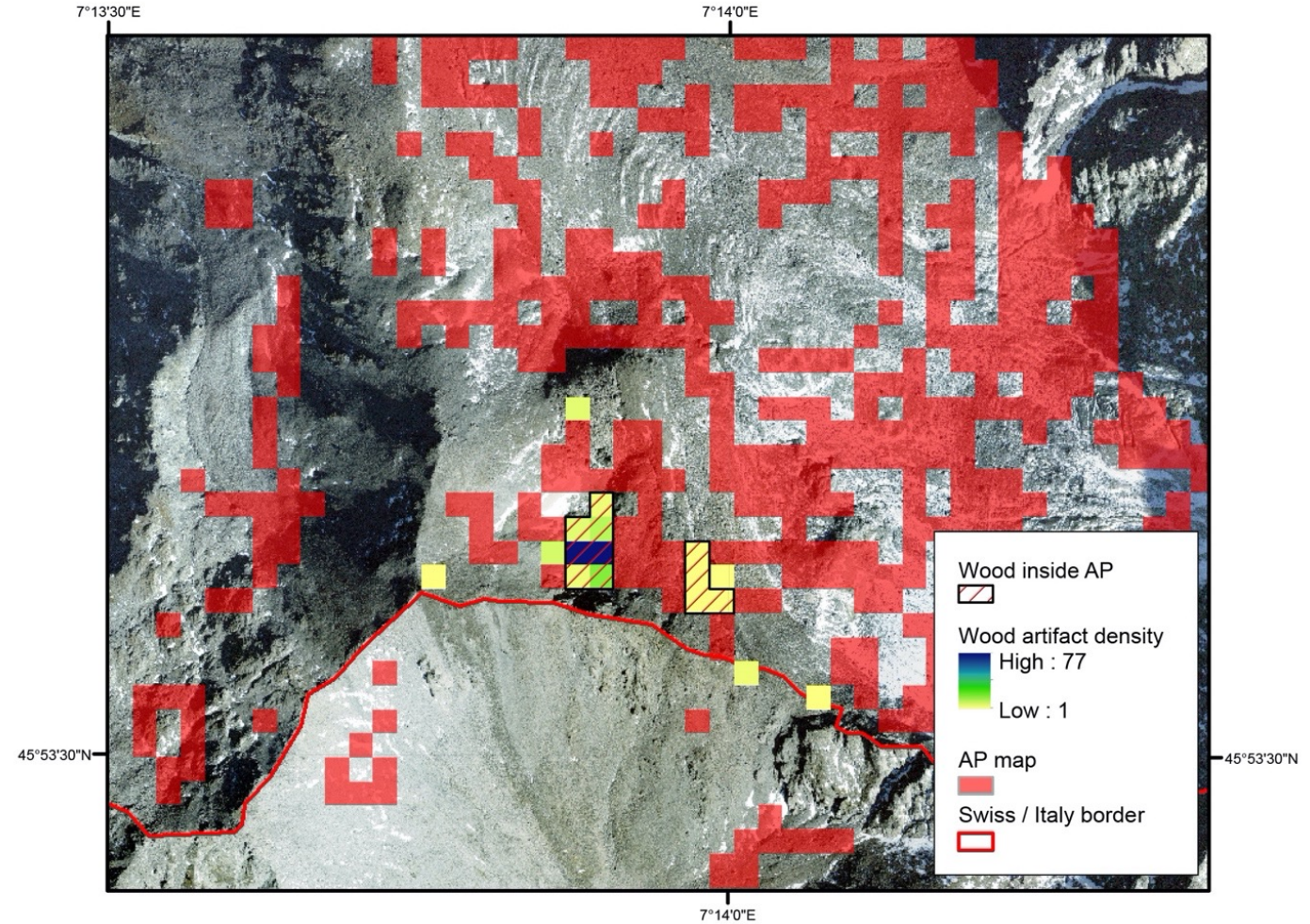
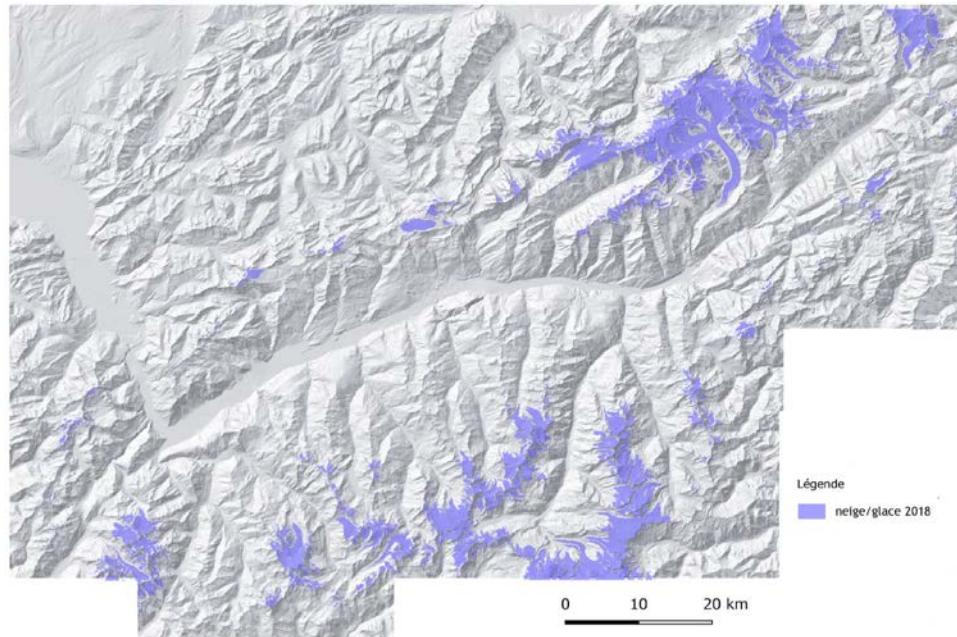
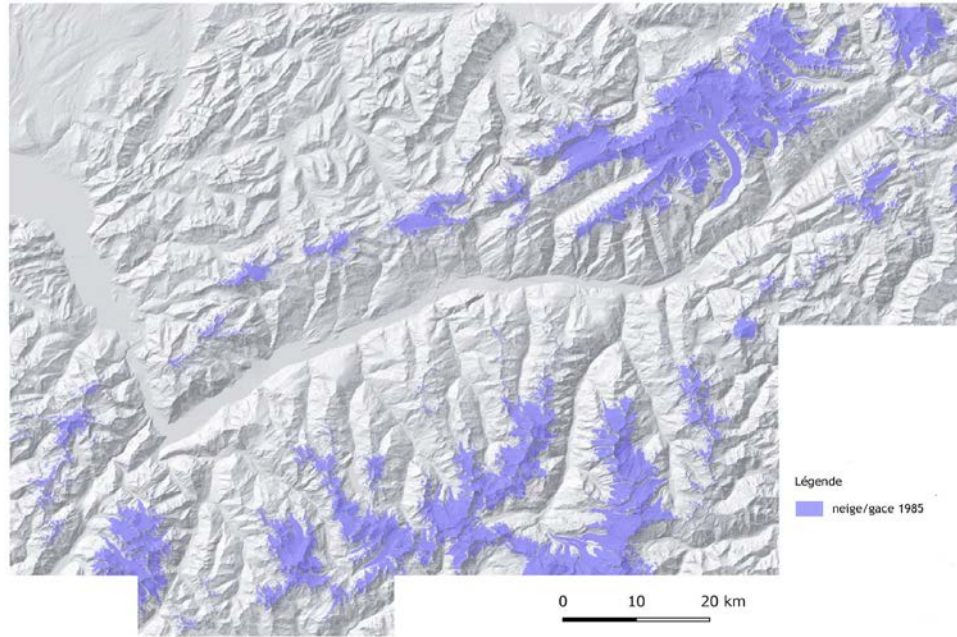


# Identifying areas of archaeological potential in the Alps



Cornut C., Ozainne S., Poussin C., Andenmatten R., Giuliani G., Identifying areas of archaeological potential in the Swiss Alps using satellite-derived time-series of snow cover estimates, Submitted to Remote Sensing Applications: Society and Environment

