Air Masses and Fronts

An *air mass* is any large homogeneous body of air. Air masses tend to acquire some of the properties (e.g., temperature, humidity, etc.) of the surface over which they reside. *Source regions* for air masses may be land (*continental* air masses) or water (*maritime* air masses). Air masses may further be of *polar* or *tropical* origin. A cP air mass is a continental polar air mass. A cT air mass is a continental tropical air mass. The corresponding maritime air masses are mP and mT. As air masses move, they leave their source regions and begin to travel over surfaces that have different characteristics. A "k" or a "w" after the aforementioned designations stands for colder than the surface over which the air mass moves, or warmer, respectively. A cPk, for example, is a continental polar air mass that is colder than the surface over which it is moving. An mTw is a maritime tropical air mass that is warmer than the surface over which it is moving.

There are several principle air masses typically found over the United States. Because of the difference in the source regions for these air masses between summer and winter, the air masses themselves take on different properties with the change if seasons. A summertime cP, for instance, differs markedly from wintertime cP.

An air mass can have its source region properties modified by moving over another source region. This modification can result in a complete transformation. As an example, cP air from Asia is the original source region for mP air that invades North America.

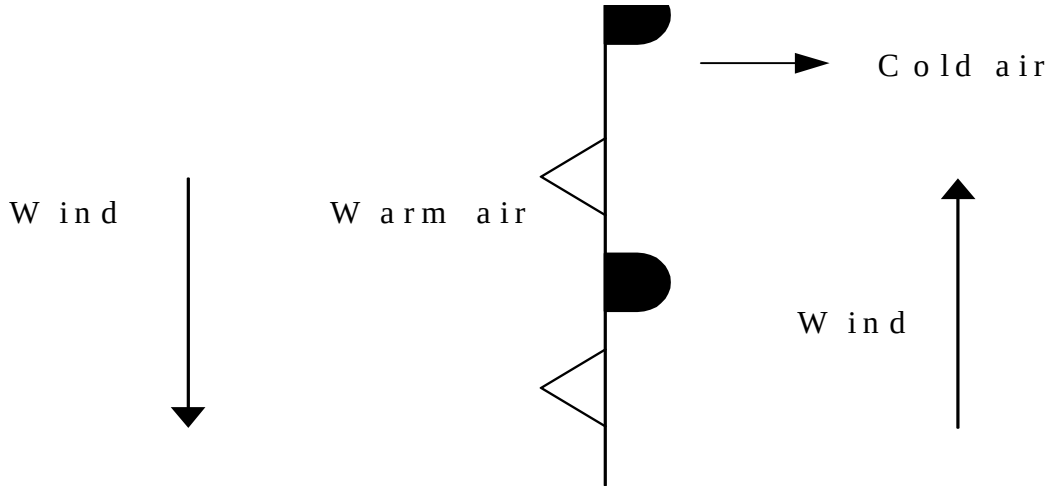
Air mass weather is the term used to denote weather patterns when influenced by a dominant air mass. Air mass weather dominates the stable weather

patterns over most of North America for much of the year.

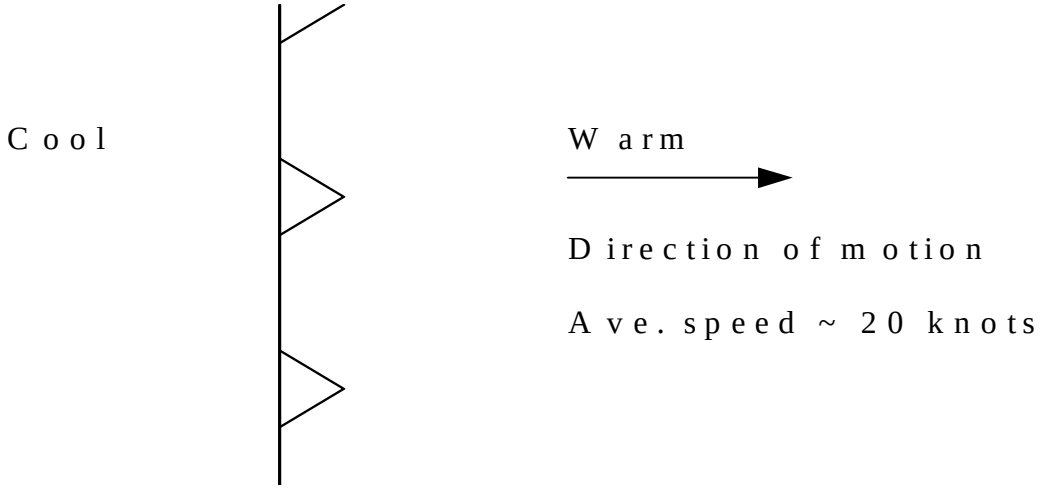
A *front* is a transition zone between two air masses of differing density, temperature, humidity, etc. A *frontal zone* is the vertical extension of a front. The positions of fronts are plotted on weather maps using data from surface readings and radiosonde soundings. Fronts are located by plotting:

- Sharp temperature differences over a relatively short distance.
- Changes in the air's moisture content (changes in dew point).
- Shifts in wind direction.
- Pressure and pressure changes.

A *stationary front* is a boundary between two air masses that displays very little movement. The winds on either side of a stationary front are parallel but blow in opposite directions.

