

African Water Cycle Monitor Tutorial

Last Updated: October 2013

Introduction:

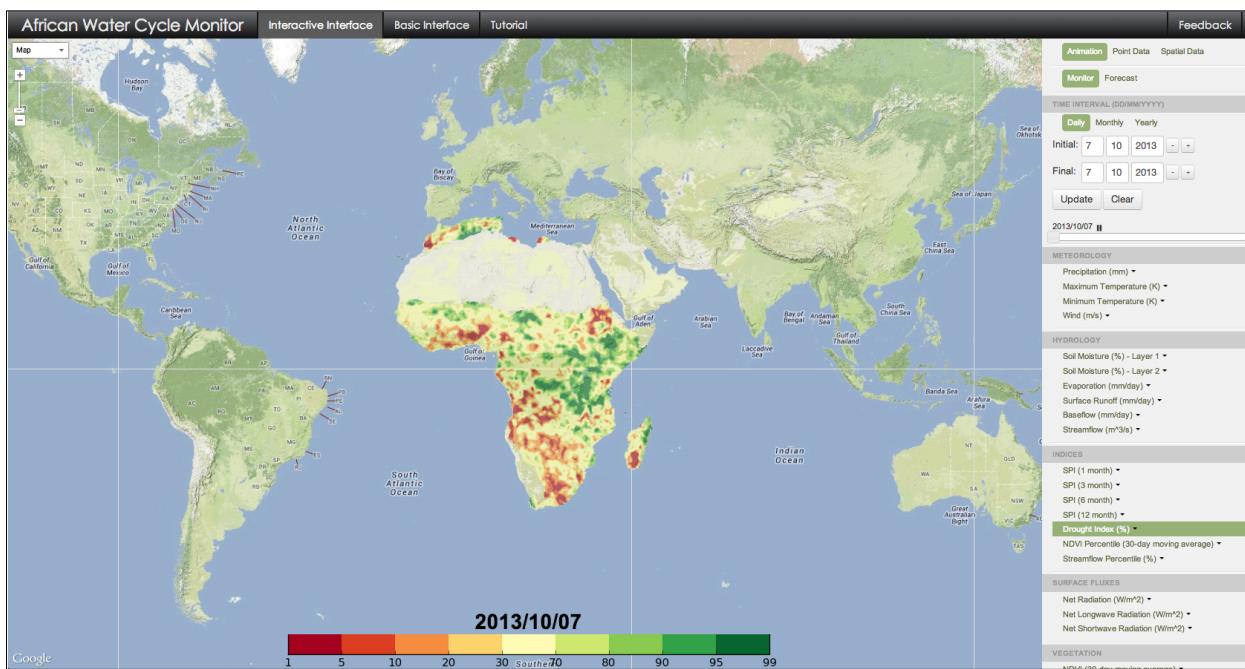
This tutorial examines the main features of the African Water Cycle Monitor web-interface. Its capabilities include the animation of spatial data information, point data visualization, and download of data in both space and time. You will learn how to visualize not only the historical and present conditions but also the daily and monthly meteorological and hydrologic forecasts.

Monitor Portal and Language Selection:



- Open your web browser (preferably Google Chrome or Firefox) and navigate to <http://stream.princeton.edu/AWCM/WEBPAGE>
- This is the monitor's main portal. Here you can select your preferred language for the Monitor and learn about the projects sponsors.
- Choose your preferred language from the dropdown menu and select "Proceed to Website" to continue to the main interface.

Main Interface:



In this page you will be able to access the information provided by the monitor. Before moving on to explaining how to access the data, you will first learn about the different tabs in the navigation bar on the top of the page.

