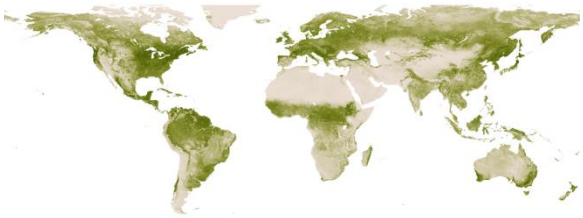
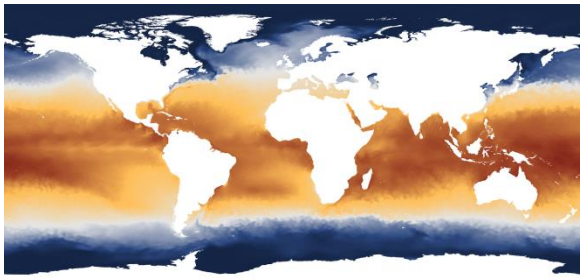
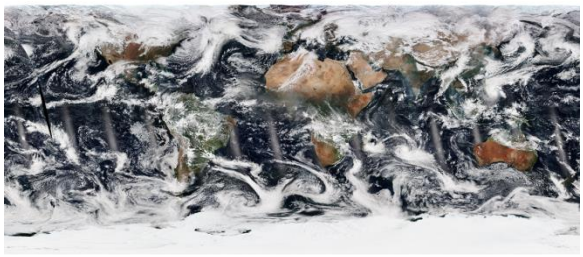


NOAAView

Data Exploration Tool





More Lessons from the Sky
Satellite Educators Association
https://SatEd.org

Please see the Acknowledgements section for historical contributions to the development of this lesson plan. This form of "NOAAView Data Exploration Tool" was published in March 2015 in "More Lessons from the Sky," a regular feature of the SEA Newsletter, and archived in the SEA Lesson Plan Library. Both the Newsletter and the Library are freely available on-line from the Satellite Educators Association (SEA) at this address: https://SatEd.org.

Content and Internet links revised and updated June 2024.

SEA Lesson Plan Library Improvement Program

Did you use this lesson plan with students? If so, please share your experience to help us improve the lesson plan for future use. Just click the Feedback link at https://sated.org/library/search.htm and complete the short form on-line. Thank you.

NOAAView

Data Exploration Tool

Invitation

Since artificial satellites first orbited Earth in 1956, scientists, both amateur and professional, have collected and studied the vast amounts of observations made by, and transmitted to us from, those satellites. Most of those data are archived in databases that have been used only by expert investigators trained in the use of specialized retrieval techniques and analysis tools.

More recently, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS), among others, have developed online tools for easy retrieval of archived data in various forms that serve the needs of every level of scientific research including middle and high school grade levels.

This hands-on tutorial guide is an introduction to **NOAAView**, an online data exploration tool from the National Oceanic and Atmospheric Administration Environmental Visualization Laboratory. NOAAView is a "data imagery portal" providing "access to NOAA's wealth of global data resources." NOAAView works with all major browser and all display types. It visualizes data from satellites, surface analysis, historical archives, and teacher predictions. Although this site was constructed for outreach and educational purposes and is not considered part of NOAA's official data centers, the outstanding imagery provides initial indications and supplies links to the original, science-quality data. (https://www.nnvl.noaa.gov/view/globaldata.html) In this tutorial lesson, learners will experience the value and utility of NOAAView for themselves while becoming familiar with its "look and feel."

Grade Level:	6-12
Time Requirement:	1-2 class period
Prerequisites:	None
Relevant Disciplines:	All

Student Learning Outcomes

By the end of this lesson, students should be able to do the following:

- Use NOAAView, an online data exploration tool
- Select a category from a menu of available datasets
- Generate and download regional and global imagery from selected datasets
- Demonstrate knowledge of how to use NOAAView independently
- Demonstrate how generated imagery can be used to infer a global or regional trend
- Access data of greater precision to support that inference
- Analyze and interpret sequences of images
- Construct explanations for the interpretations
- Assess the value of various graphical displays of data generated with NOAAView
- Communicate findings with others

Lesson Description

NOAAView is an online exploration tool for satellite-based remote sensing data of various Earth factors. NOAAView generates excellent global imagery. Younger investigators will find it easy to use. Older learners will find an easy-access first-look at data and global trends prior to more detailed analysis and interpretation.

This tutorial lesson is intended to supplement existing curriculum in order to add NOAAView to the student's toolbox of data acquisition skills. Following this tutorial guide, learners will access, visualize, and analyze selected data. Learners will compare NOAAView imagery with that generated by other tools from the same dataset. Then, learners are invited to further explore the available datasets by repeating the process to retrieve data of their own choosing. Learners will utilize NOAAView help items as well as access the same dataset with a different online access tool to compare accuracy and precision of each. Throughout the tutorial, learners will encounter questions to be answered on a separate answer sheet.

This is a Web based activity that requires computer terminals with Internet access for each student or group of students. It is recommended that no more than two to four students be assigned to a computer at one time.

The full benefit of this lesson comes from answering the questions on the answer sheet as learners work through the tutorial exercise and accomplishment of 2-4 of the application activities in the Your Turn section. The first two Your Turn activities at the very least should be required of all. The last two can be assigned only of older learners.

While no prerequisite is listed for this activity, the tutorial would be much more meaningful if students had a reason for learning how to use NOAAView. For example, learners may want to access and visualize satellite imagery of polar ice to determine how the ice extent is changing. Some knowledge of satellite remote sensing and remotely sensed datasets ahead of time would be valuable.

Important Terms

Capture (NOAAView)	Cryoshpere	Navigation
Chlorophyll	Data set	Oceanic
Concentration	Download (NOAAView)	Remote sensing

Assessment Suggestions

Summative assessment: correct completion of the answer sheet and determination of whether learners are able to use NOAAView to obtain sufficient data relevant to their own investigations. This is best determined when individual learners are able to complete the Your Turn extension activities on their own. Formative assessments can be made while learners work through the tutorial and the teacher circulates to monitor student-computer and student-student interactions.

Next Generation Science Standards

The Next Generation Science Standards present performance expectations for assessment of learning. Each suggested assessment task bundles together a

disciplinary core idea, science and engineering practice, and crosscutting concept that are to be taught simultaneously in the same lesson. The National Research Council (NRC) states that standards must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry. At the same time, they cannot show competence in practices except in the context of specific content. Following that line of reasoning, the NRC identified eight practices of science and engineering that are essential for all students to learn:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

The tutorial guide in this lesson plan is meant to augment curriculum and instruction of other content by providing broader access to specific data that may otherwise not be available to middle and high school students in the course of learning about that other content. Therefore, this lesson plan does not emphasize any specific core content, but rather supports the learning of appropriate practices associated with many content core ideas. Of the eight identified science and engineering practices listed by the NRC, this lesson plan supports the learning and teaching of these specifically:

3. **Planning and carrying out investigations**
4. **Analyzing and interpreting data**
8. **Obtaining, evaluating, and communicating information**

Components of each of these practices can be found in the Next Generation Science Standards at all grade levels K-2, 3-5, 6-8, and 9-12 and associated with disciplinary core ideas and performance expectations for all subject areas.

