

7

Dealing with Cloudy Days

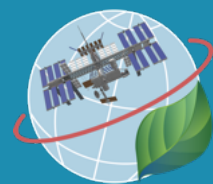
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[7.1 ECOSTRESS & Clouds](#)

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Objectives:

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



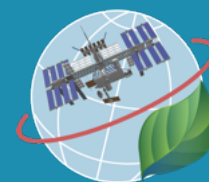
Motivation For Today's Tutorial : Upcoming Temperature Competition



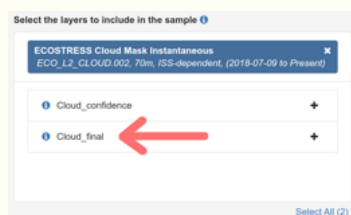
For this and the previous tutorial, our goal is to increase the skills you have in your toolkit when working with the occasionally annoying quirks associated with satellite remote sensing data. Ultimately, we will have an in class competition to see who had the hottest and coldest hometown temperatures, but for now let's talk about one of the biggest cause of headaches for remote sensing researchers: ☁️ .

7.1 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 timeframes. You may remember that we used the *Cloud_final* layer in [Tutorial 3's](#) Death Valley Experiment. This is a newer "V2" product that was introduced in late 2022. For data before that or if you are needing more information than simply presence/absence of clouds, ECOSTRESS has alternative metrics available in *AppEEARS*:



Cloud_final



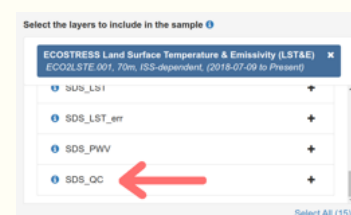
- Simple & straightforward.
- Pixels with values = 0 have been determined by the algorithm as “not cloudy”.
- Pixels with values = 1 have been determined by the algorithm as “cloudy”.
- Includes QA Stats for confidence in cloudiness determination, 0 = “confidently clear”, 1 = “probably clear”, and 2 = “probably cloudy”, and 3 = “confidently cloudy”.
- Easy to visualize clouds in QGIS.
- Only available from late 2022 on!

SDS_CloudMask



- Previous version of *Cloud_final*.
- Not as user-friendly.
- Best to visualize through AppEEARS built-in graphs.
- Contains cloud information in addition to the tests used to determine cloudiness.

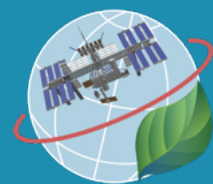
SDS_QC



- Broad quality control.
- Not as user-friendly.
- Best to visualize through AppEEARS built-in graphs.
- Contains cloud information in addition to other quality metrics regarding missing pixels and atmosphere conditions.

To showcase the differences in these layers, let's create a new request in AppEEARS for the Vancouver Island shapefile you drew in the last tutorial (ADD LINK). 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, enter 12-24-2022 and 01-01-2023 as start and end dates, and select ECOSTRESS land surface temperature (SDS_LST), SDS_QC, Cloud_final, and SDS_CloudMask as layers. Keep GeoTiff as the format and select *Native Projection* for the projection. Click *Submit*.



Extract Area Sample

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 Land Surface Temperature & Emissivity (LST&E) x
ECO2LSTE.001, 70m, ISS-dependent, (2018-07-09 to Present)

SDS_EmisWB +

SDS_LST_err +

SDS_PWV +

Select All (13)

Selected file (VancouverIsland)

Selected layers

Layer Name	Resolution	Frequency
SDS_LST	70m, ISS-dependent	-
Cloud_final	70m, ISS-dependent	-
SDS_CloudMask	70m, ISS-dependent	-
SDS_QC	70m, ISS-dependent	-

Remove All (4)

Output Options

File Format: GeoTiff

Projection: Native Projection

NOTE: Be aware that any reprojection of data from its source projection to a different projection will inherently change the data from its original format. All reprojections use GDAL's `gdalwarp` function in combination with the PROJ.4 string listed above. For additional information, see the AppEEARS [help documentation](#).

