Forecast Models

Purpose:
Develop the ability to contour two dimensional data and use the resulting information to locate a cold front.

Equipment:

Station Thermometer	Min./Max. Thermometer
Anemometer	Barometer
Psychrometer	Rain Gauge
Psychometric Tables	Barometric Correction Tables

I.   Surface observation. (Optional)

Begin the first 1/2 hour of lab performing a surface observation. Make sure you include pressure (station, sea level, and altimeter setting), temperature, dew point temperature, wind (direction, speed, and characteristics), precipitation, and sky conditions (cloud cover, cloud height, & visibility). From your observation generate a METAR and a station model.

A.   Generate a METAR for today's observation

B.   Generate a station model for today's observation.   ◯

II.   Forecast Model Data

In this lab we will look at the forecast model data available at http://wxmaps.org/pix/forecasts. There are several web sites that have similar data to this one; however, I will use this one for now. I used to use http://weather.unisys.com due to familiarity and to the fact that I know Dan Vietor, who was a principle developer of this software. From this site you can obtain current weather data, radar and satellite images, as well as forecast model data. All of these data sources are useful when making a weather forecast. However, Unisys is revamping its website and it is no longer serving weather data. Hopefully it will in the near future. We will spend today becoming familiar with the data and maps at Wxmaps.

Today we will look at MOS metograms and two models: the North American Model (NAM) and the Global Forecast System (GFS). Once you learn to read data from these model, it is easy to understand any of the other models present at this web site (AVN, MRF and ECMWF). Ohio State also has a web site with forecast model data links. You can find this data at http://twister.sbs.ohio-

state.edu/models. You can also find a number of useful products at the NOAA
Weather Prediction Center at http://www.wpc.ncep.noaa.gov/.

A.   MOS (Model Output Statistics)

The MOS Forecast product is generated from a numerical weather prediction
model. It provides forecasts for specific locations in the country using a
computational interpretation of the model data. This process uses past
performance of the model to correct for errors in its forecast. It also provides
derived products that are not directly predicted from the weather forecast model.

MOS forecasts are generated for different weather models, such as the GFS and
NAM models. You can visit http://www.nws.noaa.gov/mdl/synop/products.php
to find these weather products. Wikipedia gives a short description of MOS and
shows an example of a text-based product used at airports. The MOS results can
be displayed in a number of ways. The following will expose you to some of
them. (https://en.wikipedia.org/wiki/Model_output_statistics)

NAM MOS Data

From the http://wxmaps.org/pix/forecasts web page, click on the menu bar item
"Meteograms." The page displayed will have a list of cities as well as a map of
the United States. Before selecting a city, we want to make sure we are looking at
the 3.5 day meteogram for the NAM. It is listed as the first of three model results.
Now, we will chose Columbus since it is only an hour away and is at a similar
latitude. The data for Columbus looks complicated, but if you look closely, it will
start to make sense. In the upper-left corner you see the name of the city and the
starting time of the meteogram. Since we are on eastern daylight time (EDT), we
are four hours behind the universal time coordinate (UTC). Therefore, 12Z is 8
AM local time and 00Z is 8 PM local time.
The meteogram consists of nine graphs.

1. The top one gives wind speed and direction from the surface up to 500 mb.
    You will also see colored lines that represent the air temperature in Fahrenheit
    at different pressure levels. The freezing level is a double black line. As
    mentioned in class, if the freezing level is below 850 mb and there is
    precipication forecast, you would expect snow. This plot also has relative
    humidity over the depth of the atmosphere.
2. This graph is the thickness of the lower half of the atmosphere (1000-500mb
    thickness). The thicker the layer, the warmer the air.
3. This layer tells you how stable the atmosphere is. In the severe weather
    chapter we will look at several indicators of atmosphere stability. In this plot,
    the Lifted Index (LI) and Convective Available Potential Energy (CAPE) are
    given.
4. This plot gives the sea level pressure in mb.
5. This plot gives wind speed and direction at 10 m (~ 30 ft) above the surface. It
    is given in miles per hour. To convert to knots use the conversion *1 mph =
    0.87 knot*.

6. Air temperature at 2 m (~ 6 ft), which is the official measurement height. This plot also has the dew point at 2 m.
7. This plot is relative humidity at 2 m. Notice as the air temperature and dew point get closer together, the relative humidity increases.
8. This plot gives an indication of cloud cover at low, middle and high level. If the gray region goes to the top of its box, the cloud cover it 100%.
9. This last plot is a forecast of precipitation in inches over a 3 hour time period. The time of precipitation is indicated by the color.

Using the Columbus meteogram, draw a station model for a forecast over the next 2 ½ days in 12 hr increments. This model is for the surface and should include temperature, dew point, pressure, cloud cover, wind direction/speed and precipitation.

12 Hr	**24 Hr**	**36 Hr**	**48 Hr**	**60 Hr**
Day _____	Day _____	Day _____	Day _____	Day _____
Time _____	Time _____	Time _____	Time _____	Time _____
◯	◯	◯	◯	◯

Go back to the list of cities by hitting the back button and do station models for Cincinnatti.

12 Hr	**24 Hr**	**36 Hr**	**48 Hr**	**60 Hr**
Day _____	Day _____	Day _____	Day _____	Day _____
Time _____	Time _____	Time _____	Time _____	Time _____
◯	◯	◯	◯	◯

Summarize the differences between the 2 forecasts and make a forecast for tomorrow's low and high temperature in Cedarville**.**

Forecast: Tomorrow morning low temperature   _____

Tomorrow afternoon high temperature   _____

By the way if you want to see a 10 day forecast, go back to the meteogram city page and click on GFS Day 0-10. When you select Columbus, you will see a medium range forecast.