Preparation

An Internet enabled computer for each learner or group of learners is needed for this activity. Most of the exercise can be accomplished online. It is recommended that learners work in groups of two or no more than four at each computer.

The tutorial guide in the Student Activity pages should be duplicated and distributed one copy per learner group or one to each student for reference if desired. The answer sheet in the Student Activity section should be duplicated and distributed to each student.

The entire lesson plan document is supplied in portable document format (PDF). An acceptable PDF viewer such Adobe Reader (https://get.adobe.com/reader/) or equivalent is required to read and print the document. The Student Activity pages are also available in Microsoft Word document (DOCX) format allowing teachers greater flexibility in adapting those pages to the varying needs of the students, the curriculum, and the classroom situation.

NOAAView, according to the Environmental Visualization Laboratory, works best when accessed with Mozilla Firefox, Google Chrome, or Safari.

Captured or downloaded KMZ files are compressed or zipped KML files for use with Google Earth. The KMZ files can be opened and viewed directly with Google Earth if it is installed on your local computer. Google Earth is available at no cost from https://www.google.com/earth/versions/#earth-pro. Some of the global data files, whether KML or KMZ, are very large and take time to load in Google Earth. Be paitent. The use of the web-based version of Google Earth is not recommended.

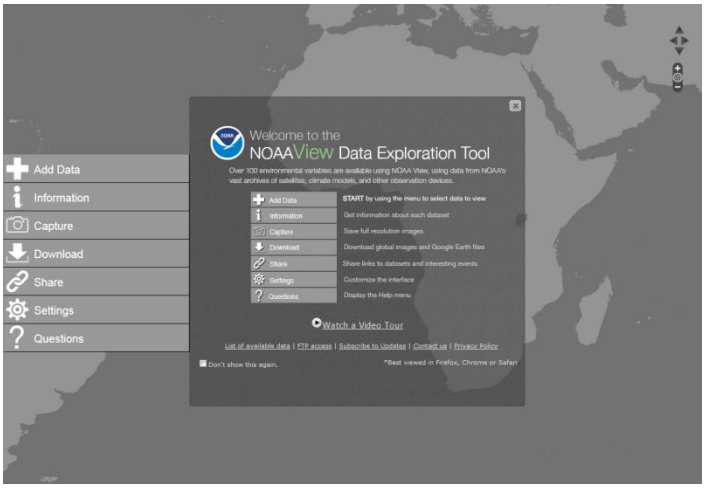
Background

Throughout this edition of Teaching Notes and the associated Student Activity, it has been assumed that learners have already been introduced to environmental satellites, some of their remote sensors and products. If needed, an introduction to satellites including environmental satellites, remote sensing, remote sensing datasets, and no-cost, high quality, professional software packages for visualization, analysis, and interpretation can be found at https://SatEd.org/satellites.htm. There can be found tutorials, videos, lesson plans, and an extensive list of resource links.

NOAA is an acronym of the U.S. Department of Commerce that stands for National Oceanic and Atmospheric Administration. NOAAView was developed by NOAA's Environmental Visualization Laboratory.

A video tour of NOAAView is given in the **Navigation Tips** panel available at the startup of NOAAView. To watch the video, follow these steps:

- **Point your browser to** https://www.nnvl.noaa.gov/view/globaldata.html**.**



- **Click** Questions **to display the Navigation Tips window. Then click** Watch a Video Tour**.**

The video player is embedded in the Navigation Tips panel which can be dragged to any other location on the screen or closed as needed by the user.

Collections and Data Sources

NOAAView can be used to investigate a wide range of environmental parameters. The type of data one visualizes with NOAAView depends on the research question or hypothesis under consideration. For example, if the question relates to melting Arctic ice, the investigator might look at sea ice concentration images, sea surface height and temperature images. The list of data available for visualization is extensive as seen in the following table:

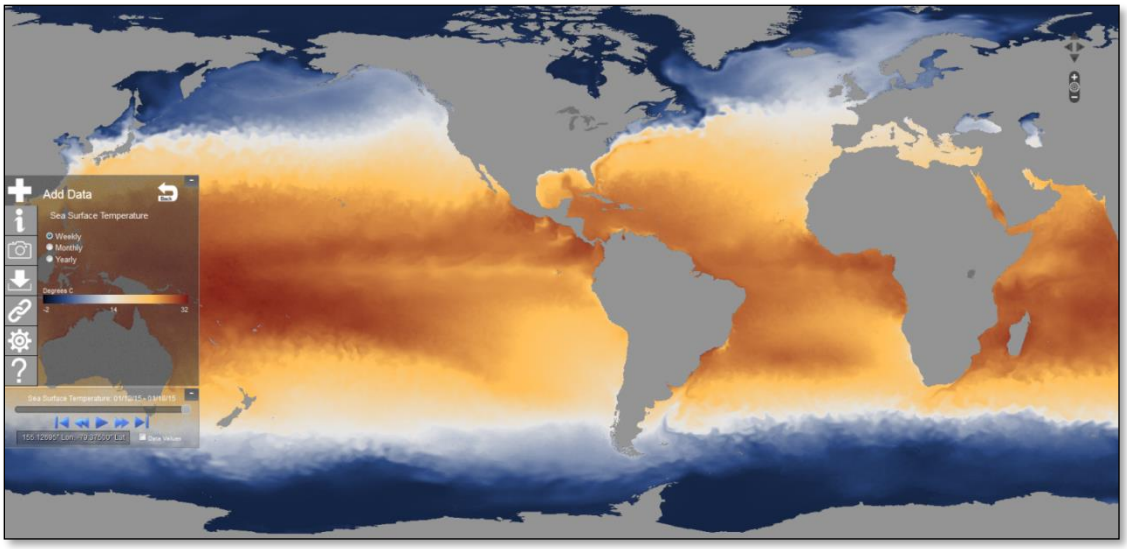
Ocean	
Sea surface temperature	Dissolved Phosphate (at depths 0-5,000m)
Temperature at depths (0-5,000m)	Dissolved Oxygen (at depths 0-5,000m)
Heat content	Coral bleaching
Tropical Cyclone heat potential	Tropical coral reef locations
Salinity (at depths 0-5,000m)	Chlorophyll concentration
Dissolved Nitrate (at depths 0-5,000m)	Sea surface height departure
Dissolved Silicate (at depths 0-5,000m)	Ocean Depth (Bathymetry)
Atmosphere	
Ozone concentration	Accumulated rainfall
Aerosol optical thickness	Atmospheric moisture
Cloud fraction	Outgoing longwave energy
Infrared Clouds	Ocean surface winds
True color imagery of Earth	
Land	
Land surface temperature	Fire estimation
Magnetic Anomaly	Soil moisture
Vegetation NDVI	Nighttime lights
Drought index	Change in nighttime lights
Cryosphere	
Snow and ice cover	Historical Sea Ice Border
Sea ice concentration	
Climate	
Ocean temperature departure	Simulations:
Surface temperature departure	Ocean-atmosphere CO_2 exchange
Precipitation departure	Aragonite saturation state
Lower-stratosphere temperature	Ocean pH
Upper-troposphere temperature	Greenhouse gas emissions: Ocean temperature
Middle-troposphere temperature	Greenhouse gas emissions: Air temperature
Overall sea level rise	Greenhouse gas emissions: Precipitation
Sea level rise trend	Greenhouse gas emissions: Sea ice concentration
Weather Models	
Accumulated precipitation: Total rainfall	Convective energy
Surface air temperature	Mean sea level pressure
Atmospheric moisture	Snow depth