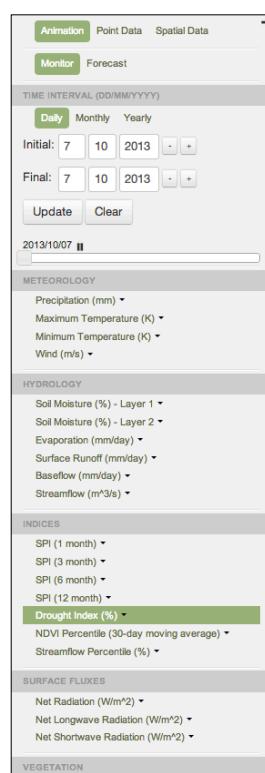
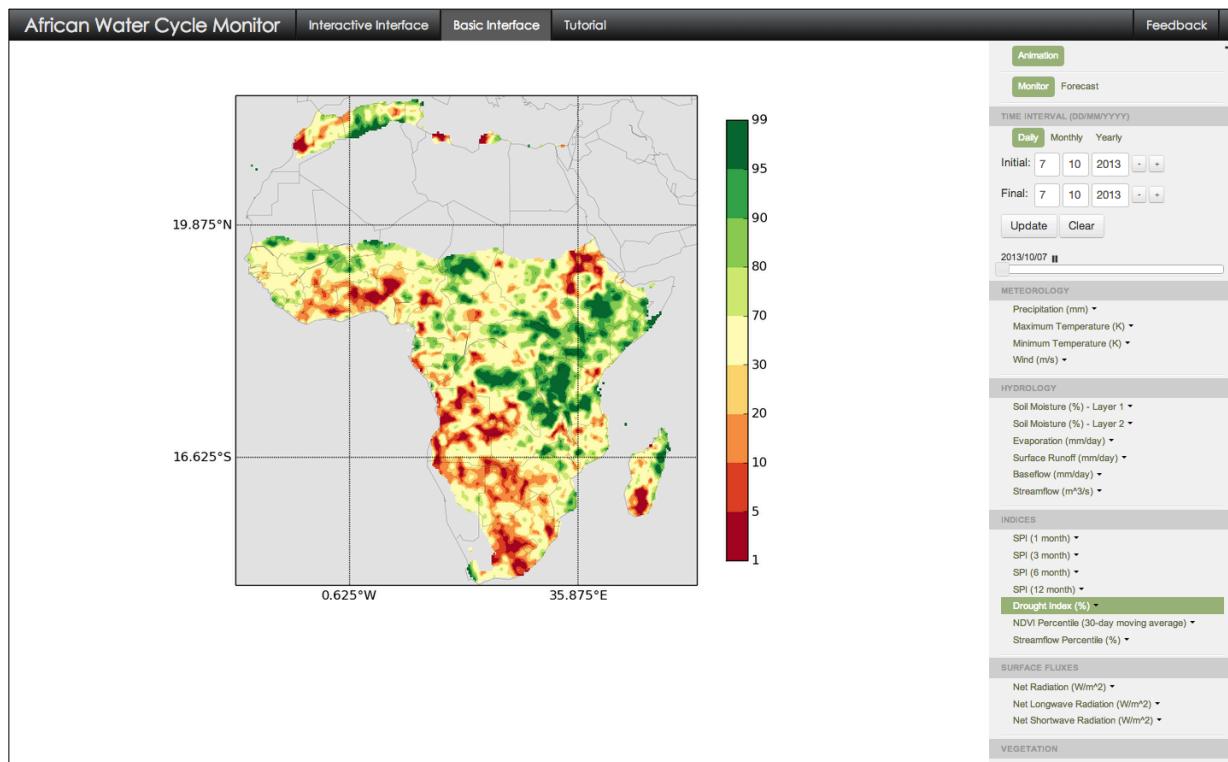


- African Water Cycle Monitor - This tab will take you back to main portal where you can change the monitor's language.
- Interactive Interface - This tab will take you to the Google Maps page where you will be able to interactively work with the monitor's data.
- Basic Interface - This tab will take you to the basic interface page where you can display static images that you can readily download to your computer for personal use.
- Tutorial - This tab will take you to this tutorial that you are currently working on.
- Feedback - Clicking on this tab will display a feedback form that you can use to provide information regarding desired improvements to the monitor.

For the remainder of this tutorial you will learn how to explore the basic and interactive interfaces and how to provide feedback. You will work on a few case studies to learn how the monitor can be used.

Basic Interface:

At this point please click on the “Basic Interface” tab. The basic interface will allow you to see the hydrological and meteorological variables, along with vegetation conditions, as spatial data layers and animations. You will be able to view historical records for variables as well as the latest forecasts. A majority of these features will be controlled by the sidebar.



The Sidebar:

As shown to the left, the sidebar controls all of the functionality of the basic interface. From this menu you will be able to view the monitored data and forecasts for a range of time intervals. Finally, you can select between a number of datasets for display and animation of a number of variables including precipitation, soil moisture, streamflow, and SPI. These functions are described in the following sections.

Animation Panel - Monitor:

- On the sidebar, ensure that the box for “Monitor” is selected.
- The currently displayed image will be the most recent data available for the Drought Index
- The interface on the screen will display the image and the associated colorbar. The units of measurement are given by the variable name in the sidebar.

- Save this figure by right-clicking and selecting “Save Image As..”. You can save any figure you visualize using the basic interface using this method
- Switch to another variable by selecting a variable from the sidebar followed by a dataset name. For example, select “Precipitation (mm)” and then select “Satellite Precipitation (3B42RT)” to view the most recent satellite precipitation data.
- Try this out with other datasets. In some cases you may receive an error upon selecting a dataset. This is because the data is not available for the current timestep. If this occurs, press “Ok” to clear the error and then try to select another variable.
- If there is a variable that you would like more information about, you can hover the mouse over the variable name in the sidebar for a few seconds to display a brief explanation. In order to remove this information from the screen, simply move your mouse away from the variable name.

Animating the Data:

- On the sidebar, under the “Time Interval” heading, change the initial time to March 1, 2011 and the final time to May 1, 2011 by typing in the corresponding date boxes. The dates can also be changed by using the plus and minus buttons to change the time by one unit.
- Select the “Drought Index (%)” and then select “Derived Hydrology”.
- Click on the “Update” button to load the animation. We can now see how the drought index changed daily over this period.
- Click on the “Precipitation (mm)” variable followed by the “Satellite Precipitation (3B42RT)” dataset to view the animation for the same period.
- To analyze individual days of the animation we can use the horizontal slider bar in the Time Interval menu.



Press the pause button to stop the animation. Drag the slider from left to right to view the individual days of the animation. This tool can be helpful if you would like to skip back and forth between different parts of the current animation. The animation can be resumed by pressing the play button.

- To clear the current animation from the display, press the Clear button on the sidebar. This will clear all of the images on the screen.
- To further investigate the data, we can also look at monthly and yearly values using the options in the Time Interval menu. Select “Monthly” to view the monthly data for all of the variables.
- Choose January 2011 to December 2011, update the animation using the “Update” button and then spend time visualizing the animations of the different indices (SPI,

Drought Index, NDVI percentiles, and Streamflow percentiles). You will be able to visualize the evolution of the Greater Horn of Africa drought of 2011.

- Spend some time exploring different variables for the same time period or other time period.

Animation Panel - Forecast:

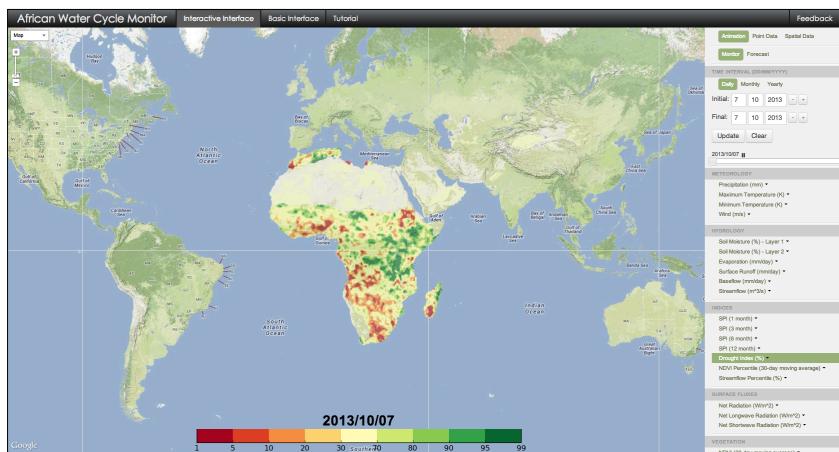
The forecast panel features a simplified version of the monitor panel in which we can view animations of 7-day and 6-month forecasts for many of the variables.

- To switch to the forecast section of the sidebar, select “Forecast” from the top of the sidebar.
- Select “Daily”. Then select “Precipitation (mm/day)” and then select “GFS 7-day forecast”. You will now see the 7-day prediction after the last monitor’s available last day.
- After selecting a variable, the animation slider can be used to pause the animation and view the individual days, as was previously done. To resume the animations press the play button.
- In order to view 6-month forecasts of a smaller set of variables, select Monthly in the Time Interval panel. Once again, select a variable to view the animation.

Congratulations! You have completed the introduction to the Basic Interface. We will now move on to some of the more interactive features of the AWCM.

Interactive Interface:

The interactive interface will allow you to see the hydrological and meteorological variables as spatial data layers and animations. Through this interface you will be able to view historical records for variables as well as the latest forecasts. A majority of these features will be controlled by the sidebar. Click on the “Interactive Interface” button in the navigation bar to switch to this view.



Google Maps:

Google Maps provides an interactive interface that allows you to intuitively explore your region of interest. You can change the map type by clicking on the map button in the upper left corner. With your map of choice selected, click and hold anywhere on the screen to move the map around. Once you have chosen a region of interest use the zoom bar on the left to zoom in or out.

The Sidebar:

As shown to the left, the sidebar controls all of the functionality of the interactive interface. From this menu you will be able to switch between Animations, Point Data extraction, and Spatial Data extraction. In addition, you will be able to view the monitored data and forecasts for a range of time intervals. Finally, you can select between a number of datasets for display and animation of a number of variables including Precipitation, Soil Moisture and a Drought Index. Each of these functions and many others will be described in the following sections.

Animation Panel - Monitor:

- On the sidebar, ensure that the boxes for “Animation” and “Monitor” are selected.
- Reset the display by selecting “Daily” from the “Time Interval” menu and then select the “Drought Index (%)” from the listed variables



- The maps interface on the screen will display the data as well as the date of the image and the corresponding colorbar.
- Switch to another variable by selecting a category from the sidebar followed by a dataset name. For example, select “Precipitation (mm)” and then select “Satellite Precipitation (3B42RT)” to view the most recent satellite precipitation data.
- Feel free to try this out with other datasets. In some cases you may receive an error upon selecting a dataset. This is because the data is not available for the current timestep. If this occurs, press “Ok” to clear the error and then try to select another variable.
- If there is a variable that you would like more information about, you can hover the mouse over the variable name in the sidebar to display a brief explanation. In order to remove this information from the screen, simply move your mouse away from the variable name.

Animating the Data:

- On the sidebar, under the “Time Interval” heading, change the initial time to January 1, 1983 and the final time to January 1, 1984 by typing in the corresponding date boxes. The dates can also be changed by using the plus and minus buttons to change the time by one unit. These dates will be used to illustrate the Sahel Drought.
- Select the Drought Index from the list of available variables.
- Click on the “Update” button to load the animation. We can now see how the drought index changed daily over this period.
- Click on the “Precipitation (mm)” variable and the “Princeton Global Forcing” dataset to view the animation for the same period
- To analyze individual days of the animation we can use the horizontal slider bar in the Time Interval menu.



Press the pause button to stop the animation. Drag the slider from left to right to view the individual days of the animation. This tool can be helpful if you would like to skip back and forth between different parts of the current animation. The animation can be resumed by pressing the play button.

- To clear the current animation from the display, press the Clear button on the sidebar. This will clear all of the images on the screen.
- To further investigate the data, we can also look at monthly and yearly values using the options in the Time Interval menu. Select “Monthly” to view the monthly data for all of the variables.

- Examine the progression of the “Precipitation” and “Drought Index” variables. From this view we can see the ability of the system to highlight many aspects of the drought events.
- Additional information about the drought can be gained by examining the streamflow percentiles. Select the “Streamflow Percentile (%)” variable and the “VIC hydrologic model” dataset to view this. We can now see how the streamflows were affected by the drought.

Animation Panel - Forecast:

The forecast panel features a simplified version of the monitor panel in which we can view animations of 7-day and 6-month forecasts for many of the variables.

- To switch to the forecast section of the sidebar, ensure that you have selected “Animation” at the top of the sidebar and then select Forecast.
- Select “Daily” to view variables for which there are 7-day forecasts.
- Using the zoom bar on the top left of the map, focus in on an area of interest and select a variable to view the forecast for this region. By examining all of the available forecasts you can gain a wide variety of information about the forecast for a region.
- After selecting a variable, the animation slider can be used to pause the animation and view the individual days, as was done previously. To resume the animations press the play button.
- In order to view 6-month forecasts of a smaller set of variables, select Monthly in the Time Interval panel. Once again, select a variable to view the animation.
- Feel free to explore the available forecasts and variables to see what data may be of interest to you. We will later see how this data can be downloaded for further study.

