



# 6

## Dealing with Cloudy Days

### Quick Links To Sections

[6.1 ECOSTRESS & Clouds](#)

#### Objectives:

1. Learn about cloud filtering options in ArcGIS.
2. Create a map of cloudiness in QGIS using cloud data from ECOSTRESS.



## Motivation For Today's Tutorial: Clouds and Remote Sensing

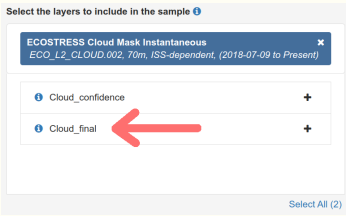
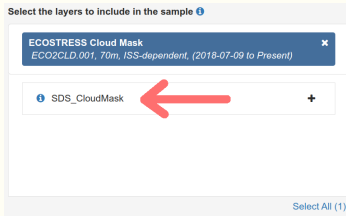
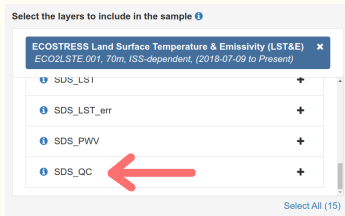


For this and the previous tutorial, our goal is to increase the tools you have in your toolkit when working with the occasional quirks associated with satellite remote sensing data. One of the most consistent issues that we encounter when working with satellite remote sensing data is interference in the images from cloud cover.

### 6.1 ECOSTRESS & CLOUDS

ECOSTRESS, like nearly all instruments used for remote sensing, cannot see through the clouds and relies on clear skies to provide reliable observations of land surface temperature. The *AppEEARS* database has a few layer options to ensure clouds aren't interfering with an analysis, depending on your goals and the period of data that you request. You may remember that we used the *Cloud\_final* layer in a previous tutorial on Death Valley. This is a newer "version2.0" layer that was introduced to ECOSTRESS in late 2022. For data before that, or if you need more information than simply the presence/absence of clouds, ECOSTRESS has alternative metrics available in *AppEEARS*:



Cloud_final	CloudMask	QC
 <ul style="list-style-type: none"> <li>• Simple &amp; straightforward.</li> <li>• Pixels with values = 0 have been determined by the algorithm as “not cloudy”.</li> <li>• Pixels with values = 1 have been determined by the algorithm as “cloudy.”</li> <li>• Includes QA Stats for confidence in cloudiness determination, 0 = “confidently clear”, 1 = “probably clear”, and 2 = “probably cloudy”, and 3 = “confidently cloudy.”</li> <li>• Easy to visualize clouds in QGIS.</li> <li>• Only available from late 2022 onwards!</li> </ul>	 <ul style="list-style-type: none"> <li>• Previous version of <i>Cloud_final</i>.</li> <li>• Not as user-friendly.</li> <li>• Best to visualize through AppEEARS built-in graphs.</li> <li>• Contains cloud information and the tests used to determine cloudiness.</li> </ul>	 <ul style="list-style-type: none"> <li>• Broad quality control.</li> <li>• Not as user-friendly.</li> <li>• Best to visualize through AppEEARS built-in graphs.</li> <li>• Contains cloud information, as well as other quality metrics regarding missing pixels and atmospheric conditions.</li> </ul>

To showcase the differences in these layers, let’s create a new request in AppEEARS for the Vancouver Island shapefile you drew in a previous tutorial (Tutorial #3). Let’s use the week between Christmas Eve 2022 and New Year’s Day 2023.

1. Head over to <https://appears.earthdatacloud.nasa.gov/> and sign in.
2. Click the *Extract* dropdown menu to select *Area*. Next, select *Start a New Request*.
3. Use the screenshot below to set up your request. Name your sample, upload your Vancouver Island .zip shapefile, and enter *12-24-2022* and *01-01-2023* as start and end dates. Search for the “ECOSTRESS Swath Land Surface Temperature and Emissivity” product and select *LST*, *QC*, and *cloud\_mask* as layers. Search for the “ECOSTRESS Cloud Mask Instantaneous” product and select *Cloud\_final* as a layer. Keep “GeoTiff” as the format and select *Native Projection* for the projection. Click *Submit*.



Enter a name to identify your sample

Vancouver Island Late December 2022

Upload a file or draw a polygon using the or icon

Drop a vector polygon file containing the area feature(s) to extract or [click here](#) to select the file.

Supported file formats:

- Shapefile (.zip including .shp, .dbf, .prj, and .shx files)
- GeoJSON (.json or .geojson)

Start Date: 12-24-2022

End Date: 01-01-2023

Is Date Recurring?