NOAAView Menu

The NOAAView menu appears in its default location on the left edge of the screen. It can be dragged to any other part of the screen for user convenience. The menu consists of seven panels displayed one at a time when the related button is activated.

The first is the **Add Data** button. It displays the categories and subsequently the data types listed in the table above. Data retrieved with NOAAView are displayed onscreen in global maps averaged on a weekly, monthly or yearly basis. A labeled color bar indicates color/data range. The image viewer control, located in the upper right corner of the screen is used to pan up, down, right or left as well as zoom in and out.

The **Information** menu lists descriptive information about the image, the data used to produce the image, links to the original datasets and suggested related links of interest.



The **Capture** button allows users to select a portion or all of the global view and download it in portable network graphic (PNG) format or Google Earth format. PNG images can be viewed in the default image viewer of most computers. Google Earth format downloads are compressed (zipped). These are viewed directly in Google Earth. There are options for full or half resolution (half resolution equates to smaller file sizes) as well as downloading multiple images over a specified time frame in one zipped archive.

The **Download** button offers the same choices as Capture but without the ability to preselect a portion of the image. The available image file formats are PNG and Google Earth. Download includes options for bundling separate images of the Base Layer (the land mask), the Color Bar (the legend), and/or a Science on a Sphere image in the zipped archive.

The **Share** menu supplies links for sharing the dataset and/or the current view, the FTP site from which the dataset and other files can be downloaded, a web-based mapping service, and the URL for the current view.

In the **Settings** menu, users can turn on or off the data value displayed for the pixel at the current cursor location. Measurements units can be set to metric or US. An added convenience is the ability to adjust the transparency of the menu.

The **Questions** menu reminds users that NOAAView content is in the public domain and thus free to use. Appropriate credit should always be given to NOAA when data or images from this site are used. There is also an e-mail contact link to the web designer.

Positioned immediately below the NOAAView Menu are the slider and animation controls. Each generated image is one of many in the dataset. Moving the slider moves the images forward or backward in time to other weeks, months, or years. The entire set of images for the chosen parameter can be animated and controlled with typical player control buttons.

Both the Menu and animation control panels can be dragged to any location on the screen or docked with retrieval tab on the left edge of the display.

At this point, teachers are invited to experience NOAAView by trying the tutorial themselves. Discover the usefulness of NOAAView imagery as a first-step tool in learning about remote sensing data analysis and interpretation by younger investigators or initiating deeper exploration of datasets by older learners.

Acknowledgements

All satellite-based imagery in this lesson is generated by NOAAView and NOAA's Environmental Visualization Laboratory.

This edition of Teaching Notes and the material in the Student Activity pages were developed as part of *More Lessons from the Sky* by J.P. Arvedson for the non-profit Satellite Educators Association, Inc. *More Lessons from the Sky* has its roots in an original collection of more than fifty lessons compiled by Satellite Educators Association and published in *Lessons from the Sky,* © 1995 by Amereon, Ltd. *More Lessons from the Sky* is a regular feature of the free, on-line Satellite Educators Association Newsletter. More information about the Satellite Educators Association, its annual Satellites & Education Conference for teachers, international student environmental research collaborative, and access to the Newsletter can be found at https://SatEd.org.

All *More Lessons from the Sky* lesson plans are archived in the on-line SEA Lesson Plan Library available at https://SatEd.org. The web site features a description of the library contents, Next Generation Science Standards addressed, several search tools for finding lessons easily, separate resource files for lessons where needed, and the library's Analysis Toolbox.

Resources

Note: All of these URLs were current and active as of this writing. If any are unreachable as printed, the use of on-line search engines such as DuckDuckGo, Ask, or Google is suggested to find current links.

_____. "ArcGIS Online." ESRI. Retrieved June 2024 from https://www.arcgis.com/home/index.html

_____. "Create Maps with Advanced Tools" (Google Earth-Pro download). Google Earth. Retrieved June 2024 from https://www.google.com/earth/versions/#earth-pro

_____. "MODIS." National Aeronautics and Space Administration Goddard Space Flight Center. Retrieved June 2024 from https://modis.gsfc.nasa.gov/

_____. "NOAA internet tool provides unique access to environmental data." GISuser. Retrieved June 2024 from https://gisuser.com/2013/11/noaa-internet-tool-provides-unique-access-to-environmental-data/

_____. "Ocean Color Web." NASA EarthData." National Aeronautics and Space Administration. Retrieved June 2024 from https://oceancolor.gsfc.nasa.gov

National Research Council. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press, 2012. Retrieved June 2024 from https://nap.nationalacademies.org/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts

National research Council. *The Next Generation Science Standards, Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press, 2013. Retrieved June 2024 from https://nap.nationalacademies.org/catalog/18290/next-generation-science-standards-for-states-by-states

Answers to Questions in the Student Activity

1. In which category or categories would you find data about each of these?
   a. Greenhouse gas emissions – Climate > Simulations
   b. Clouds – Atmosphere > Cloud Fraction or Infrared Clouds
   c. Oceanic chlorophyll concentration – Ocean > Life > Chlorophyll
   d. Snow and ice cover – Cryosphere > Snow and Ice Cover
   e. Greenness (NDVI) – Land > Vegetation > Greenness NDVI
   f. Surface air temperature – Weather Models > Surface Air Temperature

2. Describe and explain the color scale used in the legend. What do the various color mean?
   The scale is not linear. Very deep, dark blue represents an oceanic chlorophyll concentration of 0.001 mg/m^3 whereas very dark green represents 30 mg/m^3. About half way across the color scale, where blue turns to white and then green, white represents only 0.173 mg/m^3. The scale is stretched in the lower end and compressed in the upper end.

