

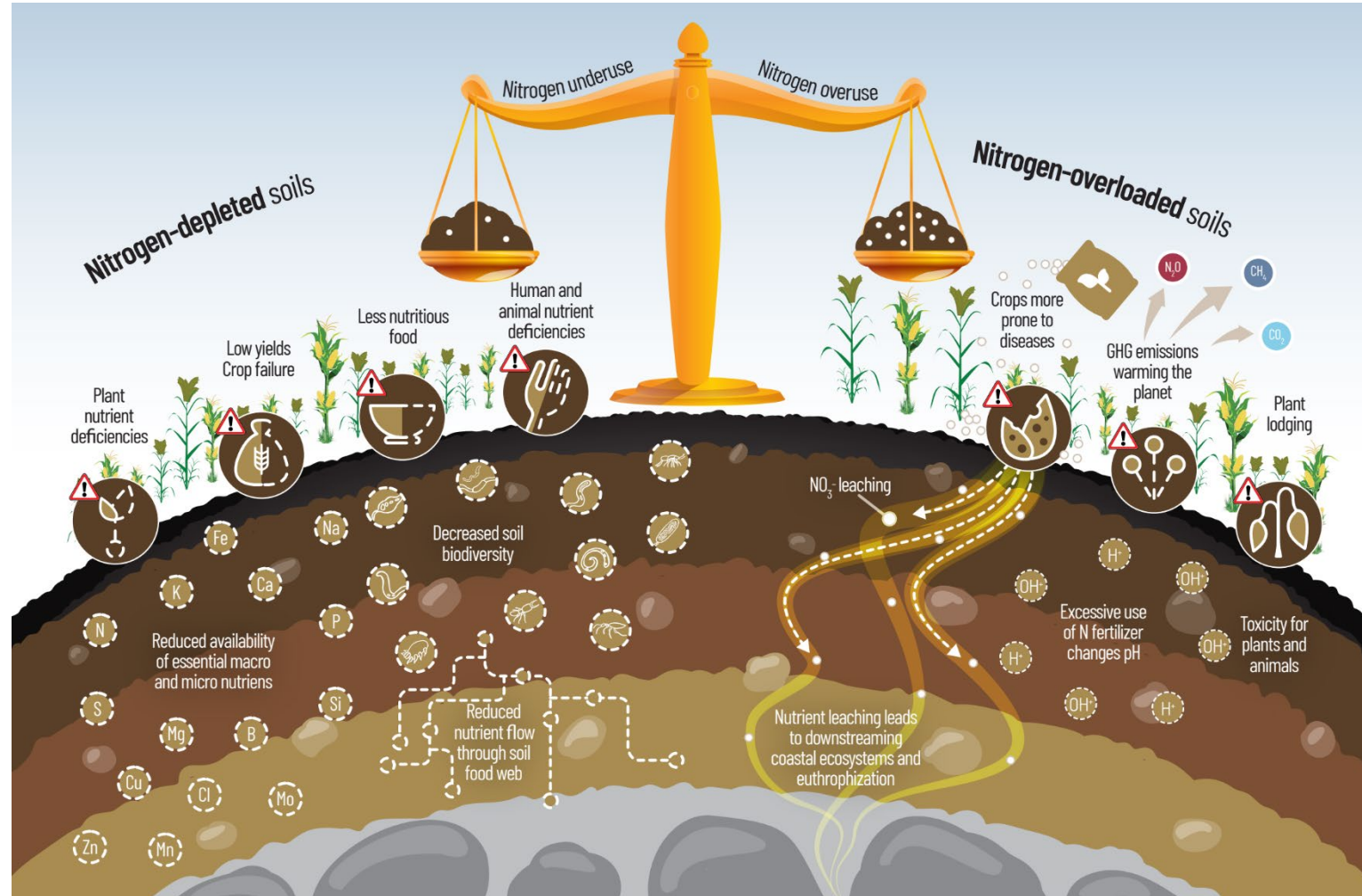
Sentinel-2 Based Detection of Nitrogen Fertilizer Applications

