Satellite detection of dry and wet snow conditions for improving snowmelt flood forecasts in the Red River basin of the North

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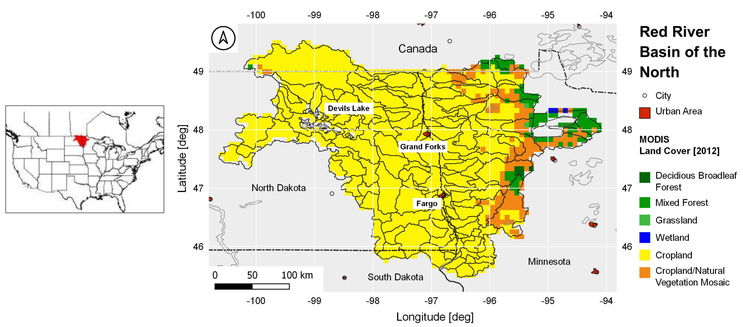
OVERVIEW

Each spring the Red River basin of the North (RRB) is vulnerable to dangerous spring snowmelt floods. NOAA's National Weather Service North Central River Forecast Center (NCRFC) and the University of New Hampshire (UNH) have partnered to improve snowmelt flood predictions for the RRB.

UNH and the NCRFC co-generate NRT (near real-time), daily satellite passive microwave SWE, snow status and soil moisture observations in a format that is readily ingested into the NCRFCs' operational computing environment. While the satellite SWE provides valuable information in this data sparse region, their utility in an operational flood forecasting context is hampered because of wet snow contamination**.**

This poster describes a new quality control (QC) protocol to detect wet snow signal contamination in the RRB. The signal detection scheme's identification of dry and wet snow events is demonstrated using 3 years (2016-2018) of daily, satellite Special Sensor Microwave Imager/Sounder (*SSMIS*) SWE time series data in the RRB.

STUDY AREA



METHODS

A dynamic thresholding algorithm identifies abrupt decreases in the satellite SSMIS SWE time series associated with wet snow. The method also detects sudden SWE increases. Further, the method identifies moderate to extreme changes. Wet snow signals determined by this method are validated with in-situ air temperature, SNODAS snowmelt and satellite SMAP thaw signals from coincident L-band radiometer data. Comparisons of satellite SWE with SNODAS SWE quantify the overall improvement resulting from the application of the wet snow detection algorithm.

DATA

Time period:
- ❑ 3-year period, water years 2016 through 2018

Satellite SWE:
- ❑ 25km, daily, morning overpasses only
- ❑ NRT-SSMIS, Tb19, Tb36 GHz (courtesy of NSIDC)

Satellite Freeze/Thaw (v. 5):
- ❑ 36km, daily, morning overpasses only
- ❑ SMAP Tb1.4 GHz

SNODAS SWE & Snowmelt:
- ❑ 1km, daily NOAA-SNODAS
- ❑ Energy-and-mass balance snow modeling and observed snow data assimilation system for the contiguous U.S.

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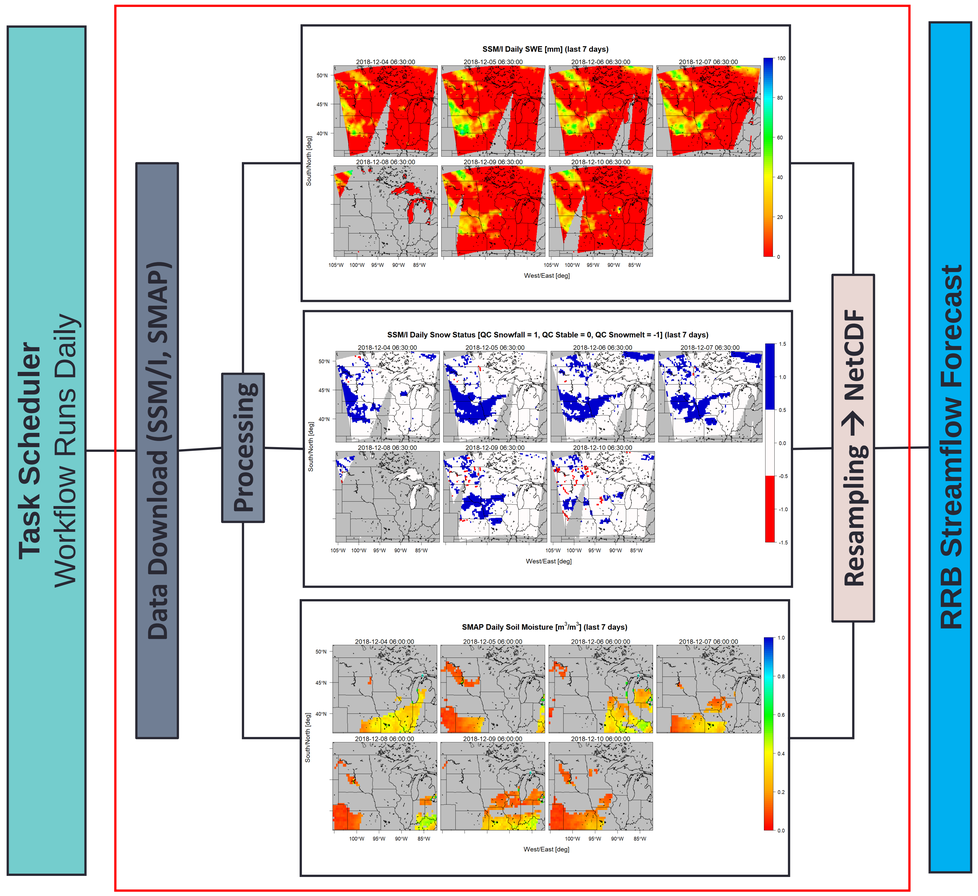
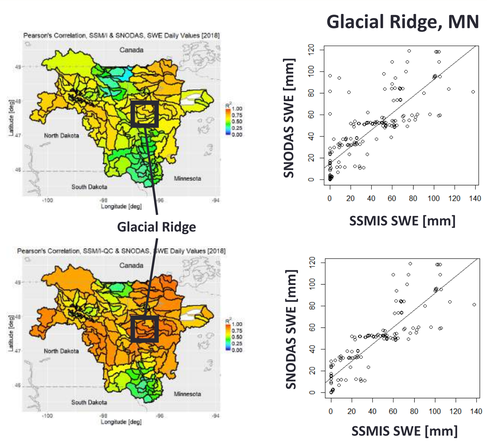
RESULTS

NRT-satellite workflow for the NCRFC domain



Prototype UNH/NCRFC NRT-satellite SWE, snow status and soil moisture workflow for the Red River of the North basin from December 04-10, 2018. Areas in grey have no observations. The workflow is outlined in red.

Before (top) and after (bottom) comparison of SSMIS with SNODAS SWE



CONCLUSIONS

1. NRT-satellite SWE, snow status and SM observations provide value in an operational flood forecasting context particularly in data sparse regions such as the RRB
2. The dynamic thresholding algorithm reliably identifies abrupt decreases in the satellite SWE time series associated with the occurrence of late season snowmelt events as indicated by in-situ air temperature, SMAP thaw and SNODAS snowmelt signals.
3. Before and after comparisons of SSMIS with SNODAS SWE suggest that the newly developed snowmelt detection algorithm can improve the quality of daily satellite SWE observations independent of ancillary data.

Satellite detection of dry and wet snow conditions in 3 forecast basins (2016 – 2018)