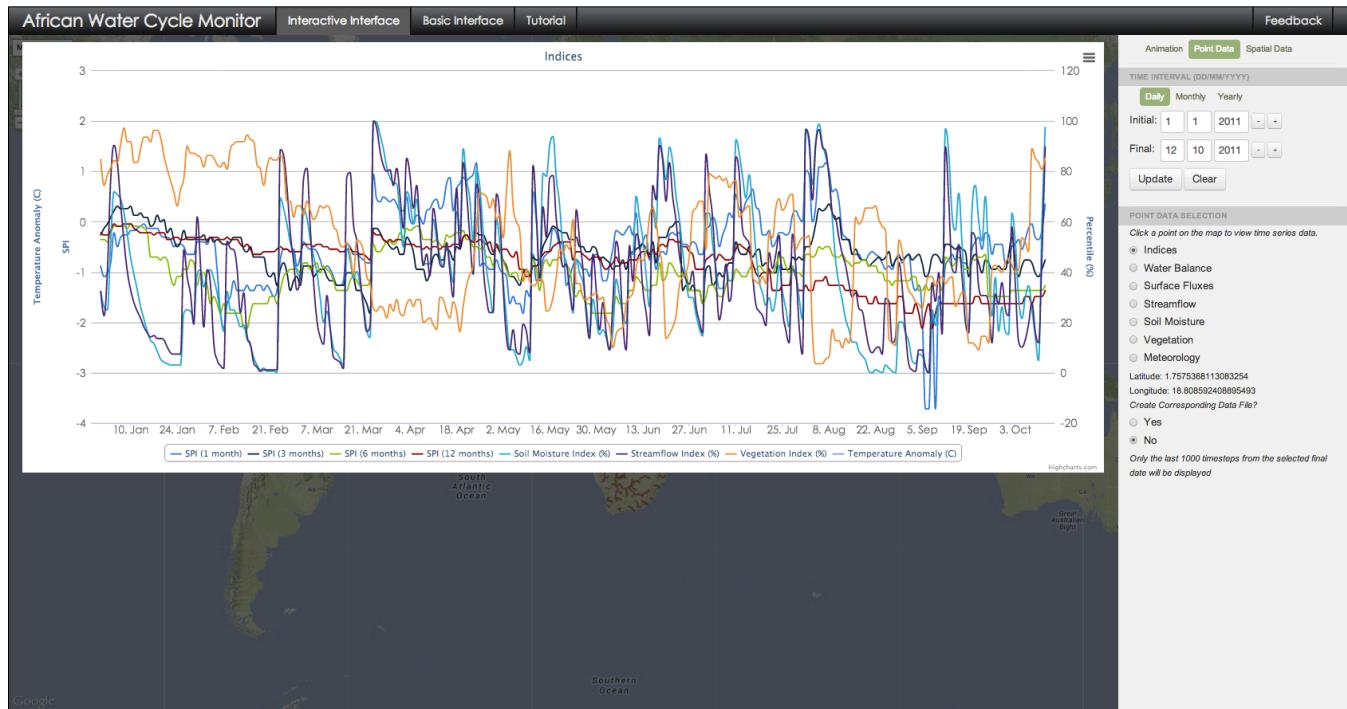
Additional periods of interest may include:

- West African Floods from June – September 2009
- West African Floods from June – November 2010
 - Be sure to examine the streamflows for the Niger River and compare these values to those from the past 10 years.
- Southern African Drought during 2006 and 2007

Congratulations! You have now completed the introduction to the Interactive Interface. We will now learn how the AWCM can be used to interact with the point and spatial data presented thus far.

Point Data:

The point data section of the sidebar features a number of sets of time series data plots that can be viewed for individual grid cells. In addition to this, the plotted data can be downloaded for future use.

