Sol-AID

A web application to estimate soil Nitrogen mineralization available for crops in Brittany

Beff, L. [1], Lambert, Y. [2], Squividant, H. [1], Lemercier, B. [1], Vincent, S. [1], Pichelin, P. [1], Elazhari, A. [1], Morvan, T. [1]

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Side event: Nutrient management and decision support systems
Rennes, 27 June 2018

Introduction

- Brittany:
  o Agriculture
    - 59% of the area is used for agriculture
    - First breeding region in France
  o Soil
    - Wide range of organic matter (2,5 % to 10 % on the surface which corresponds to a storage from 80 to 350 tons of carbon per hectare (Bretagne Environnement, dossier 10, sept 2015))
    - Almost no limestone
    - Low variability of pH and clay content
  o Surrounded by the sea

- Optimizing Nitrogen (N) fertilization is then essential **to achieve good crops yields** and **minimize environmental issue** such as nitrate leaching
  o This requires **correctly predicting** the amount of N resulting from soil organic nitrogen mineralization (*Mh*), usable by crops,
    - Which can vary greatly depending on **climatic conditions**, **soil properties** and **cropping system**
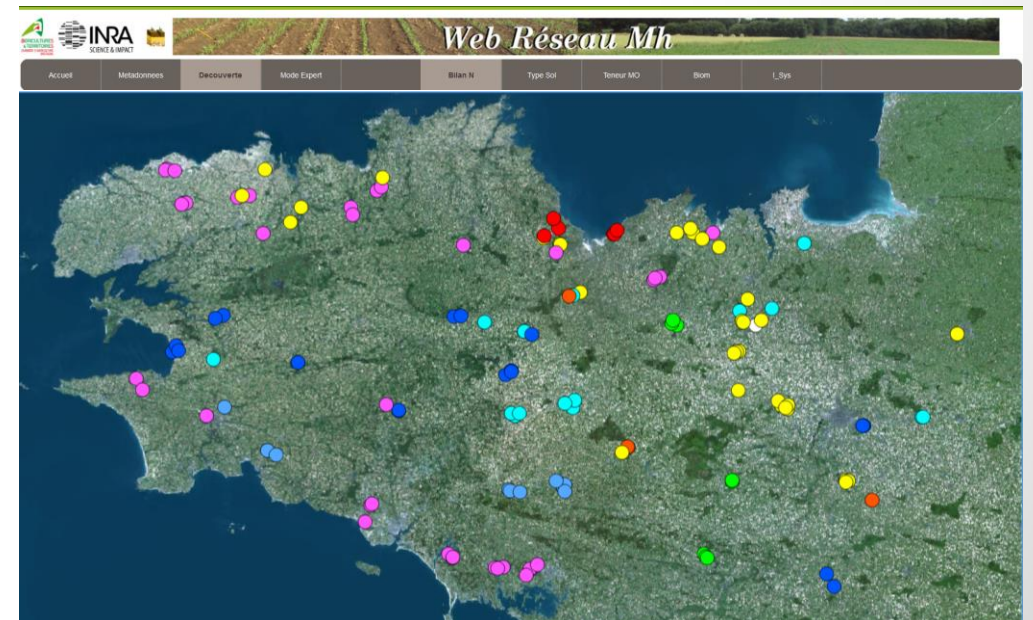   - Current models are not well adapted to the Britain pedo-climatic context

How properly estimate Mh?

Objectives of Mh Project (2010 – 2015)

- Obtain references on soil N mineralization in Brittany
- Characterize the variability of Mh
- Identify and classify the factors involved
- Evaluate the existing models
- Propose a new predictive model of Mh for Brittany

Field experiments (2010 – 2014)

- 137 fields (representative of soils, crop rotations and climate of Brittany)
- Managed during 4 years
  - Silage maize
  - Without fertilization
  - Bare soil during winter

http://geowww.agrocampus-ouest.fr/portails/portail.php?portail=mh

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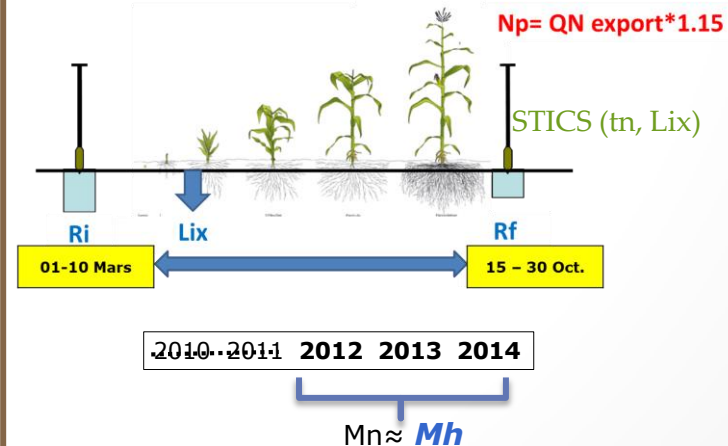- Propose a new predictive model of Mh for Brittany

