Correlations Between Relative Humidity and Cloud Types

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Abstract

Our research question is “What is the correlation between relative humidity percentage and the presence of different cloud types in the Bay Area in the years 2015-2021?” We chose this topic because we’ve noticed how often the weather changes in the Bay Area and we were interested in learning how humidity and other factors can affect clouds. We collected our data using the GLOBE observer app.

Research Question/Hypothesis

Research question: What is the correlation between relative humidity percentage and the presence of different cloud types in the Bay Area in the years 2015-2021?

Hypothesis: Humidity and certain cloud types have a positive correlation in California because humidity is defined as water vapor in the air and clouds are made of water vapor. Therefore, as humidity increases at the surface, more low-altitude clouds would form.

We are interested in researching this topic because we want to know how both humidity and the presence of different cloud types directly impact the environment, more specifically, the weather. We know that clouds play a key factor in influencing our local weather, affecting overall temperature and playing a large role in controlling the world's long-term climate. However, what is their impact like over time? As climate change starts to affect us more each day, seasonal weather patterns are constantly changing.

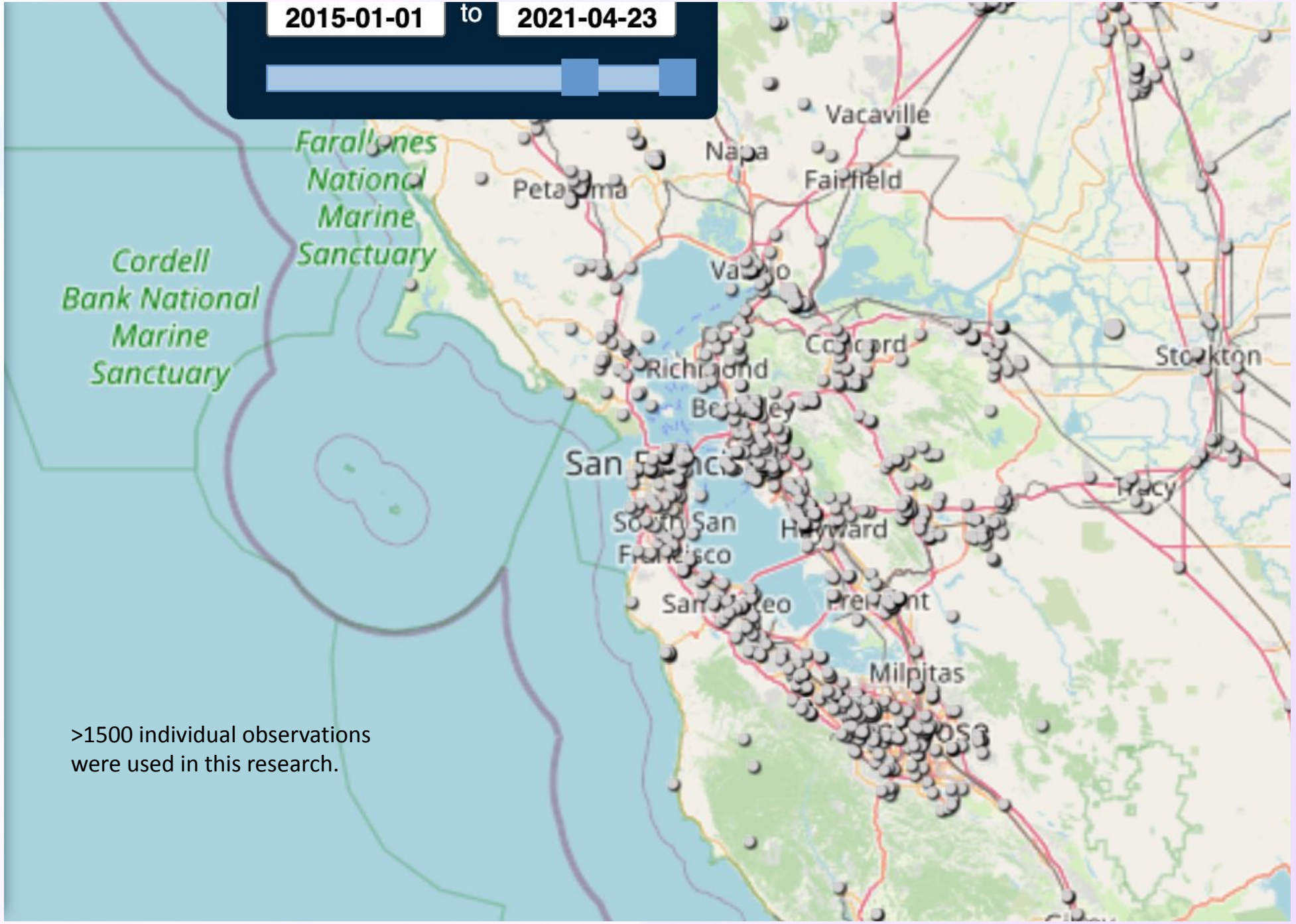
Finding a correlation between relative humidity percentage and the cloud types in an area will enable us to see patterns in overall temperature and allow us to see how our long-term climate has been changing over the years in California. If there is a positive correlation of humidity percentage and certain cloud types that increased from 2015 -2021 this can be help prove that climate change has affected our weather with mass production and the heating of the Earth being contributing factors.

Background Information for Research

We decided to do this research because we were interested in learning more in depth about clouds and the relationship they play with other factors in the environment. We knew that we wanted to focus on clouds and our community. When starting this research project, we already knew that clouds are formed when water vapor in the air condenses. Humidity on the other hand is the concentration of water vapor in the air. This inspired us to pursue this topic and investigate the relationship between cloud types and humidity in the Bay Area. This research question addresses the following issues: thunderstorms, hurricanes, and rising temperatures.

