

Case study

The 2021-2022 snow deficit in Italy



Francesco Avanzi (1), Simone Gabellani (1), Luca Pulvirenti (1),
Alexander Toniazzo (2), Alessandra Mascitelli (2), Silvia Puca (2) and the H SAF TEAM

1. CIMA Research Foundation
2. Italian Civil Protection Department

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Short Introduction

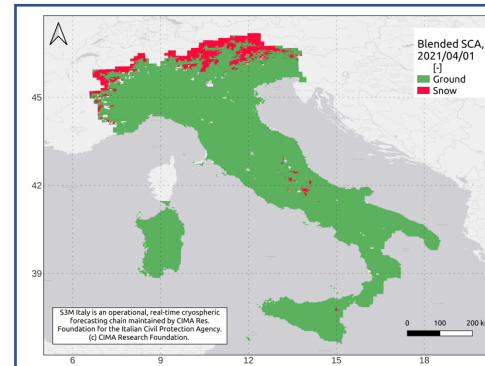
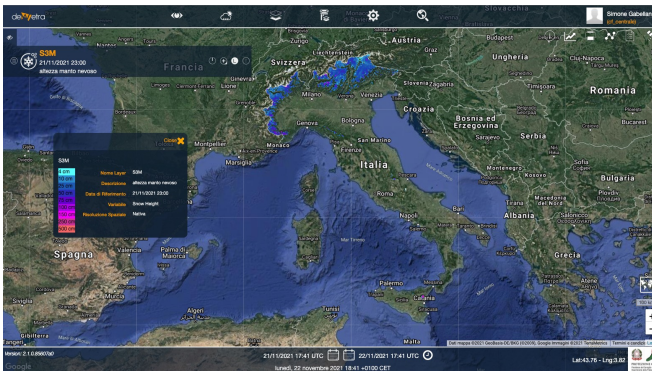
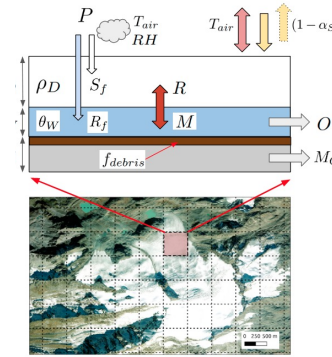
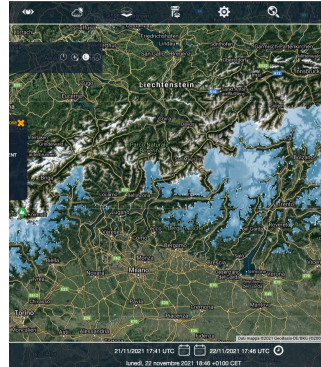


Between fall **2021** and winter **2022**, Italy experienced a **very dry and warm period**, which led to a significant negative anomaly in snow accumulation. Even spring 2022 saw severe precipitation deficits, causing one of the most severe droughts that Italy experienced over the recent decades.

Monitoring snow from a quantitative perspective is crucial to support decision makers in identifying anticipatory actions. Reliable information in this sense can only come from the integration of multiple data sources: ground observations, dynamic modelling, and satellites.

Satellite observations, as delivered from H SAF products, effectively contributed to the monitoring of water accumulated in winter and stored in the snowpack at Italian scale during 2022, as part of an operational chain called S3M Italy.

