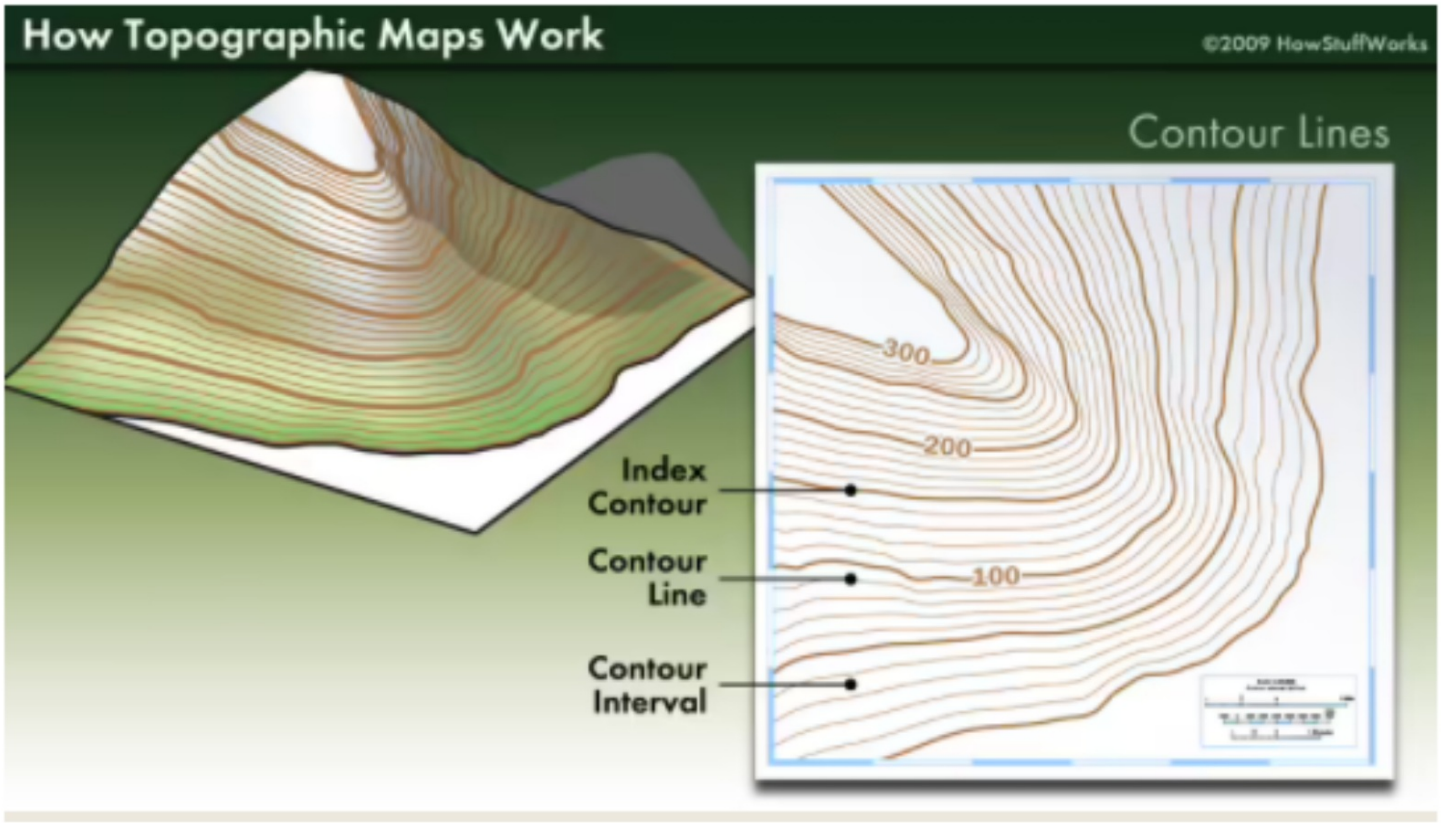
Exploring multivariable calculus through contour lines and surface sea temperature anomalies

What is a contour map? What are contour lines?

A contour map has lines drawn at regular altitude increments. We can use this to represent a 3D object on a 2D paper/image.

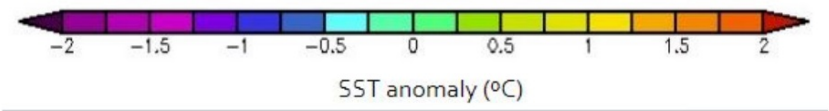

How Topographic Maps Work
©2009 HowStuffWorks
Contour Lines
300
200
100
Index Contour
Contour Line
Contour Interval

A derivative in this scenario would represent the slope of the hill at a given point on the mountain.

In this scenario, I have a collection of ocean science maps that represent surface sea temperature anomalies off of our coast. The slope will represent cooler/warmer temperatures at a selected region.

