

Planet Week del G7 Clima, Energia e Ambiente Climate, Energy and Environment



WHO NEEDS WATER? Managing drought in Alps. Climate change and Alpine water resource to be preserved

ADO platform: the Alpine Water Drought Observatory Piattaforma ADO: l'Osservatorio Alpino della Siccità Idrica

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TORINO, 24 aprile 2024 Palazzo della Regione Piemonte Piazza Piemonte 1

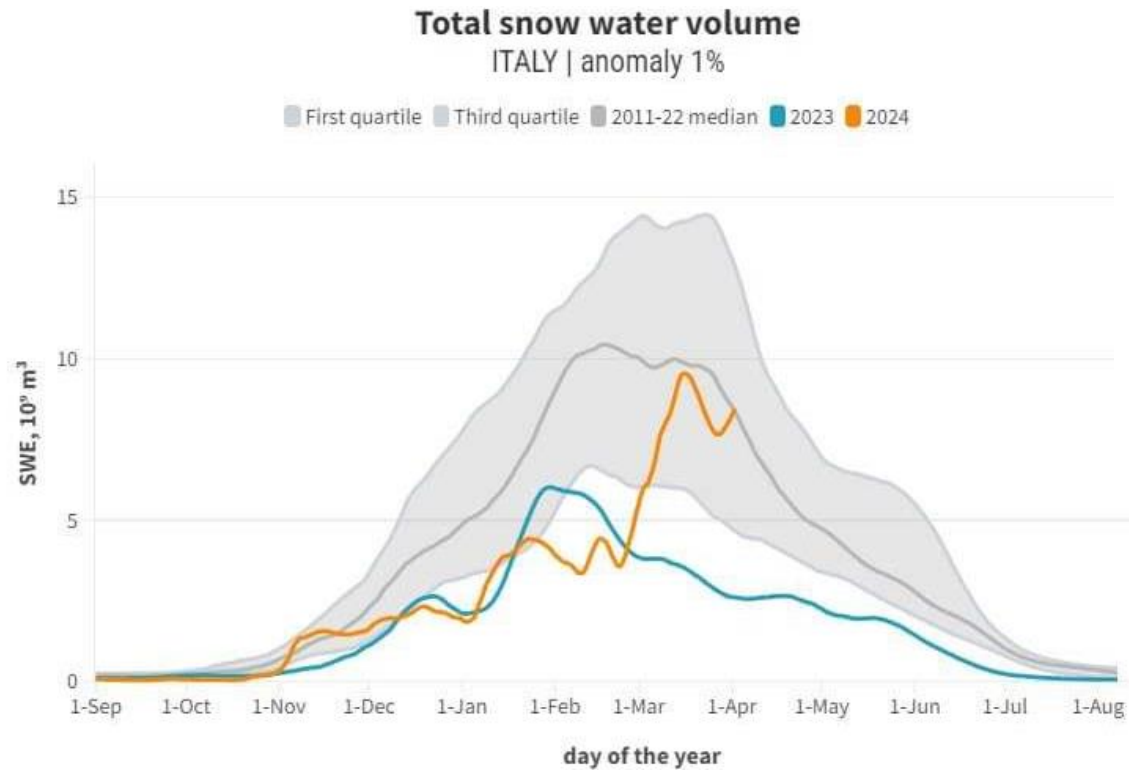


Val Martello (BZ, Italy), 28.6.2022

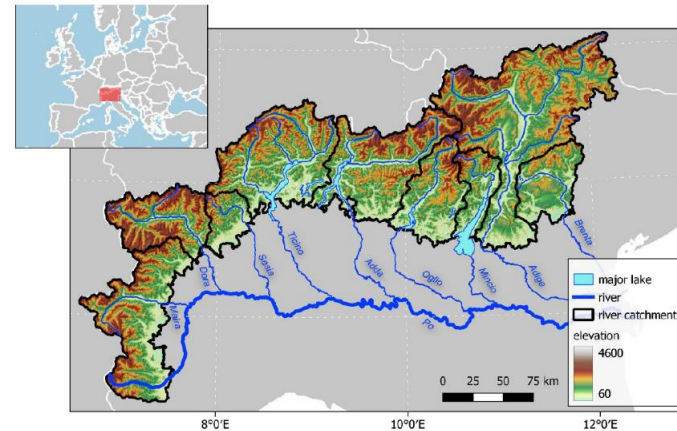


Collapsing mountain glaciers ... huge icemelt water discharge

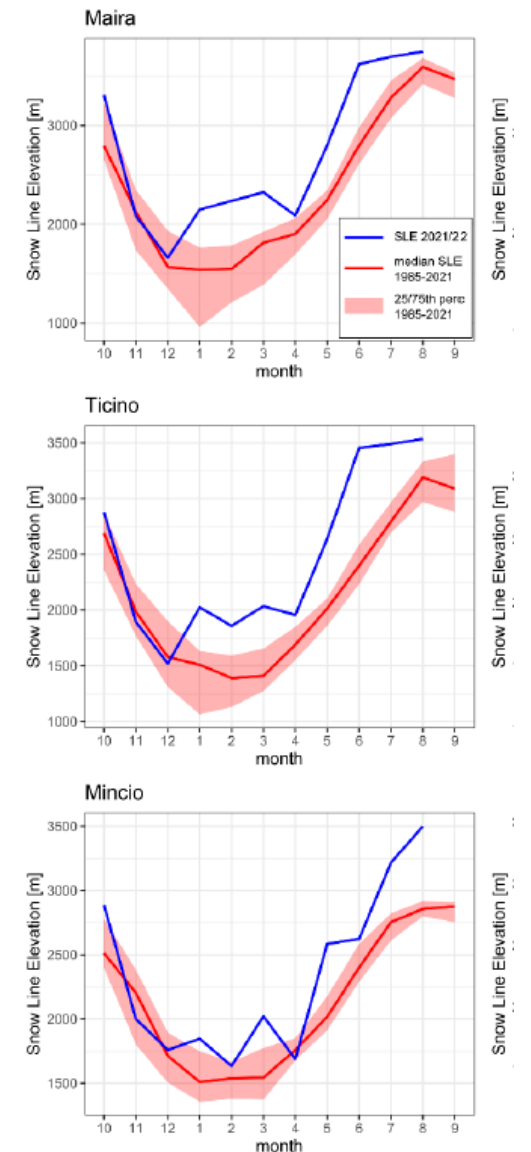
Winter 2021-2022 snow drought in the Alps



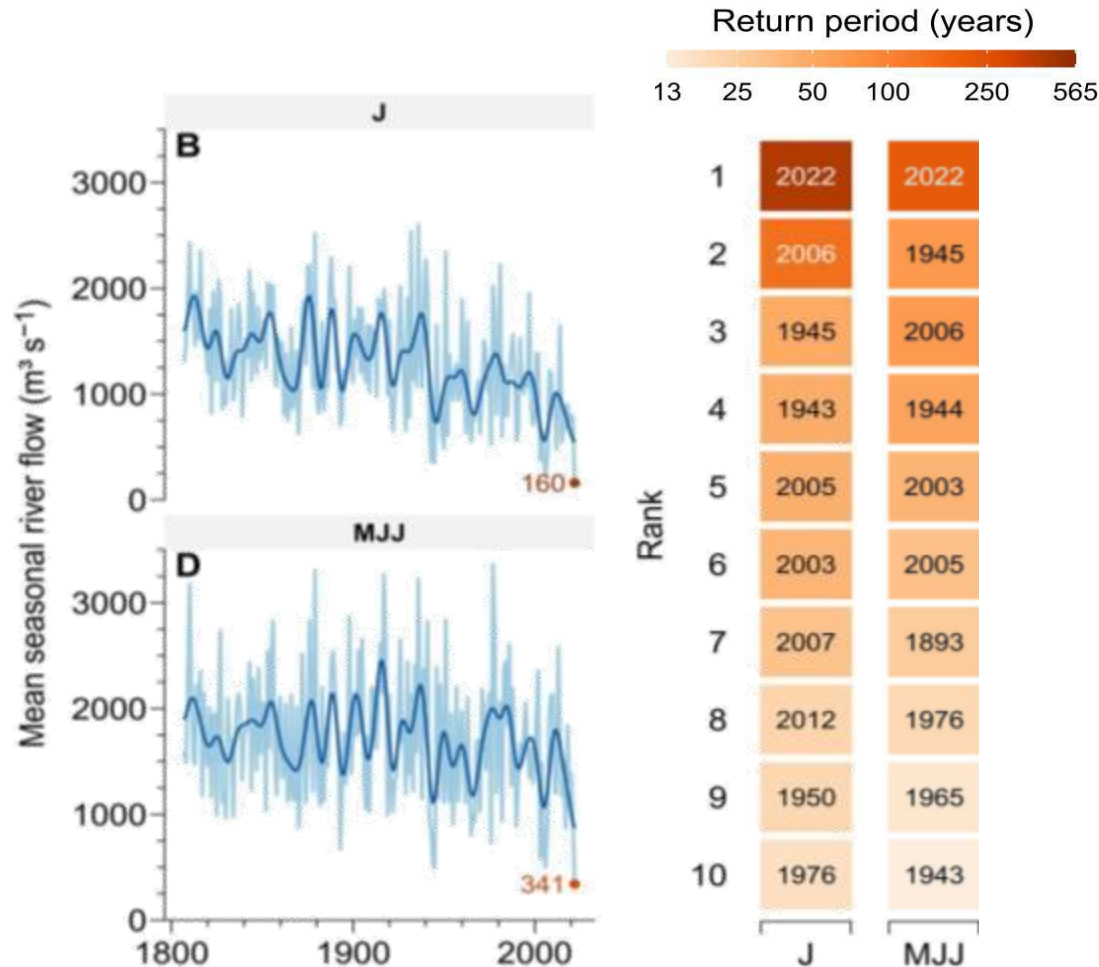
From **CIMA Foundation National Snow Monitoring system**
(Avanzi et al 2022)



