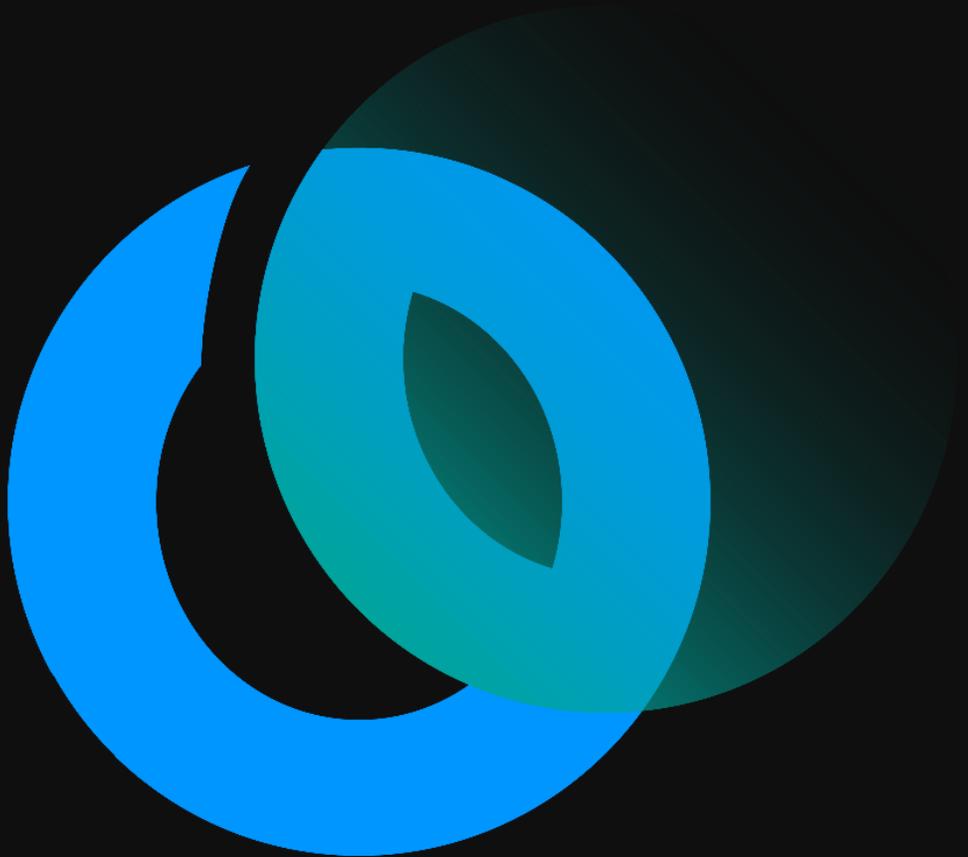


Artificial intelligence for smart agriculture, Atos Montpellier Feedback

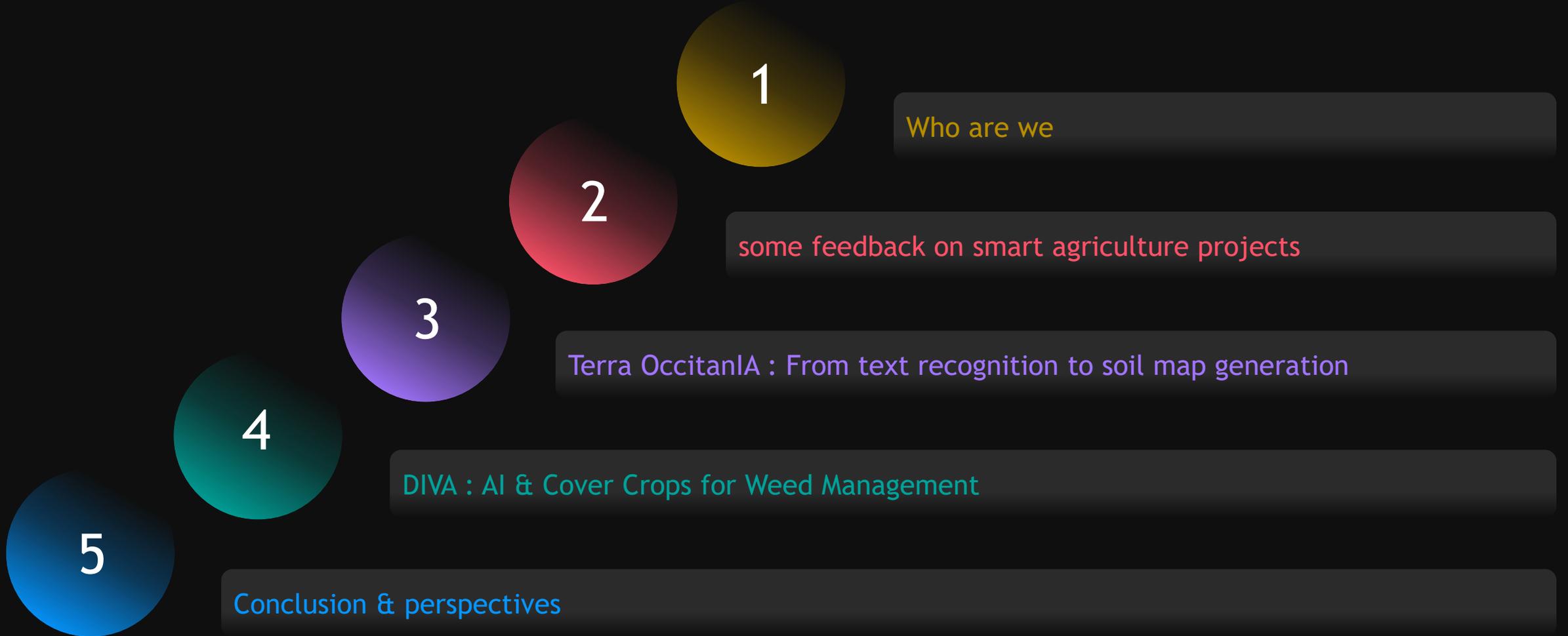
Amine Chemchem, PhD
Data scientist Researcher
Senior Expert in Artificial Intelligence
Lamine.chemchem@atos.net