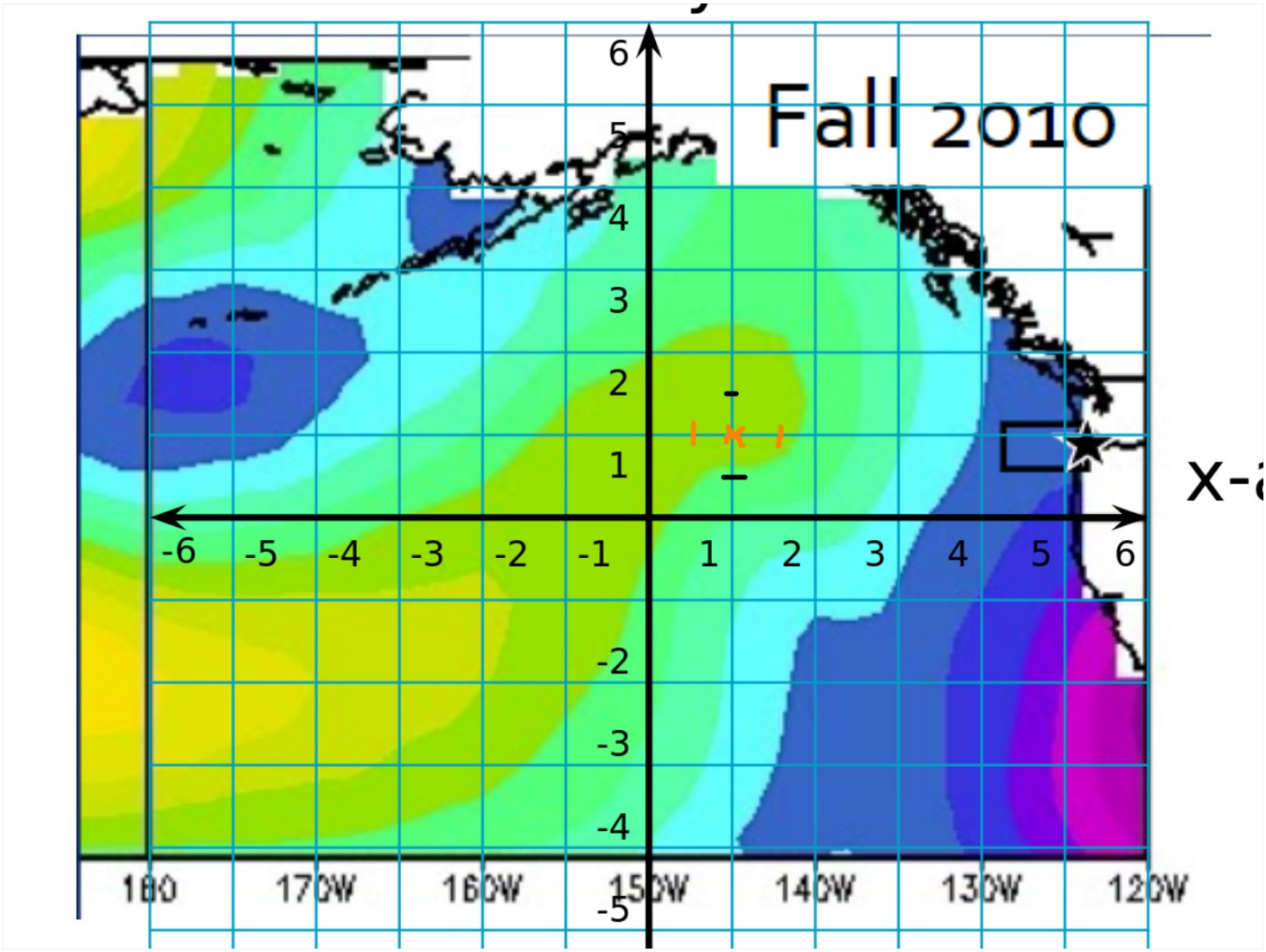
What is a sea surface anomoly?

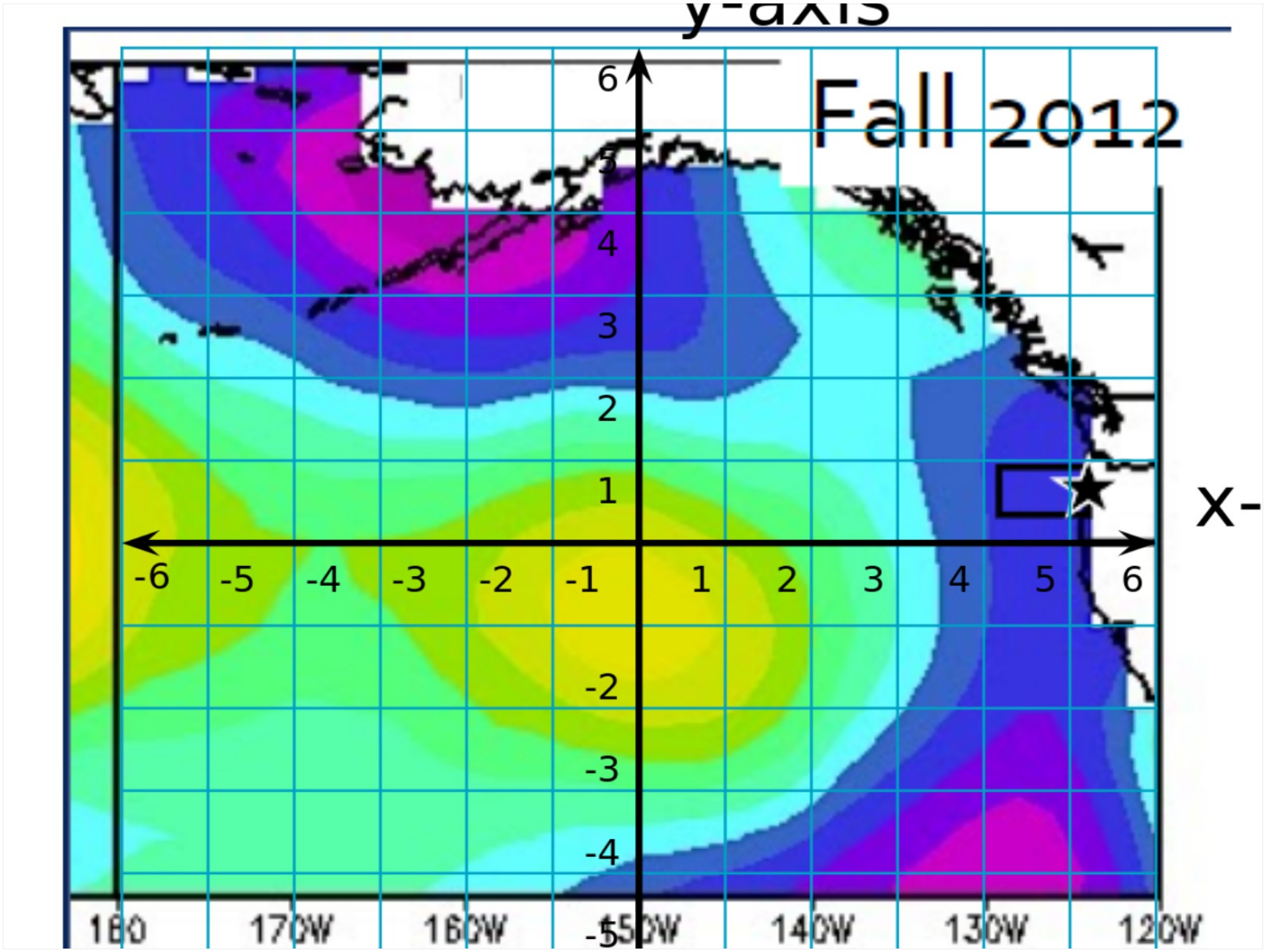
Sea surface is the first millimeter of ocean. An anomoly is a deviation from the average temperature. The data used in these experiments came from NOAA's 1990 - 2007 average sea surface temperature.

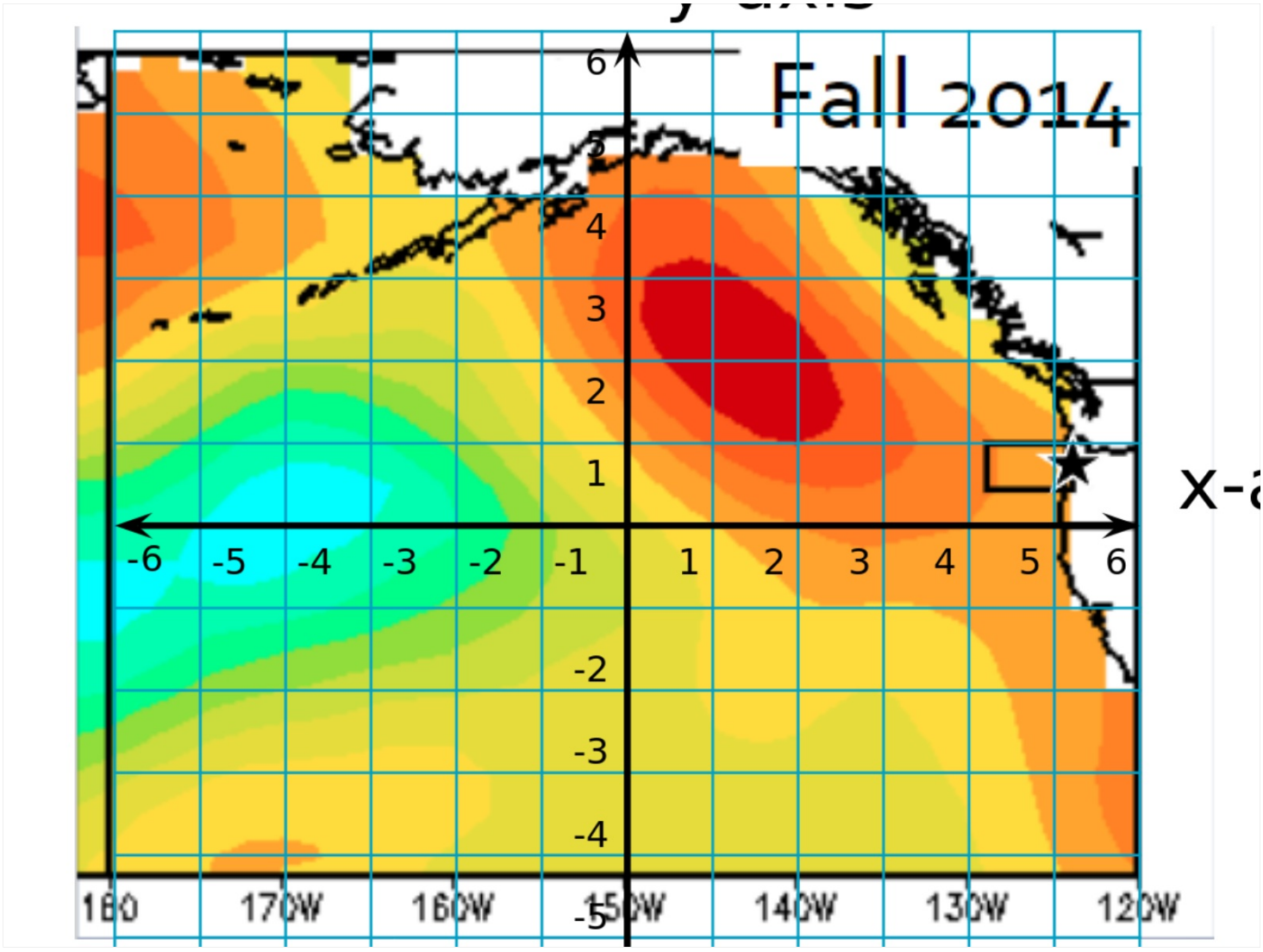


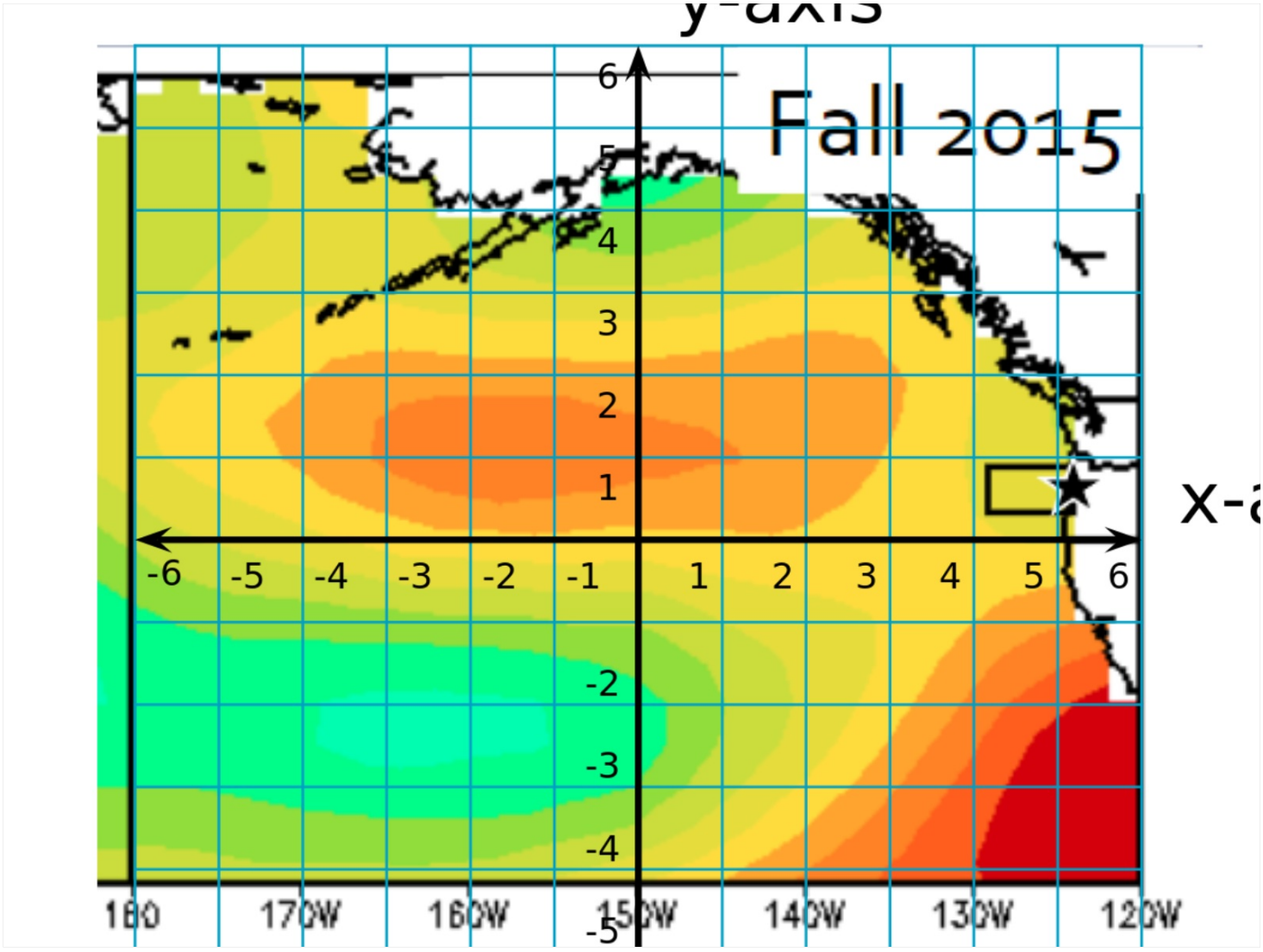
Steps:

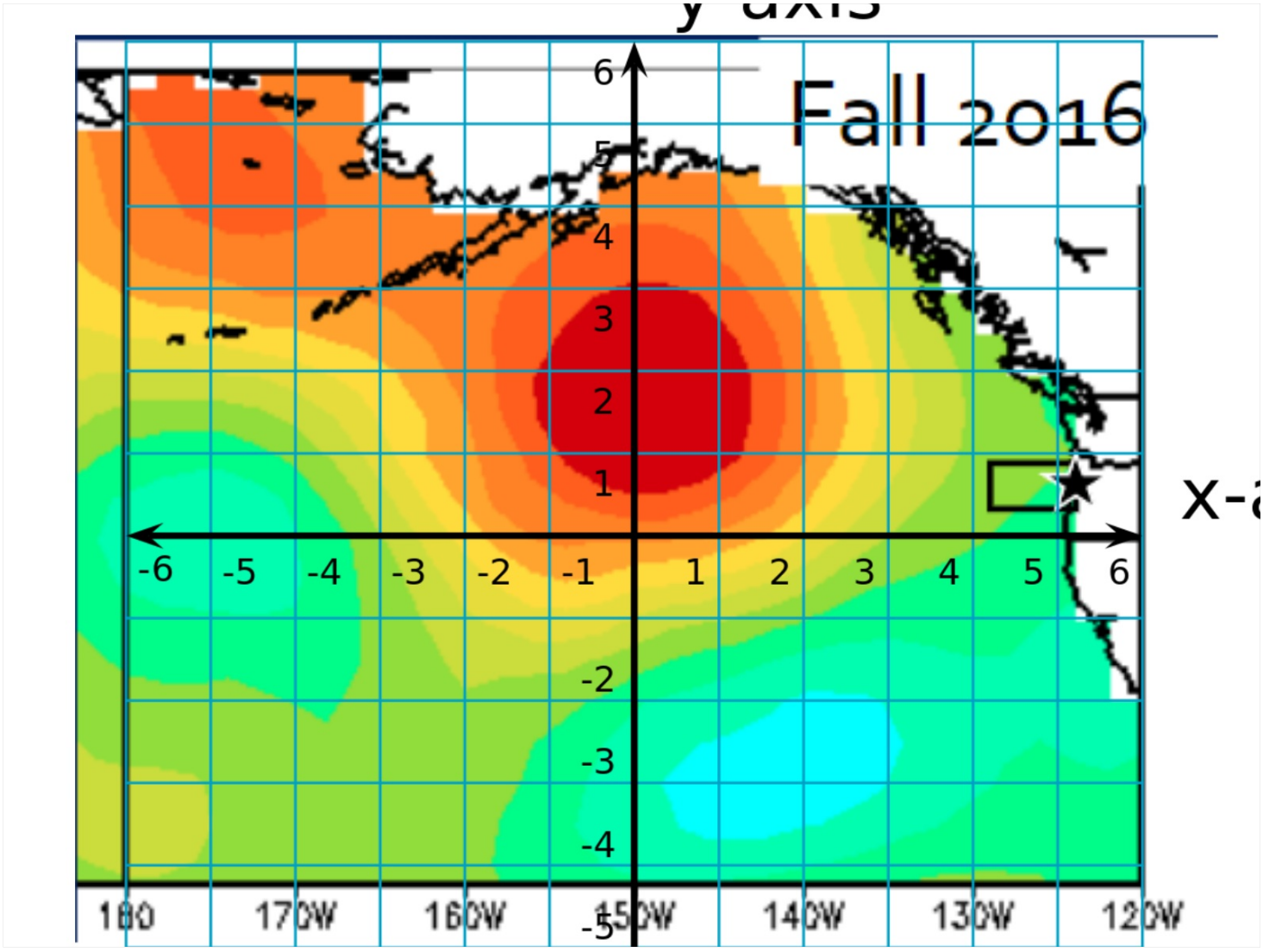
1. Determine which point that you want to estimate.
2. determine the estimated value at that point f(x,y)
3. Find the value in 'x' direction using $f'_x(x,y) = \Delta z/\Delta x$
4. Find the value in 'y' direction using $f'_y(x,y) = \Delta z/\Delta y$

