


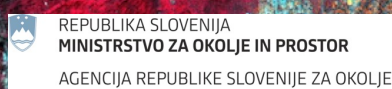


## The Alpine Drought Observatory, how to organize and share data in a cross-national mountain region following the fair data principles

Peter J. Zellner, Rufai O. Balogun, Thomas Iacopino, Luca Cattani, Mohammad H. Alasawedah, Michele Claus, Bartolomeo Ventura, Andrea Vianello, Giacomo Bertoldi, Alexander Jacob (EURAC Research)

**Interreg**   
Alpine Space  
Alpine Drought Observatory

European Regional Development Fund



BOLZANO 2-4 OCTOBER 2023





# ADO Alpine Drought Observatory

“The Alpine Drought Observatory (ADO) aims to create an online drought monitoring platform and develop policy implementation guidelines for proactive drought management in the Alpine Space region”

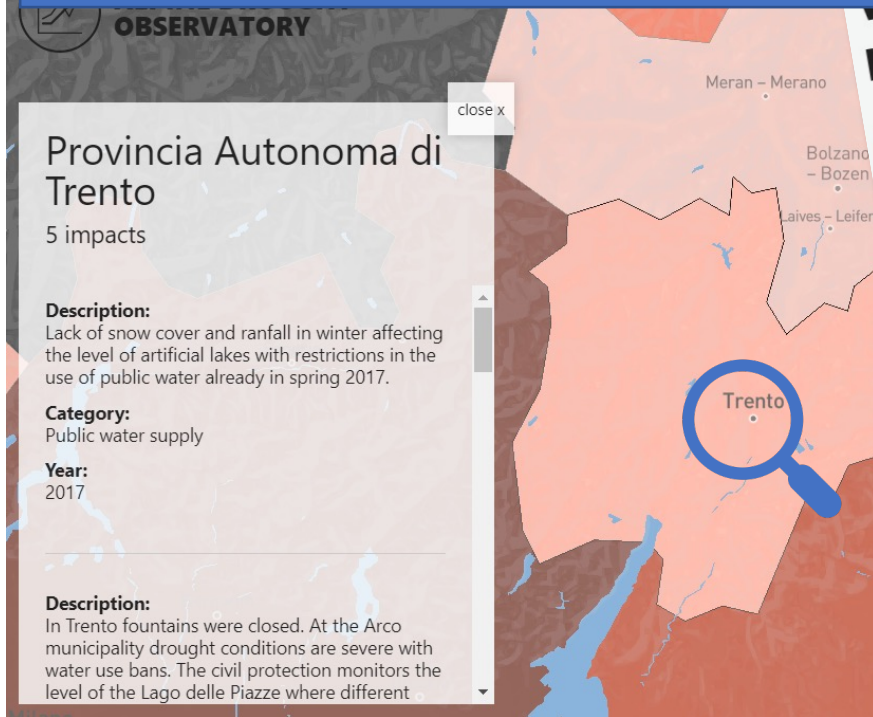
<https://www.alpine-space.org/projects/ado/en/home>





# Droughts in the Alps?

Can we detect these events using the ADO platform?



**OBSERVATORY**

close x

Provincia Autonoma di Trento

5 impacts

**Description:**  
Lack of snow cover and rainfall in winter affecting the level of artificial lakes with restrictions in the use of public water already in spring 2017.

**Category:**  
Public water supply

**Year:**  
2017

**Description:**  
In Trento fountains were closed. At the Arco municipality drought conditions are severe with water use bans. The civil protection monitors the level of the Lago delle Piazze where different

Winter 2017



nun sogar schon

Fast ganz Norditalien leidet mittlerweile stark unter der Dürre.

REUTERS

Wegen der anhaltenden Dürre ist nun auch in Südtirol tagsüber das Bewässern verboten. Die Maßnahme gilt bis auf Widerruf.

Winter 2022



SÜDTIROL NEWS

Lokal Italien Chronik Politik Wirtschaft Sport Unter

Santa-Giustina-Stausee fehlen 30 Millionen Kubikmeter

Auch im Trentino nimmt die Dürre kein Ende

Donnerstag, 23. Februar 2023 | 07:07 Uhr

Winter 2023

<https://www.heute.at/s/wassernotstand-erreicht-nun-sogar-schon-suedtirol-100217636>

<https://www.suedtirolnews.it/italien/auch-im-trentino-nimmt-die-duerre-kein-ende>

# Concept



What are the most suitable and robust drought indicators for the alps?

Produce these indicators and validate them from 1980 - 2020:

- Meteo (SPI, ...)
- Satellite (VHI, ...)
- Hydrology (Disch., ...)
- Impacts (News, ...)
- Vulnerabilities (Farms, ...)

Open Source  
Operational  
Automated  
Timely

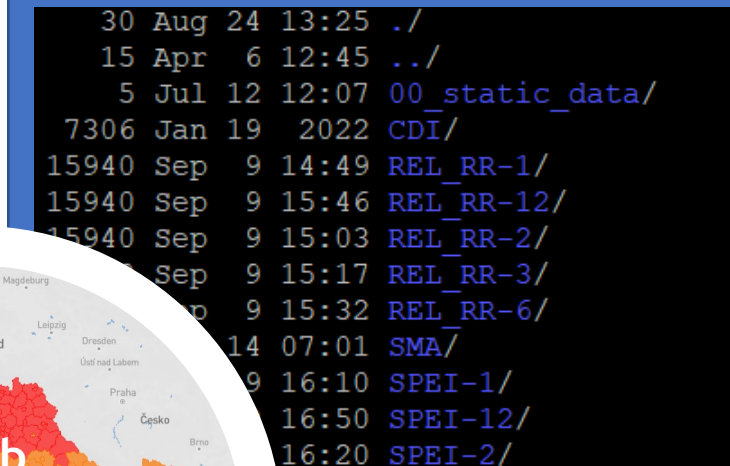
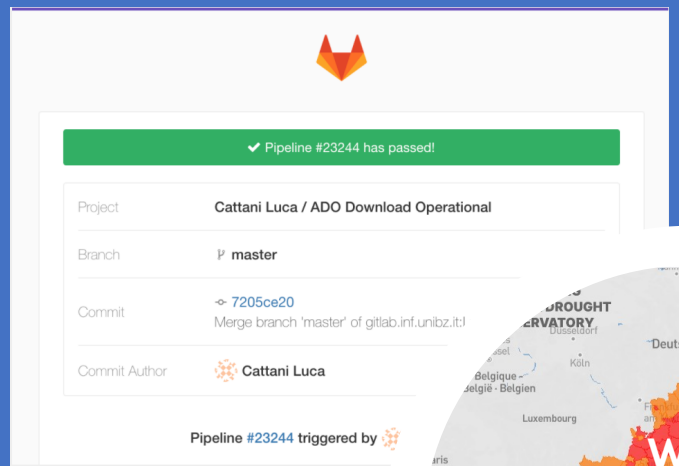
Accessible  
Understandable  
FAIR  
Actionable



# The ADO Platform

## Production

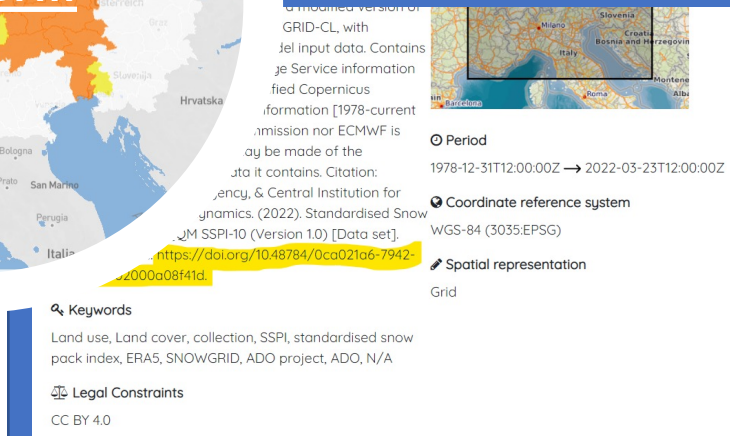
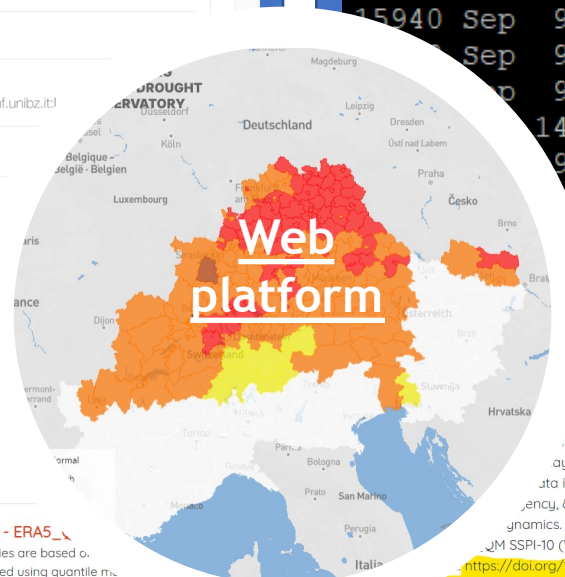
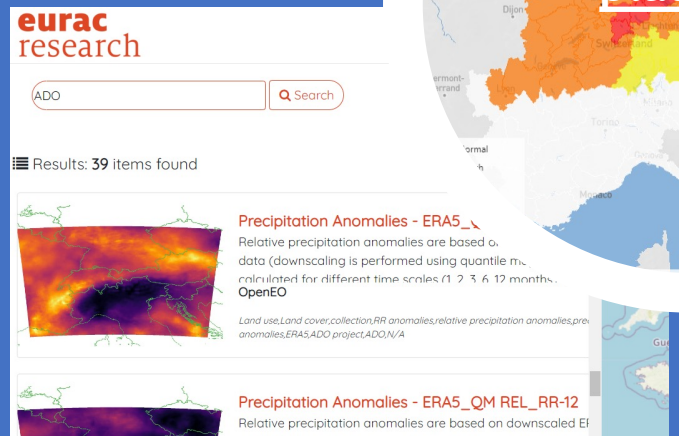
Docker  
 GitLab  
 Kubernetes