B.   NAM (North American Model)
The NAM is the standard operational model for the US, although the model details have changed over time. The AVN (Aviation Model) has served as NAM in the past and has forecasts available for not only the US, but also Europe, east Asia, South America and Australia. Each of these regions is the result of separate computer simulations.

We now want to look at weather plots for the US. To do this hit the back button of the web browser until you get to the original wxmaps page, or type in http://wxmaps.org/pix/forecasts. The upper-right entry in the first table is "North America – Short Range (NAM)." Click on this and you will be given a grid of forecast data. You can look at individual plots by click on the appropriate table entry. If you want to see a series of plots at the same time, click on "All fields" for a particular time. If you want to see the progression of the forecast for a particular model parameter, click on "All Times" for that parameter.

Precipitation
Click on "All Times" for "700 mb Vertical Velocity & Precipitation." We won't worry about the vertical velocity, which is the first plot displayed. We will now move to the remaining plots, which are the 12, 24, 36, 48, 60 and 72 hr forecasts. The legend for the color contour plots is on the upper-right corner of the plot. From these plots, record the amount of precipitation expected during each of the 12 hour forecast periods for Dayton.

Time	12 hr	24 hr	36 hr	48 hr	60 hr	72 hr
Precip (in)						

Do these values match what you recorded from the Meteograms for the same time periods?

Sea Level Pressure
Click the browser back button and select "Sea Level Pressure & 1000-500mb Thickness." There are a lot of colors on this map, so be careful what each means. The black line labeled '540' is where the geopotential height for the 500 mb level is at 5400 m. If the geopotential height is lower, the shaded portion of the map is blue to represent cold colunms of air. The shaded portion of the map that is higher than 5400 m is shaded yellow to red to indicate warm columns of air. The color contours on the map correspond to the sea level pressure. The value attributed to a particular color is not the same between the maps. However, some of the bold lines are labeled. If you see '08', this means that color contour is an isobar corresponding to 1008 mb. The color contours alternate between bold and normal thickness. Going from bold to normal, there is a pressure difference of 2 mb. Going from bold to bold the pressure difference is 4 mb. In general, closed color contours drawn in red and magenta are around high pressure regions and closed color contours drawn in green, blue to dark purple are around low pressure regions. Locate where there are high and low pressure systems over the US. Just indicate the state over which they are located. Also determine the pressure in the middle of any low pressure systems.

Time	12 hr	24 hr	36 hr	48 hr
High Pressure locations				
Low Pressure locations and their lowest pressure				

850 mb Plot
Click the browser back button and select "850 mb Temperature, RH and Winds." This plot represents a portion of the atmosphere that is about 5,000 ft above the surface (~1 mi or 1.6 km). This is the top of the atmospheric boundary layer and, therefore, is not affected by the daily heating and cooling cycle. From the available plots determine the 850 mb air temperature and wind direction for Dayton, OH.

Time	12 hr	24 hr	36 hr	48 hr
Temperature				
Wind Direction				

500 mb Plot

Go back to the previous page and select "500 mb Geopotential Height and Vorticity." This plot represents the middle of the atmosphere. The wind at this level dictates the motion of most weather systems and precipitation and is, therefore, called the steering level. The winds tend to follow the height contours giving geostrophic winds for straight contours and gradient winds for curved contours. Vorticity is an indication of rotational or eddy motion in the atmosphere. High vorticity can strengthen surface low pressure systems. From the available plots determine the 500 mb height and wind direction for Dayton, OH. The contour lines are geopotential height in dekameters (10 m) and the winds will run parallel to the lines of constant height. Also locate where the regions of high vorticity are present over the United States. Just indicate the state over which they are located.

Time	12 hr	24 hr	36 hr	48 hr
Height				
Wind Direction				
High Vorticity				

200 mb Plot

Go back to the previous page and select "200 mb Streamlines and Isotachs." This plot represents the upper troposphere. The key features on this map are the high speed upper winds or jets. Jets are locations where the wind speed exceeds 100 knots. Locate the jets over the United States and indicate their maximum wind speeds. These plots use a speed of meters per second. Use the following conversion to get to knots. *1 m/s = 1.94 knot*

Time	12 hr	24 hr	36 hr	48 hr
Jet location and wind speed				

C. Comparison of Models

Go back to the first page at wxmaps.org and select the second entry on the right top table. It should be labeled "North American – Short Range (GFS)." This model is different than NAM, but forecasts the same time period we just investigate. Each forecast model has its own idiosyncrasies and a forecaster will compare multiple models to make a final forecast. One of the hardest values to predict is precipitation. Look at "700 mb Vertical Velocity & Precipitation" and determine if precipitation will occur over Dayton and if so, how much for each of the forecast time periods.

Time	12 hr	24 hr	36 hr	48 hr	60 hr	72 hr
Precip (in)						

How do these prediction compare to the ones you recorded for the NAM, which are located on the bottom of page 4?

Finally, visit http://weather.gov/iln. Click on Greene county, which is to the right of Dayton. If you click in the upper-left portion of the county, you will be close to Cedarville. Compare your predictions of surface conditions (station models you completed on page 3) to the predictions of the National Weather Service. Answer the following questions:

1. **How close where you to the daily high and low temperatures for the forecast period?**

2. **If you read through the "Detailed Forecast," you will see winds reported. How do they compare to your predictions?**

3. **How do your precipitation forecasts compare?**