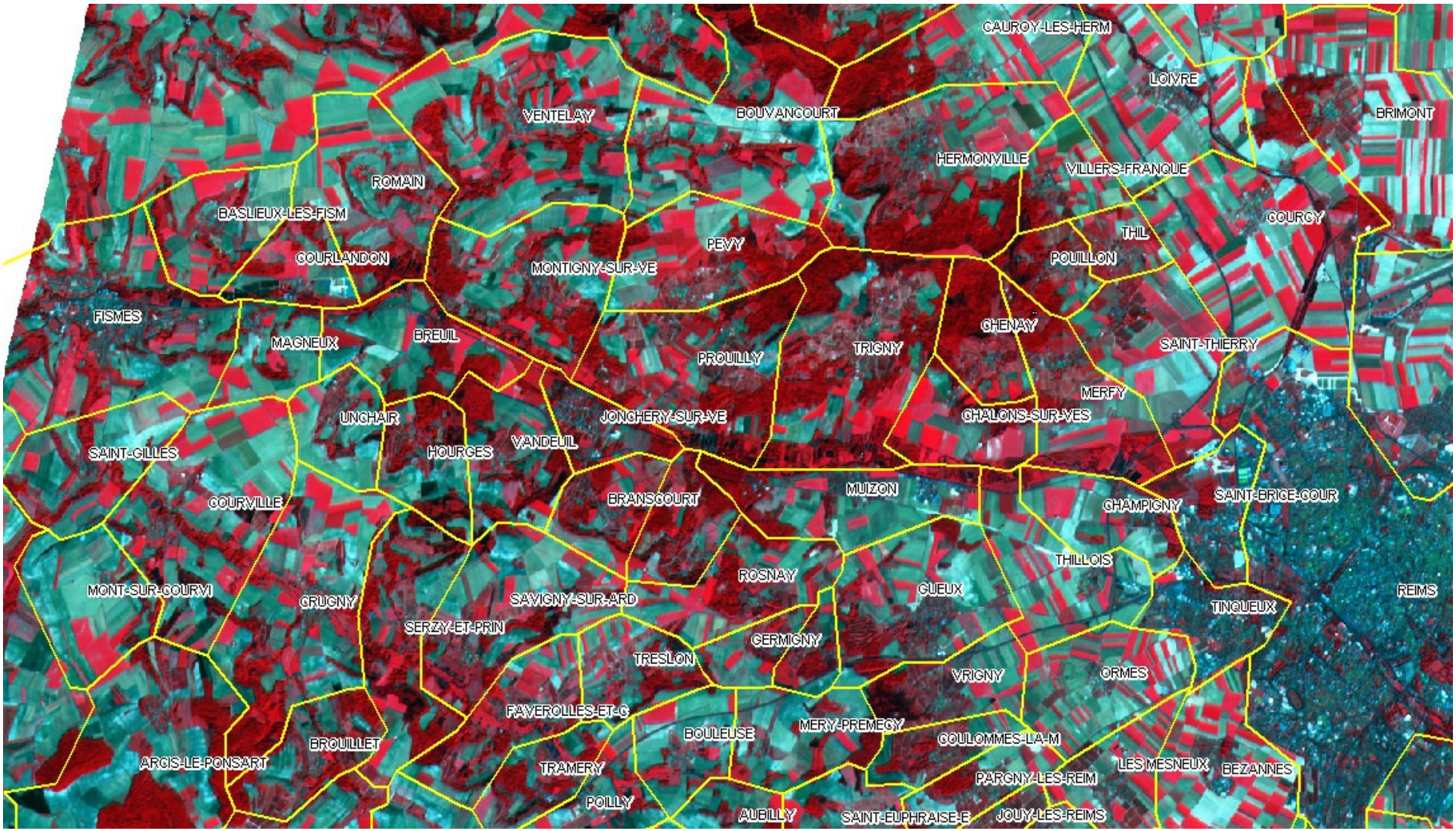

More than 50 mg/L
From 40 to 50 mg/L
From 20 to 40 mg/L
From 10 to 20 mg/L
Less than 10 mg/L


CHARLEVILLE-
-MEZIERES
REIMS
EPERNAY
CHALONS-
-CHAMPAGN
TROYES
CHAUMONT
N


teneurs en nitrates (mg/l)
0
10
20
30
40
50
60
70
80
1
7
13
19
25
31
37
43
49
55
61
67
73
79
85
91
97
103
109
115
121
captages

