Name: _____ Date: _____ Period: _____

Ground Validation and OLYMPEX Webquest: Student Capture Sheet

Go to http://pmm.nasa.gov/education/interactive/ground-validation-webquest 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 precipitation from the ground and from space using satellites, and why we need to do ground validation (also called ground truthing) of the satellite data. You will also learn about 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:

Watch the video "For Good Measure" (2:01) at http://go.nasa.gov/1efLRnl for an introduction to the Global Precipitation Measurement Mission and why it is important.

1. *What is one way we measure rain from the ground? What is a disadvantage of that method?* _____

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

Now watch the video "Getting the Big Picture (2:39) at http://go.nasa.gov/1j2PzKm to learn more about how satellites take measurements.

3. *What is the difference between active and passive remote sensing?* _____

4. *Name one thing NASA can measure via remote sensing.* _____

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. Rain gauges directly measure how much water falls from the sky, while satellites measure indirectly (and remotely) by using electromagnetic waves. To get rainfall totals from the data collected by the satellite, we use algorithms - computer programs that process the data. To make sure those algorithms are working well, we need to do what is called ground validation, comparing the data from ground measurements to satellite measurements. First, let's learn about some of the tools scientists use to measure rain from the ground.

Basic Rain Gauges:

Read the article titled "Reading a Rain Gauge," found at http://go.nasa.gov/1qmLeUJ, to learn about how simple rain gauges work.

5. *What units do we use to measure rain?* _____

6. *Does it matter how big a container we use to collect rain? Why or why not?* _____

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7. *Can you think of some reasons why we use relatively small rain gauges to measure rain, rather than something large like a swimming pool?* _____

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Not Your Backyard Rain Gauge

Beyond the simple rain gauges you saw in the last article, which is basically just a tube with markings, scientists also use more complicated (and automated) rain gauges in field campaigns. Read the blog titled "Not Your Backyard Rain Gauge" about a type called a "tipping bucket" rain gauge from a scientist working on a previous GPM field project, available here http://go.nasa.gov/1Owz44N. You can also see examples of this type of rain gauge here https://youtu.be/WmHk7bSMs08?t=1m4s (you only need to watch about two minutes) and here https://youtu.be/qzKWzTe7CEg.

8. *Draw a diagram (be sure to include labels) of how a tipping bucket rain gauge works compared to the simple rain gauge you read about before.*

9. *Based on the description of field work, do you think you would like to have the author's job? Why or why not?* _____

_____

_____

Radar on the Ground:

Scientists also used ground-based radars to compare to the satellite data. Visit the next two websites to learn how radars work: http://bit.ly/1KneGgc & http://bit.ly/1LyuKg6

10. *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 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

Hint: If you click on the first picture, it will enlarge and you can also see the caption, then use the right arrow to move through the rest of the photos. You may not need to look at all of them to answer the question below.

11. *Looking at the pictures, what are some differences and similarities you see between the two aircraft? (Think about size of the aircraft, how many people you see on board and what they are wearing, the instrument panels and displays you see, or anything else you notice.)* _____

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Why do we need ground validation?

Read about the upcoming Olympic Mountain Experiment (OLYMPEX) here: http://pmm.nasa.gov/OLYMPEX

12. *What is something that you found interesting or surprised you from the article, or something you would like to learn more about?* _____

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PART 2: Looking at Data

Now let's take a look at some actual data. First, let's look at radar data. Since the field campaign is taking place in Washington State, we'll look specifically at the Pacific Northwest. Go to http://go.nasa.gov/1Vlu882.

You'll notice that the time of the image is noted in the upper right, and cycles through about an hour's worth of data by default. You can use the "loop length" slider to extend that to up to the last 8 hours, and stop the loop and step through the images one by one using the controls. You can also zoom in if you wish to look at an area more closely.

Note the scale on the right side labelled "dBZ." That refers to the reflectivity of the clouds, and can be correlated with the intensity of 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.

1. *Do you see any activity on the radar in the last hour or two, especially near the Olympic Peninsula? Describe its intensity and location (use the maps labels to explain where you are seeing precipitation).* ___

Let's look at a particular date, September 1st, 2015. You can adjust the date by clicking on options > set end time, then choose that date from the calendar and click set. You can also go directly to http://go.nasa.gov/1KJ0OjI.

2. *What patterns do you notice in the movement of the storms?* _____

3. *What do you notice happening to the storms as they approach the mountains (wrinkly areas on the background map)?* _____

Now we'll look at some of the actual sites that will be used on the campaign. Go to http://olympex.atmos.washington.edu. You can see the sites specifically set up for OLYMPEX, as well as other more permanent sites. Click on one that has data (a number, not N/A).

4. *What are the other types of data (besides precipitation) that were collected at the station you chose? Be sure to note the units for the data being collected.*_____

5. *Describe an interesting pattern you notice in one of the data sets.* _____

Next let's look at some citizen science rain gauge data. Go to http://data.cocorahs.org/cocorahs/maps/ to see a map of citizen science rain gauge observations using very simple manual rain gauges. 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.

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

_____

_____

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

_____

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

_____

Let's take a look at Washington State specifically. Either choose Washington from the dropdown menu at the top, or go directly here http://bit.ly/1iSfgNd. You can look at today's data, select a date of your choice from the menu, or look at 9/17/2015 which has interesting data: http://bit.ly/1UXDK3n.

9. *Describe any overall patterns you see in the data for Washington State.* _____

_____

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10. *Zoom in as needed, and click on a few stations to see their exact data. Choose three stations and record their data below.* ***Make sure you change the setting to be metric from the dropdown at the top.***

    Date: _____

Station Number	Time of observation:	Precipitation amount (mm)

The data from these citizen science observations, which you could sign up to contribute to yourself at your home or school, is 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.

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 applications for the data, http://go.nasa.gov/KEUfUV.

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

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