Investigation (Data Collection) Plan

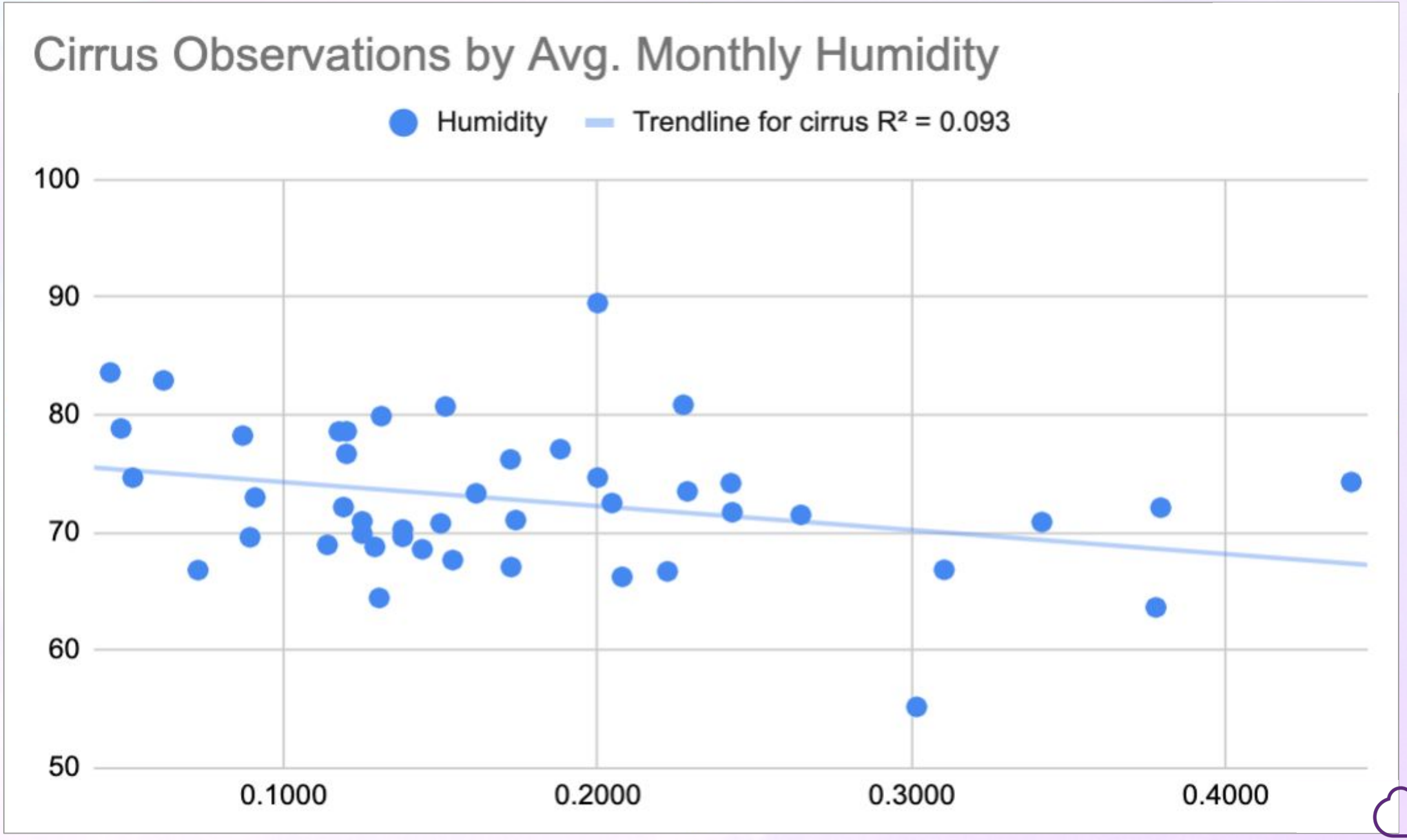
Our plan for the investigation was to get data related to California's atmosphere. We collected our data by using the GLOBE Observer App, where we recorded cloud and sky conditions daily using the GLOBE Clouds Observation Protocols. For every cloud observation we were required to capture the date, time and location and be able to identify the clouds present at that time. We also had to take photos of the sky for each observation so that we could have visual data of the current sky condition to analyze later on. Once an observation was completed it was sent to the GLOBE system to be recorded and analyzed. In order to expand the amount of data we were analyzing, we also downloaded cloud data in the Bay Area from the GLOBE website. This was a bit tricky as the number of observations varied greatly over time, so we decided to use the proportion of a cloud type compared to the total number of observations over a month to keep our data more or less consistent over time.

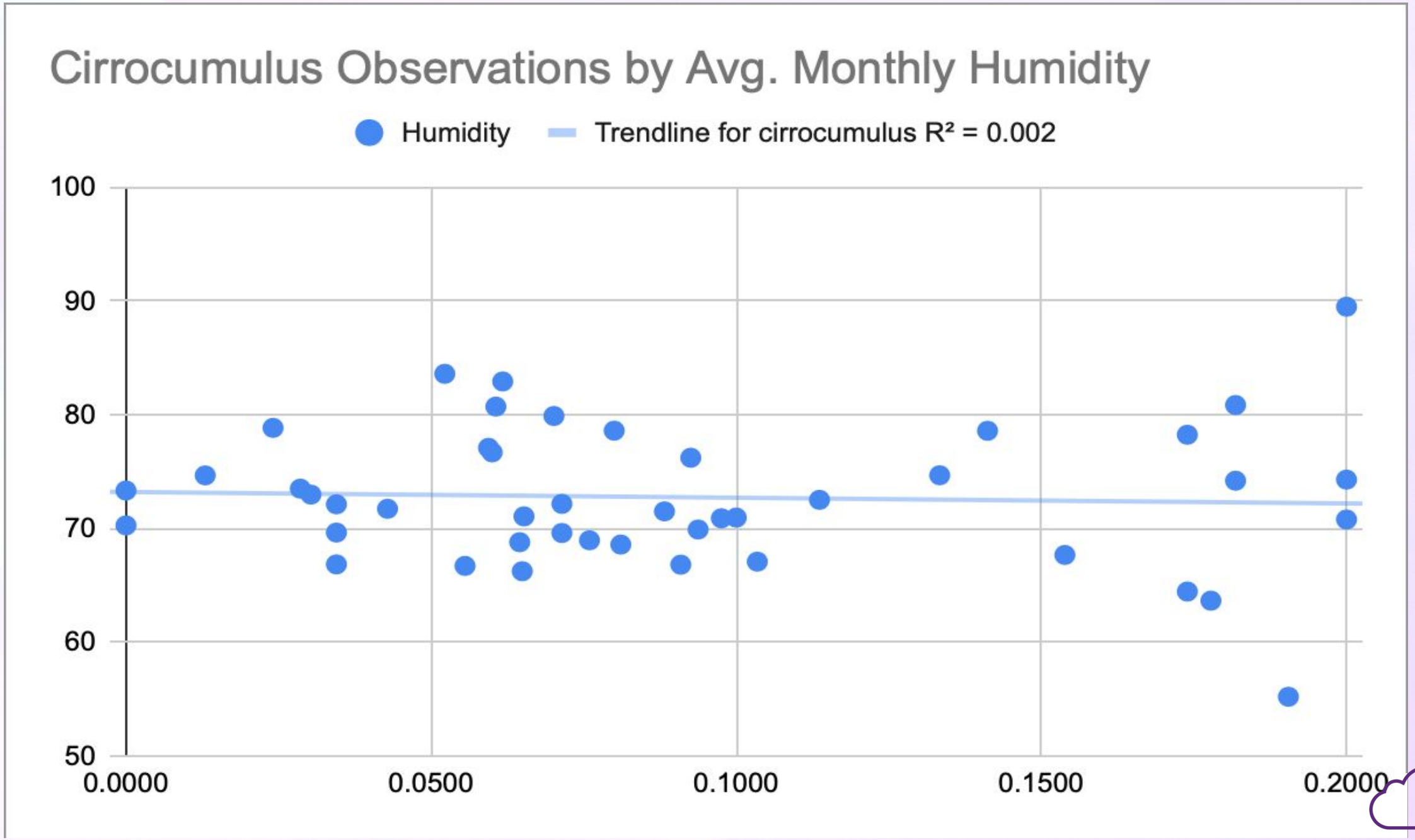

2015-01-01
to
2021-04-23
Farallones
National
Marine
Sanctuary
Cordell
Bank National
Marine
Sanctuary
Vacaville
Napa
Fairfield
Petaluma
Richmond
Stockton
Hayward
Milpitas
>1500 individual observations
were used in this research.

