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How to cite

GIULIANI, Gregory et al. The Swiss Data Cube: Earth Observations for monitoring Switzerland's environment in space and time. In: 11th International Symposium on Digital Earth (ISDE 11). Nativi, S. ; Wang, C. ; Landgraf, G. ; Liberti, M.A. ; Mazzetti, P. & Mohamed-Ghouse, Z.S. (Ed.). Florence. Bristol : IOP Publishing, 2020. p. 012021/1–2. (IOP conference series: earth and environmental science) doi: 10.1088/1755-1315/509/1/012021

This publication URL: https://archive-ouverte.unige.ch/unige:138590
Publication DOI: 10.1088/1755-1315/509/1/012021

IOP Conf. Series: Earth and Environmental Science **509** (2020) 012021 doi:10.1088/1755-1315/509/1/012021

The Swiss Data Cube: Earth Observations for monitoring Switzerland's environment in space and time

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Abstract. Pressures on natural resources are increasing and a number of challenges need to be overcome to meet the needs of a growing population in a period of environmental variability. The key to sustainable development is achieving a balance between the exploitation of natural resources for socioeconomic development and maintaining ecosystem services that are critical to human's wellbeing and livelihoods. Some of these environmental issues can be monitored using remotely sensed Earth Observations (EO) data that are increasingly available from freely and openly accessible repositories. Hereafter, we present the Swiss Data Cube, a unique Analysis Ready Data archive of satellite imagery and some use cases to monitor Sustainable Development Goals.

1. Introduction

The Swiss Data Cube (SDC) is a new paradigm revolutionizing the way users can interact with EO data. It lowers the barrier caused by Big Data challenges (e.g., Volume, Velocity, Variety) [1] and provides access to large spatiotemporal data in an analysis ready format. It significantly reduces the time and scientific knowledge required to access and prepare EO data having consistent and spatially aligned calibrated surface reflectance observations [2]. Switzerland is the second country in the world to have a national-scale Data Cube. The SDC is supported by the Federal Office for the Environment and developed, implemented and operated by the UN Environment /GRID-Geneva in partnership with the University of Geneva (UNIGE), the University of Zurich (UZH) and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). Currently, the SDC holds 35 years of Landsat 5,7,8 (1984-2019), 5 years of Sentinel-1 (2014-2019) and 4 years of Sentinel-2 (2015-2019) Analysis Ready Data (ARD) over Switzerland [2]–[4]. It took about 6 months to install the necessary software components; ingest 10TB of data; and provide an efficient access to the analytical tools on single server (64Gb RAM, 16 cores).

The SDC is aiming at delivering a unique capability to track environmental changes in unprecedented detail using EO data, enabling more effective responses to problems of national significance. This near real-time information can be readily used as an evidence base for the design, implementation, and evaluation of policies, programs, and regulation, and for developing policy advices. It will also enable scientific institutions to facilitate research and new insights on Switzerland's environment.

2. Selected examples

Using the Swiss Data Cube different use cases have been developed to demonstrate the feasibility to provide an effective monitoring tool to generate information on the SDGs [5].

Switzerland's territory represents four thousandths of Europe's total area but stores 6% of continental freshwater reserves. Monitoring the vast areas and number of water bodies can be challenging. Turbidity can be assessed using the Total Suspend Matter algorithm as a proxy to generate water quality products and contribute to the SDG 6.3.2 indicator on "Proportion of bodies of water with good ambient water quality" (figure 1).

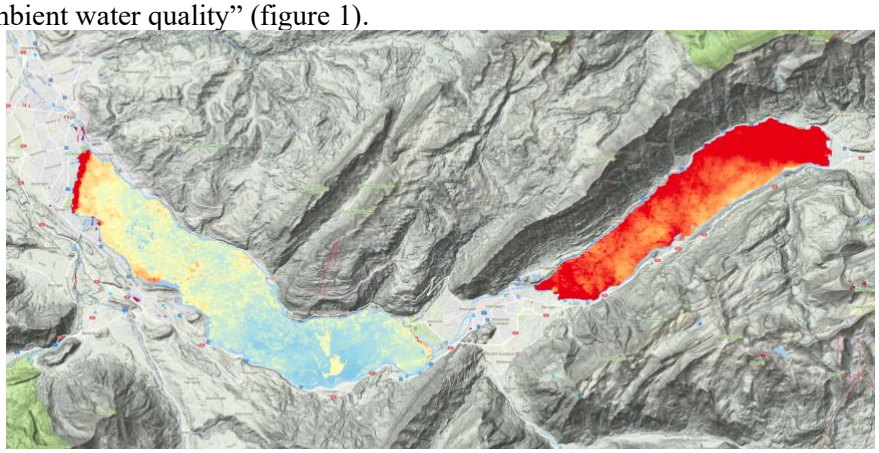

Figure 1. Estimated Total Suspended Matter (TSM) in lakes Thun (left) and Brienz (right) from Landsat data for 2016.

Monitoring snow cover and its variability is an indicator of climate change and identification of snowmelt processes is essential for effective water-resource management. Recently, a new algorithm has been developed using the SDC to map snow cover extension. Preliminary results have shown a clear decrease of snow cover extension over the Alps in the last 30 years. Finally, satellite EO data can be a reliable source for monitoring land cover change and biomass activity over long periods. It helps monitoring forest cover evolution for the SDG 15.1.1 indicator ("Forest area as a proportion of total land area") as well as assessing SDG15.3.1 indicator on land degradation ("Proportion of land that is degraded over total land area").

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