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ESTIMATING SNOW LOAD DATA USING COPERNICUS AND IN-SITU DATA

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> The snow load service for Bavaria is suitable as a planning tool for the use cases of the situation service of the Bavarian regional association and is used in daily work
>
> **Markus Stempfel**
> THW Bavaria

Disaster response personnel removing snow from a rooftop | Credits: ILS-Traunstein

Characterizing the spatial distribution of extreme snow load values is crucial in estimating their impacts on human livelihoods at present and in the future. The FPCUP SNOWLOADS action utilizes Copernicus, as well as in-situ data, to accurately predict and provide Europe-wide and regional snow load climatological information.

THE CHALLENGE

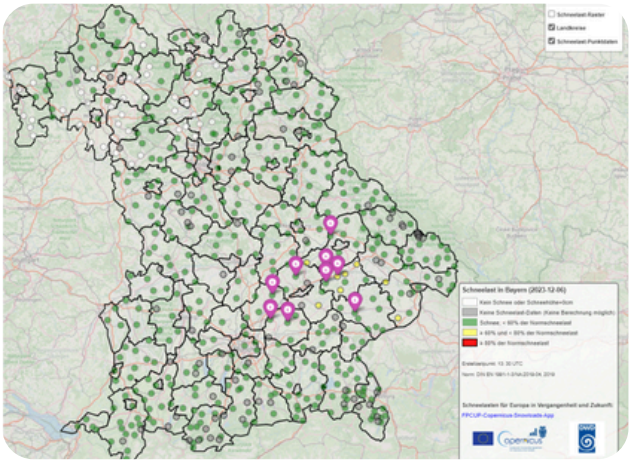
Snow loads can have significant adverse impacts on buildings and technical infrastructure. They can also cause considerable environmental damage, for example, to forests. Although snow statistics from meteorological data, such as the maximum annual snowfall or the snow depth event likely to occur once in 50 years, are relatively easy to determine, they are insufficient for understanding snow loads in the past, present, and future. To determine the snow load, knowledge of snow water equivalent (SWE) is required. SWE is the amount of water in a given volume of snow and is therefore directly related to its mass. This value is less straightforward, as it is not measured in every country with a satisfactory spatial or temporal resolution. However, to minimize the risk and impact of snow-related damage, it is essential to accurately characterize the spatial distribution and magnitude of SWE, thereby determining the resulting snow load.

THE SPACE SOLUTIONS

FPCUP SNOWLOADS, with partners from Germany, France, Finland, and Italy, addressed this topic through the joint development of a user-oriented FPCUP SNOWLOADS C3S app along with downstream services that provide Europe-wide and local climatological information on snow load.

The app and the downstream service for the region of Bavaria are based on the reanalysis and modeling of SWE derived from Copernicus data, as well as local in-situ data, providing spatially exhaustive information. Finding a good dataset with indicators for snow depth and SWE on a European scale can be particularly challenging. Fortunately, the 'Mountain Tourism Meteorological and Snow Indicators' dataset, provided by the Copernicus Climate Change Service (C3S) through the Climate Data Store (CDS), allows a comprehensive derivation of climatological snow load data over the whole of Europe and also provides a reasonable basis for estimating future snow load using climate projections.

For modeling the spatial distribution of snow load with a higher resolution in Bavaria, elevation plays a critical role as it directly affects temperature and precipitation patterns, making a precise DEM essential for accurate spatial interpolation. The Copernicus DEM 30-Global is particularly well-suited for this purpose due to its high spatial resolution and global consistency.



Example of interactive map of snow load information system Bavaria | Screenshot; Credit: DWD

THEMATIC AREA

Transports, Civil Infrastructure and Safety

REGION OF APPLICATION

Bavaria

SENTINEL MISSION USED

-

COPERNICUS SERVICE USED

C3S

THE BENEFITS AND THE BENEFICIARIES

The downstream service for Bavaria aims to provide current snow load data, enabling efficient responses to high snow load events, primarily targeting disaster agencies and response teams responsible for municipalities in Bavaria.

The current version provides snow load information as point data from measured snow depths and modeled SWE, along with a higher-resolution snow load grid (1 x 1 km^2). The service was developed in close collaboration with stakeholders in Bavaria and is already being used by, for example, municipal offices for disaster prevention.

As an additional feature, the service contextualizes high snow load events within the framework of climate change, utilizing data from the FPCUP SNOWLOADS C3S app.

The app provides an interactive map of the SWE likely to occur once in 50 years under the current climate, as well as for future scenarios. It enables end-users to visualize regional data depending on elevation and location

The app has already been used by stakeholders from the standardization community, for instance, as the recently finalized second generation of Eurocode standards demands an analysis of both the present and future snow loads.

By combining the information from these two services, the characterization of the spatial distribution of snow loads, both currently and in the future, can be achieved. Therefore, regional and local solutions can be efficiently implemented by civil engineers, as well as within catastrophe prevention, disaster risk management, and the mitigation of climate change impacts —a key component of the Paris Agreement and the 2050 Climate Action Plan.

	TIER 1 SERVICE PROVIDER	TIER 2 PRIMARY USER	TIER 3 SECONDARY USER	TIER 4 END USER BENEFICIARIES
SERVICES AND BENEFITS	Copernicus DEM GLO-30 for Europe, CDS (UERRA, MTMSI)	Downstream service for snow loads in Bavaria; FPCUP SNOWLOADS C3S app for SWE data under current and future climate conditions	Downstream service for snow load grids in Bavaria	Spatial distribution of snow loads (present and future), use in civil engineering, catastrophe prevention, disaster risk management, mitigation of climate change impacts
BENEFICIARIES	DWD in collaboration with CNRS, FMI and POLIMI	DWD, Federal authorities on both regional and national level, Federal Agency for Technical Relief (THW)	Federal authorities on all levels, authorities for civil protection, civil engineering consultants, disaster risk management and climate change management	Civil engineering consultants, service providers (e.g. telecom and transport provider), agricultural and forestry sector, broader society

EU POLICY / DIRECTIVE

Climate Action Policy

TYPE OF SERVICE PROVIDER

Public Service

TYPE OF FUNDING SOURCE

Other

USAGE MATURITY LEVEL

3



A FUTURE WITH COPERNICUS

FPCUP SNOWLOADS finally focuses on the ongoing dissemination of services to various stakeholders, such as the standardization community, local and municipal authorities, as well as disaster response teams



DID YOU KNOW?

Two snow packs of the same volume can have different weights. Why? Because different layers can differ in their water content, resulting in variable snow densities.

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