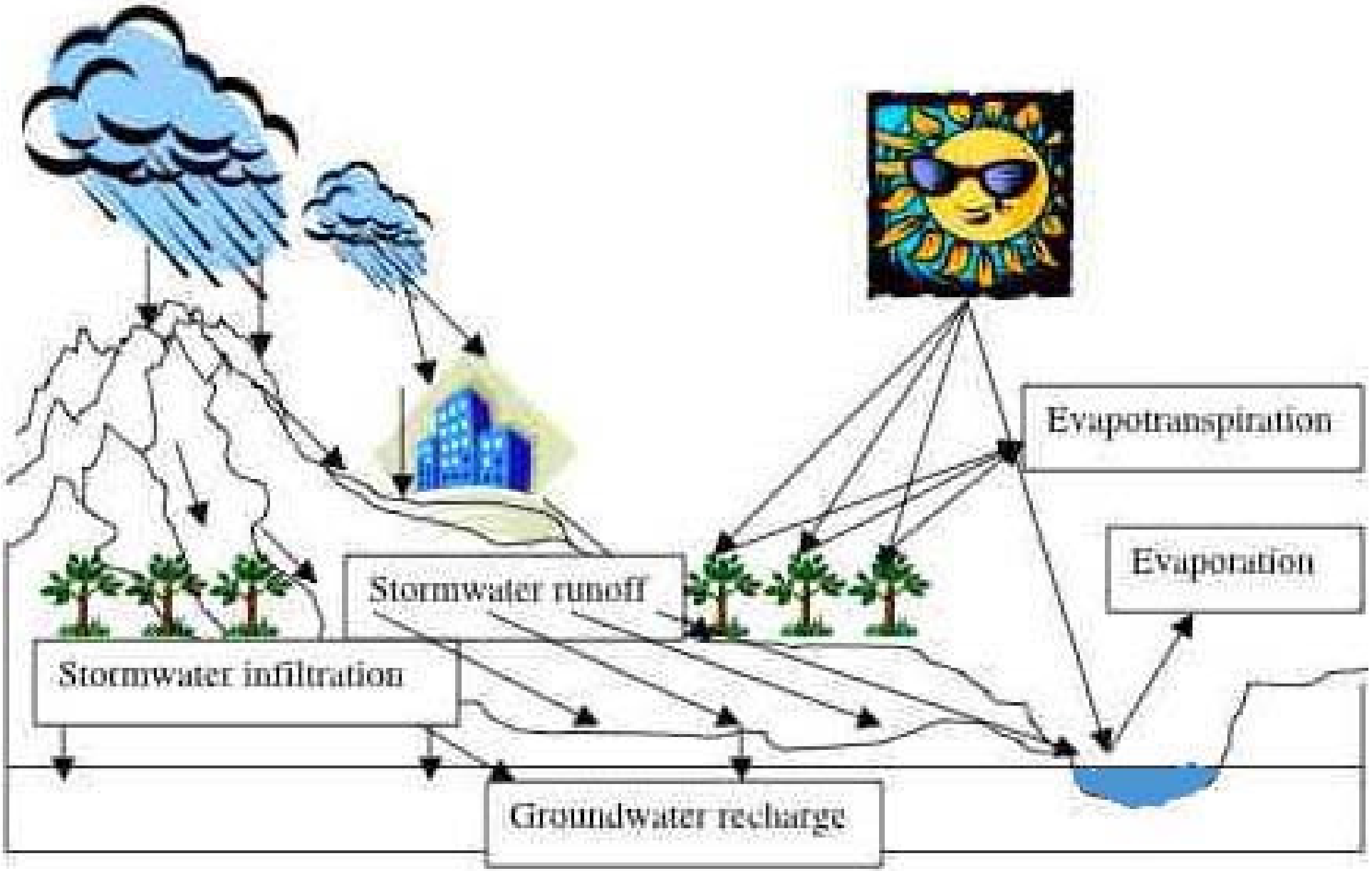

Infiltration de Nitrates dans les sols cultivés
Infiltration dans la couche sommitale des sols (mg/l)
> 100
50 - 100
25 - 50
10 - 25
0 - 10
Pas de données
Pas d'estimations pour ces régions (montagnes, forêts, etc...)
0
km
1000
Sources: Institut National de la Santé et de la Protection Environnementale des Pays Bas

