

# DEVELOPMENT OF THE 2018 DROUGHT IN EUROPE FROM A REMOTE SENSING PERSPECTIVE

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## ABSTRACT

The recent 2018 summer drought in Europe has been particularly extreme in terms of intensity and impact. However, how droughts develop in time and space is still poorly understood.

Here we used remote sensing products like soil moisture and NDVI to see where the 2018 drought started and how it developed over time and space.

The calculated NDVI and Soil moisture ranking percentiles maps showed us that the drought started in June in the Scandinavian and Baltic countries and in Britain and Ireland and with time it started to intensify and to move toward the west of Europe and then to the southeast of Europe.

## INTRODUCTION

The recent 2018 summer drought in Europe has been particularly extreme in terms of intensity and impact, (e.g., Masante and Vogt, 2018; Neslen, 2018). However, the causes and evolutions of drought are still poorly understood (Miralles et al., 2018). Long periods with anomalously low rainfall are known as meteorological droughts. Meteorological drought leads to soil moisture drought and subsequently to vegetation drought. A recent attempt to address how droughts displace by using soil moisture data from the Climate Forecast System Reanalysis yielded in better understanding of how drought evolve over time and space (Herrera-Estrada et al., 2017).

## OBJECTIVE

The objective of this study is to explore where the 2018 drought started in Europe and how it developed over time and space. Our study area is Europe (31.26791W,31.58601E,34.93055N,71.15471N).

## METHODS

- Remote sensing products:

- The soil moisture data (ESA CCI SM v04.5) which has been generated using active and passive microwave space-borne instruments (e.g., figure (1)). This product provides measurements only for the first 5 cm of the surface layer and it covers the period from 01-01-2002 to 31-12-2018.

The Monthly Percent of Saturation Soil Moisture of 2018 (ACTIVE ESA CCI SM product v04.5)