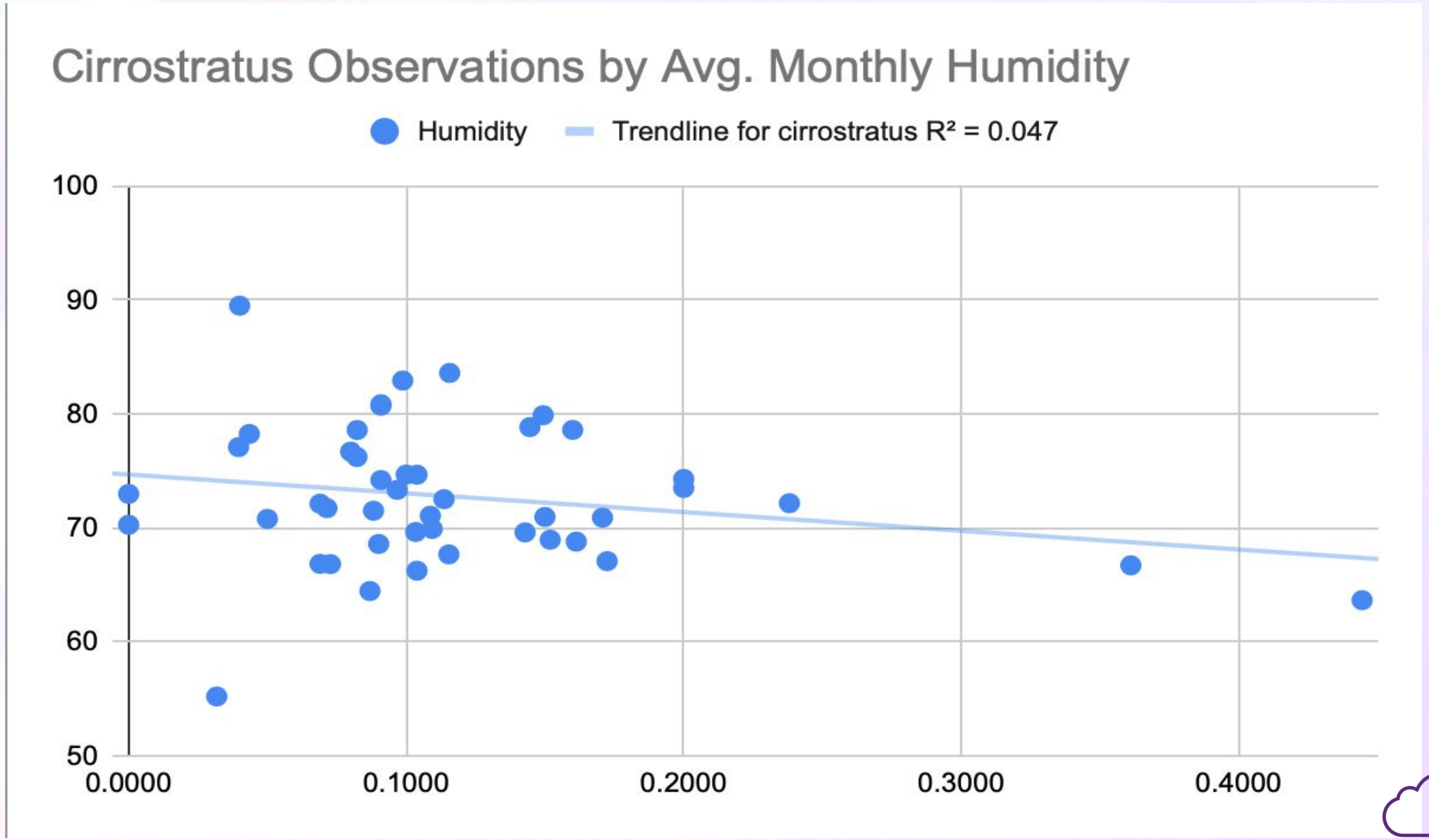
Data Presentation

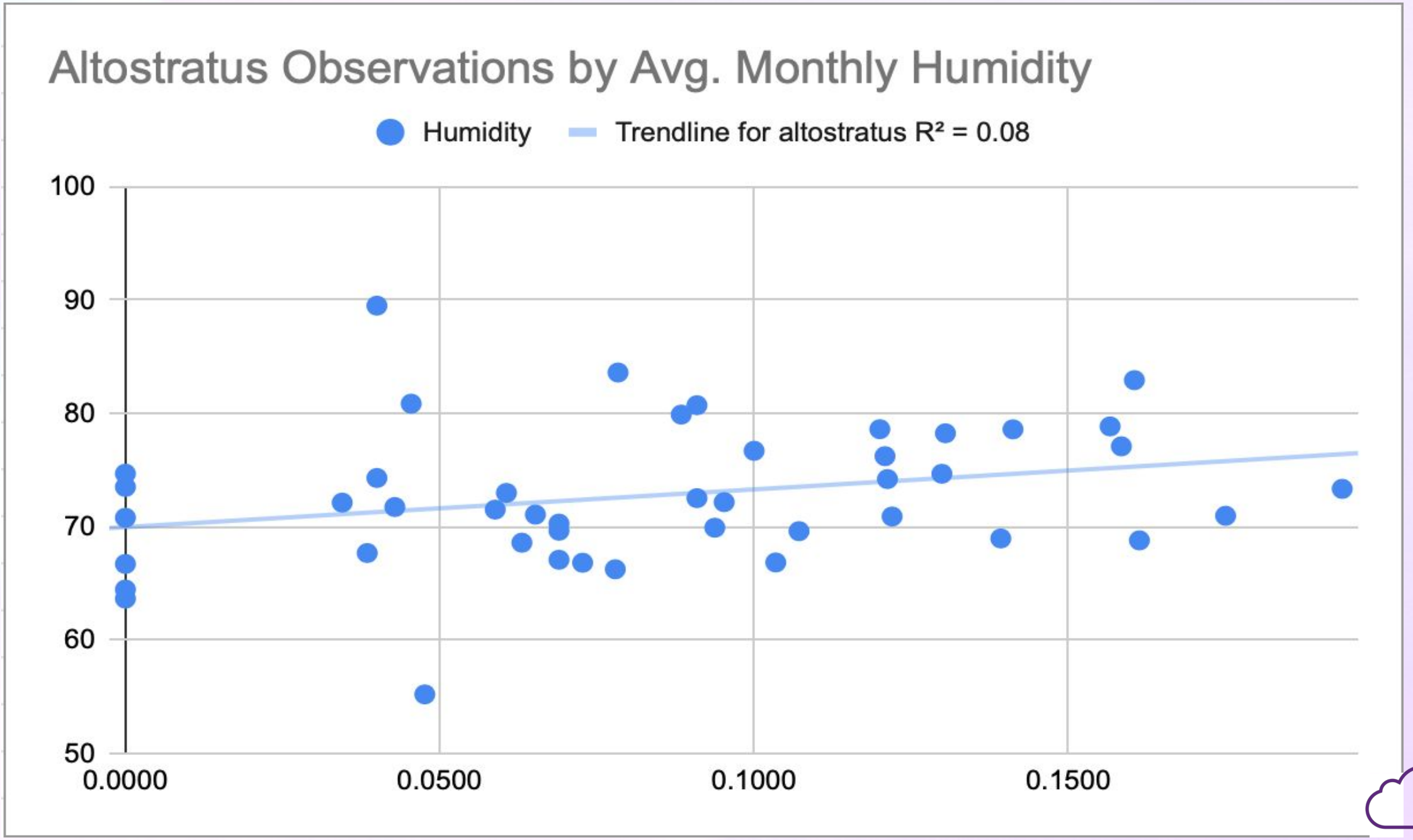
Our graphs show the proportion of particular cloud type over the total amount of observations that month vs the average monthly relative humidity. On each graph, there is a trendline that shows the general correlation between the proportion of a particular cloud type to the average monthly relative humidity as well as the R^2 Value.