31/03/2023

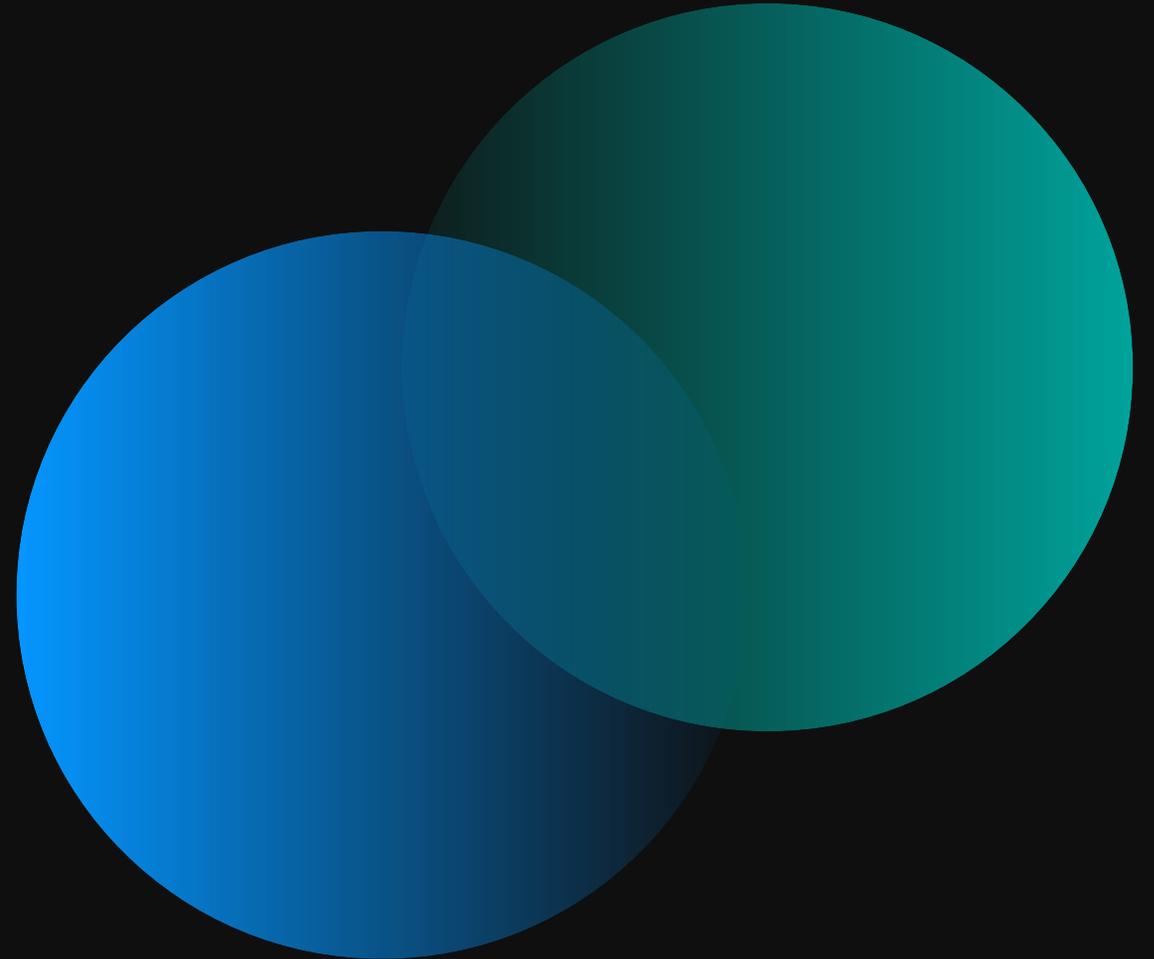
The image features a large, stylized graphic on the right side consisting of three overlapping circles in shades of blue and teal. The top circle is a dark teal, the middle one is a medium blue, and the bottom one is a bright blue. They overlap in a way that creates a central lens-like shape.

Atos

Content overview



01. Who Are we ?



Atos Worldwide

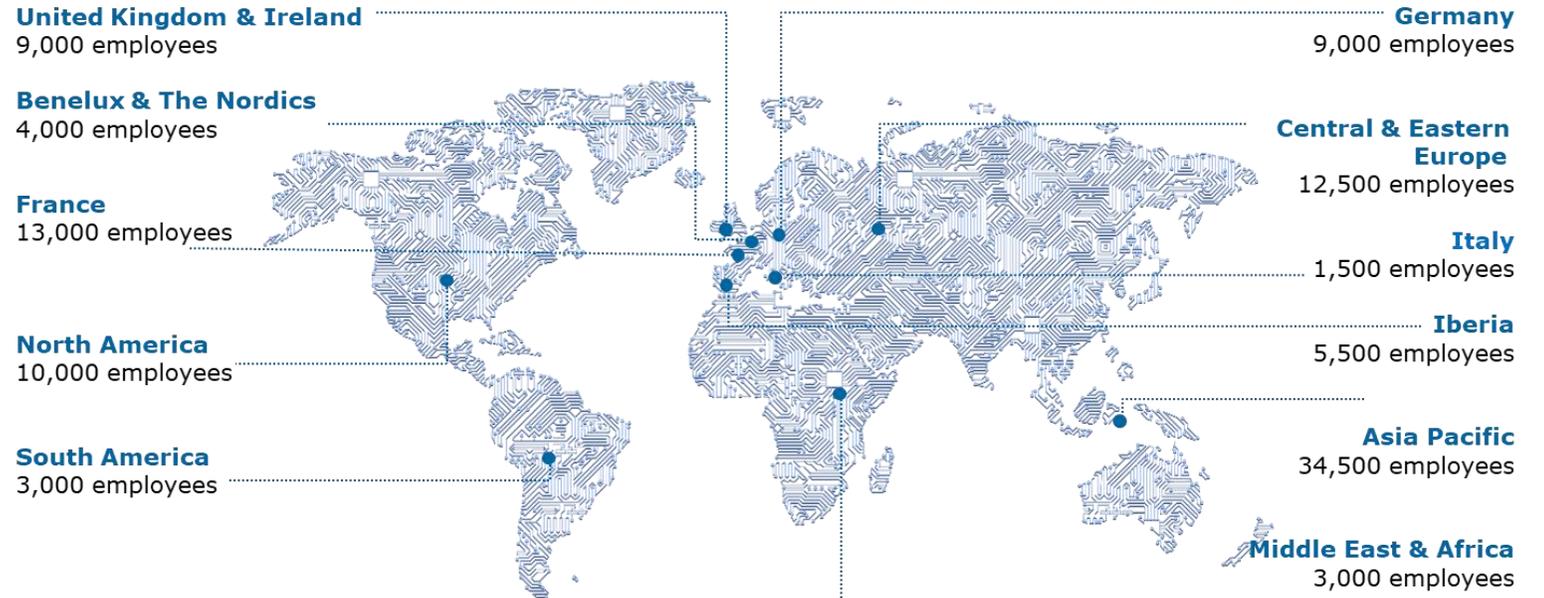
At Atos, our purpose is to **help design the future of the digital space**

Our expertise and services support the development of knowledge, education and research in a multicultural approach and contribute to the development of scientific and technological excellence.

Across the world, **the group enables its customers and employees, and members of societies at large to live, work and develop sustainably, in a safe and secure digital space.**



Learn more : <https://atos.net/en/raison-detre>



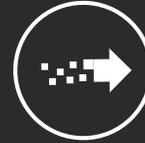
Atos: A proximity Network in France





30 DATA EXPERTS

Scientists / Engineer / Steward / Analysts
multi-disciplinary Data & Business



TECHNICAL EXPERTISE

Mastery of data technologies over the entire data
life cycle
<< modern data platform >> approach



INNOVATION - R&D

Integrated into the Atos Inno'Lab network on the
topics of Health and Environment
Participation in collaborative R&D projects



SUPPORT

More than 25 clients supported in their data
projets



USAGE ORIENTED

Enhanced data with co-creation with our
customers



ATOS Montpellier : Focus innovation

InnoLab South of Atos « AI for Better Life »



AI for environment

Climate risk management
Water resource monitoring
Decision support in agriculture

The graphic features a green background with a central globe, a leaf icon in a circle, and various hexagonal icons representing environmental and agricultural themes.



