GEOESSENTIAL ERA-PLANET

Essential Variables workflows for resource efficiency and environmental management

Deliverable 7.3

Dynamic maps and graphs on EVs

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Summary

This deliverable is the result of the Task 7.3 that processes raw EVs and generate a first type of products (e.g., graphs and maps) using the GEOEssential indicators toolbox to generate useful environmental monitoring information. An example of dynamic graphs and dynamic map is presented. All EVs products will be integrated and available by the end of the project on the GEOEssential Portal at: https://geoessential.unepgrid.ch (under the Discover and Access EVs section).

GEOEssential portal architecture

In order to create a Dashboard, data and metadata should be published in the GEOEssential GeoServer (for publishing data as OGC webservices such as WMS, WFS, WCS) and GEOEssential GeoNetwork (for metadata publication). These are the two basic components for further creating a dashboard (figure 1).

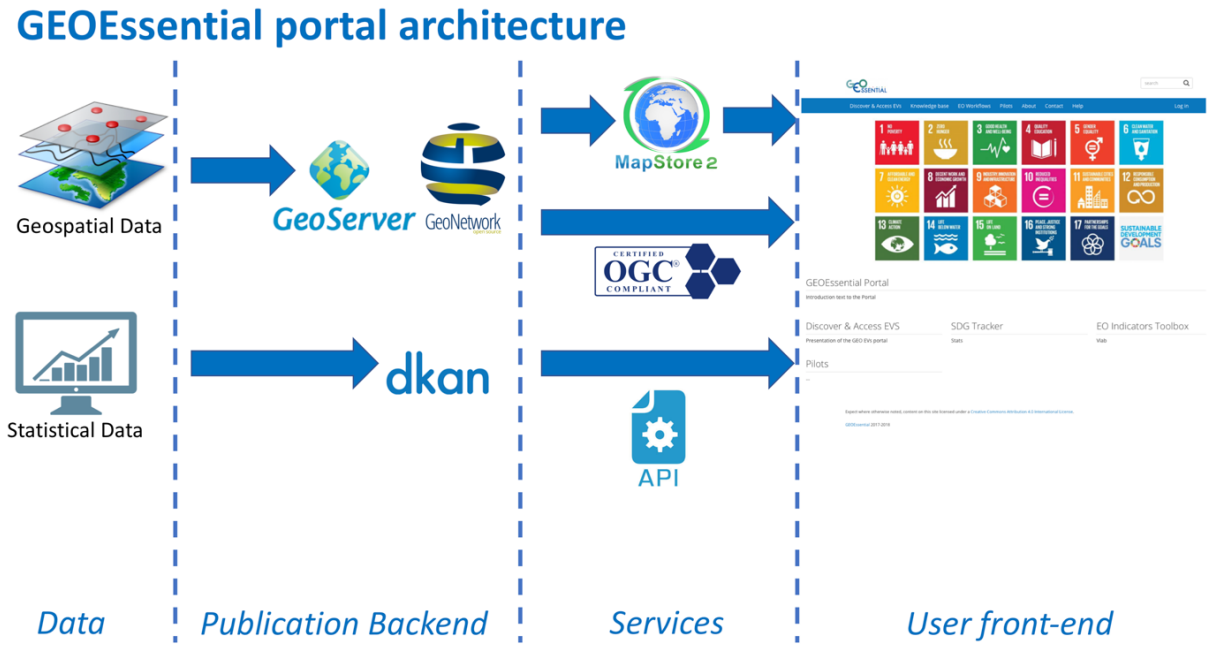

Figure 1 The integrations of workflows geospatial and statistical outputs into the GEOEssential dashboard

The endpoints are:

- GeoServer: http://geoessential.unepgrid.ch/geoserver
- GeoNetwork: https://geoessential.unepgrid.ch/geonetwork

Once data (such as output of a GEOEssential VLab model) and their description (e.g., metadata) are published then they are automatically available into the GEOEssential MapStore, that is the component to be used for thematic maps and dashboards. This component is available at: https://geoessential.unepgrid.ch/mapstore/

Users have the choice to either create a dynamic map with some widgets (e.g., text, graphs) or a complete dashboard with maps, graphs, text, images, tables that can be dynamically synchronized (see the example on SDG15.3.1). This is the recommended option to be used.