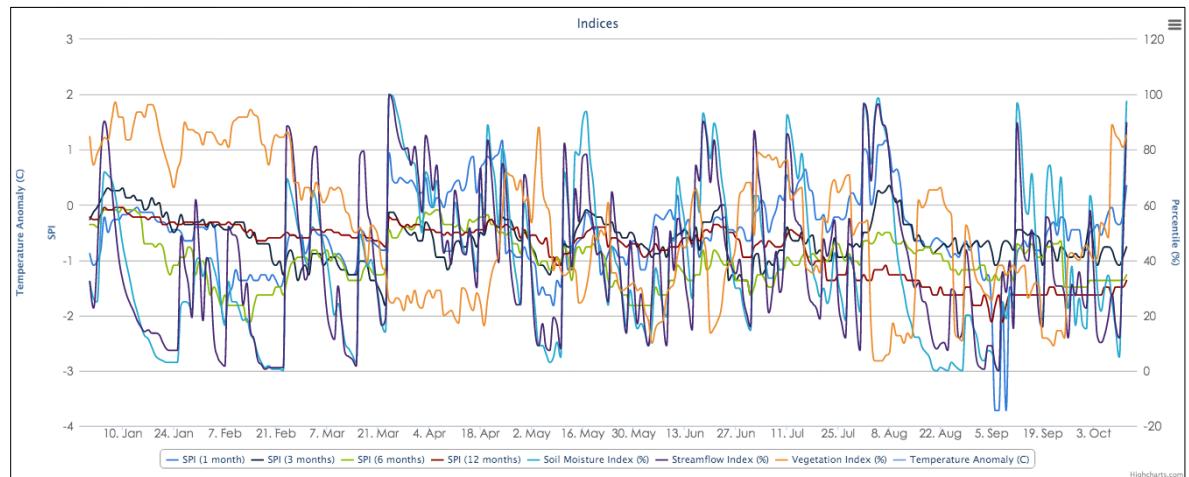


- Select Point Data at the top of the sidebar to open these options.
- Under the “Time Interval” heading, ensure that Daily is selected and change the initial time to January 1, 2011 and the final time to December 31, 2011 by typing in the corresponding date boxes. This will allow us to examine the Greater Horn of Africa drought of 2011 to a further extent than before.
- The default data set will be the “Indices”.
- In order to view the data you must select a point for which the data will be extracted. This can be done graphically by clicking on the map or by entering the latitude and longitude of a point of interest.
- To use the graphical method, select the “Map Click” option under the “Point Data Selection” menu. Using the map display with the streamflow shown, use the mouse to select a point of interest in the Horn of Africa by simply clicking on a location on the map. The streamflow is shown on the map to help you select points that may be of interest to you. The grid cell nearest to the location clicked will be used to display the data. In addition to this, the current latitude



and longitude of the mouse are shown on the sidebar when selecting a point on the map. This can be used to focus in on a certain point of interest.

- To use the manual method, select the “Manual Entry” option under the “Point Data Selection” menu. Enter the decimal latitude and longitude of your point of interest and click the “Submit” button.
- After selecting a point, a popup will be displayed with a plot of many time series. A legend of the series can be seen below the plot.



- It is possible to interact with these time series in a number of ways.
 - First, by hovering the mouse over a time series and tracing it, you can see the value of the time series at each timestep.
 - Second, by clicking on the series name in the legend, the series can be removed from the plot and then added back to it again.
 - Third, you can zoom in on a section of the plot by clicking the mouse and dragging over the region you are interested. To clear this and return to the full plot, select the “Reset Zoom” option in the upper right corner of the plot.
 - Finally, by clicking in the upper right corner of the plot you will find options for saving and printing the currently displayed plot. Use these options if you would like to save a copy of a plot you generated.
- Using the sidebar we can select another set of data to plot. For example, select “Soil Moisture” to change the plot and view the data for this series. The dates of the plot can also be changed while it is open by entering new dates in the sidebar and then clicking the update button. To clear the displayed popup, click the clear button on the sidebar.
- Clear the current plots with the Clear button and switch to Monthly or Yearly to view a different time series. Select a new point using the mouse to explore the data for a different area of interest. When viewing the monthly data, change the time range to start at February 1950 and end on October 2013, to view the entire

period of record. This can be used to look at trends over longer time periods for the variables presented.

- Set the current plot to end at the most recent date. Click “Update” to update the plot. By examining this plot we can see that there are two distinct regions.



The region with the white background represents the observed data, while the region with the blue background represents the 7-day forecast for each of the variables plotted. Any time the final time is set to the most recent day, you will be able to view the forecasts for each of the variables.

