

High Resolution Snow and Ice Monitoring

Observed Events & Application Areas











Optimising hydropower production in the context of climate change

While Europe is impacted by more frequent extreme hydrological events such as severe droughts or devastating floods, being able to accurately manage water resources and hydropower production is a growing challenge.

At higher elevations, hydropower managers rely on hydrological models to monitor and predict the inflows to their reservoirs or dams. Water is stored in the form of solid precipitation which, after several weeks, starts to melt and contributes largely to the filling of these reservoirs. In these hard-toreach areas, carrying out in-situ measurements is infrequent and difficult, which is why near real-time satellite observations are very useful for estimating the volume of water that is expected to discharge into reservoirs.



Emosson lake in Swiss (S. Mauroux)



SWE and inflows for the Emosson catchment (from WEGAW)

Through a fusion of geospatial datasets - model outputs, in-situ and remote sensing data like snow cover products (FSC) - and latest machine learning methods, <u>Wegaw</u> helps companies around the world to optimize assets by better monitoring and forecasting water and snow resources. With Wegaw's daily Snow Water Equivalent maps integrated into flow forecasting models, energy production companies and asset managers can improve the accuracy of long-term trading decisions and optimise the management of renewable energy production schedules.









A heavy snowstorm in Austria

There was heavy snowfall in Austria in the second week of December 2021. In some parts of Eastern Austria, the snowfall was <u>heaviest in nine years</u>. Here is an example from <u>East Tyrol</u> where about 50 to 60 cm of snowfall was reported. The situation of the snow cover can be monitored using the Gap-filled Fractional Snow Cover (GFSC) product. On the left, there is an image before the snowstorm and on the right bottom after the snowstorm.

According to the images, the snow cover around the town has turned back to the state before the storm on 16.12.2022. The change in the GFSC can be seen in <u>WekEo data viewer</u> by tapping the GFSC images.











"Ice Road" over Pielinen Lake

Rivers have always been one of the important pathways for trading and transport. Within Europe <u>37,000 kilometres</u> of inland waterways connect cities. The EU member states share an interconnected waterway network. <u>524 million tonnes of goods</u> were transported in 2021, with the biggest rivers Rhine and Danube just mentioned as the two most important inland waterways in Europe [\bar{Z}] River and lake ice during winter conditions can hinder optimal trade shipping. In contrast in Northern Europe during wintertime, frozen rivers and lakes are even a part of the traffic road network [\bar{Z}]. For general car traffic selected rivers and lakes are carrying winter roads on top of that frozen river and lake ice.

It is evident that for both examples of <u>transport planning</u> sufficient knowledge about river ice conditions is needed. In order to address such questions satellite remote sensing and its derived products offer great opportunities.

The River and Lake Ice Extent (RLIE) by Copernicus based on the Sentinel 1 and 2 satellite missions provides highly resolved information on surface water conditions of rivers and lakes. Those highly resolved datasets set a base for the development of all kinds of new services and applications, which can <u>support</u> the shipping industry or other sectors related to frozen inland waters.

An example of an RLIE HRSI product tile from the S1 and the S2 combination is shown below. The selected location is situated in central Finland at the Pielinen lake (63.16°N, 29.87°E).











The winter ice road is opened at winter conditions between the villages Koli, location Koli camping site (63.15061°N, 29.8457°E) and Vuonislahti, location Vuonislahti pier (63.1541°N, 29.9806°E). An <u>ice thickness of more than 40 cm</u> to be able to bear car traffic. See which information on lake ice RLIE products from March 2022 can provide.



HRSI RLIE tile T35VPL from S1+S2 combination: ice-covered pixels in cyan; clouds in grey



Information on product quality: all pixels in green stating good products quality for the date 22.03.2022.









How does snow cover affect the breeding of white-winged snowfinches?

The white-winged snowfinch (*Montifringilla nivalis*) lives in high elevations in central and southern Europe. They carefully look for a place to breed with a subtle balance between security from predators, microclimate and proximity to food. As <u>snow cover</u> <u>plays a major role in foraging conditions</u>, remote monitoring its extent through HR-S&I products is of very interest to complement observations on the field and enrich studies as those realised by the <u>Swiss Ornithological Institute</u>.



Spring snowmelt has generally become faster in mountain areas and high spatial resolution FSC/GFSC products support studies to better understand <u>how this climate-sensitive species can</u> <u>adapt</u> to changing environmental conditions.

> Species distribution in Europe (Brambilia et al., 2020) White-winged snowfinch (Beat Rüegger) Study site in the Swiss Alos (Carole A. Niflenegger)













CLMS Web Portal



FAQ





WEkEO Data Viewer



Product Catalogue

Have you been using HR S&I data? Tell us about your application by <u>submitting the use case form</u> or by emailing us at copernicus.land@eea.europa.eu.

Abbreviations

CLMS: Copernicus Land Monitoring Service HRSI: High Resolution Snow and Ice FSC: Fractional Snow Cover GFSC: Gap-filled Fractional Snow Cover RLIE: River and Lake Ice Extent ARLIE: Aggregated River and Lake Ice Extent SWE: Snow Water Equivalent EU: European Union S1: Sentinel-1 S2: Sentinel-2 PSA: Persistent Snow Area WDS: Wet/Dry Snow SWS: SAR Wet Snow