Submit Cancel

4. Use the *Explore* dropdown menu to track the status of your request.

AppEEARS Extract **Explore** ← 4

Explore Requests

Showing requests 1 - 39 of 39

« Prev 1 Next »

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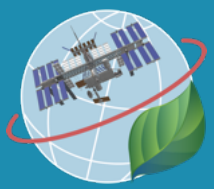
While AppEEARS crunches the numbers, a status bar will show up here.

Request	Type	Status	Details	Date Submitted	Date Completed
Vancouver Island Late December 2022	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 complete, click on the name of your request to access the layer stats.

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

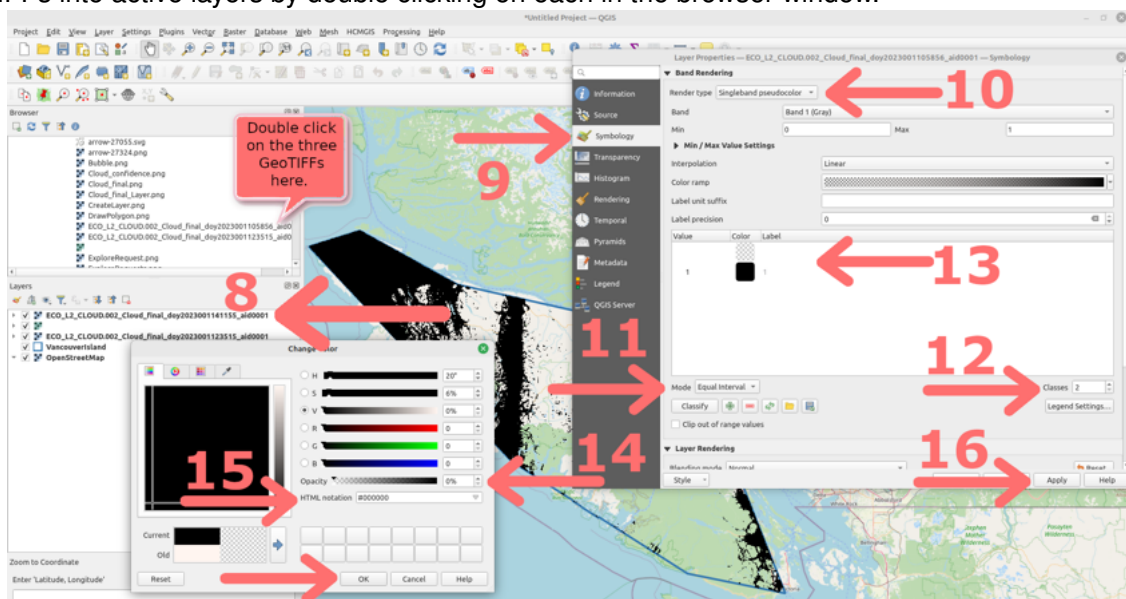


Vancouver Island *Cloud_final* Layer Files

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](#)

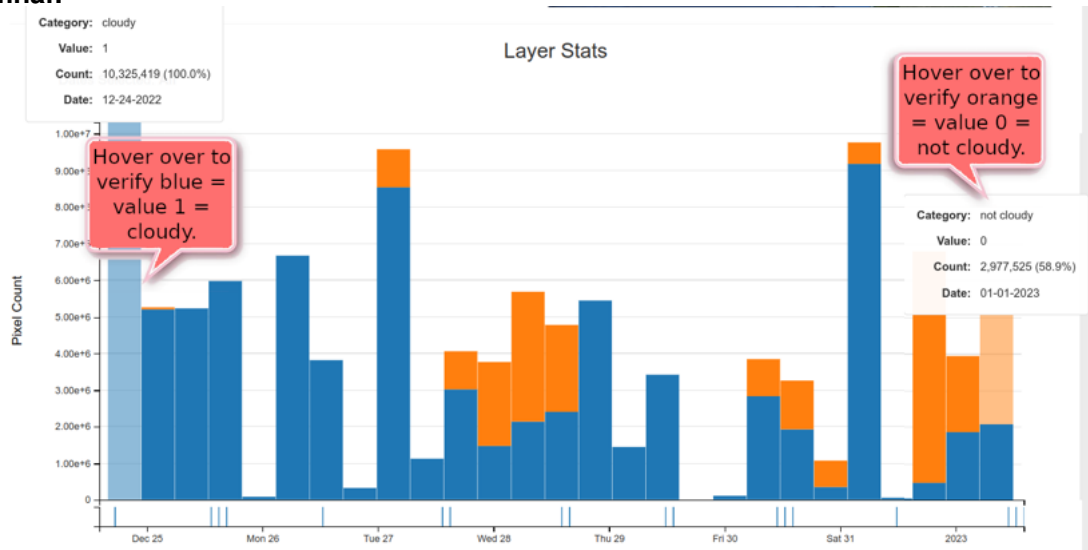
7. Switch over to QGIS, where you should still have your shapefile loaded as a layer. Load these three GeoTIFFs into active layers by double clicking on each in the browser window.