- Feel free to continue to explore the available data by selecting points of interest to you and examining each of the plots.
 - Additional periods of interest may include:
 - West African Floods from June – September 2009
 - West African Floods from June – November 2010
 - Be sure to examine the streamflows for the Niger River and compare these values to those from the past 10 years.
 - Southern African Drought during 2006 and 2007
 - To download a text file of the time series presented on the current plot, click on the Yes option on the sidebar and then click the Update button. Then click the “Download Data” link that appears. The location of this link is shown below.

Create Corresponding Data File?	
<input checked="" type="radio"/> Yes	<input type="radio"/> No
Download Data Only the last 1000 timesteps from the selected final date will be displayed	

Depending on your browser, this will either download a TXT file or open the text file within your web browser.

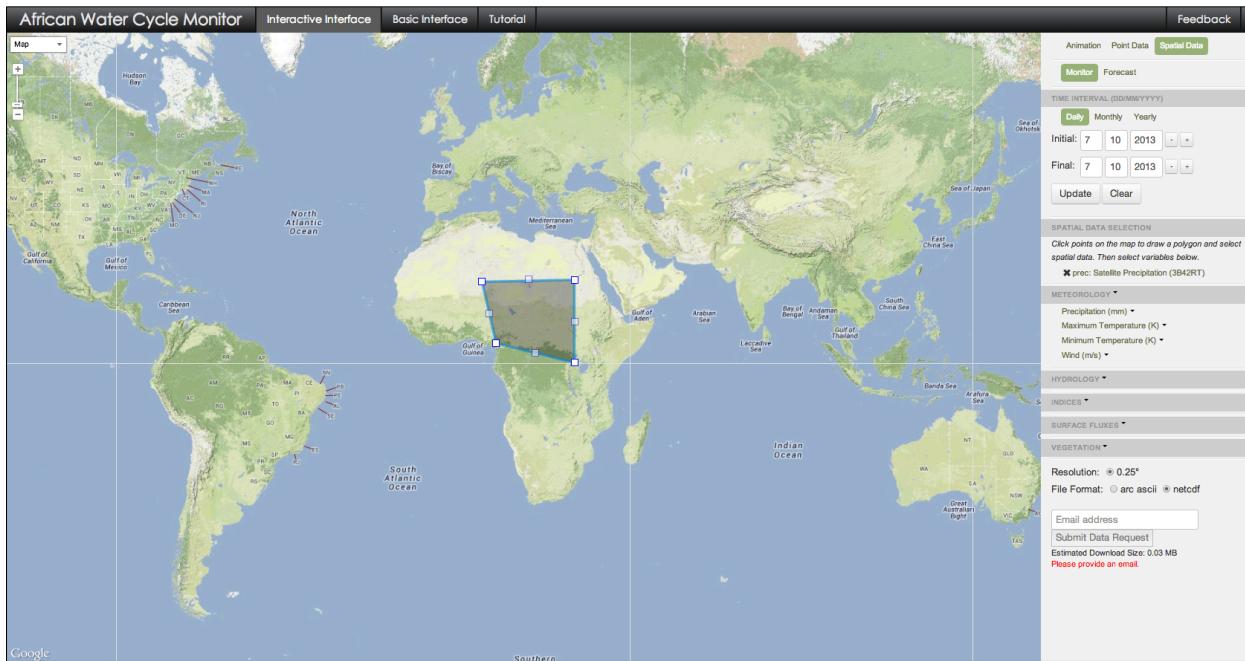
- This file can be imported into Microsoft Excel for your own use and plotting. The following instructions explain how to do this for Excel 2010 in Windows. Instructions may differ for different versions of the software.
 - Launch the Microsoft Excel application
 - Select the “Data” tab at the top of the screen and then select the “Import from Text” option.

- A window will popup allowing you to navigate to your text file and select it.
- You will now be prompted to select options for the file import. Ensure that “Delimited” is selected and then click “Next”.
- Select “Comma” as the delimiter and then click “Next”. You will now be shown how the text file will be imported.
- Click “Finish” to import the data into your Excel spreadsheet.
- You can now use this data to compare against your own records or those retrieved from other sources.

Congratulations! You have now completed the introduction to the Point Data component of the AWCM. This tool can be very helpful for examining points of interest and the time series of variables at each point. We will now move on to introduce the ways in which you can interact with the spatial data.