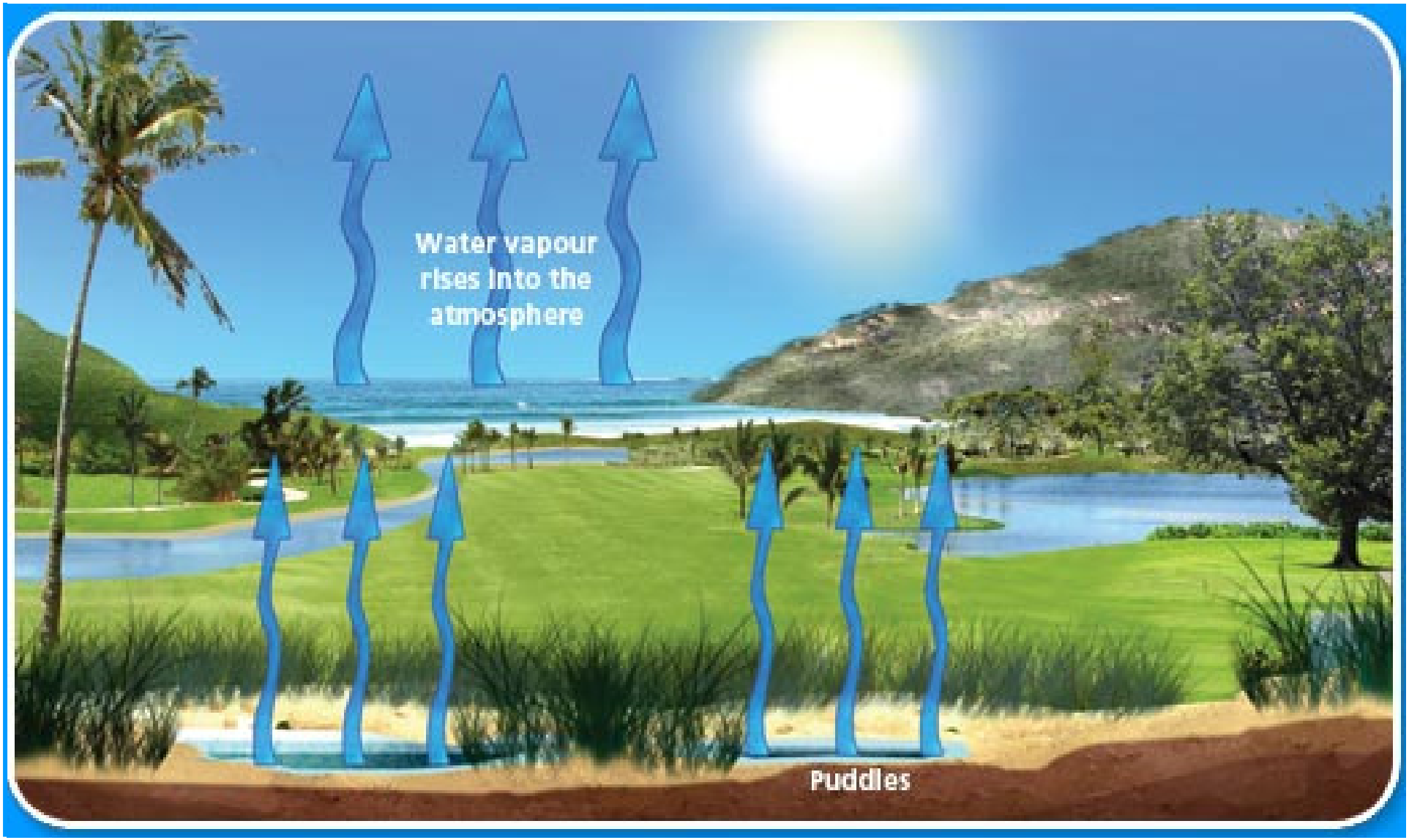
GIS

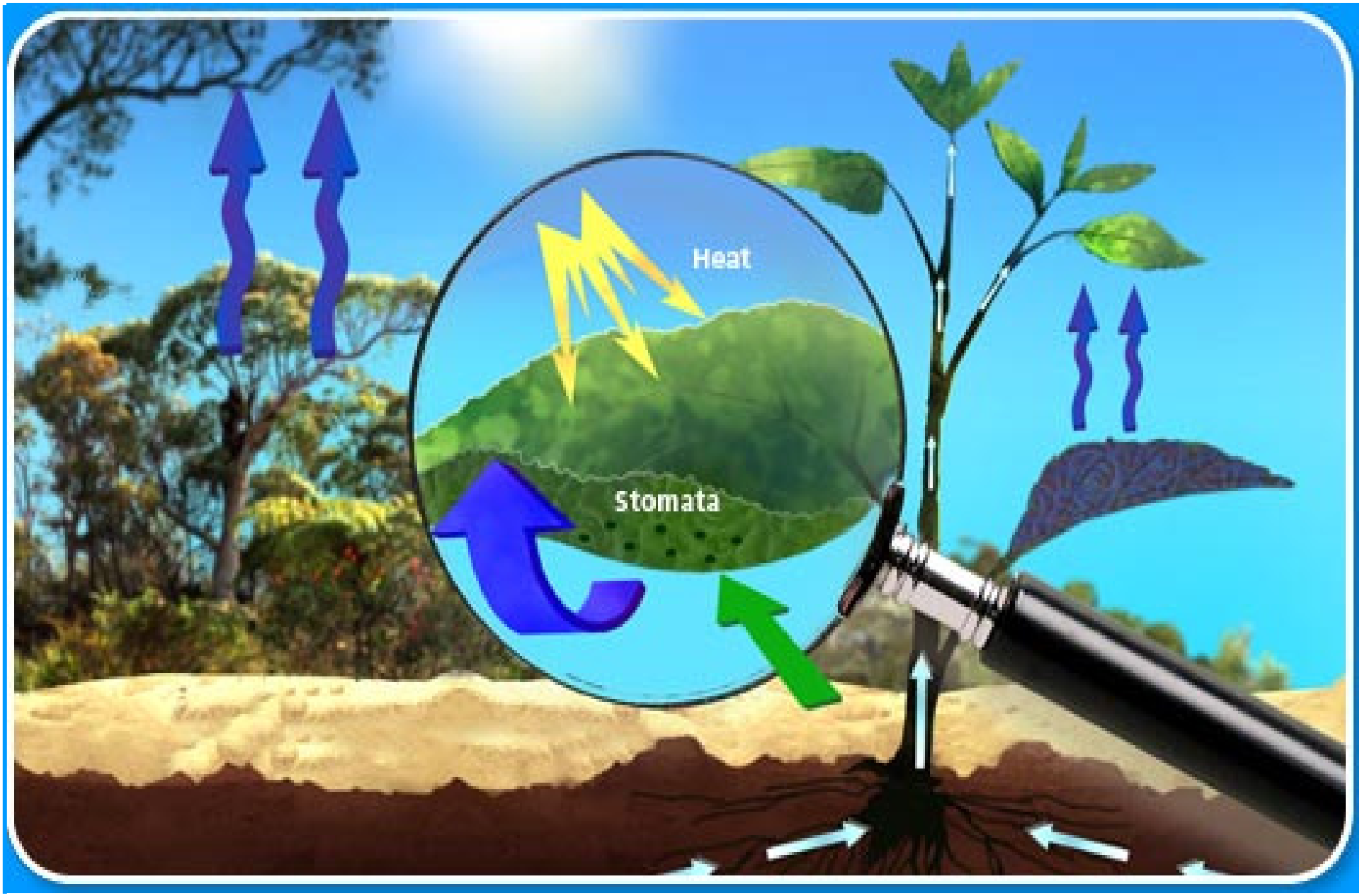

CAUROY-LES-HERM
LOIVRE
BRIMONT
VENTELAY
BOUVANCOURT
HERMONVILLE
VILLERS-FRANQUE
ROMAIN
BASLIEUX-LES-FISM
COURCY
THIL
PEVY
POUILLON
COURLANDON
MONTIGNY-SUR-VE
FISMES
CHENAY
MAGNEUX
BREUIL
SAINT-THIERRY
PROUILLY
TRIGNY
MERFY
CHALONS-SUR-VES
UNCHAIR
JONCHERY-SUR-VE
SAINT-GILLES
HOURGES
VANDEUIL
MUIZON
COURVILLE
BRANSCOURT
CHAMPIGNY
SAINT-BRICE-COUR
THILLOIS
ROSNAY
MONT-SUR-COURVI
GUEUX
REIMS
CRUGNY
SAVIGNY-SUR-ARD
TINQUEUX
SERZY-ET-PRIN
GERMIGNY
TRESLON
VRIGNY
ORMES
FAVEROLLES-ET-G
MERY-PREMECY
BOULEUSE
GOULOMMES-LA-M
BROUILLET
ARCIS-LE-PONSART
TRAMERY
LES MESNEUX
BEZANNES
PARGNY-LES-REIM
POILLY
AUBILLY
SAINT-EUPHRAISE-E
JOUY-LES-REIMS

Where is that water coming from ?