Sara Romagnoli
Environmental Crimes Workshop

CGI

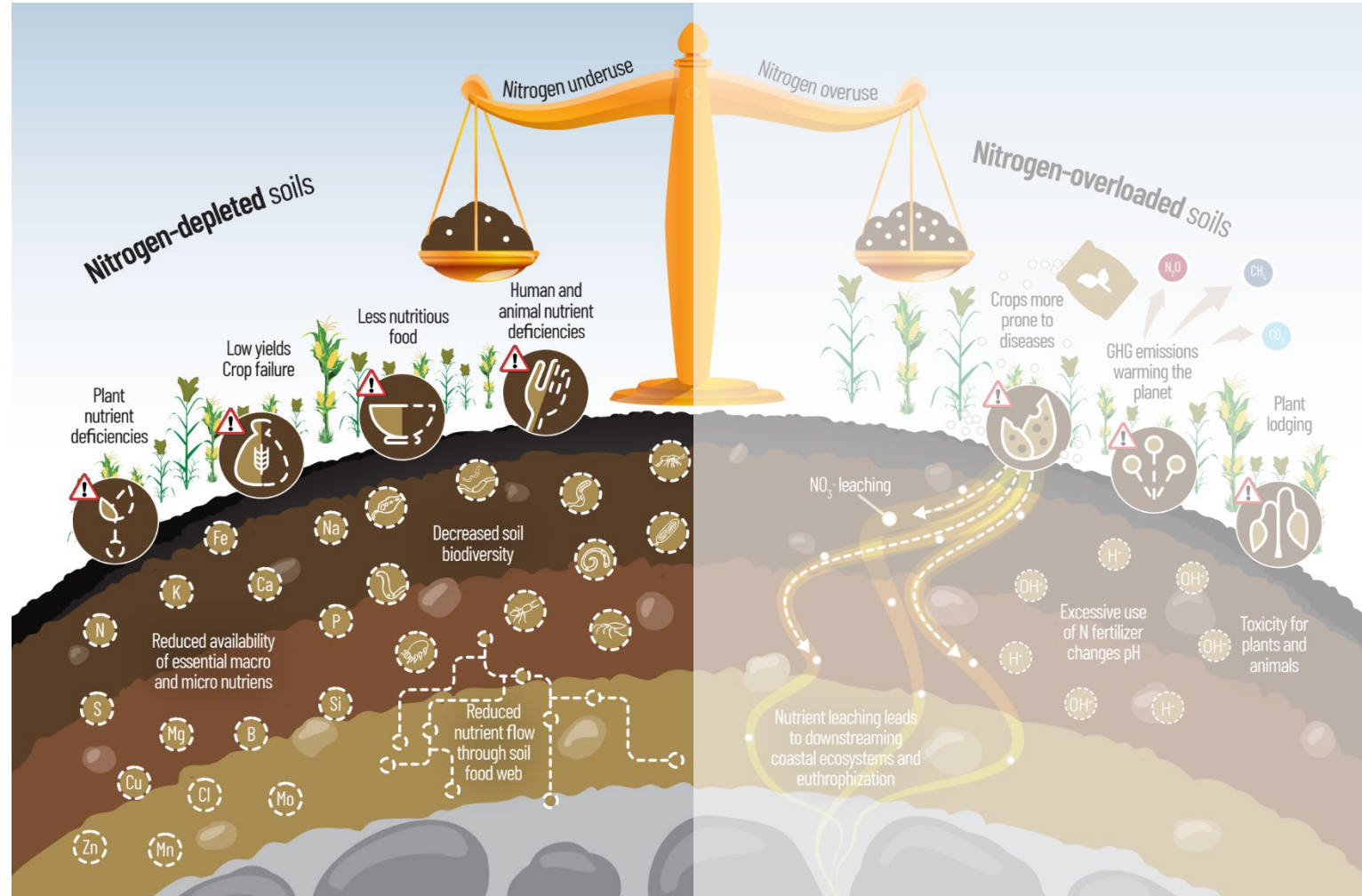


Why N is important?



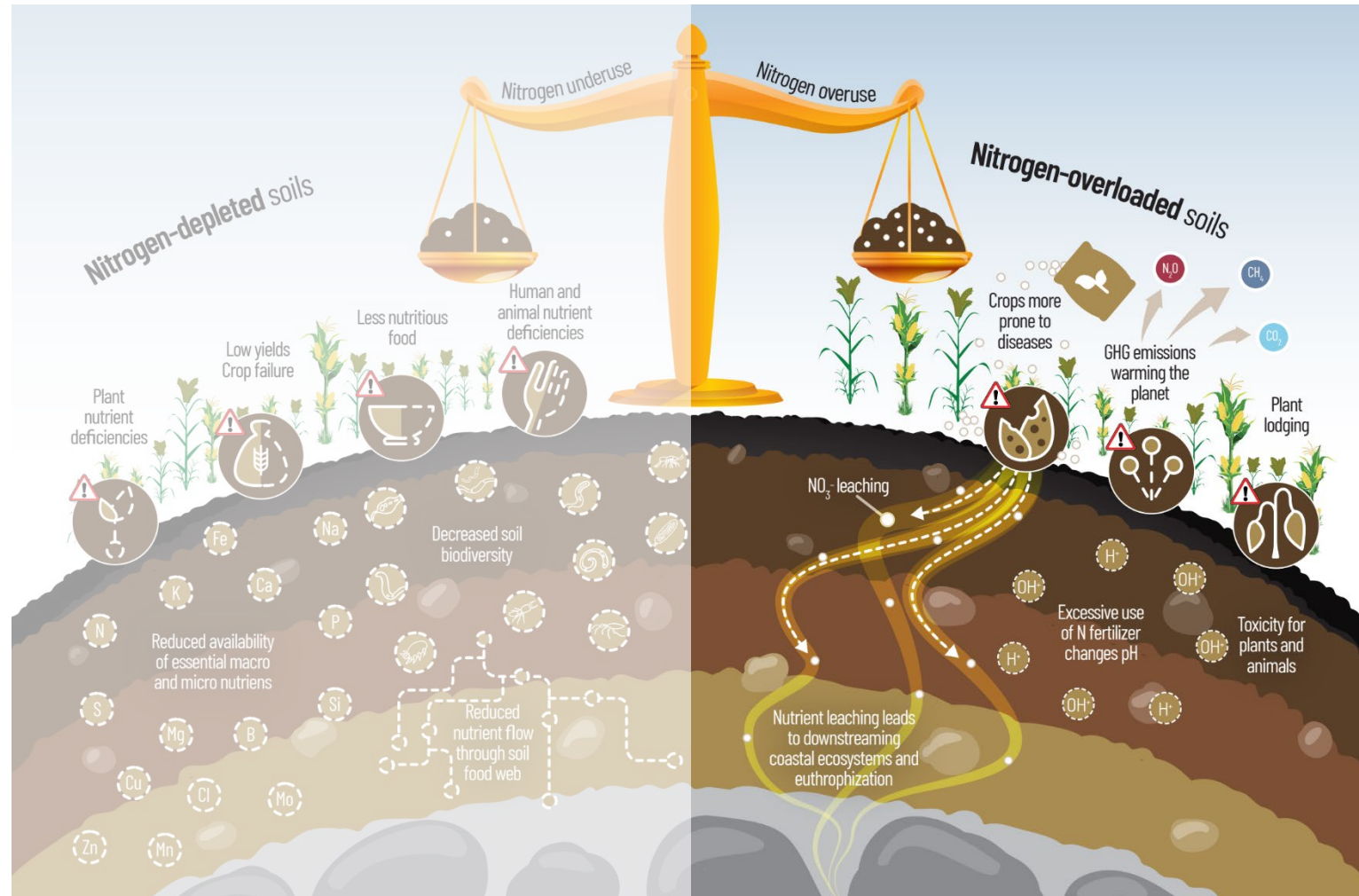
FAO. 2025. Sustainable nitrogen management in agrifood systems. Rome. <https://doi.org/10.4060/cd3388en>

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Regulation on N-Fertilizers



Europe – Nitrates Directive (91/676/EEC):

- It aims to **reduce water pollution** caused by nitrogen fertilizers and **promote good farming practices**.
- It is the **foundation for** the specific **national laws** developed by each Member State.



Italy – Environmental Code (*Legislative Decree 152/2006*):

It provides the overarching framework for nitrogen fertilization and manure management.

Regional rules specify key controls, including:

- **seasonal fertilization bans**;
- **minimum distances from watercourses**;
- **prohibitions** of application to **frozen, snow-covered or water-saturated soils**.