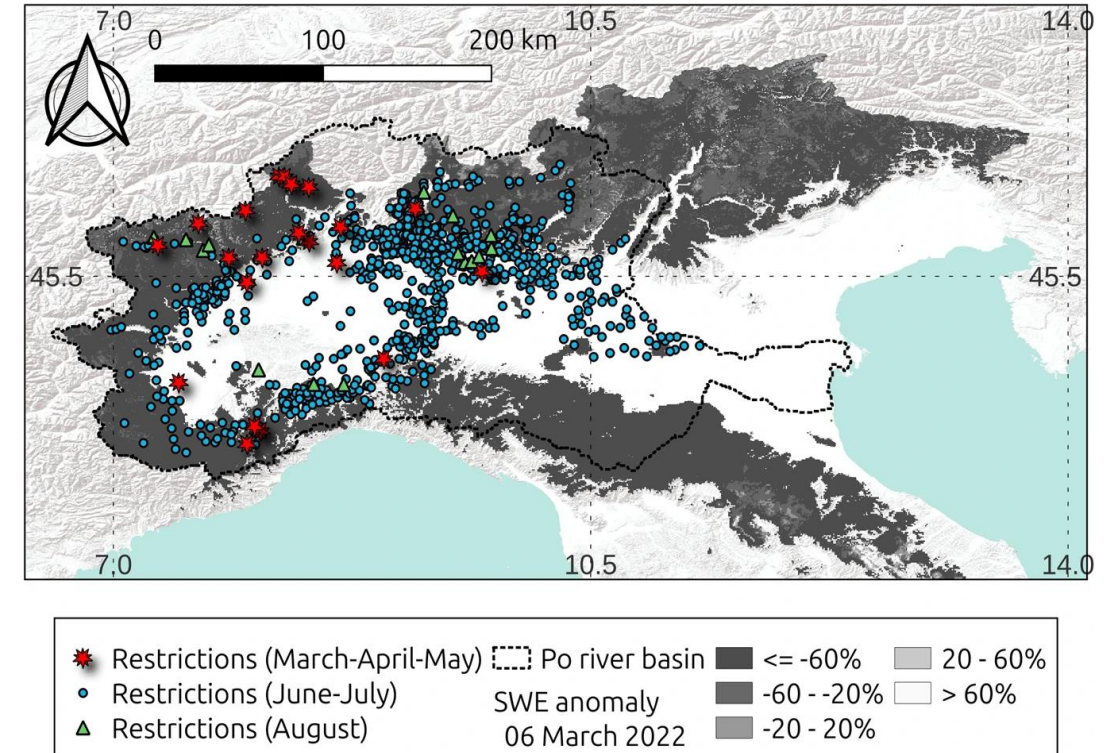
From **Kohler et al. (2022)** –
Drought in Northern Italy:
Long Earth Observation time
series reveal **Snow Line
Elevation** to be several
hundred meters above
long-term average in 2022-
Remote Sensing, 2023.



Summer 2022 drought in northern Italy

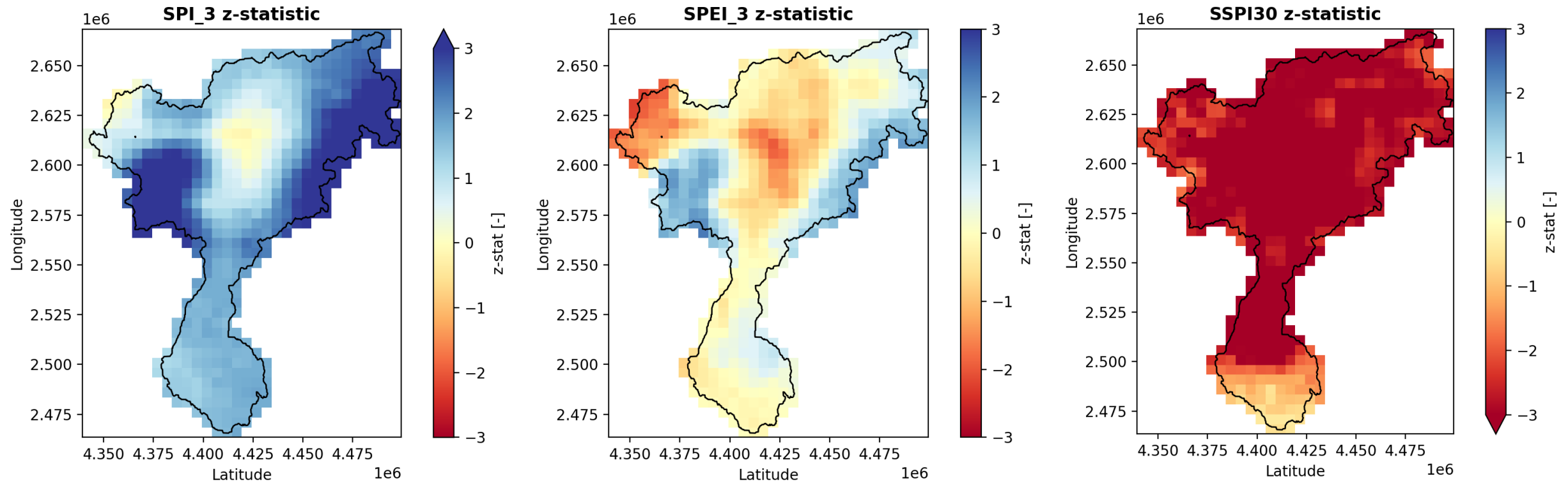


From Montanari, A. et al. Why the **2022 Po River drought is the worst in the past two centuries**. Sci. Adv. 9 (2023).



From Avanzi, F. et al. Winter snow deficit was a harbinger of summer 2022 socio-hydrologic drought in the Po Basin, Italy. Commun. Earth Environ. 5, 64 (2024).

Trends of drought indicators in the Adige basin



Spatial Mann Kendall test over 40 years of data. (ADO database; Quintero et al. in prep.)

