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## Latest scientific and technical evolutions in the Crocus snowpack model

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This contribution presents an overview of the last stable release of the Crocus detailed snowpack model in the SURFEX opensource modelling platform. It gathers numerous recent scientific and technical developments in a common code version. An explicit representation of the evolution of light absorbing particles mass in snow (e.g. black carbon, mineral dust) allows representing their impact on solar radiation absorption in the snowpack in the visible and near-infrared spectrum through the TARTES optical scheme, and the consequences on all snowpack properties. Crocus is now coupled to the MEB (Multiple Energy Balance) vegetation scheme and can therefore be applied on forested areas. A module of snow management including grooming and snow making can also be optionally activated to simulate the snowpack on ski slopes. Developments used in the French operational system in support of avalanche hazard forecasting were also fully integrated in SURFEX: the SYTRON module for snow erosion and accumulation by the wind and the expert system MEPRa which analyses the mechanical stability of the simulated snowpacks. Finally, an ensemble multiphysics version of the model (ESCROC) was also developed by implementing from 2 to 4 parameterizations from the literature for each physical process represented by an uncertain empirical parameterization. The different combinations enable the quantification of simulations uncertainty required in various applications: future projections of snow cover; sensitivity analyses of a given process; data assimilation of snow observations. Crocus and ESCROC are included in the ESM-SnowMIP model intercomparison and exhibit a robust skill in various climates and environments. Several running-time optimizations were also implemented in the latest release. We present an overview of the current numerical cost with a comparison to more classical snow schemes used in NWP and climate model applications. The code is provided through a git repository and with a simple visualization software to help users to display snowpack internal properties at local scale. On-going works are focused on the implementation of new data assimilation algorithms well suited to the numerical specificities of this scheme. An externalized version for coupling with other surface schemes is currently under development.