Composite RGB - Landsat 2003

46.6



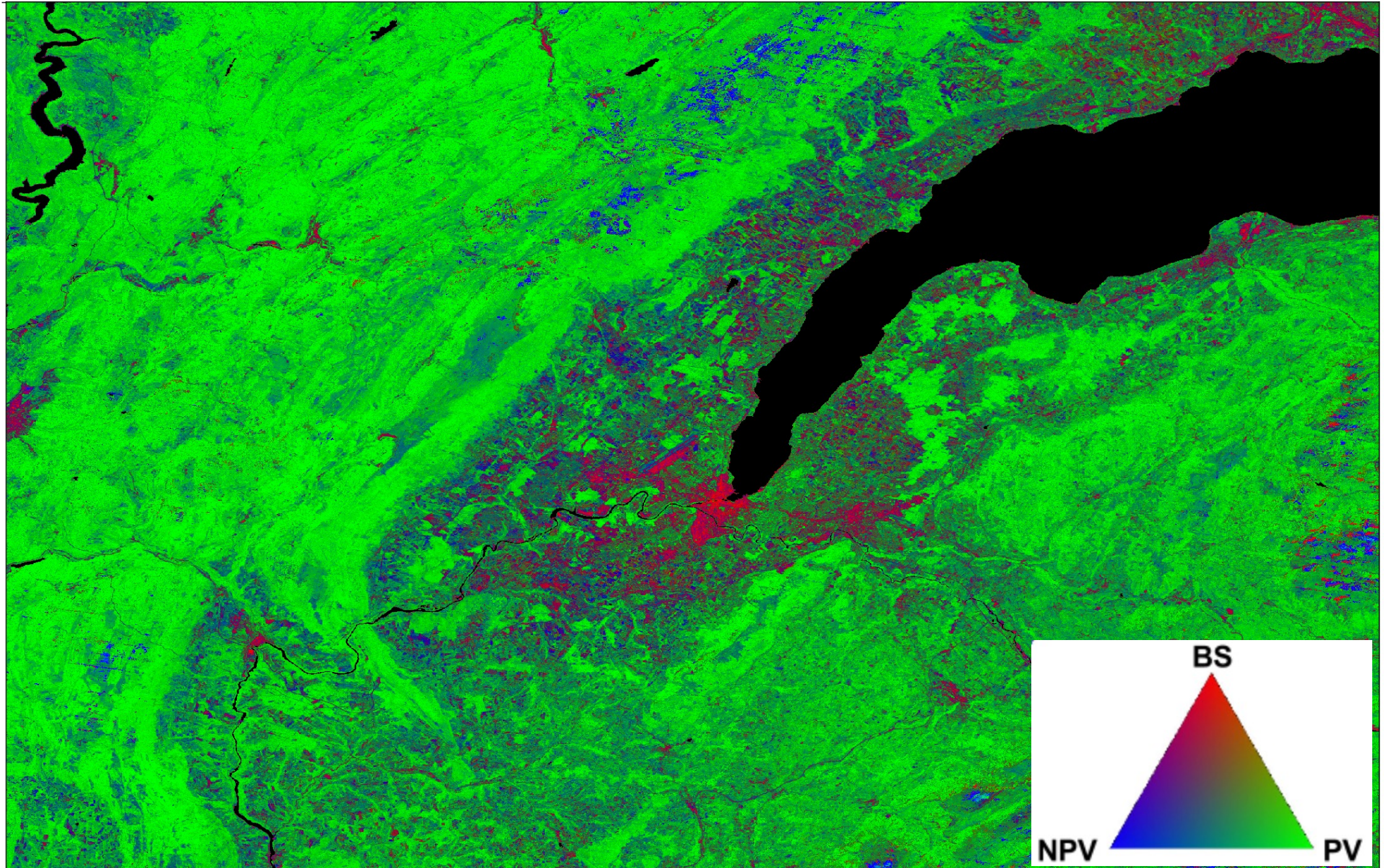
46.0

5.7

6.6

# Fractional cover - Landsat 2003

46.6



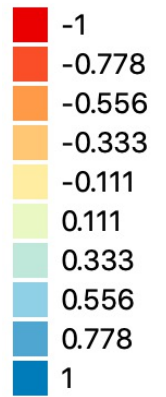
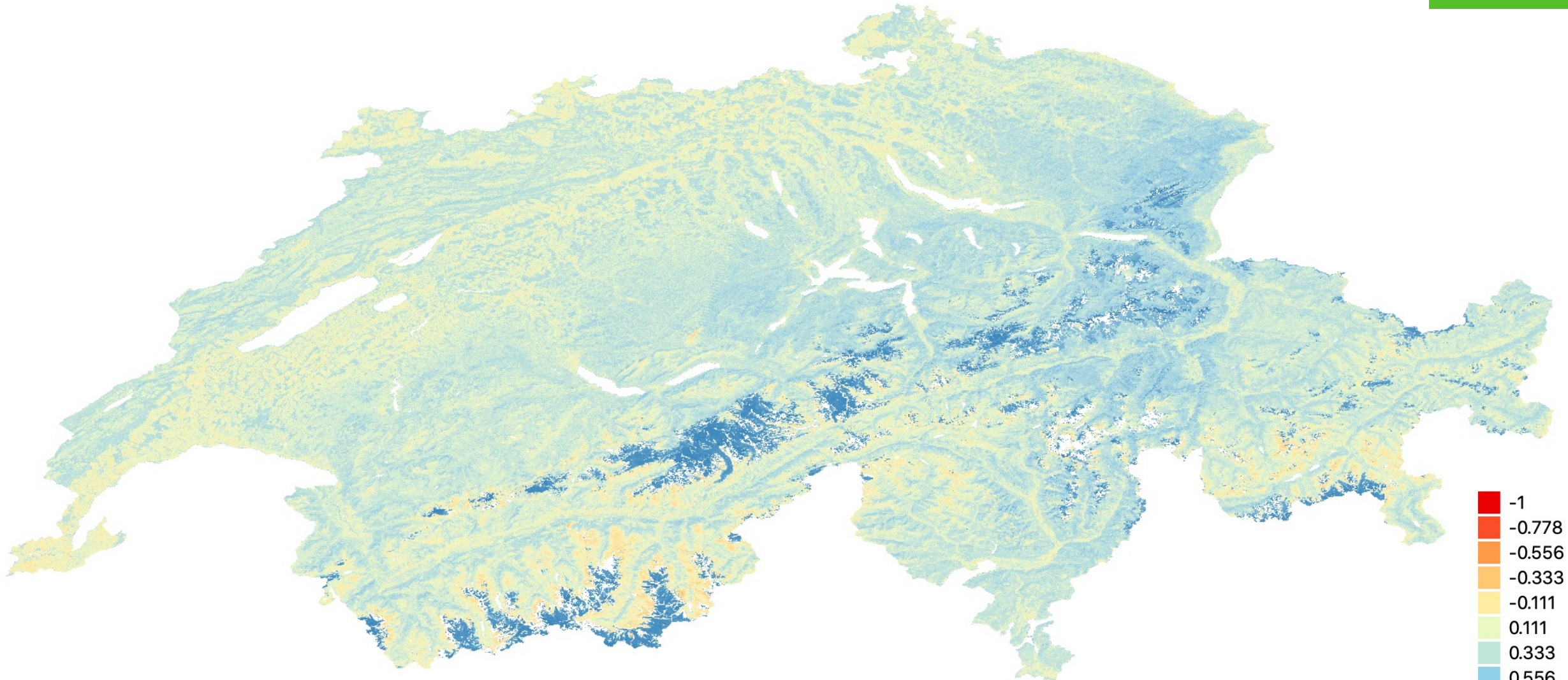
46.0

5.7

6.6

# Normalized Difference Water Index (NDWI)...

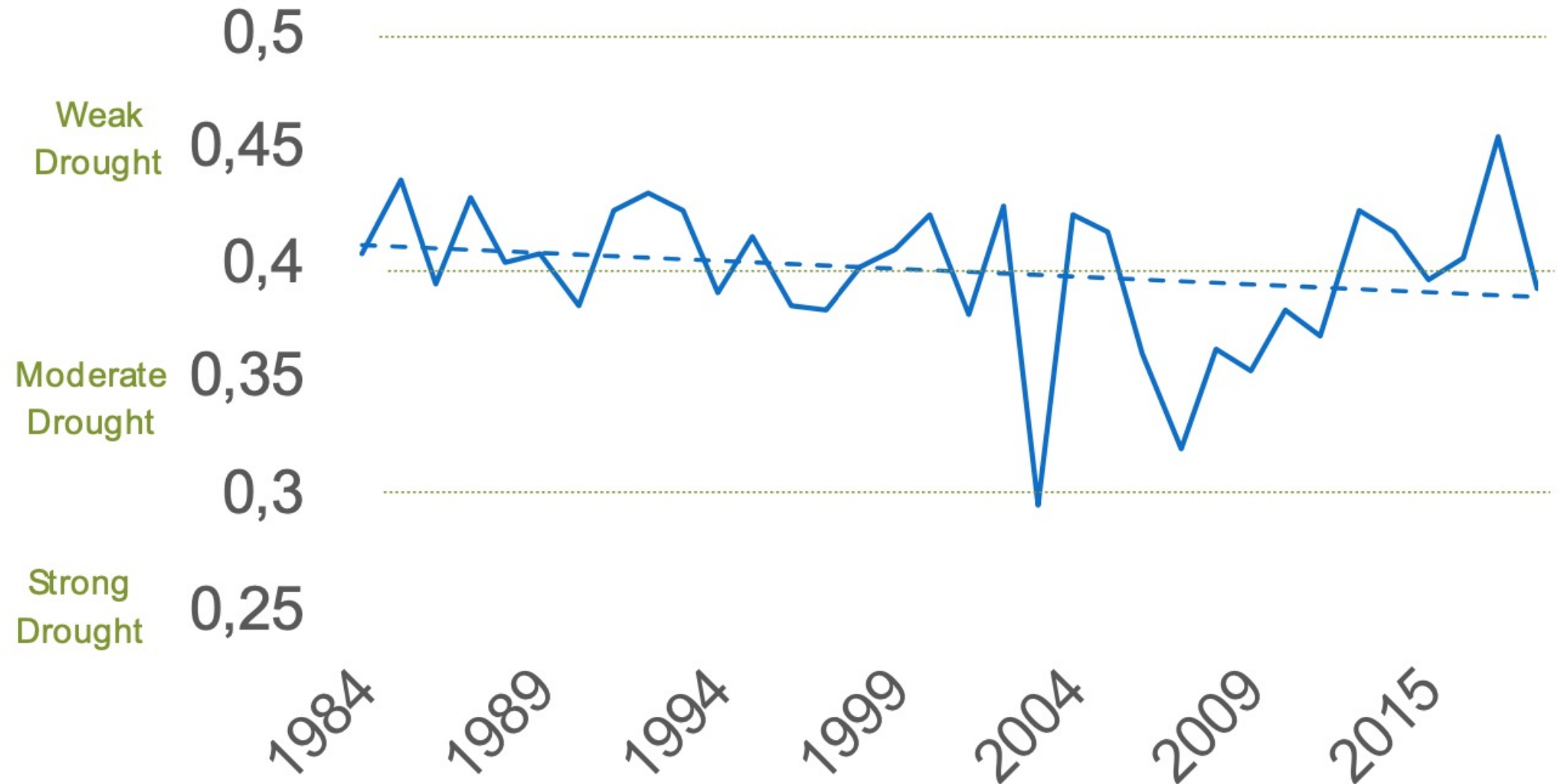
Water content of vegetation (2014 vs. 2003)



Giuliani G., Egger E., Italiano J., Poussin C., Richard J.-P., Chatenoux B. (2020) Essential Variables for environmental monitoring: What are the possible contributions of Earth Observation Data Cubes, Data 5:100 <https://www.mdpi.com/2306-5729/5/4/100>

# Trends in vegetation water content

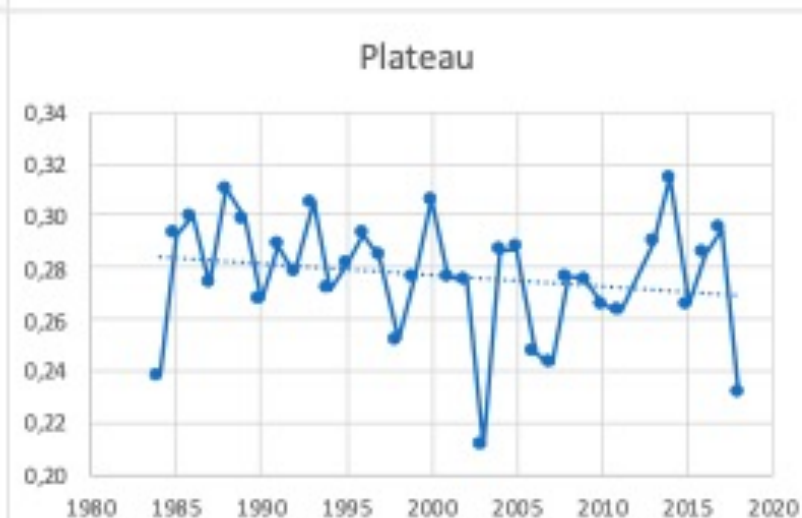
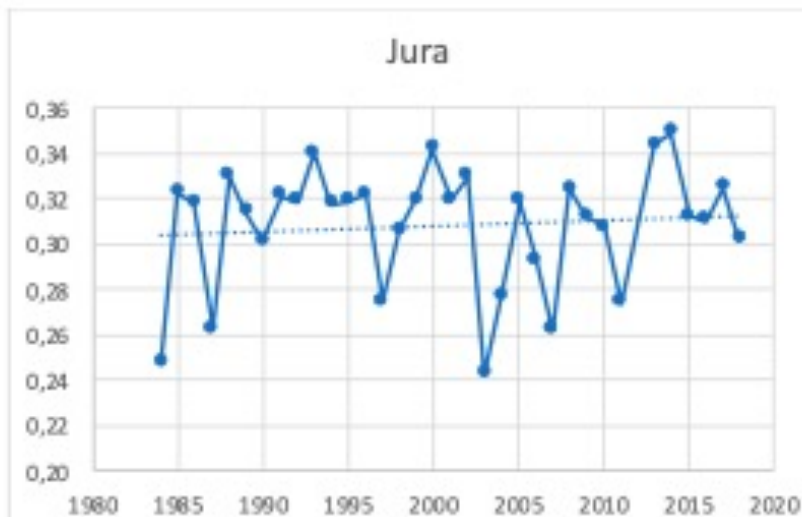
NDWI time-series from 35 years of Landsat observations – Annual mean



