INTER-COMPARISON OF SOIL MOISTURE SATELLITE PRODUCTS ON EUROPEAN ECOREGIONS

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EGU General Assembly

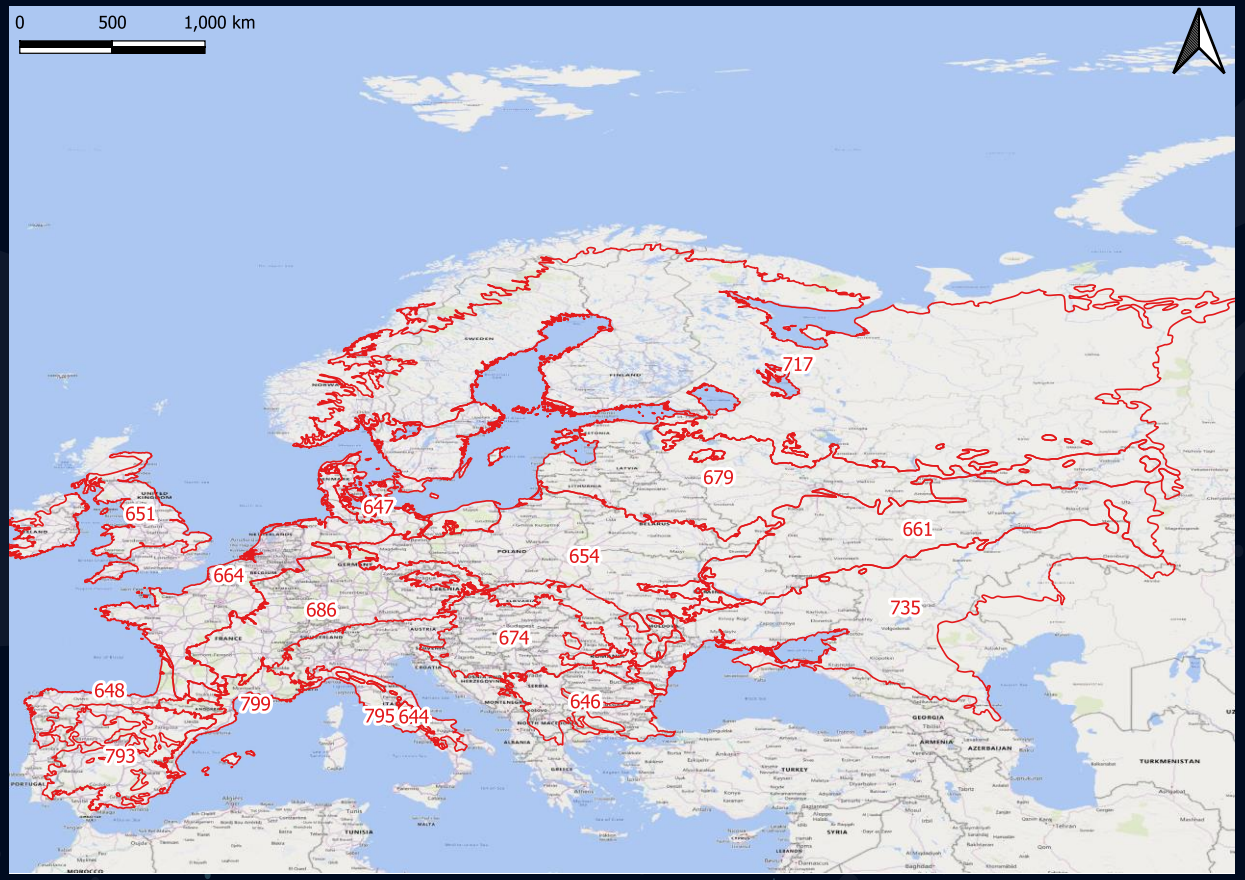
ABOUT THE TOPIC

1

This study aims at comparing the accuracy of several freely available microwave-based SM satellite products with in-situ measurements collected by the International Soil Moisture Network (ISMN) for several stations located in the European (EU) Ecoregions in the time frame 2015-2020.

WHERE?

Among the 37 total European Ecoregions, only 16 could be represented by the International Soil Moisture Network.



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WHICH SATELLITE PRODUCTS?

The SMAPL4 is used instead of SMAPL3 data due to its data consistency.

