SPOKE 7: SPACE FOR THE SUSTAINABLE DEVELOPMENT OF THE PLANET

Enhancing wetland classification with a hybrid modelling approach

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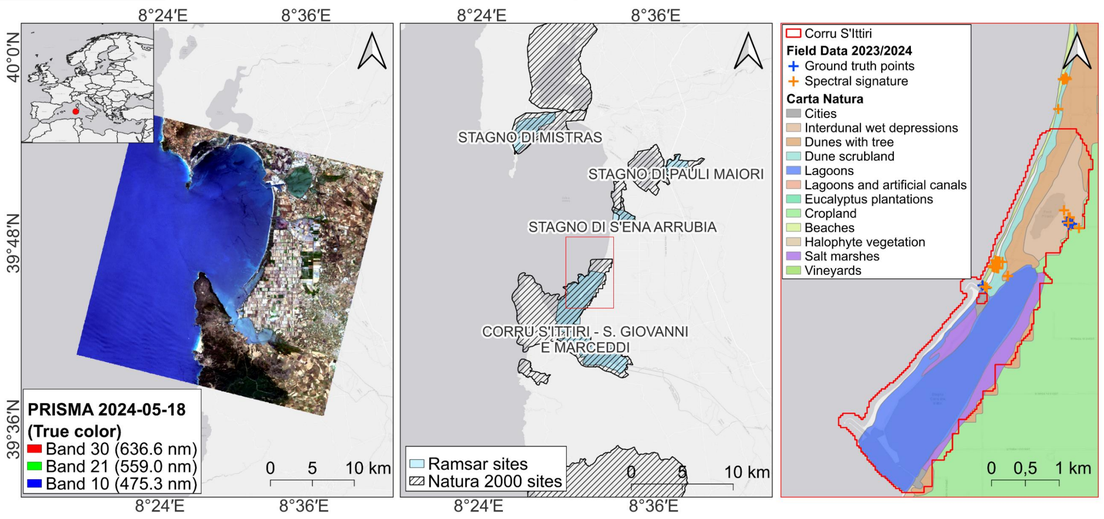
Introduction and objectives

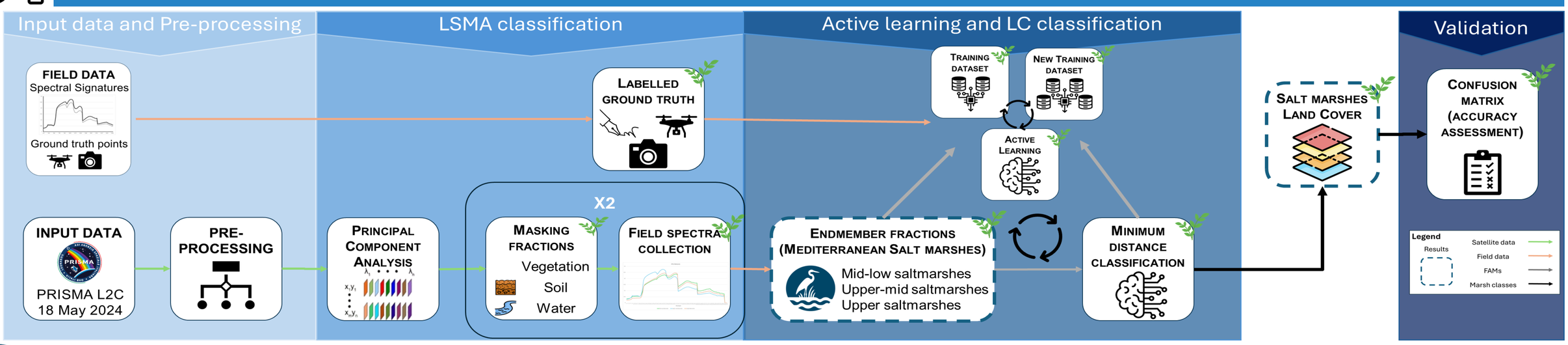
- **Marine-coastal ecosystems** play a crucial role by regulating the climate, providing ecosystem services, but they are threatened by human activities and climate change.
- **Coastal wetlands** act as a dual-function ecosystem, providing protection by storing water during coastal flooding events, while at the same time being highly vulnerable due to their low-lying nature.
- The **overall objective** is to develop and validate a processing chain focused on **coastal wetland Land Cover** (LC) products, integrating machine learning techniques, with a specific emphasis on **Active Learning (AL).**

Study area

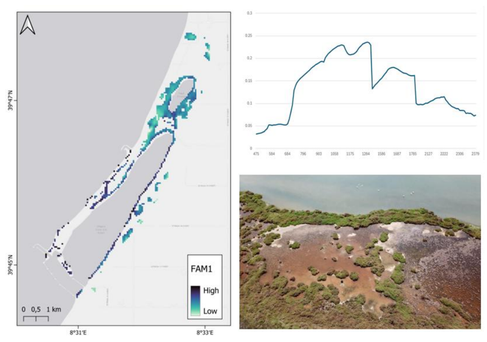
- The **Gulf of Oristano** (39.93°–8.42° and 39.67°–8.62°), on the western coast of Sardinia (Italy) is a semi-enclosed basin (~150 km²) with highly heterogeneous LC shaped by human–environment interactions.
- The area hold six of Sardinia's eight Ramsar natural sites (covering 77 km²), highlighting its exceptional **ecological importance**.
- In this study, the processing chain was tested on the **Corru S'Ittiri Pond Ramsar site**, an elongated NE-SW lagoon in the southern Gulf.