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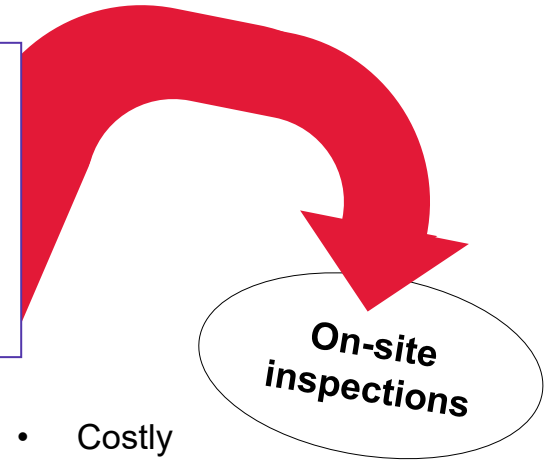


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- Costly
- Time consuming
- Lack of manpower



SERVICE TYPE

▼

OWNER

Anyone

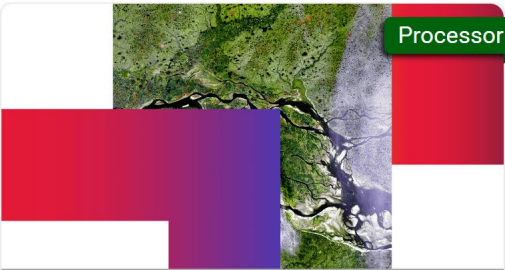
▼

Service list Select a service to run

Q N-Fertilizer Detection

Sort by ▼

↓
A
Z



Processor

N-Fertilizer Detection

Run service >

SERVICE TYPE

OWNER

Service list Select a service to run

Sort by

N-Fertilizer Detection

Run service

Input: Sentinel-2 images

Methodology: Decision tree leveraging SWIR 1, SWIR 2 and NIR bands

Output: Binary Map

0 = no N-fertilizer detected
1 = N-fertilizer detected

Home / Run / Standard processing / "N-Fertilizer Detection"

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Accuracy 86%

Insula

The hub between data and decision

[Portal Access](#)

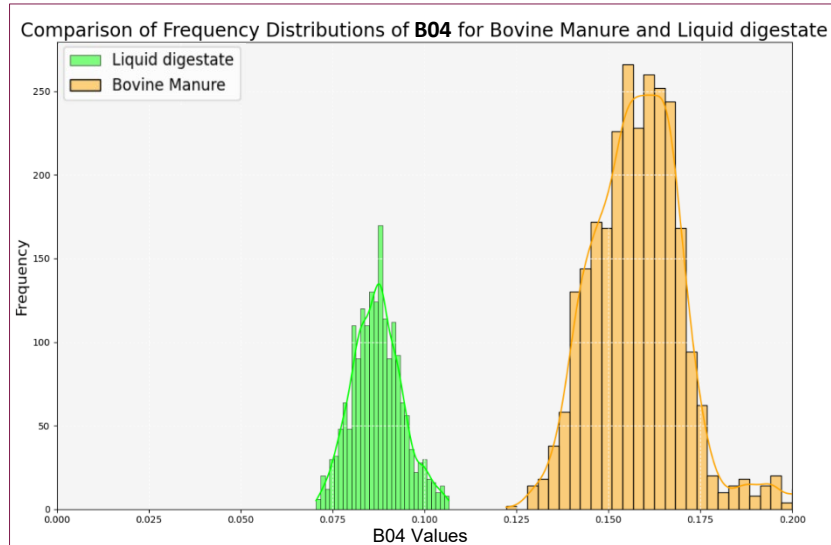
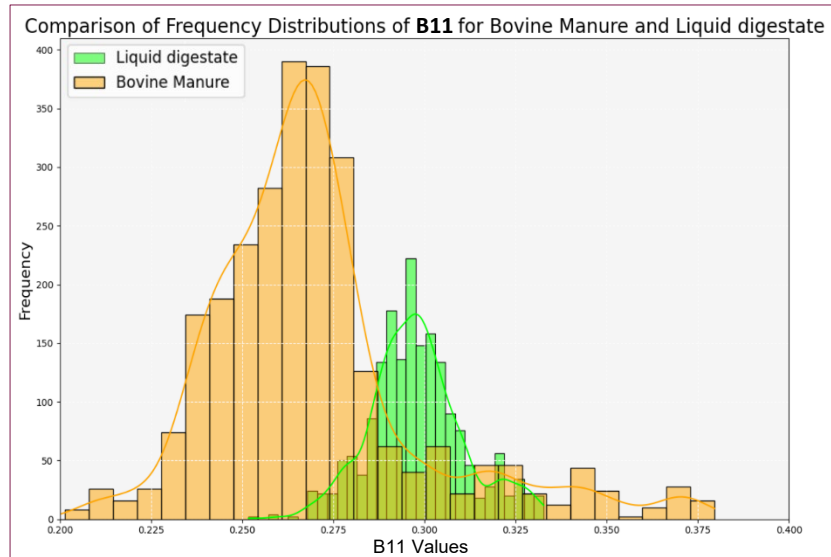




