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Le Réservoir Utilisable: Evaluation - Concepts - Incertitudes

Isabelle Cousin, Julie Constantin, Robin Lalu, Jacques-Eric Bergez, Bernard Lacroix, Claude Doussan, Mercedes Roman Dobarco, Maud Seger, Mohamed Alkacem, Guillaume Coulouma, et al.

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Le Réservoir Utilisable

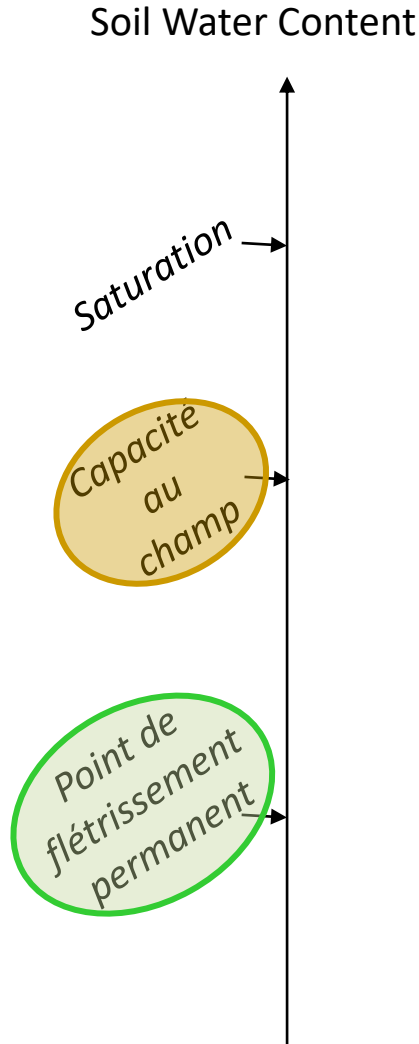
Evaluations – Concepts - Incertitudes

I. Cousin, J. Constantin, R. Lалу, J.E. Bergez, B. Lacroix, C. Doussan, M. Roman-Dobarco, M. Seger, M. Alkacem, G. Coulouma, A. Bouthier, C. Le Bas, P. Lagacherie, S. Buis, V. Picheny, V. Rivalland, L. Champolivier, H. Bourennane, M. Guérif



Le R.U., un concept mixte

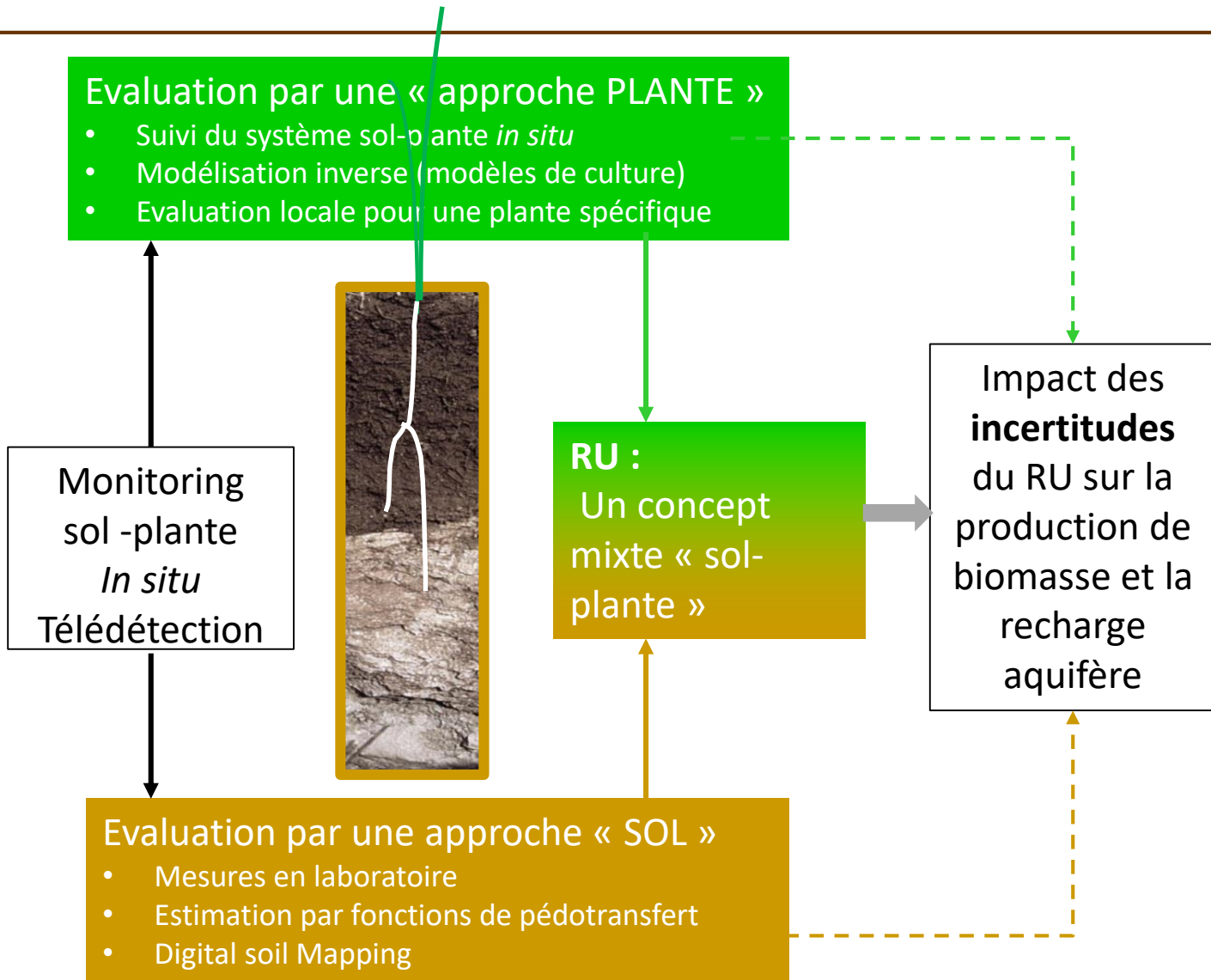
Réservoir Utilisable:
 Quantité d'eau que le sol peut **stocker** et **restituer** aux plantes pour leur **production de biomasse**



RU :
 Un concept mixte « sol-plante »

Le R.U., un concept mixte

Réservoir Utilisable:
 Quantité d'eau que le sol peut *stocker* et *restituer* aux plantes pour leur *production de biomasse*