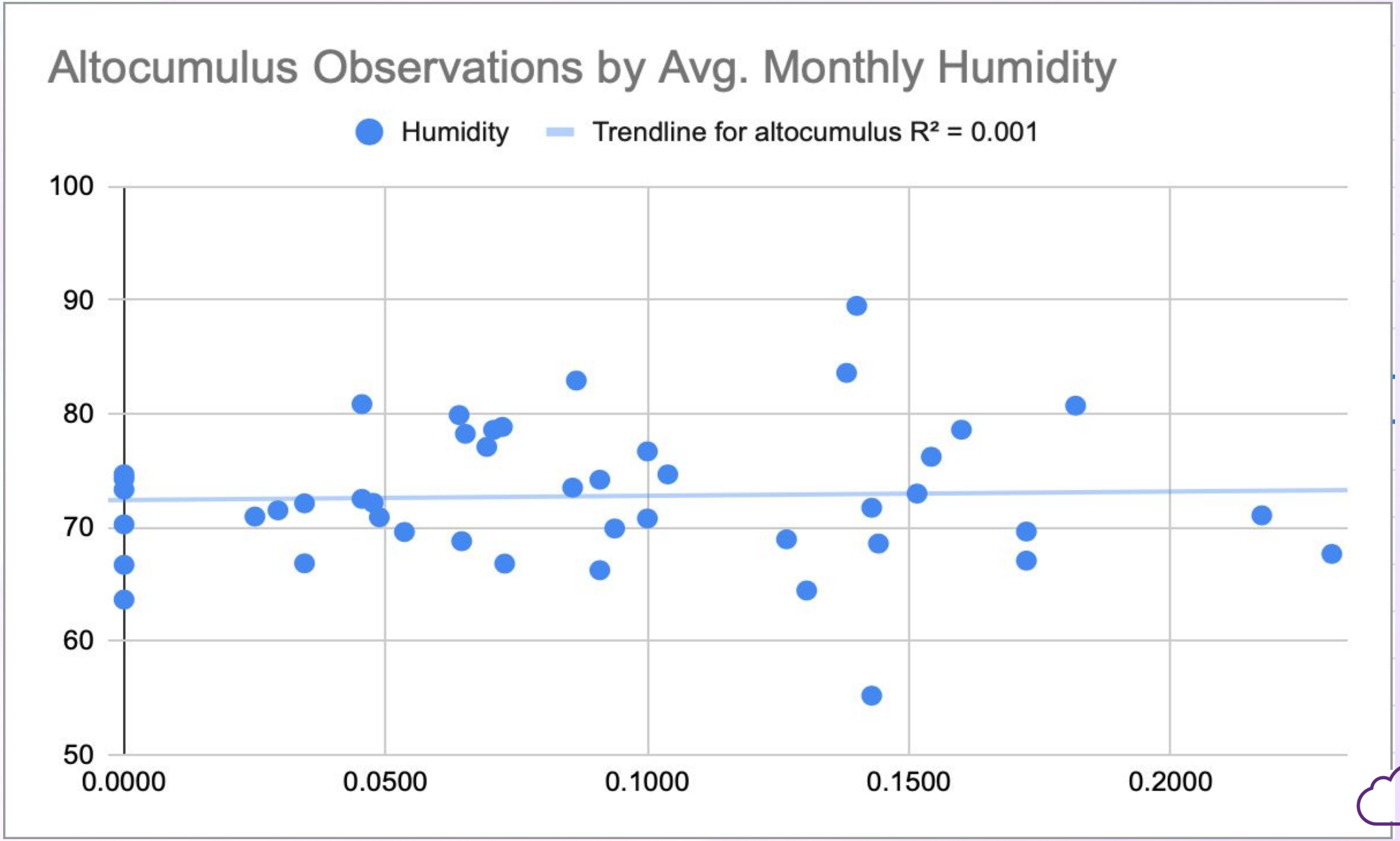
Cloud Type	Cirrus	Cirrocumulus	Cirrostratus	Altostratus	Altocumulus	Cumulus	Nimbostratus	Stratus	Stratocumulus	Cumulonimbus	Fog	Smoke
R^2 Value	0.093	0.002	0.047	0.08	0.001	0.033	0.042	0.161	0.009	0.01	0.002	0.016


Cirrus Observations by Avg. Monthly Humidity
Humidity
Trendline for cirrus R² = 0.093
100
90
80
70
60
50
0.1000
0.2000
0.3000
0.4000