Data  
 Drought Indices  
 Hydro Stations  
 Impacts  
 Vulnerability

## Access

Rasdaman/ODC  
 openEO  
 Env. Data Platform



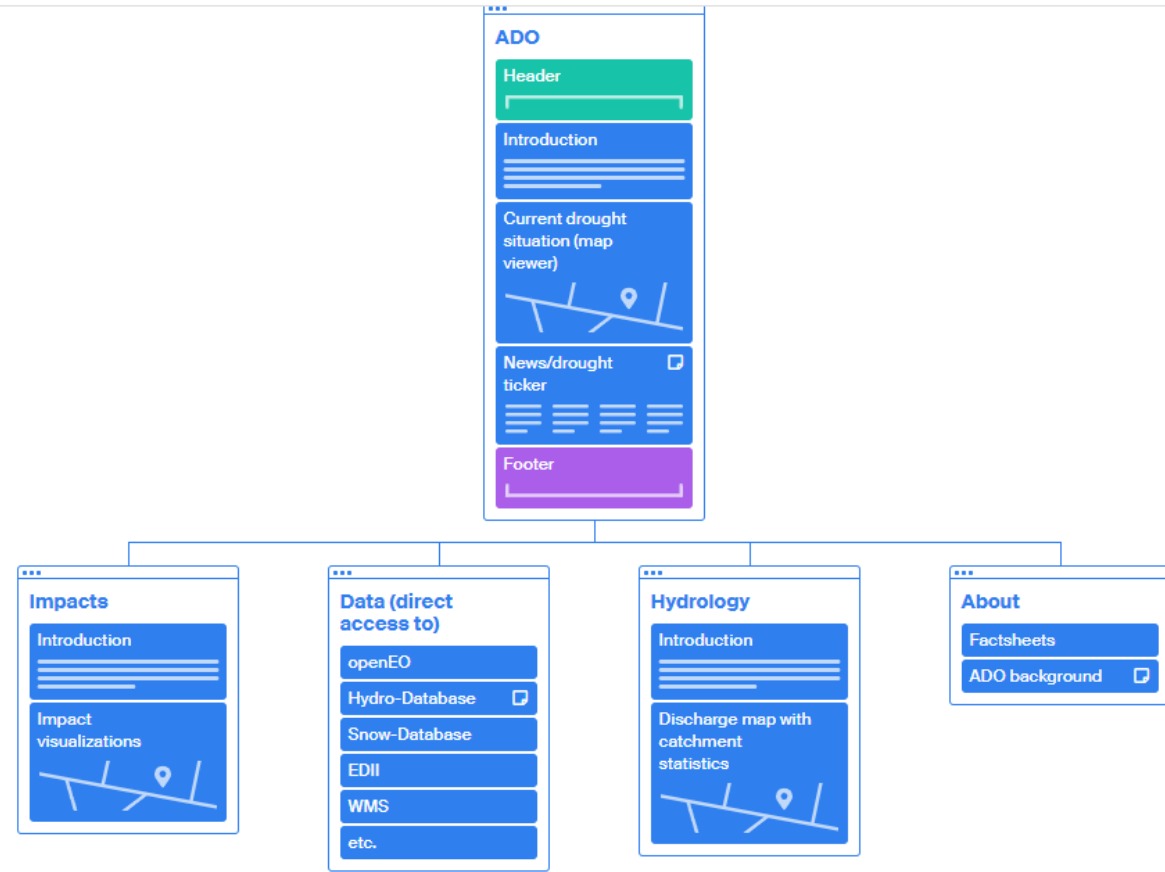
## Metadata

Fact Sheets  
 STAC  
 DOI  
 FAIR



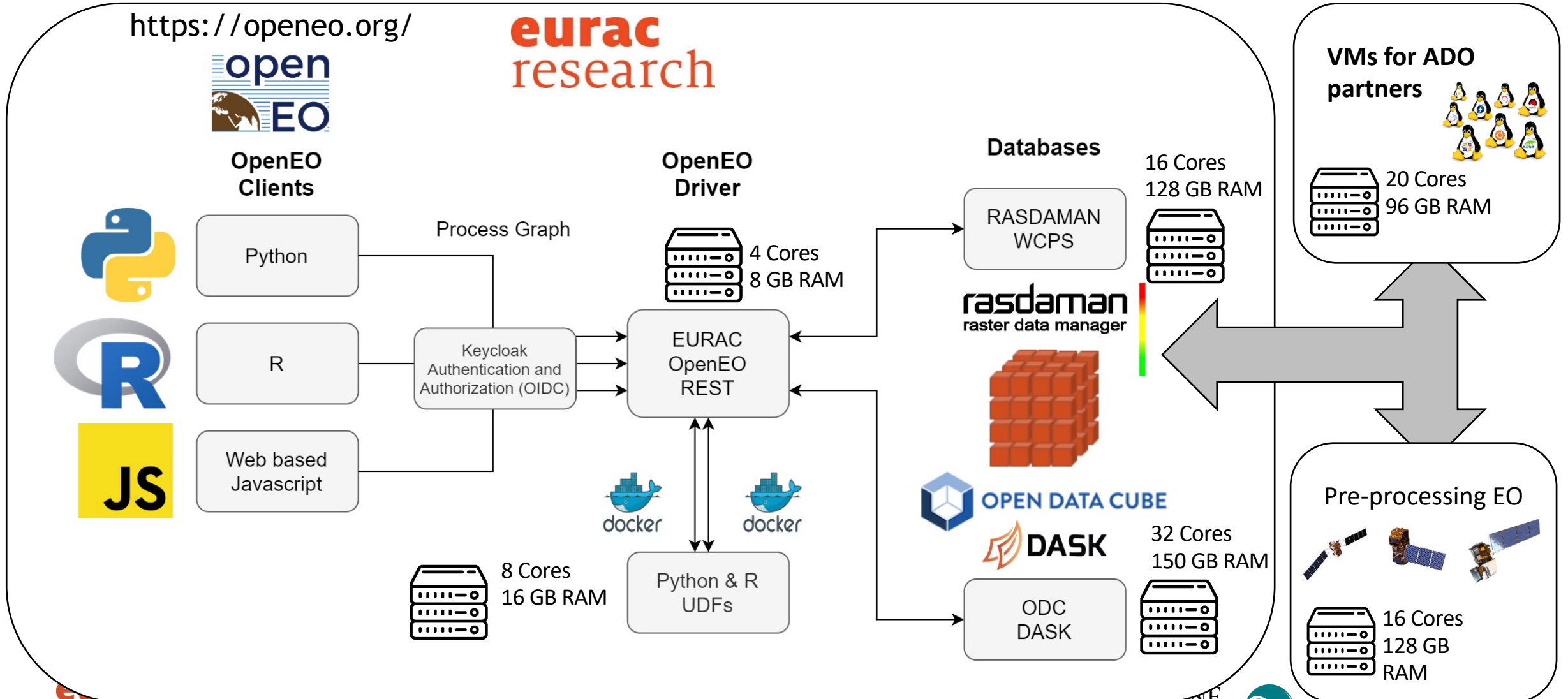
# Design Phase - Thinking about users...

Title	Description
Local/regional public authorities in the field of agriculture, water, and meteorology	Fabio Rossi is a member of the local government who helps him to interpret the local situation.
Policy Maker, e.g. Alpine Convention, EUSALP	Sebastian Wagner is employed by the government and publishes management decisions for the region.
Scientist	Camille Bernard is a researcher who studies the wine harvest of the following year for her study.
PhD, Expert in drought risk	Ramona Muhr is a PhD student who analyzes hazard and impact data to determine risk levels.
Advisor for agriculture	Lara Schmidt is an advisor for farmers who provides information on the current drought.
Private person impacted by drought	Karl Mueller is currently impacted by drought and wants to know more about the current situation and the possibility to search for solutions.
Forester in an Alpine area	Lina Rahm is a forest manager who needs to get more information on the current drought situation to manage the forest.
Journalist for environmental topics	Peter F. is a Journalist for environmental topics who visits the website to gather information for his articles.
Content manager	
Official at Administration for Civil Protection and Disaster Relief	Ana V. is an official at ACPD who uses the platform to prepare an overview of the current situation.



... not only experts!









# ADO on gitlab - Open Source

ADO

A **ADO**
  
 Group ID: 1379 [Leave group](#)
  
 ADO > openEO4ADO

<https://gitlab.inf.unibz.it/ado>

O **openEO4ADO**
  
 Project ID: 3759

57 Commits | 1 Branch | 0 Tags | 2.7 MB Files | 2.7 MB Storage

Tutorial and snippets on how to use openEO in the ADO project

master | openeo4ado / + | History | Find file | Web IDE | Clone

Update README.md
   
 Zellner Peter James authored 17 hours ago
   
 a4fbe5e3

- README
- Auto DevOps enabled
- Add LICENSE
- Add CHANGELOG
- Add CONTRIBUTING

Name	Last commit	Last update
python	Update ADO_Python_Tutorial.ipynb	1 month ago
r	updated login procedure	1 week ago
register_and_login_guide	Update README.md	17 hours ago
README.md	fixed my name	1 day ago

README.md

**openEO4ADO**

Tutorial and snippets on how to use openEO in the ADO project

V vhi 
  
 scripts for downloading mod11a1 and mod09, calculation of land surface temperature, ...