3. Which wavelengths of light are absorbed and which reflected by green chlorophyll??
   Green chlorophyll absorbs red and blue light while reflecting green light (thus appearing green).

4. Oceanic chlorophyll concentration is also called by another name. What is it?
   Oceanic chlorophyll concentration is also known as ocean color.

5. What was the first year in which oceanic chlorophyll concentration was monitored by remote sensors carried on Earth orbiting satellites?
   Oceanic chlorophyll concentration was first monitored from space in 1997 and has been monitored from space continuously since.

6. Name the satellite(s) that carried the sensor(s) that produced these data and years of operation.
   NASA's Aqua satellite carrying the MODIS instrument measured chlorophyll concentration from 1997-2012 and Suomi NPP and NOAA-20 from 2012 to present.

7. How are the images alike and how are they different?
   Answers will vary. Both cover the same geographic area and have the same color scale. In June, the area of high chlorophyll concentration extends farther offshore especially along the west coast. In December, a discernible oceanic chlorophyll concentration is apparent in ocean waters between the Cape of Good Hope and Antarctica.

8. What season of the year is shown in each image?

Since the view of Earth is the southern hemisphere, the June 2012 image is late autumn-early winter, and the December 2012 image is late spring-early summer.

9. Suggest several environmental factors that could account for the differences.
   Answers will vary. There is a possibility that warmer air and higher sea surface temperatures in the late autumn contributed to greater concentrations closer to shore. Water currents closer to shore may also be a factor.

10. Can NOAAView be used to validate any of those suggestions? If so, how?
    Answers will vary. This answer should be based on the answer given for Question 9. For example, generate image maps of sea surface temperature for the same location and times. Compare these data with the chlorophyll concentration data.

11. For what purposes might NOAAView's Capture be a better option than Download? Download a better option than Capture?
    Capture allows regional selection of data at full or hall resolution for a range of dates ending with the currently displayed screen. Capture is a better choice for display of local data and demonstrations of localized change over time. Download allows only global images of a single date or a specified range of dates that do not necessarily include the currently displayed image. Download also offers the option to include with the "data image," the base layer or land mask, and the color bar or legend in separate files. Download is a better choice if the data will be processed further by other image processing tools.

12. Which of the data formats illustrated above (PNG, KMZ, or KML) would you find most helpful in your own investigations? Why do you think so?
    Answers will vary. PNG images are probably most helpful because they are easy to view with a variety of readily available software. Land areas are transparent in PNG images so the images can be overlaid on the base map. KMZ and KML formatted data are easiest to use in Google Earth and ArcGIS Online, both of which are readily available without cost. Google Earth offers a somewhat three dimensional perspective of the Earth compared to NOAAView's two dimensional display, and ArCGIS Online offers layered maps for enhanced analysis options.

13. Which browser(s) is recommended for use with NOAAView? Will other browsers work?
    For this release of NOAAView, the recommended browser is Mozilla Firefox, Google Chrome, or Apple Safari. These are all available for both PC and Macintosh platforms. Some users report problematic functionality when using NOAAView with other browsers.

14. Compare and contrast the colors in the NOAAView chlorophyll image and the Ocean Color Web chlorophyll image including the color bars. Does the chlorophyll image from Ocean Color Web change your current understanding of seasonal changes in oceanic chlorophyll concentration? Explain.
    In both cases, the color legend must be downloaded separately. The NOAAView color bar downloads without calibration. Neither color legend is quantified on a linear scale. The The NOAAView color bar is limited to shades of blue fading to white and then shades of green 0 to 30 mg/m^3 with the bottom end of the scale stretched – half way along the color bar (the short white section between blue and green) represents 0.173 whereas the right half of the scale increases to 30. Contrastingly, the Ocean Color Web color bar seems to be a logarithmic scale. It utilizes a full rainbow of colors from violet at 0.01 to dark red at 20 mg/m^3. The wider selection of contrasting colors makes the Ocean Color Web image easier to interpret but only in the lower end of the scale where almost all chlorophyll concentrations appear blue or green in the NOAAView image. From here answers will vary. However, the learner should demonstrate recognition that, in addition to the NOAAView image, the Ocean Color Web color scale and image extend and enhance one's understanding of seasonal changes in oceanic chlorophyll by providing more detail and differentiation of concentrations in the lower end of the scale.

15. Which of these two images – the image from NOAAView or the image from Ocean Color Web - was easiest to obtain? Why was obtaining this one easier than the other?
    Answers will vary. Both web sites are easy to use although the vocabulary and menu system of NOAAView seems simpler and easier to use. Ocean Color Web offers more detailed data access in addition to its Level 3 Browser. NOAAView allows zoom-in and capture/save of a specific region of interest. In Ocean Color Web, the user must utilize a one-step zoom-in and screen capture; or use an image processing program to crop the global image.

16. Which do you think might be most useful for your investigations? Why do you think so?

    Answers will vary depending on the grade level of the learners and the purpose for which they are accessing these data. The answer should include a statement of which online tool is thought to be most useful and why.

17. To sum up, NOAAView is an online data exploration tool that allows researchers to more easily examine environmental data from satellite-based remote sensors. List at least three important characteristics of NOAAView that make it easy to use in your own investigations.

    Answers will vary. Answers could include any of these possibilities:

    - Easy to use
    - Lots of data categories
    - Global imagery or regional selection and data capture
    - Downloadable imagery
    - PNG or Google Earth-compatible image formats
    - Built-in "how to" videos
    - Links to original datasets for more detailed analysis
    - Data and imagery sharing options are built into menu system
    - Animation control for time series studies
    - Latitude & longitude indicator
    - Data values for each data pixel can be displayed at the cursor position

NOAAView

Data Exploration Tool

Introduction

Since artificial satellites first orbited Earth in 1956, scientists, both amateur and professional, have collected and studied the vast amounts of observations made by, and transmitted to us, from those satellites. Most of those data are archived in databases that have been used only by expert investigators trained in the use of specialized retrieval techniques and analysis tools.

More recently, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS), among others, have developed online tools for easy retrieval of archived data in various forms that serve the needs of every level of scientific research including middle and high school grade levels.

This hands-on tutorial guide is an introduction to **NOAAView**, an online data exploration tool from the National Oceanic and Atmospheric Administration Environmental Visualization Laboratory. NOAAView is a "data imagery portal" providing "access to NOAA's wealth of global data resources." NOAAView works on all display types including computer browsers on desktops, laptops, tablets, and many cell phones. It visualizes data from satellites, surface analysis, historical archives, and teacher predictions. Although this site was constructed for outreach and educational purposes and is not considered part of NOAA's official data centers, the outstanding imagery provides initial indications and supplies links to the original, science-quality data. (https://www.nnvl.noaa.gov/view/) In this tutorial lesson, learners will experience the value and utility of NOAAView for themselves while becoming familiar with its "look and feel."

What is NOAAView?

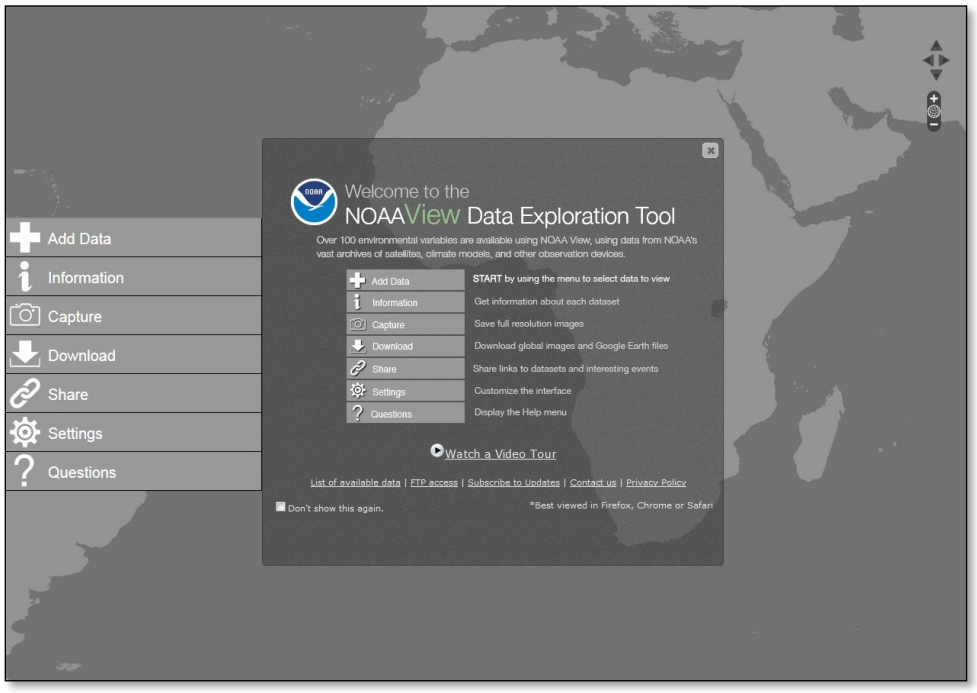
NOAAView is an extraordinarily useful, easy to use, online tool for accessing and viewing images generated from remotely sensed environmental datasets. The archived data go back in time as far as there are data available from the satellite remote sensors that produced them. Global or zoomed-in local imagery can be viewed on screen or downloaded for viewing in a computer's default image viewer, Google Earth, ArcGIS Online, or further analyzed with image processing software. NOAAView is an excellent choice for younger learners and a great first-look-at-the-data for older investigators.

NOAAView - Getting Started

NOAAView is easy to use

- **Ensure your computer is Internet enabled.**

- **Launch your browser. Point the browser to NOAAView's front page at this address: https://www.nnvl.noaa.gov/view/. If the Navigation Tips panel is not displayed, click** Questions**.**



- **Click the** Watch a Video Tour **link in the** Navigation Tips **panel (larger panel, center screen) for a brief introduction to NOAAView. Click the ▶ button to start the video.**

- **After the video, click the** X **in the upper right corner of the panel to close it.**

Accessing Data

- **Find the** Menu **panel on the left. Click the** Add Data **button . The categories of available data types are listed.**

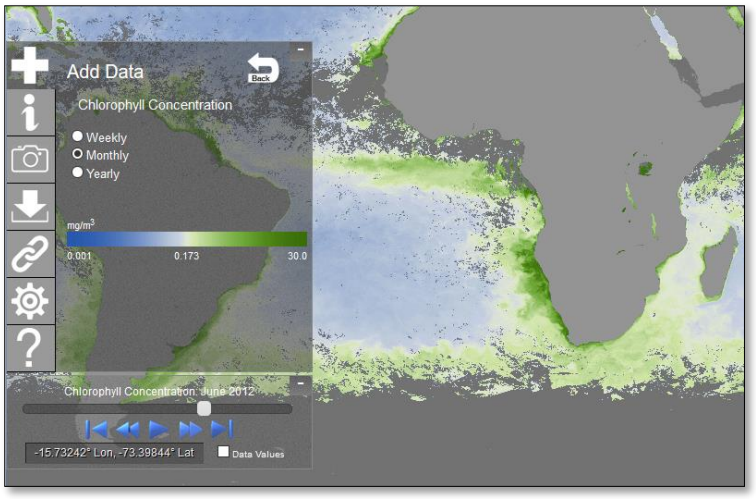
  - Ocean
  - Atmosphere
  - Land
  - Cryosphere
  - Climate
  - Weather Models

- **Click a** category **to see what it contains. Click the** Back **button**  **in the upper right corner of the Menu to return to the previous list. Explore the categories to find out what data are available.**

1. *In which category or categories would you find data about each of these:*
   a. *Greenhouse gas emissions -*
   b. *Clouds -*
   c. *Ocean chlorophyll concentration –*
   d. *Snow and ice cover -*
   e. *Greenness (NDVI) -*
   f. *Surface air temperature -*

Let's try a simple example. Suppose you are interested in the amount of phytoplankton (microscopic plants, mostly algae) in the upper layers of ocean water. Suppose you would like to know if the amount of plankton changes seasonally. Since phytoplankton is at the base of the food web, the amount of such green algae in the ocean can be an indicator of the amount of larger species present in the area and of the health of the ocean in general. Satellite-based remote sensors can scan for the particular wavelengths of light reflected by chlorophyll-a in the green algae. You will be looking for chlorophyll data from the year 2012.

- **In the Add Data menu, click** Ocean**, then** Life**, and** Chlorophyll**.**



- **Select the** Monthly **radio button.**

- **Find the slider in the Animation Control panel located below the Menu. Very slowly, click and drag the** slider **until date above the slider reads** June 2012**.**

- **You can pan to other world locations by either clicking and dragging the map on the screen or clicking the right and left arrows in the view control found in the upper right corner of the view window.** Pan **until the southern tip of Africa is clearly visible in the central region of the screen.**

- **Check the** Data Values **check box in the lower right corner of the Animation Control**

panel. Move the cursor in the ocean around the southern tip of the African continent noting chlorophyll concentrations for various colors.

2. *Describe and explain the color scale used in the legend. What do the various colors mean?*

Uncheck Data Values**. Click the** Information **button**  **in the Menu panel to get more detailed information about the image. Then click the** More detailed description… **link.**

3. *Which wavelengths of light are absorbed and which reflected by green chlorophyll?*

4. *Oceanic chlorophyll concentration is also called by another name. What is it?*

5. *What was the first year in which oceanic chlorophyll was monitored by remote sensors carried on Earth orbiting satellites?*

6. *Name the satellite(s) that carried the sensor(s) that produced these data and years of operation.*

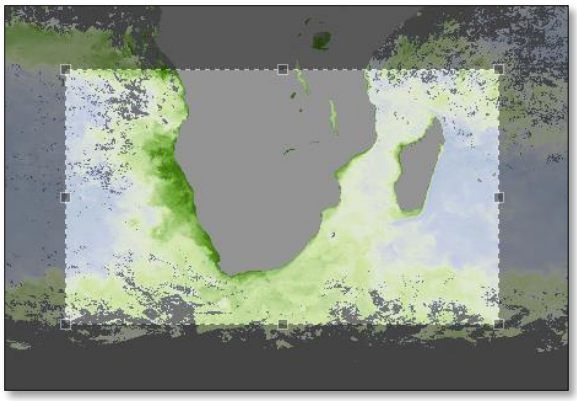
Click anywhere on the overlay outside the information block to return to the image and Menu.

Downloading Data

NOAAView provides two methods for moving the screen image to your local computer: **Capture** and **Download**. Although each method has different capabilities, both provide a choice of images in PNG or Google Earth format. Let's start with Capture.

In the Menu panel, click the Capture **button**  **.**

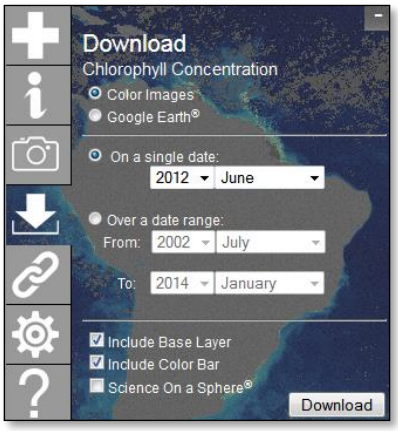
The first symbol in the Capture Image menu tells you to click and drag **a selection rectangle around the area of the image you wish to download. Try it like this:**



- **In the Menu, select the radio buttons for** Full Image Resolution **and** Save As PNG**.**
- **For now, we are only interested in downloading the data for the June 2012 monthly image, so leave** Also Include Images For Dates Since: **unchecked.**
- **Click** Save**. When your computer asks if you want to open or save the file select** Save File **and click** OK**. The file will be saved to your computer's default download location. Make a note of the file name. We will come back to it later.**
- **Click outside the selection rectangle to return to the global image.**

Now let's find the difference between Download and Capture.

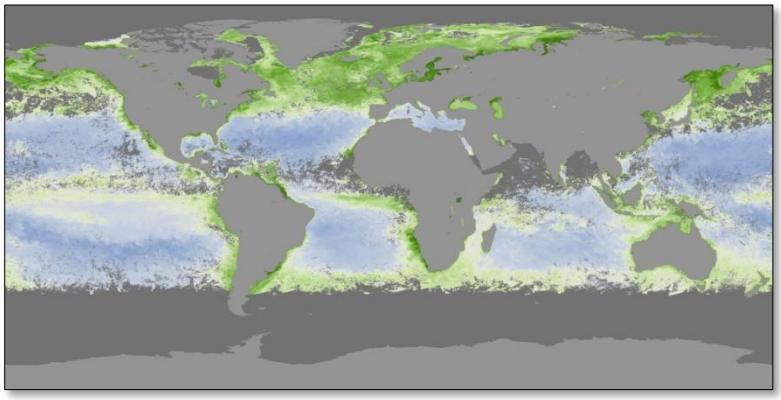
- **Click the** Download **button**  **in the Menu.**
- **For now, select the radio button for** Color Images**. You can try Google Earth downloads later. The radio button for** On a single date **should be selected and** 2012 June **shown in the date fields.**
- **Check the boxes for** Include Base Layer **and** Include Color Bar**.**



Notice the option to select only a portion of the global image is not offered with the Download function.

- **Click** Download**. When asked if you want to open or save the file, select** Save File**. Click** OK**.**

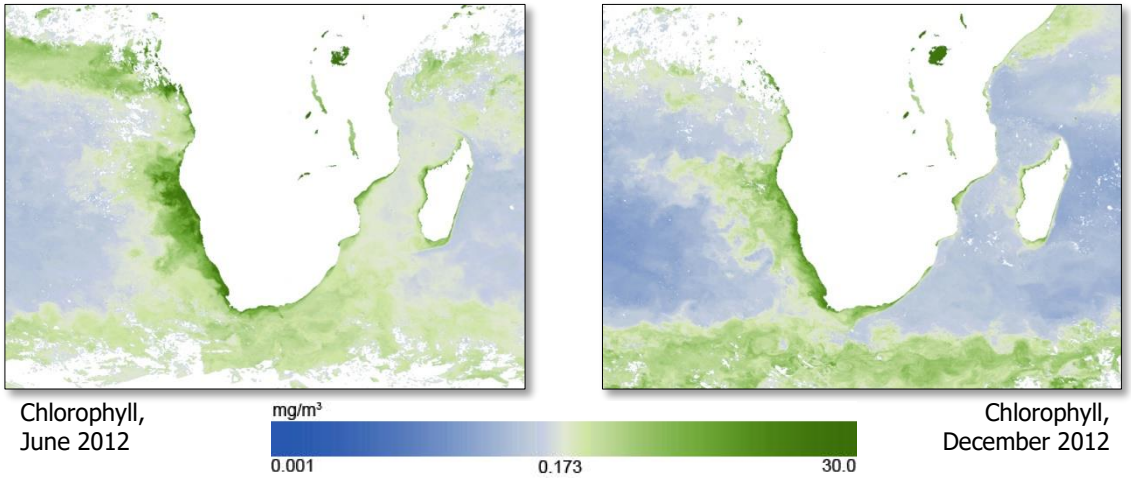
A ZIP file will be downloaded to your computer's default download location. It is composed of three files: the global image, the base layer or land mask, and the color bar or legend. They have been collected together and compressed for ease of transfer online. To view the images, they must be extracted from the archive, then reassembled or viewed separately. Some computer operating systems will extract zipped files automatically; others may require special software. The global image below is from the ZIP file you just downloaded showing the data overlaid on the base map. The color bar is shown at the bottom of this page.



Now try one on your own.

- **Capture a single, full resolution image of chlorophyll data in the ocean around sub-Saharan Africa (same area as the last Capture) for** December 2012**. Save it in a** PNG image file**.**

- **Using your computer's default PNG image viewer, open and examine each of the captured images:** June 2012 **and** December 2012**.**



7. *How are the images alike and how are they different?*

8. *What season of the year is shown in each image?*

9. *Suggest several environmental factors that could account for the differences.*

10. *Can NOAAView be used to validate any of those suggestions? If so, how?*

11. *For what purposes might NOAAView's Capture be a better option than Download? Download a better option than Capture?*

Close your image viewer.

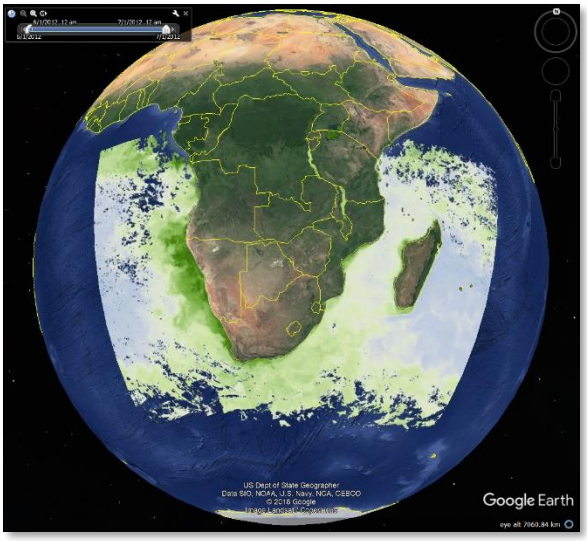
Viewing the Captured/Downloaded Data

You have seen examples of PNG images generated by NOAAView. The same data can be downloaded as KMZ files and examined in **Google Earth**. KMZ downloads are available in both Capture and Download modes. In order to view NOAAView imagery in Google Earth format, Google Earth must be installed on your local computer.

When you select Google Earth as the file format in Capture or Download, a KMZ file is generated. **KMZ** stands for *Keyhole Markup Language (Zipped)*. This is a KML file that has been compressed or zipped to reduce file size for transport. **KML** stands for *Keyhole Markup Language*. It is Google Earth's language for adding placemarks and other map related information in Google Earth displays. Since Google Earth enjoys such wide-spread use, the KML format is often an available choice when transferring files rich with geolocation information such as the images generated by NOAAView.

NOAAView Capture –

KMZ – *Keyhole Markup Language (Zipped)*
This image was captured in NOAAView and saved in Google Earth format. It was opened in and displayed in **Google Earth**. Notice the area showing chlorophyll concentrations is only the area of ocean surrounding sub-Sahel Africa – the same area selected for capture in NOAAView. The color palette is the same but the legend is not shown.



NOAAView Download –

KMZ – *Keyhole Markup Language (Zipped)*
This image was downloaded from NOAAView in Google Earth format. It was opened in and displayed in **Google Earth**. Notice the oceanic color changes indicating varying chlorophyll concentrations cover the globe instead of a limited specific area. Again, the color palette is the same, but this time, the legend is included.

12. Which of the data formats illustrated above (PNG or KMZ) would you find most helpful in your own investigations? Why do you think so?

Questions About Using NOAAView?

In addition to the Video Tour you saw at the start, NOAAView includes additional short videos illustrating how to use this data exploration tool.

- **Click the** Questions **button** ? **in the menu.**
- **Select any of the listed "How To:" categories. The video for that category appears in the Navigation Tips panel which reappears centered on the screen. Click the large ▶ in the video window to play the video.**
- **If the videos are not working or you are finished, click the** <Back to Navigations Tips **link below the video window.**

13. Which browser(s) is recommended for use with NOAAView? Will other browsers work?

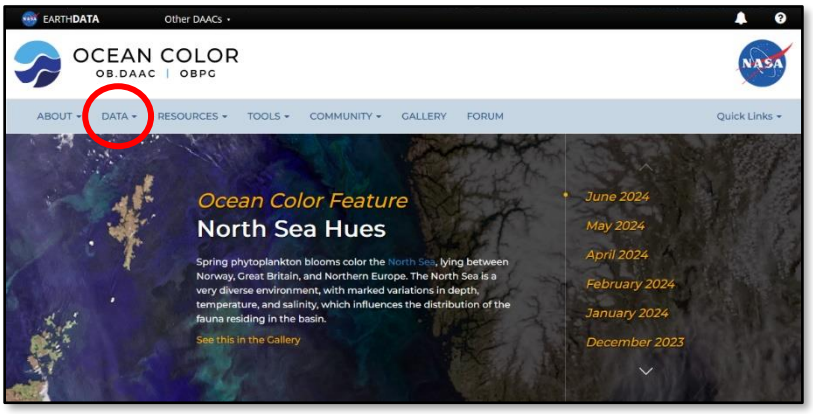
Is NOAAView the Only Way?

The easiest way to answer this is to use other online tools to access and visualize the same dataset. Different data viewers, programmed by different people, may visualize the same dataset differently. One online tool may be best for a specific investigation whereas a different online tool may generate an image more useful to a different investigation. Try this to see for yourself.

- **Point your browser to** https://oceancolor.gsfc.nasa.gov/**, the home page for NASA's Ocean**

Color Web. Datasets available here include oceanic chlorophyll concentration.

- **From the menu bar, click** Data**, and select** Find Data**.**

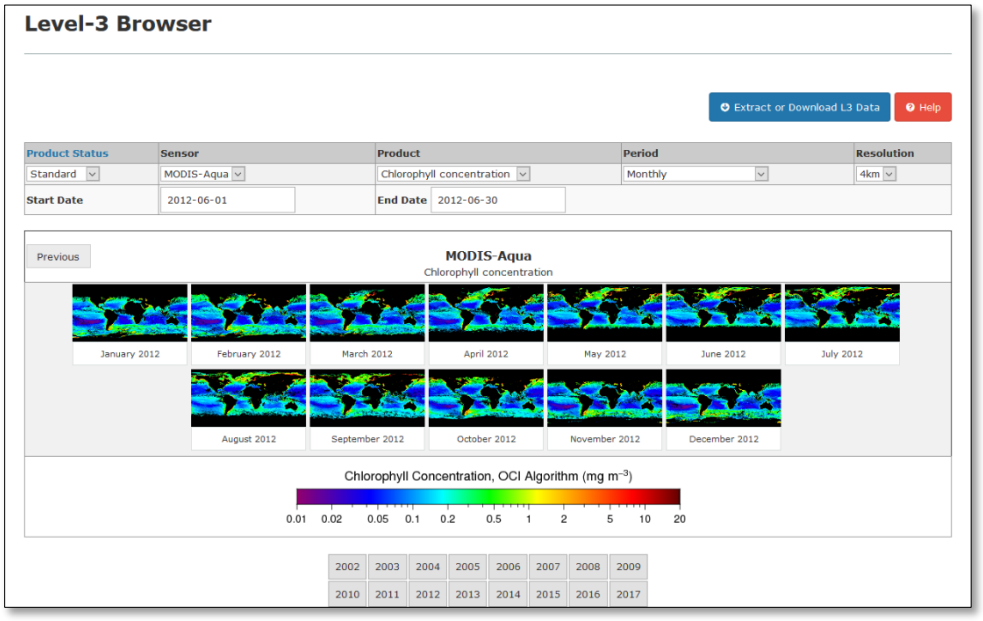


- **Scan down the page and select any** Level 3 & 4 Browser **link.**

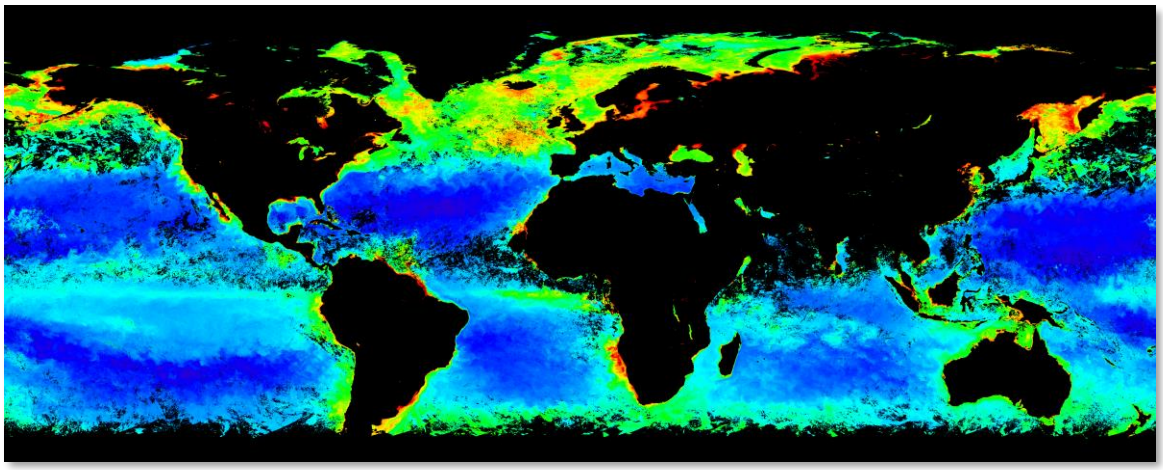
- **In the Level 3 & 4 Browser, ensure these filters are set.**
  - ✓ **Product Status:** Standard
  - ✓ **Sensor:** Aqua-MODIS
  - ✓ **Product:** Chlorophyll concentration
  - ✓ **Period:** Monthly
  - ✓ **Resolution:** 4km
  - ✓ **Start Date:** 2012-06-01
  - ✓ **End Date:** 2012-06-30

- **Scroll down slightly to see the year buttons. Click** 2012**.**

- **Above the year buttons, click the thumbnail for** June 2012 **to display the image.**



The image is displayed.



- Right-click **or** CTRL-click **the image, select** Save image as**, navigate to this lesson's data folder, and click** Save**.**
- Close **your browser.**
- Open **both the Ocean Color Web image and the downloaded PNG of chlorophyll-a for June 2012 in your default image viewer. Arrange the two image windows on the screen so you can see both at the time.**

14. *Compare and contrast the colors in the NOAAView chlorophyll image and the Ocean Color Web chlorophyll image including the color bars. Does the chlorophyll image from Ocean Color Web change your current understanding of seasonal changes in oceanic chlorophyll concentration? Explain.*

15. *Which of these two images – the image from NOAAView or the image from Ocean Color Web - was easiest to obtain? Why was obtaining this one easier than the other?*

16. *Which do you think might be most useful for your investigations? Why do you think so?*

- **Close your browser and image viewer.**

17. *To sum up, NOAAView is an online data exploration tool that allows researchers to more easily examine environmental data from satellite-based remote sensors. List at least three important characteristics of NOAAView that make it easy to use in your own investigations.*

Now, it is time to put your new knowledge and skills to work by completing at least one of the Your Turn activities on the next page.

Your Turn

- Determine how to find sea surface temperature data with NOAAView. Capture or download images for the same two time-frames and locations as the chlorophyll concentration data you found with this tutorial. Examine, compare, and contrast the two sea surface temperature images with each other and with their corresponding chlorophyll concentration images. Based on your examination, does oceanic chlorophyll concentration appear to be related in any way to sea surface temperature? If so, describe how they appear related. How does this relationship help explain the seasonal differences in oceanic chlorophyll concentration? Consult your teacher to determine the best method for sharing your discoveries.

- Select any data parameter of interest to you. This time be sure to set a date range at least 24 months in length (for example, January 2011 to December 2012). When the visualization has been generated, play the animation several times. Using the animation control panel, the animation can be played in an endless loop or stepped through frame by frame. How does animating the monthly images help you understand the way the parameter changes over time.

- Devise a plan to investigate a possible relationship between sea surface temperature, salinity, and sea ice concentration. If you decide polar views of the data are needed, remember that NOAAView does not provide Arctic and Antarctic polar views of the globe. Have the plan approved by your teacher. Carry out your investigation using NOAAView and Google Earth. Communicate your findings to your class or other audience in a manner pre-approved by your teacher.

- Why does NOAAView NOT provide Artic or Antarctic polar views of the environmental data it displays? To answer that question, you may wish to research the satellites carrying the instruments that provided the data you examined in NOAAView, and determine the orbital path of each. Does the orbit for the satellites actually carry them over either pole? If not, why not – what did the designers of the satellite have in mind that resulted in such an orbital path? In consultation with your teacher, prepare a report for your class using a poster or presentation software such as PowerPoint.

- Are you currently investigating something in your class that can be aided by using NOAAView? If so, what is it? How will you use NOAAView now?

Name_____ Class_____ Date_____

NOAAView

Answer Sheet

1. In which category or categories would you find data about each of these:
   a. Air quality -
   b. Clouds -
   c. Oceanic chlorophyll concentration -
   d. Snow and ice cover -
   e. Antarctic ozone -

2. Describe and explain the color scale used in the legend. What do the various color mean?

3. Which wavelengths of light are absorbed and which reflected by green chlorophyll?

4. Oceanic chlorophyll concentration is also called by another name. What is it?

5. What was the first year in which oceanic chlorophyll concentration was monitored by remote sensors carried on Earth orbiting satellites??

6. Name the satellite(s) that carried the sensor(s) that produced these data and the years of operation?

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