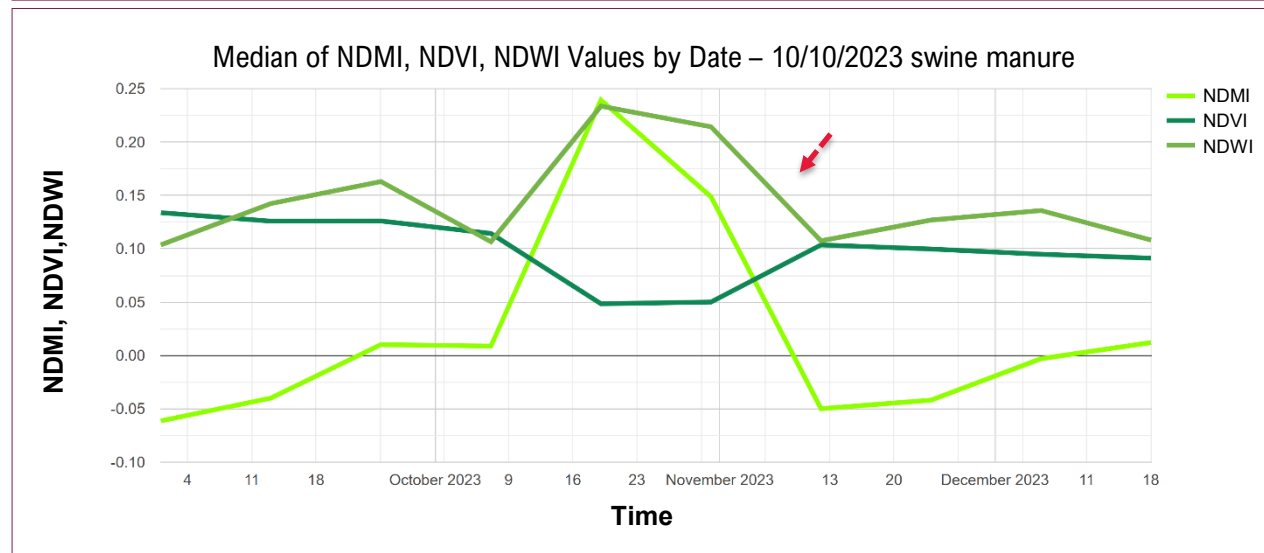
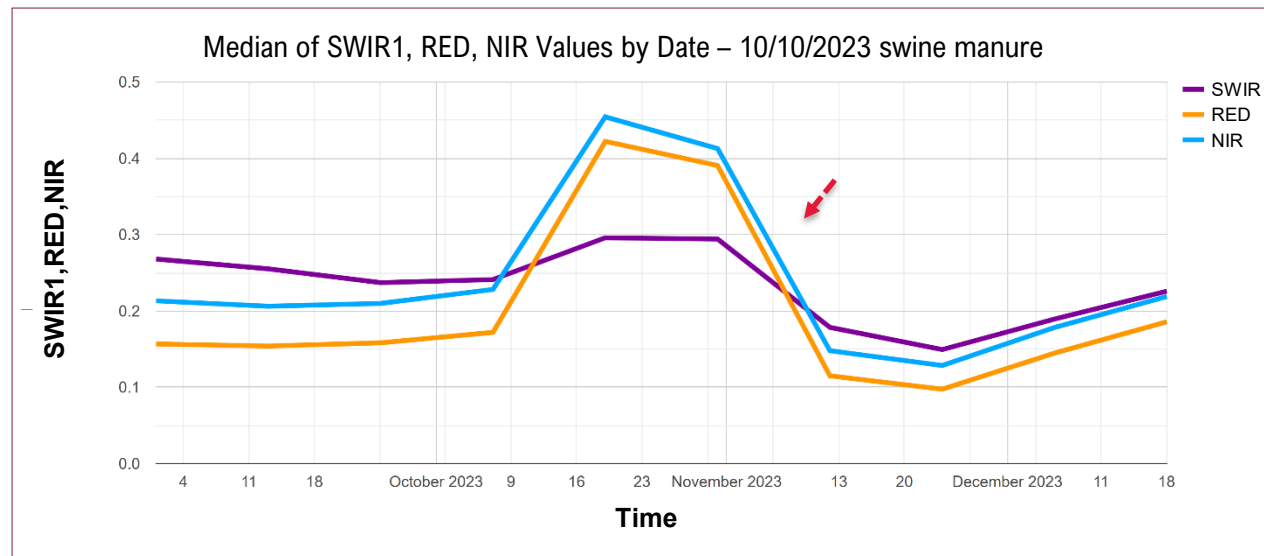
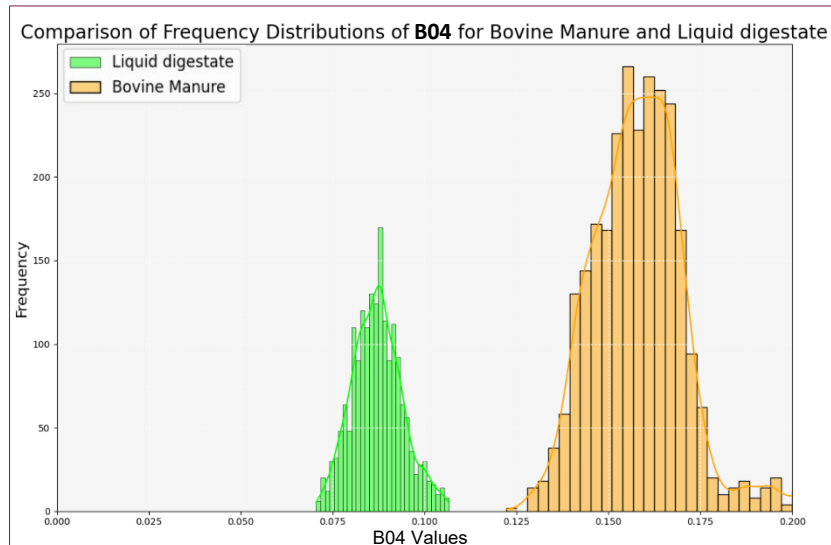
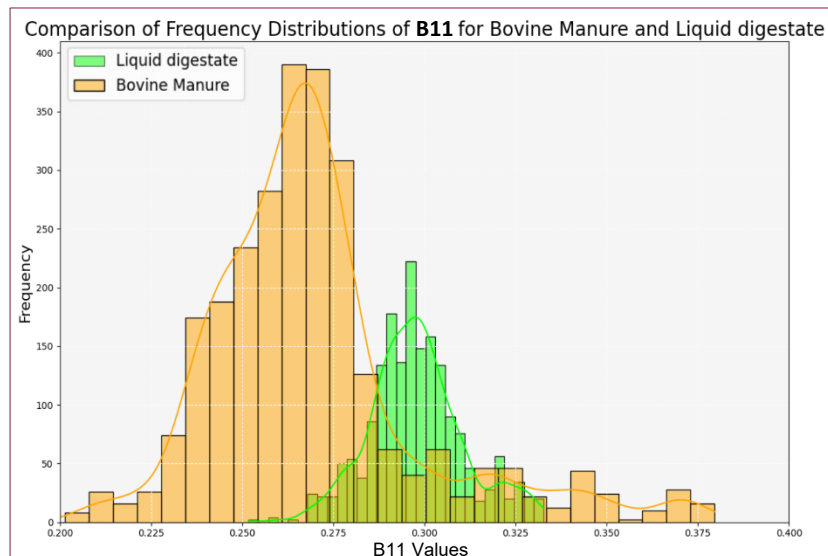
What we are working on:

Field	Period of spreading	Type of fertilizer used	Location
A	03-08/09/2020	liquid digestate	Forlimpopoli
B	15-20/09/2021	poultry litter	Cesena
C	01-05/10/2021	poultry layer manure	Cesena
D	15-18/05/2022	liquid digestate	Forlimpopoli
E	29-30/08/2022	liquid digestate	Bertinoro
F	03/10/2022	semi-liquid digestate	Forlì
G	27/10/2022	ovine	Forlì
H	20-30/09/2023	bovine	Poviglio
I	11/10/2023	swine	Castel Bolognese
L	10-13/05/2024	bovine	Bibbiano
M	28/05/2024 - 01/06/2024	bovine	San Polo d'Enza
N	15-16/06/2024	bovine	Poviglio
O	18/06/2024	solid digestate	Cesena
P	18/06/2024	solid digestate	Bertinoro

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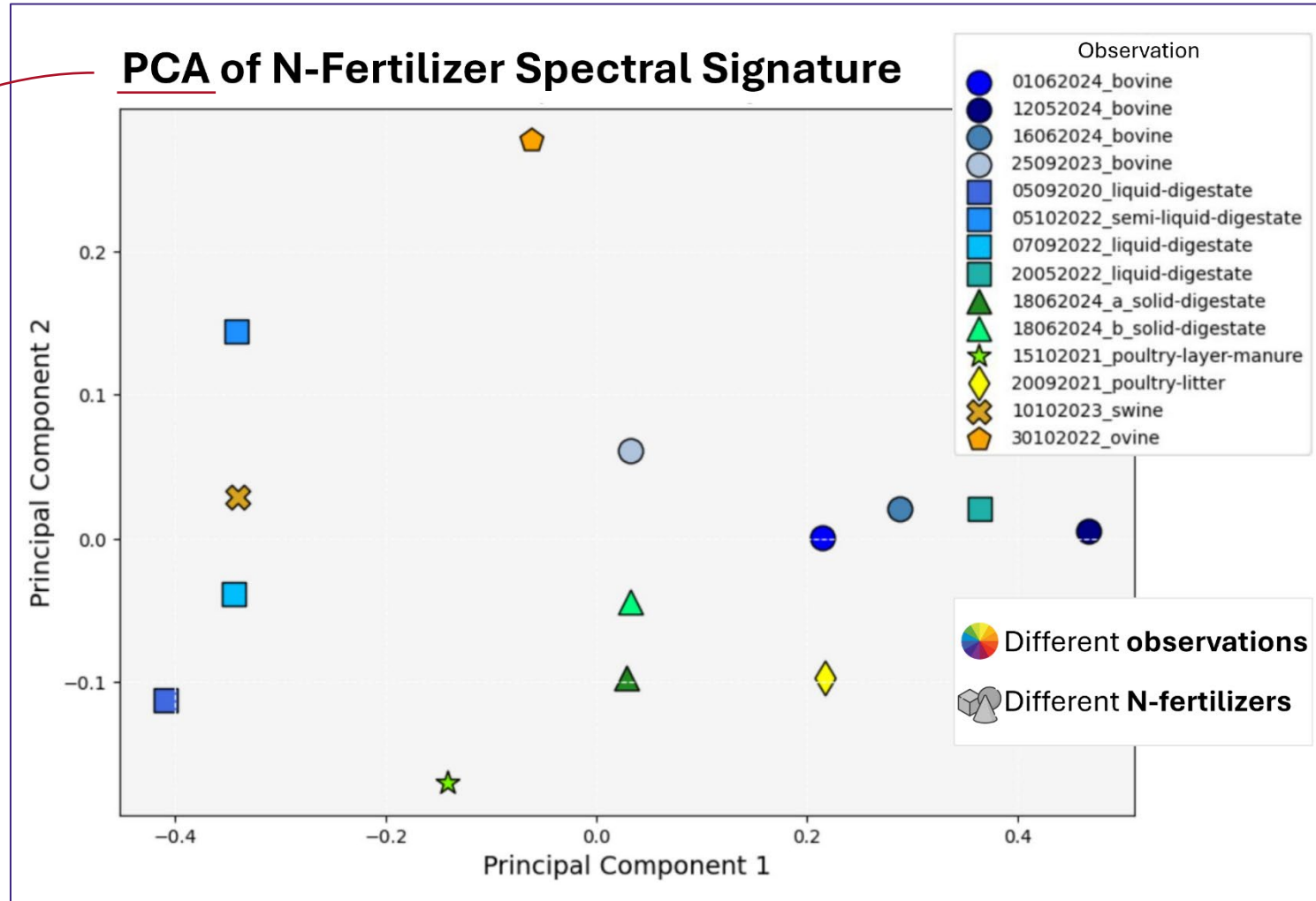