1 day ago  
 1 day ago  
 23 hours  
 1 day  
 3 days  
 1 month  
 1 month  
 1 month  
 1 month  
 2 months  
 2 months  
 4 months ago

ADO > openEO4ADO
   
 master | openeo4ado / python / + | History | Find file | Web IDE | Clone

Update ADO\_Python\_Tutorial.ipynb
   
 Claus Michele authored 1 month ago
   
 e1ad4d89

Name	Last commit	Last update
..		
.gitkeep	Update .gitkeep	1 month ago
ADO_Python_Tutorial.ipynb	Update ADO_Python_Tutorial.ipynb	1 month ago
README.md	Update README.md	1 month ago
environment.yml	added openeo conda environment	1 month ago
eo_utils.py	added eo_utils.py	1 month ago

README.md

**Accessing and Analyzing ADO Datasets with openEO**

Author [michele.claus@eurac.edu](mailto:michele.claus@eurac.edu)




Date: 2021/04/15

Useful links:




OpenEO Python Client documentation: <https://open-eo.github.io/openeo-python-client/index.html>



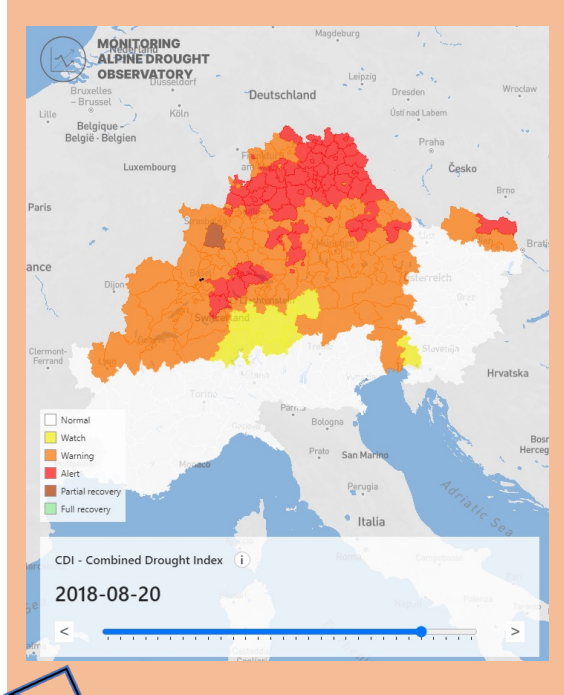
# ADO Production Pipelines

- Codes producing Data
- Environment Files
- Documentation
- (Docker Image)

- Docker
- CI/CD
- Kubernetes
- Triggering



GitLab

Development of Code

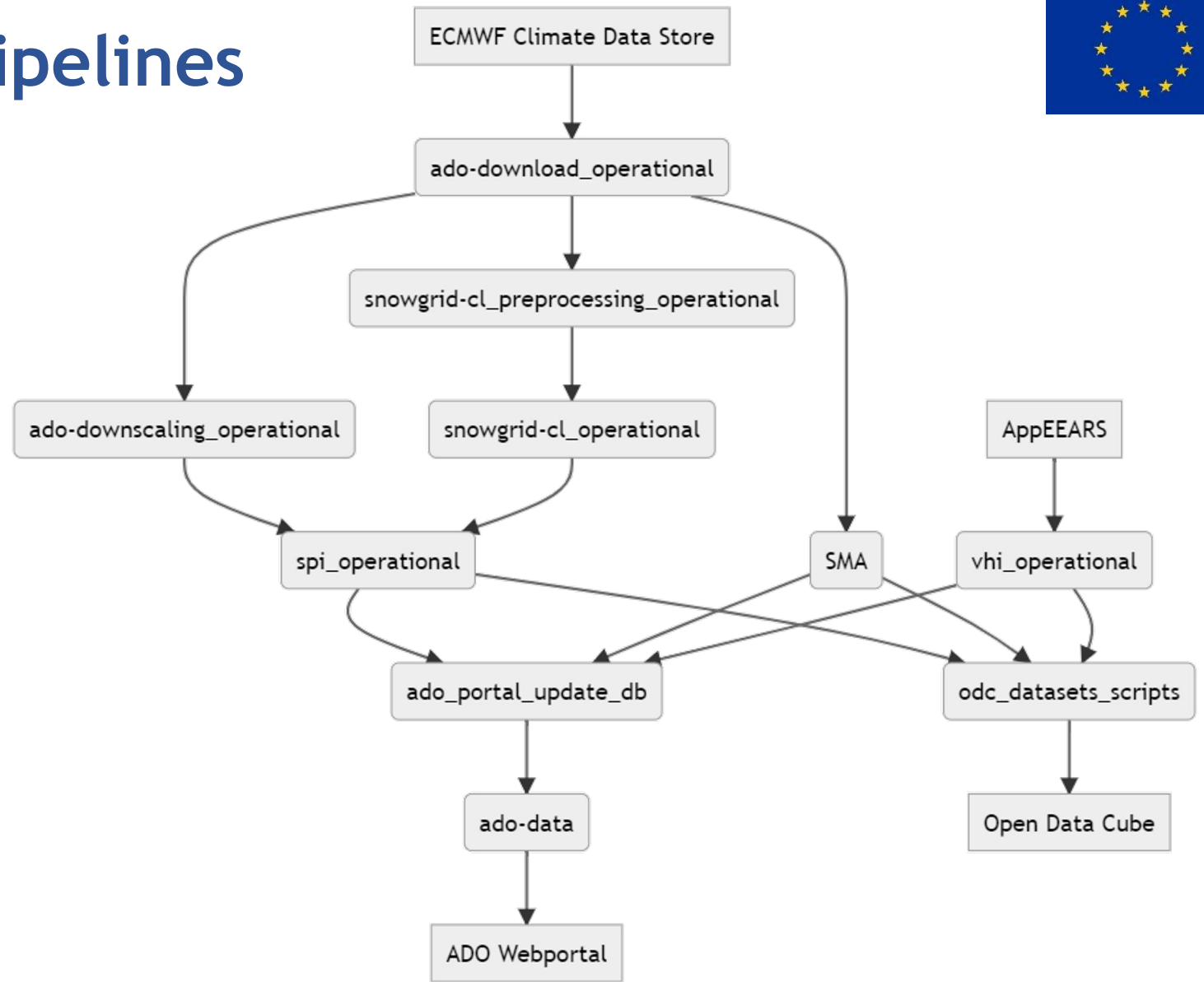
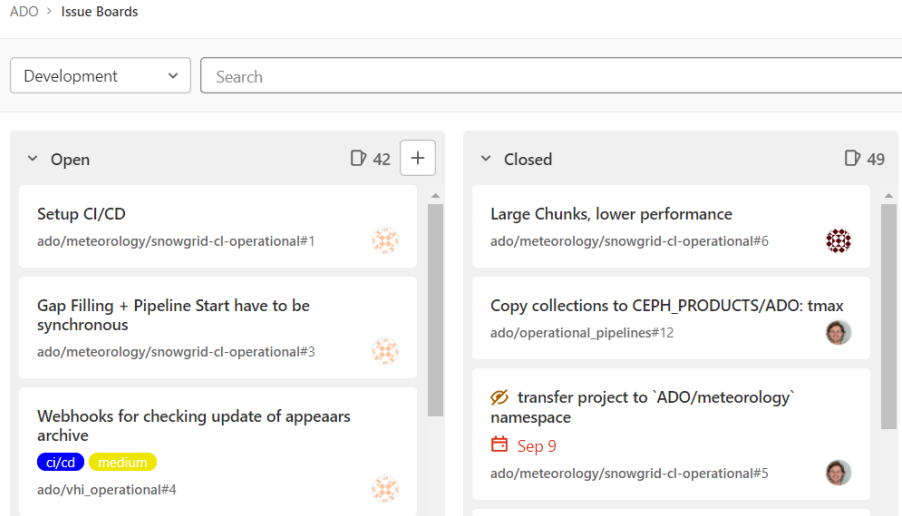
Changes are directly integrated to pipeline

