Showcase on SDG 6.4.2
Water stress levels

Policy context

Agricultural water stress (drought) is expected to increase in both frequency and severity at various countries around the globe (Wolf et al., 2013; Zhou et al., 2013). This can harshly affect various societal sectors (e.g., forestry, agriculture, water resources management, energy generation, health). For example, the 2003 drought event occurred in many European countries caused fatalities of more than 70000 (Robine et al., 2008), with agro-economical damages of about 15 billion EUR (COPA-COGECA 2003). Therefore, quantifying water stress levels in a simple, operational, and straightforward way is of great importance and urgently required, not only for farmers, policy, and decision-makers but also for the scientific community. The emergency of taking serious actions towards water stress quantification is also emphasized by the Sustainable Development Goals (SDGs), in particular, the SDG indicator 6.4.2 ("levels of water stress").

This workflow quantifies one decade (2011-2020) of monthly (agricultural) water stress levels across Europe using satellite-derived Evapotranspiration (ET) data and Evaporative Stress Index (ESI) anomalies at 4 km spatial resolution. Figure 1 shows the monthly water stress levels workflow in Virtual Laboratory (VLab) platform.

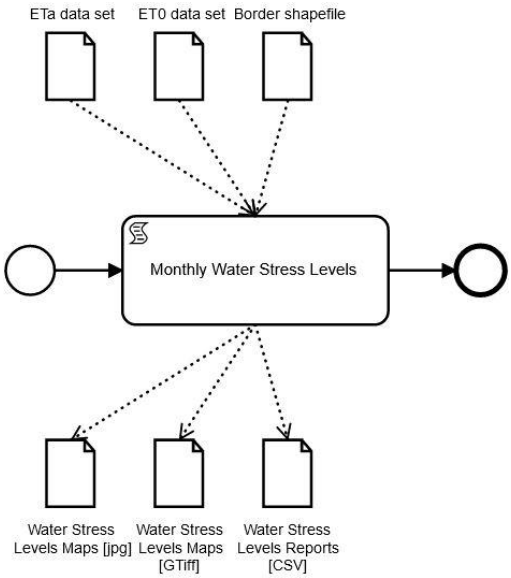


Figure 1. Monthly water stress workflow in VLab platform

The approach is adopted from previous studies (Anderson et al., 2016; Bayat et al., 2018b, 2018a; Kim and Rhee, 2016; Narasimhan and Srinivasan, 2005). Figure 2 shows water stress detection approach employed in this study.