Evaporation
Evapotranspiration


Evapotranspiration
Evaporation
Stormwater runoff
Stormwater infiltration
Groundwater recharge

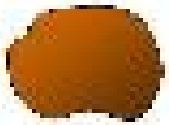

Water vapour rises into the atmosphere
Puddles


Heat
Stomata

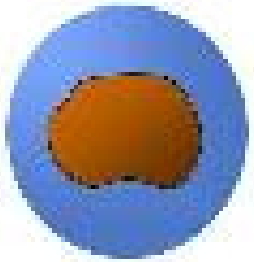
Condensation

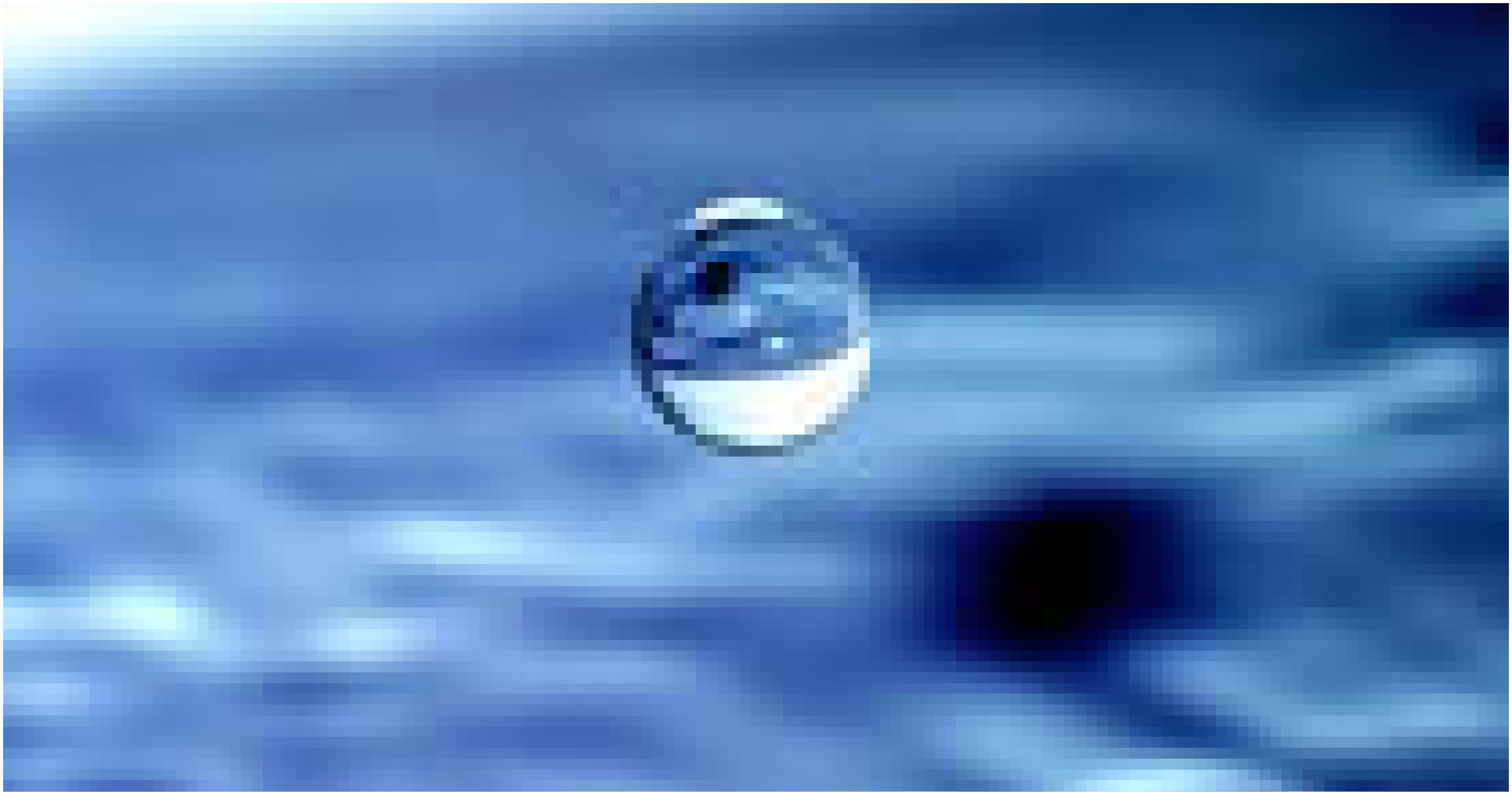

Vapour cools
and condenses
Into clouds
Warm water
vapour condenses
Into drops
Warm water
vapour rises

