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*What do you know about Hurricane Forecasting?*

From the creation of the Earth, weather has always been a driving factor of the eco-system within our planet. Every planet throughout the galaxy has some sort of weather pattern due to the moons that orbit them or the sun within their solar system. As humans evolved within Earth, we developed many ways to track the weather from the smell or feel of the wind to the color of the clouds in the morning sky. But as we became technologically advanced we became more accurate with predicting weather not perfect but enough to know if a massive weather event will occur that could affect millions of lives. Scientists are able to do this because of the various weather observatories and known history patterns that are located throughout the world. Through these institutions scientists are able to study on of the most important factors in hurricane forecasting and that is the wind. They are able to use wind patterns from the past and compare them with their readings to predict more exact types of weather we will have. Even though wind patterns are a very important factor in studying weather, scientists also use mathematics which is very important to diagnose the data received from the wind patterns. The most famous scientists to begin researching hurricane forecasting was Vilhelm Bjerknes and Lewis Fry Richardson. These scientists were among the first to apply physical law principles to the atmosphere in order to comprehend how our climate functioned [2]. Many equations would arrive due to weather prediction such as Richards first forecasting method. Still used by many meteorologists, this method divides the atmosphere into small parcels of air through a gridded area. Some other methods used to create weather predictions are the spectral method and finite method but none of them fully solves the primitive equation [1]. Seven physical parameters must be known by meteorologists in order to make a weather forecast: temperature, pressure, density, humidity, and wind velocity, which has three components that account for the three distinct wind directions. Some forecasting algorithms also consider the amount of water and ice on the ground and in clouds. In a perfect world, these values would always be known at every location in the atmosphere. Due to the restricted processing capacity, this is practically impossible, hence the values are computed for each individual air parcel in the atmosphere. The basic rules of thermodynamics and hydrodynamics, often known as the primitive equations, are used by scientists to explain large-scale atmospheric phenomena by treating the Earth's atmosphere as if it were a fluid on a spinning sphere. In essence, these are the motion equations; one for each of the three wind directions; along with the ideal gas law, the continuity equation, and the fundamental law of thermodynamics, which describes the conservation of energy and mass [1]. Therefore, the three main variables for one of each of the three wind directions are,

* Ideal Gas Law
* Law of Thermodynamics
* The Continuity Equation

The equation of motion is very important to consider and is represented by Newton’s second law.

This equation represents the force equals the product of mass and acceleration. Essentially, this equation helps describe how an object reacts or operates under different circumstances [1]. To predict the wind parcel is shown in the equation,

This equation helps predict the wind parcel through the relationship between velocity in respect to time. The is represented through the use of the equation where the change in velocity is in respect to time. Then the equation is then broken down to find the other forces in the atmosphere,

* Pressure Force
* Coriolis Force
* Drag Force
* Gravitational Force

To begin with the first force, known as the pressure force, this is represented as in the equation used to find the wind parcels. The force that transports air from a region of high pressure to an area of low pressure is known as the pressure gradient force. The pressure gradient affects the wind's velocity. The wind speed is high if the pressure gradient is strong. The wind speed is light when there is little pressure gradient [3].

Within this equation the **p** represents the pressure between the two regions. Then the ρ represents the density that is exerted. Lasty, the symbol ∇ represents the Nabla which is the vector differential operator. If the force of the pressure gradient were the sole factor influencing wind flow, the wind would blow at a right angle across isobars of high and low pressure [3]. The second force, known as the Coriolis force, this is represented as may be thought of as the difference between gravity and centrifugal force. Air traveling over the earth is forced to follow a curved route because of the Earth's rotation. Air is deflected to the right of its direction of travel in the Northern Hemisphere and to the left in the Southern Hemisphere. Due to the Earth's almost spherical form, the Coriolis force, which accelerates wind in the horizontal direction, is greatest in the poles and zero at the equator [1].

Within this equation

Citations:

1. “Weather Forecasting.” *Maths History*, <https://mathshistory.st-andrews.ac.uk/HistTopics/Weather_forecasts/>.
2. “Weatherwatch: Dream of Forecast Supercomputer That Became a Reality.” *The Guardian*, Guardian News and Media, 26 Sept. 2017, <https://www.theguardian.com/news/2017/sep/26/weatherwatch-dream-of-forecast-supercomputer-that-became-a-reality>.
3. “Integrated Publishing, Inc. - A (SDVOSB) Service Disabled Veteran Owned Small Business.” *Essentials of Meteorology, Weather Meteorology, Weather Training, and Other Related Manuals*, <https://meteorologytraining.tpub.com/14312/css/14312_65.htm>.