Name: _____ Date: _____ Period: _____

Ground Validation and OLYMPEX Webquest - Elementary: Student Capture Sheet

Go to http://pmm.nasa.gov/education/interactive/gv-webquest-elementary to find the links used for the webquest. Use this student capture sheet to provide your answers to the questions.

During this webquest, you will learn how we measure rain and snow from the ground and from space using satellites, and why we need to check the data (what's called ground validation or ground truthing) from the satellites. This particularly relates to the OLYMPEX Field Campaign which will look at precipitation in the Olympic Peninsula of Washington State from November 2015 until January of 2016.

PART 1: Measuring Precipitation

Introduction:

Let's start with the basics. What is precipitation? Write your answer below, or visit http://go.usa.gov/3tt33 to review the water cycle first.

1. *Precipitation is* _____

_____

The weather can have a big impact on our lives. Can you think of at least one way the weather has affected you recently?

2. *Recently, the weather affected me by* _____

_____

Because weather can affect people a lot, we like to be able to measure things like rain. Watch the video "For Good Measure" (2:01) at http://go.nasa.gov/1efLRnl for an introduction to a satellite that measures rain.

3. *What is one way we measure rain from the ground? Why doesn't that always work well?* _____

_____

_____

4. *Why do we need to look at precipitation using satellites?* _____

_____

_____

Satellites are extremely useful for measuring global precipitation and filling in the gaps between rain gauges and radars. However, the way satellites "see" rain and snow is not the same as the way rain gauges collect precipitation on the ground. To make sure the algorithms (computer programs used to process data) used by the satellites to give us rain totals are working well, we need to do what is called ground validation. Let's learn about some of the tools scientists use to measure rain from the ground.

Rain Gauges:

Watch this video from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) to see how a simple rain gauge works, https://youtu.be/pLRAsAo5l0o. This is the sort of rain gauge you could set up outside your home or school to measure rain yourself.

5. *What needs to be true of the top and the bottom of a container you use for measuring rain?* _____

_____

6. *Why can't we just use the outer tube of the rain gauge for measuring?*_____

_____

_____

Beyond the simple rain gauges you saw in the last video, which is basically just a tube with markings, scientists also use more complicated (and automated) rain gauges in field campaigns. Watch this video of a person showing a tipping bucket rain gauge: https://youtu.be/WmHk7bSMs08?t=1m4s (you only need to watch about two minutes). You can see another example here: https://youtu.be/qzKWzTe7CEg.

7. *Draw a diagram with labels to show how a tipping bucket rain gauge works compared to the simple rain gauge you saw before.*

Radar on the Ground:

Scientists also used ground-based radars to compare to the satellite data. Visit this website to learn how radars work: http://bit.ly/1KneGgc

8. *Draw a diagram (using labels as needed) to show how a radar works to measure precipitation.*

Note: If you want to see what the actual radars that will be used in the OLYMPEX campaign look like, you can see the NPOL radar here: http://go.nasa.gov/1OwzCrs and the Doppler on Wheels radars here: http://bit.ly/1W3E9Ur

A Flying Science Laboratory

Scientists will also use aircraft with scientific instruments aboard to take measurements during the OLYMPEX Field Campaign. During this project, two aircraft will fly, the DC-8 and the ER-2. Check out the photo galleries at these links: http://go.nasa.gov/1McdXSW & http://go.nasa.gov/1Mce2Gd

9. *What's one interesting thing you noticed about the aircraft?* _____

10. *Why do you think we need aircraft to make these measurements?* _____

PART 2: Looking at Data

Now that you've seen the instruments that will be used, from rain gauges to radar to aircraft, let's take a look at some data. We will look at rain gauge data first. Go to http://data.cocorahs.org/cocorahs/maps/ to see a map of citizen science rain gauge observations using the very simple manual rain gauges you learned about before. On the first map that comes up, you can see the reports of precipitation that were made this morning, representing the previous 24 hours of rainfall. Note that the white dots are places where zero precipitation was reported, while gray show a trace (some precipitation but not enough to properly measure), and then the scale goes from purple (least amount of precipitation) to red (most precipitation). Also, only 600 data points can be displayed at a time, so you will notice new data points appear as you zoom in.

