



## **Modelling high-resolution snow cover precipitation supply for German river catchments with SNOW 4**

Uwe Böhm, Thomas Reich, Gerold Schneider, and Anett Fiedler

Deutscher Wetterdienst, Hydrometeorology, Berlin, Germany (uwe.boehm@dwd.de)

Formation of snow cover causes a delayed response of surface to precipitation. Both melting of snow and release of liquid water retained within the snow cover form precipitation supply which contributes to runoff and infiltration. The model SNOW 4 is developed to simulate snow cover accumulation and depletion and the resulting precipitation supply on a regular grid. The core of the model is formed by a set of equations which describe the snow cover energy and mass balance. The snow surface energy balance is calculated as a result of the radiation balance and the heat fluxes between atmosphere, soil and snow cover. The available melting heat enters the mass balance computation part of the model and melting of snow or freezing of liquid water within the snow layer takes place depending on its sign. Retention, aging and snow cover regeneration are taken into consideration.

The model runs operationally 4 times a day and provides both a snow cover and precipitation supply analysis for the last 30 hours and a forecast for up to 72 hours.

For the 30-hour analysis, regionalised observations are used both to define the initial state and force the model. Hourly measurements of air temperature, water vapour pressure, wind speed, global radiation or sunshine duration and precipitation are interpolated to the model grid. For the forecast period, SNOW 4 obtains the required input data from the operational products of the COSMO-EU weather forecast model.

The size of a grid box is 1km<sup>2</sup>. The model area covers a region of 1100x1000km<sup>2</sup> and includes the catchments of the German rivers completely. The internal time step is set to 1 hour. Once a day, the compliance between model and regionalized snow cover data is assessed. If discrepancies exceed certain thresholds, the model must be adjusted by a weighted approach towards the observations.

The model simulations are updated every six hours based on the most recent observations and weather forecasts. The model works operationally since the winter 2010/2011. A comprehensive evaluation focussing on water equivalent is performed after each winter period so far and gave evidence for a good overall performance.

SNOW 4 products have so far been in use at the German Federal Institute for Hydrology, the flood forecasting authorities of ten German Länder, the Government of the Austrian Federal Länder of Tirol and Vorarlberg, the Austrian Zentralanstalt für Meteorologie und Geodynamik, the Dutch Rijkswaterstaat Waterdienst and the Polish Institute of Meteorology and Water Management. These customers make use of SNOW 4 results as input for flood warning and short-term forecasting systems.