SATELLITE-BASED SOIL MOISTURE PRODUCT PERFORMANCE ASSESSMENT AMONG THE EU ECOREGIONS

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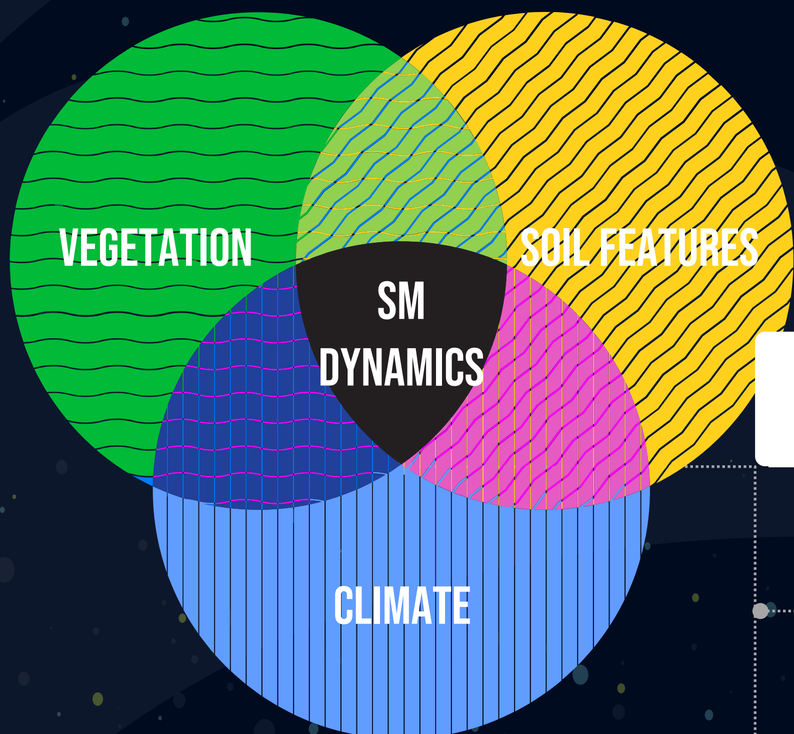
RESEARCH GOAL AND MOTIVATION

Microwave-based remote sensing (RS) products provide surface soil moisture (SSM) estimates with different levels of accuracy which are influenced by climate, vegetation, soil features and their interactions.

SSM is characherized by high temporal variability in its spatial scaling characteristics due to increased fluctuations resulting from infiltration (wetting) and evapotranspiration- leakage (drying) processes.