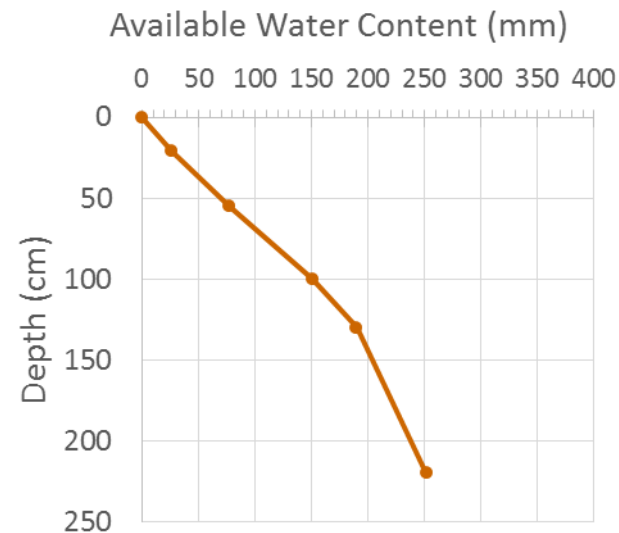
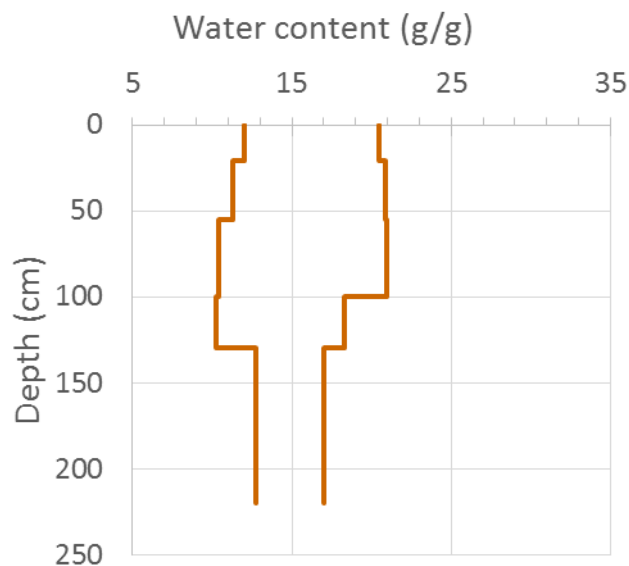


Expérimentation « labo »

Mesures sur des presses à plaque



Sol développé sur alluvions,
texture fine
(Avignon)



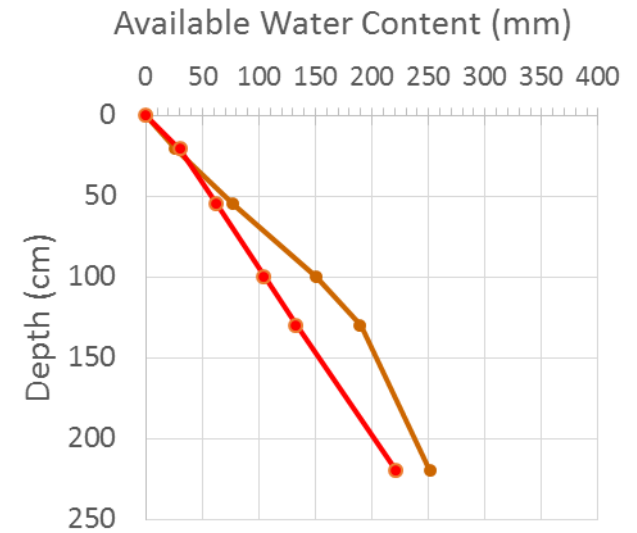
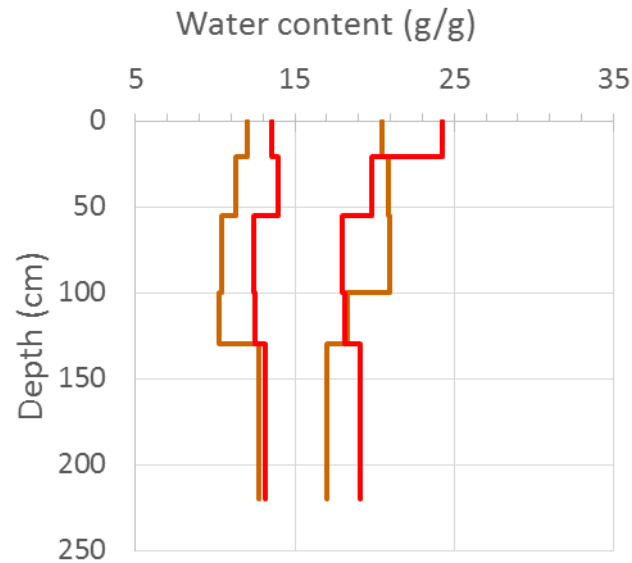
Evaluation par des approches « Sol »

Expérimentation « labo »

Mesures sur des presses à plaque



Sol développé sur alluvions,
texture fine
(Avignon)



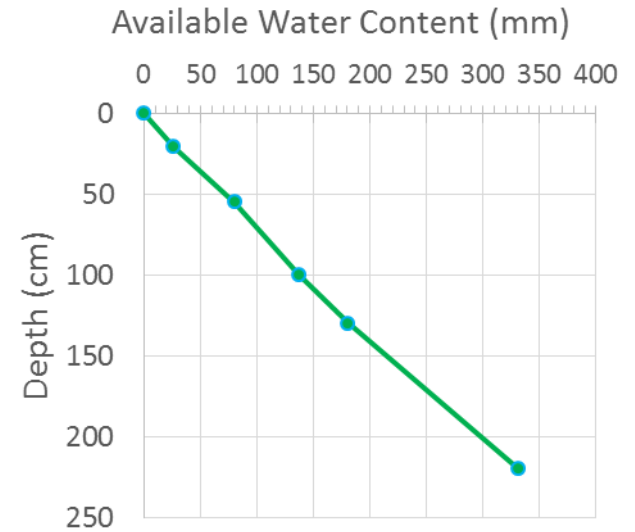
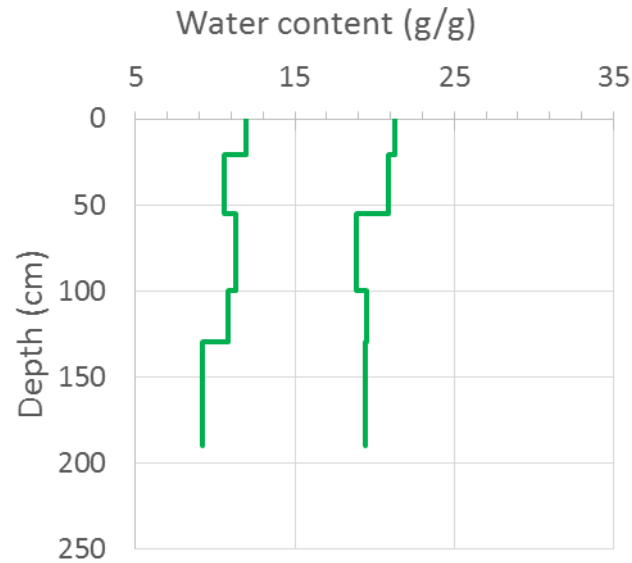
Fonction de pédotransfert

Wösten et al. (1999)

Monitoring *in situ*
Suivi par Sonde à Neutrons pendant 17 ans



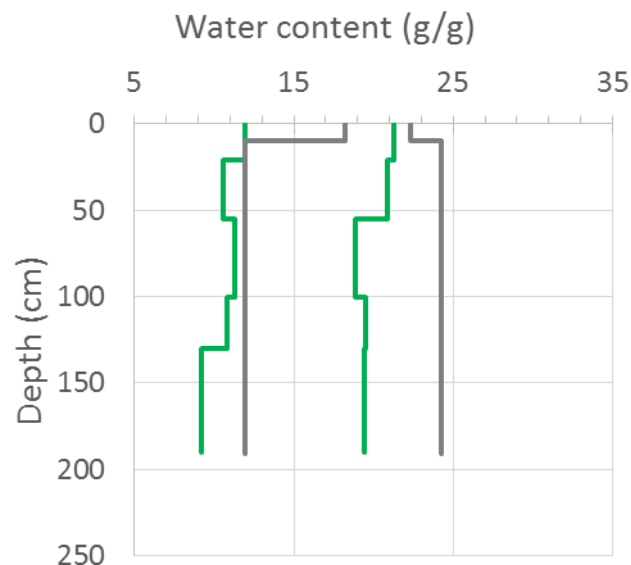
Sol développé sur alluvions,
texture fine
(Avignon)



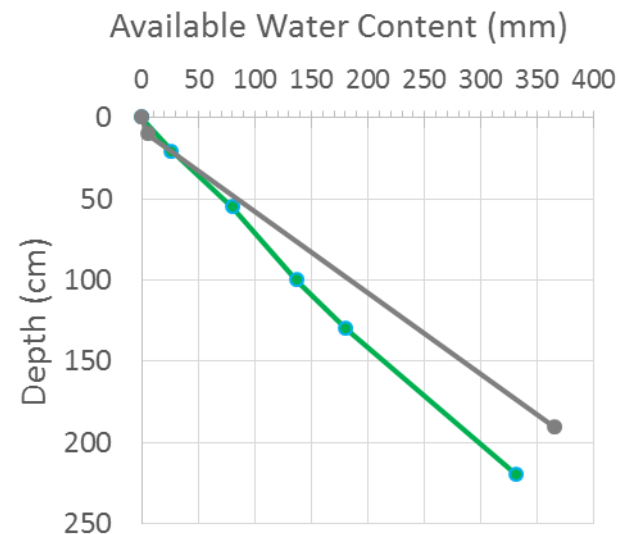
Evaluation par des approches « Plante »



Sol développé sur alluvions,
texture fine
(Avignon)



Monitoring *in situ*
Suivi par Sonde à Neutrons pendant 17 ans



Inversion du modèle STICS
(Varella et al., 2010)

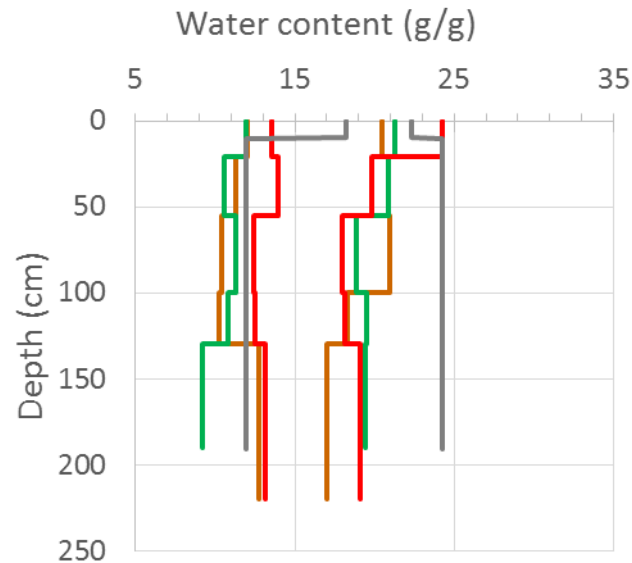
Comparaison des 4 approches

Expérimentation « labo »

Mesures sur des presses à plaque



Sol développé sur alluvions,
texture fine
(Avignon)

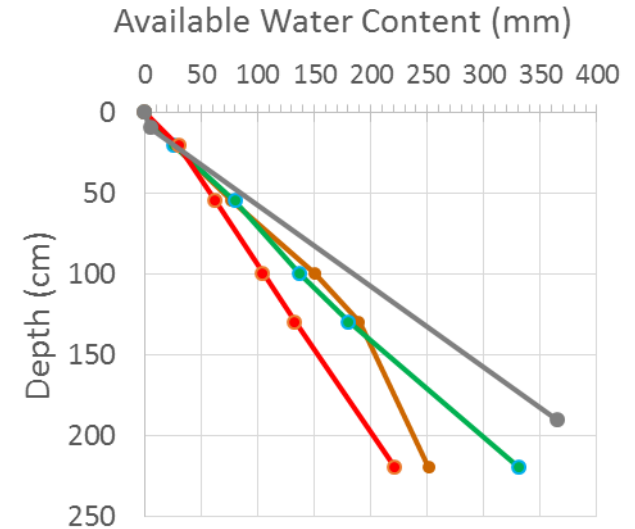


Fonction de pédotransfert

Wösten et al. (1999)