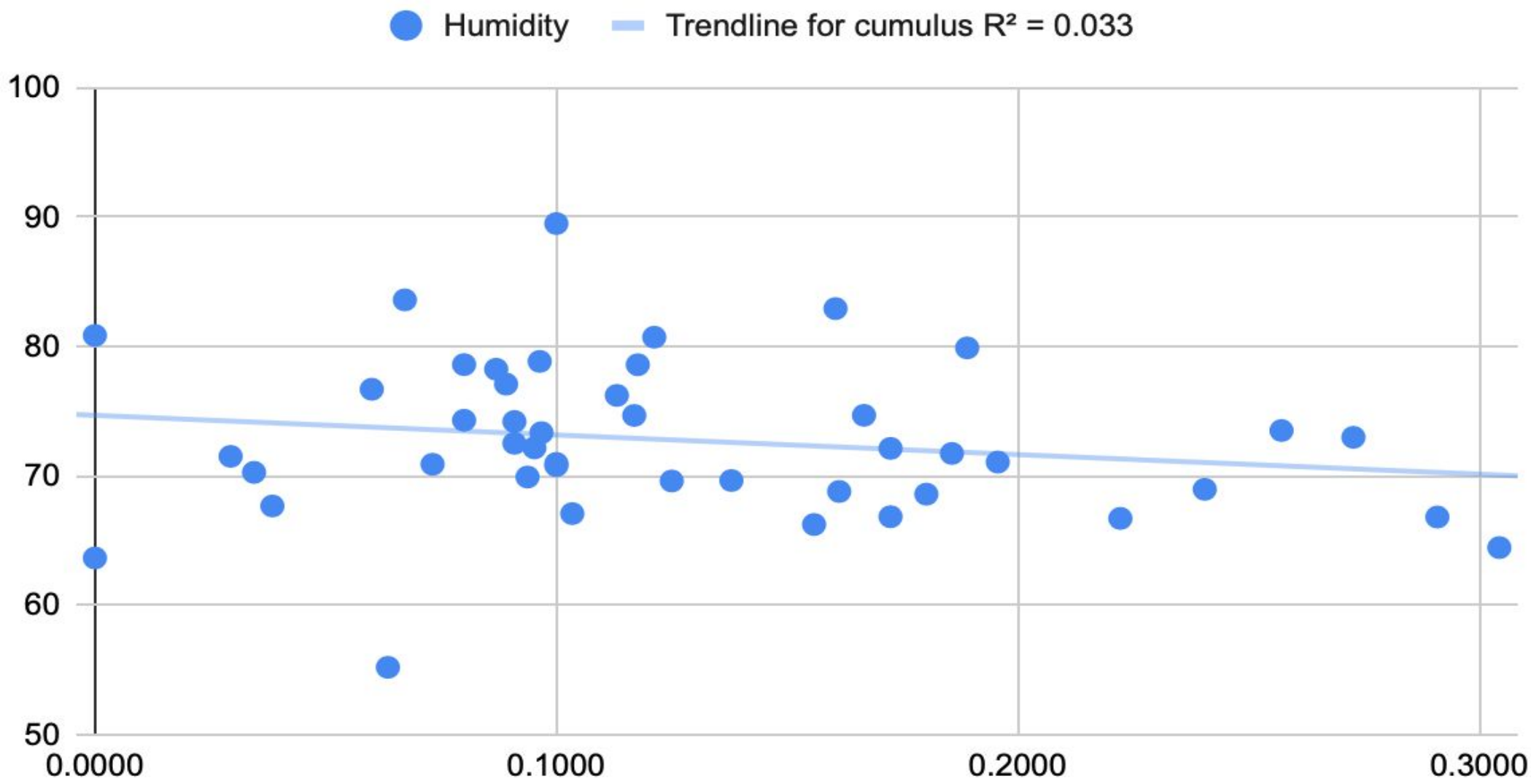

Cirrocumulus Observations by Avg. Monthly Humidity
Humidity
Trendline for cirrocumulus R² = 0.002
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500
0.2000

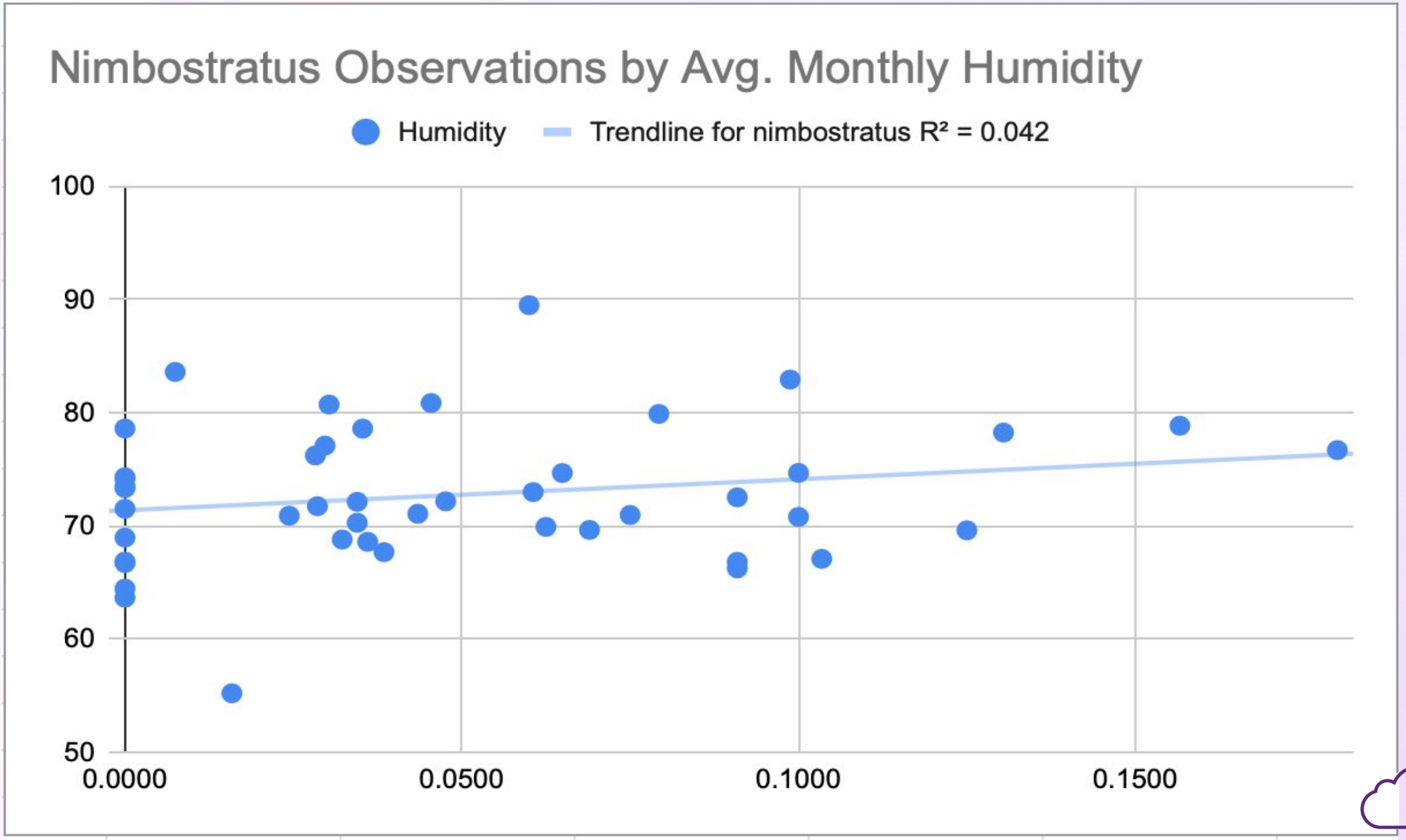

Cirrostratus Observations by Avg. Monthly Humidity
Humidity
Trendline for cirrostratus R² = 0.047
100
90
80
70
60
50
0.0000
0.1000
0.2000
0.3000
0.4000