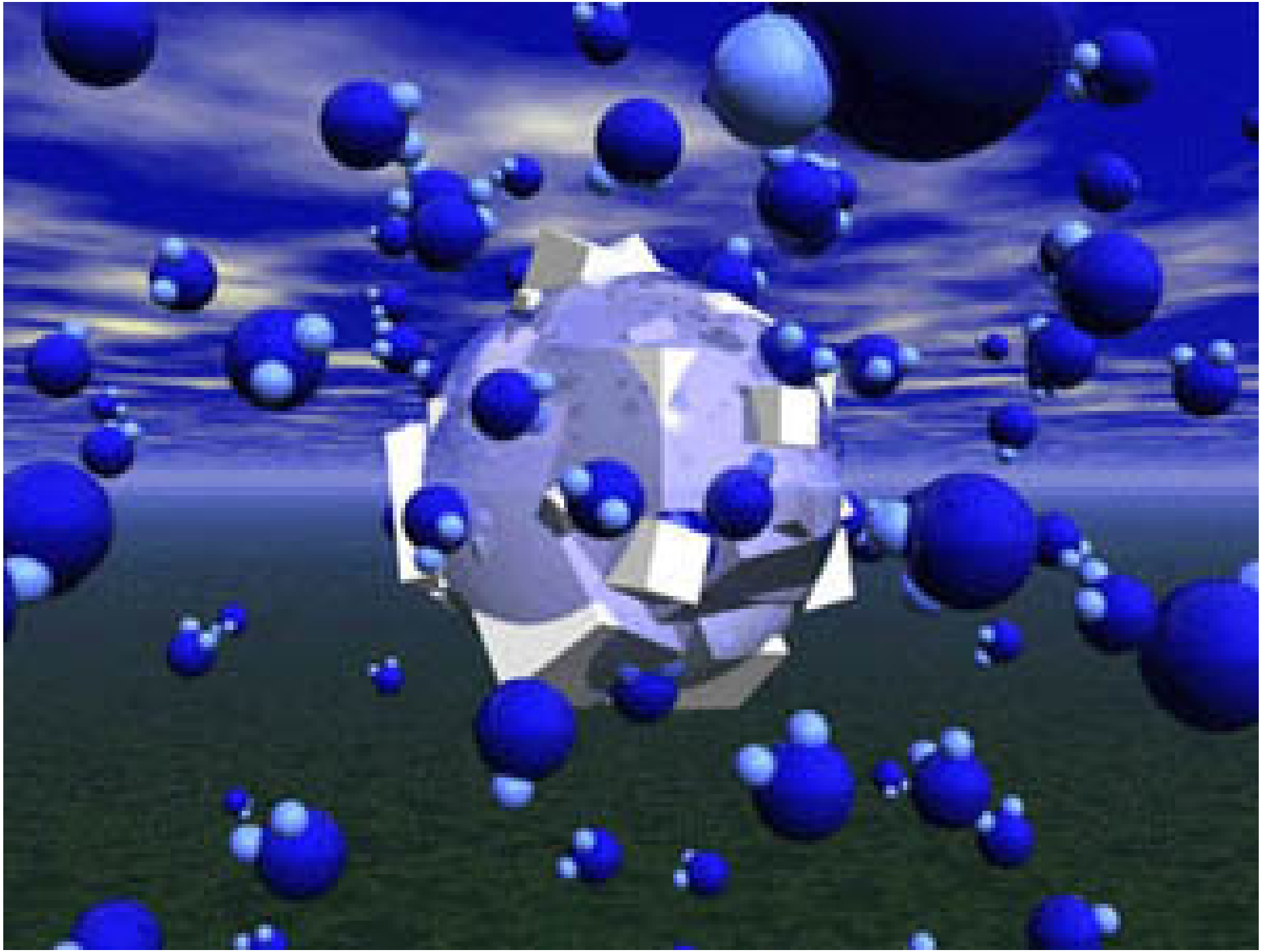
Cloud formation



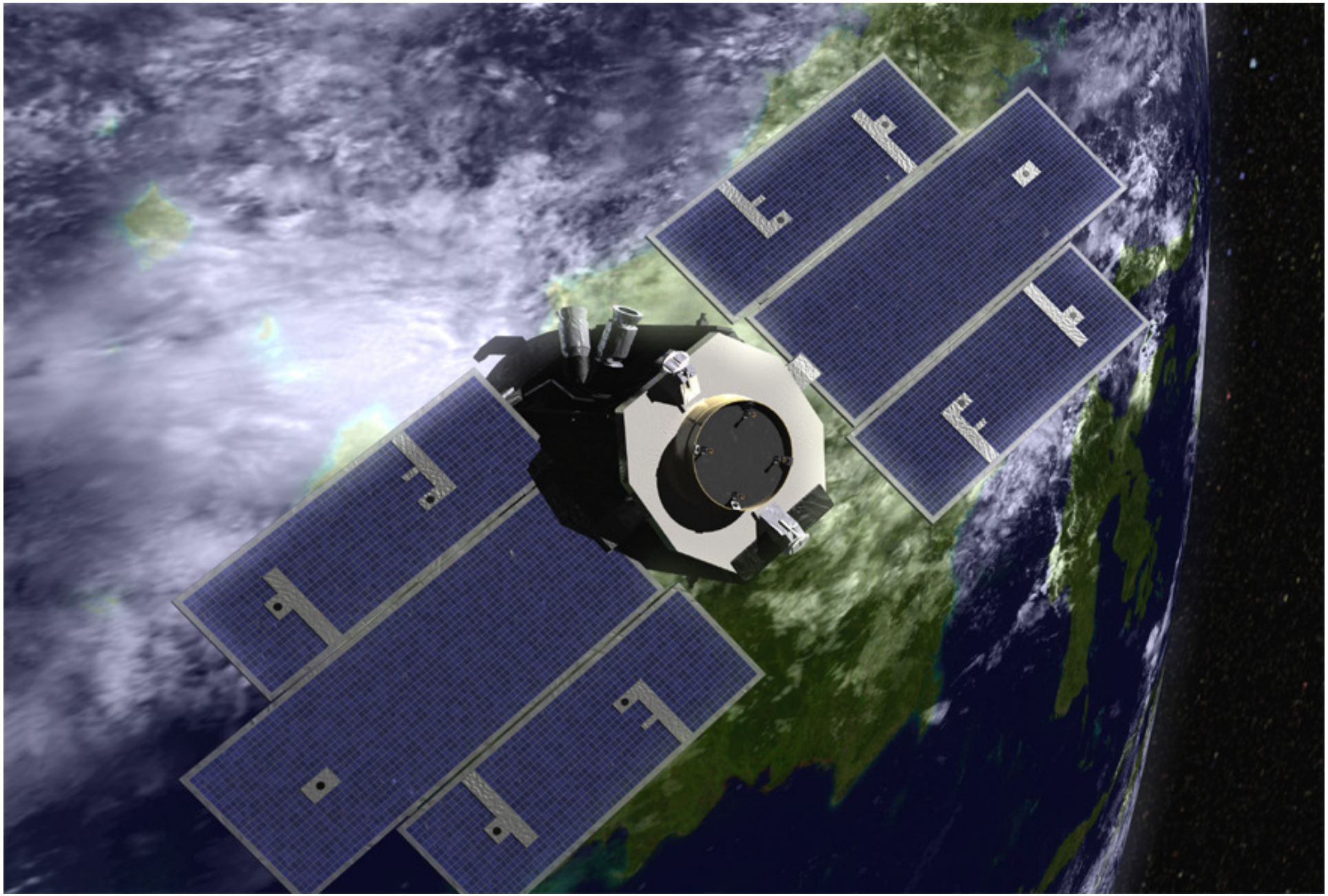
du noyau de condensation à la goutte d'eau