Poussin C., Massot A., Ginzler C., Weber D., Chatenoux B., Lacroix P., Piller T., Nguyen L., Giuliani G., Drying conditions in Switzerland - Indication from a 35-year Landsat trend analysis of vegetation water content estimates to support SDG15, Submitted to **Big Earth Data**

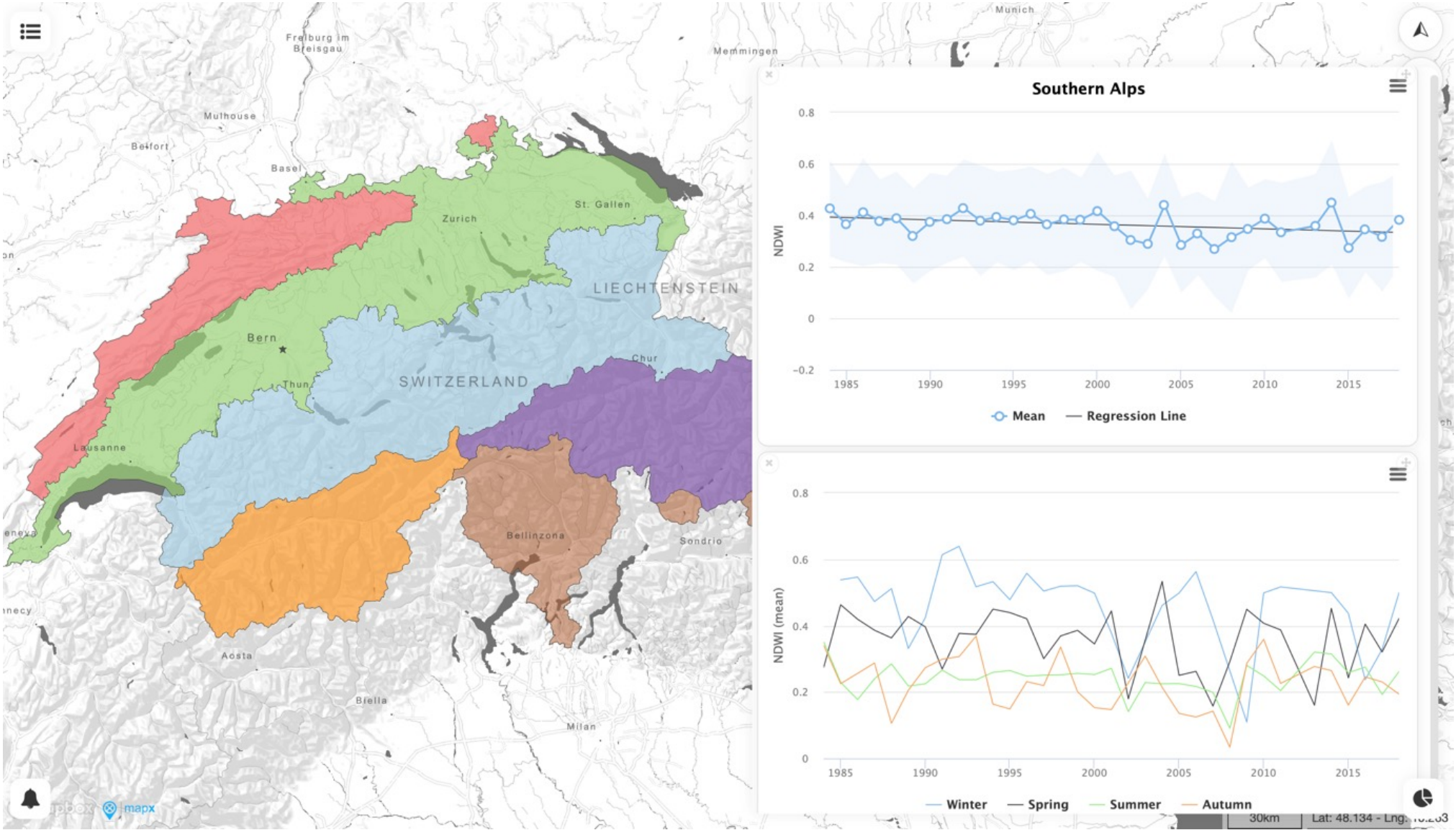
# Trends in vegetation water content

Statistics by biogeographical zones – mean summer season



# Soon...

## A dedicated service/dashboard to follow trends by regions & cantons





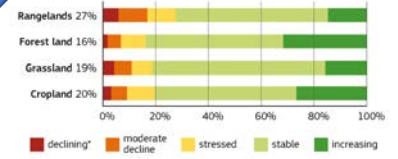
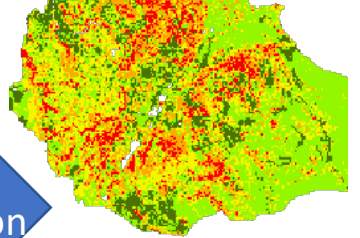
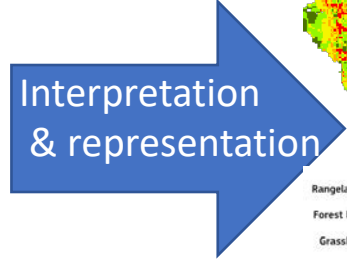
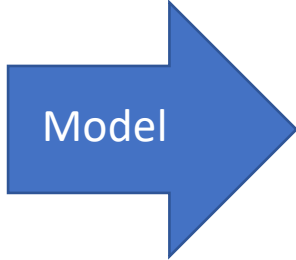
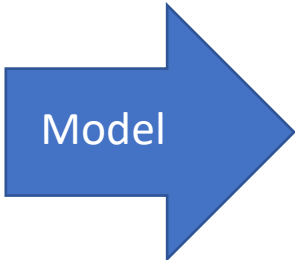
# SDG 15.3.1 Land Degradation...

...is undermining the well-being of 3.2 billion people (IPBES)

**DATA**

**INFORMATION**

**KNOWLEDGE**



- EO Data**
- MODIS/AVRRR
  - ESA CCI Land Cover
  - SoilGrids

- Sub-indicators**
- Land Productivity Dynamics
  - Land Cover Change
  - Soil Organic Carbon Stocks

**SDG15.3.1**

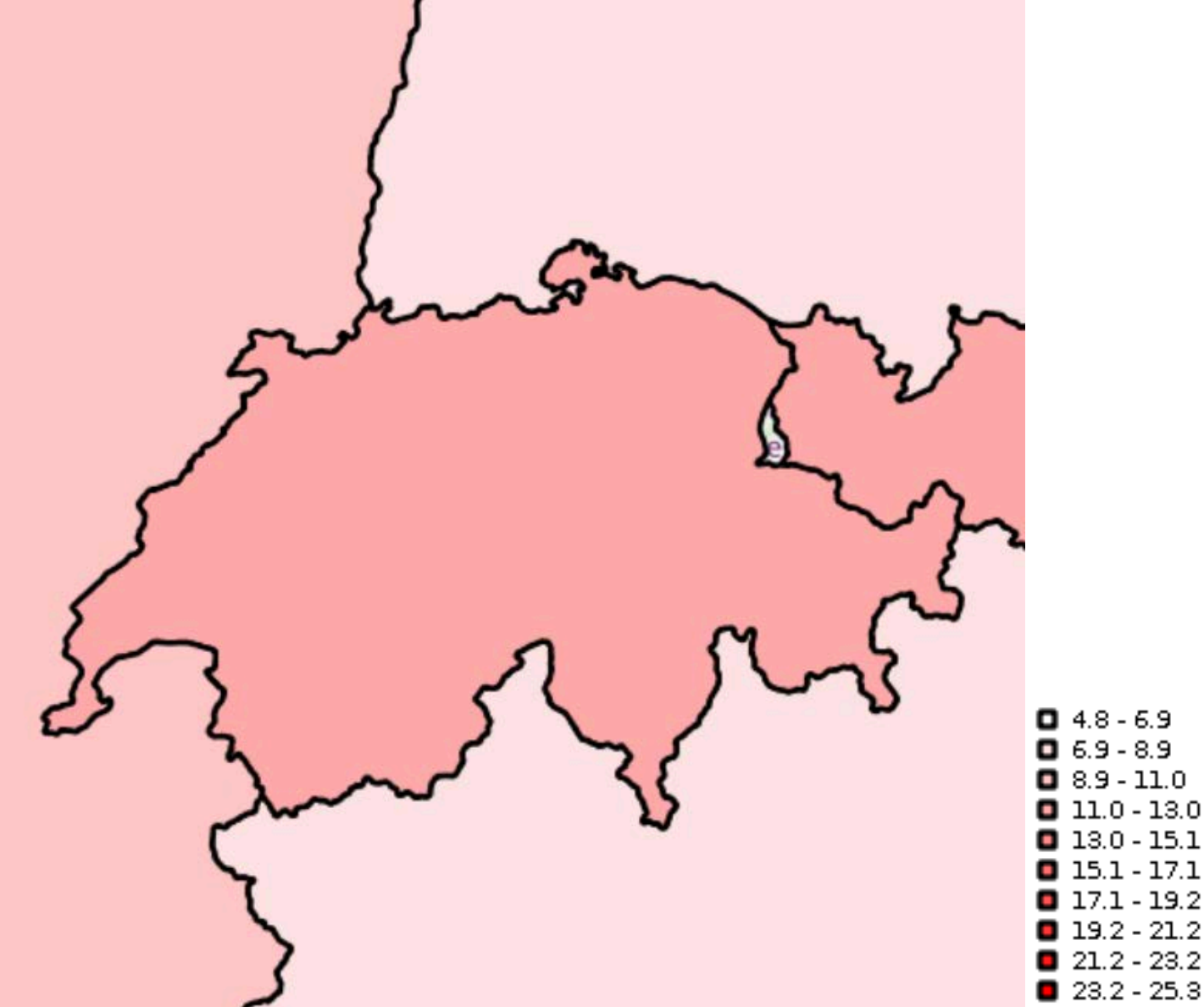
Proportion of land that is degraded over total land area

Giuliani G., Mazzetti P., Santoro M., Nativi S., Van Bemmelen J., Colangeli G., Lehmann A. (2020) Knowledge generation using satellite Earth Observations to support Sustainable Development Goals (SDG): a use case on Land Degradation, International Journal of Applied Earth Observation and Geoinformation 88:102068 <https://doi.org/10.1016/j.jag.2020.102068>



# Aggregated indicators...

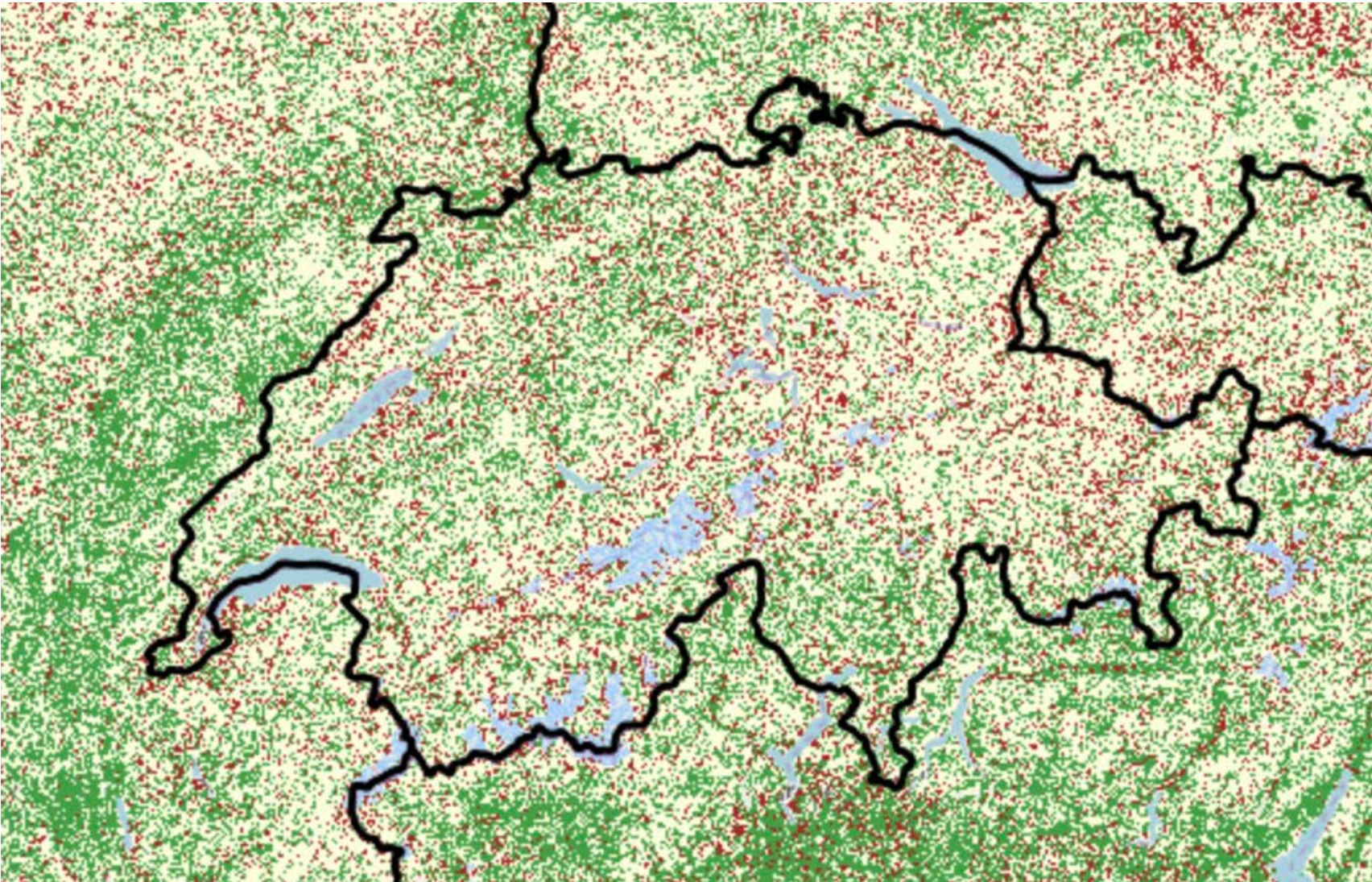
... are not enough for public policy!



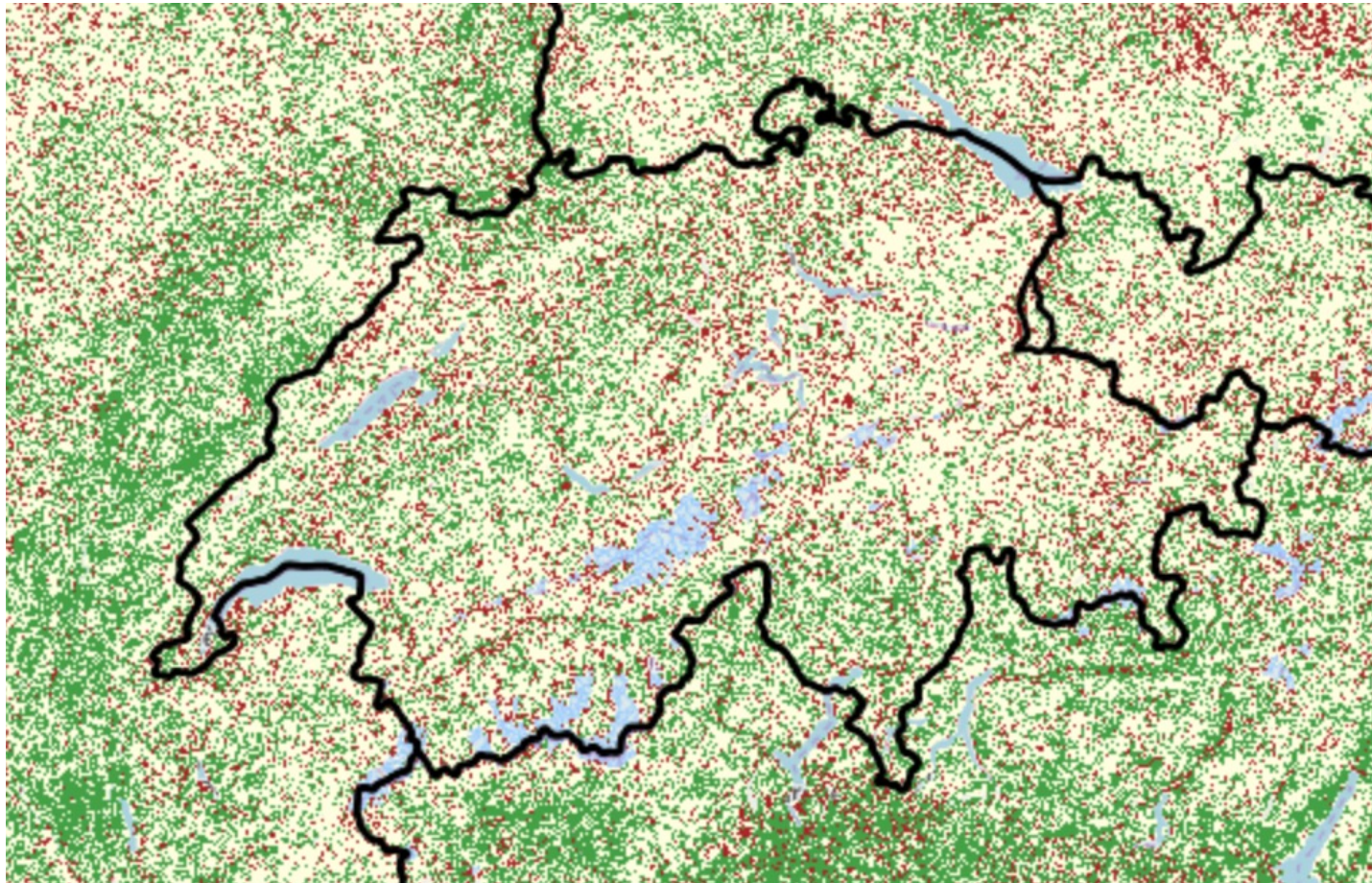
# Disaggregation of indicators...

... to capture spatial (maps) and temporal dynamics (graphs)

How much? Where? When? Who?



# SDG15.3.1 – Results from Switzerland



**Official value: 4.7%**

**SDC value: 9.7%**

Official definition in Switzerland is based only on soil sealing and do not consider land productivity!

**Do not comply with the official UN definition!**

*Giuliani G., Chatenoux B., Benvenuti A., Lacroix P., Santoro M., Mazzetti P., Monitoring Land Degradation at national level using satellite EO time-series data to support SDG15 – Exploring the potentiation of Data Cube, Big Earth Data, <https://doi.org/10.1080/20964471.2020.1711633>*

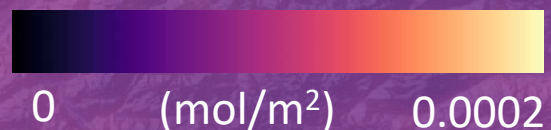
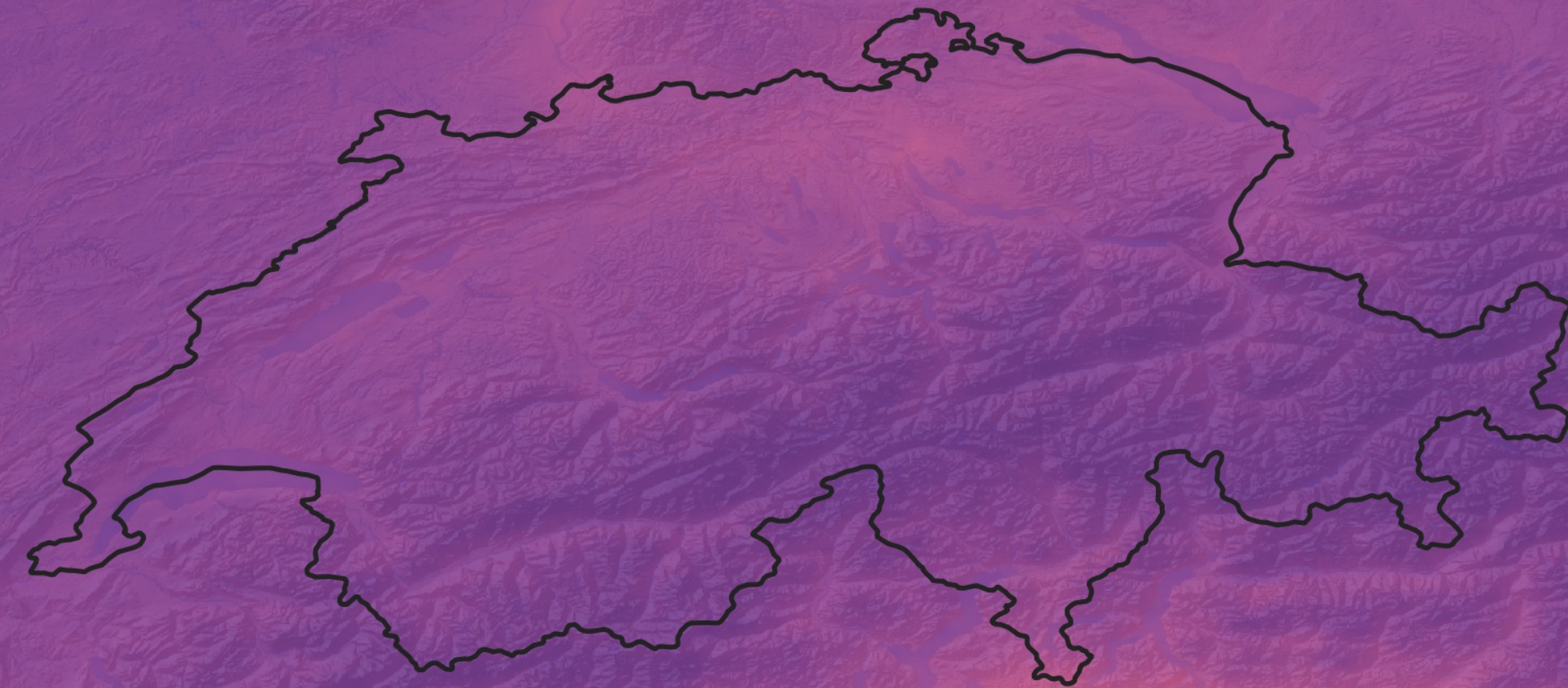
# Potential (other) applications