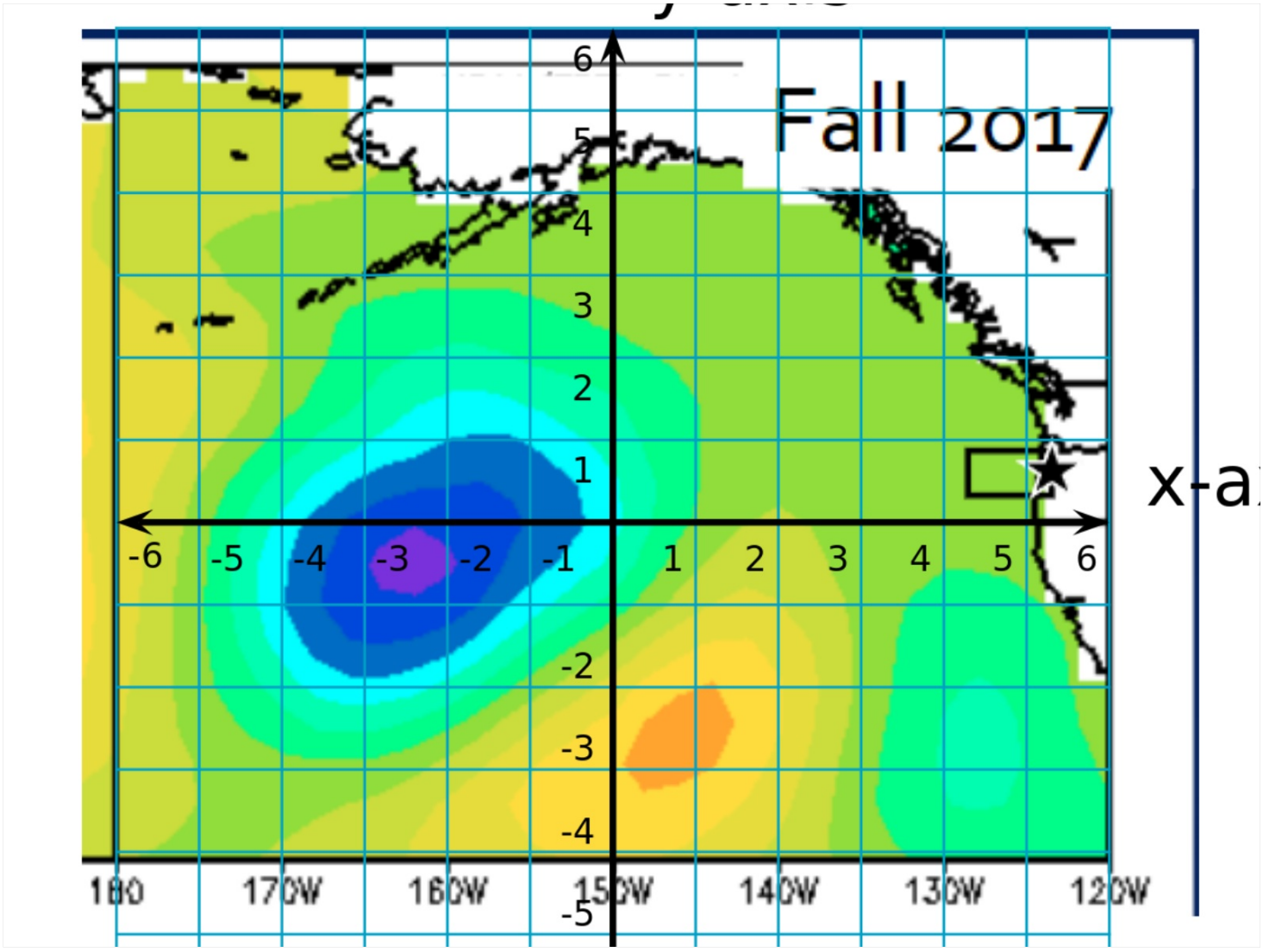

Fall 2010
6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
160W
140W
130W
120W