WHAT?
SM DYNAMIC

WHEN?
2015-2020

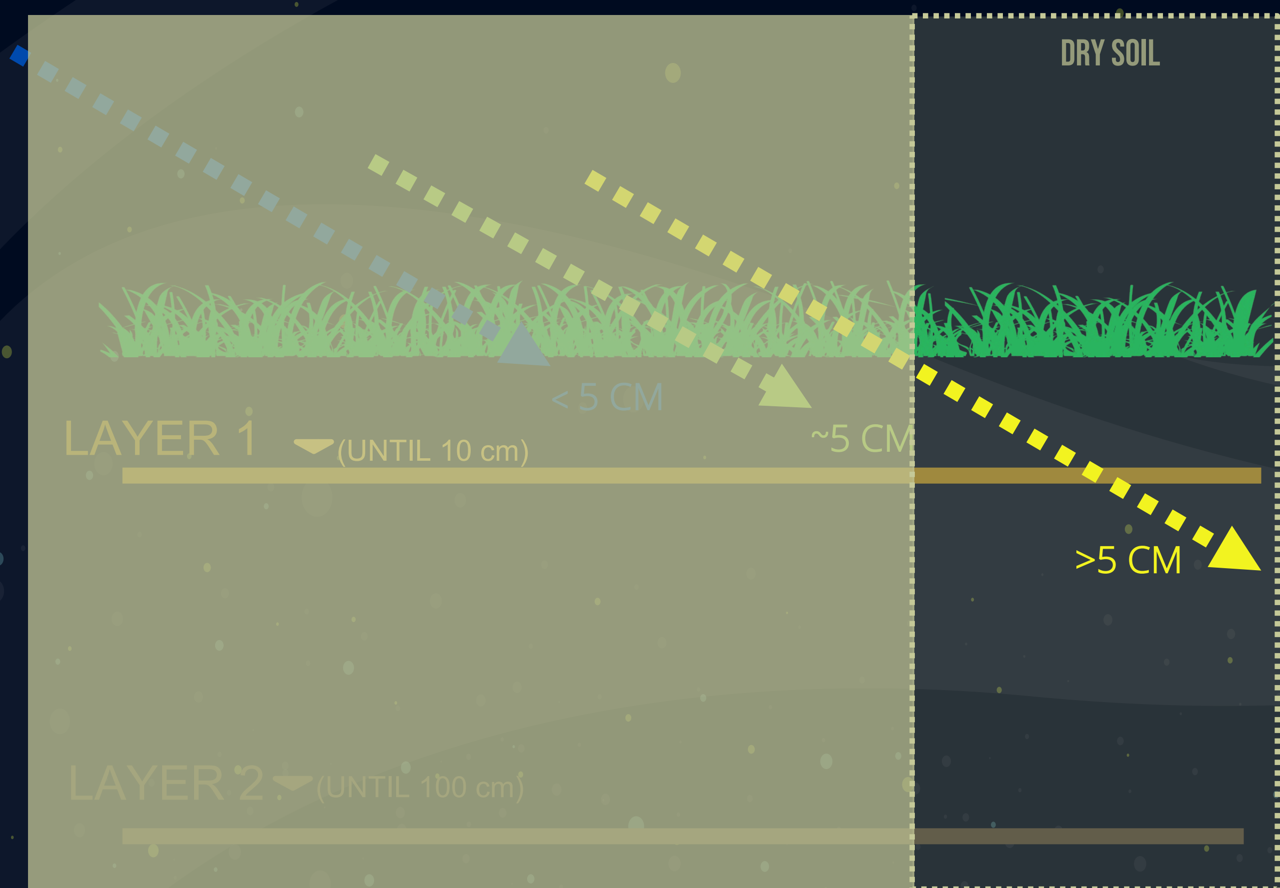
WHERE?
EUROPE - EUROPEAN ECOREGIONS

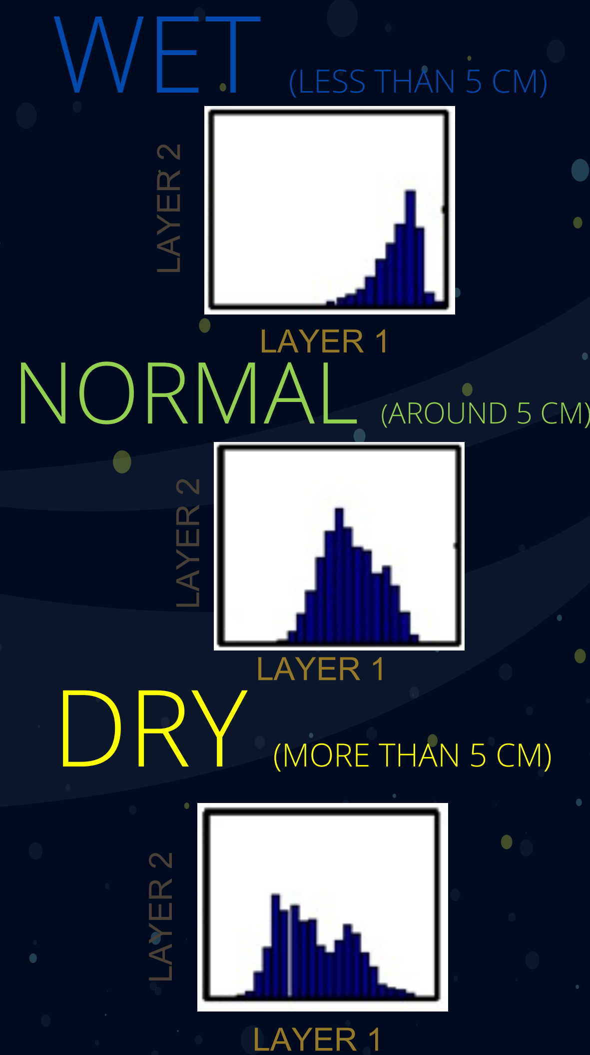
WHY?
PAST STUDIES HIGHLIGHTED DIVERSIFIED RS PERFORMANCES

SM DYNAMIC

At low levels of soil moisture, the residual water content is directly related to the type of soil and vegetation present.

The local dynamics of soil moisture due to the soil saturation condition, when