- Monitoring land cover change
- Glacier monitoring, ice extent mapping, snow cover monitoring
- Agricultural applications: crop monitoring, food security
- Vegetation and forest monitoring, parameter generation (chlorophyll concentration, carbon mass estimations)
- Water quality monitoring
- Flood mapping and management
- Urban mapping & monitoring



# Sentinel 5P - Air Pollution Monitoring (NO<sub>2</sub>)

Apr. 2020



# Interoperability challenges

Open Access

Feature Paper

Article



*data*

## Paving the Way to Increased Interoperability of Earth Observations Data Cubes

by Gregory Giuliani <sup>1,2,\*</sup> , Joan Masó <sup>3</sup> , Paolo Mazzetti <sup>4</sup>, Stefano Nativi <sup>5</sup> and Alaitz Zabala <sup>6</sup> 

<sup>1</sup> Institute for Environmental Sciences, University of Geneva, enviroSPACE, Bd Carl-Vogt 66, CH-1205 Geneva, Switzerland

<sup>2</sup> Institute for Environmental Sciences, University of Geneva, GRID-Geneva, Bd Carl-Vogt 66, CH-1211 Geneva, Switzerland

<sup>3</sup> Center for Ecological Research and Forestry Applications (CREAF), Universitat Autònoma de Barcelona (UAB), 08193 Bellaterra, Barcelona, Spain

<sup>4</sup> National Research Council of Italy (CNR)—Institute of Atmospheric Pollution Research, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy

<sup>5</sup> European Commission Joint Research Center (JRC), Via E. Fermi, 2749, 21027 Ispra, Italy

<sup>6</sup> Geography Department, Universitat Autònoma de Barcelona (UAB), 08193 Bellaterra, Barcelona, Spain

\* Author to whom correspondence should be addressed.

*Data* **2019**, *4*(3), 113; <https://doi.org/10.3390/data4030113>

**Received: 14 June 2019 / Revised: 26 July 2019 / Accepted: 27 July 2019 / Published: 30 July 2019**

(This article belongs to the Special Issue [Earth Observation Data Cubes](#))

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[Browse Figures](#)

### Abstract

Earth observations data cubes (EODCs) are a paradigm transforming the way users interact with large spatio-temporal Earth observation (EO) data. It enhances connections between data, applications and users facilitating management, access and use of analysis ready data (ARD). The ambition is allowing users to harness big EO data at a minimum cost and effort. This significant interest is illustrated by various implementations that exist. The novelty of the approach results in different innovative solutions and the lack of commonly agreed definition of EODC. Consequently, their interoperability has been recognized as a major challenge for the global change and Earth system science domains. The objective of this paper is preventing EODC from becoming silos of information; to present how interoperability can be enabled using widely-adopted geospatial standards; and to contribute to the debate of enhanced interoperability of EODC. We demonstrate how standards can be used, profiled and enriched to pave the way to increased interoperability of EODC and can help delivering and leveraging the power of EO data building, efficient discovery, access and processing services. [View Full-Text](#)

**Keywords:** Open Data Cube; remote sensing; geospatial standards; landsat; sentinel; analysis ready data

*Giuliani G., Maso J., Mazzetti P., Nativi S., Zabala A. (2019) Paving the way to increased interoperability of Earth Observations Data Cube. Data 4(3):113*

Part of the Special Issue “Earth Observation Data Cubes”:  
[https://www.mdpi.com/journal/data/special\\_issues/EODC](https://www.mdpi.com/journal/data/special_issues/EODC)

# Implemented standards in the Swiss Data Cube

- **Upstream services**
  - *Discovery*: ISO19115-2 and ISO19139-2; OGC CSW, STAC (under evaluation)
  - *View & Download*: OGC WMS & WCS
  - *Processing*: Python API; OGC WPS (under test)
- **Downstream services**
  - *Discovery*: CSW; OpenSearch; OAI
  - *View*: WMS with EO extension, WMTS, TMS, WMS-C, ncWMS
  - *Download*: WCS with EO extension



# The SDC supports the « Digital Switzerland » strategy

The screenshot shows the top navigation bar of the OFCOM website. It includes the logo of the Swiss Confederation and the text 'Schweizerische Eidgenossenschaft', 'Confédération suisse', 'Confederazione Svizzera', and 'Confederaziun svizra'. The main title is 'Federal Office of Communications OFCOM'. There is a search bar and a 'Glossary' dropdown menu. Below the header is a horizontal navigation menu with categories: 'Digital Switzerland and internet', 'Telecommunication', 'Electronic media', 'Frequencies and antennas', 'Equipments and installations', and 'OFCOM'.

Homepage > Digital Switzerland and internet > "Digital Switzerland" Strategy > Strategy

< Digital Switzerland and internet

## Strategy

### "Digital Switzerland" Strategy

#### Strategy

#### Implementation

#### Coordination Group

#### Dialogue on "Digital Switzerland"

#### Trends and developments

At the heart of the strategy is the consistent utilisation of the opportunities of digitisation so that Switzerland can position itself as an attractive place to live and as an innovative, future-oriented location for business and research. This strategy supersedes the Federal Council's Strategy for an Information Society in Switzerland of 9 March 2012.

The Confederation's digital policy places people at the heart of a prosperous, democratic information and knowledge society in Switzerland. Based on the Federal Constitution it increases common welfare, quality of life and sustainable development. It promotes cohesion between the regions and cultural diversity, and also strives to achieve national and international security and stability in the digital world. Switzerland actively promotes equal opportunities in the digital sphere at both national and international levels.

### "Digital Switzerland" Strategy

#### Principles

- > To support digital development
- > To actively address structural change
- > To create networked transformation processes

#### Key objectives

The Federal Council's "Digital Switzerland" Strategy shall pursue the following key objectives:

- > Innovation, growth and prosperity in the digital world
- > Equal opportunities and the participation of all
- > Transparency and security
- > Contribution to sustainable development

#### Action areas and goals

- > The digital economy
- > Data and digital content
- > Infrastructure and environment
- > e-Government and e-Health
- > New forms of political participation
- > Development of the knowledge-based society
- > Security and trust
- > Switzerland's international position

- Support innovation and growth in the digital economy
- Improve efficiency and effectiveness of government investments
- Improve management of natural resources
- Stimulate research
- Effective monitoring mechanism
- Generate information products
- Improve data access and use & enable new products/services that can transform everyday life



The SDC  
supports the  
UNIGE  
Digital  
strategy



UNIVERSITÉ  
DE GENÈVE

UNIVERSITY FACULTIES STUDENTS SERVICES

DIGITAL  
UNIVERSITY

Digital Strategy Skills Services Society Research Innovation Governance News



## FOREWORD

## VISION

## THEMES AND OBJECTIVES

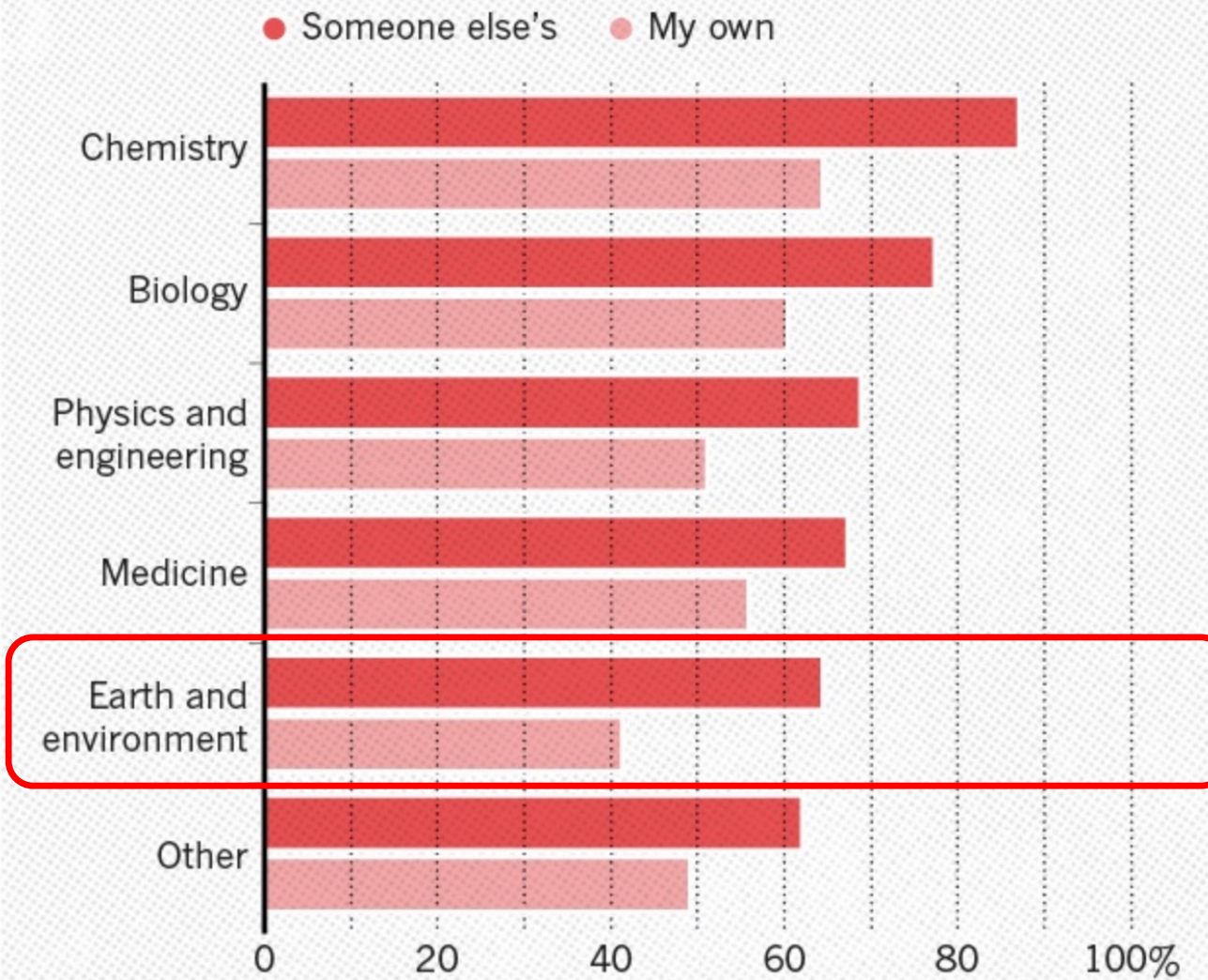
1. Digital technology for teaching and research
2. Digital solutions for open, connected science
3. Digital expertise in the service of society
4. Digital tools for the University community
5. Governance for the digital transformation of the University

