

# Testing and Comparing Precipitation Algorithms



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## Introduction

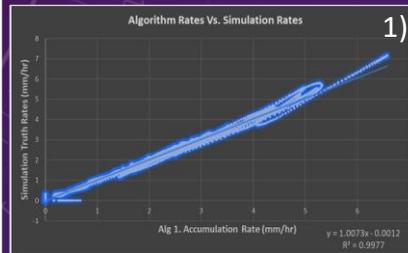
In aviation, ice and snow accumulation on aircraft are known hazards. Accurate knowledge of the precipitation rates help determine the appropriate length of time that anti-icing fluids will provide protection to an aircraft. These rates can be determined using a precipitation gauge, such as the GEONOR. However, data from these sensors can be noisy due to other environmental impacts. Algorithms that can filter the data have been developed to remove the noise, resulting in improved measurements of the precipitation rate. This research tests one of these algorithms using several different methods and a statistical analysis is presented on the results.

## Methods

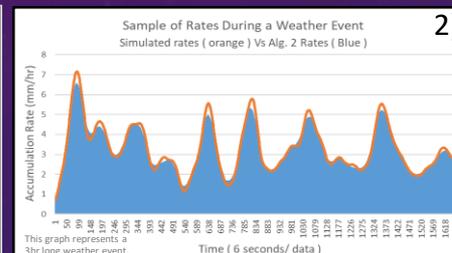
- Two rate filtering algorithms were tested
- Alg. 2 was created by changing a variety of parameters used by Alg. 1
- Alg. 1 and Alg. 2 were tested using a precipitation simulator to acquire a Pierce Skill Score (PSS) for the detection of weather events ( see results table )
- The PSS of the algorithms were compared
- Alg. 2's accumulation rate was tested for a good fit to the simulator's truth rates using a coefficient of determination ( image 1 )
- Alg. 2's rates and the simulation truth rates were plotted on a histogram for an accuracy test ( image 3 )
- Alg. 1 and Alg. 2 were visually tested for performance using raw data from the GEONOR precipitation gauge ( image 4 )

## Results

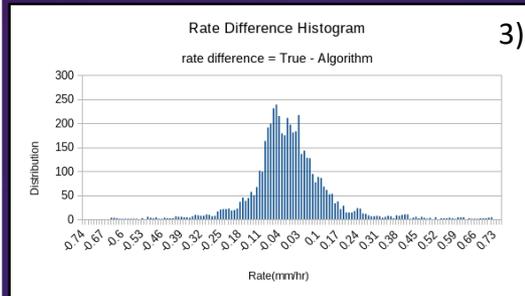
Algorithm 1		Algorithm 2	
Pierce Skill Score	0.8722	Pierce Skill Score	0.9506
Probability of Detection	0.8725	Probability of Detection	0.9518
False Alarm Rate	0.0002	False Alarm Rate	0.0012



A good fit between simulation and Alg. 2, with a coefficient of determination of 0.9977.



This diagram shows the accumulation rates being detected by Alg. 2 (blue) in contrast to the true rates of the weather event simulation (red).



The negative rate values indicate the number of rate readings being overestimated by Alg. 2, while the positive values are under estimations (simulation data).

GEONOR precipitation gauge.

This device is responsible for measuring precipitation



## Conclusion

- Alg. 2 outperformed Alg. 1 in correctly detecting weather events, with a PSS that is 8.99% higher than the Alg. 1 (table).
- Alg. 2 is quicker at detecting weather events, has a higher probability of event detection, but has a higher false alarm rate than Alg. 1.
- Alg. 2 holds a strong positive correlation to the simulated true precipitation rates (Image 1).

## Future Research

- The algorithms need to be tested on a larger simulation data sample size for a more accurate PSS comparison.
- The algorithms should be tested on a larger sample of raw GEONOR data for cross referencing.
- More testing needs to be done on Alg. 2's ability to accurately predict precipitation rates.

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