Modules of the pipelines can be triggered by different events

Results are directly integrated into web-portal



# ADO Pipelines

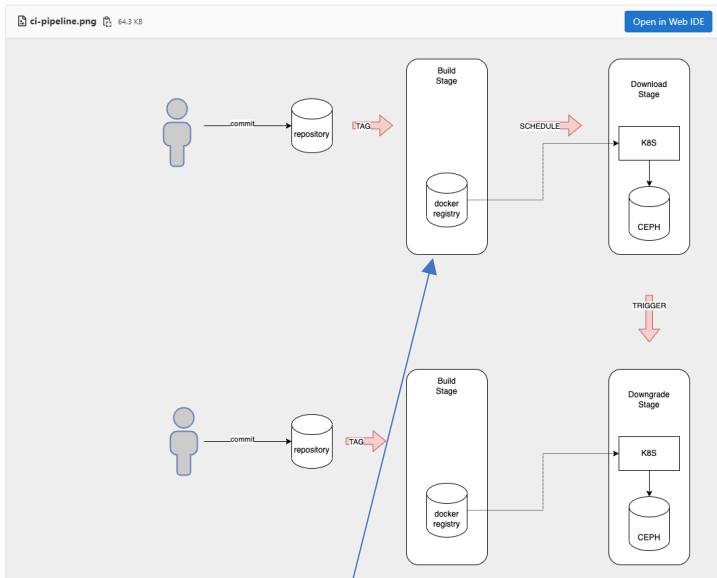




# Pipeline Operations



## Pipeline




## Jobs

Cattani Luca > ADO Download Operational > Jobs

All 113 Pending 0 Running 0 Finished 113

Status	Name	Job	Pipeline	Stage	Duration
passed	on-schedule-download	#41422 master -> eda14464	#23616 by Cattani Luca	test	00:01:10 7 hours ago
passed	on-schedule-download	#41313 master -> eda14464	#23592 by Cattani Luca	test	00:01:10 1 day ago
passed	on-schedule-download	#41275 master -> eda14464	#23578 by Cattani Luca	test	00:01:09 2 days ago
passed	on-schedule-download	#41244 master -> eda14464	#23565 by Cattani Luca	test	00:01:10 3 days ago
passed	on-schedule-download	#41217 master -> eda14464	#23548 by Cattani Luca	test	00:01:09 4 days ago
passed	on-schedule-download	#41195 master -> eda14464	#23536 by Cattani Luca	test	00:01:10 5 days ago
passed	on-schedule-download	#41174 master -> eda14464	#23525 by Cattani Luca	test	00:01:10 6 days ago

## Success Mail



✓ Pipeline #23244 has passed!

Project **Cattani Luca / ADO Download Operational**

Branch **master**

Commit **7205ce20**  
Merge branch 'master' of gitlab.inf.unibz.it:Lu...

Commit Author **Cattani Luca**

Pipeline #23244 triggered by Cattani Luca

## Error Mail

✗ Pipeline #22804 has failed!

Project **Cattani Luca / ADO Download Operational**

Branch **master**

Commit **b2622371**  
Update .gitlab-ci.yml file

Commit Author **Cattani Luca**

Pipeline #22804 triggered by Cattani Luca had 1 failed job.

### Variables

Variables store information, like passwords and secret keys, that you can use in job scrip.

Variables can be:

- Protected: Only exposed to protected branches or tags.
- Masked: Hidden in job logs. Must match masking requirements. [Learn more.](#)

Type	Key	Value	Protect
Variable	CDSAPI_KEY	*****	×

Add variable Reveal values

### Schedule

#### Edit Pipeline Schedule

Description

download

Interval Pattern

- Every day (at 5:00am)
- Every week (Friday at 5:00am)
- Every month (Day 0 at 5:00am)
- Custom ( Cron syntax )

0 3 \* \* \*

Cron Timezone

UTC

API Key etc.



# List of Production Indices

MOD16 Evapotranspiration - 500 m

ADO\_EVAP\_SSEBOP\_1km\_4326  
SSEBop Evapotranspiration - 1 km

ADO\_LST\_MODIS\_231m\_3035  
Land Surface Temperature - 231m 8 day mean

ADO\_NDVI\_MODIS\_231m\_3035  
Normalized Difference Vegetation Index - 231m 8 day Maximum Value Composite

ADO\_NDVI\_MODIS\_231m\_3035\_ODC  
ADO\_NDVI\_MODIS\_231m\_3035\_ODC

ADO\_REL\_RR\_1\_ERA5\_QM  
Precipitation Anomalies - ERA5\_QM REL\_RR-1

ADO\_REL\_RR\_2\_ERA5\_QM  
Precipitation Anomalies - ERA5\_QM REL\_RR-2

ADO\_REL\_RR\_3\_ERA5\_QM  
Precipitation Anomalies - ERA5\_QM REL\_RR-3

ADO\_REL\_RR\_6\_ERA5\_QM  
Precipitation Anomalies - ERA5\_QM REL\_RR-6

ADO\_REL\_RR\_12\_ERA5\_QM  
Precipitation Anomalies - ERA5\_QM REL\_RR-12

ADO\_SM\_anomalies\_ERA5  
Soil Moisture Anomalies - ERA5

ADO\_SPEI\_1\_ERA5\_QM  
Standardised Precipitation-Evapotranspiration Index - ERA5\_QM

ADO\_SPEI\_2\_ERA5\_QM  
Standardised Precipitation-Evapotranspiration Index - ERA5\_QM

ADO\_SPEI\_3\_ERA5\_QM  
Standardised Precipitation-Evapotranspiration Index - ERA5\_QM

ADO\_SPEI\_6\_ERA5\_QM  
Standardised Precipitation-Evapotranspiration Index - ERA5\_QM

ADO\_SPEI\_12\_ERA5\_QM  
Standardised Precipitation-Evapotranspiration Index - ERA5\_QM

ADO\_SPI\_1\_ERA5\_QM  
Standardised Precipitation Index - ERA5\_QM SPI-1

ATMOSPHERE



1. Precipitation Anomalies (%)

2. Standardised Precipitation Index

TOP-SOIL



3. Standardised Precipitation-Evapotranspiration Index

4. Soil Moisture Anomalies

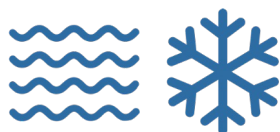
VEGETATION HEALTH



5. Normalized Difference Vegetation Index

6. Vegetation Health Index (VHI)

SURFACE WATER GROUNDWATER



7. Standardised Snowpack Index

8. Hydrological Indices (SDI, SGI)

+ combined drought index - CCI

+ integration of impacts



# Current List of Production Indices



OGC Web Coverage Service (WCS)    OGC Web Map Service (WMS)    Admin

GetCapabilities    DescribeCoverage    GetCoverage    ProcessCoverages    DeleteCoverage    InsertCoverage

WCS service endpoint:  Get Capabilities

119 coverages available, total volume 8.94 TB

Coverage ID	Coverage subtype	Coverage size	Display footprints
<input type="text" value="ADO"/>			
ADO_SM_anomalies_ERA5_QM	RectifiedGridCoverage	16.1 GB	<input type="checkbox"/>
ADO_SPEI_12_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPEI_1_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPEI_2_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPEI_3_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPEI_6_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPI_12_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPI_1_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPI_2_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>
ADO_SPI_3_ERA5_QM	ReferenceableGridCoverage	1.97 GB	<input type="checkbox"/>

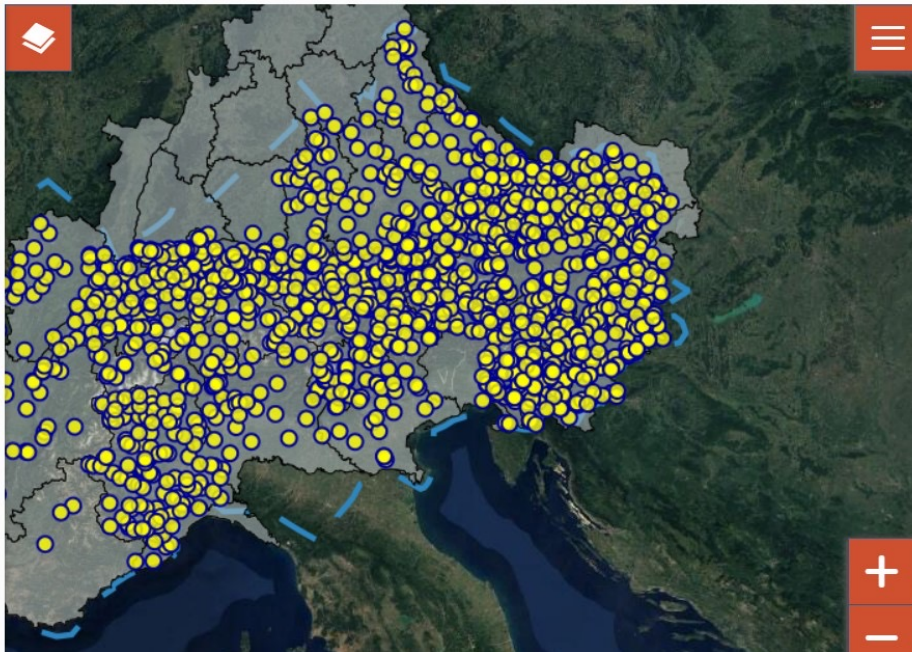
First Previous 1 2 3 Next Last

<http://saocompute.eurac.edu/rasdaman/ows#/services>

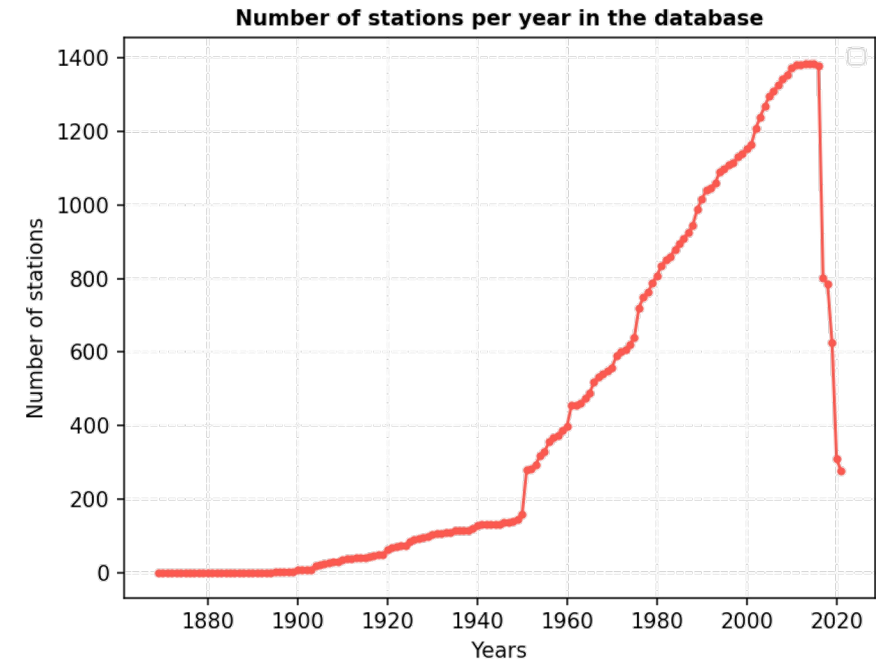


**Alpine-wide dataset:** discharge, water level, groundwater level, metadata  
 Problems: **different data providers**, real time data availability

