



Global Land Program  
4<sup>th</sup> Open Science Meeting 2019

# Satellite multispectral unmixing by drone data for wet grassland habitats classification

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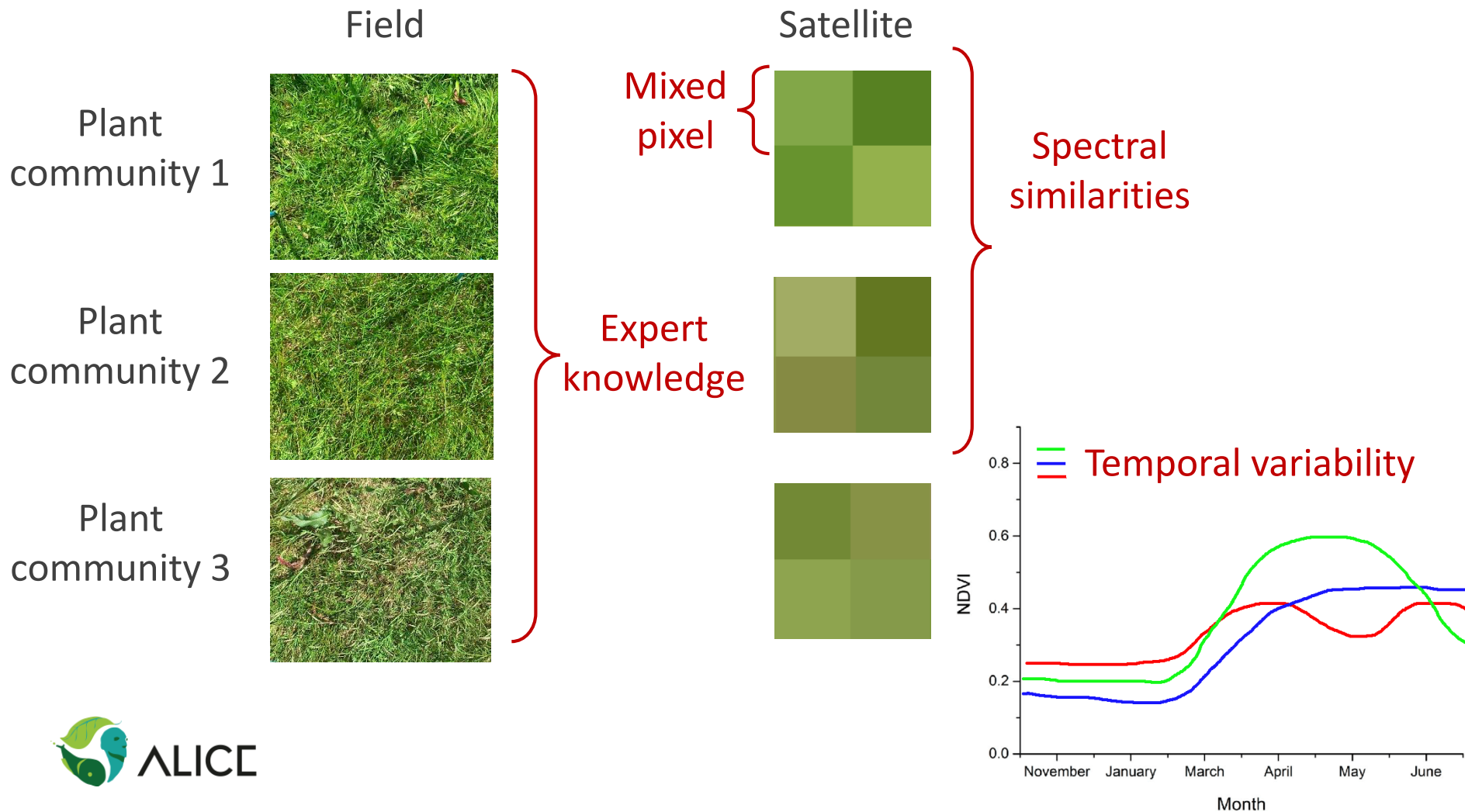


IMPROVING THE MANAGEMENT OF  
ATLANTIC LANDSCAPES ACCOUNTING  
FOR BIODIVERSITY AND ECOSYSTEM SERVICES



Introduction:

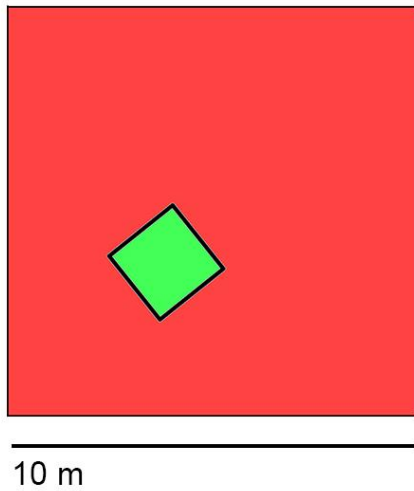
# Habitat mapping



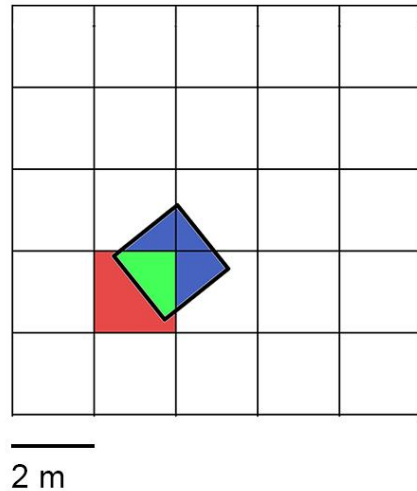
Assumption:

# UAV data provides pure pixel

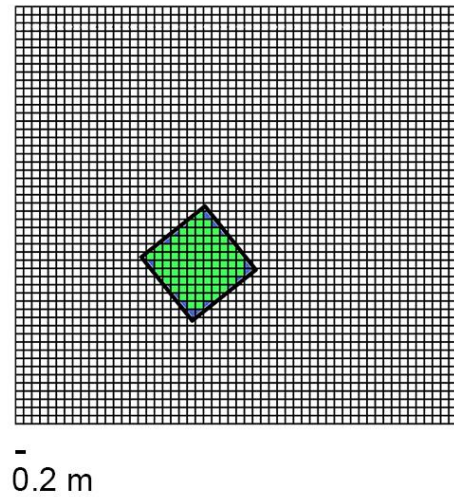
1) Sentinel-2



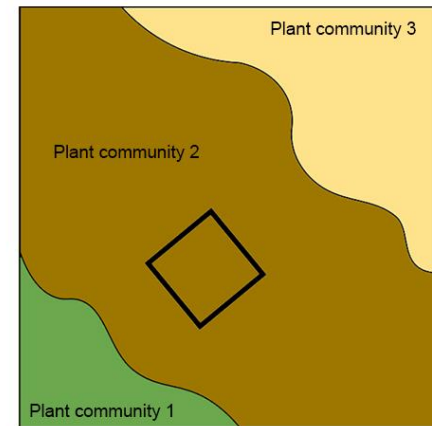
2) Pleiades






3) UAV

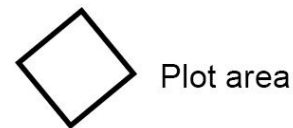


4) Vegetation cover



Spatial resolution of remotely sensed data (pixel size)