Spatial Data (Data Download):

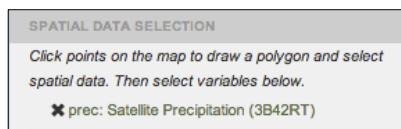
The spatial data section of the sidebar allows the user to select a region and download any of the available data for that region. The data can be downloaded in either an Arc ASCII or NetCDF format.



- Switch to the spatial data section of the sidebar by selecting the “Spatial Data” option at the top of the sidebar. This will clear any animations or pop ups that may have been opened previously.
- Select the “Monitor” option and set the dates to either the current date or a small date range of interest to you. For the spatial data download you can either set both the initial and final times to the same value to retrieve one timestep or to a range to retrieve that time period.
- In order to download the data you must select a rectangular region for which the data will be extracted. This can be done graphically by clicking on the map or by entering the bounding latitudes and longitudes of an area of interest.
- To use the graphical method, select the “Map Click” option under the “Spatial Data Selection” menu. Use the mouse to click on the map to draw a rectangle and select the region you are interested in downloading data for. When your first click a location you will set the upper right corner of the rectangle. Select a second location to set the lower left corner of the rectangle. This will set the region for which you would like data. If you would like to change the region, use the Clear button to remove your selection.



- To use the manual method, select the “Manual Entry” option under the “Spatial Data Selection” menu. Enter the decimal latitudes and longitudes that bound your region of interest and click the “Submit” button. This will display your selection on the map. If you would like to change the region, use the Clear button to remove your selection.
- After you have selected your region of interest, you will need to select the variables that you would like to download. First click on “Meteorology” to expand the list of available variables. Click on “Precipitation (mm)” and the “Satellite Precipitation (3B42RT)” to select this data. You will now see that the data has been added to a list on the sidebar.



- Add another variable to the list by clicking on “Hydrology” and then selecting “Soil Moisture (%) - Layer 1”.
- If a variable has been added to the list and no longer needs to be downloaded, it can be removed from the list by clicking on the x next to the variable name.
- Once you have completed your selections, you will need to set the file download options. The resolution of the output files will be 0.25 degrees. You can then select to download the data in Arc ASCII or NetCDF format. Do this by clicking on the corresponding file option.

The screenshot shows a form for download settings. It includes:

- Resolution: 0.25°
- File Format: arc ascii netcdf
- Email address: [Text input field]
- Submit Data Request: [Button]
- Estimated Download Size: 0.03 MB
- Please provide an email.** [Text in red]

- Enter the email address that you would like have the download instructions for the data sent to.
- Once all of these options have been set you will be able to click the “Submit Data Request” button. Doing this will generate the data and email you a link through which you will be able to download the requested data.
- Once you have received the email, click on the link and download the data.
- Explore the variable list and select any other variables that you would like to download and view.
- This data can be imported into ArcGIS for use with other data sources and in your own projects. Using the above method download any data for a region that you are interested in. Once you receive the email for your download, save this “.zip” file to your desktop. You can extract the files by double clicking on the “.zip” file

and then dragging the enclosed files to a new location on your computer. The following instructions will allow you to import this data.

- Open the ArcMap application on your computer. Click “Ok “ to open a blank map.
- Use the Search window to locate the “Make NetCDF Raster Layer” tool.
 - Click Search
 - Choose Tools
 - Type “Make NetCDF Rater Layer”
 - Click the magnifying glass icon
 - Click the Make NetCDF Raster Layer tool in the list
- For the “Input netCDF File” value, type or browse to the location of the netCDF file (.nc extension) you downloaded.
- Leave the default values for the “Variable”, “X Dimension”, and “Y Dimension” fields.
- Type a title for your data in the “Output Raster Layer” field.
- Click “OK” to run the import tool.
- After some time you will see that your data has been imported as a raster layer in ArcGIS. You can now perform any analysis that you would normally perform on a raster dataset.

Congratulations! You have now completed the introduction to the Spatial Data portion of the AWCM, as well as the entire tutorial for the AWCM. We hope that this has given you a good overview of the wide range of features for data exploration, visualization, and download that the African Water Cycle Monitor has to offer. If you have any questions or comments that you would like to give us about the contents of this tutorial or the AWCM interface itself, please use the “Feedback” button provided in the navigation bar of the website. By providing your name, email address, and a brief comment we will be able to receive and address any issues or concerns that you may have. Thanks!