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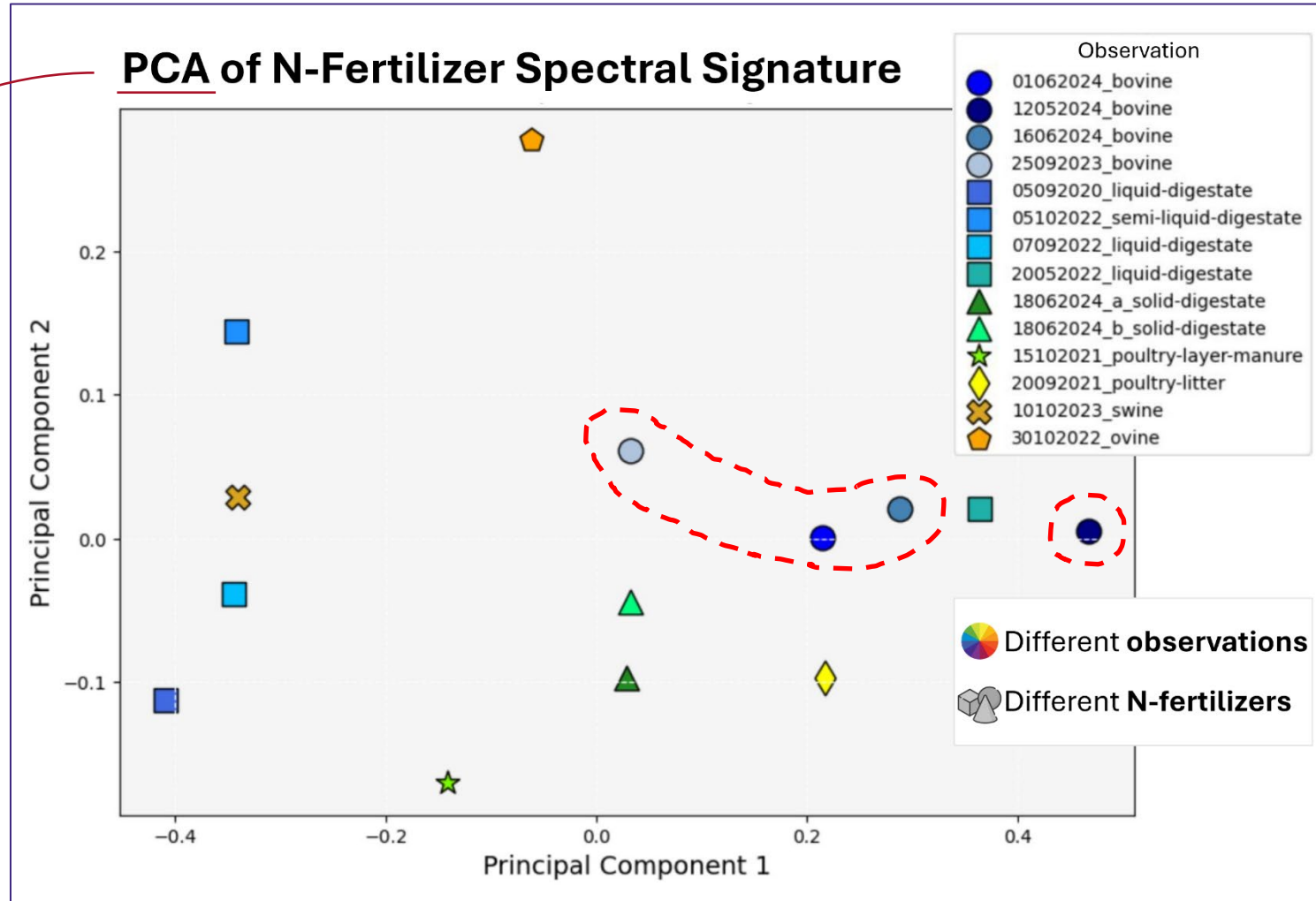
What we are working on:

Computed leveraging
Sentinel-2 **SWIR 1**,
NIR and **RED** bands
plus the indexes
NDVI, **NDMI**, **NDWI**