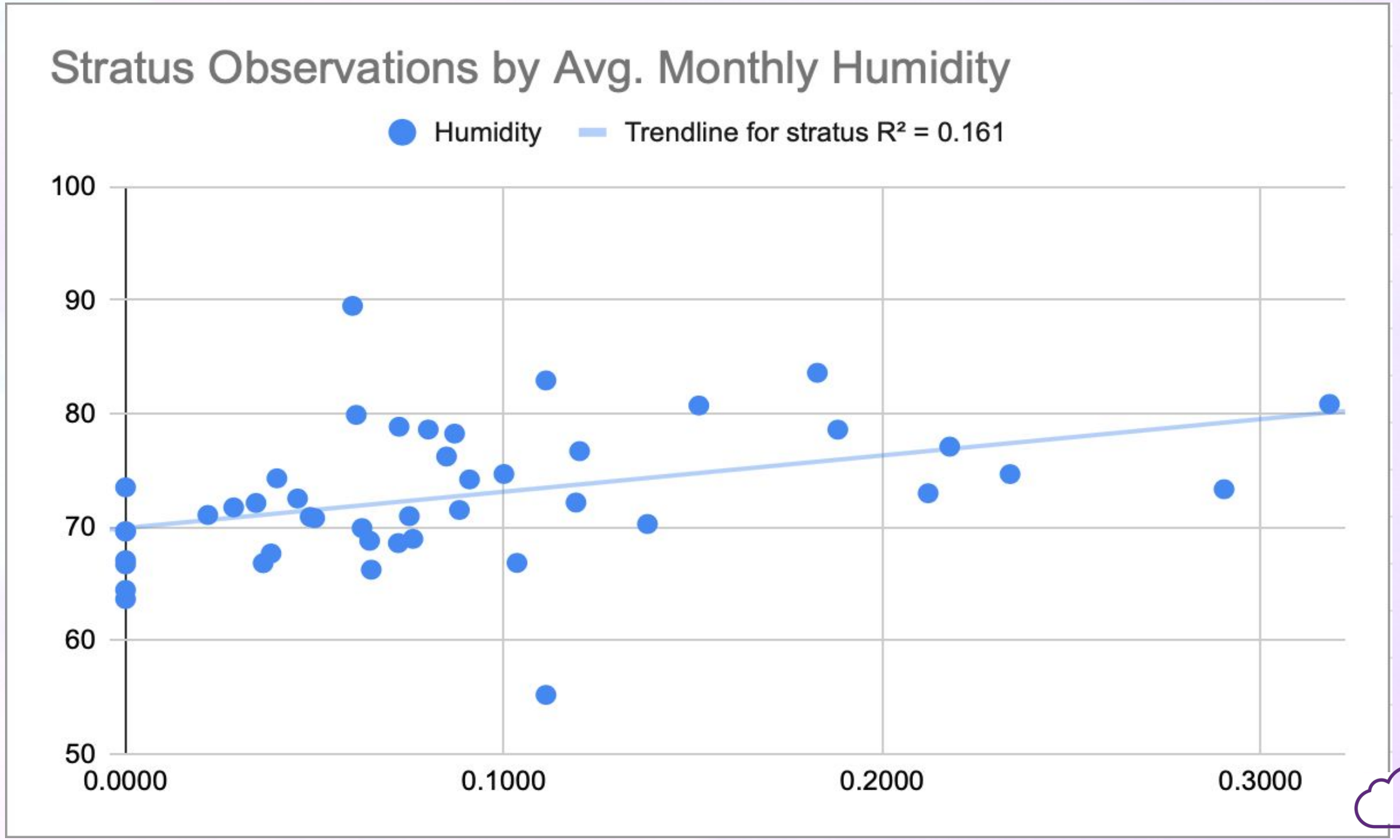

Altostratus Observations by Avg. Monthly Humidity
Humidity
Trendline for altostratus R² = 0.08
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500

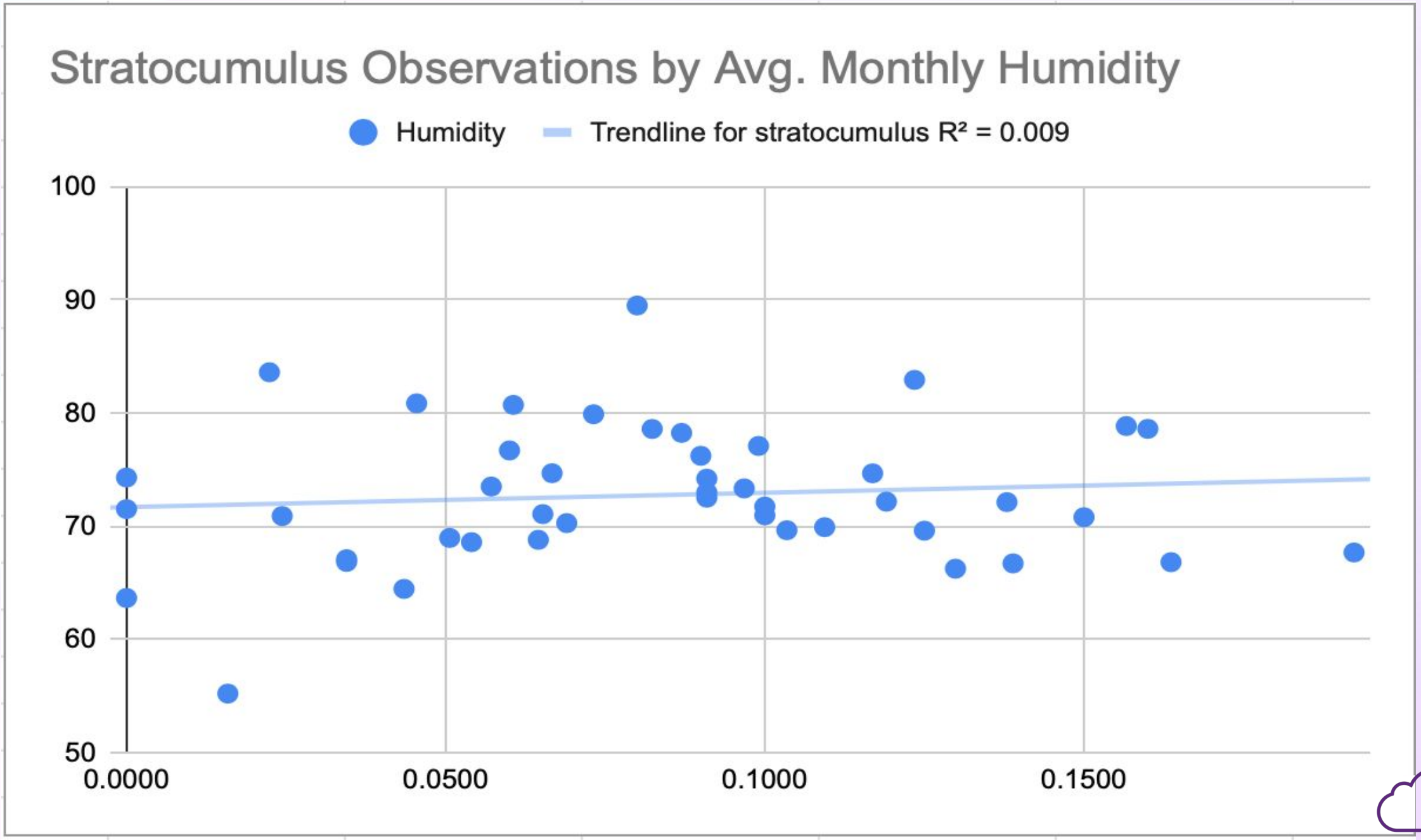

Altocumulus Observations by Avg. Monthly Humidity
Humidity
Trendline for altocumulus R² = 0.001
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500
0.2000