Examples of EVs dynamic graphs

The **dynamic graphs** mostly concentrate on Essential Climate Variables (ECV) and are already available as a service provided by UNEP/GRID-Geneva. It consists of a set of 18 graphs that are updated automatically, usually on a daily or weekly basis. They are generated using data provided by the National Snow and Ice Data Center, National Oceanic and Atmospheric Administration (NOAA), and NASA Vital Signs. It uses R scripts to format the data and HighCharts for creating the graph.
The links for each graph are provided in the box below.

The first example is the calculation of Artic Sea Ice extent[1]. This interactive graphic, created by UNEP/GRID-Geneva, is updated automatically every day. Arctic sea ice extent has been declining since well before satellite measurements began in 1979. This decline has been most pronounced in September at the end of the summer melt season. Several of the most extreme years have been since 2002, with the smallest sea ice extent ever recorded (3.34 million km2) occurring in 16 September 2012. The winter sea ice extent in 2015 was the smallest ever recorded. (Figure 2).

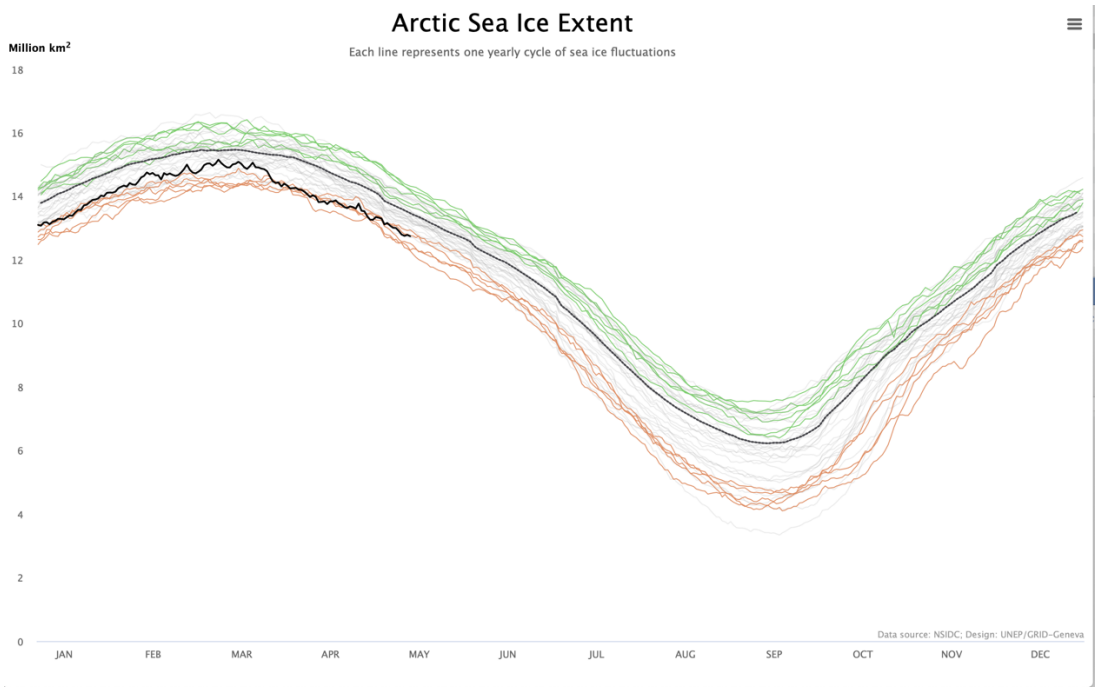

Figure 2. Arctic Sea Ice extent

[1] https://unepgrid.ch/en/resource/3807533

- *Sea Ice Extent*
  - Arctic Sea Ice Extent:
    https://graphs-test.unepgrid.ch/graph_arctic_sea_ice_resp.php
  - Arctic Sea Ice Extent (Min/Max):
    https://graphs-test.unepgrid.ch/graph_arctic_sea_ice_min_max_resp.php
  - Antarctic Sea Ice Extent:
    https://graphs-test.unepgrid.ch/graph_antarctic_sea_ice_resp.php
  - Antarctic Sea Ice Extent (Min/Max):
    https://graphs-test.unepgrid.ch/graph_antarctic_sea_ice_min_max_resp.php
- *Atmospheric CO_2 Concentration*
  - Trends, since 800.000BC:
    https://graphs-test.unepgrid.ch/graph_global_co2_concentration_800000_2_resp.php
  - Trends, since 1958:
    https://graphs-test.unepgrid.ch/graph_global_co2_concentration_1813_resp.php
  - Since 1958:
    https://graphs-test.unepgrid.ch/graph_global_co2_concentration_resp.php
- Atmospheric CH4, N20, SH6 Concentration
  - Trends in Atmospheric Methan Concentration:
    https://graphs-test.unepgrid.ch/graph_global_ch4_concentration_800000.php
  - Trends in Atmospheric Nitrous Oxide Concentration:
    https://graphs-test.unepgrid.ch/graph_global_n2o_concentration.php
  - Trends in Atmospheric SH6 Concentration:
    https://graphs-test.unepgrid.ch/graph_global_sf6_concentration.php
- Global Temperature Change
  - Global Surface Temperature:
    https://graphs-test.unepgrid.ch/graph_global_temperatures_resp.php
  - Global Land and Ocean Temperature Anomalies:
    https://graphs-test.unepgrid.ch/graph_global_temperatures_2.php
  - Climate Warmings Factors:
    https://graphs-test.unepgrid.ch/graph_co2_temp_other-factors_resp.php
  - Average World Monthly Temperature:
    https://graphs-test.unepgrid.ch/graph_global_temperature_monthly_resp.php
- Glaciers
  - Change in Glacier Mass:
    https://graphs-test.unepgrid.ch/graph_glaciers_resp.php
- Oceans
  - since 1880:
    https://graphs-test.unepgrid.ch/graph_sea_level_rise_1880.php
  - Ocean Heat Content Anomaly:
    https://graphs-test.unepgrid.ch/graph_ocean_heat_content.php
  - Ozone Antarctic Ozone Hole Area:
    https://graphs-test.unepgrid.ch/graph_antarctic_ozone_hole_area.php

Examples of EVs dynamic maps

The GEOEssential portal will also be able to present maps of EVs. An example of such maps concerns Essential Water Variables at the European Level. They represent the annual means of input and output data of an European SWAT model (Abbapsour et al. 2015 [2]) (Figure 3).

The Soil and Water Assessment Tool (SWAT) has been applied in studies ranging from catchment to continental scales. The SWAT program is a comprehensive, semi-distributed, continuous-time, process-based model. The calibrated model and results provide information support to the European Water Framework Directive and lay the basis for further assessment of the impact of climate change on water availability and quality. The approach and methods developed are general and can be applied to any large region around the world. Among other impediments to the SWAT model, a lack of data on soil moisture and/or deep aquifer percolation prevents calibration/validation of these components (Abbaspour et al. 2015). SWAT will be used to demonstrate the workflow towards useful FWE indicators, creating outputs on water quality and quantity, food productivity and hydropower potential using the SWAT model developed for Europe in Abbaspour et al. (2015).