Monitoring *in situ*

Suivi par Sonde à Neutrons pendant 17 ans

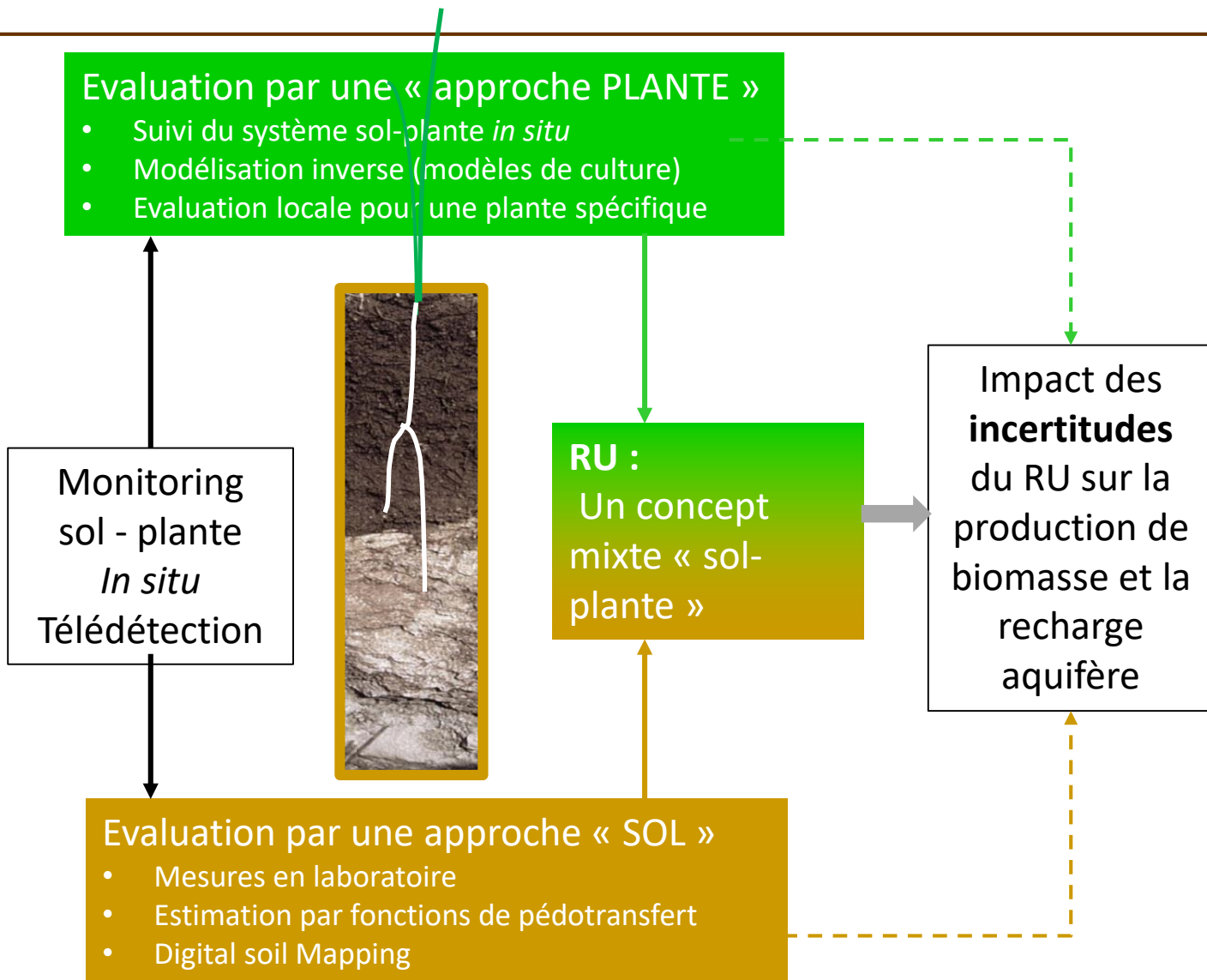


Inversion du modèle STICS

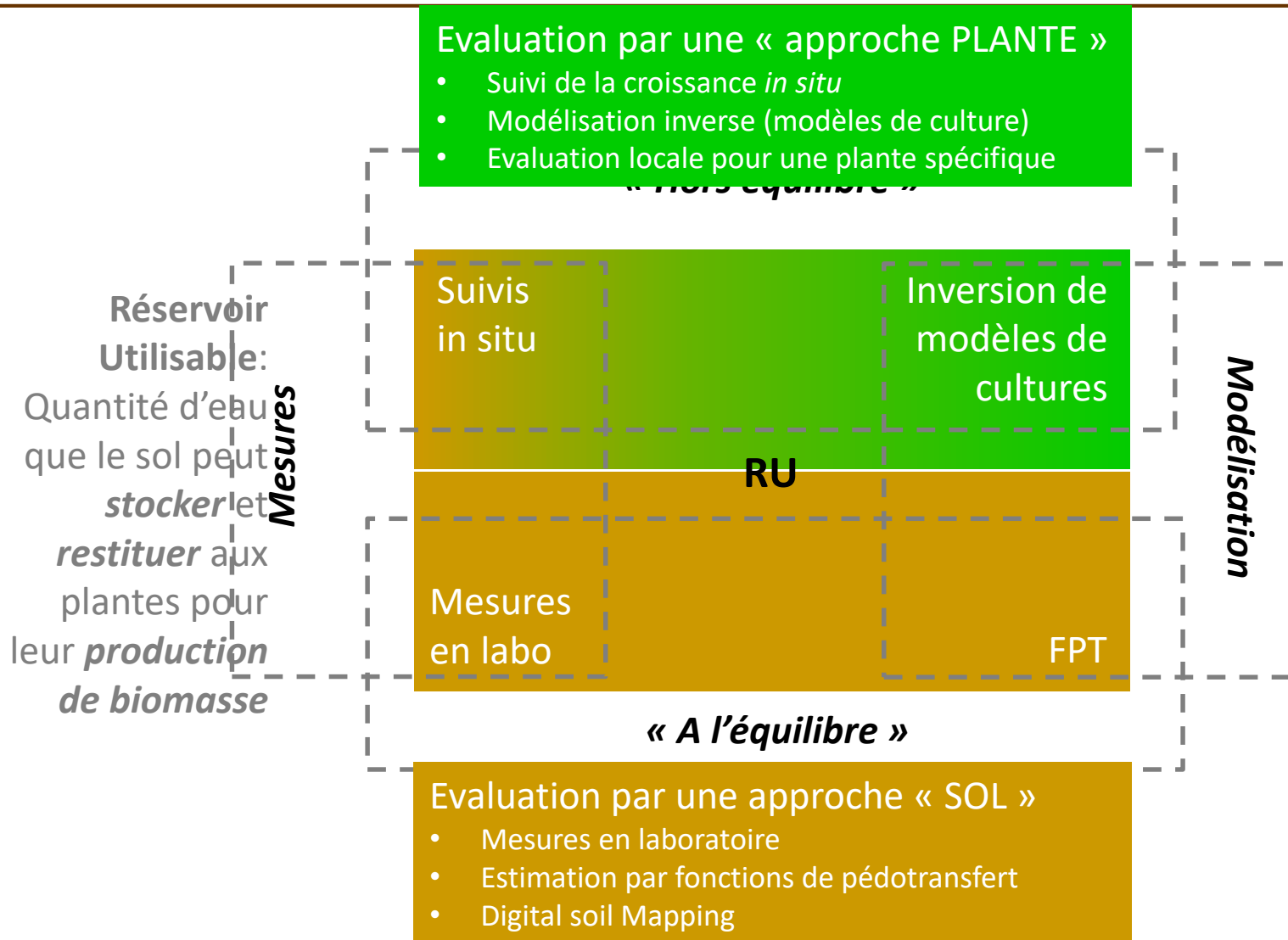
(Varella et al., 2010)

Le R.U., un concept mixte

Réservoir Utilisable:
Quantité d'eau que le sol peut *stocker* et *restituer* aux plantes pour leur *production de biomasse*

