Answer Sheet

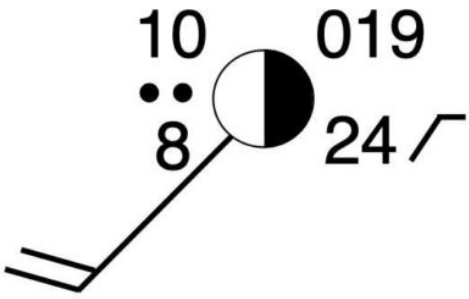
LABORATORY 4: MID-LATITUDE CYCLONES, WEATHER MAPS, AND FORECASTING

Student Name _____

Student Number _____

QUESTION 1

Using the information on "*decoding a weather station model*" found above, decipher the weather information from the following Canadian weather station:



1.1) What is the current air temperature in °C?

1.2) What is the current dew point temperature in °C?

1.3) Wind direction is from the

A Northeast.
B Southwest.
C North.
D South.

1.4) Wind velocity at the location is

A 14-19 kilometers per hour.
B 20-32 kilometers per hour.
C 33-40 kilometers per hour.
D 41-50 kilometers per hour.

1.5) Clouds cover how much of the sky?

A 20-30%.
B 40%.
C 50%.
D 60%.

1.6) Atmospheric pressure in millibars at the location is

_____ mb.

1.7) The change in atmospheric pressure in millibars over the last 3 hours at the location is

_____ mb.

1.8) The pressure tendency at the weather station is

A rising steadily.
B rising, then steady.
C rising, then falling.
D steady.

1.9) Describe the precipitation occurring at the weather station?

A Light rain.
B Rainshower.
C Light snow.
D Moderate rain.

QUESTION 2

Please review the following YouTube video on "*How to read a synoptic chart*".

https://www.youtube.com/watch?v=wl_FFK_HbjY

The following three synoptic weather maps (charts) found in Questions 2, 3, and 4 (**Figures 4.10**, **4.11**, and **4.12**) were generated by NOAA's Weather Prediction Center in the United States. Each of these maps displays the actual weather experienced daily at *7:00 EST or 11:00 UTC (Z)* on April 16, 17, and 18, 2020. These maps are also available in a single PDF file called *Lab4_Questions_234_Maps.pdf* located at the end of this lab. This PDF document is useful for answering the questions that follow. Please note that this PDF file allows you to zoom in on each of the maps to get a closer look at individual weather station information.

The following two YouTube videos were constructed using 47 hourly synoptic map forecasts between April 16, 2020 at 7:00 EST or 11:00 UTC (Z) to April 18, 2020 at 7:00 EST or 11:00 UTC (Z). These maps were collected from **Climate Reanalyzer'sHourly Forecast Maps** webpage. The first video shows the hourly change in precipitation rate (mm per hour) and mean sea level pressure (mb).

https://www.youtube.com/watch?v=-XxErR5Geuo

Video – Precipitation (mm per hour) and Air Pressure (mb) Variations, April 16 to 18, 2020

The second video shows the hourly change in air temperature at 2 meters above the ground surface (°F).

https://www.youtube.com/watch?v=ylLahEYC7bk

Video – Temperature (°F) Variations, April 16 to 18, 2020

Review the two videos above noting the spatial changes in precipitation rate, mean sea level pressure, and air temperature over the 47 hours animated before attempting Questions 2, 3, and 4.

On the April 16, 2020 surface weather map, an area of low pressure (red **L**) is located in southern Utah. The mid-latitude cyclone shown here is at the early stages of cyclogenesis. The questions that follow are related to this storm system.