[https://edp-portal.eurac.edu/cdb\\_doc/ado/](https://edp-portal.eurac.edu/cdb_doc/ado/)



Country	Runoff stations
Austria	567
Italy	242
Switzerland	235
Slovenia	185
Germany	129
France	65
<b>TOTAL</b>	<b>1423</b>





# Drought Impacts

- Substantial update of EDII database

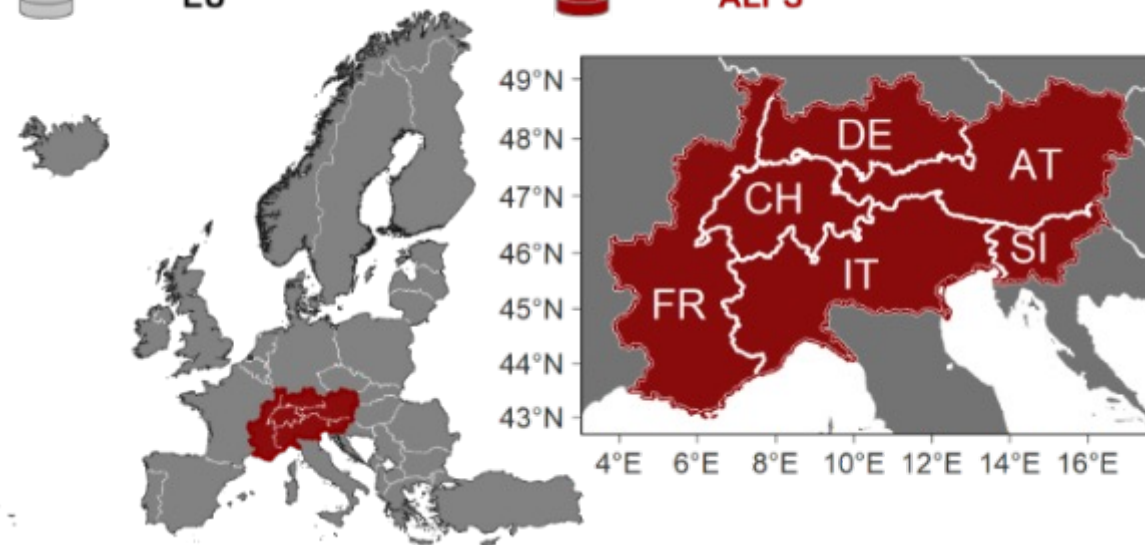
- Various German and Italian text-reports
- Unwetterchronik ZAMG
- Drought.ch
- DMCSEE
- Propluvia.fr

- Filtered to the Alpine Space

→ First version of EDII<sub>ALPS</sub> allows various analyses

EDII<sub>EU</sub>

EDII<sub>ALPS</sub>



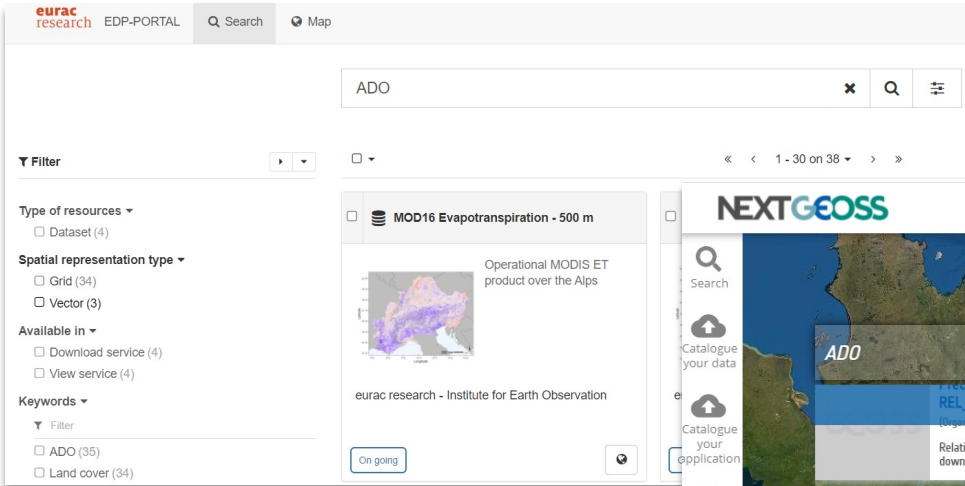
Stephan, R. *et al.* An inventory of Alpine drought impact reports to explore past droughts in a mountain region. *Nat Hazard Earth Sys* 21, 2485-2501 (2021). <https://nhess.copernicus.org/articles/21/2485/2021/>



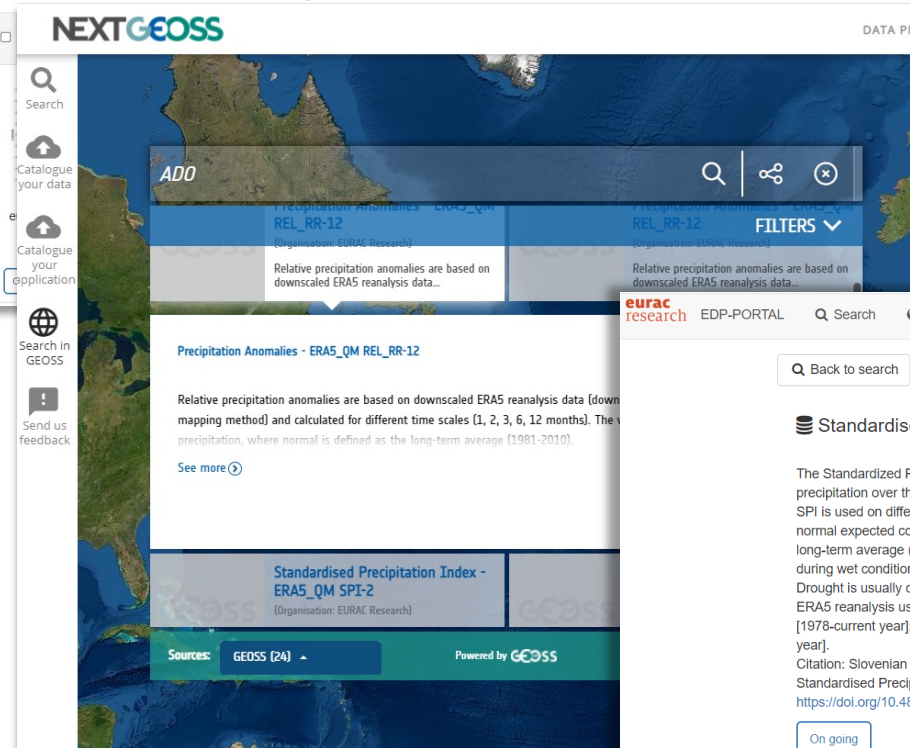
# Meta Data

Findable on EDP Environmental Data Platform

Metadata available in  
 ISO 19139 (XML)  
 or  
 STAC (JSON)