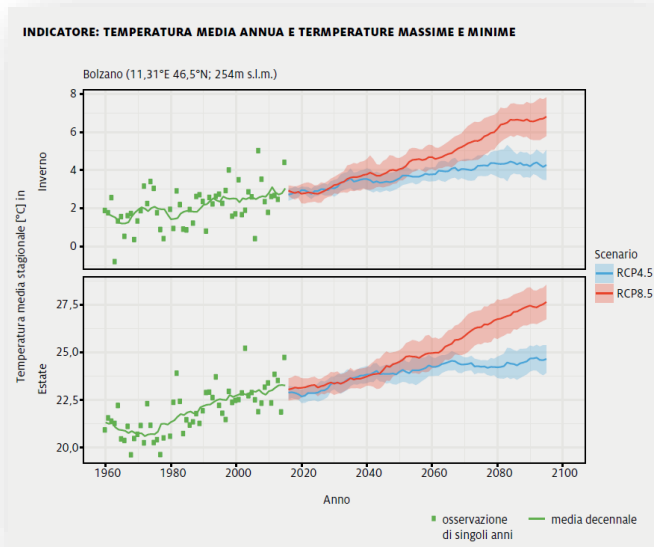
The Adige basin shows a **significant decrease in snow accumulation in the last 40 years.**

Matiu, M. et al. Observed **snow depth trends in the European Alps**: 1971 to 2019. Cryosphere 15, 1343–1382 (2021).

Bertoldi, G. et al. Diverging snowfall trends across months and elevation in the northeastern Italian Alps. Int. J. Climatol. (2023)

doi:10.1002/joc.8002.

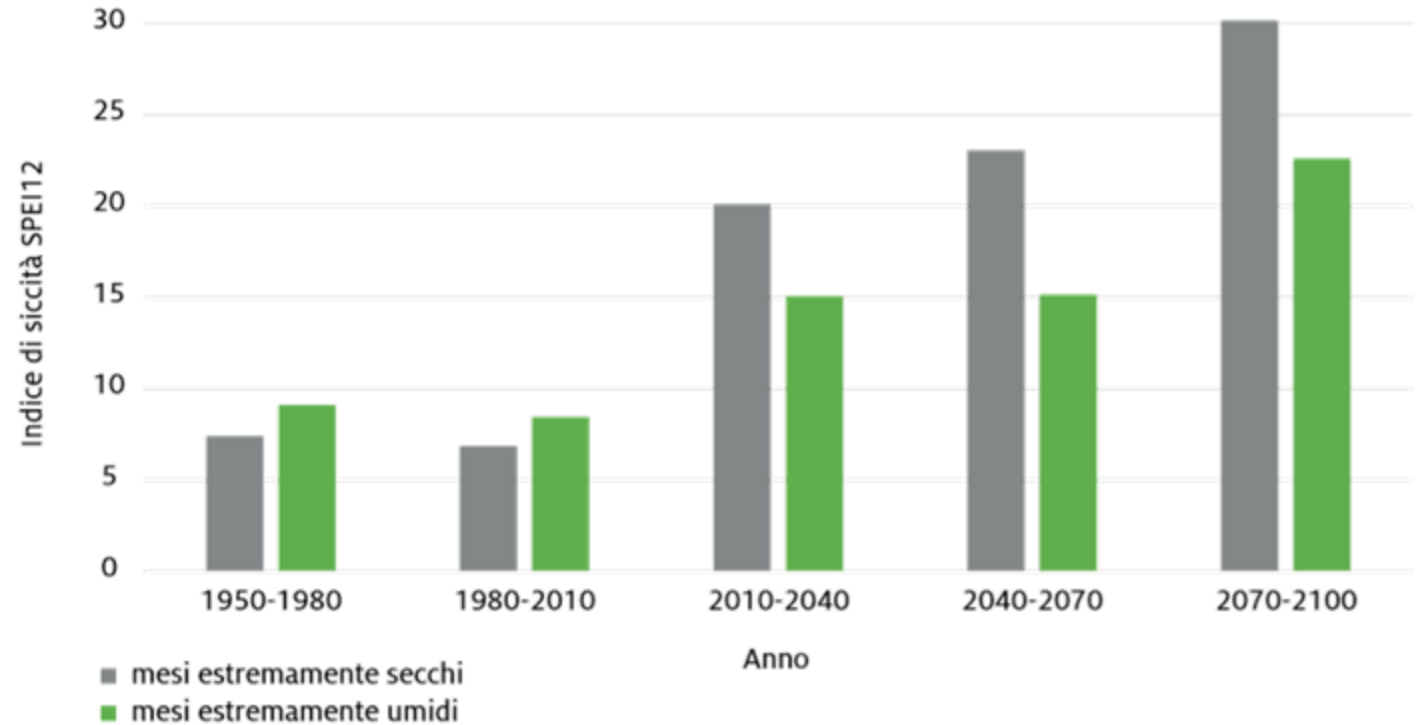
Come cambierà il rischio futuro di siccità?