the surface soil layer is excessively dry or excessively wet, can add further uncertainty in satellite products assessment.

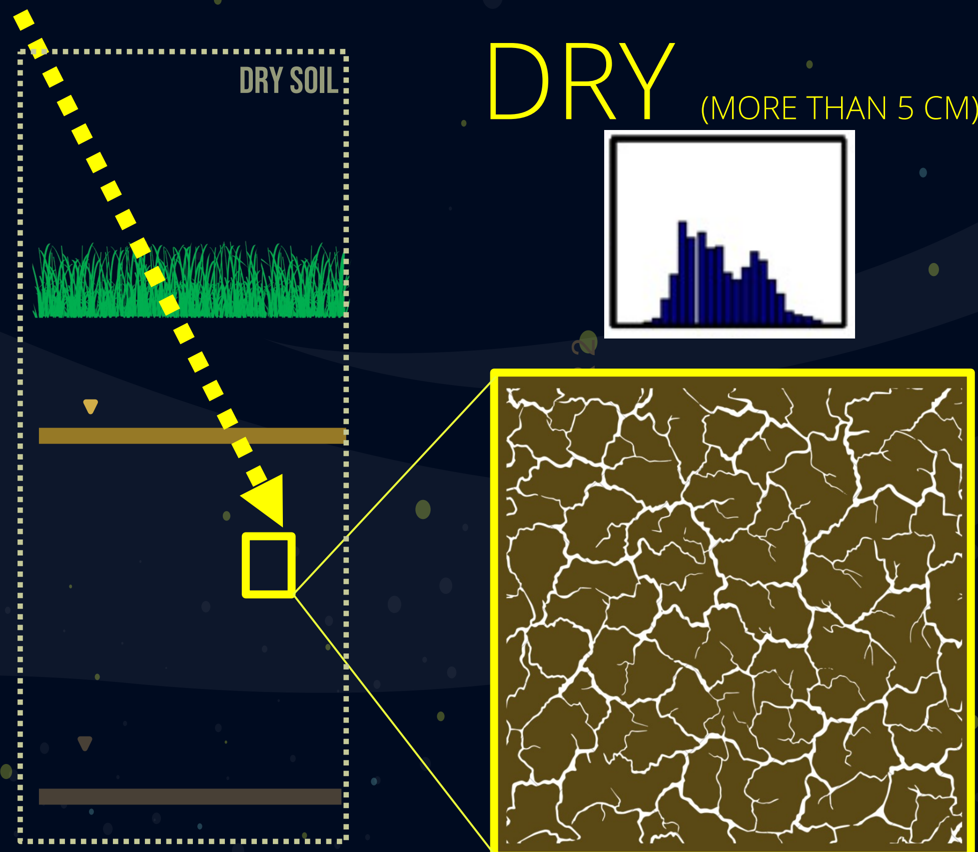




SM DYNAMICS AND RS MICROWAVE PRODUCTS DURING DRYING PROCESS

The drying process tends to reduce the spatial correlation of the soil moisture (SATELLITE SSM vs GROUND-BASED SSM), since microwave sensing depth can increase with decreasing soil moisture levels.