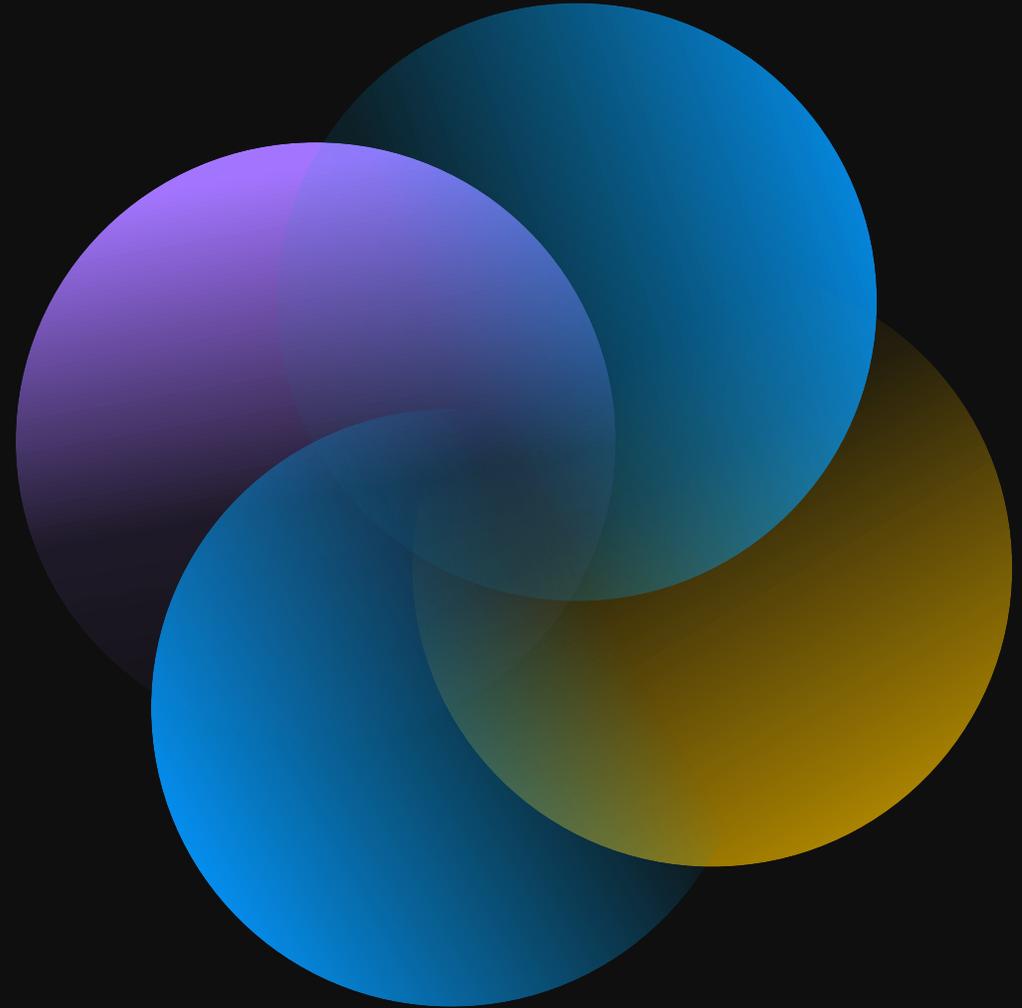
AI for Health

Genetics
Life Sciences
Health pathways

The graphic features a blue background with a robotic arm holding a magnifying glass over a heart icon, surrounded by various hexagonal icons representing health and life sciences.