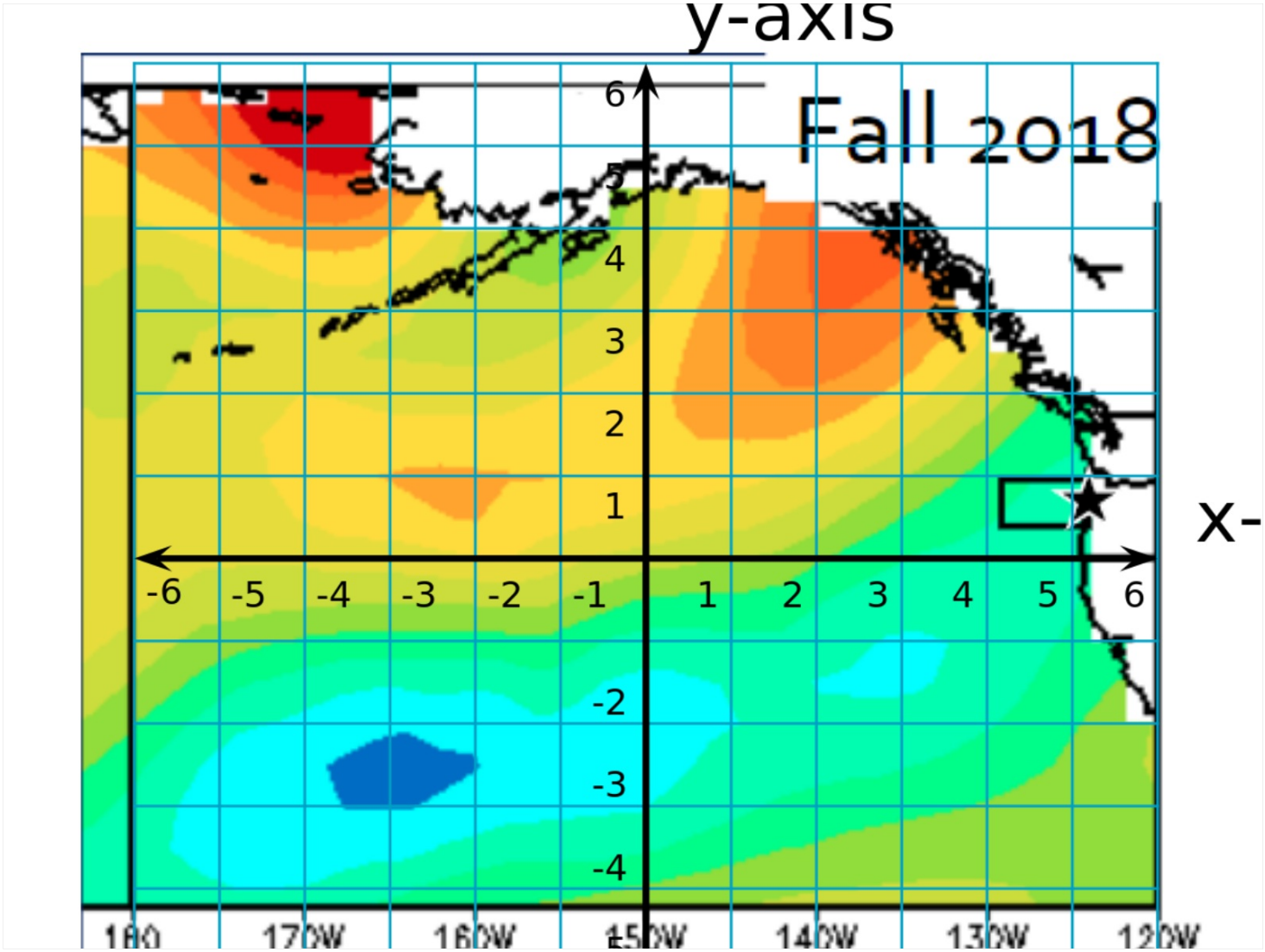

y-axis
Fall 2012
6
4
3
2
1
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
-2
-3
-4
160
170W
160W
150W
140W
130W
120W