Downscaling of EUROCORDEX projections for:

- RCP4.5 and RCP8.5 scenarios
- > 10 climatic indices

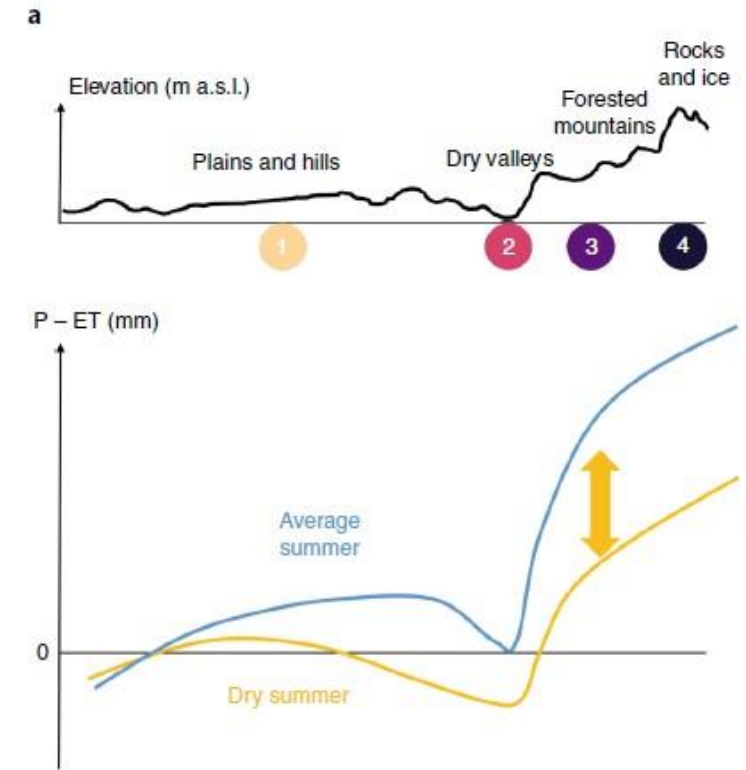
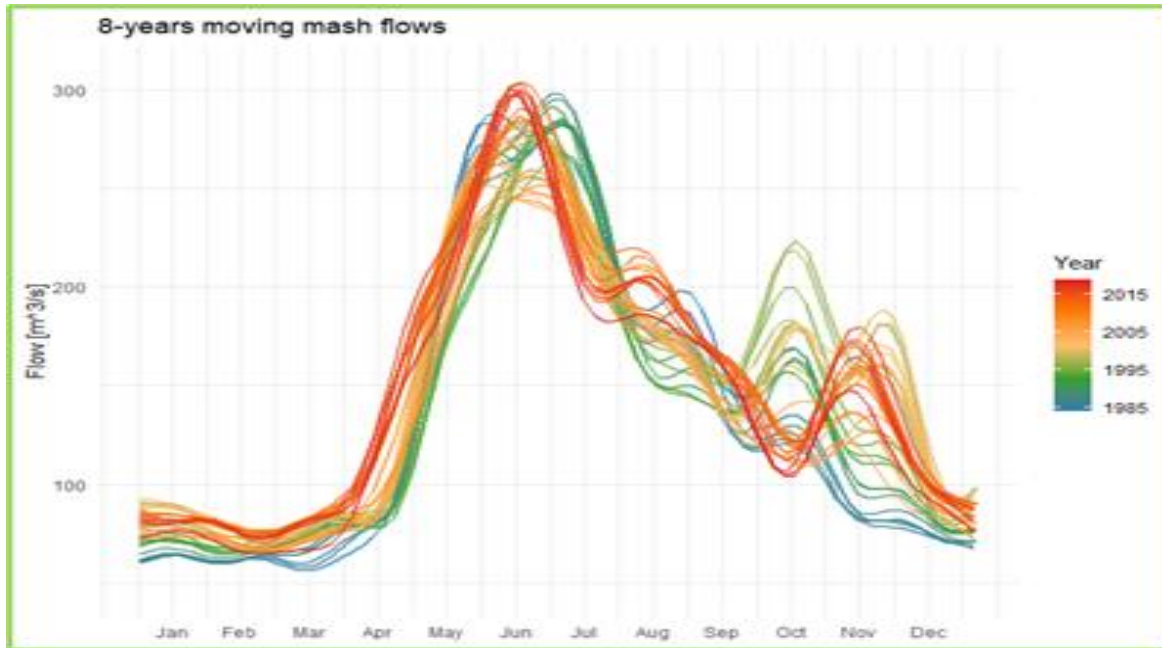
INDICATORE: NUMERO DI MESI CON VALORI DI UMIDITÀ E SICCITÀ ESTREMI NELL'ARCO DI 30 ANNI – STAZIONE DI BOLZANO



Klimareport Südtirol, 2018 https://www.klimaland.bz/wp-content/uploads/Klimareport_it.pdf

Haslinger, K. *et al.* Contradictory signal in future surface water availability in Austria: **increase on average** vs. higher **probability of droughts**. *Egusphere* **2022**, 1–28 (2022). <https://dx.doi.org/10.5194/egusphere-2022-191>

How will change mountains runoff production?



- **Changes in alpine rivers runoff regime:** Summer: reduction of discharge Winter: increased runoff
- Evaporation increase: more "green" and less "blue" water during warmers summers

Increasing drought risk in the Alps ?