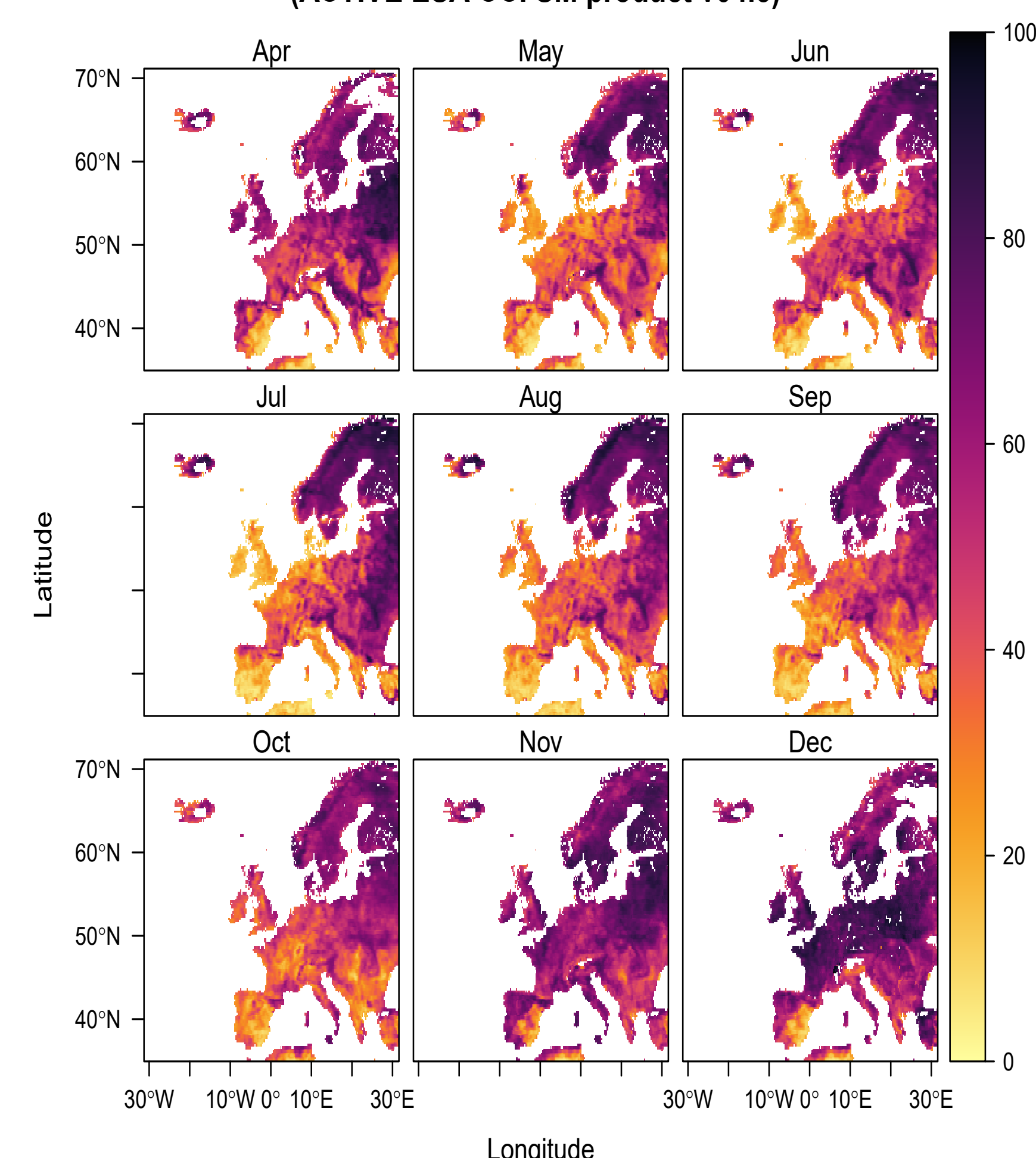


Figure 1 shows the 2018 monthly percent of saturation soil moisture resulted from the aggregation of the daily active ESA CCI SM product v04.5.

- The Normalized Difference Vegetation Index (NDVI) which is one of Modis Terre Vegetation indices product. This product covers the period from 02-2002 to 12-2018.

- Calculated ranking percentiles:

- The calculated soil moisture ranking percentile and the calculated NDVI ranking percentile figure(2) and figure(3) respectively were generated by first ranking remote sensing data on each grid point on monthly basis and then calculate the percentile by using the below formula:

$$P = 100(R/(N+1))$$

$P$  is the calculated ranking percentile of a specific month.

$R$  is the rank of the data point in the time series of that specific month.

$N$  is the sum of that specific month.

Calculated Soil Moisture Ranking Percentile of 2018 (COMBINED ESA CCI SM product versions v04.5)