Select the layers to include in the sample

ECOSTRESS Cloud Mask Instantaneous  
ECO\_L2\_CLOUD.002, 70m, ISS-dependent, (2018-07-09 to Present)

Cloud\_confidence  
70m, ISS-dependent  
Cloud confidence

Cloud\_final  
70m, ISS-dependent  
Final Cloud Mask

Select All (2)

Selected file

Lat: 25.866 Lon: -118.617

To clear a polygon, draw a new polygon or upload a vector polygon file.

Selected layers

LST  
70m, ISS-dependent  
Land Surface Temperature

QC  
70m, ISS-dependent  
Quality Control for LST and emissivity

cloud\_mask  
70m, ISS-dependent  
Final cloud mask

Remove All (3)

Output Options

File Format: GeoTiff

Filename Date Format:  Use calendar date and time for output filenames

Projection: Native Projection

4. Use the *Explore* drop-down menu to track the status of your request.

AppEEARS Extract **Explore** ← 4

Explore Requests

Showing requests 1 - 39 of 39

« Prev 1 Next »

5 ↓

While AppEEARS crunches the numbers, a status bar will show up here.

Request	Type	Status	Details	Date Submitted	Date Completed
<a href="#">Vancouver Island Late December 2022</a>	Area Sample	Done		09-05-2023 9:17:51 PM PDT	09-05-2023 9:33:02 PM PDT

Please see [Sample Request Retention](#) for

5. When the request is completed, click on the name of your request to access the layer stats.

6. In the meantime, let's visualize some of the cloud data. We have already accessed the *Cloud\_final* layer for Vancouver Island from 1/1/2023.

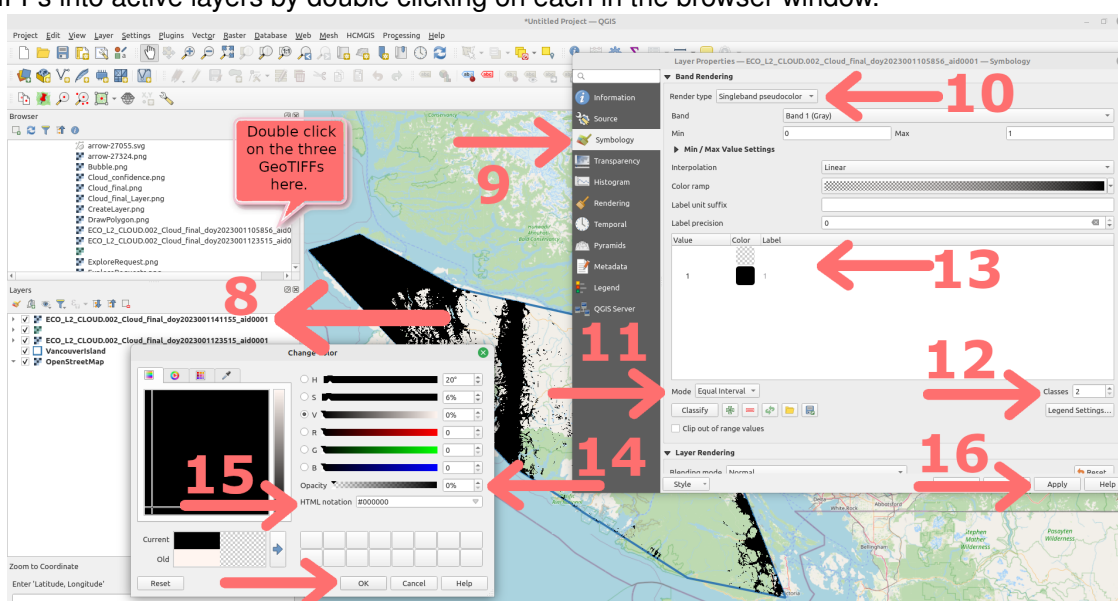


### Vancouver Island *Cloud\_final* Layer Files

Please download these three GeoTIFF files, saving them somewhere logical and accessible, such as the same folder you used for the Vancouver Island shapefile:

- [ECO\\_L2\\_CLOUD.002\\_Cloud\\_final\\_doy2023001105856\\_aid0001.tif](#)
- [ECO\\_L2\\_CLOUD.002\\_Cloud\\_final\\_doy2023001123515\\_aid0001.tif](#)
- [ECO\\_L2\\_CLOUD.002\\_Cloud\\_final\\_doy2023001141155\\_aid0001.tif](#)