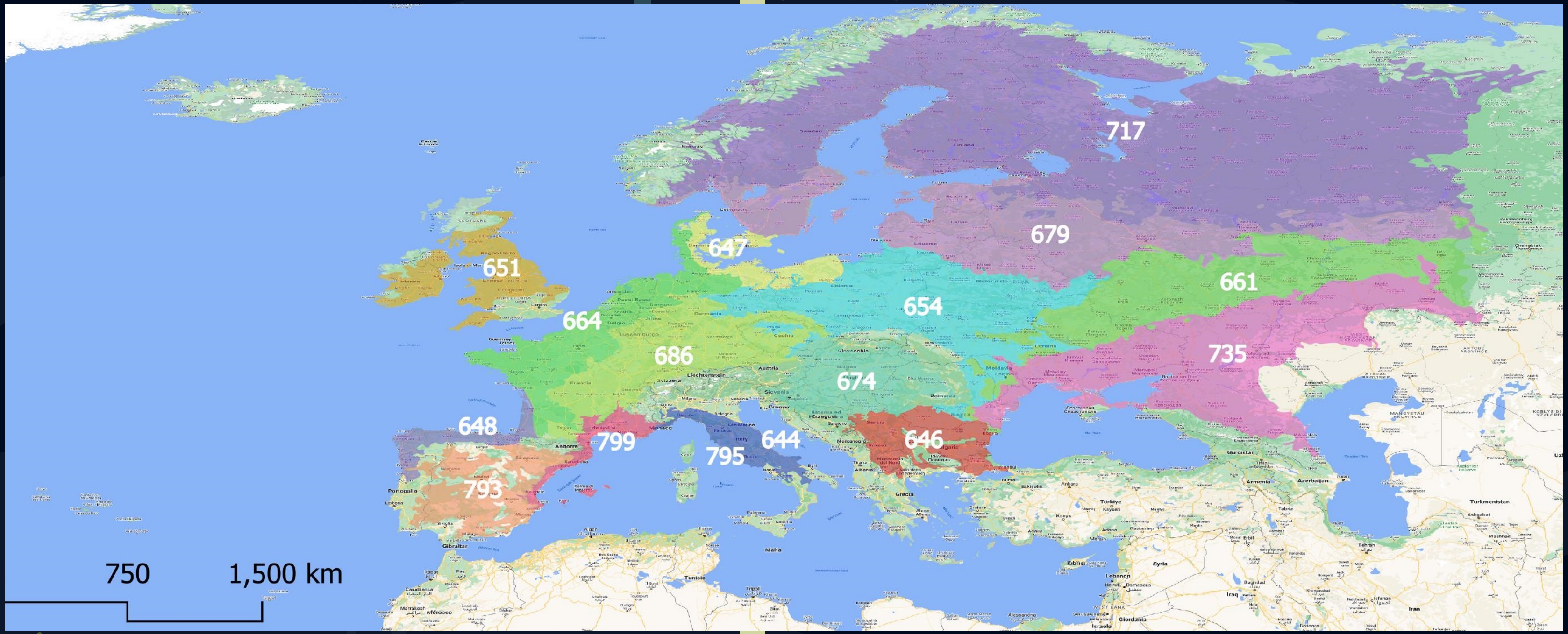
In this condition, there could be additional factors as strong subsurface scatterers (e.g., karstic rock) may become detectable during dry spells, especially when they are near the soil surface, adding uncertainty in the retrieved soil moisture value.



SM ERROR CHARACTERIZATION

1 Splitting Europe by Terrestrial Ecoregions:

Ecoregions taking into account climate, vegetation and land cover gives a landscape view.

