Showcase on SDG 6.4.2
Levels of water stress

Policy context

Drought (water stress) affected 2.2 billion people in various countries around the world from 1950 to 2014 (Guha-Sapir et al., 2015). This is even expected to increase in both frequency and severity at nearly all ecosystems around the world (Wolf et al., 2013; Zhou et al., 2013).

Water stress 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 countries within Europe, caused 7000 fatalities in Germany alone (European Commission 2012) and had agro economical damages around 1.5 billion EUR (Zink et al., 2016). For the same event at the European level, the number of fatalities exceeded 70 000 (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 needed, 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”).

In this workflow, we used daily actual and reference satellite evapotranspiration (ET) products [from EUMETSAF LSA-SAF geostationary satellite products] to quantify water stress levels (Anderson et al., 2016; Bayat et al., 2018b, 2018a; Kim and Rhee, 2016; Narasimhan and Srinivasan, 2005) in European countries. We established all process chains in VLab on Amazon Web Services and successfully implemented our workflow to gather baseline data to document initial conditions and map water stress status. This provides a synoptic overview of water stress changes in European level at daily step with a spatial resolution of 4 kilometers. The workflow to receive the Evaporative Drought Index can easily be adapted to use any other ET products and also can be executed for any other location around the world.

There are two main outputs for this workflow:

1. Maps of water stress (drought) levels explaining spatio-temporal variations of water stress in EU level at daily step with a spatial resolution of 4 km (stress classes are adopted from PDSI index classes).
2. Text reports (tables) containing various water stress levels for each country based on the percentage of the total land area of that country.
Fig 1 shows the outputs of the proposed workflow for one day (i.e., 28 of October) in different years (i.e., 2017 and 2018).

(a)

![Evaporative Drought Index_20171028](image)

(b)

![Evaporative Drought Index_20181028](image)

Figure 1. Water stress (drought) maps for day 28 of October in 2017 (a) and 2018 (b) generated by the proposed workflow.

Furthermore, Table 1 shows two text files, corresponding to two maps shown in Fig.1, to summarize the status of water stress in each country within Europe based on the percentage of its total land area.
Table 1. Water stress (drought) tables for day 28 of August in 2017 and 2018 generated by the proposed workflow. Germany is highlighted as an example for the sake of better comparison.

This workflow 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

Workflow 6.4: Water stress levels

Spatial Extent
European Union (can also be easily adapted for any specific country or Global)

Dashboard link
To be included soon
<table>
<thead>
<tr>
<th>Temporal Extent</th>
<th>Currently from 2016-2018 at daily step (but will be extended from 2005 to 2019 at daily step in the final version)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVs used</td>
<td>Evapotranspiration (ET)</td>
</tr>
<tr>
<td>Inputs</td>
<td>EU METSAF LSA-SAF geostationary satellite ET products</td>
</tr>
<tr>
<td>Outputs</td>
<td>Maps of water stress (drought) levels and text reports (tables) containing various water stress levels for each country based on the percentage of the total land area of that country.</td>
</tr>
<tr>
<td>Targeted Policy</td>
<td>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</td>
</tr>
<tr>
<td>Targeted indicators</td>
<td>6.4.2: Levels of water stress</td>
</tr>
<tr>
<td>Main Process</td>
<td>This workflow simply uses ET as an essential variable from satellite observations to quantify water stress levels based on Evaporative Drought Index (EDI).</td>
</tr>
<tr>
<td>Level of development</td>
<td>80%</td>
</tr>
<tr>
<td>GitHub code</td>
<td>To be included soon</td>
</tr>
<tr>
<td>Outputs endpoint</td>
<td>To be included soon</td>
</tr>
<tr>
<td>Partner(s)</td>
<td>Forschungszentrum Juellich (FZJ)</td>
</tr>
<tr>
<td>Contact person</td>
<td>Bagher Bayat*, Carsten Montzka, Harry Vereecken (FZJ)</td>
</tr>
</tbody>
</table>

* b.bayat@fz-juelich.de

References: