Objectives:
-Become familiar with online resources and image searching tools
-Interpret different types of satellite imagery
-Learn about the variety of different types of TCs

Part 1: Browse available data, learn how to use websites:
Below is a list of useful TC data websites. Spend a few minutes looking at each site. Click on links and practice looking up data.

Help pages if you do not know how to understand/interpret an image:
-NRL Satellite Training page: http://www.nrlmry.navy.mil/training-bin/training.cgi
  -Use the left menu: Tropical Cyclones > SSMI or TRMM
-RAMMB Information Page: http://rammb.cira.colostate.edu/products/tc_realtime/about.asp

-Feel free to ask for help also, we will try our best to answer your question or at least direct you to where you can find the answer.

National Hurricane Center
URL: http://www.nhc.noaa.gov/
Site summary: Official real-time forecasts for active storms. Very good real time satellite page (click "Satellite" on left side menu). Advisory archive for all named Atlantic/East Pacific storms since 1998. The advisory archive is useful because it contains the archived forecast discussions, which are issued every 6 hours. The discussions contain a description of the storm's current conditions and the forecasted track and intensity. The discussions will also refer you to the observations made to make the forecast such as aircraft recon data, visible/IR/microwave satellite imagery, and surface observations.
Useful data:
-Track, advisory and forecast discussion archive
-Satellite data for current storms
Instructions for access: Click on "Advisory Archive" on left side menu. Choose year and storm. Click on desired issue time for advisories and discussions. For graphics, click "Graphics Archive" on the top of the storm page. You can navigate through the loop of advisory graphics to pick the desired date/time of the forecast graphics. Also keep in mind that the graphics represent the current location and intensity, but the forecast positions do not necessarily reflect where the storm actually went.

Navy Research Lab (NRL) Tropical Cyclones Page

URL: http://www.nrlmry.navy.mil/TC.html

Or, to access the data structure directly: http://www.nrlmry.navy.mil/tcdat/

Site summary: A wealth of microwave satellite imagery for all global storms. Archive to 1997. Site is difficult to use and has been known to break down, but is still overall the best TC image site available. All images are centered on the storm and are well labeled. There are also good "training"

Useful data:

-Visible, IR, and Water Vapor Images

-37 and 85 GHz MW images (for SSMI, SSMIS, TMI/TRMM, AMSR-E, WINDSAT, and AMSUB satellites)

-37 GHz and 85 GHz "Color" image (special type of color enhancement)

-CIMSS Wind Shear product (need to use data structure > shear)

-Total Precipitable Water (data structure > tpw)

-A few surface wind speed products, but other sites have better wind images

Instructions for access: There are two options to use the site. One option is to use the actual webpage and the other is to just go straight for the file structure. I recommend exploring both and using the method that you feel is easiest.

a) Data structure: From the link, click on the year, then the basin, and the storm name. Then all you have to do is choose the instrument, followed by the image you want to see, and select the appropriate time.

b) Actual interactive webpage:

-When you first load the page, ignore all the colored buttons and click the "Year" button in the upper left to access the archives. Select the year you are interested in and a list of storms will appear on the left. Click on the storm that you want to see, which loads up the grid with red buttons.

To see images:

1. Click on the red box for the satellite and type of image that you would like to view. This will load the most recent image for active storms and the last image before dissipation for archived storms.

2. To see the archive, click the yellow "Previous" button on the top bar (next to latest). Then select your image from the list that appears below

To make a loop:

1. One again, select the type of image you want by clicking on the appropriate red box.

2. Scroll the mouse over the grey "Loop" button at the top and select "GIF89a".

3. You should now have loaded the blue "Animator Control Panel". You can select up to 16 images to be made into a loop by holding down the Ctrl key and clicking on the images that you want to include in the loop. After selecting the images, click "Submit Query".

To see image thumbnails:

-Try using the "Pass Mosaic" and "Mosaic" buttons at the top (next to loop). You can quickly load all the images for a particular instrument or for a particular time. Then it is easy to select the image that you think is most useful.

CIMSS Tropical Cyclones

URL: http://tropic.ssec.wisc.edu/

Site Summary: Excellent real-time tracking software. Some images are available from the Archive, but a software package is needed to fully access all data.