Increased climate variability
+
Increased temperature and evapotranspiration
+
Reduction of the snowpack
=
Increased risk of drought

Snow cover, December 2017



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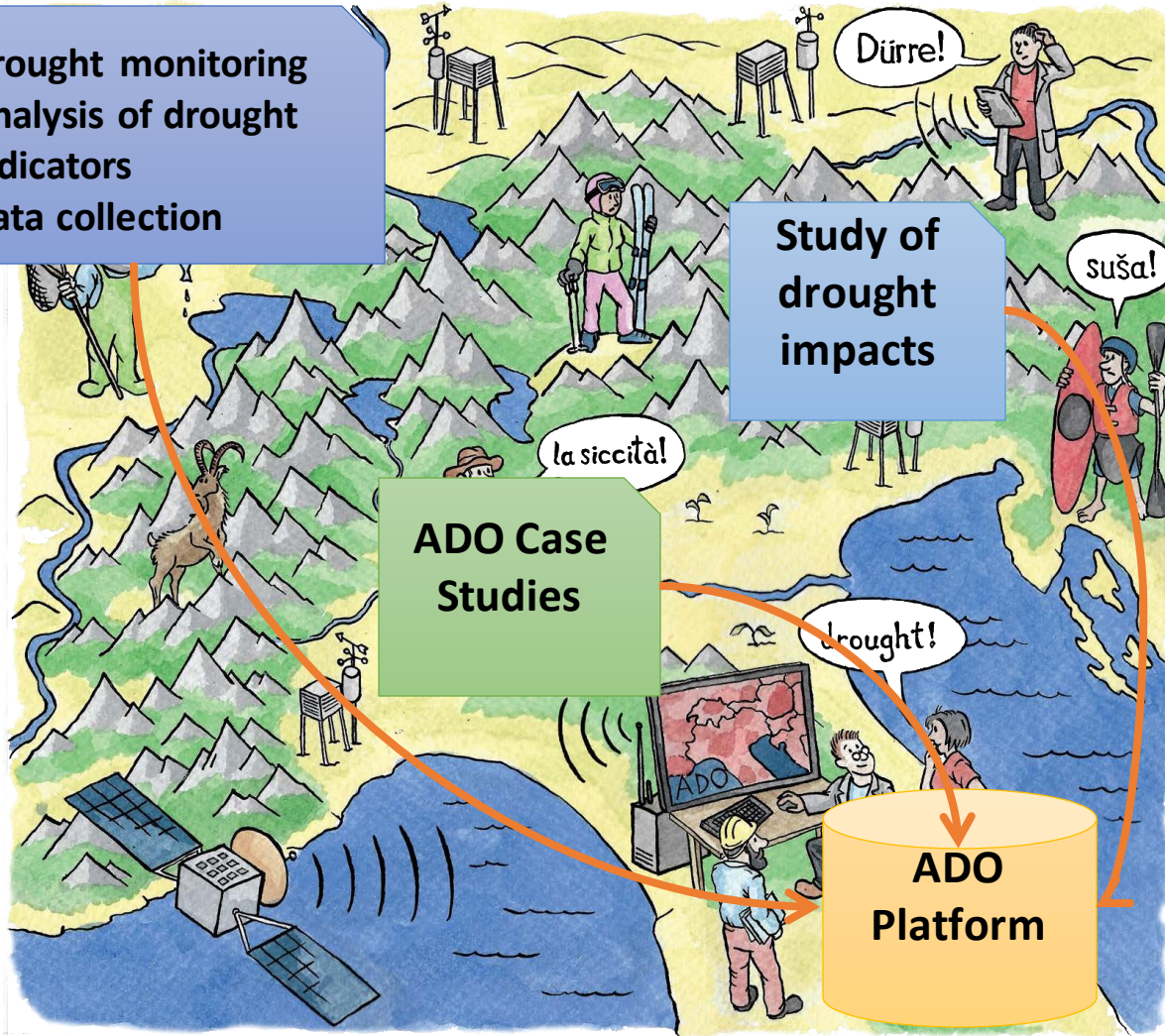


Italiadomani
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

This study was carried out within the RETURN Extended Partnership and received funding from the European Union Next-GenerationEU (National Recovery and Resilience Plan – NRRP, Mission 4, Component 2, Investment 1.3 – D.D. 1243 2/8/2022, PE0000005)

The Alpine Drought Observatory project

- Drought monitoring
- Analysis of drought indicators
- Data collection



Study of
drought
impacts

ADO Case
Studies

ADO
Platform

Project goals

Alpine-wide mapping of meteorological, hydrological and agricultural droughts

Drought **Impacts** analysis

Methods for assessing drought **risk** and **economic** impacts

ADO Web data **Platform**

Recommendations and guidelines for better drought management

Data collection and harmonization



From reanalysis (ERA5):

- Total precipitation
- Wind speed
- Relative Humidity
- Temperature
- Solar/Thermal Radiation

Derived variables:

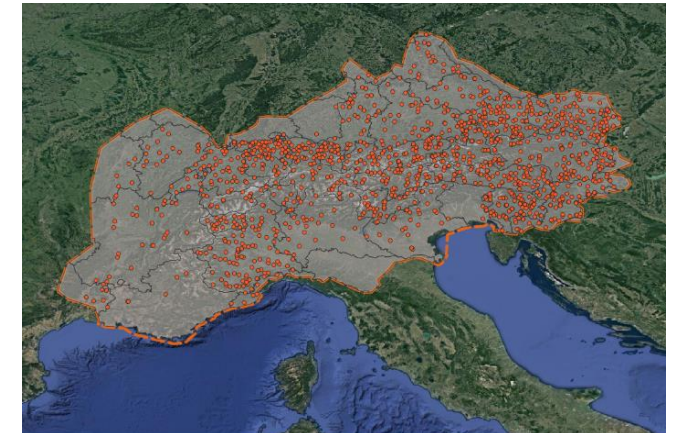
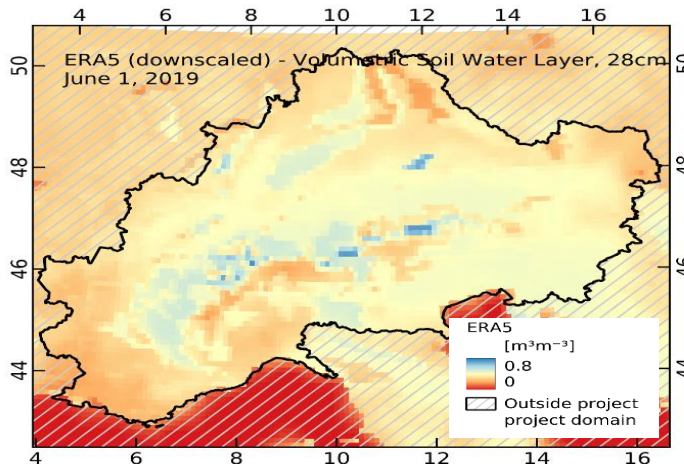
- Potential Evapotranspiration (Penman-Monteith)
- Snow-Water-Equivalent (Snowgrid)

From satellite:

- MODIS optical and thermal imagery
- Soil moisture
- Vegetation: NDVI, VHI, ...

In-situ:

- Alpine wide river gauging data



Selected drought indexes

ATMOSPHERE



1. Precipitation Anomalies (%)



2. Standardised Precipitation Index (SPI)



TOP-SOIL



3. Standardised Precipitation-
Evapotranspiration Index (SPEI)



4. Soil Moisture Anomalies



VEGETATION HEALTH



5. Normalized Difference Vegetation Index (NDVI)



6. Vegetation Health Index (VHI)



SNOW WATER



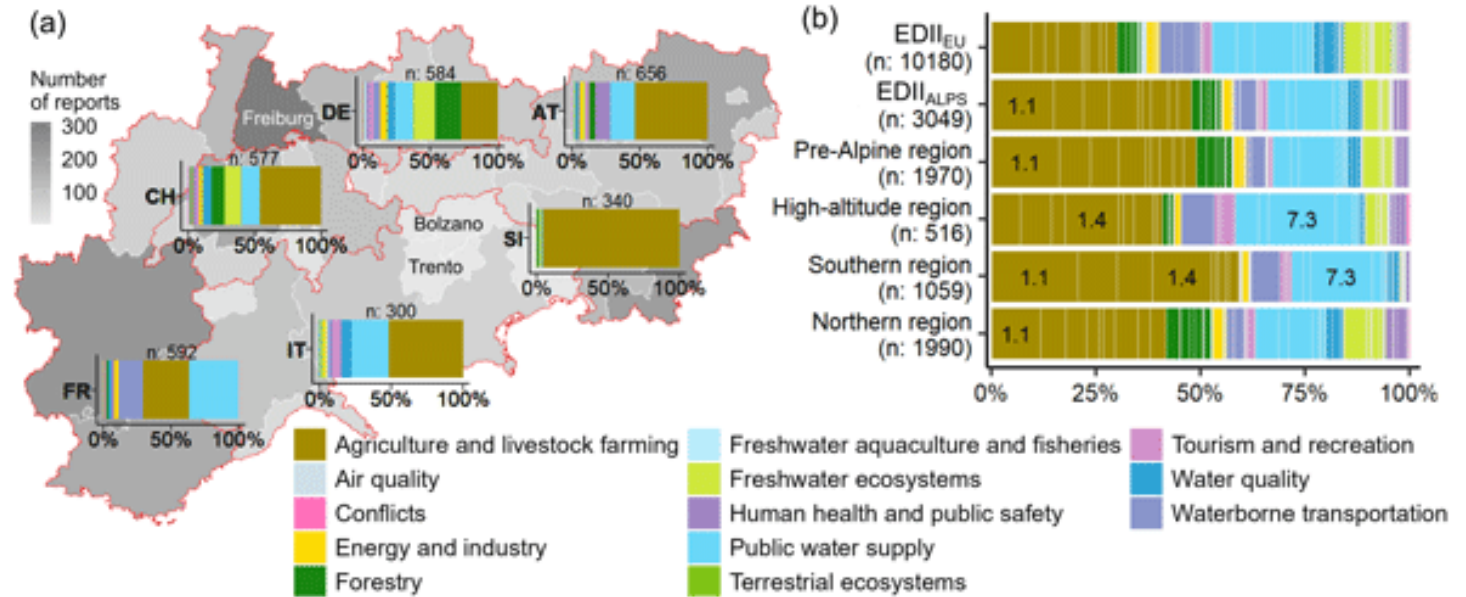
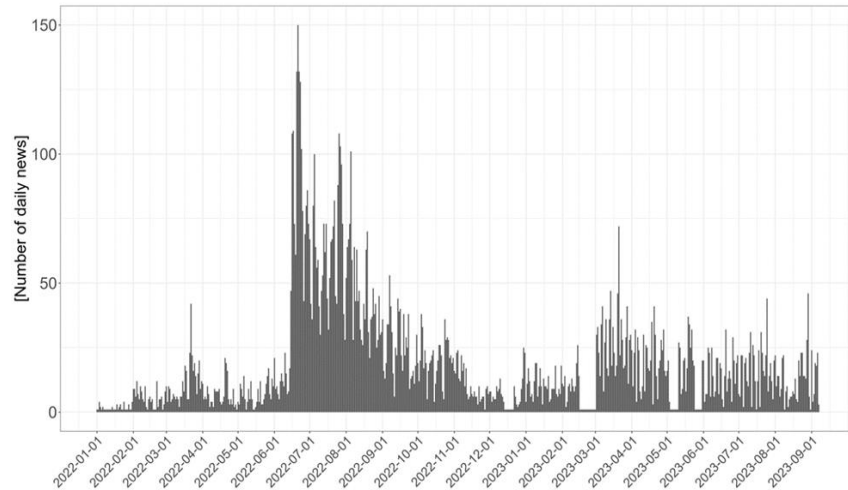
7. Standardised Snowpack Index (SSPI)