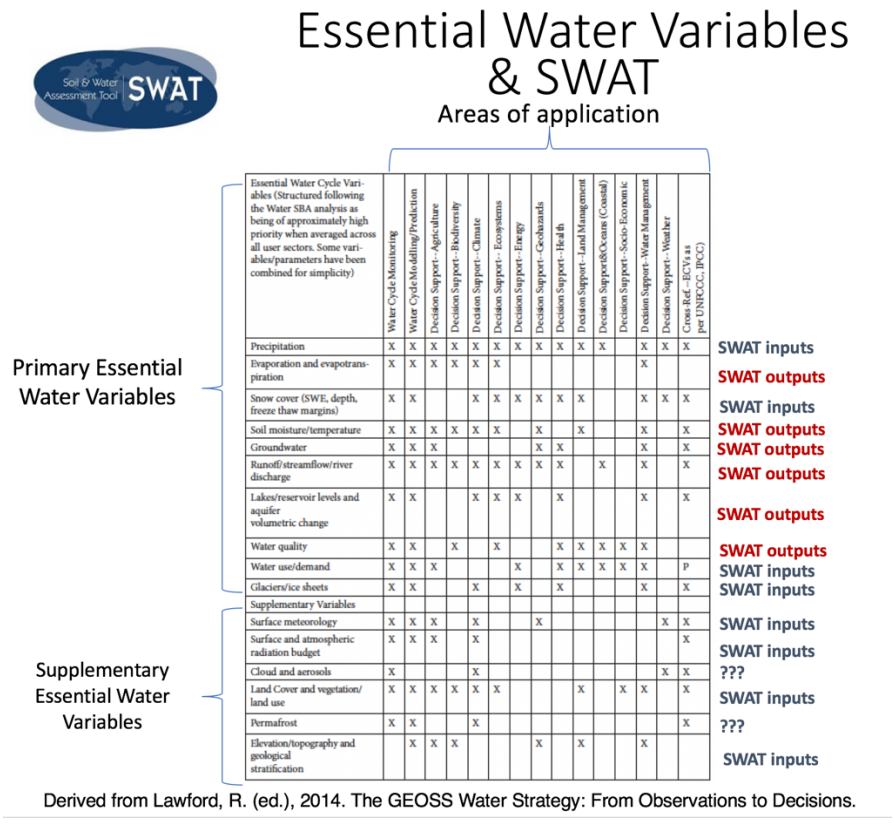

Figure 3 SWAT inputs and outputs relationships with EWVs

[2] http://dx.doi.org/10.1016/j.jhydrol.2015.03.027

They are available on the GEOEssential WMS instance in Table 1: http://geoessential.unepgrid.ch/geoserver/ewv/ows?service=wms&version=1.3.0&request=GetCapabilities. The list below can be obtained from : http://geoessential.unepgrid.ch/geoserver.

Table 1 SWAT inputs and outputs relationships with EWVs

Streamflow [cubic meter per second]	ewv:rch_FLOW_OUTcms	OpenLayers KML GML	Select one
Nitrate transported with water out of reach [kg]	ewv:rch_NO3_OUTkg	OpenLayers KML GML	Select one
Evapotranspiration [mm]	ewv:sub_ETmm	OpenLayers KML GML	Select one
Groundwater contribution to streamflow [mm]	ewv:sub_GW_Qmm	OpenLayers KML GML	Select one
Percolation part the root zone [mm]	ewv:sub_PERCmm	OpenLayers KML GML	Select one
Precipitation [mm]	ewv:sub_PRECIPmm	OpenLayers KML GML	Select one
Snow melt [mm]	ewv:sub_SNOMELTmm	OpenLayers KML GML	Select one
Runoff [mm]	ewv:sub_SURQmm	OpenLayers KML GML	Select one
Soil moisture [mm]	ewv:sub_SWmm	OpenLayers KML GML	Select one

On example of representation of EWV is given below with the OpenLayers representation of Precipitation (Figure 3).