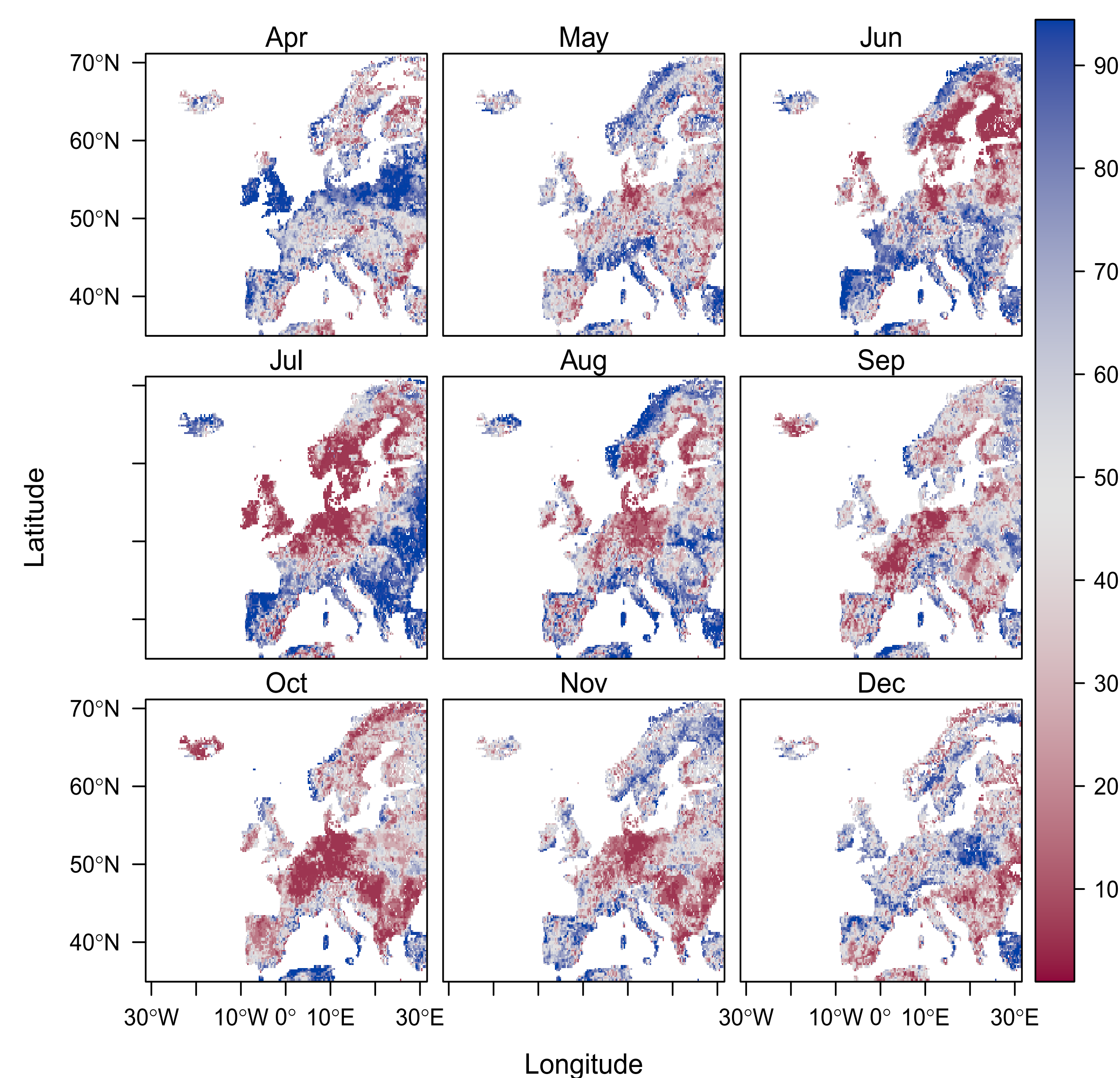


Figure 2 shows the 2018 monthly calculated soil moisture ranking percentile derived from Combined ESA CCI SM product v04.5.

Calculated NDVI Ranking Percentile of 2018 (Monthly L3 global 0.05 Deg Modis Terre Vegetation indices product)