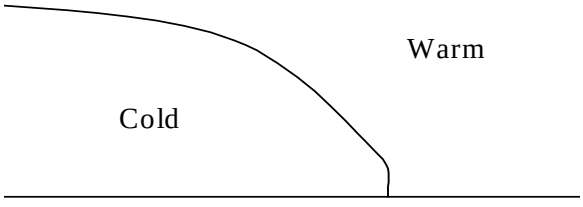


Cold fronts form along the boundary between cold, stable air and warm, unstable air. Because cold air is denser than warm air, the cold air mass tends to laterally displace the warm air mass, causing it to rise.



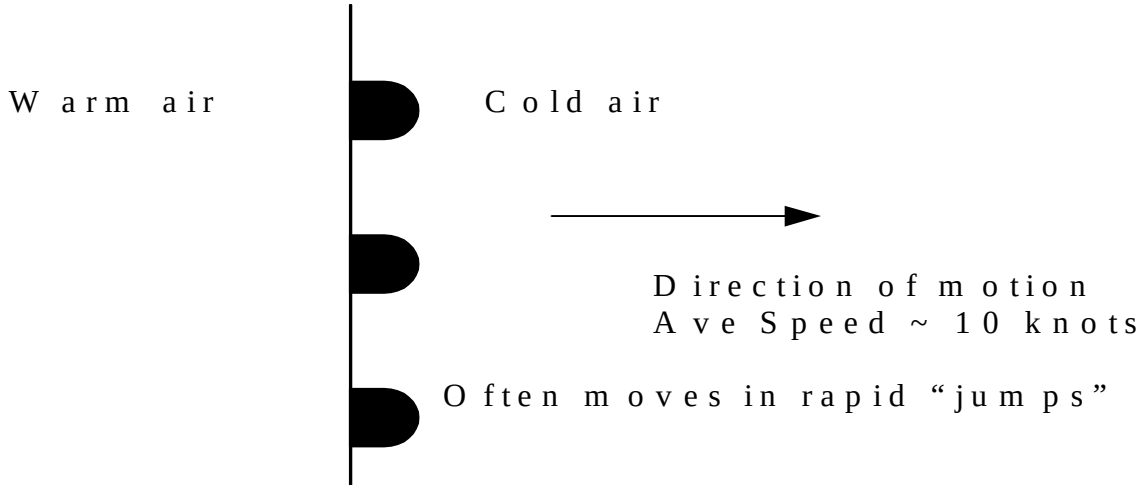
Cold fronts are associated with a trough of low pressure (denoted by a "kink" in isobars on a weather map). Lowest pressures are found just before the arrival of the front and temperatures decrease as the front passes. The leading edge of a cold front is steep due to friction between the dense air and the ground.

The horizontal cross section of a typical cold front is shown below. The cold air is on the left in this diagram.



Back-door cold fronts are fronts that move westward over the continental U.S., as opposed to the usual eastward moving fronts. These are common in the Northeastern United States.

Warm fronts are an overrunning of cold air by warm air. Warm air, being less dense, rises up over cold air. The frontal boundary between the warm and cold air has a very gentle slope. The winds shift with increasing altitude clockwise.



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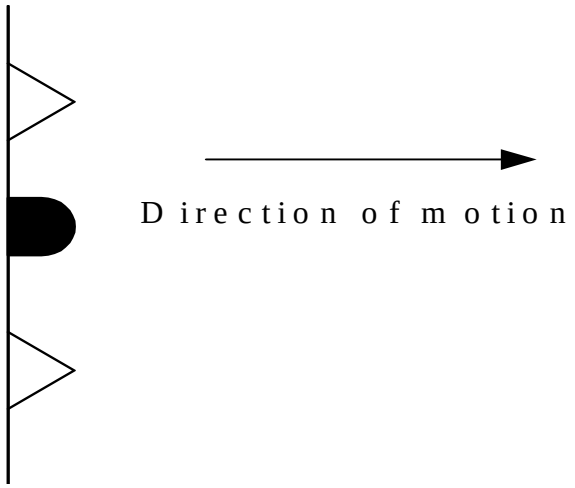
The transition between the air masses involved in a warm front is more gradual that that involved in a cold front due to the gentle slope of the latter. Whereas the distance between the leading edge of a cold front (on the surface) and its leading edge higher in the atmosphere may be only a few kilometers, horizontally, the transition between cold air and warm air in a warm front may occur over distances up to hundreds of kilometers. As the frontal boundary of a warm front approaches (say, from the west) one encounters:

- In advance of the front surface winds are light and variable. Cirrus clouds form overhead.
- As the front approaches, cirrus clouds thicken into cirrostratus, cirrostratus thicken into altocumulus and altostratus, creating an overcast, gray sky.
- Altostratus become nimbostratus. Winds become brisk out of the southeast and the pressure drops. The air begins to warm slightly accompanied by stratus clouds and fog.
- As the front passes the air warms and the dew point increases. Winds shift from the south or southwest. The barometer holds steady and stratocumulus (Sc) clouds form.

Occluded Fronts occur when a cold front overtakes a warm front.



There are two types of occluded fronts: cold occlusions and warm occlusions. A cold occlusion occurs when the air behind the front is colder than the air ahead of the front. A cold occlusion is very similar to a cold front. A warm occlusion occurs when the air behind the front is warmer than the air ahead of the front. Occluded fronts are usually very instrumental weather makers.