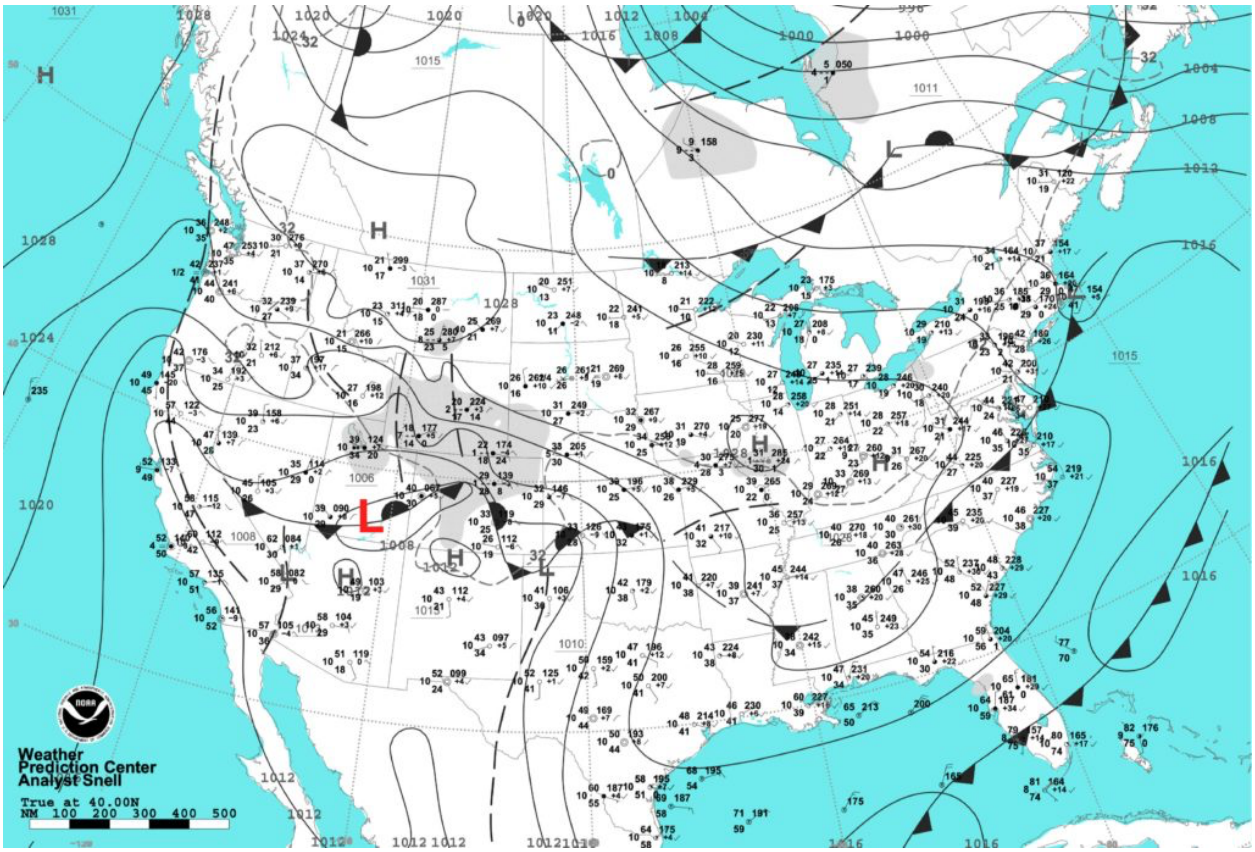


Figure 4.10. *Surface weather map and station weather for Thursday April 16, 2020 at 7:00 EST or 11:00 UTC (Z). Map Source:National Oceanic and Atmospheric Administration, Weather Prediction Center, Daily Weather Map website.*

2.1) What is the approximate atmospheric pressure of the storm's low center? Note that this value is usually found on the synoptic map in a font smaller than the one used to identify isobars – look above the **L**.

2.2) What type of front is found west of storm's low pressure center?

A Stationary front.
B Occluded front.
C Warm front.
D Cold front.

2.3) What type of front is found east of storm's low pressure center?

A Stationary front.
B Occluded front.
C Warm front.
D Cold front.

2.4) Wind flow around the low pressure center is

A clockwise.
B counter-clockwise.

QUESTION 3

On the April 17, 2020 surface weather map, the low pressure center of a mid-latitude cyclone (red **L**) has moved and is now influencing the eastern United States (**Figure 4.11**). The questions that follow are related to this storm system.

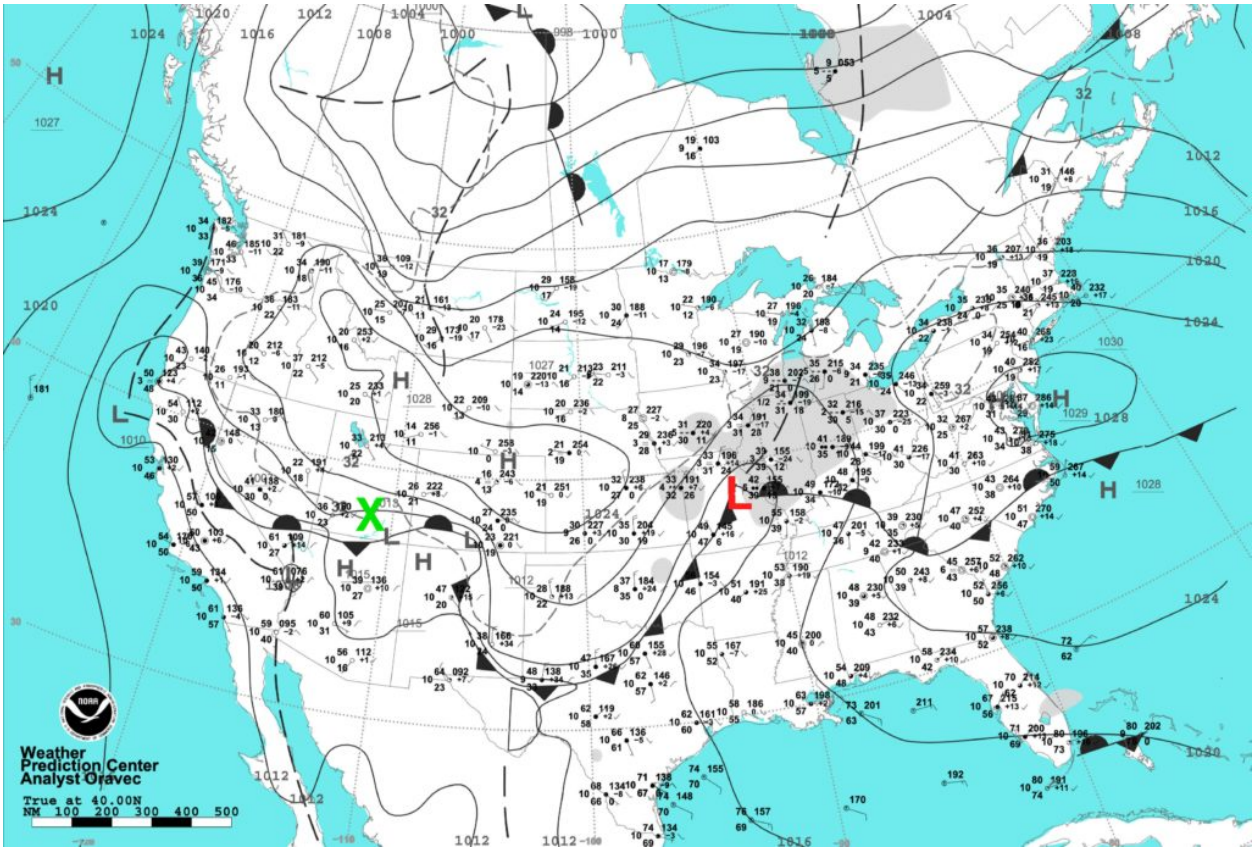


Figure 4.11. *Surface weather map and station weather for Friday April 17, 2020 at 7:00 EST or 11:00 UTC (Z). Map Source: National Oceanic and Atmospheric Administration, Weather Prediction Center, Daily Weather Map website.*

3.1) What is the approximate atmospheric pressure of the storm's low center? Note that this value is usually found on the synoptic map in a font smaller than the one used to identify isobars – look below and to the right of the **L**.

3.2) What type of front is found south-southwest of storm's low pressure center?

A Stationary front.
B Occluded front.
C Warm front.
D Cold front.

3.3) The surface air just east of the front mentioned in question 2b has temperatures roughly between

A 20 to 30 °F.
B 30 to 50 °F.
C 50 to 62°F.

3.4) The surface air just west of the front mentioned in question 2b has temperatures roughly between

A 20 to 30 °F.
B 30 to 50 °F.
C 50 to 62°F.

3.5) What type of front is found east of storm's low pressure center?

A Stationary front.
B Occluded front.
C Warm front.
D Cold front.

3.6) The surface winds just south of the front mentioned in question 2e are generally coming from the

A north.
B south.
C east.
D west.

3.7) The surface winds just north of the front mentioned in question 2e are generally coming from the

A north.
B south.
C east.
D west.

3.8) Grey shading on the synoptic weather map indicates areas where precipitation is occurring. What type of precipitation is associated (type and rate) with the mid-latitude cyclone? Where is it falling relative to the storm system?

3.9) How far has the storm travel in the last 24 hours? Note the green X shows the position of the low center 24 hours prior.

A About 400 nautical miles or 720 kilometers.
B About 800 nautical miles or 1440 kilometers.
C About 1200 nautical miles or 2160 kilometers.

3.10) What direction has the storm travel in the last 24 hours?

A North.
B East.
C South.

QUESTION 4

On the April 18, 2020 surface weather map, the low pressure center of a mid-latitude cyclone (red **L**) is now on the coastline of northeastern United States (**Figure 4.12**). The questions that follow are related to this storm system.

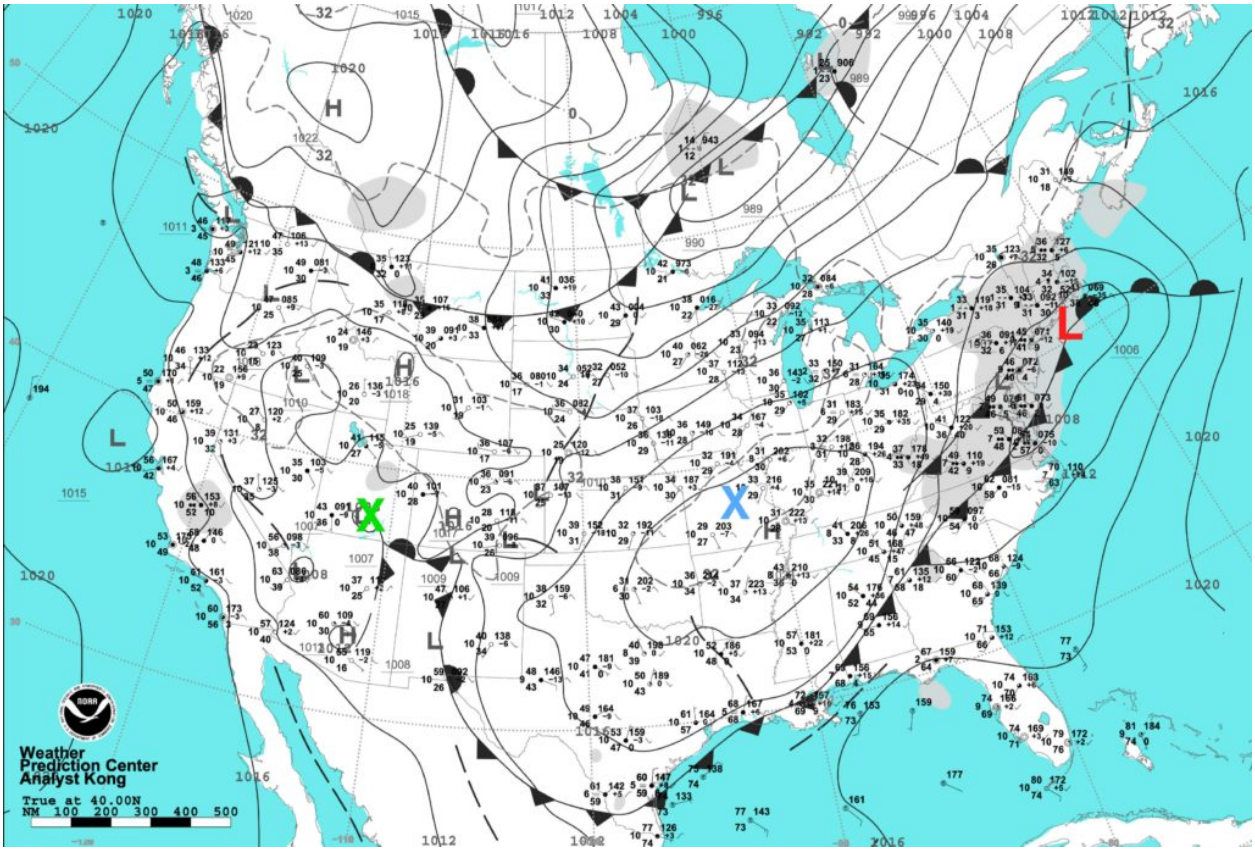


Figure 4.12. *Surface weather map and station weather for Saturday April 18, 2020 at 7:00 EST or 11:00 UTC (Z). Map Source:National Oceanic and Atmospheric Administration, Weather Prediction Center, Daily Weather Map website.*

4.1) What is the approximate atmospheric pressure of the storm's low center? Note that this value is usually found on the synoptic map in a font smaller than the one used to identify isobars – look to the right of the **L**.

4.2) How far has the storm travel in the last 24 hours? Note the blue X shows the position of the low center 24 hours prior.

A About 400 nautical miles or 720 kilometers.
B About 800 nautical miles or 1440 kilometers.
C About 1200 nautical miles or 2160 kilometers.

4.3) How has the weather of the area south of the storm's previous location 24 hours ago changed in terms of precipitation, temperature, atmospheric pressure, and cloud cover?