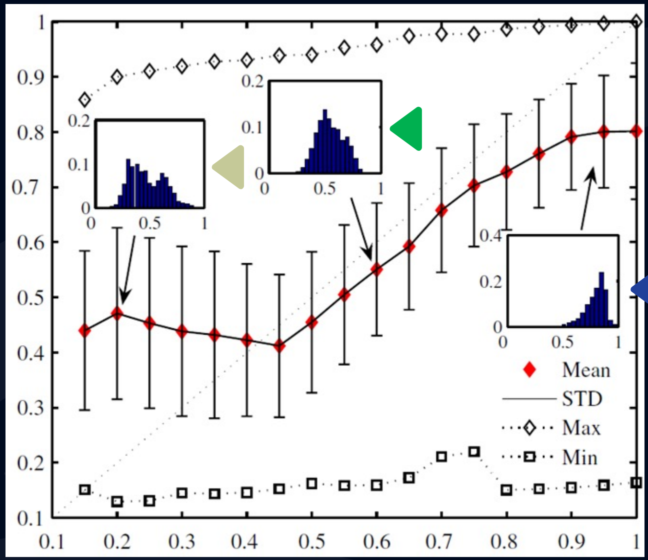


Name	ID
Apennine deciduous montane forests:	644
Balkan mixed forests:	646
Baltic mixed forests:	647
Cantabrian mixed forests:	648
Celtic broadleaf forests:	651
Central European mixed forests:	654
East European forest steppe:	661
European Atlantic mixed forests:	664

Pannonian mixed forests:	674
Sarmatic mixed forests:	679
Western European broadleaf forests:	686
Scandinavian and Russian taiga:	717
Pontic steppe:	735
Iberian sclerophyllous and semi-deciduous forests:	793
Italian sclerophyllous and semi-deciduous forests:	795
Northeast Spain and Southern France Mediterranean forests	799

3

SM dynamic by type of soil
(Manfreda et al., 2007)



Ecoregion: Balkan mixed forests
Biome: Temperate Broadleaf & Mixed Forests
Realm: Palearctic
Eco ID: 646

E.g. Balkan mixed forests as normal area.

Dry: Multimodal distribution

Normal: Gaussian distribution

Wet: Negatively Skewed Distribution

4

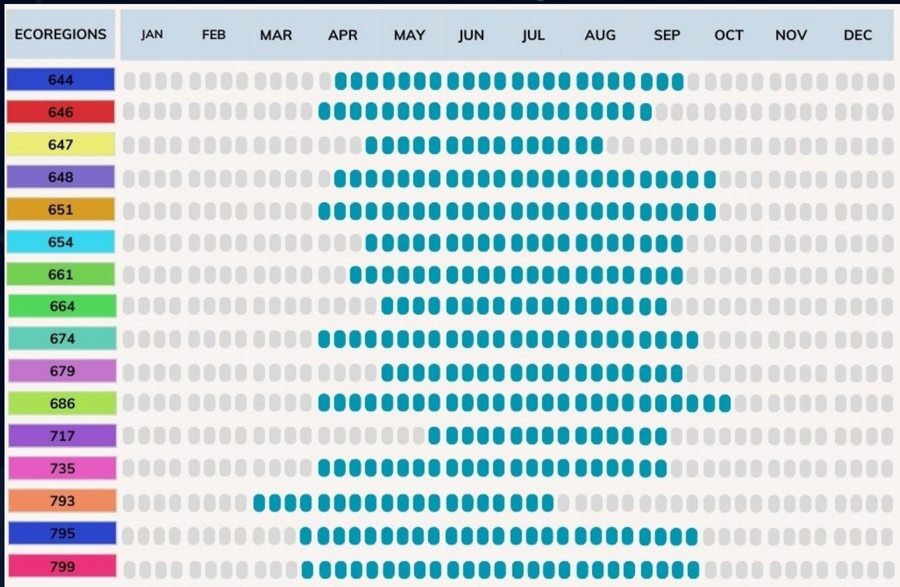
A priori classification of ecoregions based on SM dynamic:

Ecoregion: Scandinavian and Russian taiga
Biome: Boreal Forests/Taiga
Realm: Palearctic
Eco ID: 717