Material and methods

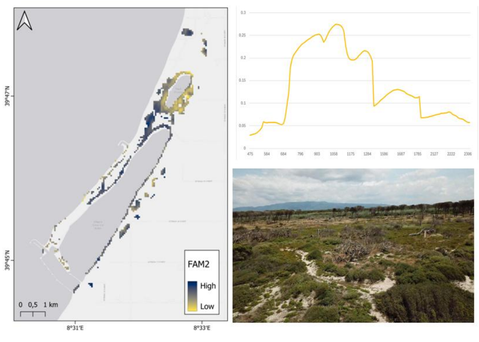


Results - LSMA classification (Endmember fractions)



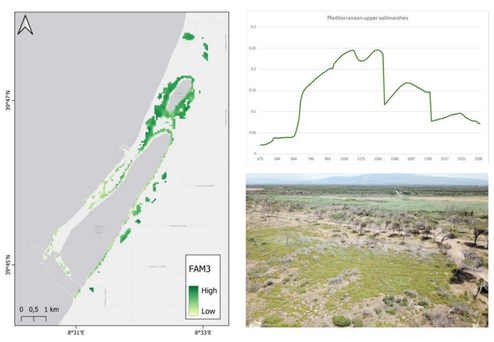
Mediterranean mid-low salt marshes

Highest values are located along the coastline and the west border of the S'Ittiri lagoon, while the values gradually decrease towards inland.



Mediterranean upper-mid salt marshes

Highest values are located on the western border of the S'Ittiri Lagoon and between it and the Pauli Pirastu lagoon, while the lowest values are located along the Pauli Pirastu lagoon's border.



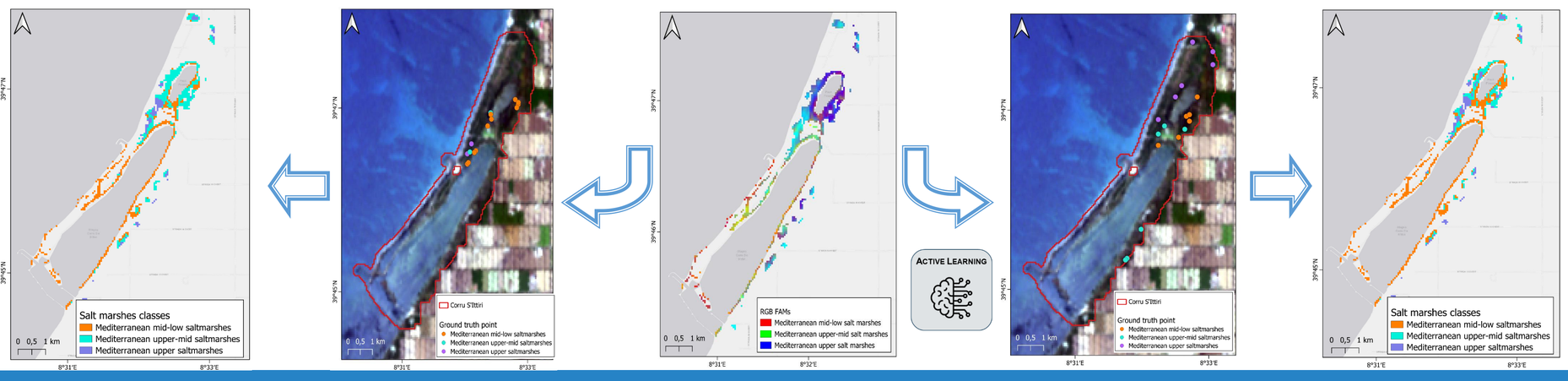
Mediterranean upper salt marshes

Highest values are mainly distributed in the inland areas and along the border of the Pauli Pirastu lagoon, while the lowest values are found along the border of the S'Ittiri lagoon.

Results - Active Learning and LC Classification (Salt marshes)

Producer's accuracy

- **0.6** for mid-low marshes,
- **0.7** for upper-mid marshes,
- **0.7** for upper marshes



Producer's accuracy

- **0.6** for mid-low marshes,
- **0.6** for upper-mid marshes,
- **0.8** for upper marshes

Take home messages

- The high spectral resolution of **hyperspectral data** has enabled an **improvement in the thematic resolution** of wetland LC mapping, moving from a 3°-level classification with a salt marsh class to a 4°-level classification characterized by three distinct salt marsh classes. Future developments will exploit data from upcoming hyperspectral missions, such as PLATINO, as part of the **Italian Constellation of Constellations "IRIDE"**.
- The **hybrid modelling approach**, based on the **integration of AL** with LSMA, enhanced class separability and the characterization of transitional zones, enabling the identification of three wetland classes and **improving the classification accuracy** of the upper marsh class from 0.7 to 0.8.
- Future work will refine the active-learning loop, test additional spectral features and classifiers, and extend the workflow **to other coastal LC classes**.

References

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