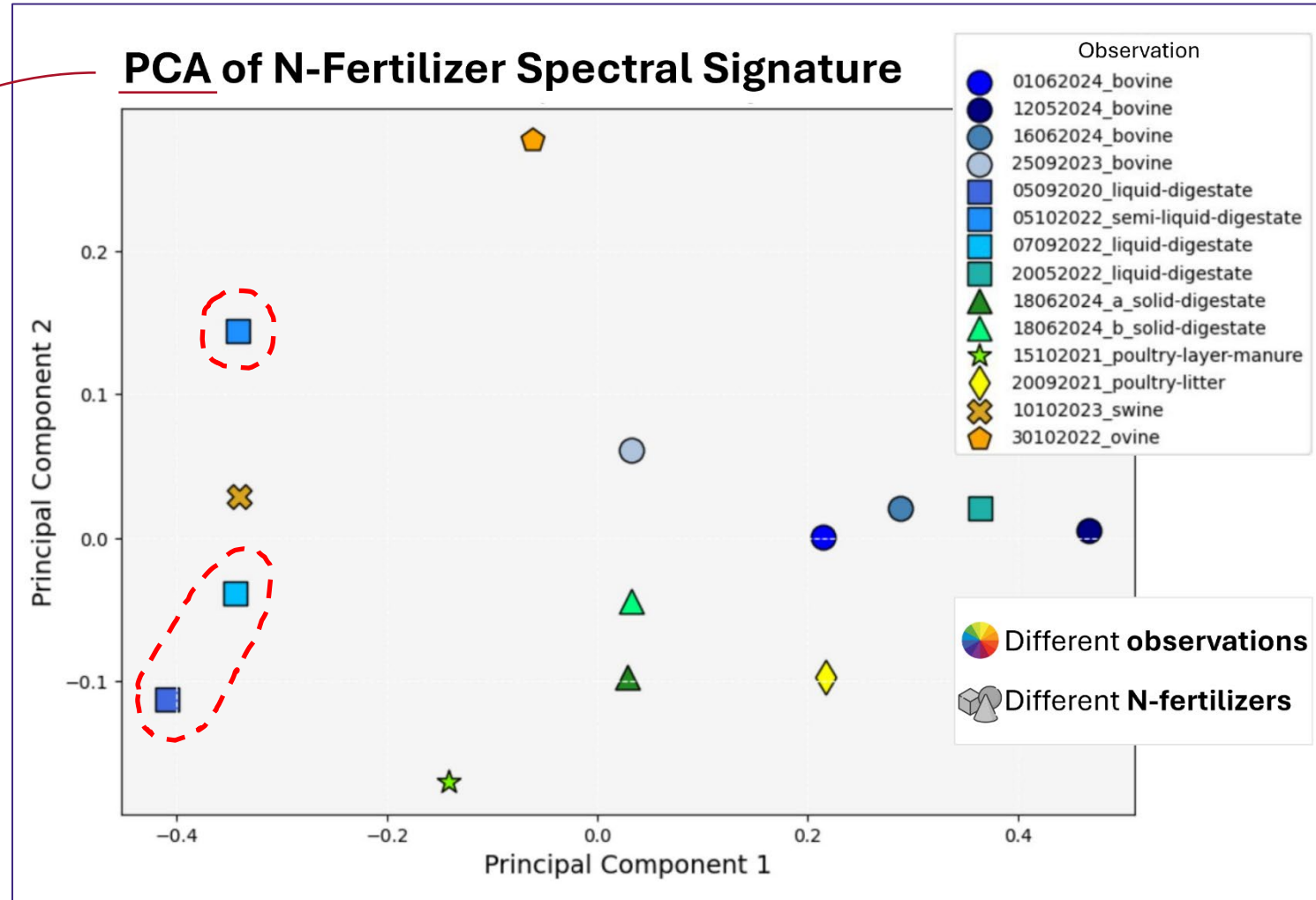
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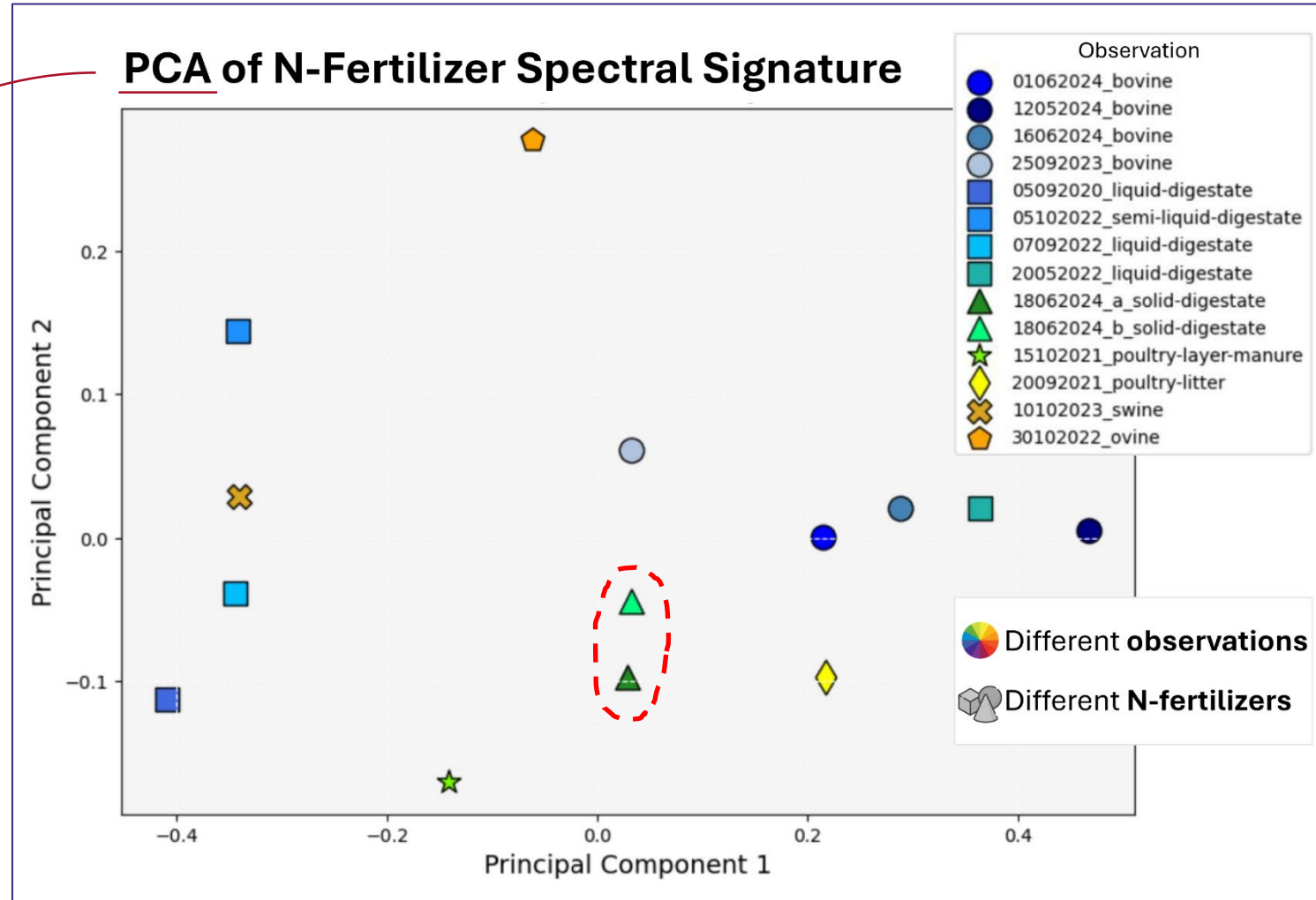
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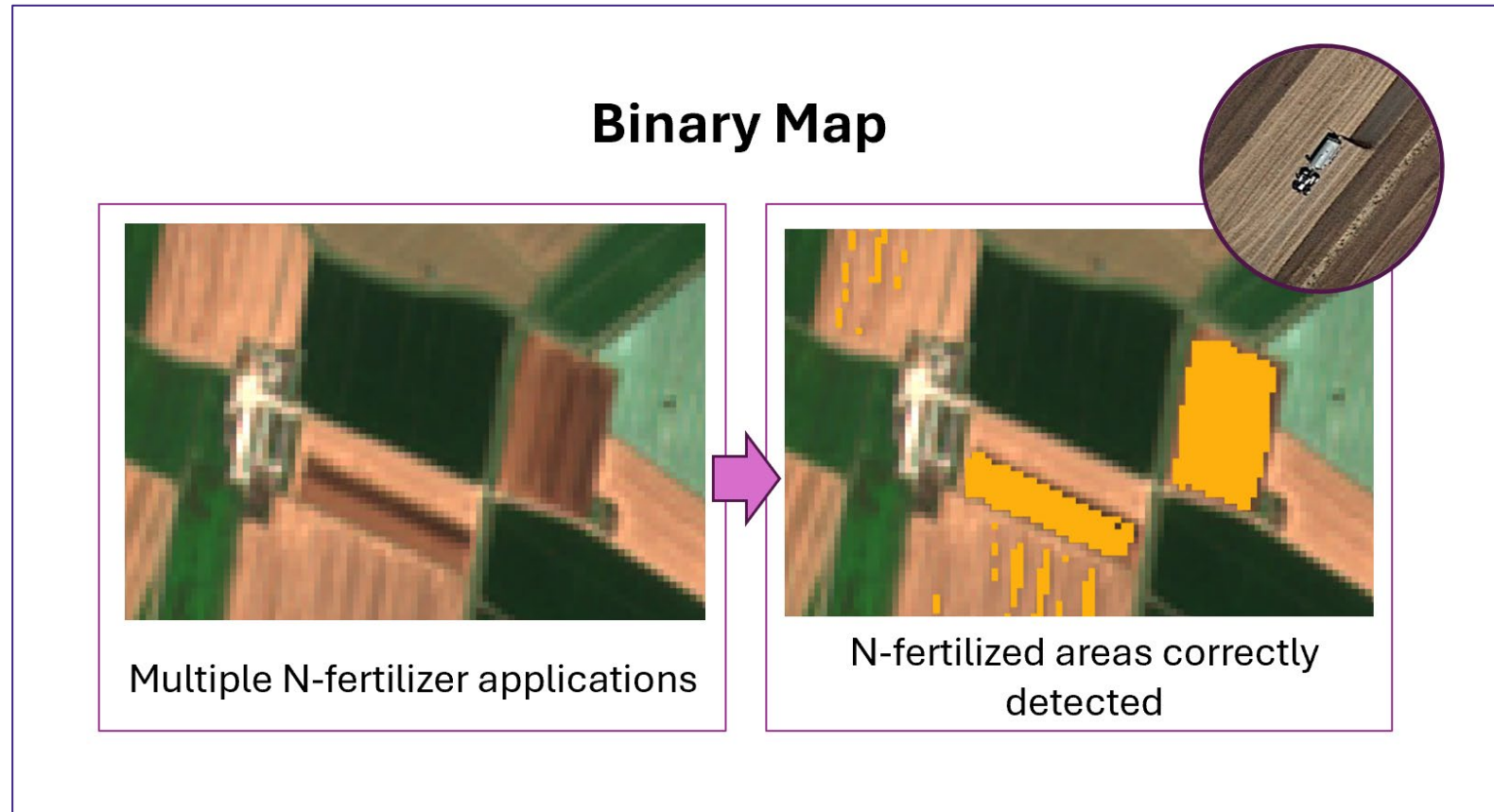