-  Potential mixture
-  Pure signal
-  Missing signal

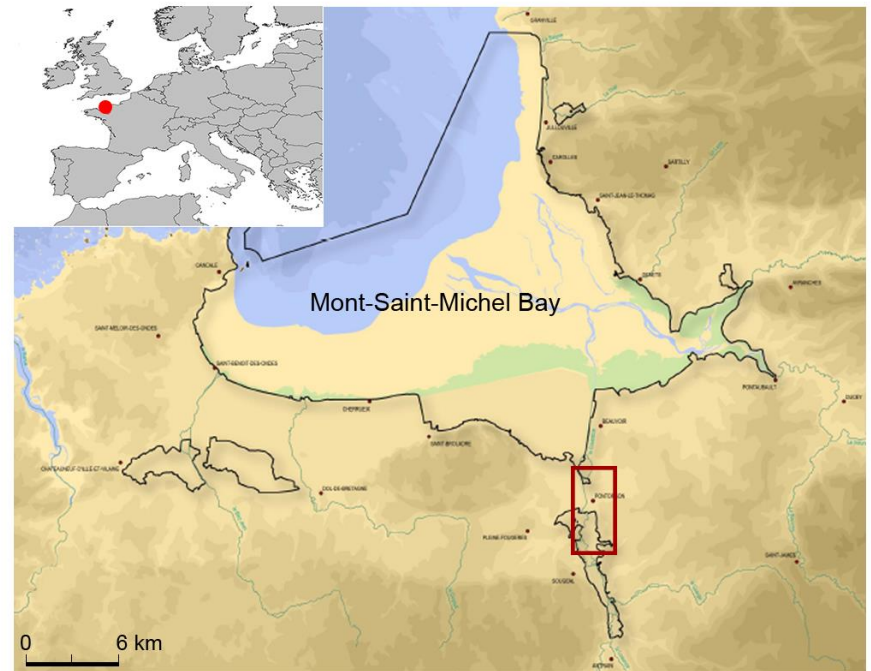






Evaluating the supply of UAV data to unmix  
satellite data for habitat mapping

# Study area

## The Sougeal marsh



 Natura 2000 area

 Sougeal marsh



# Water periods



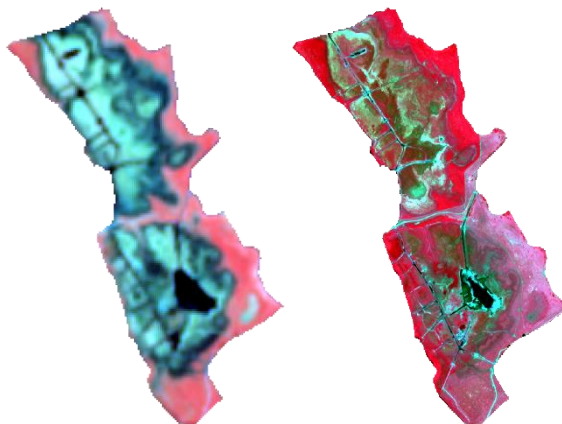
# Data

Floristic survey

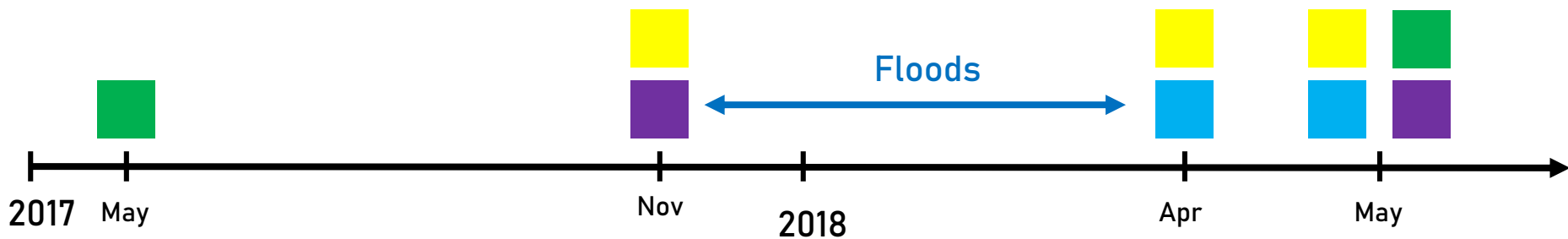
Sentinel-2

Pleiades

UAV



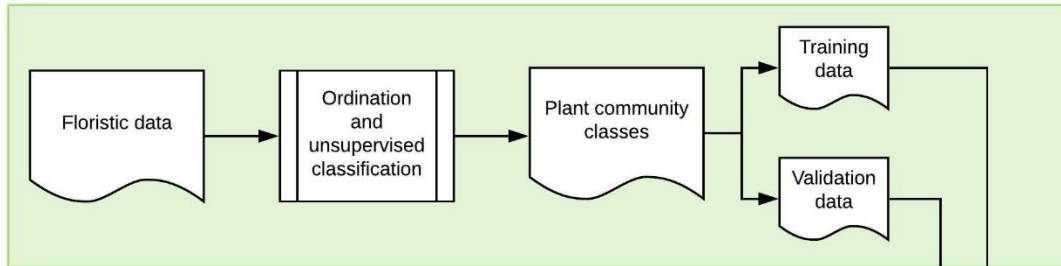
Resolutions	S-2	Pleiades	UAV
Spectral bands	10	4	4
Spatial (m)	10 to 20	2,4	0,2



Methodology:

# General workflow

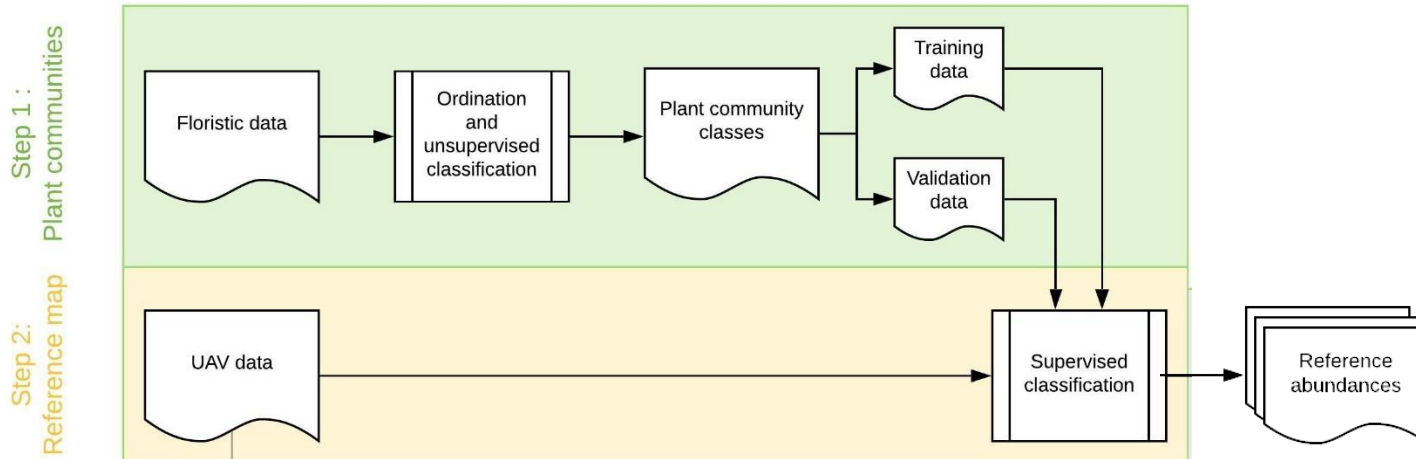
Step 1 :  
Plant communities





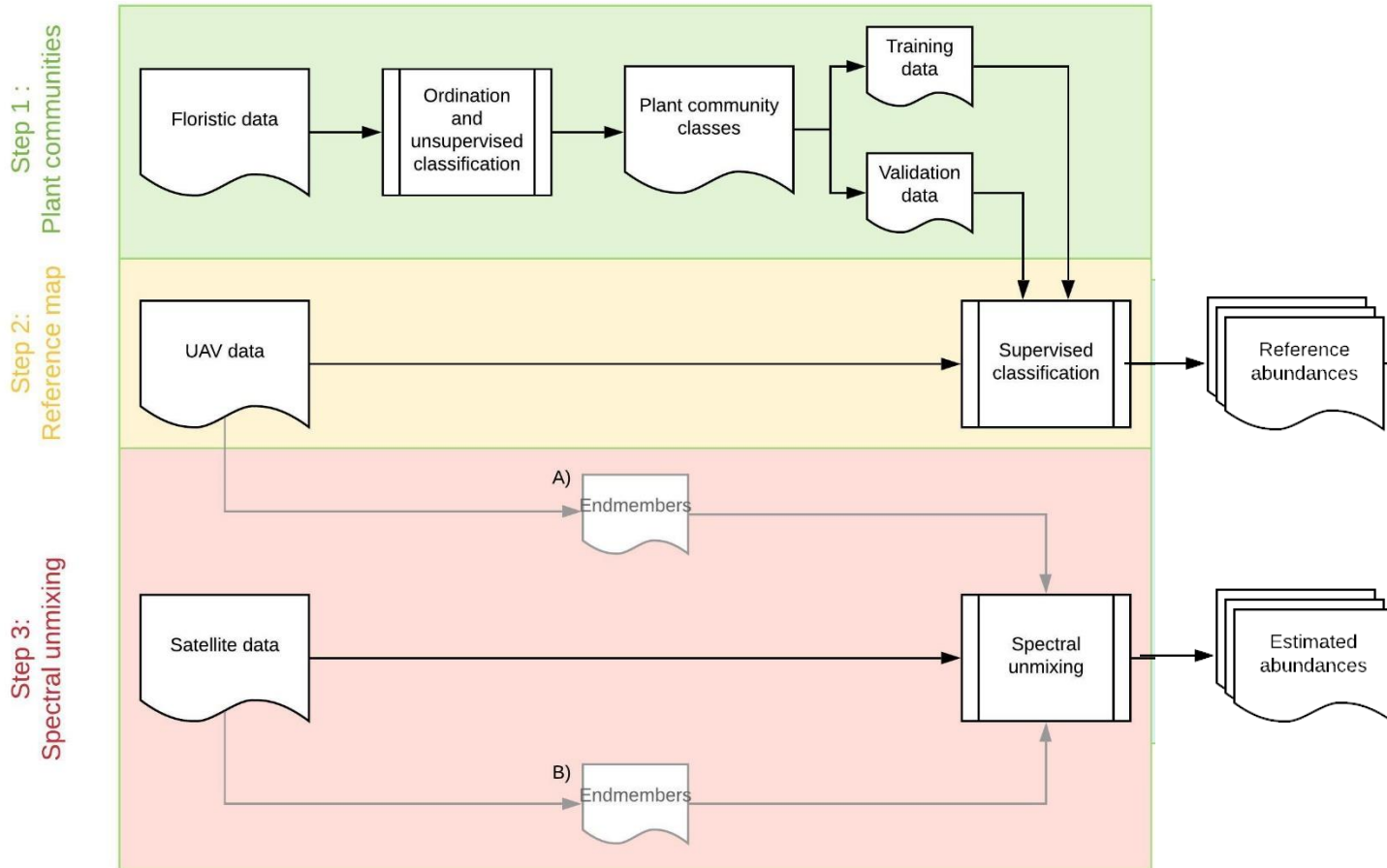
Methodology:

# General workflow



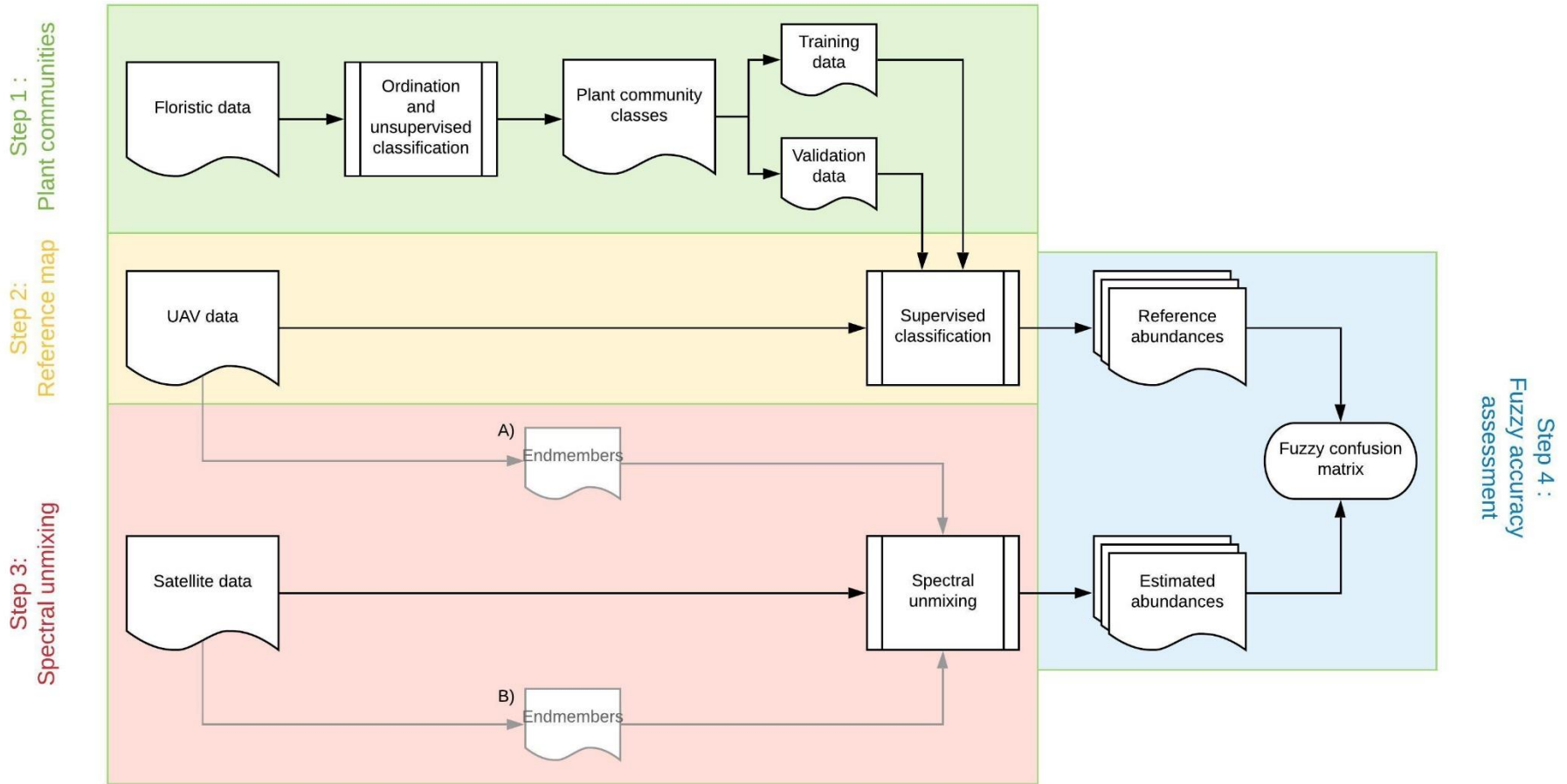
Methodology:

# General workflow



Methodology:

# General workflow



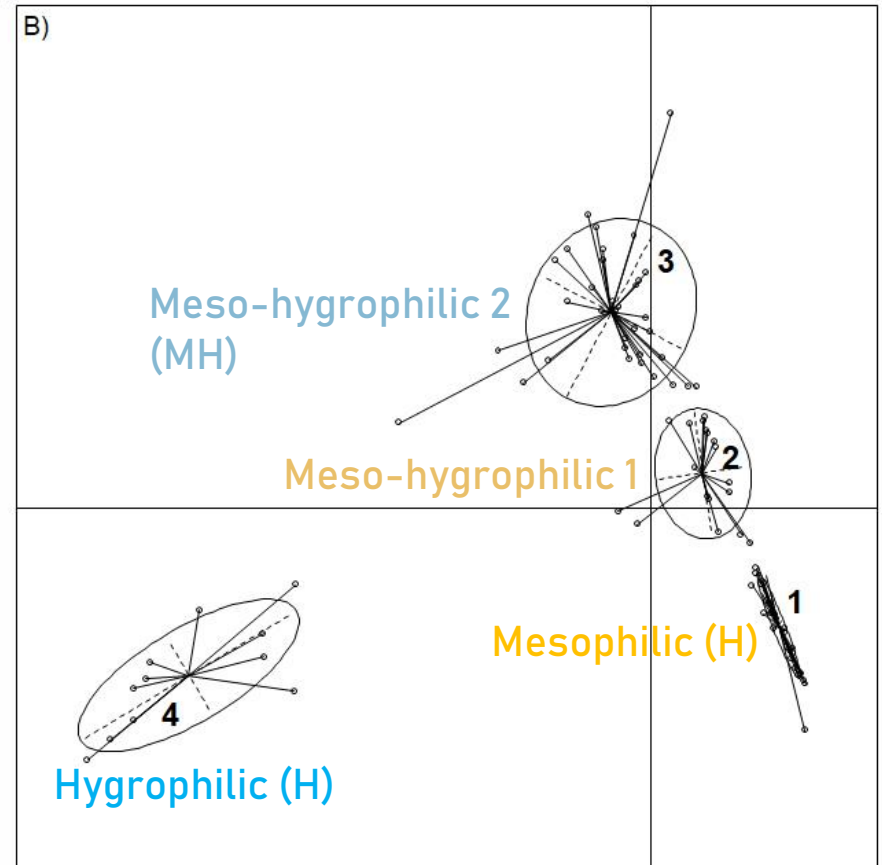
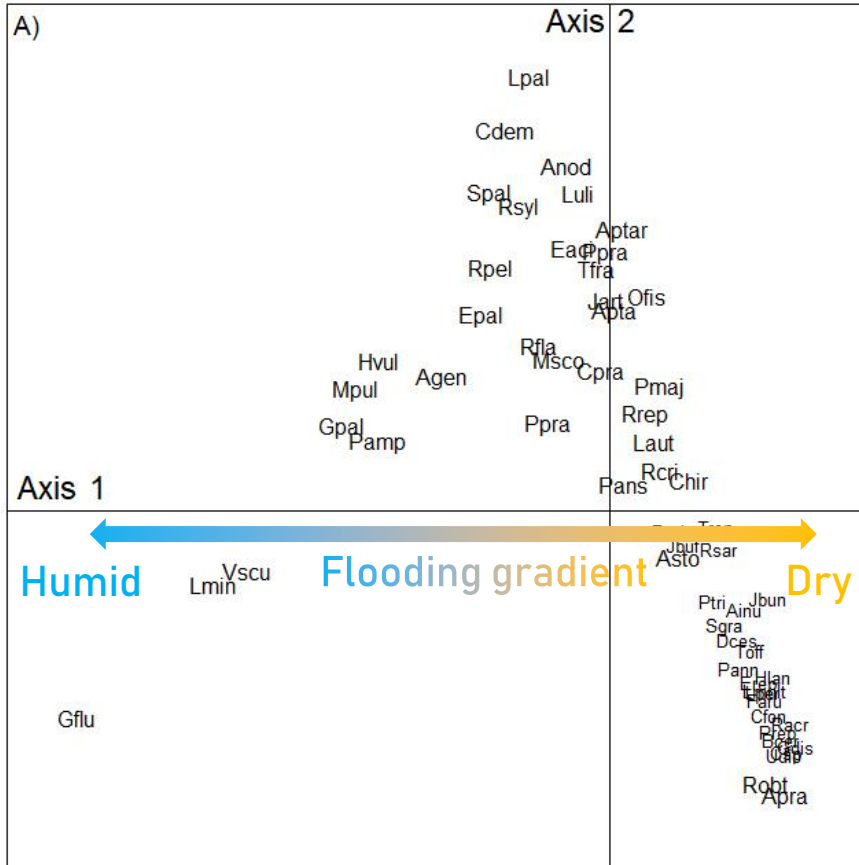
Methodology:

# Experiments

- Influence of the sensor features
- Influence of the acquisition date
- Influence of endmember  
extracted from UAV vs Satellite

