

GOESR3 Periodic Reporting

Reporting Period: July 2018 – December 2018 (1st half of FY18 funding cycle)

Team Lead: Pettersen/Kulie

Team Members: Wagner/Heidinger/Walter/Wanzong/Mateling/Beachler

Project Title: An Enhanced Lake-Effect Snow Nowcasting Tool Using Synergistic GOES-R, NEXRAD, and Ground-Based Snowfall Microphysics Observations

Project Number: 480

Executive Summary

We are working to develop an enhanced Lake Effect Snow (LES) now-casting tool using products from the current GOES-16 observations. This product is in development with National Weather Service (NWS) offices in the Great Lakes Region and aims to improve forecasts of LES events through cultivating better estimates of radar and satellite derived snow accumulations.

Progress toward FY17 Milestones

Towards our Year 2 goals, we have achieved the following:

- Continued regular meetings with NOAA GOES-16 collaborators, Drs. Andy Heidinger, Dr. Mark Kulie (NOAA), Mr. Steve Wanzong, and Ms. Marian Mateling.
- Drs. Claire Pettersen and Tim Wagner worked with CLAVRX GOES-16 algorithm products of cloud effective radius, cloud liquid water path (CLWP), and cloud optical depth.
- Ms. Mateling produced plots of CLWP and three available channels from GOES16, which helped guide the joint GOES16 CLWP and NEXRAD snow rate analyses. See Figure 1 as an example.
- Dr. Pettersen identified three distinctly different snow events in December 2017 and January 2018 to use to explore the relationship of co-located GOES16 CLWP values and NEXRAD-derived snow rates.
- Dr. Wagner created a merged grid of snow rate (from the lowest scan angle of the NEXRAD and averaged over a larger area to match the GOES16 product resolution) and the GOES16 CLWP values over the lake for the three identified test events. See Figure 2 for the relationship of CLWP and snow rate for the test cases.
- Drs. Pettersen and Kulie redeployed the network of previously deployed Pluvios in October and November 2018. These snow accumulation instruments were installed in a 15 km radius area around the NWS Marquette, MI (MQT) office. These Pluvios will help augment data for the 2018 – 2019 winter season.
- Dr. Pettersen updated and maintained Precipitation Imaging Package (PIP – snow microphysics measurements) and Micro Rain Radar (MRR – profiling radar) instrumentation in November 2018. These instruments are deployed at the NWS MQT office and are used to refine radar reflectivity (Z) to snowfall rate (S) relationships.

Additionally, quality control measures were applied to create final products through December 2018.

- Dr. Pettersen completed a manuscript highlighting 4 winters of ground-based observations of snow at the NWS MQT office. This will be submitted to JAMC in April 2019.
- Two journal articles focused on the Marquette, MI enhanced snow observations are currently in preparation. Dr. Pettersen and colleagues on this work will be submitting a manuscript to JAMC in April 2019. Dr. Kulie and colleagues on this work will be submitting an additional manuscript (BAMS) before the next reporting period.

Plans for Next Reporting Period

- In addition to already available GOES16 products for the 2017-2018 winter season, we are working with our colleagues to obtain and analyse the same values for the 2018-2019 winter season.
- A database of co-located over-lake CLWP from GOES16 and NEXRAD snow rate is in development. This database will help guide any regime-based relationships of CLWP and snow rate going forward.
- In addition to the case-based PIP/Z to S comparisons, we are now doing a broader snow type study based on criteria that emerged from the JAMC manuscript analyses. These are showing promising results.

Additional Information

1. Interaction with operational partners – Drs. Pettersen, Kulie, and Ms. Mateling travelled to the NWS MQT office in October and November 2018 to work with their colleagues to both update and maintain the enhanced snow observation site at the office (MRR, PIP, Parsivel, Pluvio) and re-deploy a Pluvio network to quantify spatial variability of snowfall accumulation.

2. Conference/workshop participation – Dr. Pettersen was invited to give a presentation at the NWS MQT winter preparedness workshop in October 2018 (Title: Enhancing our Understanding of Snowfall Modes with Ground-Based Observations). Dr. Kulie presented PIP a snowfall regime-dependent particle size distribution analysis at the NASA Precipitation Measurement Missions Science Team Meeting in October 2018.

3. Outside project publicity –

4. Journal articles – Dr. Pettersen and colleagues on this work will be submitting to JAMC in April 2019. Dr. Kulie and colleagues on this work will be submitting an additional manuscript (BAMS) before the next reporting period.