E.g. Scandinavian and Russian taiga as wet area

Phenological cycle by ecoregion

5

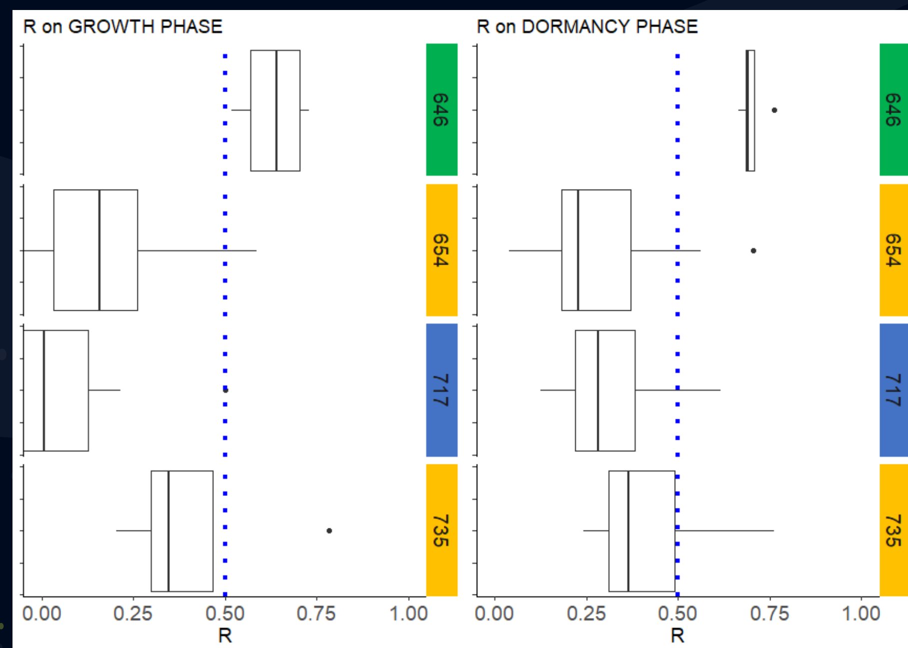


Since vegetation introduce a phenological seasonality on SM, it is essential to asses SM dynamic in different phenological to evaluate SM error characterization.

Divisions of the year into a phase of growth and a phase of dormancy according to mean values of Start of vegetation growing season and Vegetation growing season length 2000-2016 (EEA).