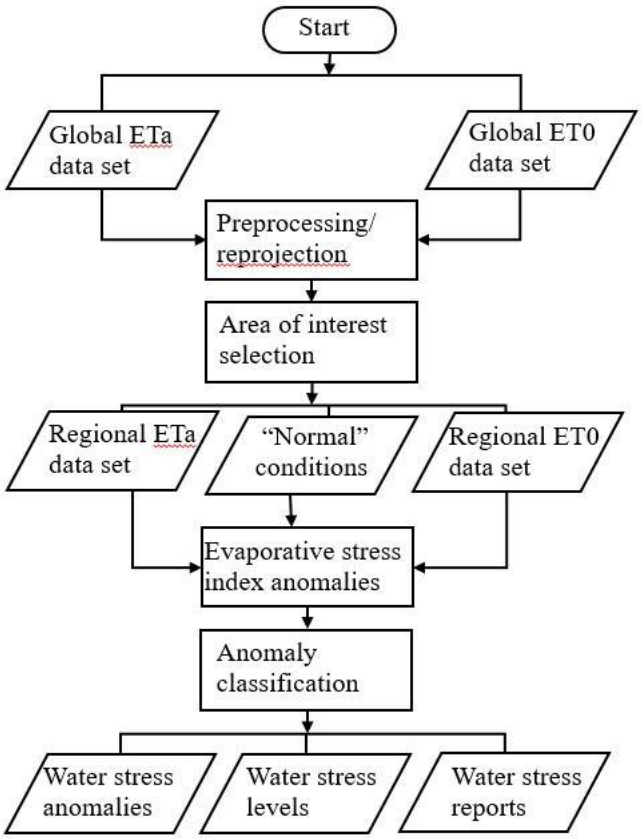
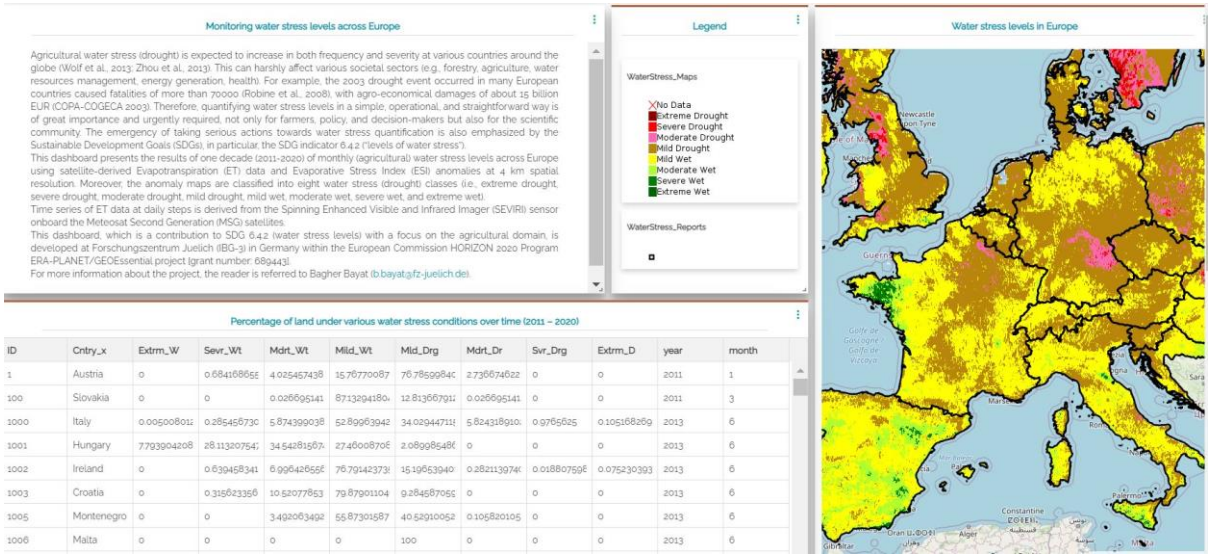


Figure 2. Water stress detection approach employed in this study

Moreover, the anomaly maps are classified into eight water stress (drought) classes (i.e., extreme drought, severe drought, moderate drought, mild drought, mild wet, moderate wet, severe wet, and extreme wet). Time series of ET data at daily steps is derived from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) sensor onboard the Meteosat Second Generation (MSG) satellites. Figure 3 shows the GEOEssential dashboard for workflow 1.4 with data from monthly water stress levels in Europe.