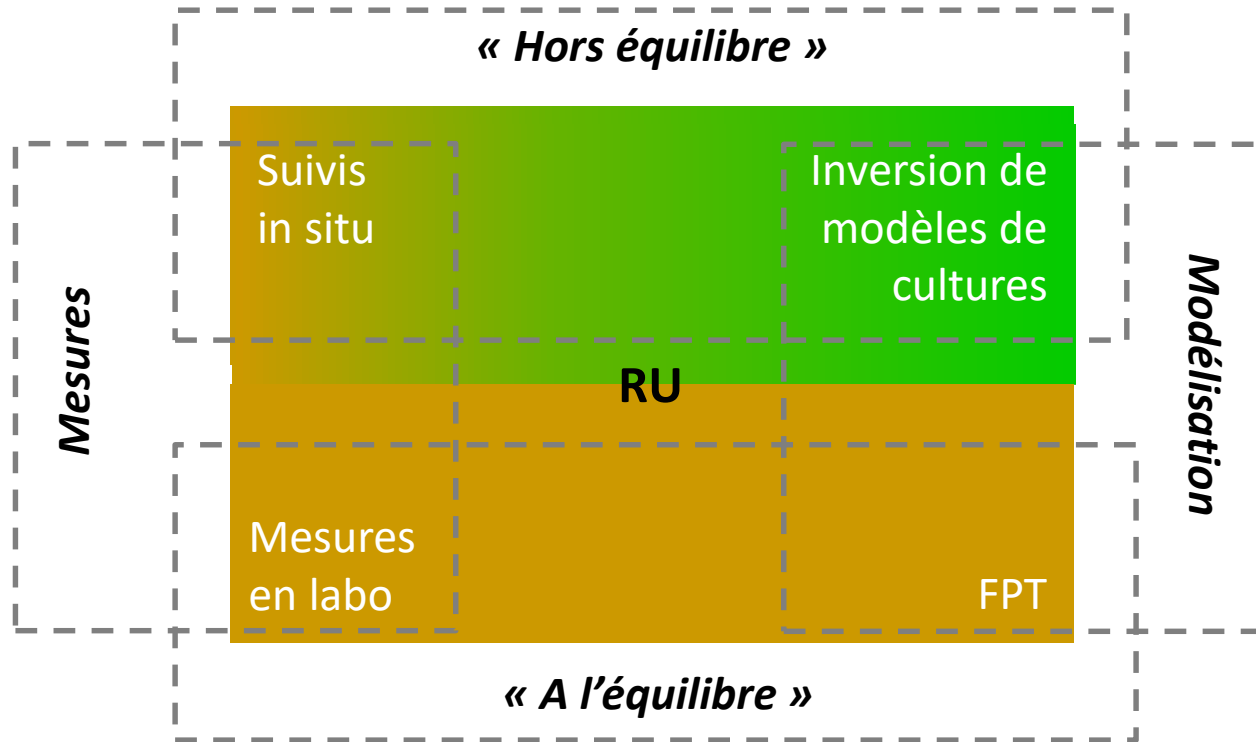


Le R.U., un concept mixte



Un R.U, deux acceptions

RU : quantité d'eau que les plantes **utilisent** (?)
 (paramètre d'un modèle décrivant la **capacité réelle** du milieu)

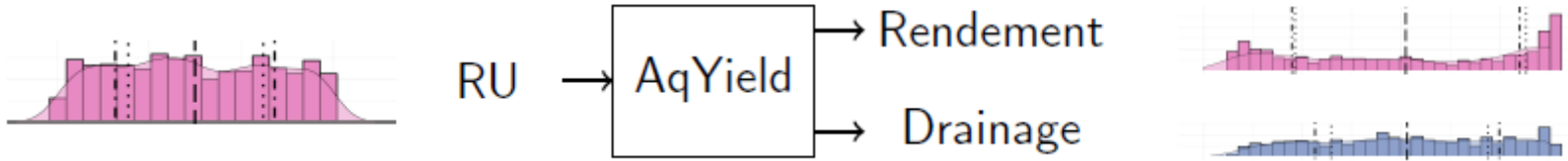


RU : quantité d'eau que le sol **peut stocker et restituer** aux plantes (**potentialité** du milieu pour une culture donnée)

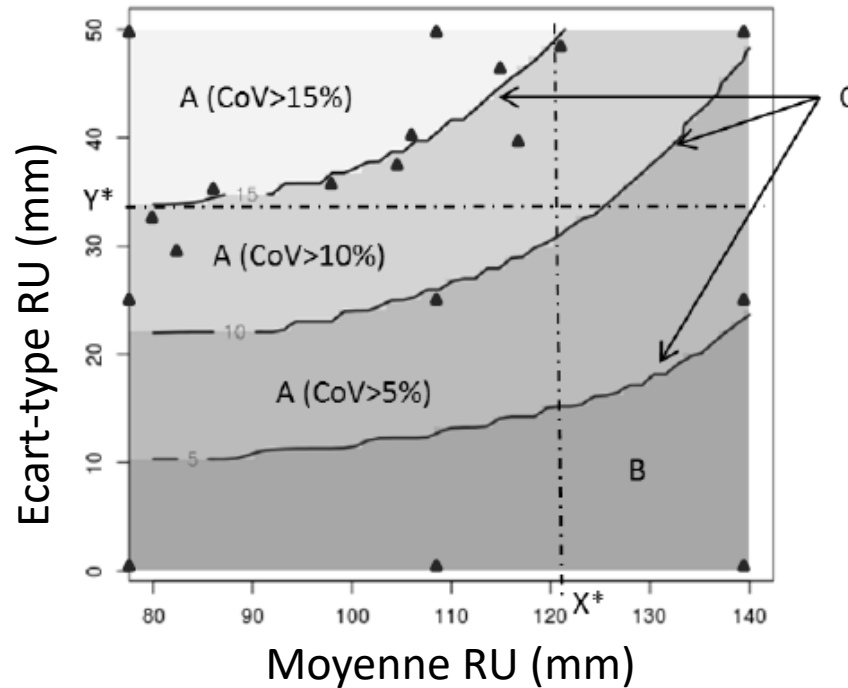
Propagation des incertitudes

Evaluation sur un jeu de données fictif

Propagation d'incertitude par simulation (Monte-Carlo)