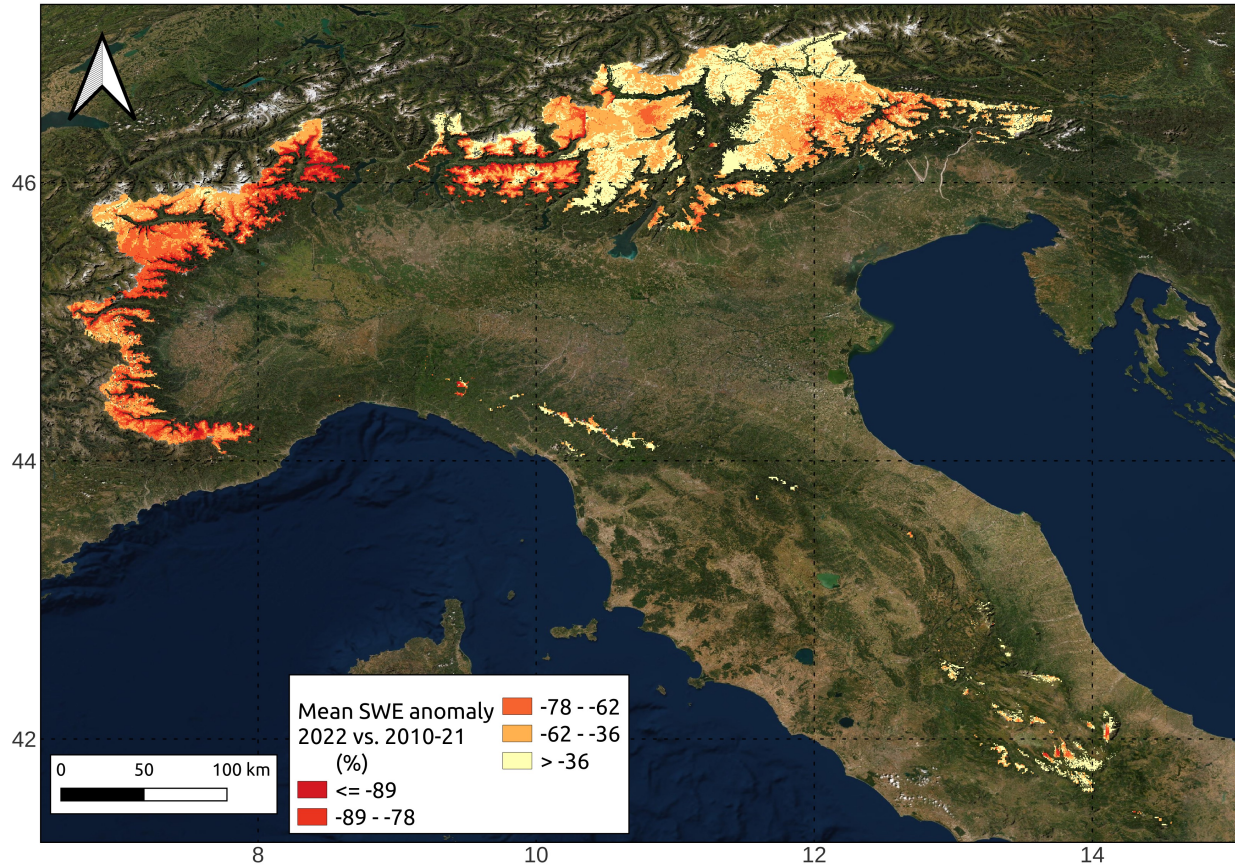
Satellite product for operational snow modelling