4.4) The air southeast of the cold front would most likely represent what type of air mass?

A Maritime polar.
B Maritime tropical.
C Continental tropical.
D Continental polar.

4.5) The air northwest of the cold front would most likely represent what type of air mass?

A Maritime polar.
B Maritime tropical.
C Continental tropical.
D Continental polar.

QUESTION 5

Examine the following two animations available on YouTube. These animations show the weather conditions that occurred in southern Canada, the USA, and northern Mexico for a 48-hour period from February 16th to February 18th, 2008.

One video shows surface air temperatures (°F), surface air pressure (isobars in mb), and centers of low and high pressure. The opening frames of this video display a mid-latitude cyclone located in the south-central USA. By the end of this video, this weather system moves in a northeasterly direction with it now being located in northern Quebec, Canada.

https://www.youtube.com/watch?v=CfeeW0TFObs

Video – Surface Temperature (°F) and Surface Air Pressure (mb), February 16 to 18, 2008

The second video displays GOES satellite infrared (IR) imagery combined with surface air pressure measurements. The infrared satellite images show information associated with the temperature of clouds and the Earth's surface. Ground surfaces vary in shade from light grey to dark grey depending on the time of day. Ground surfaces become dark grey when incoming sunlight is converted into heat which in turn produces a higher surface emission of longwave radiation. After sunset, ground surfaces become lighter in tone as they cool off and their emission of infrared energy declines. The generally much colder cloud surfaces have a tone that varies from light grey to white. The white tone represents cold temperatures and the lowest emission of infrared radiation in the satellite image.

https://www.youtube.com/watch?v=9X47iuxSKhE

Video – Clouds and Surface Air Pressure (mb), February 16 to 18, 2008

Answer the following questions related to the two videos shown above. You will need the file *Lab4_Question_5_Map.pdf* found below to answer the first two questions.

5.1) On February 16th at 22 Z there is a low pressure center located in the south-eastern corner of Colorado. Follow the development of this low pressure center into a mid-latitude cyclone in both animations. Using the map given plot the location of the low pressure center on February 16th at 22 Z and February 18th at 22 Z. Draw a line between these points that traces the path taken by the mid-latitude cyclone. Submit this map to your teaching assistant. Estimate how far the storm system traveled in two days. Show your work.

5.2) Calculate the cyclone's speed of travel in kilometers per hour. Show your work. Note that speed is equal to the distance traveled divided by the time, or duration, of travel.

5.3) Determine the surface air pressure (in millibars) of the cyclone's low pressure center on February 16th at 22 Z.

5.4) Determine the surface air pressure (in millibars) of the cyclone's low pressure center on February 18th at 22 Z.

5.5) According to the last two questions, did the storm intensify and become stronger? What happened to its central pressure? How would this influence wind flow? Explain.