## DOWNLOAD THE DOCUMENTS

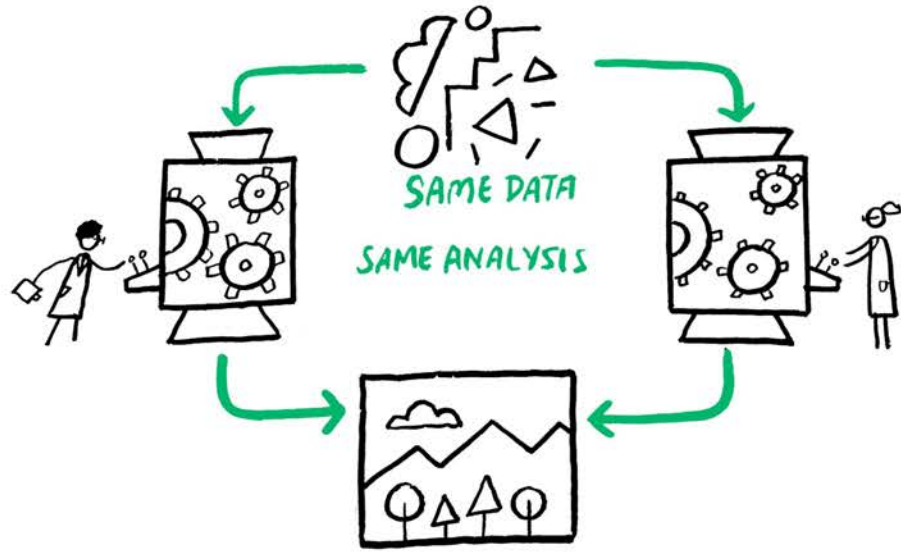
- Digital Strategy (.pdf)
- Digital Strategy Action Plan (.pdf)

# HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?

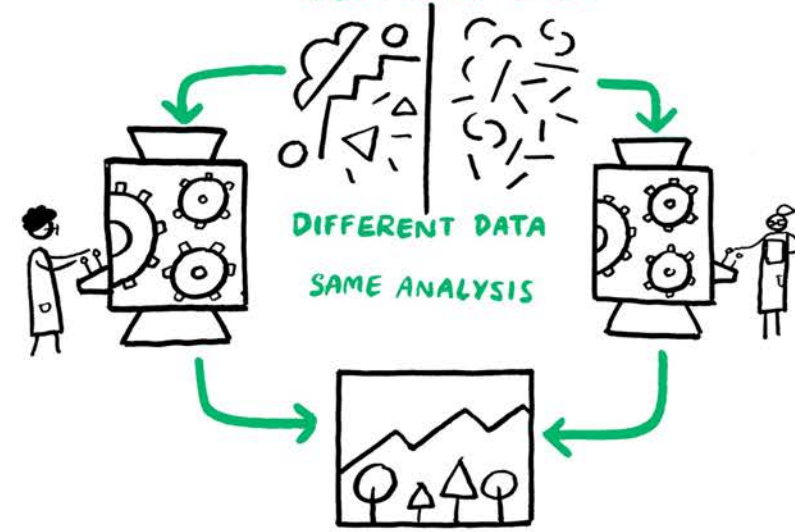
Most scientists have experienced failure to reproduce results.



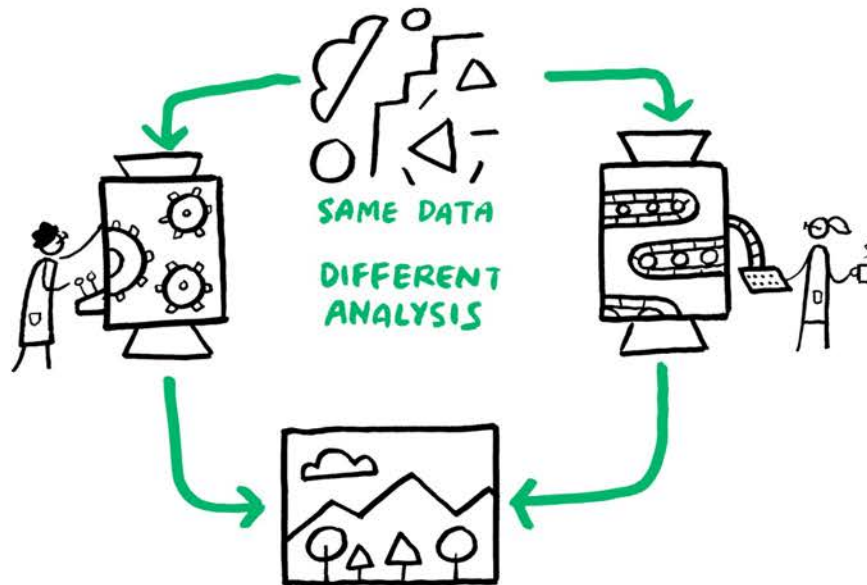
## REPRODUCIBLE



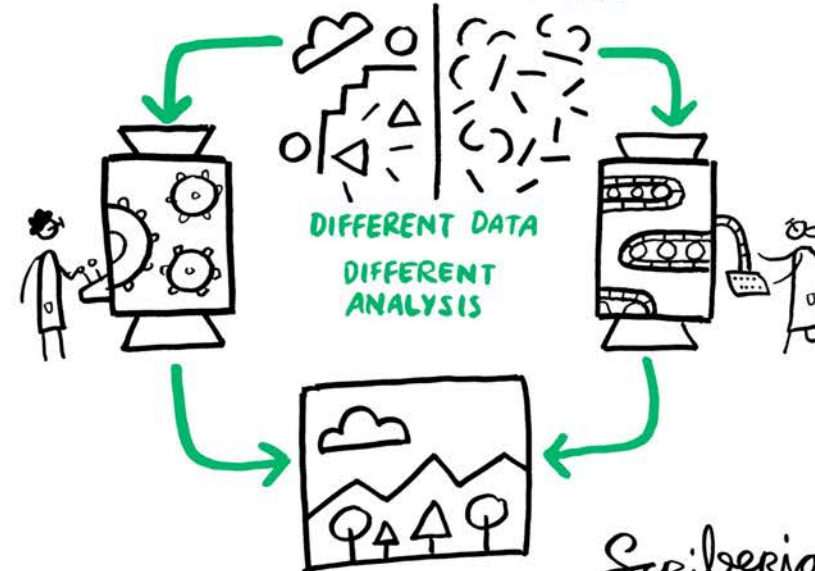
## REPLICABLE



## ROBUST



## GENERALISABLE





**FAIR**  
COOKBOOK  
**DATA**  
Recipes

- ▶ GIVE PEOPLE THE TOOLS TO MAKE **CLEAN DATA**
- ▶ **CLEAN DATA IS MORE REUSABLE AND INTEGRATABLE**
- ▶ DATA FROM **VARIOUS PIPELINES** TO BE USED ACROSS **DIFFERENT SYSTEMS**