- SMOS-IC V2.0
- SMAPL4 V5
- H115 – H116
- SSM1km -CGLS
- ESA CCI

WHEN?

From JAN **2015**

To **DEC** 2020

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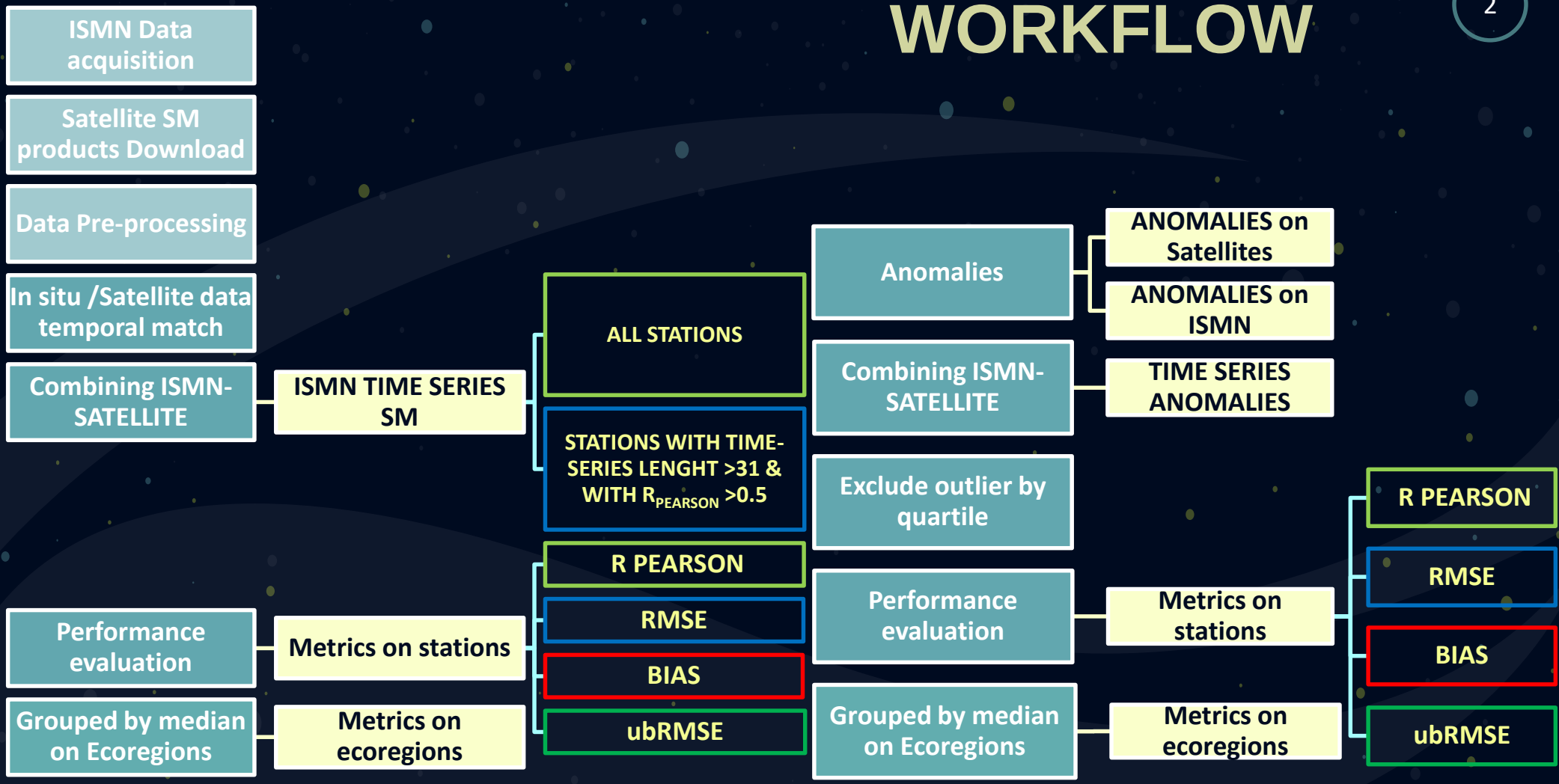
WORKFLOW



