Assessing the Origin of Noise in the Precipitation Gauge Geonor T-200B

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Introduction

The Geonor T-200B is an all-weather precipitation gauge that is utilized by the Research Applications Laboratory (RAL) working under the National Center for Atmospheric Research (NCAR). For over 20 years NCAR and RAL have been working to address an issue of noise within the device. Noise an uncounted for and abnormal variation in what would be expected to seen in the data. Figure 1 below shows a sample of noise in the data. The tremor like lines are during times of no precipitation where the accumulation should be a flat line. The purpose of this research was to attempt to pinpoint the cause of the Noise.

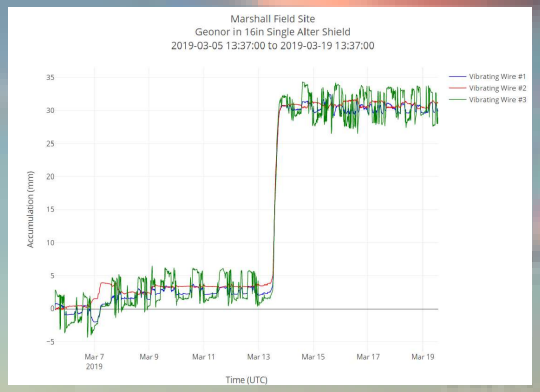


Figure 1. Sample of Geonor Data showing noise between precipitation events

How the Geonor Works

- Three vibrating wires
- Plucked by magnets
- Frequency Emitted
- Bucket suspended by wires
- Collects precipitation
- More precipitation means more weight
- Frequency increases
- Program converts frequency to mm accumulation

Figure 2. The inside of a Geonor-T200B

Control Test

- Gather control data to form a baseline for experiments
- Assembled two Geonors
- Covered the top and placed 1kg weight in bucket
- One set to run inside, the other set to run outside

Figure 3. From left to right, Indoor control set up, the placement of 1 kg weight in both set ups, and the covered top of the outdoor control set up.

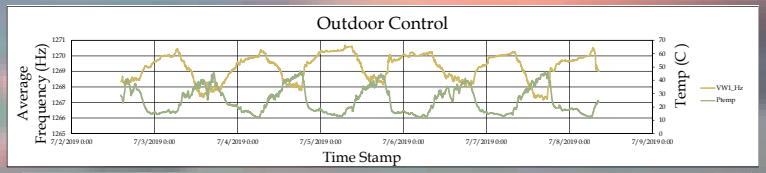


Figure 4. The Daily change in frequency of the outdoor control Geonor compared to the daily temperature change outside. A Diurnal signal in the frequency can be seen matching cycles with the temperature change. An increasing temperature shows a decreasing frequency.

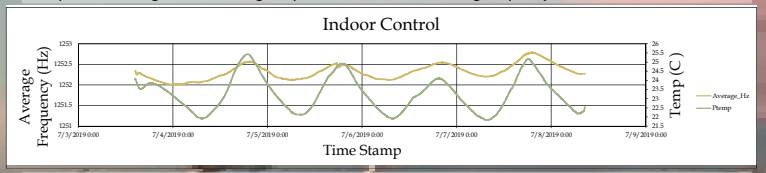
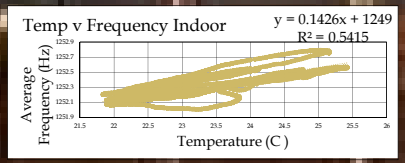
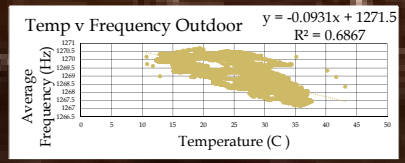


Figure 5. The daily change in the frequcny of the indoor control Geonor compared to the daily change in the logger panel temperature. A diurnal signal in the frequency matches the temperature change. An increasing temperature shows an increasing frequency.





Results

Figures 6 and 7

- Correlation Plots between frequency and temperature
- Indoor has weak positive correlation of 50%
- Outdoor has a strong negative correlation of 70%
- Confirms that an increase in temp results in a decreased frequency

Grounded Wire Test

- Test for electrical interference
- Use the same Geonor set up as control for consistency
- Add a grounding wire to Shield the device
- Compare to control test

Figure 8. Photograph of The outdoor control with the grounding wire

Results

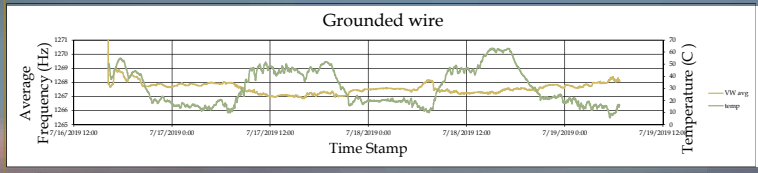


Figure 9. The Daily Change in frequency of the grounded Geonor Compared to the daily outdoor temperature change. There is a reduction in the diurnal signal of the frequency compared to the change in temperature.

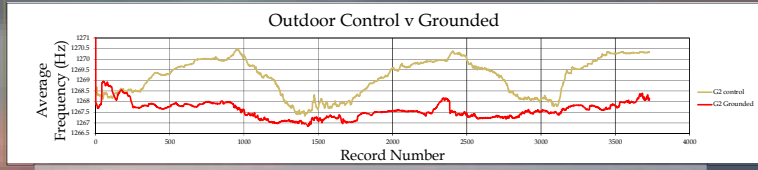


Figure 10. Comparison of the change in frequency between the outdoor control and the grounded Geonor test. The direct comparison shows a reduction in the diurnal frequency effect from temperature. There is also a visible reduction of frequency variation between the control and grounded Geonor. The grounding wire reduced the variation in the frequency by about 3 Hz on average.

Future Research to be conducted could include a correlation between wind and the frequency, or a comparison of the effect of temperature change on the datalogger panel. A panel temp test could be run by setting up heaters inside a box with the dataloggers and collecting frequency data.

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