Key Graphics

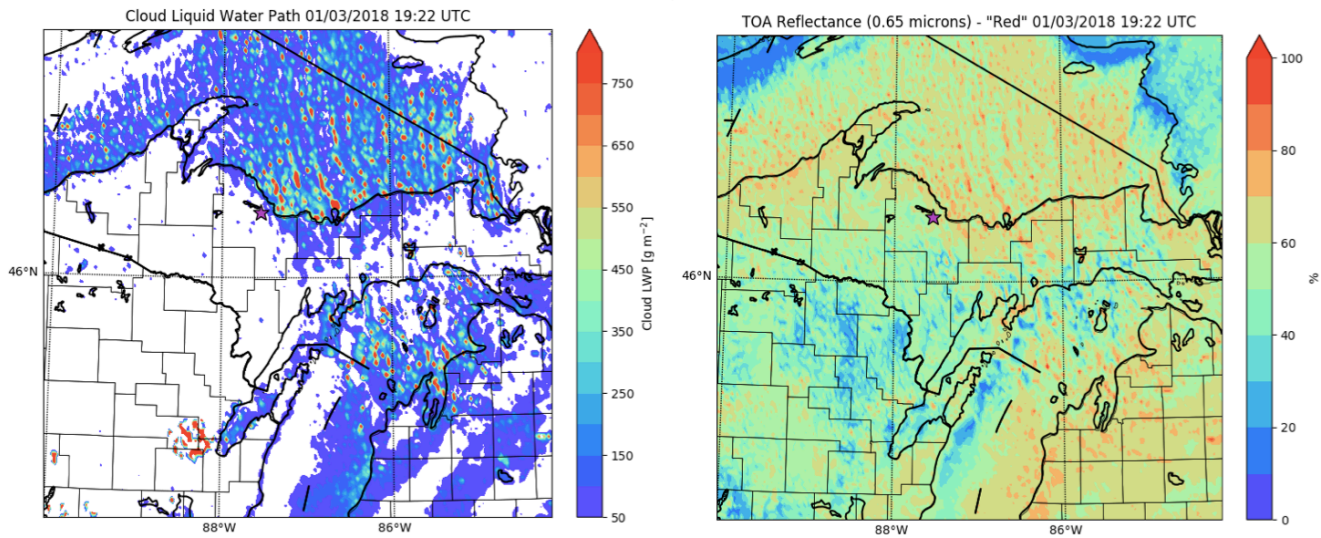


Figure 1: January 3, 2018 lake-effect snow event. The left panel shows the retrieved values of CLWP from the GOES16 products. The right panel illustrates the top of the atmosphere reflectance from the GOES16 0.65 micrometer band. The magenta star is the location of the NWS MQT site.

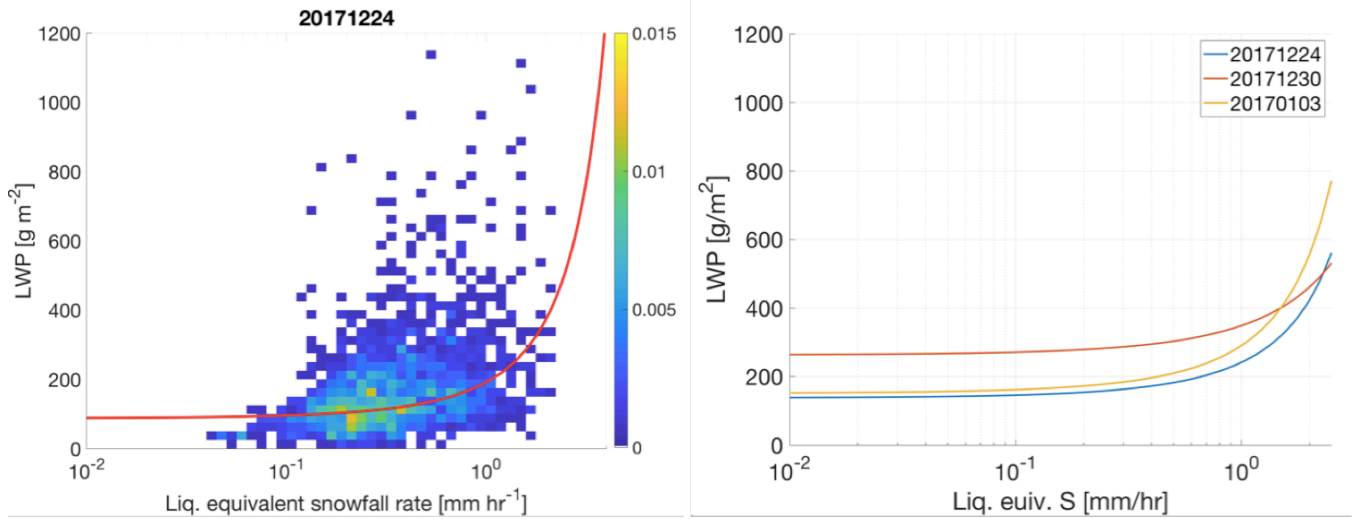


Figure 2: The left panel is a normalized two-dimensional histogram of the co-located CLWP from the GOES16 products and the standard snow rate values retrieved from the NEXRAD. The red line in the left panel is the exponential fit of the relationship for the December 24, 2017 event. The right panel illustrates the exponential fits for all three test cases of different snow types.