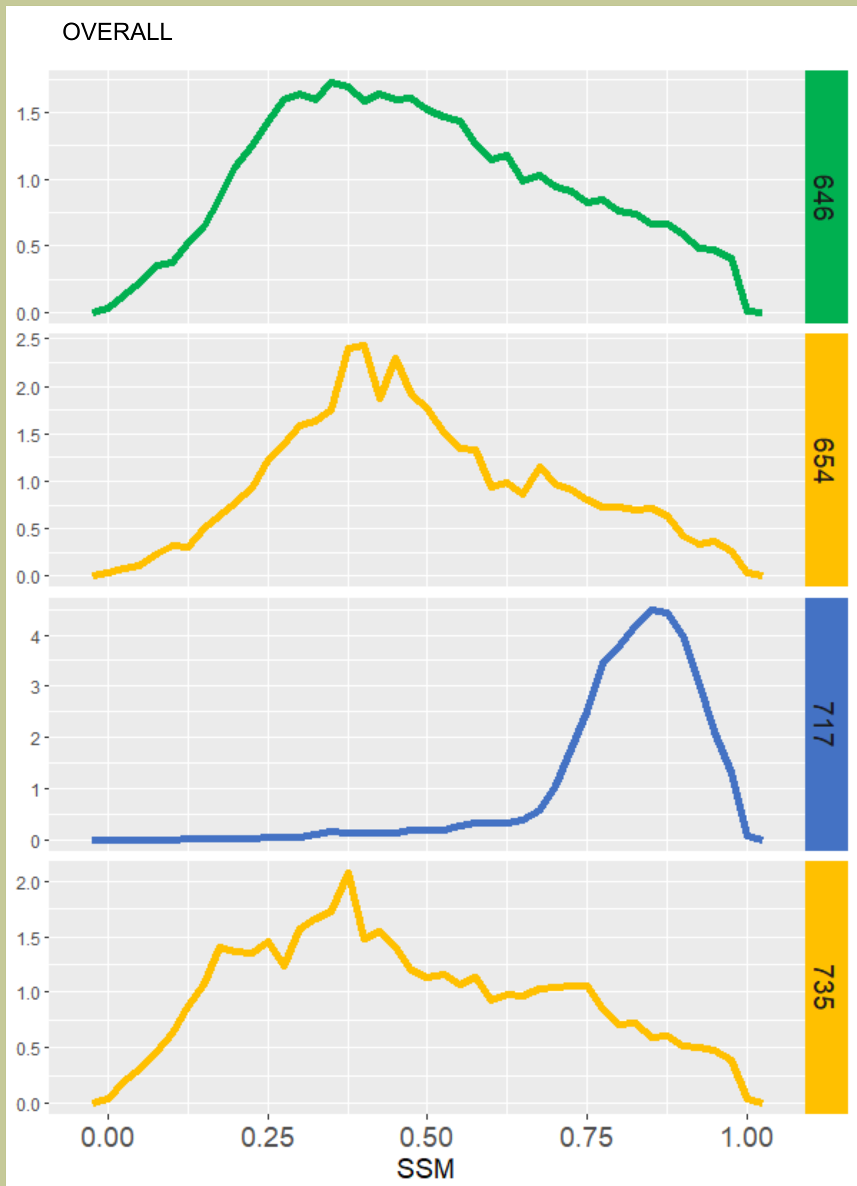
6

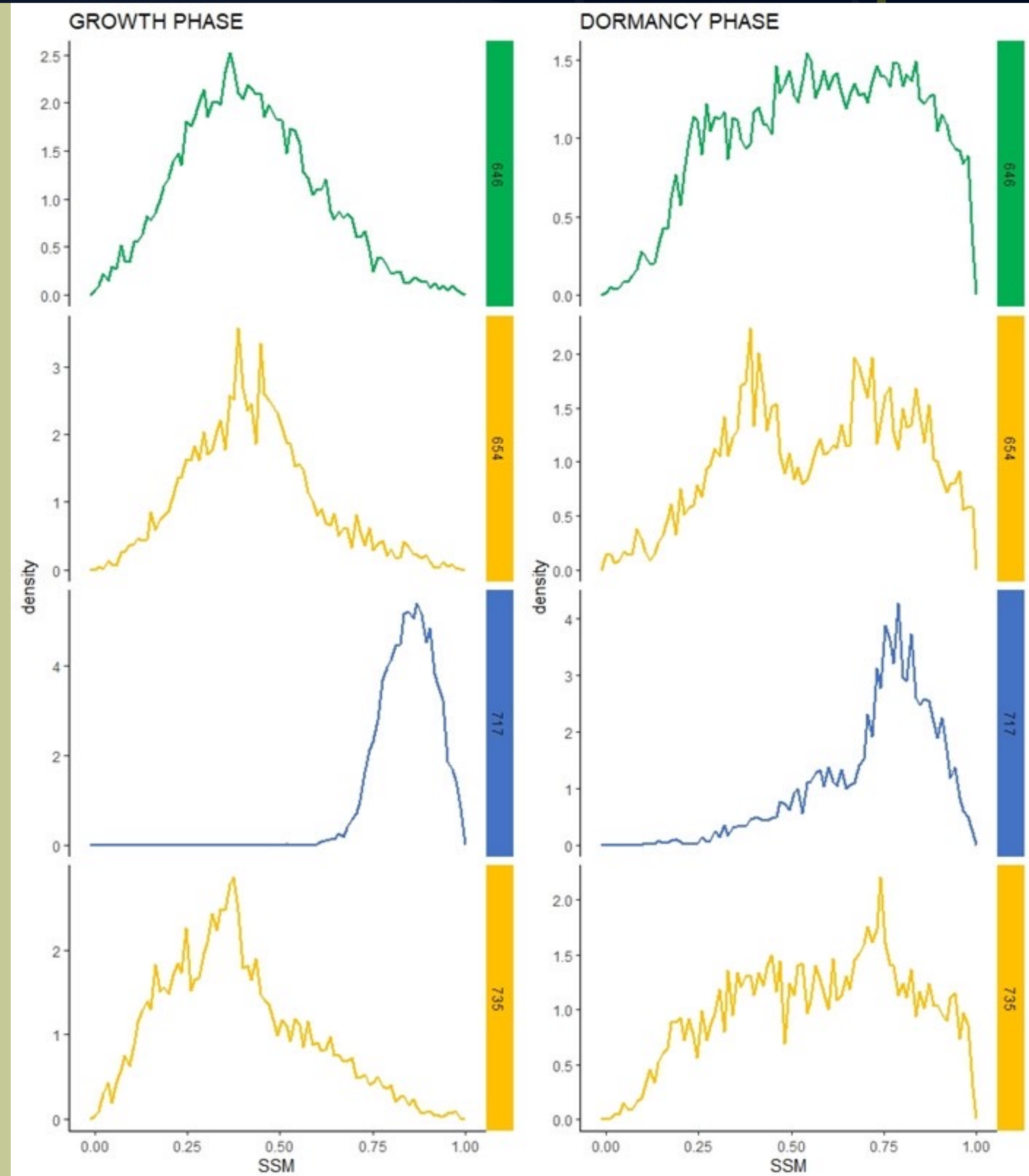
Impact of phenological cycle on ecoregions