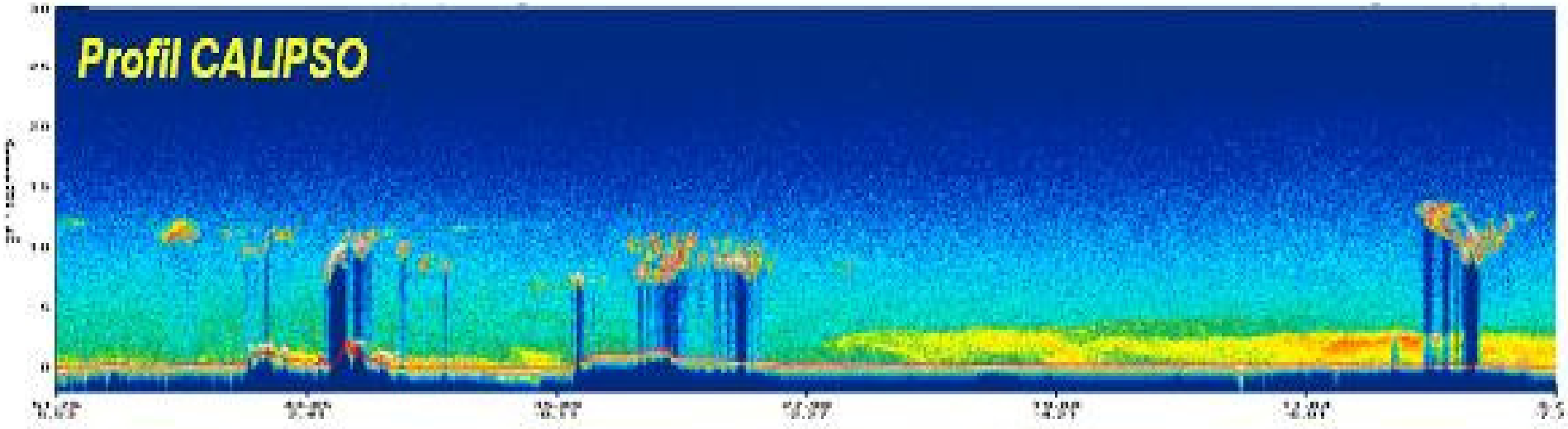


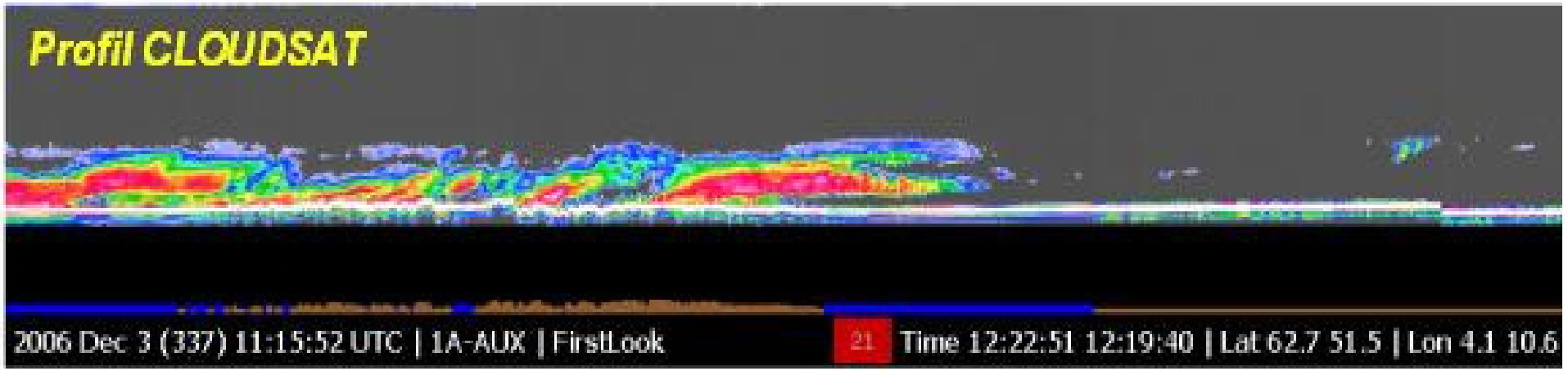
Mission USA - Canada : CloudSat



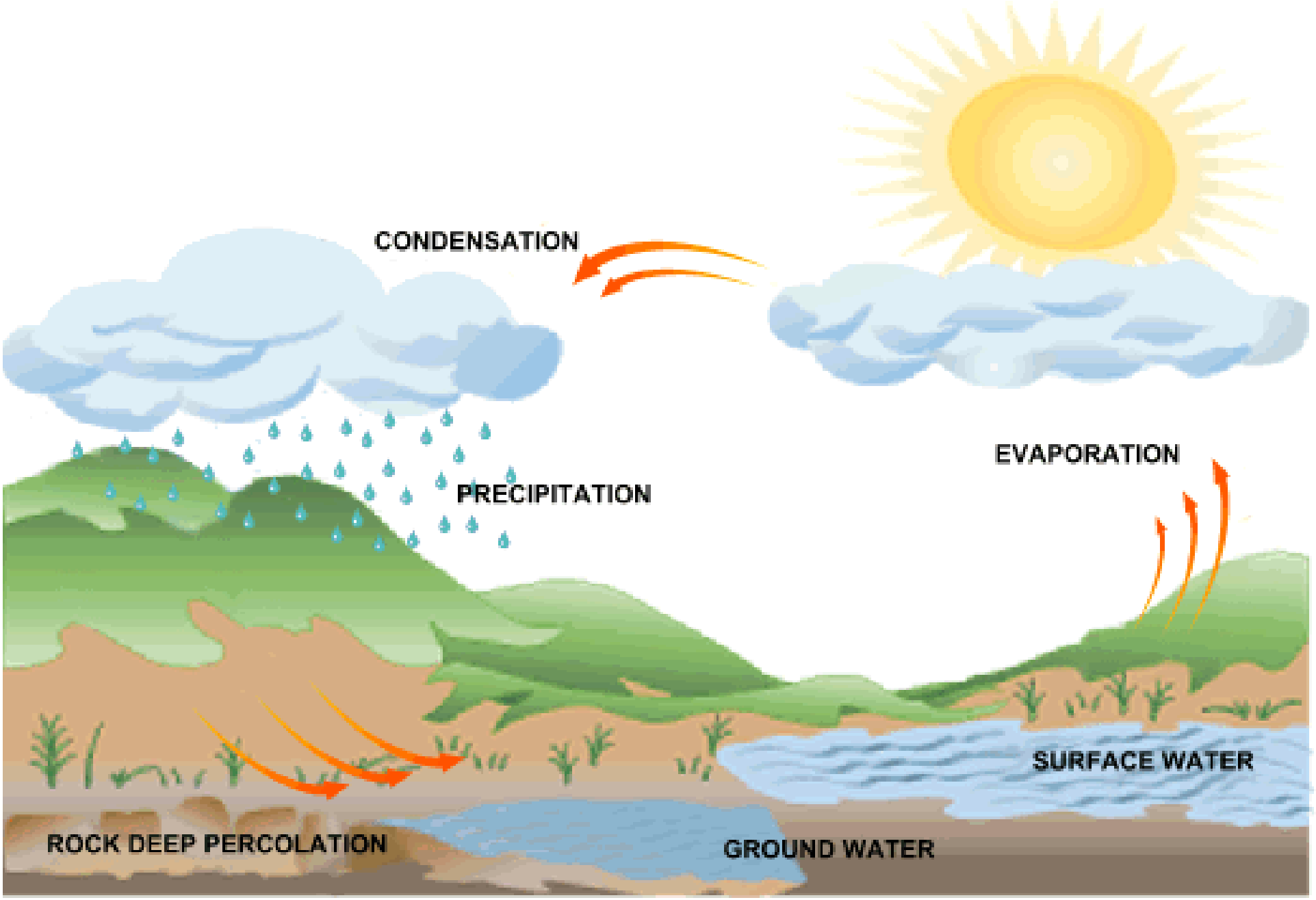
Mission USA – France : CALIPSO

Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observations

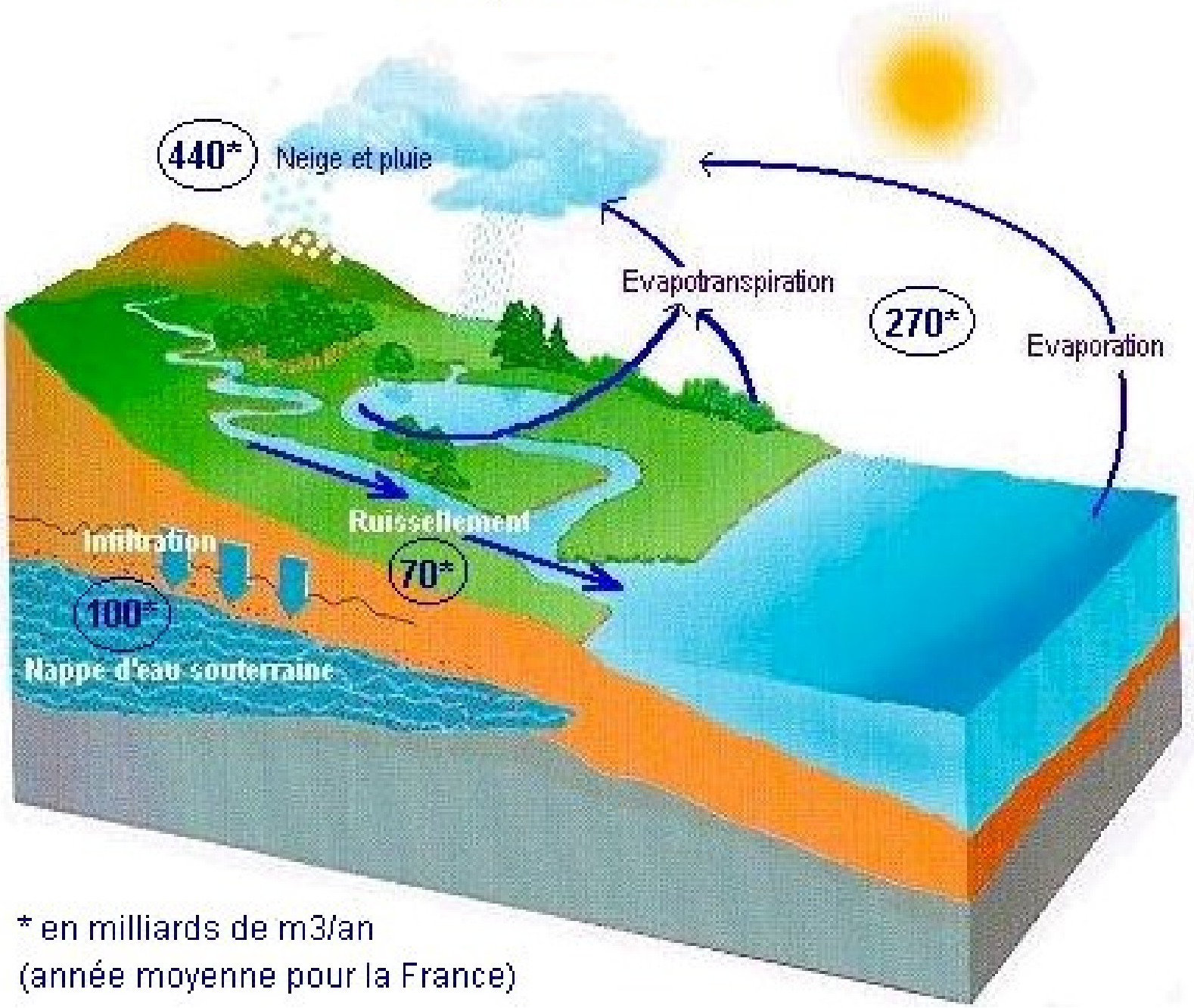

Profil CALIPSO


Profil CLOUDSAT
2006 Dec 3 (337) 11:15:52 UTC | 1A-AUX | FirstLook
21