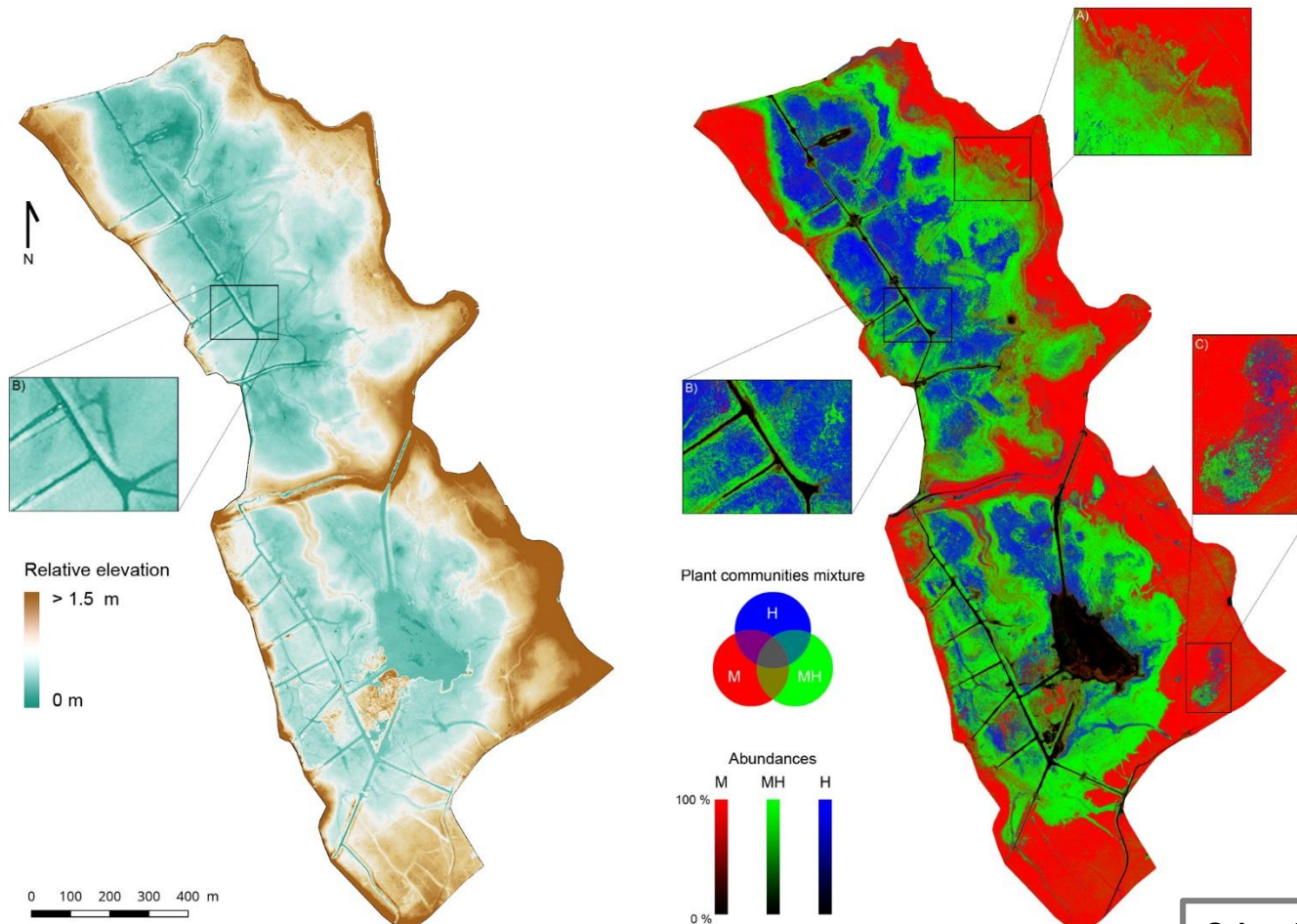
Results Step 1:

# Plant communities



Results Step 2:

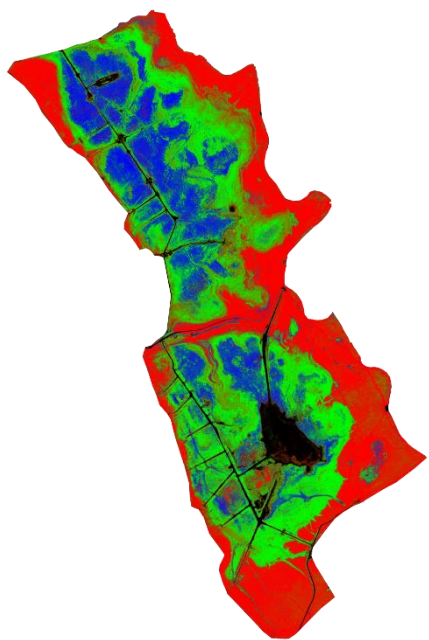
# Reference map



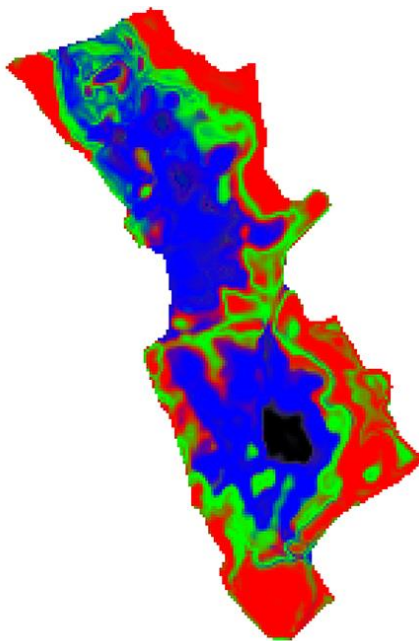
Results Step 3&4:

# Influence of the sensor features

Reference map



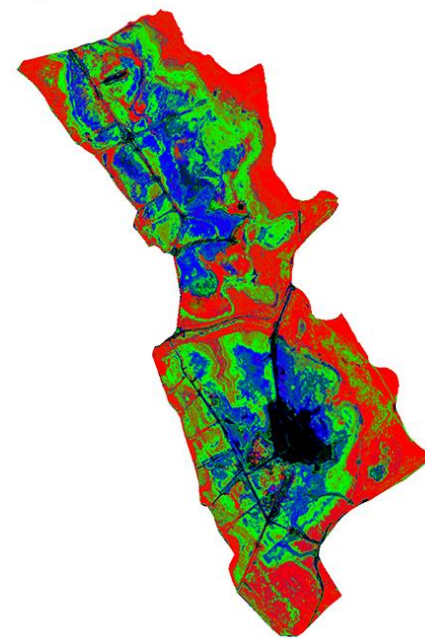
Sentinel-2 May



$OA_F = 0.60$

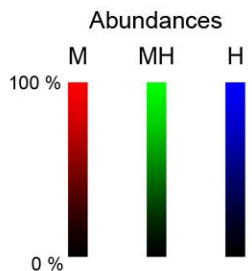
$KIA_F = 0.43$

Pleiades May

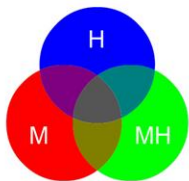


$OA_F = 0.68$

$KIA_F = 0.53$



Plant communities mixture

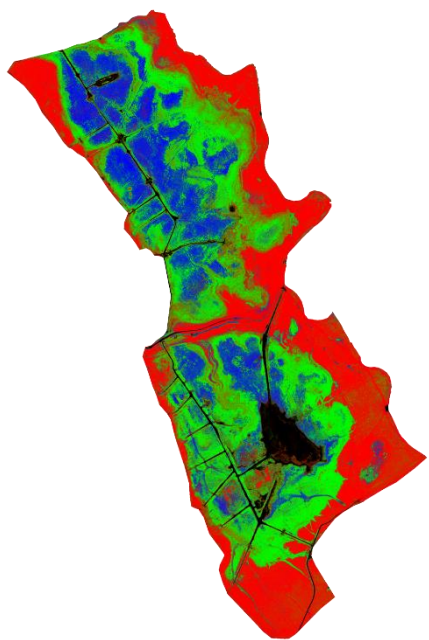


**Pleiades > Sentinel-2**

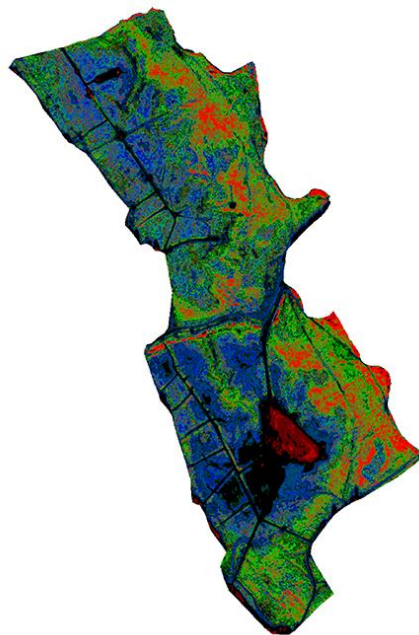
Results Step 3&4:

# Influence of the acquisition date

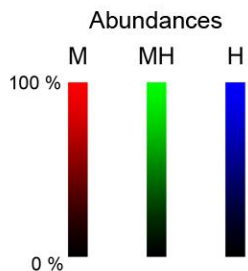
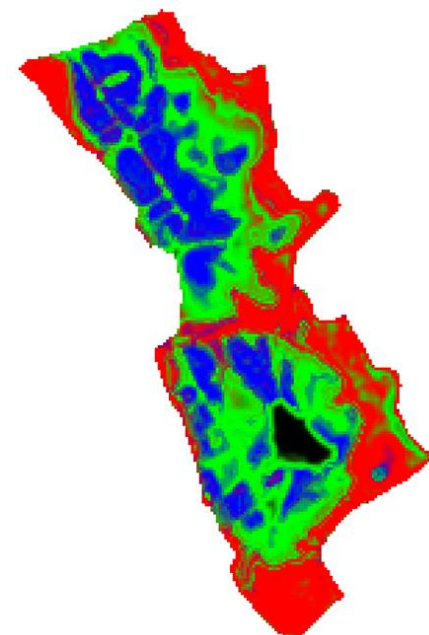
Reference map



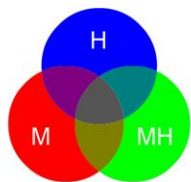
Pleiades November



Sentinel-2 April



Plant communities mixture



$$OA_F = 0.58$$

$$KIA_F = 0.40$$

$$OA_F = 0.76$$

$$KIA_F = 0.64$$

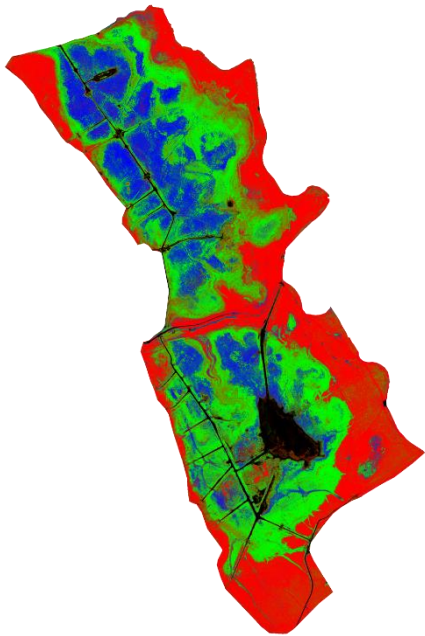
April > May > November



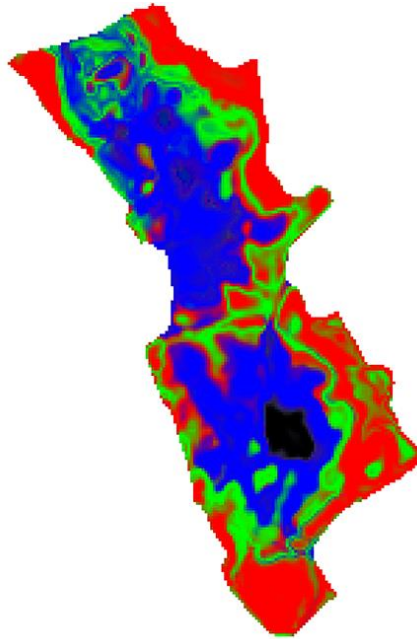
Results Step 3&4:

# Influence of endmember extracted from UAV vs Satellite

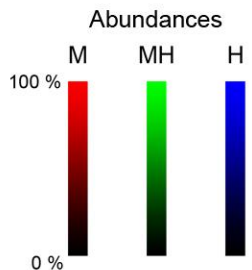
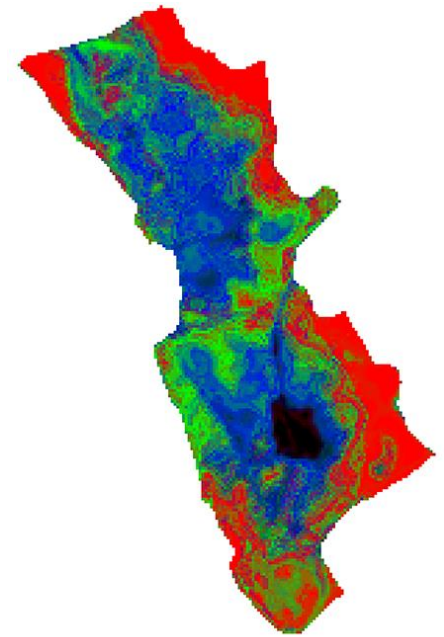
Reference map