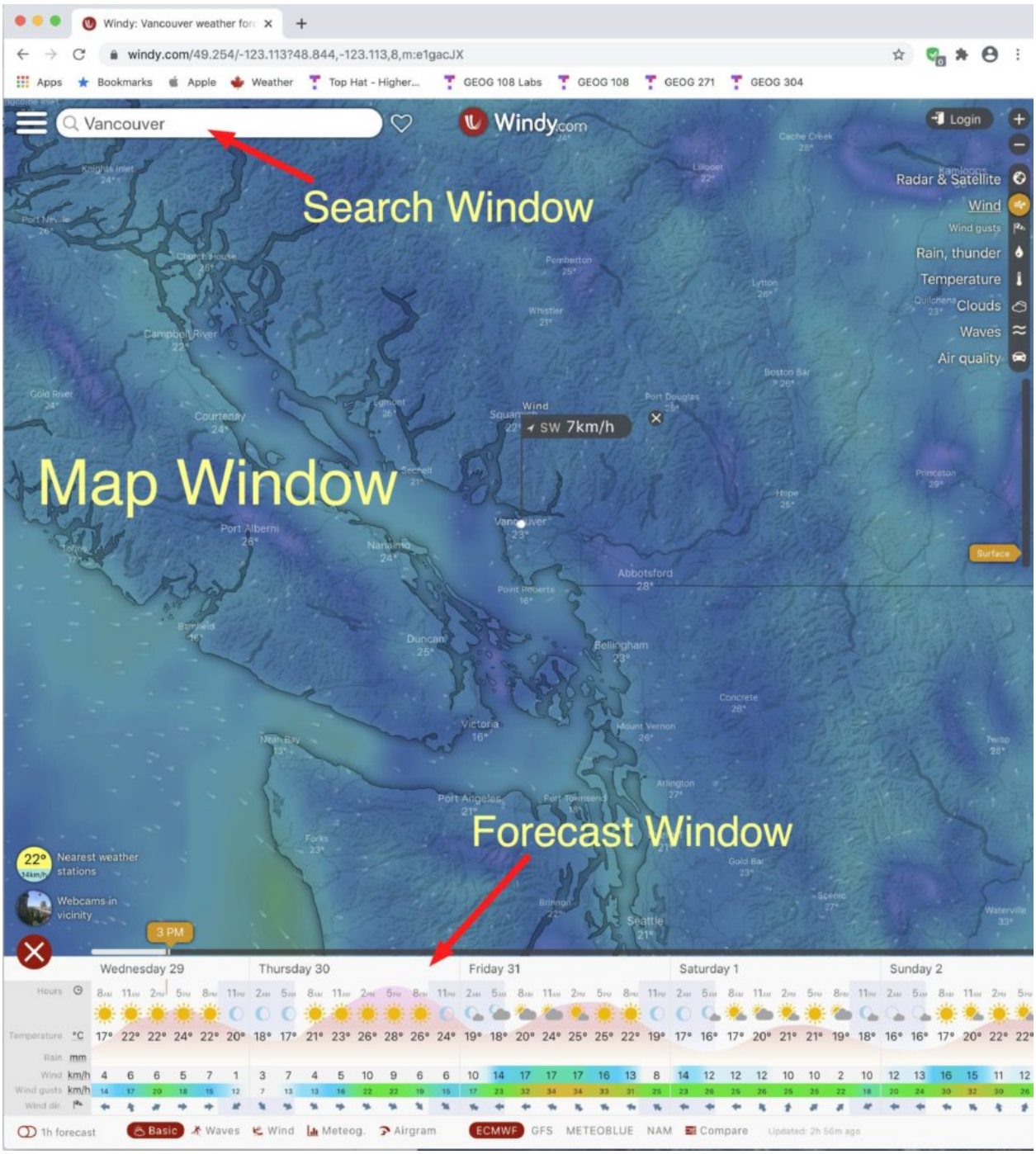
5.6) Describe the temperature characteristics of air in the region slightly southeast of the mid-latitude cyclone's low pressure center. How do the characteristics of this air (temperature and pressure) change after the cyclone leaves this area? Explain.

