Princeton African Drought Monitor Tutorial

Exploring the Horn of Africa Drought of 2011

In this tutorial, we will explore the main features of the African Drought Monitor web-interface through the analysis of the eastern Africa drought that took place during the Spring and Summer of 2011. If you have any questions about the terminology and background of the monitor please refer to the African Drought Monitor Glossary and the Introduction to the African Drought Monitor

- **Step 1: The Basic Interface**
    - Open your web browser (Preferably Google Chrome) and navigate to:
        - http://hydrology.princeton.edu/~nchaney/Africa_Drought_Monitor_Webpage/index.php
    - This page acts as the home page and the basic interface. The page shows current daily hydrological and meteorological conditions as static maps. The user is also able to access daily maps for any day from 1950 to present. Take some time to familiarize yourself with the basic interface and the different meteorological and hydrological variables. Note that temperature, wind speed and stream gauge percentiles images are only available after October 1st, 2011.

Figure1 Example of the basic interface control panel.

- Choose a date you are interested in and change the date as shown in Figure 1. Press "Update Images" to show the maps for the chosen day. Once you have explored the maps for that day, press the left or right arrows to view the previous or next day. You can save a map as an image (png) by right clicking on it and pressing "save image as..".
- Next change the date to April 1st, 2011. Look at the map of the drought index (soil moisture percentile). Which area is in severe drought?
- Now, compare the precipitation maps for April 1st, 2011 and April 1st, 2010. *What are the main differences in the Kenya, Ethiopia and Somalia region?*
- Because precipitation is a highly variable process, comparing two days is not sufficient to draw any conclusions regarding the reasons behind the drought. You could explore the entire previous month, however it would be tedious

and take too long. Instead let's move to the interactive interface where we will be able to explore the temporal evolution of drought in a much simpler and faster manner.

- **Step 2: The Google Maps Interface**

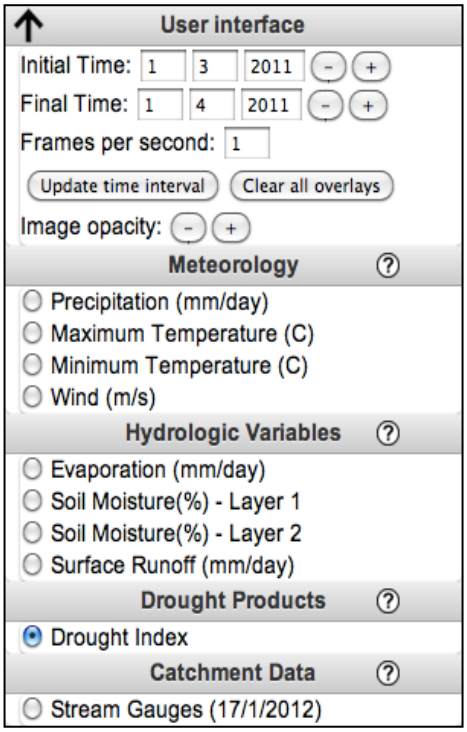

Figure 2 Menu of the interactive interface. The user can change the time interval and view maps of different meteorological, hydrological and drought products. Streamflow and basin average data can also be viewed by selecting "Stream Gauges"

- Click on "Google Maps Interface" to go to the interactive interface. Take a few minutes to familiarize yourself with the interface.

- Use the tool on the upper left to zoom into eastern Africa.

- On the upper right menu (Figure 2), change the initial time to March 1st, 2011 and the final time to April 1st, 2011. Then click "Update time interval".

- Then click on "Drought Index". An animation of the drought index will appear covering the time period selected. You can change the animation speed by changing "Frames per second" and clicking "Update time interval". *How does the drought evolve over this time period?*

- Click on "Precipitation" to view the rainfall over the same period. Compare the rainfall to the previous year by changing the Initial Time to March 1st, 2010 and the Final Time to April 1st, 2010. Remember to click on "Update time interval". *Note the lack of rainfall in 2011 compared to 2010 that was responsible for the severity of the drought.*

- Feel free to explore animations for other variables including soil moisture and evaporation for the same time period. After you are done, click on "Clear all overlays".