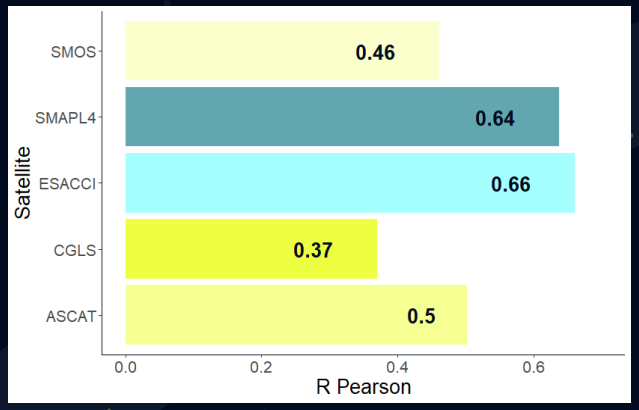
After acquisition and pre-processing, Satellites SM Products are compared with ISMN ground-based data, considering all available observations. Each performance metric is evaluated on individual stations and then aggregated at ecoregions level.

In the following step, the accuracy of satellite-based SM retrievals are evaluated computing anomalies time- series and performances are estimated using the workflow described above.

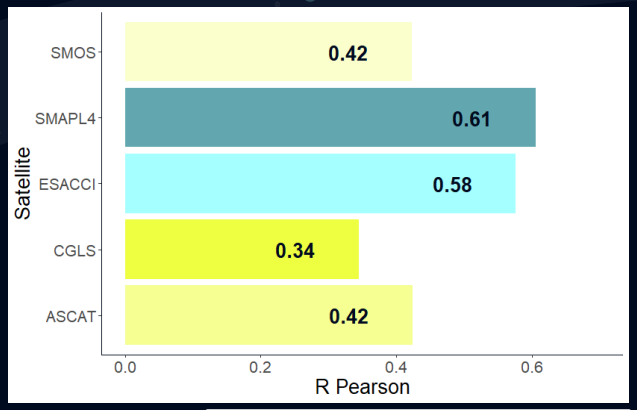
RESULTS ON ECOREGIONS

$R_{Pearson}$ coefficient

Stations with lenght of time-series >31 & with $R_{pearson}$ >0.5

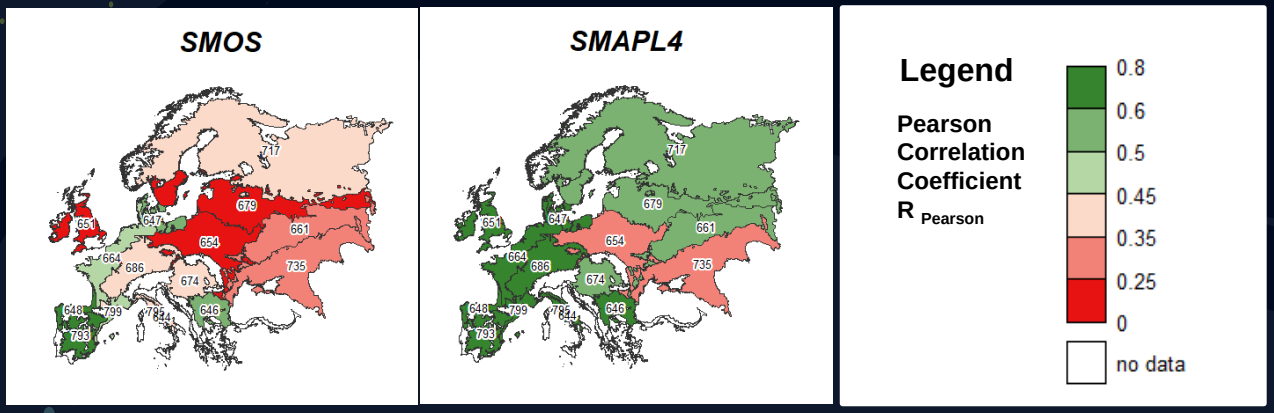


All stations

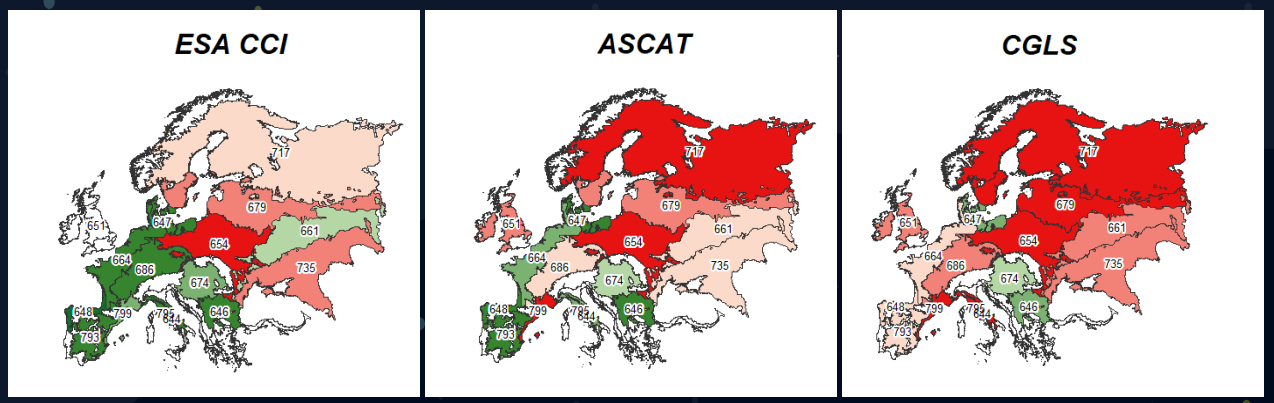


