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Historical snow mapping over Eastern Canada using daily NOAA-AVHRR and SSM/I data for the validation of the Canadian Regional Climate Model

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This work is part of a multidisciplinary study aiming at the validation of the hydrological simulations of the Canadian regional climate model (CRCM) over the province of Quebec and Labrador (Eastern Canada). In this modelling process, snow cover represents a key parameter. And because of their low density, conventional local observation networks do not provide enough accurate data to map snow cover on a large scale and with an adequate spatial resolution for regional climate modelling. Alternatively, this is easily feasible using satellite imagery. However, available satellite snow cover products are unusable for our special needs, because they either have an inadequate spatial resolution or too short observation series. In 2004, two snow mapping algorithms were developed and tested: one using AVHRR imagery and the other using SMM/I data. In order to mitigate the disadvantages related to each type of data: useless AVHRR images due to the presence of cloud cover and insufficient space resolution in the case SMM/I imagery, it was therefore decided to develop a merging procedure of the snow mapping results obtained using both sensors. This procedure allows combining the high space resolution of AVHRR to the capacity of SSM/I to penetrate clouds. Prior to the fusion algorithm implementation, the two individual algorithms have been improved. In the case of the AVHRR algorithm, the classification thresholds are better defined according to the time period. Concerning SSM/I algorithm, its performances were improved using a threshold detection based on emissitivity instead of brightness temperature. The results of the snow mapping using the merging

procedure was validated using snow occurrence observations and this, as well on the spatial and temporal levels. The quantitative analysis was conducted on a dozen of major watershed in Eastern Canada. These basins have been selected according to their specific climatic and physiographical characteristics. The comparison between the merging procedure results and snow occurrence observations showed that the algorithm can detect the surface cover type (snow, no-snow) with a global success rate of 86%. The algorithm identifies the presence or not of snow with a success rate of 83% and 88%, respectively. However, when compared to snow mapping using high resolution imagery (Landsat-TM), the algorithm overestimates the presence of snow especially in the areas dominated by coniferous and mixed forest. Primary compilation of snow mapping results over a selection of watersheds, cut out on the grid of the CRCM, showed that in more than 80% of the cases, the date of the end of the melt season as estimated by the CRCM correspond to conditions where less than 20% of the basin is still covered with snow.