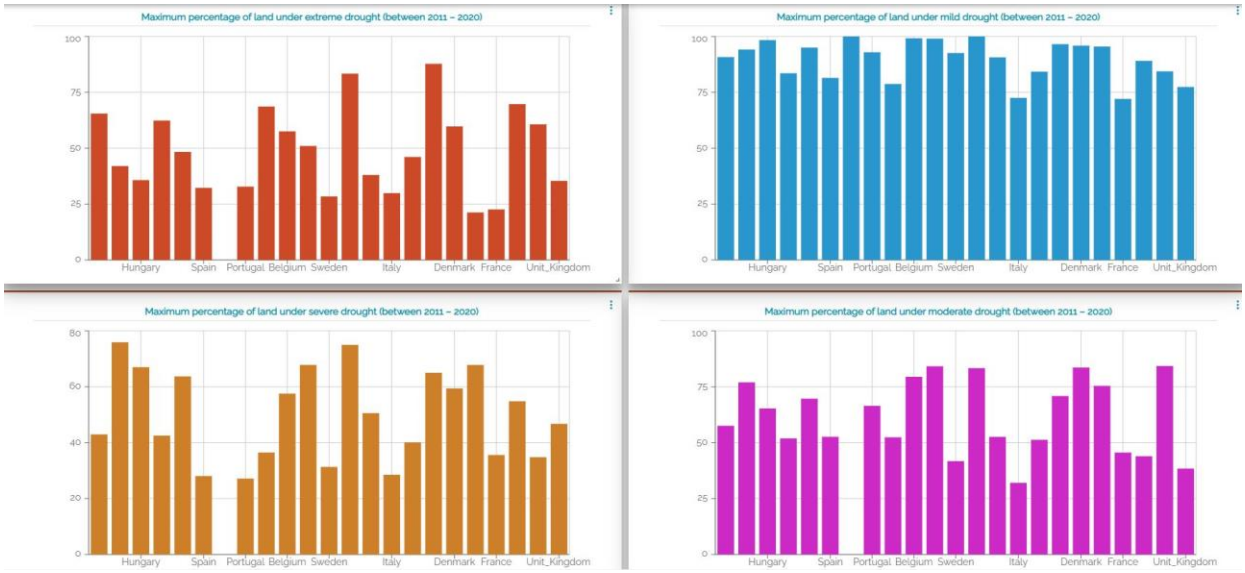


Figure 3. GEOEssential dashboard for workflow 1.4 with data from monthly water stress levels in Europe

This dashboard can provide valuable information for farmers, policy and decision-makers who usually need simple numbers and instructions for making quick and efficient decisions.

Showcase description

Work package 6: Food-Water-Energy Nexus

Workflow 1.4*:	Monthly water stress levels
Spatial Extent	European Union (EU)
Dashboard link	https://geoessential.unepgrid.ch/mapstore/#/dashboard/105/
MapStore link	https://geoessential.unepgrid.ch/mapstore/#/viewer/openlayers/103/
Temporal Extent	One decade (2011-2020)
EVs used	Evapotranspiration (ET)
Inputs	1. Time series of actual evapotranspiration (ETa) data at daily steps [mm] derived from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) sensor onboard the Meteosat Second Generation (MSG) satellites 2. Time series of reference evapotranspiration (ET0) data at daily steps [mm] derived from SEVIRI sensor onboard the MSG satellites 3. Study area administrative borders as a (polygon) shapefile
Outputs	One-decade (2011-2020) maps of monthly water stress anomalies and stress levels and text reports (tables) containing water stress conditions based on the percentage of the total land area
Targeted Policy	SDG 6.4: substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
Targeted indicators	SDG 6.4.2: levels of water stress

Main Process	This workflow quantifies one decade (2011-2020) of monthly (agricultural) water stress levels across Europe using satellite-derived Evapotranspiration (ET) data and Evaporative Stress Index (ESI) anomalies at 4 km spatial resolution. Moreover, the anomaly maps are classified into eight water stress (drought) classes (i.e., extreme drought, severe drought, moderate drought, mild drought, mild wet, moderate wet, severe wet, and extreme wet).
Level of development	100%
GitHub code	https://github.com/bagherbayat/Monthly_Water_Stress_Levels.git
Outputs endpoint	https://vlab.geodab.org/ https://geoessential.unepgrid.ch/geoserver/ https://geoessential.unepgrid.ch/geonetwork/
Partner(s)	Forschungzentrum Juelich (FZJ)
Contact person	Bagher Bayat (b.bayat@fz-juelich.de) and Carsten Montzka [FZJ]

**This workflow is the fourth one among a series of water stress detection workflows developed at FZJ within GeoEssential project. For detailed information about other workflows [i.e., workflow 1.1: water stress levels, workflow 1.2: water stress (EDI values), workflow 1.3: water stress (ESI anomalies)] the reader is referred to VLab platform.*

References:

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