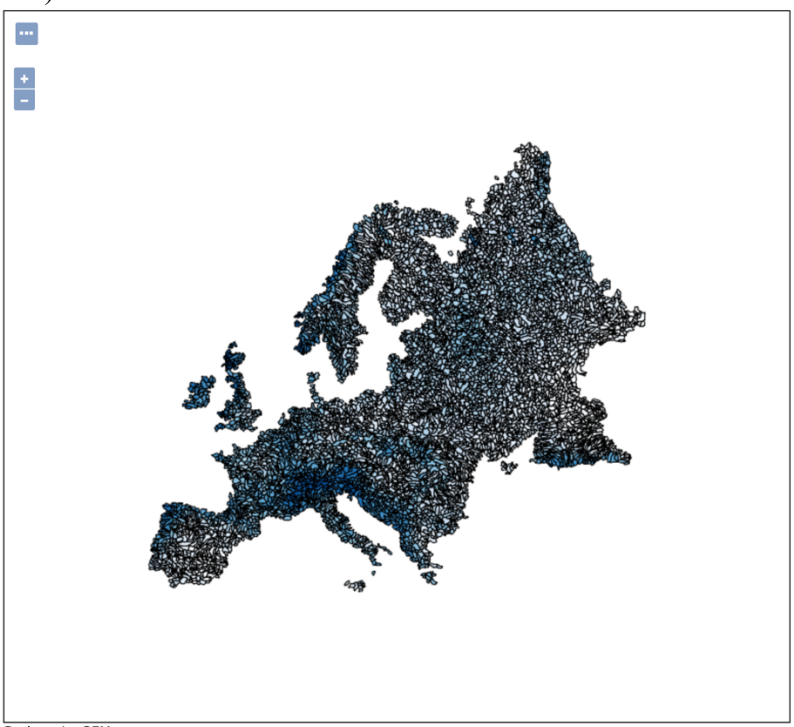

Figure 3. Arctic Sea Ice extent

SWAT outputs are also described in GEOnetwork under : https://geoessential.unepgrid.ch/geonetwork/srv/eng/catalog.search#/search?facet.q=keyword%2Fswat%2520output&resultType=details&sortBy=relevance&fast=index&_content_type=json&from=1&to=20

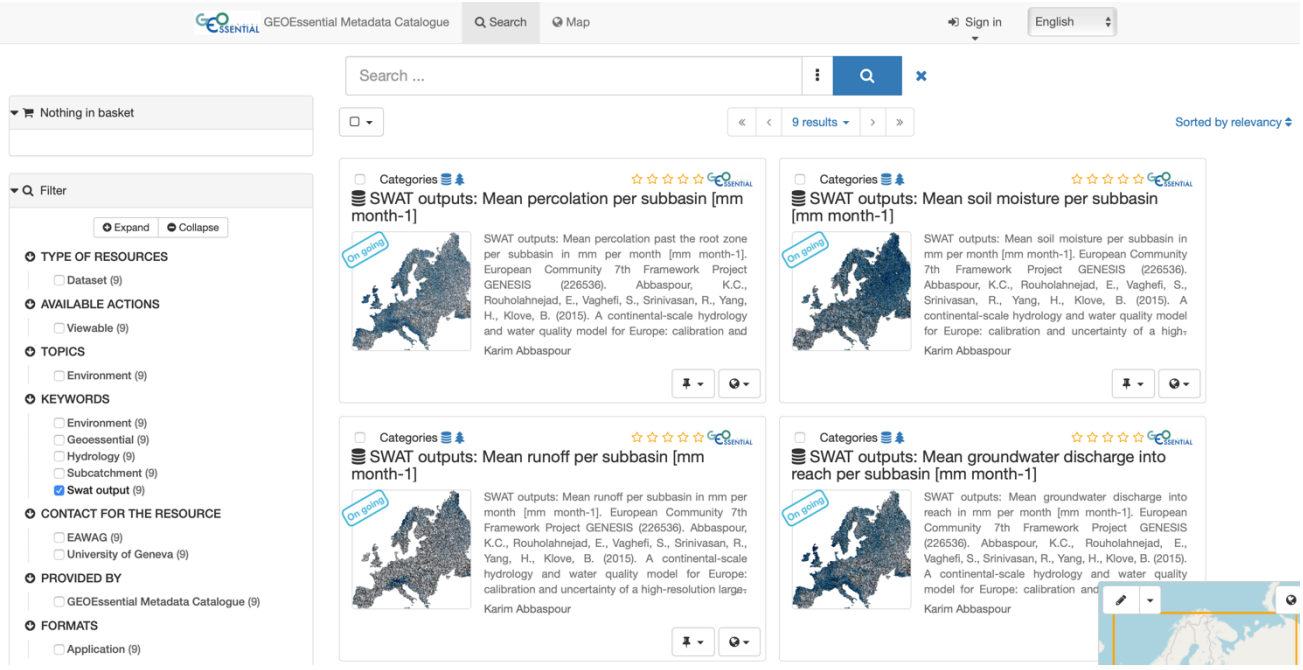

Figure 4. EWVs described in GEONetwork

Dynamic maps of these EWV will be obtained in MapStore with the new timeline extension to show yearly, monthly, or daily changes of SWAT outputs: https://mapstore.readthedocs.io/en/latest/user-guide/timeline