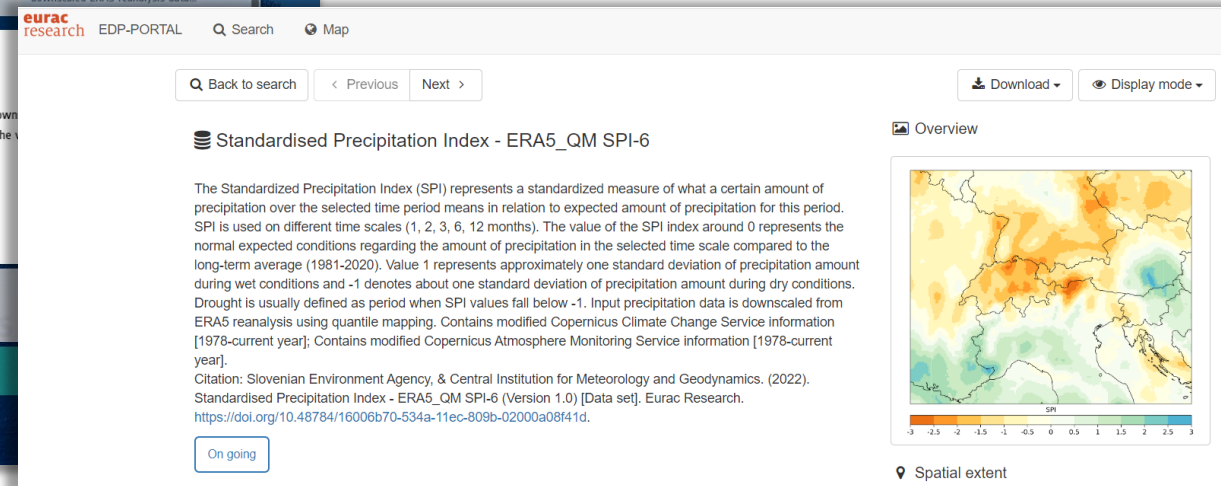


Findable on GEOSS



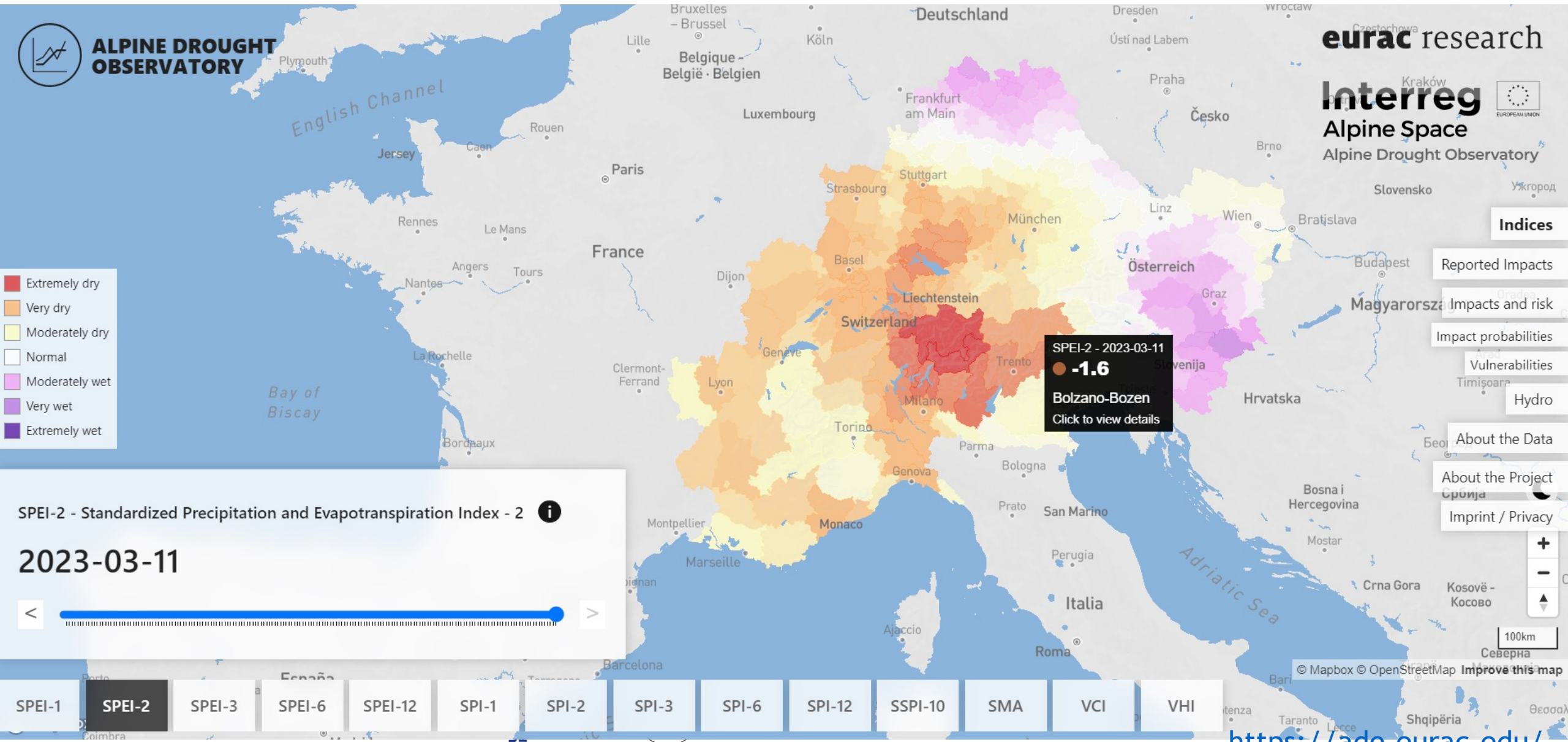
Digital Object Identifiers DOI  
<https://doi.org/10.48784/16006b70-534a-11ec-809b-02000a08f41d>

<https://edp-portal.eurac.edu/geonetwork/>





# Drought Indices - Maps



# Drought Indices - Time Series



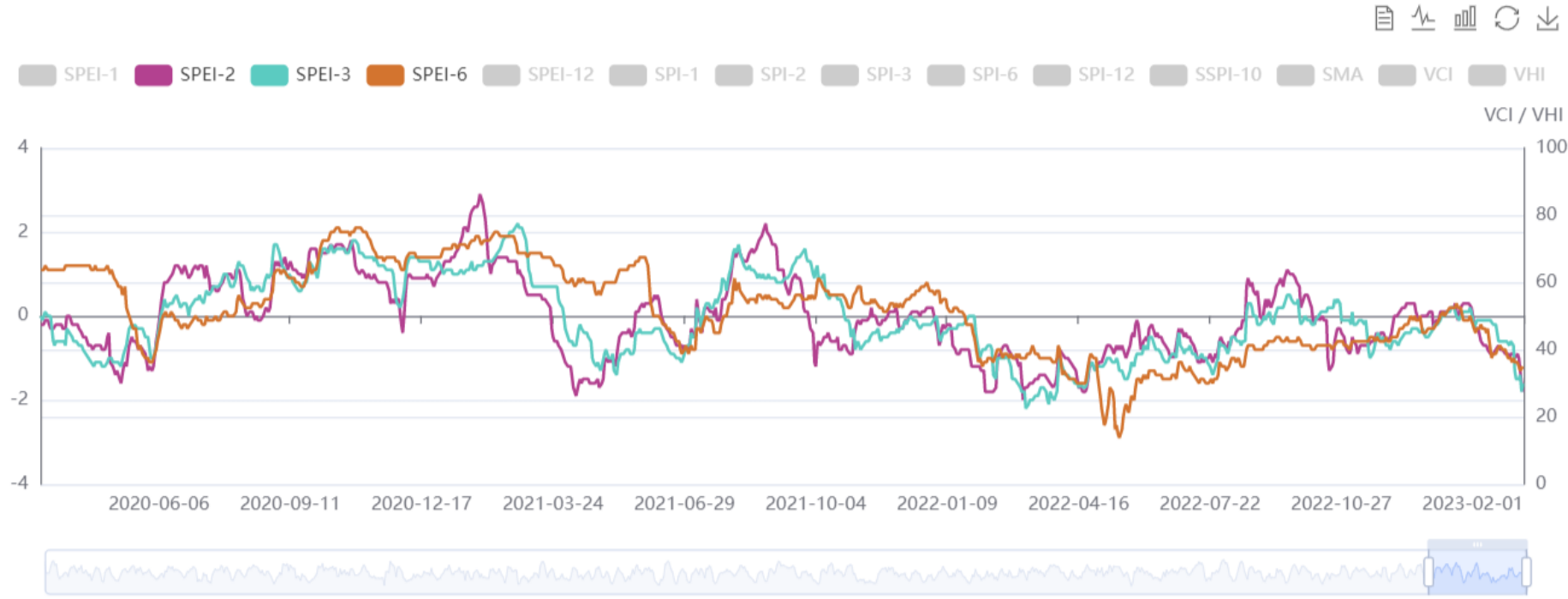
How to read the values

Did you know? You can select and compare several indices.

SPEI / SPI / SMA	
2	Extremely wet
1.5	Very wet
1	Moderately wet
0	<b>Normal</b>
-1	Moderately dry
-1.5	Very dry
-2	Extremely dry

SSPI	
2	Highly more than normal
1.5	Much more than normal
1	More than normal
0	<b>Near normal conditions</b>
-1	Less than normal
-1.5	Much less than normal
-2	Highly less than normal

VCI / VHI	
100	Extremely high vitality
75	High vitality
50	<b>Average vitality</b>
25	Low vitality
0	Extremely low vitality



