DATA Nugget

What Do Trees Know About Rain?

Featured scientist: Alison O'Donnell from The University of Western Australia.
Co-produced with Science Journal for Kids.

Research Background:

Did you know that Australia is the driest inhabited continent in the world? Because it is so dry, we need to be able to predict how often and how much rain will fall. Predictions about future droughts help farmers care for their crops, cities plan their water use, and scientists better understand how ecosystems will change. The typical climate of arid northwest Australia consists of long drought periods with a few very wet years sprinkled in. Scientists predict that climate change will cause these cycles to become more extreme – droughts will become longer and periods of rain will become wetter. When variability is the norm, how can scientists tell if the climate is changing and droughts and rain events today are more intense than what we've seen in the past?

To make rainfall predictions for the future, scientists need data on past rainfall. However, humans have only recorded rainfall in Australia for the past 100 years. Because climate changes slowly and goes through long-term cycles, scientists need very long term datasets of rainfall.

The answer to this challenge comes from trees! Using **dendrochronology**, the study of tree rings, scientists get a window back in time. Many tree species add a ring to their trunks every year. The width of this ring varies from year to year depending on how much water is available. If it rains a lot in a year, the tree grows relatively fast and ends up with a wide tree ring. If there isn't much rain in a year, the tree doesn't grow much and the ring is narrow. We can compare the width of rings from recent years to the known rain data humans have collected. Then, assuming the same forces that determine tree ring width are operating today as in the past, we can go back and interpret how much rain fell in years where we have no recorded rainfall data. This indirect information from tree rings is known as a **proxy**, and helps us infer data about past climates.

For this study, the scientists used cypress-pine, or *Callitris columellaris*. This species is able to survive in Australia's dry climates and is long lived enough to provide data far back in time. Fortunately, scientists don't have to cut down the trees to see their rings. Instead, they use a corer – a hollow metal drill with the diameter of a straw. They drill it through the tree all the way to its core, and extract a sample of the tissue that shows all the tree rings. The scientists took 40 cores from 27 different cypress-pine trees. The oldest trees in the sample were more than 200 years old. Next, they developed a chronology where they lined up ring widths from one tree with all the other trees, wide with wide and narrow with narrow. This chronology gives them many replicate samples, and data going back all the way to the 19th century! Next, they used a dataset of rainfall from rain gauges that have been set out in Australia since 1910. They then take this precipitation data and overlay it with the tree ring widths since 1910. For tree rings before 1910, they then project back in time using this formula:

Rainfall = 125.85 + (104.973 x ring width)

Scientist Alison coring a cypress pine

A cypress pine tree growing in Australia

Scientific Questions: What do tree rings tell us about the past climates of Australia? What do we learn about modern droughts and rain events by comparing them to what we've seen in the past?

Hypotheses: Climate is changing and droughts and rain events are becoming more intense than in the past. More specifically, droughts will become longer and periods of rain will be more intense.

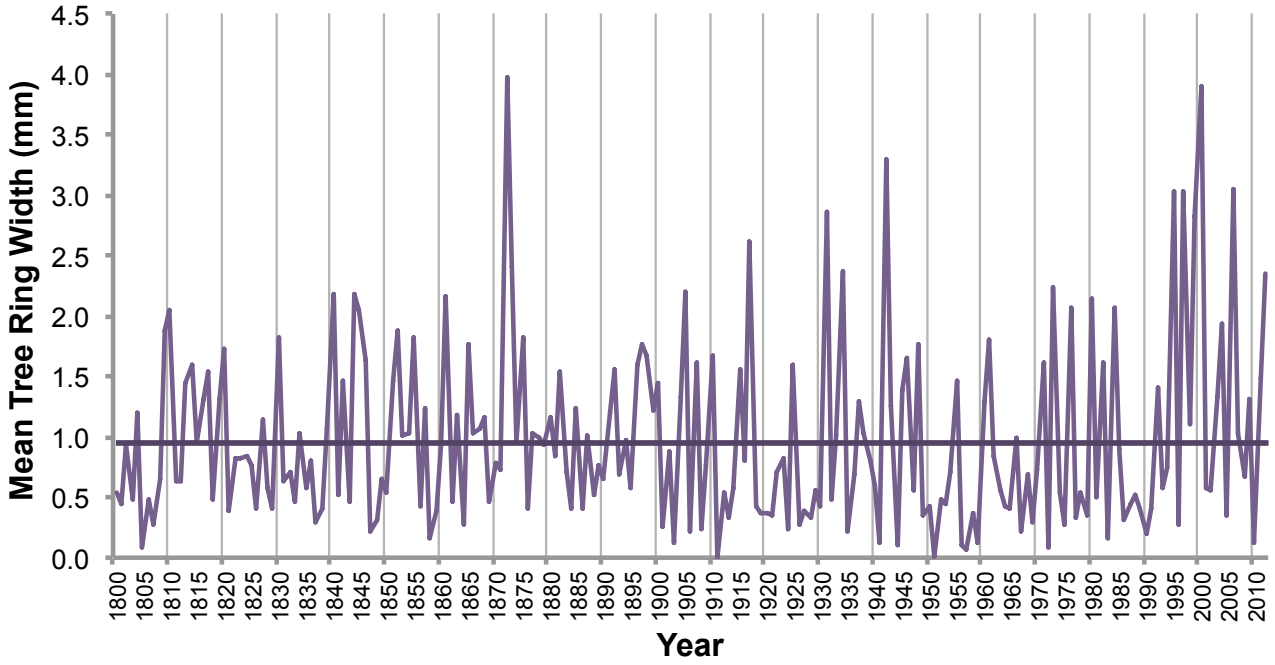
Questions to Answer. There are 10 in total, so make sure you look past the graphs.

