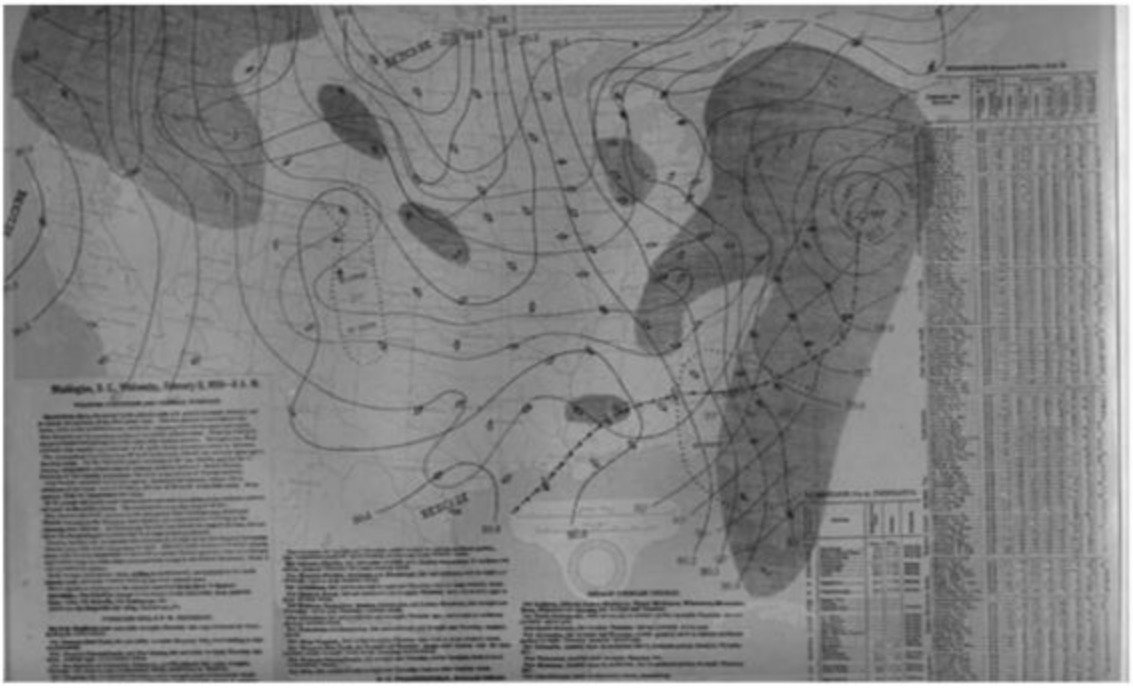
Air Masses and Weather Conditions: How Do the Motions and Interactions of Air Masses Result in Changes in Weather Conditions?

Introduction

Meteorology is the study of the atmosphere. Meteorologists study the atmosphere so they can make accurate predictions about future weather conditions. In fact, meteorologists have generated detailed weather maps that include information about the atmosphere and current weather conditions in different regions of the United States for over a century. In the late 1800s, for example, newspapers printed a weather map every morning. An example of a U.S. daily weather map from 1899 can be seen in the figure below. People relied on these weather maps to make predictions about the weather so they could make better decisions about what to do during the day, where to go, or what to wear. As technologies advanced, we developed faster ways to deliver up-to-date information about current weather conditions, including radios, live television broadcasts, and internet posts. Meteorologists are now able to consult many sources, such as computer models, real-time weather station data, and Doppler radar, to generate forecasts. These forecasts are often very accurate and can predict general daily weather up to 10 days in advance.