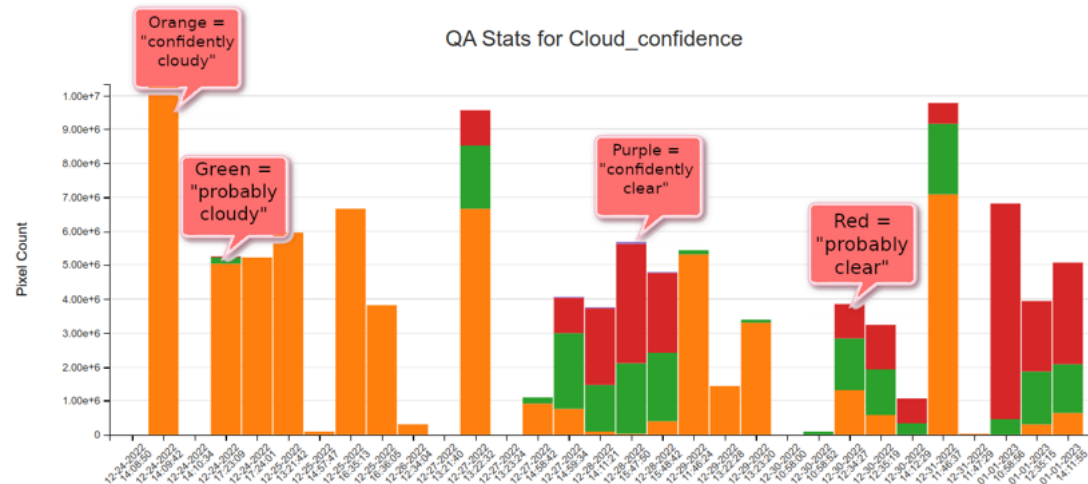
8. Right click on one of the layers in the *Layer* browser, and select *Properties*.
9. In the panel, make sure *Symbolology* is selected.
10. Change *Render type* to *Singleband pseudocolor*, which tells QGIS that we want this layer to be in color.
11. Change *Mode* to *Equal Interval*. Now, we have told QGIS that we want this layer to be 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”, lets 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.
18. Checking back on our Vancouver Island request in *AppEEARS*. If it is ready, you can browse through the different layers shows to see how the quality and cloud metrics work.



