

How Often Should I Measure the Weather?

Name:

Introduction

Computers run many of today's weather instruments automatically. Data can be measured and saved at very short time intervals and at any time of day. But what happens when you don't have fancy electronic weather instruments? Will you still be able to have useful weather records if you don't measure every 5 minutes?

What is the least number of measurements needed to have accurate details of the weather? If you have an automated weather station, think of an experiment you can do to measure how often you should measure.

For a complete day, 24 hours, measure the temperature, dewpoint temperature, relative humidity, and air pressure as often as your instruments can accomplish. In this case, the weather station could make measurements every 15 minutes.

Question: If measurements were made every 15 minutes for a complete day, how many measurements will be made?

Procedure: Using a copy of the data, eliminate every other measurement so you have one measurement every 30 minutes. Make a copy of this new data and eliminate every other measurement, resulting in one measurement per hour. Repeat this so you have data sets ranging from 96 to 3 measurements per day. The amount of time between a series of measurements should be the same throughout the day.

Question: By halving the number of observations for each data set, how many data sets will you have if you start with 96 measurements per day in the first data set and the final data set has 3 measurements per day.

Question: In order to have 3 equally spaced measurements throughout the day, how much time must occur between each measurement?

Graphing Data

Using the Excel data that has time measurements for the same data but with different time intervals: 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, and 8 hours.

Question: Plot the 15-minute data and the two sets of 8-hour data on the same graph and describe the similarities and differences between the three plots.

Next is to numerically describe each set of data with one number to find out how different they are from each other. First try comparing daily averages of values for the different data sets. Create a table to compare the average values for temperature, dew point temperature, relative humidity, and air pressure for the first 6 data sets (use the first of the 8-hour data sets). Obs means observation or measurement of the weather conditions at a particular time.

Time	Temp	Dew Pt	RH	Pressure
Spacing of Obs	Average	Average	Average	Average
15 min				
30 min				
1 hour				
2 hour				
4 hour				
8 hour				

Question: Compare and discuss the range of average values of the 4 variables for the 6 data sets. **Hint:** The range is the maximum value minus the minimum observed value.

Try another number that describes a series of numbers to see if this is affected by the spacing of measurements over time. Examine the observed range of the observed maximum and minimum values for the different data sets. Do the ranges differ more than the averages when there are fewer points?

Time Spacing	Temp	Dewpoint	RH	Pressure
[hour]	Range	Range	Range	Range
0.25				
0.5				
1				
2				
4				
8				

Question: What is the range of these values for the 6 data sets? Is this a larger difference than observed for the average values?

Question: Plot the range of temperature, dew point temperature, relative humidity, or pressure to examine what happens when fewer measurements are made over time. Describe the observed trends.

Question: But are these values very large? Compare the ranges to those of the largest observed range by calculating the percent range of the values:

$$\text{Percent Range} = 100 * (\text{Range} / \text{Maximum Range})$$

Note: the Maximum Range should occur with the shortest time interval, so, in this case, use the 15-minute time spacing.

Time Spacing of Obs	Temp % Range	Dewpoint % Range	RH % Range	Pressure % Range
15 min				
30 min				
1 hour				
2 hour				
4 hour				
8 hour				

Activity: Study the graphs and tables you have generated, and decide what is an adequate rate of sampling the weather. Justify your answer.