

**CHAPTER 7:**  
**AIR QUALITY ANALYSIS: AUTOMATIC WEATHER**  
**STATION**

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**INTRODUCTION**

Meteorology is the study of weather. Weather is the condition of the atmosphere at any particular time and place. Generally, it is caused by the movement of the transfer of energy. Energy is transferred where there is a temperature difference between two objects or locations. In nature, a large proportion of our weather phenomena result from a transfer of energy that occurs via the movement of air in the atmosphere [1]. This movement of air is known as convection and forms the basis of many meteorological patterns and features, including thunderstorms, monsoons, fronts, cyclones and tornadoes. Through the convective processes, heat, momentum and moisture are distributed horizontally across latitudes and vertically up the atmosphere. Other examples of energy transfer include radiation and condensation/evaporation. Radiation is the transfer of energy without involving the movement of air, such as the formation of dew, frost and fog. The process of condensation and/or evaporation, on the other hand, involves the phase changes of water when air moves about the Earth [1]. For example, water vapour formed from the evaporation of liquid water sources such as the oceans, lakes and rivers; as well as from evapotranspiration by plants. When moisture (water vapour)-filled air is lifted vertically or transported horizontally as part of air masses, it cools and releases water vapour through the process of condensation and forms clouds, which subsequently rain out and replenishes the water sources on Earth.

The underlying principle that drives weather is the unequal heating of the atmosphere, with energy from the sun. Therefore, the sun's rising and setting create a repeated cycle of events on a daily basis. This daily cycle is known as the diurnal cycle. The diurnal cycle is the simplest and most predictable pattern in meteorology [2]. The basic variables for measuring the weather include air pressure, temperature, dew point temperature, relative humidity, precipitation, wind speed and direction.

Air pressure is caused by the pressure exerted by the weight of the air in the atmosphere. It is the amount of force (air molecules) exerted over an area of surface by the air above. Typically, air pressure decreases as we go further up the atmosphere. The instrument used to measure air pressure is the barometer.

Temperature is a measure of sensible energy (the energy that we can feel), i.e. the heat content of the atmosphere. Dewpoint temperature is the temperature at which a particular air mass will be saturated. It reflects the humidity of the air. When a parcel of air is cooled to its dewpoint temperature, the air parcel is said to be saturated and attain 100% relative humidity.

Relative humidity is the measure of how close the air is to being saturated with water vapour. It refers to the ratio of the actual amount of water vapour in the air relative to the maximum amount of water vapour required for saturation at that particular temperature and pressure.

Precipitation is the falling of either solid or liquid water particles from clouds to the earth's surface due to gravitational forces. Precipitation can be in the form of rain, snow or hail, which is measured using rain and snow gauges, respectively.

The wind speed is the speed of the wind commonly measured in metres per second or *knots* (kts; 1 knot = 1.1852 km h<sup>-1</sup>). On the other hand, the wind direction refers to the direction the prevailing wind is from. It is reported in degrees with 360°, 270°, 180°, and 90° representing wind from the north, west, south and east, respectively. Intermediate values represent