Satellite Snow
 Cover by blending
 Sentinel 2,
 MODIS, H-SAF
 (SE-E-SEVIRI) data

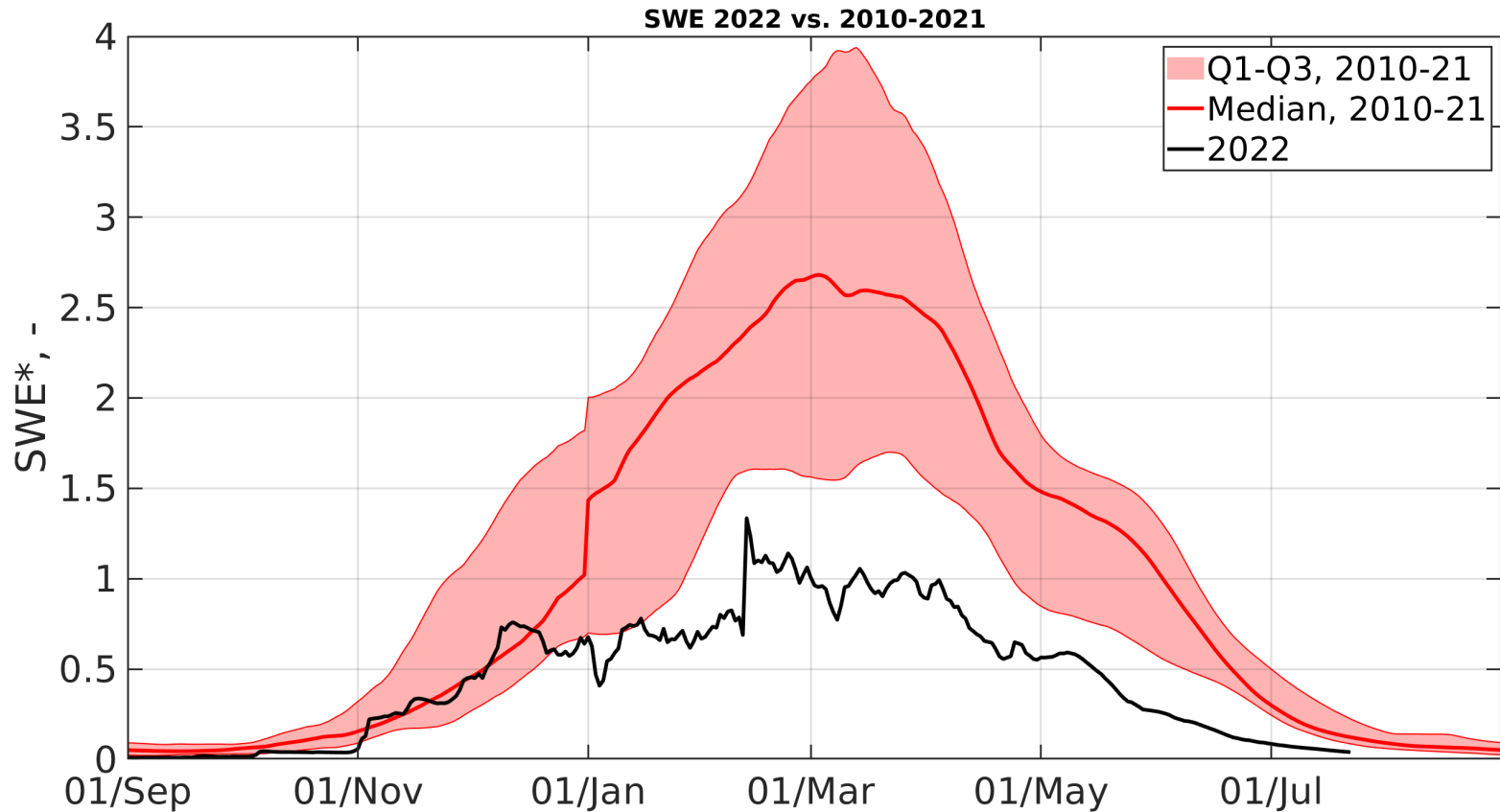
The Italian Civil Protection in Italy uses an **operational** cryospheric model (S3M) driven by ground observation and satellite Sentinel 2, MODIS, **H-SAF (SE-E-SEVIRI)** data. S3M-Italy models snow depth, snow water equivalent, snow density, snow albedo and glacier melting.