Performances are estimated: (i) using all available observations or (ii) screening out the in-situ stations where all remotely sensed SM products obtained Pearson correlation values (R) < 0.5.

Performances exhibit similar behaviour for all satellites retrievals except for the ESA CCI.



SMAPL4 and ESA CCI highlight the best performance across all sites with differences on ecoregions.



All satellite products show worse performances ($R_{PEARSON}$ < 0.5) in ecoregions 654 and 735.

Central European mixed forests (654): This ecoregion spans large area. SM Network stations are located in Poland and Moldova.

Pontic steppes (735): stations are located mostly in Southeast Romania.

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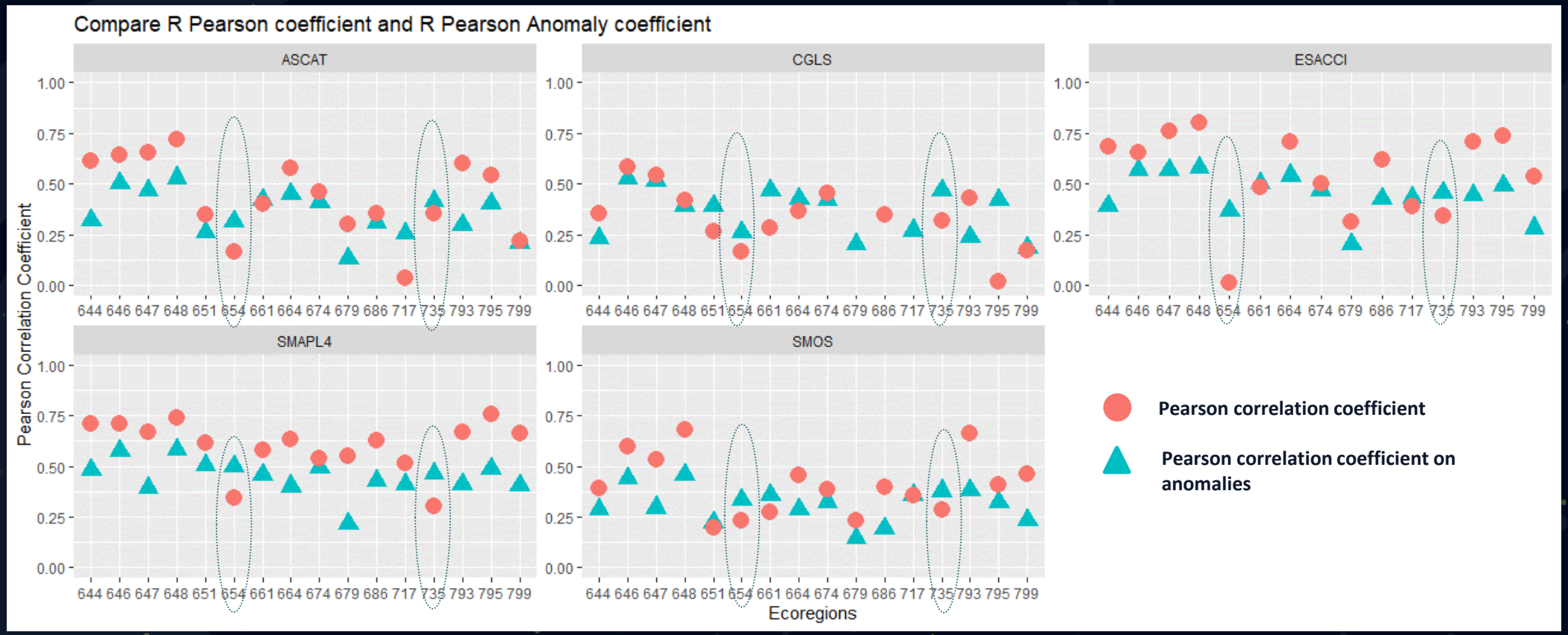
RESULTS ON ECOREGIONS

Compare $R_{Pearson}$ coefficient and $R_{Pearson}$ Anomaly coefficient

The SM seasonal cycle was removed by computing anomalies using the ALICE INDEX (Tramutoli , 1998, 2005, 2007). We expect a reduction of R Person performances using such an index but this behavior has not been shown in Ecoregion 654 and Ecoregion 735.

$$\text{ALICE INDEX} \otimes = \frac{V(r,\tau) - VREF(r,\tau,T)}{\sigma(r,\tau,T)}$$



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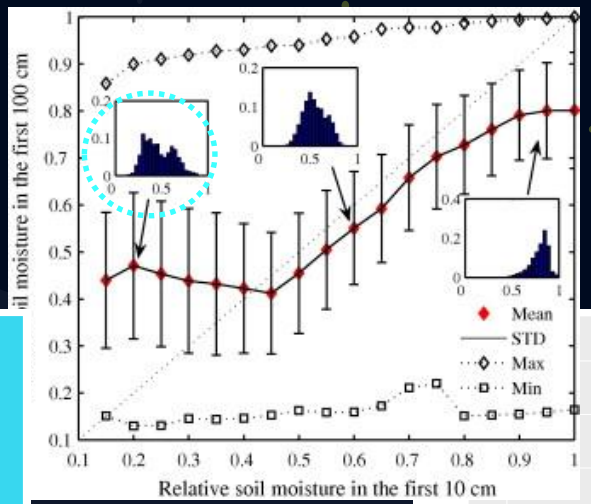
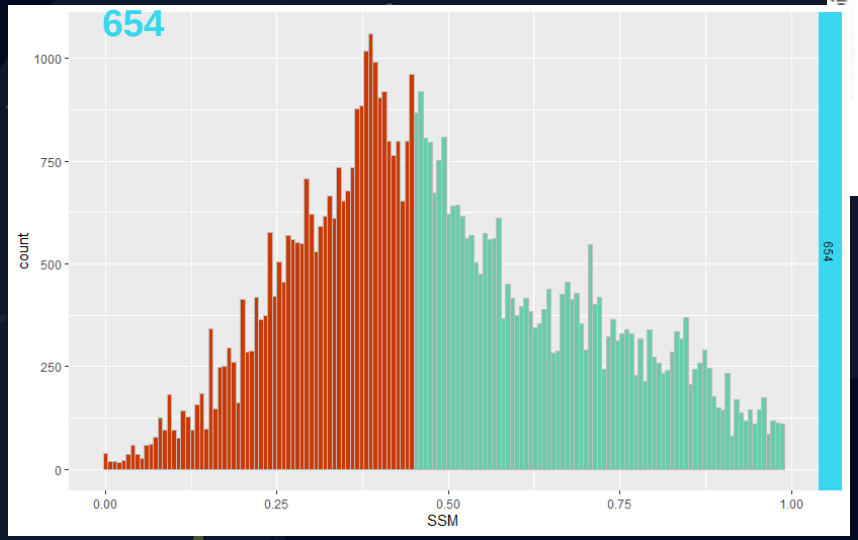
DISCUSSION