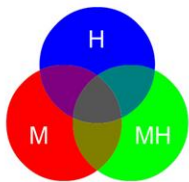
Sentinel-2 May Satellite



Sentinel-2 May UAV



Plant communities mixture



$$OA_F = 0.60$$

$$KIA_F = 0.43$$

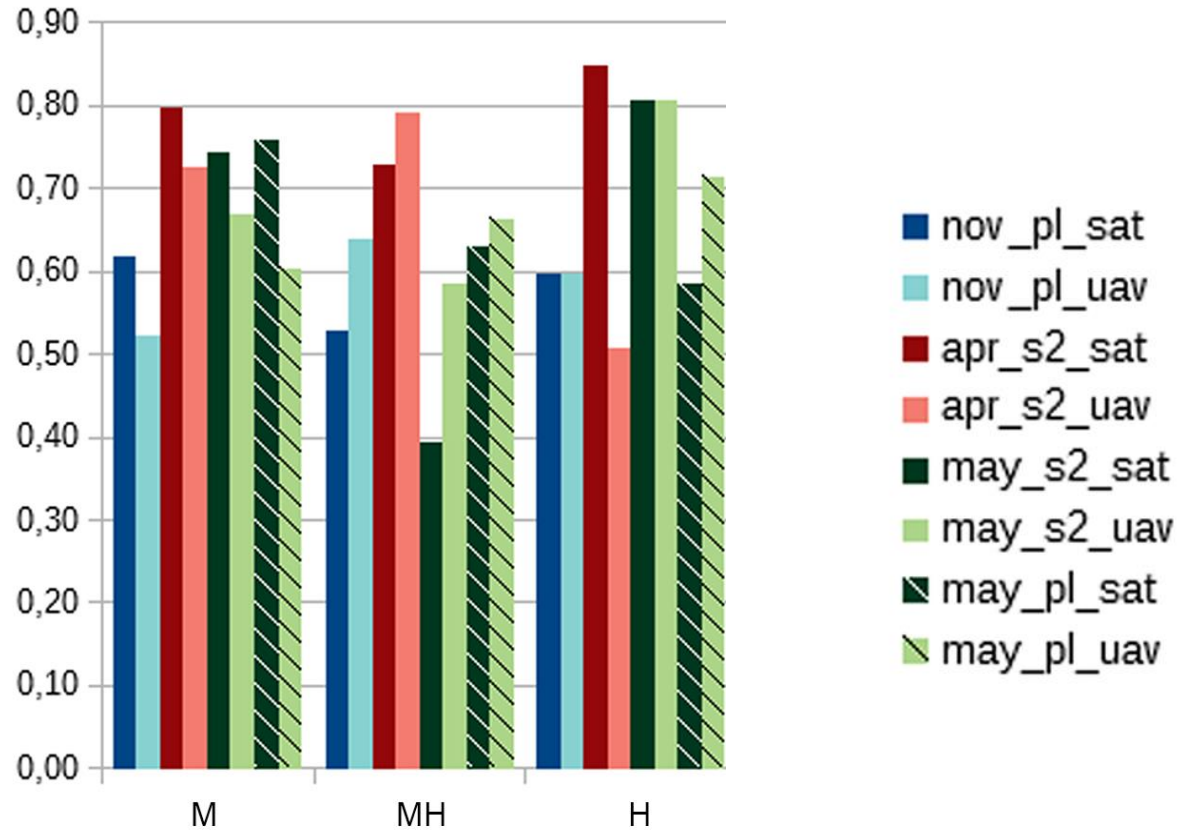
$$OA_F = 0.65$$

$$KIA_F = 0.51$$

**UAV > Satellite, for Sentinel-2 in May**

Results Step 3&4:

# Influence of endmember extracted from UAV vs Satellite



Fuzzy Producer's accuracy

**UAV endmembers always improve the estimation of MH habitats**

Discussion & Conclusion:

# Wet grassland mapping

- **Unmixing approach provides sub-pixel information on habitats and identify relevant features**

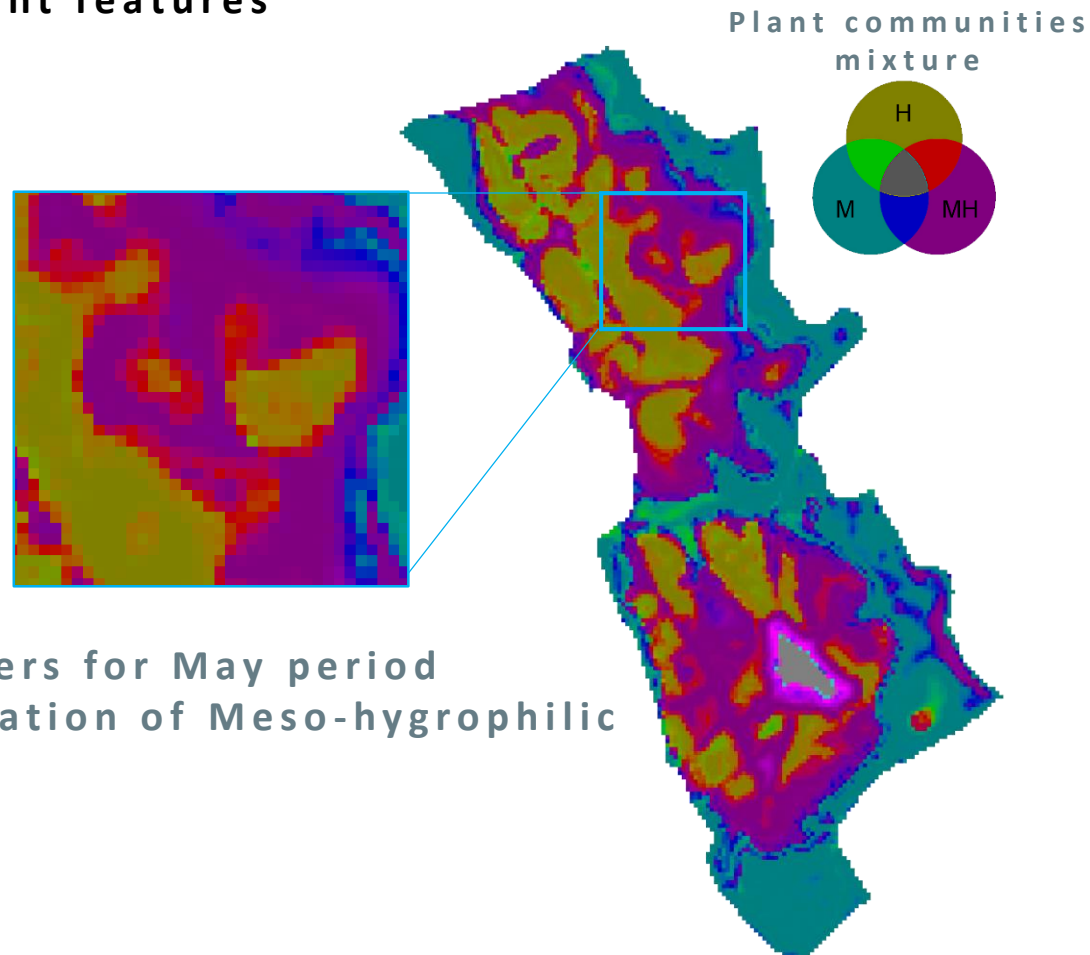
- Fine patterns
- Ecotones

- **Key resolutions identified**

- Spectral (-)
- Spatial (+)
- Temporal (++)