Snow Deficit



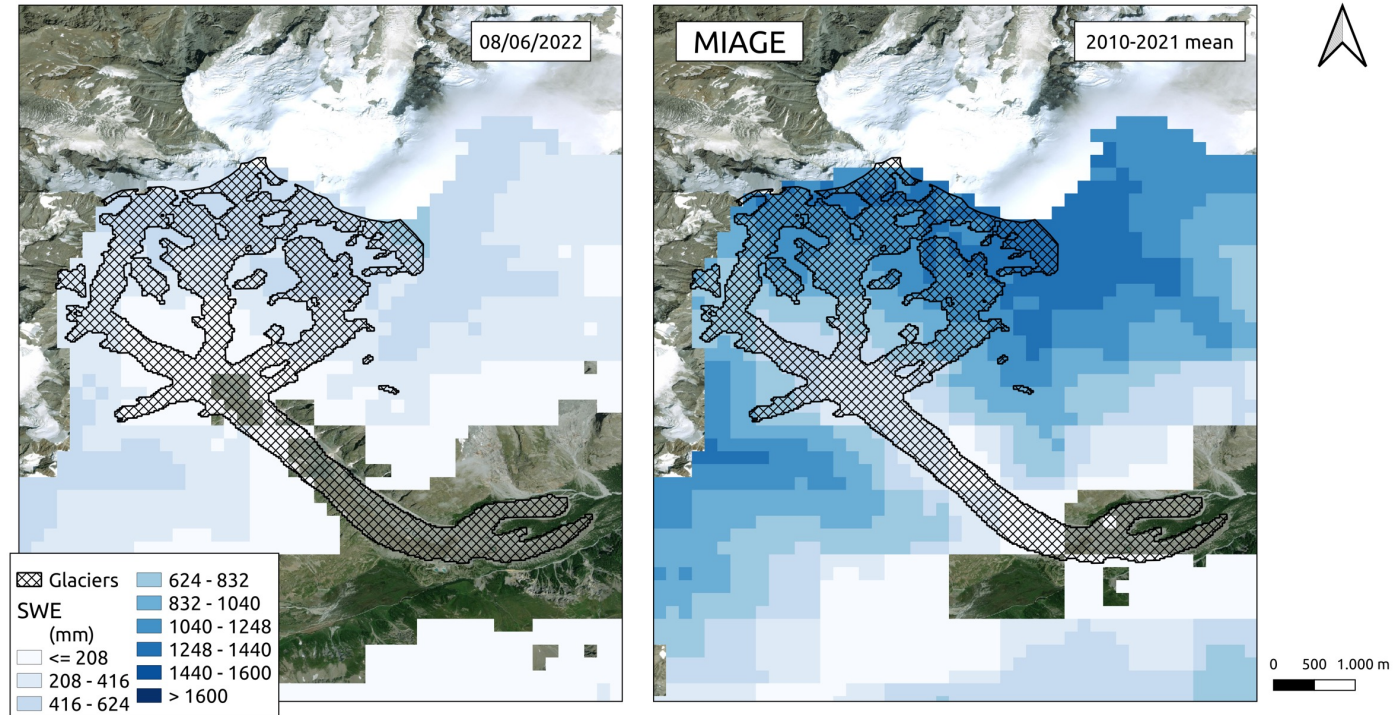
Snow water equivalent anomaly for 2021-2022 vs. 2010-21. SWE was estimated from the combination of physical modelling, ground data, and satellite data. The seasonal deficit was particularly significant in north-western Italy (even -80% or more) and gradually less intense in north-eastern and central Italy (background: ESRI satellite theme).