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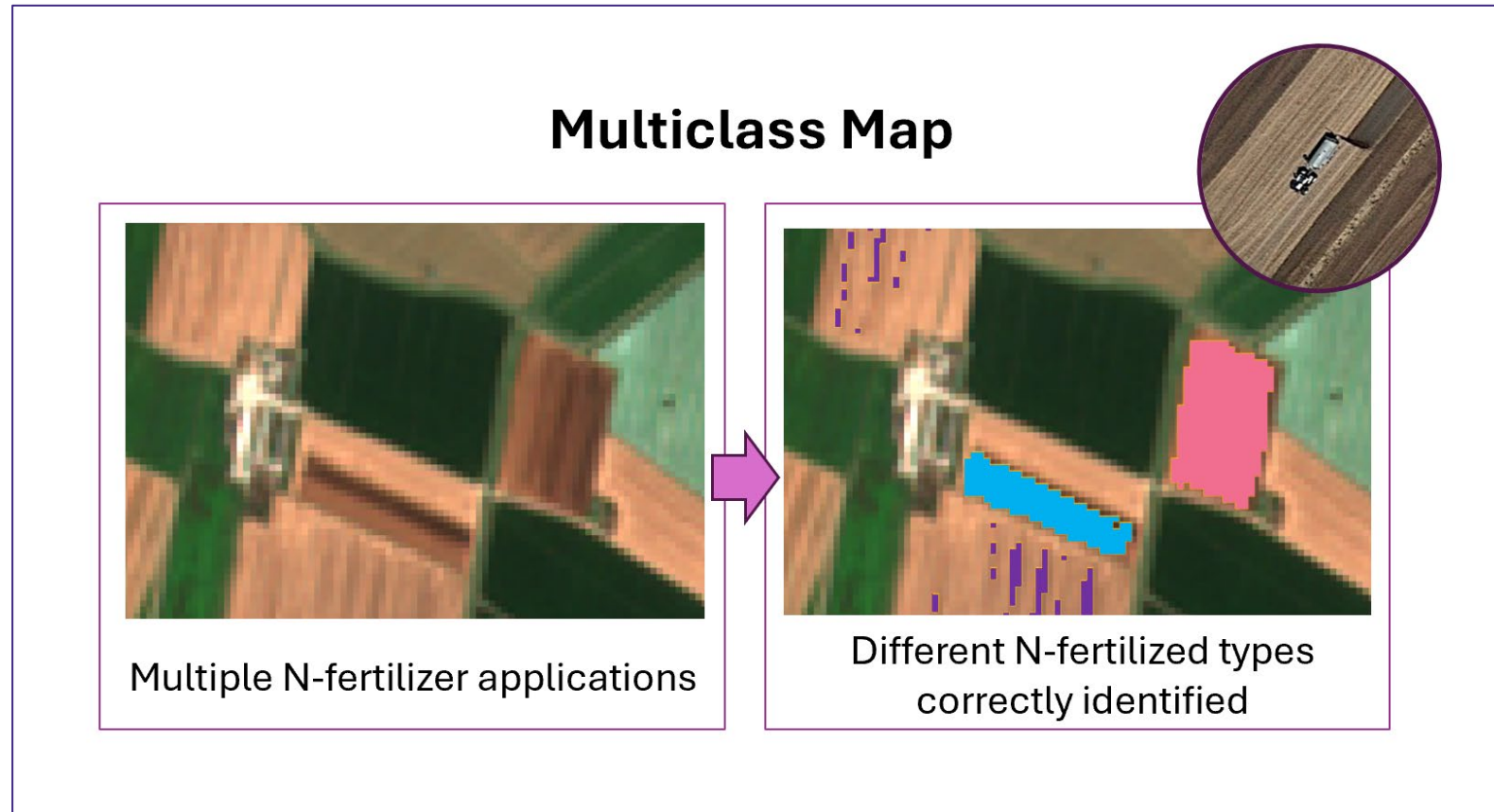
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Next steps

- **Enlarge** our **dataset** of N-fertilizer applications with **known fertilizer type**



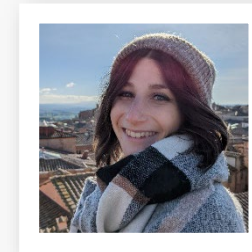
Not trivial because a
verified source on
the **ground** is needed



Collaboration with **ARPAE**

- **Train and validate** a **model** to upgrade the N-Fertilizer Detection service
- Explore **hyperspectral** potentialities

Thank You!



Sara Romagnoli
sara.romagnoli@cgi.com