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## The GEOEssential project: "From Essential Water Variables to Policy Indicators"

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SENCKENBERG

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**GEOEssential Variables workflows for resource efficiency and environmental management** HORIZON 2020 – ERA-PLANET the European network for observing our changing planet

HELMHOLT2



## **GEO GROUP ON** EARTH OBSERVATIONS Societal Benefit Areas



https://www.earthobservations.org/index2.php





The project aims at demonstrating the **feasibility and generality** of the concept of Essential Variables (EVs) across the Nexus of GEOSS Societal Benefit Areas (SBAs).



 Sustainable and trustable sources of data and information to monitor the progresses made on environmental conditions

✓ Cross-thematic workflows and knowledge base
to evaluate, predict and monitor Sustainable Development Goals (SDGs)

 ✓ Gaps and synergies for addressing the needs of environmental policy in agriculture, soil, water, biodiversity, energy, light, and raw materials



Contents lists available at ScienceDirect



journal homepage: www.elsevier.com/locate/jhydrol

## Reviewing innovative Earth observation solutions for filling science-policy gaps in hydrology



HYDROLOGY

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Fig. 1. Selected projects and main international initiatives contributing to the development of water related Spatial Data Infrastructures.



Journal of Hydrology 518 (2014) 267-277



Lifting the information barriers to address sustainability challenges through workflows



Lehmann et al. 2017. Sustainability

http://www.mdpi.com/2071-1050/9/5/858



## From Data to Knowledge

**SDGs** 





Nativi et al. in prep.



#### ECOLOGY

### **Essential Biodiversity Variables**

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SCIENCE VOL 339 18 JANUARY 2013



Generalisation of the EV concept across SBAs and connection with SDGs through a knowledge base



