



## Analysing long-term (1991-2021) daily records of Snow Water Equivalent in the Po River District, Italy

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Snow is a critical component of the mountain cryosphere and plays a significant role in shaping the hydrology of the snow-fed basins during summer months. The snowpack serves as a vital water reservoir, accumulating during the wintertime and gradually releasing water during the melt season, to sustain the downstream water demands. Snow is highly sensitive to climate change, particularly in low- and mid-elevation mountain regions like the European Alps.

We present an analysis of a long-term (30 years) dataset of snow water equivalent (SWE) in the Po River district, Italy, which partially covers the mountain ranges of Alps and Apennines from 1991 to 2021. The dataset is available at a spatial resolution of 500x500m and at a daily time step. It was created using a hybrid modelling approach called “J-Snow” that integrates the physically based GEOTop model and assimilation of in-situ snow height data and Earth Observation snow products like MODIS snow cover data.

The Po River basin is the largest in Italy and is considered to be the second most sensitive river basin in Europe after the Rhone basin. In recent years, the Po River basin experienced several droughts, including a recent one in 2022. Therefore, these kinds of long-term spatial datasets help to monitor and analyse the spatial and temporal changes in the SWE and provide vital insights for addressing the snow drought alerts in the study region.

In this study, we analysed several snow phenology metrics that includes snow persistence, first snow date (FSD), snow disappearance date (SDD), peak SWE volume, peak SWE timing, and regional snow line elevation. Our initial results show that the long-term spatially averaged volume of water and snow-covered area are 3.34 Gm<sup>3</sup> and 15471 Km<sup>2</sup>, respectively. Additionally, elevation-wise analysis of the snow phenology metrics show that most changes occur in the low-elevation bands (0-2000 m a.s.l). Changes in snow-water storage start, snowmelt timing, and its variability can directly affect the water availability in snow-fed basins, with significant implications for both ecosystems and human populations.