02 some feedbacks on
smart agriculture
projects

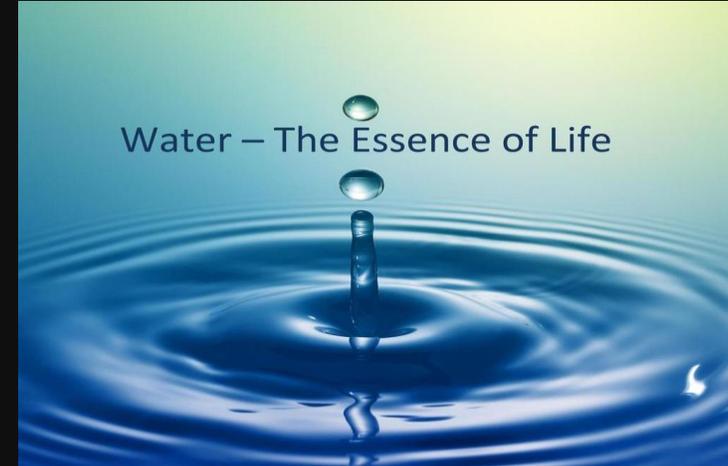


My Feedbacks on smart agriculture

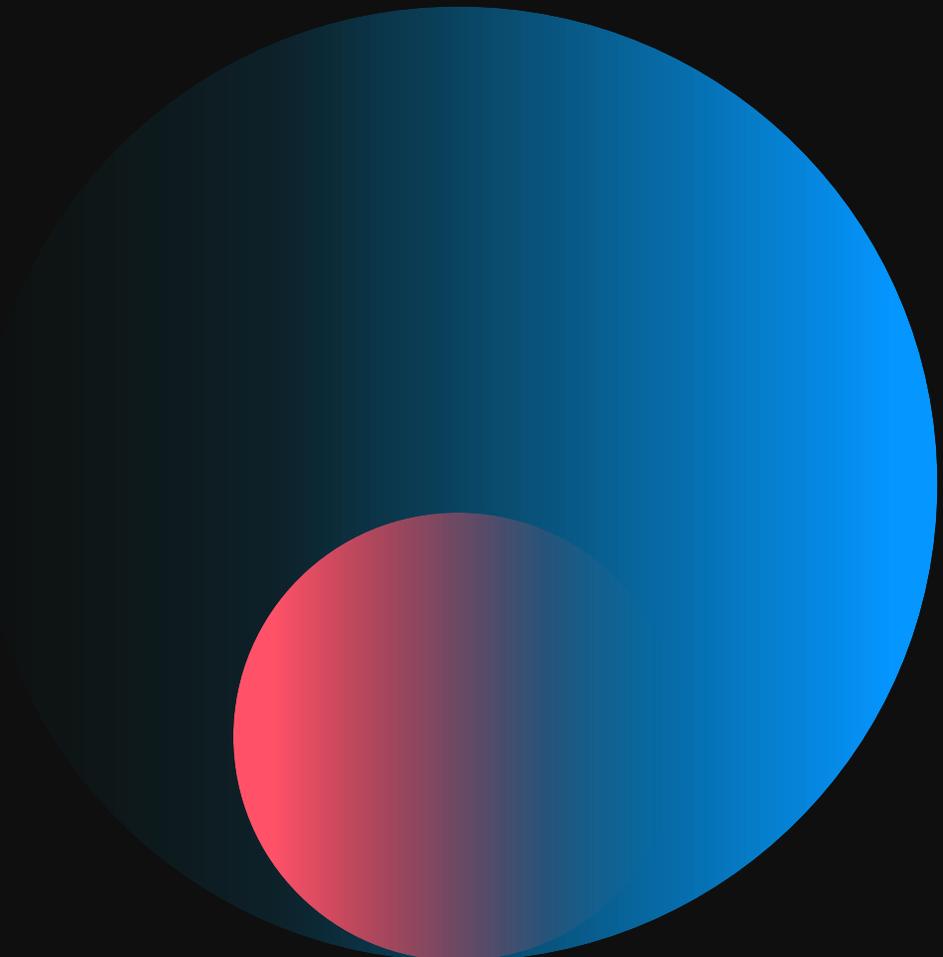
In Atos Montpellier

- Digital soil mapping and enhancing the value of water resources
- Save water and suggest crops according to the soil available water capacity (SAWC)
→ [TerraOccitanIA Project](#)

- Chemical products are more and more limited and rejected by the UE and by the population,
- Weeds have dynamical interactions with the vines (could have positive and negative impact)
- Automatic Identification & localization of harmful weeds that negatively impact the growth of plants
→ [DIVA Project](#)



03 Terra OccitanIA : From text recognition to soil map generation



TerraOccitanIA Project

From text recognition to soil map generation

Processing of old soil data to produce more accurate soil maps

First use case: soil available water capacity (SAWC) to control the irrigation of vineyards



- Capitalization by the automatic digitization (LAD/RAD) of legacy soil data



- Harmonization and qualification of soil data for interoperability and data backup in the national DoneSol database



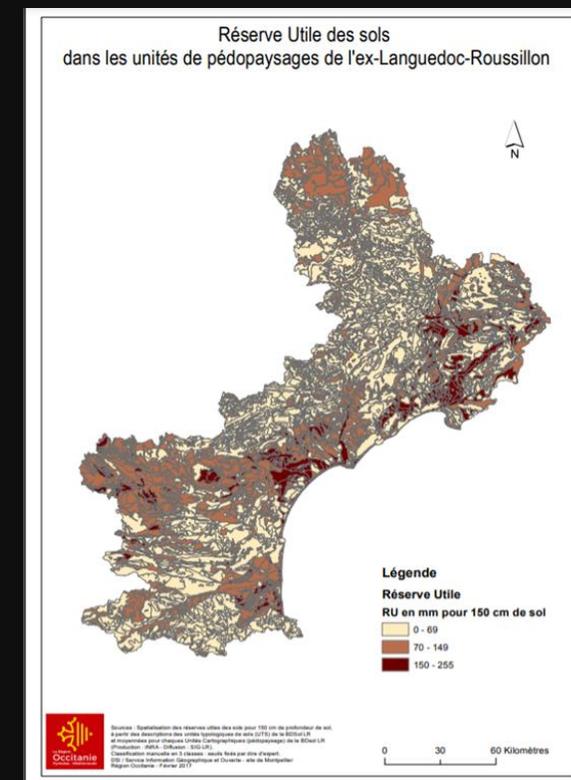
- Development of AI algorithms to improve digital soil mapping model performances



- Development of applications of soil indicators maps



- Elaboration of a model for sharing and disseminating the data produced



TerraOccitania Project

From text recognition to soil map generation



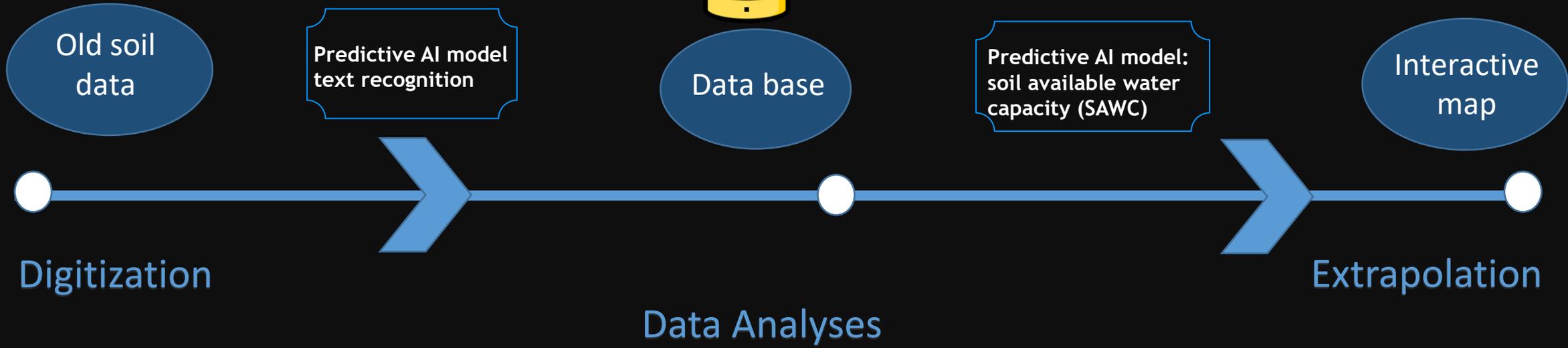
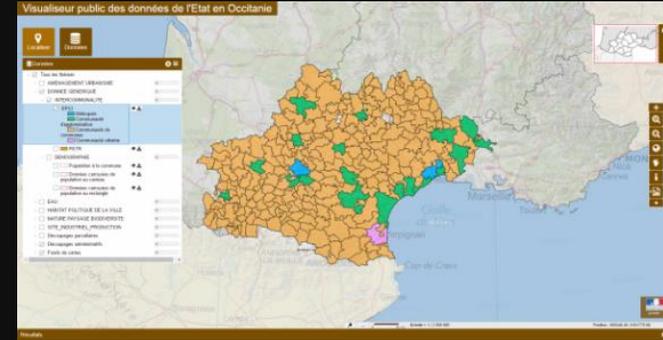
9200 soil profile sheets



DONESOL



Data correction/
validation and
harmonization



TerraOccitania Project

Dataset of soil profiles

- 4 different formats
- 9200 sheets processed

Format 1

C.N.A.R.B.R.L. D.E.M.V. S.E.S. (mod. 8.63)

FICHE DE SOL

211 Fe 3-1 Fe 2

CARACTÈRES GÉNÉRAUX

OBSERVATEUR: VIRE
 DATE DE PRÉLÈVEMENT: 21.11.62
 CARNET N° 167, FEUILLET N° 6
 CARTE 1/50.000
 CARTE 1/20.000 Béziers N° 3-1
 LOCALITÉ: Béziers
 COORDONNÉES (LAMBERT): X: 668,760; Y: 130,760
 ALTITUDE: 15 m