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N mass balance to determine Mh

Np= QN export*1.15

STICS (tn, Lix)

Ri   Lix   Rf

01-10 Mars   15 – 30 Oct.
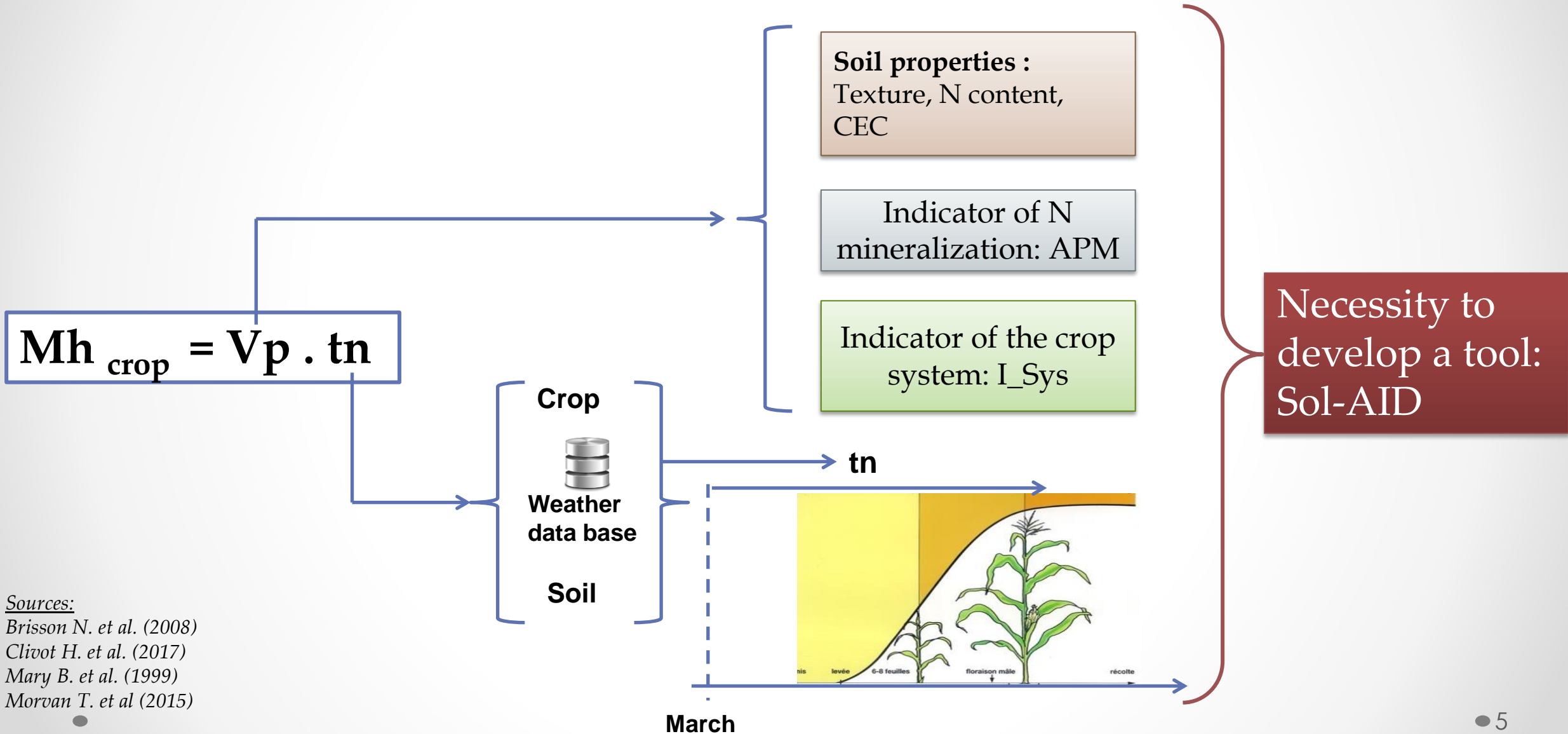
2010   2011   2012   2013   2014

Mn≈ *Mh*

Fields information

- Soil analysis
- Indicators of N mineralization (APM, etc.)

