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# Network Dynamics of a Linear Flux of Rainfall due to Straight Line Winds

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**Abstract :** Straight line winds or derecho (Spanish origin) which are also known as damaging winds resulting due to any natural climatic catastrophe occurred during a peculiar atmospheric change instance. The major event causes a series of events to occur in the course of time. These events depend on the specific conditions that are manifested during the advent of the primary event. The major catastrophe responsible for the straight line wind is a climatic storm which may be called as tornado or severeconvective storm or particular hurricanes in other parts of the world. The main aspect of this research paper is to focus on the pattern of flow of these events with a graph theoretical approach and furthernarrow down the mathematical approach on the behavior of the straight line winds in a dynamic form.The major achievements of this work shall deal over the dynamics of the wind forms and the parallel events occurring out of it there by gaining a different perspective to study climate change globally.

**Keywords :** Linear, Storm, Graphs, Climate change.

## 1. Introduction.

**1.1 Dynamics:** This is one of the modern branches of mathematical fields that are developed in order to identify and analyze patterns which are not easily understood with the help of mere association between certain entities. The branch developed in the pursuit of visualizing patterns associating elementsand further studying their motion with respect to the other elements. Dynamics as a study may not be restricted to a particular field of physical domain but it may also be molded to understand certain otherparameters as well. The current elements in our domain shall be the wind force that results due to the advent of the tornadoes or severe convective storms. The elements used to understand the wind dynamics shall be determined in the following part after creating a visualization of the system of climaticconditions required to form a particular catastrophe.

**1.2 The Straight line Winds (derecho) or Damaging Winds :** It is very important to understand the physiology of a straight line wind or the linear wind before we incident a

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theory to study its behavior and other outcomes. The main course that causes this variety of winds is the storms or climatic catastrophes. In general climatic catastrophe can be termed as a varied event that categorizes as hurricane, severe convective storms, wind storms, tornadoes and etc. these being the primary events there are always secondary events associated to these events. The associated events or the secondary events may betermed as hail storms, thunder storms, surge, and straight line winds, etc. below is a diagrammatic representation of one such event.

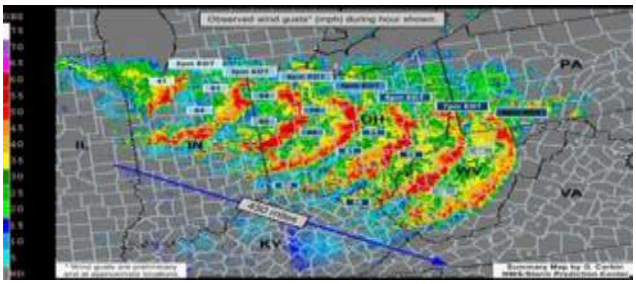


Figure1.1 A general representation of the Derecho (historical data NOAA)

**Environmental Conditions :** Specific climatic conditions play a very critical role in the formation ofsuch powerful long lasting winds. As described it is a post event of a large catastrophe known as hurricane or tornadoes, the wind speed that flows along the line may vary from place and altitude. Mostly it is caused over the troposphere and it flows along a quasi linear convective system as seen below.


Figure 1.2 General representations of straight line winds causing event. (Hurricane)

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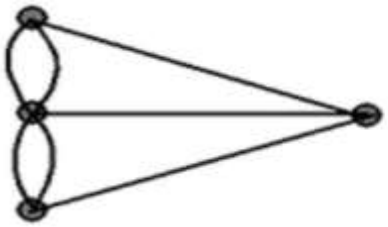
**1.1 Mathematical Overview :** The science of study and analysis of the climatic behavior and its change with respect to time is termed as a dominating definition of climatology. The approach alwaysused in this field is that of recording the historical data in collation to the current data and its change patterns. Mathematics plays an important role in studying any aspect related to patterns and change of behavior in climatic conditions. The very next approach is to compare these many techniques to gain more reliable methodology and keep a continuous process of improving the models. The traditional process of predicting the further occurrence of a certain



Visualization of the Konigsberg bridge problem with the land components considered as dots.

climatic condition over a particular location is majorly through the concept of probability. However, the current work shall involve certain aspects

Figure 1.3 General form of network graph.