SITUATION TOPOGRAPHIQUE: sans pente
 INCLINAISON: Nulle
 EXPOSITION: ...
 RELIEF: ...
 SIGNES D'ÉROSION: ...
 UTILISATION ACTUELLE: vignes (jusqu'à 10-15) belle
 VÉGÉTATION SPONTANÉE: Aristolochia clematitis, Stellaria media, grande oseille
 ÉTAT DE LA SURFACE: Minco-pellucide-argileuse (40 de vin) déposée-récompact.
 GÉOLOGIE: alluvions-fines-actuelles-de-l'Érault
 DRAINAGE: vignes à piedsec
 PLAN D'EAU: 70 cm
 TYPE DE SOL: alluvial

CARACTÉRISTIQUES HYDRODYNAMIQUES

N° des échantillons	Profondeur	Pourcentage en poids				Viscosité de torsion		Végétation	t % L.L.	L.C.	H. no.	Dose
		P	G	S	L.L.	K1	K2					
I 111	0-10	0	0	1	99			1,50		28	13,4	
V 116	10-60	0	0	0	100	8,7 · 10 ⁻³	6,7 · 10 ⁻³	1,35		3	10,9	
P 396	60-120	0	0	0	100	1,1 · 10 ⁻²	9,3 · 10 ⁻³	1,38		4	9,5	

C.N.A.R.B.R.L. S.E.S. (mod. 8.63)

CARACTÉRISTIQUES PÉDOLOGIQUES

211 Fe 3-1 Fe 2

CARACTÈRES DU SOL EN PLACE

Horizon	No	Épaisseur	Couleur	Texture	Structure	Sous-Structure	Consistance	Notion HCl %	Observations complémentaires
1	10	10	brun rouille lie de vin	4	Minco-pellucide argileuse Granuleuse		Friable ++		Horizon de labour. Ramon agronome.
2	60	50	brun rouille lie de vin	4	Polyédrique à micropolyédrique		Friable ++		Exploité par racines et radicelles. Porosité bonne. Rares débris de coquilles. Rares graviers et galets noirs.
3	120	60	brun rouille lie de vin	4	Polyédrique à micropolyédrique		Friable ++		Racines et radicelles. Porosité moyenne. Rares débris de coquilles. Rares graviers et galets colorés. Gorgé d'eau.

Le niveau de la crue de 8 Novembre 62 a atteint ici 1 mètre.

ANALYSES

Granulométrie (en valeurs non exprimées en % de terre sèche)

N°	Pourcentage en poids				Viscosité de torsion				Végétation	t % L.L.	L.C.	Dose
	P	G	S	L.L.	K1	K2						
I 669	0-20	0	3	3	97			1,55		16	7,5	
V 155	20-55	0	2	2	98	8,2 · 10 ⁻³	5,7 · 10 ⁻³	1,52		5	15	6,8
P 644	55-120	2	6	8	92	3,5 · 10 ⁻³	3,2 · 10 ⁻³	1,56		6	14	6,1

Analyse chimique - complexe absorbant - tests des sols salés

N°	Cations		pH	Cations absorbants				Cations échangeables				Cations totaux	Cations totaux	
	Totaux	Asif		Ca	Mg	K	Na	Ca	Mg	K	Na			
1	4													
2	7													
3	5													

CONCLUSIONS :
 Choix des cultures limité par les inondations.
 Epaisseur utile : 120 cm.

Format 2

C.N.A.R.B.R.L.

FICHE DE SOL

806 Be 3 Be 1

CARACTÉRISTIQUES HYDRODYNAMIQUES

OBSERVATEUR: JY
 DATE PRÉLÈVEMENT: 25/6/58
 FEUILLE N° 23
 CARNET N° 53, FEUILLET N° 11
 LOCALITÉ: BÉZIERS-NORD
 CARTE 1/20.000 Béziers N° 3
 COORDONNÉES (LAMBERT): X: 664,250; Y: 118,180
 ALTITUDE: 36 m

Situation topographique: ...
 Inclinaison: légère
 Exposition: E.S.T.
 Relief: uni
 Érosion: non apparente
 Drainage: assez bon
 Plan d'eau: absent

ANALYSES

Granulométrie (en valeurs non exprimées en % de terre sèche)

N° des échantillons	Profondeur	Pourcentage en poids				Viscosité de torsion		Végétation	t % L.L.	L.C.	Dose	
		P	G	S	L.L.	K1	K2					
I 669	0-20	0	3	3	97			1,55		16	7,5	
V 155	20-55	0	2	2	98	8,2 · 10 ⁻³	5,7 · 10 ⁻³	1,52		5	15	6,8
P 644	55-120	2	6	8	92	3,5 · 10 ⁻³	3,2 · 10 ⁻³	1,56		6	14	6,1

Analyse chimique - complexe absorbant - tests des sols salés

N°	Cations		pH	Cations absorbants				Cations échangeables				Cations totaux	Cations totaux	
	Totaux	Asif		Ca	Mg	K	Na	Ca	Mg	K	Na			
1	18	1,5												
2	19	2												
3	12	1												

CONCLUSIONS :
 Toute culture en assurant le drainage.
 Portes crues
 Irrigation : à la raie ou aspersion

C.N.A.R.B.R.L.

CARACTÉRISTIQUES PÉDOLOGIQUES

806 Be 3 Be 1

CARACTÈRES DU SOL EN PLACE

GÉOLOGIE: alluvion du Lirou
 USAGE ACTUEL: vignes
 VÉGÉTATION SPONTANÉE: ...

ÉTAT DE LA SURFACE
 ORIGINE ET TYPE DU SOL: Sol alluvial peu évolué.

N° des échantillons	Profondeur	Couleur	Texture	Structure		Consistance	Réaction HCl %	Observations complémentaires
				Masse	Masse			
1	0-20	beige D 65	2	continue	Pseudoparticulaire à grumeleuse	meuble	++	R et r Horizon de culture
2	20-55	beige orangé D 72	2	continue	polyédrique fragile	friable	++	R et r. Rux-graviers poreux. Coquilles 'abondantes'. Débris de galets et galets.
3	55-120	brun rougeâtre E 65	2	continue	polyédrique fragile	friable	++	R et r. Nombreux graviers poreux. Coquilles Débris de galets et galets.