Information on crop management (rotation, manure application) over the last 15 years

Conclusion

- New predictive model for Mh for Brittany
- Mh = Vp * tn
  - Vp = f(Sol, APM, I_Sys)
  - tn = normalized time

Prediction of Mh

Soil properties :
Texture, N content, CEC

Indicator of N mineralization: APM

Indicator of the crop system: I_Sys

$$Mh_{crop} = Vp \cdot tn$$

Crop

Weather data base

Soil

tn

Necessity to develop a tool: Sol-AID

Sources:
Brisson N. et al. (2008)
Clivot H. et al. (2017)
Mary B. et al. (1999)
Morvan T. et al (2015)

March

What is Sol-AID?

User friendly and interoperable web application which will be (fully) available in 2020

Help to the farmers to determine Mh of their fields (input data, calculation, ...)

Modular application

With a module to determine soil types

Prediction of Mh

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Texture, N content, C content, CEC...

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nis levée 6-8 feuilles floraison mâle récolte

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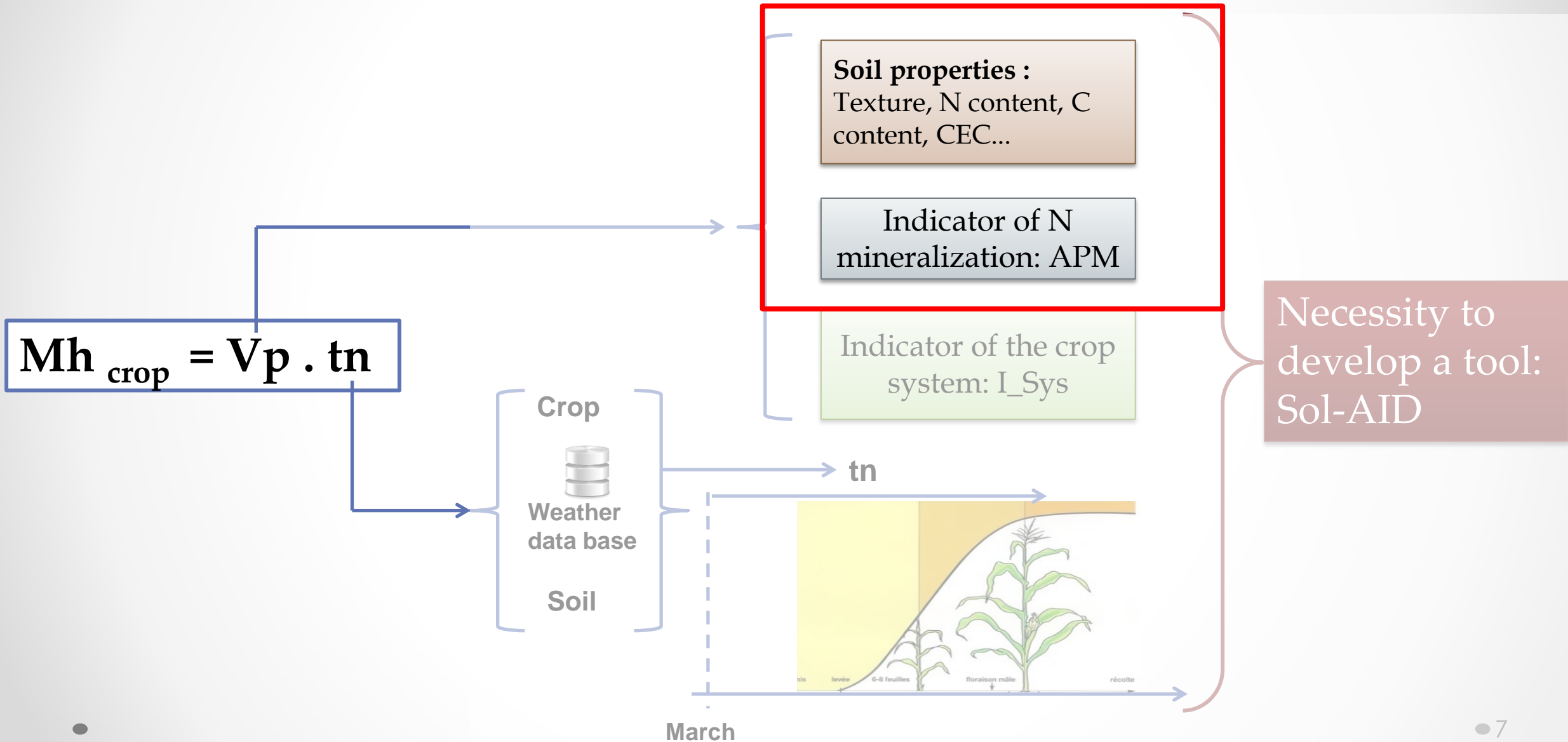
The farmer has soil analysis