More information about the data:  
[Download SPEI-1 Factsheet](#)  
<https://doi.org/10.48784/166E51EE-534A-11EC-9143-02000A08F41D>

eurac research  
 Kraków  
 Alpine Space  
 Alpine Drought Observatory

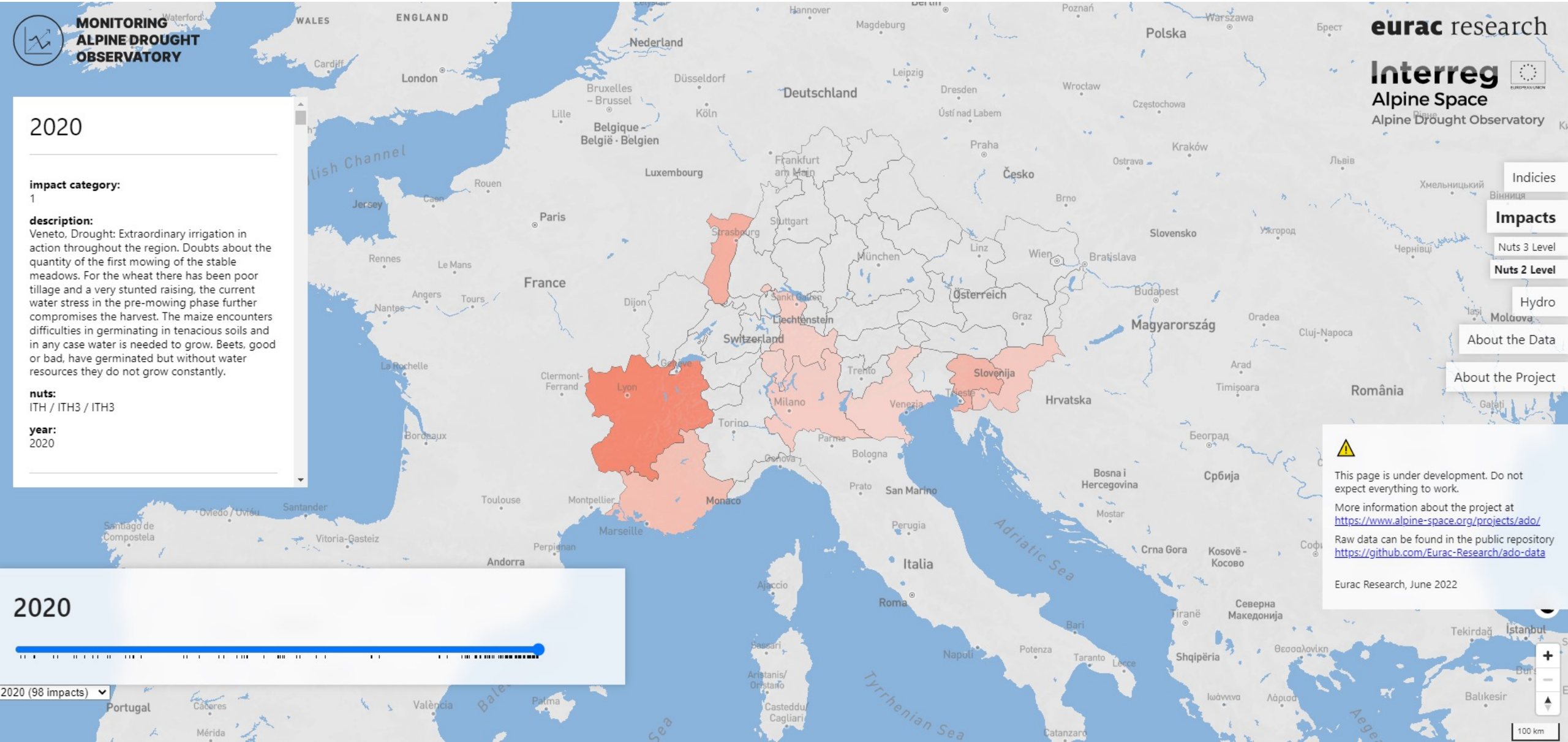
Slovensko  
 Ужгород  
 Budapest  
 Magyarország  
 Timișoara  
 Beograd  
 Crna Gora  
 Kosovë - Kosovo  
 Северна  
 Shqipëria  
 Θεσσαλονίκη

Indices  
 Reported Impacts  
 Impacts and risk  
 Impact probabilities  
 Vulnerabilities  
 Hydro  
 About the Data  
 About the Project  
 Imprint / Privacy

100km  
 © OpenStreetMap Improve this map



# Drought Impacts




**MONITORING ALPINE DROUGHT OBSERVATORY**

2020

---

**impact category:**  
1


**description:**  
Veneto, Drought: Extraordinary irrigation in action throughout the region. Doubts about the quantity of the first mowing of the stable meadows. For the wheat there has been poor tillage and a very stunted raising, the current water stress in the pre-mowing phase further compromises the harvest. The maize encounters difficulties in germinating in tenacious soils and in any case water is needed to grow. Beets, good or bad, have germinated but without water resources they do not grow constantly.

**nuts:**  
ITH / ITH3 / ITH3

**year:**  
2020


  
**Interreg Alpine Space**  
 Alpine Drought Observatory

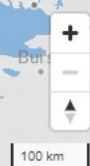
- Indicies
- Impacts**
- Nuts 3 Level
- Nuts 2 Level**
- Hydro
- Molrouva
- About the Data
- About the Project


 This page is under development. Do not expect everything to work.  
 More information about the project at <https://www.alpine-space.org/projects/ado/>  
 Raw data can be found in the public repository <https://github.com/Eurac-Research/ado-data>  
 Eurac Research, June 2022

2020

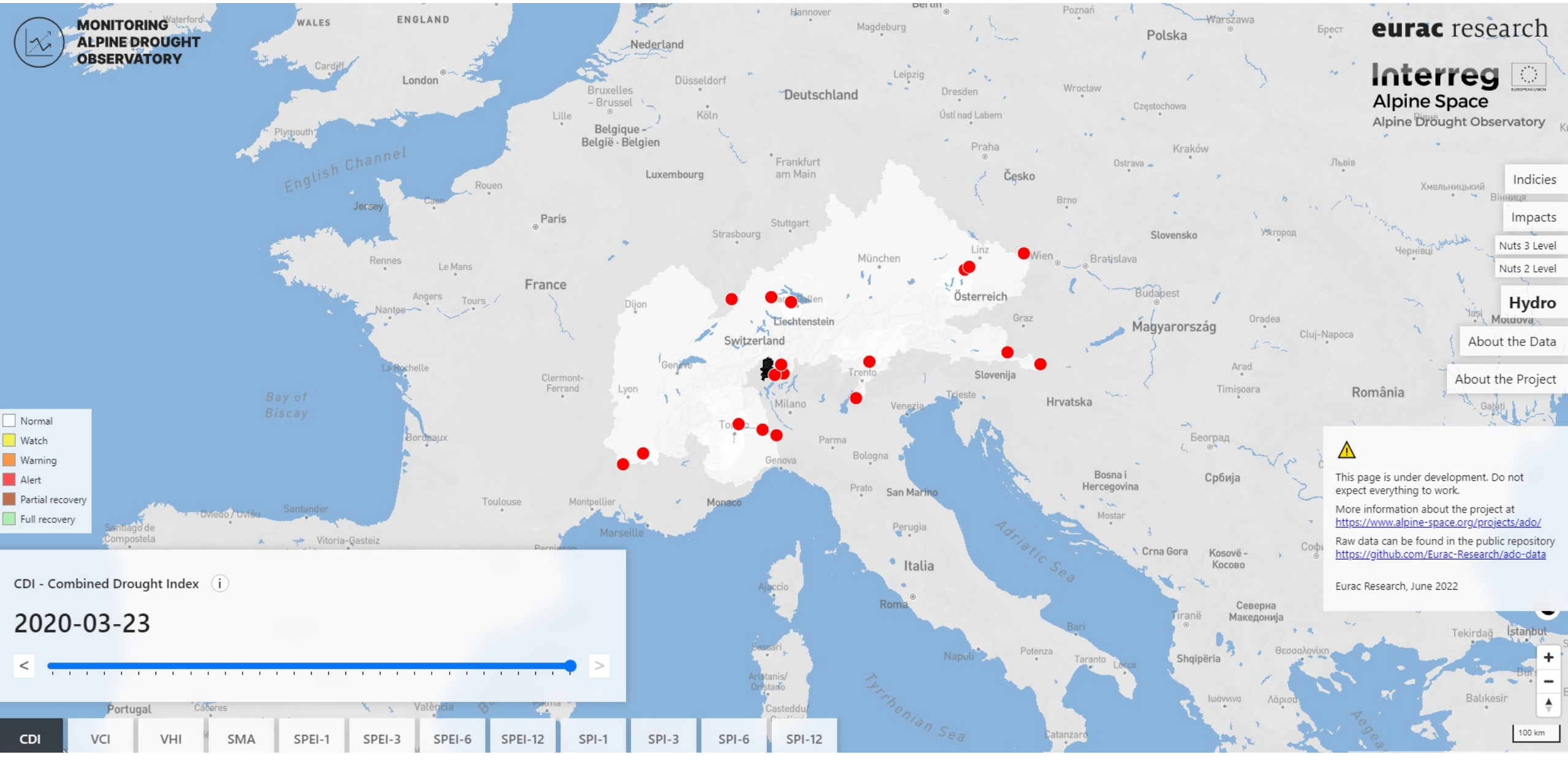


2020 (98 impacts)






# Hydrology



 This page is under development. Do not expect everything to work.  
 More information about the project at <https://www.alpine-space.org/projects/ado/>  
 Raw data can be found in the public repository <https://github.com/Eurac-Research/ado-data>  
 Eurac Research, June 2022



CDI - Combined Drought Index ⓘ  
 2020-03-23  


## Quality check

Quality check and statistics for hydrological station from the ADO project database

Summary of Station **ADO\_DSC\_ITC1\_0037** in **Italy** in the region **Piemonte** in **Isola S. Antonio Po** with coordinates latitude: **45.036153** and longitude: **8.821928**

## Metadata information

Description of the dataset

country	region	location_site	lat	lon	start_date	end_date	wat
Italy	Piemonte	Isola S. Antonio Po	45.036153	8.821928	1996-01-02 00:00:00	2019-12-31 00:00:00	Po