Useful data:

-Saharan Air Layer (SAL) dry/dusty air GOES product

-Deep layer mean steering (to figure out steering currents that guide direction of TC movement)

-Deep layer shear (best wind shear product)

-Deep layer 24 hour shear tendency (to figure out if shear has increased or decreased in last 24 hours)

-Individual products for the low, mid, and upper level winds

Instructions for access:

-First, hold mouse over red "Archive" button in top menu. Select "Full Product Archive". Search for the storm name that you are looking for. Click "Fetch List of available products". This will make little checkboxes appear below with the types of data. The two types that are useful are "Overlays" and "Images". Pick the type of image or overlay that you want and choose the date to find the time you are looking for.

For Total Precipitable Water Archive**:**

http://cimss.ssec.wisc.edu/tropic/real-time/tpw2/natl/main.html

-Click on "FTP Archive" at the bottom and follow links

AOML TCHP Page

URL: http://www.aoml.noaa.gov/phod/cyclone/data/at.html

Site Summary: Sea Surface Temperature and Tropical Cyclone Heat Potential (TCHP) data archives.

Useful data:

-Sea Surface Temperature (By basin or globally)

-TCHP

Instructions for access: You can use the simple search to get at data for 2009-2011, but you can get at even older data by searching and then modifying the URL:

http://www.aoml.noaa.gov/cgi-bin/trinanes/searchmaps1.cgi?month=1&day=1&year=2008

-Change the month, day, and year in the URL to get the data back to 2005.

FIU Tropical Cyclone Precipitation Feature (TCPF) Database

URL: http://tcpf.fiu.edu/ (This is our research group's webage!!!)

Site summary: Provides access to each storm for the six TC-prone basins viewed by TRMM since its launch in late 1997. Storms are sorted by year, basin, name, and TRMM orbit. Most long-lived storms have many overpasses, some of which did not directly go over the storm. It is easiest to know in advance the storm and general timeframe that you are looking for to save time looking up images.

Useful data:

-Total Precipitable Water (TPW)

-Sea Surface Temperature, centered on storm

-TRMM Precipitation Radar (PR) 2A25 near-surface rainrate

-TRMM Microwave Imager (TMI) 2A12 near-surface rainrate

-TMI 85 and 37 GHz PCT

-Infrared Brightness Temperature

-Rain Type (Stratiform or Convective)

-Storm height (km)

Instructions for access: Scroll down to bottom of homepage. Click on "TCs viewed by TRMM" hyperlink. Click on desired basin and year. Choose storm of interest. For storm summary, click "snapshots" or "rain accumulation". For specific orbits, click on the storm name, then click on SST for Sea Surface Temperature or the orbit number for a nine-panel plot of TRMM products (most useful).

FNMOC

URL: https://www.fnmoc.navy.mil/tcweb/cgi-bin/tc_home.cgi

Site Summary: Very similar data to the NRL page. Sometimes the NRL page does not work properly, use this as a backup.

Useful Data: Same as the NRL page.

Instructions for access: Click "Year" in the left side menu to bring up archive. Choose year. Choose basin (on left). Choose image by satellite using drop down menu. Use "Mosaic" button at top to get list of times.

RAMMB:

URL: http://rammb.cira.colostate.edu/products/tc_realtime/

Site Summary: Stands for NOAA's Regional And Mesoscale Meteorology Branch. Very useful site. Image archives are easy to access. You also only have to press one button to make a loop which is much easier than the NRL site.

Useful data:

-Easy access to the Latitude/Longitude and Intensity—use this or NHC site to figure out how strong your storm is at any given point

-Zoomed in high resolution Visible Imagery

-Ocean Heat Content

-Multiplatform Satellite Surface Wind Analysis (Mid-level, 700 mb wind analysis)

Instructions for access: Click on the year on the left, then choose desired storm. To access image list, click the "Archive" link under each product. Then you can make a loop by clicking the starting and ending image buttons, or pick a single image.