- Soil analysis encoding will be possible
- Pedotransfert functions are included to estimate the missing value (soil water content at field capacity and wilting point, bulk density, APM, etc.)

ID	Strate	Carbone	CEC	pH	Clay	Silt	Sand
85	1	19	11.4	6.1	156	642	204
85	2	4.9	5.4	6.1	142	670	188
85	3	2.7	4.9	5.7	117	482	400

Pedotransfert functions

Soil properties and APM necessary to Mh determination

How get soil properties without soil analysis?

Soil Map 1:250 000 with 434 cartographic units of soil (www.sols-de-bretagne.fr)
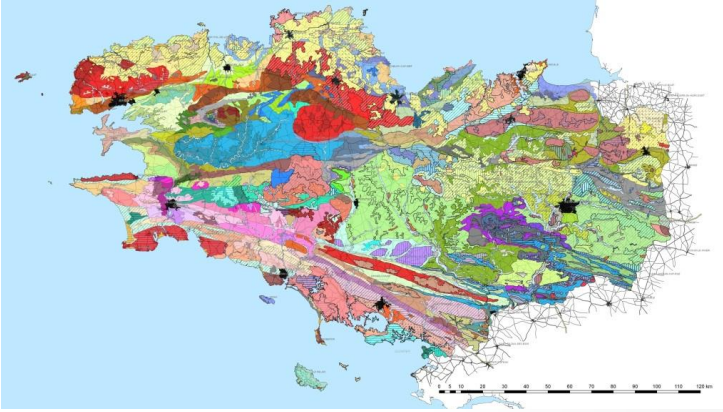
1 to 10 types of soil per cartographic unit of soil

Soil information in Brittany

320 soil types with reference soil properties

ID	Strate	Carbone	CEC	pH	Clay	Silt	Sand
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? How determine the soil type of a field ?

With a simple decision tree

Soil types decision trees

- Decision trees were realized jointly between agronomists, soil scientists and agricultural advisors
- Determining soil type is required only at the first connection and is stored in the Sol-AID database

Prediction of Mh

Soil properties : Texture, N content, C content, CEC...

Indicator of N mineralization: APM

Indicator of the crop system: I_Sys

Necessity to develop a tool: Sol-AID

$$Mh_{crop} = Vp . tn$$

Crop

Weather data base

Soil

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I_Sys: indicator of the crop system

- I_Sys is determined with crop history (rotation and manure application) over the last 15 years

$$\text{I\_Sys} = \text{I\_Rot} + \text{I\_Man}$$

Calculation

I_Rot:
Average annual nitrogen balance calculated for each crop

I_Man:
Estimation of mineralization flow related to manure inputs with a dynamic model (DSM *Pratt P. F. et al. (1976)*)

How it is managed in Sol-AID?

- Crop rotations are retrieved via graphical plot register (RPG): Spatial joint
- Validation is required