à 150 rien à signaler

ANALYSES : granulométrie (en valeurs non exprimées en % de terre sèche)

N°	Pourcentage en poids				Viscosité de torsion				Végétation	t % L.L.	L.C.	Dose					
	P	G	S	L.L.	K1	K2											
1	0	0	1	2	3			1,1	2,7	22	14	10	36	20	22	11	L
2	0	0	2	0	2	1	2	8	22	15	11	57	20	18	11	L	
3	2	2	0	4	8	2	2	9	29	14	13	43	15	14	12	LSP	

analyse chimique - complexe absorbant - tests des sols salés

N°	Cations		pH	Cations absorbants				Cations échangeables				Cations totaux	Cations totaux	
	Totaux	Asif		Ca	Mg	K	Na	Ca	Mg	K	Na			
1	18	1,5												
2	19	2												
3	12	1												

TerraOccitanIA Project

Metrics of the digitisation model

Count of Submission ID Column Labels							
Row Labels	FALSE	TRUE (blank)	Grand Total	Cumulative Automation	Automation %	Cumulative Errors	Accuracy %
0.95-1		64	64	64	1,1%	0	100,0%
0.9-0.95	1	2884	2885	2949	51,2%	1	100,0%
0.85-0.9	1	902	903	3852	66,9%	2	99,9%
0.8-0.85	3	519	522	4374	75,9%	5	99,9%
0.75-0.8	4	286	290	4664	80,9%	9	99,8%
0.7-0.75	8	178	186	4850	84,2%	17	99,6%
0.65-0.7	6	100	106	4956	86,0%	23	99,5%
0.6-0.65	4	87	91	5047	87,6%	27	99,5%
0.55-0.6	5	65	70	5117	88,8%	32	99,4%
0.5-0.55	10	64	74	5191	90,1%	42	99,2%
0.45-0.5	9	59	68	5259	91,3%	51	99,0%
0.4-0.45	16	42	58	5317	92,3%	67	98,7%
0.35-0.4	11	55	66	5383	93,4%	78	98,6%
0.3-0.35	13	32	45	5428	94,2%	91	98,3%
0.25-0.3	17	37	54	5482	95,1%	108	98,0%
0.2-0.25	11	39	50	5532	96,0%	119	97,8%
0.15-0.2	24	45	69	5601	97,2%	143	97,4%
0.1-0.15	15	36	51	5652	98,1%	158	97,2%
0.05-0.1	46	8	54	5706	99,0%	204	96,4%
0-0.05	55	1	56	5762	100,0%	259	95,5%
<0 or (blank)				5762	100,0%	259	95,5%
Grand Total	259	5503	5762				

Dataset

- 4 different formats
- 9200 sheets processed

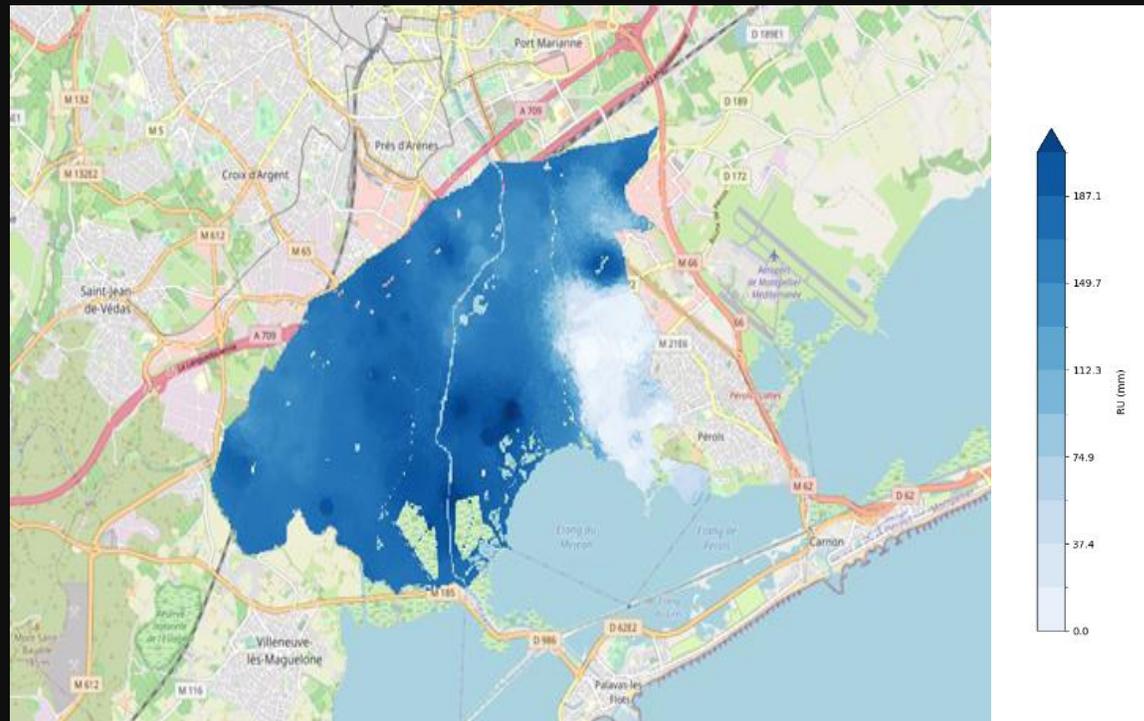
Implementation of the system :

- Accuracy : 99,5 %
- Automation : 87,6 %
- 36 fields to be transcribed manually
≈ - 3 min / sheet

Compromise between the automation and the Accuracy rates

TerraOccitania Project

Predictive AI model : soil available water capacity (SAWC)

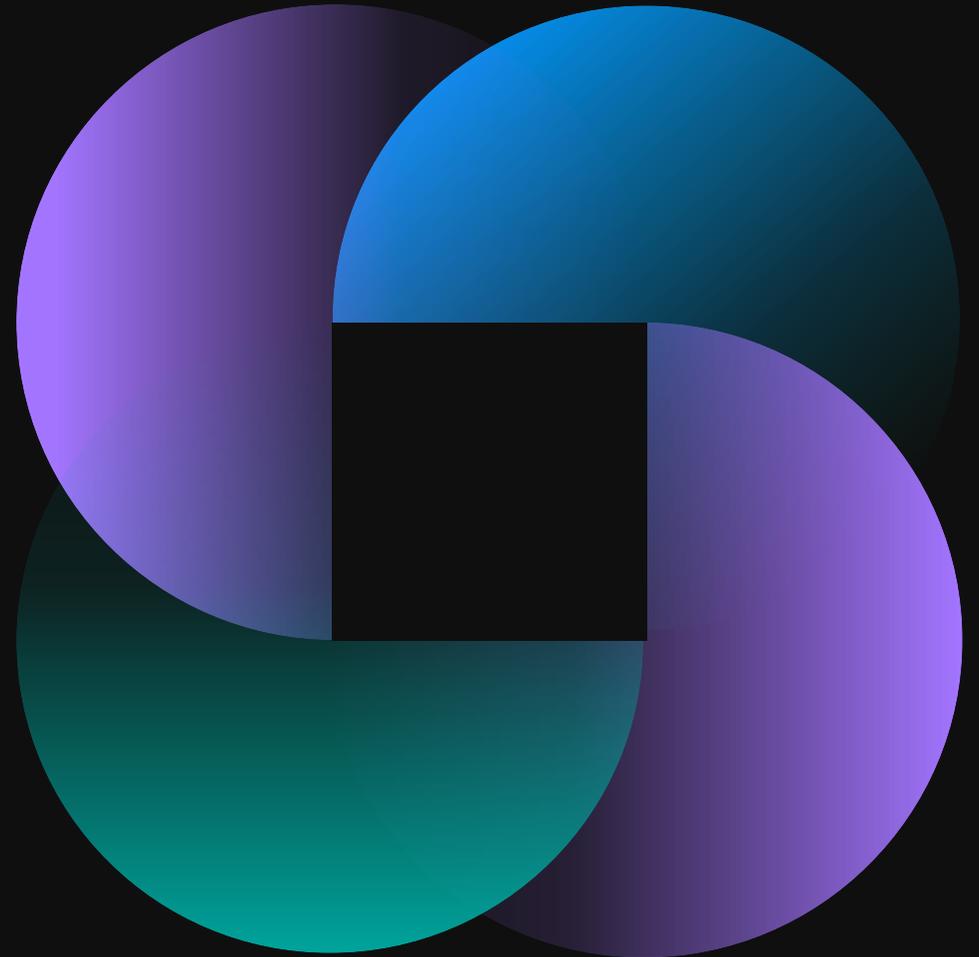


Predicted SAWC in Lattes (south of Montpellier)