The U.S. Daily Weather Map for February 8, 1899

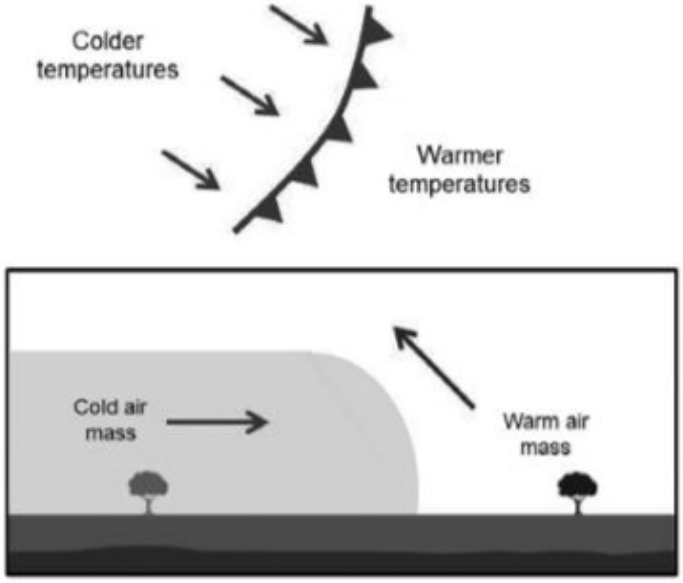


Although weather maps may look complicated, they simply display information about air masses and other atmospheric conditions. An *air mass* is a large body of air that has a relatively uniform temperature and humidity level. The curved lines on a weather map mark the boundaries of different air masses. The center of an air mass is marked with the letter *H* or *L,* which denotes whether the air mass has a high or low atmospheric pressure. The temperature of air affects the atmospheric pressure within an air mass. Warm air consists of molecules that are moving faster and more spread out compared with cold air. This makes hot air less dense than cold air.

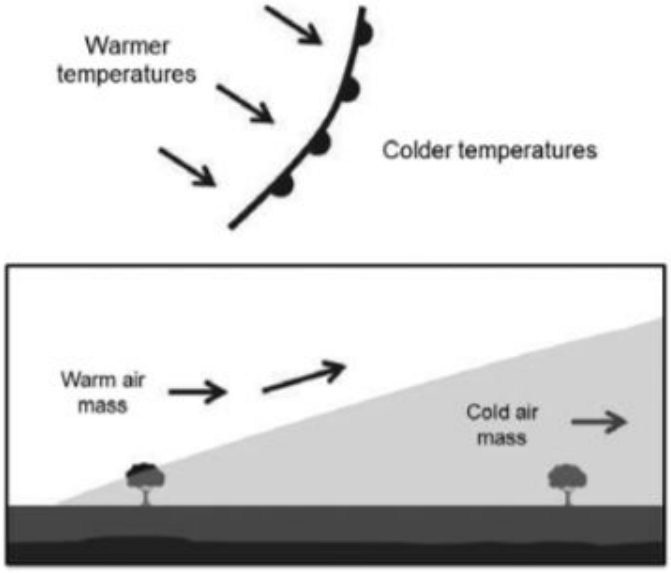
When thinking about air masses, it is important to remember that air masses are three-dimensional; they spread out across a region (North, East, South, and West), while also extending upward from the surface of Earth. When an air mass warms at Earth's surface, it becomes less dense and begins

to rise. As it rises farther away from Earth's surface, it cools, becomes denser, and sinks. When two air masses meet, the warmer, less dense air mass will rise above the colder, denser air mass.
The area where two air masses meet is called a front. Meteorologists categorize fronts based on the nature of the air mass that is moving into an area or how two or more air masses are interacting with each other. A cold front, for example, refers to instances when a cold air mass moves into an area that was previously occupied by a warm air mass. On a weather map, lines with shapes on them represent different types of fronts. A line with triangles is used to indicate the boundary and movement of a cold front. A line with semicircles is used to indicate the boundary and movement of a warm front. The shapes always point in the direction an air mass is moving. A third type of front is called a stationary front. Stationary fronts form in areas where warm air masses and cold air masses move past each other in opposite directions. The warm air mass is always on the side of the line without the semicircles, and the cold air mass is always on the side of the line without the triangles.

Cold fronts are shown with triangles on weather maps; the triangles point to the direction that the air is moving