Snow Deficit



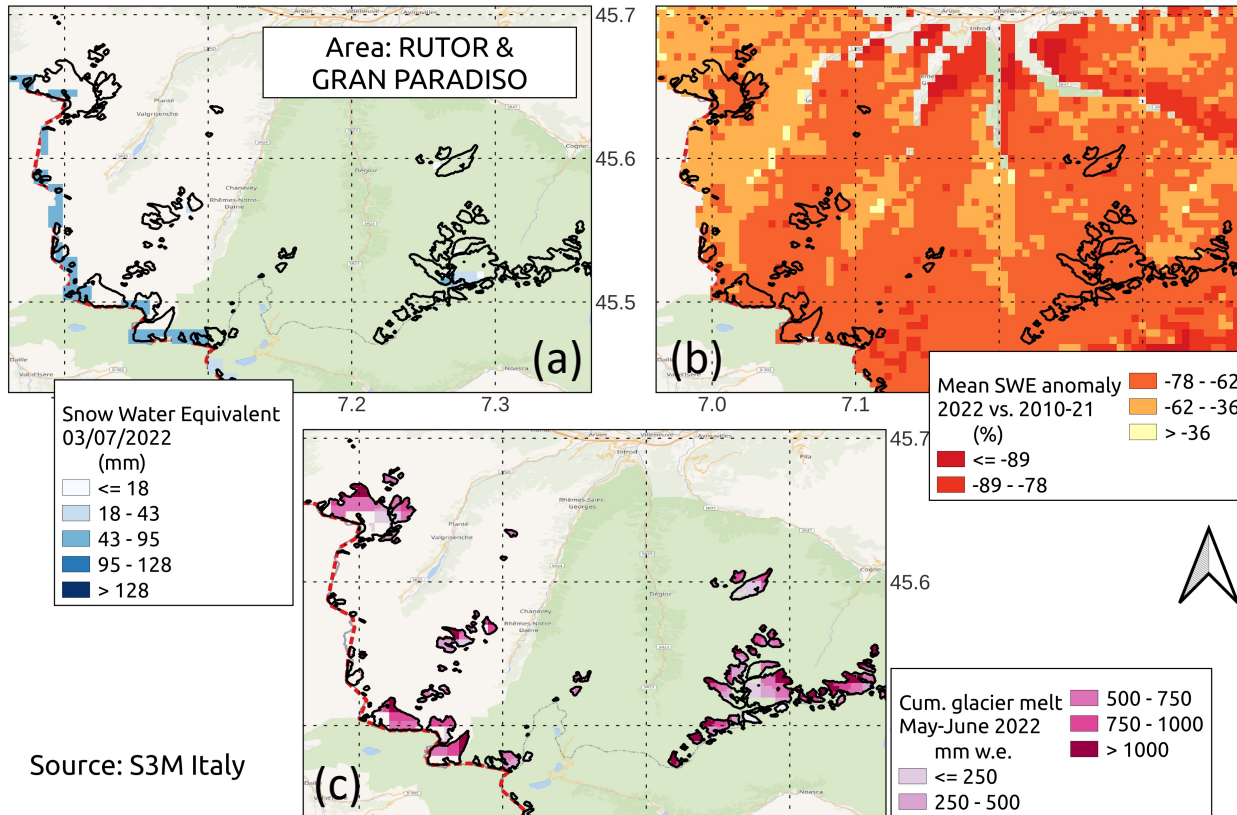
Normalized Snow Water Equivalent in northern Italy. The black line is 2021-2022, while the red area delimits the two quartiles of the 2010-21 climatology. Since January, we have observed a clear deficit in SWE, which has remained stably below the first quartile and has depleted much earlier than usual.

Impact on glaciers



In addition to water deficit, scarce winter snow meant that, as early as June, many Italian glaciers had already lost snow cover and were therefore subject to possible early melt. The picture shows an example from the Miage glacier (Mony Blanc massif): on the left, snow water equivalent for 08/June/2022; on the right, mean snow water equivalent (2010-21, background is the ESRI satellite theme).

Impact on glaciers



Gran Paradiso and Rutor, Aosta valley: (a) Snow water equivalent at the beginning of July; (b) Snow water equivalent mean seasonal anomaly; (c) Cumulative glacier melt, May to June (background: Open Street Map).

Summary and conclusion

- Satellite products from **H SAF contribute to operational snow monitoring in Italy.**
- The combination of satellite data, ground observations, and physical modelling leads to operational, real time, and reliable distributed information.
- Availability of satellite data and observations over the last 12 years allowed us to compute anomalies in water stored in snowpack in 2022.
- The analysis on snow was included in the European Drought observatory report on drought in Italy https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202203_Northern_Italy.pdf