Predicted SAWC on the East of Herault department

04. DIVA : AI & Cover Crops for Weed Management



DIVA Project

Weeds need to be managed carefully in vineyards

➤ The facts:

- Chemical products are more and more limited and rejected by the population (the glyphosate example)
- Mechanical intervention is costly and time consuming
- Weeds have dynamical interactions with the vines (could have positive and negative impact)
- Timing is of essence

➤ Solutions usually evolves around automation of treatment (robotics) but without necessarily providing recommendations; sometimes no action is better

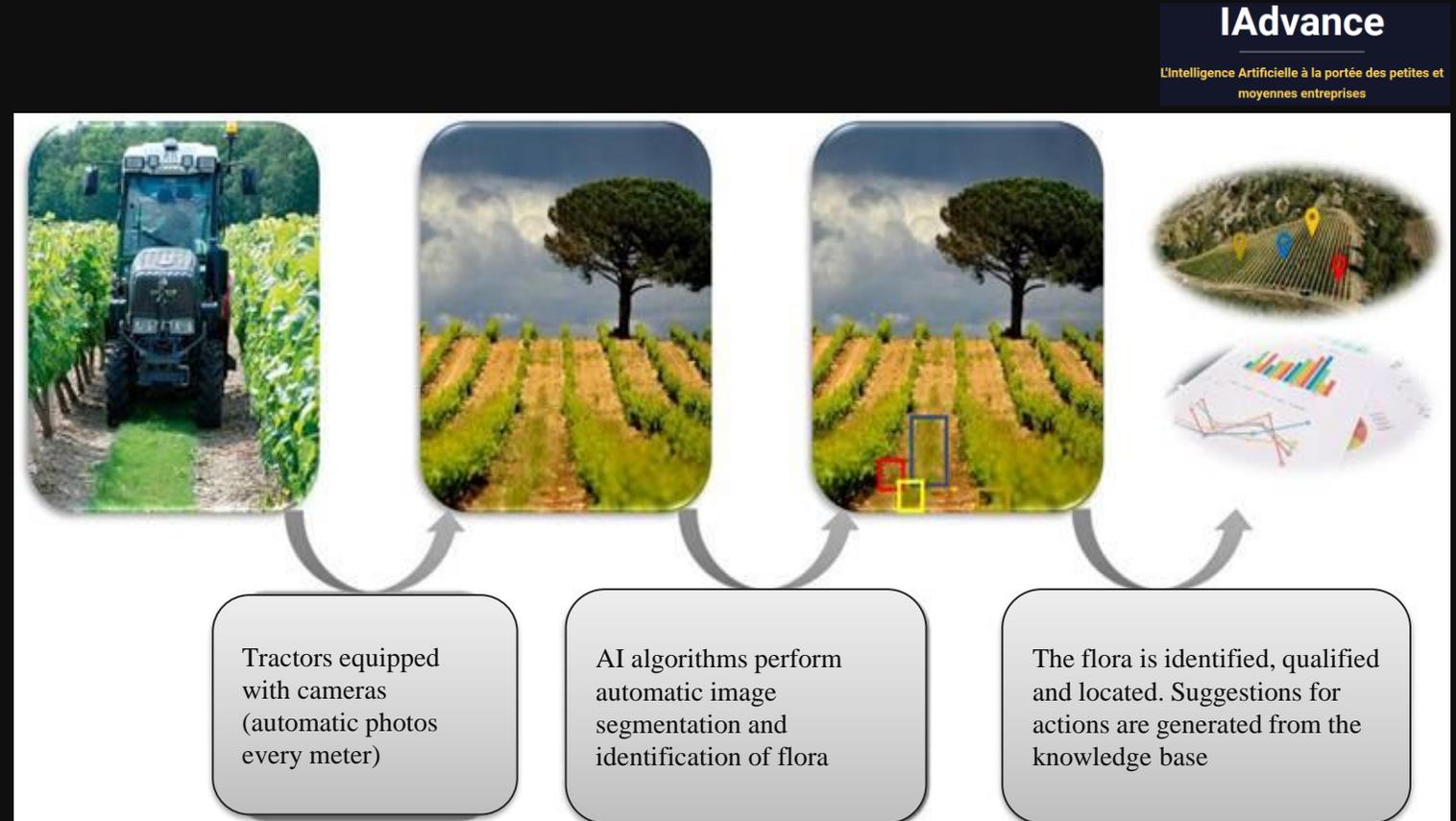


DIVA Project

Identification & localisation of flora

DIVA: An intelligent tool to assist in the flora management in viticulture,
Implementation of a multi-stage image analysis pipeline based on different neural network architectures,

- 1 – Take pictures from the inter rows
- 2 – Detection and identification of the flora
- 3 – Suggestion of actions