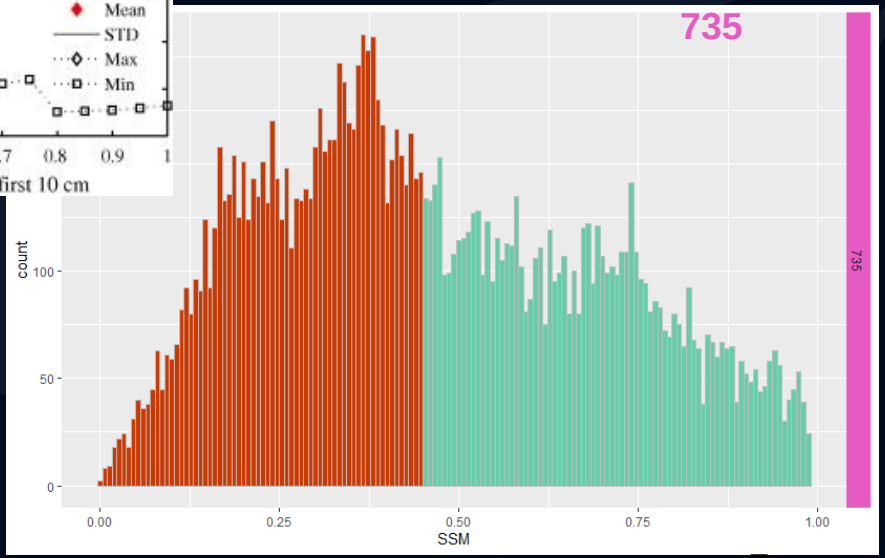
Results obtained display a certain degree of variability which may be due to several climatic factors. One interpretation that may justify the observed errors in two specific regions may be due to the prolonged dry phases observed. Following the results by Manfreda et al. (2007), the prediction of soil moisture in the deep layer, given the superficial soil moisture, becomes more uncertain with a reduced near surface soil water content.

Using ASCAT time-series:

(Manfreda Ad. Water Res. 2007)





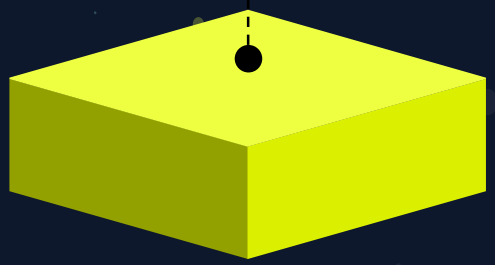


The soil moisture has a consistently larger variability when the soil is dry (Saturation⩽ 0.45)

CONCLUSION

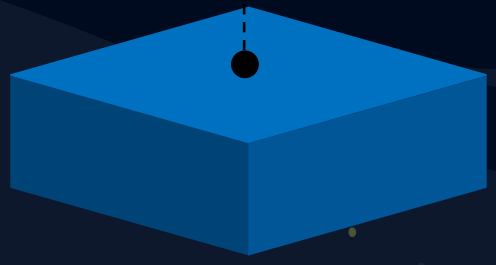
SMAPL4 V5

- ✔ High temporal resolution (3-hour)
- ✔ Overall Good performance at continental scale
- ✔ Very Good performance at single ecoregion scale, except 654 and 735



ESA CCI

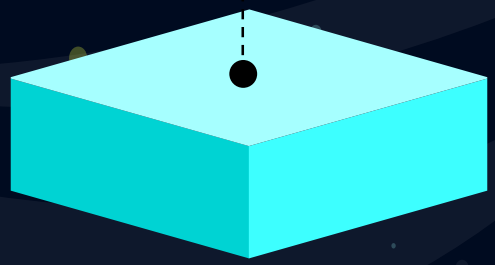
- ✔ Fair temporal resolution (1-day)
- ✔ Overall Very Good performance at continental scale
- ✔ Good performances for several ecoregions



ASCAT

(H115 – H116)

- ✔ Good temporal resolution (at least 2-day)
- ✔ Overall Good perfromance at continental scale
- ✔ Fair performances on ecoregions
- ✔ Based only on Satellite data



The worst performance is achieved by SSM 1km- CGLS, while SMOS-IC achieves overall fair performance ($R_{Pearson} < 0.5$) with performance similar to ASCAT at ecoregions scale. Regardless of satellite, the Central European mixed forests ecoregion (654) and the Pontic steppes ecoregion (735) are undescribed due to increased variability in soil moisture measurements with dry soil.

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THANK YOU !