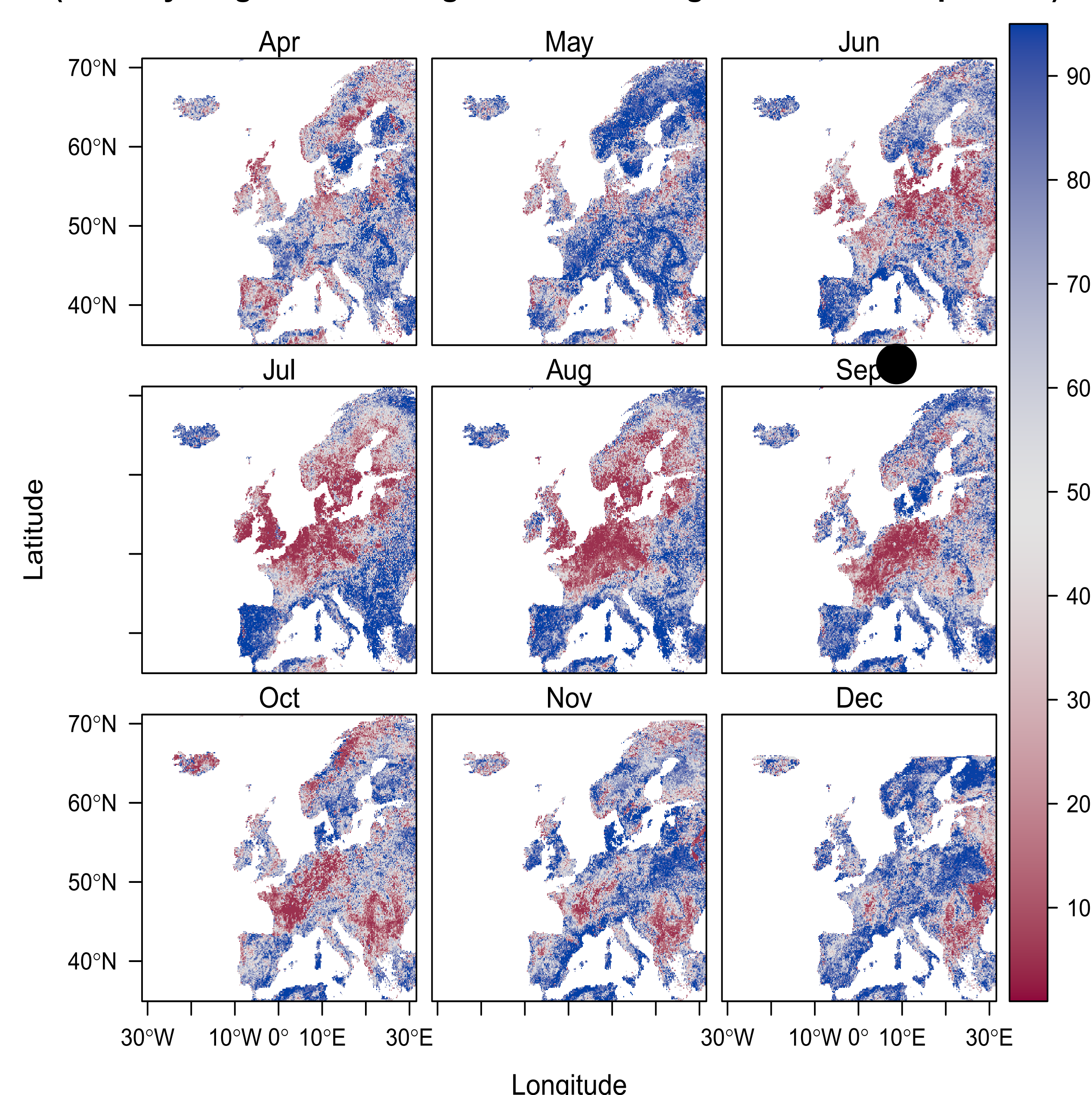


Figure 3 shows the 2018 monthly calculated NDVI ranking percentile derived from Monthly L3 global 0.05 Deg Modis Terre Vegetation indices product.

## RESULTS

- The Spatio-temporal propagation of 2018 drought: Figure (2) shows that the 2018 drought started in June in the Scandinavian and Baltic countries and in Britain and Ireland and then started to expand in July toward the west of Europe and then it moved in October toward southeast part of Europe.

- The Spatio-temporal intensification of 2018 drought: figure(3) shows how the vegetation drought was severe during months of July and August in the Scandinavian and Baltic countries, Britain and Ireland, and west of Europe while in September was only severe in west of Europe. It shows also that the severity of vegetation drought moved to the southeast part of Europe in October.

- The 2018 drought regions: We can divide Europe to 6 drought regions according to the spatio-temporal similarity of drought characteristics inside each region figure(4).