- **Step 3:** Basin Streamflow and Basin Average Variables

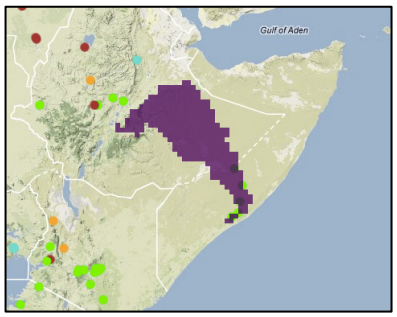

Figure 1 – Shebelle river basin at Mogadishu, Somalia.

  - We will explore the data for the Shebelle basin that covers a large part of the drought area. Click on "Stream Gauges", and then hover the mouse over one of the stream gauge points for the Shebelle River in Somalia. The boundary of the corresponding upstream catchment will appear as shown in Figure 3.

  - Next click on the streamflow point that you hovered over. A new window will appear on the screen similar to that shown in Figure 4 showing the streamflow for the past several days. Change the initial time to January 1st, 2011 and final time to July 31st, 2011. Then click "Process New Interval". The monitor will calculate the basin averaged daily data available for this time period, and display the time series graph in the window as shown in Figure 4.

  - The top panel of the graph shows the model simulated discharge (black line) and the climatological discharge in terms of percentiles (colored shading). The lower panel shows the annual cumulative surplus (blue shading) or deficit (red shading) of discharge relative to the median discharge. *Note the cumulative deficit in simulated discharge between March 1st and May 1st that relates to the rainfall animation viewed previously.*

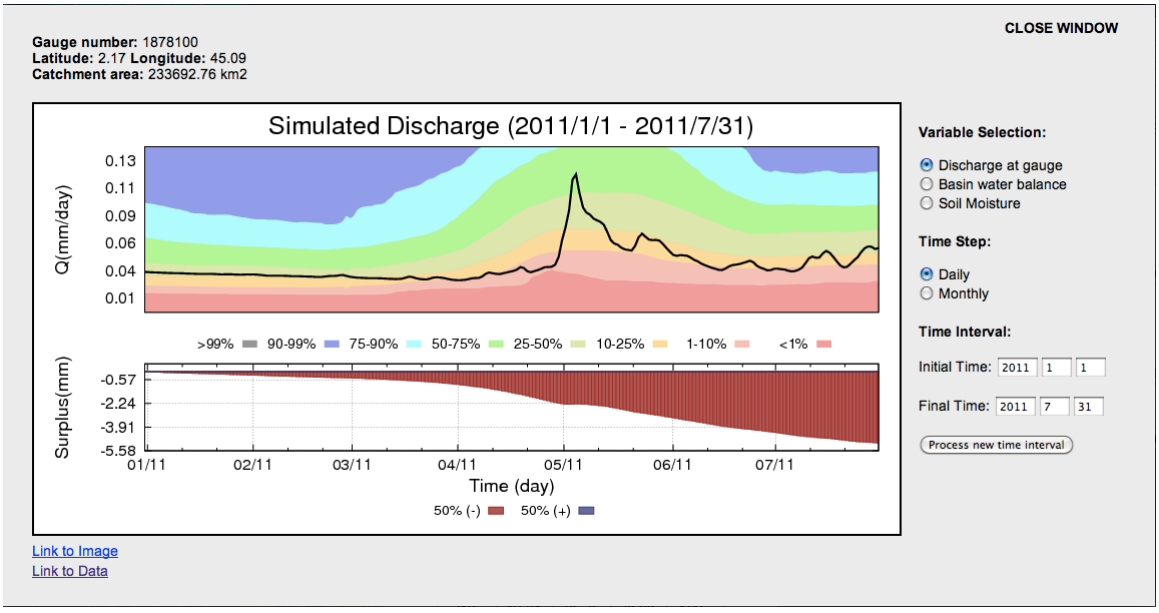

Figure 2 - Simulated Discharge of the Shebelle river on its way through Mogadishu, Somalia. The time interval has been updated to reflect the period between January 1st, 2011 and July 31st, 2011.