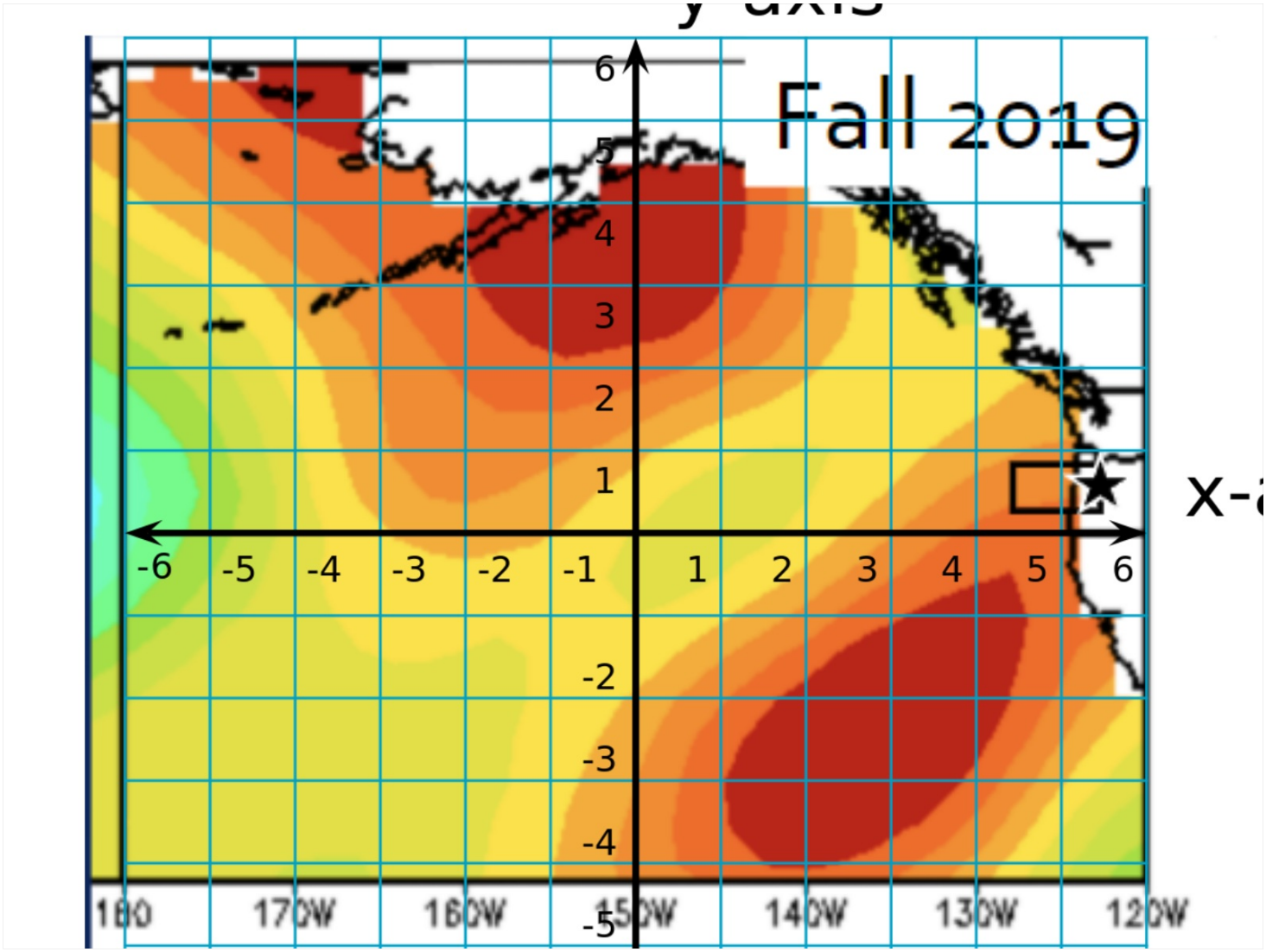

Fall 2014
6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
1
2
3
4
5
6
160
170W
160W
140W
130W
120W


y-axis
Fall 2015
6
5
4
3
2
1
-2
-3
-4
-5
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
160
170W
160W
150W
140W
130W
120W


Fall 2016
6
5
4
3
2
1
-2
-3
-4
-5
-6 -5 -4 -3 -2 -1 1 2 3 4 5 6
180
170W
160W
150W
140W
130W
120W


Fall 2017
6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
180
170W
160W
150W
140W
130W
120W


y-axis
Fall 2018
x-
6
5
4
3
2
1
-2
-3
-4
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
180
170W
160W
150W
140W
130W
120W


Fall 2019
6
5
4
3
2
1
-2
-3
-4
-5
-6 -5 -4 -3 -2 -1 1 2 3 4 5 6
160W
150W
140W
130W
120W

$$\text{Average} = (x_1+x_2+x_3+\ldots+x_n)/n$$

What was the average value for the point that you selected? How did it change as the years increased?

What was average change in x?

What was the average change in y?

What does this data suggest for that point?

Ticket out the door:

Write down the data and observations from two other groups of students.

What did they say about their observations? How was this similar to what you discovered? How was it different?