# Achieving reproducible knowledge... ...exposing all parts of an application

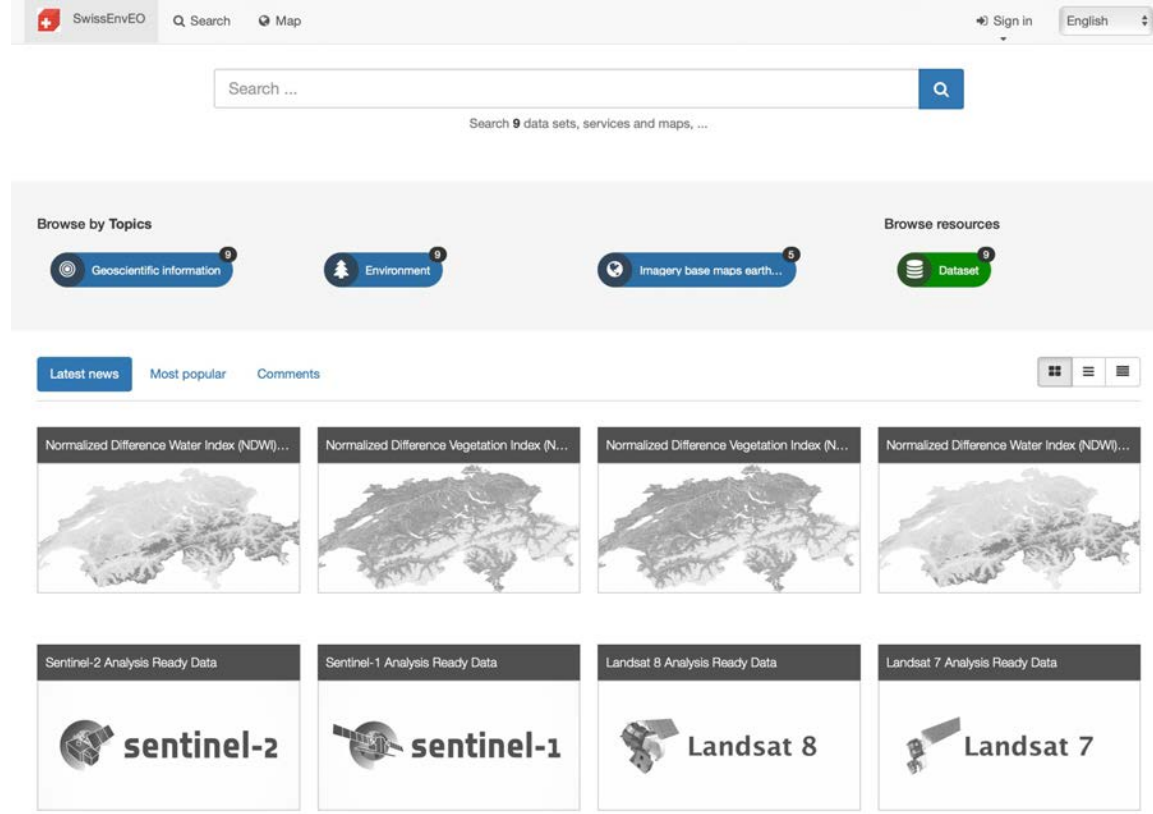
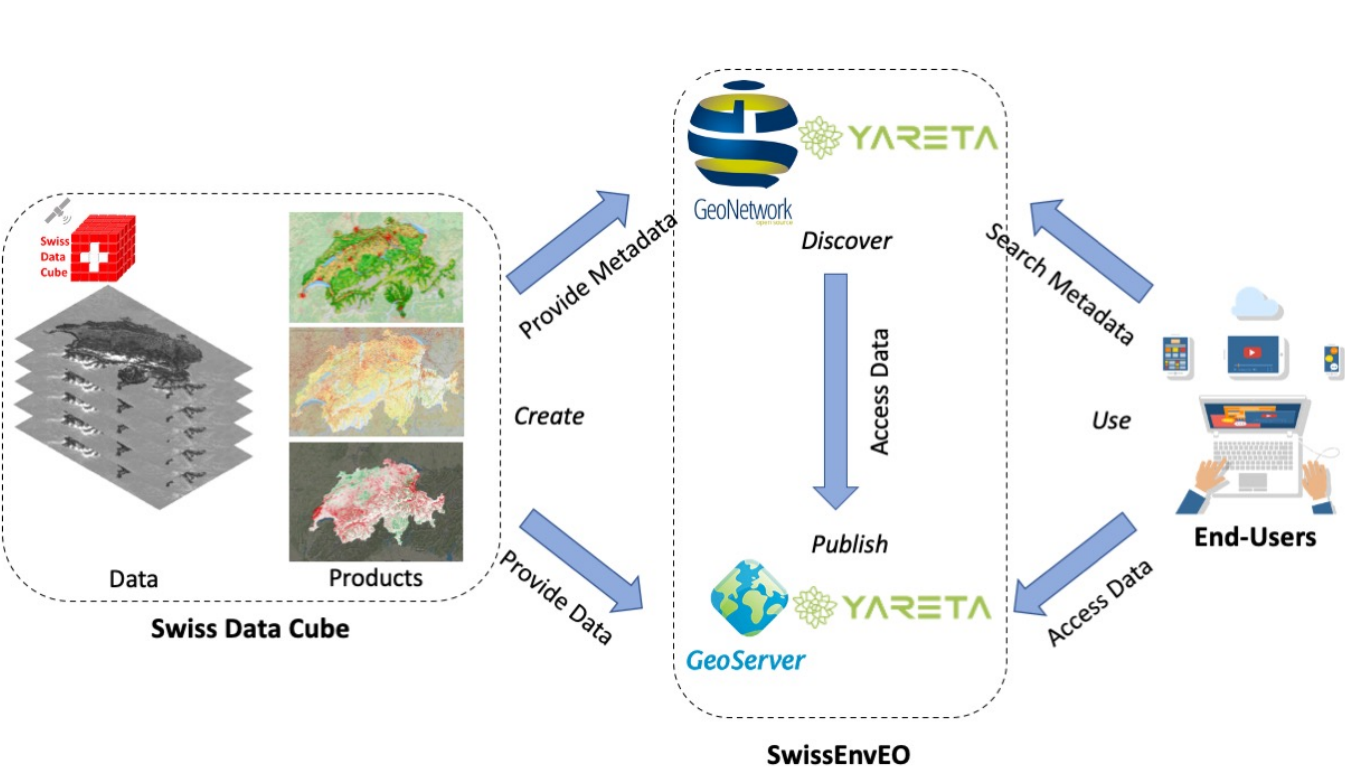


**Good application:**  
Good in-situ, satellite data & models > produce new knowledge

**Trust is the key (data):**  
For decision makers

# SwissEnvEO: a FAIR national EO environmental database

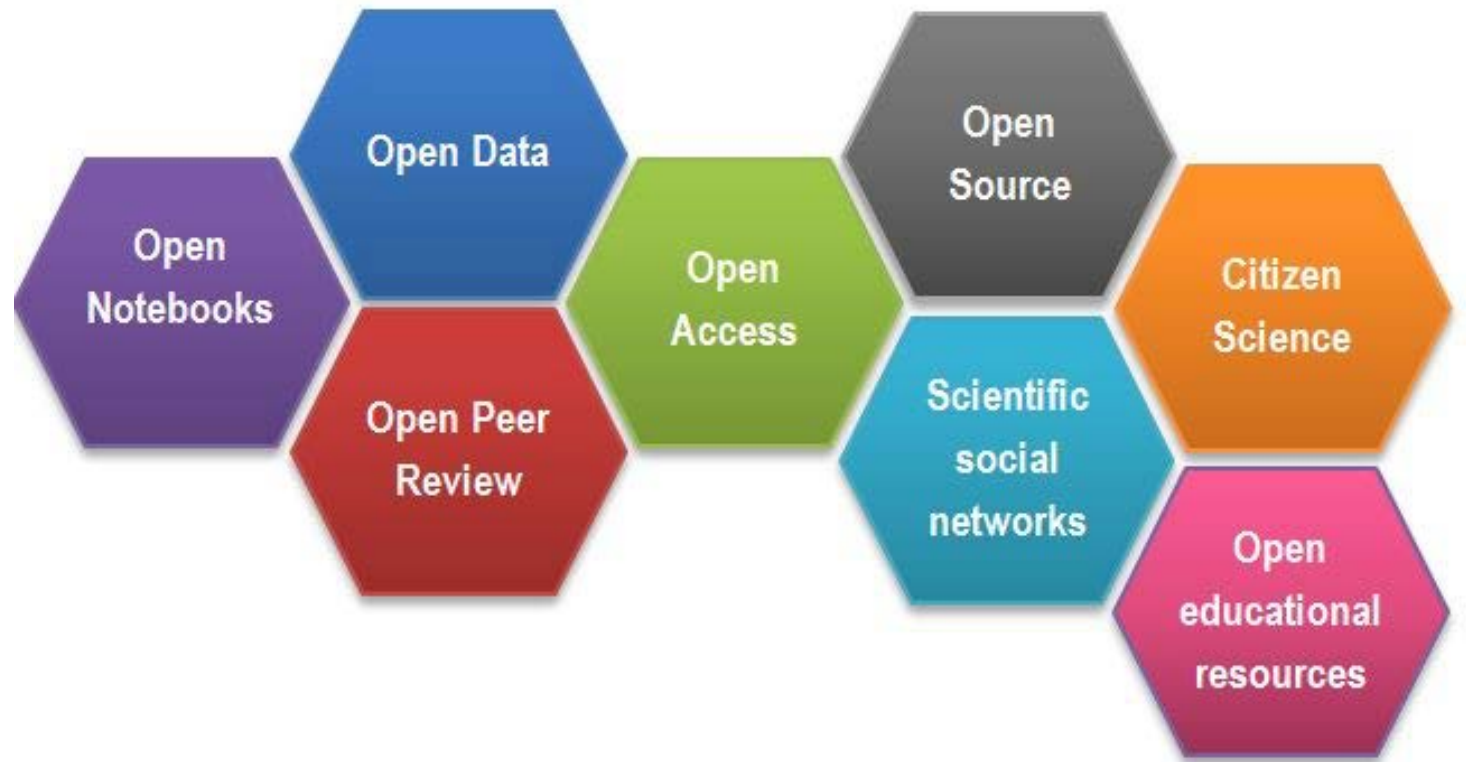
<http://geonetwork.swissdatacube.org>



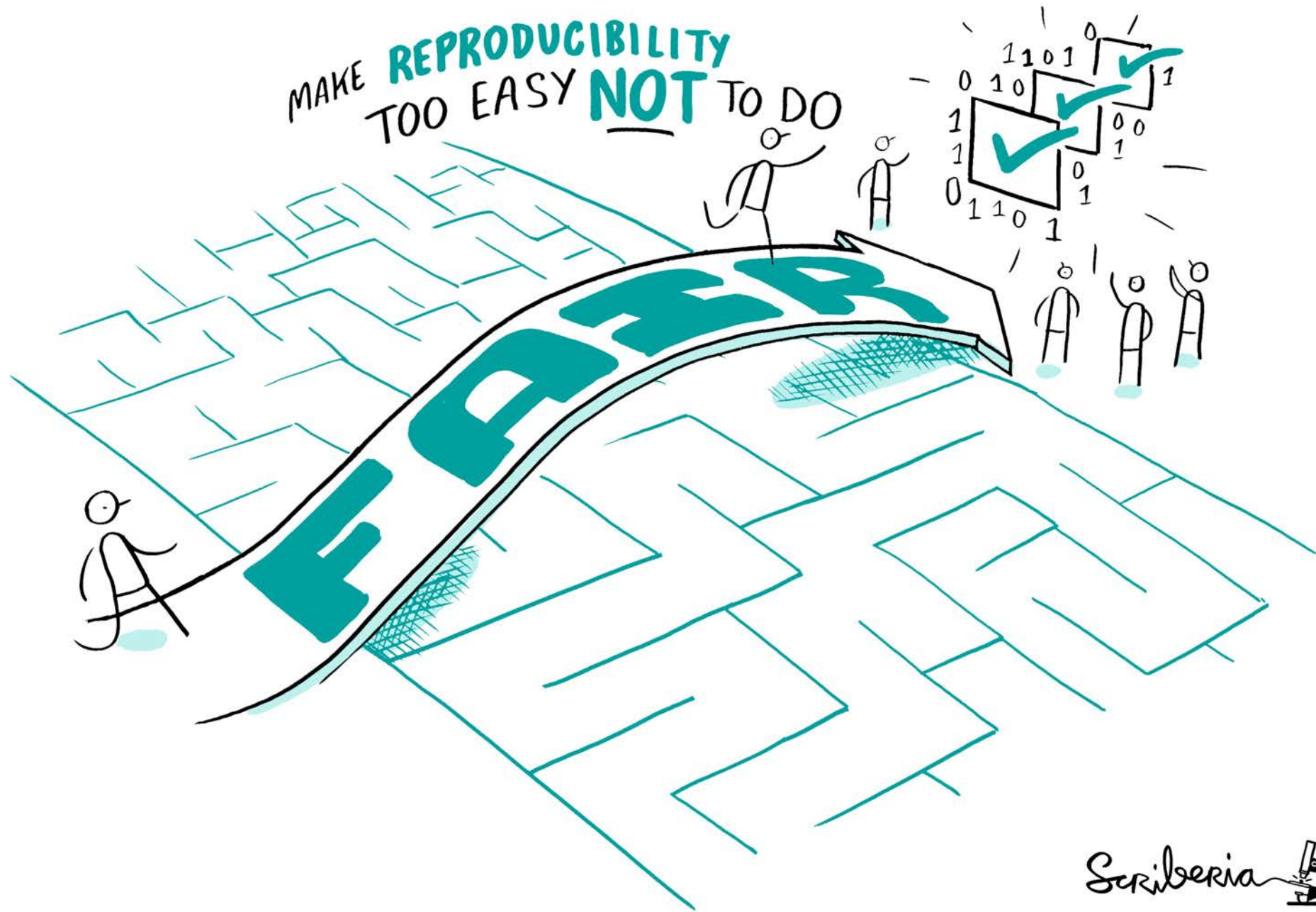
Giuliani G., Cazeaux H., Burgi P.-Y., Poussin C., Richard J.-P., Chatenoux B. (2021) SwissEnvEO: a FAIR national environmental data repository for Earth Observation Open Science, CODATA Data Science Journal 20(1):2 <http://doi.org/10.5334/dsj-2021-022>