Lehmann et al, submitted



### Primary Essential Water Variables

Supplementary Essential Water Variables

## Essential Water Variables & SWAT

Areas of application



|   |   |                        |                                 |                             |                              |                         |                             |                        | _                          |                         |                                 |                                   |                                |                                   |                         |   |              |
|---|---|------------------------|---------------------------------|-----------------------------|------------------------------|-------------------------|-----------------------------|------------------------|----------------------------|-------------------------|---------------------------------|-----------------------------------|--------------------------------|-----------------------------------|-------------------------|---|--------------|
|   |   |                        |                                 |                             |                              |                         |                             |                        |                            |                         |                                 |                                   |                                |                                   |                         |   |              |
|   | Essential Water Cycle Vari-<br>ables (Structured following<br>the Water SBA analysis as<br>being of approximately high<br>priority when averaged across<br>all user sectors. Some vari-<br>ables/parameters have been<br>combined for simplicity) | Wa ter Cyde Monitoring | Water Cyde Modelling/Prediction | Decision SupportAgriculture | Decision SupportBiodiversity | Decision SupportClimate | Decision Support Ecosystems | Decision SupportEnergy | Decision SupportGeohazards | Decision SupportHeal th | Decision SupportLand Management | Decision Support&Oceans (Coastal) | Decision SupportSocio-Economic | D ecision SupportWater Management | Decision SupportWeather | Cross-Ref. – ECVs as<br>per UNFCCC, IPCC) |              |
|   | Precipitation   | х                      | х                               | х                           | х                            | х                       | х                           | х                      | х                          | х                       | х                               | х                                 |                                | х                                 | х                       | Х   | SWAT inputs  |
|   | Evaporation and evapotrans-<br>piration   | х                      | х                               | х                           | х                            | х                       | х                           |                        |                            |                         |                                 |                                   |                                | х                                 |                         |   | SWAT outputs |
|   | Snow cover (SWE, depth, freeze thaw margins)  | х                      | х                               |                             |                              | х                       | х                           | х                      | х                          | х                       | х                               |                                   |                                | х                                 | х                       | х   | SWAT inputs  |
|   | Soil moisture/temperature   | х                      | х                               | х                           | х                            | х                       | х                           |                        | х                          |                         | х                               |                                   |                                | х                                 |                         | Х   | SWAT outputs |
|   | Groundwater   | х                      | х                               | х                           |                              |                         |                             |                        | х                          | х                       |                                 |                                   |                                | х                                 |                         | Х   | SWAT outputs |
|   | Runoff/streamflow/river<br>discharge  | х                      | х                               | х                           | х                            | х                       | х                           | х                      | х                          | х                       |                                 | х                                 |                                | х                                 |                         | х   | SWAT outputs |
|   | Lakes/reservoir levels and<br>aquifer<br>volumetric change  | х                      | x                               |                             |                              | x                       | х                           | х                      |                            | х                       |                                 |                                   |                                | х                                 |                         | x   | SWAT outputs |
|   | Water quality   | х                      | х                               |                             | х                            |                         | х                           |                        |                            | х                       | х                               | х                                 | х                              | х                                 |                         |   | SWAT outputs |
|   | Water use/demand  | х                      | х                               | х                           |                              |                         |                             | х                      |                            | х                       | х                               | х                                 | х                              | х                                 |                         | р   | SWAT inputs  |
|   | Glaciers/ice sheets   | х                      | х                               |                             |                              | х                       |                             | х                      |                            | х                       |                                 |                                   |                                | х                                 |                         | Х   | SWAT inputs  |
| _ | Supplementary Variables   |                        |                                 |                             |                              |                         |                             |                        |                            |                         |                                 |                                   |                                |                                   |                         |   |              |
|   | Surface meteorology   | х                      | х                               | х                           |                              | х                       |                             |                        | х                          |                         |                                 |                                   |                                |                                   | х                       | х   | SWAT inputs  |
|   | Surface and atmospheric<br>radiation budget   | х                      | х                               | х                           |                              | х                       |                             |                        |                            |                         |                                 |                                   |                                |                                   |                         | х   | SWAT inputs  |
|   | Cloud and aerosols  | х                      |                                 |                             |                              | х                       |                             |                        |                            |                         |                                 |                                   |                                |                                   | х                       | Х   | ???          |
|   | Land Cover and vegetation/<br>land use  | х                      | х                               | х                           | х                            | х                       | х                           |                        |                            |                         | х                               |                                   | х                              | х                                 |                         | х   | SWAT inputs  |
|   | Permafrost  | х                      | х                               |                             |                              | х                       |                             |                        |                            |                         |                                 |                                   |                                |                                   |                         | х   | ???          |
|   | Elevation/topography and<br>geological  |                        | х                               | х                           | х                            |                         |                             |                        | х                          |                         | х                               |                                   |                                | х                                 |                         |   | SWAT inputs  |

Derived from Lawford, R. (ed.), 2014. The GEOSS Water Strategy: From Observations to Decisions.



Lehmann et al, submitted





## SWAT outputs workflow





## Next steps

The next challenge for GEOEssential is to execute new workflows over the VLab platform for instance on the Nexus approach (based on WOFOST model) and to connect it with the Knowledge base and export the output towards the Dashboard.

in



GEOEssential Variables workflows for resource efficiency and environmental management

HORIZON 2020 – ERA-PLANET the European network for observing our changing planet



# An example from a SWAT-Europe model





A continental-scale hydrology and water quality model for Europe: Calibration and uncertainty of a high-resolution large-scale SWAT model

del CrossMark

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Journal of Hydrology 524 (2015) 733-752



## EU SWAT outputs presented as OGC web services





https://geoessential.unepgrid.ch/geonetwork/srv/eng/catalog.search#/home



### https://geoessential.unepgrid.ch/geonetwork/srv/eng/catalog.search#/home



## Towards GEOEssential Dashboard

### **GEOEssential portal architecture**



Giuliani et al. in prep.





## Towards a Worldwide **WATER** Assessment of Freshwater Quality







## SDG6 Monitoring and Reporting





#### Essential Variables workflows for resource





### GEOSS Portal





next 🕨



## Conclusions

- We need to accelerate workflows from data to knowledge
- We need to use interoperability standards (OGC, WaterML,...)
- Essential Water Variables (EWVs) can help defining what needs to be monitor through time to inform Policy Indicators
- SWAT inputs and outputs are closely related to EWVs
- Workflows can be ported with VLab on the Internet and connected to the GEO data sharing platform
- Other Essential Variables on Cliamte, Biodiversity, Agricultrure,... are needed to fully inform DPSIR indicators
- SWAT is providing much more than monitoring capacities by modeling also future scenarios



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### Thank you



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