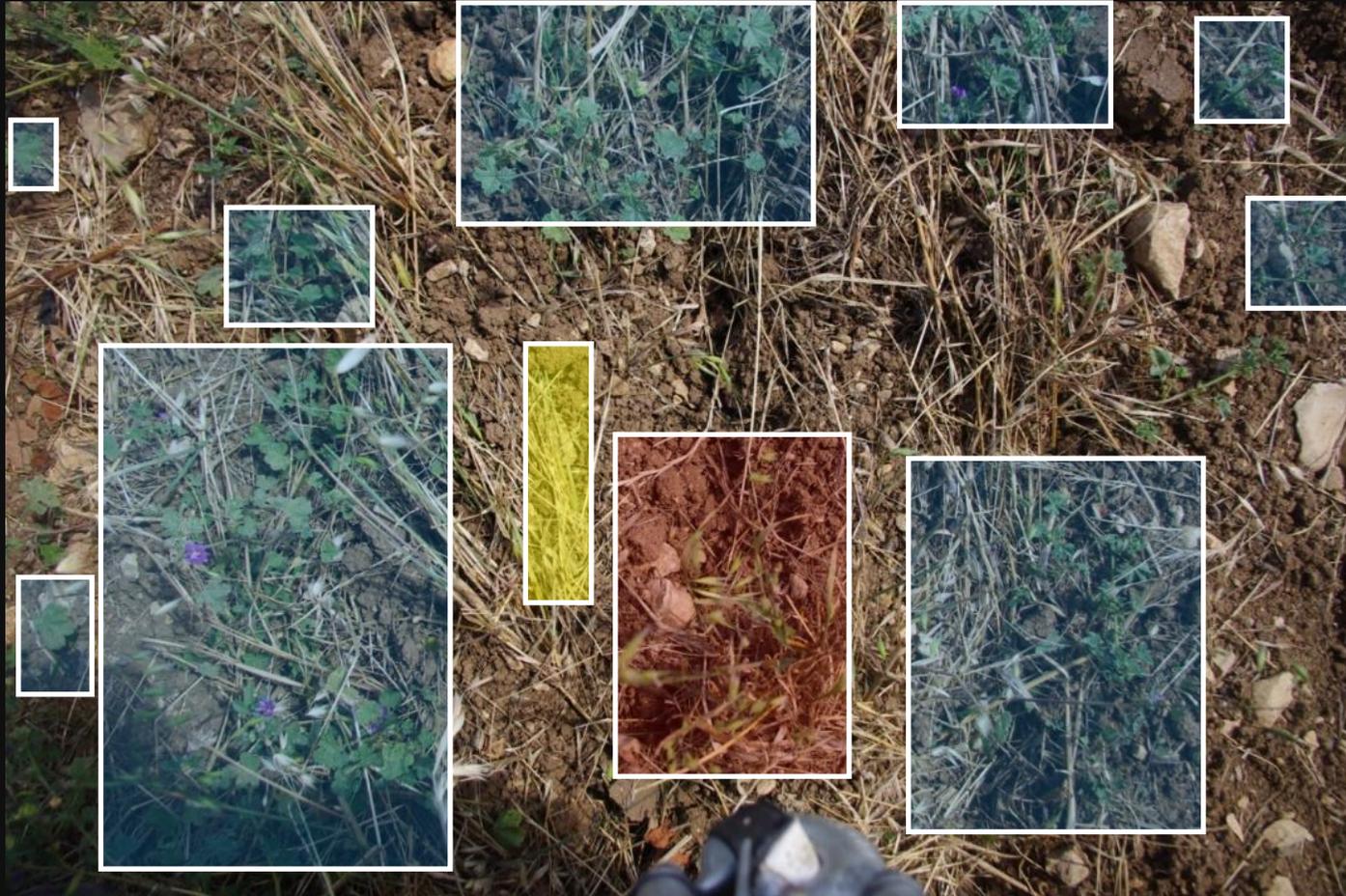
DIVA Project

From raw images...



DIVA Project

The algorithm detects, identifies and quantifies the species



 Malva sylvestris – 10 cm²

 Oats – 2 cm²

 Not identified – 0,1 cm²

DIVA Project

One of the challenge is linked with the quality of the images



Diva Project

Labelling was a tricky aspect

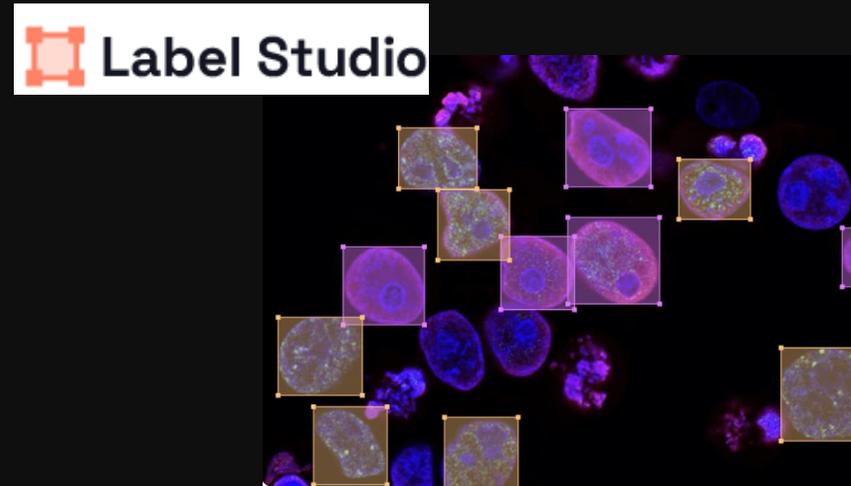


- You cannot expect to find an expert to label the images!
- External data were used to auto-label content of generic “weed” boxes

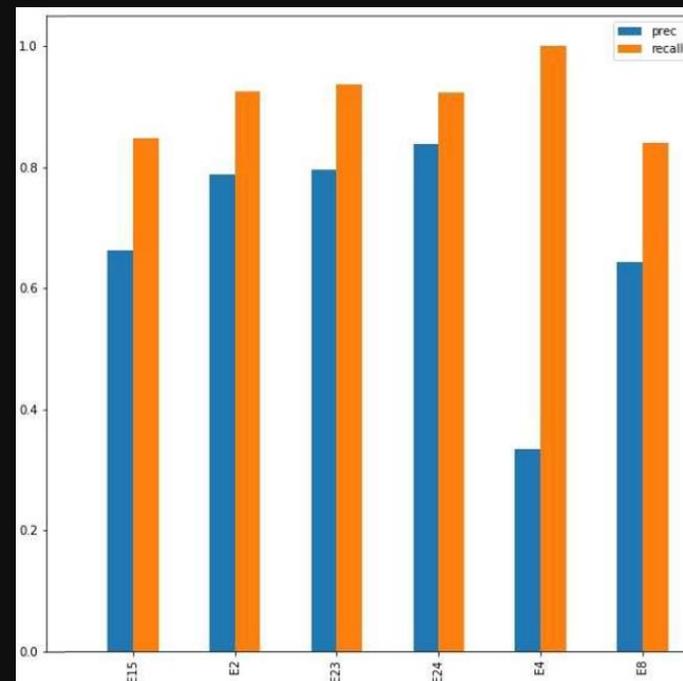
Diva Project

Model training and metrics

- Dataset of 1000 pictures
 - Five different classes of Weeds
- By using Label Studio (open source tool)
- 2 models are implemented
 1. Detect Weeds (Weeds/no weeds)
 2. Classify weeds into 5 classes.



Recall and precesion of the classification model



DIVA Project

Examples that work



DIVA Project

Examples that work



DIVA Project

Examples to be improved



DIVA Project

Conclusion & future works

- Several difficulties encountered
 - image quality - shadows on the image - data labelling
- The first results are encouraging but some classes need more data examples.

As future works :

- Take more pictures of certain weed classes and retrain the model.
- Transfer of the developed solution on mobile / edge in order to deploy the tool.



Funding from the Horizon 2020 DIVA project
Collaboration with IFV to work on refining the use cases and in the context of finding alternative to the use of glyphosate.



EU Horizon 2020



28



Atos

Conclusion & Perspectives

Future works & collaborations

we plan to work on these topics but not only:

- Flood forecasting and management
- Water management and dryness prevention
- Remote sensing and GIS in agriculture
- Disease detection in plots
- ...



Thank you!

For more information please contact:

Tel +33 758789334

lamine.chemchem@atos.net

Atos is a registered trademark of Atos SE. June 2022. © 2022 Atos. Confidential information owned by Atos, to be used by the recipient only. This document, or any part of it, may not be reproduced, copied, circulated and/ or distributed nor quoted without prior written approval from Atos.