First, we verified if the division of year into two vegetation stages address the effect of seasonality to SM.
As expected, in vegetation dormancy phase the Pearson Correlation Coefficient between in-situ ISMN measurements and ASCAT SSM values increases independently by the ecoregion characteristics.

7 Computation of SM dynamic by growth and dormancy phase accordingly to ecoregions.





7 Computation of SM dynamic by growth and dormancy phase accordingly to ecoregions.

As an example, are reported the distribution computed on H115-H116 ASCAT (on the left) and the Ameijeiras-Alonso et al., 2019 test using R language on:

- Ecoregion assumed as normal pattern (green).
- Ecoregion assumed as wet pattern (blue).
- Ecoregions assumed as dry areas (yellow).

Ecoregions	Overall	Growth	Dormancy
	P- value	P- value	P- value
646	0.244	0.068	2.20E-16
654	2.20E-16	2.20E-16	2.20E-16
717	0.414	0.524	6.00E-04
735	2.20E-16	2.00E-03	2.20E-16

CONCLUSION

The use of ecoregions contributes to the understanding of the complex relationships between soil moisture and climate, vegetation and soil feature provides a reasonable compromise between specificity and generality in assessing the performance of satellite products for soil moisture monitoring.

The SM dynamic, taking into account the phenological seasonality, highlights the importance of the dynamics of the wetting and drying cycles in the soil for improving the accuracy of satellite products in SM state assessment.

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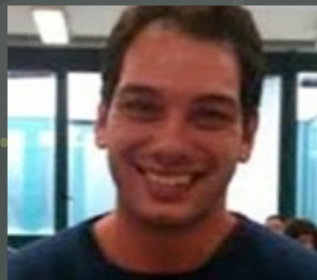

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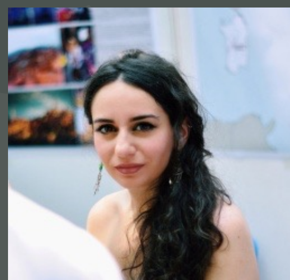

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