## SDC Open & Reproducible EO Science

- **Open Data:** Landsat 5,7, 8 ARD; Sentinel 1-2 ARD + All scientific/decision-ready products are freely, openly available & FAIR compliant
- **Open Notebooks:** All algorithms are documented and openly available
- **Open Access:** All publications
- **Open Source:** All applications
- **Open Educational Resources:** Bringing ODC into practice



MAKE **REPRODUCIBILITY**  
TOO EASY **NOT** TO DO







TIME FOR A  
**CULTURAL**

**SHIFT**

WE SHOULD VALUE  
REPRODUCIBILITY  
AS MUCH AS # OF  
PAPERS PUBLISHED

# The Vision...

## ... being a National Infrastructure in the next 3-5 years

The Swiss Data Cube (SDC) will **deliver a unique capability to track changes across Switzerland** to process, interrogate, and present Earth observation satellite data in response to environmental issues of Switzerland.

This near real-time information can be **readily used as an evidence** base for the design, implementation, and evaluation of national policies.



# Towards Digital Earth Switzerland...

## ...a comprehensive digital replicate/twin for analysis of nature's system and enabling reliable monitoring and prediction of the changing environment

2021 | Report

### Geosciences Roadmap

for Research Infrastructures 2025–2028 by the Swiss Geosciences Community

This community roadmap presents an integrative approach including the most urgent infrastructure requests for the future development of geosciences in Switzerland. It recommends to strengthen the multidisciplinary nature of the geosciences by putting all activities under the roof of the Integrated Swiss Geosciences supported by four specific research infrastructure pillars.



Image: SCNAT

Pages: 60

Standard identifier: DOI: doi.org/10.5281/zenodo.4588881

The roadmap represents the view of the Swiss scientific community in the field of geosciences and is a formal element of the process to elaborate the Swiss Roadmap for Research Infrastructures 2023. This bottom-up contribution to the identification and selection of important national and international research infrastructures has been coordinated by the Swiss Academy of Sciences (SCNAT) on a mandate by the State Secretariat for Education, Research and Innovation (SERI).

Edition / Volume: Swiss Academies Reports 16 (4)

Publisher  
Platform Geosciences

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Languages ×

English

Schweizerische Eidgenossenschaft  
Confédération suisse  
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Confederaziun svizra

State Secretariat for Education, Research and Innovation SERI

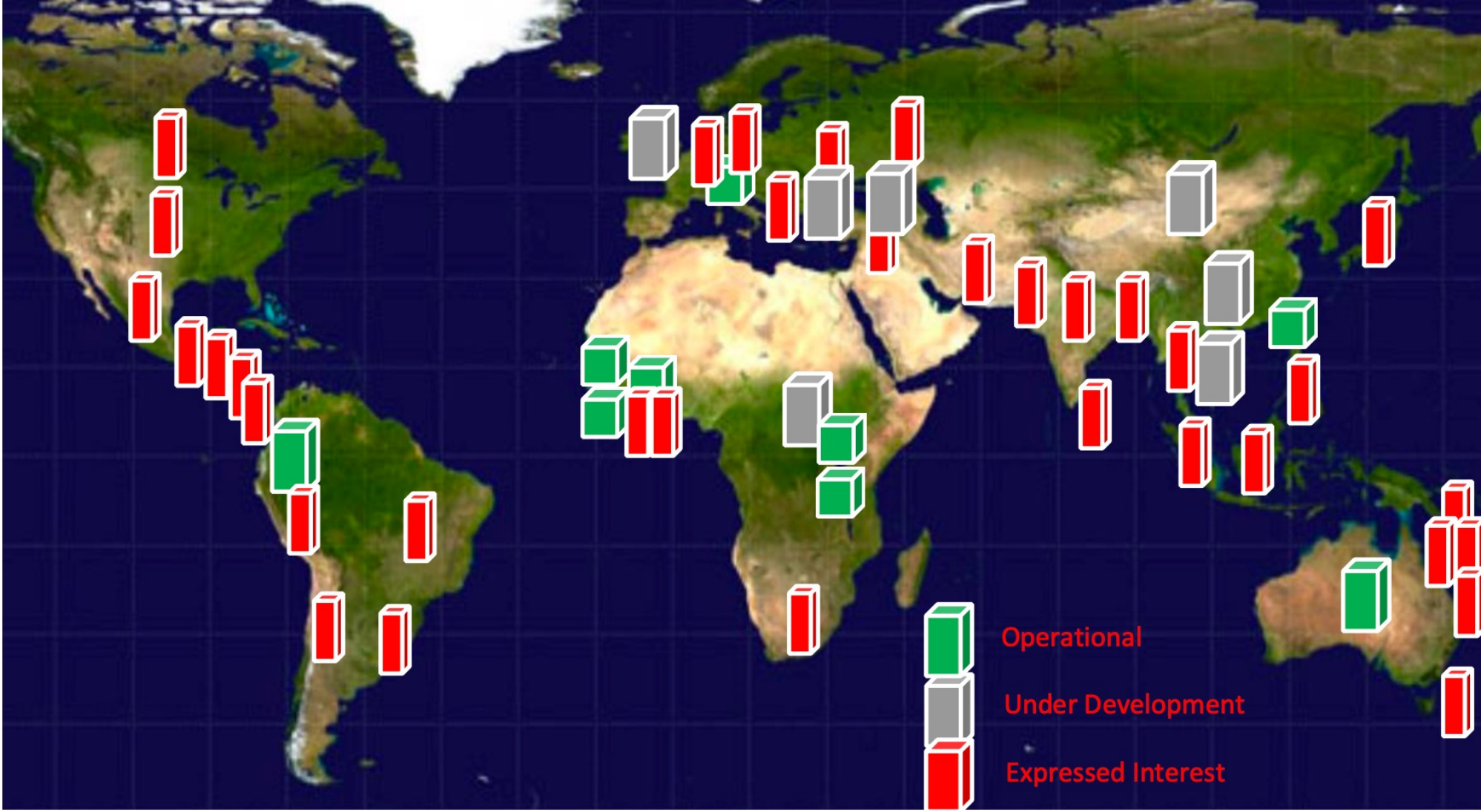
# swissuniversities



## SWISS NATIONAL SCIENCE FOUNDATION

# Global Impact

More than 50 countries are interested with 9 in operation and 7 coming soon!



EO Data Cubes have the potential...

... to enhance scientific  
accountability and credibility

Without trust and shared knowledge:

- Doing science can be difficult
- Taking sound decisions can be problematic
- And envisioning a sustainable development can be complicated

## Amazon deforestation: Brazil's Bolsonaro dismisses data as 'lies'

🕒 20 July 2019

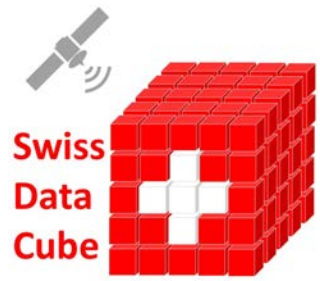
f 📧 🐦 ✉️ Share



Amazon has suffered losses at an accelerated rate since Mr Bolsonaro took office

Bolsonaro has accused his own country's national  
at the scale of deforestation in the Amazon.

Brazil's reputation abroad by publishing data  
on there.



# Follow us

<http://www.swissdatacube.ch>

Swiss Data Cube (SDC)

EO for monitoring the environment of Switzerland in space and time

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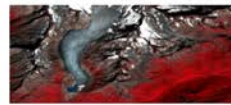
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## Latest News

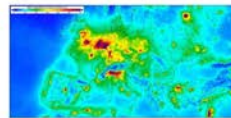


### Climate Change in the Alps – Rhône Glacier Melting

September 30, 2020

The Rhône Glacier is located in the Swiss Alps (Valais) and is known for being the source of the Rhône river, the primary tributary of Lake Léman (the largest lake in Switzerland). This glacier is a perfect example of the ongoing impacts of climate change in the Alps. Increasing temperatures are gradually melting the ice [...]

[More... »](#)



### Sentinel-5P data for studying air pollutants: soon available for Switzerland

April 8, 2020

The Swiss Data Cube team, in collaboration with the Institute of Global Health and the Institute for Environmental Sciences of the University of Geneva, has started working in ingesting Level 2 data from the Copernicus Sentinel-5P satellite (a mission dedicated to monitoring air pollution). It is a mission dedicated to monitoring air pollution. We will [...]

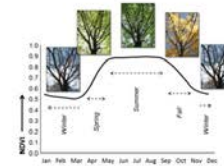


### Launch of the Atlas of Changing Switzerland

September 27, 2019

Today, for the 10th anniversary of the Institute for Environmental Sciences of the University of Geneva, we are launching an interactive atlas allowing anyone to explore different sites across Switzerland looking at how the landscape has changed over the last two-three decades. This can help visualising and understanding how environmental changes such as climate, natural [...]

[More... »](#)



### PhenoSwiss: Monitoring Land Surface Phenology over Switzerland using the Swiss Data Cube satellite Earth Observations time-series

August 16, 2019

We have received the good news that the project "PhenoSwiss: Monitoring Land Surface Phenology over Switzerland using the

We have used the [#SwissDataCube](#) to explore what are the possible contributions of [#EOC](#) to generate [#EssentialVariables](#) for [#Environmental Monitoring](#) via [#mdpidata](#) via [@MDPIOpenAccess](#) <http://doi.org/10.3390/data50..> [@UNIGenews](#) [@unige\\_ise](#) [@UZH\\_en](#) [@WSL\\_research](#) [@GRIDgva](#) [#EO4impact](#) [#EVs](#)

[🗨](#) [🔗](#) [❤️](#) 1

**UZH** University of Zurich 9 Oct



[#SwissDataCube](#) About the use of satellite remote sensing data to tackle environmental challenges. Claudia Rösli, group leader at the UZH Remote Sensing Laboratories, took part in yesterday's Conversations with Academia with [@UZH\\_Science](#) [@UZHspacehub](#) [@unige\\_en](#) [@UNOG](#) [@GRIDgva](#).

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Thank you!

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<http://www.unige.ch/envirospace/people/giuliani/>