1. *What are some areas that got rain in the last day? Areas that did not?* _____

2. *Name one area that looks like it has a sparse network of rain gauges (few reports).* _____

3. *Name one area that looks like it has a dense network of rain gauges (lots of reports).* _____

4. *Zoom in and explore the map a bit. You can click on a particular station to get the exact amount of rain they reported. What is one interesting thing you notice?* _____

The data from these citizen science observations, which you could contribute to yourself at your home or school, is actually used by the National Weather Service, along with satellite measurements and data from other sources, to help with the computer models that help forecast the weather.

Now we're going to focus on the location where the field campaign will take place, the Olympic Peninsula in the state of Washington. Go to this map to see where that is: http://goo.gl/KNJ8hM. The Olympic Peninsula is outlined in red.

1. *Make some observations about the Peninsula. Think about whether it looks greener or browner than other areas, whether water is nearby, zoom in to look at the land features, etc.*

One of the reasons scientists chose this location is because of its interesting climate and geography. The peninsula has the only temperate rain forest in the Northern Hemisphere, for example. The winter storm season can be quite active, with storms coming from the Pacific Ocean over the coastal region into the Olympic Mountains. The changes in the storms over land are very interesting to study. And if want to study rain, you need it to rain – the peninsula usually receives from 100 inches (2500 mm) of precipitation on the coast to about 180 inches (4500 mm) in the forested mountainous interior.

Four points are marked on the map, two on the left near the Pacific Ocean and two at the top of the peninsula near the Strait of Juan de Fuca, and labelled with total average rainfall. You can also click anywhere on the outlined area to pull up a graph with details of the four locations by season

2. *What do you notice about the differences in rainfall for the four locations? Which are most similar to each other? Any other patterns you notice?*

Look at this picture showing the average annual precipitation next to a map showing the land features. http://go.nasa.gov/1KX408u.

3. *Do your observations from the four points match up with what you see on the Average Annual Precipitation map? Explain.*

4. *What land features (from the left-hand map) can you see matching up with the areas showing high average precipitation (green and blue on the right-hand map)?*

You should have noticed that mountains seem to be having some effect on the rain. Let's explore that more by looking at radar data. Go to http://go.nasa.gov/1KJ0OjI, and will look at September 1st, 2015 (a day with some nice storms to observe.)

Note the scale on the right side labelled "dBZ." That refers to how much the clouds reflect, and can be matched with rainfall. The colors at the top of the scale (pinks/purples) indicate large drops and heavier precipitation, while those toward the bottom (green/blues) are smaller drops and lighter precipitation. You can also zoom in if you wish to look at an area more closely.

5. *What direction does it look like the storms are moving?* _____

6. *What do you notice happening to the storms as they approach the mountains (wrinkly areas on the background map), especially the larger mountain rain to the east (right in the picture)?* _____

Here's a video explaining the variations in wet and dry areas because of mountains, what you saw in the data, and what we call a rain shadow, https://youtu.be/DoKTTHd-XEQ. (Start here https://youtu.be/DoKTTHd-XEQ?t=1m6s to skip directly to the part about the Pacific Northwest.)

7. *If someone asked you, "How do mountains affect rain patterns?", what do you think is the most important thing to tell them?* _____

Wrap-up:

Now that you understand the types of instruments scientists use to collect precipitation data, and have looked at some data, we'll wrap up with a look at why these measurements are important. Watch the video "Too Much, Too Little" (4:44) to see some of the most significant uses for the data, http://go.nasa.gov/KEUfUV.

1. *What do you think is the most important use for precipitation data? Why?* _____