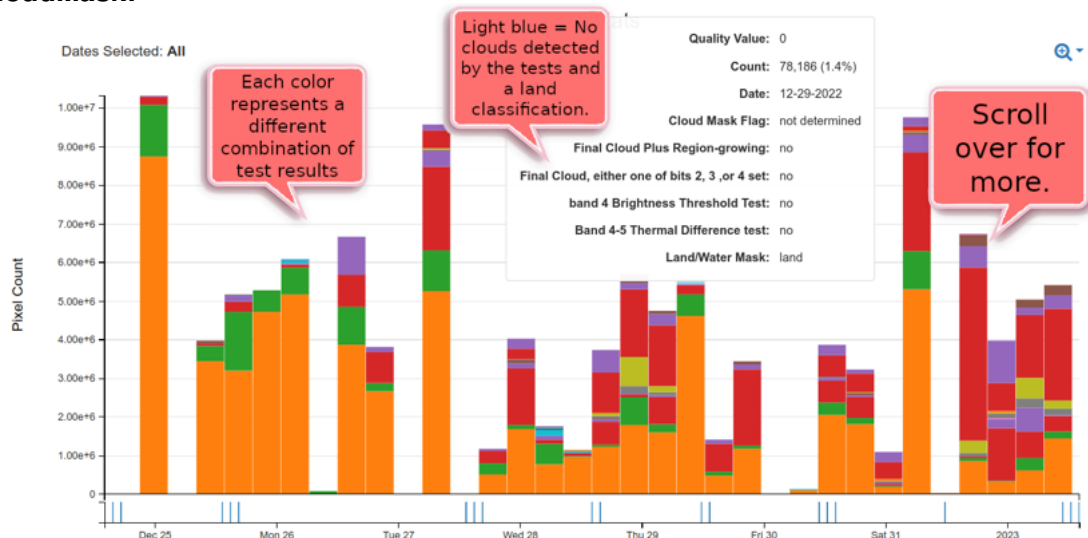
Cloud_final:

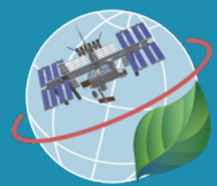


Cloud_confidence:

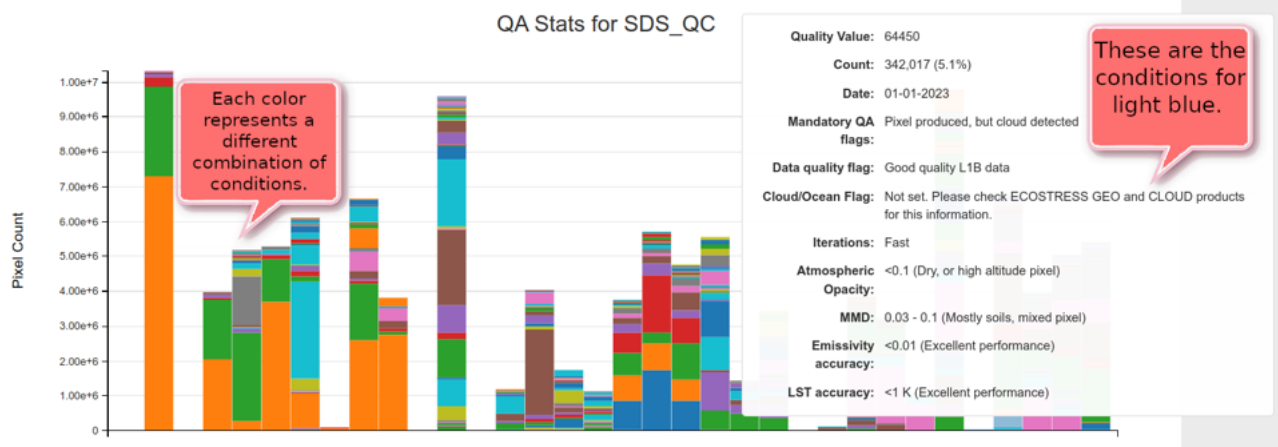


SDS_CloudMask:





SDS_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 is after November 2022, stick with the Cloud_final layer. If it is before November 2022, use the SDS_CloudMask. Finally, as your interest in remote sensing grows, you can learn more about the SDS_QC layer in the [ECOSTRESS Level 2 Product User Guide](#).

Map of the Week Assignments

1. Read about how your choice of colors in maps can be very important in the article: [How rainbow colour maps can distort data and be misleading](#).
2. Submit a cloudiness map for New Year's Day 2023 for Vancouver Island along with a brief description of your map. Think of it like a caption underneath. Which parts of the island were cloudy that day? Do you see any interesting patterns?

Submit your map via Canvas before Monday's class.

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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