The mathematical approach essential to study these patterns are those related to the understanding of the vector bodies over a real plane. Sometimes the behavior of these wind may be curved shape so asto form a curve like structure diverging to a critical point that may involve topological qualities.

We shall display a pattern of specific graphs that relate similar mathematical aspects to be implemented onto the climatic elements of the storm. The further part shall talk about the development of the researchwork with the influence of graph theory.

**2. Problem evaluation/ Objectives and Methodology :**

The major aspect of the problem deals with finding a proper association graph that deals withproper analysis of the elements over the derecho linear flows.

Use a graph of a past occurred derechoevents and trace network graphs over the linear flows of itstrack.

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Obtain relation between the network graphs so formed over the derecho and its linear maps toobtain graphical properties.

**Methodology :**

Choose a particular pattern of a derecho event as per the historical data available.

Trace a network graph by locating nodes over the location on the linear maps of derecho.

Characterize these graphs according to the patterns and various formats.

Describe the study in a proper form so as to satisfy the problem statement.

Derecho maps and network patterns over it :

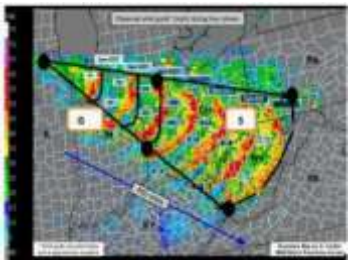
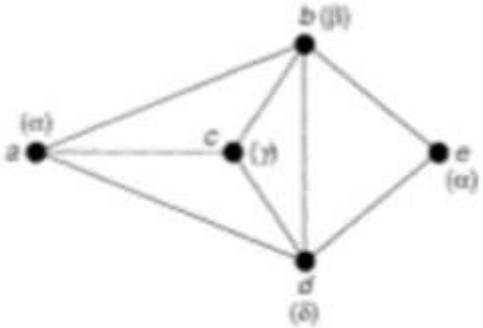


Figure 2.1 Network graph over the historical data of derecho event.

**Results, Analysis and characterization of the Network graph G and sub graph S** : Let the network graph be G and the notes or vertices connecting a particular linear precipitation form various sub graphs one of which may be termed as S. We shall characterize the aspects of the linear network graph so as to understand its features satisfying our problem statement.

To begin with this concept, we shall introduce and take support of the coloring theorem



that describesthe connected features such network graphs adjoining their edges.

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Figure 2.2 Example of a derived simply connected planar graph from GIf S is a sub graph of G and G is primarily connected then, G may be simply connected which may not be complete.

One such feature of Brook's theorem is that G is sigma colorable.

(i.e. collection of specific nodes and antinodes to have even number of characters and adjoining edgeson the sub graph.)

The further obtained co graphs may be recolored to obtain perfectly grouped collection of simply planarsub graphs of G.

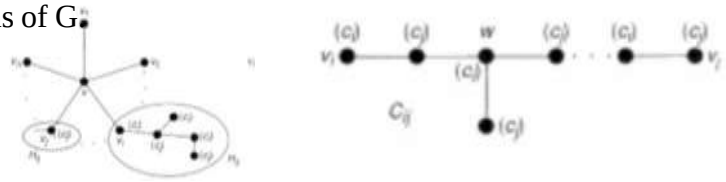

Figure 2.3 Recoloring of planar network sub graph

Figure 2.4 simply connected Overcoming linear discontinuity of the derecho flows.

The final stance where G is considered as a planar graph without any loops and we imagine a dual ofG then there is a sub collection of G that is colorable pertaining the integral value.

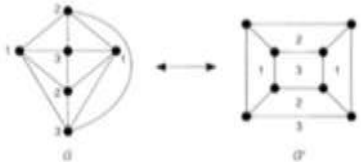

Figure 2.5A linear transformation of the planar graph satisfying its integral character.

### 3. Outcome of the research work and Conclusion :

The following are the desired outcomes which shall fall part of our later discussion below :

The network graphs so formed satisfy the coloring aspects of the sub graphs and its other forms.

This being satisfied for one such historical data of the derecho, there lies scope of applying it ontoother such data and extend study of characteristics.

Straight line winds that behave probabilistic approach also does satisfy connected network flow ofcolor graphs thereby showing association of edges and vertices adjoint to extended discontinuity.

Convolution of results of network dynamics and other spatial approach may result into better efficiency of tracing the effects of derecho events.

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