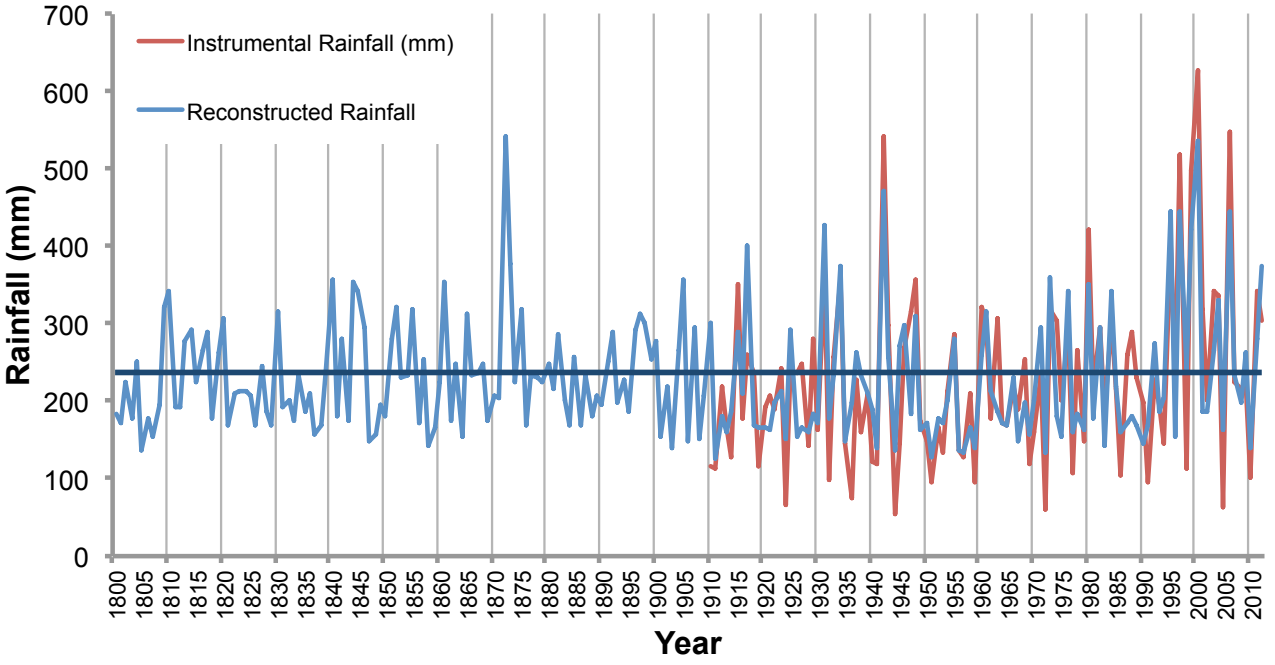
1. Use the rainfall formula on page 2 to complete the partial data table below by filling in the values for the empty squares:

Year	Tree Ring Width (mm)	Instrumental Rainfall (mm)	Reconstructed Rainfall
1800	0.539	X	
1810	2.054	X	
1820	1.723	X	
1830	1.814	X	
1840	2.188	X	
1850	0.532	X	
1860	0.942	X	
1870	0.782	X	
1880	1.164	X	
1890	0.651	X	
1900	1.451	X	
1910	1.672	115.20	301.36
1920	0.378	193.80	165.53
1930	0.432	163.80	171.20
1940	0.600	121.80	188.83
1950	0.433	148.40	171.30
1960	1.288	320.80	261.06
1970	0.726	160.30	202.06
1980	2.147	420.40	351.23
1990	0.197	199.20	146.53
2000	3.902	627.60	535.45
2100	0.122	102.30	138.66

2. Does it appear that the reconstructed rainfall estimates are a good approximation for the instrumental rainfall? Why or why not?

Below are graphs of the full dataset:





**** Horizontal dark lines represent the average tree ring width and rainfall across all recorded years (1800-2012). Use these lines to determine which years have above average rainfall or above average tree ring widths.***

**** Vertical light gray bars represent decades, or intervals of 10 years.***

3. What trends, changes, or differences over time do you see on the graph?

4. Make a claim (1-2 sentences) that answers the scientific questions.

5. Support your claim using data as evidence. Reference specific parts of the table or graph as appropriate.

6. What do the data from this study tell us about the scientist's hypothesis?

7. *Your next steps as a scientist:* Science is an ongoing process. What new question do you think should be investigated? What future data should be collected to answer your question?

8. How long did it take you to complete this assignment?

9. Were there any parts that were confusing or hard to understand?

10. What did you find most interesting about this assignment?