- **UAV supply**

- More suitable endmembers for May period
- More accurate discrimination of Meso-hygrophilic habitat



Alvarez-Vanhard, E., Houet, T., Mony, C., Lecoq, L., Corpetti, T., 2019. Satellite multispectral unmixing with UAV data for a fuzzy classification of plant communities of wet grasslands – Application to the regional preserve of the Sougeal marsh (France). Remote Sens. Environ. (Submitted)



# Thank you



Contact us:

[emilien.alvarez-vanhard@univ-rennes2.fr](mailto:emilien.alvarez-vanhard@univ-rennes2.fr)

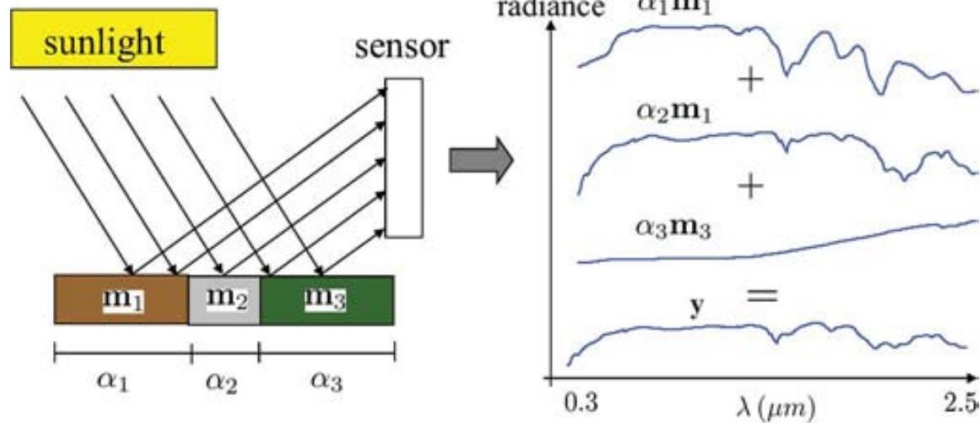
[www.project-alice.com](http://www.project-alice.com)



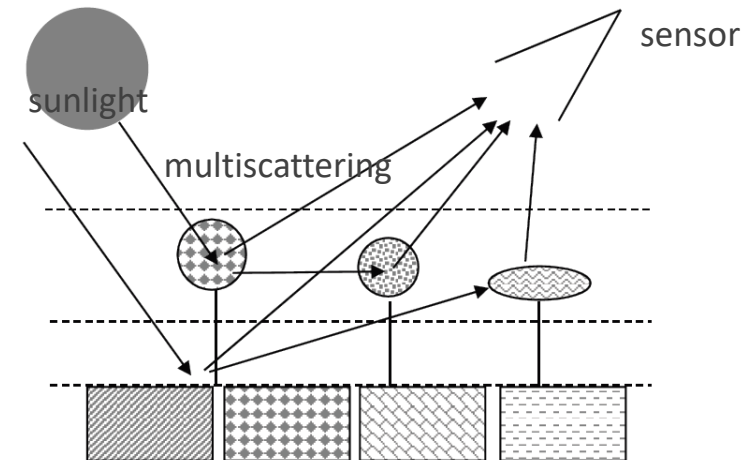
Assumption:

# Non-linear mixture

Linear mixture



Non-linear mixture



Discussion & Conclusion:

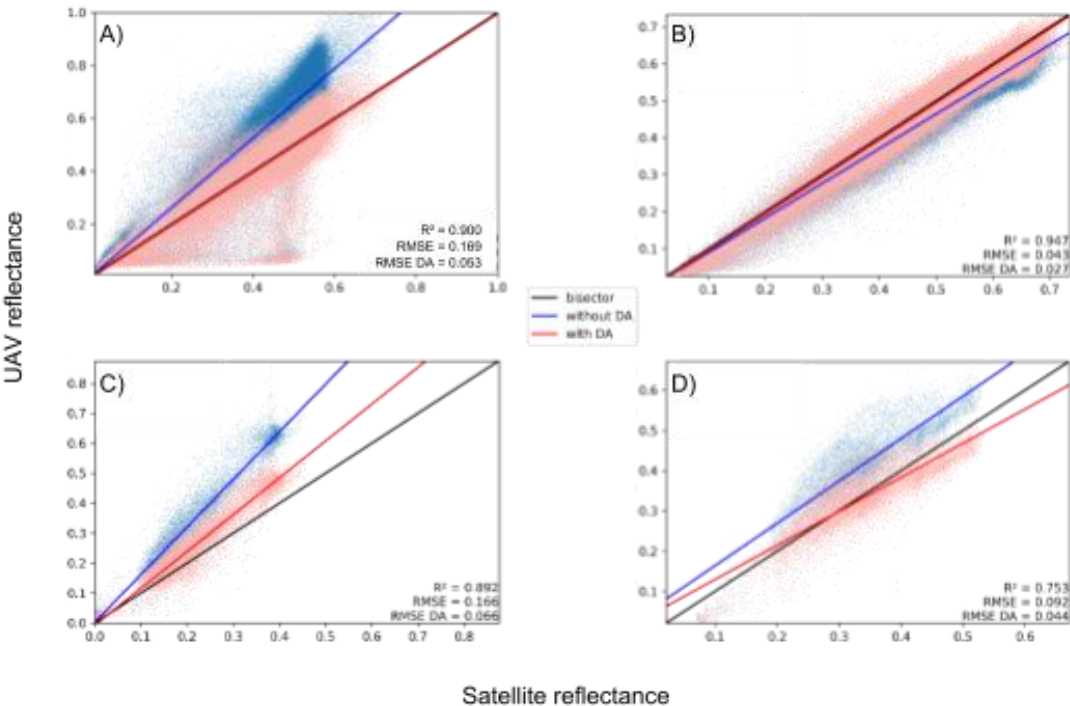
# UAV and Satellite data synergies

- **Sensor intercalibration (Not shown)**
  - Spectral mismatches between satellite and UAV data
  - Usefulness of domain adaptation
- **UAV complementarity**
  - Validation
  - Explicitation (Further works : spatio-temporal fusion)

Results Step 3&4:

# Abundances estimation

## Influence of radiometric intercalibration



	$\Delta OA_f$	$\Delta KIA_f$	$\Delta RMSE$ (PIR)
<b>Pléiades (2017-11-06)</b>	+0.09	+0.16	-0.116
<b>Pléiades (2018-05-18)</b>	+0.01	+0.01	-0.016
<b>Sentinel-2 (2018-04-20)</b>	+0.06	+0.09	-0.096
<b>Sentinel-2 (2018-05-18)</b>	+0.09	+0.11	-0.048

Methodology:

# Fuzzy accuracy

- Fuzzy set theory as framework, introducing vagueness
- Capture semantic flexibility inherent in complex categories
- Preserves error localization
- Generalization of traditional matrix
- More precise

Binaghi et al. (1999)