## Primary statistics

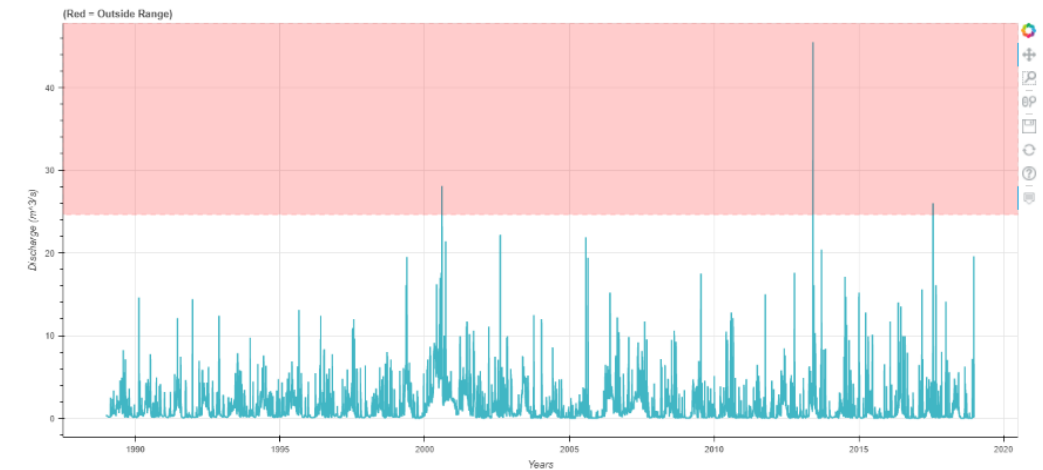
Statistic description of the dataset

	ADO_DSC_ITC1_0037
count	8322.000000
mean	441.090795
std	511.930453
min	30.200000
25%	202.000000
50%	294.000000
75%	495.000000
max	9780.000000

## Missing values

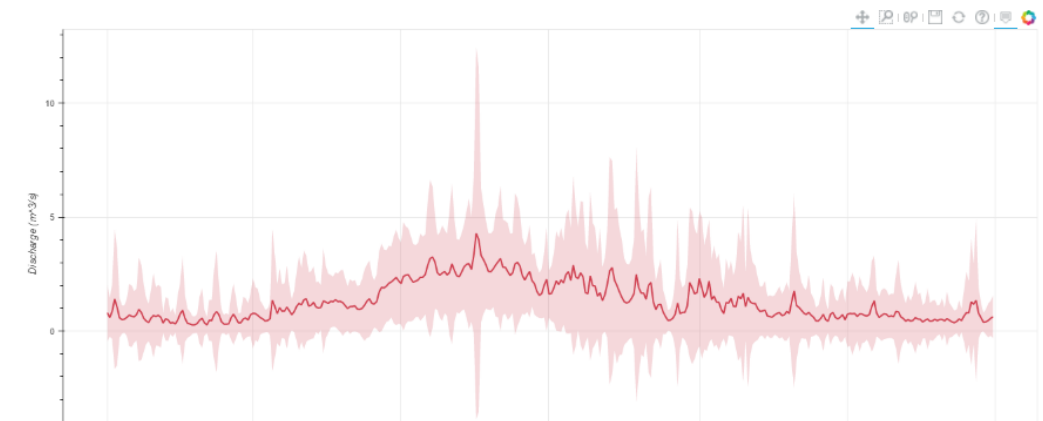
### Discharge time series

Station ADO\_DSC\_CH05\_0191 in Trento

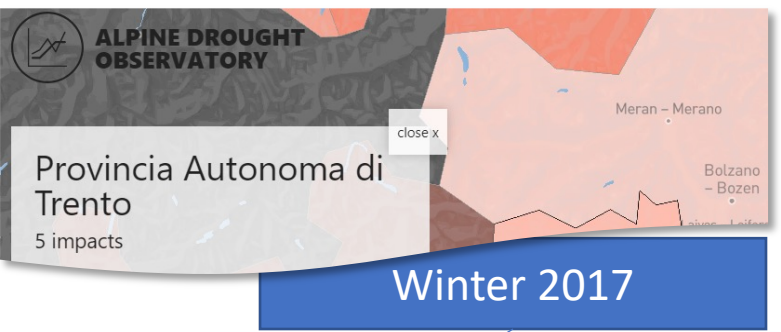


### Mean annual cycle

Station ADO\_DSC\_CH05\_0191



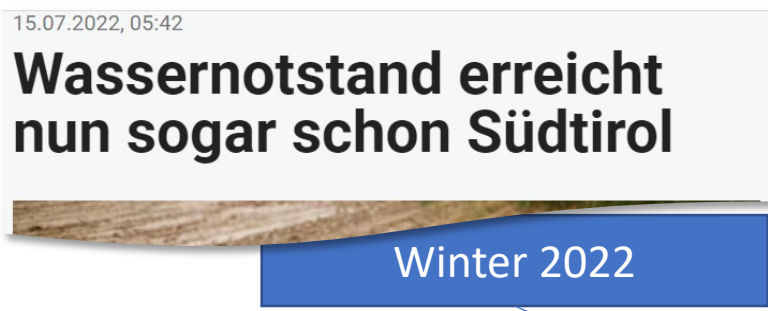
# Can we detect the reported impacts?



**ALPINE DROUGHT OBSERVATORY**
  
 Meran – Merano
   
 Bolzano – Bozen
   
 Provincia Autonoma di Trento
   
 5 impacts
   
 Winter 2017

15.07.2022, 05:42

## Wassernotstand erreicht nun sogar schon Südtirol



Winter 2022

SÜDTIROL NEWS

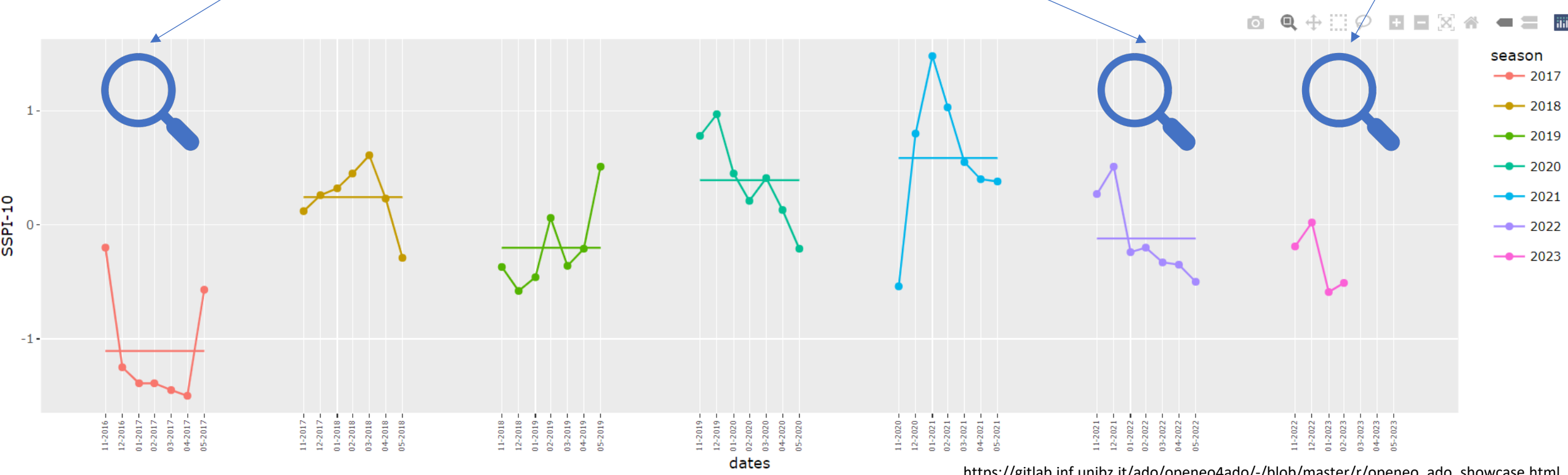
Lokal Italien Chronik Politik Wirtschaft Sport Unte

## Santa-Giustina-Stausee fehlen 30 Millionen Kubikmeter

### Auch im Trentino nimmt die Dürre kein Ende

Donnerstag, 23. Februar 2023 | 07:07 Uhr

Winter 2023

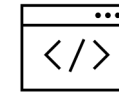




# Conclusion & Outlook



- Web and Data Portal following FAIR data principles
- Combining data from all relevant sources
- Catering to the needs of different target user groups
- Maintaining the portal to be fully operational
  
- Framework is a **blueprint** for further drought monitoring platforms (Regional Drought Observatories/JRC)
- **Open Source**, deployable in other institutes/regions/countries!
- Great collaboration between domain experts and IT





# EUROGEO WORKSHOP 2023



<http://ado.eurac.edu>

<https://gitlab.inf.unibz.it/ado>

<https://www.alpine-space.eu/projects/ado/en/home>

Thank you for your kind attention!

[alexander.jacob@eurac.edu](mailto:alexander.jacob@eurac.edu)  
[peterjames.zellner@eurac.edu](mailto:peterjames.zellner@eurac.edu)

**Interreg**   
Alpine Space  
Alpine Drought Observatory

European Regional Development Fund

**eurac**  
research

REPUBLIKA SLOVENIJA  
MINISTRSTVO ZA OKOLJE IN PROSTOR  
AGENCIJA REPUBLIKE SLOVENIJE ZA OKOLJE



**ISKRIVA**  
skrišče za razvoj lokalnih potencialov



LAND  
OBERÖSTERREICH

**ANB**

REGIONE  
PIEMONTE



**INRAE**

**ZAMG**  
Zentralanstalt für  
Meteorologie und Geodynamik

**BOLZANO 2-4 OCTOBER 2023**

**eurac**  
research



Institute of  
Atmospheric Pollution  
Research  
National Research Council of Italy



European  
Commission