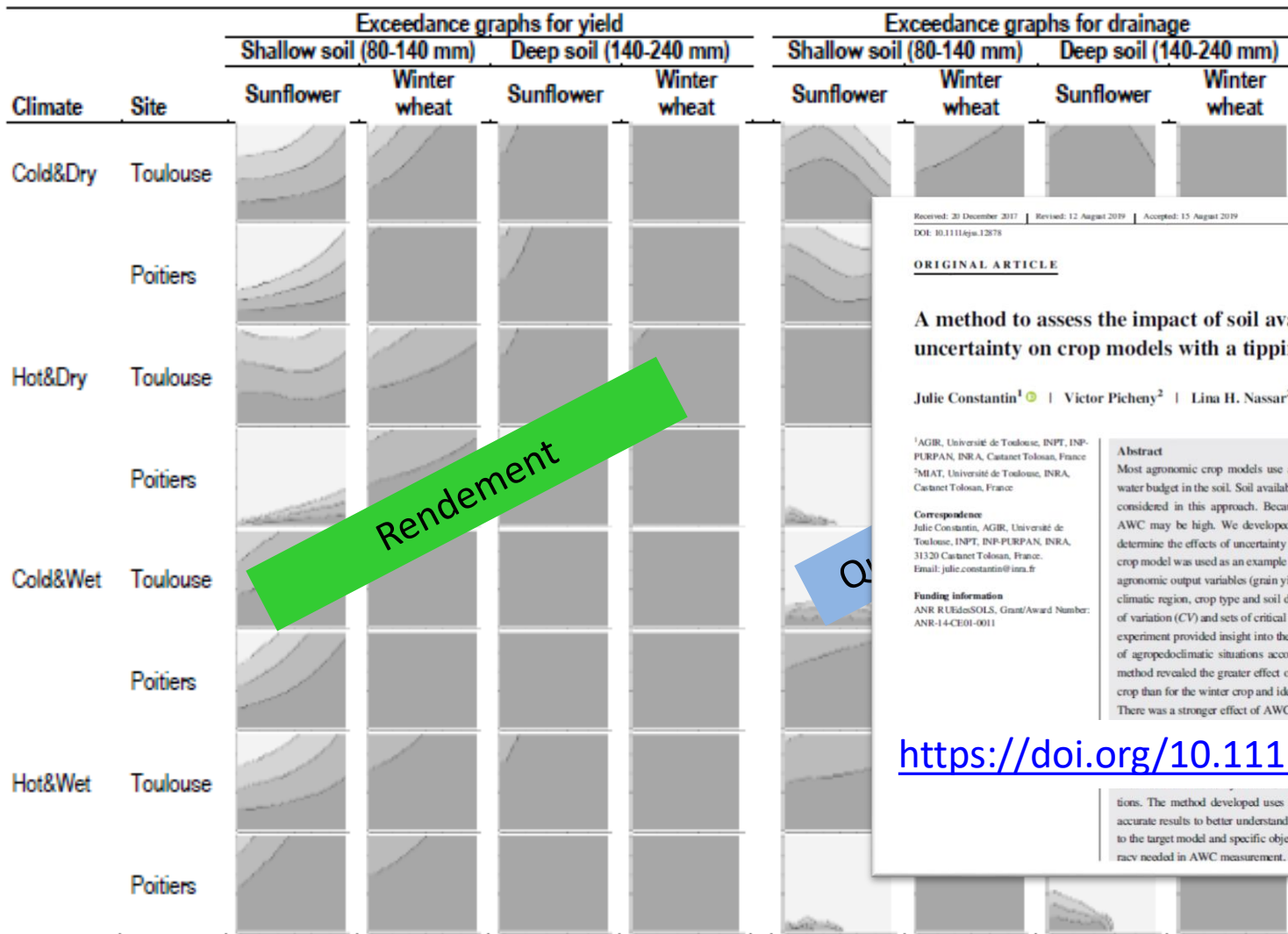


Carte de criticité



Propagation des incertitudes

Evaluation sur un jeu de données fictif



Rendement

Q

Received: 20 December 2017 | Revised: 12 August 2019 | Accepted: 15 August 2019
 DOI: 10.1111/ejss.12878

ORIGINAL ARTICLE

A method to assess the impact of soil available water capacity uncertainty on crop models with a tipping-bucket approach

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Abstract
 Most agronomic crop models use a reservoir tipping-bucket approach to model the water budget in the soil. Soil available water capacity (AWC) is the main soil property considered in this approach. Because AWC is difficult to measure, uncertainty in AWC may be high. We developed a method using a specific kriging technique to determine the effects of uncertainty in AWC on crop model predictions. The AqYield crop model was used as an example to assess the effects of uncertainty in AWC on two agronomic output variables (grain yield and drainage). The factors considered were the climatic region, crop type and soil depth. We assessed the results using the coefficient of variation (CV) and sets of critical values for which CV exceeded 5, 10 and 15%. The experiment provided insight into the criticality of AWC uncertainty over a wide range of agropedoclimatic situations according to crop, model and output of interest. The method revealed the greater effect of AWC uncertainty on both outputs for the spring crop than for the winter crop and identified cases where AWC uncertainty was critical. There was a stronger effect of AWC uncertainty on yield for shallow soil and climatic

<https://doi.org/10.1111/ejss.12878>

The method developed uses a small number of model simulations to produce accurate results to better understand the impact of this major soil input data according to the target model and specific objectives. It could help to determine the level of accuracy needed in AWC measurement, depending on the objectives.

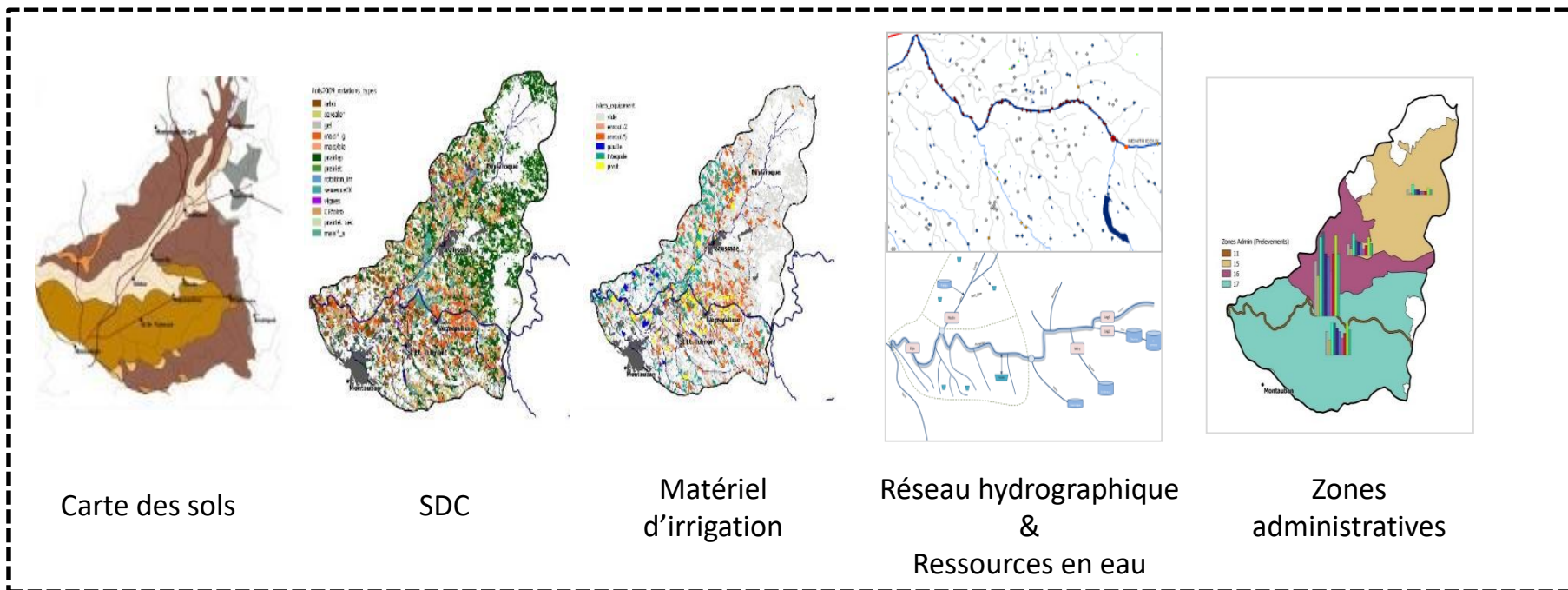
Propagation des incertitudes

Evaluation sur le BV Aveyron-Aval (MAELIA)

