Ruminations on Machine Learning and Snow Mass

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ABSTRACT

Machine learning applications, with particular relevance to terrestrial snow, have received a lot of attention in recent years. Despite all the efforts to harness machine learning in the prediction of snow depth (or SWE), many challenges remain. This presentation highlights commonly used machine learning techniques and will discuss the many perils and pitfalls.

A suite of commonly-used algorithms – support vector machine regression (SVM), Gaussian process regression (GP), ensemble learners (EL), long short-term memory networks (LSTM), and gated recurrent networks (GRU) – focused on time series regression will be presented. The machine learning predictions presented here rely on a mixture of satellite-based measurements of passive microwave radiometry from AMSR-E and AMSR2 or advanced land surface model output from the NASA Land Information System (LIS) as the inputs. All algorithms discussed here employ supervised learning using either ground-based observations from SNOTEL (geophysical space) or passive microwave brightness temperature (observation space) serving as the training targets.

Examples of what does work, and more importantly, what does *not* work, will be presented. This presentation will show that machine learning is not, despite all the marketing, magic. Machine learning is merely applied math. Furthermore, it will be argued that machine learning is not a panacea. However, as more and more snow researchers find machine learning increasingly useful in their research, the trend of machine learning adoption will continue to increase as "big data" grows ever bigger. The goal of this research is to help share ideas and enhance community understanding of machine learning algorithms as applied to terrestrial snow in pursuit of a solution to an ill-posed, underdetermined problem that has vexed the snow community for decades.

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