QUESTION 6

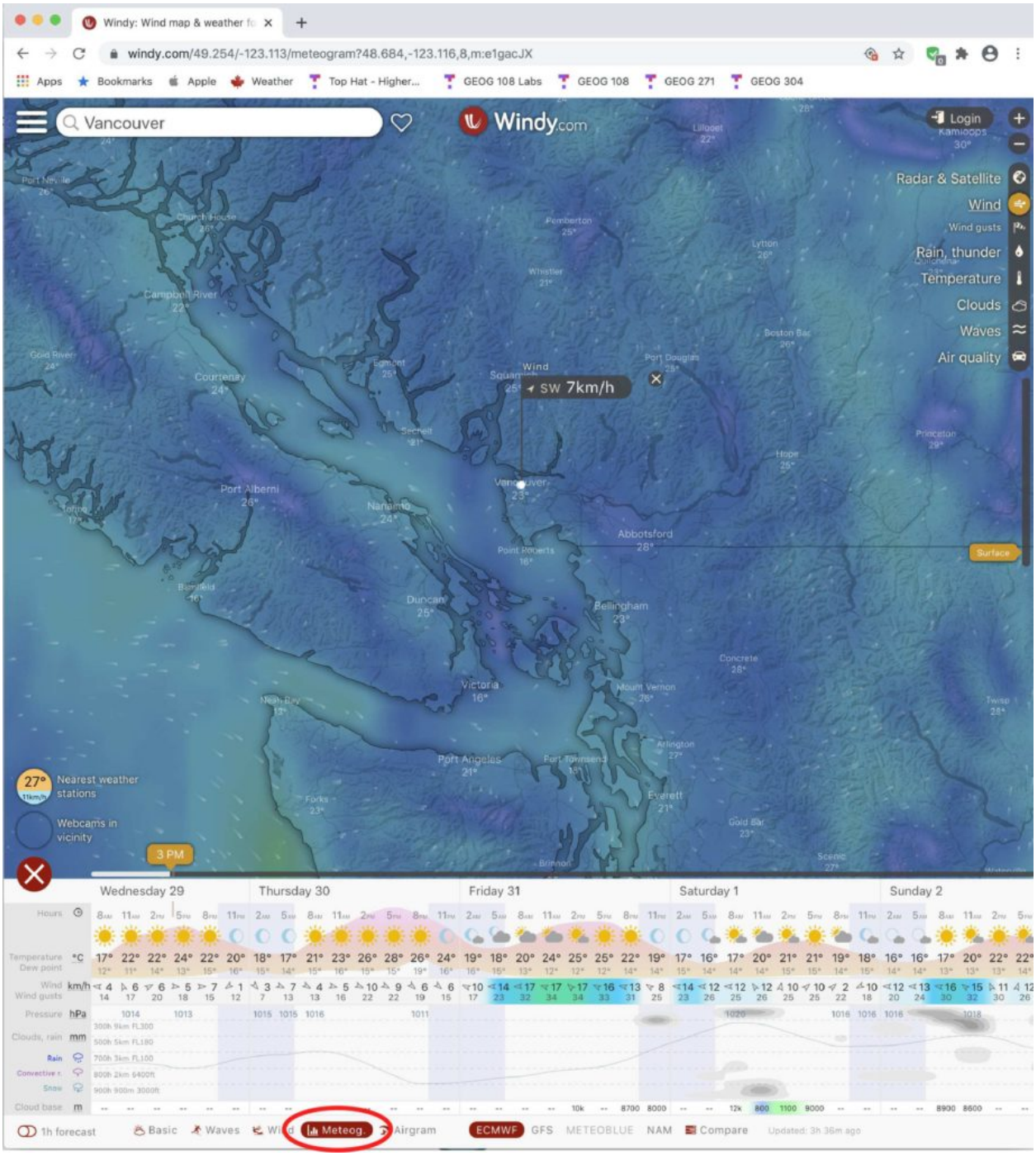
Meteorologists use General Circulation Models (GCMs) routinely to produce weather forecasts at regular intervals. Such forecasts are usually made up to seven days into the future, usually at either 3 or 6 hour intervals. The accuracy of these predictions is normally very high for about 3 days. After this threshold, accuracy declines steadily with time because of the difficulty of modeling the inherent chaotic behavior of many atmospheric processes.

We can access weather forecasts from government organizations like NOAA's (National Oceanic and Atmospheric Administration) Weather Prediction Centerwebsite or Environment and Climate Change Canada's Weather Informationwebsite. Weather forecasts are also available from a variety of companies and non-governmental organizations. This is possible because current weather data and climate model-produced forecasts are made freely available through the World Meteorological Organization.