MAELIA : Modèle agro-hydrologique de bassin versant, spatialisé, dynamique et fonctionnel

- Rendement
- Débits des cours d'eau
- Restriction pour l'irrigation
- Prélèvement d'eau pour l'irrigation

Zones agricoles -> AqYield
Zones non agricoles -> SWAT



Propagation des incertitudes

Evaluation sur le BV Aveyron-Aval (MAELIA)

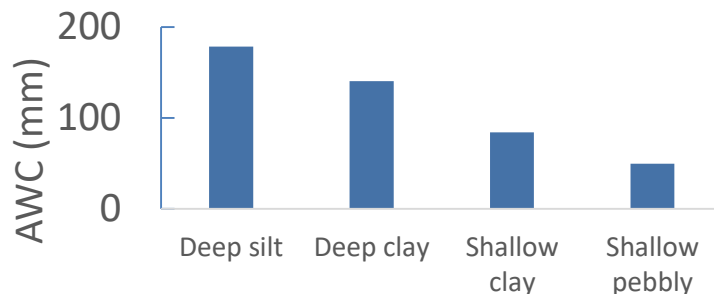
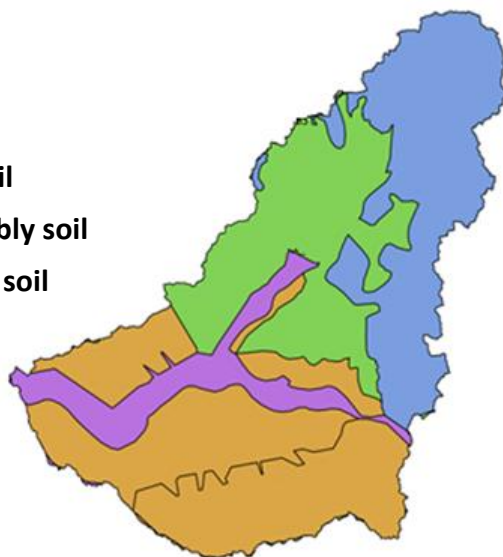
MAELIA : Modèle agro-hydrologique de bassin versant, spatialisé, dynamique et fonctionnel

- Rendement
- Débits des cours d'eau
- Restriction pour l'irrigation
- Prélèvement d'eau pour l'irrigation

Zones agricoles -> AqYield
Zones non agricoles -> SWAT

Soil types

- Deep silt soil
- Deep clay soil
- Shallow pebbly soil
- Shallow clay soil

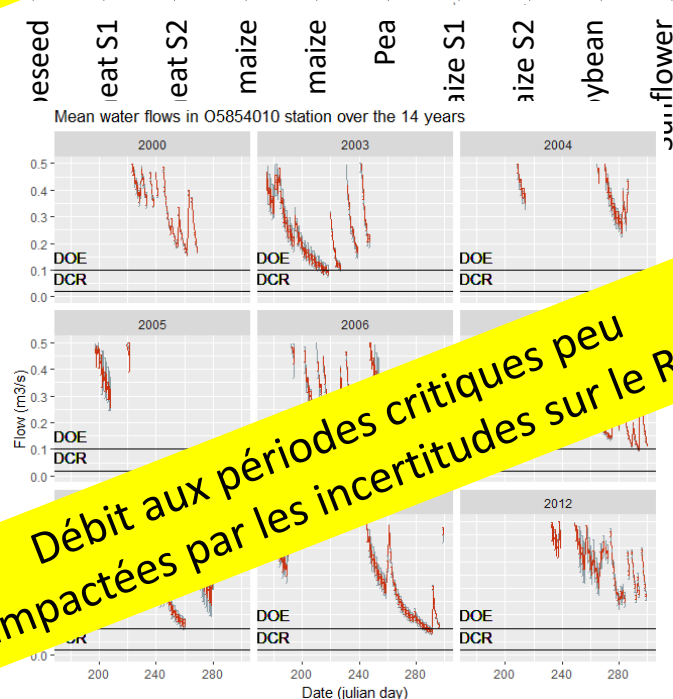
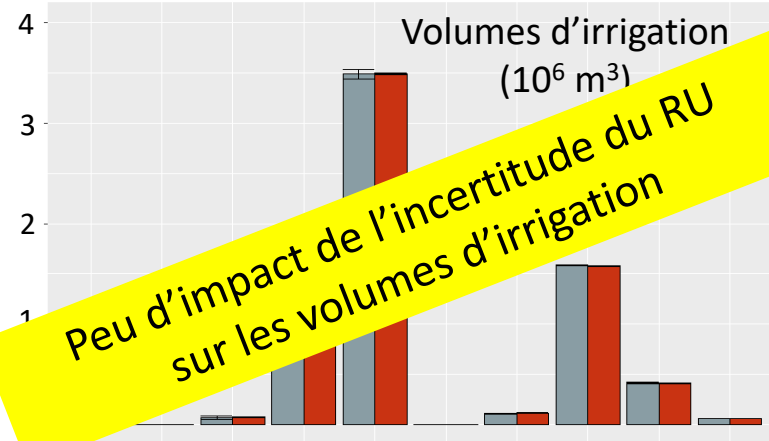
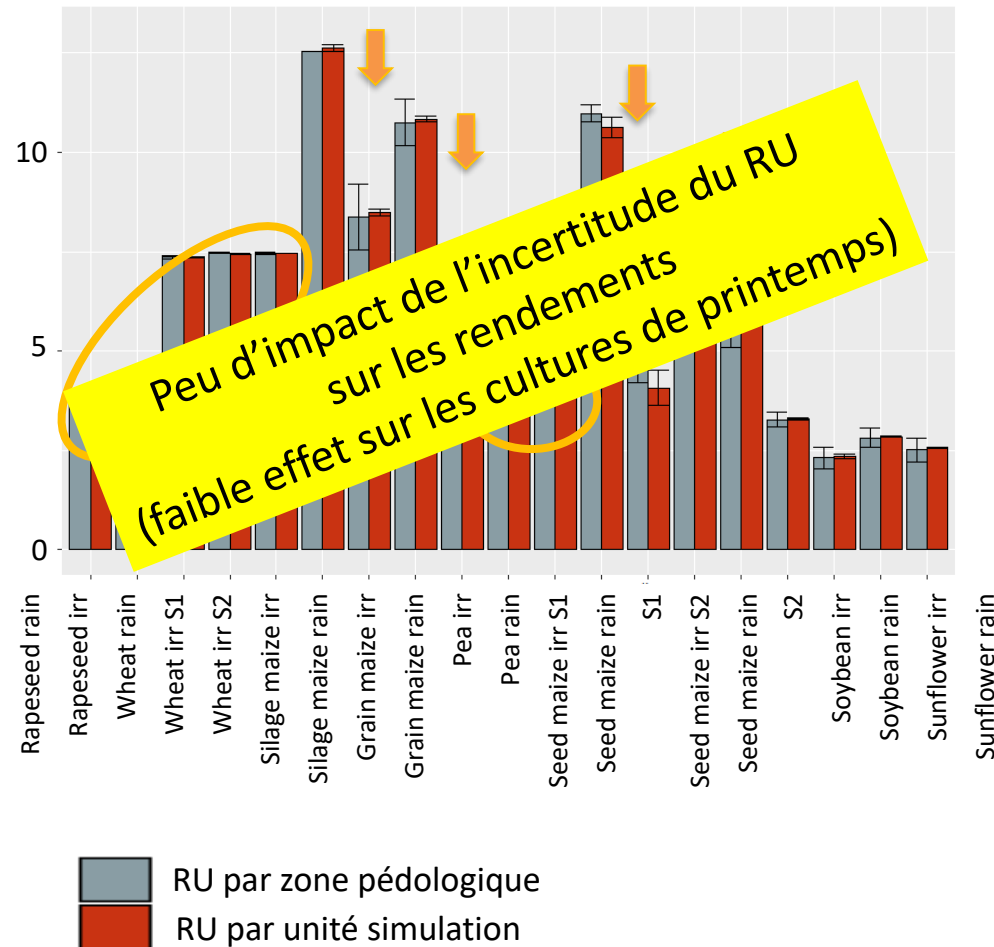


