On the assimilation of MODIS reflectance into a detailed snowpack model

Luc Charrois (1), Marie Dumont (1), Emmanuel Cosme (2,3), Matthieu Lafaysse (1), Samuel Morin (1), Quentin Libois (2,3,4), Ghislain Picard (2,3)

(1) Météo-France – CNRS, CNRM – GAME (UMR 3589), Centre d'Études de la Neige, Grenoble, France, (2) Univ. Grenoble Alpes, LGGE (UMR5183), 38041 Grenoble, France, (3) CNRS, LGGE (UMR5183), 38041 Grenoble, France, (4) now at: ESCER Centre, Department of Earth and Atmospheric Sciences, Université du Québec à Montréal, 201 Av. du Président-Kennedy, Montréal, H3C3P8, Canada

One of the major sources of uncertainty in detailed snowpack simulations lies in the quality of meteorological forcings. The limited spatial resolution of common reanalysis and forecast data used as inputs for snowpack models usually makes it difficult to simulate the local horizontal heterogeneity of snowpack physical properties, especially in mountainous areas. Using satellite data to incorporate snowpack state observations into the simulations appears as an alluring way to improve the snow simulations, to account for spatial variability and to mitigate the impact of meteorological forcings uncertainties.

This work presents an original study of the impact of the assimilation of visible and near-infrared reflectances into the detailed snowpack model SURFEX/ISBA-Crocus. We performed ensemble simulations by perturbing the atmospheric forcing consistently with its estimated uncertainty. In a first step, we performed assimilation experiments with synthetic imager (MODIS like) observations and a particle filter. The experiments were carried out at Col du Lautaret area (2100 m altitude, French Alps) over 5 hydrologic seasons. They provide a good insight about the potential and limitations of assimilating imager data to improve the representation of the snowpack. In particular, they demonstrate the significance of the temporal distribution of the observation to assimilate. In a second step, we assimilated actual MODIS data and evaluated the impact of the assimilation using snow measurements acquired during one winter season at Col du Lautaret. These real experiments enlighten the need for a relevant screening method for MODIS reflectances.