- The user can also view basin average time series of other hydrological variables. Click the "Basin water balance" button to view basin average water balance variables (precipitation, evapotranspiration, runoff and change in soil moisture) and the "Soil moisture" button to view the time series of soil moisture at different depths and the drought index. Note the decline in rainfall during March that is reflected in a decrease in the basin averaged drought index. You can also look at a different time period from 1950 to 3 days before the current time using the "Time Interval" fields.

- **Step 4: Data Download**

  - Finally, look at the monthly output for the basin. Change the time step to "Monthly". The basin discharge and basin averaged variables are now shown at monthly time step for the past 5 years. Again you can change the time interval to view other time periods. Set the time interval from January 2011 to December 2011 and click "Process new time interval".

  - To download the discharge data, click on the "Discharge at gauge" option, and then click on "Link to Data" at the bottom left. The raw data are displayed as text. Right click anywhere on the data and press "Save as.." to download the text file. Then close the text window and click on either "Basin water balance" or "Soil moisture" to download the data in a similar manner.

  - Repeat the previous two paragraphs for the time period between January 2010 and December 2010 and download the text file of the data.

  - Open the text files for the streamflow and basin water balance data in a text editor and explore the different variables. Then import the water balance data from 2010 and 2011 into Excel to compare the data for the two time periods. Now plot the precipitation of 2010 and 2011 in the same graph. Your result should be similar to Figure 5. *Note the failure of the rains at the beginning of the rainy season.*

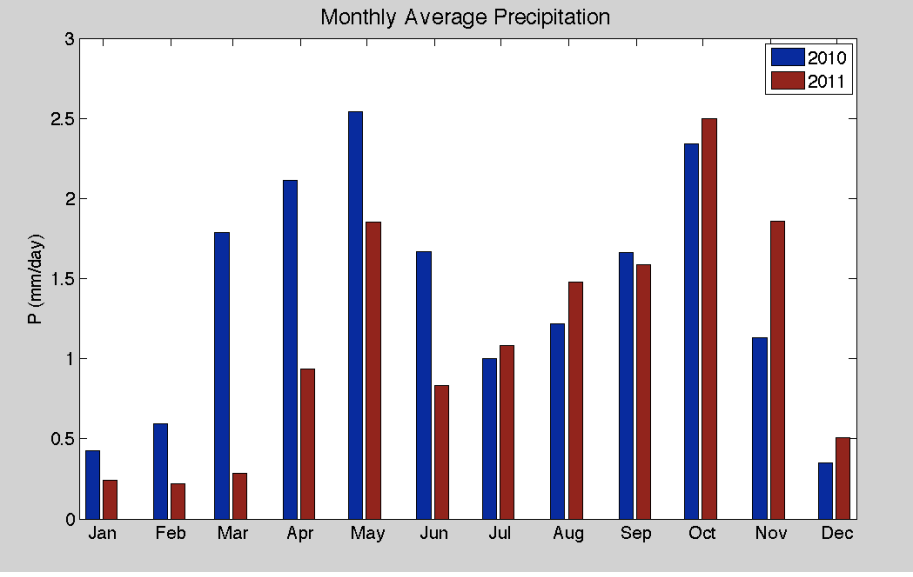

Figure 5- Basin averaged monthly precipitation (mm/day) over the Shebelle River for 2010 and 2011.

- **Congratulations!** If you have reached this point you have successfully explored the main features of the African Drought Monitor. Feel free to choose your own region and time period and do a similar analysis. If you have any suggestions on how this tutorial/monitor could be improved feel free to email Nathaniel Chaney at nchaney@princeton.edu. I would appreciate your feedback.