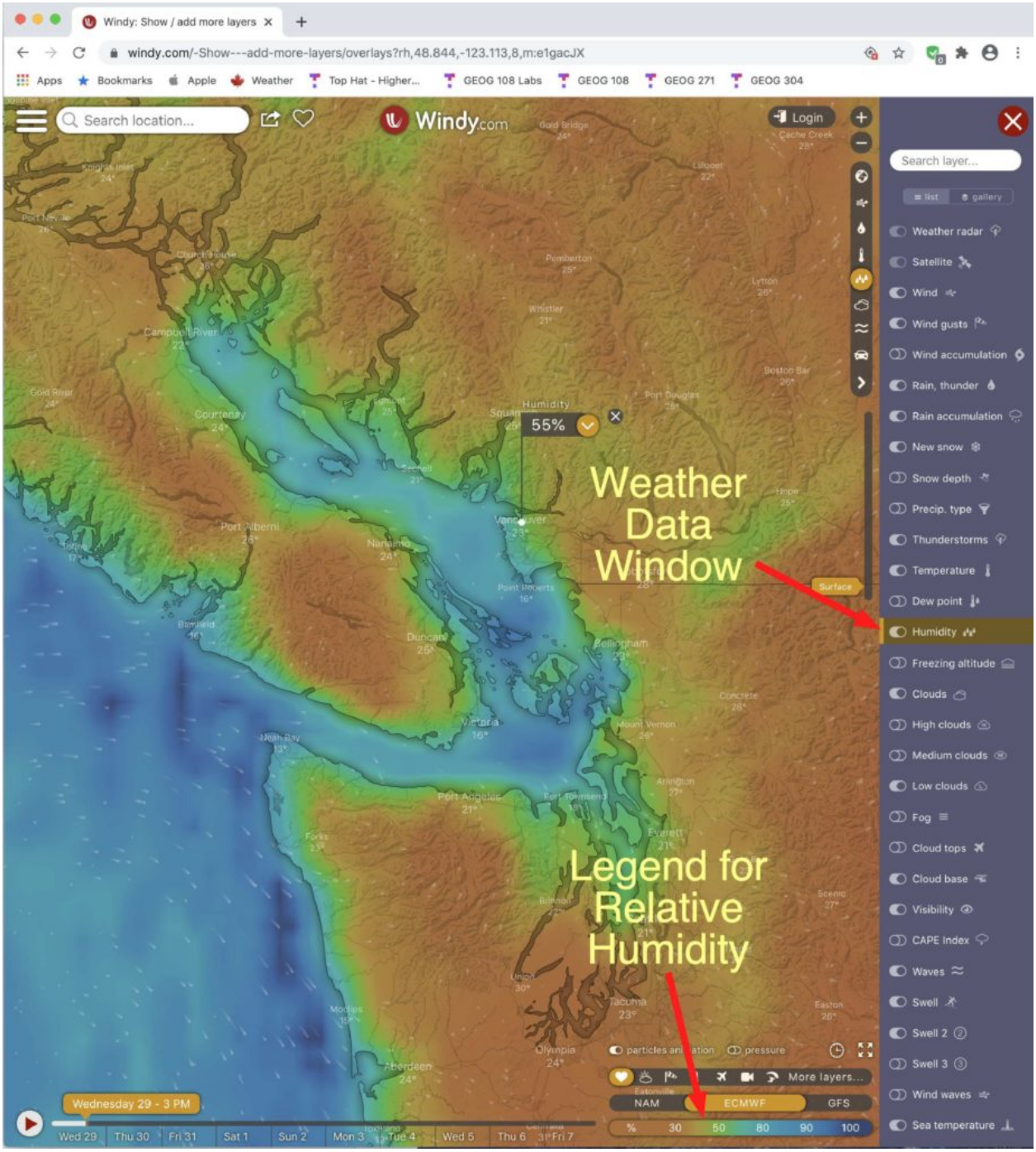
One website that offers an exceptional graphic interface for viewing prevailing weather conditions and future forecasts from local to the global scale is Windy.com. **Windy** is also available as an App that runs on smartphones, iPads, and other tablet computers. The image below shows Windy.com's opening screen after I **searched** for Vancouver, British Columbia. The **map window** shows wind data (direction and speed). Along the bottom of the wind map window is a **forecast window** describing the first 5 days of a 7-day forecast, with each day segmented into 3-hour intervals (2 am, 5 am, 8 am, 11 am, 2 pm, 5 pm, and 11 pm), and the following "**basic**" weather information displayed: sky conditions, temperature (°C), rain (mm), wind speed (kph), wind gusts speed (kph), and wind direction.


Windy: Vancouver weather for
windy.com/49.254/-123.113?48.844,-123.113,8,m:e1gacJX
Apps
Bookmarks
Apple
Weather
Top Hat - Higher...
GEOG 108 Labs
GEOG 108
GEOG 271
GEOG 304
Vancouver
Windy.com
Login
Search Window
Radar & Satellite
Wind
Wind gusts
Rain, thunder
Temperature
Clouds
Waves
Air quality
Map Window
SW 7km/h
Surface
Forecast Window
22°
Nearest weather stations
Webcams in vicinity
3 PM
Wednesday 29
Thursday 30
Friday 31
Saturday 1
Sunday 2
Hours
Temperature °C
Rain mm
Wind km/h
Wind gusts km/h
Wind dir.
1h forecast
Basic
Waves
Wind
Meteog.
Airgram
ECMWF
GFS
METEOBLUE
NAM
Compare
Updated: 2h 56m ago

In the next image, the "**meteogram**" option (red oval) was selected for the 7 day forecast output and the following weather data was made available: sky conditions, temperature (°C), dew point temperature (°C), wind speed (kph), wind gusts speed (kph), atmospheric pressure (hPa or mb), rain (mm), and cloud base (m).



Running down the right side is a series of buttons that control access to the **weather data window** in **windy.com**. The next image shows the **Humidity** (relative humidity) layer turned on in the **map window**. The **Legend** for this data layer is located in the bottom right-hand corner. It suggests the surface air over water bodies has a relative humidity of around 80-90%, while the air over land has a humidity of about 30-50%.



6.1) Produce a 24-hour forecast 3 days into the future for Winnipeg using Windy.com. Note the date of this forecast. Provide information on maximum and minimum temperature, dew point temperature, precipitation, wind speed and direction, atmospheric pressure, and sky conditions.