Carte 1/1 000 000^e (INRA, 1998)
RU = 54 - 178 mm

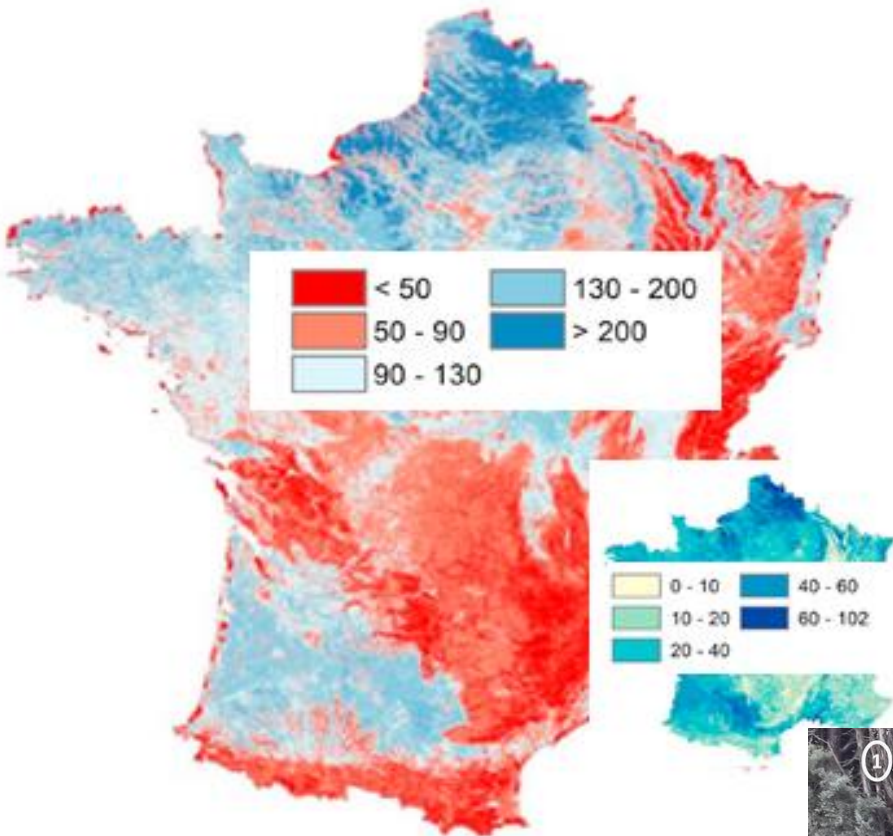
Propagation des incertitudes

Evaluation sur le BV Aveyron-Aval (MAELIA)

Rendement (t/ha)



Merci de votre attention !



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Uncertainty assessment of GlobalSoilMap soil available water capacity products: A French case study

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ARTICLE INFO

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 Digital soil mapping
 Pedotransfer function
 Soil moisture at field capacity
 Soil moisture at permanent wilting point

ABSTRACT

Plant available water capacity (AWC) refers to the maximum amount of water that a soil can store and provide to plant roots. Spatial predictions of AWC through digital soil mapping at high resolution and national extent provide relevant information for upscaling ecological and hydrological models, and assessment of the provision of ecosystem services like water quantity and quality regulation, carbon sequestration, and provision of food and raw materials. However, the spatial predictions of AWC are prone to errors and uncertainties. Moreover, this digital soil mapping process requires using pedotransfer functions (PTFs) due to the lack of sufficient georeferenced measurements of the upper (i.e., soil moisture at field capacity, θ_{fc}) and lower (i.e., soil moisture at permanent wilting point, θ_{pwp}) limits of soil moisture contents defining AWC. This adds an additional source of uncertainty to the final estimates of AWC. The objectives of this study were: 1) to predict AWC for mainland France following the GlobalSoilMap (GSM) select specifications on depth intervals and uncertainty, and 2) to

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the lowest R^2 (clay $R^2 = 0.27$, silt $R^2 = 0.43$ and sand $R^2 = 0.46$) and RMSE (clay RMSE = 128 kg ^{-1} , silt RMSE = 139 kg ^{-1} and sand RMSE = 172 kg ^{-1}) from the three particle size fractions. However, the model for coarse elements had the worst predictive performance ($R^2 = 0.14$ and RMSE = 21%) among all AWC input variables. The performance of the GSM predictions for θ_{fc} and θ_{pwp} had a R^2 of 0.21 and 0.29. When the PTFs were applied to the spatial predictions of sand and clay, the RMSE for θ_{fc} and θ_{pwp} had a relative increase of 25% and 34% respectively compared to when they were applied to measured horizon data. Across the majority of mainland France, the main sources of uncertainty of elementary AWC were coarse elements and soil texture, but the contribution of uncertainty of PTF coefficients increased in areas dominated by very sandy and clayey textures. An advantage of the produced maps of θ_{fc} , θ_{pwp} and AWC is that the end users can incorporate associated uncertainties into ecological and agricultural modeling, and decision-making processes involved in soil and water planning.