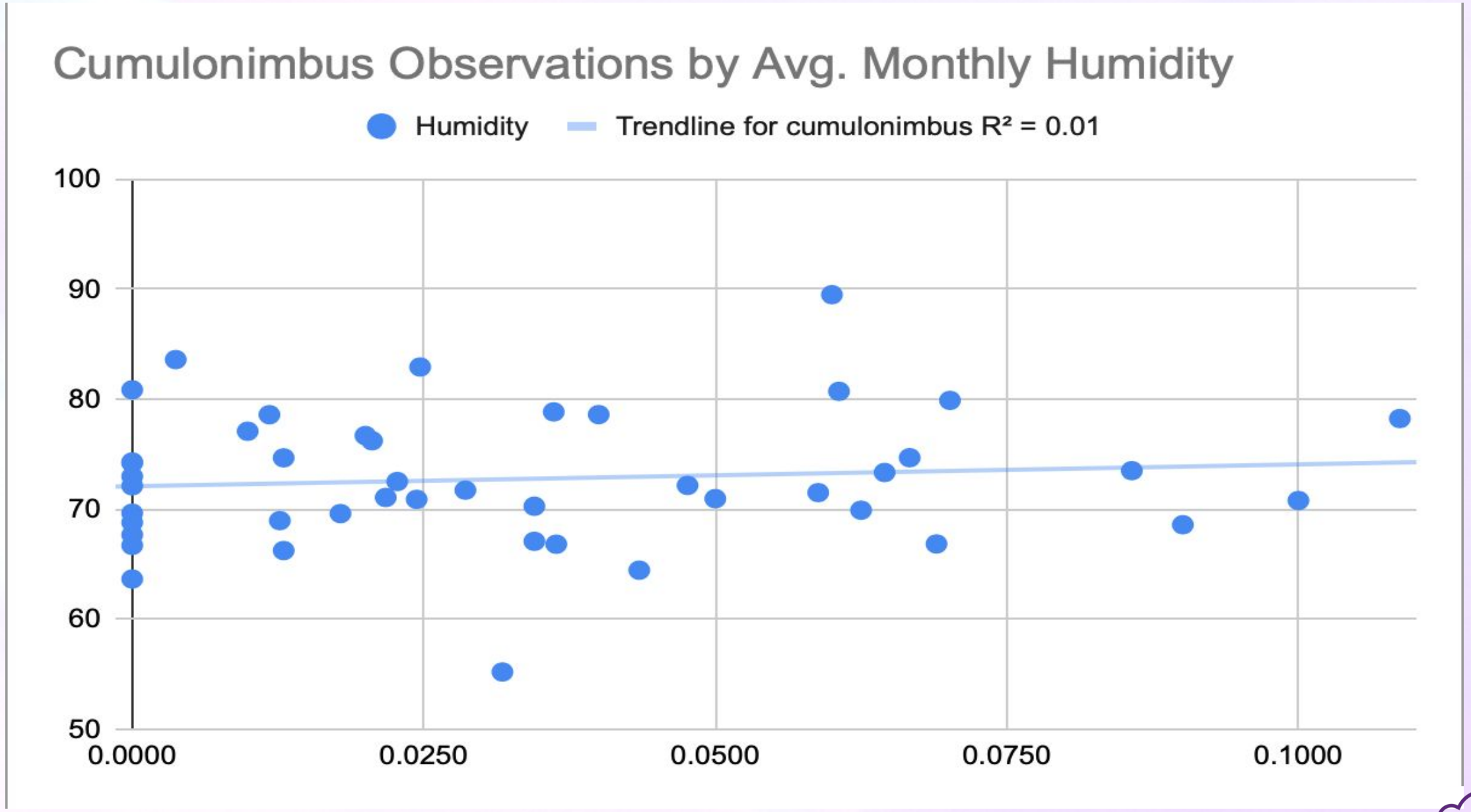
Cumulus Observations by Avg. Monthly Humidity