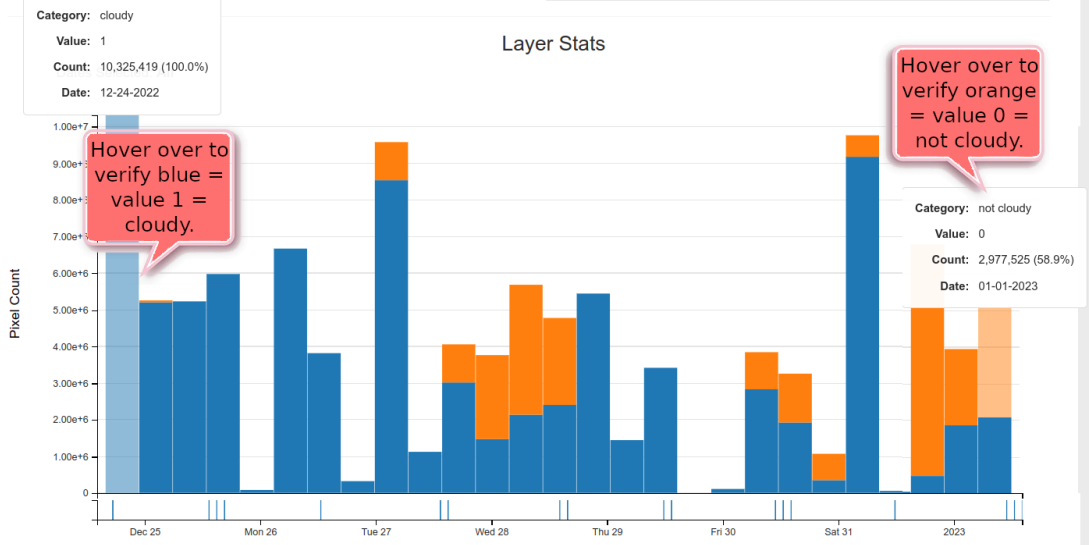
7. Switch over to QGIS, where you should still have your shapefile loaded as a layer. Load these three GeoTIFFs into active layers by double clicking on each in the browser window.



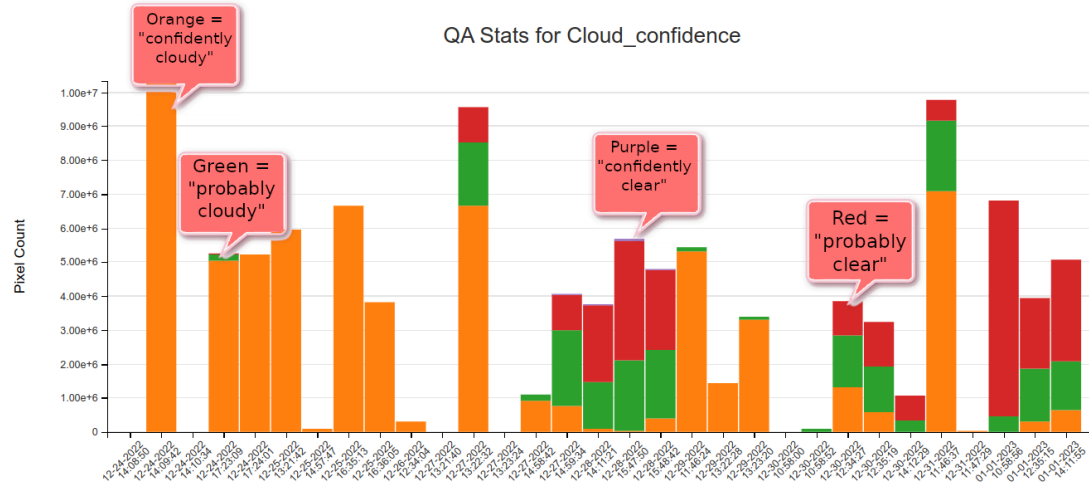
8. Right-click on one of the layers in the *Layer* browser and select *Properties*.
9. In the panel, make sure *Symbology* is selected.
10. Change *Render type* to *Singleband pseudocolor*, which tells QGIS that we want this layer to be in color.
11. Change *Mode* to *Equal Interval*. Now, we have told QGIS that we want this layer to have different colors for each value.
12. Change *Classes* to 2. Remember *Cloud\_final* has only two values. 0 = “not cloudy” and 1 = “cloudy”. Now, we can change the color for each value.
13. Right-click on Windows/Linux or ctrl-click on Mac for the first value, 0.
14. Since 0 = “not cloudy,” let’s change this to be completely transparent by sliding the *Opacity* bar all the way to zero. Click *OK* and then right-click on Windows / Linux or ctrl-click on Mac for the second value, 1.
15. If you are feeling particularly dark, make the clouds black by typing “#000000” in the *HTML notation* box (this is HTML code for black). Click *OK*.
16. Click *Apply* to apply the color changes to your map.
17. Repeat these steps for the other two *Cloud\_final* layers. You now have a cloudiness map for New Year’s Day 2023 on Vancouver Island. Upload a screenshot of this map to Canvas.
18. Check your Vancouver Island request in *AppEEARS*. If it is ready, you can browse through the different layers to see how the quality and cloud metrics work.



