



## STARBASE Challenge: Tracking Water By Satellite!

For this challenge, you are going to explore how water moves around our planet using data collected by a satellite! The GRACE (Gravity Research And Climate Experiment) is an Earth science mission that was put together by scientists from the German Research Centre for Geosciences and NASA. You will start by reviewing the water cycle and learning about how the GRACE-FO mission is continuing to collect information. Then you will use the data collected during the first GRACE mission to visualize how water cycles through our planet and create a line graph of how the amount of water in our state changes over time.

Use this YouTube video to find out more about groundwater and answer the questions below: [What Is Groundwater?](#) Or <https://tinyurl.com/sbctgroundwater>

1. What are some examples of surface water in our state?
2. Where is more water available – on the surface or inside of aquifers?
3. How does water move in and out of aquifers?
4. How is most of our groundwater used? Why do you think so?
5. Will we ever run out of water? Why do you think so?

Use these YouTube videos to learn more about how the GRACE and GRACE-FO missions track how and where water is moving across the planet: [NASA GRACE: Tracking water from space](#) or <https://tinyurl.com/sbctNASAGRACE> and [NASA's Earth Minute: Scale in the Sky](#) or <https://tinyurl.com/sbctNASAscale>

1. How are gravity, mass, and water tracking related?
2. Describe how the GRACE satellites work.

Now we are going to start to examine some data. The multicolored maps in this animation below show changes in Earth's gravity field. These changes in Earth's gravity field show that the amount of mass in that area has changed. This change in mass is due to the changes in the amount of water. Here's the animation: [GRACE Data Over the United States](#) or <https://tinyurl.com/NASAGRACEdata>

1. What unit was used to measure the amount of water?
2. Which color meant the amount of water was increasing? Which color meant it was decreasing?
3. Look closely at Connecticut on the map. How does the amount of water change over time? What time of year tends to be the wettest? The driest?
4. Based on that pattern, how could you tell if there was a flood or a drought in an area of the country?

Your final challenge is to create a line graph of the amount of water in our state from 2003-2017. Use the resources below and either a piece of graph paper or Google Sheets to put create your graph.

Reminders for making a graph:

- You graph should have a title that describes the information inside
- Your x-axis in a line graph should measure time
- Your y-axis in a line graph should measure whatever is changing over time
- Include units in your axis labels
- For this graph some of your values will be negative numbers. Set the middle of your scale at "0" and make sure it will fit the highest and lowest values from your data

If you are making your graph in Google Sheets, check out this tutorial: [Creating a Line Graph in Google Sheets](#) or <https://tinyurl.com/sbctgraph>

GRACE Water Storage Data for Connecticut from 2003-2012

Date (Month/Year)	Change in Water Storage (mm)	Date (Month/Year)	Change in Water Storage (mm)	Date (Month/Year)	Change in Water Storage (mm)	Date (Month/Year)	Change in Water Storage (mm)
1/2003	0	7/2005	-60	1/2008	+80	7/2010	-30
2/2003	+10	8/2005	-110	2/2008	+90	8/2010	-80
3/2003	+20	9/2005	-70	3/2008	+140	9/2010	-70
4/2003	0	10/2005	-30	4/2008	+70	10/2010	-50
5/2003	0	11/2005	0	5/2008	+10	11/2010	-20
6/2003	-10	12/2005	+50	6/2008	-10	12/2010	+10
7/2003	-40	1/2006	+100	7/2008	-10	1/2011	+40
8/2003	-50	2/2006	+40	8/2008	-30	2/2011	+70
9/2003	-30	3/2006	+30	9/2008	-60	3/2011	+90
10/2003	0	4/2006	+10	10/2008	-60	4/2011	+80
011/2003	+50	5/2006	0	11/2008	-30	5/2011	+40
12/2003	+70	6/2006	0	12/2008	+20	6/2011	0
1/2004	+90	7/2006	-60	1/2009	+60	7/2011	-10
2/2004	+70	8/2006	-50	2/2009	+100	8/2011	-30
3/2004	+30	9/2006	-70	3/2009	+120	9/2011	+30
4/2004	0	10/2006	0	4/2009	+80	10/2011	+50
5/2004	0	11/2006	0	5/2009	+30	11/2011	+70
6/2004	-20	12/2006	+10	6/2009	+10	12/2011	+60
7/2004	-40	1/2007	+10	7/2009	0	1/2012	+90
8/2004	-50	2/2007	+30	8/2009	-20	2/2012	+110
9/2004	-30	3/2007	+30	9/2009	-10	3/2012	+80
10/2004	-10	4/2007	+40	10/2009	0	4/2012	+50
11/2004	+40	5/2007	+10	11/2009	0	5/2012	+40
12/2004	+70	6/2007	-20	12/2009	+20	6/2012	+20
1/2005	+100	7/2007	-90	1/2010	+50	7/2012	-20
2/2005	+80	8/2007	-110	2/2010	+80	8/2012	-110
3/2005	+70	9/2007	-140	3/2010	+60	9/2012	-70
4/2005	+30	10/2007	-120	4/2010	+50	10/2012	-30
5/2005	+20	11/2007	-40	5/2010	+30	11/2012	-10
6/2005	0	12/2007	+40	6/2010	+10	12/2012	+10

