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Snowload in the Bulgarian mountains: assessment from snow-cover modelling

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Mountains in Bulgaria represent more than 30% of the territory of the country. The snow accumulated there acts as significant load on buildings and constructions, especially on places where large snow depth is expected. Knowledge about maximum possible snow loads is thus very important in construction design. In 2009 a contract between the Bulgarian National Institute for Meteorology and Hydrology (NIMH) and the Ministry of Regional Development and Public Works (MRRB) for the implementations of the Eurocodes in Bulgaria related to meteorological loads was completed. Eurocodes now take account of meteorological loads with return periods up to 50 years. Despite the results of several field campaigns showing the relationship between altitude, snow depth, and snow water equivalent (SWE), it was decided not to include regions above 1200 m a.s.l. in the snow load map. The complexity of the terrain in these regions thus requires case by case assessments. The present study aimed at filling this gap by using snow-cover models for detailed evaluations.

Snow load is intimately linked to SWE, which is the mass of snow per unit area. Snow-cover models of varying complexity driven by suitable input data can simulate SWE quite accurately, particularly at the point scale, where we can quite easily compare simulations with measurements. This is less obvious for larger areas. In this context one has to take into account altitudinal gradients or the effect of spatial variability that may smear out as the spatial scale increases. On the other hand, studies in small catchments reveal the importance of small scale variability and dynamical effects, questioning the representativeness of point measurements for an entire region. These two points are of great importance to snow load though. At higher elevations, the network of meteorological stations is less dense and model approaches are hampered by a lack of relevant and good input data. Furthermore, assessment of maximal snow load depends on long term series of maximal SWE to determine the return period. This puts additional constraints as input data should be available over long periods of time and one may think of using reanalysis data to solve this problem. It is thus most appropriate to use a combination of measurements, numerical models, and statistical approaches to make a step forward with regards to long term SWE and snow load assessments.

To address the above challenges, we have adapted the Swiss snow-cover model SNOWPACK to Bulgarian conditions. We use data from synoptic stations to calculate model snow depth and SWE outputs. These are then compared to a comprehensive set of measurements that have been collected at four mountain meteorological stations in Bulgaria for the period of 8 winters – 2008/09 – 2015/16. We have also performed first simulations with the ERA-Interim reanalysis of the European Centre for Medium-Range Weather Forecasts for the same period. This will then be used to reconstruct time series of snow load based on modelled SWE.

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