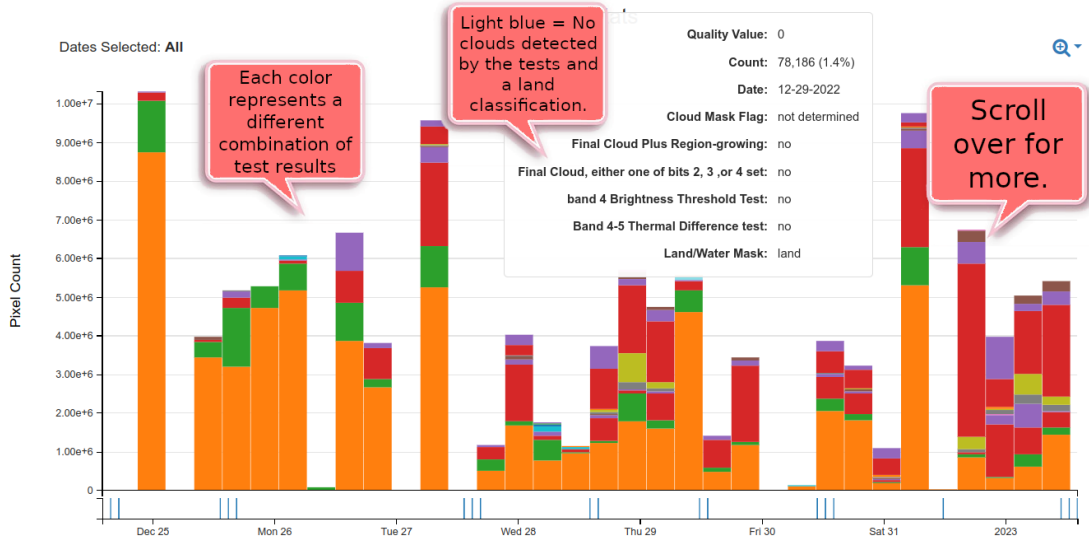
## Cloud\_final:



## Cloud\_confidence:

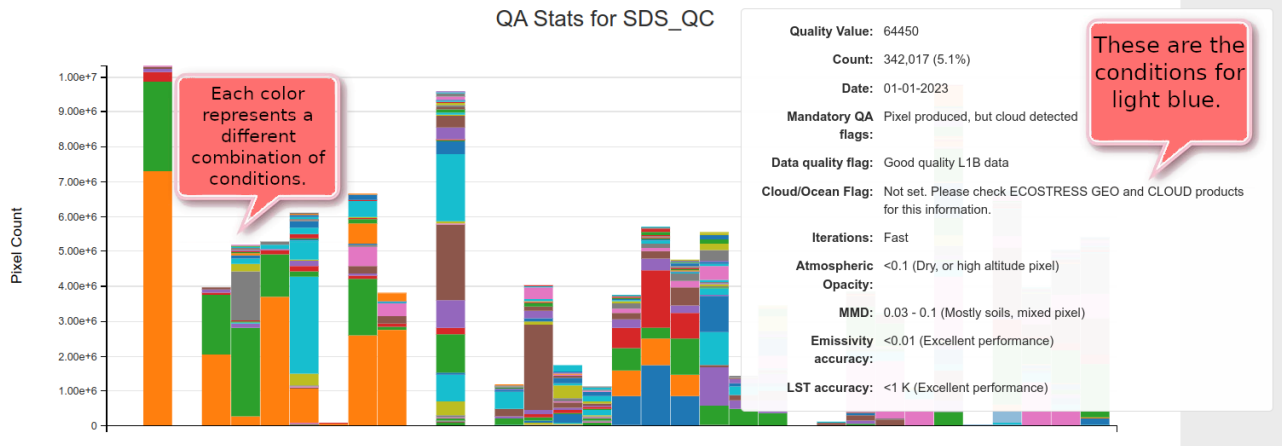


## CloudMask:





## QC:



The layers we have described here start simple and increase in complexity. As a general rule, we suggest using the simplest tools to complete your task. So, if your desired data are after November 2022, stick with the Cloud\_final layer. If your data are before November 2022, use cloud\_mask. Finally, as your interest in remote sensing grows, you can learn more about the QC layer in the [ECOSTRESS Level 2 Product User Guide](#).

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**Recommended Citation:** Forsythe, J.D., G.R. Goldsmith, and J.B. Fisher. 2023. Observing Earth from Above Tutorials. Chapman University. <https://jeremydforsythe.github.io/icecream-tutorials/>

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