Time 12:22:51 12:19:40 | Lat 62.7 51.5 | Lon 4.1 10.6

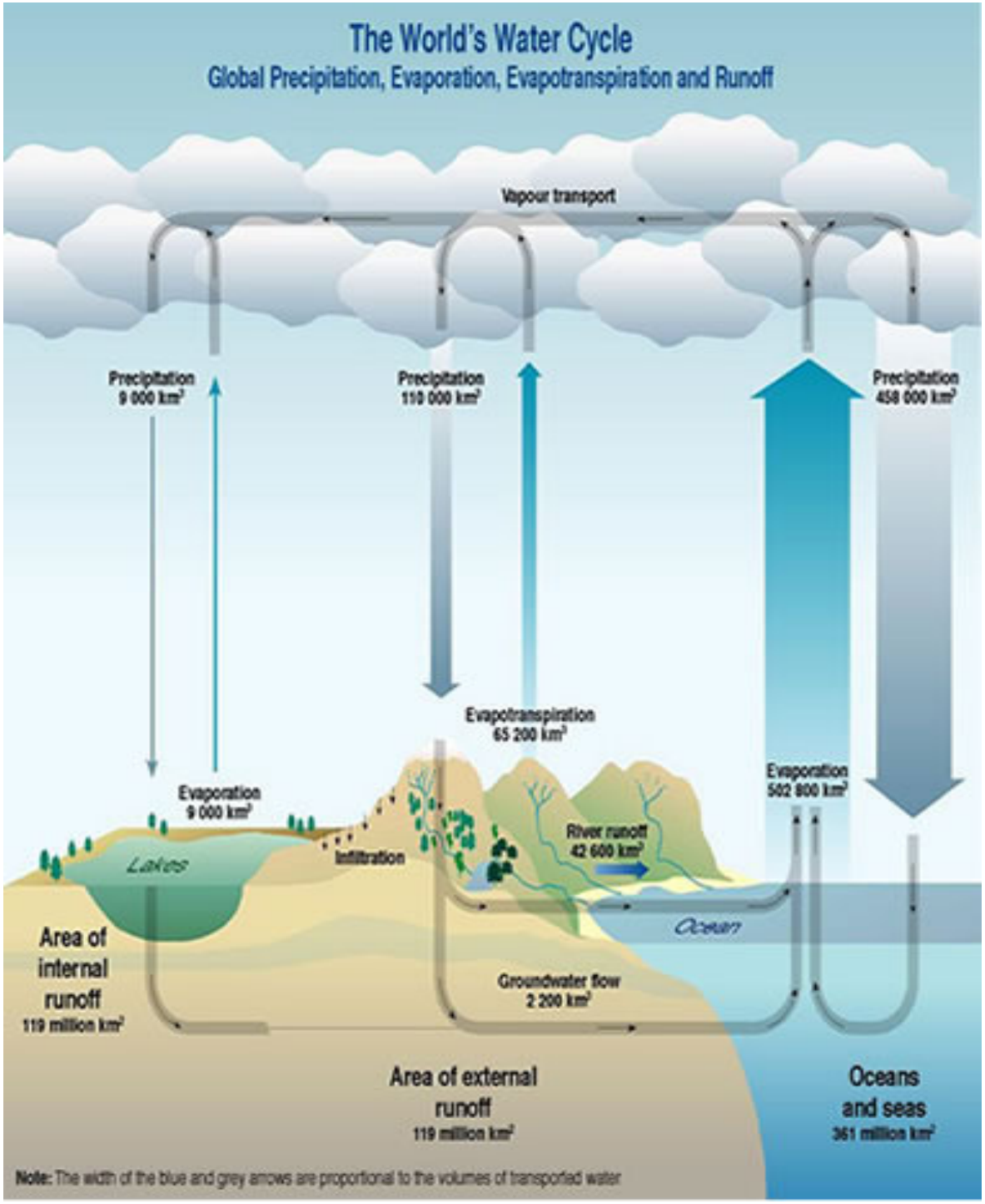
The whole water cycle


CONDENSATION
PRECIPITATION
EVAPORATION
SURFACE WATER
ROCK DEEP PERCOLATION
GROUND WATER

Le cycle de l'eau



* en milliards de m3/an
(année moyenne pour la France)


The World's Water Cycle
Global Precipitation, Evaporation, Evapotranspiration and Runoff
Vapour transport
Precipitation 9 000 km³
Precipitation 110 000 km³
Precipitation 458 600 km³
Evapotranspiration 65 200 km³
Evaporation 9 000 km³
Evaporation 502 800 km³
River runoff 42 600 km³
Infiltration
Lakes
Ocean
Area of internal runoff 119 million km²
Groundwater flow 2 200 km³
Area of external runoff 119 million km²
Oceans and seas 361 million km²
Note: The width of the blue and grey arrows are proportional to the volumes of transported water

The END