- Simple questions about their usual manure practices: type, quantity, N content (work in progress)
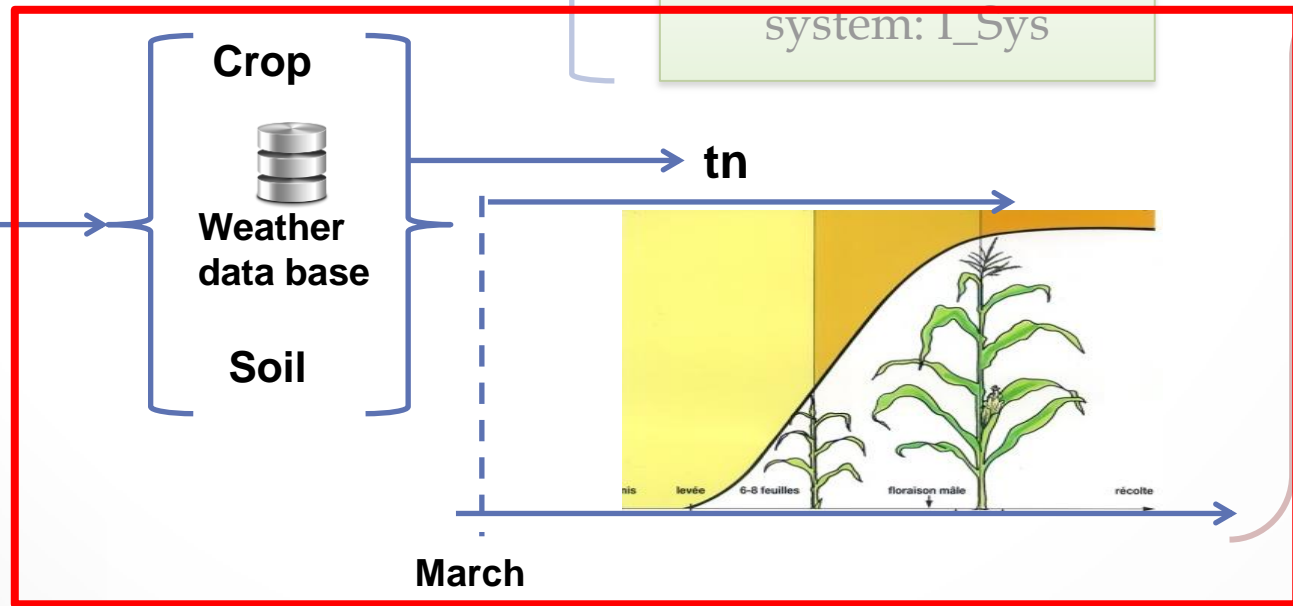
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Necessity to develop a tool: Sol-AID

Crop

Weather data base
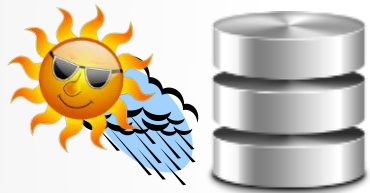
Soil

tn

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Estimation of tn

- tn = normalized time = climate normalization
  - Depends of soil water content and soil temperature (dynamic)

- What will be the weather next year?
- How it will impact Mh?

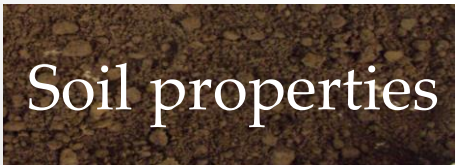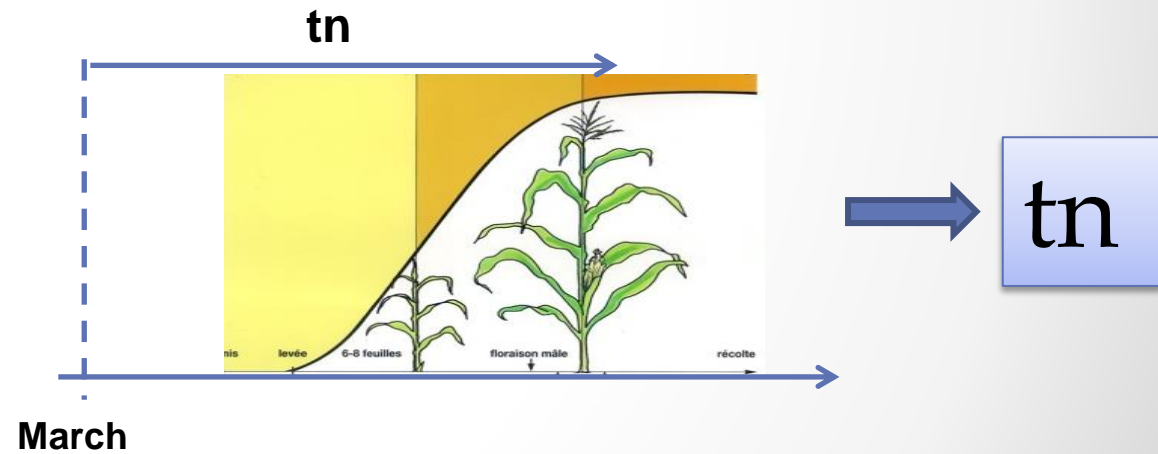- Calculation of a forecast tn with the weather of the past 20 years

Sol-AID

Weather data base

Crop

Soil properties

tn

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Let's go to the demo