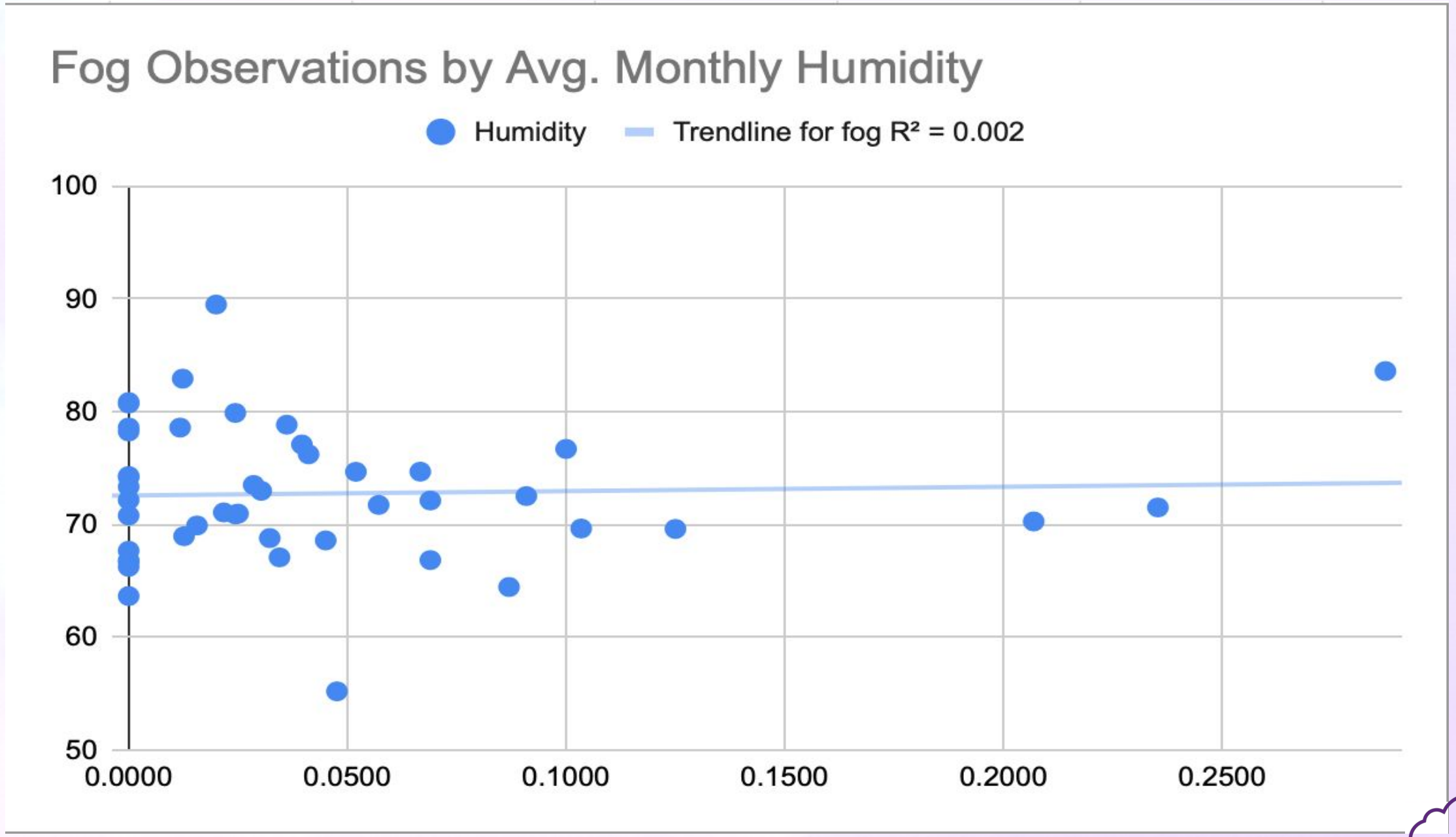


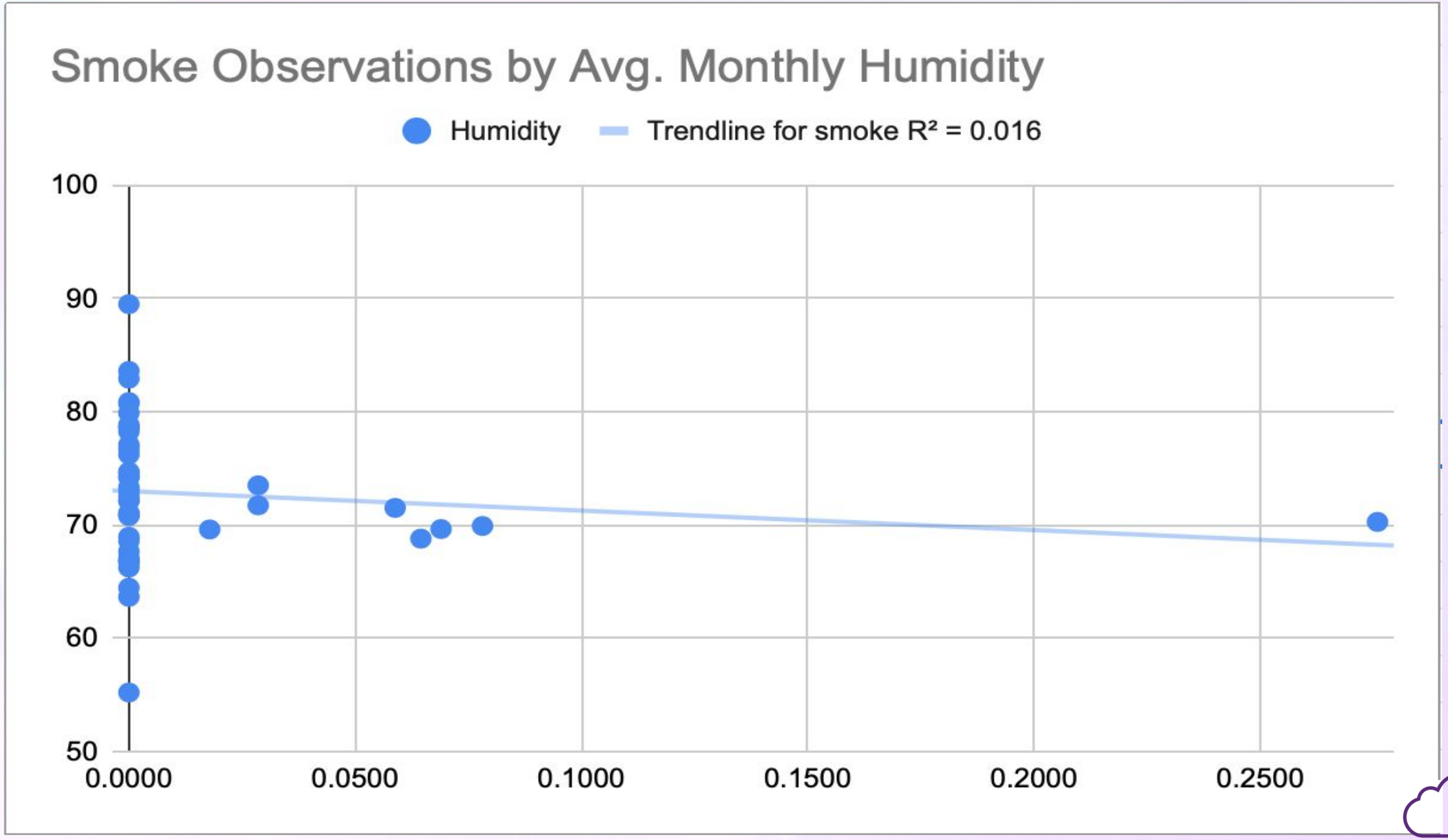

Nimbostratus Observations by Avg. Monthly Humidity
Humidity
Trendline for nimbostratus R² = 0.042
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500


Stratus Observations by Avg. Monthly Humidity
Humidity
Trendline for stratus R² = 0.161
100
90
80
70
60
50
0.0000
0.1000
0.2000
0.3000


Stratocumulus Observations by Avg. Monthly Humidity
Humidity
Trendline for stratocumulus R² = 0.009
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500


Cumulonimbus Observations by Avg. Monthly Humidity
Humidity
Trendline for cumulonimbus R² = 0.01
100
90
80
70
60
50
0.0000
0.0250
0.0500
0.0750
0.1000


Fog Observations by Avg. Monthly Humidity
Humidity
Trendline for fog R² = 0.002
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500
0.2000
0.2500


Smoke Observations by Avg. Monthly Humidity
Humidity
Trendline for smoke R² = 0.016
100
90
80
70
60
50
0.0000
0.0500
0.1000
0.1500
0.2000
0.2500

Data Analysis

- According to our data, there is no strong correlation between the types of cloud present and the average monthly relative humidity.
- There is low value for R^2 for each of the graphs and this points to a lack of correlation between the variables. This data addresses the research question by graphing and correlating the proportion of different cloud types and the relative humidity. As shown in the data, 12 different types of clouds were analyzed and an R^2 value was found. One noteworthy data point is the Stratus clouds have the highest R^2 value of 0.161, indicating the strongest correlation of the data. This correlation is still fairly low and does not reach a high enough threshold to be considered statistically significant.

Interpretation of Data

Our results allowed us to answer the research question because we were able to use the data to create scatterplots. From there, we were able to calculate the R^2 values and compare them to each other. This allowed us to see trends, correlations, and individual data points all in one place. Based on the data collected, we see that while the correlation is weak, humidity and low cloud coverage do have a positive correlation in California in the years 2015-2020. The results do support our original hypothesis that humidity and certain low cloud coverage have a positive correlation in California in the years 2015-2020, although the actual correlations of the observed data are weak. Uncertainties and limitations in our research process do have slight effects on the data collected and can include incorrect observations, observations that occurred at the same time/day, and the omission of certain months due to a low observation count.

Conclusion/Next Steps

There is a small correlation of humidity, and cloud observation. We came to this conclusion based on the results shown in the graphs and the data collected from the years 2015-2020.

In order to make our research more accurate and precise, we will further improved our researching techniques by strictly using data collected by our team to minimize errors and avoid misidentified sky conditions. In addition, we will make daily observations at different times of the day to identify the transition of cloud coverage early in the morning and late in the afternoon to create a wider, diverse variation of data. Thus, making our analysis more reliable and observations stronger.

By completing this research for GLOBE and NASA, we gained more extensive knowledge about the effects of climate change. We enjoyed making contributions as young scientists towards future research projects regarding the earth and global environment. It was a fun and unique experience for all of us to have, it was a hands-on opportunity to go outside and make observations on our own. This process was easy for us thanks to the GLOBE app that ensured our data was properly collected.

References/Bibliography

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