Enhancement of Snowfall Detection for NOAA Snowfall Product through Machine Learning

Abstract

Snowfall accounts for a large fraction of winter precipitation in mid- and high latitudes. It is also an important indicator of climate change. The NOAA NESDIS operational Snowfall Rate (SFR) product is generated at near real time from a suite of PMW sensors onboard several polar orbiting satellites operated by NOAA and its partner agencies. It estimates liquid equivalent snowfall rate over global land and has been in operation since 2012. The SFR algorithm consists of two main components: snowfall detection (SD) and snowfall rate estimation. The SD algorithm utilizes a logistic regression model which performs well in relatively warm regions but shows inferior performance or is inapplicable under colder weather conditions. The reduced accuracy and lack of retrievals in colder weather are major obstacles to applications in areas where snowfall observations are scarcest such as the western US and most of Alaska. We recently developed machine learning (ML) algorithms to extend SD to extremely cold conditions and to improve its overall performance. We built a global precipitation dataset that consists of collocated ground weather reports, satellite measurements, and NWP model analysis. SD models were developed using several ML techniques and validated globally. We will present the development of the ML SD algorithms for ATMS and MHS sensors and their global validation results. Case study compared with Stage IV radar and gauge combined precipitation rate, NOHRSC hourly snow precipitation and ERA5 hourly snowfall rate reanalysis will also be provided.