8. Hydrological Indices (SDI, SSII, ...)



Impacts of drought



- Alpine drought impact database
- It observes correctly 2022-23 drought

- EDII (European Atlas of Drought Impacts) methodology:
- Web search by keywords updated weekly starting in 2022
- Store Asset Title, Date, Link

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/>



The ADO web platform

<https://ado.eurac.edu/>

Extremely dry
Very dry
Moderately dry
Normal
Moderately wet
Very wet
Extremely wet

SPEI-6 - Standardized Precipitation and Evapotranspiration Index - 6

2022-03-23



SPEI-1 SPEI-2 SPEI-3 **SPEI-6** SPEI-12 SPI-1 SPI-3 SPI-6 SPI-12 SSPI-10 CDI SMA VCI VHI

Indicies

Impacts

Nuts 3 Level

Nuts 2 Level

Hydro

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



MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE



ALPENKONVENTION
CONVENTION ALPINE
ALPSKA KONVENCIJA
CONVENZIONE DELLE ALPI

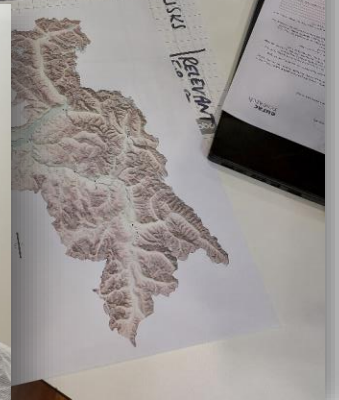
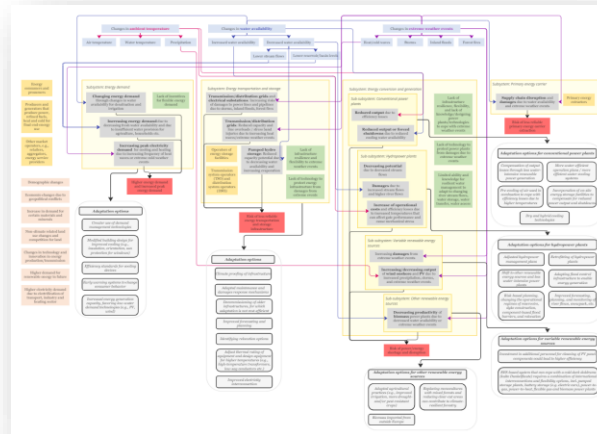
THE ALPINE
CONVENTION
IS THE FIRST
INTERNATIONAL
TREATY FOR THE
PROTECTION
AND PROMOTION
OF A CROSS-BORDER
MOUNTAINOUS
REGION
Italian delegation
alpine convention

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research



EURAC Research Perspectives

- **PNRR RETURN** Multi-risk science for resilient communities under a changing climate
- [Interreg Alpine Space](#) Water Drop – medium term forecast
- Bolzano Province Climate Change **Adaptation Strategy**



Wrap - up

Lessons learned

Several monitoring platforms in place, but **regional** or **continental**.

Little use of **snowpack** and accumulation information for water resources **prediction**.

Need of better link **meteorological**, **hydrological**, **agricultural** information.

Fragmentation of information, especially on hydrology and drought impacts.

Very complex **institutional** water management framework leads to **conflicts**.

Future scenarios

Reduction of water resources (especially in summer)

Increased water needs in agriculture (irrigation) and tourism (artificial snow)

Possible **exacerbation of conflicts** over the use of water resources.



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Thank you for your attention!

THE RESULTS PRESENTED IN THIS STUDY WERE PARTLY SUPPORTED
BY THE INTERREG ALPINE SPACE ADO PROJECT AND THE PNRR
RETURN PROJECT

<https://ado.eurac.edu/>



This study was carried out within the RETURN Extended Partnership and received funding from the European Union Next-GenerationEU (National Recovery and Resilience Plan – NRRP, Mission 4, Component 2, Investment 1.3 – D.D. 1243 2/8/2022, PE0000005)



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Water management: what to do

- **Adaptation** measures:
 - Investments in **water-saving** measures, e.g. through efficient forms of irrigation in agriculture, **optimisation** of **networks**. and consortia or the creation of **new reservoirs**.
 - Management of **mixed-use hydroelectric** reservoirs (irrigation and drinking water).
 - **Proactive** management of water crises based on **quantitative data**.
 - Explicitly introduce the impacts and **risks related to climate change** in sector **planning** and in the granting of new water **concessions**.