Part 2: TC Image Search

Now that you are familiar with the various databases, search and save images for storms meeting the 20 criteria below. It will be easiest to put the images in a Power Point presentation.

With each image, please record:
1) Name of storm, year, basin (i.e. Katrina, 2005, Atlantic)
2) Intensity at the time of image (Knots or MPH is ok)
2) Image type (Visible, IR, TRMM 37 GHz, etc.) and explain why this particular type of image was the best for each case
3) Environmental conditions:
  a) Is the TC intensifying or weakening or maintaining its current intensity? Why?
  b) What environmental factors may be causing the TC to display the observed characteristics?

Presentation:
-At the end of the lab (around 2:15 on Thursday) you will be expected to pick about 10 of the cases and explain them (about 1 minute for each case) in a Power Point presentation to the class.

Other rules:
-You must use at least one TC image from every basin: Atlantic, NE Pacific, NW Pacific, N Indian, S Indian, and SW Pacific
- If you find additional images that help you explain the environment, save those also. The idea is to make a good scientific argument for why the storm is evolving as it is, using the best available evidence.
-Make sure to use the NHC Forecast Discussion archive and read the forecasters' opinions (but keep in mind the forecasts were sometimes later proven to be wrong).

Images to collect:
1) Category 3+ TC making landfall
-Visible, IR, topography, 85 GHz H or 85 GHz Color, do not use 37 GHz over land
2) TC going through extratropical transition
-Visible, IR, sea surface temperature, 37 GHz H or 37 GHz color
-Might be hard to get a good MW pass due to large size of extratropical cyclone
3) TC with dry air intrusion inhibiting development
-Water Vapor, SAL, Wind Shear, Visible, 85 GHz color
4) Sheared TC with exposed low-level circulation
-Visible, Multiplatform Wind Analysis, 85 Color
5) TC forming from an Easterly Wave (in Eastern Atlantic, near Cape Verde islands)
-Any type of image is ok that shows the wave structure
6) TC forming from a Monsoonal Trough or ITCZ disturbance (look in Indian Ocean)
-Indian Ocean: http://202.54.31.45/archive/ENHANCED_IMAGES/ENHANCED_IR/
-Also archived on RAMMB very well
7) TC before/after Rapid Intensification (2 images—definition of RI is winds increasing by 35 kts in 24 hr)
-85 GHz H is best or 37/85 Color
8) TC before/after rapid weakening (not involving landfall, explain what caused weakening)

-SST, CIMSS Shear product, CIMSS SAL product

9) TC dissipating over cold water (can show image of TC and ocean temps)

-Do Eastern Pacific, SST, 37-H, 37-Color (shallow convection)

10) Category 5 TC at peak intensity

-85 GHz Color, 85-H, 37 GHz color, IR

11) A tropical storm with a good spiral/curved band structure

-37-Color, 87-Color

12) TC making a direct impact in South Florida

-Any type of image

13) The smallest hurricane that you can find

-Multisatellite wind analysis R34, R64

14) The largest hurricane that you can find

-Multisatellite wind analysis R34, R64

15) A TC in a location or track that is climatologically unusual

-37-H

16) TC with concentric eyewalls or a TC going through an eyewall replacement cycle

-85-H, IR-10.7, Visible-Eye Radius

17) TC with an eye obscured by a Central Dense Overcast (show one image of CDO and one MW image)

-85-H, IR/Vis

18) TC with a partial/open eyewall

-85-H

19) TC that never intensified past minimal Tropical Storm level

-Shear, 37-H, or 37-Color

20) The strangest/most unusual TC that you find (explain why it is unusual)

Optional (if you finish 1-20):

21) TC forming from a frontal boundary or MCS/MCV (show 2 images, before/after TC strengthened)

22) TC that intensified while the center was located over land (hint: happened over Florida)

23) TC with low-level vorticies in the eye (often called "mesovorticies")

24) TC that was centered over land for more than 12 hours and later redeveloped over water

25) TC with a path that made a complete loop (or even two complete loops)

26) TC impacting Hawaii

27) A hurricane with a very small eye and a hurricane with a very large eye.

Hint: if you need help finding storms, try using Google search or browsing through season summaries in Wikipedia.