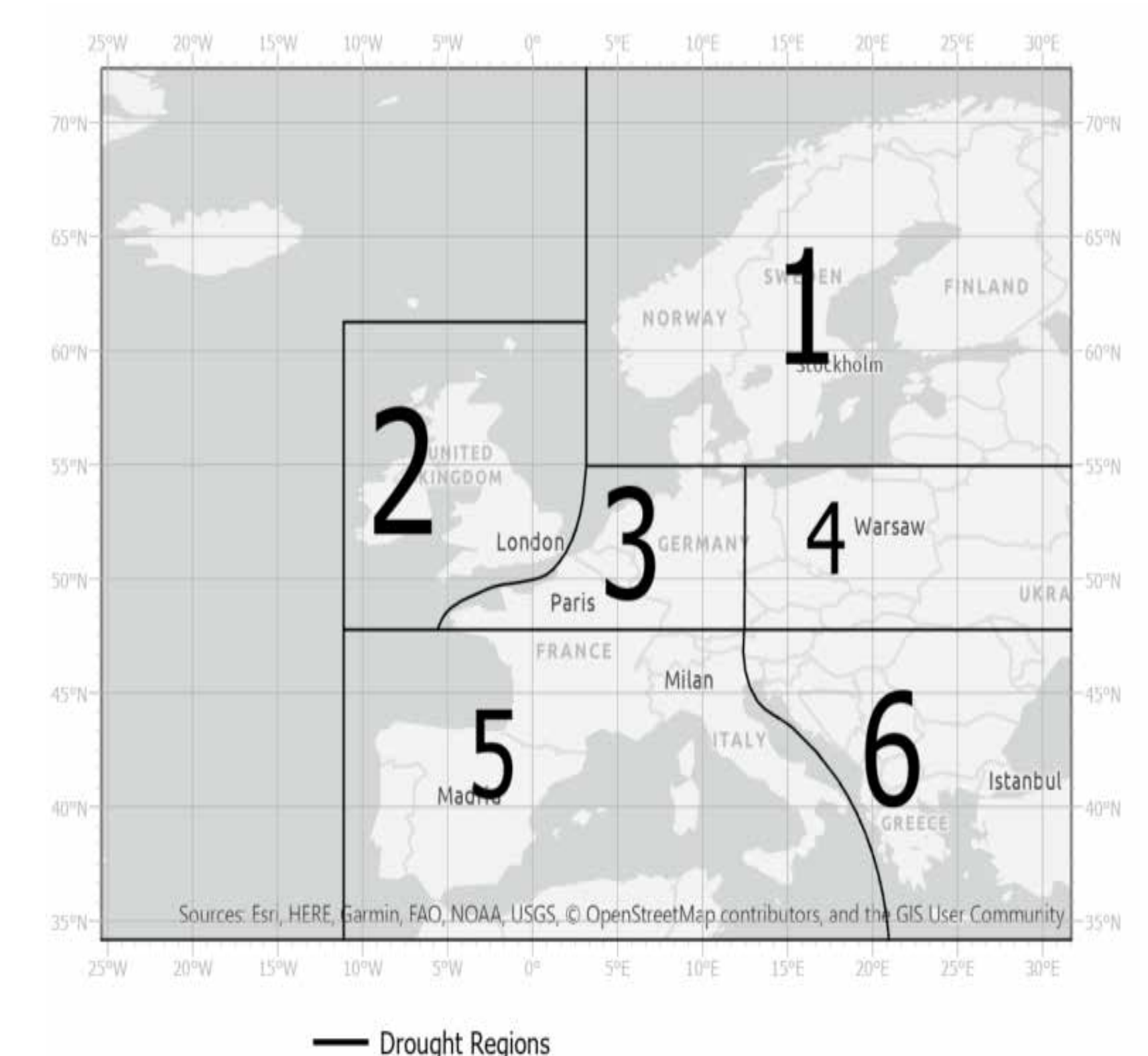


Figure 4 shows the different drought regions in Europe where 1,2,3,4,5, and 6 represent Scandinavian and Baltic countries, Britain and Ireland, West Europe, East Europe, South Europe, and Southeast of Europe respectively.

## CONCLUSIONS

The remote sensing products like soil moisture and NDVI can improve our understanding of development of the 2018 drought and how it was severe in terms of duration and area. This analysis will give us the basis to test the following hypothesis: there was displacement and intensification of the 2018 drought between regions 1,2,3, and 6.

## ONGOING RESEARCH

The next step in the project is to identify the anomalies in atmospheric moisture imports and exports within Europe during spring, summer, and autumn of 2018. This will be done based on ERA5 reanalysis data and the modifying moisture tracking model WAM-2layers (van der Ent et al., 2014).

## MAJOR REFERENCES

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