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Satellite Based Probabilistic Snow Cover Extent Mapping (SCE) at Hydro-Québec

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Over 40% of Canada's water resources are in Quebec and Hydro-Quebec has developed potential to become one of the largest producers of hydroelectricity in the world, with a total installed capacity of 36,643 MW. The Hydro-Québec fleet park includes 27 large reservoirs with a combined storage capacity of 176 TWh, and 668 dams and 98 controls. Thus, over 98% of all electricity used to supply the domestic market comes from water resources and the excess output is sold on the wholesale markets. In this perspective the efficient management of water resources is needed and it is based primarily on a good river flow estimation including appropriate hydrological data. Snow on ground is one of the significant variables representing 30% to 40% of its annual energy reserve. More specifically, information on snow cover extent (SCE) and snow water equivalent (SWE) is crucial for hydrological forecasting, particularly in northern regions since the snowmelt provides the water that fills the reservoirs and is subsequently used for hydropower generation.

For several years Hydro Quebec's research institute (IREQ) developed several algorithms to map SCE and SWE. So far all the methods were deterministic. However, given the need to maximize the efficient use of all resources while ensuring reliability, the electrical systems must now be managed taking into account all risks. Since snow cover estimation is based on limited spatial information, it is important to quantify and handle its uncertainty in the hydrological forecasting system.

This paper presents the first results of a probabilistic algorithm for mapping SCE by combining Bayesian mixture of probability distributions and multiple logistic regression models applied to passive microwave data. This approach allows assigning for each grid point, probabilities to the set of the mutually exclusive discrete outcomes: "snow" and "no snow". Its performance was evaluated using the Brier score since it is particularly appropriate to measure the accuracy of probabilistic discrete predictions. The scores were measured by comparing the snow probabilities produced by our models with the Hydro-Québec's snow ground data.