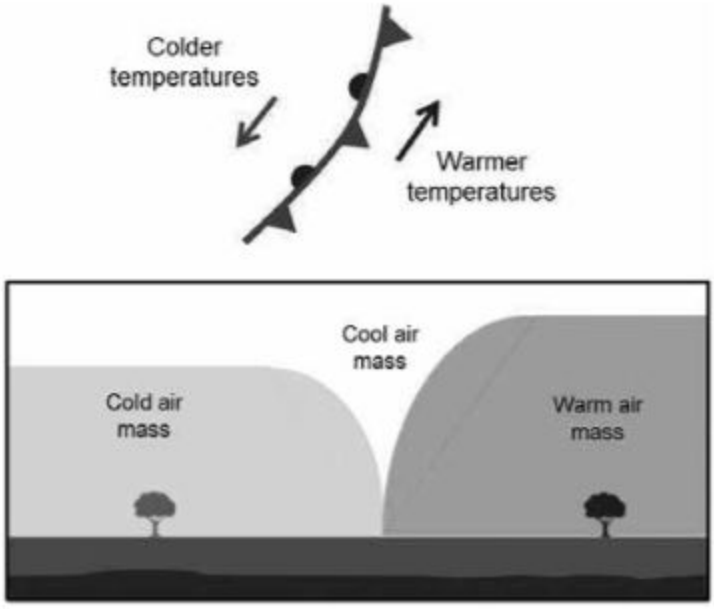


Warm fronts are shown with semicircles on weather maps; the semicircles indicate the direction that the air is moving



The interaction between two air masses can cause a change in weather conditions. Meteorologists therefore track the movement of air masses to make predictions about future weather conditions. In this investigation, you will have an opportunity to use historical weather maps and weather data from several different regions to learn how the motions and complex interactions of air masses are related to changes in weather conditions. Your goal is to develop a conceptual model that you can use to not only explain how the motions and interactions of air masses result in specific weather conditions but also predict how

Stationary fronts are depicted with triangles and semicircles on weather maps



weather conditions will change over time in a given area.

Your Task
Develop a conceptual model that can be used to explain weather conditions based on the movement and interactions of air masses. Your conceptual model must be based on what we know about the weather, the kinds of air masses found in the atmosphere, the importance of looking for patterns in nature, and cause-and-effect relationships. Once you have developed your model, you will need to test it to see if you can use it to make accurate predictions about the weather conditions in different cities on a given date.

The guiding question of this investigation is: ***How do the motions and interactions of air masses result in changes in weather conditions?***

Materials
You may use any of the following materials during your investigation:
- Computer or tablet with internet access
- Weather Map A (use to test your model)
- Weather Conditions Table A (use to test your model)
- Weather Map B (use to test your model)
- Weather Conditions Table B (use to test your model)

Getting Started
The first step in this investigation is to analyze an existing data set to determine how the movement or interaction of different kinds of air masses is related to specific weather conditions. To accomplish this goal, you will need to examine several different historical weather maps and look for patterns that you can use to explain and predict changes in weather conditions. You can access U.S. Daily Weather Maps from the National Oceanic and Atmospheric Administration (NOAA) / National Weather Service Weather Prediction Center at *www.wpc.ncep.noaa.gov/dwm/dwm.shtml.*

Once you have identified patterns in the historical weather maps, you can develop your conceptual model. A conceptual model is an idea or set of ideas that explains what causes a particular phenomenon in nature. People often use words, images, and arrows to describe a conceptual model. Your conceptual model needs to be able to explain changes in weather conditions based on the movement and interactions of air masses. The model also needs to be consistent with what we know about what causes changes in atmospheric pressure, the nature of wind, and the cycling of water on Earth.

The last step in this investigation is to test your model. To accomplish this goal, you can make predictions about the weather conditions at several different cities using the information found on Weather Maps A and B. Your teacher will identify the cities that you will need to include in your predictions. You can then use Weather Conditions Tables A and B to determine if your predictions were accurate. If you are able to use your model to make accurate predictions about the weather conditions in different cities, then you will be able to generate the evidence you need to convince others that the conceptual model you developed is valid or acceptable.

Report
Once you have completed your research, you will need to prepare an investigation report that consists of four sections (be sure to have section headings):
1. <u>Introduction</u>: Give some background information on the topic. Explain what question you were trying to answer and include a hypothesis. (Background info, research question and hypothesis)

2. Procedure: What did you do during your investigation and why did you conduct your investigation in this way? (How you collected and analyzed data)
3. Data: Include a data table and/or graph to show your results. Be sure to include a title for your table or graph with labels for the variables.
4. Conclusion: What is your argument? (Claim - Evidence - Reasoning)

Your report should answer these questions in two pages or less. The report must be typed, and any diagrams, figures, or tables should be embedded into the document. Type your report on Google Docs (12 point font, double-spaced) and share it with your teacher. Your report will be graded based on the rubric in the class syllabus.